STABLE ISOTOPE CHEMISTRY AND GEOCHRONOLOGY OF SCAPOLITE-BEARING PEGMATITES IN NORDØYANE, WESTERN GNEISS REGION, NORWAY: A MONITOR FOR THE ROLE OF FLUIDS IN (U)HP PARTIAL MELTING

by

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Table of Contents

List of Tables

List of Figures

Abstract

Scapolite ($(Ca, Na)_4Al_{3-6}Si_{6-9}O_{24}(SO_4, CO_3, Cl)$), a volatile-bearing framework silicate, is found in pegmatites and leucosomes in close field association with (ultra)-high pressure ((U)HP) eclogites in the Nordøyane domain of the Western Gneiss Region (WGR) of Norway. Study of the field relationships, stable isotope geochemistry, and geochronology of these scapolite-bearing rocks provides insights into the role of fluids in partial melting of (U)HP rocks during the Scandian Orogeny (425-380 Ma). Scapolite-bearing pegmatites in Nordøyane were divided into three types based on mineralogy, texture, and scapolite chemistry. The most abundant Type 1 pegmatites are associated with granodioritic rocks which cut amphibolite-facies fabrics in adjacent basement gneisses and host numerous eclogite bodies. The pegmatites, which are concentrated in low-strain areas, are interpreted as a late-stage differentiate of the granodiorites. Scapolites from Type 1, 2 and 3 pegmatites, and basement leucosomes, all share similar $\delta^{13}C$ (-7.97 to -2.24 ‰) and $\delta^{34}S$ (-1.1 to 5.7‰) compositions, interpreted to indicate a common source of volatiles, derived from the mantle. Type 1 pegmatites crystallized at ~ 395 Ma under amphibolite-facies conditions (*ca.* 750 °C, assuming P = 1.0 GPa), at the same time as Type 3 pegmatites (396±2 Ma; Gordon *et al*., 2013). An older ~ 420 Ma subpopulation of titanites is interpreted as inherited, likely from adjacent basement gneisses. Scapolite $\delta^{18}O$ (16.21 to 20.05‰) and titanite εNd (-6.8 to -10.8) values indicate that Type 1 pegmatites crystallized from a crustal melt, suggesting that the introduction of mantle fluids promoted melting of crustal rocks. Mantle fluids are interpreted to have infiltrated subducted Baltican continental crust during subduction (*ca.*415-400 Ma), or in the early stages of extension and exhumation (*ca.* 399-395 Ma). These fluids may have been present in Laurentian lithospheric mantle prior to the Caledonian orogeny, or introduced from the down-going slab during early Caledonian subduction.

List of Abbreviations Used

Rock and Mineral Abbreviations

Ab	Albite	Hbl	Hornblende
AG	Augen Gneiss	Ilm	Ilmenite
Alm	Almandine	LMGG	Layered Migmatitic Granite Gneiss
Aln	Allanite	Jd	Jadeite
Alt	Alteration	Kfs	K-feldspar
An	Anorthite	Ma	Marialite
Ann	Annite	Me	Meionite
Ap	Apatite	Or	Orthoclase
APt	Antiperthite	P	Pegmatite
Bar	Barite	Phe	Phengite
Bt	Biotite	Phl	Phlogopite
Cc	Calcite	Plg	Plagioclase
Chl	Chlorite	Py	Pyrite
Coe	Coesite	Pyr	Pyrope
Cpx	Clinopyroxnene	Qtz	Quartz
Cpy	Chalcopyrite	Rut	Rutile
Dia	Diamond	Scp	Scapolite
E	Eclogite	Sp	Spessartine
GD	Granodiorite	Sph	Sulphide
Gr	Graphite	Ti	Titanite
Gro	Grossular	UG	Ulla Gneiss
Grt	Garnet	Zrn	Zircon

Geological Terms

BSE	Backscattered Electron
EDS	Energy Dispersive Spectrometer
EPMA	Electron Probe Microanalysis
FMSZ	Finnøya Migmatitic Shear Zone
HP	High Pressure
HREE	Heavy Rare Earth Element
HR-ICP-MS	High-Resolution-Inductively Coupled Plasma-Mass Spectrometer
LASS	Laser Ablation Split Stream
LP	Low Pressure
LREE	Light Rare Earth Element
MC-ICP-MS	Multi-Collector Inductively Coupled Plasma-Mass Spectrometer
MFC	Mass Flow Controller
MSWD	Mean Square of Weighted Deviates
P	Pressure
PPL	Plane Polarized Light
REE	Rare Earth Element
SEM	Scanning Electron Microscope
T	Temperature
t	Time
UHP	Ultra-High Pressure
WDS	Wavelength Dispersive Spectrometer
WGR	Western Gneiss Region
XPL	Crossed Polarized Light

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Chapter 1: Introduction

1.1 Statement of Problem

The volatile-bearing framework silicate scapolite ($(Ca, Na)_4Al_{3-6}Si_{6-9}O_{24}(SO_4, CO_3, Cl)$) is an important constituent of pegmatitic leucosomes and migmatitic orthogneisses in parts of the Nordøyane ultra-high pressure (UHP) domain of the Western Gneiss Region (WGR) of Norway. These rocks record the history of subduction and exhumation of Baltican continental crust during the Scandian Orogeny, where fluids have been speculated to play a role in partial melting at UHP conditions (Labrousse *et al.*, 2011; Ganzhorn *et al.*, 2014). Although the presence of primary scapolite in pegmatites and leucosomes has been previously reported in the Nordøyane domain (Butler *et al.*, 2013; Gordon *et al.*, 2013), it has not been the focus of detailed study. Scapolite is an important tracer for fluids in the lower crust (Goldsmith, 1976; Hoefs *et al.*, 1981; Moecher, 1993) and the discovery of scapolite pegmatites in close field association with (U)HP eclogites presents an avenue for investigating the role of fluids in partial melting of (U)HP rocks. Constraining the source of volatiles in scapolite and timing of pegmatite crystallization would therefore provide important insights into the history of partial melting in Nordøyane, and the exhumation of the WGR.

1.2 Regional Geology

1.2.1 Western Gneiss Region

The WGR (Fig. 1.1) is an erosional window through overlying Caledonian thrust nappes into Baltican Proterozoic basement, exposing gneisses reworked during the

Scandian Orogeny (Roberts and Gee, 1985; Terry and Robinson, 2003, 2004; Hacker *et al.*, 2010). A phase of the Ordovician-Devonian Caledonian Orogeny, the 425-380 Ma Scandian Orogeny (Krill, 1980; Gee, 1980; Roberts and Gee, 1985; Hacker *et al.*, 2010) was the terminal continent-continent collision between Baltica and Laurentia following a protracted history of arc and microcontinent accretion and deformation that resulted from the closure of the Iapetus Ocean (Tucker *et al.*, 2004; Hacker and Gans, 2005; Corfu *et al.*, 2014). This led to the eastward emplacement of allochthonous nappes onto the Baltican margin, and the westward subduction of Baltican crust (along with portions of the earlier accreted allochthons) beneath Laurentia to mantle depths and UHP conditions (Smith, 1984; Dobrzhinetzkaya *et al.*, 1995; Kylander-Clark *et al.*, 2007; Hacker *et al.*, 2010; Corfu *et al.*, 2014).

The WGR is composed mainly of granitoid orthogneisses which host abundant eclogites. The gneisses are derived from protoliths of late Paleoproterozoic to Mesoproterozoic age (Tucker *et al.*, 1991; Austerheim *et al.*, 2003; Krogh *et al.*, 2011; Rohr *et al.*, 2013), while eclogites are derived from *ca.* 1465-1255 Ma gabbros (Tucker *et al*., 2004; Krogh *et al*., 2011). In the Moldefjord area and the adjacent Nordøyane UHP domain (Fig. 1.1) much of the granitoid basement formed during a magmatic interval between 1685-1635 Ma with a few augen gneiss bodies from Nordøyane recording younger intrusive events between 1614 ± 19 Ma and 1594 ± 10 Ma (Rohr *et al.*, 2013). Much of the Baltican basement experienced metamorphism to granulite facies at *ca.* 950 Ma during the Sveconorwegian Orogeny (Krabbendam *et al.*, 2000; Røhr *et al.*, 2004; Glodny *et al.*, 2008). This protracted series of collisional events

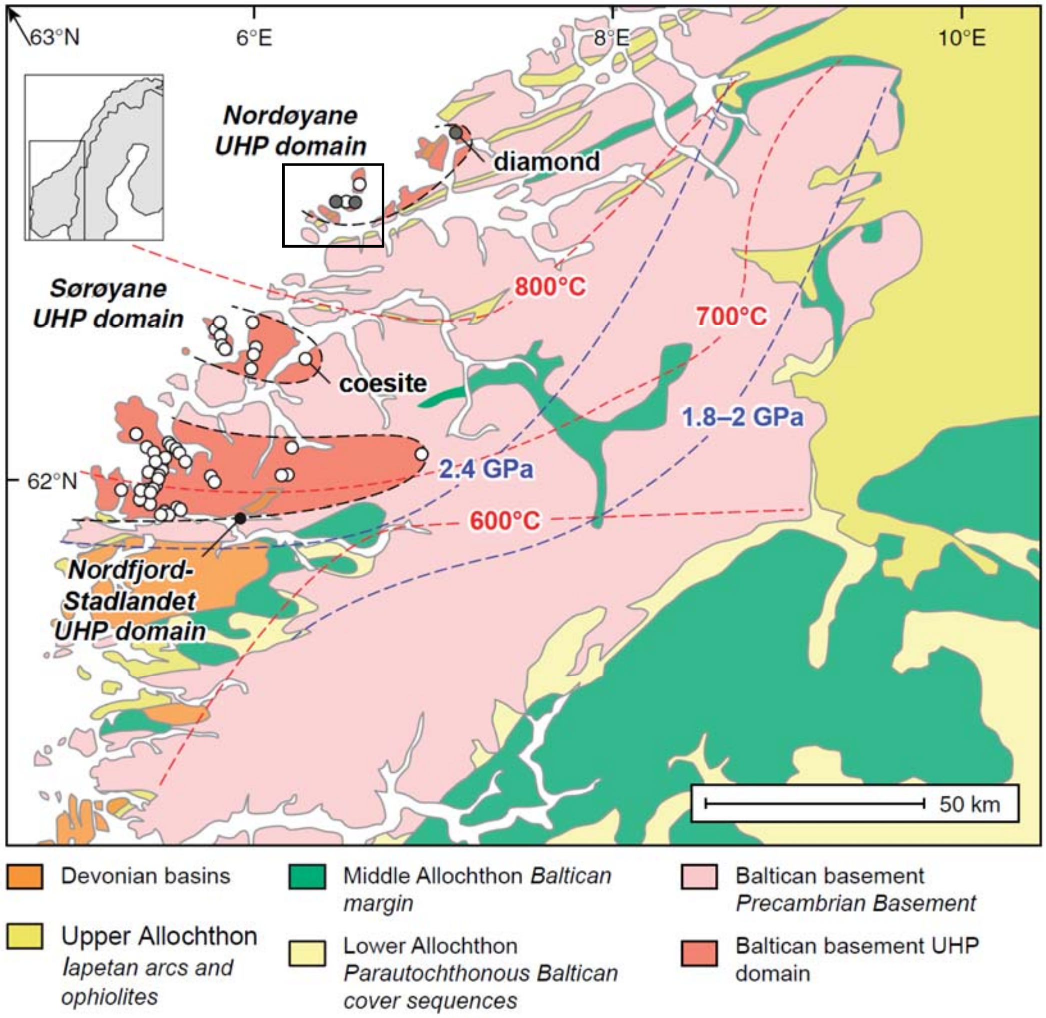


Figure 1.1: Simplified geological map of the Western Gneiss Region (WGR) modified from Butler *et al.* (2015), showing the erosional window into the Baltican basement through the overlying Caledonian allochthons. Dashed lines show the distribution of peak metamorphic pressures (blue) and temperatures (red) from Hacker *et al.* (2010). P-T conditions increase from SE to NW across the WGR, reaching a peak in the Nordøyane UHP domain. Recognized UHP domains are outlined in red with white and grey dots marking the localities of coesite/pseudomorph - and microdiamond-bearing rocks respectively. The Nordøyane islands which are the study area for this thesis are outlined in black.

was accompanied by granitic plutonism between 1000-900 Ma (Tucker *et al.*, 1991). Therefore, prior to Scandian metamorphism and deformation, the WGR crust was already composed of granulite gneisses which had experienced polycylic tectonism, and was partly dehydrated and relatively strong (Krabbendam *et al.*, 2000; Hacker *et al.*, 2010). During the Scandian Orogeny, the leading edge of the subducted Baltican crust was metamorphosed under (U)HP eclogite-facies conditions, with conditions ≥ 2.5 GPa recorded by the presence of coesite (a high-P polymorph of SiO_2), coesite pseudomorphs, and microdiamonds (Smith, 1984; Dobrzhinetskaya *et al.*, 1995; Wain *et al.*, 2000; Root *et al.*, 2005; Butler *et al.*, 2013). Although the nature and trigger mechanism of its exhumation are debated (Cuthbert *et al.*, 2000; Kylander-Clark *et al.*, 2008; Labrousse *et al.*, 2011 Ganzhorn *et al.*, 2014, Butler *et al.*, 2015), it is agreed that subducted Baltican crust was exhumed to lower crustal levels (~ 1 GPa) and overprinted by retrograde amphibolite-facies metamorphism between ~400-380 Ma (Andersen, 1998; Terry *et al.*, 2000a, Tucker *et al.*, 2004; Hacker, 2007; Walsh *et al.*, 2007). Exhumation and amphibolite-facies metamorphism were accompanied by widespread decompressional melting, as evident from locally abundant migmatites with amphibolite-facies mineralogy and cross-cutting relationships (Auzenneau *et al.*, 2006; Hacker *et al.*, 2010; Butler *et al.*, 2013). However, due to the presence of multiple generations of pre-Scandian migmatites and intrusions and the effects of Scandian deformation, the extent of Scandian partial melting, and whether or not melting began at UHP conditions, are still uncertain.

In the WGR, coesite (± microdiamond)-bearing eclogites and gneisses are found within three discrete UHP domains – Nordfjord-Stadlandet, Sorøyane, and Nordøyane, now separated at the surface by regions where the gneisses and eclogites are coesite-free (Wain *et al.*, 2000; Root *et al.*, 2005; Butler *et al.*, 2013). The apparent northeast-southwest P-T gradient (Fig. 1.1) and the eastward decrease in the intensity of Scandian deformation have been interpreted to indicate subduction and exhumation was as a coherent slab (Hacker *et al.*, 2010; Butler *et al.*, 2015). However, deformation and localized thrusting within the Baltican basement (Terry and Robinson, 2003; Gee *et al.*, 2013; Robinson *et al.*, 2014) and the complex 'mixed zone' of interspersed HP/UHP eclogites on the north side of the Nordfjord-Stadlandet domain (Cuthbert *et al.*, 2000) have led to other interpretations. These features may indicate diachronous metamorphism (Cuthbert *et al.*, 2000), the separate subduction and exhumation of the 3 UHP domains (Kylander-Clark *et al.*, 2008), and/or exhumation as a 'plume' of melt-weakened crust that was detached from the down-going slab and rose buoyantly up the subduction channel (Labrousse *et al.*, 2011; Gordon *et al.*, 2013; Ganzhorn *et al.*, 2014).

1.2.2 Partial Melting at Peak Pressure Conditions?

The presence of partial melt has a significant, non-linear effect on the aggregate strength of crustal rocks (Rosenberg and Handy, 2005). It has been hypothesized that partial melting at peak P conditions could have weakened subducted Baltican crust sufficiently to decouple it from its dense lithospheric root, triggering exhumation (Labrousse *et al.* 2011; Ganzhorn *et al.* 2014). Although evidence for partial melting during decompression is preserved in the form of multiple generations of granitic leucosomes throughout the WGR, it is debated whether this process initiated at peak P (Butler *et al.*, 2013). The peak pressure reached by the WGR in the Nordøyane domain was 3.9 GPa at ca. 800 °C (Dobrzhinetskaya *et al.*, 1995; Butler *et al.*, 2013, 2015), but at this P it was not hot enough for dehydration melting (Auzanneau *et al.*, 2006; Butler *et al.*, 2015; Fig. 1.2). This has led proponents of the UHP melting hypothesis to infer the presence of fluids at depth, to lower the solidus sufficiently for

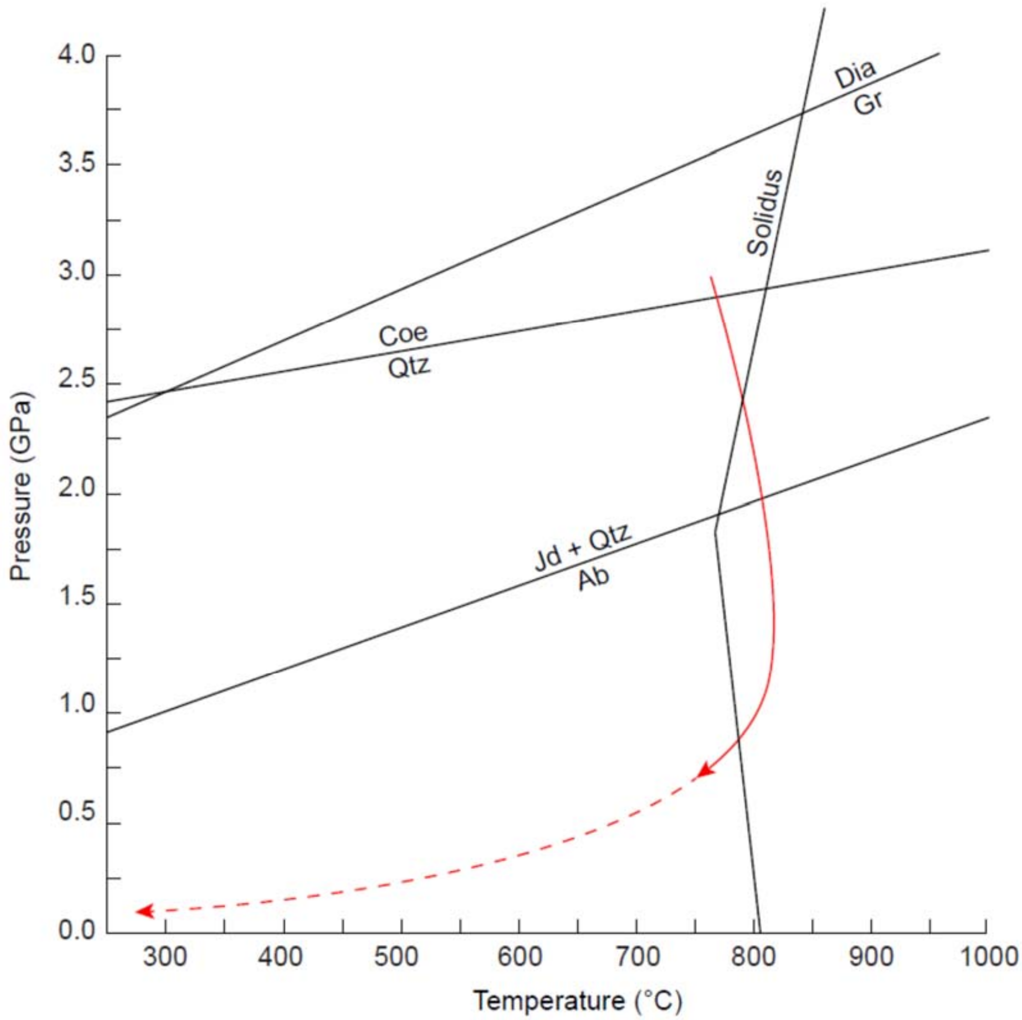


Figure 1.2: PTt path for the Nordøyane UHP domain (simplified from Butler *et al.,* in prep.) superimposed on an experimentally determined low H_2O activity solidus for metagreywacke (a proxy for WGR crust), from Auzanneau *et al*. (2006) Note that the PT path does not cross the solidus until after peak P conditions are reached *i.e.* during decompression.

melting to begin (Labrousse *et al.*, 2011; Ganzhorn *et al.*, 2014). While Butler *et al.* (2015) concluded that orogen-scale extension rather than plume-style exhumation best fits the evidence as a model for the exhumation of the WGR, their numerical models-did show that if the solidus was lowered by ~ 100 °C, melting and weakening at UHP conditions could trigger plume-style exhumation.

Several lines of evidence have been used to support the hypothesis of melting at peak P conditions. Partial melting experiments, using a WGR bulk compositional analogue and varying amounts of added water, produced melts that overlapped compositionally with natural leucosomes in the WGR (Labrousse *et al.* 2011). U-Pb zircon geochronology by Gordon *et al.* (2013) found some overlap between UHP metamorphic ages (*ca.* 425–400 Ma) and texturally magmatic zircon (*ca*. 410-400 Ma), which they interpreted as evidence for zircon growth from melt at the transition from eclogite facies to lower pressure conditions based on trace element geochemistry. Ganzhorn *et al.* (2014) also described the presence of polyphase inclusions in eclogite-facies garnet, which they interpreted as melt inclusions formed at UHP conditions. Although these authors recognized the necessity of fluids at depth to trigger melting at peak P, independent evidence of such a fluid has yet to be presented.

1.3 Scapolite in the Nordøyane UHP domain

Scapolite-bearing pegmatites and leucosomes have been reported on the islands of Harøya and Finnøya in previous work (Steenkamp, 2012; Butler, 2013; Butler *et al.*, 2013; Gordon *et al.*, 2013), however they have never been a primary focus of study. Steenkamp (2012) and Butler *et al.* (2013) noted that the shear zone separating (U)HP basement rocks on Harøya and Finnøya from overlying supracrustal rocks of the Blåhø nappe was locally cut by scapolite-bearing pegmatites. Steenkamp (2012) speculated that marble lenses in the overlying supracrustal rocks may have provided a source of carbonate for the formation of scapolite. Furthermore, Butler *et al.* (2013) found some hornblende+scapolite-bearing leucosomes in migmatitic basement gneisses on Harøya, interpreted to have crystallized under amphibolite-facies conditions. Zircon in a scapolite pegmatite on Finnøya was dated by Gordon *et al.* (2013) at 396±2 Ma. Zircon geochemistry showed a negative Eu anomaly and a steep REE pattern, consistent with crystallization in the presence of plagioclase at amphibolite-facies conditions.

Although this previous work indicated that scapolite was primarily associated with amphibolite-facies leucosomes, its presence offers an avenue for investgating the role of fluids in melting – a key feature of the UHP melting hypothesis. As the hottest, deepest portion of the orogen (Fig. 1.1; Hacker *et al.*, 2010) the Nordøyane domain is the best place to look for evidence of UHP melting. This led to the decision to do further fieldwork in Nordøyane specifically in search of scapolite-bearing leucosomes and pegmatites in, or associated with, (U)HP rocks. The basement rocks on Harøya are highly strained (Butler *et al.*, 2013) which can obscure cross-cutting relationships, so segments of the coasts of the nearby islands of Haramsøya and Flemsøya (see Ch. 2 for further detail) were chosen as the targets for study. Previous large-scale mapping by M. Terry (Terry and Robinson, 2003, 2004), and visits to the area by R.A. Jamieson and J.P. Butler in 2010 had found the selected localities to be enclaves of relatively low strain, and therefore likely to preserve early features and cross-cutting relationships. This choice of field area was vindicated by the discovery of abundant scapolite-bearing pegmatites and leucosomes, a number of which showed a close field relationship with (U)HP eclogites (see Ch. 2 for further details). Therefore, investigation into the source of volatiles and timing of formation of scapolite pegmatites in Nordøyane will provide valuable insights into the viability of the UHP melting hypothesis.

1.4 Objectives

The main objective of this project is to constrain the origin of scapolite pegmatites and associated fluids, and to assess their implications for the fluid-present melting hypothesis within the regional metamorphic history of the Nordøyane UHP domain, including subduction and exhumation of the WGR. This objective will be addressed by:

1 – Mapping the rocks of the chosen field areas to determine the abundance, distribution, relative timing relationships of scapolite pegmatites.

2 – Analyzing the petrography and mineral chemistry of scapolite to determine stable mineral assemblages, the range of scapolite types, and the relationship between pegmatites and host rocks.

3 – Determining the origin of volatiles in scapolite-bearing pegmatites and leucosomes through C, S and O stable isotope geochemistry from among the following possible sources: 1) scapolite or scapolite-forming fluids already present in metasomatised crust prior to subduction 2) fluids expelled from sedimentary cover rocks; and, 3) mantle fluids introduced into the crust during subduction.

4 – Dating the absolute timing of crystallization of scapolite pegmatites through titanite U-Pb and Sm-Nd geochronology to determine whether this was coeval with eclogite-facies metamorphism or later.

Chapter 2: Regional Geology and Field Relationships

2.1 Geology of Nordøyane

2.1.1 Regional Overview

Encompassing the islands of the Nordøyane archipelago and a portion of the adjacent mainland coast, the Nordøyane UHP domain (Fig. 2.1) records the highest pressures and temperatures reached by rocks subducted during the Scandian Orogeny (Dorbzhinetskaya *et al.*, 1995; Terry *et al.*, 2000b, Root *et al.*, 2005, Butler *et al.*, 2013). Lithologically the domain consists largely of tonalitic, dioritic, and granodioritic basement gneisses, locally infolded with and overlain by supracrustal rocks of the Sætra and Blåhø Nappes (Terry *et al.*, 2000b; Terry and Robinson, 2003, 2004; Butler *et al.*, 2013). Structurally, it is divided into three fault-bounded segments, of which only the eclogite-hosting northern segment shows evidence of UHP metamorphism (Terry *et al.*, 2000b; Terry and Robinson, 2003, 2004). The northern segment is separated from the central and southern segments by the Åkre Mylonite, a late, lower-amphibolite facies sinistral shear zone (Terry *et al.*, 2003; van Roermund, 2009). While the gneisses of the southern segment do contain eclogite boudins, they did not reach UHP conditions (Terry and Robinson, 2004). The central segment also contains abundant amphibolite boudins interpreted as deformed mafic dikes, but these do not show any evidence of having reached eclogite facies conditions (Terry and Robinson, 2004). The central and southern segments were juxtaposed along an early extensional fault. Both the fault and the adjacent segments underwent subsequent ductile deformation at amphibolite facies conditions (Terry and Robinson 2003, 2004).

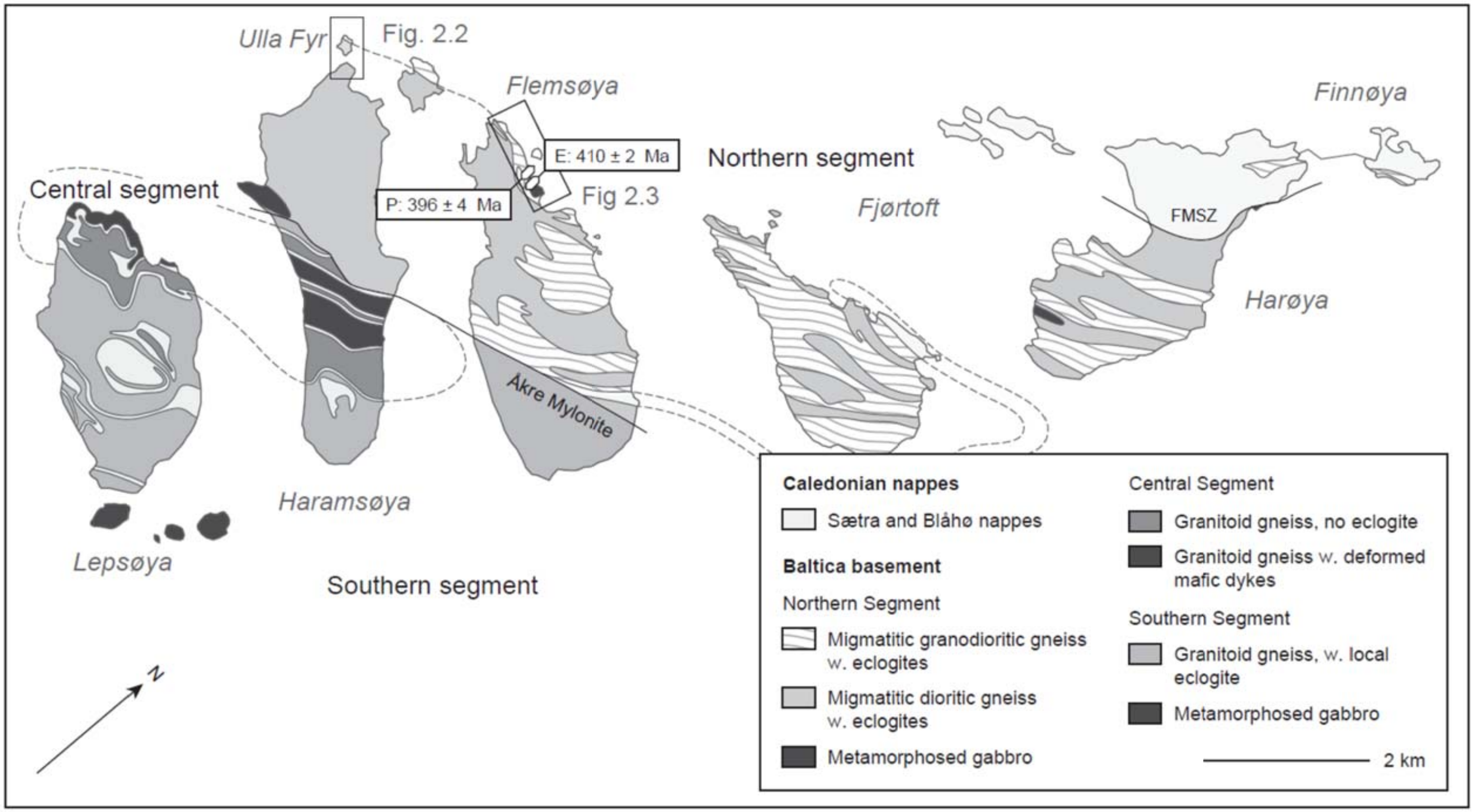


Figure 2.1: Simplified geological map of the Nordøyane UHP domain (mainland excluded) modified from Butler et al. (2013) after Terry and Robinson (2003). Map areas for this study, shown in Figures 2.2 and 2.3, are outlined in black. Selected U-Pb zircon ages that fall within the Flemsøy map area (Krogh *et al*., 2011) are shown for eclogite (E) and an undeformed, crosscutting granite pegmatite (P). FMSZ = Finnøya migmatitic shear zone.

The islands of Harøya and Finnøya, mapped in 2010 by Steenkamp (2012) and Butler (2013), are underlain by allochthonous supracrustal and autochthonous basement gneisses. Northern Harøya and Finnøya consist of supracrustal rocks of the Blåhø and Sætra Nappes, which are juxtaposed against the basement along the Finnøya migmatitic shear zone (FMSZ; Steenkamp, 2012). South of the FMSZ, the exposed rocks consist of dioritic, granodioritic and tonalitic basement gneisses which have been linked lithologically with the northern segment rocks on neighbouring Fjørtoft, and likewise show evidence of UHP metamorphism (Butler *et al.*, 2013). No evidence of UHP metamorphism has been found in the supracrustal rocks north of the shear zone, and thermobarometry indicates that prograde peak P metamorphism only reached upper amphibolite- to granulite-facies conditions (*ca*. 0.9-1.5 GPa). From this it is inferred that the two domains did not follow the same prograde PTt path-but were juxtaposed later during isothermal decompression (Steenkamp, 2012).

2.1.2 Previous Mapping of the Study Area

The field area covered by this study is within the northern segment defined by Terry and Robinson (2003, 2004), The basement gneisses were grouped into three major rock types: the Ulla Gneiss, a heterogenous garnet-biotite-amphibolite gneiss which hosts numerous eclogite boudins; a migmatitic – biotite – plagioclase – quartz ± hornblende – gneiss; and K-feldspar augen orthogneiss with metagabbro. The crosscutting relationship between Ulla Gneiss and migmatitic gneiss was not observed, but the protolith for the augen gneiss was interpreted to cut the protoliths for both the migmatitic gneiss and Ulla

Gneiss (Terry and Robinson; 2003). The protolith ages of these gneiss units have not been determined directly in Nordøyane, but U-Pb zircon ages ranging from *ca.* 1644-1594 Ma from correlated augen orthogneisses on the Molde Peninsula gives a minimum age for Ulla Gneiss which it cuts (Tucker *et al.*, 1991; Røhr *et al.*, 2013). All three gneiss units are cut by coronitic metagabbros, notably the 1255 ± 2 Ma Flem and 1466 ± 2 Ma Haram gabbros (Terry and Robinson, 2004; Krogh *et al.*, 2011), and others of unknown, but inferred pre-Scandian, age.

Direct evidence of UHP metamorphism in the northern segment has been documented at a number of localities. Microdiamonds were recovered from a supracrustal garnet–biotite–kyanite gneiss on Fjørtoft (Dobrzhinetskaya *et al.*, 1995), as well as from peridotites on both Fjørtoft and the mainland coastal portion of the Nordøyane domain (van Roermund and Drury, 1998; van Roermund *et al.*, 2002; Vrijmoed *et al.*, 2006, 2008). Coesite, and/or polycrystalline quartz pseudomorphs after coesite, have been found in eclogites on Fjørtoft, Flemsøya, and Harøya (Cuthbert *et al.*, 2000; Terry *et al.*, 2000b; Butler *et al.*, 2013). Supporting thermobarometry from kyanite and coesite eclogites on Fjørtoft, Flemsøya and Harøya (Cuthbert *et al.*, 2000; Terry *et al.*, 2000 Butler *et al.*, 2013), and from orthopyroxene-bearing eclogites from Fjørtoft (Carswell *et al.*, 2006) place PT conditions between *ca.* 2.7 – 3.8 GPa and *ca*. 760 – 850 ̊C. UHP eclogite facies metamorphism in this area has been dated at *ca*. 415 – 410 Ma (Krogh *et al.*, 2011), while recent work involving a combination of U-Pb dating by CA-TIMS and LA-ICP-MS on zircons from eclogites and their host gniesses on Harøya yielded a broad range of ages from 400 – 415 Ma (including an age of 404.3±4.3 Ma from the Harøya coesite-eclogite), indicating that the subducted crust may have spent a protracted period at depth (Butler, 2013; Butler *et al.*, 2015, 2016, in prep.). In Nordøyane, steeply plunging linear fabrics and tubular folds with steep fold axes have been linked to eclogite facies metamorphism and deformation (Terry and Robinson, 2004). These structures are also locally associated with asymmetric fabrics indicating top-southeast thrusting (Terry & Robinson, 2004), consistent with the northwestward subduction of Baltica beneath Laurentia during the Scandian (Torsvik, 1998).

The subsequent exhumation of Baltican crust formed upper amphibolite-facies mineral assemblages and structures that overprinted earlier eclogite-facies assemblages (Terry and Robinson, 2003; Tucker *et al.*, 2004; Krogh *et al.*, 2011). Thermobarometry for the Nordøyane domain indicates that decompression was nearly isothermal, with peak T reached after peak P (Larsen *et al.*, 1998; Terry *et al.*, 2000b; Root *et al.*, 2005; Steenkamp, 2012; Butler *et al.*, 2013). Decompression was locally accompanied by partial melting at *ca.* 395 Ma based on U-Pb zircon dating of post-kinematic granite pegmatites (Krogh *et al.*, 2011; Butler, 2013). U-Pb zircon dates from inter-boudin leucosomes on the island of Finnøya fall within a similar range at *ca.* 391-396 Ma (Gordon *et al.*, 2013). These include a scapolite-bearing pegmatite, dated at 396±2 Ma, which cuts amphibolite-facies foliations (Gordon *et al.*, 2013). Recent 'campaign-style' dating of titanites from leucosomes across Nordøyane, and elsewhere in the WGR yielded ages between *ca*. 396 and 384 Ma, with errors of up to ± 15 Ma on the oldest ages, at temperatures of *ca*. 750 °C (Spencer *et al.*, 2013). The later stages of exhumation were accompanied by rotation of earlier steep lineations to shallower plunges (Terry and Robinson, 2003) and regional-scale amphibolite-facies sinistral shear along northwestdipping foliations (Milnes *et al.*, 1997; Andersen, 1998; Krabbendam and Dewey, 1998; Butler, 2013).

2.1.3 Role of Fluids

Fluids are thought to have played an important role in partial melting in the WGR, possibly even at UHP conditions (Labrousse *et al.*, 2011). As such, reports of the presence of the volatile-bearing framework silicate scapolite from multiple localities in the Nordøyane Domain offer an important avenue of investigation. Scapolite has been found both as a minor constituent in the basement gneisses of Harøya (Butler *et al.*, 2013), and in leucosomes on Harøya, Finnøya, and Vigra (one of the Nordøyane islands outside the boundary of the UHP domain; Steenkamp, 2012; Butler *et al.*, 2013; Gordon *et al.*, 2013; Spencer *et al.*, 2013). Dating of accessory minerals from hornblende-biotite-scapolite pegmatites cutting amphibolite-facies structures on Finnøya (U-Pb zircon; Gordon *et al.*, 2013) and Vigra (U-Pb titanite; Spencer *et al.*, 2013) yielded ages of 396±2 Ma and ~384 Ma respectively. These ages, combined with the associated amphibolite-facies mineralogy, link these leucosomes to decompression melting during exhumation and amphibolite-facies retrogression (Hacker *et al.*, 2013). However, neither mineral chemistry or stable isotope composition of scapolite in either the basement gneisses or later leucosomes have been systematically investigated and reported. These data may provide insight into the source and role of scapolite-forming fluids in these rocks.

2.2 Study Area

Mapping at 1:2000 was carried out in the summer of 2015 in two areas: 1) the island of Kvernholmen, also known as Ulla Fyr after the lighthouse located there, along with a small portion of the adjacent Haramsøya coastline (Fig. 2.2); and 2) a section of the northern coast of Flemsøya between a point called Lillegeita and the tidal island of

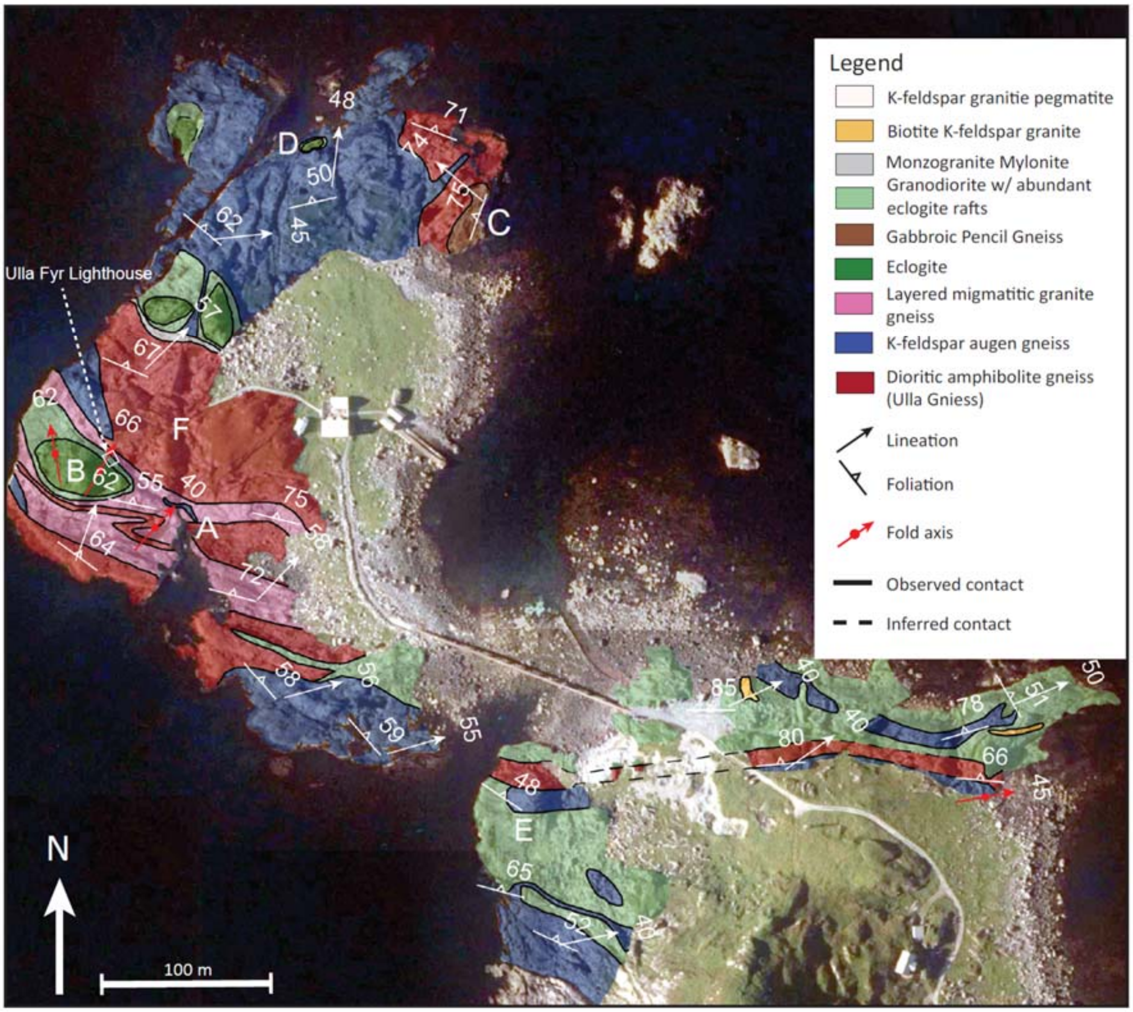


Figure 2.2: Geological map of Ulla Fyr and adjacent Harmsøya coast. Letters on the map mark the locations of important outcrops and informal place names referred to in the text. A) Small outcrop of augen gneiss, interpreted to be a raft in the layered migmatitc granitoid gneiss. B) The Lighthouse Hill eclogite outcrop. C) Gabbro pencil-gneiss outcrop, interpreted to cut the Ulla Gneiss and augen gneiss. D) Outcrop where eclogite-bearing granodiorite is interpreted to cut the augen gneiss. E) Scapolite Hill, an important outcrop for scapolite pegmatites. F) The Ulla Gneiss Field, another important scapolite locality.

Figure 2.3: Geological map of the northeastern coast of Flemsøya between Lillegeita and Seiholmen. This map uses the same legend as Figure 2.2. Norwegian place names referenced in the text are labeled on the map. Letters on the map mark the locations of important outcrops referred to in the text. A) Outcrop with a gradational contact between migmatitc and non-migmatitic augen gneiss. B) Eclogite boudin chain, east of Storetjønna pond. C) Arhaugen gabbro pencil gneiss outcrop, preserving early fabrics.

Seiholmen (Fig. 2.3). These areas were selected on the basis their excellent exposure and relatively low degree of strain. This lower degree of deformation compared to other parts of the same structural domain was a key consideration, as early eclogite-facies fabrics and the relative timing relationships between multiple generations of leucosome and these fabrics are relatively well preserved. Mapping at a larger scale than the previous survey undertaken by Terry and Robinson (2003, 2004) also allowed for finer sub-division of the map units, including of individual eclogite bodies.

2.3 Lithologies and Crosscutting Relationships

2.3.1 Ulla Gneiss

The Ulla Gneiss and augen orthogneiss units defined by Terry and Robinson (2003, 2004) are the most abundant rock units in both study areas. The Ulla Gneiss is an amphibolite-facies gneiss of mafic to intermediate composition. Displaying a mineralogy of hornblende + biotite + plagioclase + quartz + garnet, it also locally contains clinopyroxene. It displays a relatively weak compositional layering, and can locally appear massive. In general, however, a foliation is defined by the alignment of biotite and/or hornblende. Clear evidence of cross-cutting relationships between Ulla Gneiss and augen gneiss is rare within the study areas, as most contacts are strained roughly into parallelism, with the two units sharing the same foliation (Fig. 2.4a). No evidence was found to dispute the conclusion by Terry and Robinson (2003) that the Ulla Gneiss is the older lithology, probably derived from a dioritic protolith. Massive examples of this lithology are interpreted to have lost their fabric due to recrystallization of hornblende under lower-strain conditions.

2.3.2 Augen Gneiss

The augen gneiss consists of K-feldspar augen in a matrix of quartz + plagioclase + biotite and rare scapolite. In places the augen gneiss is migmatitic, with quartzo-feldspathic leucosomes bordered by melanosomes of biotite, surrounding, and in places obliterating, the augen (Fig. 2.4b). A transition between non-migmatitic and migmatitic augen gneiss can be observed on a small hill near the south-east corner of the Flemsøya area (Fig. 2.2, B; Fig. 2.4c). Discovery of this gradation between augen gneiss and migmatitic gneiss marks a change from the mapping scheme used by Terry and Robinson (2003, 2004) where the two were mapped as separate units. On Ulla Fyr, the augen gneiss becomes increasingly migmatitic towards the northern end of the island, while on the Flemsøya coast, evidence of melting is most prevalent on the northern side of Arhaugen, and north and east of Storetjønna Pond towards Sieholmen. The augen gneiss typically displays a well-developed foliation defined by the alignment of biotite grains, and a strong linear fabric (Fig. 2.4d) formed by the elongation of K-feldspar augen. This linear fabric is lost along with the augen in the migmatitic equivalents. The augen gneiss is interpreted to have been derived from a K-feldsar megacrystic granite protolith.

2.3.3 Layered Migmatitic Granite Gneiss

A third type of orthogneiss crops out on the south-eastern portion of the island of Ulla Fyr, but not on the Flemsøya coast. It consists of alternating meter-scale bands of pink syenogranitic and grey granodioritic rock (Fig. 2.4e). Small-scale folds are quite common in this unit. The pink, syenogranitic portions of the gneiss are quite migmatitic. This unit preserves a foliation defined by the alignment of biotite grains, but lacks a strong lineation. Although the layered migmatitic granitoid gneiss forms sharp, foliation-parallel contacts with the adjacent Ulla Gneiss (Fig. 2.4f), it has a more ambiguous relationship with augen gneiss. A small, tightly folded body of augen gneiss outcrops within the layered gneiss, near the base of Lighthouse Hill (Fig. 2.2, A). Whether this is a crosscutting dike or an incorporated enclave is obscured by extensive deformation; however, the layered migmatitic gneiss is tentatively interpreted to cut the augen gneiss. The layering is interpreted to be the result of tight- to-isoclinal folding between two different granitoid rock types.

2.3.4 Eclogite Bodies

The Ulla Gneiss, augen gneisses, and the grey portions of the layered migmatitic gneiss all host a significant number of eclogite bodies. These bodies range in size from decimeter-scale to several tens of meters across, and typically present as roughly foliation-parallel chains of boudins, with the largest of these boudin chains visible at map scale north-east of Storetjønna pond (Fig. 2.3, B). Eclogite boudins are most abundant in the Ulla Gneiss; however, all eclogite bodies large enough to appear at map scale are hosted within the augen gneiss or layered migmatitic granitoid gneiss. The smaller boudins tend to be massive and preserve only a retrograde amphibolite-facies assemblage (hornblende + garnet + biotite ± plagioclase ± quartz). In contrast, the cores of the larger bodies typically preserve both an eclogite facies mineralogy and fabric. A common feature of the less retrogressed eclogites is compositional layering defined by variable proportions of garnet and omphacite. This is best observed on ‘Lighthouse Hill’, the large eclogite-cored hill (Fig. 2.2, B) west of the Ulla Fyr lighthouse (Fig. 2.5a), but is also

Figure 2.4: Field photographs of basement gneisses. a) Sharp, parallel contact between Ulla Gneiss (UG) and augen gneiss (AG); Flemsøya, near Sieholmen. b) Migmatitc augen gneiss, in which leucosomes have formed around the augen, which are surrounded by melanosomes of biotite; Arhaugen, Flemsøya. c) Transition from augen gneiss (right) to migmatitc gneiss (left) captured in outcrop; Flemsøya - A on Fig. 2.3. d) Steep lineations in augen gneiss (marked in red); Ulla Fyr. e) Layered migmatitc granite gneiss; Ulla Fyr. f) Sharp contact between Ulla Gneiss and syenogranitic portion of layered migmatitc granite gneiss (LMGG); Ulla Fyr, south of Ulla Gneiss Field.

present in other large eclogite bodies. This layering is reminiscent of the cumulate layering seen in the nearby Haram Gabbro (Terry and Robinson, 2004) and may be a relict primary texture or the result of later deformation. In places this layered fabric is folded by steeply plunging tubular folds (Fig. 2.6b), indicating constrictional strain under eclogite-facies conditions. A number of large (partially eclogitized) gabbro bodies near this study area, such as the Flem Gabbro (Terry and Robinson, 2004), share similar field relationships and textures with the eclogite bodies described here. Relict gabbroic textures can also be found in several of the larger eclogites on Sieholmen (R.A. Jamieson pers. comm. 2016). Based on this, the larger eclogite bodies are interpreted to be metamorphosed gabbro intrusions. The small eclogite boudin chains in the Ulla and other basement gniesses are interpreted to have originated as mafic dikes, possibly related to the larger intrusions. Some of these bodies have internal fabrics truncated by fabrics in adjacent augen gneiss. This may indicate a competence contrast between the two lithologies and/or the effects of migmatization of the augen gneiss.

2.3.5 Gabbro Pencil Gneiss

In addition to the 'layered' eclogites, two outcrops of partially eclogitized gabbroic gneiss have been mapped, one on the north-east coast of Ulla Fyr, where it cuts both the Ulla and augen gneisses (Fig. 2.2, C), and the other in Arhaugen (Fig. 2.3, C) where it cuts other eclogites. Preserving a high-grade transitional eclogite-facies mineral assemblage of garnet + omphacite + biotite + ilmenite + quartz + plagioclase, these metagabbros are strained into pencil gneisses (L>>S) with a steep lineation defined by garnet and ilmenite (Fig. 2.5c, d). These steeply plunging lineations, along with top-to-the-south shear-sense indicators documented in the adjacent Ulla Gneiss at Ulla Fyr

(Terry and Robinson, 2004; this study), are excellent examples of the early eclogite-facies fabrics recorded throughout the region. The transitional eclogite-facies assemblage could be retrograde, or indicate that these were originally plagioclase-rich leucogabbros in which excess plagioclase survived the transition to eclogite facies. In either case, it may also explain why these rocks were so heavily deformed, as the relict plagioclase would make the rocks weaker than plagioclase-free eclogites.

2.3.6 Eclogite-bearing Granodiorite

The lithology most closely associated with the eclogites is not one of the basement gneisses, but a younger suite of granodiorites. Found as ubiquitous envelopes around the large eclogite rafts on the meter- to decameter-scale (Fig. 2.6a), the granodiorite also forms extensive bodies, tens to hundreds of meters across, commonly extending along-strike from the larger eclogite bodies. The larger granodiorite bodies were referred to in the field as ‘eclogite soup’ (Fig. 2.6b) because they contain numerous rafts of eclogite, 0.1-10 m across, preserving various stages of disaggregation by and assimilation into the granodiorite. The fabric ranges from massive, adjacent to larger eclogite bodies, to well foliated in areas of higher strain, and contacts with the basement gneisses are commonly strained into parallelism. However, the granitoid envelope around a small eclogite on the north coast of Ulla Fyr (Fig. 2.2, D; Fig. 2.6c) and one of the larger eclogites in the chain east of Storetjønna Pond (Fig. 2.3, B; Fig. 2.6d) both cut the augen gneiss. Furthermore, immediately east of Ulla Fyr, the granodiorite contains rafts of both the Ulla and augen gniesses, indicating that it is younger than both.

The granodiorite contains phenocrysts of hornblende ± titanite within a matrix of quartz, plagioclase, K-feldspar and biotite. Scapolite is locally found as a minor phase in the matrix of the granodiorite. Crystals of garnet and clinopyroxene are relatively common in the granodiorite, however, at the hand-sample scale it is unclear whether these phases are xenocrysts from adjacent eclogites, or whether some are primary. One sample from Arhaugen (Fig. 2.6e) contains abundant small, euhedral garnets, suggesting primary crystallization from melt. Around the largest eclogite bodies, at Arhaugen, Storetjønna, and Lighthouse Hill, there is also a noticeable 'zoning' in the granodiorite envelope, which becomes more melanocratic the farther it gets from the main eclogites owing to increasing concentration of hornblende (Fig. 2.6f). In places, this can give the granodiorite a striking resemblance, in both appearance and mineralogy, to the Ulla Gneiss. However, the lack of gneissic banding, more common massive texture, and gradational contacts with more felsic granodiorite can be used to distinguish these hornblende-rich zones from the Ulla Gneiss. In general, there are fewer small eclogite enclaves in the darker portions of the granodiorite.

Figure 2.5: Field photographs of eclogites and gabbro pencil gneisses. a) ‘Layered’ eclogite; Lighthouse Hill, Ulla Fyr. b) Steeply plunging, tubular fold in layered eclogite; Lighthouse Hill, Ulla Fyr. c) Steep eclogite facies lineations (black) in gabbroic pencil gneiss (outlined in red), cut by granodiorite; Arhaugen, Flemsøya – C on Fig. 2.3. d) Steep eclogite facies lineations (black) in gabbroic pencil gneiss; Ulla Fyr – C on Fig. 2.2.

Figure 2.6: Field photos of eclogite-hosting granodiorite. a) Layered eclogite (LE) enveloped on all sides by granodiorite; Lighthouse Hill, Ulla Fyr. b) 'Eclogite soup' of small eclogite boudins within massive granodiorite; Haramsøya, near the bridge to Ulla Fyr. c) Granodiorite (GD) crosscutting fabric in augen gneiss (AG); Flemsøya – B on Fig. 2.3. d) Granodiorite crosscutting fabric in augen gneiss; Ulla Fyr –D on Fig. 2.2. e) Eclogite (E), cut by granodiorite (GD) with abundant, possibly primary, euhedral garnets (Grt); Arhaugen, Flemsøya. f) Transition from felsic (pale grey) to hornblende-rich granodiorite (dark grey, right), away from eclogite; east of Storetjønna, Flemsøya.

2.3.7 Scapolite Pegmatites

The scapolite-bearing pegmatites which are the primary focus of this research are also a key component of the enigmatic granodiorites. These pegmatites are found in the strain shadows adjacent to eclogite boudins (Fig. 2.7a), or on the margins of the granodiorite. There is a strong resemblance between these scapolite pegmatites and the one on the south coast of Finnøya (Steenkamp, 2012; Gordon *et al.* 2013). The scapolite pegmatites are unevenly distributed within the granodiorite, and several locations proved to have extremely dense concentrations of pegmatites, from which a large volume of samples could be collected. On the Flemsøya coast, these areas included Lillegeita Point, Skobergo, and the south-west margin of the granodiorite enveloping the boudin chain east of Storetjønna. In the Ulla Fyr map area, large concentrations of scapolite were found on the west side of 'Scapolite Hill' (Fig. 2.2, E), a small knoll on the southeast (mainland) side of the footbridge. Specific scapolite localities are discussed further in Ch. 4.

The pegmatites are typically heterogeneous with segregated scapolite-rich and hornblende-rich portions (Fig. 2.7b). The hornblende-rich portions of the rock consist of sub- to euhedral, poikilitic hornblende megacrysts, with interstitial plagioclase + biotite + quartz ± scapolite. Large, euhedral titanites (Fig 2.7c) and subhedral garnets are also common in these portions of the leucosome. Garnets are more abundant in leucosomes directly in the strain shadows of eclogites. This may indicate that this garnet is xenocrystic, but primary crystallization cannot be ruled out from hand-sample-scale textures alone.

The scapolite-bearing portions of the leucosome are dominated by macro-graphically intergrown scapolite and quartz (Fig 2.7d), with lesser amounts of biotite, plagioclase, and titanite. Scapolite is typically blue-white, although in a small number of cases, such as a few leucosome pods on Lillegeita, scapolite can take on a brown hue (Fig. 2.7d) owing to a high concentration of pyrite inclusions. In one outcrop, the graphic intergrowth texture is obliterated in deformed and recrystallized rocks (Fig. 2.7e), e.g., at Skobergo, an area affected by late amphibolite-facies folding (Terry and Robinson, 2004).

A second, and much rarer, variety of scapolite pegmatite was found within the 'Ulla Gneiss Field' (Fig. 2.2, F), the relatively flat-lying, extensive outcrop of Ulla Gneiss in central Ulla Fyr. Two pegmatites consisting almost solely of prismatic, bladed, blue-grey scapolite with minor amounts of quartz and hornblende (Fig. 2.7f) were identified and sampled. Only the smaller of the two pegmatites was clearly associated with an eclogite boudin, although much of the area around the larger pegmatite was obscured by moss. The scapolite pegmatites encountered in the field were divided into 'Types' based on differences in mineralogy, texture, and field relationships (and reinforced by compositional differences; see Ch. 3). The more common, hornblende+plagioclase-rich, macro-graphic pegmatites associated with the granodiorite were classified as Type 1, while the blue-grey prismatic scapolite pegmatites on the Ulla Gneiss Field were classified as Type 2.

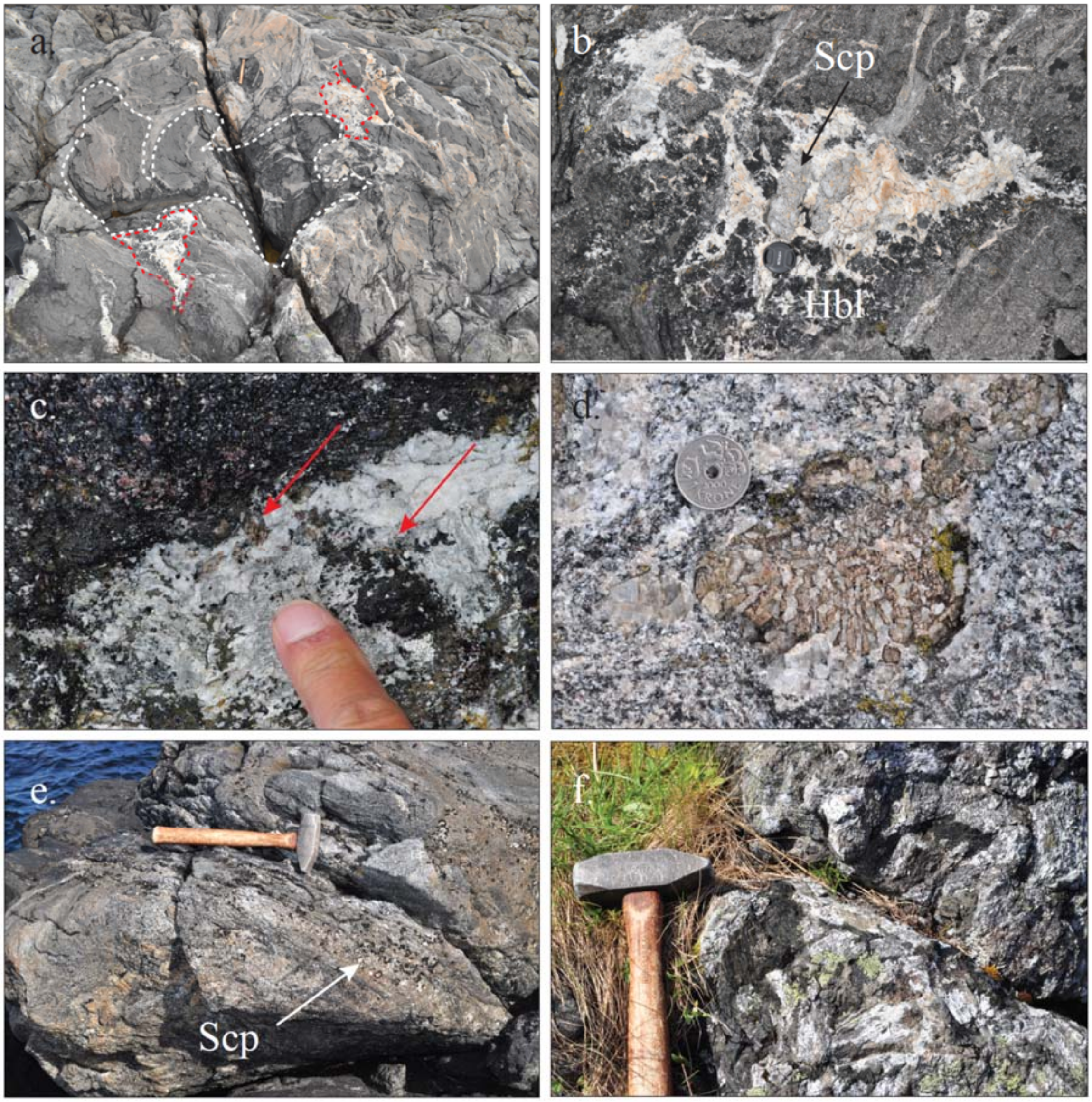


Figure 2.7: Field photos of scapolite-bearing pegmatites. a) Scapolite-hornblende pegmatites (outlined in red) in the strain shadows of a deformed, retrograded, eclogite boudin (outlined in white) included in granodiorite; Scapolite Hill – E on Fig. 2.2. b) Segregation of leucosomes into hornblende (Hbl) rich and scapolite (Scp) rich portions; Scapolite Hill, Haramsøya. c) Large, euhedral titanites (indicated with red arrows) in scapoite-bearing leucosome; Skobergo, Flemsøya. d) Macrographic intergrowth of scapolite (brown) with quartz (raised, translucent/white). In this case, the brown color in scapolite is the result of abundant sulphide inclusions; Lillegeita, Flemsøya. e) Highly deformed scapolite+hornblende leucosome. Large, white, granular scapolite porphyroclasts indicated by the arrow; Skobergo, Flemsøya. f) Prismatic scapolite pegmatite, found only in Ulla Gneiss Field.

2.3.8 Other Leucosomes

The augen orthogneiss and layered granitic gneiss are both migmatitic. In addition to the roughly foliation-parallel leucosomes produced by melting of the augen gneiss (Fig. 2.8a), both the syenogranitic portions of the layered granitic gneiss and the augen gneisses that outcrop on Lillegeita contain a younger generation of leucosomes (Fig. 2.8b, c). These leucosomes lack scapolite, are generally monzogranitic to granodioritic in composition, and are bordered by a biotite-rich melanosome. This generation of leucosomes cuts the host-rock foliation at a low to moderate angle, and has a relatively regular NW-SE orientation. On Lillegeita, they form en-echelon arrays resembling tension gashes formed in shear zones (Fig. 2.8b), possibly indicating that they formed during late top-to-the-west shear (Terry and Robinson, 2003). It is difficult to determine the age of these leucosomes relative to the scapolite-bearing ones, as the two do not occur in the same rock types. With the exception of the deformed pegmatite at Skobergo, scapolite leucosomes are generally undeformed, while the granitic leucosomes do show evidence of deformation, which may suggest that the scapolite leucosomes are younger. However, as scapolite leucosomes are preferentially confined to the low-strain shadows behind eclogite boudins, the majority of them may simply have been shielded from this deformation.

Late granitic intrusions form the youngest mappable unit in each area. Two, small biotite-K-feldspar granite bodies crop out on the Haramsøya coastline. Both of these cut the augen gneiss and granodiorite, but are strongly foliated with a shallow lineation, defined by elongated K-feldspar grains, and parallel to fold axes. The larger of the two bodies on the coast is folded into an open antiform (Fig. 2.8d). A different variety of granitic intrusion is found on the Flemsoya coast, where undeformed K-feldspar granite pegmatites cut both eclogite- and amphibolite-facies structures, including the granodiorite (Fig. 2.8e). These pegmatites are post-kinematic, and one, found in the neck of a boudin east of Storetjønna (B on Fig. 2.3), was dated by Krogh *et al.* (2011) at 396±4 Ma.

2.4 Structure

In both map areas, variations in structures, particularly linear fabrics, can be used to distinguish different stages of metamorphism and deformation. The steeply plunging fold axes of tubular folds preserved in the less retrogressed eclogites, and parallel lineations in the gabbro pencil gneisses and Ulla Gneiss, are the earliest generation of fabrics, and were identified by Terry and Robinson (2004) as recording eclogite-facies deformation (Fig. 2.9a, b). In the augen gneiss on Ulla Fyr, and in rare cases on Flemsøya, moderate to steep lineations plunge north-east, similar to the eclogite-facies fabrics. Typically slightly shallower than those which can be directly linked to eclogite facies mineral assemblages, they are interpreted to have formed during the same early deformation events, and to have largely escaped the subsequent amphibolite facies overprint. On Ulla Fyr, shallow lineations are associated with late, amphibolite-facies folding (Terry and Robinson, 2003), like that seen in the biotite-K-feldspar granites and less commonly in the basement gneisses. This is even more pronounced on Flemsøya, where the early steep fabrics are nearly absent in the augen gneiss, and where not obliterated by leucosomes, lineations range from shallow to subhorizontal. The transition from steep lineations in the augen gneiss on Ulla Fyr to shallow lineations on Flemsøy may indicate an eastward increase in the intensity of amphibolite-facies deformation.

Figure 2.8: Field photos of leucosomes and late granites. a) Migmatitc augen gneiss; near Lillegita; Flemsøya. b) Quartzo-feldspathic leucosome in layered migmatitic granitoid gneiss, cutting foliation; Ulla Fyr. These late leucosomes do not contain scapolite. c) Similar quartzo-feldspathic leucosomes in en-echelon pattern, cutting fabric in augen gneiss; Lillegeita, Flemsøya. d) Folded biotite-K-feldspar granite cutting granodiorite; Haramsøya coast. e) Undeformed granite pegmatite (P) in eclogite (E) boudin neck; east of Storetjønna, Flemsøya. f) Crenulation fabric in augen gneiss; Ulla Fyr.

This is consistent with the regional pattern, where the intensity of late strain increases to NE towards Haroya, where it dominates (Butler, 2013; Butler *et al.*, 2013).

Unlike the lineations, foliations in both map areas show a relatively consistent orientation, dipping steeply northeast except where deformed by amphibolite-facies folds (Terry and Robinson, 2003; Fig. 2.9c, d). Even on the Flemsøya coast, where the earlier steep lineations have been rotated to shallower plunges, the orientation of the foliation remains relatively unchanged. Only along the margins of the large body of augen gneiss that covers northern Ulla Fyr can a clear second foliation be distinguished, in the form of a steep crenulation cleavage (Fig. 2.8f). Compared to broader structure of the entire northern segment of the Nordøyane UHP domain (Terry and Robinson, 2004), the dominant foliations on Ulla Fyr and the Flemsøya coast are consistent with the regional amphibolite-facies foliation (Fig. 2.10).

2.5 Discussion

The field relationships between eclogites, granodiorites and Type 1 scapolite-bearing pegmatites provide constraints on relative ages and possible genetic associations. While there is a clear spatial association with the eclogites, the origin of the granodiorite remains unclear. One possibility is that it was derived by partial melting of other local rock types, although it is compositionally different from leucosomes derived from the partial melting of the basement gneisses. All granodiorites in both field areas contain eclogite enclaves, suggesting a genetic relationship between the two rock types. Many of the smaller eclogite enclaves within the granodiorite (Fig. 2.11a) show textural evidence of melting such as thin discordant leucosomes or a melanosome bordering the granodorite

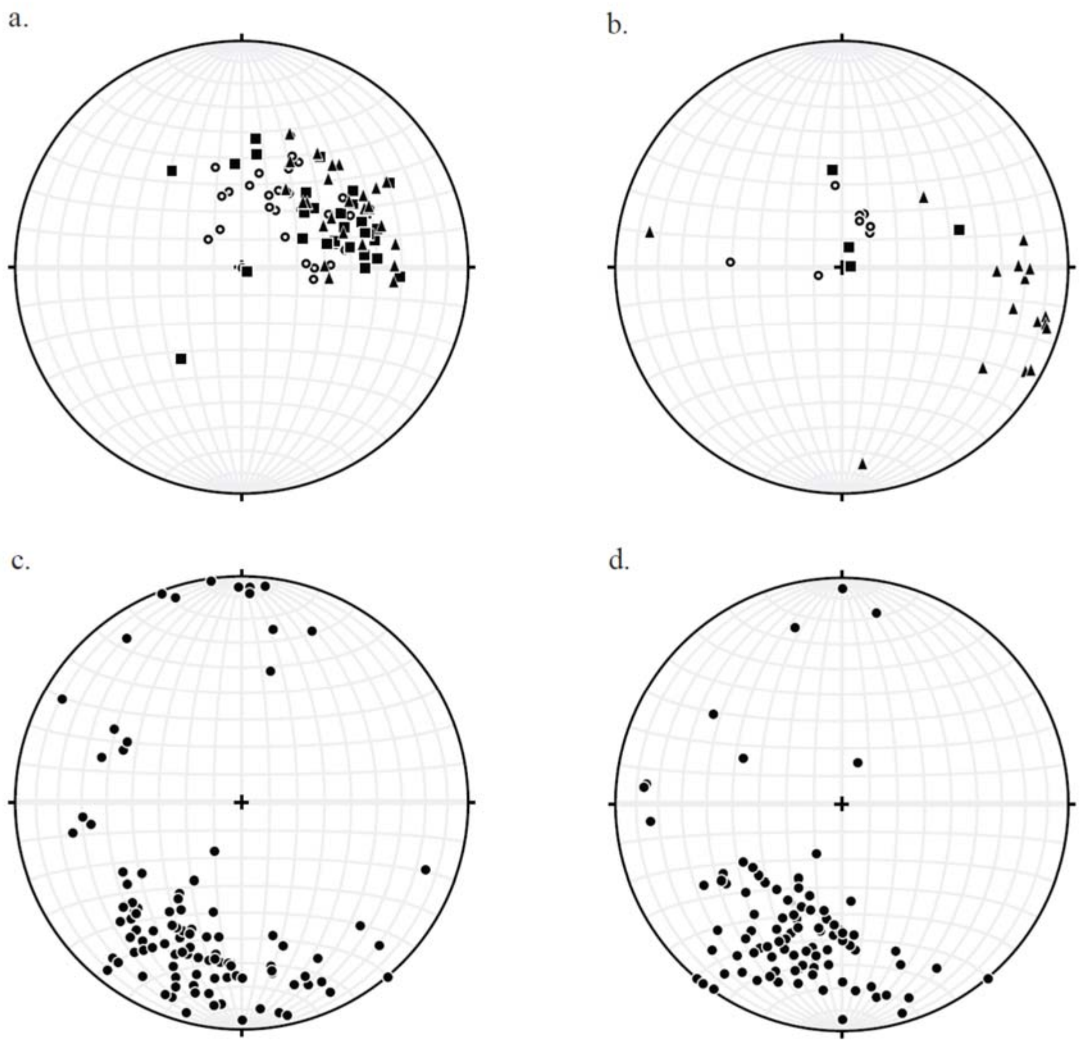


Figure 2.9: Lineations (a and b) and poles to foliations (c and d) from Ulla Fyr (a and c) and Flemsøya (b and d). Open circles = eclogite facies linear fabrics, squares = early linear fabrics in the augen orthogneiss, triangles = late amphibolite facies linear fabrics, closed circles = poles to foliations.

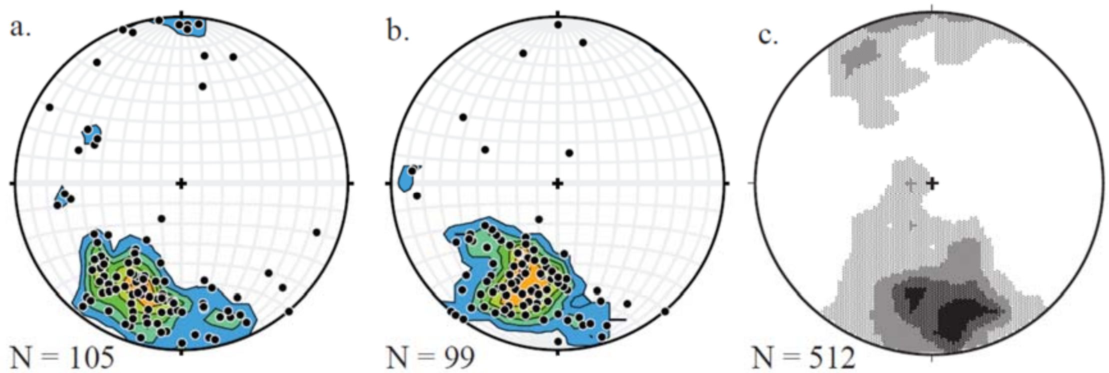


Figure 2.10: Contoured equal area projections (contour interval 1% area) comparing poles to foliations from a) Ulla Fyr b) the northeastern coast of Flemsøya and c) amphibolite facies planar fabrics across the northern segment of the Nordøyane domain (Terry and Robinson, 2004). Fig. 2.10a and b are equivalent to Fig. 2.9c and d.

'leucosome'. However, it is not clear from this if the eclogite melted to produce the granodiorite, or was intruded by and partially dissolved in the granodiorite.

The core of the large eclogite body on Lighthouse Hill lacks the melting textures seen on the margins of eclogites in direct contact with the granodiorite. Although the close spatial association is not evidence of partial melting, the granodiorite is closely associated with a number of other pervasive phenomena observed in the eclogites. Most large eclogites contain a small proportion of a distinctive apple-green eclogite (found to have a matrix of plagioclase-omphacite symplectite when viewed under high magnification) adjacent to the intruding granodiorite (Fig. 2.11b). In other places, eclogites in contact with the granodiorite have noticeably coarser garnets than those shielded from it (Fig. 2.11c, d). These features may indicate reactions or recrystallization as a result of interaction with fluids or melt.

The field association between the Type 1 pegmatites and the granodiorites also suggests a genetic relationship. The Type 1 pegmatites are not associated with any other lithology. Furthermore, the low-strain areas where the pegmatites are almost always found, such as the strain shadows behind eclogite boudins, are the areas where melt would be most likely to collect. Therefore, the Type 1 pegmatites are provisionally interpreted to have crystallized from a late-stage differentiate of the granodiorite melt that hosts the eclogites.

The possibility of eclogite partial melting at (U)HP conditions has significant tectonic implications for the exhumation of the WGR (Labrousse *et al.*, 2011; Ganzhorn *et al.*, 2015; Butler *et al.*, 2015). To produce the volume of granodiorite relative to eclogite encountered in the field would require a high degree of partial melting. Further investigation of the eclogites and associated granodiorite in thin section may provide a clearer understanding of the relationship between the two rock types than can be determined through field observation alone. Further discussion of the origin of the granodiorite and Type 1 scapolite pegmatites is presented in Ch. 6.

Figure 2.11: Interaction between eclogite and granodiorite. a) Eclogite enclaves in various stages of disaggregation and assimilation by host granodirotite; arrow indicates patch of granodiotite within eclogite; Flemsøya – near C on Fig. 2.2. b) 'Apple Green' eclogite (outlined in red) adjacent to granodiorite (outlined in white); Flemsøya – near B on Fig. 2.3. c, d) Garnet porphyroblasts in eclogite (E) adjacent to granodiorite (GD); Ulla Fyr.

2.6 Conclusions

Two types of scapolite-bearing pegmatites were discovered during mapping. Type 1 pegmatites have a hornblende+plagioclase+biotite+scapolite+quartz assemblage, are associated with the eclogite-bearing granodiorite lithology, and are present in both Ulla Fyr and Flemsøya. Type 2 pegmatites have a scapolite+quartz±hornblende assemblage and are found only on Ulla Fyr, hosted in the Ulla Gneiss. Scapolite is also a constituent of leucosomes in both the Ulla Gneiss and augen gneiss. The granodiorites associated Type 1 pegmatites also share a ubiquitous field association with eclogite, and cut amphibolite-facies fabrics in adjacent augen gneisses. Some of the smaller eclogite bodies included in the granodiorite contain thin granitic seams or veins, which could have been externally derived or show evidence of partial melting. Whether these constitute evidence of melting at UHP conditions cannot be determined based on field observations alone. However, the close field relationship between eclogite, granodiorite and Type 1 pegmatites provides an important constraint on interpreting other data. The petrogenesis of the pegmatites is discussed further in Ch. 6.

Chapter 3: Petrography and Mineral Chemistry

3.1 Introduction

In order to begin answering the topical questions relating to the presence, source and composition of fluids, and the timing of partial melting relative to exhumation, detailed compositional information is needed on scapolite, the main volatile-bearing phase observed in the field. Stable under high pressure and temperature conditions, scapolite is one of the few common rock-forming silicates to contain volatile species such as CO_3^{2-}, SO_4^{2-} and Cl^- (Moecher *et al.* 1992). As such, scapolite has long been considered an important sink for volatiles in the lower crust (Goldsmith, 1976). In 'dry' scapolite-bearing lower crustal rocks such as granulites, where the source of volatile-bearing fluids is unclear, stable isotope analysis of C (Moecher, 1993; Moecher *et al.* 1994), S (Hoefs *et al.* 1981), and O (Yoshino and Satish-Kumar, 2001) has been used to distinguish between possible fluid sources. Prior to conducting stable isotope analysis and geochronology, it was necessary to characterize the scapolite in the three types of pegmatites and other scapolite-bearing lithologies.

3.2 Petrographic Descriptions and Mineral Chemistry

Samples were first characterized and described in thin section using a petrographic microscope. In some cases, microscale textures were photographed using a Nikon Eclipse 50i POL microscope with a Nikon DS-F1 camera. Polished thin sections from 20 scapolite-bearing samples were analyzed by EPMA. Standard thin sections from these, and other samples of the same rock types, were studied under the microscope, and in some cases used to produce photomicrographs of various textures and inclusion relationships. Sample numbers for each type of scapolite-bearing lithology are listed in Table 3.1.

Lithology	Sample Numbers	Locality	Figure References
Type 1 pegmatite	CB15-12, 20, 24, 25, 27, 40, 57, 58, 59, 72, 74, 78	12-40: Ulla Fyr 57-78: Flemsøya	Fig. 3.1, 3.2, 3.8, 3.9
Type 2 pegmatite	CB15-32, 41	Ulla Fyr	Fig. 3.3, 3.10
Type 3 pegmatite	PR15-01	Finnøya	Fig. 3.4, 3.11
Ulla Gneiss	CB15-34	Ulla Fyr	Fig. 3.5a, b
Augen gneiss	CB15-42	Ulla Fyr	Fig. 3.5c, d, 3.12
Granodiorite	CB15-28, 63	28: Ulla Fyr 63: Flemsøya	Fig. 3.5e
Migmatitic tonalite gneiss	JB10-51	Harøya	N/A
Migmatitic garnet-amphibolite gneiss	CB15-04	Harøya	Fig. 3.5f
Eclogite	CB15-15, JB10-63	15: Ulla Fyr 63: Harøya	Fig 3.6

Table 3.1: Polished thin section lithologies, sample numbers, sample localities, and figure references for photomicrographs, BSE images and X-ray maps.

Quantitative microprobe analysis, x-ray mapping, and backscattered electron (BSE) imaging of scapolite and other associated minerals were carried out using a JEOL 8200 Superprobe equipped with 5 wavelength dispersive spectrometers (WDS) at the Robert M. MacKay Electron Microprobe Laboratory at Dalhousie University. Operating conditions for quantitative WDS analysis were an accelerating voltage of 15 kV, 20 nA beam current, and 1-2 µm beam diameter. Analytical standards and accompanying references are presented in Table 3.2. Selected analyses for minerals discussed in this section are presented in Table 3.3 with further analyses presented in Appendix A. Scapolite compositions are discussed separately in section 3.4.

Element	Count Times: Peak / Background (s)	Standard (References)
Ca	20 / 10	Kakanui kaersutite (Jarosewich *et al.*, 1980)
Cl	30 / 15	Tugtupite
F	40 / 20	Durango fluor-apatite (Young *et al.*, 1969)
Si	20 / 10	Sanidine
Cr	20 / 10	Cr metal
K	20 / 10	Sanidine
Ti	20 / 10	Kakanui kaersutite (Jarosewich *et al.*, 1980)
Na	20 / 10	Jadeite
Al	20 / 10	Sanidine
Mn	20 / 10	Pyrolusite
S	20 / 10	$Cu_{1.8}S$
Mg	20 / 10	Kakanui kaersutite (Jarosewich *et al.*, 1980)
Fe	20 / 10	Garnet – Almandine 12442

Table 3.2: Count times, standards and references for the elements analyzed by electron microprobe. Not all standards have literature references.

3.2.1 Type 1 Pegmatites

As noted in Chapter 2, the Type 1 pegmatites are typically segregated into scapolite+quartz-rich and hornblende+biotite+plagioclase-rich portions. The former are almost entirely composed of macrographically intergrown scapolite and quartz (Fig. 3.1a, b, c) in roughly equal proportions. Scapolites are typically highly poikilitic, with quartz inclusions being nearly ubiquitous. These come in a range of sizes and shapes from irregular blebs up to ~0.5 mm across, to 'pinprick' inclusions a few microns in size (Fig. 3.1d). Small inclusions of magnetite and pyrite are also common, typically as 'pinprick' inclusions, but more rarely (e.g., CB15-58, Fig. 3.1c), pyrite inclusions may be large and common enough to discolour the scapolite in hand sample. In two samples, CB15-58 and 59, minor amounts of calcite were found in fractures on the margins of scapolite grains (Fig. 3.1c, e). Other minor phases included in scapolite, from most to least abundant, include biotite, K-feldspar, plagioclase, apatite, and zircon, although these phases can also be found as separate grains. In addition to the abundant inclusions, scapolites are commonly mantled by a discontinuous rim of K-feldspar (Fig. 3.1d). These rims can also be found around some of the larger quartz inclusions in scapolite. Aside from small inclusions and the K-feldspar rims, larger grains of feldspar are antiperthitic, with K-feldspar (Or_{87-97}) exsolution lamellae in a plagioclase (An_{20-45}) host (Fig. 3.1f). Because the K-feldspar rims are discontinuous and only present on some scapolite grains, we interpret them to be late-crystallized melt films.

The hornblende+biotite+plagioclase portions of these rocks (represented by samples CB15-20, 40, 78) are mineralogically and texturally more varied than the scapolite+quartz portions. Hornblende (potassic-ferro-pargasite, under the Leake *et al.*

(1997) classification) comprises ~25-40 % of these portions of the rock, and ranges from large (up to 2.5 cm) sub- to euhedral prismatic megacrysts (Fig. 3.2a) to anhedral mm-scale grains. The larger hornblende megacrysts are highly poikilitc, and can contain inclusions of scapolite, feldspar, quartz and various accessory phases (Fig. 3.2b). Biotite is intergrown with hornblende in all samples, accounting for ~10-15% of the rock. Biotite is much finer-grained than the hornblende, and forms sub-to euhedral flakes of intermediate composition (Phl_{47-57}). Scapolite is much rarer in these portions of the pegmatite, generally accounting for less than 5% of the rock, and is typically granular and anhedral (Fig. 3.2c). As in the macrographic portions of the pegmatites, scapolite may also contain inclusions, particularly quartz, apatite and zircon (Fig. 3.2d). Both apatite and zircon are more common in the hornblende-rich portion of the rock, and can also be found as inclusions in a number of phases, most commonly biotite, scapolite, and feldspar. Titanite, another common accessory phase, is covered in greater detail in Chapter 5. There is evidence of minor alteration in some of these rocks, particularly affecting feldspars (Fig. 3.2c, e). Antiperthitic exsolution lamellae (Fig. 3.2b) are common, although grains with well developed polysynthetic twinning (Fig. 3.2c) generally lack them. The composition of plagioclase in the hornblende+biotite+ plagioclase-rich zone ranges in composition from An_{36-45}. Feldspar and quartz typically make up ~50% of the rock, with a 'transition zone' of nearly pure quartz and feldspar generally separating the hornblende+biotite+plagioclase and scapolite+quartz parts of a given pegmatite.

Garnet and clinopyroxene are both minor constituents of the hornblende-rich portions of Type 1 pegmatites (Fig. 3.2f). These phases are only encountered in portions of the rock which are directly adjacent to eclogites. The smaller anhedral hornblende grains commonly contain inclusions of clinopyroxene (Fig. 3.2f), suggesting that they may have formed by partial replacement of clinopyroxene. Garnet grains typically have highly irregular, embayed grain boundaries containing plagioclase±biotite± quartz. This texture is interpreted to indicate that garnet was breaking down. Based on the replacement/breakdown textures and close spatial association with the eclogites, the garnet and clinopyroxene are interpreted to be eclogite-derived xenocrysts, which are not in equilibrium with the rest of the Type 1 assemblage.

3.2.2 Type 2 Pegmatites

Type 2 pegmatites are considerably different from their Type 1 counterparts in texture, mineralogy and mineral chemistry. Of the two Type 2 pegmatites encountered on Ulla Fyr, only CB15-41 contained any significant amount of mafic minerals, and both lacked the distinctive macrographic scapolite+quartz intergrowths characteristic of Type 1. CB15-32 consists almost entirely of 1-2 cm long bladelike prismatic crystals, which are heavily fractured and have minor amounts of interstitial quartz (Fig. 3.3a). The other Type 2 sample, CB15-41, is finer grained and shows evidence of extensive recrystallization, with quartz and scapolite forming a granoblastic polygonal texture (Fig. 3.3b). While similar in texture and major element chemistry to the hornblende megacrysts in Type 1 pegmatites (both are potassic-ferro-pargasite), the hornblende in CB15-41 is significantly more Cl-rich (1.41 wt% on average for Type 2 *vs.* 0.08 wt% for Type 1). Chlorite pseudomorphs replace biotite in CB15-41, with fine grains of ilmenite formed along relict cleavage planes (Fig. 3.3c, d). Scapolite is highly poikilitic in both samples, with a similar ‘pinprick’ inclusion pattern of quartz and sulphides as in the Type 1 pegmatites (Figure 3.3e). However, the sulphide phase in these rocks is chalcopyrite, rather than pyrite. Feldspar is a much rarer component in Type 2 pegmatites relative to Type 1, only present as weathered laths of K-feldspar (Fig. 3.3f). These K-feldspar grains are intergrown with another phase identified as a K-rich mica based on qualitative EDS analysis (quantitative analysis totals were too low to calculate a composition).

3.2.3 Type 3 Pegmatites

The scapolite sample provided by Peter Robinson (PR15-01) from the now destroyed outcrop on Finnøya consists of a single large scapolite lath, such as those pictured in Figure 3.4a, attached to a small amount of the garnet-amphibolite gneiss host rock. Although there is no corresponding sample, field photos of the same outcrop taken by Holly Steenkamp in 2010 reveal that some portions of the pegmatite also displayed the macrographic intergrowth texture observed in the Type 1 pegmatites (Fig. 3.4b). Like the other pegmatite samples, the subhedral prismatic scapolite crystals from PR15-01 are highly poikilitic with numerous micron-scale inclusions of quartz (Fig. 3.4c). Rounded, 1-3 mm quartz grains surrounded by multiple larger scapolites are also common (Fig. 3.4c). Numerous, straight, irregularly oriented fractures (Fig. 3.4d) cut across the scapolite grains. Typically filled with quartz, these fractures can also contain biotite, garnet and pyrite (Fig. 3.4e, f), possibly scavenged from the garnet amphibolite host gneiss. This sample was placed in a separate category from the other pegmatites based on differences in mineralogy, principally the lack of hornblende, biotite and plagioclase. and scapolite texture.

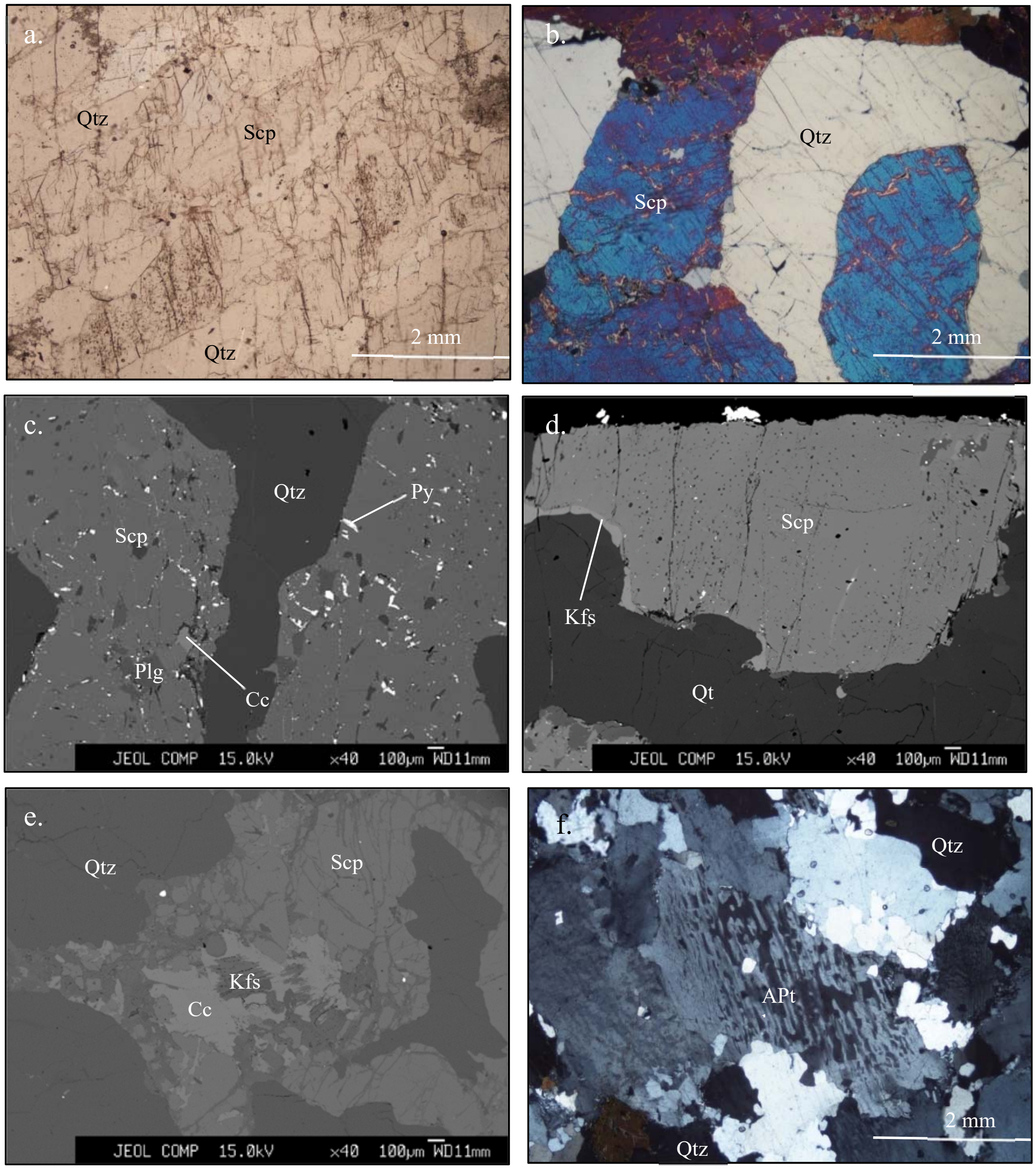


Figure 3.1: PPL and XPL photomicrographs and BSE images of the 'scapolite-quartz' portion of Type 1 pegmatites. a, b) Macrographic intergrowth of scapolite and quartz (a - PPL; b - XPL), the most common texture in this portion of the Type 1 pegmatites. c) Inclusions of coarse pyrite (CB15-58). Other common inclusions in scapolite include plagioclase, K-feldspar, biotite and small rounded to subrounded "pinprick" inclusions of quartz and magnetite, visible only at very high magnification. d) Thin, discontinuous rim of K-feldspar on a scapolite grain boundary (CB15-58). e) Calcite in fractured scapolite (CB15-59), interpreted to be secondary. f) XPL image of antiperthitic feldspar (CB15-54).

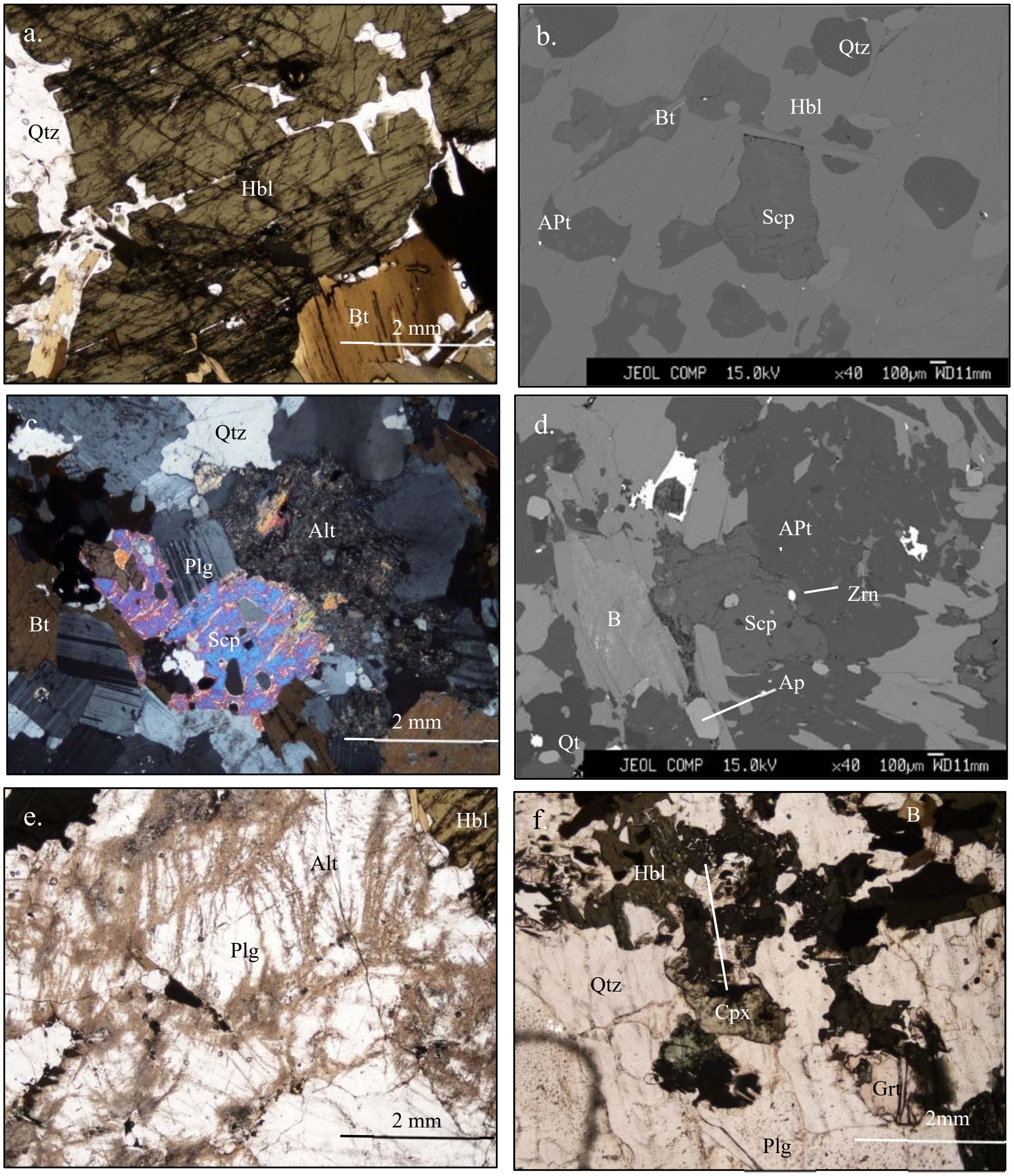


Figure 3.2: PPL and XPL photomicrographs and BSE images of the hbl+bt+plg-rich portion of Type 1 pegmatites. a) Typical hornblende megacryst, with inclusions of biotite and quartz (CB15-40). b) Inclusions of scapolite, biotite, quartz and antiperthitic feldspar in a poikilitic hornblende megacryst. c) Typical scapolite grain in this portion of the pegmatite (CB15-40). d) Zircon and apatite included in scapolite (CB15-40). e) Extensive alteration of plagioclase (CB15-40). f) Garnet and clinopyroxene (CB15-20). The hornblende grain indicated by the white line includes small grains of clinopyroxene. This is interpreted as partial replacement of clinopyroxene by hornblende.

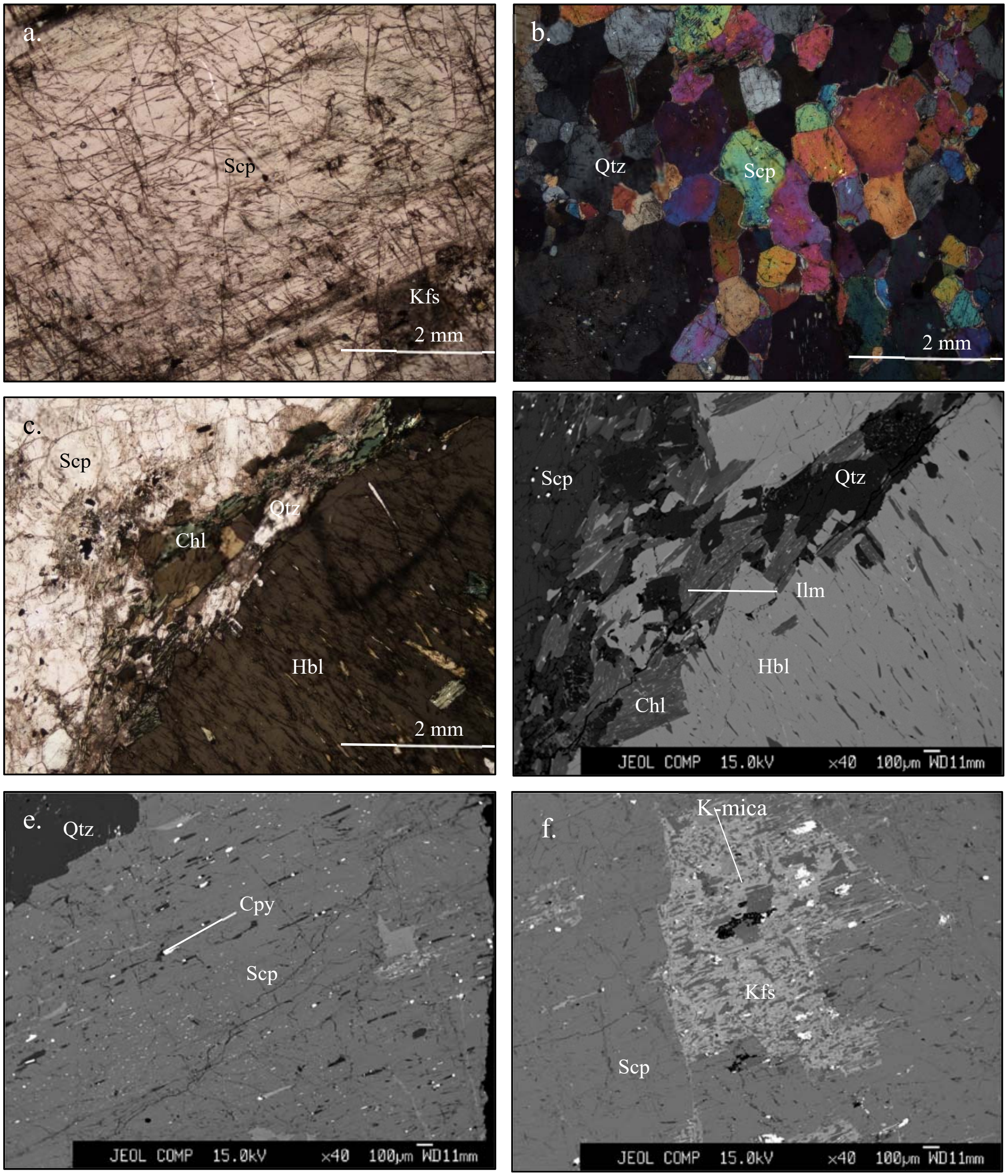


Figure 3.3: PPL and XPL photomicrographs and BSE images of Type 2 pegmatites CB15-32 and 41. a) Heavily fractured prismatic scapolite grains in CB15-32. b) Granoblastic-polygonal scapolite and quartz grains in CB15-41 c,d) Hornblende and biotite altered to chlorite and ilmenite in CB15-41. e) Small inclusions of quartz and chalcopyrite in CB15-32. These inclusions are also common in CB15-41. f) Altered K-feldspar intergrown with a K-rich mica (based on qualitative EDS analysis).

3.2.4 Other Scapolite-Bearing Lithologies

Most of the basement gneiss units on Haramsøya and Flemsøya have undergone at least some degree of partial melting, and while uncommon, scapolite is an accessory phase in the leucosomes of several different migmatite lithologies. In the Ulla Gneiss, which is largely composed of an amphibolite-facies assemblage of hornblende (potassic-pargasitic-hornblende; Leake *et al.* 1997) +biotite+plagioclase+quartz, scapolite is relatively rare. Thin leucosomes of scapolite+plagioclase+quartz, commonly surrounded by a biotite-rich melanosome (Fig. 3.5a) make up a small proportion of the rock, and scapolite is commonly absent. Garnet and clinopyroxene are also abundant in the Ulla Gneiss. Both of these phases display similar textures to those described in the hornblende-rich portions of Type 1 pegmatites (Fig 3.5b). However, these phases are present throughout the Ulla Gneiss, rather than only in portions adjacent to eclogites, as in the pegmatites. Based on this, these minerals are not interpreted as xenocrysts, but instead as relicts of the peak Ulla Gneiss mineral assemblage.

In the augen gneiss, leucosomes are best preserved around K-feldspar porphyroclasts, and typically consist of a mixture of scapolite, microcline, and quartz (Fig. 3.5b). These leucosomes, as well as the intact augen, are bordered by bands of biotite melanosome, which defines a foliation. Minor green-brown hornblende and titanite are also present in these melanocratic layers. The matrix of the rock consists of roughly equigranular, anhedral quartz with minor plagioclase. Scapolite grains are anhedral and show some evidence of alteration along fractures and grain boundaries. Apatite, zircon and allanite are present as accessory phases throughout the matrix, although zircon can also be found in the leucosomes, in one case included in scapolite

(Fig. 3.5c). Also included in the same scapolites are a number of small subrounded grains of Ca+Mn-rich garnet ($Pyr_6Alm_{44}Grs_{31}Sps_{19}$). The origin of these garnets is not clear, as they are not found elsewhere in the rock, or in any other rock types. The inclusion relationship indicates that crystallization of the garnets predates that of the scapolite.

The granodiorite from which the pegmatites crystallized is relatively scapolite-poor. The granodiorite is composed of a matrix of anhedral quartz, plagioclase, and K-feldspar (commonly together in the form of antiperthite) hosting phenocrysts of biotite and hornblende (Fig. 3.5e). As shown in Figure 3.5e, many of the grains of quartz, plagioclase and biotite are surrounded by thin rims of K-feldspar. These are interpreted as melt films (Sawyer, 1999). Where present, small anhedral scapolite grains are found in the matrix along with quartz and feldspar. Hornblende in the granodiorite is very similar in composition to that in Type 1 pegmatites. Accessory allanite and zircon are relatively abundant throughout the matrix or included in biotite. Clinopyroxene and garnet also make up a significant portion of the granodiorite. These phases are more common in the granodiorite than they are in the Type 1 pegmatites, but display the same textures, and the same close field association with eclogites. Therefore, they are also interpreted as eclogite-derived xenocrysts.

Scapolite is more abundant in the leucosomes of basement gneisses on Harøya, and two samples were analyzed for comparison with the scapolite from Haramsøya and Flemsøoya. CB15-04, a garnet amphibolite gneiss collected from a roadcut in central Harøya, contains scapolite in pockets of deformed leucosome (Figure 3.5f) bounded by melanocratic layers of weakly foliated anhedral green-brown hornblende and biotite. These darker layers also contain rounded pokilitic garnets with inclusions of quartz. In addition to scapolite, leucosomes consist of quartz and plagioclase, with abundant titanite. Sample JB10-51 was collected from a deformed migmatitic tonalitic gneiss (Butler, 2013) in Myklebust at the southern tip of the island. In Myklebust, the migmatitic gneisses are juxtaposed against a garnet-porphyroclastic mylonite, speculated by Butler (2013) to be part of the Blåhø Nappe. Sample JB10-51 is principally composed of scapolite, feldspar, quartz, biotite and hornblende. Leucosomes consist of coarse porphyroclasts of scapolite and feldspar (both plagioclase and antiperthite) in a quartzo-feldspathic matrix. Scapolite commonly contains abundant inclusions of quartz and biotite, with minor apatite and pyrite. Melanocratic layers consist of biotite, which defines a schistosity, and hornblende as both fine anhedral grains and some coarse porphyroclasts. Subhedral garnet porphyroclasts with embayed grain boundaries form a minor component of these rocks. Zircon, zoisite, pyrite, apatite and titanite are present as minor phases throughout the matrix.

3.2.5 Eclogite

Although none of the eclogites have (so far) been found to contain scapolite, some eclogite samples from Ulla Fyr and Harøya contain carbonate, sulphide, and sulphate minerals. In addition to the standard eclogite assemblage garnet+omphacite+quartz, biotite is a common phase in these rocks (Fig. 3.6a). Calcite, which has been found in some of the Ulla Fyr samples from Lighthouse Hill, is interstitial between larger grains of garnet and clinopyroxene (Fig. 3,6b), along with smaller recrystallized grains of biotite and clinopyroxene. In contrast, sulphide and sulphate minerals are restricted to veins which cut the eclogite (3.6c, d). So far, only Harøya sample JB10-63 has been found to contain sulphate in the form of barite. However, JB10-63 was also found to contain pyrite. Sulphides in the Ulla Fyr samples have yet to be analyzed, although based on

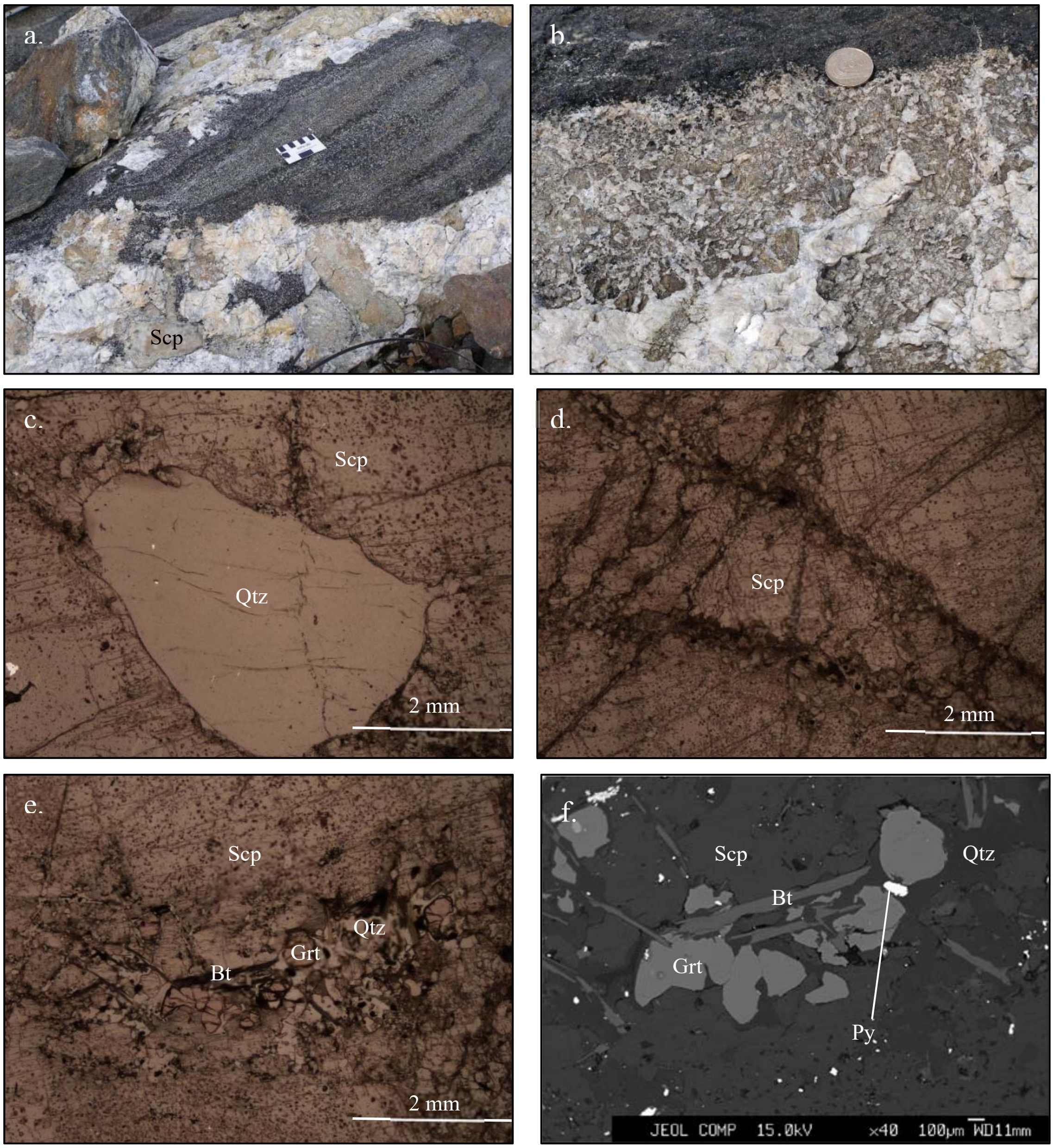


Figure 3.4: PPL and XPL photomicrographs, BSE images, and field photos of Type 3 pegmatite PR15-01. a) Field photo, courtesy of H. Steenkamp, of the now-destroyed outcrop from which this sample was taken, showing large prismatic crystals of scapolite. b) Another field photo of the same outcrop showing macrographic intergrowths of scapolite+quartz like those seen in Type 1 pegmatites (20-krone coin for scalec) Large rounded quartz grain included in larger scapolite that also includes small pinprick inclusions of quartz. d) Fractures in scapolite-filled with mainly by quartz and biotite. e, f) Interstitial quartz, biotite, garnet, and pyrite between scapolite grains.

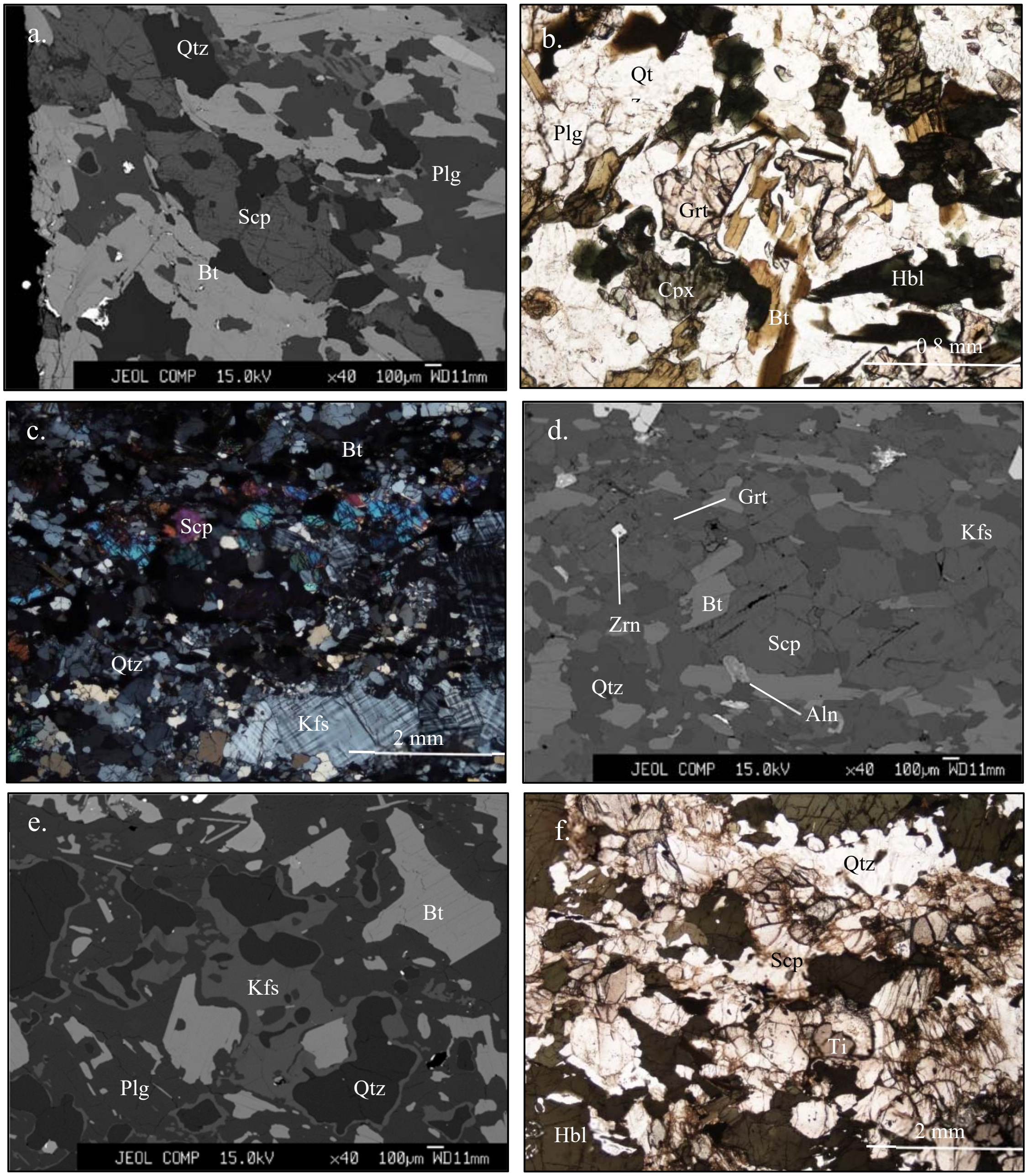


Figure 3.5: PPL and XPL photomicrographs and BSE images of scapolite in basement rocks and the granodiorite associated with Type 1 pegmatites. a) Scapolite in Ulla Gneiss (CB15-34) leucosome, associated with quartz and biotite b) Anhedral garnet in Ulla Gneiss (CB15-34), with embayed grain boundaries filled by biotite+quartz. c) Scapolite in the leucosome of a migmatitic augen gneiss (CB15-42). Leucosomes are typically a mixture of scapolite, K-feldspar, and quartz. K-feldspar porphyroclast in lower left corner. d) BSE image of scapolite in augen gneiss leucosome, showing inclusions of zircon and garnet. e) BSE image of the matrix in granodiorite CB15-64. Note thin films of K-feldspar surrounding most minerals, interpreted as melt films. f) Scapolite+quartz leucosome in garnet-amphibolite gneiss CB15-04.

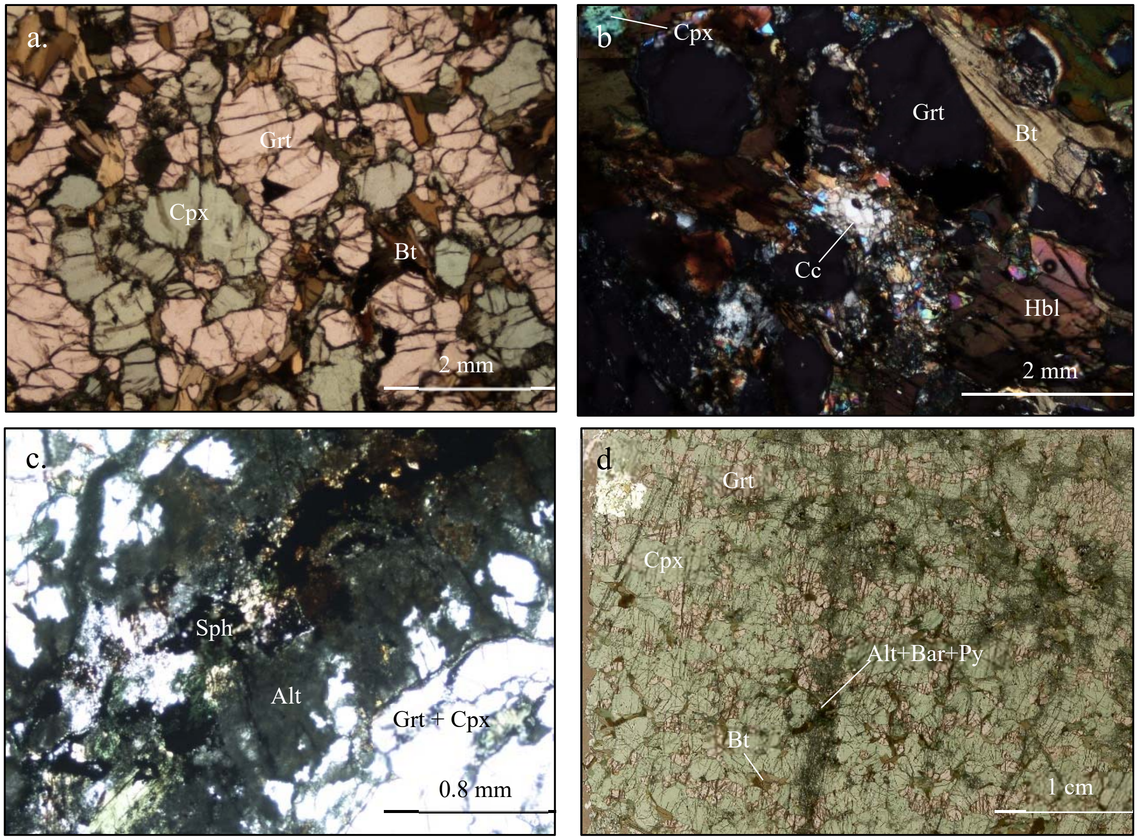


Figure 3.6: PPL and XPL photomicrographs of eclogites. a) Garnet, omphacitic clinopyroxene, and biotite in eclogite CB15-15 from Lighthouse Hill. b) Interstitial calcite (CB15-15). c) Sulphide-bearing vein surrounded by alteration minerals (CB15-15). d) Full thin section scan from Harøya eclogite JB10-63. The prominent dark vein (labeled Alt+Bar+Py) contains alteration minerals as well as the sulphate mineral barite and the sulphide mineral pyrite. S-bearing phases are very fine-grained, and were identified by EDS (R.A. Jamieson, unpublished data).

grain shape the sulphides are interpreted to be pyrite. In both cases S-bearing phases are accompanied by as yet unidentified, fine-grained alteration minerals, and their presence is attributed to post-eclogite facies fluid infiltration.

Table 3.3: Representative Mineral Analyses (Plg, Kfs, Bt, Hbl, Grt)

Sample:	CB15-25 (Type 1 Pegmatite)			CB15-74 (Type 1 Pegmatite)			CB15-40 (Type 1)		CB15-74 (Type 1)		CB15-40 (Type 1 Pegmatite)		
Mineral:	Plagioclase			K-Feldspar			Biotite		Biotite		Hornblende		
No.	198	200	201	185	186		213	261	603	604	220	221	222
Wt%													
SiO2	61.57	62.93	64.09	61.01	61.02		36.68	36.49	36.02	36.22	40.25	40.73	40.13
TiO2	0.00	0.00	0.00	0.00	0.00		4.53	4.53	3.64	3.59	1.51	1.57	1.57
Al2O3	25.02	23.83	22.69	17.44	17.54		15.40	15.69	15.35	15.18	14.10	13.12	13.37
Cr2O3	0.00	0.01	0.00	0.00	0.00		0.04	0.04	3.64	3.59	0.05	0.03	0.06
FeO	0.04	0.06	0.07	0.02	0.03		18.77	18.61	19.07	19.61	18.87	18.83	18.86
MgO	0.00	0.00	0.00	0.00	0.00		11.02	10.79	10.22	10.21	0.42	0.39	0.38
MnO	0.00	0.00	0.00	0.00	0.00		0.23	0.28	0.25	0.24	8.12	8.33	8.26
CaO	6.18	4.95	4.13	0.06	0.03		0.03	0.03	0.00	0.00	11.38	11.60	11.52
Na2O	7.12	8.58	8.78	0.77	0.81		0.08	0.04	0.07	0.07	1.54	1.45	1.47
K2O	0.29	0.40	0.52	15.38	15.66		9.88	9.73	9.72	9.77	1.93	1.91	1.89
SO3	0.00	0.00	0.00	0.04	0.01		0.07	0.08	0.07	0.08	0.05	0.04	0.02
Cl	0.00	0.00	0.00	0.00	0.01		0.08	0.07	0.06	0.05	0.09	0.08	0.10
F	0.00	0.00	0.00	0.00	0.00		0.15	0.13	0.19	0.12	0.08	0.08	0.06
Total	100.21	100.75	100.28	94.71	95.10		96.86	96.44	94.57	95.08	98.32	98.09	97.62
Cations Recalculated on the Basis of 8O							11O				23O		
Si	2.72	2.77	2.82	2.98	2.98		2.76	2.75	2.78	2.79	6.13	6.22	6.16
Ti	0.00	0.00	0.00	0.00	0.00		0.26	0.26	0.21	0.21	0.17	0.18	0.18
Al	1.30	1.24	1.18	1.00	1.01		1.36	1.39	1.40	1.38	2.53	2.36	2.42
Cr	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.01
Fe	0.00	0.00	0.00	0.00	0.00		1.18	1.17	1.23	1.26	2.40	2.40	2.42
Mg	0.00	0.00	0.00	0.00	0.00		1.24	1.21	1.18	1.17	0.05	0.05	0.05
Mn	0.00	0.00	0.00	0.00	0.00		0.01	0.02	0.02	0.02	1.84	1.90	1.89
Ca	0.29	0.23	0.19	0.00	0.00		0.00	0.00	0.00	0.00	1.86	1.90	1.90
Na	0.61	0.73	0.75	0.07	0.08		0.01	0.01	0.01	0.01	0.46	0.43	0.44
K	0.02	0.02	0.03	0.96	0.98		0.95	0.94	0.96	0.96	0.37	0.37	0.37
S	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.01	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00		0.01	0.01	0.01	0.01	0.03	0.02	0.03
F	0.00	0.00	0.00	0.00	0.00		0.03	0.03	0.05	0.03	0.04	0.04	0.03
Total	4.94	4.99	4.98	5.03	5.04		7.82	7.80	7.84	7.83	15.89	15.87	15.90
%Ab	66	74	77	7	7								
%An	32	24	20	0	0	%Ann	49	49	51	52			
%Or	2	2	3	93	93	%Phl	51	51	49	48		**Continued→**	

Sample:	CB15-28		CB15-42	CB15-32			CB15-28		CB15-63	CB15-34	CB15-41		CB15-42
Mineral:	Plagioclase			K-Feldspar			Biotite		Hornblende				Garnet
No.	632	633	74	875	876		644	645	58	688	235		79
Wt%													
SiO2	59.77	58.32	60.29	63.20	64.31		36.84	37.00	41.52	40.98	37.90		38.70
TiO2	0.00	0.00	0.00	0.12	0.07		3.37	3.53	1.40	1.26	1.12		0.07
Al2O3	26.01	26.59	24.84	18.18	17.89		15.57	15.61	13.32	13.37	13.95		21.11
Cr2O3	0.02	0.02	0.01	0.00	0.04		3.37	3.53	0.02	0.00	0.04		0.02
FeO	0.12	0.20	0.01	0.03	0.02		17.74	18.08	16.99	15.78	16.11		19.39
MgO	0.01	0.00	0.00	0.02	0.01		11.62	11.77	0.20	0.30	0.30		1.60
MnO	0.02	0.04	0.00	0.02	0.03		0.34	0.34	9.65	9.55	8.64		8.19
CaO	7.73	8.64	6.32	0.02	0.02		0.04	0.01	12.12	11.61	11.90		11.81
Na2O	6.97	6.45	7.98	0.37	0.36		0.05	0.06	1.39	1.39	1.37		0.01
K2O	0.21	0.21	0.13	15.54	14.38		10.01	10.01	1.99	1.90	2.20		0.02
SO3	0.02	0.01	0.00	0.04	0.02		0.04	0.04	0.05	0.05	0.01		0.00
Cl	0.00	0.00	0.00	0.02	0.08		0.05	0.06	0.03	0.29	1.48		0.00
F	0.01	0.00	0.00	0.00	0.00		0.20	0.16	0.02	0.05	0.02		0.02
Total	100.89	100.48	99.59	97.54	97.20		95.82	96.64	98.68	96.44	94.69		100.93
Cations Recalculated on the Basis of 8O							11O		23O				12O
Si	2.64	2.60	2.69	2.99	3.03		2.79	2.78	6.23	6.27	6.04		3.03
Ti	0.00	0.00	0.00	0.00	0.00		0.19	0.20	0.16	0.14	0.13		0.00
Al	1.36	1.40	1.31	1.01	0.99		1.39	1.38	2.36	2.41	2.62		1.95
Cr	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00
Fe	0.00	0.01	0.00	0.00	0.00		1.12	1.14	2.13	2.02	2.15		1.27
Mg	0.00	0.00	0.00	0.00	0.00		1.31	1.32	0.03	0.04	0.04		0.19
Mn	0.00	0.00	0.00	0.00	0.00		0.02	0.02	2.16	2.18	2.05		0.54
Ca	0.37	0.41	0.30	0.00	0.00		0.00	0.00	1.95	1.90	2.03		0.99
Na	0.60	0.56	0.69	0.03	0.03		0.01	0.01	0.40	0.41	0.42		0.00
K	0.01	0.01	0.01	0.94	0.86		0.97	0.96	0.38	0.37	0.45		0.00
S	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00		0.00
Cl	0.00	0.00	0.00	0.00	0.01		0.01	0.01	0.01	0.07	0.39		0.00
F	0.00	0.00	0.00	0.00	0.00		0.05	0.04	0.01	0.03	0.01		0.00
Total	4.98	4.99	5.00	4.99	4.93		7.86	7.85	15.82	15.86	16.35		7.99
												%Pyr	6.25
%Ab	61	57	69	3.54	3.57							%Alm	42.44
%An	38	42	30	0.08	0.09	%Ann	46	46				%Gro	33.15
%Or	1	1	1	96.38	96.34	%Phl	54	54				%Sp	18.16

3.3 Scapolite Chemistry

3.3.1 Scapolite Crystal Chemistry

Scapolite is a tetragonal framework silicate that is a solid solution between three end-members: marialite, $Na_4Al_3Si_9O_{24}Cl$; meionite, $Ca_4Al_6Si_6O_{24}CO_3$; and sylvialite (also known as sulphate meionite), $(Ca,Na)_4Al_{3-6}Si_{6-9}O_{24}SO_4$ (Brauns, 1917; Teertstra and Sherriff, 1997; Sokolova and Hawthorne, 2008). The general formula for scapolite is $M_4[T_{12}O_{24}]A$, where *M* accommodates Na and Ca, as well as minor K, Sr, Ba and Fe^{2+}, *T* is a tetrahedral site filled by Si, Al, and minor Fe^{3+}, and *A* is the volatile-bearing site accommodating Cl, CO_3, and SO_4 (Sokolova and Hawthorne, 2008). The *M* cation site is [8]- or [9]-coordinated, by one Cl atom and seven framework O atoms in marialite, and seven framework O atoms and one to two O atoms of the CO_3 group in meionite and sylvialite (Sokolova and Hawthorne, 2008). The crystal structure of scapolite, which can occur in two space groups (*I*4/*m* and *P*42/*n*), is presented in Figure 3.7. It is conventional to report scapolite compositions relative to the marialite (Ma) and meionite (Me) endmembers based on cation proportions, even in samples with considerable concentrations of SO_4 (Hoefs *et al.*, 1981; Moecher *et al.*, 1993; Yoshino and Satish-Kumar, 2001).

Scapolite can form in a variety of metamorphic rock types, but can also more rarely be found as a primary phase in igneous rocks (Goldsmith, 1976; Hoefs *et al.*, 1981; Moecher *et al.*, 1994). Metamorphic meionitie and sylvialite are relatively common in lower crustal rocks, including mafic granulites and anorthosites, with the species formed depending on the availability of volatiles (Goldsmith, 1976; Hoefs *et al.*, 1981; Moecher *et al.*, 1993; Yoshino and Satish-Kumar, 2001). Marialite can form in metaevaporites or

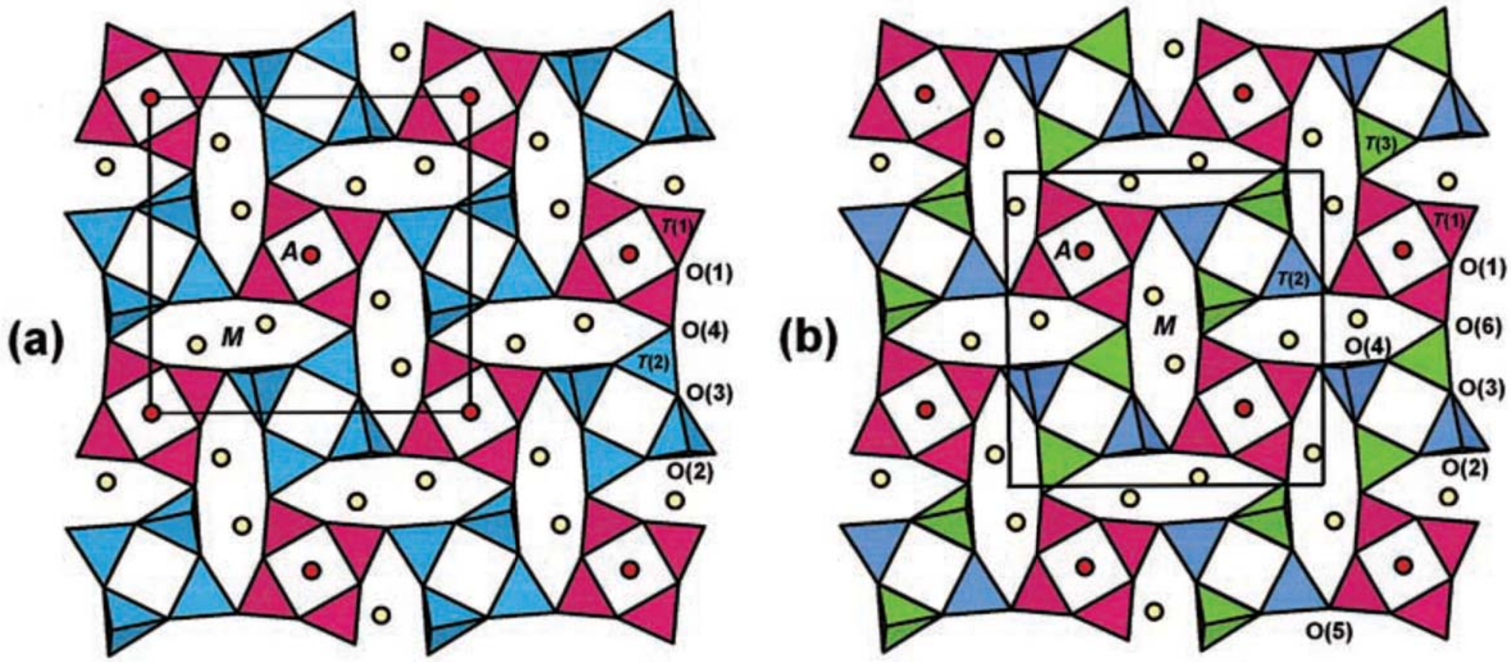


Figure 3.7: Crystal structure of scapolite (Sokolova and Hawthorne, 2008) projected onto (001) for space groups (a) $I4/m$ and (b) $P42/n$. The different space groups and tetrahedral arrangements are related to differences in Al-Si ordering depending on composition. General formula is $M_4[T_{12}O_{24}]A$, with M site atoms (Ca, Na, K, Sr, Ba, Fe^{2+}) represented by yellow circles, T site (Si, Al, Fe^{3+}), and A site volatiles (Cl, CO_3, SO_4) represented by red triangles and dots, respectively. The unit cell of each space group is outlined in black.

by metasomatism of feldspars by Cl-rich brines (Gomez-Pugnaire *et al.*, 1994; Satish-Kumar *et al.*, 2006). Igneous scapolite is more likely to be calcic than sodic, reflecting elevated liquidus temperatures, although rare examples of primary marialite have also been reported (Bovin and Camus, 1981; Mittwede, 1994; Skrigitil', 1996; Owen and Greenough, 1999; Kuznetsova *et al.*, 2011). Experimental data indicate that pure end-member meionite and sylvialite crystallize only at T > 800°C over the P range 0.1-1.5 GPa, although scapolite stability expands to lower temperatures with increasing Na content (Goldsmith, 1976).

3.3.2 Scapolite X-ray Maps

Qualitative energy dispersive spectrometry (EDS) mapping was done on scapolite to look for zoning in Na, Ca, K, Sr, Mn, Cl and S. A 15 kV accelerating voltage, 100 nA beam current and 5 μm spot size with a dwell time of 40 ms per pixel were used for mapping. All maps are 300 x 300 pixels, with a 4 μm x 4 μm pixel size. X-ray maps of both the quartz+scapolite (Fig. 3.8) and hornblende+plagioclase+biotite (Fig. 3.9) portions of the Type 1 pegmatites show that the scapolite in them is compositionally homogenous. Scapolite in one of the Type 2 samples, CB15-32, is also fairly homogenous, although the recrystallized portions of CB15-41 are much less so (Fig. 3.10). A number of larger grains in CB15-41 show evidence of alteration around fractures, with grain boundaries depleted in S and enriched in Cl relative to the cores of the grains. In Type 3 pegmatites scapolite grains (Fig. 3.11) show a slight decrease in Cl concentrations from the rim to the core, but are otherwise homogeneous. X-ray maps for scapolite from basement leucosomes are all similar. Much of the scapolite in these rocks, whether from Harøya, Flemsøya or Haramsøya, shows some evidence of alteration along fractures and grain boundaries. These areas are slightly enriched in Na+Cl and depleted in Ca+S relative to the rest of the grain. An example from augen gneiss CB15-42 is shown in Figure 3.12. Additional x-ray maps are presented in Appendix B.

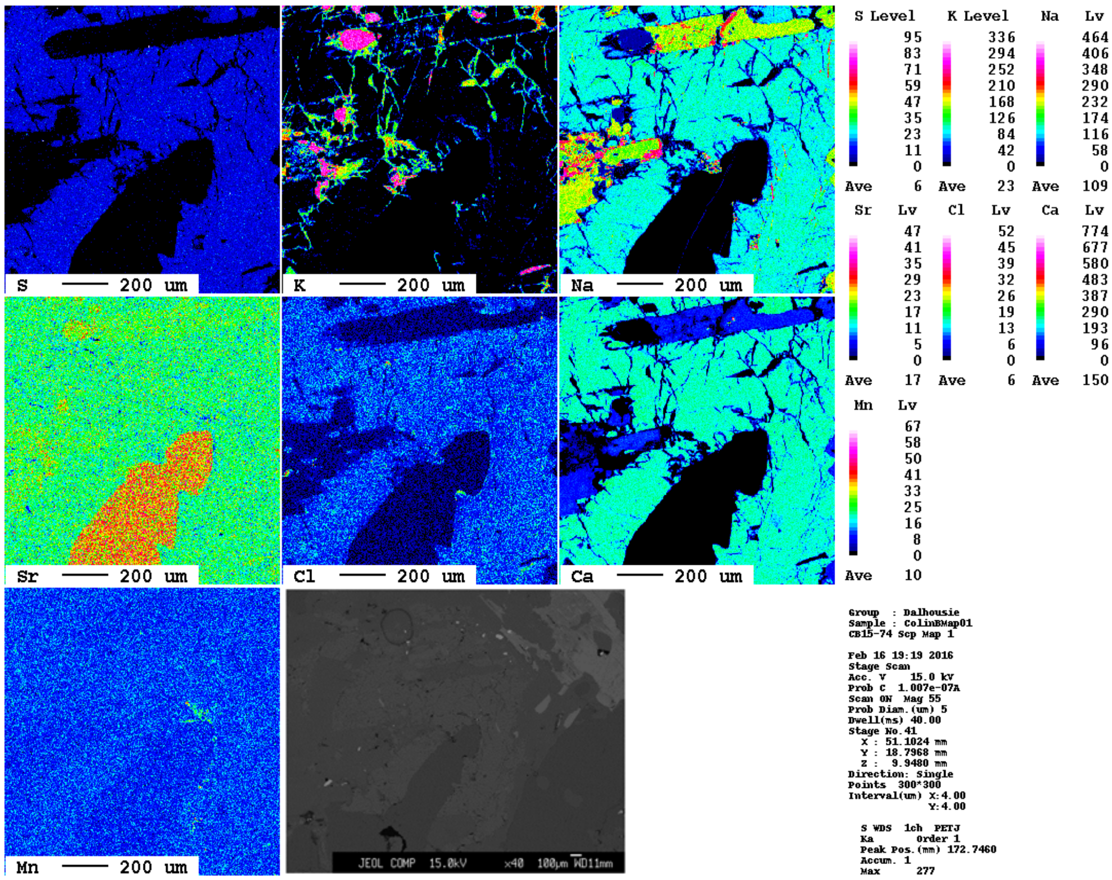


Figure 3.8: EDS x-ray chemical maps of scapolite in Type 1 pegmatite CB15-74. An accompanying BSE image of the mapped area and its immediate surroundings is provided in the lower central panel for context. This sample is typical of the macrographically intergrown scapolite and quartz in that is largely homogeneous in composition.

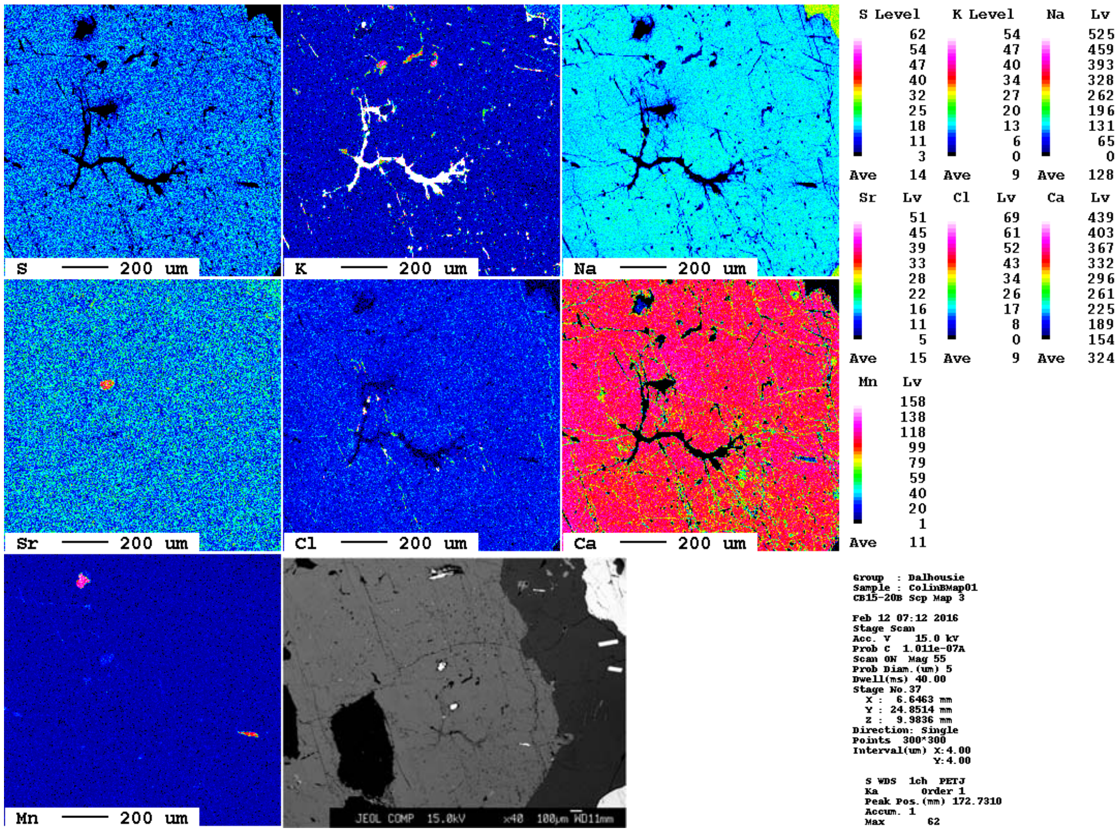


Figure 3.9: EDS x-ray chemical maps of scapolite from the hornblende+biotite+ plagioclase-rich portion of Type 1 pegmatite CB15-20. An accompanying BSE image of the mapped area and its immediate surroundings is provided in the lower central panel for context. This scapolite also shows little zoning, although there is alteration around inclusions and fractures.

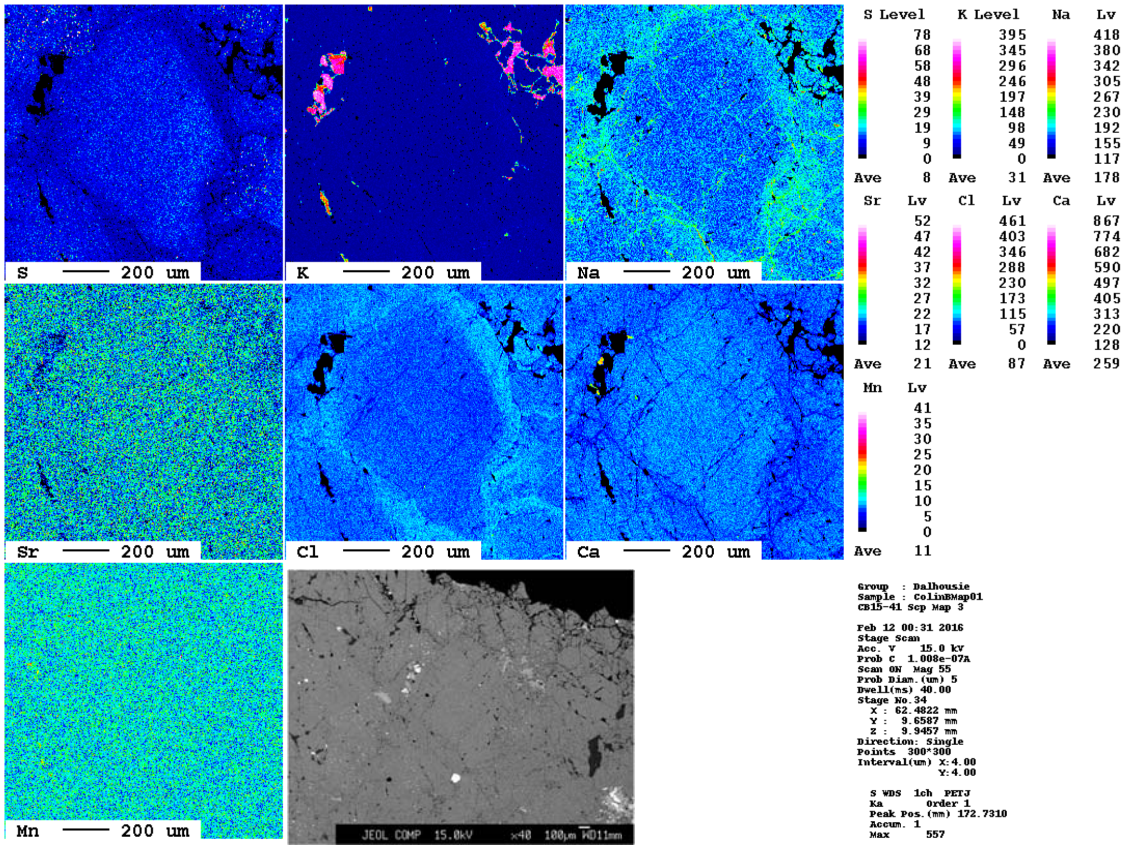


Figure 3.10: EDS x-ray chemical maps of scapolite in Type 2 pegmatite CB15-41. An accompanying BSE image of the mapped area and its immediate surroundings is provided in the lower central panel for context. Note S-depleted, Na+Cl-enriched zone around grain boundaries and fractures in the scapolite grains. This zoning is interpreted to be a secondary feature, possibly related to interaction with late Na+Cl rich brines.

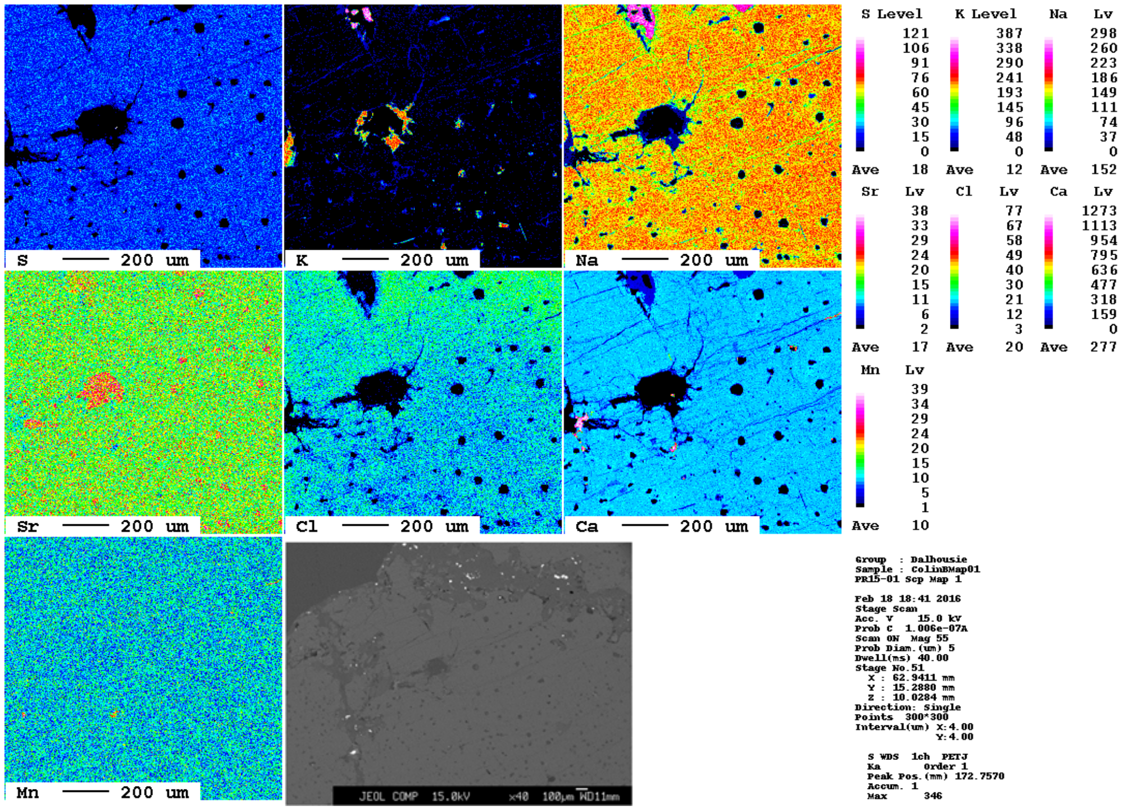


Figure 3.11: EDS x-ray chemical maps of scapolite in Type 3 pegmatite PR15-01. An accompanying BSE image of the mapped area and its immediate surroundings is provided in the lower central panel for context. There is a slight increase in Cl towards the rim of the grain. The numerous dark inclusions are quartz.

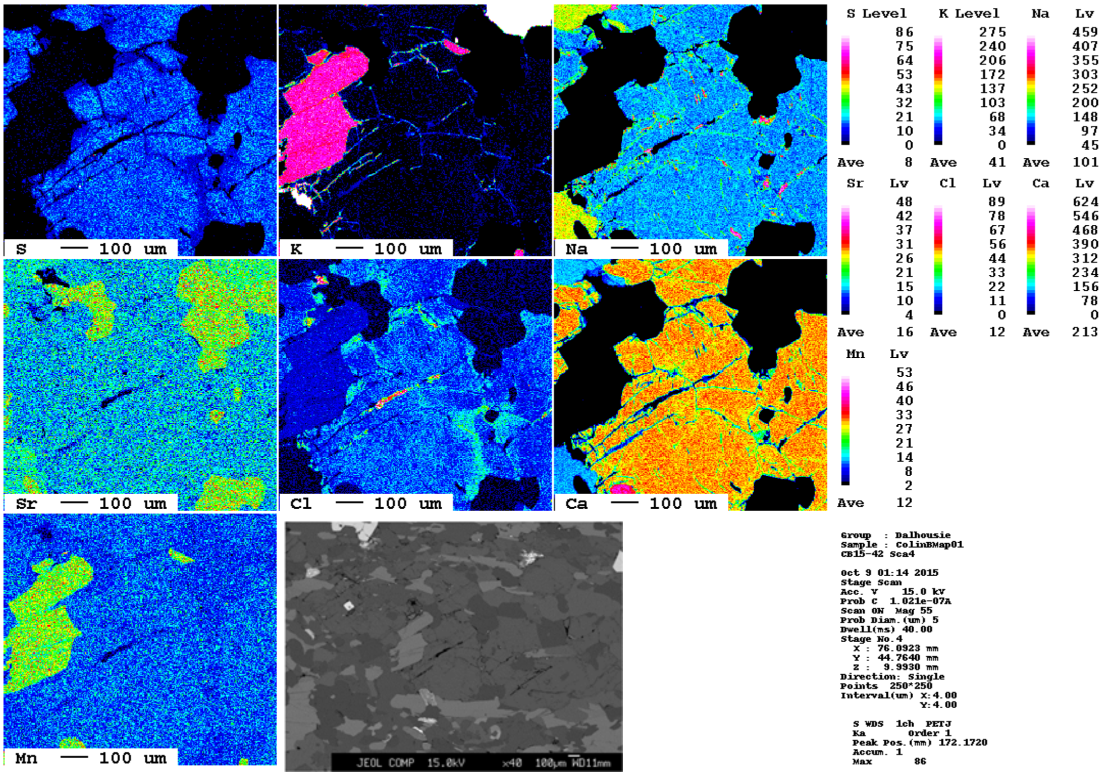


Figure 3.12: EDS x-ray chemical maps of scapolite in migmatitic augen gneiss CB15-42. An accompanying BSE image of the mapped area and its immediate surroundings is provided in the lower central panel for context. Typical of the basement gneiss leucosome scapolites, these samples show alteration along fractures and grain boundaries marked by enrichment in Cl and depletion in S relative to the rest of the grain, which is otherwise homogeneous.

3.3.3 Scapolite Major Element Chemistry

Scapolites in all three types of pegmatites and basement leucosomes are broadly sylvialitic in composition, although there are significant differences in both major element and volatile chemistry between these groups. To compare major element chemistry of the *M* site cations, mole percent meionite content for all analyses was calculated and plotted as histograms in Figure 3.13. Meionite content was calculated using the formula %Me = 100*(Ca+Mg+Fe+Mn)/(Na+K+Ca+Mg+Fe+Mn), where cations were calculated on the basis of 24 oxygens per formula unit. With the exception of a handful of outliers the data from each group show approximately normal distributions. Type 1 pegmatites have a compositional range from Me_{63-75} with an average composition of Me_{69}. Scapolite compositions are indistinguishable between the felsic and mafic portions of the pegmatites. Compared with scapolite in other sample types, the scapolite in Type 2 pegmatites is the most Na+K-rich and Ca-poor, with compositions ranging from Me_{45-66}, averaging Me_{56}. In Type 3 pegmatites, major element compositions overlap with the more sodic end of the Type 1 range, with compositions ranging from Me_{61-74}, averaging Me_{64}. Scapolites in the various basement leucosomes have the broadest range of major element compositions. Ulla and augen gneiss scapolites are similar to each other, ranging from Me_{64-88}, with an average of Me_{71}. The most calcic outliers belong to the Ulla Gneiss. As with the other basement leucosome scapolites, phenocrysts in the granodiorite are very similar to Type 1 pegmatite scapolite in composition (Me_{69-83}, average Me_{72}). The scapolites in the Harøya gneisses have similar major element compositions, ranging from Me_{66-74} with an average of Me_{69} in CB15-04, compared to Me_{68-73} with an average of Me_{70} in JB10-15. Representative scapolite analyses are presented in Table 3.4.

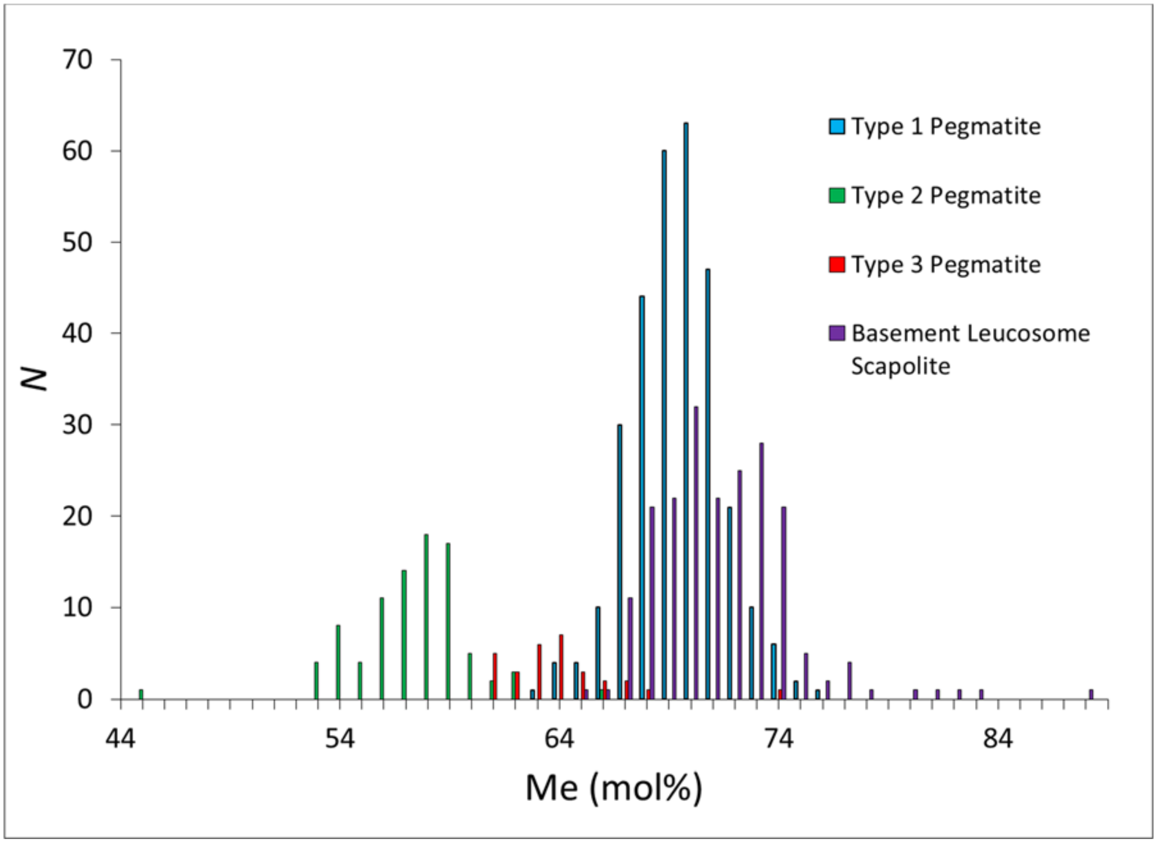


Figure 3.13: Comparison of meionite (Me) content between scapolite types. *N* = number of analyses. Note the overlap between Type 1 and basement leucosome scapolite, with the exception of high-Ca outliers in basement rocks,, and between Type 1 and 3 scapolite compositions. Type 2 pegmatites are distinctly more sodic.

3.3.4 Scapolite Volatile Chemistry

In order to compare the volatile components in each scapolite type, proportions of CO_3, SO_4 and Cl for each analysis were plotted in a ternary diagram (Figure 3.14). CO_3 is marked with an asterisk because C was not measured directly by electron microprobe, but calculated assuming complete A-site occupancy using the formula C=1-S+Cl. On average, Type 1 pegmatites have the highest concentrations of CO_3 (0.64) and the lowest of Cl (0.03), and also contain significant amounts of SO_4 (0.33). Scapolites in Type 3 pegmatites are generally similar in composition to those in Type 1, overlapping the SO_4-rich end of the Type 1 pegmatite array (red boxes, Fig. 3.14). The Type 3 sample contains the highest concentrations of SO_4 (avg. 0.41), and like the Type 1 pegmatites, is CO_3-rich (avg. 0.51) and Cl-poor (avg. 0.09). Type 2 pegmatite samples are very different from any other samples encountered in Nordøyane, being by far the most Cl-rich (avg. 0.39). Concentrations of CO_3 are roughly equal to Cl (avg. 0.40) in Type 2 samples, while SO_4 is low relative to most Type 1 analyses (avg. 0.19). Basement leucosome scapolites show the greatest range in compositions, both overall and within individual samples. In general, they are most similar to and strongly overlap with the Type 1 pegmatites, although Harøya sample CB15-04 (avg. CO_3 0.51, SO_4 0.46, Cl 0.02; marked with a red asterisk in Fig. 3.14) shows strong similarities to the Type 3 sample. Outlier analyses (relative to typical values from within the same sample) from the more altered scapolite in the augen gneiss, Ulla Gneiss, and granodiorite have the most CO_3-rich (up to 0.81), SO_4- and Cl-poor (as low as 0.09 and 0.00 respectively), compositions of all samples.

Table 3.4: Representative Scapolite Analyses

Sample:	CB15-24 (Type 1)		CB15-72 (Type 1)		CB15-32 (Type 2)		CB15-41 (Type 2)		PR15-01 (Type 3)		CB15-63 (GD)		CB15-42 (AG)
Mineral	Scapolite												
No.	56	57	134	142	805	812	52	53	724	725	52	53	91
Wt%													
SiO2	48.43	48.38	45.40	46.85	51.97	51.89	49.58	50.13	49.65	49.38	46.35	46.93	48.39
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	24.99	24.81	24.66	23.44	23.64	23.94	23.82	23.81	23.80	23.67	26.65	26.27	25.92
Cr2O3	0.00	0.00	0.00	0.02	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
FeO	0.13	0.14	0.13	0.14	0.07	0.06	0.03	0.00	0.02	0.19	0.06	0.07	0.17
MgO	0.03	0.01	0.02	0.00	0.02	0.01	0.01	0.01	0.02	0.29	0.02	0.02	0.00
MnO	0.01	0.01	0.03	0.02	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01
CaO	15.30	15.41	16.96	15.44	11.45	11.80	12.60	11.99	13.96	13.59	17.63	17.37	16.00
Na2O	3.24	4.36	4.00	4.18	4.36	3.87	4.89	5.19	4.51	4.27	3.84	4.03	4.17
K2O	0.18	0.19	0.11	0.15	0.87	0.80	1.03	1.09	0.27	0.32	0.11	0.10	0.31
SO3	3.07	3.04	3.56	3.82	1.85	1.89	1.42	1.07	3.89	3.66	2.82	3.08	1.93
Cl	0.17	0.15	0.06	0.11	1.80	1.71	1.68	1.74	0.32	0.32	0.04	0.03	0.39
F	0.00	0.00	0.00	0.00	0.02	0.04	0.03	0.05	0.00	0.00	0.00	0.00	0.00
Total	95.51	96.47	94.91	94.14	95.64	95.63	94.71	94.67	96.36	95.60	97.51	97.89	97.20
Cation Proportions Recalculated on the Basis of 24O													
Si	6.93	6.89	6.62	6.83	7.47	7.44	7.28	7.37	7.02	7.04	6.59	6.63	6.89
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.21	4.17	4.24	4.03	4.00	4.05	4.12	4.12	3.97	3.98	4.46	4.38	4.35
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.02	0.02	0.02	0.01	0.01	0.00	0.00	0.00	0.02	0.01	0.01	0.02
Mg	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.34	2.35	2.65	2.41	1.76	1.81	1.98	1.89	2.12	2.08	2.68	2.63	2.44
Na	0.90	1.20	1.13	1.18	1.21	1.08	1.39	1.48	1.24	1.18	1.06	1.10	1.15
K	0.03	0.04	0.02	0.03	0.16	0.15	0.19	0.20	0.05	0.06	0.02	0.02	0.06
S	0.33	0.32	0.39	0.42	0.20	0.20	0.16	0.12	0.41	0.39	0.30	0.33	0.21
C*	0.63	0.64	0.59	0.56	0.36	0.37	0.42	0.44	0.51	0.53	0.69	0.67	0.70
Cl	0.04	0.04	0.02	0.03	0.43	0.41	0.41	0.42	0.08	0.08	0.01	0.01	0.09
F	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.02	0.00	0.00	0.00	0.00	0.00
Total	15.44	15.67	15.68	15.50	15.62	15.54	15.99	16.06	15.40	15.41	15.82	15.77	15.92
%Me	72	66	70	67	56	60	56	53	62	64	71	70	67
%Ma	28	34	30	33	44	40	44	47	38	36	29	30	33

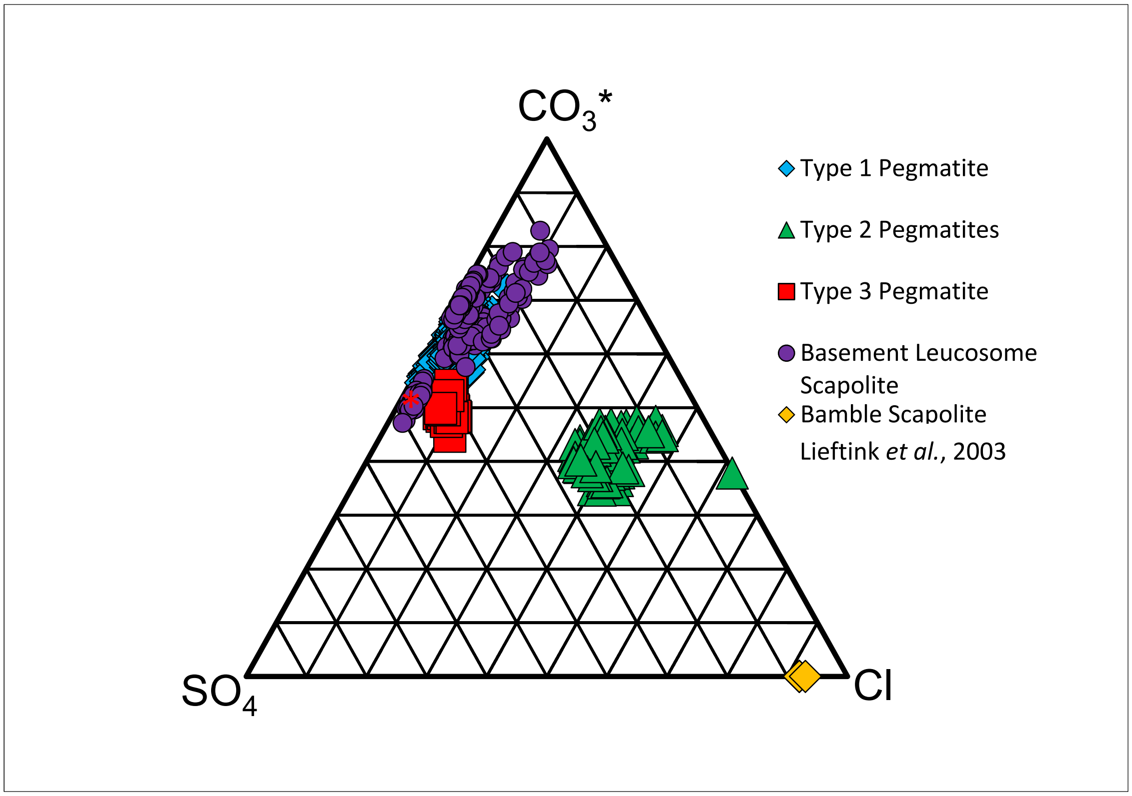


Figure 3.14: Scapolite volatile compositions, showing proportions of Cl, CO_3, and SO_4 ions in the volatile-bearing A crystallographic site (Sokolova and Hawthorne, 2008) in each of the types of scapolite encountered in Nordøyane. The low-SO_4 group of basement leucosome scapolite analyses (red asterisk) are from sample CB15-04, and are notable for showing a greater compositional similarity to scapolite in Type 3 pegmatites than do other basement leucosome scapolites. Samples from the Bamble Sector (Lieftink *et al.*, 2003) were included for comparison against Nordøyane scapolites (discussed further in section 3.5).

3.4 Geothermometry

3.4.1 Zr-in-Titanite Thermometry

Several methods of geothermometry were used to gain further insight into the cyrstallization and cooling history of the Type 1 pegmatites. Titanites in two samples (CB15-20, 27) were analyzed for their Zr content in order to assess their crystallization temperature using the Zr-in-titanite thermometer formulated by Hayden *et al.* (2008).

Four titanites, two from each sample, were analyzed in thin section by electron microprobe at Dalhousie University. These titanites are part of the same group analyzed prior to U-Pb/Sm-Nd dating, and their compositions and textures are discussed further in Ch. 5. Operating conditions for quantitative analysis of Zr were an accelerating voltage of 15 kV, 100 nA beam current, and 1 μm diameter analysis spot size. For the purpose of ZAF corrections, a fixed titanite composition was used, based on an average of the major and trace element compositions discussed in Ch. 5. Analytical uncertainty in Zr concentration is ±0.36 ppm (2σ), based on the detection limits of the instrument.

Zr concentrations and corresponding temperatures are presented in Table 3.5. Temperature was calculated at P=1 GPa and $a TiO_2$ = 0.75±0.25. The 1.0 GPa value was chosen to correspond to the P obtained by Butler *et al.* (2013) for the retrograde M2 mineral assemblage in the Harøya coesite-eclogite, which formed during exhumation and decompression. Activity of TiO_2 was below 1.0 in these samples because there is no rutile present. A sensitivity test was carried out by performing calculations at a range of activities between 1.0-0.75. These calculations revealed that T is not particularly sensitive to changes in $a TiO_2$, as a drop in activity of 25% only lowered the average temperature by 15 °C. This is low relative to the uncertainty in T related to uncertainty in Zr concentration. Calculations of $a TiO_2$ in titanite-bearing, rutile-absent epidote-amphibolites by Kapp *et al.,* (2009) yielded activities of 0.75±0.25. Although these samples are not epidote-amphibolites, $a TiO_2$ of 0.75±0.25 was deemed to be reasonable.The full dataset of analyses and calculations related to Zr-in-titanite and other forms of thermometry are presented in Appendix C.

Sample	Zr (ppm)			T (°C)		
	Max.	Min.	Ave.	Max.	Min.	Ave.
CB15-20	250	80	148	779±41	719±53	748±44
CB15-27	230	120	177	773±41	739±45	759±43

Table 3.5: Compilation of maximum, minimum and average Zr concentrations and temperatures from the Zr-in-titanite thermometer of Hayden *et al.* (2008).

3.4.2 Hornblende-Plagioclase Thermometry

Hornblende-plagioclase thermometry was used as an independent check on the T calculated by the Zr-in-titanite thermometer. Using the thermometer of Holland and Blundy (1994) a temperature of 776 °C was calculated at a P of 1.0 GPa. This temperature was based on the composition of coexisting plagioclase and hornblende in CB15-20 (plagioclase and hornblende data were not collected for CB15-27 due to time constraints).

3.4.3 Two-Feldspar Thermometry

Further information on the cooling history of these rocks was obtained by using two-feldspar thermometry to calculate sub-solidus exsolution temperatures for K-feldspar in antiperthite grains. Two grains each from samples CB15-27 and CB15-40 (Fig. 3.15) were analyzed for this purpose. Temperature was calculated using the two calibrations of Putirka (2008; equations 27a and 27b), based on different sets of experimental data (Putirka *et al.* 2008 and references therein), and are precise to ±44 °C and ±30 °C respectively. Pressure was set at 0.5 and 1.0 GPa, consistent with

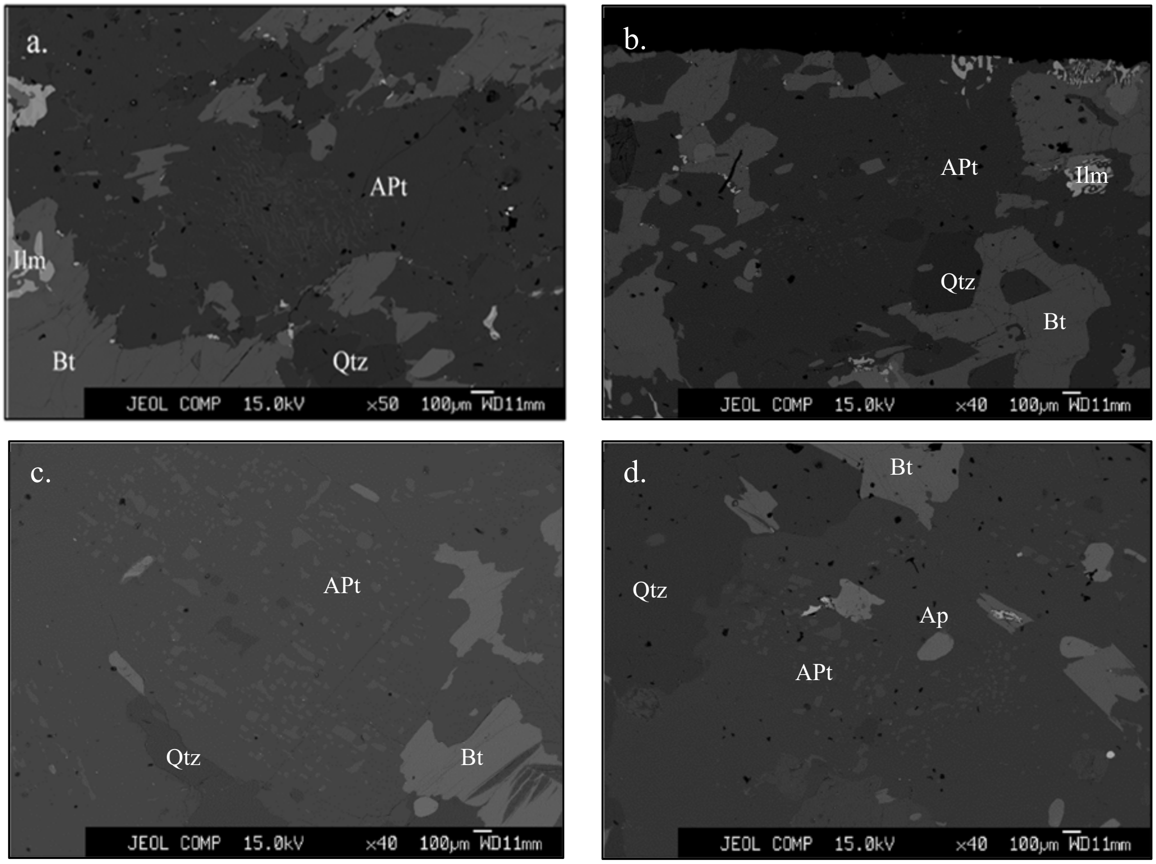


Figure 3.15: Antiperthite grains used for two-feldspar thermometry. a, b) CB15-27, antiperthite grains 1 and 2. c, d) CB15-40, antiperthite grains 1 and 2. Higher brightness 'blebs' of K-feldspar are exsolved from a plagioclase host.

amphibolite-facies decompression pressures recorded throughout the WGR (Labrousse *et al.*, 2004; Root *et al.*, 2005; Terry and Robinson, 2003; Walsh and Hacker, 2004; Butler *et al.*, 2013). These results provide constraints on the post-crystallization cooling of the rock during the later stages of exhumation after the early isothermal decompression (Butler *et al.*, 2013, 2015)

Sample	T (°C) (Putirka Eqn. 27a)			T (°C) (Putirka Eqn. 27b)		
P (GPa)	Max. (0.5/1.0)	Min. (0.5/1.0)	Ave. (0.5/1.0)	Max. (0.5/1.0)	Min. (0.5/1.0)	Ave. (0.5/1.0)
CB15-27	604/606	444/445	506/507	550/553	422/424	472/474
CB15-40	649/632	520/522	585/586	588/590	485/487	535/538

Table 3.6: Compilation of maximum, minimum and average temperatures for the two calibrations of the two-feldspar thermometer of Putirka (2008) at pressures of 0.5 and 1.0 GPa.

3.5 Discussion

The strong chemical and textural similarity between scapolites in the Type 1 and 3 pegmatites suggests that these two types of pegmatites are either the same or closely related. In terms of major element and volatile chemistry, the same can be said of scapolite in the deformed leucosomes from across Harøya, Flemsøya or Haramsøya. However, without further geochemical, and geochronological information it is difficult to determine whether any of these compositional similarities imply genetic relationships.

Scapolite+plagioclase+quartz is the stable mineral assemblage common to all three types of pegmatites (as well as the basement leucosomes). In at least the Type 1 and 2 pegmatites, biotite+hornblende also formed part of the stable mineral assemblage. It is clear that clinopyroxene is not in equilibrium with the rest of the assemblage, as evident from its replacement by hornblende. The embayed grain boundaries of garnet, replaced by plagioclase+biotite+quartz also indicate that garnet is not part of the stable mineral assemblage. However, based on the samples observed in this study, it is not clear whether the breakdown of garnet was related to melt-producing reactions or sub-solidus reactions with other minerals in the Type 1 pegmatites.

It is possible that scapolite was already present in pre-Scandian leucosomes or their host rocks and was simply remobilized during metamorphism and partial melting, rather than being related to the introduction of fluids at some point during subduction or exhumation. To test this possibility, scapolites from Nordøyane were compared with scapolites from the Bamble sector in southern Norway (Fig 3.14). Rocks in the Bamble sector were affected by the Sveconorwegian Orogeny (*ca.* 1140-1080 Ma in the Bamble sector relative to *ca.* 1000-950 Ma in the WGR; Gorbatschev and Gaàl, 1987), but not the Scandian (Nijland *et al.*, 2014). Widespread scapolite in the Bamble sector has been interpreted to be metasomatic in origin (Nijland *et al.*, 2014 and references therein), related to albitization of metagabbroic and other rocks by Na+Cl brines during the Sveconorwegian (Engvik *et al.*, 2014). Metasomatic scapolite from scapolite-rutile-phlogopite rocks at Ødegårdens Verk (historic mine on the coast of Telemark County, *ca.* 450 km SSE of Nordøyane) reported by Lieftink *et al.* (1993), is almost pure marialite. These compositions are clearly incompatible with those found in Nordøyane (Fig. 3.14).

Based on both petrography and composition it is clear that the Type 2 pegmatites have a different history from any of the other scapolites encountered in Nordøyane. However, the field relationships do not provide any clear evidence of relative age of these pegmatites except that they are younger than their Ulla Gneiss host rocks. Type 2 scapolite compositions lie between the Bamble scapolite analyzed by Lieftink *et al.* (1993) and other Nordøyane scapolites, although they are closer to the latter than the former. Strong evidence of alteration and recrystallization in the Type 2 samples, particularly CB15-41, suggests that these scapolites were recrystallized by Na+K+Cl-rich fluids. Therefore, the Type 2 pegmatites may be metasomatized and recrystallized Type 1 pegmatites, rather than a completely different variety.

3.6 Conclusions

The common stable mineral assemblage for scapolite pegmatites in Nordøyane is scapolite+quartz+plagioclase±biotite±hornblende. Differences in composition between the Type 2 pegmatites and all other scapolites in Nordøyane indicate that the former experienced a different history from the rest. The Na+K+Cl-rich zone around the rims of recrystallized scapolite grains suggests that the Type 2 pegmatites were altered by interaction with later brines. The T data determined by Zr-in-titanite and hornblende-plagioclase thermometry, indicates that the scapolite pegmatites crystallized at a T of ca. 750 °C (assuming a P of *ca.* 1 GPa). These values agree with the amphibolite- to granulite-facies conditions recorded during decompression elsewhere in the WGR (Labrousse *et al.*, 2004; Root *et al.*, 2005; Terry and Robinson, 2003; Walsh and Hacker, 2004; Butler *et al.*, 2013). Furthermore, two-feldspar exsolution temperatures in antiperthite grains of ca 600-450 °C are consistent with the low-pressure (≤ 0.5 GPa) portion of the PTt path for Nordøyane (Butler *et al.*, 2013, 2015). Compositional data alone however are not enough to determine where the volatiles in the system came from, nor to determine the age of the pegmatites and other scapolite leucosomes. To address these questions, stable isotope (Ch. 4) and geochronological data (Ch. 5) were acquired in order to complement the compositional analyses.

Chapter 4: Stable Isotope Chemistry

4.1. Introduction

Differences in mineralogy, texture, and scapolite mineral chemistry provide sufficient grounds to divide the scapolite pegmatites in Nordøyane into three types. However, these criteria alone cannot constrain the source of S- and C-bearing fluids related to scapolite crystallization. In order to do so, C, S and O stable isotope data are necessary. These isotope systems have been previously used to discriminate between possible fluid sources in a range of scapolite-bearing rocks (Hoefs *et al.*, 1981; Moecher *et al.*, 1992; Yoshino and Satish-Kumar, 2001). In order to cover as broad as possible a range of pegmatite and basement leucosome scapolite types from across Ulla Fyr, Flemsøya, Harøya, and Finnøya, seventeen scapolite samples (Fig 4.1) were selected for stable isotope analysis.

4.2 Sample Preparation

Preliminary processing was carried out at Dalhousie University, using mineral separation equipment in the low-temperature thermochronology lab. In order to separate scapolite for analysis, a 1-2 mm thick slice was cut from the same billet from which thin sections for microprobe analysis were cut, using a low-speed saw. Pieces of scapolite were then drilled out using a rotary tool, with the aid of a short-wave UV lamp. The resulting scapolite was then coarsely crushed to a fine sand size with an agate mortar and pestle. At this stage, preliminary sorting was done using tweezers and a UV lamp to remove obvious impurities, such as large grains of mica and quartz. Samples CB15-41

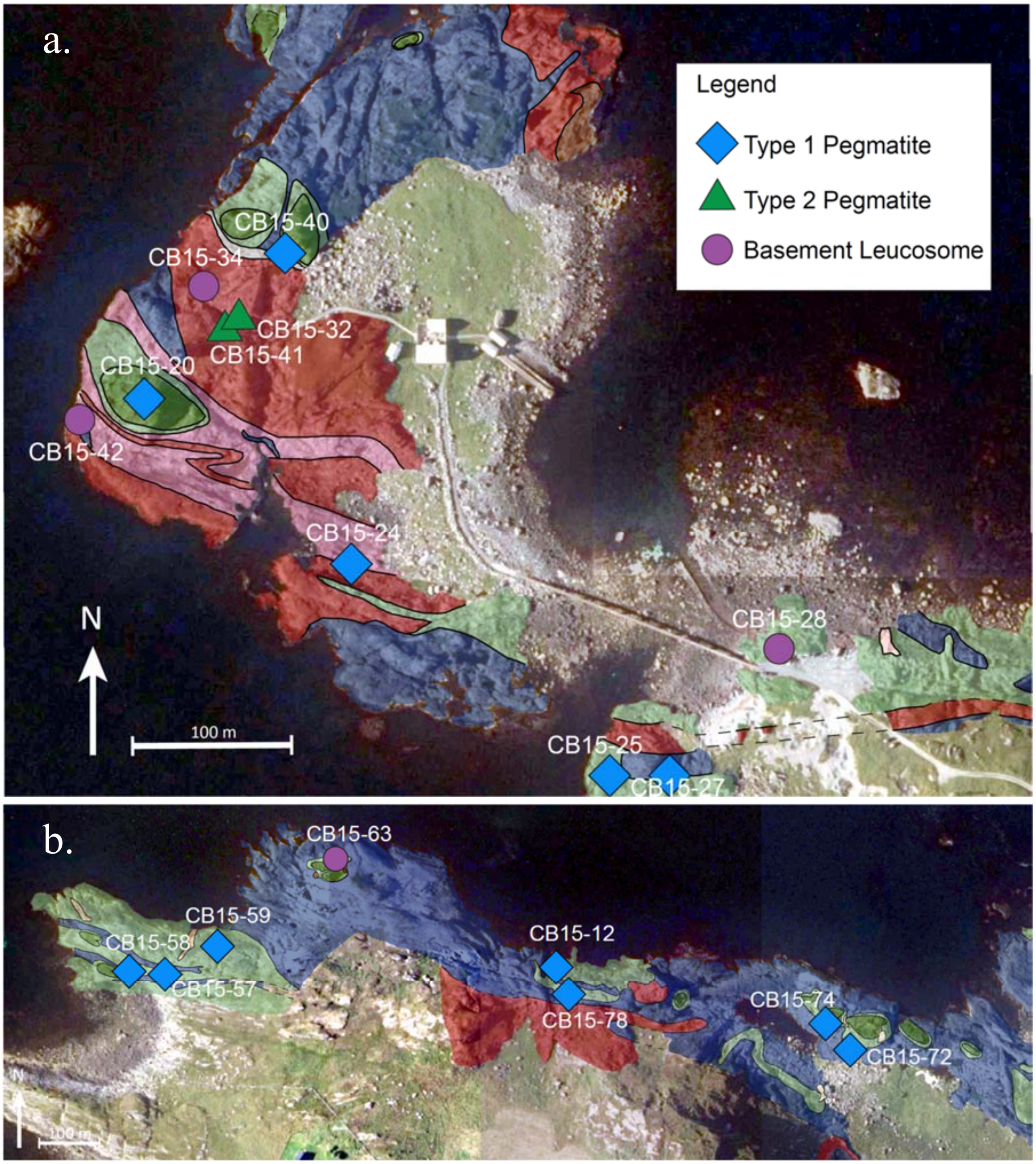


Figure 4.1: Scapolite sample locations on a.) Ulla Fyr and b.) Flemsøya. Maps a. and b. are simplified from Figures 2.2 and 2.3 respectively. Samples from Harøya and Finnøya (including the Type 3 pegmatite) are not shown.

and CB15-74 were too thin to fit in the sample holder for the saw, and were crushed with a hammer, with pieces of scapolite then selected by hand. For samples CB15-41, CB15-42, and PR15-01, where X-ray mapping had revealed an altered rim of Cl- enriched scapolite, material was sampled from the cores of grains as much as possible.

All samples were then run through a Frantz magnetic separator three times, at 0.4, 0.8 and 1.2 A to remove impurities such as magnetite, biotite and hornblende. Due to its low magnetic susceptibility (> 1.70 A; Rosenblum and Brownfield, 1999), scapolite, along with minor amounts of quartz and feldspar, ended up in the non-magnetic fraction of the final 1.2A separation. For samples CB15-41 and CB15-74, an additional sorting with tweezers was used to remove all flakes of epoxy. Samples CB15-58, CB15-59, CB15-32, and CB15-41, which contained large amounts of non-magnetic sulphides (pyrite and chalcopyrite) were treated to a heavy liquid separation using LST, a solution of sodium heteropolytungstates dissolved in water (density 2.85 g/ml) to remove the denser sulphides. Samples CB15-58 and CB15-59, which also contained calcite, were given a further bath in 0.10 M HCl for 10 minutes, following the protocol of Moecher *et al*. (1992). Once all separation had been completed, samples were ground to a fine powder in preparation for analysis.

4.3 Analytical Methods

Stable isotope analysis, and the final preparations for it, were carried out at G.G. Hatch Stable Isotope Laboratory at the University of Ottawa under the supervision of lab manager Paul Middlestead and lab technicians Wendy Abdi and Patricia Wickham. For C and O isotope analysis, approximately 10 mg of each sample were weighed into exetainers. The exetainers were then placed in a horizontal rack and 0.1 ml of H_3PO_4

(S.G. 1.91) was added to the side of each, to prevent the acid from coming into contact with the sample. The exetainers were capped and flushed with He while horizontal, then placed upright in a heating block at 70.0°C overnight for the scapolite to react with the acid. Product gas was extracted in continuous flow with measurements performed on a Thermo Finnigan Delta XP and Gas Bench II with a 2σ analytical precision of ± 0.1 ‰. Both C and O were normalized against international standards NBS-18 and NBS-19 (Friedman *et al*., 1982), with C further normalized against the LSVEC standard (Coplen *et al*., 2006). For S isotope analysis, samples are weighed into tin capsules with approximately 10 mg of tungstic oxide (WO_3). Samples were loaded into an Elementar Vario Micro Cube elemental analyser to be flash combusted at 1800 °C with released gas carried by helium through the analyser to be cleaned, then separated by a trap and purge method. Separated SO_2 gas was carried into a Thermo Finnigan Delta XP isotope ratio mass spectrometer with an analytical precision of ± 0.2 ‰. Data were normalised to international standard NBS-127 (Hut, 1987), and internal (University of Ottawa) $BaSO_4$ standards HAS-1 and T-123, defined by international standards and SO-5 (Halas and Szarin, 2001) and NBS-127 (Hut, 1987) respectively. Due to the low concentration of S in the unknown samples, a linear correction was made based on the change in signal intensity between three different weights of standard T-123.

In addition to the main run of scapolite samples, data from a small run of comparison samples, analysed in 2015 as a preliminary pilot project, are also presented here. These include a calcite sample (HS1 with duplicate HS1B) from a supracrustal marble (Steenkamp, 2012), and a piece of the now-destroyed Type 3 pegmatite outcrop from Finnøya (FN10B), both collected by H. Steenkamp, as well as an enigmatic scapolite-garnet-hornblende vein assemblage (EM1) crosscutting retrogressed eclogite from near Emsdale, Ontario, in the Central Gneiss Belt of the Grenville Province, collected by R.A. Jamieson. These samples were chipped from a hand specimen and crushed into a powder without using the same separation process as the other scapolite samples. These samples were analyzed for C, O, and S isotope concentrations by the same methods as the main sample run, with the exception that the calcite was reacted with acid at 25 °C for 24 hours and the two scapolite samples at 70 °C for 2.5 hours. Because of its very low S content, S isotopes were not analyzed for sample HS1.

4.4 Results

Stable isotope analysis results are presented in Figure 4.2, with the accompanying dataset presented in Table 4.1. The 'δ' notation used for presenting isotope results reports the deviation of the isotope ratio (*e.g.* ^{18}O to ^{16}O) measured for a sample from that of a standard, and is reported in parts per thousand (‰). This is calculated (again using $\delta^{18}O$ as an example) by the formula:

$$\delta^{18}O = \frac{R_{sample} - R_{standard}}{R_{standard}} \cdot 1000‰$$

where R is the ratio of ^{18}O to ^{16}O. The standards used for ^{13}C, ^{18}O, and ^{34}S are the Pee Dee Belemnite (PDB), Vienna Standard Mean Ocean Water (SMOW), and Canyon Diablo Troilite (CDT).

That all duplicates save one agree within error lends a high degree of confidence to the precision of the data. The two points that do not agree, FN10A/B, were not subjected to the same sample processing and analytical conditions, which may account

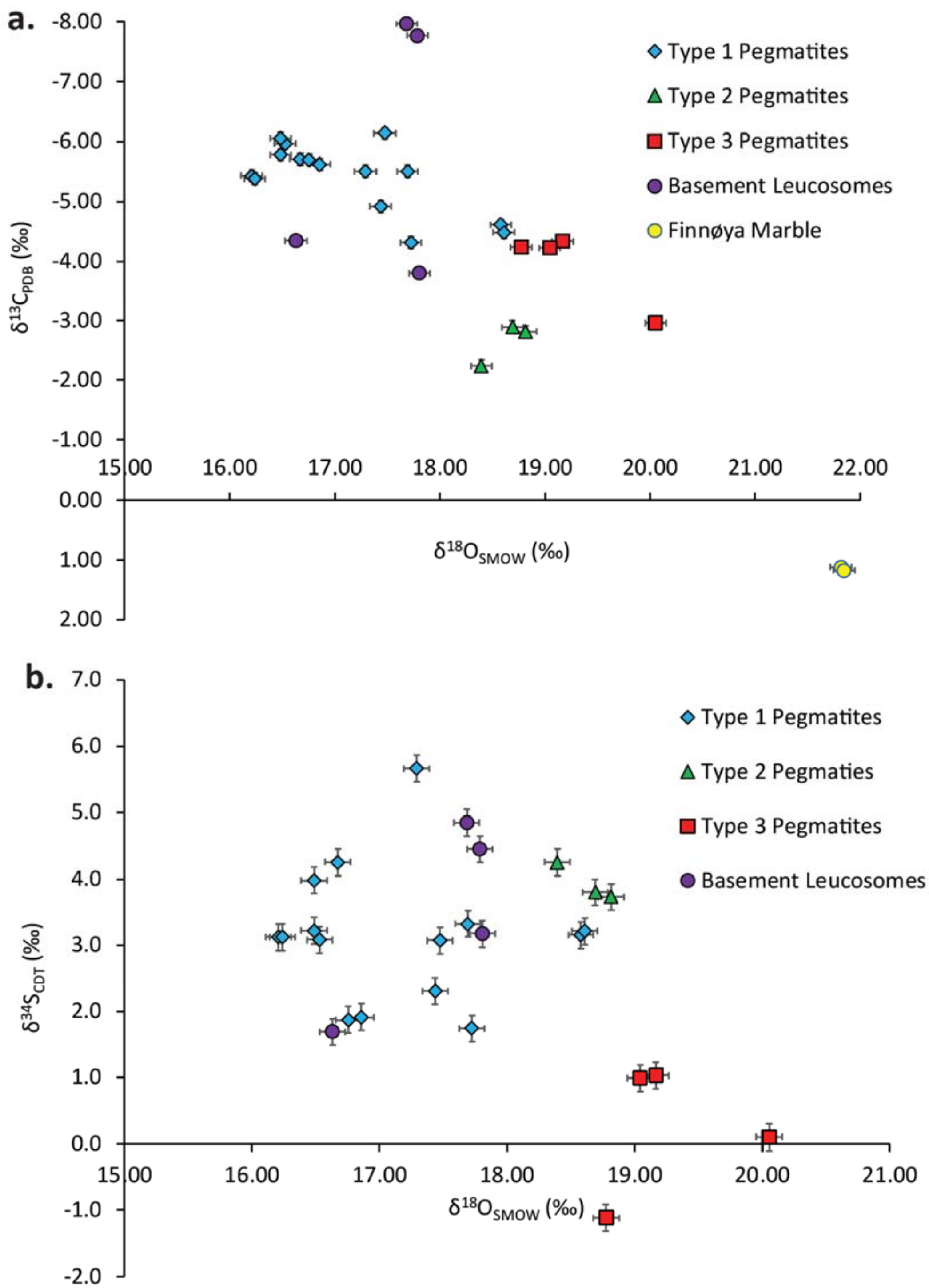


Figure 4.2: Scapolite stable isotope data for Nordøyane samples. a) $\delta^{18}O_{SMOW}$ vs. $\delta^{13}C_{PDB}$. Analyses of marble sample HS1 (Finnøya Marble) are plotted for on this diagram for comparison purposes. b) $\delta^{18}O_{SMOW}$ vs. $\delta^{34}S_{CDT}$. Error bars indicate the analytical precision of the mass spectrometers: ± 0.1‰ for $\delta^{18}O$ and $\delta^{13}C$, ± 0.2‰ for $\delta^{34}S$.

Sample Number	$\delta^{13}C_{PDB}$ (‰)	$\delta^{18}O_{SMOW}$ (‰)	$\delta^{34}S_{CDT}$ (‰)
Type 1 Pegmatites			
CB15-12	-5.50	17.69	3.3
CB15-20A	-5.62	16.86	1.9
CB15-20B	-5.70	16.76	1.9
CB15-24	-4.92	17.44	2.3
CB15-25A	-4.61	18.58	3.2
CB15-25B	-4.48	18.61	3.2
CB15-40	-4.31	17.72	1.7
CB15-57A	-5.78	16.49	4.0
CB15-57B	-5.71	16.67	4.3
CB15-58	-5.50	17.29	5.7
CB15-59A	-5.97	16.53	3.1
CB15-59B	-6.06	16.49	3.2
CB15-72A	-5.43	16.21	3.1
CB15-72B	-5.38	16.24	3.1
CB15-74	-6.14	17.48	3.1
Type 2 Pegmatites			
CB15-32A	-2.89	18.69	3.8
CB15-32B	-2.82	18.82	3.7
CB15-41	-2.24	18.39	4.3
Type 3 Pegmatites			
PR15-01A	-4.33	19.17	1.0
PR15-01B	-4.22	19.04	1.0
FN-10A	-4.23	18.78	-1.1
FN-10B*	-2.96	20.05	0.1
Basement Leucosome Porphyroblasts			
CB15-04	-3.80	17.81	3.2
CB15-42A	-7.77	17.79	4.5
CB15-42B	-7.97	17.68	4.9
CB15-63	-4.34	16.63	1.7
Finnøya Marble Calcite			
HS1A*	1.12	21.82	-
HS1B*	1.18	21.85	-
Emsdale Vein Scapolite			
EM1*	-9.35	15.60	7.4

Table 4.1: Stable isotope data. 2σ analytical precision is ± 0.1‰ for $\delta^{13}C$ and $\delta^{18}O$, and ±0.2 for $\delta^{34}S$. Analytical precision for $\delta^{34}S$ is lower than for the other two isotopes, only being significant to one decimal place. Accuracy was determined by comparison to a range of standarsd. Samples designated A and B are duplicates for quality control. Samples marked by * are from the initial test batch of samples which were not subjected to the same rigorous pre-processing as the other samples.

for the differences between them. The overall spread across all data is low with differences of 3.84‰ in $\delta^{18}O$, 5.73‰ in $\delta^{13}C$ and 6.8‰ in $\delta^{34}S$ between the highest and lowest recorded values. Overlap relationships between the different types of scapolite vary between isotope systems. Type 1 pegmatite $\delta^{13}C$ values partially overlap Type 3 pegmatite and basement leucosome values, while Type 1 $\delta^{34}S$ values completely overlap those of Type 2 pegmatites and basement leucosomes. Type 2 and 3 pegmatites are distinct from all other scapolite types in their $\delta^{13}C$ and $\delta^{34}S$ values respectively, but partially overlap with respect to their $\delta^{18}O$ values. Basement leucosome scapolites have a similar $\delta^{18}O$ signature to Type 1 pegmatites, both of which are consistently lighter than either Type 2 or 3 pegmatites. The basement leucosome scapolite also displays variable $\delta^{13}C$ values ranging from the lightest of all values recorded (augen gneiss leucosome samples CB15-42A/B) to intermediate between Type 2 and 3 pegmatites. Both $\delta^{13}C$ and $\delta^{18}O$ values for the Finnøya calcite-marble sample HS1 are heavier than all types of scapolite.

4.5 Discussion

Scapolites from Haramsøya and those from Flemsøya show similar compositions, with the exception of samples CB15-20 and CB15-40 (both from Haramsøya) which have consistently lighter $\delta^{34}S$ values. However, these samples were collected from the matrix of the hornblende-rich portions of the pegmatite, and this difference may therefore represent a change in scapolite isotopic composition over the crystallization history of the rock, rather than a regional difference. Although the Type 2 and 3 pegmatites have signatures that are subtly distinct from the compositionally similar Type 1 and basement leucosome varieties, the overlaps across the four groups and the narrow range of all three isotope ratios is interpreted to indicate that the C and S in all four groups of scapolite come from a single source. For the purposes of comparison with data from samples with known volatile source, all four groups of Nordøyane scapolite data are therefore displayed together in Figures 4.4 and 4.5.

There are several possible sources of volatiles related to scapolite crystallization in this system, including: 1) scapolite or scapolite-forming fluids already present in metasomatised crust prior to subduction; 2) fluids expelled from sedimentary cover rocks; and, 3) mantle fluids introduced into the crust during subduction. Typical $\delta^{13}C$ and $\delta^{34}S$ ranges from a variety of different rocks and minerals are presented in Figure 4.3. This figure demonstrates that many different geological environments can produce identical isotope signatures (particularly in terms of $\delta^{34}S$). However, by using a combination of multiple isotope systems and ruling out various possibilities based on geological setting and field relationships, it is possible to constrain the origin of the fluids associated with scapolite formation.

4.5.1. Carbon

Carbon isotopes are widely used for identifying the origin of volatiles involved in scapolite formation. In addition to the general isotope signature data presented in Figure 4.3, examples in the literature cover a range of geological environments and fluid sources for comparison with the data from Nordøyane. These include sylvialitic scapolites in lower-crustal mafic to intermediate and calc-silicate granulites of the Furua Granulite Complex in Tanzania (Hoefs *et al*., 1981), meionitic scapolite in metamorphosed

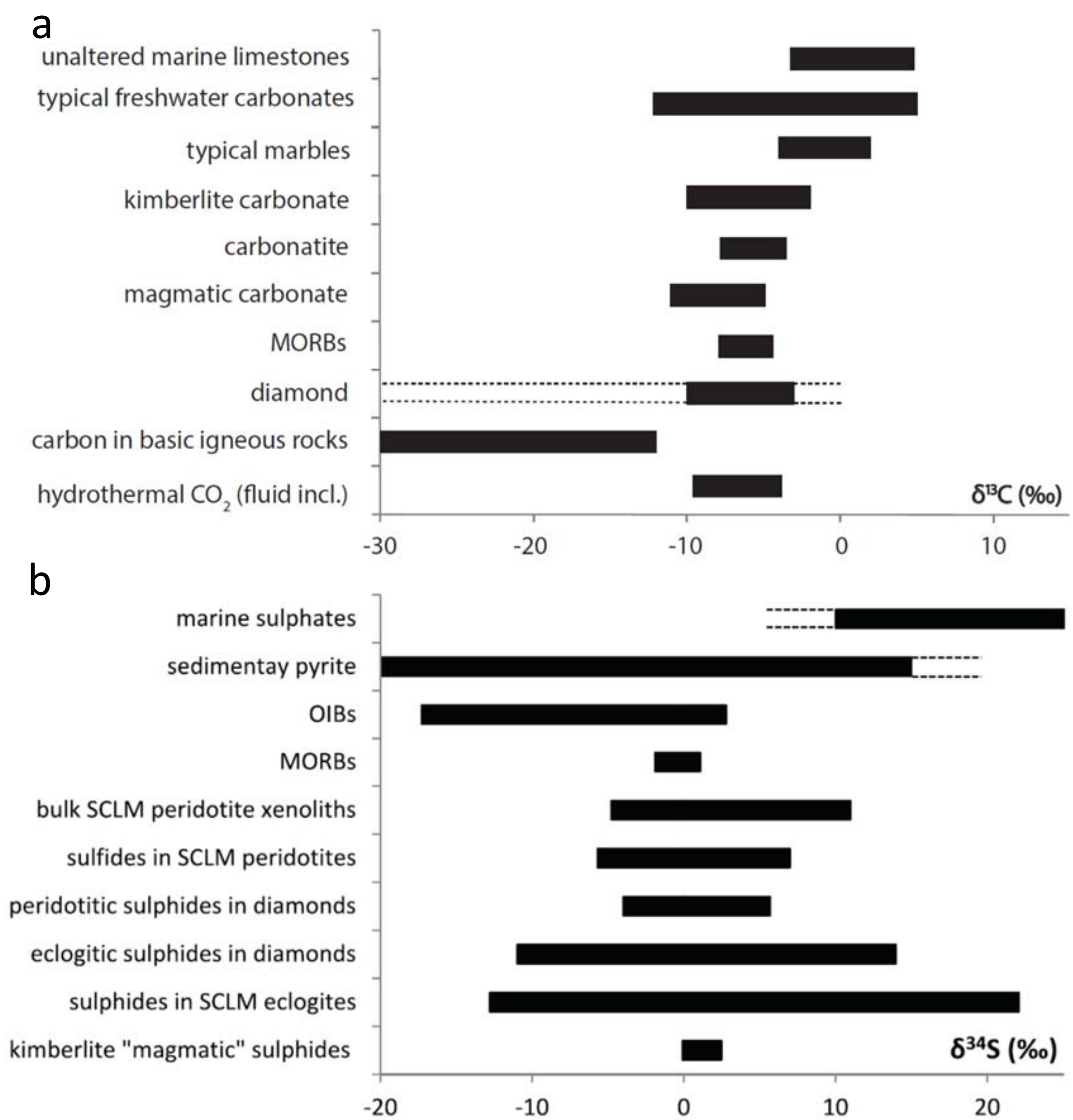


Figure 4.3: Typical isotopic compositional ranges from a variety of rocks and minerals. a) $\delta^{13}C$ compositions relative to PDB, modified from Sharp (2007). b) $\delta^{34}S$ compositions relative to CDT, from Giuliani *et al.* (2016).

anorthosites of the Whitestone Anorthosite (WSA) in the Central Gneiss Belt (Moecher *et al*., 1992) of the Grenville Province, Ontario, and two separate populations of scapolite, one sylvialitic and one meionitic, in metagabbros from the Kohistan Arc in the western Himalayas (Yoshino and Satish-Kumar, 2001). These comparisons are illustrated in Figure 4.4, along with the combined data from Nordøyane (Fig. 4.4a) and average isotopic compositions of selected possible fluid sources (Fig. 4.4b) as compiled from Figure 4.3a (Hoefs *et al*. 1981; Giuliani *et al*., 2016).

The simplest interpretation that can be made from these comparisons is that the C in the Nordøyane and Furua scapolites was not derived from a similar fluid source. Hoefs *et al*. (1981) tentatively concluded that the carbon in the Furua scapolites was too isotopically light to have come from a mantle source, and may have been related to 'lower crustal' metamorphic fluids, such as those commonly found as CO_2 fluid inclusions in granulite terranes. These inclusions, which typically have $\delta^{13}C$ values between -14 and -24 ‰ (Hoefs *et al*. 1981, and references therein), are a relatively close match with their scapolite $\delta^{13}C$ data, and possibly the enigmatic Emsdale scapolite veins (EM1, this study), but do not match the scapolite C data from Nordøyane.

Carbon isotopic data from the WSA scapolite and the two populations from the Kohistan Arc are more difficult to interpret, as all three groups overlap with the Nordøyane data to varying degrees. Carbon in both the WSA and the sylvialitic (S-Scp in Fig. 4.4a) scapolite from Kohistan was derived form fluids expelled from carbonate rocks - marbles adjacent to the meta-anorthosite (Moecher *et al*., 1992), and subducted pelagic carbonate sediments (Yoshino and Satish-Kumar, 2001), respectively. The $\delta^{13}C$ range of scapolite from the WSA extends to both lighter and heavier values than that of the

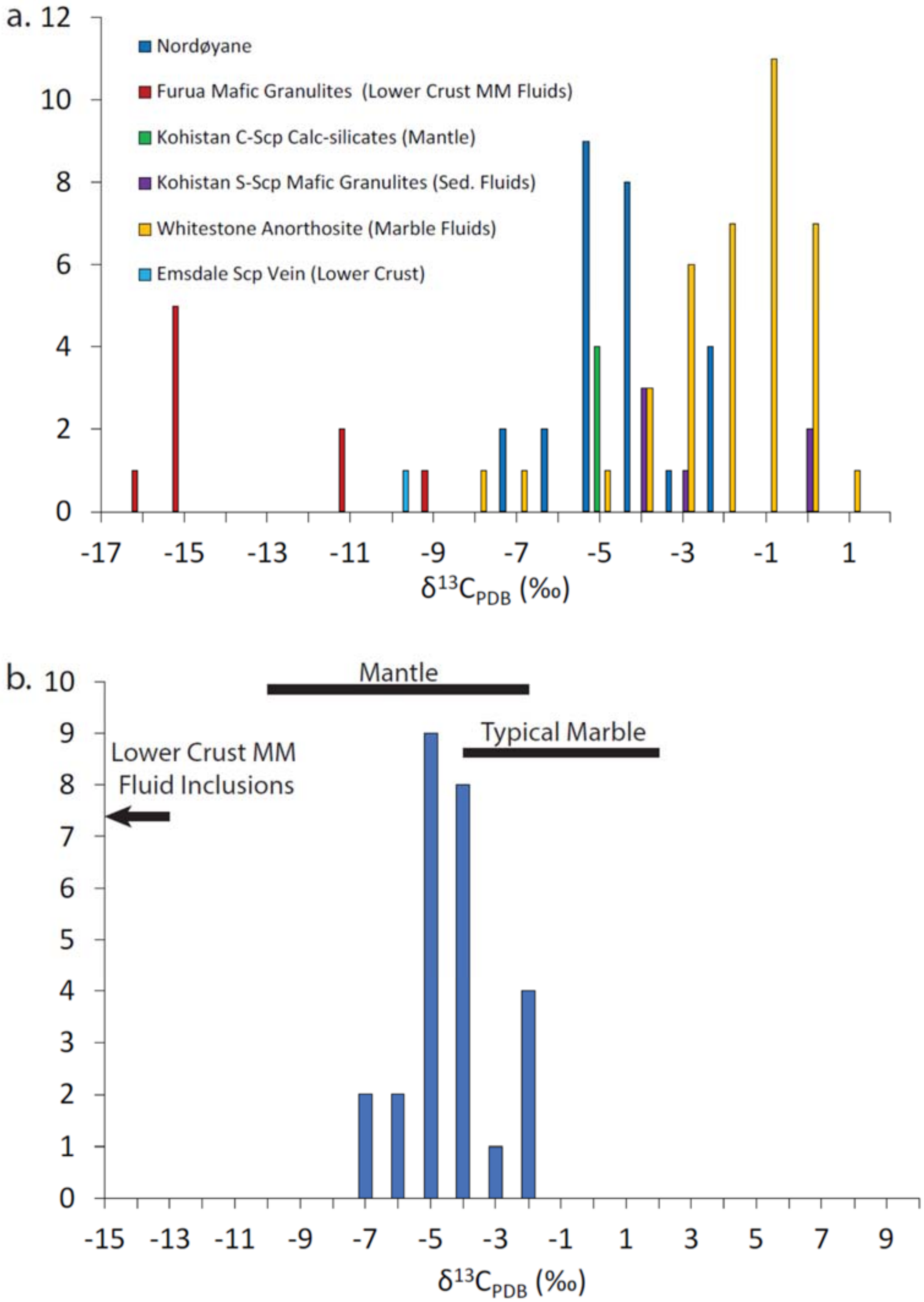
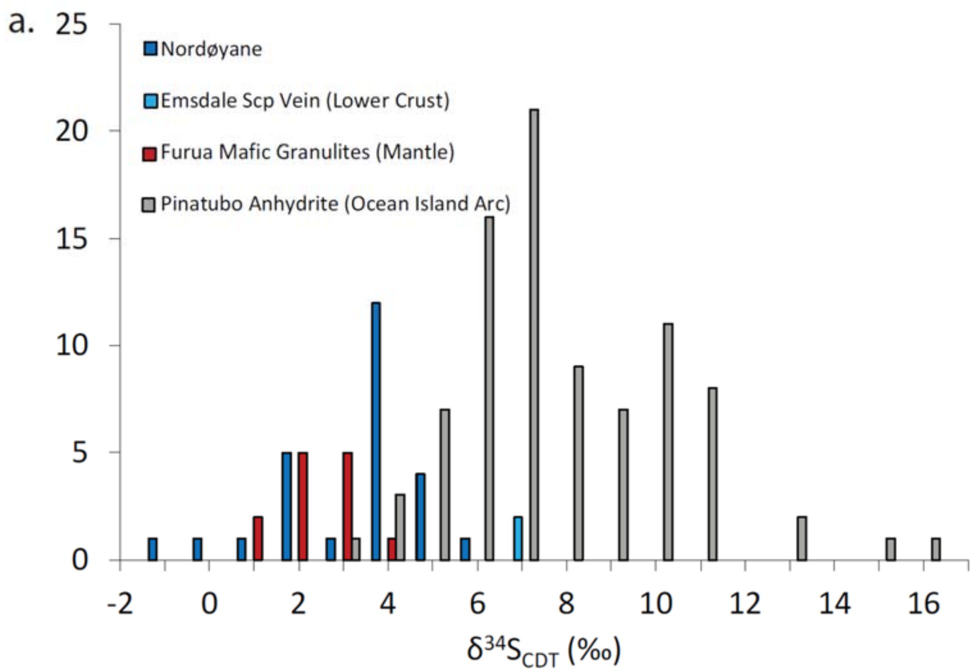


Figure 4.4: Comparison of Nordøyane $\delta^{13}C$ values with other scapolite and fluid reservoir values a) Comparison against other scapolites in: Furua mafic granulites (Hoefs *et al*., 1981), Whitestone Anorthosie (Moecher *et al*., 1992), Kohistan calc-silicates and mafic granulites (Yoshino and Satish-Kumar, 2001) and the eclogite-hosted Emsdale scapolite vein. b) Comparison with typical isotope values of relevant reservoirs. Mantle and Typical Marble values from Giuliani *et al*. (2016) and references therein, Lower Crustal MM (metamorphic) Fluids from Hoefs *et al*. (1981) and references therein.

Nordøyane dataset. However, the mean (-2.4 ‰) and median (-1.9 ‰) values for the WSA are heavier than those for Nordøyane (-4.95 ‰ and -5.15 ‰ respectively). A similar trend can be observed for data from the Kohistan sylvialite and in $\delta^{13}C$ values for 'typical marbles' (Giuliani *et al*., 2016); $\delta^{13}C$ values are either heavier than the Nordøyane data, or overlap towards their heavier limits. Although the number of data points is small, the meionitic (C-Scp in Fig. 4.4a) population from Kohistan scapolite is a better fit with the Nordøyane data. Interpreted as derived from mantle fluids (Yoshino and Satish-Kumar, 2001), the C isotope values in these scapolites all plot close to the mean values of Nordøyane scapolite. Typical mantle carbon values (defined by the range covered by kimberlite carbonate, MORB, and typical diamonds; Giuliani *et al*., 2016) reinforce this interpretation, as they overlap more of the Nordøyane data (including the mean, median and modal values) than data from typical marbles (the Finnøya marble sample falls near the high end of the typical marble range). Based on these observations, and given the difference between Nordøyane scapolite and Finnøya marble carbon signatures, it can be concluded that while marble-derived fluids are a possible source of C in scapolite-forming fluids, a mantle source is a better fit for the data.

4.5.2 Sulphur

Sulphur isotopes are less frequently analyzed than carbon isotopes for determining the origin of volatiles in scapolite, with only Hoefs *et al*. (1981) providing $\delta^{34}S$ data. To give a broader range of relevant data for comparison, S isotope data from anhydrite from the 1991 eruption of the Pinatubo ocean island arc volcano (McKibben *et al*., 1996) are also presented to show the isotope profile of a setting in which S isotopes are strongly influenced by fluids from subducted oceanic crust. A major caveat of this



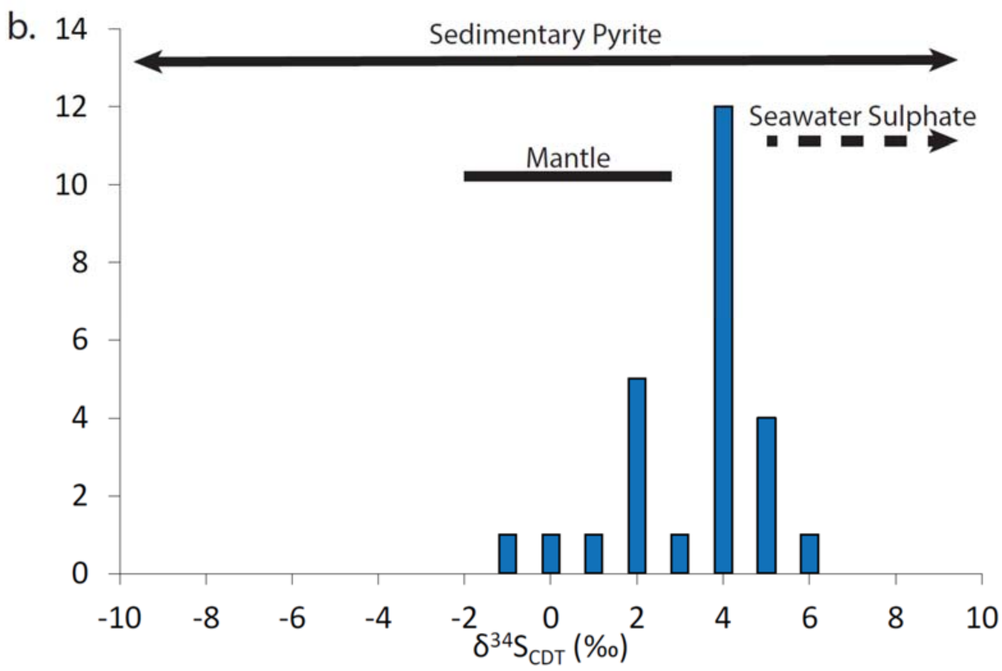


Figure 4.5: Comparison of Nordøyane $\delta^{34}S$ values with other minerals and fluid reservoir values. a) Comparison against scapolite/anhydrite in the Emsdale scapolite vein, Furua mafic granulites (Hoefs *et al*. 1981), and Pinatubo anhydrite (McKibben *et al*., 1996). b) Comparison with typical isotope values of relevant reservoirs from Giuliani *et al*. (2016) and references therein.

comparison is that S fractionation between fluids and anhydrite is likely different from that between fluid and scapolite, although to what degree is unknown. However, as no scapolite data exist for subducted oceanic crust, another sulphate mineral was deemed a reasonable standard for comparison.

In contrast to their conclusions on the source of C, Hoefs *et al*. (1981) interpreted a mantle source for S in the Furua scapolite. Of these, the mantle-derived S from the Furua scapolite overlaps completely with the Nordøyane scapolite while the Pinatubo anhydrite overlaps only with the upper end of the Nordøyane spectrum of values. The same trends can be observed in Figure 4.3b, where mantle values (Giuliani *et al*., 2016) more closely capture the range of Nordøyane scapolite than the outliers (indicated by the dashed line), seawater sulphate (a proxy for subduction zone fluids) do. As with the $\delta^{13}C$ values, the Emsdale scapolite $\delta^{34}S$ data do not match those from Nordøyane. While it is difficult to determine the origin of volatiles based on $\delta^{34}S$ values alone (as illustrated by the wide range of values from sedimentary pyrite), in conjunction with the $\delta^{13}C$ data the S in this system is concluded to be of mantle origin.

4.5.3 Oxygen

Although generally analyzed with C, O isotopes are the least commonly used in the determination of volatile sources in scapolite systems. Due to the ubiquity of oxygen in silicate rocks, $\delta^{18}O$ values for scapolite are generally deemed to reflect the isotopic composition of the host rock more than that of volatile-bearing fluids, and are typically discussed in comparison to related silicate phases in the same rock or whole-rock data form the host and adjacent rocks (Moecher *et al*., 1992; Yoshino and Satish-Kumar, 2001). Without data on whole rocks or other silicate phases it is difficult to determine whether Nordøyane scapolite conforms to the same pattern. Compared to literature values, Nordøyane scapolite has a heavier isotope signature than any scapolite in Furua, the Grenville Province, or the Kohistan Arc (Hoefs *et al*., 1981; Moecher *et al*., 1992; Yoshino and Satish-Kumar, 2001). Relative to general $\delta^{18}O$ values for common rock types, Nordøyane scapolite $\delta^{18}O$ most closely resembles sediments/metasediments, while being slightly enriched relative to felsic igneous rocks and highly enriched relative to mafic igneous rocks (Bindeman, 2008).

4.6 Conclusions

Based on the combined evidence from the different isotope systems, the C and S isotope signatures in Nordøyane are consistent with a mantle source. However, there are a number of limitations to this comparison-based approach. Isotope partitioning behaviour between scapolite and fluid/melt and between scapolite and sulphide species remains poorly understood. There is, as yet, no direct evidence, such as fluid inclusions, for the compositions of fluids in this system. It is possible that the observed mantle signature is the result of partitioning between scapolite and a crustal fluid. Without further constraints on the behaviour of scapolite and other relevant factors such as the isotope composition of coexisting sulphide phases this would be difficult to model. Furthermore, while a mantle origin is compatible with the data, and the subducted Baltican crust was in contact with an overlying mantle wedge for a prolonged period of time, the mechanism of fluid infiltration and transfer remains speculative (see Ch. 6 for further discussion).

Chapter 5: Geochronology

5.1 Introduction

In conjunction with stable isotope geochemistry, geochronology can help to place constraints on the source of volatiles related to scapolite crystallization. By determining the age of pegmatite crystallization, geochronology places a minimum age limit on when C- and S- bearing fluids must have interacted with the rocks. Several minerals suitable for geochronology were found in the Type 1 pegmatites during petrographic analysis, including titanite, zircon, and apatite. Titanite was chosen as the main geochronology target for several reasons: it is coarse-grained, abundant, and easy to sample, there is a large body of comparable literature data from the region to compare against and it was deemed more likely than zircon (much of which is likely inherited) to provide an accurate age for the crystallization of the pegmatites. No titanite, or any other datable mineral, was found in the Type 2 pegmatites, and as the Type 3 pegmatites on Finnøya had already been dated (Gordon *et al*., 2013) the geochronology data presented here focuses entirely on the Type 1 pegmatites.

In order to gain the most geochronological and geochemical information from these titanites in the most cost-effective manner, Laser Ablation Split Stream (LASS) dating was carried out at the University of Alberta Arctic Resources Laboratory. This form of analysis allows for the acquisition of *in situ* data for both the U-Pb and Sm-Nd isotope systems in a way that provides the best compromise between precision, accuracy, and spatial resolution. Analyzing the two isotope systems together also provides a greater range of information than either isotope system alone. Not only does it provide two different chronometers to compare within the same mineral, but εNd data can provide a valuable monitor for the source (crust vs. mantle) of melts (DePaolo and Wasserburg, 1976). Following preliminary characterization in thin section, two titanite grains from each of four samples (CB15-25,40,72, 74) were analyzed to produce the following dataset.

5.2 Methods

5.2.1 Titanite Petrography and Electron Microprobe Analysis

Four polished thin sections containing titanite (CB15-20, 25, 27 and 40) were selected for imaging and quantitative analysis. After initial observations and photomicrographs were made using a petrographic microscope, each sample was further imaged and analyzed by electron microprobe. These analyses were carried out at the Robert M. MacKay Electron Microprobe Laboratory at Dalhousie University using a JEOL JXA-8200 Superprobe equipped with five wavelength dispersive spectrometers. Titanites were analyzed under the following operating conditions: 15 kV accelerating voltage, 20 nA beam current, and 5 μm spot size. Analyzed elements, count times and standards are presented in Table 5.1. Cation proportions were calculated on the basis of 5 oxygens.

Following preliminary analysis, titanites were separated from hand samples to prepare grain mounts for Laser Ablation Split-Stream (LASS) analysis. In order to include samples from both map areas, and the scarcity of titanite in the hand samples, two of the samples in thin section (CB15-20 and 27) were dropped in favour of samples from Flemsøya (CB15-72 and 74). Individual titanite grains were cut from hand samples using a rock saw at Dalhousie, and sent to the University of Alberta for mounting and polishing. The titanite mounts (Fig. 5.1) were then imaged at the University of Alberta Scanning Electron Microscope Laboratory using a Zeiss Sigma 300 VP-FESEM.

5.2.2 LASS Geochronology

LASS is a form of Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) in which a laser ablation cell is connected to multiple mass spectrometers (Fig. 5.2) to allow simultaneous analysis of multiple isotope systems and/or trace elements from a single analysis spot. A Geo-Las 193nm Ar-F excimer laser ablation system was used to sample material for analysis. This system was connected to two mass spectrometers: a Thermo-Finnigan ELEMENT XR high-resolution magnetic-sector inductively coupled plasma mass spectrometer (HR-ICP-MS) used to measure U-Pb isotopes and a Thermo-Finnigan NEPTUNE multi-collector inductively coupled plasma mass spectrometer (MC-ICP-MS) for Sm-Nd. For each titanite, a single rim-to-core or cross-grain traverse of 15 ablation spots was carried out. The exception to this was sample CB15-74 T1 in which four additional analyses in line with spot 7 were accidentally added. Analyses used a 90 µm beam diameter, with a ~150 µm centre-to-centre distance between each analysis. Each spot was ablated for 60 s, following a 30 s gas background measurement, with He used as a carrier gas between the ablation cell and the mass spectrometers. The laser was operated at a frequency of 5 Hz for the first 65 analyses (60 on standards, and 5 on titanite CB15-72 T1), changing to 8 Hz for the remaining analyses (beginning with analysis spot 6 of CB15-72 T1) to improve signal strength given the low concentrations of Nd in in this sample. Energy density for all analyses was 5 J/cm^2. Data reduction was carried out by Chris Fischer using a custom

Element	Count Times: Peak / Background (s)	Standard (References)
Th	40 / 20	ThO_2
La	55 / 20	$LaPO_4$
F	40 / 20	Durango fluor-apatite (Young *et al*., 1969)
Si	20 / 10	Sanidine
Nd	40 / 20	REE Glass (Drake and Weill, 1972)
U	40 / 20	UO_2
Ce	55 / 20	$CePO_4$
Al	20 / 10	Sanidine
Eu	40 / 20	REE Glass (Drake and Weill, 1972)
Ca	20 / 10	Durango fluor-apatite (Young *et al*., 1969)
Fe	40 / 20	Garnet – Almandine 12442
Sr	20 / 10	Celestite
Sm	40 / 20	REE Glass (Drake and Weill, 1972)
Ti	20 / 10	Ilmenite (Jarosewich *et al*., 1980)
Dy	40 / 20	REE Glass (Drake and Weill, 1972)
Gd	40 / 20	REE Glass (Drake and Weill, 1972)
Zr	40 / 20	Zirconia

Table 5.1: Titanite EPMA elements, count times and standards.

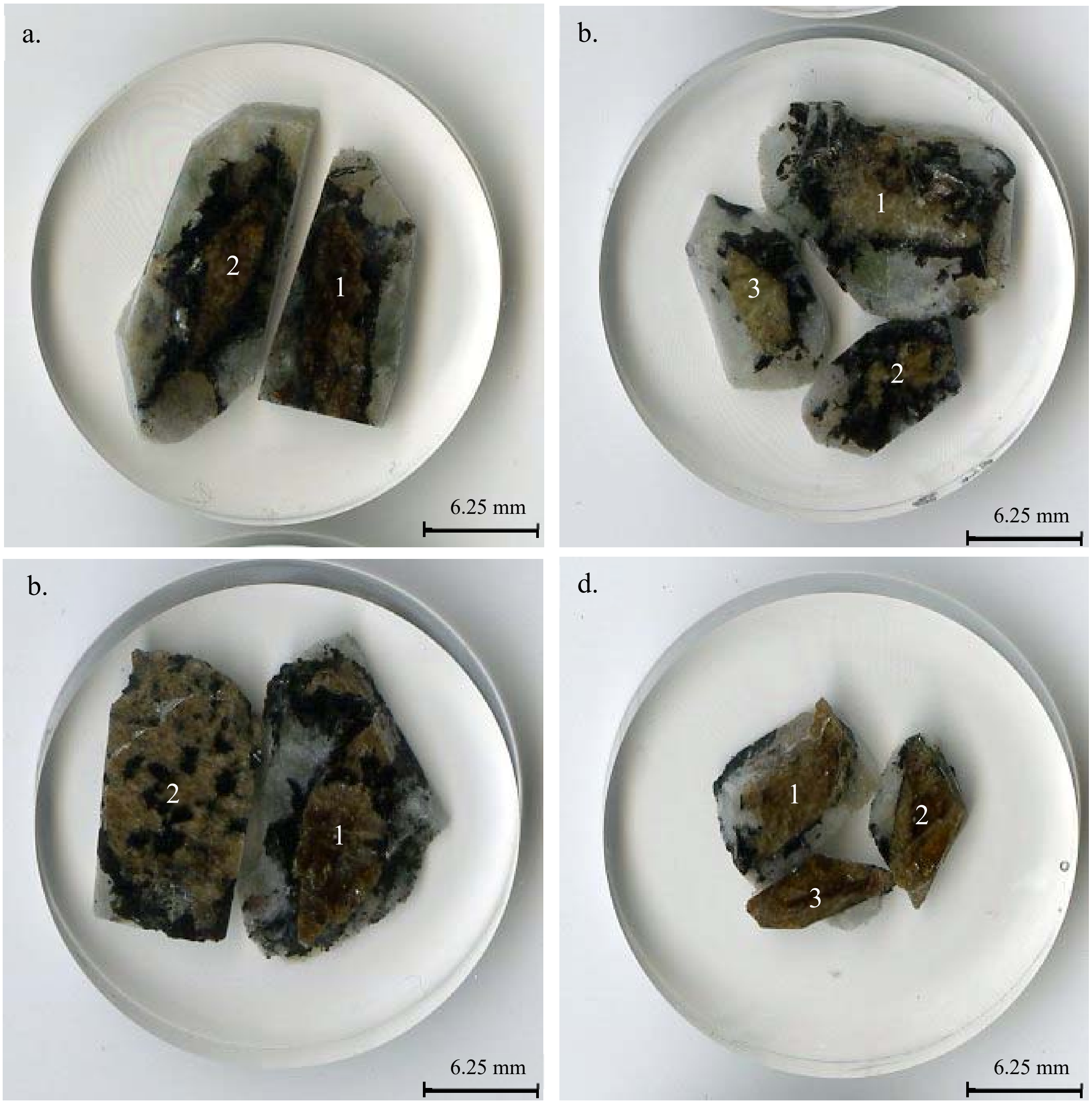


Figure 5.1: Polished titanite grain mounts, for geochronology. a) CB15-25 b) CB15-40 c) CB15-72 d) CB15-74. Grains are marked with the numbers by which they are referred to throughout the text. Grains CB15-40 T1 and CB15-74 T3 were not analyzed due to time constraints.

data reduction scheme (Goudie *et al*., 2014) written in the Iolite program (Paton *et al*., 2011) which runs in the IgorPro software package (www.wavemetrics.com). Further data processing and display were carried out in Microsoft Excel, using the Isoplot 4.1 software package (Ludwig, 2012). Standards used to check the accuracy of the data are presented in Appendix D. For further information on theory, instrument set-up, and data processing for this technique see Fischer *et al*. (2011), Goudie *et al*. (2014), and references therein.

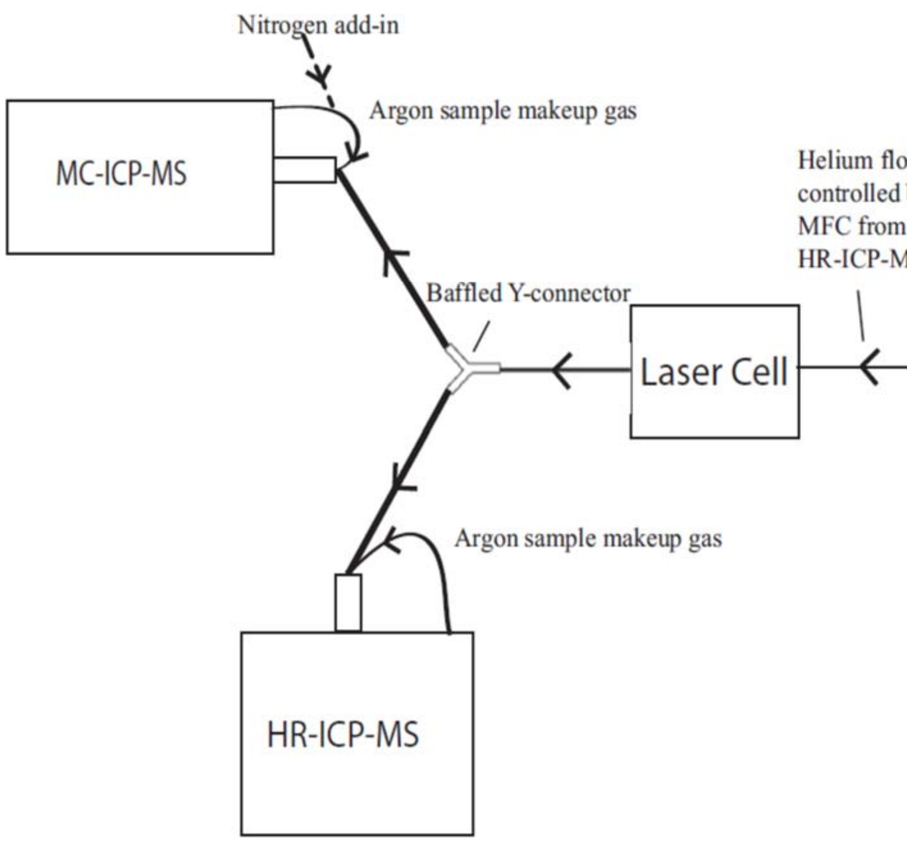


Figure 5.2: Typical laser ablation-split stream instrument configuration (Goudie *et al.*, 2014) at the University of Alberta Arctic Resources Laboratory. MFC: mass flow controller, HR-ICP-MS: high-resolution magnetic-sector inductively coupled plasma mass spectrometer, MC-ICP-MS: multi-collector inductively coupled plasma mass spectrometer.

5.3 Results

5.3.1 Petrography and Microprobe Data

Coarse titanites, typically ranging from 0.25-1 cm in size, are a minor phase in many of the Type 1 pegmatites on both Ulla Fyr and Flemsøya. Fine-scale textures and mineral associations are outlined using photomicrographs in Figure 5.3. Titanites are most abundant in the hornblende-biotite-plagioclase-dominated portion of the pegmatite (Fig. 5.3a-c, e,f), although they can more rarely be found in the scapolite-quartz-rich portions (Fig. 5.3d). A wide range of titanite morphologies is encountered in these samples, ranging from prismatic sphenoidal crystals (e.g. CB15-74, Fig. 5.1d), to totally anhedral grains. Both types of titanite can be found within the same sample, although the anhedral or irregular grains are more common, and the only type represented in all four thin sections. Although present as individual grains within the plagioclase-quartz matrix (Fig. 5.3c, d), titanite is commonly associated with biotite (Fig. 5.3a, b) and may also be included in large hornblende phenocrysts (Fig.5.3e, f). Small apatite grains are also abundant in these rocks, locally intergrown with titanite (Fig. 5.3f). Many titanite grains are surrounded by a reaction rim (Fig. 5.3c, d), determined to be a symplectite of ilmenite+plagioclase+quartz in high magnification BSE images (Fig. 5.4a, b). Plagioclase in these symplectites ranges in composition from An_{24-35}. Hornblende is also intergrown with some, but not all symplectites (Fig. 5.4a, b). This may indicate that hornblende also participated in this reaction. Some titanites also contain small inclusions of other phases, including ilmenite and biotite. Samples chosen for geochronology were selected based on 1) coarse grain size, and 2) a large grain area or core unaffected by the titanite-ilmenite reaction, although many do have at least some ilmenite on their grain boundaries (Fig. 5.1).

High-contrast BSE images revealed that all the titanites in the thin section samples are strongly zoned. Zoning takes one of two forms, either highly irregular (Figure 5.4c, d) or regular and prismatic (Figure 5.4e, f). In both cases, zoning is coarse, with individual zones being tens to hundreds of microns across. Irregular zoning is more common than prismatic zoning, being the only type present in thin sections CB15-25, 27 and 40, although both types of zoning are found in CB15-20. In order to compare across grains, zones were divided into three categories based on brightness in BSE images (high, medium, and low). Representative titanite analyses from each group are presented in Table 5.2, with further analyses presented in Appendix C. Compositional differences across a range of major and trace elements are presented in Figure 5.5. Of these, subtle differences in Ti, Al, and REE (particularly HREE) content seem to account for most of the difference. Th and U content seems to play a smaller role, as there is considerable overlap between all three brightness zones in these elements. Differences in the trace elements are relatively minor, and at the count times used, many analyses registered one or more trace elements at below detection levels, which may obscure some of the true variation.

Table 5.2: Representative Titanite Analyses

Sample:	CB15-25			CB15-40		CB15-27		CB15-20			CB15-25		CB15-40		
Zone	HB	HB	HB	HB	HB	MB	MB	MB	MB	MB	LB	LB	LB	LB	LB
No.	13	16	20	110	66	185	186	370	371	377	36	45	147	148	149
Wt%															
SiO2	30.11	30.22	30.27	29.56	29.22	30.05	30.10	29.90	30.01	30.06	30.34	30.57	30.22	30.22	30.32
TiO2	35.20	35.75	35.93	35.36	35.22	36.86	36.90	35.35	35.32	35.64	35.19	35.33	36.41	36.06	35.84
Al2O3	1.73	1.64	1.68	1.54	1.38	0.86	0.84	2.06	2.02	1.84	2.04	2.05	1.14	1.66	1.59
FeO	0.90	0.75	0.78	0.85	0.81	0.51	0.47	0.51	0.52	0.55	0.66	0.62	0.76	0.58	0.55
CaO	27.91	28.26	28.28	27.00	27.30	27.79	27.86	28.28	28.07	28.11	28.63	28.60	28.10	28.46	28.18
SrO	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.00	0.00	0.00	0.00	0.00	0.03	0.04	0.02	0.01	0.01	0.00	0.02	0.03	0.00	0.01
F	0.19	0.16	0.23	0.15	0.09	0.12	0.12	0.20	0.23	0.19	0.27	0.29	0.15	0.15	0.15
La2O3	0.00	0.00	0.00	0.00	0.01	0.00	0.07	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.15	0.04	0.08	0.24	0.28	0.23	0.09	0.00	0.05	0.00	0.05	0.00	0.13	0.01	0.00
Sm2O3	0.06	0.00	0.03	0.06	0.04	0.03	0.06	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.00
Eu2O3	0.00	0.01	0.00	0.03	0.03	0.02	0.06	0.04	0.02	0.06	0.00	0.02	0.03	0.00	0.00
Gd2O3	0.11	0.01	0.02	0.21	0.25	0.00	0.07	0.01	0.05	0.05	0.00	0.00	0.00	0.00	0.07
Dy2O3	0.14	0.09	0.00	0.26	0.21	0.10	0.09	0.00	0.00	0.11	0.08	0.01	0.06	0.03	0.07
ThO2	0.04	0.00	0.06	0.05	0.02	0.02	0.00	0.04	0.08	0.00	0.00	0.00	0.00	0.04	0.03
UO2	0.04	0.00	0.03	0.00	0.01	0.00	0.04	0.00	0.01	0.00	0.00	0.06	0.00	0.00	0.00
Total	96.49	96.85	97.29	95.22	94.81	96.58	96.75	96.31	96.33	96.53	97.14	97.43	96.98	97.14	96.74
Cations Recalulated on the basis of 5O															
Si	1.02	1.02	1.02	1.00	1.02	1.02	1.02	1.02	1.01	1.02	1.02	1.03	1.02	1.02	1.02
Ti	0.90	0.91	0.91	0.94	0.90	0.93	0.94	0.90	0.91	0.88	0.89	0.89	0.93	0.92	0.92
Al	0.07	0.07	0.07	0.05	0.07	0.05	0.03	0.08	0.08	0.10	0.08	0.08	0.04	0.05	0.05
Fe	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Ca	1.02	1.02	1.02	1.02	1.02	1.01	1.01	1.03	1.02	1.03	1.03	1.03	1.01	1.02	1.02
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.03	0.03	0.03	0.03	0.03	0.01	0.01	0.02
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.06	3.06	3.06	3.05	3.06	3.04	3.03	3.07	3.07	3.07	3.07	3.07	3.04	3.04	3.05

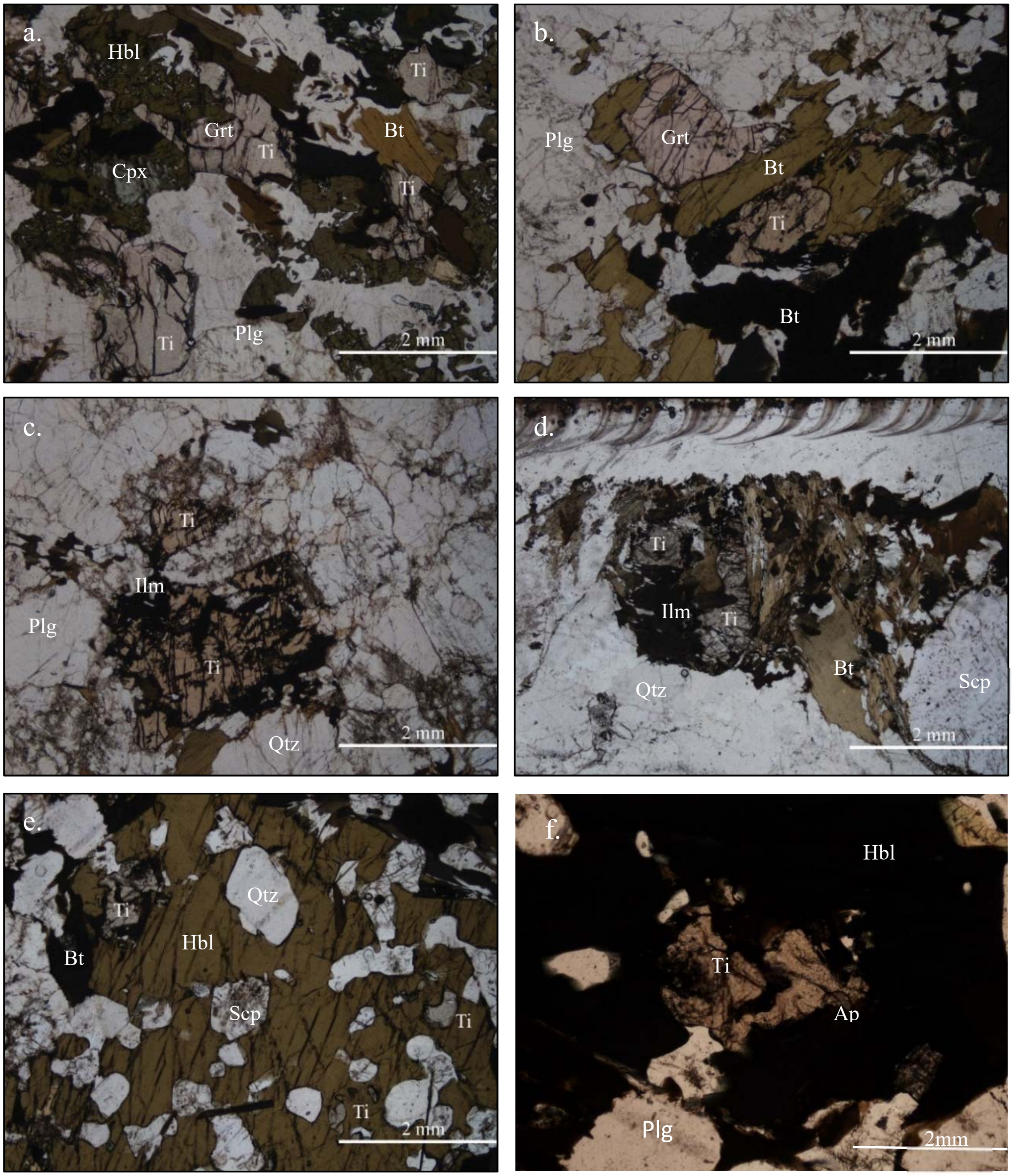


Figure 5.3: PPL photomicrographs of titanite and associated minerals in Type 1 pegmatite. a) CB15-20. Titanite is most abundant in the hornblende-biotite-plagioclase rich portions of the pegmatite. This sample was collected close to the margin between the pegmatite and its host eclogite, and contains xenocrysts of garnet and clinopyroxene. b) CB15-27. Titanite grain surrounded by biotite. c) CB15-27. Ilmenite +quartz+plagioclase symplectite found in most, but not all titanites in these rocks. d) CB15-25. Titanite in the scapolite-quartz portion of the pegmatite. Note the familiar association with biotite and ilmenite. e) CB15-40. Titanite and other phases included in large hornblende phenocrysts. f) CB15-40. Titanite and apatite included in hornblende, a relatively common mineral association in these rocks.

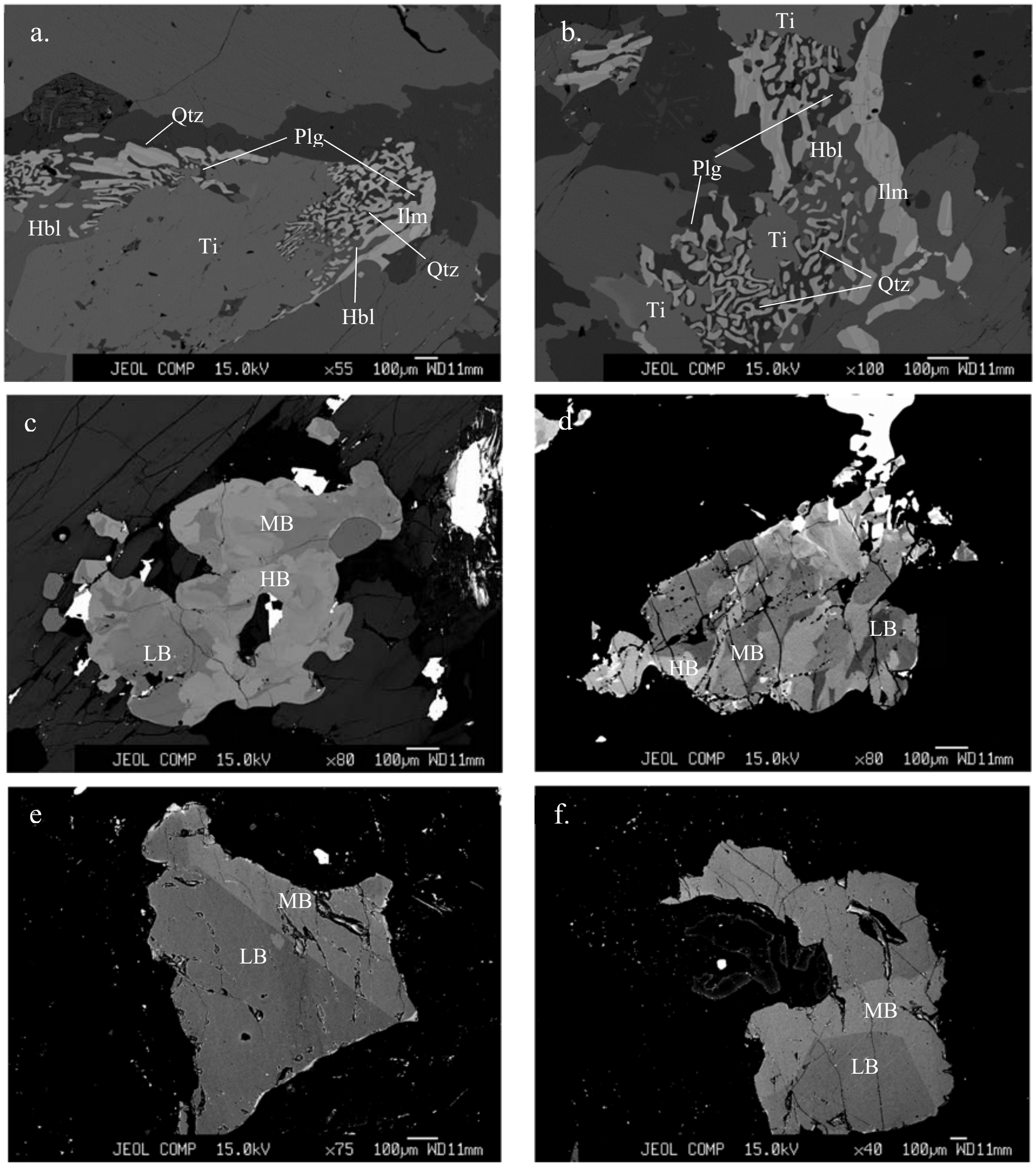


Figure 5.4: BSE images of titanite, showing reaction and zoning textures. Zones were divided into low brightness (LB), moderate brightness (MB) and high brightness (HB) areas, corresponding to increasing mean atomic number. a and b) CB15-27. Titanite is partly replaced by ilmenite+plagioclase+quartz±hornblende symplectites. c) CB15-40. Anhedral titanite with irregular zoning; see photomicrograph of this grain in Figure 2f. d) CB15-27. Anhedral titanite with irregular zoning. The bright mineral at the top of the image is ilmenite, which is commonly associated with titanites of this morphology. e and f) CB15-20. Prismatically zoned subhedral titanites.

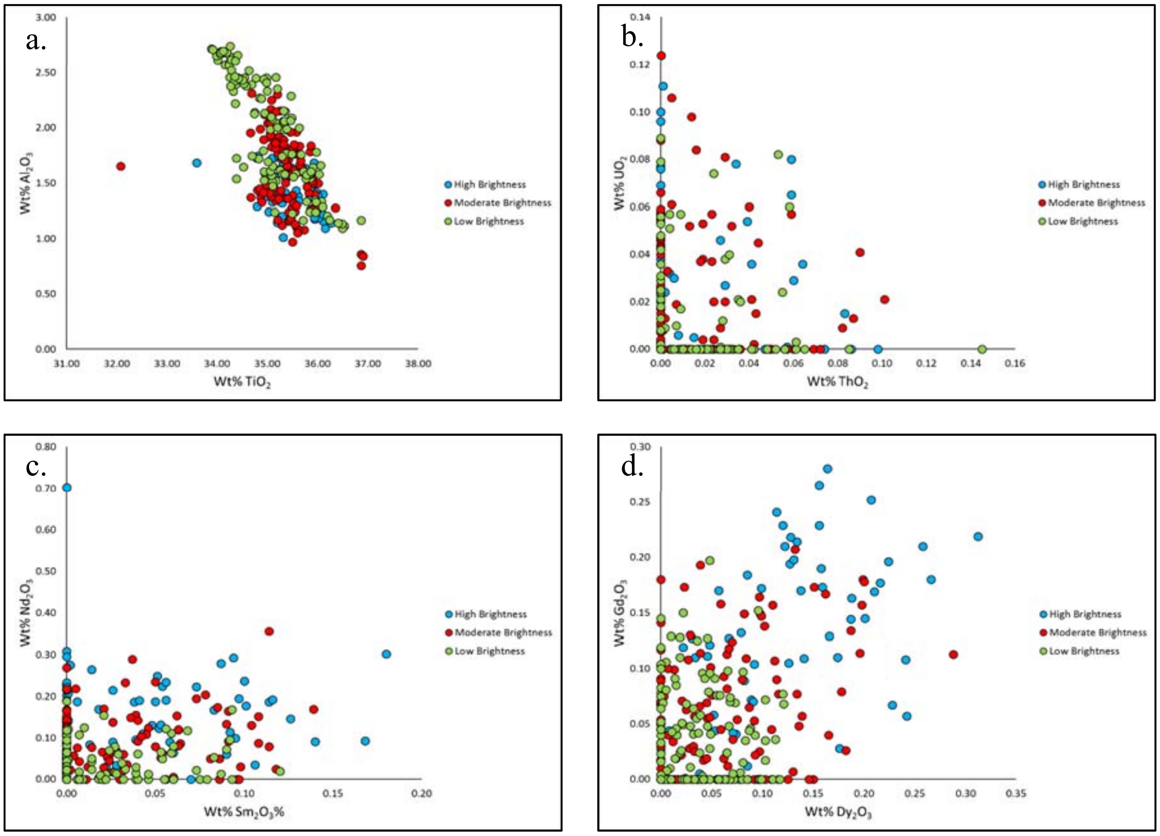


Figure 5.5: Compositional zoning in titanites. These plots represent data from 14 titanite grains spread across four thin sections (samples CB15-20, 25, 27 and 40). All compositional data are plotted as wt% oxides. a) TiO_2 vs Al_2O_3; plotted to show zoning in major elements. LB zones are consistently lower in TiO_2 and higher in Al_2O_3 the MB or HB zones. b) ThO_2 vs UO_2; plotted to show zoning in heavy radioactive elements. No clear trends relative to brightness. c) Sm_2O_3 vs Nd_2O_3; plotted to show zoning in LREEs. There is a relatively weak correlation between higher brightness and higher concentrations of Sm and Nd d) Dy_2O_3 vs Gd_2O_3; plotted to show zoning in HREEs. There is a relatively clear correlation between higher brightness and higher concentrations of Dy and Gd.

5.3.2 LASS Geochronology

Geochronology results are presented individually for each analyzed titanite grain in Figures 5.6 through 5.13, with accompanying data in Table 5.3. U-Pb data for all titanites are highly discordant, indicating large amounts of common Pb (Pb_c), a combination of inherited non-radiogenic Pb, and minor contamination in the laboratory (the ‘lab blank’). Due to a lack of constraint on the Pb_c composition from associated phases such as plagioclase, it was not anchored to a particular value for any of the samples, but allowed to vary to give the best fit to the data, with a range of 0.79-0.91. U-Pb ages form strongly linear arrays with few to no outliers for all samples, and lower intercept ages projected back to concordia are interpreted to record the crystallization of the grain. Wetherill (1956) and Tera and Wasserberg (1972) (T-W) type concordia ages for all samples are internally consistent, with the two types agreeing within error for any given sample. Unless otherwise noted, the ages reported in the text are T-W ages. Sm-Nd isochron ages (Figs. 5.6e-13e) lack the same precision as the U-Pb ages, and give a wide range of dates with very large errors. These large uncertainties are due to the low concentrations of radiogenic Nd in these young samples, and the relatively restricted range of $^{143}Nd/^{144}Nd$ and $^{147}Sm/^{144}Nd$ ratios, leading to large uncertainties in extrapolating the data. A Short summary paragraphs on each geochronology sample is presented here.

CB15-25. The sample is a Type 1 scapolite pegmatite from Scapolite Hill, Haramsøya (Fig. 4.1). Titanite in this sample shows evidence of having undergone a reaction to form ilmenite+plagioclase+quartz (Fig. 5.1a). Both grains are relatively euhedral prisms (Figs. 5.6b, 5.7b). Grain T1 yielded a U-Pb age of 397.9±7.9 Ma (Fig. 5.6d), a Sm-Nd age of 419±110 Ma (Fig. 5.6e), and an average $\varepsilon Nd_{initial}$ of -10.0 (Fig. 5.14a). Grain T2 has a U-Pb age of 407±10 Ma (Fig.5.7d), a Sm-Nd age of 413±270 Ma (Fig. 5.7e), and an average $\varepsilon Nd_{initial}$ of -9.6 (Fig. 5.14a).

CB15-40. The sample is a Type 1 scapolite pegmatite from Ulla Fyr, on the northern end of the Ulla Gneiss Field (Fig. 4.1). Titanites in this sample are intergrown with biotite, and also have thin reaction rims of ilmenite (Fig. 5.1a). Both grains show irregular zoning (Fig. 5.8b, 5.9b). Grain T2 is anhedral, while T3 is subhdral and prismatic. Both grains contain minor inclusions of biotite and quartz. Grain T2 yielded a U-Pb age of 422.2±7 Ma (Fig. 5.8d), a Sm-Nd age of 253±260 Ma (Fig. 5.8e), and an average $\varepsilon Nd_{initial}$ of -8.8 (Fig. 5.14a). Grain T3 has a U-Pb age of 406±12 Ma (Fig.5.9d), a Sm-Nd age of 641±120 Ma (Fig. 5.9e), and an average $\varepsilon Nd_{initial}$ of -8.7 (Fig. 5.14a).

CB15-72. The sample is a Type 1 scapolite pegmatite from the Flemsøya boudin chain, east of Storetjønna (Fig. 4.2). Neither grain shows evidence of zoning (Fig.5.9b, .10b). Grain T2 has numerous inclusions of biotite (Fig.5.10b). Grain T1 yielded a U-Pb age of 394±13 Ma (Fig. 5.10d), a Sm-Nd age of 601±110 Ma (Fig. 5.10e), and an average $\varepsilon Nd_{initial}$ of -8.7 (Fig. 5.14a). Grain T2 has a U-Pb age of 419.1±5.9 Ma (Fig.5.11d), a Sm-Nd age of 559±140 Ma (Fig. 5.11e), and an average $\varepsilon Nd_{initial}$ of -8.8 (Fig. 5.14a).

CB15-74. The sample is a Type 1 scapolite pegmatite from Skobergo, Flemsøya (Fig. 4.2). Both grains are prismatic and euhedral, and show prismatic zoning (Figs. 5.12b, 5.13b). Grain T2 shows minor evidence of the breakdown to ilmenite+plagioclase+quartz on its grain boundaries (Fig 5.13b). Grain T1 yielded a U-Pb age of 405±30 Ma (Fig. 5.12d), a Sm-Nd age of 437±130 Ma (Fig. 5.12e), and an average $\varepsilon Nd_{initial}$ of -8.8 (Fig. 5.14a). Grain T2 has a U-Pb age of 396±11 Ma (Fig.5.13d), a Sm-Nd age of 361±160 Ma (Fig. 5.13e), and an average $\varepsilon Nd_{initial}$ of -8.3 (Fig. 5.14a).

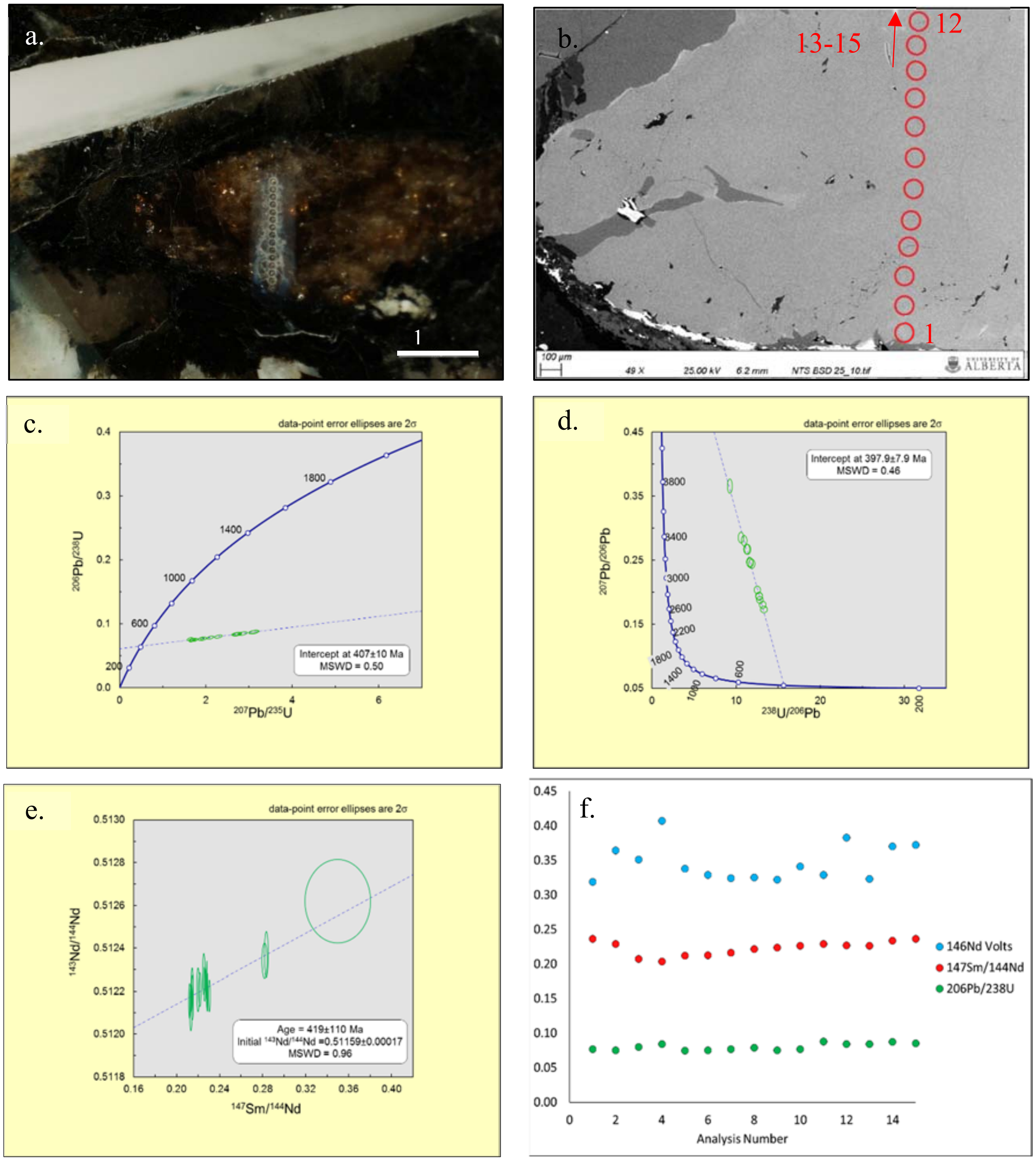


Figure 5.6: CB15-25 Titanite 1 geochronology results. a.) Photomicrograph of the grain, post-analysis, showing the laser ablation transect. b.) SEM BSE image showing the fine-scale textures of the grain, and approximate location of laser ablation pits. Analyses 13-15 are off the edge of the image. c.) Standard U-Pb concordia diagram. Upper intercept at 4940±290 Ma. d.) Terra-Wasserburg U-Pb concordia diagram. Pb_c = 0.85. e.) Sm-Nd isochron diagram. f.) Zoning profiles of stable isotope ^{146}Nd volts (concentration), $^{147}Sm/^{144}Nd$ ratio, and $^{206}Pb/^{238}U$ ratio along the laser ablation

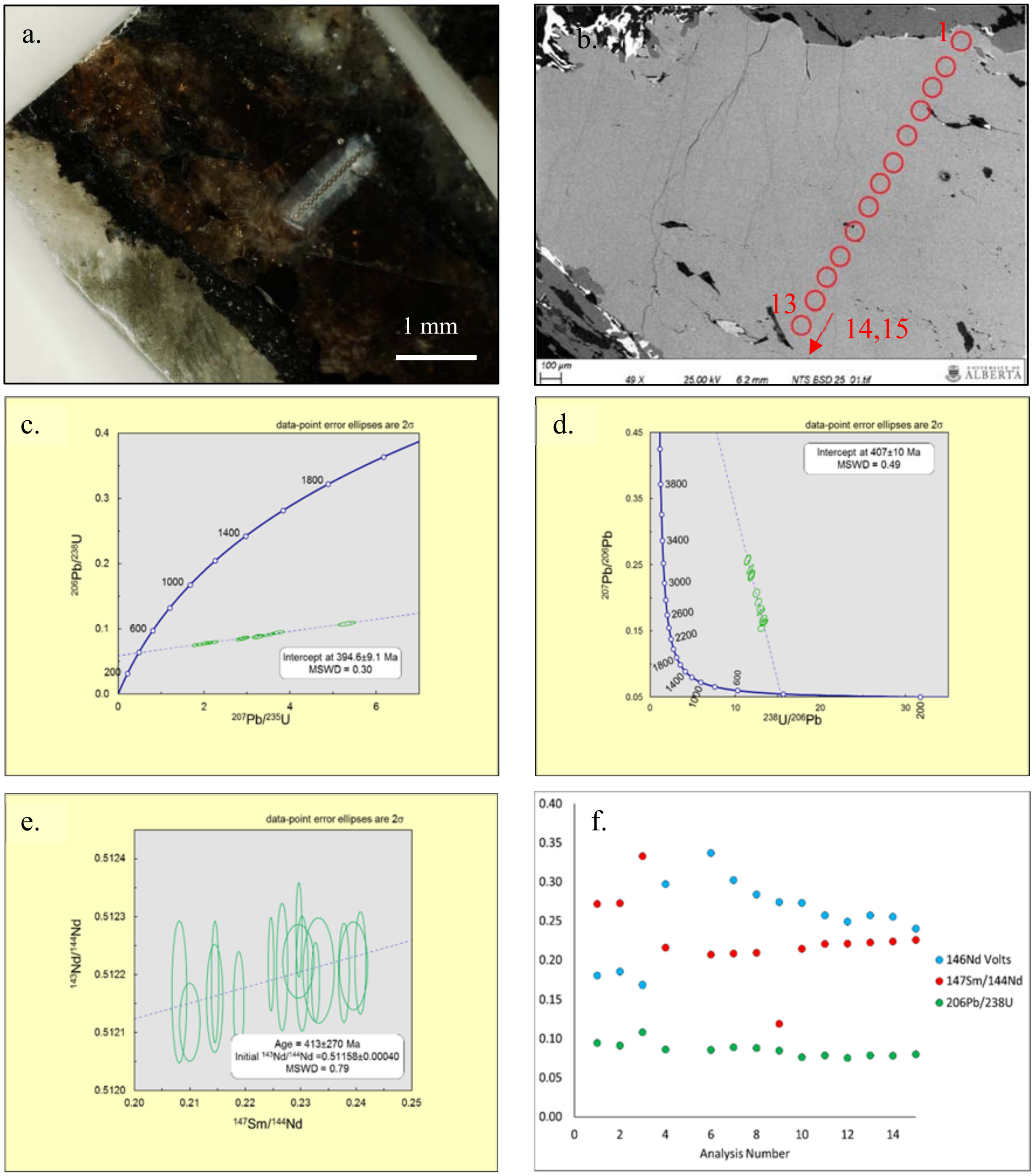


Figure 5.7: CB15-25 Titanite 2 geochronology results. a.) Photomicrograph of the grain, post-analysis, showing the laser ablation transect. b.) SEM BSE image showing the fine-scale textures of the grain, and approximate location of laser ablation pits. Analyses 14 and 15 are off the edge of the image. c.) Standard U-Pb concordia diagram. Upper intercept at 4808±180 Ma. d.) Terra-Wasserburg U-Pb concordia diagram. Pb_c = 0.80. e.) Sm-Nd isochron diagram. f.) Zoning profiles of stable isotope ^{146}Nd volts (concentration), $^{147}Sm/^{144}Nd$ ratio, and $^{206}Pb/^{238}U$ ratio along the laser ablation transect.

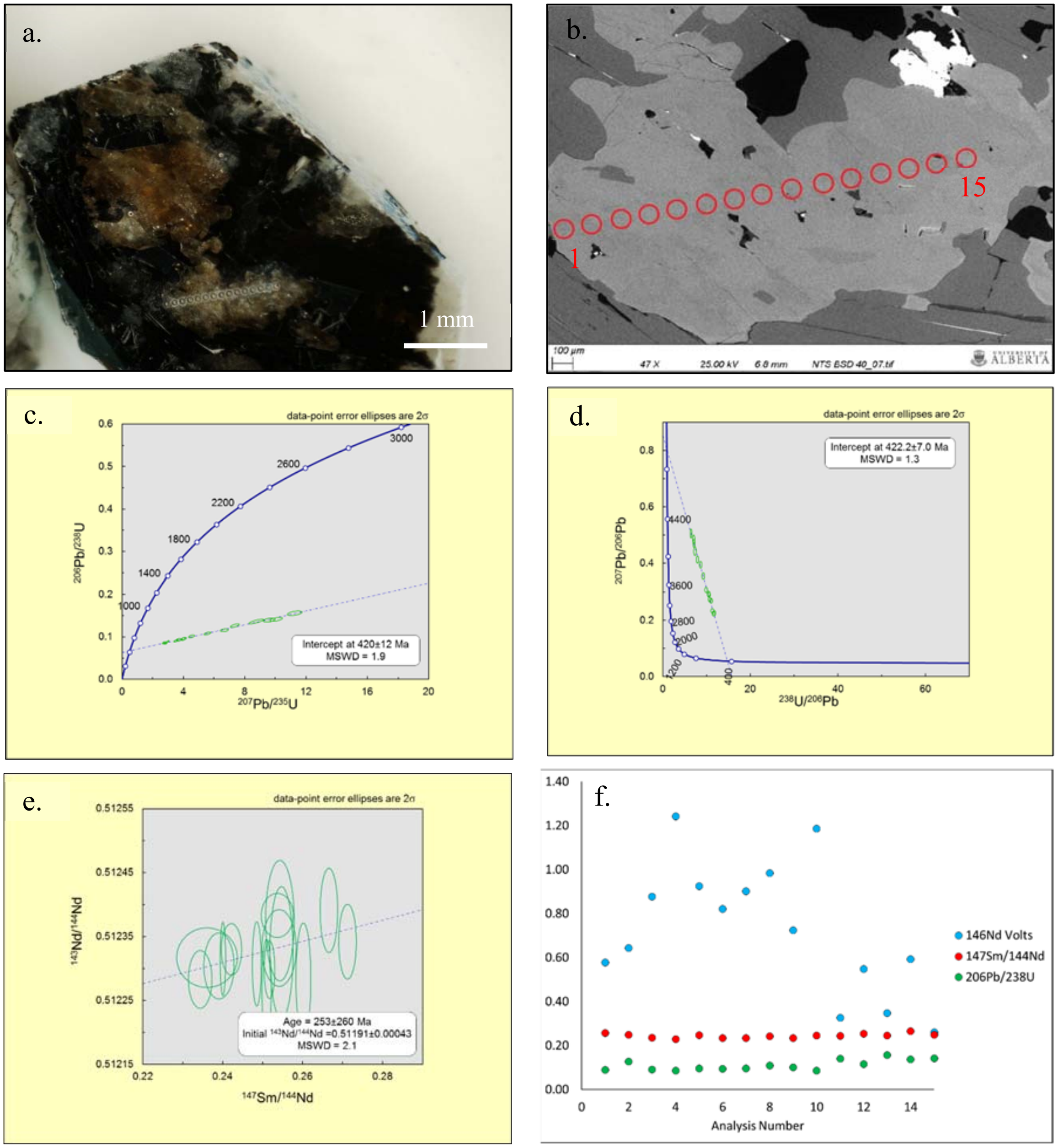


Figure 5.8: CB15-40 Titanite 2 geochronology results. a.) Photomicrograph of the grain, post-analysis, showing the laser ablation transect. b.) SEM BSE image showing the fine-scale textures of the grain, and approximate location of laser ablation pits. c.) Standard U-Pb concordia diagram. Upper intercept at 4994±86 Ma. d.) Terra-Wasserburg U-Pb concordia diagram. Pb_c = 0.84. e.) Sm-Nd isochron diagram. f.) Zoning profiles of stable isotope ^{146}Nd volts (concentration), ^{147}Sm/^{144}Nd ratio, and ^{206}Pb/^{238}U ratio along the laser ablation transect.

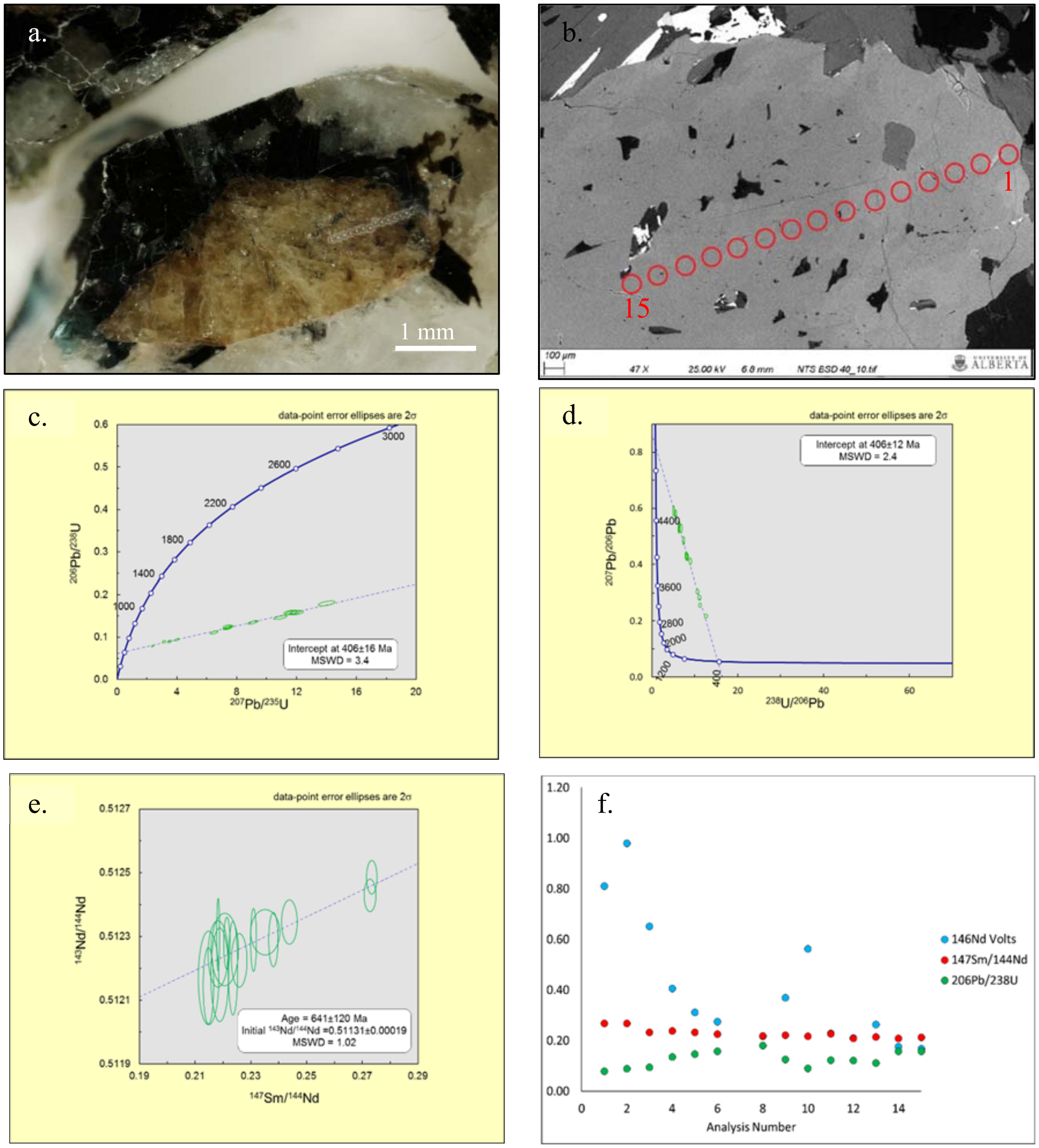


Figure 5.9: CB15-40 Titanite 3 geochronology results. a.) Photomicrograph of the grain, post-analysis, showing the laser ablation transect b.) SEM BSE image showing the fine-scale textures of the grain, and approximate location of laser ablation pits. c.) Standard U-Pb concordia diagram. Upper intercept at 4989±65 Ma. d.) Terra-Wasserburg U-Pb concordia diagram. Pb_c = 0.88. e.) Sm-Nd isochron diagram. f.) Zoning profiles of stable isotope ^{146}Nd volts (concentration), $^{147}Sm/^{144}Nd$ ratio, and $^{206}Pb/^{238}U$ ratio along the laser ablation transect.

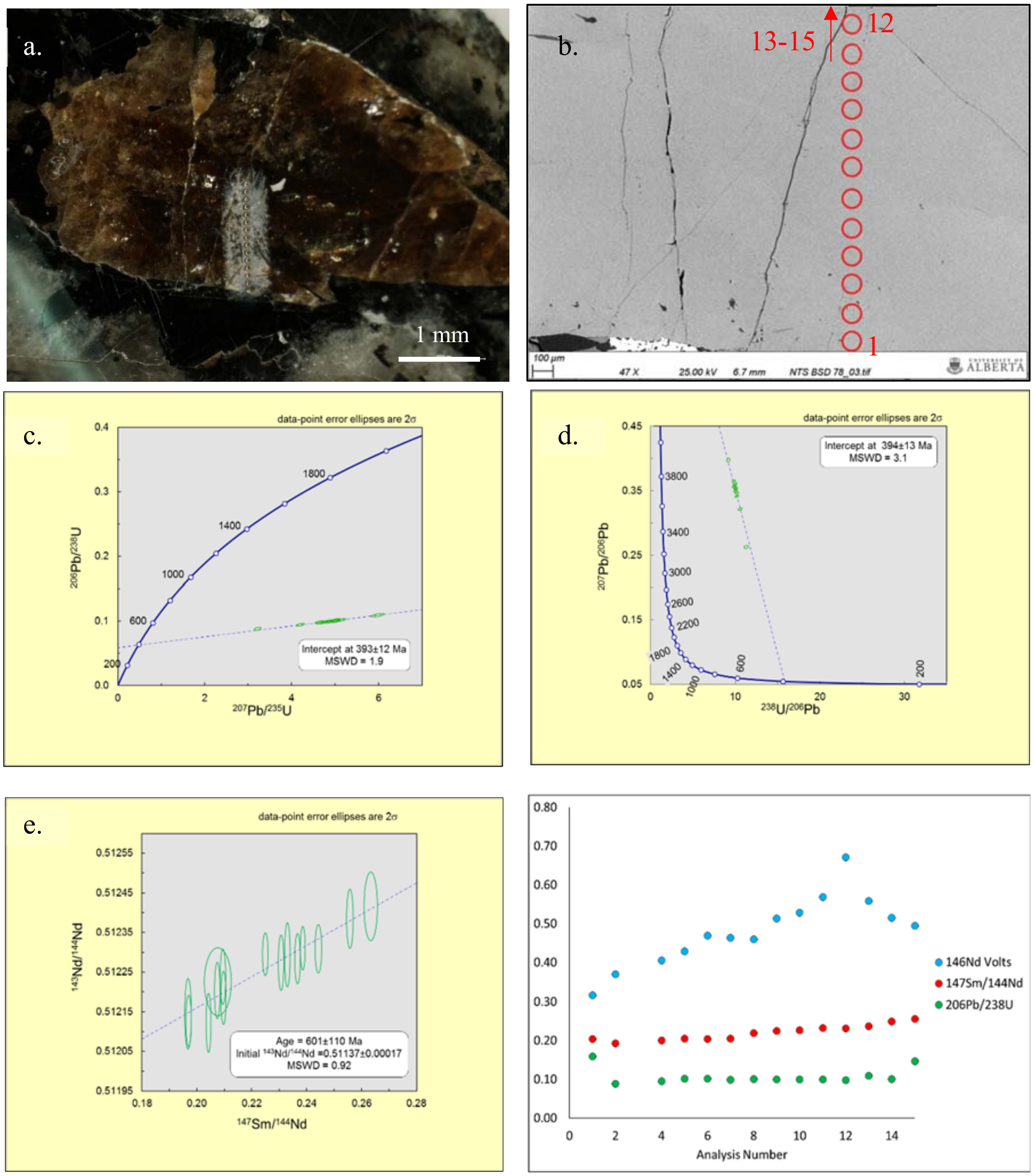


Figure 5.10: CB15-72 Titanite 1 geochronology results. a.) Photomicrograph of the grain, post-analysis, showing the laser ablation transect. b.) SEM BSE image showing the fine-scale textures of the grain, and approximate location of laser ablation pits. Analyses 13-15 are off the edge of the image. c.) Standard U-Pb concordia diagram. Upper intercept at 4947±80 Ma. d.) Terra-Wasserburg U-Pb concordia diagram. Pb_c = 0.86. e.) Sm-Nd isochron diagram. f.) Zoning profiles of stable isotope ^{146}Nd volts (concentration), ^{147}Sm/^{144}Nd ratio, and ^{206}Pb/^{238}U ratio along the laser ablation transect.

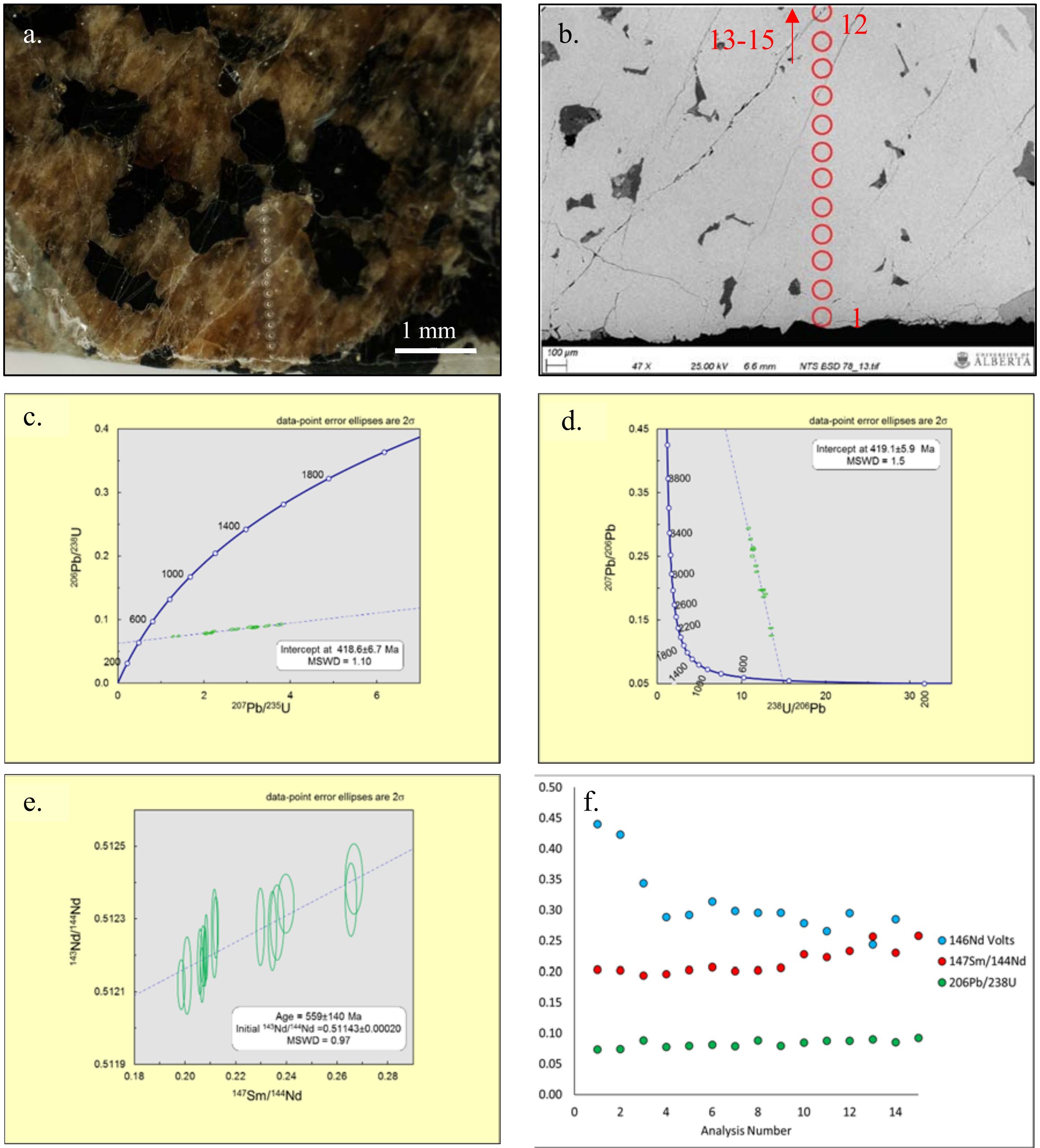


Figure 5.11: CB15-72 Titanite 2 geochronology results. a.) Photomicrograph of the grain, post-analysis, showing the laser ablation transect. b.) SEM BSE image showing the fine-scale textures of the grain, and approximate location of laser ablation pits. Analyses 13-15 are off the edge of the image. c.) Standard U-Pb concordia diagram. Upper intercept at 5032±170 Ma.d.) Terra-Wasserburg U-Pb concordia diagram. Pb_c = 0.91. e.) Sm-Nd isochron diagram. f.) Zoning profiles of stable isotope ^{146}Nd volts (concentration), ^{147}Sm/^{144}Nd ratio, and ^{206}Pb/^{238}U ratio along the laser ablation transect

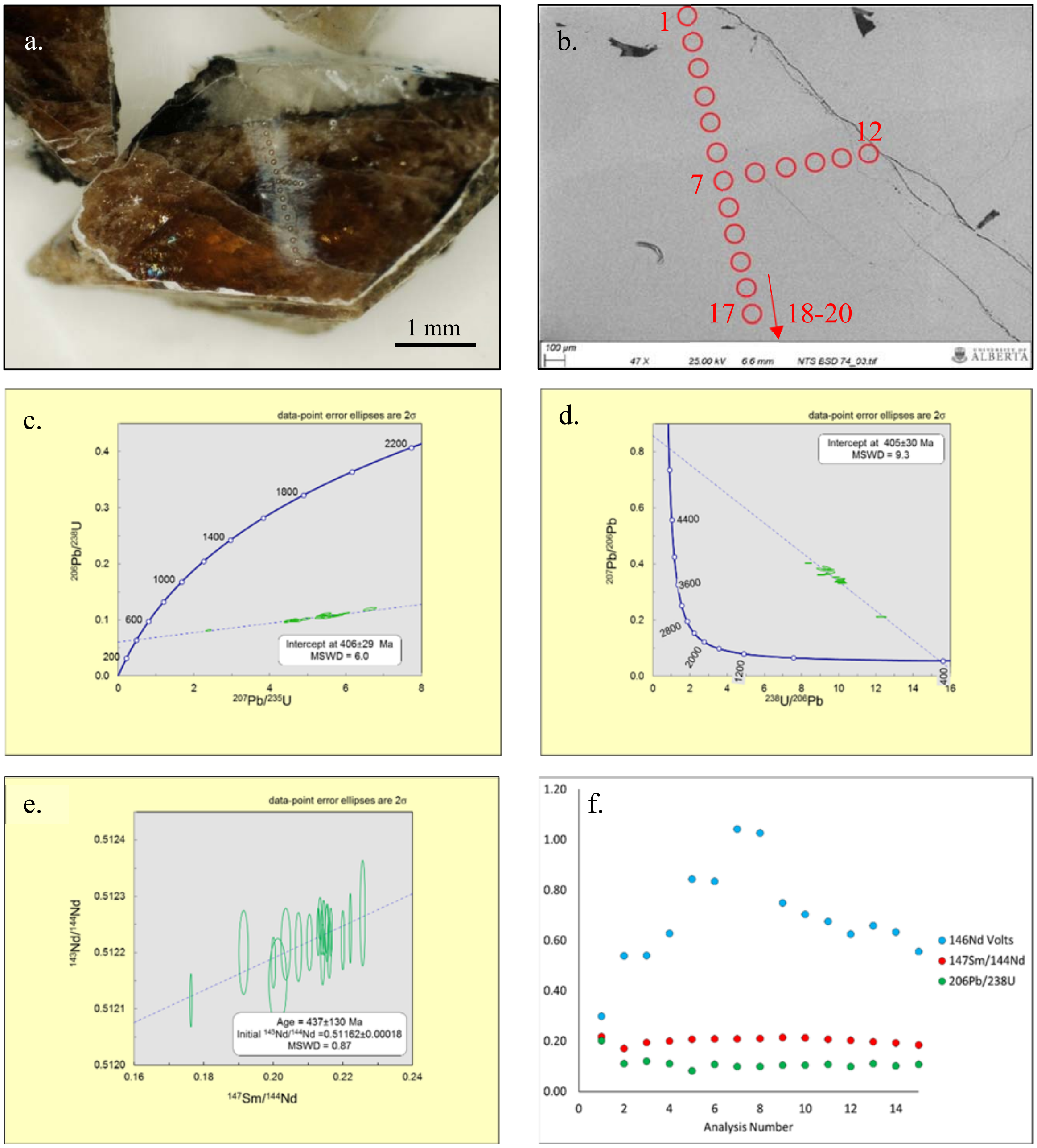


Figure 5.12: CB15-74 Titanite 1 geochronology results. Photomicrograph of the grain, post-analysis, showing the laser ablation transect. b.) SEM BSE image showing the fine-scale textures of the grain, and approximate location of laser ablation pits. Analyses 18-20 are off the edge of the image. c.) Standard U-Pb concordia diagram. Upper intercept at 4959±160 Ma.d.) Terra-Wasserburg U-Pb concordia diagram. Pb_c = 0.81. e.) Sm-Nd isochron diagram. f.) Zoning profiles of stable isotope ^{146}Nd volts (concentration), ^{147}Sm/^{144}Nd ratio, and ^{206}Pb/^{238}U ratio along the laser ablation transect. Only analyses from the main traverse are included in 5.12f, although the additional analyses are plotted on 5.12c, d and e.

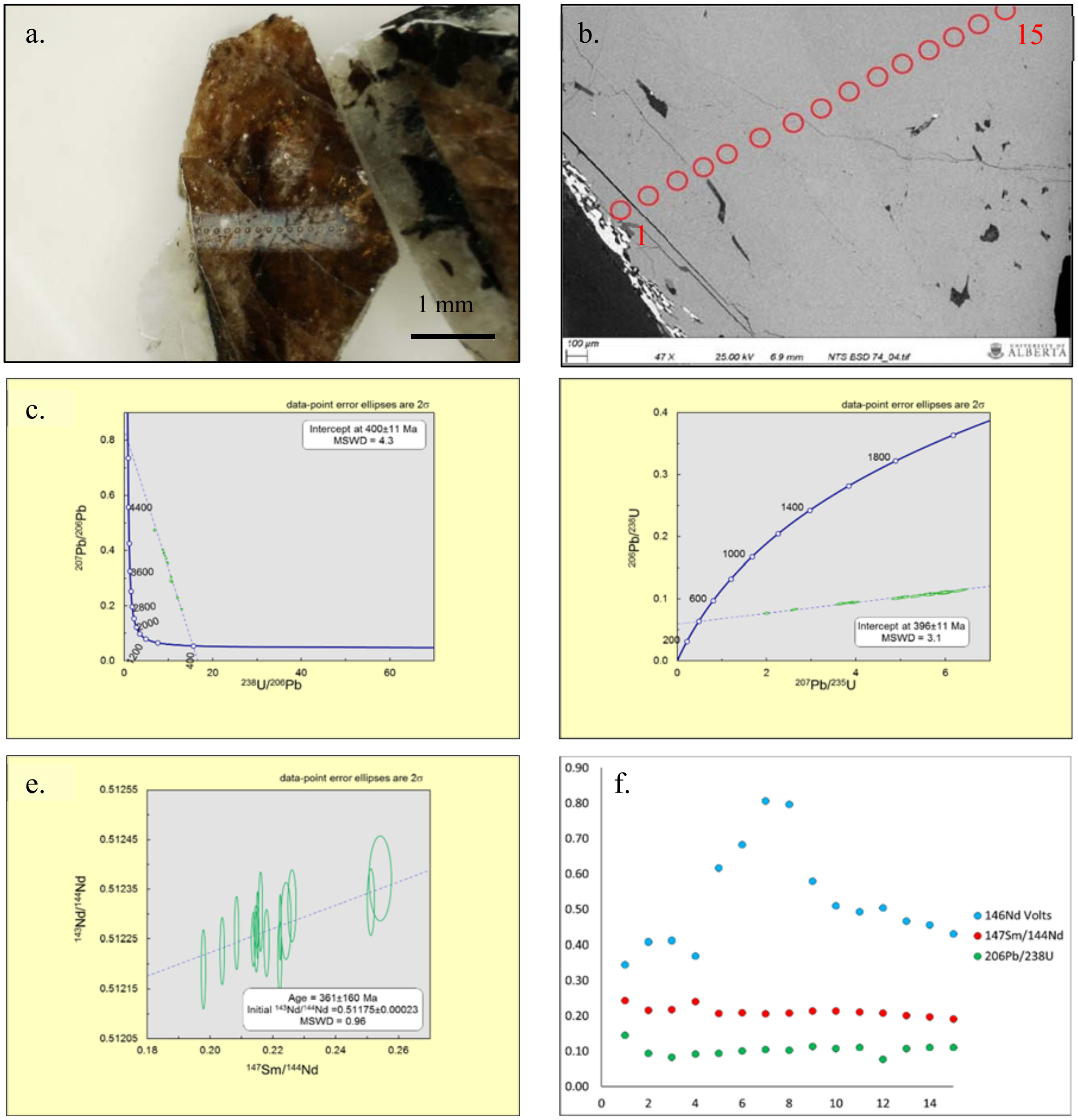


Figure 5.13: CB15-74 Titanite 2 geochronology results. a.) Photomicrograph of the grain, post-analysis, showing the laser ablation transect. b.) SEM BSE image showing the fine-scale textures of the grain, and approximate location of laser ablation pits c.) Standard U-Pb concordia diagram. Upper intercept at 4890±54 Ma.d.) Terra-Wasserburg U-Pb concordia diagram. Pb_c = 0.81. e.) Sm-Nd isochron diagram. f.) Zoning profiles of stable isotope ^{146}Nd volts (concentration), $^{147}Sm/^{144}Nd$ ratio, and $^{206}Pb/^{238}U$ ratio along the laser ablation transect.

Table 5.3a: U-Pb Geochronology Data

Grain/Analysis Number	$^{207}Pb/^{235}U$	±2σ %	$^{206}Pb/^{238}U$	±2σ%	Error Correlation	$^{206}Pb/^{238}U$	±2σ %	$^{207}Pb/^{206}Pb$	±2σ%	Error Correlation	$^{206}Pb/^{238}U$ Age (Ma)	±2σ	$^{207}Pb/^{235}U$ Age (Ma)	±2σ	$^{207}Pb/^{206}Pb$ Age (Ma)	±2σ
25- T1 - 1	1.625	0.050	0.0765	0.0019	0.67	13.08	0.33	0.1540	0.0037	0.29	475.0	12.0	980.0	20.0	2390.7	19.9
25- T1 - 2	1.709	0.053	0.0753	0.0019	0.37	13.28	0.34	0.1643	0.0039	0.18	468.0	11.0	1011.3	20.0	2500.7	35.6
25- T1 - 3	2.290	0.072	0.0801	0.0020	0.47	12.49	0.31	0.2072	0.0050	0.32	496.6	12.0	1208.1	22.0	2883.9	23.6
25- T1 - 4	2.695	0.083	0.0841	0.0021	0.52	11.89	0.30	0.2320	0.0055	0.57	520.4	13.0	1326.7	23.0	3065.8	14.2
25- T1 - 5	1.670	0.052	0.0746	0.0019	0.36	13.41	0.34	0.1620	0.0039	0.92	463.5	11.0	996.0	20.0	2477.1	6.0
25- T1 - 6	1.748	0.054	0.0750	0.0019	0.61	13.33	0.34	0.1690	0.0041	0.43	466.2	12.0	1025.8	20.0	2547.3	14.3
25- T1 - 7	1.891	0.059	0.0769	0.0020	0.53	13.01	0.34	0.1784	0.0044	0.91	477.4	12.0	1077.3	21.0	2638.1	6.9
25- T1 - 8	2.100	0.065	0.0786	0.0020	0.52	12.72	0.32	0.1934	0.0046	0.42	487.8	12.0	1148.6	21.0	2771.5	16.3
25- T1 - 9	1.678	0.052	0.0750	0.0019	0.51	13.34	0.34	0.1623	0.0039	0.50	466.1	12.0	999.6	20.0	2480.1	11.5
25- T1 - 10	1.943	0.062	0.0769	0.0020	0.46	13.01	0.34	0.1827	0.0045	0.17	477.2	12.0	1093.5	21.0	2677.5	45.3
25- T1 - 11	3.105	0.096	0.0876	0.0022	0.58	11.42	0.29	0.2570	0.0062	0.65	541.2	13.0	1433.3	24.0	3228.4	13.9
25- T1 - 12	2.729	0.084	0.0840	0.0021	0.55	11.91	0.30	0.2353	0.0056	0.55	519.8	13.0	1335.9	23.0	3088.7	14.8
25- T1 - 13	2.722	0.085	0.0839	0.0021	0.53	11.92	0.30	0.2344	0.0056	0.77	519.5	13.0	1333.5	23.0	3082.1	10.4
25- T1 - 14	3.107	0.096	0.0872	0.0022	0.47	11.47	0.29	0.2575	0.0062	0.51	538.9	13.0	1433.8	24.0	3231.5	18.0
25- T1 - 15	2.849	0.089	0.0851	0.0022	0.49	11.75	0.30	0.2434	0.0059	0.91	526.4	13.0	1367.4	23.0	3142.3	9.2
25- T2 - 1	3.716	0.120	0.0944	0.0024	0.55	10.59	0.27	0.2852	0.0068	0.28	581.5	14.0	1573.8	25.0	3391.8	38.1
25- T2 - 2	3.516	0.110	0.0913	0.0023	0.74	10.96	0.28	0.2804	0.0067	-0.11	562.9	14.0	1529.8	24.0	3365.2	-
25- T2 - 3	5.314	0.170	0.1081	0.0028	0.60	9.25	0.24	0.3655	0.0090	0.41	661.8	17.0	1870.6	27.0	3772.9	32.9
25- T2 - 4	2.938	0.093	0.0862	0.0022	0.49	11.61	0.30	0.2471	0.0060	0.26	532.7	13.0	1389.4	25.0	3166.3	36.3
25- T2 - 6	2.909	0.090	0.0857	0.0022	0.52	11.66	0.30	0.2458	0.0059	0.30	530.3	13.0	1383.7	23.0	3158.2	30.3
25- T2 - 7	3.276	0.100	0.0888	0.0023	0.29	11.26	0.29	0.2672	0.0064	0.96	548.3	13.0	1474.7	24.0	3289.7	9.4
25- T2 - 8	3.242	0.100	0.0880	0.0023	0.48	11.36	0.30	0.2669	0.0064	0.66	543.7	13.0	1467.2	24.0	3287.9	13.9
25- T2 - 9	2.854	0.091	0.0844	0.0022	0.41	11.85	0.31	0.2443	0.0060	0.61	522.3	13.0	1367.1	24.0	3148.2	14.3
25- T2 - 10	1.893	0.060	0.0760	0.0019	0.34	13.16	0.33	0.1804	0.0044	0.64	472.2	12.0	1078.0	21.0	2656.6	9.9
25- T2 - 11	2.110	0.066	0.0786	0.0020	0.46	12.73	0.32	0.1940	0.0047	0.36	487.5	12.0	1151.2	21.0	2776.6	19.8
25- T2 - 12	1.797	0.056	0.0752	0.0019	0.48	13.30	0.34	0.1729	0.0042	0.46	467.2	12.0	1044.8	20.0	2585.8	13.7
25- T2 - 13	2.103	0.069	0.0785	0.0020	0.79	12.74	0.32	0.1936	0.0048	-0.46	487.2	12.0	1146.1	21.0	2773.0	-
25- T2 - 14	2.023	0.063	0.0779	0.0020	0.39	12.83	0.33	0.1878	0.0045	0.92	484.0	12.0	1122.8	21.0	2723.3	6.9
25- T2 - 15	2.242	0.070	0.0798	0.0020	0.53	12.53	0.31	0.2038	0.0049	0.89	495.0	12.0	1194.7	22.0	2856.7	7.8
40- T2 - 1	2.949	0.095	0.0883	0.0023	0.84	11.32	0.29	0.2339	0.0058	-0.57	545.5	13.0	1391.0	24.0	3078.9	-
40- T2 - 2	7.355	0.240	0.1267	0.0033	0.69	7.89	0.21	0.4133	0.0100	-0.11	769.1	19.0	2153.3	29.0	3958.2	-
40- T2 - 3	3.518	0.120	0.0908	0.0023	0.75	11.01	0.28	0.2693	0.0070	-0.51	560.1	14.0	1523.0	26.0	3302.0	-
40- T2 - 4	2.747	0.092	0.0859	0.0022	0.55	11.64	0.30	0.2219	0.0056	-0.17	531.2	13.0	1334.6	24.0	2994.5	-
40- T2 - 5	4.039	0.130	0.0956	0.0025	0.51	10.46	0.27	0.2949	0.0072	0.35	588.3	15.0	1640.0	26.0	3443.6	31.3
40- T2 - 6	3.716	0.120	0.0936	0.0024	0.20	10.69	0.27	0.2737	0.0068	0.55	576.5	14.0	1572.3	25.0	3327.4	18.0
40- T2 - 7	3.986	0.120	0.0951	0.0024	0.37	10.52	0.27	0.2899	0.0070	0.58	585.4	14.0	1630.6	25.0	3417.1	17.5
40- T2 - 8	5.578	0.180	0.1082	0.0028	0.64	9.24	0.24	0.3556	0.0087	0.00	662.6	16.0	1910.6	27.0	3731.2	-
40- T2 - 9	4.539	0.150	0.1012	0.0026	0.48	9.88	0.25	0.3074	0.0077	0.17	621.3	15.0	1733.2	28.0	3507.9	76.7
40- T2 - 10	2.830	0.089	0.0857	0.0022	0.30	11.67	0.30	0.2274	0.0056	0.41	529.7	13.0	1362.5	23.0	3033.8	20.2
40- T2 - 11	9.596	0.310	0.1398	0.0038	0.42	7.15	0.19	0.4711	0.0120	0.60	843.1	22.0	2393.1	30.0	4153.2	29.2
40- T2 - 12	6.673	0.210	0.1156	0.0030	0.30	8.65	0.22	0.3951	0.0097	0.37	704.8	17.0	2067.8	27.0	3890.5	39.7
40- T2 - 13	11.270	0.390	0.1558	0.0045	0.50	6.42	0.19	0.5055	0.0130	0.43	934.0	24.0	2541.0	32.0	4257.3	45.5
40- T2 - 14	8.750	0.390	0.1365	0.0043	0.81	7.33	0.23	0.4428	0.0130	-0.37	824.0	24.0	2292.0	40.0	4061.2	-
40- T2 - 15	10.060	0.330	0.1413	0.0039	0.57	7.08	0.20	0.4854	0.0120	0.41	851.9	22.0	2435.0	31.0	4197.5	43.6
																-
40- T3 - 1	2.390	0.078	0.0793	0.0020	0.85	12.60	0.32	0.2171	0.0054	-0.55	492.1	12.0	1235.9	23.0	2959.3	-
40- T3 - 2	3.136	0.098	0.0893	0.0023	0.31	11.20	0.29	0.2557	0.0062	0.35	551.4	13.0	1441.2	24.0	3220.4	27.2
40- T3 - 3	4.008	0.130	0.0943	0.0024	0.72	10.60	0.27	0.3046	0.0076	-0.35	580.9	14.0	1630.3	27.0	3493.8	-
40- T3 - 4	9.088	0.290	0.1351	0.0036	0.73	7.40	0.20	0.4846	0.0120	0.31	816.4	20.0	2345.1	29.0	4195.0	58.9
40- T3 - 5	10.930	0.360	0.1463	0.0039	0.69	6.84	0.18	0.5282	0.0130	0.11	879.8	22.0	2513.0	31.0	4321.9	207.2
40- T3 - 6	11.747	0.370	0.1575	0.0041	0.45	6.35	0.17	0.5373	0.0130	0.27	942.5	23.0	2582.0	29.0	4347.0	74.7
40- T3 - 8	14.010	0.460	0.1800	0.0049	0.59	5.56	0.15	0.5759	0.0150	0.37	1066.0	27.0	2748.0	31.0	4448.3	61.4
40- T3 - 9	7.375	0.240	0.1250	0.0033	0.49	8.00	0.21	0.4313	0.0110	0.34	759.3	19.0	2155.6	28.0	4022.0	48.8
40- T3 - 10	3.520	0.110	0.0902	0.0023	0.42	11.09	0.28	0.2831	0.0071	0.20	556.4	14.0	1530.3	26.0	3380.1	57.2
40- T3 - 11	7.460	0.260	0.1233	0.0034	0.81	8.11	0.22	0.4274	0.0110	-0.34	749.3	19.0	2159.0	31.0	4008.4	-
40- T3 - 12	7.390	0.250	0.1218	0.0034	0.66	8.21	0.23	0.4263	0.0110	-0.21	740.3	19.0	2149.0	30.0	4004.5	-
40- T3 - 13	6.485	0.210	0.1110	0.0029	0.67	9.01	0.24	0.4105	0.0100	0.09	678.5	17.0	2040.9	28.0	3948.0	206.4
40- T3 - 14	11.987	0.380	0.1575	0.0041	0.51	6.35	0.17	0.5311	0.0130	0.46	942.3	23.0	2601.3	29.0	4329.9	41.7
40- T3 - 15	11.614	0.370	0.1585	0.0043	0.44	6.31	0.17	0.5272	0.0130	0.60	948.3	24.0	2572.7	29.0	4319.1	31.4

Continued →

Grain/Analysis Number	$^{207}Pb/^{235}U$	±2σ %	$^{206}Pb/^{238}U$	±2σ%	Error Correlation	$^{206}Pb/^{238}U$	±2σ %	$^{207}Pb/^{206}Pb$	±2σ%	Error Correlation	$^{206}Pb/^{238}U$ Age (Ma)	±2σ	$^{207}Pb/^{235}U$ Age (Ma)	±2σ	$^{207}Pb/^{206}Pb$ Age (Ma)	±2σ
72- T1 - 1	11.390	0.240	0.1585	0.0033	0.67	6.31	0.13	0.5224	0.0046	0.36	948.4	18.0	2554.0	20.0	4305.7	19.2
72- T1 - 2	3.216	0.065	0.0884	0.0017	0.46	11.31	0.22	0.2627	0.0019	0.26	546.0	9.9	1457.7	16.0	3263.0	11.3
72- T1 - 4	4.199	0.079	0.0946	0.0018	0.63	10.57	0.20	0.3215	0.0014	0.50	582.4	10.0	1672.7	15.0	3577.0	4.1
72- T1 - 5	5.012	0.093	0.1016	0.0019	0.56	9.85	0.18	0.3571	0.0016	0.52	623.5	11.0	1820.7	16.0	3737.6	4.6
72- T1 - 6	5.130	0.095	0.1018	0.0019	0.60	9.83	0.18	0.3651	0.0015	0.65	624.5	11.0	1840.3	16.0	3771.2	3.3
72- T1 - 7	4.639	0.086	0.0983	0.0018	0.59	10.17	0.19	0.3415	0.0015	0.54	604.4	11.0	1756.0	16.0	3669.5	4.1
72- T1 - 8	4.989	0.092	0.1008	0.0019	0.45	9.92	0.19	0.3584	0.0015	0.70	619.0	11.0	1816.7	16.0	3743.1	3.1
72- T1 - 9	4.846	0.090	0.0992	0.0018	0.65	10.08	0.18	0.3533	0.0013	0.51	609.6	11.0	1792.1	16.0	3721.3	3.7
72- T1 - 10	4.850	0.090	0.0994	0.0018	0.47	10.07	0.18	0.3539	0.0015	0.54	610.5	11.0	1793.2	16.0	3723.9	4.1
72- T1 - 11	4.818	0.090	0.0998	0.0019	0.66	10.02	0.19	0.3501	0.0014	0.50	612.9	11.0	1787.9	16.0	3707.4	4.1
72- T1 - 12	4.697	0.088	0.0981	0.0018	0.61	10.19	0.19	0.3464	0.0014	0.41	603.2	11.0	1765.7	16.0	3691.2	5.1
72- T1 - 13	5.983	0.120	0.1092	0.0021	0.62	9.15	0.18	0.3976	0.0021	0.32	668.2	12.0	1971.8	17.0	3900.0	10.3
72- T1 - 14	5.003	0.093	0.1002	0.0018	0.61	9.98	0.18	0.3612	0.0014	0.51	615.4	11.0	1819.1	16.0	3754.9	4.0
72- T1 - 15	10.487	0.210	0.1464	0.0028	0.72	6.83	0.13	0.5178	0.0026	0.21	880.6	15.0	2476.0	18.0	4292.7	20.5
72- T2-1 - 1	1.278	0.024	0.0737	0.0013	0.58	13.56	0.24	0.1254	0.0006	0.09	458.6	8.1	835.2	11.0	2034.9	13.3
72- T2-1 - 2	1.406	0.026	0.0742	0.0014	0.45	13.48	0.25	0.1372	0.0006	0.31	461.2	8.1	891.1	11.0	2192.0	3.1
72- T2-1 - 3	3.185	0.060	0.0886	0.0016	0.55	11.29	0.20	0.2602	0.0011	0.31	547.1	9.6	1452.6	14.0	3247.9	5.5
72- T2-1 - 4	2.054	0.039	0.0779	0.0014	0.39	12.84	0.23	0.1907	0.0012	0.19	483.6	8.5	1132.2	13.0	2748.2	10.1
72- T2-1 - 5	2.178	0.041	0.0796	0.0015	0.37	12.56	0.24	0.1980	0.0009	0.32	493.9	8.7	1173.4	13.0	2809.8	4.2
72- T2-1 - 6	2.220	0.042	0.0815	0.0015	0.40	12.26	0.23	0.1970	0.0009	0.30	505.3	8.9	1186.8	13.0	2801.6	4.6
72- T2-1 - 7	2.031	0.038	0.0790	0.0015	0.48	12.66	0.24	0.1862	0.0008	0.13	490.1	8.7	1125.2	13.0	2708.8	10.6
72- T2-1 - 8	3.060	0.061	0.0886	0.0016	0.63	11.29	0.20	0.2501	0.0017	-0.05	547.2	9.7	1421.0	15.0	3185.4	-
72- T2-1 - 9	2.158	0.041	0.0799	0.0015	0.67	12.52	0.24	0.1960	0.0010	-0.18	495.3	8.8	1166.5	13.0	2793.2	-
72- T2-1 - 10	2.651	0.050	0.0848	0.0016	0.37	11.79	0.22	0.2258	0.0011	0.24	524.7	9.4	1313.4	14.0	3022.5	7.2
72- T2-1 - 11	3.197	0.063	0.0880	0.0017	0.41	11.36	0.22	0.2632	0.0018	0.20	543.7	9.8	1454.5	15.0	3266.0	15.1
72- T2-1 - 12	3.158	0.066	0.0876	0.0017	0.65	11.42	0.22	0.2613	0.0019	0.06	541.1	10.0	1444.4	16.0	3254.6	72.0
72- T2-1 - 13	3.458	0.066	0.0904	0.0017	0.64	11.06	0.21	0.2770	0.0013	0.41	557.7	10.0	1516.9	15.0	3346.1	4.7
72- T2-1 - 14	2.764	0.052	0.0853	0.0016	0.60	11.72	0.22	0.2352	0.0012	0.19	527.5	9.4	1344.5	14.0	3087.8	10.2
72- T2-1 - 15	3.747	0.071	0.0924	0.0017	0.44	10.82	0.20	0.2939	0.0017	0.36	569.6	10.0	1580.1	15.0	3438.4	7.1
74- T1 - 1	15.300	0.560	0.2018	0.0056	0.95	4.96	0.14	0.5527	0.0062	-0.60	1183.0	30.0	2821.0	33.0	4388.3	-
74- T1 - 2	5.451	0.110	0.1094	0.0020	0.58	9.14	0.17	0.3619	0.0013	0.40	669.3	11.0	1891.9	17.0	3757.8	4.9
74- T1 - 3	6.644	0.140	0.1195	0.0022	0.69	8.37	0.15	0.4033	0.0018	0.06	728.0	12.0	2063.1	18.0	3921.4	61.6
74- T1 - 4	5.495	0.110	0.1104	0.0020	0.70	9.06	0.16	0.3613	0.0018	0.01	674.9	12.0	1897.5	18.0	3755.3	-
74- T1 - 5	2.380	0.055	0.0814	0.0015	0.53	12.29	0.23	0.2115	0.0020	-0.21	504.4	8.8	1231.6	16.0	2917.1	-
74- T1 - 6	5.359	0.110	0.1072	0.0019	0.62	9.33	0.17	0.3632	0.0012	0.42	656.2	11.0	1877.5	17.0	3763.3	4.2
74- T1 - 8	4.486	0.089	0.0981	0.0018	0.63	10.20	0.19	0.3320	0.0011	0.54	602.9	10.0	1728.0	17.0	3626.3	3.0
74- T1 - 9	4.518	0.091	0.0983	0.0018	0.65	10.17	0.19	0.3331	0.0013	0.46	604.5	10.0	1733.6	17.0	3631.4	4.2
74- T1 - 10	4.657	0.093	0.0992	0.0018	0.48	10.08	0.18	0.3406	0.0016	0.63	609.5	11.0	1758.9	17.0	3665.5	3.7
74- T1 - 11	4.565	0.092	0.0987	0.0018	0.43	10.14	0.18	0.3361	0.0016	0.54	606.6	11.0	1742.8	17.0	3645.1	4.3
74- T1 - 12	4.645	0.094	0.0999	0.0019	0.34	10.01	0.19	0.3375	0.0019	0.66	613.5	11.0	1756.5	17.0	3651.5	4.2
74- T1 - 13	5.333	0.110	0.1046	0.0022	0.56	9.56	0.20	0.3688	0.0033	0.47	641.1	13.0	1873.2	18.0	3786.5	10.4
74- T1 - 14	5.492	0.110	0.1048	0.0019	0.42	9.54	0.17	0.3790	0.0019	0.67	642.6	11.0	1898.2	17.0	3827.8	4.1
74- T1 - 15	5.649	0.110	0.1071	0.0019	0.55	9.34	0.17	0.3819	0.0018	0.30	655.7	11.0	1923.0	18.0	3839.3	9.4
74- T1 - 16	4.729	0.094	0.0988	0.0018	0.50	10.12	0.18	0.3462	0.0012	0.52	607.3	10.0	1771.8	17.0	3690.4	3.4
74- T1 - 17	5.910	0.170	0.1106	0.0023	0.96	9.04	0.19	0.3804	0.0042	-0.83	675.8	13.0	1941.0	25.0	3833.4	-
74- T1 - 18	4.946	0.098	0.1015	0.0018	0.64	9.85	0.17	0.3527	0.0011	0.47	623.0	11.0	1809.8	17.0	3718.7	3.5
74- T1 - 19	5.740	0.170	0.1067	0.0022	0.94	9.37	0.19	0.3866	0.0047	-0.80	653.3	13.0	1921.0	26.0	3857.8	-
74- T2 - 1	9.610	0.260	0.1454	0.0030	0.96	6.88	0.14	0.4734	0.0041	-0.79	874.5	17.0	2380.0	25.0	4160.4	-
74- T2 - 2	3.816	0.110	0.0940	0.0018	0.92	10.64	0.20	0.2910	0.0044	-0.80	578.9	11.0	1581.0	24.0	3423.0	-
74- T2 - 3	2.614	0.070	0.0829	0.0015	0.84	12.06	0.22	0.2284	0.0030	-0.59	513.5	9.2	1301.0	19.0	3040.9	-
74- T2 - 4	3.648	0.076	0.0924	0.0017	0.57	10.82	0.20	0.2860	0.0016	-0.02	569.6	9.8	1558.1	16.0	3396.0	-
74- T2 - 5	3.964	0.086	0.0941	0.0017	0.73	10.63	0.19	0.3046	0.0018	-0.35	579.8	9.9	1623.6	17.0	3493.8	-
74- T2 - 6	4.925	0.098	0.1012	0.0018	0.64	9.88	0.18	0.3532	0.0010	0.42	621.3	11.0	1806.4	17.0	3720.6	3.5
74- T2 - 7	5.355	0.110	0.1049	0.0019	0.75	9.53	0.17	0.3702	0.0011	0.06	643.2	11.0	1877.2	17.0	3792.2	42.7
74- T2 - 8	5.070	0.100	0.1029	0.0018	0.59	9.72	0.17	0.3569	0.0010	0.18	631.4	11.0	1830.4	17.0	3736.7	9.1
74- T2 - 9	6.319	0.140	0.1137	0.0021	0.86	8.80	0.16	0.4014	0.0022	-0.52	694.0	12.0	2015.5	19.0	3914.3	-
74- T2 - 10	5.633	0.110	0.1076	0.0019	0.34	9.29	0.16	0.3795	0.0011	0.47	658.9	11.0	1920.8	17.0	3829.8	3.5
74- T2 - 11	5.997	0.120	0.1109	0.0020	0.48	9.02	0.16	0.3918	0.0012	0.46	677.8	11.0	1974.6	18.0	3877.9	3.9
74- T2 - 12	2.003	0.041	0.0771	0.0014	0.07	12.98	0.24	0.1883	0.0010	0.44	478.6	8.2	1115.8	14.0	2727.4	3.4
74- T2 - 13	5.658	0.110	0.1080	0.0019	0.53	9.26	0.16	0.3793	0.0011	0.56	661.2	11.0	1924.8	17.0	3829.0	2.9
74- T2 - 14	5.954	0.120	0.1106	0.0020	0.61	9.04	0.16	0.3897	0.0011	0.45	676.3	11.0	1968.7	17.0	3869.8	3.7
74- T2 - 15	5.982	0.120	0.1107	0.0020	0.33	9.03	0.16	0.3914	0.0012	0.63	676.8	11.0	1973.1	17.0	3876.4	2.7

Table 5.3b: Sm-Nd Geochronology Data

Grain/Analysis Number	Duration(s)	TotalNdBeam	$^{147}Sm/^{144}Nd$	±2σ	$^{143}Nd/^{144}Nd$	±2σ	$^{145}Nd/^{144}Nd$	±2σ	$^{148}Nd/^{144}Nd$	±2σ	$^{150}Nd/^{144}Nd$	±2σ	Age (Ma)	$^{143}Nd/^{144}Nd$	$\varepsilon Nd_{(initial)}$	$\varepsilon Nd_{(present)}$	±2σ
25- T1 - 1	78	2.4	0.2395	0.0021	0.512215	0.000062	0.348393	0.000050	0.241639	0.000055	0.236453	0.000083	400	0.511588	-10.3	-8.1	1.2
25- T1 - 2	66	2.7	0.2332	0.0023	0.512207	0.000074	0.348389	0.000046	0.241614	0.000060	0.236453	0.000087	400	0.511596	-10.2	-8.3	1.4
25- T1 - 3	66	2.6	0.2100	0.0015	0.512118	0.000055	0.348402	0.000047	0.241629	0.000040	0.236477	0.000060	400	0.511568	-10.7	-10.0	1.1
25- T1 - 4	37	3.0	0.2081	0.0011	0.512170	0.000100	0.348379	0.000051	0.241533	0.000053	0.236411	0.000070	400	0.511625	-9.6	-9.0	2.0
25- T1 - 5	66	2.5	0.2145	0.0012	0.512159	0.000076	0.348357	0.000035	0.241613	0.000051	0.236451	0.000062	400	0.511597	-10.1	-9.2	1.5
25- T1 - 6	66	2.4	0.2145	0.0005	0.512187	0.000086	0.348381	0.000055	0.241605	0.000075	0.236478	0.000070	400	0.511625	-9.6	-8.6	1.7
25- T1 - 7	66	2.4	0.2188	0.0008	0.512150	0.000073	0.348373	0.000038	0.241586	0.000054	0.236478	0.000067	400	0.511577	-10.5	-9.4	1.4
25- T1 - 8	66	2.4	0.2247	0.0004	0.512218	0.000066	0.348388	0.000037	0.241592	0.000064	0.236521	0.000062	400	0.511629	-9.5	-8.0	1.3
25- T1 - 9	66	2.4	0.2267	0.0008	0.512213	0.000090	0.348389	0.000040	0.241623	0.000069	0.236482	0.000062	400	0.511619	-9.7	-8.1	1.8
25- T1 - 10	66	2.5	0.2297	0.0005	0.512277	0.000067	0.348413	0.000046	0.241611	0.000066	0.236501	0.000076	400	0.511675	-8.6	-6.9	1.3
25- T1 - 11	66	2.4	0.2327	0.0006	0.512187	0.000056	0.348396	0.000032	0.241614	0.000046	0.236499	0.000067	400	0.511578	-10.5	-8.6	1.1
25- T1 - 12	66	2.8	0.2302	0.0009	0.512202	0.000081	0.348385	0.000049	0.241568	0.000048	0.236449	0.000044	400	0.511599	-10.1	-8.3	1.6
25- T1 - 13	66	2.4	0.2296	0.0023	0.512223	0.000052	0.348402	0.000048	0.241517	0.000059	0.236401	0.000078	400	0.511622	-9.7	-7.9	1.0
25- T1 - 14	66	2.8	0.2378	0.0008	0.512203	0.000070	0.348384	0.000047	0.241572	0.000059	0.236434	0.000067	400	0.511580	-10.5	-8.3	1.4
25- T1 - 15	66	2.8	0.2408	0.0008	0.512220	0.000072	0.348410	0.000045	0.241639	0.000055	0.236511	0.000078	400	0.511589	-10.3	-8.0	1.4
25- T2 - 1	66	1.3	0.2819	0.0020	0.512342	0.000067	0.348336	0.000071	0.241570	0.000110	0.236520	0.000140	400	0.511604	-10.0	-5.6	1.3
25- T2 - 2	66	1.4	0.2834	0.0014	0.512371	0.000087	0.348422	0.000059	0.241586	0.000076	0.236540	0.000120	400	0.511629	-9.5	-5.1	1.7
25- T2 - 3	62	1.3	0.3500	0.0250	0.512620	0.000160	0.348399	0.000062	0.241620	0.000130	0.236490	0.000120	400	0.511703	-8.1	-0.2	3.1
25- T2 - 4	66	2.2	0.2215	0.0011	0.512207	0.000064	0.348406	0.000047	0.241608	0.000060	0.236441	0.000075	400	0.511627	-9.6	-8.3	1.3
25- T2 - 6	66	2.5	0.2121	0.0008	0.512155	0.000067	0.348384	0.000037	0.241514	0.000088	0.236328	0.000079	400	0.511600	-10.1	-9.3	1.3
25- T2 - 7	54	2.2	0.2142	0.0005	0.512167	0.000054	0.348377	0.000054	0.241579	0.000070	0.236523	0.000072	400	0.511606	-10.0	-9.0	1.1
25- T2 - 8	62	2.1	0.2147	0.0007	0.512170	0.000085	0.348401	0.000032	0.241597	0.000073	0.236495	0.000093	400	0.511608	-9.9	-9.0	1.7
25- T2 - 9	62	2.0	0.2144	0.0007	0.512231	0.000063	0.348422	0.000055	0.241550	0.000051	0.236519	0.000071	400	0.511669	-8.7	-7.8	1.2
25- T2 - 10	58	2.0	0.2199	0.0011	0.512206	0.000083	0.348430	0.000041	0.241576	0.000060	0.236457	0.000089	400	0.511630	-9.5	-8.3	1.6
25- T2 - 11	66	1.9	0.2261	0.0008	0.512234	0.000065	0.348388	0.000053	0.241540	0.000080	0.236325	0.000058	400	0.511642	-9.3	-7.7	1.3
25- T2 - 12	66	1.8	0.2253	0.0010	0.512280	0.000078	0.348366	0.000052	0.241630	0.000093	0.236500	0.000095	400	0.511690	-8.3	-6.8	1.5
25- T2 - 13	66	1.9	0.2280	0.0004	0.512230	0.000090	0.348441	0.000073	0.241574	0.000075	0.236450	0.000100	400	0.511633	-9.4	-7.8	1.8
25- T2 - 14	66	1.9	0.2286	0.0004	0.512194	0.000072	0.348410	0.000053	0.241635	0.000095	0.236536	0.000093	400	0.511595	-10.2	-8.5	1.4
25- T2 - 15	66	1.8	0.2305	0.0006	0.512179	0.000061	0.348350	0.000054	0.241608	0.000074	0.236478	0.000097	400	0.511575	-10.6	-8.8	1.2
40- T2 - 1	66	4.3	0.2666	0.0018	0.512391	0.000054	0.348402	0.000035	0.241576	0.000030	0.236431	0.000039	400	0.511693	-8.3	-4.7	1.1
40- T2 - 2	66	4.8	0.2541	0.0035	0.512332	0.000049	0.348397	0.000027	0.241560	0.000043	0.236443	0.000060	400	0.511666	-8.8	-5.8	1.0
40- T2 - 3	66	6.5	0.2422	0.0021	0.512330	0.000033	0.348412	0.000022	0.241559	0.000024	0.236433	0.000037	400	0.511696	-8.2	-5.9	0.6
40- T2 - 4	66	9.2	0.2344	0.0024	0.512283	0.000037	0.348401	0.000038	0.241577	0.000039	0.236447	0.000035	400	0.511669	-8.7	-6.8	0.7
40- T2 - 5	66	6.9	0.2537	0.0033	0.512383	0.000028	0.348385	0.000017	0.241556	0.000035	0.236466	0.000042	400	0.511718	-7.8	-4.8	0.5
40- T2 - 6	66	6.1	0.2361	0.0062	0.512317	0.000038	0.348405	0.000031	0.241546	0.000044	0.236404	0.000041	400	0.511699	-8.2	-6.1	0.7
40- T2 - 7	66	6.7	0.2400	0.0005	0.512315	0.000047	0.348441	0.000028	0.241557	0.000038	0.236403	0.000050	400	0.511686	-8.4	-6.1	0.9
40- T2 - 8	66	7.3	0.2485	0.0009	0.512307	0.000054	0.348443	0.000023	0.241555	0.000035	0.236419	0.000034	400	0.511656	-9.0	-6.3	1.1
40- T2 - 9	66	5.4	0.2391	0.0031	0.512304	0.000042	0.348401	0.000027	0.241570	0.000037	0.236423	0.000044	400	0.511678	-8.6	-6.4	0.8
40- T2 - 10	66	8.8	0.2517	0.0011	0.512298	0.000037	0.348431	0.000019	0.241584	0.000026	0.236469	0.000040	400	0.511639	-9.3	-6.5	0.7
40- T2 - 11	66	2.4	0.2510	0.0009	0.512267	0.000064	0.348411	0.000056	0.241592	0.000078	0.236433	0.000087	400	0.511610	-9.9	-7.1	1.3
40- T2 - 12	66	4.1	0.2602	0.0015	0.512283	0.000072	0.348413	0.000032	0.241594	0.000040	0.236442	0.000055	400	0.511601	-10.1	-6.8	1.4
40- T2 - 13	66	2.6	0.2543	0.0029	0.512375	0.000077	0.348422	0.000040	0.241579	0.000041	0.236330	0.000072	400	0.511709	-8.0	-5.0	1.5
40- T2 - 14	66	4.5	0.2712	0.0018	0.512342	0.000048	0.348426	0.000034	0.241607	0.000043	0.236447	0.000065	400	0.511632	-9.5	-5.6	0.9
40- T2 - 15	66	1.9	0.2547	0.0024	0.512325	0.000084	0.348476	0.000046	0.241641	0.000076	0.236466	0.000063	400	0.511658	-9.0	-5.9	1.6
40- T3 - 1	66	6.0	0.2734	0.0015	0.512486	0.000043	0.348406	0.000036	0.241561	0.000041	0.236416	0.000052	400	0.511770	-6.8	-2.8	0.8
40- T3 - 2	60	7.3	0.2728	0.0017	0.512429	0.000042	0.348413	0.000028	0.241567	0.000043	0.236424	0.000055	400	0.511714	-7.9	-3.9	0.8
40- T3 - 3	66	4.8	0.2352	0.0043	0.512313	0.000058	0.348434	0.000034	0.241624	0.000048	0.236441	0.000059	400	0.511697	-8.2	-6.2	1.1
40- T3 - 4	66	3.0	0.2439	0.0023	0.512345	0.000057	0.348404	0.000040	0.241590	0.000056	0.236474	0.000054	400	0.511706	-8.0	-5.6	1.1
40- T3 - 5	66	2.3	0.2381	0.0014	0.512290	0.000070	0.348391	0.000046	0.241590	0.000063	0.236506	0.000079	400	0.511666	-8.8	-6.6	1.4
40- T3 - 6	66	2.0	0.2309	0.0009	0.512289	0.000081	0.348478	0.000047	0.241575	0.000070	0.236481	0.000089	400	0.511684	-8.4	-6.7	1.6
40- T3 - 8	58	1.6	0.2236	0.0014	0.512200	0.000120	0.348480	0.000059	0.241623	0.000074	0.236480	0.000110	400	0.511614	-9.8	-8.4	2.3
40- T3 - 9	66	2.7	0.2258	0.0023	0.512225	0.000069	0.348449	0.000042	0.241614	0.000070	0.236493	0.000071	400	0.511634	-9.4	-7.9	1.3
40- T3 - 10	66	4.1	0.2214	0.0009	0.512279	0.000067	0.348437	0.000042	0.241533	0.000050	0.236496	0.000065	400	0.511699	-8.2	-6.8	1.3
40- T3 - 11	66	1.7	0.2207	0.0040	0.512259	0.000093	0.348424	0.000068	0.241550	0.000080	0.236378	0.000071	400	0.511681	-8.5	-7.2	1.8
40- T3 - 12	66	1.5	0.2149	0.0030	0.512170	0.000120	0.348411	0.000068	0.241709	0.000099	0.236490	0.000130	400	0.511607	-9.9	-9.0	2.3
40- T3 - 13	66	1.9	0.2182	0.0029	0.512245	0.000085	0.348398	0.000059	0.241605	0.000071	0.236515	0.000080	400	0.511673	-8.7	-7.5	1.7
40- T3 - 14	66	1.3	0.2148	0.0015	0.512145	0.000098	0.348382	0.000081	0.241504	0.000078	0.236400	0.000130	400	0.511582	-10.4	-9.5	1.9
40- T3 - 15	66	1.2	0.2188	0.0026	0.512180	0.000120	0.348356	0.000071	0.241613	0.000084	0.236420	0.000110	400	0.511607	-10.0	-8.8	2.3

Continued →

Grain/Analysis Number	Duration(s)	TotalNdBeam	$^{147}Sm/^{144}Nd$	±2σ %	$^{143}Nd/^{144}Nd$	±2σ %	$^{145}Nd/^{144}Nd$	2SE	$^{148}Nd/^{144}Nd$	±2σ %	$^{150}Nd/^{144}Nd$	±2σ %	Age (Ma)	$^{143}Nd/^{144}Nd$	$\varepsilon Nd_{(initial)}$	$\varepsilon Nd_{(present)}$	±2σ %
72- T1 - 1	67	2.3	0.2076	0.0040	0.512226	0.000070	0.348400	0.000037	0.241542	0.000050	0.236449	0.000062	400	0.511682	-8.5	-7.9	1.4
72- T1 - 2	66	2.7	0.1968	0.0010	0.512145	0.000073	0.348418	0.000039	0.241558	0.000056	0.236390	0.000073	400	0.511630	-9.5	-9.5	1.4
72- T1 - 4	66	2.9	0.2042	0.0007	0.512122	0.000061	0.348376	0.000043	0.241594	0.000038	0.236440	0.000057	400	0.511587	-10.3	-9.9	1.2
72- T1 - 5	66	3.1	0.2097	0.0008	0.512185	0.000055	0.348422	0.000041	0.241597	0.000048	0.236481	0.000056	400	0.511636	-9.4	-8.7	1.1
72- T1 - 6	66	3.4	0.2074	0.0008	0.512204	0.000058	0.348420	0.000040	0.241541	0.000050	0.236420	0.000050	400	0.511661	-8.9	-8.3	1.1
72- T1 - 7	66	3.4	0.2095	0.0008	0.512238	0.000057	0.348427	0.000041	0.241569	0.000041	0.236396	0.000046	400	0.511689	-8.3	-7.6	1.1
72- T1 - 8	66	3.4	0.2250	0.0008	0.512295	0.000044	0.348427	0.000026	0.241597	0.000058	0.236433	0.000074	400	0.511706	-8.0	-6.5	0.9
72- T1 - 9	66	3.8	0.2307	0.0008	0.512274	0.000057	0.348420	0.000032	0.241562	0.000038	0.236418	0.000044	400	0.511670	-8.7	-6.9	1.1
72- T1 - 10	66	3.9	0.2330	0.0009	0.512294	0.000066	0.348404	0.000029	0.241594	0.000048	0.236441	0.000056	400	0.511684	-8.5	-6.6	1.3
72- T1 - 11	66	4.2	0.2386	0.0008	0.512310	0.000045	0.348423	0.000037	0.241524	0.000057	0.236420	0.000054	400	0.511685	-8.4	-6.2	0.9
72- T1 - 12	66	4.9	0.2367	0.0008	0.512284	0.000052	0.348405	0.000034	0.241603	0.000039	0.236460	0.000061	400	0.511664	-8.8	-6.7	1.0
72- T1 - 13	66	4.1	0.2443	0.0010	0.512309	0.000050	0.348422	0.000029	0.241571	0.000047	0.236428	0.000062	400	0.511669	-8.7	-6.3	1.0
72- T1 - 14	66	3.8	0.2558	0.0010	0.512385	0.000061	0.348385	0.000032	0.241554	0.000037	0.236401	0.000036	400	0.511715	-7.8	-4.8	1.2
72- T1 - 15	66	3.7	0.2633	0.0020	0.512416	0.000071	0.348374	0.000032	0.241491	0.000058	0.236365	0.000073	400	0.511726	-7.6	-4.2	1.4
72- T2-1 - 1	66	3.2	0.2084	0.0006	0.512222	0.000074	0.348394	0.000043	0.241555	0.000041	0.236399	0.000068	400	0.511676	-8.6	-8.0	1.4
72- T2-1 - 2	66	3.1	0.2068	0.0007	0.512146	0.000062	0.348393	0.000049	0.241573	0.000042	0.236448	0.000053	400	0.511604	-10.0	-9.4	1.2
72- T2-1 - 3	66	2.5	0.1985	0.0012	0.512119	0.000056	0.348385	0.000043	0.241641	0.000051	0.236435	0.000055	400	0.511599	-10.1	-10.0	1.1
72- T2-1 - 4	66	2.1	0.2008	0.0013	0.512144	0.000087	0.348421	0.000053	0.241553	0.000060	0.236431	0.000076	400	0.511618	-9.7	-9.5	1.7
72- T2-1 - 5	66	2.1	0.2072	0.0010	0.512198	0.000068	0.348424	0.000049	0.241577	0.000058	0.236422	0.000063	400	0.511655	-9.0	-8.4	1.3
72- T2-1 - 6	67	2.3	0.2122	0.0009	0.512277	0.000069	0.348429	0.000059	0.241553	0.000066	0.236445	0.000079	400	0.511721	-7.7	-6.9	1.3
72- T2-1 - 7	66	2.2	0.2059	0.0009	0.512182	0.000074	0.348404	0.000048	0.241564	0.000064	0.236380	0.000100	400	0.511643	-9.3	-8.7	1.4
72- T2-1 - 8	66	2.1	0.2079	0.0005	0.512196	0.000066	0.348383	0.000053	0.241584	0.000076	0.236480	0.000100	400	0.511651	-9.1	-8.5	1.3
72- T2-1 - 9	66	2.1	0.2116	0.0009	0.512260	0.000100	0.348441	0.000046	0.241613	0.000081	0.236390	0.000088	400	0.511706	-8.0	-7.2	2.0
72- T2-1 - 10	66	2.0	0.2345	0.0013	0.512267	0.000089	0.348433	0.000054	0.241586	0.000091	0.236436	0.000086	400	0.511653	-9.1	-7.1	1.7
72- T2-1 - 11	66	1.9	0.2297	0.0013	0.512278	0.000087	0.348446	0.000055	0.241551	0.000066	0.236427	0.000075	400	0.511676	-8.6	-6.9	1.7
72- T2-1 - 12	66	2.2	0.2398	0.0026	0.512342	0.000066	0.348382	0.000051	0.241496	0.000066	0.236400	0.000110	400	0.511714	-7.9	-5.6	1.3
72- T2-1 - 13	66	1.8	0.2655	0.0019	0.512353	0.000082	0.348418	0.000045	0.241553	0.000064	0.236441	0.000089	400	0.511658	-9.0	-5.4	1.6
72- T2-1 - 14	66	2.1	0.2364	0.0022	0.512290	0.000085	0.348372	0.000045	0.241584	0.000059	0.236450	0.000081	400	0.511671	-8.7	-6.6	1.7
72- T2-1 - 15	66	1.9	0.2667	0.0028	0.512410	0.000079	0.348407	0.000054	0.241487	0.000079	0.236343	0.000092	400	0.511711	-7.9	-4.3	1.5
74- T1 - 1	66	2.2	0.2257	0.0006	0.512270	0.000077	0.348383	0.000044	0.241577	0.000058	0.236498	0.000075	400	0.511679	-8.5	-7.0	1.5
74- T1 - 2	66	3.9	0.1763	0.0002	0.512115	0.000039	0.348394	0.000046	0.241604	0.000042	0.236481	0.000076	400	0.511653	-9.1	-10.0	0.8
74- T1 - 3	66	3.9	0.2013	0.0021	0.512148	0.000063	0.348418	0.000041	0.241576	0.000046	0.236461	0.000070	400	0.511621	-9.7	-9.4	1.2
74- T1 - 4	66	4.5	0.2072	0.0007	0.512210	0.000050	0.348363	0.000038	0.241569	0.000049	0.236473	0.000039	400	0.511667	-8.8	-8.2	1.0
74- T1 - 5	66	6.2	0.2142	0.0005	0.512196	0.000044	0.348388	0.000023	0.241576	0.000030	0.236456	0.000035	400	0.511635	-9.4	-8.5	0.9
74- T1 - 6	66	6.1	0.2161	0.0005	0.512208	0.000044	0.348374	0.000032	0.241606	0.000036	0.236495	0.000045	400	0.511642	-9.3	-8.2	0.9
74- T1 - 8	66	7.7	0.2145	0.0004	0.512244	0.000040	0.348400	0.000026	0.241594	0.000034	0.236468	0.000035	400	0.511682	-8.5	-7.5	0.8
74- T1 - 9	66	7.5	0.2139	0.0004	0.512235	0.000032	0.348386	0.000018	0.241557	0.000036	0.236456	0.000035	400	0.511675	-8.6	-7.7	0.6
74- T1 - 10	66	7.7	0.2134	0.0004	0.512260	0.000031	0.348397	0.000025	0.241590	0.000033	0.236461	0.000049	400	0.511701	-8.1	-7.2	0.6
74- T1 - 11	66	7.4	0.2130	0.0003	0.512237	0.000035	0.348387	0.000017	0.241588	0.000039	0.236474	0.000041	400	0.511679	-8.5	-7.7	0.7
74- T1 - 12	66	7.5	0.2165	0.0003	0.512236	0.000035	0.348396	0.000024	0.241584	0.000029	0.236468	0.000034	400	0.511669	-8.7	-7.7	0.7
74- T1 - 13	66	5.5	0.2221	0.0003	0.512243	0.000051	0.348433	0.000033	0.241611	0.000045	0.236475	0.000047	400	0.511661	-8.9	-7.5	1.0
74- T1 - 14	66	5.2	0.2200	0.0004	0.512222	0.000043	0.348367	0.000039	0.241568	0.000048	0.236464	0.000048	400	0.511646	-9.2	-8.0	0.8
74- T1 - 15	66	4.9	0.2155	0.0005	0.512235	0.000042	0.348384	0.000026	0.241599	0.000046	0.236495	0.000041	400	0.511671	-8.7	-7.7	0.8
74- T1 - 16	66	4.6	0.2104	0.0006	0.512218	0.000041	0.348412	0.000025	0.241610	0.000035	0.236454	0.000047	400	0.511667	-8.8	-8.0	0.8
74- T1 - 17	66	4.8	0.2036	0.0011	0.512215	0.000052	0.348393	0.000028	0.241629	0.000041	0.236486	0.000057	400	0.511682	-8.5	-8.1	1.0
74- T1 - 18	66	4.6	0.2000	0.0005	0.512182	0.000037	0.348396	0.000033	0.241595	0.000049	0.236465	0.000049	400	0.511658	-9.0	-8.7	0.7
74- T1 - 19	66	4.0	0.1915	0.0011	0.512200	0.000061	0.348401	0.000024	0.241621	0.000049	0.236473	0.000047	400	0.511698	-8.2	-8.4	1.2
74- T2 - 1	66	2.6	0.2542	0.0029	0.512372	0.000070	0.348422	0.000033	0.241643	0.000064	0.236572	0.000067	400	0.511706	-8.0	-5.0	1.4
74- T2 - 2	66	3.0	0.2242	0.0013	0.512287	0.000063	0.348420	0.000024	0.241603	0.000069	0.236482	0.000073	400	0.511700	-8.1	-6.7	1.2
74- T2 - 3	66	3.0	0.2261	0.0011	0.512317	0.000059	0.348395	0.000035	0.241560	0.000053	0.236435	0.000071	400	0.511725	-7.7	-6.1	1.2
74- T2 - 4	66	2.7	0.2512	0.0009	0.512324	0.000055	0.348428	0.000039	0.241629	0.000044	0.236502	0.000062	400	0.511666	-8.8	-6.0	1.1
74- T2 - 5	66	4.5	0.2147	0.0005	0.512245	0.000050	0.348415	0.000023	0.241600	0.000036	0.236474	0.000053	400	0.511683	-8.5	-7.5	1.0
74- T2 - 6	66	5.0	0.2161	0.0005	0.512305	0.000065	0.348419	0.000026	0.241579	0.000051	0.236488	0.000064	400	0.511739	-7.4	-6.3	1.3
74- T2 - 7	66	5.9	0.2138	0.0005	0.512249	0.000044	0.348357	0.000028	0.241576	0.000033	0.236468	0.000029	400	0.511689	-8.4	-7.4	0.9
74- T2 - 8	66	5.8	0.2148	0.0007	0.512275	0.000034	0.348402	0.000024	0.241587	0.000047	0.236510	0.000055	400	0.511712	-7.9	-6.9	0.7
74- T2 - 9	66	4.2	0.2224	0.0003	0.512274	0.000054	0.348394	0.000033	0.241612	0.000052	0.236524	0.000053	400	0.511692	-8.3	-6.9	1.1
74- T2 - 10	66	3.7	0.2223	0.0005	0.512213	0.000058	0.348388	0.000042	0.241610	0.000053	0.236511	0.000054	400	0.511631	-9.5	-8.1	1.1
74- T2 - 11	66	3.6	0.2180	0.0007	0.512242	0.000055	0.348385	0.000027	0.241583	0.000036	0.236520	0.000061	400	0.511671	-8.7	-7.6	1.1
74- T2 - 12	66	3.7	0.2152	0.0003	0.512278	0.000055	0.348408	0.000037	0.241552	0.000035	0.236474	0.000069	400	0.511714	-7.9	-6.9	1.1
74- T2 - 13	66	3.4	0.2085	0.0006	0.512262	0.000060	0.348366	0.000043	0.241570	0.000058	0.236401	0.000080	400	0.511716	-7.8	-7.2	1.2
74- T2 - 14	66	3.3	0.2039	0.0006	0.512226	0.000055	0.348404	0.000027	0.241583	0.000057	0.236484	0.000064	400	0.511692	-8.3	-7.9	1.1
74- T2 - 15	66	3.1	0.1979	0.0006	0.512189	0.000065	0.348370	0.000030	0.241532	0.000049	0.236458	0.000065	400	0.511671	-8.7	-8.6	1.3

Compared to the preliminary petrographic and microprobe observations (Fig. 5.4) zoning appears to be less pronounced in the titanite grains mounted for geochronology (Fig 5.6b-13b). In part, this is likely due to a difference in instrumentation; zoning appears less distinct on the uncoated samples imaged by SEM than on carbon-coated samples imaged using an electron microprobe. Part of this may also be a result of sample selection; the large, prismatic, sub- to euhedral grains, with minimal evidence of breakdown to ilmenite selected for geochronological analysis were under-represented in the thin sections. Nonetheless, some degree of zoning can be observed in the SEM images in Figures 5.6b-13b, particularly in samples 40 and 74 which display prominent irregular and prismatic zoning respectively. In order to assess zoning quantitatively along core-to-rim or cross-grain laser ablation transects, a number of parameters, ^{146}Nd volts (concentration), ^{147}Sm/^{144}Nd ratio, and ^{206}Pb/^{238}U ratio are plotted in Figures 5.6f-13f. The ^{147}Sm/^{144}Nd and ^{206}Pb/^{238}U ratios were plotted to monitor age zoning, while the stable ^{146}Nd isotope was plotted as a general monitor of zoning in REEs. ^{147}Sm/^{144}Nd and ^{207}Pb/^{235}U ratios for all grains show relatively flat profiles, with the exception of a handful of outliers, such as ^{206}Pb/^{238}U in CB15-74 T1. The stable isotope ^{146}Nd shows greater variation, although no consistent zoning pattern appears. Both grains from CB15-72 look unzoned in BSE but show subtle core-to-rim zoning in ^{146}Nd with a decreasing concentration in T1, and a slight increase towards the core in T2. Both grains from CB15-25 have relatively smooth ^{146}Nd profiles, in contrast to CB15-40, which shows the most variation. This corresponds to the irregular zoning, with spots on higher brightness zones corresponding to higher ^{146}Nd concentrations. The ^{146}Nd concentration also follows the prismatic zoning in in both grains CB15-74 relatively closely, increasing from rim to core in the brighter zones, and then dropping off and decreasing towards the core once the zone boundary is crossed. These compositional changes may reflect primary igneous zoning.

Samples CB15-72, 40, and 74 all yielded one grain which records a significantly younger age, with differences of 14-25 Ma depending on which concordia ages are used for comparison. Whereas the CB15-40 and 74 ages agree within error between the two different grains, the differences were great enough to warrant reporting and displaying the age of each grain individually. For CB15-25 the difference in the ages is minimal, and a determination of which grain is older depends on whether the standard or inverse concordia age is used. Across the whole of the sample population, the recorded ages can be drawn into two distinct groups: an older population with ages of ~420 Ma comprising 40 T2 (422.2±7 Ma, MSWD = 1.3), and 72 T2 (419.5±5.9 Ma, MSWD = 1.5), and a younger population with ages ranging from ~405-395 Ma including 25 T1 (397.9±7.9 Ma, MSWD = 0.46), 25 T2 (407±10 Ma, MSWD = 0.49), 40 T3 (406±12 Ma, MSWD = 2.4), 72 T1 (394±13 Ma, MSWD = 3.1), 74 T1 (405±30 Ma, MSWD = 9.3), and 74 T2 (400±11 Ma, MSWD = 4.3).

Most Sm-Nd isochron ages agree within error of the U-Pb ages for their respective grains. These include grains CB15-25 T1 (419±110 Ma, MSWD = 0.96), 25 T2 (419±270 Ma, MSWD = 0.79), 40 T2 (253±260 Ma, MSWD = 2.1), 74 T1(437±130 Ma, MSWD = 0.87), and 74 T2 (361±160 Ma, MSWD = 0.96). Even with uncertainties of over 100 Ma however, three older Sm-Nd ages in grains 72 T1 (601±110 Ma, MSWD = 0.92), 72 T2 (559±140 Ma, MSWD = 0.97) and 40T3 (641±120 Ma, MSWD = 2.1) do not agree within error with U-Pb ages in the same grain. In contrast, $\varepsilon Nd_{(initial)}$ values for these titanite samples are relatively homogenous, with small errors. $\varepsilon Nd_{(initial)}$ values (Fig. 5.14) range from -6.8 (CB15-40 T3) to -10.8 (CB15-25 T2) with an average across all samples of -9.0 and an average error of ±1.3. These values clearly correspond to a crustal source (Fig. 5.14).

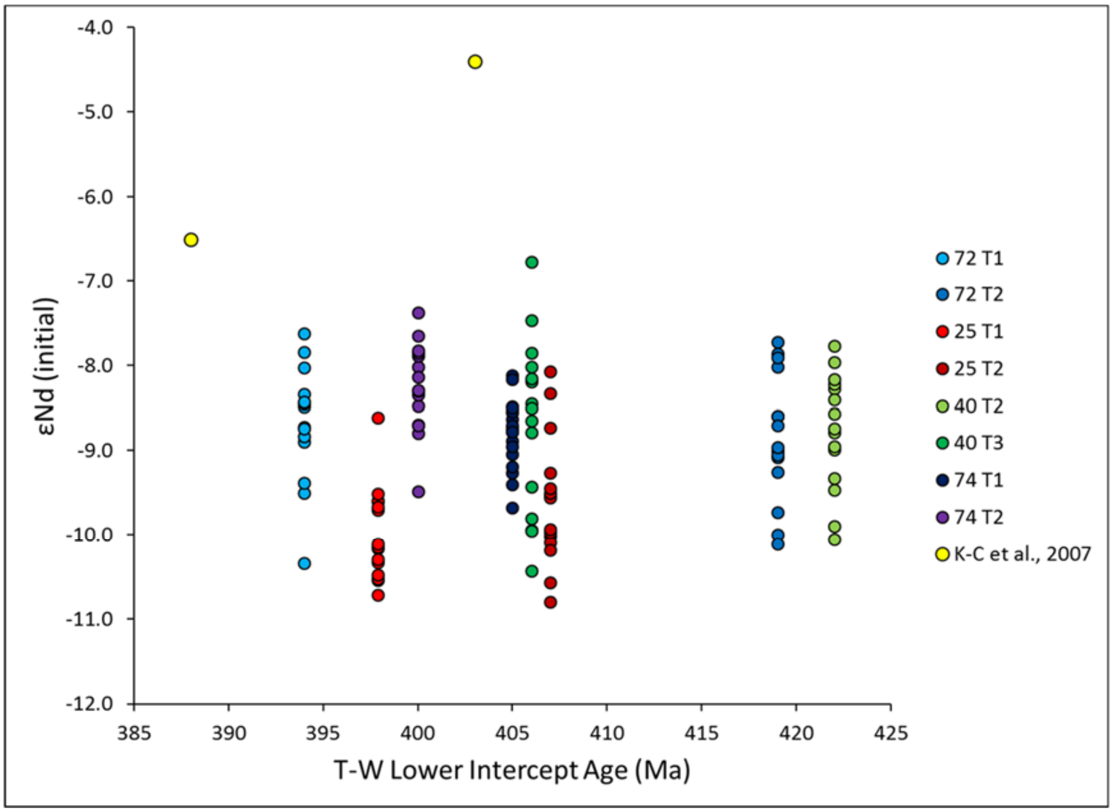


Figure 5.14: Titanite $\varepsilon Nd_{(initial)}$ vs. Age plot, showing the variation in $\varepsilon Nd_{(initial)}$ for each grain. Errors in both age and εNd are excluded for clarity and can be found in Table 5.3. Whole-rock eclogite εNd data from the islands of Vigra and Otrøy (Kylander-Clark *et al.*, 2007) are plotted for comparison.

5.4 Discussion

The age range of the titanites within these pegmatites spans several stages in the evolution of subducted Baltican crust (Hacker *et al.*, 2010; Krogh *et al.*, 2011; Spencer *et al.*, 2013), indicating a complex history. In order to understand the significance of ages from each individual grain and from the sample set as a whole, it is necessary to consider their field and petrographic relationships, and to compare them to ages in the literature. Each of the age populations will be dealt with in turn, from oldest to youngest, in order to piece together the history of these pegmatites within the broader tectonic evolution of the Nordøyane domain.

The older group of ages, from CB15-40 T2 (422.2±7 Ma, MSWD = 1.3), and CB15-72 T2 (419.5±5.9 Ma, MSWD = 1.5) are the most challenging to interpret. These grains record ages that either pre-date, or overlap with the earliest eclogite facies metamorphism recorded in the WGR (~415-400 Ma; Kylander-Clark *et al*., 2007; Krogh *et al*., 2011; Butler *et al*., 2016). However, the pegmatites cut amphibolite-facies foliations in the augen orthogneiss, and contain large, primary hornblende phenocrysts, both indicating that they crystallized post-eclogite facies conditions. One possible explanation is that these older grains are inherited. Several Type 1 pegmatites contain xenocrysts of clinopyroxene and garnet on their margins, likely derived from host eclogites. Although the eclogites have not (thus far) been found to contain titanites several augen gneiss samples have. Both pegmatites containing the oldest group of titanites are emplaced directly adjacent to augen gneiss which is locally cut by the granodiorite associated with Type 1 pegmatites. Therefore, if these grains are inherited, the augen gneiss may be the source. Spencer *et al*. (2013), in their regionally extensive 'campaign style' titanite dating study, reported titanites in basement gneisses with ages in the range of 400-420 Ma on the mainland southeast of Nordøyane; however, none have been reported from the UHP domain. In general, the titanite ages in the Nordøyane region increase westward with all previously dated titanites from the islands themselves recording ages of *ca.* 370-399 Ma (Tucker *et al.*, 1990; Tucker *et al.,* 2004; Spencer *et al.*, 2013).

The younger group of titanites, CB15-25 T1 (397.9±7.9 Ma), 25 T2 (407±10 Ma), 40 T3 (406±12 Ma), 72 T1 (394±13 Ma), 74 T1 (405±30 Ma), and 74 T2 (400±11 Ma), all overlap with eclogite-facies ages reported from Nordøyane. Therefore, one possibility is that, like the older population, they too could be inherited from an older source. All of these samples also agree within error with a broad range of amphibolite-facies ages from Nordøyane and elsewhere in the WGR. Most relevant are the zircon U-Pb ages from the Type 3 pegmatite (NW10-55) from Finnøya, dated by Gordon *et al*. (2013) at 396±2 Ma, and the late-stage-granitic pegmatites cutting eclogites on Flemsøya, dated by Krogh *et al*. (2011) at 396±4 Ma. Several titanites dated by Spencer *et al*. (2013) from other parts of Nordøyane also fall within this range, including those from a concordant plagioclase-hornblende pegmatite on Haramsøya (A0721A1), dated at 394.7±4.3 Ma, and a discordant pegmatite on Flemsøya (A07201E5), dated at 396±15 Ma. Taken in combination with the field and petrographic evidence, it is reasonable to conclude that these titanite ages represent a single group of crystallization ages from the early stages of the amphibolite-facies retrogression.

Compared to the U-Pb ages, Sm-Nd ages are too imprecise to be relied upon, or given serious weight for interpretation. The εNd values on the other hand provide valuable information on the possible source(s) of the partial melts which ultimately crystallized to form these pegmatites. As shown in Figure 5.14, these titanites have strongly negative εNd values, indicating depletion in the parent isotope ^{147}Sm. This rules out a mantle source for the melts, as the mantle would be relatively enriched in ^{147}Sm

(DePaulo and Wasserburg, 1976). Unfortunately, there are few εNd data in the literature for the Nordøyane UHP domain, either for the eclogites or the basement gneisses. The closest values that can be used for comparison are form eclogite whole rock analyses from the islands of Vigra and Otrøy (Kylander-Clark *et al.*, 2007), outside the Nordøyane domain but close to its boundaries. Corrected for an age of *ca.* 400 Ma, the εNd values for these rocks are -6.5 and -4.4 respectively, within error of, or less depleted than, the values for the titanites of this study. It should be noted that the data from Kylander-Clark *et al.*, (2007) are derived from whole-rock analysis, rather than data from a single mineral. Titanite would likely have a more negative εNd than whole-rock values due to partitioning of Sm and Nd between different phases in the rock. If rocks with this εNd signature were the protoliths for the melts from which the scapolite pegmatites crystallized, the pegmatites should have more depleted εNd values, as observed here. However, given the very long half life of ^{147}Sm, over as short a period of time as ~400 Ma little difference would have developed between the partial melt and the parent rock. Assuming other eclogites in Nordøyane have similar εNd values to those on Vigra and Otrøy, they could be a possible source for the melts, although a more depleted source is also possible.

The homogeneity of the U-Pb and Sm-Nd ratios along laser ablation grain transects, and the fact that no transect encountered more than a single age population in any of the 8 grains, is interpreted to indicate that on the scale of individual grains the compositional zoning seen in these samples does not reflect multiple growth ages. As seen in both the EPMA and LASS data, zoning largely reflects minor changes in major element (Al and Ti) and HREE content, and does not record significantly different ages of crystallization. There also seems to be no systematic age distinction between the prismatic and irregular zoned grains. Why some grains show prismatic zoning and others do not is unclear. Evidence of local titanite breakdown to ilmenite+plagioclase indicates that these rocks crossed from the titanite into the ilmenite stability field (Spencer *et al*., 2013), but that the reaction did not go to completion. The implications of this are discussed further in Ch. 6.

5.5 Conclusions

Several important conclusions can be drawn from the U-Pb and Sm-Nd data. The majority of titanite U-Pb ages, supported by field, petrographic, and geochemical information, indicates that the titanites in these pegmatites crystallized during the early amphibolite-facies stages of exhumation and retrogression. However, given the presence of a handful of both older grains, neither titanite inheritance, nor prolonged crystallization of titanite over a period of several million years can be ruled out. Although the stable isotope data presented in Ch. 4 indicate that the fluids which carried the volatiles related to scapolite crystallization came from the mantle, the evidence for titanite inheritance and the εNd data presented here indicate that the melts themselves were derived from crustal rocks.

Chapter 6: Discussion and Conclusions

6.1 Discussion

The observations and data presented here have a range of implications for the history of the Nordøyane domain, and the WGR as a whole. The mantle C and S signatures of Nordøyane scapolite (Ch. 4), as well as the calcite, barite and pyrite discovered in (U)HP eclogites (Ch. 3) provide evidence for the presence of C- and S-bearing fluids at depth, as proposed by advocates of the hypothesis that melting at UHP conditions triggered plume-style exhumation (Labrousse *et al*., 2011, Ganzhorn *et al*., 2014). However, in the absence (so far) of clear textural evidence for the presence of melt in UHP assemblages, the data presented here neither preclude nor confirm that fluid-present melting occurred at peak UHP conditions.

While isotopic evidence suggests the fluids were of mantle origin, the question of when they infiltrated the Nordøyane crust is open to debate. Furthermore, the introduction of mantle fluids to the rocks of the Nordøyane domain at some stage during the subduction-exhumation cycle does not change the fact that geodynamic models of plume-style exhumation poorly replicate the observed field relationships in the WGR compared to exhumation by extension during plate divergence (Butler *et al*., 2015). Therefore, further speculation on how mantle fluids were introduced to the Nordøyane basement is based on the models of Butler *et al*. (2015).

Although there is insufficient evidence to form conclusions on the timing and mechanism of fluid introduction at this stage, it is possible to form a working hypothesis based on what is currently known (Fig. 6.1). Pegmatite crystallization at ~395 Ma indicates that mantle fluids must have infiltrated the crust in Nordøyane at or prior to that time. Butler *et al*. (2015) model results (Fig. 6.1a) indicate that material streaming off the downgoing oceanic crustal slab could have been underplated at the base of the Laurentian lithospheric mantle. This material must have included some fluid, which could have hydrated and/or metasomatized the mantle lithosphere. This could have taken place during the earlier subduction of the Iapetus oceanic crust or during the collisional Scandian phase. That the isotope data indicate a mantle, rather than an oceanic crustal signature suggests that this process likely happened earlier rather than later, as this would have given the fluids more time to acquire a mantle signature. Alternately, metasomatism of the Laurentian lithospheric mantle could have been unrelated to Caledonian subduction, with fluids related to earlier mantle metasomatism. Whatever the case, fluids from the Laurentian lithospheric mantle could have infiltrated Baltican crust while the two were juxtaposed during subduction. This could have taken place either during the apparent prolonged period of residence of the crust at UHP conditions (Butler *et al.*,2016; Fig. 6.1b) between ~415-400 Ma following the collision between Laurentia and Baltica, or during the early stages of extension and exhumation (Fig 6.1c). Mantle xenoliths, such as the Kvalvika mantle peridotite on Flemsøya (Terry *et al.* 2005), were also entrained in the crust during subduction and exhumation. If peridotite fragments contained fluids, their dehydration through interaction with the crust may also have provided the necessary fluids.

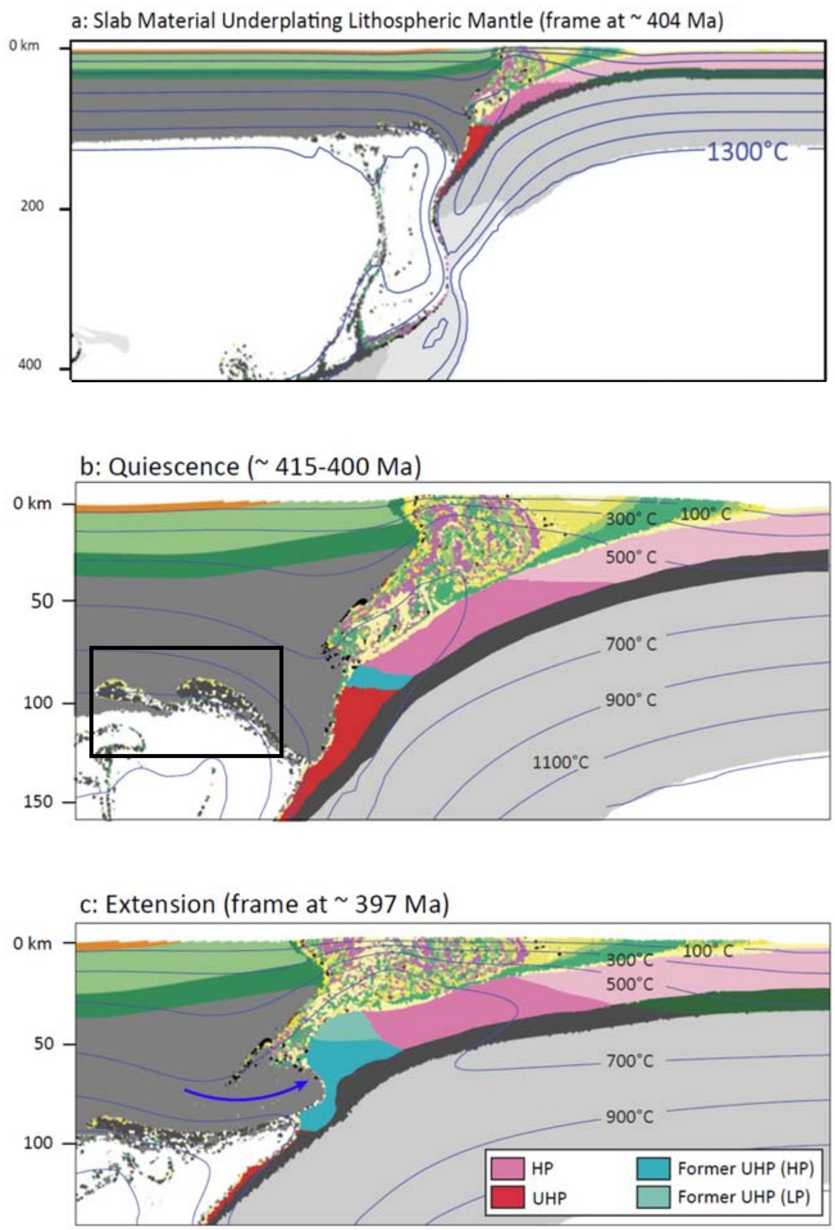


Figure 6.1: Conceptual model for the introduction of mantle fluids to (U)HP crust in Nordøyane, based on the geodynamic models of Butler *et al*. (2015). Frames a, b, and c are simplified from the f50 model presented by Butler *et al*. (2015), modeling exhumation by extension during plate divergence. A) Underplating of Laurentian lithospheric mantle (dark grey, left) by material from the down-going slab (highlighted by the black box in 6.1b). Metasomatism of Baltican crust by mantle fluids (blue arrow) could have occurred during b) the post-collision 'quiescence period' (a phase of the model used to approximate the transition between transpression and transtension, when velocity was ~ 0), or c) the early stages of exhumation.

Although C and S stable isotope signatures indicate a mantle fluid source, the $\delta^{18}O$ of scapolite and εNd values of titanite in Type 1 pegmatites both have a crustal signature. This suggests that mantle fluids promoted melting of crustal rocks. Whether melting took place at UHP conditions or during decompression is unclear based on current evidence. Melting models (Butler *et al*., 2015) suggest that melting was more likely during decompression, although independent evidence is necessary to prove this one way or the other. Zircon geochronology and geochemistry may help in constraining the timing of melting, as the presence of igneous zircon with ages of ≥ 404 Ma (the age of the Harøya coesite-eclogite; Butler *et al*., 2016) could indicate melting at UHP conditions. The two titanite grains (72 T2 and 40 T2) which have ages of *ca.* 420 Ma agree within uncertainty with the age range of UHP metamorphism, and could be linked to UHP melting. However, these ages also overlap with monazite ages (*ca.* 440-415 Ma) from the Blåhø Nappe which record early-Scandian prograde metamorphism (Steenkamp, 2012); If the older titanites are inherited, they may also record early metamorphism. The eclogites with which the pegmatites share a close field assocition have not (so far) been found to contain titanite. However, titanites have been found in several samples of augen gneiss, which are locally cut by the granodiorites from which the Type 1 pegmatites are interpreted to have crystallized as a late-stage differentiate. As eclogite xenocrysts are abundant in both granodiorites and pegmatites, it is reasonable to suggest that they could both also contain xenocrysts from other adjacent rock types.

In addition to the mechanism of fluid transfer from the mantle to subducted crust, a number of other questions remain about the petrogenesis of the scapolite-bearing pegmatites. Scapolite is more common as a metamorphic mineral (Hoefs *et al.*, 1981, Yoshino and Sattish-Kumar, 2001) or a metasomatic mineral replacing feldspar (Moecher *et al.*, 1991, Engvik *et al.*, 2014), than as a primary igneous mineral like the scapolite in the Nordøyane pegmatites and leucosomes. Literature examples of primary scapolite pegmatites include gemstone-rich tourmaline+topaz+marialite examples in granitic rocks from the Muzkol-Rangkul' anticlinorium in the Pamir Mountains of Tajikistan (Skrigitil', 1996), and a REE-rich tourmaline+spodumene+meionite pegmatite from the Sangilen Upland of Tuva, Russia (Kuznetsova *et al.*, 2011), neither of which remotely resembles the pegmatites in the WGR. Another pegmatite, in granitic rocks from the Inner Piedmont Belt of South Carolina, contains the assemblage plagioclase+ biotite+quartz+microcline+ scapolite+tourmaline+epidote+hornblende (Mittwede, 1994). Scapolite compositions in this pegmatite (Me_{59-70}) are similar to those of Type 1 pegmatites, with high CO_3 and SO_4 and minor Cl. Mittwede (1994) was unable to reach firm conclusions about the origin of either the melt from which the pegmatite crystalized or the volatiles, suggesting 1) interaction between the melt and carbonate rocks, 2) a deep crustal magmatic source enriched in CO_2 and SO_3, or 3) interaction between the melt and paleoevaporites.

Several features of the mineralogy of the pegmatites give some clues as to the nature of the melts from which they crystallized. The high Ca-content of scapolite, as well as the presence of other high-Ca phases (intermediate plagioclase, hornblende, titanite, apatite) in these rocks, indicates that the melts from which these pegmatites (and by extension the granodiorites) crystallized from were calcic (Ca>Na+K). As Na and K are more incompatible than Ca, this would suggest a high degree of partial melting of a calcic protolith. Partial melting experiments conducted by Auzanneau *et al*. (2006) using metagreywacke as an analog for a generalized WGR bulk composition produced the model decompression melting reaction: Phe + CPx + Qtz = Bt + Plg + Grt + melt (Fig. 6.2). While there is no evidence from this study to say that this reaction took place in any of the rocks described herein, it does suggest the possibility that residual phases in the protolith, or produced as part of a melting reaction (such as the biotite and plagioclase produced in the Auzanneau *et al.*, 2006 reaction) could have served as a 'sink' for some of the alkalis. The partial melting experiments of Labrousse *et al*. (2011; Schmidt *et al.* 2004; Auzanneau *et al.*, 2006; Herman and Spandler, 2008) found that the modal proportions of Ab, An and Or in leucosomes depend on P and T. The most calcic leucosomes (close to granodiorite in composition) were produced at P-T conditions of *ca.* 2.5 GPa and 800 °C (Labrousse *et al*., 2011). This may indicate that the calcic melts from which the pegmatites crystallized formed at similar, elevated P-T conditions.

These pegmatites contain both sulphate (in scapolite) and sulfides (pyrite or chalcopyrite inclusions), perhaps indicating a particular set of fO_2 conditions near the sulphide/sulphate redox boundary, like those of the Mount Pinatubo magma which contained both primary anhydrite and pyrrhotite (Hattori, 1997; Luhr, 2008). The high concentration of sulphur-bearing phases in these pegmatites also suggests that the partial melting was initiated at relatively high pressure. Partial melting experiments on basaltic and pelitic lithologies by Prouteau and Scaillet (2013) at 2-3 GPa and 700-950 °C indicated that hydrous silicic melts can contain as much as 20 times more dissolved sulphur (up to 1 wt%) than lower pressure (0.2-0.4 GPa) partial melts. The increased solubility of S in melt at (U)HP, suggests that scapolite would have crystallized along the decompression path, as a result of S solubility decreasing at lower pressure conditions.

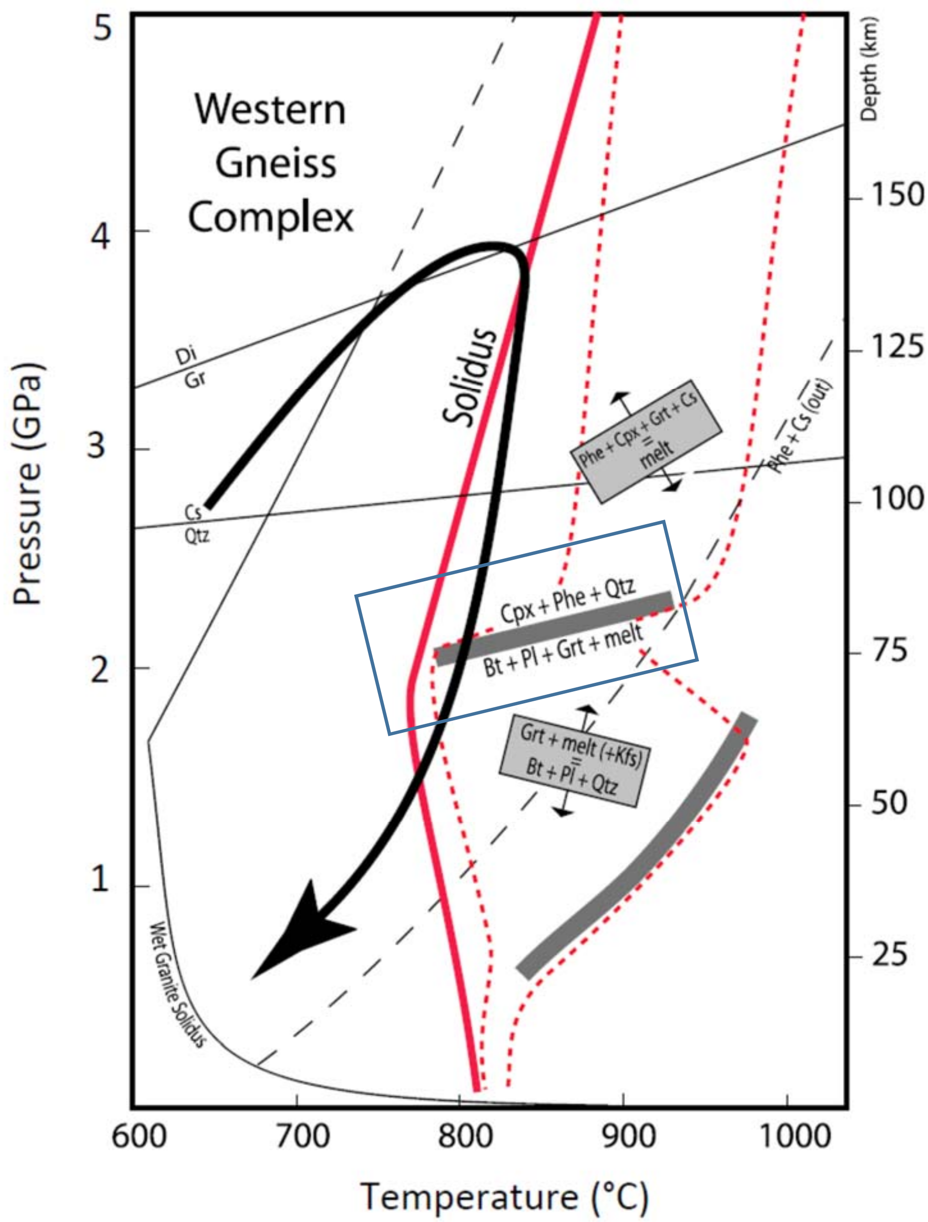


Figure 6.2: Experimentally determined melting reactions for metagreywacke (used as a proxy for WGR crust) from Auzanneau *et al*. (2006). This figure shows the PTt path determined for the Fjørtoft kyanite-eclogite (Terry *et al.*, 2000b) and an experimental low H_2O activity fluid-present solidus for metagreywacke as well as several possible melting reactions. The path crosses the reaction Phe + Cpx + Qtz = Bt + Plg + Grt + melt during decompression (outlined in blue).

While their ultimate origin remains enigmatic, several constraints can be placed on the P-T history of the Type 1 pegmatites. Geothermometry results from Zr-in-titanite are consistent between the two samples analyzed, and agree within error with the results from the hornblende-plagioclase thermometer. Together, these indicate that the Type 1 pegmatites crystallized at *ca.* 750 °C. These data are compatible with the P-T path worked out by Butler *et al.* (2013) from the coesite-eclogite on Harøya. The 813 °C T reported by Butler *et al.* (2013) is higher than that recorded here, and was noted as being within the P-T range of water-saturated partial melting. Therefore, a crystallization temperature of *ca.* 750 °C at a similar or lower pressure seems reasonable. Although the two-feldspar thermometer results are less consistent between the two samples analyzed, they are consistent with the low-pressure cooling portions of the PTt path determined by Butler *et al.* (2013) for Harøya. The partially completed sub-solidus breakdown reaction of titanite to ilmenite+plagioclase+quartz±hornblende also provides further constraints on the P-T path of these rocks. Other titanites within the WGR have been found to display similar incomplete reaction textures, as a result of the transition from rutile to ilmenite, and then from the ilmenite to titianite stability fields during cooling and decompression (Spencer *et al*., 2013). Assuming a similar P-T-t path for Harøya and the present study area, these rocks would have entered the ilmenite stability field at a T of *ca.* 750 °C based on Zr-in-titanite thermometry. As this is a sub-solidus reaction, that would imply melt was present at P > 1.0 GPa (Fig. 6.3).

The mineralogical similarities and field association between Type 1 pegmatites and the granodiorite is also crucial to interpreting the origin of the pegmatites. Although the crystallization of the granodiorite has yet to be dated, the field relationships (cutting amphibolite-facies fabrics in adjacent augen gneisses) suggest a broadly similar age to the pegmatites. Although different in their proportions and compositions, both the granodiorite and Type 1 pegmatites crystallized a very similar

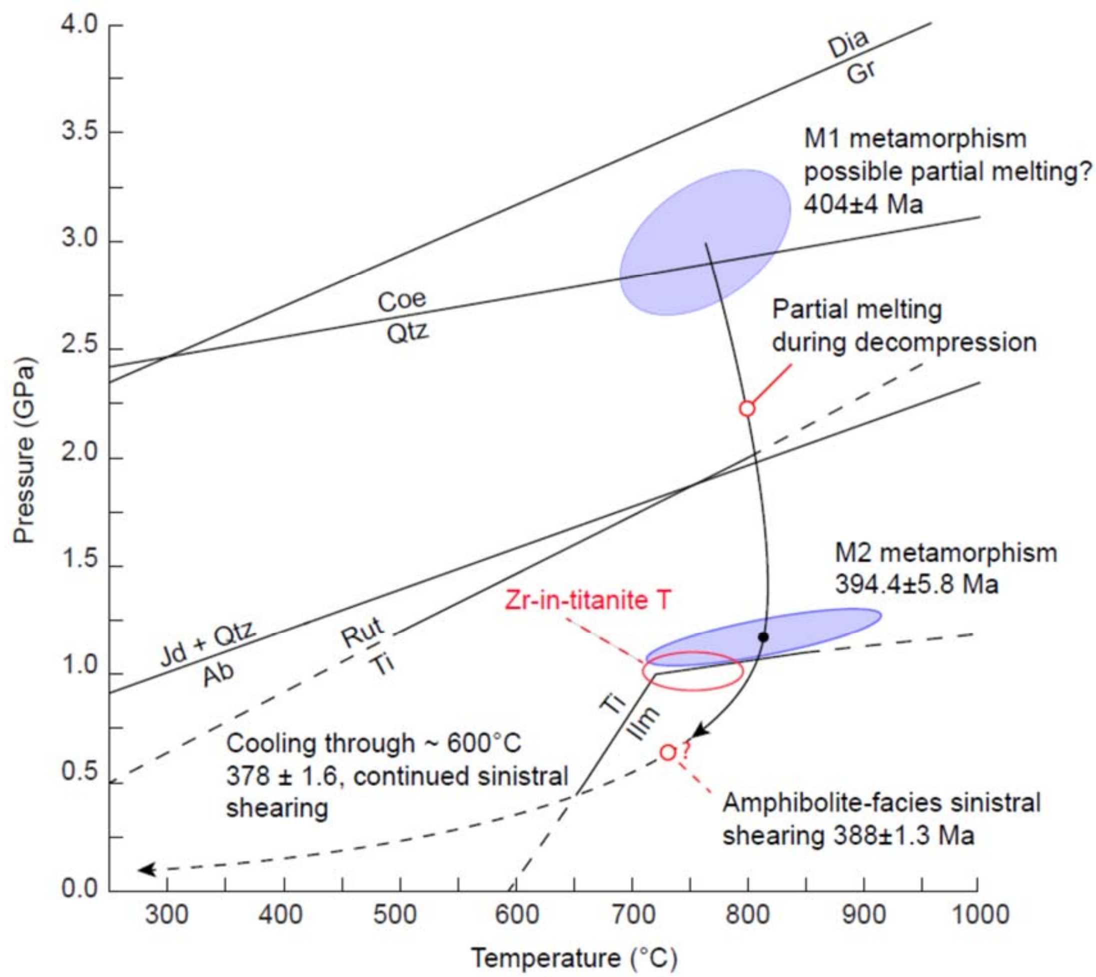


Figure 6.3: P-T-t path of the Harøya coesite-eclogite (Butler *et al*., in prep., 2013) superimposed on rutile-titanite-ilmenite stability fields (Spencer *et al.*, 2013). As part of the Nordøyane UHP domain, the samples presented here likely followed a similar P-T-t path. The decompression path of this sample crosses from the titanite stability field into the ilmenite stability field at *ca.* 800 °C and 1.0 GPa. The range of Zr-in-titanite T data from this study is outlined in red.

assemblage of minerals: hornblende+plagioclase+K-feldspar+biotite+quartz+scapolite. Scapolite in the granodiorite reaches more calcic compositions than in the pegmatites (up to Me_{83} relative to Me_{75}), and pegmatites contain higher concentrations of volatile-rich scapolite and quartz, as would be expected for a late-stage differentiate of the main granodiorite melt. Whereas there is evidence to suggest that Type 1 pegmatites are derived from the main granodiorite melt, the origins of the granodiorite remain an open question.

6.2 Future Work

The relatively widespread presence of scapolite in the portions of the Nordøyane UHP domain covered here has several implications beyond the immediate study areas. Although both Ulla Fyr and the mapped portion of Flemsøya had been covered by previous studies (Terry and Robinson, 2003, 2004; Krogh *et al.*, 2011) the scapolite-bearing pegmatites and leucosomes were only discovered by a targeted search. Searching for scapolite-bearing pegmatites and leucosomes in other parts of the Nordøyane domain, particularly in low-strain areas like those discussed here, could help to document their distribution and provide further targets for geochemistry and geochronology work to test and refine the conclusions presented here. A search for scapolite in Scandian leucosomes and pegmatites in the Sørøyane and Nordfjord-Stadlandet UHP domains could also help to clarify whether scapolite crystallization was a widespread phenomenon throughout the WGR or localized only to Nordøyane. Further study of the Kvalvika mantle peridotite (Terry *et al.*, 2005), located approximately ~ 1 km away from the Flemsøya map area could also shed light on the origin, presence, composition and transfer mechanism of mantle fluids related to scapolite.

Scapolite pegmatites represent a small part of a larger story that includes the host granodiorite and associated eclogites. Therefore, further work remains to be done in order to answer outstanding questions about the origin of these rocks, and their significance to the Scandian history of the WGR. Investigation of eclogite-facies mineral assemblages, particularly garnets, for polycrystalline (former melt) inclusions and related textures could shed light on the question of the timing of melting relative to UHP metamorphism. Given the level of contamination of the granodiorite by eclogite xenoliths/xenocrysts, textural and modal compositional analysis could help to determine the original composition of the melt from which the granodiorite crystallized. Modeling and/or partial melting experiments, similar to those of Labrousse *et al*. (2011), could then be used to constrain possible protoliths for a partial melt of this original composition. Geochronological and geochemical work on zircons in the pegmatites, and comparing the results to the titanites studied here and other zircons from eclogites in Nordøyane, will also help to understand the metamorphic, melting, and crystallization history of the pegmatites and their parent rocks. This work is in progress but could not be completed before the thesis was submitted owing to instrument problems at the University of Alberta.

Identification and stable isotope analysis of carbonate, sulphide, and sulphate minerals in both scapolite pegmatites and eclogites could also shed further light on the source of volatiles in this system. Comparing isotopic compositions from these minerals with those obtained from scapolite may either support or refute the hypothesis advanced here that the C and S in the system were mantle-derived. Knowing the isotopic compositions of calcite or pyrite coexisting with scapolite could also provide some controls on inter-species isotopic fractionation, and help in modeling fluid-rock interactions. Furthermore, scapolite in supracrustal amphibolite gneisses of the Blåhø Nappe on Harøya and Finnøya (Steenkamp, 2012) requires further study to determine whether or not it is related to the scapolite in the basement rocks. Looking for, and analysing, fluid inclusions in scapolite or other pegmatite minerals would provide another avenue to investigate the composition of fluids related to scapolite formation, as well as any late stage brines, such as those speculated to have altered the Type 2 pegmatites.

6.3 Conclusions

(1) Two types of scapolite pegmatites were identified and mapped within the study area, with a third type identified on the island of Finnøya.

(2) In all examples encountered, the most abundant Type 1 pegmatites showed a field association with granodioritic rocks, which are themselves invariably associated with eclogites. These granodiorites cut amphibolite-facies fabrics in adjacent basement gneisses, and intrude numerous eclogite bodies. The granodiorites must have formed by the partial melting of an as yet undetermined (likely crustal) protolith. The pegmatites, which are typically concentrated in low-strain areas such as boudin necks, are interpreted to be a late-stage differentiate of the granodiorites.

(3) Type 1 pegmatites crystallized at a T of *ca.* 750 °C, assuming a P of 1.0 GPa consistent with the retrograde amphibolite-facies conditions during exhumation (Auzanneau *et al*., 2006; Butler *et al*., 2013). Sub-solvus exsolution of K-felspar from plagioclase took place over a T range of *ca.* 600-450 °C (assuming P between 0.5-1.0 GPa).

(4) Scapolites from Type 1, 2 and 3 pegmatites, as well as various basement leucosomes, all share similar $\delta^{13}C$, $\delta^{34}S$ and $\delta^{18}O$ compositions, interpreted to indicate a common source of volatiles. Comparison with other scapolite isotopic compositions from a range of geologic settings, and typical values for possible volatile sources, indicate a mantle fluid source for the C and S in Nordøyane scapolite. The same analysis has ruled out the supracrustal marbles of the Blåhø Nappe as a source for fluids.

(5) Type 1 pegmatites crystallized at ~ 395 Ma under amphibolite-facies conditions, at the same time as the previously dated Type 3 pegmatites (396±2 Ma; Gordon *et al*., 2013). An older ~ 420 Ma subpopulation of titanites is interpreted as inherited, most likely from adjacent basement gneisses where titanite is abundant.

(6) Type 2 pegmatites show recrystallization textures, pervasive alteration, and Na + Cl enrichment in the rims of scapolite grains. Based on the similarity in isotope chemistry between all scapolite types, we speculate that the Type 2 pegmatites were once part of the same suite of pegmatites as Types 1 and 3, but were altered at some stage by Na+K+Cl-rich brines.

(7) Scapolite pegmatites crystallized from crustally-derived melts, based on scapolite $\delta^{18}O$ and titanite εNd values. This suggests that the introduction of mantle fluids promoted melting of crustal rocks.

(8) Mantle fluids could have interacted with subducted Baltican continental crust during the prolonged post-collisional residence time at UHP conditions (*ca.* 415-400 Ma), or in the early stages of extension and exhumation (*ca.* 399-395 Ma). These mantle fluids may have either already been present in Laurentian lithospheric mantle, or been

introduced in the earlier stages of the Caledonian Orogeny by material (likely containing fluids, hydrous minerals and/or melts) derived from the down-going oceanic slab.

Appendix A: Mineral Chemistry

EPMA results for scapolite, plagioclase, K-feldspar, biotite, hornblende, and garnet are presented in the tables below. The tables are organized by sample type (Type 1 pegmatite, Type 2 pegmatite, Type 3 pegmatite, and basement lithologies), with minerals presented in the same order as above.

Sample:	CB15-12 (Type 1 Pegmatite)												
Mineral	Scapolite												
No.	144	145	146	147	148	149	193	194	195	196	197	198	199
Wt%													
SiO2	48.64	47.82	47.50	48.32	47.46	48.63	47.50	47.06	46.89	47.21	46.49	46.44	45.35
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.49	25.76	25.84	25.75	25.68	24.92	25.99	25.73	25.98	26.05	25.84	25.68	25.08
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.09	0.11	0.09	0.15	0.09	0.13	0.05	0.06	0.11	0.06	0.05	0.03	0.04
MgO	0.02	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
MnO	0.03	0.03	0.01	0.03	0.02	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	15.63	16.08	16.45	15.96	16.47	15.48	16.58	16.41	16.44	16.65	16.30	16.29	16.15
Na2O	4.43	4.17	4.03	3.94	4.02	3.62	3.90	3.94	3.96	3.86	3.88	3.72	3.57
K2O	0.12	0.12	0.13	0.16	0.12	0.12	0.12	0.12	0.13	0.11	0.10	0.11	0.10
SO3	3.11	2.86	2.85	2.92	3.02	3.33	3.23	3.23	2.90	2.97	2.81	3.19	2.88
Cl	0.16	0.12	0.13	0.15	0.10	0.14	0.09	0.10	0.12	0.10	0.14	0.11	0.15
F	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Total	97.67	97.04	97.00	97.36	96.96	96.40	97.45	96.63	96.50	96.98	95.57	95.54	93.29
Cations Recalculated on the Basis of 24O													
Si	6.84	6.79	6.75	6.83	6.75	6.90	6.71	6.71	6.70	6.71	6.71	6.69	6.70
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.23	4.31	4.33	4.29	4.30	4.17	4.33	4.32	4.38	4.37	4.39	4.36	4.37
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.36	2.45	2.51	2.42	2.51	2.35	2.51	2.51	2.52	2.54	2.52	2.52	2.56
Na	1.21	1.15	1.11	1.08	1.11	1.00	1.07	1.09	1.10	1.06	1.08	1.04	1.02
K	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
S	0.33	0.30	0.30	0.31	0.32	0.36	0.34	0.35	0.31	0.32	0.30	0.35	0.32
C*	0.63	0.67	0.66	0.65	0.65	0.60	0.64	0.63	0.66	0.66	0.66	0.63	0.64
Cl	0.04	0.03	0.03	0.04	0.02	0.03	0.02	0.02	0.03	0.02	0.03	0.03	0.04
F	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.67	15.73	15.74	15.66	15.70	15.46	15.64	15.65	15.73	15.70	15.73	15.63	15.68
%Me	66	68	69	69	69	70	70	69	69	70	70	70	71
%Ma	34	32	31	31	31	30	30	31	31	30	30	30	29

Continued→

Sample:	CB15-12 (Type 1 Pegmatite)												
Mineral	Scapolite												
No.	200	201	202	203	204	205	206	207	208	209	210	211	212
Wt%													
SiO2	48.16	47.26	46.93	47.70	47.22	47.71	47.77	47.55	47.27	48.15	47.72	47.83	47.86
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.01	26.12	25.97	25.39	25.50	25.43	25.46	25.43	25.80	25.16	25.06	25.53	25.62
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
FeO	0.07	0.08	0.07	0.13	0.08	0.12	0.12	0.09	0.10	0.14	0.12	0.14	0.13
MgO	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.01	0.01	0.01	0.01	0.02
MnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.05	0.06	0.03
CaO	15.45	16.76	16.54	16.11	16.10	16.12	15.76	16.01	16.19	15.83	15.88	15.99	16.14
Na2O	4.27	3.74	3.76	4.03	4.08	4.26	4.08	4.34	4.05	3.63	4.28	4.19	3.83
K2O	0.11	0.15	0.12	0.12	0.13	0.13	0.14	0.09	0.11	0.14	0.13	0.15	0.12
SO3	2.92	2.85	2.87	3.40	3.18	3.27	3.19	3.26	3.27	3.08	3.25	3.12	3.24
Cl	0.16	0.13	0.14	0.08	0.10	0.09	0.12	0.07	0.11	0.14	0.11	0.12	0.10
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	96.11	97.05	96.37	96.95	96.39	97.11	96.60	96.84	96.87	96.27	96.59	97.12	97.06
Cations Recalculated on the Basis of 24O													
Si	6.88	6.72	6.72	6.76	6.74	6.76	6.79	6.76	6.72	6.86	6.80	6.78	6.78
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.21	4.38	4.38	4.24	4.29	4.25	4.27	4.26	4.32	4.22	4.21	4.26	4.27
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Ca	2.37	2.55	2.53	2.45	2.46	2.45	2.40	2.44	2.46	2.42	2.42	2.43	2.45
Na	1.18	1.03	1.04	1.11	1.13	1.17	1.13	1.20	1.11	1.00	1.18	1.15	1.05
K	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02
S	0.31	0.30	0.31	0.36	0.34	0.35	0.34	0.35	0.35	0.33	0.35	0.33	0.34
C*	0.65	0.66	0.66	0.62	0.64	0.63	0.63	0.64	0.63	0.64	0.63	0.64	0.64
Cl	0.04	0.03	0.03	0.02	0.02	0.02	0.03	0.02	0.02	0.03	0.03	0.03	0.02
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.68	15.71	15.70	15.60	15.67	15.66	15.63	15.68	15.65	15.55	15.66	15.68	15.59
%Me	66	71	70	69	68	67	68	67	69	70	67	68	70
%Ma	34	29	30	31	32	33	32	33	31	30	33	32	30

Continued→

Sample:	CB15-12 (Type 1 Pegmatite)					CB15-20 (Type 1 Pegmatite)						
Mineral	Scapolite											
No.	213	214	215	216	217	85	86	87	88	89	90	91
Wt%												
SiO2	48.03	48.01	48.41	47.56	47.75	46.60	46.24	46.84	46.02	46.23	47.02	46.60
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.22	25.57	25.02	25.52	25.62	23.50	23.87	23.73	23.88	23.39	23.71	23.75
Cr2O3	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.02
FeO	0.11	0.07	0.11	0.10	0.11	0.21	0.22	0.17	0.18	0.14	0.19	0.16
MgO	0.01	0.01	0.01	0.01	0.01	0.03	0.06	0.04	0.03	0.02	0.03	0.03
MnO	0.05	0.01	0.04	0.03	0.04	0.02	0.04	0.03	0.04	0.02	0.02	0.02
CaO	15.83	15.76	15.39	16.17	16.24	15.53	15.68	15.61	15.94	15.53	15.75	15.76
Na2O	4.23	4.28	4.29	4.15	4.12	3.24	4.12	4.36	4.27	4.14	4.18	4.17
K2O	0.14	0.11	0.14	0.13	0.15	0.13	0.17	0.15	0.17	0.13	0.15	0.17
SO3	3.43	3.31	3.45	3.45	3.22	2.70	2.98	2.76	3.03	3.07	2.85	2.88
Cl	0.11	0.10	0.13	0.13	0.09	0.09	0.09	0.11	0.10	0.10	0.11	0.10
F	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.04	0.01	0.01	0.00	0.01
Total	97.12	97.19	96.97	97.22	97.33	92.04	93.44	93.79	93.64	92.77	93.99	93.64
Cations Recalculated on the Basis of 24O												
Si	6.79	6.78	6.84	6.73	6.75	6.95	6.83	6.89	6.79	6.86	6.90	6.86
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.20	4.26	4.17	4.26	4.27	4.13	4.15	4.12	4.15	4.09	4.10	4.12
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.01	0.01	0.01	0.03	0.03	0.02	0.02	0.02	0.02	0.02
Mg	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.40	2.39	2.33	2.45	2.46	2.48	2.48	2.46	2.52	2.47	2.47	2.49
Na	1.16	1.17	1.18	1.14	1.13	0.94	1.18	1.25	1.22	1.19	1.19	1.19
K	0.02	0.02	0.03	0.02	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03
S	0.36	0.35	0.37	0.37	0.34	0.30	0.33	0.30	0.34	0.34	0.31	0.32
C*	0.61	0.63	0.60	0.60	0.64	0.67	0.65	0.65	0.64	0.63	0.66	0.65
Cl	0.03	0.02	0.03	0.03	0.02	0.02	0.02	0.03	0.02	0.02	0.03	0.02
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
Total	15.60	15.63	15.58	15.62	15.67	15.56	15.72	15.78	15.75	15.67	15.72	15.73
%Me	67	67	66	68	68	72	68	66	67	67	67	67
%Ma	33	33	34	32	32	28	32	34	33	33	33	33

Continued→

Sample:	CB15-20 (Type 1 Pegmatite)												
Mineral	Scapolite												
No.	92	93	94	95	96	97	98	99	100	101	102	103	104
Wt%													
SiO2	46.28	46.56	46.37	45.69	45.15	46.73	46.00	45.99	46.35	46.08	46.24	46.51	46.17
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	23.53	24.74	24.23	24.21	24.60	23.83	23.88	23.75	23.65	24.09	24.07	24.15	24.32
Cr2O3	0.03	0.03	0.01	0.00	0.01	0.02	0.02	0.01	0.00	0.00	0.01	0.00	0.01
FeO	0.13	0.17	0.19	0.15	0.13	0.11	0.12	0.14	0.08	0.11	0.12	0.14	0.10
MgO	0.04	0.04	0.05	0.04	0.02	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.01
MnO	0.04	0.04	0.04	0.02	0.04	0.02	0.03	0.04	0.03	0.03	0.03	0.04	0.01
CaO	15.63	16.63	16.21	16.35	16.81	15.74	15.87	15.98	15.82	16.02	15.93	16.01	16.23
Na2O	4.01	3.77	3.98	4.10	3.78	4.40	4.24	4.30	4.21	4.14	3.94	4.30	4.04
K2O	0.14	0.13	0.15	0.15	0.13	0.18	0.17	0.16	0.16	0.16	0.17	0.17	0.14
SO3	3.02	2.79	3.03	2.88	2.87	3.01	2.87	2.87	2.93	2.97	2.91	2.93	3.00
Cl	0.09	0.08	0.09	0.09	0.07	0.11	0.10	0.12	0.10	0.10	0.09	0.10	0.08
F	0.03	0.00	0.01	0.02	0.03	0.04	0.04	0.03	0.02	0.02	0.02	0.02	0.00
Total	92.92	94.96	94.33	93.67	93.62	94.16	93.29	93.36	93.34	93.71	93.51	94.34	94.09
Cations Recalculated on the Basis of 24O													
Si	6.86	6.77	6.79	6.75	6.68	6.85	6.81	6.81	6.85	6.79	6.82	6.81	6.77
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.11	4.24	4.18	4.22	4.29	4.12	4.17	4.15	4.12	4.19	4.18	4.17	4.20
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.01
Mg	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.48	2.59	2.54	2.59	2.66	2.47	2.52	2.54	2.51	2.53	2.52	2.51	2.55
Na	1.15	1.06	1.13	1.17	1.08	1.25	1.22	1.23	1.21	1.18	1.13	1.22	1.15
K	0.03	0.02	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
S	0.34	0.30	0.33	0.32	0.32	0.33	0.32	0.32	0.33	0.33	0.32	0.32	0.33
C*	0.63	0.67	0.64	0.65	0.65	0.62	0.64	0.64	0.64	0.64	0.65	0.64	0.65
Cl	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02
F	0.01	0.00	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.00
Total	15.66	15.73	15.70	15.79	15.77	15.74	15.77	15.79	15.73	15.74	15.70	15.77	15.72
%Me	68	71	69	69	71	66	67	67	67	68	69	67	69
%Ma	32	29	31	31	29	34	33	33	33	32	31	33	31

Continued→

Sample:	CB15-20 (Type 1 Pegmatite)									
Mineral	Scapolite									
No.	105	106	107	108	109	110	111	112	113	114
Wt%										
SiO2	45.92	46.40	45.76	45.78	45.13	46.13	45.49	45.14	46.01	46.57
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	23.64	23.40	24.15	23.89	23.61	23.99	24.27	23.97	23.85	23.10
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
FeO	0.22	0.22	0.20	0.21	0.22	0.19	0.23	0.20	0.23	0.23
MgO	0.04	0.03	0.03	0.04	0.03	0.03	0.04	0.04	0.04	0.04
MnO	0.02	0.03	0.03	0.01	0.05	0.02	0.02	0.03	0.03	0.01
CaO	15.80	15.62	16.21	16.04	16.34	16.17	16.46	16.55	16.30	15.66
Na2O	3.64	4.36	4.12	4.02	4.03	4.21	3.93	3.86	4.20	4.27
K2O	0.16	0.18	0.16	0.17	0.16	0.17	0.15	0.16	0.16	0.17
SO3	2.76	2.75	2.76	2.63	2.80	2.83	2.76	2.82	2.70	2.89
Cl	0.14	0.17	0.10	0.13	0.13	0.13	0.12	0.11	0.13	0.14
F	0.02	0.00	0.00	0.03	0.04	0.00	0.02	0.01	0.02	0.00
Total	92.32	93.10	93.50	92.90	92.49	93.84	93.46	92.88	93.63	93.05
Cations Recalculated on the Basis of 24O										
Si	6.86	6.89	6.78	6.82	6.77	6.80	6.74	6.73	6.81	6.91
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.16	4.09	4.21	4.19	4.17	4.17	4.24	4.22	4.16	4.04
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.03	0.03	0.02	0.03	0.03	0.02	0.03	0.03	0.03	0.03
Mg	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mn	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Ca	2.53	2.48	2.57	2.56	2.63	2.55	2.61	2.64	2.58	2.49
Na	1.05	1.26	1.18	1.16	1.17	1.20	1.13	1.12	1.21	1.23
K	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
S	0.31	0.31	0.31	0.29	0.31	0.31	0.31	0.32	0.30	0.32
C*	0.65	0.65	0.67	0.66	0.64	0.66	0.65	0.65	0.66	0.64
Cl	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
F	0.01	0.00	0.00	0.01	0.02	0.00	0.01	0.00	0.01	0.00
Total	15.68	15.79	15.80	15.80	15.81	15.79	15.80	15.78	15.83	15.73
%Me	70	66	68	69	69	68	70	70	68	67
%Ma	30	34	32	31	31	32	30	30	32	33

Continued→

Sample:	CB15-24 (Type 1 Pegmatite)											
Mineral	Scapolite											
No.	56	57	58	59	60	61	62	63	64	65	66	67	68
Wt%													
SiO2	48.43	48.38	48.58	48.12	47.59	48.27	48.56	48.71	47.97	47.74	48.26	48.56	48.42
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	24.99	24.81	24.67	24.70	25.01	24.71	24.87	24.78	24.68	25.59	24.84	25.29	25.19
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.13	0.14	0.10	0.08	0.07	0.07	0.14	0.11	0.07	0.06	0.10	0.10	0.09
MgO	0.03	0.01	0.01	0.03	0.02	0.02	0.03	0.03	0.02	0.01	0.01	0.03	0.01
MnO	0.01	0.01	0.00	0.02	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.01
CaO	15.30	15.41	15.51	15.52	15.90	15.47	15.50	15.52	15.46	15.99	15.55	15.65	15.93
Na2O	3.24	4.36	3.50	4.08	3.95	4.03	3.10	3.18	3.84	3.65	3.38	3.69	3.43
K2O	0.18	0.19	0.15	0.17	0.17	0.18	0.18	0.18	0.16	0.19	0.18	0.18	0.17
SO3	3.07	3.04	3.23	3.42	3.34	3.34	3.05	2.96	3.35	3.23	3.50	3.10	3.25
Cl	0.17	0.15	0.12	0.18	0.13	0.16	0.12	0.19	0.17	0.15	0.12	0.14	0.12
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	95.51	96.47	95.84	96.28	96.15	96.23	95.52	95.61	95.69	96.58	95.90	96.71	96.59
Cations Recalculated on the Basis of 24O													
Si	6.93	6.89	6.93	6.86	6.80	6.88	6.95	6.96	6.87	6.78	6.88	6.88	6.86
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.21	4.17	4.15	4.15	4.21	4.15	4.19	4.18	4.17	4.29	4.17	4.22	4.21
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Mg	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.34	2.35	2.37	2.37	2.43	2.36	2.37	2.38	2.37	2.44	2.37	2.38	2.42
Na	0.90	1.20	0.97	1.13	1.09	1.11	0.86	0.88	1.07	1.01	0.93	1.01	0.94
K	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
S	0.33	0.32	0.35	0.37	0.36	0.36	0.33	0.32	0.36	0.34	0.37	0.33	0.35
C*	0.63	0.64	0.63	0.59	0.61	0.60	0.64	0.64	0.60	0.62	0.60	0.64	0.63
Cl	0.04	0.04	0.03	0.04	0.03	0.04	0.03	0.05	0.04	0.04	0.03	0.03	0.03
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.44	15.67	15.46	15.55	15.58	15.55	15.43	15.46	15.52	15.56	15.40	15.54	15.48
%Me	72	66	71	67	68	68	73	72	69	70	71	70	71
%Ma	28	34	29	33	32	32	27	28	31	30	29	30	29

Continued→

Sample:	CB15-24 (Type 1 Pegmatite)										
Mineral	Scapolite										
No.	69	70	71	72	73	74	75	76	77	78	79	80
Wt%												
SiO2	48.63	47.46	48.47	48.24	48.19	48.21	48.23	47.52	47.19	47.58	47.47	46.97
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Al2O3	24.84	24.84	24.73	24.91	24.84	24.85	24.63	25.47	25.44	25.30	25.60	25.72
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.05	0.02	0.19	0.17	0.20	0.19	0.14	0.08	0.08	0.10	0.10	0.07
MgO	0.03	0.03	0.02	0.04	0.02	0.02	0.02	0.01	0.03	0.02	0.02	0.02
MnO	0.00	0.00	0.04	0.03	0.04	0.03	0.05	0.03	0.04	0.04	0.06	0.03
CaO	15.48	15.74	15.17	15.33	15.38	15.42	15.49	16.48	16.12	16.21	16.50	16.43
Na2O	3.41	3.73	3.33	4.00	4.12	4.05	4.19	3.87	3.79	3.88	3.76	3.15
K2O	0.17	0.16	0.22	0.19	0.22	0.18	0.17	0.13	0.15	0.16	0.14	0.15
SO3	3.27	3.36	3.48	3.24	3.25	3.13	3.53	3.44	3.53	3.48	3.48	3.41
Cl	0.15	0.14	0.17	0.17	0.16	0.15	0.18	0.13	0.14	0.15	0.14	0.14
F	0.00	0.00	0.01	0.00	0.03	0.02	0.03	0.02	0.03	0.05	0.02	0.02
Total	96.00	95.44	95.79	96.28	96.40	96.22	96.60	97.15	96.50	96.92	97.24	96.06
Cations Recalculated on the Basis of 24O												
Si	6.92	6.82	6.91	6.87	6.87	6.88	6.85	6.73	6.72	6.75	6.72	6.71
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.17	4.21	4.16	4.18	4.17	4.18	4.13	4.25	4.27	4.23	4.27	4.33
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.00	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01
Mg	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Ca	2.36	2.42	2.32	2.34	2.35	2.36	2.36	2.50	2.46	2.46	2.50	2.52
Na	0.94	1.04	0.92	1.10	1.14	1.12	1.15	1.06	1.05	1.07	1.03	0.87
K	0.03	0.03	0.04	0.04	0.04	0.03	0.03	0.02	0.03	0.03	0.02	0.03
S	0.35	0.36	0.37	0.35	0.35	0.34	0.38	0.36	0.38	0.37	0.37	0.36
C*	0.62	0.60	0.58	0.61	0.60	0.62	0.57	0.59	0.58	0.58	0.59	0.59
Cl	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.04	0.03	0.03
F	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
Total	15.43	15.53	15.38	15.57	15.60	15.60	15.55	15.59	15.55	15.57	15.57	15.47
%Me	71	69	71	68	67	67	67	70	70	69	71	74
%Ma	29	31	29	32	33	33	33	30	30	31	29	26

Continued→

Sample:	CB15-25 (Type 1 Pegmatite)												
Mineral	Scapolite												
No.	21	22	23	24	25	26	27	28	29	30	31	32	33
Wt%													
SiO2	49.00	48.14	47.90	49.03	48.44	48.66	49.26	48.61	48.84	48.14	48.54	47.49	47.73
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	24.32	25.06	24.61	24.48	24.65	24.53	24.42	24.51	24.11	24.70	24.90	24.93	25.24
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.02
FeO	0.12	0.08	0.04	0.14	0.14	0.16	0.09	0.08	0.07	0.08	0.10	0.07	0.11
MgO	0.02	0.03	0.02	0.04	0.03	0.04	0.02	0.01	0.00	0.02	0.03	0.01	0.01
MnO	0.03	0.01	0.04	0.03	0.02	0.03	0.03	0.02	0.01	0.03	0.04	0.01	0.04
CaO	14.95	15.40	15.14	15.06	15.06	15.00	14.64	14.67	14.62	15.29	15.26	15.76	15.77
Na2O	4.73	4.42	4.20	4.45	4.27	4.43	3.54	4.53	4.67	4.24	3.51	3.96	3.97
K2O	0.24	0.18	0.25	0.21	0.18	0.19	0.22	0.17	0.21	0.16	0.19	0.17	0.16
SO3	2.98	2.90	3.23	3.03	2.96	3.05	3.20	3.29	3.36	3.36	3.09	3.12	3.84
Cl	0.32	0.29	0.35	0.34	0.27	0.26	0.36	0.25	0.29	0.19	0.29	0.24	0.20
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Total	96.65	96.45	95.69	96.73	95.96	96.29	95.69	96.08	96.13	96.16	95.90	95.72	97.05
Cations Recalculated on the Basis of 24O													
Si	6.97	6.87	6.88	6.96	6.93	6.94	7.02	6.93	6.96	6.87	6.93	6.82	6.75
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.08	4.22	4.17	4.10	4.16	4.13	4.10	4.12	4.05	4.15	4.19	4.22	4.20
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.00	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mg	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.28	2.36	2.33	2.29	2.31	2.29	2.24	2.24	2.23	2.34	2.33	2.43	2.39
Na	1.31	1.22	1.17	1.22	1.18	1.23	0.98	1.25	1.29	1.17	0.97	1.10	1.09
K	0.04	0.03	0.05	0.04	0.03	0.03	0.04	0.03	0.04	0.03	0.03	0.03	0.03
S	0.32	0.31	0.35	0.32	0.32	0.33	0.34	0.35	0.36	0.36	0.33	0.34	0.41
C*	0.60	0.62	0.57	0.59	0.62	0.61	0.57	0.59	0.57	0.59	0.60	0.60	0.53
Cl	0.08	0.07	0.09	0.08	0.06	0.06	0.09	0.06	0.07	0.05	0.07	0.06	0.05
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Total	15.70	15.72	15.60	15.65	15.64	15.65	15.40	15.59	15.59	15.58	15.48	15.62	15.48
%Me	63	65	66	65	66	65	69	64	63	66	70	68	68
%Ma	37	35	34	35	34	35	31	36	37	34	30	32	32

Continued→

Sample:	CB15-25 (Type 1 Pegmatite)												
Mineral	Scapolite												
No.	34	35	36	37	38	39	40	41	42	43	44	45	146
Wt%													
SiO2	48.57	48.47	48.06	47.33	48.19	48.96	47.25	48.53	48.42	49.03	47.51	48.55	47.73
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	24.46	24.86	25.22	25.26	24.36	24.77	25.58	24.82	25.05	24.72	25.15	25.16	25.33
Cr2O3	0.02	0.01	0.01	0.00	0.03	0.02	0.03	0.04	0.01	0.03	0.03	0.01	0.00
FeO	0.07	0.11	0.09	0.11	0.12	0.10	0.07	0.14	0.15	0.16	0.12	0.14	0.48
MgO	0.00	0.02	0.01	0.02	0.03	0.02	0.02	0.02	0.02	0.01	0.04	0.03	0.04
MnO	0.05	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.04	0.03	0.00
CaO	14.99	15.28	15.69	16.12	14.90	14.88	16.14	15.19	15.59	15.09	16.00	15.40	15.73
Na2O	4.15	3.22	4.16	3.83	4.56	4.46	3.92	4.47	4.42	4.67	4.25	4.12	4.06
K2O	0.17	0.19	0.18	0.18	0.23	0.22	0.18	0.22	0.20	0.24	0.19	0.22	0.22
SO3	3.26	3.12	3.13	3.13	3.23	2.98	3.07	3.05	3.32	3.11	3.15	2.96	2.32
Cl	0.28	0.28	0.27	0.21	0.29	0.30	0.22	0.30	0.27	0.32	0.21	0.28	0.29
F	0.00	0.02	0.01	0.00	0.01	0.02	0.01	0.05	0.00	0.01	0.01	0.01	0.00
Total	95.95	95.54	96.79	96.15	95.91	96.66	96.47	96.75	97.42	97.32	96.64	96.85	96.14
Cations Recalculated on the Basis of 24O													
Si	6.94	6.94	6.83	6.78	6.91	6.95	6.75	6.90	6.84	6.93	6.78	6.89	6.86
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.12	4.19	4.23	4.26	4.12	4.15	4.31	4.16	4.17	4.12	4.23	4.21	4.29
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.02	0.06
Mg	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.29	2.34	2.39	2.47	2.29	2.26	2.47	2.32	2.36	2.28	2.45	2.34	2.42
Na	1.15	0.89	1.15	1.06	1.26	1.23	1.09	1.23	1.21	1.28	1.18	1.13	1.13
K	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.04	0.04	0.04	0.03	0.04	0.04
S	0.35	0.34	0.33	0.34	0.35	0.32	0.33	0.33	0.35	0.33	0.34	0.31	0.25
C*	0.58	0.59	0.60	0.61	0.58	0.60	0.62	0.58	0.58	0.59	0.61	0.61	0.68
Cl	0.07	0.07	0.06	0.05	0.07	0.07	0.05	0.07	0.06	0.08	0.05	0.07	0.07
F	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00
Total	15.55	15.42	15.65	15.63	15.64	15.65	15.67	15.68	15.64	15.68	15.70	15.64	15.82
%Me	66	72	67	69	64	64	69	65	66	64	67	67	68
%Ma	34	28	33	31	36	36	31	35	34	36	33	33	32

Continued→

Sample:	CB15-25 (Type 1 Pegmatite)			CB15-40 (Type 1 Pegmatite)									
Mineral	Scapolite												
No.	147	148		208	209	210	211	238	239	240	241	242	243
Wt%													
SiO2	47.97	48.37		47.18	47.46	47.67	47.38	47.19	46.77	46.69	47.62	46.64	46.97
TiO2	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.65	25.89		26.22	25.44	25.57	25.72	26.12	26.17	26.16	25.70	26.28	25.59
Cr2O3	0.00	0.00		0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.41	0.24		0.11	0.14	0.14	0.10	0.11	0.09	0.10	0.12	0.08	0.18
MgO	0.04	0.01		0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.01
MnO	0.00	0.00		0.00	0.01	0.00	0.01	0.02	0.05	0.03	0.03	0.03	0.02
CaO	15.78	15.76		16.80	15.97	16.20	15.91	16.55	16.57	16.45	15.90	16.93	16.07
Na2O	4.12	4.52		3.79	3.70	3.89	4.22	3.96	3.74	3.67	4.12	3.74	3.89
K2O	0.20	0.23		0.15	0.19	0.16	0.14	0.14	0.13	0.12	0.17	0.11	0.17
SO3	2.47	1.94		2.55	2.90	2.61	2.59	2.50	2.69	2.65	2.65	2.62	2.61
Cl	0.25	0.31		0.10	0.12	0.15	0.13	0.11	0.11	0.08	0.12	0.09	0.12
F	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Total	96.83	97.20		96.88	95.89	96.37	96.18	96.69	96.28	95.94	96.40	96.49	95.60
Cations Recalculated on the Basis of 24O													
Si	6.84	6.89		6.73	6.81	6.82	6.79	6.74	6.70	6.71	6.81	6.68	6.78
Ti	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.31	4.35		4.41	4.30	4.31	4.35	4.40	4.42	4.43	4.33	4.44	4.35
Cr	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.05	0.03		0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02
Mg	0.01	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.41	2.40		2.57	2.46	2.48	2.44	2.53	2.54	2.53	2.44	2.60	2.48
Na	1.14	1.25		1.05	1.03	1.08	1.17	1.10	1.04	1.02	1.14	1.04	1.09
K	0.04	0.04		0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.02	0.03
S	0.26	0.21		0.27	0.31	0.28	0.28	0.27	0.29	0.29	0.29	0.28	0.28
C*	0.68	0.72		0.70	0.66	0.68	0.69	0.70	0.68	0.70	0.69	0.70	0.69
Cl	0.06	0.07		0.02	0.03	0.04	0.03	0.03	0.03	0.02	0.03	0.02	0.03
F	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.79	15.96		15.79	15.64	15.74	15.80	15.82	15.75	15.74	15.76	15.78	15.76
%Me	68	65		71	70	69	67	69	71	71	68	71	69
%Ma	32	35	100	29	30	31	33	31	29	29	32	29	31

Continued→

Sample:	CB15-40 (Type 1 Pegmatite)												
Mineral	Scapolite												
No.	244	245	246	247	248	249	250	251	252	253	254	255	256
Wt%													
SiO2	47.61	47.37	47.24	47.43	47.92	47.31	46.68	47.16	47.29	47.22	47.07	46.74	47.62
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.76	25.52	25.83	25.73	25.43	25.81	26.24	25.78	25.99	25.75	25.80	26.26	25.67
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.13	0.12	0.09	0.10	0.03	0.21	0.11	0.13	0.14	0.29	0.12	0.08	0.10
MgO	0.00	0.01	0.00	0.00	0.00	0.02	0.00	0.01	0.01	0.25	0.01	0.00	0.02
MnO	0.03	0.02	0.04	0.04	0.03	0.02	0.04	0.06	0.02	0.04	0.03	0.04	0.04
CaO	16.05	16.22	16.15	16.25	15.80	16.22	16.47	16.06	15.97	15.86	16.14	16.84	16.07
Na2O	3.88	3.90	3.79	4.03	4.04	3.32	3.80	4.05	4.02	3.80	3.83	3.94	4.04
K2O	0.16	0.16	0.16	0.12	0.13	0.17	0.14	0.15	0.15	0.14	0.14	0.14	0.13
SO3	2.63	2.50	2.56	2.67	2.73	2.75	2.83	2.79	2.96	2.86	2.72	2.77	2.72
Cl	0.12	0.12	0.11	0.11	0.09	0.11	0.12	0.14	0.14	0.11	0.13	0.10	0.14
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.01
Total	96.35	95.90	95.95	96.47	96.17	95.90	96.42	96.29	96.66	96.33	95.94	96.87	96.51
Cations Recalculated on the Basis of 24O													
Si	6.81	6.81	6.78	6.78	6.85	6.78	6.68	6.75	6.74	6.75	6.76	6.67	6.80
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.34	4.32	4.37	4.34	4.28	4.36	4.43	4.35	4.37	4.34	4.37	4.42	4.32
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.01	0.01	0.00	0.02	0.01	0.01	0.02	0.04	0.01	0.01	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Ca	2.46	2.50	2.49	2.49	2.42	2.49	2.53	2.46	2.44	2.43	2.48	2.58	2.46
Na	1.08	1.09	1.06	1.12	1.12	0.92	1.05	1.13	1.11	1.05	1.07	1.09	1.12
K	0.03	0.03	0.03	0.02	0.02	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.02
S	0.28	0.27	0.28	0.29	0.29	0.30	0.30	0.30	0.32	0.31	0.29	0.30	0.29
C*	0.69	0.70	0.70	0.69	0.69	0.68	0.67	0.67	0.65	0.65	0.68	0.68	0.67
Cl	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.03
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Total	15.73	15.77	15.74	15.76	15.70	15.62	15.73	15.75	15.70	15.70	15.72	15.79	15.74
%Me	69	69	70	69	68	73	70	68	68	70	70	70	68
%Ma	31	31	30	31	32	27	30	32	32	30	30	30	32

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Sample:	CB15-40 (Type 1 Pegmatite)				CB15-57 (Type 1 Pegmatite)								
Mineral	Scapolite												
No.	257	258	259	260		91	92	93	94	95	96	97	98
Wt%													
SiO2	47.33	47.02	47.43	47.62		47.02	48.48	46.78	47.28	44.58	47.45	48.14	46.81
TiO2	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00
Al2O3	25.28	25.43	25.56	25.38		25.76	25.12	25.52	26.00	24.79	25.94	25.07	25.85
Cr2O3	0.00	0.00	0.00	0.00		0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01
FeO	0.20	0.20	0.14	0.12		0.11	0.09	0.13	0.09	0.06	0.10	0.09	0.10
MgO	0.03	0.03	0.01	0.00		0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
MnO	0.03	0.03	0.03	0.04		0.01	0.02	0.01	0.03	0.00	0.01	0.01	0.02
CaO	16.15	16.03	16.01	15.65		16.53	15.79	16.64	16.70	15.16	16.57	16.07	16.79
Na2O	3.98	3.84	4.04	3.85		2.83	4.25	3.84	3.63	4.06	3.92	3.82	3.74
K2O	0.15	0.18	0.16	0.15		0.17	0.13	0.17	0.14	0.12	0.16	0.15	0.13
SO3	2.71	2.77	2.80	3.13		3.02	2.83	3.05	2.95	2.74	3.03	2.72	2.85
Cl	0.11	0.12	0.11	0.13		0.13	0.11	0.10	0.10	0.28	0.13	0.15	0.12
F	0.01	0.00	0.00	0.00		0.00	0.00	0.00	0.01	0.05	0.00	0.01	0.01
Total	95.94	95.61	96.28	96.04		95.57	96.80	96.22	96.90	92.24	97.26	96.19	96.39
Cations Recalculated on the Basis of 24O													
Si	6.80	6.78	6.79	6.81		6.75	6.89	6.71	6.72	6.68	6.72	6.88	6.71
Ti	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00
Al	4.28	4.32	4.31	4.28		4.36	4.20	4.32	4.36	4.38	4.33	4.23	4.37
Cr	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.02	0.02	0.02	0.01		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mg	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.49	2.48	2.46	2.40		2.54	2.40	2.56	2.54	2.43	2.52	2.46	2.58
Na	1.11	1.07	1.12	1.07		0.79	1.17	1.07	1.00	1.18	1.08	1.06	1.04
K	0.03	0.03	0.03	0.03		0.03	0.02	0.03	0.02	0.02	0.03	0.03	0.02
S	0.29	0.30	0.30	0.34		0.33	0.30	0.33	0.31	0.31	0.32	0.29	0.31
C*	0.68	0.67	0.67	0.63		0.64	0.67	0.65	0.66	0.60	0.65	0.67	0.66
Cl	0.03	0.03	0.03	0.03		0.03	0.03	0.02	0.02	0.07	0.03	0.04	0.03
F	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Total	15.75	15.72	15.73	15.59		15.50	15.70	15.70	15.66	15.76	15.69	15.67	15.72
%Me	69	69	68	69		76	67	70	71	67	70	70	71
%Ma	31	31	32	31	100	24	33	30	29	33	30	30	29

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Sample:	CB15-57 (Type 1 Pegmatite)												
Mineral	Scapolite												
No.	99	100	101	102	103	104	105	106	107	108	109	110	111
Wt%													
SiO2	47.25	47.16	48.40	47.95	46.79	48.02	48.52	47.86	47.86	46.68	46.66	46.98	47.44
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.57	25.70	24.87	25.59	25.78	25.29	24.87	25.19	25.36	25.74	25.74	25.56	25.64
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.02
FeO	0.08	0.10	0.10	0.07	0.06	0.09	0.12	0.11	0.08	0.07	0.13	0.06	0.10
MgO	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.02	0.00	0.01
MnO	0.00	0.02	0.00	0.00	0.01	0.02	0.03	0.01	0.03	0.03	0.03	0.01	0.03
CaO	16.55	16.82	15.79	16.26	16.61	16.01	15.50	16.06	16.19	16.63	16.77	16.74	16.54
Na2O	3.95	3.80	4.23	3.94	3.70	4.13	3.81	3.87	4.19	3.85	3.68	3.80	3.09
K2O	0.15	0.15	0.14	0.16	0.12	0.15	0.12	0.15	0.14	0.11	0.18	0.12	0.13
SO3	2.89	2.87	2.83	2.80	3.03	2.89	2.91	2.73	2.90	3.14	2.99	2.99	3.05
Cl	0.10	0.14	0.12	0.12	0.09	0.12	0.12	0.13	0.13	0.10	0.10	0.11	0.08
F	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.01	0.02	0.00	0.00	0.00
Total	96.52	96.73	96.46	96.85	96.17	96.70	95.96	96.08	96.87	96.34	96.28	96.33	96.10
Cations Recalculated on the Basis of 24O													
Si	6.75	6.73	6.90	6.82	6.71	6.84	6.93	6.85	6.81	6.68	6.69	6.73	6.78
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.31	4.32	4.18	4.29	4.35	4.24	4.19	4.25	4.25	4.34	4.35	4.31	4.32
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.53	2.57	2.41	2.48	2.55	2.44	2.37	2.46	2.47	2.55	2.58	2.57	2.53
Na	1.09	1.05	1.17	1.08	1.03	1.14	1.05	1.07	1.16	1.07	1.02	1.05	0.86
K	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.03	0.03	0.02	0.03	0.02	0.02
S	0.31	0.31	0.30	0.30	0.33	0.31	0.31	0.29	0.31	0.34	0.32	0.32	0.33
C*	0.67	0.66	0.67	0.67	0.65	0.65	0.66	0.68	0.65	0.63	0.65	0.65	0.65
Cl	0.02	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.02
F	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Total	15.72	15.72	15.70	15.70	15.67	15.70	15.58	15.69	15.72	15.68	15.70	15.69	15.52
%Me	69	71	67	69	71	68	69	69	68	70	71	71	74
%Ma	31	29	33	31	29	32	31	31	32	30	29	29	26

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Sample:	CB15-57 (Type 1 Pegmatite)						CB15-58 (Type 1 Pegmatite)						
Mineral	Scapolite												
No.	112	113	114	115	116		24	25	26	27	28	29	42
Wt%													
SiO2	47.67	48.92	47.70	47.31	47.11		47.81	48.14	48.32	47.87	48.41	47.84	46.71
TiO2	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.33	24.67	25.70	25.84	25.73		25.46	25.26	25.47	25.12	25.24	24.99	25.85
Cr2O3	0.00	0.00	0.02	0.00	0.02		0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.12	0.09	0.10	0.10	0.27		0.05	0.04	0.00	0.24	0.03	0.00	0.00
MgO	0.00	0.00	0.02	0.00	0.00		0.02	0.04	0.04	0.31	0.02	0.04	0.08
MnO	0.01	0.04	0.02	0.03	0.03		0.00	0.00	0.00	0.00	0.00	0.00	0.02
CaO	16.30	15.32	16.61	16.73	16.53		15.92	15.67	15.88	14.76	15.57	15.67	16.19
Na2O	3.84	4.23	4.02	3.91	3.63		4.01	3.91	3.90	2.84	4.22	4.01	4.03
K2O	0.14	0.12	0.16	0.14	0.16		0.20	0.22	0.19	0.21	0.21	0.21	0.14
SO3	3.26	2.86	2.85	3.03	3.12		2.83	2.77	2.78	3.02	3.09	2.66	2.99
Cl	0.10	0.13	0.11	0.10	0.09		0.20	0.21	0.22	0.21	0.20	0.27	0.12
F	0.00	0.02	0.00	0.00	0.00		0.01	0.00	0.00	0.00	0.01	0.01	0.05
Total	96.75	96.37	97.27	97.16	96.66		96.47	96.20	96.76	94.53	96.94	95.63	96.13
Cations Recalculated on the Basis of 24O													
Si	6.78	6.96	6.77	6.72	6.72		6.82	6.88	6.86	6.91	6.86	6.89	6.70
Ti	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.24	4.14	4.30	4.32	4.32		4.28	4.25	4.26	4.27	4.21	4.24	4.37
Cr	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.01	0.01	0.03		0.00	0.00	0.00	0.03	0.00	0.00	0.00
Mg	0.00	0.00	0.00	0.00	0.00		0.00	0.01	0.01	0.07	0.00	0.01	0.02
Mn	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.48	2.34	2.52	2.54	2.52		2.43	2.40	2.42	2.28	2.36	2.42	2.49
Na	1.06	1.17	1.11	1.08	1.00		1.11	1.08	1.08	0.79	1.16	1.12	1.12
K	0.03	0.02	0.03	0.03	0.03		0.04	0.04	0.04	0.04	0.04	0.04	0.02
S	0.35	0.30	0.30	0.32	0.33		0.30	0.30	0.30	0.33	0.33	0.29	0.32
C*	0.63	0.65	0.67	0.65	0.64		0.64	0.65	0.65	0.62	0.62	0.64	0.63
Cl	0.02	0.03	0.03	0.02	0.02		0.05	0.05	0.05	0.05	0.05	0.06	0.03
F	0.00	0.01	0.00	0.00	0.00		0.01	0.00	0.00	0.00	0.00	0.00	0.02
Total	15.60	15.64	15.75	15.70	15.63		15.70	15.66	15.67	15.39	15.64	15.71	15.72
%Me	70	66	69	70	71		68	68	69	74	66	68	69
%Ma	30	34	31	30	29	100	32	32	31	26	34	32	31

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Sample:	CB15-58 (Type 1 Pegmatite)												
Mineral	Scapolite												
No.	43	44	58	59	60	61	62	65	66	67	68	69	70
Wt%													
SiO2	47.95	47.16	47.26	46.72	47.87	47.06	47.76	47.73	47.49	48.36	47.60	48.33	47.84
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.55	25.87	25.30	26.03	25.12	25.83	25.23	25.46	25.35	25.03	25.20	24.85	25.06
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.07	0.00
MgO	0.10	0.09	0.02	0.01	0.03	0.00	0.02	0.01	0.00	0.01	0.03	0.15	0.04
MnO	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	15.70	16.52	15.97	16.49	15.51	16.39	15.64	15.78	15.73	14.85	15.60	14.85	15.38
Na2O	4.17	3.92	4.19	3.83	4.23	3.92	4.21	4.14	4.07	4.19	4.22	3.86	4.18
K2O	0.17	0.14	0.10	0.08	0.15	0.11	0.15	0.16	0.17	0.20	0.15	0.17	0.15
SO3	2.86	3.22	3.13	2.66	2.99	3.07	3.03	2.76	2.77	2.93	3.03	2.94	3.03
Cl	0.19	0.15	0.16	0.13	0.20	0.12	0.17	0.19	0.17	0.20	0.20	0.17	0.19
F	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	96.69	97.09	96.09	95.91	96.05	96.47	96.17	96.18	95.73	95.76	95.99	95.35	95.83
Cations Recalculated on the Basis of 24O													
Si	6.82	6.69	6.77	6.72	6.85	6.72	6.83	6.83	6.83	6.92	6.82	6.93	6.85
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.28	4.33	4.27	4.41	4.24	4.34	4.25	4.29	4.30	4.22	4.26	4.20	4.23
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Mg	0.02	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.01
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.39	2.51	2.45	2.54	2.38	2.51	2.40	2.42	2.42	2.28	2.40	2.28	2.36
Na	1.15	1.08	1.16	1.07	1.17	1.08	1.17	1.15	1.14	1.16	1.17	1.08	1.16
K	0.03	0.03	0.02	0.01	0.03	0.02	0.03	0.03	0.03	0.04	0.03	0.03	0.03
S	0.30	0.34	0.34	0.29	0.32	0.33	0.33	0.30	0.30	0.31	0.33	0.32	0.33
C*	0.65	0.60	0.63	0.68	0.63	0.64	0.63	0.66	0.66	0.64	0.62	0.64	0.63
Cl	0.05	0.04	0.04	0.03	0.05	0.03	0.04	0.05	0.04	0.05	0.05	0.04	0.05
F	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.71	15.66	15.68	15.76	15.67	15.67	15.67	15.72	15.71	15.63	15.68	15.57	15.65
%Me	67	70	67	70	67	69	67	67	68	66	67	68	67
%Ma	33	30	33	30	33	31	33	33	32	34	33	32	33

Continued→

Sample:	CB15-58 (Type 1 Pegmatite)						CB15-59 (Type 1 Pegmatite)					
Mineral	Scapolite											
No.	71	72	73	74	75	76	835	836	837	838	839	840
Wt%												
SiO2	47.87	47.21	46.84	47.53	47.86	46.94	48.48	48.10	48.17	48.37	48.28	48.19
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Al2O3	25.05	25.42	25.60	25.10	25.32	25.72	24.82	24.99	25.14	25.08	24.86	25.00
Cr2O3	0.00	0.00	0.00	0.02	0.00	0.01	0.01	0.01	0.00	0.03	0.00	0.03
FeO	0.01	0.00	0.00	0.02	0.03	0.02	0.11	0.12	0.16	0.10	0.17	0.09
MgO	0.02	0.03	0.02	0.02	0.02	0.02	0.01	0.03	0.04	0.01	0.02	0.02
MnO	0.00	0.00	0.00	0.00	0.00	0.01	0.06	0.03	0.04	0.03	0.04	0.06
CaO	15.65	15.92	16.08	15.55	15.65	16.46	15.85	16.07	16.21	15.94	15.81	16.17
Na2O	4.14	4.03	3.98	3.56	4.17	3.41	3.96	3.94	3.99	4.08	3.95	4.12
K2O	0.13	0.17	0.15	0.21	0.21	0.16	0.11	0.13	0.15	0.10	0.11	0.13
SO3	3.06	3.10	3.13	3.20	3.06	2.96	2.71	2.81	2.92	2.78	2.84	2.62
Cl	0.18	0.19	0.19	0.27	0.25	0.16	0.11	0.15	0.12	0.12	0.14	0.15
F	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Total	96.06	96.03	95.96	95.42	96.50	95.82	96.19	96.35	96.91	96.61	96.18	96.55
Cations Recalculated on the Basis of 24O												
Si	6.85	6.77	6.72	6.83	6.82	6.74	6.93	6.87	6.84	6.89	6.90	6.88
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.22	4.29	4.33	4.25	4.25	4.35	4.18	4.21	4.21	4.21	4.19	4.21
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01
Ca	2.40	2.45	2.47	2.40	2.39	2.53	2.43	2.46	2.47	2.43	2.42	2.47
Na	1.15	1.12	1.11	0.99	1.15	0.95	1.10	1.09	1.10	1.13	1.09	1.14
K	0.02	0.03	0.03	0.04	0.04	0.03	0.02	0.02	0.03	0.02	0.02	0.02
S	0.33	0.33	0.34	0.35	0.33	0.32	0.29	0.30	0.31	0.30	0.30	0.28
C*	0.63	0.62	0.62	0.58	0.61	0.64	0.68	0.66	0.66	0.67	0.66	0.68
Cl	0.04	0.05	0.05	0.06	0.06	0.04	0.03	0.04	0.03	0.03	0.03	0.04
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.64	15.66	15.67	15.52	15.66	15.61	15.67	15.68	15.68	15.69	15.65	15.75
%Me	67	68	69	70	67	72	69	69	69	68	69	68
%Ma	33	32	31	30	33	28	31	31	31	32	31	32

Sample:	CB15-59 (Type 1 Pegmatite)												
Mineral	Scapolite												
No.	841	842	843	844	45	46	47	77	78	79	80	81	82
Wt%													
SiO2	47.49	47.64	48.44	47.93	47.04	48.20	46.52	47.68	47.66	47.07	46.70	47.53	46.04
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Al2O3	25.17	25.43	24.62	25.09	26.07	24.85	26.20	25.50	25.33	26.36	25.93	25.37	25.81
Cr2O3	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.02	0.01	0.02	0.01	0.02	0.01
FeO	0.15	0.13	0.14	0.15	0.05	0.09	0.09	0.12	0.09	0.13	0.08	0.07	0.07
MgO	0.03	0.02	0.03	0.03	0.07	0.08	0.06	0.01	0.00	0.02	0.00	0.00	0.00
MnO	0.04	0.04	0.04	0.02	0.03	0.02	0.03	0.02	0.01	0.04	0.02	0.00	0.01
CaO	16.67	16.59	15.94	16.36	16.25	15.35	16.97	16.25	16.09	16.88	16.43	15.68	16.43
Na2O	3.72	3.96	4.08	4.05	3.59	4.31	3.90	4.02	3.97	3.83	3.76	3.78	3.24
K2O	0.14	0.11	0.13	0.12	0.11	0.10	0.13	0.14	0.13	0.14	0.13	0.12	0.10
SO3	2.65	2.72	2.89	2.87	2.80	3.11	2.89	2.71	3.07	3.01	3.09	2.93	2.88
Cl	0.11	0.11	0.14	0.15	0.15	0.13	0.06	0.17	0.14	0.10	0.10	0.16	0.08
F	0.00	0.00	0.00	0.00	0.07	0.02	0.07	0.01	0.00	0.01	0.00	0.00	0.00
Total	96.13	96.75	96.43	96.72	96.18	96.22	96.87	96.61	96.45	97.58	96.23	95.62	94.67
Cations Recalculated on the Basis of 24O													
Si	6.82	6.79	6.91	6.83	6.73	6.88	6.64	6.81	6.80	6.66	6.69	6.83	6.69
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.26	4.28	4.14	4.21	4.40	4.18	4.41	4.29	4.26	4.40	4.38	4.29	4.42
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.02	0.01	0.02	0.02	0.00	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01
Mg	0.01	0.00	0.00	0.00	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.56	2.54	2.44	2.50	2.49	2.34	2.60	2.49	2.46	2.56	2.52	2.41	2.56
Na	1.03	1.09	1.13	1.12	1.00	1.19	1.08	1.11	1.10	1.05	1.04	1.05	0.91
K	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.03	0.02	0.02	0.02
S	0.29	0.29	0.31	0.31	0.30	0.33	0.31	0.29	0.33	0.32	0.33	0.32	0.31
C*	0.69	0.68	0.66	0.66	0.63	0.63	0.64	0.66	0.64	0.65	0.64	0.64	0.67
Cl	0.03	0.03	0.03	0.04	0.04	0.03	0.01	0.04	0.03	0.02	0.02	0.04	0.02
F	0.00	0.00	0.00	0.00	0.03	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.72	15.75	15.67	15.71	15.67	15.64	15.77	15.75	15.65	15.72	15.66	15.62	15.62
%Me	71	70	68	69	71	66	70	69	69	71	70	69	73
%Ma	29	30	32	31	29	34	30	31	31	29	30	31	27

Continued→

Sample:	CB15-59 (Type 1 Pegmatite)												
Mineral	Scapolite												
No.	93	94	95	96	97	98	99	107	108	109	110	111	112
Wt%													
SiO2	47.12	46.79	47.41	47.72	47.04	48.08	47.57	47.63	46.30	46.63	47.41	47.29	48.03
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.56	26.02	25.29	25.55	25.49	24.78	25.02	25.69	26.34	26.30	25.51	25.47	25.52
Cr2O3	0.02	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
FeO	0.06	0.07	0.07	0.12	0.10	0.10	0.06	0.11	0.09	0.09	0.13	0.15	0.13
MgO	0.00	0.01	0.02	0.05	0.03	0.03	0.01	0.03	0.00	0.02	0.02	0.03	0.06
MnO	0.02	0.03	0.04	0.01	0.03	0.04	0.03	0.03	0.04	0.03	0.04	0.04	0.03
CaO	16.19	16.54	16.14	15.98	15.99	15.32	15.88	16.49	17.03	17.06	16.29	16.43	16.03
Na2O	3.80	3.37	4.15	3.82	3.57	4.35	4.04	3.94	3.69	3.70	3.90	4.16	4.14
K2O	0.10	0.09	0.15	0.13	0.12	0.11	0.09	0.12	0.10	0.12	0.15	0.15	0.16
SO3	2.94	2.86	2.84	2.79	2.52	2.70	2.83	2.72	2.82	2.66	2.66	2.79	2.74
Cl	0.09	0.10	0.13	0.16	0.13	0.12	0.11	0.11	0.07	0.08	0.12	0.12	0.12
F	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	95.87	95.86	96.22	96.28	94.97	95.60	95.60	96.84	96.46	96.67	96.21	96.60	96.93
Cations Recalculated on the Basis of 24O													
Si	6.76	6.72	6.79	6.82	6.82	6.91	6.84	6.78	6.63	6.67	6.80	6.76	6.83
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.32	4.40	4.27	4.30	4.35	4.20	4.24	4.31	4.45	4.43	4.31	4.29	4.27
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01
Mg	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.49	2.54	2.48	2.45	2.48	2.36	2.45	2.52	2.61	2.61	2.50	2.52	2.44
Na	1.06	0.94	1.15	1.06	1.00	1.21	1.13	1.09	1.03	1.02	1.08	1.15	1.14
K	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
S	0.32	0.31	0.30	0.30	0.27	0.29	0.30	0.29	0.30	0.29	0.29	0.30	0.29
C*	0.66	0.67	0.66	0.66	0.70	0.68	0.67	0.68	0.68	0.70	0.69	0.67	0.68
Cl	0.02	0.02	0.03	0.04	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.66	15.64	15.74	15.68	15.70	15.73	15.69	15.74	15.76	15.78	15.74	15.78	15.74
%Me	70	73	68	70	71	66	68	70	72	72	70	68	68
%Ma	30	27	32	30	29	34	32	30	28	28	30	32	32

Continued→

Sample:	CB15-59 (Type 1 Pegmatite)			CB15-72 (Type 1 Pegmatite)								
Mineral	Scapolite											
No.	113	114	115	125	126	127	128	129	130	131	132	133
Wt%												
SiO2	47.88	47.79	47.13	46.13	45.50	46.54	46.08	45.56	44.55	45.26	44.77	45.08
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.62	25.43	25.86	23.92	23.87	23.47	23.65	23.64	24.19	24.21	24.25	24.23
Cr2O3	0.01	0.00	0.01	0.02	0.01	0.00	0.01	0.00	0.01	0.02	0.03	0.02
FeO	0.14	0.10	0.09	0.12	0.12	0.10	0.14	0.12	0.11	0.11	0.13	0.12
MgO	0.01	0.02	0.02	0.02	0.01	0.00	0.01	0.00	0.02	0.02	0.02	0.03
MnO	0.03	0.02	0.06	0.03	0.04	0.03	0.04	0.04	0.05	0.01	0.04	0.04
CaO	16.06	15.84	16.61	16.04	15.80	15.85	15.94	15.98	16.85	16.55	16.44	16.62
Na2O	3.98	3.33	3.87	3.48	4.10	4.23	3.96	4.33	3.82	4.02	3.43	3.96
K2O	0.13	0.14	0.12	0.13	0.11	0.12	0.13	0.15	0.12	0.11	0.10	0.11
SO3	2.74	2.78	2.83	3.90	3.83	3.84	3.81	3.80	3.50	3.76	3.42	3.71
Cl	0.10	0.11	0.10	0.06	0.06	0.07	0.09	0.08	0.06	0.07	0.07	0.06
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	96.67	95.54	96.67	93.83	93.43	94.24	93.83	93.67	93.24	94.13	92.69	93.96
Cations Recalculated on the Basis of 24O												
Si	6.82	6.86	6.73	6.74	6.70	6.79	6.76	6.71	6.61	6.64	6.66	6.63
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.30	4.30	4.35	4.12	4.14	4.04	4.09	4.10	4.23	4.19	4.25	4.20
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.45	2.44	2.54	2.51	2.49	2.48	2.50	2.52	2.68	2.60	2.62	2.62
Na	1.10	0.93	1.07	0.99	1.17	1.20	1.13	1.24	1.10	1.14	0.99	1.13
K	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02
S	0.29	0.30	0.30	0.43	0.42	0.42	0.42	0.42	0.39	0.42	0.38	0.41
C*	0.68	0.67	0.67	0.56	0.56	0.56	0.56	0.56	0.60	0.57	0.60	0.58
Cl	0.02	0.03	0.02	0.01	0.01	0.02	0.02	0.02	0.01	0.02	0.02	0.01
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.71	15.57	15.73	15.42	15.55	15.54	15.52	15.61	15.66	15.61	15.57	15.62
%Me	69	72	70	72	68	67	69	67	71	69	72	70
%Ma	31	28	30	28	32	33	31	33	29	31	28	30

Continued→

Sample:	CB15-72 (Type 1 Pegmatite)												
Mineral	Scapolite												
No.	134	135	136	137	138	139	140	141	142	143	144	145	146
Wt%													
SiO2	45.40	46.89	46.89	46.93	47.09	47.04	46.33	46.55	46.85	46.53	45.83	45.96	45.91
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	24.66	24.07	23.93	23.95	24.07	23.97	23.50	23.69	23.44	23.66	23.33	24.09	24.12
Cr2O3	0.00	0.01	0.00	0.01	0.01	0.02	0.00	0.01	0.02	0.02	0.02	0.00	0.00
FeO	0.13	0.16	0.15	0.13	0.16	0.14	0.20	0.13	0.14	0.12	0.14	0.16	0.16
MgO	0.02	0.01	0.02	0.00	0.01	0.00	0.02	0.01	0.00	0.01	0.00	0.02	0.01
MnO	0.03	0.04	0.01	0.05	0.05	0.04	0.02	0.05	0.02	0.00	0.02	0.04	0.04
CaO	16.96	15.88	15.89	15.64	15.80	15.73	15.53	15.71	15.44	15.63	15.61	16.17	16.02
Na2O	4.00	3.95	4.14	3.78	4.26	4.16	4.24	3.94	4.18	4.16	3.87	3.48	3.95
K2O	0.11	0.13	0.13	0.14	0.15	0.12	0.17	0.15	0.15	0.17	0.16	0.14	0.15
SO3	3.56	3.87	3.85	3.95	3.94	4.05	3.97	3.94	3.82	3.82	3.85	3.42	3.70
Cl	0.06	0.07	0.08	0.07	0.08	0.07	0.10	0.12	0.11	0.13	0.10	0.10	0.10
F	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	94.91	95.06	95.07	94.65	95.59	95.32	94.06	94.26	94.14	94.22	92.89	93.55	94.13
Cations Recalculated on the Basis of 24O													
Si	6.62	6.77	6.78	6.79	6.77	6.77	6.77	6.78	6.83	6.79	6.78	6.76	6.72
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.24	4.10	4.08	4.09	4.08	4.07	4.05	4.07	4.03	4.07	4.07	4.18	4.16
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.65	2.46	2.46	2.43	2.43	2.43	2.43	2.45	2.41	2.44	2.47	2.55	2.51
Na	1.13	1.10	1.16	1.06	1.19	1.16	1.20	1.11	1.18	1.18	1.11	0.99	1.12
K	0.02	0.02	0.02	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03
S	0.39	0.42	0.42	0.43	0.42	0.44	0.44	0.43	0.42	0.42	0.43	0.38	0.41
C*	0.59	0.56	0.56	0.55	0.55	0.55	0.54	0.54	0.56	0.55	0.55	0.60	0.57
Cl	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.02
F	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.68	15.48	15.52	15.42	15.52	15.47	15.51	15.46	15.50	15.52	15.48	15.53	15.56
%Me	70	69	68	69	67	67	67	68	67	67	69	72	69
%Ma	30	31	32	31	33	33	33	32	33	33	31	28	31

Continued→

Sample:	CB15-72 (Type 1 Pegmatite)								CB15-74 (Type 1 Pegmatite)			
Mineral	Scapolite											
No.	147	148	149	150	151	152	153	154	401	402	403	404
Wt%												
SiO2	46.50	45.44	45.46	45.43	45.36	45.12	45.25	43.86	47.68	47.91	48.18	48.31
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	23.90	24.19	24.04	24.00	24.21	24.24	24.02	24.08	25.18	24.88	25.25	25.15
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.10	0.18	0.20	0.16	0.18	0.17	0.21	0.14	0.07	0.14	0.05	0.10
MgO	0.01	0.03	0.03	0.02	0.04	0.04	0.04	0.03	0.06	0.04	0.04	0.05
MnO	0.03	0.01	0.03	0.02	0.06	0.03	0.04	0.03	0.01	0.00	0.02	0.02
CaO	15.96	16.36	16.38	16.37	16.45	16.33	16.08	16.69	15.98	15.72	16.11	15.91
Na2O	4.15	3.85	3.74	4.00	3.88	3.96	3.99	3.45	3.14	3.74	3.84	3.93
K2O	0.13	0.13	0.16	0.15	0.14	0.16	0.13	0.13	0.17	0.17	0.18	0.20
SO3	3.73	3.70	3.62	3.54	3.59	3.44	3.66	3.51	2.96	2.87	2.88	2.75
Cl	0.09	0.08	0.08	0.08	0.09	0.09	0.08	0.08	0.16	0.15	0.16	0.16
F	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Total	94.59	93.94	93.72	93.75	93.96	93.56	93.46	91.97	95.36	95.58	96.68	96.53
Cations Recalculated on the Basis of 24O												
Si	6.76	6.67	6.69	6.69	6.66	6.66	6.68	6.59	6.85	6.89	6.85	6.88
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.10	4.18	4.17	4.17	4.19	4.22	4.18	4.26	4.27	4.21	4.23	4.22
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.01	0.02	0.00	0.01
Mg	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01
Mn	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.49	2.57	2.58	2.58	2.59	2.58	2.54	2.69	2.46	2.42	2.46	2.43
Na	1.17	1.09	1.07	1.14	1.10	1.14	1.14	1.01	0.88	1.04	1.06	1.09
K	0.02	0.02	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.04
S	0.41	0.41	0.40	0.39	0.40	0.38	0.41	0.40	0.32	0.31	0.31	0.30
C*	0.57	0.57	0.58	0.59	0.58	0.59	0.57	0.58	0.64	0.65	0.65	0.67
Cl	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.04	0.04	0.04
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.56	15.57	15.58	15.64	15.61	15.67	15.60	15.60	15.51	15.62	15.65	15.68
%Me	68	70	70	69	70	69	69	72	73	69	69	69
%Ma	32	30	30	31	30	31	31	28	27	31	31	31

Continued→

Sample:	CB15-74 (Type 1 Pegmatite)												
Mineral	Scapolite												
No.	405	406	407	408	409	410	411	412	413	414	415	416	417
Wt%													
SiO2	48.05	47.90	47.58	47.58	48.24	47.74	47.86	47.86	47.44	47.55	47.80	47.77	47.97
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.14	25.21	24.87	25.40	25.01	25.26	25.04	24.97	25.10	25.38	25.13	25.05	25.54
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01
FeO	0.13	0.10	0.10	0.07	0.12	0.10	0.15	0.18	0.16	0.17	0.18	0.18	0.19
MgO	0.04	0.04	0.04	0.03	0.04	0.03	0.04	0.04	0.05	0.04	0.03	0.04	0.05
MnO	0.01	0.02	0.00	0.00	0.01	0.02	0.03	0.05	0.02	0.04	0.03	0.02	0.06
CaO	16.08	15.93	15.80	16.31	15.88	15.95	16.19	16.03	16.34	16.35	16.23	16.06	16.33
Na2O	3.91	3.66	3.64	3.89	3.77	3.83	3.06	3.85	3.63	3.92	3.81	3.86	3.75
K2O	0.15	0.14	0.16	0.15	0.18	0.17	0.20	0.21	0.18	0.19	0.19	0.35	0.18
SO3	2.93	2.94	2.83	2.90	2.84	2.80	2.91	2.74	3.09	3.04	2.99	2.91	2.96
Cl	0.15	0.14	0.14	0.16	0.17	0.17	0.17	0.16	0.12	0.13	0.17	0.14	0.15
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00
Total	96.55	96.05	95.13	96.45	96.21	96.04	95.61	96.04	96.10	96.77	96.54	96.34	97.15
Cations Recalculated on the Basis of 24O													
Si	6.85	6.85	6.87	6.79	6.89	6.84	6.87	6.86	6.79	6.78	6.82	6.83	6.80
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.22	4.25	4.23	4.28	4.21	4.27	4.24	4.22	4.24	4.26	4.23	4.22	4.27
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Mg	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Ca	2.46	2.44	2.44	2.50	2.43	2.45	2.49	2.46	2.51	2.50	2.48	2.46	2.48
Na	1.08	1.02	1.02	1.08	1.04	1.06	0.85	1.07	1.01	1.08	1.05	1.07	1.03
K	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.03	0.04	0.06	0.03
S	0.31	0.31	0.31	0.31	0.30	0.30	0.31	0.30	0.33	0.32	0.32	0.31	0.31
C*	0.65	0.65	0.66	0.65	0.65	0.66	0.64	0.66	0.64	0.64	0.64	0.65	0.65
Cl	0.04	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.04	0.03	0.04
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.65	15.60	15.62	15.69	15.63	15.67	15.51	15.69	15.61	15.68	15.65	15.68	15.66
%Me	69	70	70	69	69	69	74	69	71	69	70	69	70
%Ma	31	30	30	31	31	31	26	31	29	31	30	31	30

Continued→

Sample:	CB15-74 (Type 1 Pegmatite)			CB15-78 (Type 1 Pegmatite)									
Mineral	Scapolite												
No.	418	419	420		421	422	423	424	425	426	427	428	429
Wt%													
SiO2	47.42	47.39	47.29		46.20	46.98	47.03	46.39	46.61	46.69	46.32	47.31	47.22
TiO2	0.00	0.00	0.00		0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.42	25.59	25.69		25.42	25.39	25.46	25.82	25.43	25.65	25.76	25.18	25.49
Cr2O3	0.00	0.00	0.01		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.17	0.19	0.19		0.09	0.09	0.08	0.12	0.08	0.08	0.07	0.10	0.09
MgO	0.04	0.03	0.03		0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00
MnO	0.02	0.02	0.03		0.03	0.05	0.05	0.03	0.01	0.03	0.04	0.03	0.01
CaO	16.32	16.52	16.78		16.58	16.60	16.45	17.19	16.43	16.92	17.03	16.20	16.09
Na2O	3.84	3.61	3.63		3.73	3.93	4.08	3.96	4.19	3.78	3.80	4.31	4.08
K2O	0.16	0.19	0.21		0.14	0.15	0.13	0.13	0.13	0.13	0.11	0.12	0.14
SO3	2.84	2.76	3.07		2.87	2.64	2.73	2.71	2.68	2.57	2.58	2.73	2.69
Cl	0.13	0.15	0.12		0.11	0.10	0.13	0.10	0.12	0.12	0.10	0.13	0.12
F	0.02	0.00	0.01		0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Total	96.34	96.41	97.01		95.14	95.91	96.11	96.43	95.64	95.94	95.79	96.08	95.91
Cations Recalculated on the Basis of 24O													
Si	6.78	6.78	6.72		6.71	6.77	6.76	6.67	6.74	6.73	6.69	6.80	6.79
Ti	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.29	4.32	4.31		4.35	4.31	4.31	4.37	4.33	4.36	4.39	4.26	4.32
Cr	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.02	0.02	0.02		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mg	0.01	0.01	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00		0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.50	2.53	2.56		2.58	2.56	2.53	2.65	2.54	2.61	2.64	2.49	2.48
Na	1.07	1.00	1.00		1.05	1.10	1.14	1.10	1.17	1.06	1.07	1.20	1.14
K	0.03	0.03	0.04		0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02
S	0.30	0.30	0.33		0.31	0.29	0.30	0.29	0.29	0.28	0.28	0.29	0.29
C*	0.66	0.67	0.64		0.66	0.69	0.67	0.68	0.68	0.69	0.70	0.67	0.68
Cl	0.03	0.04	0.03		0.03	0.02	0.03	0.02	0.03	0.03	0.02	0.03	0.03
F	0.01	0.00	0.01		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.70	15.69	15.66		15.72	15.78	15.78	15.83	15.82	15.79	15.82	15.80	15.76
%Me	70	71	71		71	70	69	70	68	71	71	67	68
%Ma	30	29	29	100	29	30	31	30	32	29	29	33	32

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Sample:	CB15-78 (Type 1 Pegmatite)												
Mineral	Scapolite												
No.	430	431	432	433	434	435	445	446	447	448	449	450	451
Wt%													
SiO2	46.93	46.80	46.54	46.49	45.95	46.15	46.69	44.90	46.88	46.14	46.52	47.75	43.26
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.51	25.65	25.06	25.32	25.53	25.66	25.76	24.94	25.52	25.61	25.62	25.64	23.97
Cr2O3	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.00
FeO	0.08	0.05	0.06	0.06	0.06	0.08	0.07	0.07	0.14	0.09	0.08	0.13	0.09
MgO	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.02	0.03	0.00	0.00	0.02	0.01
MnO	0.03	0.03	0.06	0.01	0.03	0.04	0.04	0.04	0.04	0.03	0.03	0.02	0.04
CaO	16.33	16.70	16.19	16.32	16.80	16.82	16.70	16.18	16.68	16.65	16.85	15.49	15.47
Na2O	4.16	3.28	3.96	3.87	3.62	3.63	3.83	3.73	3.74	3.53	3.84	3.17	3.03
K2O	0.12	0.10	0.12	0.11	0.12	0.13	0.12	0.11	0.14	0.13	0.11	0.14	0.12
SO3	2.80	2.58	2.74	2.95	2.62	2.64	3.05	2.70	3.03	2.90	2.74	2.64	2.63
Cl	0.11	0.11	0.12	0.12	0.09	0.10	0.11	0.17	0.10	0.10	0.12	0.09	0.19
F	0.00	0.02	0.06	0.03	0.03	0.00	0.04	0.07	0.02	0.02	0.01	0.00	0.00
Total	96.06	95.32	94.86	95.24	94.82	95.23	96.38	92.86	96.28	95.17	95.90	95.08	88.77
Cations Recalculated on the Basis of 24O													
Si	6.75	6.77	6.77	6.73	6.70	6.70	6.69	6.69	6.72	6.69	6.71	6.88	6.72
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.32	4.37	4.30	4.32	4.39	4.39	4.35	4.38	4.31	4.38	4.35	4.35	4.39
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.02	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.52	2.59	2.52	2.53	2.63	2.62	2.56	2.58	2.56	2.59	2.60	2.39	2.58
Na	1.16	0.92	1.12	1.09	1.02	1.02	1.06	1.08	1.04	0.99	1.08	0.89	0.91
K	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.03	0.02
S	0.30	0.28	0.30	0.32	0.29	0.29	0.33	0.30	0.33	0.32	0.30	0.29	0.30
C*	0.67	0.68	0.64	0.64	0.68	0.69	0.63	0.62	0.64	0.65	0.67	0.69	0.65
Cl	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.04	0.02	0.02	0.03	0.02	0.05
F	0.00	0.01	0.03	0.01	0.01	0.00	0.02	0.03	0.01	0.01	0.00	0.00	0.00
Total	15.78	15.67	15.75	15.70	15.76	15.77	15.70	15.76	15.68	15.68	15.77	15.55	15.64
%Me	68	74	69	70	72	72	70	70	71	72	71	73	73
%Ma	32	26	31	30	28	28	30	30	29	28	29	27	27

Continued→

Sample:	CB15-78 (Type 1 Pegmatite)			Sample:	CB15-12 (Type 1 Pegmatite)							
Mineral	Scapolite			Mineral:	Plagioclase							
No.	452	453	454	No.	259	260	261	262	263	264	265	291
Wt%				Wt%								
SiO2	46.83	45.51	46.28	SiO2	61.76	61.74	62.40	62.18	61.73	61.93	61.97	62.31
TiO2	0.01	0.00	0.00	TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.78	24.96	25.74	Al2O3	24.54	24.85	24.23	24.42	24.66	24.36	24.61	25.07
Cr2O3	0.00	0.01	0.00	Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.12	0.11	0.13	FeO	0.02	0.02	0.01	0.00	0.01	0.02	0.03	0.08
MgO	0.02	0.03	0.02	MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MnO	0.04	0.02	0.05	MnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	17.00	15.91	17.07	CaO	5.74	5.87	5.38	5.65	5.90	5.70	5.58	5.92
Na2O	3.97	3.90	3.64	Na2O	8.36	8.08	8.30	8.30	8.48	8.50	8.64	8.22
K2O	0.14	0.14	0.14	K2O	0.24	0.17	0.35	0.30	0.23	0.32	0.28	0.14
SO3	3.06	2.71	2.95	SO3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Cl	0.11	0.18	0.09	Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.06	0.00	0.00	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	97.08	93.42	96.08	Total	100.65	100.73	100.68	100.86	101.01	100.82	101.09	101.76
Cations Recalculated on the Basis of 24O				Cations Recalculated on the Basis of 8O								
Si	6.67	6.73	6.66	Si	2.72	2.72	2.75	2.74	2.72	2.73	2.72	2.72
Ti	0.00	0.00	0.00	Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.33	4.35	4.37	Al	1.28	1.29	1.26	1.27	1.28	1.27	1.28	1.29
Cr	0.00	0.00	0.00	Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.01	Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mg	0.00	0.01	0.00	Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.01	Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.59	2.52	2.63	Ca	0.27	0.28	0.25	0.27	0.28	0.27	0.26	0.28
Na	1.10	1.12	1.02	Na	0.72	0.69	0.71	0.71	0.72	0.73	0.74	0.69
K	0.03	0.03	0.03	K	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.01
S	0.33	0.30	0.32	S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C*	0.62	0.65	0.66	Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.03	0.05	0.02	F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.03	0.00	0.00	Total	5.00	4.99	4.99	4.99	5.01	5.01	5.01	4.99
Total	15.74	15.77	15.72									
				%Ab	72	71	72	71	71	72	73	71
%Me	70	69	72	%An	27	28	26	27	27	27	26	28
%Ma	30	31	28	%Or	1	1	2	2	1	2	1	1

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Sample:	CB15-12 (Type 1 Pegmatite)							CB15-25 (Type 1 Pegmatite)				
Mineral:	Plagioclase											
No.	292	293	294	295	296	297	298	198	199	200	201	202
Wt%												
SiO2	61.50	62.23	61.54	62.18	61.37	61.37	62.43	61.57	61.11	62.93	64.09	63.83
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.12	24.72	25.31	24.17	25.43	25.09	24.89	25.02	25.23	23.83	22.69	22.64
Cr2O3	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00
FeO	0.08	0.09	0.07	0.10	0.08	0.05	0.07	0.04	0.03	0.06	0.07	0.06
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MnO	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
CaO	6.11	5.72	6.41	5.33	6.46	6.15	5.63	6.18	6.49	4.95	4.13	4.15
Na2O	7.78	8.24	7.85	8.38	8.03	7.74	8.48	7.12	7.68	8.58	8.78	7.25
K2O	0.18	0.29	0.17	0.31	0.15	0.20	0.24	0.29	0.17	0.40	0.52	0.60
SO3	0.04	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.81	101.30	101.34	100.49	101.55	100.60	101.76	100.21	100.71	100.75	100.28	98.52
Cations Recalculated on the Basis of 8O												
Si	2.71	2.73	2.70	2.74	2.69	2.71	2.72	2.72	2.70	2.77	2.82	2.84
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.30	1.28	1.31	1.26	1.31	1.30	1.28	1.30	1.31	1.24	1.18	1.19
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.29	0.27	0.30	0.25	0.30	0.29	0.26	0.29	0.31	0.23	0.19	0.20
Na	0.66	0.70	0.67	0.72	0.68	0.66	0.72	0.61	0.66	0.73	0.75	0.63
K	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.02	0.03	0.03
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.98	4.99	4.99	4.99	5.00	4.98	5.00	4.94	4.98	4.99	4.98	4.89
%Ab	69	71	68	73	69	69	72	66	68	74	77	73
%An	30	27	31	26	31	30	26	32	31	24	20	23
%Or	1	2	1	2	1	1	1	2	1	2	3	4

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Sample:	CB15-25 (Type 1 Pegmatite)					CB15-20 (Type 1 Pegmatite)						
Mineral:	Plagioclase											
No.	203	204	205	206	207	262	263	306	307	309	310	311
Wt%												
SiO2	60.26	63.68	63.97	63.16	62.70	57.61	57.90	57.89	57.58	55.83	57.63	57.44
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.68	22.76	22.74	23.58	23.52	24.80	24.76	25.03	24.86	25.62	25.23	25.13
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
FeO	0.00	0.08	0.07	0.08	0.03	0.16	0.09	0.21	0.23	0.19	0.26	0.20
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
CaO	7.12	4.14	4.13	4.81	4.71	7.76	7.60	7.49	7.43	8.83	8.08	8.36
Na2O	6.26	6.54	8.33	8.39	8.69	7.02	7.32	7.25	7.07	6.87	6.92	6.87
K2O	0.10	0.51	0.59	0.47	0.35	0.25	0.29	0.32	0.38	0.31	0.33	0.30
SO3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.04	0.03	0.01
Cl	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.02	0.00
Total	99.43	97.71	99.81	100.49	100.00	97.60	97.95	98.21	97.59	97.69	98.50	98.33
Cations Recalculated on the Basis of 8O												
Si	2.68	2.85	2.83	2.78	2.78	2.64	2.65	2.64	2.64	2.57	2.62	2.62
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.35	1.20	1.18	1.22	1.23	1.34	1.33	1.34	1.34	1.39	1.35	1.35
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.34	0.20	0.20	0.23	0.22	0.38	0.37	0.37	0.36	0.44	0.39	0.41
Na	0.54	0.57	0.71	0.72	0.75	0.62	0.65	0.64	0.63	0.61	0.61	0.61
K	0.01	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.92	4.85	4.95	4.98	4.99	5.01	5.02	5.02	5.01	5.04	5.01	5.02
%Ab	61	71	76	74	75	61	63	63	62	57	60	59
%An	38	25	21	23	23	37	36	36	36	41	39	40
%Or	1	4	3	3	2	1	2	2	2	2	2	2

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Sample:	CB15-20 (Type 1 Pegmatite)			CB15-59 (Type 1 Pegmatite)								
Mineral:	Plagioclase											
No.	312	313	314	865	866	867	868	869	870	871	872	873
Wt%												
SiO2	57.50	57.85	57.76	59.33	58.97	58.65	58.95	58.60	57.40	59.06	59.22	58.68
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.17	25.23	25.20	25.60	25.55	25.59	25.59	25.72	25.86	25.81	25.84	26.05
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00
FeO	0.19	0.26	0.21	0.05	0.05	0.06	0.05	0.04	0.04	0.03	0.07	0.02
MgO	0.00	0.00	0.00	0.01	0.01	0.01	0.02	0.01	0.00	0.01	0.01	0.00
MnO	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	8.01	8.09	8.01	7.59	7.46	7.46	7.68	7.69	7.96	7.80	7.79	7.89
Na2O	6.92	6.08	7.02	7.14	6.88	7.10	7.00	6.91	6.76	6.93	7.00	7.10
K2O	0.23	0.25	0.28	0.34	0.40	0.41	0.39	0.38	0.34	0.31	0.31	0.13
SO3	0.05	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	98.09	97.79	98.53	100.06	99.32	99.28	99.67	99.33	98.37	99.94	100.24	99.88
Cations Recalculated on the Basis of 8O												
Si	2.62	2.64	2.63	2.65	2.65	2.64	2.64	2.64	2.61	2.64	2.64	2.62
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.35	1.36	1.35	1.35	1.35	1.36	1.35	1.36	1.39	1.36	1.36	1.37
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.39	0.40	0.39	0.36	0.36	0.36	0.37	0.37	0.39	0.37	0.37	0.38
Na	0.61	0.54	0.62	0.62	0.60	0.62	0.61	0.60	0.60	0.60	0.60	0.62
K	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	5.01	4.96	5.01	5.00	4.99	5.00	5.00	4.99	5.00	4.99	4.99	5.00
%Ab	60	57	60	62	61	62	61	61	59	61	61	62
%An	38	42	38	36	37	36	37	37	39	38	37	38
%Or	1	2	2	2	2	2	2	2	2	2	2	1

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Sample:	CB15-59	CB15-74 (Type 1 Pegmatite)									
Mineral:	Plagioclase										
No.	874	550	551	552	553	554	555	556	557	558	559
Wt%											
SiO2	59.05	61.35	60.43	61.69	62.16	62.89	60.49	61.11	60.43	61.15	61.77
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.61	23.86	24.04	23.27	22.95	22.53	24.42	23.98	23.84	23.69	23.19
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.10	0.08	0.10	0.13	0.18	0.15	0.11	0.12	0.11	0.12	0.10
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
MnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01
CaO	7.79	5.73	6.11	5.15	4.75	4.44	6.26	5.90	5.95	5.77	5.23
Na2O	6.31	6.79	5.55	6.66	7.67	7.31	7.62	6.71	7.70	7.53	7.16
K2O	0.27	0.45	0.40	0.48	0.44	0.42	0.31	0.35	0.39	0.46	0.49
SO3	0.03	0.00	0.02	0.02	0.02	0.00	0.03	0.01	0.03	0.00	0.03
Cl	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	99.17	98.26	96.65	97.42	98.17	97.73	99.24	98.20	98.45	98.72	97.99
Cations Recalculated on the Basis of 8O											
Si	2.65	2.76	2.75	2.79	2.80	2.83	2.71	2.75	2.73	2.75	2.78
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.36	1.26	1.29	1.24	1.22	1.19	1.29	1.27	1.27	1.25	1.23
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.37	0.28	0.30	0.25	0.23	0.21	0.30	0.28	0.29	0.28	0.25
Na	0.55	0.59	0.49	0.58	0.67	0.64	0.66	0.59	0.67	0.66	0.63
K	0.02	0.03	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.03	0.03
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.95	4.92	4.86	4.90	4.94	4.90	4.98	4.92	4.98	4.97	4.93
%Ab	59	66	60	68	73	73	68	66	68	68	69
%An	40	31	37	29	25	24	31	32	29	29	28
%Or	2	3	3	3	3	3	2	2	2	3	3

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Sample:	CB15-78 (Type 1 Pegmatite)										CB15-12 (Type 1 Pegı	
Mineral:	Plagioclase										K-Feldspar	
No.	610	611	612	613	614	615	616	617	618	619	266	267
Wt%												
SiO2	59.09	58.61	60.44	59.67	60.70	61.09	60.15	59.49	60.02	60.70	64.11	65.15
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Al2O3	25.20	25.29	24.50	25.40	24.47	24.16	24.73	25.35	24.99	24.26	18.94	18.92
Cr2O3	0.00	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.03	0.14	0.07	0.09	0.09	0.08	0.10	0.10	0.09	0.08	0.00	0.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MnO	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
CaO	7.09	7.53	6.44	7.17	6.31	6.06	6.81	7.26	6.95	6.44	0.03	0.04
Na2O	6.21	5.73	6.82	7.11	6.71	6.88	7.46	7.05	6.91	6.91	0.99	0.99
K2O	0.20	0.24	0.21	0.27	0.31	0.27	0.22	0.26	0.28	0.28	15.44	15.70
SO3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02
Cl	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00
F	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.01	0.02	0.00	0.00
Total	97.81	97.54	98.47	99.72	98.62	98.55	99.47	99.50	99.24	98.69	99.51	100.81
Cations Recalculated on the Basis of 8O												
Si	2.68	2.67	2.72	2.67	2.72	2.74	2.69	2.66	2.69	2.73	2.97	2.98
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.35	1.36	1.30	1.34	1.29	1.28	1.30	1.34	1.32	1.28	1.04	1.02
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.34	0.37	0.31	0.34	0.30	0.29	0.33	0.35	0.33	0.31	0.00	0.00
Na	0.55	0.50	0.59	0.62	0.58	0.60	0.65	0.61	0.60	0.60	0.09	0.09
K	0.01	0.01	0.01	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.91	0.92
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.93	4.91	4.94	4.98	4.93	4.93	4.98	4.98	4.96	4.94	5.01	5.01
%Ab	61	57	65	63	65	66	66	63	63	65	9	9
%An	38	41	34	35	34	32	33	36	35	33	0	0
%Or	1	2	1	2	2	2	1	1	2	2	91	91

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Sample:	CB15-12 (Type 1 Pegmatite)												
Mineral:	K-Feldspar												
No.	268	269	270	281	282	283	284	285	286	287	288	289	290
Wt%													
SiO2	65.71	64.98	64.42	64.91	64.71	65.22	65.20	64.72	65.31	65.06	64.70	65.03	65.16
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	19.10	18.99	18.83	19.00	18.69	19.01	18.77	18.96	18.87	19.02	18.95	18.91	18.97
Cr2O3	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.01	0.00	0.03	0.02
FeO	0.00	0.03	0.04	0.03	0.02	0.04	0.04	0.03	0.05	0.03	0.05	0.03	0.04
MgO	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	0.04	0.05	0.09	0.07	0.03	0.05	0.03	0.04	0.07	0.05	0.00	0.05	0.08
Na2O	1.19	0.93	0.88	0.98	0.93	1.12	1.00	0.98	1.33	1.44	1.03	1.21	1.12
K2O	13.04	15.69	15.87	15.68	15.78	15.53	15.79	15.73	14.70	14.83	15.64	14.89	15.13
SO3	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00
F	0.00	0.01	0.02	0.04	0.03	0.06	0.03	0.01	0.02	0.03	0.02	0.00	0.00
Total	99.09	100.68	100.16	100.69	100.17	101.01	100.84	100.48	100.34	100.46	100.39	100.15	100.53
Cations Recalculated on the Basis of 8O													
Si	3.01	2.98	2.97	2.98	2.98	2.98	2.99	2.98	2.99	2.98	2.98	2.99	2.98
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.03	1.03	1.02	1.03	1.02	1.02	1.01	1.03	1.02	1.03	1.03	1.02	1.02
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	0.11	0.08	0.08	0.09	0.08	0.10	0.09	0.09	0.12	0.13	0.09	0.11	0.10
K	0.76	0.92	0.94	0.92	0.93	0.90	0.92	0.92	0.86	0.87	0.92	0.87	0.88
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.91	5.01	5.02	5.02	5.02	5.02	5.02	5.02	4.99	5.01	5.02	4.99	5.00
%Ab	12	8	8	9	8	10	9	9	12	13	9	11	10
%An	0	0	0	0	0	0	0	0	0	0	0	0	0
%Or	88	92	92	91	92	90	91	91	88	87	91	89	90

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Sample:	CB15-25 (Type 1 Pegmatite)								CB15-74 (Type 1 Pegmatite)			
Mineral:	K-Feldspar											
No.	190	191	192	193	194	195	196	197	185	186	187	188
Wt%												
SiO2	65.10	65.06	65.40	65.02	65.32	65.42	64.90	65.28	61.01	61.02	61.30	62.66
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	18.78	18.63	18.63	18.70	18.61	18.58	18.74	18.72	17.44	17.54	17.41	17.69
Cr2O3	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.03	0.03	0.00	0.02	0.02	0.00	0.00	0.00	0.02	0.03	0.02	0.04
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
CaO	0.04	0.01	0.02	0.05	0.03	0.04	0.07	0.03	0.06	0.03	0.01	0.04
Na2O	0.71	0.78	0.41	0.61	0.38	0.48	0.64	0.41	0.77	0.81	0.59	0.73
K2O	16.00	15.98	16.32	15.72	16.62	16.36	16.12	16.55	15.38	15.66	16.10	15.78
SO3	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.02
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.66	100.48	100.80	100.12	100.98	100.89	100.47	100.99	94.71	95.10	95.42	96.96
Cations Recalculated on the Basis of 8O												
Si	2.99	2.99	3.00	2.99	2.99	3.00	2.99	2.99	2.98	2.98	2.99	2.99
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.02	1.01	1.01	1.01	1.01	1.00	1.02	1.01	1.00	1.01	1.00	1.00
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	0.06	0.07	0.04	0.06	0.03	0.04	0.06	0.04	0.07	0.08	0.06	0.07
K	0.94	0.94	0.95	0.92	0.97	0.96	0.95	0.97	0.96	0.98	1.00	0.96
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	5.01	5.01	4.99	4.99	5.01	5.00	5.01	5.01	5.03	5.04	5.04	5.02
%Ab	6	7	4	6	3	4	6	4	7	7	5	7
%An	0	0	0	0	0	0	0	0	0	0	0	0
%Or	93	93	96	94	97	96	94	96	93	93	95	93

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Sample:	CB15-74 (Type 1 Pegmatite)								CB15-78 (Type 1 Pegmatite)			
Mineral:	K-Feldspar											
No.	189	190	191	192	193	194	195	196	560	561	562	563
Wt%												
SiO2	61.86	61.77	62.63	61.81	63.11	62.54	62.29	62.07	64.15	64.65	64.50	64.45
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01
Al2O3	17.61	17.55	17.72	17.60	18.01	18.10	17.93	17.92	18.12	18.32	18.03	18.11
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.02	0.00
FeO	0.05	0.02	0.04	0.01	0.05	0.07	0.04	0.03	0.05	0.05	0.05	0.07
MgO	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
MnO	0.02	0.02	0.00	0.00	0.02	0.01	0.00	0.00	0.03	0.02	0.01	0.00
CaO	0.07	0.03	0.04	0.03	0.05	0.07	0.06	0.07	0.05	0.04	0.06	0.05
Na2O	0.80	0.64	0.74	0.90	0.64	0.70	0.71	0.85	0.32	0.38	0.34	0.40
K2O	15.81	15.87	15.81	15.60	15.90	15.79	15.83	15.61	16.30	16.39	16.34	16.51
SO3	0.03	0.02	0.02	0.02	0.02	0.04	0.03	0.01	0.03	0.05	0.03	0.03
Cl	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.01	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	96.25	95.94	96.99	95.97	97.81	97.31	96.89	96.56	99.08	99.91	99.39	99.63
Cations Recalculated on the Basis of 8O												
Si	2.98	2.99	2.99	2.98	2.99	2.98	2.98	2.98	3.00	2.99	3.00	3.00
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.00	1.00	1.00	1.00	1.00	1.02	1.01	1.01	1.00	1.00	0.99	0.99
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	0.08	0.06	0.07	0.08	0.06	0.06	0.07	0.08	0.03	0.03	0.03	0.04
K	0.97	0.98	0.96	0.96	0.96	0.96	0.97	0.96	0.97	0.97	0.97	0.98
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	5.04	5.03	5.03	5.04	5.02	5.02	5.03	5.03	5.00	5.00	5.00	5.01
%Ab	7	6	7	8	6	6	6	8	3	3	3	4
%An	0	0	0	0	0	0	0	0	0	0	0	0
%Or	92	94	93	92	94	93	93	92	97	96	97	96

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Sample:	CB15-78 (Type 1 Pegmatite)							CB15-12 (Type 1 Pegmatite)					
Mineral:	K-Feldspar							Biotite					
No.	564	565	566	567	568	569		228	229	230	231	232	233
Wt%													
SiO2	64.61	64.61	64.89	64.57	64.53	64.53		36.13	36.37	36.68	36.39	36.18	35.98
TiO2	0.00	0.01	0.00	0.00	0.00	0.00		3.78	3.63	3.72	3.71	3.61	3.49
Al2O3	18.24	18.36	18.09	18.15	18.20	18.11		15.32	15.43	15.48	15.08	15.12	15.05
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00		0.05	0.03	0.01	0.02	0.03	0.02
FeO	0.04	0.07	0.04	0.04	0.06	0.06		20.66	20.71	21.05	20.72	20.62	20.25
MgO	0.01	0.01	0.01	0.01	0.00	0.01		10.25	10.33	10.47	10.36	10.21	10.61
MnO	0.01	0.02	0.01	0.00	0.00	0.00		0.30	0.24	0.25	0.28	0.26	0.22
CaO	0.05	0.05	0.03	0.05	0.05	0.05		0.07	0.02	0.00	0.00	0.03	0.05
Na2O	0.48	0.48	0.53	0.48	0.56	0.64		0.04	0.03	0.02	0.04	0.01	0.08
K2O	15.64	16.46	16.36	16.37	16.16	16.04		10.06	9.90	10.27	10.22	9.85	9.40
SO3	0.04	0.04	0.02	0.01	0.02	0.01		0.11	0.09	0.08	0.06	0.09	0.11
Cl	0.01	0.00	0.01	0.01	0.00	0.00		0.04	0.04	0.02	0.04	0.08	0.03
F	0.00	0.00	0.00	0.00	0.00	0.01		0.16	0.12	0.14	0.15	0.14	0.14
Total	99.12	100.10	100.00	99.68	99.57	99.45		96.88	96.89	98.13	97.00	96.15	95.36
Cations Recalculated on the Basis of 8O								Cations Recalculated on the Basis of 11O					
Si	3.00	2.99	3.00	3.00	3.00	3.00		2.75	2.76	2.75	2.77	2.77	2.77
Ti	0.00	0.00	0.00	0.00	0.00	0.00		0.22	0.21	0.21	0.21	0.21	0.20
Al	1.00	1.00	0.99	0.99	1.00	0.99		1.37	1.38	1.37	1.35	1.36	1.36
Cr	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.00	0.00		1.31	1.31	1.32	1.32	1.32	1.30
Mg	0.00	0.00	0.00	0.00	0.00	0.00		1.16	1.17	1.17	1.17	1.16	1.22
Mn	0.00	0.00	0.00	0.00	0.00	0.00		0.02	0.02	0.02	0.02	0.02	0.01
Ca	0.00	0.00	0.00	0.00	0.00	0.00		0.01	0.00	0.00	0.00	0.00	0.00
Na	0.04	0.04	0.05	0.04	0.05	0.06		0.01	0.00	0.00	0.01	0.00	0.01
K	0.93	0.97	0.97	0.97	0.96	0.95		0.98	0.96	0.98	0.99	0.96	0.92
S	0.00	0.00	0.00	0.00	0.00	0.00		0.01	0.01	0.00	0.00	0.01	0.01
Cl	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.01	0.00	0.01	0.01	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00		0.04	0.03	0.03	0.04	0.03	0.03
Total	4.98	5.02	5.01	5.01	5.01	5.01		7.87	7.85	7.87	7.88	7.86	7.84
%Ab	4	4	5	4	5	6							
%An	0	0	0	0	0	0	%Ann	53	53	53	53	53	52
%Or	95	96	95	96	95	94	%Phl	47	47	47	47	47	48

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Sample:	CB15-12 (Type 1 Pegmatite)									CB15-20	
Mineral:	Biotite										
No.	234	235	236	237	238	239	240	241	242	243	315	316
Wt%												
SiO2	36.10	36.23	36.31	34.01	36.01	36.41	36.25	35.73	36.49	36.26	34.85	34.41
TiO2	3.63	3.74	3.54	3.86	3.76	3.84	3.78	4.10	3.99	3.95	3.43	3.59
Al2O3	15.29	15.45	15.14	14.19	15.54	15.71	15.29	15.06	15.60	15.81	14.70	14.67
Cr2O3	0.02	0.00	0.03	0.02	0.00	0.04	0.01	0.01	0.02	0.02	3.43	3.59
FeO	20.47	19.89	20.90	17.90	19.38	19.12	18.40	18.68	18.38	18.52	17.43	17.64
MgO	10.28	10.66	10.36	10.28	10.88	10.97	10.92	10.45	11.03	11.08	12.01	11.98
MnO	0.26	0.13	0.29	0.24	0.23	0.21	0.20	0.18	0.21	0.22	0.18	0.18
CaO	0.00	0.08	0.00	0.08	0.01	0.00	0.03	0.04	0.00	0.04	0.03	0.03
Na2O	0.01	0.03	0.02	0.09	0.02	0.01	0.05	0.02	0.03	0.03	0.05	0.06
K2O	9.92	9.95	10.07	9.99	9.46	9.80	9.29	9.58	9.75	9.61	9.77	9.86
SO3	0.09	0.06	0.12	0.11	0.06	0.06	0.10	0.11	0.08	0.09	0.14	0.14
Cl	0.04	0.04	0.03	0.06	0.06	0.06	0.08	0.06	0.05	0.05	0.04	0.05
F	0.14	0.14	0.15	0.09	0.10	0.13	0.17	0.14	0.16	0.13	0.18	0.16
Total	96.19	96.30	96.88	90.86	95.44	96.29	94.45	94.08	95.70	95.74	92.74	92.72
Cations Recalculated on the Basis of 11O												
Si	2.76	2.76	2.76	2.75	2.75	2.76	2.78	2.77	2.77	2.75	2.74	2.71
Ti	0.21	0.21	0.20	0.23	0.22	0.22	0.22	0.24	0.23	0.23	0.20	0.21
Al	1.38	1.38	1.36	1.35	1.40	1.40	1.38	1.38	1.39	1.41	1.36	1.36
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	1.31	1.27	1.33	1.21	1.24	1.21	1.18	1.21	1.17	1.17	1.14	1.16
Mg	1.17	1.21	1.17	1.24	1.24	1.24	1.25	1.21	1.25	1.25	1.40	1.41
Mn	0.02	0.01	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ca	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01
K	0.97	0.97	0.98	1.03	0.92	0.95	0.91	0.95	0.94	0.93	0.98	0.99
S	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.01	0.01
Cl	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
F	0.03	0.03	0.04	0.02	0.02	0.03	0.04	0.03	0.04	0.03	0.04	0.04
Total	7.86	7.85	7.87	7.88	7.82	7.83	7.80	7.81	7.82	7.81	7.91	7.93
%Ann	53	51	53	49	50	49	49	50	48	48	45	45
%Phl	47	49	47	51	50	51	51	50	52	52	55	55

Continued→

Sample:	CB15-20 (Type 1 Pegmatite)												
Mineral:	Biotite												
No.	317	318	319	320	321	322	323	324	351	352	353	354	355
Wt%													
SiO2	35.03	34.70	34.80	34.75	34.48	34.37	34.31	34.30	35.20	35.18	35.38	35.36	35.08
TiO2	3.43	3.49	3.44	3.37	3.87	3.60	3.92	4.71	4.68	4.68	4.64	4.69	4.60
Al2O3	14.31	14.63	14.73	14.22	14.14	14.06	14.05	14.23	14.20	14.24	14.26	14.05	14.28
Cr2O3	3.43	3.49	3.44	3.37	3.87	3.60	3.92	4.71	4.68	4.68	4.64	4.69	4.60
FeO	17.63	17.88	17.44	17.37	17.65	17.93	17.49	17.98	17.16	17.29	16.93	17.22	17.42
MgO	11.93	11.96	11.95	12.19	11.93	12.17	11.95	11.33	11.76	11.84	11.89	11.98	11.93
MnO	0.20	0.17	0.18	0.18	0.18	0.18	0.17	0.20	0.14	0.12	0.14	0.14	0.12
CaO	0.05	0.07	0.05	0.02	0.03	0.03	0.04	0.04	0.01	0.00	0.00	0.00	0.00
Na2O	0.04	0.06	0.05	0.08	0.06	0.06	0.07	0.08	0.04	0.04	0.03	0.03	0.03
K2O	9.97	9.80	9.76	9.79	9.75	9.92	9.84	9.78	9.88	10.02	9.94	9.87	9.89
SO3	0.11	0.18	0.10	0.10	0.09	0.14	0.10	0.10	0.05	0.06	0.04	0.02	0.03
Cl	0.05	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.03	0.04	0.04	0.04	0.03
F	0.18	0.18	0.19	0.20	0.16	0.18	0.16	0.14	0.12	0.13	0.15	0.12	0.16
Total	92.84	93.11	92.69	92.27	92.36	92.67	92.10	92.92	93.24	93.61	93.40	93.49	93.53
Cations Recalculated on the Basis of 11O													
Si	2.75	2.72	2.73	2.75	2.73	2.72	2.72	2.70	2.75	2.74	2.75	2.75	2.73
Ti	0.20	0.21	0.20	0.20	0.23	0.21	0.23	0.28	0.27	0.27	0.27	0.27	0.27
Al	1.33	1.35	1.36	1.32	1.32	1.31	1.31	1.32	1.31	1.31	1.31	1.29	1.31
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	1.16	1.17	1.15	1.15	1.17	1.19	1.16	1.18	1.12	1.12	1.10	1.12	1.14
Mg	1.40	1.40	1.40	1.44	1.41	1.43	1.41	1.33	1.37	1.37	1.38	1.39	1.38
Mn	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ca	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
K	1.00	0.98	0.98	0.99	0.98	1.00	1.00	0.98	0.98	0.99	0.99	0.98	0.98
S	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Cl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.00
F	0.05	0.04	0.05	0.05	0.04	0.04	0.04	0.03	0.03	0.03	0.04	0.03	0.04
Total	7.92	7.92	7.91	7.93	7.91	7.95	7.92	7.88	7.85	7.86	7.85	7.86	7.87
%Ann	45	46	45	44	45	45	45	47	45	45	44	45	45
%Phl	55	54	55	56	55	55	55	53	55	55	56	55	55

Continued→

Sample:	CB15-20 (Type 1 Pegmatite)					CB15-25 (Type 1 Pegmatite)						
Mineral:	Biotite											
No.	356	357	358	359	360	180	181	182	183	184	185	186
Wt%												
SiO2	34.79	34.96	35.06	35.10	35.11	36.68	36.41	36.73	36.54	36.53	37.05	35.68
TiO2	4.63	4.50	4.56	4.59	4.50	5.13	4.96	5.03	4.49	4.33	4.84	4.65
Al2O3	14.45	14.36	14.25	14.33	14.48	15.01	15.01	15.02	15.18	15.16	15.26	14.96
Cr2O3	4.63	4.50	4.56	4.59	4.50	0.01	0.00	0.02	0.02	0.02	0.00	0.01
FeO	17.53	16.91	17.15	17.07	17.14	17.66	18.11	17.84	17.64	17.18	17.92	17.44
MgO	11.77	11.86	11.75	11.88	11.85	11.73	11.52	11.77	12.03	12.20	12.11	11.80
MnO	0.12	0.12	0.14	0.13	0.14	0.14	0.17	0.15	0.12	0.10	0.13	0.13
CaO	0.01	0.00	0.00	0.00	0.01	0.05	0.04	0.03	0.02	0.03	0.02	0.05
Na2O	0.06	0.03	0.04	0.05	0.04	0.05	0.08	0.05	0.03	0.04	0.05	0.08
K2O	9.85	9.73	9.77	9.89	9.68	10.01	9.37	10.00	9.95	9.61	10.03	9.36
SO3	0.06	0.05	0.05	0.06	0.05	0.08	0.08	0.13	0.09	0.11	0.12	0.09
Cl	0.03	0.04	0.04	0.03	0.04	0.11	0.13	0.11	0.13	0.13	0.12	0.14
F	0.17	0.15	0.11	0.14	0.13	0.14	0.15	0.13	0.15	0.16	0.16	0.17
Total	93.44	92.66	92.91	93.23	93.14	96.71	95.92	96.92	96.29	95.50	97.71	94.43
Cations Recalculated on the Basis of 11O												
Si	2.72	2.74	2.74	2.74	2.74	2.75	2.75	2.75	2.75	2.76	2.75	2.74
Ti	0.27	0.27	0.27	0.27	0.26	0.29	0.28	0.28	0.25	0.25	0.27	0.27
Al	1.33	1.33	1.31	1.32	1.33	1.33	1.34	1.33	1.35	1.35	1.33	1.35
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	1.14	1.11	1.12	1.11	1.12	1.11	1.15	1.12	1.11	1.09	1.11	1.12
Mg	1.37	1.38	1.37	1.38	1.38	1.31	1.30	1.31	1.35	1.38	1.34	1.35
Mn	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01
K	0.98	0.97	0.98	0.98	0.96	0.96	0.90	0.95	0.96	0.93	0.95	0.92
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
Cl	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.01	0.02	0.02	0.01	0.02
F	0.04	0.04	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.04	0.04	0.04
Total	7.88	7.86	7.85	7.86	7.85	7.82	7.80	7.81	7.84	7.82	7.83	7.83
%Ann	46	44	45	45	45	46	47	46	45	44	45	45
%Phl	54	56	55	55	55	54	53	54	55	56	55	55

Continued→

Sample:	CB15-25 (Type 1 Pegmatite)			CB15-40 (Type 1 Pegmatite)								
Mineral:	Biotite											
No.	187	188	189	213	261	262	263	264	265	266	267	268
Wt%												
SiO2	36.69	36.86	36.72	36.68	36.49	36.44	35.89	35.90	36.23	36.38	36.45	36.27
TiO2	4.79	4.46	4.68	4.53	4.53	4.51	4.48	4.33	4.41	4.44	4.38	4.34
Al2O3	15.08	15.07	15.31	15.40	15.69	15.73	15.52	15.40	15.44	15.85	15.76	15.71
Cr2O3	0.02	0.01	0.03	0.04	0.04	0.02	0.00	0.02	0.00	0.02	0.01	0.01
FeO	17.72	17.38	17.84	18.77	18.61	19.03	18.30	18.31	18.60	18.29	18.40	18.13
MgO	11.89	12.19	12.28	11.02	10.79	11.02	10.71	10.63	10.87	11.12	11.04	10.97
MnO	0.17	0.11	0.10	0.23	0.28	0.30	0.25	0.25	0.27	0.29	0.29	0.28
CaO	0.03	0.05	0.01	0.03	0.03	0.01	0.02	0.05	0.02	0.02	0.01	0.01
Na2O	0.02	0.05	0.04	0.08	0.04	0.05	0.05	0.05	0.06	0.04	0.04	0.04
K2O	9.95	9.77	10.02	9.88	9.73	9.93	9.86	9.44	9.81	10.07	10.00	9.88
SO3	0.13	0.08	0.08	0.07	0.08	0.07	0.07	0.10	0.07	0.03	0.08	0.05
Cl	0.12	0.12	0.13	0.08	0.07	0.07	0.07	0.06	0.07	0.07	0.07	0.07
F	0.15	0.11	0.11	0.15	0.13	0.12	0.12	0.14	0.10	0.10	0.13	0.13
Total	96.66	96.17	97.28	96.86	96.44	97.23	95.27	94.60	95.87	96.66	96.58	95.81
Cations Recalculated on the Basis of 11O												
Si	2.75	2.77	2.74	2.76	2.75	2.73	2.74	2.76	2.75	2.74	2.74	2.75
Ti	0.27	0.25	0.26	0.26	0.26	0.25	0.26	0.25	0.25	0.25	0.25	0.25
Al	1.33	1.34	1.35	1.36	1.39	1.39	1.40	1.39	1.38	1.41	1.40	1.40
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	1.11	1.09	1.11	1.18	1.17	1.19	1.17	1.18	1.18	1.15	1.16	1.15
Mg	1.33	1.37	1.37	1.24	1.21	1.23	1.22	1.22	1.23	1.25	1.24	1.24
Mn	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
K	0.95	0.94	0.95	0.95	0.94	0.95	0.96	0.92	0.95	0.97	0.96	0.96
S	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Cl	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
F	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.03
Total	7.82	7.81	7.84	7.82	7.80	7.82	7.82	7.79	7.81	7.82	7.82	7.81
%Ann	46	44	45	49	49	49	49	49	49	48	48	48
%Phl	54	56	55	51	51	51	51	51	51	52	52	52

Continued→

Sample:	CB15-40 (Type 1 Pegmatite)			CB15-72 (Type 1 Pegmatite)								
Mineral:	Biotite											
No.	269	270	271	165	166	167	168	169	170	171	172	173
Wt%												
SiO2	36.14	36.27	35.50	34.98	34.94	34.72	34.97	34.67	34.40	34.56	33.81	34.74
TiO2	4.30	4.31	3.94	3.33	3.30	3.30	3.28	3.21	3.19	3.16	3.05	3.09
Al2O3	15.96	15.95	16.10	14.86	14.70	14.62	14.74	14.75	14.32	14.58	14.03	14.62
Cr2O3	0.04	0.01	0.00	3.33	3.30	3.30	3.28	3.21	3.19	3.16	3.05	3.09
FeO	18.17	18.30	17.48	19.26	19.04	19.03	19.14	19.18	18.48	18.76	18.72	19.03
MgO	10.88	10.93	10.98	10.57	10.49	10.48	10.49	10.42	10.39	10.37	10.28	10.55
MnO	0.22	0.27	0.21	0.25	0.25	0.21	0.26	0.23	0.24	0.26	0.23	0.22
CaO	0.00	0.01	0.00	0.01	0.03	0.01	0.00	0.00	0.00	0.02	0.03	0.01
Na2O	0.02	0.05	0.03	0.02	0.02	0.05	0.02	0.02	0.02	0.02	0.00	0.03
K2O	10.07	9.86	9.76	9.96	9.73	9.29	9.69	9.61	9.63	9.16	9.18	9.87
SO3	0.00	0.01	0.01	0.10	0.14	0.11	0.09	0.11	0.08	0.10	0.11	0.13
Cl	0.06	0.06	0.06	0.04	0.05	0.04	0.04	0.04	0.04	0.05	0.04	0.04
F	0.08	0.08	0.07	0.18	0.18	0.18	0.18	0.19	0.17	0.19	0.22	0.19
Total	95.88	96.08	94.07	93.50	92.81	91.99	92.86	92.38	90.90	91.17	89.60	92.46
Cations Recalculated on the Basis of 11O												
Si	2.74	2.74	2.73	2.75	2.76	2.76	2.76	2.75	2.77	2.77	2.77	2.76
Ti	0.25	0.25	0.23	0.20	0.20	0.20	0.19	0.19	0.19	0.19	0.19	0.18
Al	1.43	1.42	1.46	1.38	1.37	1.37	1.37	1.38	1.36	1.38	1.35	1.37
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	1.15	1.16	1.13	1.27	1.26	1.27	1.27	1.27	1.25	1.26	1.28	1.27
Mg	1.23	1.23	1.26	1.24	1.24	1.24	1.24	1.23	1.25	1.24	1.25	1.25
Mn	0.01	0.02	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
K	0.97	0.95	0.96	1.00	0.98	0.94	0.98	0.97	0.99	0.94	0.96	1.00
S	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cl	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01
F	0.02	0.02	0.01	0.04	0.04	0.05	0.05	0.05	0.04	0.05	0.06	0.05
Total	7.82	7.81	7.81	7.90	7.88	7.87	7.88	7.89	7.89	7.86	7.89	7.91
%Ann	48	48	47	51	50	50	51	51	50	50	51	50
%Phl	52	52	53	49	50	50	49	49	50	50	49	50

Continued→

Sample:	CB15-72 (Type 1 Pegmatite)										
Mineral:	Biotite										
No.	174	175	176	177	178	179	180	181	182	183	184
Wt%											
SiO2	34.05	34.31	34.24	33.96	34.44	34.38	34.97	34.34	34.84	34.57	33.90
TiO2	2.87	3.38	3.43	3.40	3.36	3.44	3.36	3.31	3.45	3.32	3.48
Al2O3	14.45	14.35	14.70	14.52	14.52	14.41	14.52	14.63	14.70	14.59	14.31
Cr2O3	2.87	3.38	3.43	3.40	3.36	3.44	3.36	3.31	3.45	3.32	3.48
FeO	18.85	18.94	18.88	18.70	18.85	18.80	18.77	18.94	18.97	18.99	18.65
MgO	10.21	10.45	10.30	10.51	10.38	10.24	10.35	10.39	10.43	10.46	10.19
MnO	0.25	0.22	0.22	0.21	0.23	0.22	0.21	0.22	0.21	0.19	0.20
CaO	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.02	0.00	0.02
Na2O	0.02	0.03	0.02	0.02	0.02	0.03	0.01	0.03	0.04	0.01	0.06
K2O	8.98	9.86	9.60	9.60	9.76	9.13	9.89	9.67	9.85	9.82	9.69
SO3	0.10	0.11	0.11	0.08	0.14	0.11	0.11	0.13	0.10	0.12	0.13
Cl	0.03	0.04	0.04	0.04	0.05	0.05	0.05	0.04	0.04	0.04	0.04
F	0.20	0.17	0.18	0.16	0.15	0.17	0.17	0.19	0.17	0.20	0.17
Total	89.96	91.79	91.67	91.16	91.85	90.90	92.35	91.83	92.74	92.25	90.80
Cations Recalculated on the Basis of 11O											
Si	2.77	2.75	2.74	2.74	2.75	2.77	2.78	2.75	2.76	2.75	2.74
Ti	0.18	0.20	0.21	0.21	0.20	0.21	0.20	0.20	0.21	0.20	0.21
Al	1.39	1.36	1.39	1.38	1.37	1.37	1.36	1.38	1.37	1.37	1.37
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	1.28	1.27	1.26	1.26	1.26	1.27	1.25	1.27	1.26	1.27	1.26
Mg	1.24	1.25	1.23	1.26	1.24	1.23	1.23	1.24	1.23	1.24	1.23
Mn	0.02	0.01	0.02	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01
K	0.93	1.01	0.98	0.99	0.99	0.94	1.00	0.99	0.99	1.00	1.00
S	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cl	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
F	0.05	0.04	0.05	0.04	0.04	0.04	0.04	0.05	0.04	0.05	0.04
Total	7.87	7.91	7.89	7.90	7.89	7.85	7.88	7.90	7.89	7.90	7.90
%Ann	51	50	51	50	50	51	50	51	51	50	51
%Phl	49	50	49	50	50	49	50	49	49	50	49

Continued→

Sample:	CB15-74 (Type 1 Pegmatite)												
Mineral:	Biotite												
No.	540	541	542	543	544	545	546	547	548	549	600	601	602
Wt%													
SiO2	36.00	35.77	35.34	36.27	35.95	35.96	36.27	36.21	36.20	36.20	36.14	36.13	36.08
TiO2	3.68	3.50	3.45	3.61	3.57	3.51	3.46	3.51	3.48	3.59	3.48	3.08	3.53
Al2O3	14.68	14.68	14.49	14.75	14.77	14.62	14.62	14.82	14.54	14.72	15.34	15.32	15.17
Cr2O3	3.68	3.50	3.45	3.61	3.57	3.51	3.46	3.51	3.48	3.59	3.48	3.08	3.53
FeO	19.48	19.43	19.01	19.59	20.00	19.89	19.74	20.02	19.77	20.12	19.83	19.50	19.57
MgO	10.70	10.68	10.34	10.62	10.71	10.66	10.73	10.70	10.68	10.67	10.00	10.22	10.10
MnO	0.15	0.13	0.17	0.17	0.14	0.13	0.14	0.15	0.12	0.15	0.25	0.24	0.22
CaO	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.02
Na2O	0.02	0.06	0.03	0.05	0.02	0.04	0.04	0.03	0.03	0.04	0.05	0.08	0.07
K2O	9.90	9.57	9.45	9.77	9.91	9.70	9.65	9.49	9.62	9.76	9.55	9.58	9.58
SO3	0.14	0.16	0.16	0.11	0.14	0.15	0.11	0.15	0.12	0.13	0.06	0.09	0.07
Cl	0.09	0.11	0.12	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.05	0.05	0.05
F	0.16	0.21	0.16	0.21	0.19	0.18	0.18	0.19	0.22	0.17	0.14	0.20	0.19
Total	94.92	94.19	92.68	95.16	95.39	94.87	94.96	95.30	94.75	95.58	94.84	94.42	94.58
Cations Recalculated on the Basis of 11O													
Si	2.78	2.78	2.79	2.79	2.77	2.78	2.80	2.78	2.80	2.78	2.79	2.80	2.79
Ti	0.21	0.20	0.20	0.21	0.21	0.20	0.20	0.20	0.20	0.21	0.20	0.18	0.21
Al	1.34	1.34	1.35	1.34	1.34	1.33	1.33	1.34	1.32	1.33	1.39	1.40	1.38
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	1.26	1.26	1.25	1.26	1.29	1.29	1.27	1.29	1.28	1.29	1.28	1.26	1.27
Mg	1.23	1.24	1.22	1.22	1.23	1.23	1.23	1.23	1.23	1.22	1.15	1.18	1.16
Mn	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01
K	0.97	0.95	0.95	0.96	0.97	0.96	0.95	0.93	0.95	0.96	0.94	0.95	0.94
S	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.00
Cl	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
F	0.04	0.05	0.04	0.05	0.05	0.04	0.04	0.05	0.05	0.04	0.03	0.05	0.05
Total	7.86	7.87	7.85	7.87	7.89	7.87	7.86	7.85	7.87	7.87	7.82	7.85	7.84
%Ann	51	51	51	51	51	51	51	51	51	51	53	52	52
%Phl	49	49	49	49	49	49	49	49	49	49	47	48	48

Continued→

Sample:	CB15-74 (Type 1 Pegmatite)							CB15-12 (Type 1 Pegmatite)				
Mineral:	Biotite							Hornblende				
No.	603	604	605	606	607	608	609	244	245	246	247	248
Wt%												
SiO2	36.02	36.22	35.99	36.21	35.83	36.32	36.20	40.57	40.53	40.29	40.23	40.70
TiO2	3.64	3.59	3.58	3.56	3.55	3.35	3.55	1.37	1.36	1.44	1.29	1.31
Al2O3	15.35	15.18	15.04	15.22	15.01	15.28	15.21	13.67	13.00	13.18	13.40	12.78
Cr2O3	3.64	3.59	3.58	3.56	3.55	3.35	3.55	0.03	0.03	0.01	0.02	0.00
FeO	19.07	19.61	19.53	19.74	19.30	19.66	19.64	18.82	19.33	19.05	19.35	19.12
MgO	10.22	10.21	10.12	10.15	10.07	10.21	10.08	0.36	0.41	0.35	0.35	0.35
MnO	0.25	0.24	0.23	0.25	0.26	0.24	0.21	8.45	8.51	8.35	8.36	8.63
CaO	0.00	0.00	0.02	0.00	0.02	0.00	0.01	11.70	11.77	11.77	11.82	11.93
Na2O	0.07	0.07	0.09	0.09	0.06	0.09	0.08	1.54	1.56	1.59	1.57	1.43
K2O	9.72	9.77	9.70	9.69	9.40	9.88	9.70	2.10	2.04	2.06	1.96	1.87
SO3	0.07	0.08	0.07	0.07	0.10	0.07	0.12	0.02	0.05	0.06	0.03	0.05
Cl	0.06	0.05	0.05	0.05	0.06	0.05	0.06	0.09	0.09	0.08	0.10	0.08
F	0.19	0.12	0.16	0.15	0.15	0.19	0.15	0.05	0.05	0.04	0.04	0.06
Total	94.57	95.08	94.52	95.12	93.75	95.25	94.95	98.73	98.67	98.22	98.48	98.26
Cations Recalculated on the Basis of 11O								Cations Recalculated on the Basis of 23O				
Si	2.78	2.79	2.79	2.79	2.79	2.79	2.79	6.16	6.18	6.16	6.15	6.22
Ti	0.21	0.21	0.21	0.21	0.21	0.19	0.21	0.16	0.16	0.17	0.15	0.15
Al	1.40	1.38	1.37	1.38	1.38	1.38	1.38	2.45	2.34	2.38	2.41	2.30
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	1.23	1.26	1.27	1.27	1.26	1.26	1.27	2.39	2.46	2.44	2.47	2.44
Mg	1.18	1.17	1.17	1.16	1.17	1.17	1.16	0.05	0.05	0.05	0.04	0.05
Mn	0.02	0.02	0.02	0.02	0.02	0.02	0.01	1.91	1.93	1.90	1.90	1.96
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.90	1.92	1.93	1.93	1.95
Na	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.45	0.46	0.47	0.46	0.42
K	0.96	0.96	0.96	0.95	0.93	0.97	0.95	0.41	0.40	0.40	0.38	0.36
S	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.00
Cl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.02
F	0.05	0.03	0.04	0.04	0.04	0.05	0.04	0.03	0.02	0.02	0.02	0.03
Total	7.84	7.83	7.84	7.84	7.82	7.86	7.83	15.93	15.96	15.95	15.96	15.91
%Ann	51	52	52	52	52	52	52					
%Phl	49	48	48	48	48	48	48					

Continued→

Sample:	CB15-12 (Type 1 Pegmatite)										CB15-20 (
Mineral:	Hornblende										
No.	249	250	251	252	253	254	255	256	257	258	275	276
Wt%												
SiO2	40.47	40.09	40.43	40.51	40.22	40.56	40.45	40.70	40.75	40.83	39.75	39.51
TiO2	1.42	1.41	1.31	1.46	1.39	1.40	1.38	1.43	1.35	1.37	1.03	1.00
Al2O3	13.43	14.18	14.13	13.88	13.99	14.08	13.69	13.03	13.10	12.99	12.89	12.89
Cr2O3	0.02	0.01	0.01	0.02	0.01	0.01	0.03	0.02	0.02	0.02	0.05	0.04
FeO	19.25	18.16	18.86	18.91	18.24	18.14	18.54	19.27	19.06	19.19	16.00	15.77
MgO	0.35	0.39	0.43	0.37	0.39	0.39	0.34	0.36	0.35	0.35	0.29	0.29
MnO	8.28	8.42	8.44	8.59	8.46	8.51	8.63	8.49	8.52	8.49	9.66	9.72
CaO	11.77	11.57	11.60	11.80	11.64	11.59	11.76	11.80	11.77	11.77	11.79	11.69
Na2O	1.58	1.68	1.69	1.53	1.64	1.61	1.62	1.54	1.56	1.58	1.57	1.59
K2O	2.03	2.12	2.12	2.11	2.19	2.15	2.03	2.01	2.06	2.00	1.74	1.79
SO3	0.02	0.02	0.04	0.03	0.04	0.04	0.03	0.04	0.05	0.03	0.00	0.00
Cl	0.09	0.07	0.08	0.09	0.08	0.10	0.08	0.09	0.08	0.09	0.04	0.05
F	0.15	0.12	0.14	0.10	0.10	0.12	0.13	0.13	0.12	0.11	0.09	0.05
Total	98.77	98.17	99.19	99.33	98.32	98.63	98.64	98.82	98.73	98.75	94.85	94.36
Cations Recalculated on the Basis of 23O												
Si	6.16	6.11	6.12	6.12	6.12	6.15	6.15	6.19	6.20	6.21	6.21	6.20
Ti	0.16	0.16	0.15	0.17	0.16	0.16	0.16	0.16	0.15	0.16	0.12	0.12
Al	2.41	2.55	2.52	2.47	2.51	2.52	2.45	2.34	2.35	2.33	2.37	2.39
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Fe	2.45	2.32	2.39	2.39	2.32	2.30	2.36	2.45	2.42	2.44	2.09	2.07
Mg	0.05	0.05	0.06	0.05	0.05	0.05	0.04	0.05	0.04	0.05	0.04	0.04
Mn	1.88	1.91	1.90	1.93	1.92	1.92	1.95	1.93	1.93	1.93	2.25	2.27
Ca	1.92	1.89	1.88	1.91	1.90	1.88	1.91	1.93	1.92	1.92	1.97	1.97
Na	0.46	0.49	0.49	0.45	0.49	0.47	0.48	0.45	0.46	0.46	0.47	0.49
K	0.40	0.41	0.41	0.41	0.43	0.41	0.39	0.39	0.40	0.39	0.35	0.36
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Cl	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.01	0.01
F	0.07	0.06	0.06	0.05	0.05	0.06	0.06	0.06	0.06	0.05	0.04	0.03
Total	15.99	15.97	16.01	15.97	15.97	15.95	15.98	15.98	15.96	15.96	15.94	15.94

Continued→

Sample:	CB15-20 (Type 1 Pegmatite)												
Mineral:	Hornblende												
No.	277	278	279	280	281	282	283	284	325	326	327	328	329
Wt%													
SiO2	39.90	40.65	39.82	38.75	40.63	40.37	39.99	40.71	39.27	39.82	40.68	39.88	40.37
TiO2	0.80	0.83	0.80	0.81	0.55	0.66	0.77	0.75	0.67	0.45	0.88	0.81	0.71
Al2O3	12.73	12.00	12.80	14.22	12.93	12.39	12.94	12.50	13.47	13.31	12.17	12.57	12.21
Cr2O3	0.02	0.03	0.05	0.04	0.03	0.04	0.04	0.05	0.04	0.02	0.06	0.05	0.02
FeO	15.46	15.52	15.42	16.12	15.41	15.01	15.05	15.04	16.91	16.17	15.25	16.00	15.86
MgO	0.22	0.26	0.24	0.26	0.27	0.26	0.27	0.26	0.29	0.27	0.22	0.29	0.27
MnO	10.09	10.36	9.85	9.45	10.35	10.66	10.43	10.58	9.42	9.93	10.56	9.92	10.23
CaO	11.94	11.99	11.53	11.83	11.74	12.14	11.87	11.93	11.73	11.79	12.11	11.90	11.85
Na2O	1.51	1.46	1.48	1.58	1.50	1.40	1.43	1.28	1.58	1.60	1.36	1.50	1.53
K2O	1.77	1.57	1.68	1.89	1.67	1.47	1.72	1.46	1.83	1.75	1.58	1.67	1.62
SO3	0.00	0.00	0.01	0.03	0.01	0.03	0.03	0.00	0.03	0.02	0.06	0.01	0.01
Cl	0.05	0.04	0.04	0.05	0.04	0.03	0.03	0.05	0.05	0.04	0.03	0.05	0.03
F	0.11	0.11	0.07	0.10	0.11	0.07	0.13	0.10	0.08	0.09	0.06	0.05	0.06
Total	94.54	94.76	93.75	95.07	95.18	94.48	94.62	94.65	95.32	95.22	94.99	94.64	94.74
Cations Recalculated on the Basis of 23O													
Si	6.24	6.33	6.27	6.06	6.29	6.29	6.23	6.32	6.14	6.20	6.30	6.24	6.30
Ti	0.09	0.10	0.09	0.09	0.06	0.08	0.09	0.09	0.08	0.05	0.10	0.09	0.08
Al	2.35	2.20	2.37	2.62	2.36	2.27	2.38	2.29	2.48	2.44	2.22	2.32	2.24
Cr	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
Fe	2.02	2.02	2.03	2.11	1.99	1.96	1.96	1.95	2.21	2.10	1.98	2.09	2.07
Mg	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.03	0.04	0.04
Mn	2.35	2.41	2.31	2.20	2.39	2.47	2.42	2.45	2.19	2.30	2.44	2.31	2.38
Ca	2.00	2.00	1.94	1.98	1.95	2.03	1.98	1.98	1.96	1.97	2.01	2.00	1.98
Na	0.46	0.44	0.45	0.48	0.45	0.42	0.43	0.39	0.48	0.48	0.41	0.45	0.46
K	0.35	0.31	0.34	0.38	0.33	0.29	0.34	0.29	0.37	0.35	0.31	0.33	0.32
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Cl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
F	0.06	0.06	0.04	0.05	0.06	0.03	0.06	0.05	0.04	0.04	0.03	0.03	0.03
Total	15.97	15.91	15.89	16.02	15.92	15.89	15.94	15.85	16.01	15.99	15.86	15.93	15.92

Continued→

Sample:	CB15-20 (Type 1 Pegmatite)					CB15-40 (Type 1 Pegmatite)						
Mineral:	Hornblende											
No.	361	362	363	364	365	212	214	Hornblend	216	217	218	219
Wt%												
SiO2	39.90	39.93	40.46	39.69	38.57	40.40	40.35	39.28	40.72	40.31	40.44	40.40
TiO2	1.75	1.56	1.49	1.70	1.76	1.52	1.56	1.62	1.47	1.55	1.57	1.56
Al2O3	12.16	12.40	12.17	12.70	13.75	13.36	13.74	14.19	13.18	13.52	13.34	13.02
Cr2O3	0.04	0.03	0.03	0.03	0.02	0.04	0.04	0.05	0.05	0.04	0.04	0.02
FeO	15.54	15.95	15.50	15.87	16.04	18.91	19.04	18.96	18.75	18.94	19.01	18.99
MgO	0.24	0.27	0.28	0.27	0.26	0.40	0.37	0.42	0.41	0.40	0.42	0.45
MnO	9.98	9.87	10.16	9.79	9.33	8.19	8.15	7.81	8.23	8.19	8.21	8.30
CaO	12.05	11.99	11.76	11.92	11.90	11.48	11.56	11.39	11.57	11.47	11.40	11.53
Na2O	1.61	1.65	1.61	1.62	1.61	1.50	1.59	1.55	1.32	1.56	1.58	1.36
K2O	1.66	1.76	1.61	1.79	1.99	1.93	1.97	2.00	1.87	2.00	1.97	1.90
SO3	0.02	0.03	0.00	0.02	0.06	0.06	0.01	0.05	0.03	0.03	0.03	0.06
Cl	0.04	0.04	0.04	0.05	0.04	0.08	0.08	0.11	0.09	0.09	0.09	0.09
F	0.09	0.10	0.09	0.06	0.07	0.08	0.10	0.07	0.09	0.08	0.09	0.06
Total	95.02	95.52	95.15	95.46	95.37	97.91	98.50	97.43	97.72	98.13	98.14	97.68
Cations Recalculated on the Basis of 23O												
Si	6.22	6.20	6.28	6.17	6.02	6.18	6.15	6.06	6.23	6.16	6.18	6.20
Ti	0.20	0.18	0.17	0.20	0.21	0.17	0.18	0.19	0.17	0.18	0.18	0.18
Al	2.23	2.27	2.22	2.33	2.53	2.41	2.47	2.58	2.38	2.44	2.40	2.36
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	2.03	2.07	2.01	2.06	2.09	2.42	2.43	2.44	2.40	2.42	2.43	2.44
Mg	0.03	0.03	0.04	0.03	0.03	0.05	0.05	0.06	0.05	0.05	0.06	0.06
Mn	2.32	2.29	2.35	2.27	2.17	1.87	1.85	1.80	1.88	1.87	1.87	1.90
Ca	2.01	1.99	1.96	1.98	1.99	1.88	1.89	1.88	1.90	1.88	1.87	1.90
Na	0.49	0.50	0.49	0.49	0.49	0.44	0.47	0.46	0.39	0.46	0.47	0.40
K	0.33	0.35	0.32	0.35	0.40	0.38	0.38	0.39	0.37	0.39	0.38	0.37
S	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.01
Cl	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.02	0.02	0.02	0.02
F	0.05	0.05	0.04	0.03	0.03	0.04	0.05	0.03	0.04	0.04	0.04	0.03
Total	15.92	15.95	15.89	15.93	15.98	15.89	15.93	15.94	15.84	15.92	15.92	15.86

Continued→

Sample:	CB15-40 (Type 1 Pegmatite)								CB15-78 (Type 1 Pegmatite)			
Mineral:	Hornblende											
No.	220	221	222	223	224	225	226	227	590	591	592	593
Wt%												
SiO2	40.25	40.73	40.13	40.38	40.11	40.37	40.60	39.85	40.54	40.44	40.92	41.10
TiO2	1.51	1.57	1.57	1.51	1.49	1.62	1.64	1.56	1.23	1.09	1.15	1.13
Al2O3	14.10	13.12	13.37	13.72	13.68	13.15	13.26	13.78	13.30	13.38	12.69	13.04
Cr2O3	0.05	0.03	0.06	0.05	0.04	0.03	0.03	0.05	0.02	0.01	0.04	0.03
FeO	18.87	18.83	18.86	18.74	19.04	18.85	19.23	19.00	18.95	19.11	18.67	18.92
MgO	0.42	0.39	0.38	0.41	0.43	0.43	0.39	0.38	0.43	0.42	0.42	0.42
MnO	8.12	8.33	8.26	8.14	8.09	8.22	8.29	8.05	7.84	7.90	8.18	8.30
CaO	11.38	11.60	11.52	11.39	11.50	11.30	11.66	11.55	11.58	11.68	11.57	11.67
Na2O	1.54	1.45	1.47	1.59	1.57	1.50	1.37	1.53	1.35	1.30	1.31	1.40
K2O	1.93	1.91	1.89	1.97	1.92	1.93	1.78	2.03	1.82	1.71	1.64	1.75
SO3	0.05	0.04	0.02	0.01	0.01	0.04	0.04	0.02	0.05	0.04	0.04	0.00
Cl	0.09	0.08	0.10	0.09	0.09	0.08	0.09	0.09	0.06	0.07	0.06	0.07
F	0.08	0.08	0.06	0.10	0.09	0.08	0.07	0.06	0.10	0.05	0.08	0.10
Total	98.32	98.09	97.62	98.02	98.00	97.54	98.39	97.91	97.21	97.15	96.72	97.87
Cations Recalculated on the Basis of 23O												
Si	6.13	6.22	6.16	6.17	6.15	6.20	6.19	6.12	6.24	6.23	6.32	6.28
Ti	0.17	0.18	0.18	0.17	0.17	0.19	0.19	0.18	0.14	0.13	0.13	0.13
Al	2.53	2.36	2.42	2.47	2.47	2.38	2.38	2.49	2.42	2.43	2.31	2.35
Cr	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Fe	2.40	2.40	2.42	2.39	2.44	2.42	2.45	2.44	2.44	2.46	2.41	2.42
Mg	0.05	0.05	0.05	0.05	0.06	0.06	0.05	0.05	0.06	0.06	0.06	0.05
Mn	1.84	1.90	1.89	1.86	1.85	1.88	1.88	1.84	1.80	1.81	1.88	1.89
Ca	1.86	1.90	1.90	1.87	1.89	1.86	1.90	1.90	1.91	1.93	1.91	1.91
Na	0.46	0.43	0.44	0.47	0.47	0.45	0.40	0.46	0.40	0.39	0.39	0.41
K	0.37	0.37	0.37	0.38	0.37	0.38	0.35	0.40	0.36	0.34	0.32	0.34
S	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.03	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
F	0.04	0.04	0.03	0.05	0.04	0.04	0.03	0.03	0.05	0.02	0.04	0.05
Total	15.89	15.87	15.90	15.92	15.93	15.89	15.86	15.93	15.84	15.82	15.79	15.85

Continued→

Sample:	CB15-78 (Type 1 Pegmatite)					
Mineral:	Hornblende					
No.	594	595	596	597	598	599
Wt%						
SiO2	40.63	40.94	41.22	41.03	41.08	41.10
TiO2	1.13	1.13	1.08	1.15	1.04	0.99
Al2O3	13.18	12.89	12.66	12.57	12.73	12.80
Cr2O3	0.01	0.02	0.02	0.05	0.00	0.00
FeO	18.78	18.44	18.52	18.44	18.43	18.43
MgO	0.41	0.45	0.42	0.43	0.42	0.46
MnO	7.99	8.18	8.29	8.36	8.42	8.42
CaO	11.46	11.49	11.55	11.45	11.41	11.45
Na2O	1.30	1.35	1.33	1.38	1.33	1.36
K2O	1.93	1.67	1.72	1.79	1.70	1.66
SO3	0.03	0.03	0.00	0.02	0.00	0.02
Cl	0.05	0.07	0.05	0.06	0.06	0.06
F	0.11	0.10	0.11	0.09	0.13	0.09
Total	96.94	96.69	96.91	96.76	96.66	96.79
Cations Recalculated on the Basis of 23O						
Si	6.27	6.31	6.34	6.33	6.34	6.33
Ti	0.13	0.13	0.12	0.13	0.12	0.12
Al	2.40	2.34	2.30	2.28	2.31	2.32
Cr	0.00	0.00	0.00	0.00	0.00	0.00
Fe	2.42	2.38	2.38	2.38	2.38	2.37
Mg	0.05	0.06	0.06	0.06	0.06	0.06
Mn	1.84	1.88	1.90	1.92	1.93	1.93
Ca	1.90	1.90	1.90	1.89	1.89	1.89
Na	0.39	0.40	0.40	0.41	0.40	0.40
K	0.38	0.33	0.34	0.35	0.34	0.33
S	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.01	0.02	0.01	0.01	0.02	0.02
F	0.06	0.05	0.05	0.05	0.06	0.05
Total	15.85	15.81	15.81	15.83	15.84	15.82

Sample:	CB15-41 (Type 2 Pegmatite)												
Mineral:	Scapolite												
No.	35	36	37	38	39	48	50	51	52	53	54	55	56
Wt%													
SiO2	48.74	49.35	50.19	49.39	50.34	49.81	49.94	49.53	49.58	50.13	49.47	50.03	49.91
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	23.59	23.39	23.96	24.07	23.79	23.45	23.72	23.70	23.82	23.81	23.87	23.06	23.04
Cr2O3	0.00	0.00	0.01	0.00	0.00	0.02	0.02	0.00	0.01	0.01	0.01	0.01	0.00
FeO	0.01	0.00	0.01	0.00	0.00	0.03	0.01	0.01	0.03	0.00	0.03	0.08	0.07
MgO	0.02	0.01	0.02	0.01	0.01	0.02	0.00	0.00	0.01	0.01	0.01	0.03	0.03
MnO	0.00	0.00	0.00	0.01	0.00	0.02	0.01	0.02	0.01	0.01	0.03	0.01	0.02
CaO	12.55	11.94	11.98	12.33	11.70	12.22	12.26	12.34	12.60	11.99	12.51	12.01	11.55
Na2O	4.70	4.99	5.03	4.77	5.11	4.98	5.49	5.22	4.89	5.19	4.91	5.15	5.17
K2O	0.96	1.05	1.09	0.97	1.09	1.03	1.07	0.98	1.03	1.09	0.98	0.95	0.92
SO3	1.21	0.69	0.88	1.30	0.73	0.97	1.02	1.25	1.42	1.07	1.50	1.93	2.00
Cl	1.60	1.85	1.81	1.59	1.81	1.77	1.67	1.72	1.68	1.74	1.63	1.60	1.62
F	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.02	0.03	0.05	0.04	0.02	0.01
Total	93.00	92.85	94.57	94.07	94.17	93.93	94.85	94.39	94.71	94.67	94.60	94.49	93.99
Cations Recalculated on the Basis of 24O													
Si	7.29	7.41	7.38	7.28	7.43	7.38	7.34	7.31	7.28	7.37	7.27	7.33	7.34
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.16	4.14	4.15	4.18	4.14	4.10	4.11	4.12	4.12	4.12	4.13	3.98	4.00
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.01	1.92	1.89	1.95	1.85	1.94	1.93	1.95	1.98	1.89	1.97	1.89	1.82
Na	1.36	1.45	1.44	1.36	1.46	1.43	1.56	1.49	1.39	1.48	1.40	1.46	1.48
K	0.18	0.20	0.21	0.18	0.21	0.19	0.20	0.18	0.19	0.20	0.18	0.18	0.17
S	0.13	0.08	0.10	0.14	0.08	0.11	0.11	0.14	0.16	0.12	0.17	0.21	0.22
C*	0.47	0.46	0.46	0.46	0.47	0.44	0.47	0.43	0.42	0.44	0.42	0.39	0.38
Cl	0.40	0.46	0.44	0.39	0.44	0.44	0.41	0.42	0.41	0.42	0.40	0.39	0.40
F	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.02	0.02	0.01	0.01
Total	16.00	16.12	16.07	15.96	16.09	16.06	16.15	16.06	15.99	16.06	15.96	15.86	15.83
%Me	57	54	54	56	53	55	52	54	56	53	56	54	53
%Ma	43	46	46	44	47	45	48	46	44	47	44	46	47

Continued→

Sample:	CB15-41 (Type 2 Pegmatite)												
Mineral:	Scapolite												
No.	57	58	65	66	67	68	69	227	40	41	42	43	44
Wt%													
SiO2	49.32	49.84	49.93	50.08	49.94	48.80	48.55	50.64	50.61	49.59	50.02	49.61	50.11
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	22.87	23.05	24.01	23.93	23.58	23.39	23.75	22.86	23.88	23.66	23.60	23.98	24.06
Cr2O3	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.06	0.07	0.04	0.03	0.05	0.03	0.03	0.26	0.02	0.01	0.00	0.00	0.00
MgO	0.02	0.03	0.00	0.01	0.01	0.00	0.00	0.00	0.02	0.01	0.02	0.01	0.02
MnO	0.02	0.02	0.02	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
CaO	11.77	12.09	12.45	12.10	11.89	12.29	12.74	9.77	12.15	12.67	12.19	12.70	12.64
Na2O	5.15	4.62	3.71	4.78	4.36	5.16	4.62	6.03	4.89	4.67	4.97	4.57	4.91
K2O	0.95	0.87	1.01	1.09	1.17	1.17	0.96	1.24	0.88	0.82	0.91	0.91	0.95
SO3	2.20	2.05	1.08	0.87	0.75	0.91	1.34	0.02	1.75	2.05	1.75	1.56	1.52
Cl	1.62	1.58	1.72	1.86	1.89	1.77	1.60	2.48	1.58	1.38	1.53	1.53	1.55
F	0.03	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Total	93.63	93.86	93.58	94.35	93.22	93.13	93.26	92.75	95.42	94.55	94.62	94.52	95.41
Cations Recalculated on the Basis of 24O													
Si	7.29	7.33	7.38	7.38	7.44	7.32	7.24	7.64	7.33	7.25	7.31	7.27	7.28
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	3.98	4.00	4.18	4.16	4.14	4.14	4.18	4.07	4.08	4.08	4.07	4.14	4.12
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.00	0.00	0.01	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
Mg	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	1.86	1.91	1.97	1.91	1.90	1.98	2.04	1.58	1.88	1.98	1.91	1.99	1.97
Na	1.48	1.32	1.06	1.37	1.26	1.50	1.34	1.76	1.37	1.32	1.41	1.30	1.38
K	0.18	0.16	0.19	0.20	0.22	0.22	0.18	0.24	0.16	0.15	0.17	0.17	0.18
S	0.24	0.23	0.12	0.10	0.08	0.10	0.15	0.00	0.19	0.23	0.19	0.17	0.17
C*	0.34	0.39	0.46	0.44	0.45	0.46	0.45	0.38	0.43	0.44	0.44	0.46	0.46
Cl	0.40	0.39	0.42	0.46	0.47	0.44	0.40	0.62	0.38	0.34	0.37	0.37	0.38
F	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.81	15.73	15.80	16.03	15.98	16.16	15.98	16.32	15.83	15.78	15.87	15.88	15.94
%Me	53	57	61	55	56	53	57	45	55	57	55	58	56
%Ma	47	43	39	45	44	47	43	55	45	43	45	42	44

Continued→

Sample:	CB15-41 (Type 2 Pegmatite)												
Mineral:	Scapolite												
No.	45	46	47	49	59	60	61	62	63	64	70	71	72
Wt%													
SiO2	49.67	49.67	49.74	48.94	49.26	49.22	48.80	48.47	48.60	49.41	48.75	48.47	48.43
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
Al2O3	23.75	23.96	23.73	23.73	23.96	23.92	23.66	23.58	23.84	23.36	23.68	23.39	23.54
Cr2O3	0.00	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
FeO	0.05	0.07	0.05	0.04	0.02	0.05	0.02	0.02	0.02	0.05	0.08	0.07	0.05
MgO	0.02	0.02	0.02	0.03	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.00
MnO	0.02	0.03	0.02	0.03	0.03	0.02	0.02	0.04	0.03	0.01	0.02	0.00	0.01
CaO	12.84	12.87	12.49	12.95	12.81	12.80	12.50	13.08	13.08	12.80	12.92	12.98	12.90
Na2O	3.94	4.42	4.70	4.72	4.76	4.75	4.82	4.65	4.64	4.83	4.67	4.55	4.60
K2O	0.92	0.90	0.96	0.92	0.93	0.91	0.98	0.93	0.91	0.88	0.96	0.88	0.92
SO3	1.81	1.70	1.44	1.65	1.58	1.72	1.95	1.67	2.04	1.93	1.72	1.90	1.92
Cl	1.45	1.48	1.52	1.46	1.49	1.50	1.49	1.48	1.36	1.55	1.44	1.49	1.49
F	0.04	0.02	0.00	0.01	0.03	0.05	0.02	0.03	0.03	0.00	0.00	0.00	0.00
Total	94.16	94.79	94.33	94.13	94.55	94.59	93.92	93.62	94.25	94.50	93.94	93.41	93.53
Cations Recalculated on the Basis of 24O													
Si	7.28	7.26	7.31	7.22	7.23	7.22	7.20	7.20	7.15	7.25	7.21	7.20	7.19
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.10	4.13	4.11	4.13	4.15	4.14	4.12	4.13	4.14	4.04	4.13	4.10	4.12
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.02	2.01	1.97	2.05	2.02	2.01	1.98	2.08	2.06	2.01	2.05	2.07	2.05
Na	1.12	1.25	1.34	1.35	1.35	1.35	1.38	1.34	1.32	1.38	1.34	1.31	1.32
K	0.17	0.17	0.18	0.17	0.17	0.17	0.18	0.18	0.17	0.17	0.18	0.17	0.18
S	0.20	0.19	0.16	0.18	0.17	0.19	0.22	0.18	0.23	0.21	0.19	0.21	0.21
C*	0.43	0.45	0.47	0.46	0.45	0.42	0.41	0.44	0.42	0.41	0.46	0.42	0.42
Cl	0.36	0.36	0.37	0.36	0.36	0.37	0.37	0.37	0.33	0.38	0.36	0.37	0.37
F	0.02	0.01	0.00	0.00	0.01	0.02	0.01	0.01	0.02	0.00	0.00	0.00	0.00
Total	15.71	15.83	15.92	15.93	15.94	15.90	15.87	15.94	15.85	15.86	15.91	15.85	15.86
%Me	61	59	57	58	57	57	56	58	58	57	58	58	58
%Ma	39	41	43	42	43	43	44	42	42	43	42	42	42

Continued→

Sample:	CB15-41 (Type 2 Pegmatite)			CB15-32 (Type 2 Pegmatite)									
Mineral:	Scapolite			Scapolite									
No.	73	74		795	796	797	798	799	800	801	802	803	804
Wt%													
SiO2	48.51	48.89		50.97	51.12	51.05	51.05	51.08	50.68	50.73	50.79	50.81	50.87
TiO2	0.00	0.00		0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01
Al2O3	23.54	23.56		23.60	23.77	23.61	23.60	23.80	23.63	23.67	23.47	23.79	23.80
Cr2O3	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.01
FeO	0.06	0.03		0.11	0.09	0.10	0.13	0.10	0.11	0.12	0.12	0.10	0.12
MgO	0.02	0.00		0.02	0.03	0.03	0.03	0.03	0.04	0.03	0.04	0.04	0.03
MnO	0.00	0.03		0.00	0.01	0.01	0.03	0.01	0.02	0.01	0.02	0.00	0.02
CaO	12.97	12.87		12.12	11.85	11.93	12.23	11.96	12.29	12.40	12.15	12.18	12.25
Na2O	4.49	4.41		4.38	4.43	4.35	4.58	3.65	4.46	4.27	4.11	4.13	4.28
K2O	0.91	0.87		0.82	0.92	0.85	0.83	0.81	0.87	0.93	0.92	0.90	0.97
SO3	1.71	1.77		2.13	2.11	1.95	2.30	2.19	2.28	2.29	2.12	1.78	1.84
Cl	1.44	1.49		1.57	1.61	1.58	1.40	1.37	1.41	1.48	1.56	1.56	1.45
F	0.00	0.00		0.03	0.02	0.05	0.02	0.00	0.02	0.03	0.02	0.03	0.01
Total	93.33	93.59		95.38	95.59	95.13	95.87	94.70	95.48	95.63	94.95	94.96	95.31
Cations Recalculated on the Basis of 24O													
Si	7.21	7.24		7.35	7.36	7.38	7.33	7.38	7.31	7.31	7.36	7.37	7.35
Ti	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.13	4.11		4.01	4.03	4.02	3.99	4.05	4.02	4.02	4.01	4.07	4.06
Cr	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.00		0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Mg	0.00	0.00		0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00
Mn	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.07	2.04		1.87	1.83	1.85	1.88	1.85	1.90	1.91	1.89	1.89	1.90
Na	1.29	1.26		1.22	1.24	1.22	1.27	1.02	1.25	1.19	1.15	1.16	1.20
K	0.17	0.16		0.15	0.17	0.16	0.15	0.15	0.16	0.17	0.17	0.17	0.18
S	0.19	0.20		0.23	0.23	0.21	0.25	0.24	0.25	0.25	0.23	0.19	0.20
C*	0.45	0.43		0.38	0.38	0.39	0.41	0.43	0.40	0.38	0.39	0.42	0.45
Cl	0.36	0.37		0.38	0.39	0.38	0.34	0.33	0.34	0.36	0.38	0.38	0.35
F	0.00	0.00		0.01	0.01	0.02	0.01	0.00	0.01	0.01	0.01	0.01	0.00
Total	15.88	15.83		15.64	15.64	15.65	15.65	15.47	15.65	15.62	15.60	15.68	15.71
%Me	59	59		58	57	58	57	61	58	59	59	59	58
%Ma	41	41	100	42	43	42	43	39	42	41	41	41	42

Continued→

Sample:	CB15-32 (Type 2 Pegmatite)												
Mineral:	Scapolite												
No.	805	806	807	808	809	810	811	812	813	814	139	140	141
Wt%													
SiO2	51.97	51.88	51.92	51.88	52.03	51.51	52.04	51.89	50.74	50.61	50.51	50.20	50.22
TiO2	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	23.64	23.70	23.61	23.58	23.66	23.92	23.66	23.94	23.90	24.54	25.27	24.96	25.29
Cr2O3	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
FeO	0.07	0.07	0.07	0.07	0.06	0.06	0.05	0.06	0.04	0.04	0.03	0.05	0.04
MgO	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.00	0.01	0.01	0.00
MnO	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.01	0.00	0.01	0.02	0.01	0.00
CaO	11.45	11.68	11.53	11.68	11.73	11.95	11.50	11.80	12.12	12.64	12.80	12.83	12.98
Na2O	4.36	4.32	4.48	3.99	4.17	4.10	4.04	3.87	4.72	3.15	5.08	4.41	4.37
K2O	0.87	0.83	0.89	0.81	0.84	0.82	0.81	0.80	0.84	0.81	0.77	0.90	0.85
SO3	1.85	2.01	1.76	2.09	1.86	1.85	1.96	1.89	1.65	1.83	1.63	1.65	1.91
Cl	1.80	1.77	1.78	1.71	1.76	1.76	1.83	1.71	1.71	1.62	1.62	1.47	1.55
F	0.02	0.04	0.02	0.00	0.01	0.00	0.02	0.04	0.01	0.00	0.00	0.00	0.00
Total	95.64	95.90	95.67	95.44	95.75	95.62	95.54	95.63	95.35	94.88	97.38	96.16	96.86
Cations Recalculated on the Basis of 24O													
Si	7.47	7.43	7.47	7.45	7.46	7.41	7.47	7.44	7.35	7.32	7.19	7.22	7.17
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.00	4.00	4.00	3.99	4.00	4.05	4.00	4.05	4.08	4.19	4.24	4.23	4.25
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	1.76	1.79	1.78	1.80	1.80	1.84	1.77	1.81	1.88	1.96	1.95	1.98	1.98
Na	1.21	1.20	1.25	1.11	1.16	1.14	1.13	1.08	1.33	0.88	1.40	1.23	1.21
K	0.16	0.15	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.17	0.16
S	0.20	0.22	0.19	0.23	0.20	0.20	0.21	0.20	0.18	0.20	0.18	0.18	0.20
C*	0.36	0.34	0.38	0.36	0.38	0.38	0.34	0.37	0.40	0.41	0.44	0.47	0.43
Cl	0.43	0.42	0.43	0.41	0.42	0.42	0.44	0.41	0.41	0.39	0.38	0.35	0.37
F	0.01	0.02	0.01	0.00	0.00	0.00	0.01	0.02	0.01	0.00	0.00	0.00	0.00
Total	15.62	15.59	15.67	15.51	15.59	15.61	15.53	15.54	15.81	15.50	15.93	15.83	15.77
%Me	56	57	56	59	58	59	58	60	56	66	56	59	59
%Ma	44	43	44	41	42	41	42	40	44	34	44	41	41

Continued→

Sample:	CB15-32 (Type 2 Pegmatite)												
Mineral:	Scapolite												
No.	150	151	152	153	154	155	156	157	158	159	160	161	162
Wt%													
SiO2	51.06	51.45	51.75	51.95	50.39	50.70	50.88	50.40	50.60	51.00	50.51	50.08	51.22
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.27	24.54	24.36	24.32	25.13	25.07	25.02	24.96	24.92	24.27	24.29	25.00	24.34
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
FeO	0.03	0.07	0.08	0.09	0.08	0.12	0.05	0.07	0.08	0.06	0.04	0.05	0.05
MgO	0.00	0.01	0.02	0.02	0.01	0.03	0.00	0.02	0.02	0.00	0.00	0.00	0.00
MnO	0.01	0.02	0.01	0.03	0.03	0.03	0.02	0.00	0.01	0.01	0.00	0.00	0.00
CaO	12.47	11.92	11.59	11.61	12.92	12.96	12.73	12.81	12.90	12.06	12.22	12.80	11.43
Na2O	5.52	4.55	4.55	4.17	4.66	4.32	4.49	3.98	3.99	4.68	4.67	4.19	4.35
K2O	0.86	0.96	0.91	0.91	0.93	0.91	0.93	1.00	0.93	0.90	0.86	0.85	0.78
SO3	1.48	2.08	2.20	2.11	1.72	1.73	1.66	1.62	1.70	1.57	2.08	1.91	2.00
Cl	1.72	1.73	1.74	1.74	1.52	1.52	1.62	1.54	1.52	1.84	1.65	1.52	1.72
F	0.01	0.04	0.03	0.01	0.02	0.00	0.03	0.02	0.00	0.03	0.01	0.03	0.03
Total	98.03	96.95	96.82	96.57	97.04	97.04	97.05	96.07	96.31	95.99	95.97	96.08	95.52
Cations Recalculated on the Basis of 24O													
Si	7.23	7.31	7.35	7.38	7.19	7.22	7.25	7.25	7.25	7.35	7.26	7.20	7.36
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.22	4.11	4.08	4.08	4.23	4.21	4.20	4.23	4.21	4.12	4.12	4.23	4.12
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	1.89	1.81	1.76	1.77	1.98	1.98	1.94	1.98	1.98	1.86	1.88	1.97	1.76
Na	1.52	1.25	1.25	1.15	1.29	1.19	1.24	1.11	1.11	1.31	1.30	1.17	1.21
K	0.15	0.18	0.17	0.17	0.17	0.17	0.17	0.18	0.17	0.17	0.16	0.16	0.14
S	0.16	0.22	0.24	0.23	0.18	0.18	0.18	0.18	0.18	0.17	0.23	0.21	0.22
C*	0.43	0.35	0.34	0.36	0.45	0.45	0.42	0.45	0.46	0.38	0.37	0.41	0.36
Cl	0.41	0.41	0.41	0.41	0.36	0.36	0.38	0.37	0.36	0.44	0.40	0.36	0.41
F	0.00	0.02	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.01
Total	16.02	15.68	15.62	15.56	15.87	15.79	15.82	15.76	15.74	15.82	15.73	15.73	15.61
%Me	53	56	56	58	58	60	58	61	61	56	56	60	57
%Ma	47	44	44	42	42	40	42	39	39	44	44	40	43

Continued→

Sample:	CB15-32 (Type 2 Pegmatite)										
Mineral:	Scapolite										
No.	163	164	165	166	171	172	173	174	175	181	182
Wt%											
SiO2	50.13	51.03	51.12	50.51	50.70	50.63	49.64	51.35	51.33	51.41	50.75
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.16	24.66	24.82	24.77	24.15	24.28	24.44	23.83	23.82	24.15	24.36
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.05	0.04	0.08	0.09	0.08	0.06	0.07	0.06	0.09	0.08	0.07
MgO	0.00	0.00	0.00	0.03	0.01	0.02	0.02	0.01	0.01	0.01	0.02
MnO	0.03	0.01	0.03	0.00	0.02	0.00	0.04	0.02	0.04	0.00	0.00
CaO	12.99	12.34	12.47	12.96	12.31	12.24	12.58	11.66	11.94	11.89	12.18
Na2O	4.59	4.82	4.29	4.60	4.36	4.32	4.75	4.78	4.44	5.15	4.61
K2O	0.82	0.94	0.82	0.84	0.94	0.95	1.01	0.96	0.93	0.90	0.87
SO3	1.76	1.65	2.11	1.70	2.34	2.38	1.88	2.18	2.25	2.10	2.26
Cl	1.58	1.79	1.64	1.54	1.49	1.45	1.49	1.63	1.58	1.62	1.49
F	0.03	0.03	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	96.75	96.89	97.02	96.71	96.06	96.00	95.58	96.11	96.06	96.94	96.26
Cations Recalculated on the Basis of 24O											
Si	7.18	7.29	7.26	7.23	7.26	7.25	7.20	7.35	7.35	7.32	7.26
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.25	4.15	4.15	4.18	4.08	4.10	4.18	4.02	4.02	4.05	4.11
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	1.99	1.89	1.90	1.99	1.89	1.88	1.95	1.79	1.83	1.81	1.87
Na	1.27	1.34	1.18	1.28	1.21	1.20	1.33	1.33	1.23	1.42	1.28
K	0.15	0.17	0.15	0.15	0.17	0.17	0.19	0.18	0.17	0.16	0.16
S	0.19	0.18	0.23	0.18	0.25	0.26	0.20	0.24	0.24	0.22	0.24
C*	0.42	0.38	0.37	0.44	0.39	0.40	0.43	0.37	0.38	0.39	0.40
Cl	0.38	0.43	0.39	0.37	0.36	0.35	0.36	0.39	0.38	0.39	0.36
F	0.01	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.84	15.85	15.65	15.85	15.63	15.61	15.86	15.68	15.62	15.78	15.68
%Me	58	56	59	58	58	58	56	55	57	53	57
%Ma	42	44	41	42	42	42	44	45	43	47	43

Continued→

Sample:	CB15-32 (Type 2 Pegmatite)											
Mineral:	K-Feldspar											
No.	875	876	877	878	879	880	881	882	883	884	885	886
Wt%												
SiO2	63.20	64.31	63.85	64.37	63.29	64.01	60.80	58.58	60.03	60.24	57.80	60.76
TiO2	0.12	0.07	0.10	0.05	0.13	0.11	0.36	0.49	0.31	0.35	0.32	0.25
Al2O3	18.18	17.89	18.19	17.79	18.38	18.13	18.91	18.92	18.82	18.81	20.99	18.92
Cr2O3	0.00	0.04	0.03	0.01	0.01	0.03	0.03	0.04	0.01	0.02	0.00	0.01
FeO	0.03	0.02	0.02	0.02	0.01	0.05	0.03	0.07	0.03	0.04	0.17	0.02
MgO	0.02	0.01	0.01	0.02	0.01	0.02	0.00	0.01	0.04	0.05	0.11	0.02
MnO	0.02	0.03	0.02	0.00	0.01	0.01	0.03	0.03	0.01	0.01	0.04	0.00
CaO	0.02	0.02	0.02	0.02	0.01	0.01	0.11	0.06	0.21	0.59	0.49	0.20
Na2O	0.37	0.36	0.28	0.35	0.36	0.36	0.31	0.24	0.37	0.47	0.37	0.20
K2O	15.54	14.38	15.07	15.55	15.70	15.63	14.65	14.47	13.69	12.42	13.36	14.72
SO3	0.04	0.02	0.04	0.03	0.06	0.04	0.06	0.05	0.03	0.18	0.20	0.15
Cl	0.02	0.08	0.04	0.01	0.02	0.01	0.02	0.02	0.29	0.49	0.08	0.04
F	0.00	0.00	0.00	0.03	0.00	0.00	0.02	0.03	0.00	0.00	0.01	0.00
Total	97.54	97.20	97.65	98.23	97.98	98.39	95.33	92.98	93.78	93.56	93.92	95.27
Cations Recalculated on the Basis of 8O												
Si	2.99	3.03	3.00	3.02	2.98	3.00	2.94	2.91	2.94	2.94	2.83	2.94
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.01	0.01	0.01	0.01
Al	1.01	0.99	1.01	0.98	1.02	1.00	1.08	1.11	1.09	1.08	1.21	1.08
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.03	0.03	0.01
Na	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.04	0.04	0.04	0.02
K	0.94	0.86	0.90	0.93	0.94	0.93	0.90	0.92	0.86	0.77	0.83	0.91
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Cl	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.04	0.01	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.99	4.93	4.95	4.97	4.99	4.98	4.98	4.99	4.97	4.94	4.98	4.97
%Ab	3.54	3.57	2.67	3.24	3.36	3.39	3.07	2.38	3.90	5.28	3.93	1.96
%An	0.08	0.09	0.09	0.08	0.08	0.08	0.60	0.34	1.24	3.58	2.86	1.11
%Or	96.38	96.34	97.25	96.67	96.56	96.53	96.33	97.28	94.86	91.14	93.21	96.93

Continued→

Sample:	CB15-32 (Type 2 Pegmatite)									
Mineral:	Hornblende									
No.	142	143	167	168	169	176	177	178	179	180
Wt%										
SiO2	37.88	37.86	38.02	37.75	38.38	37.82	38.10	38.00	38.12	37.63
TiO2	0.00	0.00	0.00	0.01	0.04	0.01	0.01	0.04	0.01	0.02
Al2O3	25.67	25.09	26.66	25.98	28.40	24.62	25.48	25.90	25.94	24.48
Cr2O3	0.00	0.01	0.01	0.02	0.00	0.01	0.00	0.03	0.02	0.00
FeO	9.87	10.63	8.75	9.24	7.11	10.92	10.07	9.57	9.43	11.25
MgO	0.17	0.26	0.25	2.97	0.16	0.16	0.47	1.19	0.25	0.15
MnO	0.04	0.02	0.06	0.03	0.02	0.01	0.01	0.02	0.04	0.00
CaO	23.32	23.57	23.86	19.99	24.28	23.78	23.45	22.10	23.75	23.68
Na2O	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
K2O	0.03	0.01	0.03	0.03	0.02	0.02	0.03	0.03	0.02	0.03
SO3	0.01	0.00	0.00	0.02	0.04	0.00	0.02	0.02	0.00	0.00
Cl	0.00	0.00	0.01	0.02	0.00	0.00	0.01	0.00	0.00	0.00
F	0.01	0.00	0.04	0.04	0.00	0.00	0.00	0.00	0.00	0.00
Total	96.99	97.46	97.67	96.09	98.43	97.36	97.64	96.90	97.58	97.23
Cations Recalculated on the Basis of 23O										
Si	5.64	5.64	5.59	5.66	5.54	5.65	5.64	5.65	5.63	5.64
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.50	4.40	4.62	4.60	4.83	4.33	4.45	4.54	4.51	4.32
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	1.23	1.32	1.08	1.16	0.86	1.36	1.25	1.19	1.16	1.41
Mg	0.02	0.03	0.03	0.38	0.02	0.02	0.06	0.15	0.03	0.02
Mn	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Ca	3.72	3.76	3.76	3.21	3.76	3.81	3.72	3.52	3.76	3.80
Na	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
K	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.12	15.16	15.12	15.06	15.03	15.18	15.13	15.07	15.12	15.20

Sample:	CB15-41 (Type 2 Pegmatite)											
Mineral:	Hornblende											
No.	218	219	220	221	222	235	236	238	239	240	241	242
Wt%												
SiO2	37.44	37.63	38.55	38.11	37.78	37.90	37.49	37.46	37.59	37.98	38.55	38.63
TiO2	0.95	0.89	0.79	0.83	1.06	1.12	1.23	1.21	1.13	1.14	1.03	1.02
Al2O3	14.26	14.18	13.63	13.92	14.20	13.95	14.01	14.08	14.06	14.43	13.76	13.98
Cr2O3	0.00	0.00	0.00	0.01	0.02	0.04	0.03	0.03	0.04	0.03	0.04	0.04
FeO	15.71	15.87	15.57	15.58	15.75	16.11	15.75	15.79	15.81	15.74	16.00	15.78
MgO	0.22	0.24	0.27	0.23	0.29	0.30	0.27	0.30	0.28	0.28	0.29	0.29
MnO	8.97	8.86	9.30	8.98	8.84	8.64	8.81	8.76	8.77	8.73	8.83	8.96
CaO	11.73	11.94	11.89	11.83	11.42	11.90	11.66	11.74	11.77	11.59	11.96	11.90
Na2O	1.39	1.36	1.44	1.41	1.47	1.37	1.47	1.46	1.46	1.44	1.40	1.47
K2O	2.21	2.03	1.98	2.08	2.29	2.20	2.20	2.21	2.13	2.34	2.11	2.14
SO3	0.03	0.04	0.04	0.03	0.02	0.01	0.02	0.04	0.00	0.03	0.00	0.03
Cl	1.40	1.43	1.37	1.34	1.56	1.48	1.39	1.38	1.38	1.44	1.51	1.45
F	0.05	0.09	0.09	0.08	0.09	0.02	0.02	0.00	0.00	0.00	0.01	0.03
Total	94.02	94.19	94.56	94.10	94.37	94.69	94.02	94.16	94.09	94.83	95.12	95.37
Cations Recalculated on the Basis of 23O												
Si	6.00	6.02	6.12	6.08	6.03	6.04	6.01	6.00	6.02	6.03	6.10	6.09
Ti	0.12	0.11	0.09	0.10	0.13	0.13	0.15	0.14	0.14	0.14	0.12	0.12
Al	2.69	2.67	2.55	2.62	2.67	2.62	2.65	2.66	2.65	2.70	2.57	2.60
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	2.10	2.12	2.07	2.08	2.10	2.15	2.11	2.11	2.12	2.09	2.12	2.08
Mg	0.03	0.03	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Mn	2.14	2.11	2.20	2.13	2.10	2.05	2.10	2.09	2.09	2.06	2.08	2.10
Ca	2.01	2.04	2.02	2.02	1.96	2.03	2.00	2.01	2.02	1.97	2.03	2.01
Na	0.43	0.42	0.44	0.44	0.46	0.42	0.46	0.45	0.45	0.44	0.43	0.45
K	0.45	0.41	0.40	0.42	0.47	0.45	0.45	0.45	0.43	0.47	0.43	0.43
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.37	0.38	0.36	0.36	0.41	0.39	0.37	0.37	0.37	0.38	0.40	0.38
F	0.03	0.05	0.04	0.04	0.05	0.01	0.01	0.00	0.00	0.00	0.00	0.01
Total	16.38	16.38	16.33	16.33	16.42	16.35	16.35	16.34	16.33	16.32	16.32	16.31

Sample:	PR15-01 (Type 3 Pegmatite)												
Mineral:	Scapolite												
No.	724	725	726	727	729	730	731	732	733	734	735	736	737
Wt%													
SiO2	49.65	49.38	49.67	49.82	49.68	49.57	49.07	49.64	48.88	49.24	49.88	50.02	50.05
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	23.80	23.67	23.63	23.68	23.43	23.72	24.49	23.76	24.08	23.31	23.48	23.50	23.47
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.02	0.19	0.00	0.00	0.01	0.01	0.14	0.01	0.01	0.03	0.12	0.06	0.03
MgO	0.02	0.29	0.02	0.01	0.04	0.04	0.39	0.02	0.03	0.00	0.16	0.01	0.01
MnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02	0.02
CaO	13.96	13.59	14.04	13.83	13.59	14.02	13.22	13.79	14.14	13.75	13.19	13.83	13.76
Na2O	4.51	4.27	4.35	4.69	4.32	4.81	4.25	3.99	4.51	3.45	4.19	4.70	3.64
K2O	0.27	0.32	0.24	0.25	0.26	0.30	0.35	0.29	0.28	0.24	0.30	0.24	0.23
SO3	3.89	3.66	3.79	3.73	3.76	3.87	3.83	4.10	3.87	4.02	3.82	4.05	4.05
Cl	0.32	0.32	0.33	0.33	0.32	0.46	0.42	0.49	0.44	0.31	0.33	0.33	0.36
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00
Total	96.36	95.60	95.99	96.26	95.34	96.70	96.07	95.98	96.14	94.28	95.40	96.67	95.54
Cations Recalculated on the Basis of 24O													
Si	7.02	7.04	7.05	7.06	7.09	7.01	6.96	7.03	6.95	7.08	7.10	7.05	7.10
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	3.97	3.98	3.95	3.95	3.94	3.95	4.09	3.97	4.04	3.95	3.94	3.90	3.92
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.01	0.00
Mg	0.00	0.06	0.00	0.00	0.01	0.01	0.08	0.00	0.00	0.00	0.03	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.12	2.08	2.14	2.10	2.08	2.12	2.01	2.09	2.16	2.12	2.01	2.09	2.09
Na	1.24	1.18	1.20	1.29	1.20	1.32	1.17	1.10	1.24	0.96	1.15	1.28	1.00
K	0.05	0.06	0.04	0.05	0.05	0.06	0.06	0.05	0.05	0.04	0.05	0.04	0.04
S	0.41	0.39	0.40	0.40	0.40	0.41	0.41	0.44	0.41	0.43	0.41	0.43	0.43
C*	0.51	0.53	0.52	0.52	0.52	0.48	0.49	0.45	0.48	0.49	0.51	0.49	0.48
Cl	0.08	0.08	0.08	0.08	0.08	0.11	0.10	0.12	0.11	0.08	0.08	0.08	0.08
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.40	15.41	15.38	15.44	15.36	15.47	15.39	15.25	15.44	15.15	15.31	15.38	15.16
%Me	62	64	63	61	63	61	63	65	63	68	63	61	67
%Ma	38	36	37	39	37	39	37	35	37	32	37	39	33

Continued→

Sample:	PR15-01 (Type 3 Pegmatite)												
Mineral:	Scapolite												
No.	738	739	740	741	742	743	744	745	746	747	748	749	750
Wt%													
SiO2	50.23	49.49	49.89	49.88	50.19	50.08	49.64	49.72	49.43	49.62	49.68	49.63	49.39
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	23.49	23.40	23.33	23.39	23.28	23.28	23.70	23.71	23.75	23.69	23.90	23.48	23.50
Cr2O3	0.00	0.02	0.02	0.01	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00
FeO	0.06	0.07	0.04	0.06	0.13	0.03	0.04	0.06	0.05	0.04	0.05	0.05	0.05
MgO	0.02	0.03	0.02	0.03	0.10	0.02	0.05	0.06	0.06	0.04	0.06	0.06	0.05
MnO	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.03
CaO	13.96	13.74	13.61	13.76	13.32	13.66	14.40	14.23	14.29	14.33	14.24	14.15	14.06
Na2O	4.60	4.49	4.75	4.75	4.63	4.68	4.45	4.11	4.01	3.97	4.32	4.22	4.38
K2O	0.27	0.24	0.25	0.24	0.29	0.30	0.24	0.27	0.25	0.22	0.25	0.24	0.24
SO3	4.04	3.83	3.75	3.86	3.81	3.96	4.07	3.83	3.94	3.91	3.88	3.87	3.92
Cl	0.35	0.33	0.34	0.36	0.35	0.34	0.41	0.41	0.41	0.37	0.44	0.42	0.31
F	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.01
Total	96.96	95.56	95.92	96.27	96.02	96.29	96.91	96.31	96.12	96.12	96.71	96.05	95.87
Cations Recalculated on the Basis of 24O													
Si	7.06	7.06	7.09	7.07	7.11	7.08	6.99	7.04	7.01	7.03	7.01	7.05	7.02
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	3.89	3.93	3.91	3.91	3.89	3.88	3.94	3.96	3.97	3.96	3.97	3.93	3.94
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.01	0.00	0.01	0.00	0.01
Mg	0.00	0.00	0.00	0.01	0.02	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.10	2.10	2.07	2.09	2.02	2.07	2.17	2.16	2.17	2.18	2.15	2.15	2.14
Na	1.26	1.24	1.31	1.31	1.27	1.28	1.21	1.13	1.10	1.09	1.18	1.16	1.21
K	0.05	0.04	0.05	0.04	0.05	0.06	0.04	0.05	0.05	0.04	0.05	0.04	0.04
S	0.43	0.41	0.40	0.41	0.41	0.42	0.43	0.41	0.42	0.42	0.41	0.41	0.42
C*	0.49	0.51	0.52	0.50	0.51	0.49	0.47	0.50	0.48	0.50	0.48	0.48	0.50
Cl	0.08	0.08	0.08	0.09	0.08	0.08	0.10	0.10	0.10	0.09	0.11	0.10	0.07
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
Total	15.37	15.39	15.44	15.43	15.39	15.38	15.38	15.35	15.32	15.30	15.38	15.36	15.38
%Me	62	62	61	61	61	61	64	65	66	66	64	64	63
%Ma	38	38	39	39	39	39	36	35	34	34	36	36	37

Continued→

Sample:	PR15-01 (Type 3 Pegmatite)			
Mineral:	Scapolite			
No.	751	752	753	754
Wt%				
SiO2	49.12	49.32	49.47	49.29
TiO2	0.01	0.00	0.00	0.00
Al2O3	23.65	23.81	23.83	23.91
Cr2O3	0.01	0.01	0.00	0.00
FeO	0.03	0.08	0.06	0.04
MgO	0.05	0.04	0.06	0.03
MnO	0.00	0.00	0.01	0.01
CaO	14.41	14.38	14.31	14.22
Na2O	3.82	4.70	4.62	2.69
K2O	0.24	0.25	0.27	0.24
SO3	3.94	3.66	3.81	3.98
Cl	0.34	0.29	0.31	0.31
F	0.00	0.00	0.00	0.00
Total	95.55	96.48	96.68	94.64
Cations Recalculated on the Basis of 24O				
Si	7.00	6.99	6.99	7.05
Ti	0.00	0.00	0.00	0.00
Al	3.97	3.98	3.97	4.03
Cr	0.00	0.00	0.00	0.00
Fe	0.00	0.01	0.01	0.00
Mg	0.01	0.01	0.01	0.01
Mn	0.00	0.00	0.00	0.00
Ca	2.20	2.18	2.17	2.18
Na	1.06	1.29	1.27	0.75
K	0.04	0.05	0.05	0.04
S	0.42	0.39	0.40	0.43
C*	0.50	0.54	0.52	0.50
Cl	0.08	0.07	0.07	0.07
F	0.00	0.00	0.00	0.00
Total	15.29	15.52	15.47	15.05
%Me	67	62	62	73
%Ma	33	38	38	27

Sample:	PR15-01 (Type 3 Pegmatite)						
Mineral:	Plagioclase						
No.	917	918	919	920	921	922	923
Wt%							
SiO2	56.42	61.21	61.76	61.37	59.27	57.55	59.24
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	27.16	24.09	23.16	23.45	25.29	26.53	25.42
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.03	0.07	0.02	0.03	0.05	0.07	0.10
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	9.34	5.87	4.82	5.28	7.12	8.59	7.27
Na2O	5.66	6.80	6.26	6.61	5.89	5.80	5.93
K2O	0.14	0.13	0.23	0.23	0.21	0.13	0.16
SO3	0.01	0.00	0.00	0.02	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	98.76	98.17	96.26	96.99	97.82	98.67	98.13
Cation Recalculated on the Basis of 8O							
Si	2.56	2.75	2.81	2.78	2.68	2.60	2.68
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.45	1.28	1.24	1.25	1.35	1.41	1.35
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.45	0.28	0.24	0.26	0.35	0.42	0.35
Na	0.50	0.59	0.55	0.58	0.52	0.51	0.52
K	0.01	0.01	0.01	0.01	0.01	0.01	0.01
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.97	4.91	4.85	4.89	4.91	4.95	4.91
%Ab	52	67	69	68	59	55	59
%An	47	32	29	30	40	45	40
%Or	1	1	2	2	1	1	1

Continued→

Sample:	PR15-01 (Type 3 Pegmatite)			Sample:	PR15-01 (Type 3 Pegmatite)								
Mineral:	Plagioclase			Mineral:	Biotite								
No.	924	925	926		907	908	909	910	911	912	913	914	915
Wt%													
SiO2	56.84	60.59	61.77		37.46	37.92	37.54	37.69	37.37	37.28	36.73	37.33	37.60
TiO2	0.00	0.00	0.00		0.64	0.59	0.57	0.57	0.58	0.59	0.39	0.35	0.19
Al2O3	27.10	24.48	23.68		17.17	17.27	17.01	16.92	16.80	17.00	17.25	17.64	18.85
Cr2O3	0.00	0.00	0.00		0.64	0.59	0.57	0.57	0.58	0.59	0.39	0.35	0.19
FeO	0.32	0.18	0.07		15.58	15.54	16.27	16.15	15.94	15.81	15.15	16.03	15.07
MgO	0.00	0.00	0.00		14.53	14.33	14.50	14.41	14.51	14.42	14.06	14.40	13.24
MnO	0.01	0.00	0.00		0.10	0.10	0.09	0.08	0.08	0.06	0.08	0.07	0.03
CaO	9.17	6.29	5.24		0.07	0.04	0.05	0.04	0.03	0.06	0.04	0.02	0.01
Na2O	6.08	7.16	7.64		0.01	0.02	0.00	0.01	0.00	0.02	0.05	0.04	0.04
K2O	0.11	0.18	0.20		9.03	9.50	9.43	9.63	9.58	9.27	9.20	8.94	9.38
SO3	0.00	0.00	0.00		0.10	0.08	0.10	0.11	0.08	0.10	0.13	0.08	0.07
Cl	0.00	0.00	0.00		0.14	0.11	0.12	0.16	0.14	0.14	0.14	0.13	0.14
F	0.00	0.00	0.00		0.16	0.20	0.15	0.18	0.21	0.20	0.17	0.11	0.08
Total	99.62	98.89	98.60		94.92	95.59	95.74	95.85	95.21	94.87	93.30	95.07	94.63
Cations Recalculated on the Basis of 8O				Cations Recalculated on the Basis of 11O									
Si	2.56	2.72	2.77		2.80	2.82	2.80	2.81	2.80	2.80	2.80	2.79	2.81
Ti	0.00	0.00	0.00		0.04	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.01
Al	1.44	1.29	1.25		1.51	1.51	1.49	1.49	1.49	1.50	1.55	1.55	1.66
Cr	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.00		0.97	0.97	1.01	1.01	1.00	0.99	0.96	1.00	0.94
Mg	0.00	0.00	0.00		1.62	1.59	1.61	1.60	1.62	1.61	1.60	1.60	1.47
Mn	0.00	0.00	0.00		0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Ca	0.44	0.30	0.25		0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	0.53	0.62	0.66		0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
K	0.01	0.01	0.01		0.86	0.90	0.90	0.92	0.92	0.89	0.89	0.85	0.89
S	0.00	0.00	0.00		0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.00
Cl	0.00	0.00	0.00		0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02
F	0.00	0.00	0.00		0.04	0.05	0.04	0.04	0.05	0.05	0.04	0.03	0.02
Total	4.99	4.95	4.94		7.88	7.90	7.91	7.92	7.94	7.91	7.90	7.88	7.83
Ab	54	67	72										
An	45	32	27	%Ann	38	38	39	39	38	38	38	38	39
Or	1	1	1	%Phl	62	62	61	61	62	62	62	62	61

Continued→

Sample:	PR15-01 (Type 3 Pegmatite)
Mineral:	Biotite
No.	916
Wt%	
SiO2	38.35
TiO2	0.19
Al2O3	18.69
Cr2O3	0.19
FeO	14.94
MgO	13.55
MnO	0.02
CaO	0.01
Na2O	0.03
K2O	9.37
SO3	0.09
Cl	0.13
F	0.13
Total	95.42
Cations Recalculated on the Basis of 11O	
Si	2.83
Ti	0.01
Al	1.63
Cr	0.00
Fe	0.92
Mg	1.49
Mn	0.00
Ca	0.00
Na	0.00
K	0.88
S	0.01
Cl	0.02
F	0.03
Total	7.82
%Ann	38
%Phl	62

Sample:	JB10-51 (Haroya Migmatitic Tonalite Gneiss)												
Mineral:	Scapolite												
No.	70	71	72	73	74	76	77	78	79	80	81	82	83
Wt.%													
SiO2	47.15	47.26	47.42	47.24	47.13	47.21	47.19	47.44	47.56	47.60	47.56	47.99	47.29
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.89	25.91	25.85	25.98	26.12	26.05	26.14	26.06	25.81	25.86	25.58	25.68	25.86
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
FeO	0.06	0.08	0.09	0.12	0.09	0.18	0.07	0.19	0.05	0.06	0.09	0.10	0.12
MgO	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.00
MnO	0.01	0.01	0.03	0.02	0.03	0.03	0.05	0.04	0.04	0.01	0.07	0.07	0.05
CaO	16.59	16.64	16.65	16.88	16.93	16.94	16.90	16.81	16.59	16.47	16.27	16.43	16.68
Na2O	3.55	3.42	3.81	3.86	3.93	3.87	3.93	3.75	4.12	4.04	3.34	4.13	4.06
K2O	0.13	0.14	0.16	0.17	0.17	0.16	0.17	0.19	0.14	0.10	0.15	0.15	0.15
SO3	3.19	3.02	2.83	3.02	3.19	3.10	2.90	3.25	3.22	3.21	3.33	3.38	3.22
Cl	0.12	0.14	0.15	0.14	0.13	0.14	0.16	0.12	0.14	0.12	0.13	0.14	0.13
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	96.66	96.60	96.96	97.40	97.69	97.65	97.47	97.84	97.63	97.45	96.50	98.04	97.50
Cations Recalculated on the Basis of 24O													
Si	6.71	6.73	6.75	6.70	6.66	6.68	6.69	6.69	6.72	6.72	6.76	6.74	6.69
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.34	4.35	4.34	4.34	4.35	4.34	4.37	4.33	4.30	4.31	4.29	4.25	4.32
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00
Ca	2.53	2.54	2.54	2.56	2.56	2.57	2.57	2.54	2.51	2.49	2.48	2.47	2.53
Na	0.98	0.95	1.05	1.06	1.08	1.06	1.08	1.02	1.13	1.11	0.92	1.13	1.11
K	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.03	0.03	0.03
S	0.34	0.32	0.30	0.32	0.34	0.33	0.31	0.34	0.34	0.34	0.36	0.36	0.34
C*	0.63	0.64	0.66	0.64	0.63	0.64	0.65	0.63	0.63	0.63	0.61	0.61	0.63
Cl	0.03	0.03	0.04	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.03
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.60	15.61	15.72	15.71	15.70	15.71	15.75	15.64	15.69	15.66	15.50	15.64	15.70
%Me	72	72	70	70	70	70	70	71	69	69	73	68	69
%Ma	28	28	30	30	30	30	30	29	31	31	27	32	31

Continued→

Sample:	JB10-51 (Haroya Migmatitic Tonalite Gneiss)												
Mineral:	Scapolite												
No.	84	85	86	87	88	89	90	91	92	93	94	95	96
Wt.%													
SiO2	47.23	46.78	47.50	47.50	47.43	47.20	47.48	47.48	47.57	47.17	47.27	47.21	47.04
TiO2	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Al2O3	25.69	25.87	25.72	25.97	25.82	26.05	25.90	25.50	25.35	25.61	25.82	25.44	25.69
Cr2O3	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.12	0.09	0.09	0.10	0.09	0.08	0.11	0.12	0.10	0.11	0.10	0.14	0.10
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00
MnO	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.09	0.08	0.09
CaO	16.74	16.97	16.61	16.75	16.91	16.85	16.80	16.43	16.49	16.68	16.79	16.48	16.69
Na2O	3.97	3.95	3.98	3.94	3.91	3.98	4.06	3.94	4.01	4.05	3.94	3.95	3.84
K2O	0.17	0.17	0.15	0.15	0.14	0.17	0.17	0.17	0.18	0.15	0.19	0.19	0.15
SO3	3.38	3.30	3.04	2.94	3.19	3.26	3.17	3.15	3.41	3.52	3.10	3.01	3.03
Cl	0.11	0.16	0.15	0.14	0.13	0.14	0.16	0.17	0.17	0.14	0.17	0.17	0.16
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	97.45	97.33	97.29	97.54	97.64	97.77	97.88	96.99	97.32	97.45	97.44	96.63	96.74
Cations Recalculated on the Basis of 24O													
Si	6.69	6.64	6.74	6.72	6.70	6.66	6.70	6.75	6.74	6.68	6.70	6.75	6.71
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.29	4.33	4.30	4.33	4.30	4.34	4.31	4.27	4.23	4.27	4.32	4.28	4.32
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ca	2.54	2.58	2.52	2.54	2.56	2.55	2.54	2.50	2.50	2.53	2.55	2.52	2.55
Na	1.09	1.09	1.10	1.08	1.07	1.09	1.11	1.09	1.10	1.11	1.08	1.09	1.06
K	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.03
S	0.36	0.35	0.32	0.31	0.34	0.35	0.34	0.34	0.36	0.37	0.33	0.32	0.32
C*	0.61	0.61	0.64	0.65	0.63	0.62	0.63	0.62	0.60	0.59	0.63	0.64	0.64
Cl	0.03	0.04	0.04	0.03	0.03	0.03	0.04	0.04	0.04	0.03	0.04	0.04	0.04
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.66	15.70	15.70	15.73	15.68	15.69	15.71	15.66	15.63	15.64	15.71	15.71	15.70
%Me	70	70	69	70	70	70	69	69	69	69	70	69	70
%Ma	30	30	31	30	30	30	31	31	31	31	30	31	30

Continued→

Sample:	JB10-51 (Haroya Migmatitic Tonalite Gneiss)				CB15-04 (Migmatitic garnet-amphibolite gneiss)								
Mineral:	Scapolite												
No.	97	98	99		765	766	767	768	769	770	771	772	773
Wt.%													
SiO2	46.84	47.21	47.68		47.98	47.74	47.76	47.30	47.46	47.63	47.58	47.44	47.79
TiO2	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01
Al2O3	25.68	25.74	25.42		24.39	24.56	24.64	24.61	24.79	24.76	24.63	24.79	24.64
Cr2O3	0.00	0.00	0.01		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.10	0.11	0.12		0.17	0.15	0.21	0.15	0.14	0.14	0.14	0.15	0.18
MgO	0.00	0.00	0.01		0.04	0.04	0.05	0.04	0.05	0.03	0.04	0.04	0.05
MnO	0.07	0.06	0.05		0.02	0.02	0.01	0.01	0.02	0.02	0.00	0.02	0.03
CaO	16.77	16.44	16.31		15.72	16.16	15.93	15.95	15.94	16.15	16.05	16.00	15.80
Na2O	3.78	3.92	3.98		4.07	3.94	4.08	3.82	4.04	4.21	4.18	4.07	3.96
K2O	0.15	0.14	0.17		0.12	0.12	0.14	0.14	0.11	0.14	0.12	0.13	0.13
SO3	3.13	3.10	3.25		4.22	4.20	4.02	4.12	4.31	4.07	4.51	4.24	4.35
Cl	0.13	0.16	0.16		0.10	0.08	0.08	0.09	0.07	0.08	0.09	0.07	0.09
F	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	96.61	96.84	97.10		96.81	96.98	96.88	96.20	96.92	97.22	97.33	96.94	97.01
Cations Recalculated on the Basis of 24O													
Si	6.69	6.72	6.76		6.79	6.75	6.76	6.74	6.71	6.73	6.70	6.71	6.74
Ti	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.32	4.32	4.25		4.07	4.09	4.11	4.13	4.13	4.12	4.09	4.13	4.10
Cr	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.01		0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Mg	0.00	0.00	0.00		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mn	0.01	0.01	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.57	2.51	2.48		2.38	2.45	2.42	2.44	2.41	2.45	2.42	2.43	2.39
Na	1.05	1.08	1.09		1.12	1.08	1.12	1.05	1.11	1.15	1.14	1.12	1.08
K	0.03	0.02	0.03		0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
S	0.34	0.33	0.35		0.45	0.45	0.43	0.44	0.46	0.43	0.48	0.45	0.46
C*	0.63	0.63	0.62		0.53	0.53	0.55	0.54	0.52	0.55	0.50	0.53	0.52
Cl	0.03	0.04	0.04		0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
F	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.68	15.68	15.63		15.40	15.42	15.47	15.41	15.41	15.50	15.40	15.44	15.37
%Me	71	70	69		68	69	68	70	68	68	68	68	69
%Ma	29	30	31	100	32	31	32	30	32	32	32	32	31

Continued→

Sample:	CB15-04 (Haroya Migmatitic garnet-amphibolite gneiss)												
Mineral:	Scapolite												
No.	774	775	776	777	778	779	780	781	782	783	784	785	786
Wt.%													
SiO2	47.58	47.38	48.21	47.94	48.07	47.92	47.62	47.61	47.76	47.83	47.91	48.53	48.36
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	24.32	24.89	24.10	24.31	24.50	24.29	24.63	24.70	24.39	24.50	24.57	23.95	24.46
Cr2O3	0.03	0.01	0.02	0.04	0.01	0.02	0.02	0.01	0.01	0.02	0.01	0.02	0.03
FeO	0.20	0.17	0.21	0.18	0.18	0.20	0.17	0.19	0.18	0.16	0.16	0.20	0.22
MgO	0.07	0.07	0.09	0.07	0.08	0.07	0.07	0.08	0.08	0.06	0.08	0.10	0.09
MnO	0.02	0.01	0.01	0.01	0.00	0.00	0.00	0.02	0.01	0.01	0.00	0.02	0.02
CaO	16.04	16.23	15.58	15.59	15.51	15.48	15.90	15.97	15.89	15.97	15.57	15.22	15.23
Na2O	3.60	3.64	4.35	3.73	4.34	4.37	3.58	3.38	3.94	3.59	4.12	3.86	4.10
K2O	0.14	0.11	0.14	0.14	0.14	0.15	0.14	0.11	0.12	0.12	0.11	0.16	0.13
SO3	4.23	4.47	4.44	4.28	4.43	4.42	4.51	4.51	4.58	4.50	4.33	4.49	4.24
Cl	0.09	0.06	0.08	0.09	0.09	0.09	0.08	0.09	0.07	0.08	0.07	0.12	0.10
F	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00
Total	96.32	97.02	97.23	96.35	97.32	96.99	96.69	96.65	97.00	96.82	96.91	96.65	96.95
Cations Recalculated on the Basis of 24O													
Si	6.77	6.69	6.79	6.80	6.76	6.77	6.73	6.73	6.74	6.75	6.76	6.85	6.82
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.08	4.14	4.00	4.07	4.06	4.04	4.10	4.12	4.05	4.08	4.09	3.98	4.06
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03
Mg	0.01	0.01	0.02	0.01	0.02	0.01	0.02	0.02	0.02	0.01	0.02	0.02	0.02
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.44	2.46	2.35	2.37	2.34	2.34	2.41	2.42	2.40	2.42	2.36	2.30	2.30
Na	0.99	0.99	1.19	1.02	1.18	1.20	0.98	0.93	1.08	0.98	1.13	1.06	1.12
K	0.03	0.02	0.03	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.03	0.02
S	0.45	0.47	0.47	0.46	0.47	0.47	0.48	0.48	0.48	0.48	0.46	0.48	0.45
C*	0.52	0.51	0.51	0.52	0.51	0.51	0.50	0.50	0.50	0.50	0.52	0.50	0.53
Cl	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02
F	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Total	15.35	15.33	15.41	15.33	15.41	15.42	15.29	15.25	15.33	15.28	15.39	15.27	15.37
%Me	71	71	66	70	66	66	71	72	69	71	68	68	67
%Ma	29	29	34	30	34	34	29	28	31	29	32	32	33

Continued→

Sample:	CB15-04 (Haroya Migmatitic garnet-amphibolite gneiss)									Sample:	CB15-28 (Granodiorite)		
Mineral:	Scapolite												
No.	787	788	789	790	791	792	793	794		490	491	492	493
Wt.%													
SiO2	48.83	48.79	48.95	48.91	48.64	48.74	48.35	48.33		46.22	46.27	45.76	46.84
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01		0.00	0.00	0.00	0.00
Al2O3	24.17	23.97	24.05	24.03	23.93	24.12	24.27	24.31		26.22	26.09	26.09	25.45
Cr2O3	0.01	0.01	0.03	0.02	0.01	0.00	0.03	0.00		0.02	0.00	0.00	0.00
FeO	0.27	0.22	0.22	0.24	0.20	0.23	0.24	0.23		0.06	0.10	0.30	0.09
MgO	0.09	0.10	0.08	0.08	0.09	0.09	0.07	0.08		0.00	0.00	0.08	0.00
MnO	0.01	0.02	0.00	0.00	0.00	0.02	0.01	0.01		0.04	0.02	0.03	0.02
CaO	15.03	14.98	14.97	15.21	15.23	15.23	15.34	15.42		17.47	17.29	17.21	16.49
Na2O	4.15	3.78	4.08	4.23	4.11	3.88	3.16	3.00		3.61	3.15	3.41	3.52
K2O	0.14	0.16	0.16	0.16	0.14	0.13	0.15	0.13		0.16	0.14	0.16	0.12
SO3	4.16	4.45	4.30	4.25	4.66	4.55	4.75	4.38		2.14	2.78	2.26	2.88
Cl	0.12	0.13	0.12	0.12	0.11	0.10	0.10	0.11		0.15	0.11	0.12	0.10
F	0.01	0.00	0.01	0.00	0.02	0.00	0.01	0.02		0.00	0.01	0.03	0.01
Total	96.95	96.57	96.92	97.21	97.10	97.07	96.45	96.00		96.05	95.92	95.40	95.48
Cations Recalculated on the Basis of 24O													
Si	6.88	6.88	6.89	6.88	6.84	6.84	6.82	6.85		6.68	6.66	6.66	6.76
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
Al	4.02	3.98	3.99	3.98	3.96	3.99	4.03	4.06		4.47	4.43	4.47	4.32
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
Fe	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03		0.01	0.01	0.04	0.01
Mg	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02		0.00	0.00	0.02	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
Ca	2.27	2.26	2.26	2.29	2.29	2.29	2.32	2.34		2.70	2.67	2.68	2.55
Na	1.13	1.03	1.11	1.15	1.12	1.06	0.86	0.83		1.01	0.88	0.96	0.98
K	0.03	0.03	0.03	0.03	0.03	0.02	0.03	0.02		0.03	0.03	0.03	0.02
S	0.44	0.47	0.45	0.45	0.49	0.48	0.50	0.47		0.23	0.30	0.25	0.31
C*	0.52	0.50	0.51	0.52	0.47	0.50	0.47	0.50		0.73	0.67	0.71	0.66
Cl	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.03		0.04	0.03	0.03	0.02
F	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.01		0.00	0.00	0.01	0.00
Total	15.37	15.24	15.32	15.38	15.28	15.26	15.10	15.14		15.91	15.68	15.86	15.65
%Me	67	68	67	66	67	68	73	74		72	75	73	72
%Ma	33	32	33	34	33	32	27	26	100	28	25	27	28

Sample:	CB15-28 (Granodiorite)												
Mineral:	Scapolite												
No.	494	495	496	497	498	499	500	501	502	503	504	505	506
Wt.%													
SiO2	46.95	45.71	46.43	45.83	45.22	46.05	46.22	45.93	44.55	46.01	45.89	45.85	46.04
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.96	26.08	26.07	25.75	25.87	25.47	26.09	26.21	24.72	25.78	26.16	26.04	26.18
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.14	0.09	0.15	0.10	0.13	0.13	0.08	0.13	2.56	0.09	0.16	0.13	0.11
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.77	0.00	0.00	0.03	0.00
MnO	0.02	0.02	0.02	0.03	0.01	0.04	0.03	0.03	0.11	0.03	0.03	0.01	0.00
CaO	17.07	16.92	17.22	17.03	17.23	16.62	17.38	17.35	14.71	17.13	17.30	17.20	17.26
Na2O	3.51	3.62	3.61	3.85	3.34	3.71	3.54	3.49	2.27	3.52	3.49	3.69	2.99
K2O	0.16	0.12	0.20	0.15	0.16	0.17	0.17	0.16	0.13	0.14	0.16	0.16	0.15
SO3	2.72	2.79	2.06	2.76	1.72	2.60	2.72	2.14	2.37	2.92	1.86	2.55	2.58
Cl	0.14	0.10	0.16	0.11	0.14	0.12	0.15	0.13	0.11	0.12	0.15	0.13	0.12
F	0.02	0.02	0.03	0.01	0.03	0.04	0.00	0.03	0.00	0.04	0.03	0.01	0.02
Total	96.64	95.43	95.90	95.60	93.82	94.90	96.35	95.56	93.26	95.74	95.17	95.76	95.43
Cations Recalculated on the Basis of 24O													
Si	6.71	6.62	6.72	6.64	6.70	6.71	6.64	6.67	6.64	6.65	6.70	6.64	6.66
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.38	4.45	4.45	4.40	4.52	4.38	4.42	4.49	4.34	4.39	4.50	4.44	4.47
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.32	0.01	0.02	0.01	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.39	0.00	0.00	0.01	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Ca	2.62	2.63	2.67	2.64	2.74	2.60	2.68	2.70	2.35	2.65	2.71	2.67	2.68
Na	0.97	1.02	1.01	1.08	0.96	1.05	0.99	0.98	0.66	0.99	0.99	1.03	0.84
K	0.03	0.02	0.04	0.03	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03
S	0.29	0.30	0.22	0.30	0.19	0.29	0.29	0.23	0.26	0.32	0.20	0.28	0.28
C*	0.66	0.66	0.72	0.67	0.76	0.66	0.67	0.72	0.71	0.64	0.74	0.69	0.68
Cl	0.03	0.03	0.04	0.03	0.04	0.03	0.04	0.03	0.03	0.03	0.04	0.03	0.03
F	0.01	0.01	0.01	0.00	0.01	0.02	0.00	0.01	0.00	0.02	0.01	0.00	0.01
Total	15.73	15.76	15.91	15.81	15.97	15.78	15.77	15.89	15.74	15.72	15.95	15.84	15.69
%Me	72	72	72	71	74	71	73	73	82	72	73	72	76
%Ma	28	28	28	29	26	29	27	27	18	28	27	28	24

Continued→

Sample:	CB15-28 (Granodiorite)												
Mineral:	Scapolite												
No.	507	508	509	510	511	512	513	514	515	516	517	518	519
Wt.%													
SiO2	45.86	45.89	46.03	46.24	46.12	46.55	46.59	47.00	45.75	46.88	46.85	46.84	46.26
TiO2	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	26.46	26.39	26.27	26.03	25.71	25.85	25.87	25.23	25.94	25.47	26.16	26.05	26.07
Cr2O3	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.04	0.00	0.01	0.01	0.02
FeO	0.13	0.10	0.09	0.08	0.11	0.11	0.14	0.09	0.07	0.13	0.12	0.11	0.18
MgO	0.00	0.00	0.00	0.00	0.01	0.15	0.03	0.00	0.01	0.01	0.02	0.01	0.01
MnO	0.03	0.04	0.03	0.02	0.05	0.02	0.03	0.03	0.05	0.03	0.01	0.03	0.03
CaO	17.70	17.51	17.41	17.13	17.08	16.49	17.23	16.49	17.07	16.60	16.91	17.00	17.27
Na2O	3.47	3.56	3.40	3.71	3.17	3.33	3.39	3.84	3.36	3.23	3.64	3.67	3.48
K2O	0.19	0.14	0.17	0.14	0.17	0.13	0.18	0.14	0.17	0.18	0.23	0.22	0.21
SO3	2.11	2.11	2.43	2.90	2.66	2.72	2.03	2.80	1.78	2.65	1.63	1.48	2.02
Cl	0.13	0.14	0.12	0.12	0.12	0.13	0.16	0.13	0.16	0.14	0.17	0.19	0.14
F	0.04	0.04	0.02	0.03	0.04	0.02	0.00	0.01	0.02	0.04	0.00	0.01	0.04
Total	96.07	95.88	95.95	96.36	95.22	95.47	95.61	95.74	94.36	95.31	95.71	95.57	95.67
Cations Recalculated on the Basis of 24O													
Si	6.64	6.65	6.65	6.64	6.69	6.72	6.75	6.78	6.73	6.78	6.79	6.81	6.71
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.51	4.51	4.47	4.41	4.40	4.40	4.42	4.29	4.50	4.34	4.47	4.46	4.46
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02
Mg	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.75	2.72	2.70	2.64	2.66	2.55	2.68	2.55	2.69	2.57	2.63	2.65	2.69
Na	0.97	1.00	0.95	1.03	0.89	0.93	0.95	1.07	0.96	0.91	1.02	1.03	0.98
K	0.04	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.04	0.04	0.04
S	0.23	0.23	0.26	0.31	0.29	0.30	0.22	0.30	0.20	0.29	0.18	0.16	0.22
C*	0.72	0.72	0.70	0.65	0.66	0.66	0.74	0.66	0.76	0.66	0.78	0.78	0.73
Cl	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.04	0.03	0.04	0.05	0.03
F	0.02	0.02	0.01	0.01	0.02	0.01	0.00	0.00	0.01	0.02	0.00	0.01	0.02
Total	15.93	15.92	15.82	15.75	15.70	15.67	15.86	15.72	15.93	15.66	15.98	16.01	15.90
%Me	73	73	73	71	74	73	73	70	73	73	71	71	73
%Ma	27	27	27	29	26	27	27	30	27	27	29	29	27

Continued→

Sample:	Sample: CB15-63 (Granodiorite)												
Mineral:	Mineral: Scapolite												
No.	146	147	148	149	150	151	152	153	154	155	156	157	158
Wt.%													
SiO2	46.87	46.71	46.26	46.40	46.90	46.98	47.38	46.88	46.68	46.50	44.75	46.83	47.20
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.91	26.12	26.27	25.84	26.11	25.39	25.71	25.43	25.90	25.89	25.69	25.59	25.95
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.12	0.14	0.10	0.11	0.14	0.58	0.22	0.13	0.15	0.15	3.09	0.27	0.13
MgO	0.02	0.02	0.01	0.02	0.03	0.32	0.04	0.02	0.02	0.03	1.85	0.14	0.05
MnO	0.03	0.01	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.03	0.03	0.01
CaO	16.53	16.69	17.06	16.84	16.88	16.04	16.43	16.51	16.57	16.53	14.05	16.69	16.40
Na2O	3.88	3.79	3.43	3.57	3.68	3.26	3.63	3.72	3.68	3.57	2.61	3.68	3.74
K2O	0.11	0.10	0.11	0.10	0.10	0.12	0.14	0.15	0.11	0.12	0.16	0.14	0.13
SO3	2.65	2.54	2.21	2.75	2.72	2.33	2.74	2.46	2.71	2.47	2.18	2.77	2.56
Cl	0.05	0.02	0.05	0.05	0.06	0.04	0.04	0.04	0.03	0.04	0.04	0.05	0.06
F	0.01	0.00	0.00	0.02	0.00	0.00	0.00	0.03	0.01	0.00	0.00	0.00	0.00
Total	96.16	96.14	95.48	95.68	96.59	95.04	96.30	95.36	95.84	95.30	94.44	96.18	96.22
Cations Recalculated on the Basis of 24O													
Si	6.73	6.71	6.70	6.69	6.70	6.81	6.78	6.78	6.72	6.73	6.59	6.72	6.76
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.38	4.42	4.49	4.39	4.40	4.34	4.33	4.34	4.39	4.42	4.46	4.33	4.38
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.02	0.01	0.01	0.02	0.07	0.03	0.02	0.02	0.02	0.38	0.03	0.02
Mg	0.00	0.00	0.00	0.00	0.00	0.07	0.01	0.00	0.00	0.00	0.41	0.03	0.01
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.54	2.57	2.65	2.60	2.58	2.49	2.52	2.56	2.55	2.56	2.22	2.57	2.52
Na	1.08	1.06	0.96	1.00	1.02	0.91	1.01	1.04	1.02	1.00	0.74	1.02	1.04
K	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.03	0.03	0.02
S	0.29	0.27	0.24	0.30	0.29	0.25	0.29	0.27	0.29	0.27	0.24	0.30	0.28
C*	0.70	0.72	0.75	0.68	0.69	0.74	0.70	0.71	0.70	0.72	0.75	0.69	0.71
Cl	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
F	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Total	15.77	15.80	15.83	15.72	15.74	15.72	15.70	15.78	15.73	15.76	15.83	15.74	15.75
%Me	70	71	73	72	72	74	71	71	71	72	80	71	71
%Ma	30	29	27	28	28	26	29	29	29	28	20	29	29

Continued→

Sample:	CB15-63 (Granodiorite)												
Mineral:	Scapolite												
No.	159	160	161	162	163	164	165	166	167	168	169	170	171
Wt.%													
SiO2	46.54	46.55	46.17	46.80	46.40	46.27	47.35	47.82	46.62	46.34	46.13	46.53	46.30
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.57	26.22	26.28	26.05	26.39	26.44	25.62	25.57	26.26	26.66	26.65	26.34	26.44
Cr2O3	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.02	0.00	0.01	0.00	0.00	0.01
FeO	0.49	0.13	0.08	0.14	0.08	0.10	0.15	0.19	0.14	0.14	0.07	0.14	0.12
MgO	0.34	0.04	0.01	0.04	0.02	0.02	0.03	0.05	0.03	0.02	0.02	0.02	0.01
MnO	0.01	0.00	0.01	0.00	0.01	0.02	0.03	0.03	0.01	0.04	0.02	0.01	0.02
CaO	16.24	17.28	17.31	16.82	17.03	17.14	16.49	16.41	17.01	17.39	17.20	17.03	17.22
Na2O	3.23	3.30	3.52	3.66	3.50	3.34	3.79	3.97	3.49	3.35	3.41	3.57	3.43
K2O	0.13	0.20	0.11	0.12	0.10	0.10	0.12	0.14	0.13	0.10	0.10	0.12	0.10
SO3	2.60	2.66	2.58	2.48	2.40	2.56	2.79	2.52	2.53	2.34	2.52	2.51	2.36
Cl	0.05	0.05	0.04	0.05	0.04	0.04	0.06	0.05	0.04	0.04	0.05	0.04	0.04
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02
Total	95.19	96.41	96.11	96.15	95.97	96.01	96.43	96.75	96.26	96.41	96.16	96.30	96.07
Cations Recalculated on the Basis of 24O													
Si	6.74	6.67	6.65	6.72	6.68	6.66	6.77	6.82	6.69	6.65	6.63	6.68	6.67
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.37	4.43	4.46	4.41	4.48	4.48	4.32	4.30	4.44	4.51	4.51	4.45	4.49
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.06	0.02	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.02	0.01
Mg	0.07	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.52	2.65	2.67	2.59	2.63	2.64	2.52	2.51	2.62	2.68	2.65	2.62	2.66
Na	0.91	0.92	0.98	1.02	0.98	0.93	1.05	1.10	0.97	0.93	0.95	0.99	0.96
K	0.02	0.04	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02
S	0.28	0.29	0.28	0.27	0.26	0.28	0.30	0.27	0.27	0.25	0.27	0.27	0.25
C*	0.70	0.70	0.71	0.72	0.73	0.71	0.69	0.72	0.72	0.73	0.72	0.72	0.73
Cl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01
Total	15.69	15.74	15.79	15.79	15.80	15.75	15.71	15.78	15.77	15.81	15.78	15.79	15.81
%Me	74	74	73	72	73	74	70	69	73	74	73	72	73
%Ma	26	26	27	28	27	26	30	31	27	26	27	28	27

Continued→

Sample:	CB15-63 (Granodiorite)												
Mineral:	Scapolite												
No.	172	173	174	175	32	33	34	35	36	37	49	50	51
Wt.%													
SiO2	46.68	46.14	46.92	47.15	46.16	46.54	46.25	45.99	46.45	46.27	46.81	47.06	46.97
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	26.60	26.47	26.12	25.78	26.52	26.65	26.09	26.11	26.89	26.74	25.84	26.07	26.28
Cr2O3	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.19	0.14	0.21	0.17	0.08	0.09	0.13	0.09	0.26	0.14	0.09	0.15	0.09
MgO	0.00	0.03	0.04	0.03	0.01	0.01	0.02	0.01	0.01	0.00	0.02	0.04	0.03
MnO	0.03	0.02	0.02	0.01	0.02	0.02	0.01	0.02	0.02	0.01	0.00	0.00	0.00
CaO	17.38	17.19	16.76	16.68	17.91	17.71	17.55	17.36	17.85	17.87	17.24	17.17	17.45
Na2O	3.68	3.42	3.64	3.89	3.70	3.68	3.72	3.67	3.54	3.73	4.15	3.89	3.85
K2O	0.11	0.11	0.12	0.13	0.10	0.09	0.11	0.10	0.14	0.09	0.13	0.12	0.12
SO3	2.56	2.44	2.71	2.59	2.87	2.92	2.95	2.84	2.98	2.70	2.83	3.03	2.95
Cl	0.04	0.04	0.03	0.05	0.04	0.04	0.05	0.04	0.03	0.03	0.03	0.03	0.04
F	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Total	97.28	95.99	96.56	96.48	97.40	97.75	96.87	96.21	98.16	97.58	97.14	97.54	97.77
Cations Recalculated on the Basis of 24O													
Si	6.64	6.65	6.71	6.75	6.57	6.59	6.61	6.61	6.56	6.58	6.67	6.66	6.64
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.46	4.50	4.40	4.35	4.45	4.45	4.40	4.43	4.47	4.48	4.34	4.35	4.38
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.03	0.02	0.01	0.02	0.01
Mg	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.65	2.65	2.57	2.56	2.73	2.69	2.69	2.68	2.70	2.72	2.63	2.60	2.64
Na	1.02	0.96	1.01	1.08	1.02	1.01	1.03	1.02	0.97	1.03	1.15	1.07	1.06
K	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
S	0.27	0.26	0.29	0.28	0.31	0.31	0.32	0.31	0.32	0.29	0.30	0.32	0.31
C*	0.72	0.73	0.70	0.71	0.67	0.68	0.66	0.68	0.68	0.70	0.69	0.67	0.68
Cl	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
F	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.82	15.80	15.73	15.79	15.81	15.77	15.76	15.77	15.76	15.84	15.83	15.73	15.76
%Me	72	73	72	70	73	72	72	72	73	72	69	71	71
%Ma	28	27	28	30	27	28	28	28	27	28	31	29	29

Continued→

Sample:	CB15-63 (Granodiorite)								Sample:	CB14-34 (Ulla Gneiss)		
Mineral:	Scapolite											
No.	52	53	75	76	77	78	79		455	456	457	458	459
Wt.%													
SiO2	46.35	46.93	46.61	47.42	46.85	47.09	46.26		47.48	46.45	46.60	47.49	46.84
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Al2O3	26.65	26.27	25.83	25.83	26.20	26.02	26.80		26.18	25.63	26.24	25.30	25.16
Cr2O3	0.00	0.00	0.00	0.00	0.02	0.00	0.00		0.01	0.00	0.00	0.02	0.00
FeO	0.06	0.07	0.16	0.16	0.19	0.15	0.25		0.12	0.18	0.12	0.16	0.08
MgO	0.02	0.02	0.03	0.04	0.03	0.04	0.01		0.10	0.03	0.04	0.04	0.03
MnO	0.00	0.00	0.02	0.00	0.01	0.01	0.02		0.03	0.04	0.05	0.03	0.03
CaO	17.63	17.37	17.31	16.74	17.17	17.15	17.81		15.25	15.89	17.04	15.68	16.02
Na2O	3.84	4.03	3.79	4.10	3.79	3.96	3.79		2.29	2.62	3.86	3.88	3.82
K2O	0.11	0.10	0.13	0.10	0.11	0.12	0.09		0.34	0.34	0.37	0.33	0.29
SO3	2.82	3.08	2.90	3.05	2.97	2.79	2.82		1.66	1.93	1.65	2.55	2.71
Cl	0.04	0.03	0.05	0.05	0.04	0.05	0.04		0.32	0.36	0.41	0.38	0.33
F	0.00	0.00	0.00	0.01	0.00	0.00	0.00		0.05	0.03	0.01	0.01	0.00
Total	97.51	97.89	96.82	97.48	97.37	97.36	97.86		93.73	93.40	96.28	95.78	95.24
Cations Recalculated on the Basis of 24O													
Si	6.59	6.63	6.66	6.71	6.65	6.69	6.56		6.95	6.86	6.75	6.85	6.79
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Al	4.46	4.38	4.35	4.31	4.38	4.36	4.48		4.51	4.46	4.48	4.30	4.30
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.02	0.02	0.02	0.02	0.03		0.01	0.02	0.01	0.02	0.01
Mg	0.00	0.00	0.01	0.01	0.01	0.01	0.00		0.02	0.00	0.01	0.01	0.01
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.01	0.00	0.00
Ca	2.68	2.63	2.65	2.54	2.61	2.61	2.70		2.39	2.51	2.64	2.42	2.49
Na	1.06	1.10	1.05	1.13	1.04	1.09	1.04		0.65	0.75	1.08	1.08	1.08
K	0.02	0.02	0.02	0.02	0.02	0.02	0.02		0.06	0.06	0.07	0.06	0.05
S	0.30	0.33	0.31	0.32	0.32	0.30	0.30		0.18	0.21	0.18	0.28	0.30
C*	0.69	0.67	0.67	0.66	0.67	0.69	0.69		0.72	0.69	0.72	0.63	0.62
Cl	0.01	0.01	0.01	0.01	0.01	0.01	0.01		0.08	0.09	0.10	0.09	0.08
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.02	0.01	0.00	0.00	0.00
Total	15.82	15.77	15.77	15.73	15.74	15.79	15.83		15.60	15.67	16.05	15.75	15.74
%Me	71	70	71	69	71	70	72		77	76	70	68	69
%Ma	29	30	29	31	29	30	28	100	23	24	30	32	31

Continued→

Sample:	CB14-34 (Ulla Gneiss)												
Mineral:	Scapolite												
No.	460	461	462	463	464	465	466	467	468	469	470	471	472
Wt.%													
SiO2	48.16	42.49	46.04	46.12	46.67	48.07	49.30	47.12	47.96	47.15	46.73	47.61	46.98
TiO2	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Al2O3	25.55	22.73	26.28	26.15	26.47	24.71	23.98	25.52	25.15	25.53	25.90	25.88	25.73
Cr2O3	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.01	0.01
FeO	0.25	6.08	0.09	0.11	0.21	0.34	2.82	0.26	0.34	0.28	0.11	0.11	0.15
MgO	0.26	4.76	0.03	0.05	0.12	0.05	0.67	0.06	0.06	0.05	0.04	0.02	0.08
MnO	0.03	0.11	0.04	0.03	0.03	0.02	0.03	0.04	0.03	0.05	0.02	0.02	0.00
CaO	14.19	8.62	16.85	15.86	15.35	14.21	10.11	16.01	14.83	16.22	14.47	14.49	15.19
Na2O	1.74	1.35	3.34	2.47	2.79	3.24	2.47	3.87	3.21	4.12	2.71	1.54	2.65
K2O	0.31	0.26	0.38	0.35	0.47	0.26	0.23	0.32	0.28	0.31	0.30	0.26	0.33
SO3	1.18	0.78	0.90	1.37	1.40	2.30	3.17	2.56	2.51	2.33	1.75	1.43	1.28
Cl	0.37	0.26	0.42	0.37	0.33	0.41	0.31	0.37	0.36	0.39	0.36	0.32	0.45
F	0.02	0.06	0.01	0.00	0.01	0.01	0.01	0.02	0.00	0.01	0.01	0.00	0.00
Total	91.96	87.42	94.29	92.80	93.78	93.54	93.03	96.08	94.66	96.34	92.31	91.62	92.75
Cations Recalculated on the Basis of 24O													
Si	7.14	6.80	6.81	6.86	6.87	7.04	7.18	6.79	6.95	6.79	6.94	7.07	6.97
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.47	4.29	4.58	4.58	4.59	4.26	4.11	4.33	4.29	4.33	4.53	4.53	4.50
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.03	0.81	0.01	0.01	0.03	0.04	0.34	0.03	0.04	0.03	0.01	0.01	0.02
Mg	0.06	1.14	0.01	0.01	0.03	0.01	0.15	0.01	0.01	0.01	0.01	0.00	0.02
Mn	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.26	1.48	2.67	2.53	2.42	2.23	1.58	2.47	2.30	2.50	2.30	2.31	2.42
Na	0.50	0.42	0.96	0.71	0.80	0.92	0.70	1.08	0.90	1.15	0.78	0.44	0.76
K	0.06	0.05	0.07	0.06	0.09	0.05	0.04	0.06	0.05	0.06	0.06	0.05	0.06
S	0.13	0.09	0.10	0.15	0.16	0.25	0.35	0.28	0.27	0.25	0.19	0.16	0.14
C*	0.76	0.81	0.79	0.76	0.76	0.64	0.57	0.62	0.64	0.65	0.71	0.76	0.75
Cl	0.09	0.07	0.11	0.09	0.08	0.10	0.08	0.09	0.09	0.09	0.09	0.08	0.11
F	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Total	15.51	16.00	16.11	15.78	15.82	15.55	15.10	15.78	15.56	15.89	15.63	15.42	15.76
%Me	81	88	72	77	74	70	74	69	71	68	74	83	75
%Ma	19	12	28	23	26	30	26	31	29	32	26	17	25

Continued→

Sample:	CB14-34 (Ulla Gneiss)							Sample:	CB15-42 (Augen Gneiss)			
Mineral:	Scapolite											
No.	473	474	475	476	477	478	479	62	63	64	65	66
Wt.%												
SiO2	47.07	47.34	46.36	46.52	47.42	46.94	47.78	47.80	47.97	47.96	47.51	46.89
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.95	25.95	26.02	25.75	25.70	25.88	25.19	25.52	25.53	25.76	25.55	25.51
Cr2O3	0.01	0.01	0.03	0.02	0.03	0.01	0.02	0.01	0.00	0.00	0.01	0.01
FeO	0.09	0.18	0.10	0.09	0.13	0.08	0.07	0.11	0.09	0.10	0.11	0.08
MgO	0.02	0.02	0.02	0.02	0.09	0.00	0.03	0.00	0.00	0.00	0.00	0.00
MnO	0.03	0.03	0.02	0.04	0.02	0.03	0.02	0.02	0.02	0.04	0.02	0.03
CaO	15.90	15.33	15.95	15.05	15.13	16.11	13.73	16.07	16.03	16.06	16.18	16.06
Na2O	3.29	2.44	3.38	2.35	2.75	2.52	2.41	4.17	3.82	3.73	3.47	4.13
K2O	0.31	0.34	0.35	0.28	0.63	0.32	0.29	0.26	0.21	0.20	0.17	0.20
SO3	1.09	1.39	1.04	1.06	1.24	1.04	1.05	2.52	2.97	2.91	3.28	3.00
Cl	0.42	0.38	0.47	0.37	0.38	0.44	0.37	0.25	0.19	0.19	0.16	0.22
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	94.09	93.33	93.63	91.45	93.43	93.26	90.86	96.67	96.78	96.90	96.42	96.08
Cations Recalculated on the Basis of 24O												
Si	6.93	6.97	6.88	6.99	7.00	6.96	7.18	6.83	6.82	6.81	6.77	6.73
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.50	4.51	4.55	4.56	4.47	4.52	4.46	4.30	4.28	4.31	4.29	4.32
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Mg	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.51	2.42	2.53	2.42	2.39	2.56	2.21	2.46	2.44	2.44	2.47	2.47
Na	0.94	0.70	0.97	0.69	0.79	0.72	0.70	1.16	1.05	1.03	0.96	1.15
K	0.06	0.06	0.07	0.05	0.12	0.06	0.06	0.05	0.04	0.04	0.03	0.04
S	0.12	0.15	0.12	0.12	0.14	0.12	0.12	0.27	0.32	0.31	0.35	0.32
C*	0.77	0.75	0.77	0.79	0.77	0.77	0.79	0.67	0.64	0.64	0.61	0.62
Cl	0.11	0.09	0.12	0.09	0.09	0.11	0.09	0.06	0.05	0.05	0.04	0.05
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.95	15.69	16.02	15.74	15.81	15.83	15.62	15.81	15.64	15.64	15.53	15.73
%Me	72	76	71	77	73	77	75	67	69	70	71	68
%Ma	28	24	29	23	27	23	25	33	31	30	29	32

Continued→

Sample:	CB15-42 (Augen Gneiss)												
Mineral:	Scapolite												
No.	67	68	82	83	84	95	96	107	108	109	110	111	112
Wt.%													
SiO2	47.99	48.25	48.16	47.90	47.86	47.20	47.41	47.91	47.72	47.99	47.44	47.54	47.74
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.61	25.73	25.44	25.45	25.63	25.40	25.43	25.63	25.63	25.52	25.29	25.31	25.60
Cr2O3	0.00	0.00	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.09	0.15	0.10	0.18	0.08	0.06	0.10	0.05	0.06	0.04	0.01	0.08	0.05
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
MnO	0.04	0.02	0.03	0.04	0.05	0.02	0.01	0.03	0.01	0.02	0.02	0.02	0.04
CaO	15.98	15.84	15.83	16.05	15.84	15.84	15.86	15.79	15.92	15.86	15.71	15.77	15.87
Na2O	4.05	3.96	4.11	4.19	3.77	4.13	3.98	4.03	3.86	3.96	3.98	3.78	3.21
K2O	0.21	0.22	0.22	0.21	0.16	0.20	0.25	0.20	0.22	0.19	0.18	0.20	0.23
SO3	2.85	2.59	2.66	2.93	3.27	3.20	2.91	2.84	2.70	2.67	2.97	2.86	2.73
Cl	0.23	0.27	0.29	0.20	0.23	0.21	0.30	0.27	0.27	0.27	0.24	0.22	0.28
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	96.99	96.96	96.80	97.09	96.86	96.22	96.18	96.68	96.32	96.46	95.79	95.71	95.71
Cations Recalculated on the Basis of 24O													
Si	6.82	6.86	6.86	6.80	6.79	6.76	6.80	6.82	6.83	6.85	6.81	6.83	6.85
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.29	4.31	4.27	4.26	4.28	4.28	4.30	4.30	4.32	4.29	4.28	4.29	4.33
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.43	2.41	2.41	2.44	2.41	2.43	2.44	2.41	2.44	2.43	2.42	2.43	2.44
Na	1.11	1.09	1.14	1.15	1.03	1.14	1.11	1.11	1.07	1.10	1.11	1.05	0.89
K	0.04	0.04	0.04	0.04	0.03	0.04	0.05	0.04	0.04	0.04	0.03	0.04	0.04
S	0.30	0.28	0.29	0.31	0.35	0.34	0.31	0.30	0.29	0.29	0.32	0.31	0.30
C*	0.64	0.66	0.64	0.64	0.60	0.61	0.62	0.63	0.64	0.65	0.62	0.64	0.64
Cl	0.05	0.06	0.07	0.05	0.06	0.05	0.07	0.06	0.06	0.06	0.06	0.05	0.07
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.70	15.73	15.74	15.73	15.56	15.66	15.69	15.69	15.71	15.71	15.66	15.64	15.57
%Me	68	68	67	67	70	67	68	68	69	68	68	69	72
%Ma	32	32	33	33	30	33	32	32	31	32	32	31	28

Continued→

Sample:	CB15-42 (Augen Gneiss)												
Mineral:	Scapolite												
No.	113	114	115	91	92	93	94	95	96	118	119	120	121
Wt.%													
SiO2	47.75	48.09	47.90	48.39	48.20	48.22	48.27	47.92	46.90	47.48	47.75	47.06	47.93
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.54	25.78	25.50	25.92	25.65	25.57	25.72	25.77	25.53	25.70	25.89	25.60	25.85
Cr2O3	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
FeO	0.03	0.09	0.04	0.17	0.05	0.00	0.16	0.29	0.04	0.07	0.08	0.03	0.11
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MnO	0.04	0.04	0.02	0.01	0.00	0.03	0.00	0.01	0.00	0.02	0.03	0.02	0.03
CaO	15.74	15.82	15.84	16.00	15.95	15.52	15.99	16.10	15.93	16.16	16.10	16.09	16.15
Na2O	3.40	3.92	3.73	4.17	3.93	4.70	4.26	4.40	3.65	3.90	4.59	3.80	3.81
K2O	0.24	0.19	0.20	0.31	0.24	0.20	0.34	0.30	0.26	0.27	0.28	0.19	0.27
SO3	2.56	3.17	2.92	1.93	2.02	2.11	1.70	1.97	2.21	2.34	1.83	2.86	2.07
Cl	0.31	0.22	0.26	0.39	0.39	0.44	0.40	0.35	0.37	0.35	0.36	0.27	0.37
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	95.55	97.27	96.35	97.20	96.34	96.69	96.75	97.02	94.79	96.21	96.84	95.85	96.52
Cations Recalculated on the Basis of 24O													
Si	6.87	6.79	6.83	6.89	6.91	6.90	6.92	6.85	6.84	6.82	6.85	6.77	6.87
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.33	4.29	4.29	4.35	4.33	4.31	4.34	4.34	4.38	4.35	4.38	4.34	4.37
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.01	0.00	0.02	0.00	0.00	0.02	0.03	0.00	0.01	0.01	0.00	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	2.43	2.39	2.42	2.44	2.45	2.38	2.46	2.47	2.49	2.49	2.47	2.48	2.48
Na	0.95	1.07	1.03	1.15	1.09	1.30	1.18	1.22	1.03	1.09	1.28	1.06	1.06
K	0.04	0.03	0.04	0.06	0.04	0.04	0.06	0.06	0.05	0.05	0.05	0.04	0.05
S	0.28	0.34	0.31	0.21	0.22	0.23	0.18	0.21	0.24	0.25	0.20	0.31	0.22
C*	0.65	0.61	0.63	0.70	0.69	0.67	0.72	0.70	0.67	0.66	0.72	0.63	0.69
Cl	0.07	0.05	0.06	0.09	0.10	0.11	0.10	0.08	0.09	0.08	0.09	0.06	0.09
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.63	15.60	15.62	15.92	15.83	15.93	15.98	15.97	15.79	15.81	16.04	15.69	15.83
%Me	71	69	69	67	68	64	67	66	70	69	65	69	69
%Ma	29	31	31	33	32	36	33	34	30	31	35	31	31

Continued→

Sample:	CB15-42 (Augen Gneiss)									
Mineral:	Scapolite									
No.	122	123	97	98	99	100	124	125	126	127
Wt.%										
SiO2	48.11	48.25	47.07	47.68	47.92	47.53	47.05	47.40	47.15	47.25
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.63	25.64	25.66	26.00	25.65	25.61	25.76	25.66	25.70	25.54
Cr2O3	0.01	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.02	0.01
FeO	0.09	0.09	0.02	0.05	0.02	0.01	0.08	0.12	0.13	0.11
MgO	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.01
MnO	0.03	0.03	0.00	0.00	0.00	0.00	0.05	0.04	0.06	0.05
CaO	15.93	15.96	16.30	16.17	16.15	16.37	16.21	16.29	16.32	16.14
Na2O	3.18	4.33	3.96	4.18	4.20	3.90	4.34	4.47	4.19	4.20
K2O	0.28	0.30	0.22	0.29	0.17	0.19	0.21	0.19	0.19	0.22
SO3	1.74	1.80	2.87	2.26	3.26	2.81	2.90	3.13	3.20	2.88
Cl	0.44	0.41	0.25	0.34	0.23	0.26	0.27	0.21	0.18	0.24
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	95.36	96.73	96.29	96.88	97.55	96.61	96.82	97.47	97.11	96.59
Cations Recalculated on the Basis of 24O										
Si	6.96	6.91	6.75	6.81	6.76	6.78	6.72	6.72	6.70	6.76
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	4.37	4.33	4.33	4.38	4.27	4.31	4.34	4.29	4.31	4.31
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Ca	2.47	2.45	2.50	2.47	2.44	2.50	2.48	2.47	2.49	2.47
Na	0.89	1.20	1.10	1.16	1.15	1.08	1.20	1.23	1.16	1.16
K	0.05	0.05	0.04	0.05	0.03	0.04	0.04	0.03	0.03	0.04
S	0.19	0.19	0.31	0.24	0.35	0.30	0.31	0.33	0.34	0.31
C*	0.70	0.71	0.63	0.68	0.60	0.64	0.63	0.62	0.62	0.63
Cl	0.11	0.10	0.06	0.08	0.06	0.06	0.06	0.05	0.04	0.06
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	15.76	15.97	15.73	15.88	15.66	15.71	15.80	15.77	15.71	15.76
%Me	73	66	69	67	67	69	67	66	68	67
%Ma	27	34	31	33	33	31	33	34	32	33

Continued→

Sample:	CB15-04 (Haroya Migmatitic garnet-amphibolite gneiss)										CB15-28 (Granodiori	
Mineral:	Plagioclase											
No.	967	968	969	970	971	972	973	974	975	976	630	631
Wt%												
SiO2	62.08	62.00	61.93	61.81	61.56	61.87	61.56	62.27	62.48	61.96		
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	58.03	58.70
Al2O3	23.39	23.69	23.59	23.54	23.78	23.68	23.76	22.83	23.44	23.51	0.00	0.00
Cr2O3	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.03	26.73	26.21
FeO	0.06	0.06	0.06	0.07	0.05	0.06	0.07	0.11	0.11	0.08	0.00	0.01
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.11
MnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
CaO	4.98	5.20	5.22	5.20	5.29	5.33	5.48	4.61	4.98	5.13	0.00	0.02
Na2O	6.88	7.09	7.24	7.21	7.21	7.10	7.14	4.60	7.69	7.09	8.72	7.99
K2O	0.61	0.58	0.59	0.60	0.54	0.46	0.46	0.56	0.55	0.53	6.62	5.75
SO3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.19	0.23
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.01	0.00	0.01
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	97.99	98.62	98.64	98.43	98.43	98.50	98.47	95.01	99.27	98.33	0.01	0.01
											100.42	99.03
Cations Recalculated on the Basis of 8O												
Si	2.79	2.78	2.77	2.77	2.76	2.77	2.76	2.85	2.78	2.78	2.59	2.64
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.24	1.25	1.25	1.25	1.26	1.25	1.26	1.23	1.23	1.24	1.41	1.39
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.24	0.25	0.25	0.25	0.25	0.26	0.26	0.23	0.24	0.25	0.42	0.38
Na	0.60	0.62	0.63	0.63	0.63	0.62	0.62	0.41	0.66	0.62	0.57	0.50
K	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.01	0.01
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.91	4.92	4.93	4.93	4.94	4.92	4.93	4.76	4.95	4.92	5.00	4.93
%Ab	69	69	69	69	69	69	68	61	71	69	57	56
%An	27	28	27	27	28	28	29	34	25	28	42	43
%Or	4	4	4	4	3	3	3	5	3	3	1	2

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Sample:	CB15-28 (Granodiorite)								CB15-63 (Granodiorite)			
Mineral:	Plagioclase											
No.	632	633	634	635	636	637	638	639	186	187	188	189
Wt%												
SiO2	59.77	58.32	59.64	58.04	57.51	58.29	59.37	57.24	59.18	59.20	59.50	59.94
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	26.01	26.59	25.48	26.75	26.71	26.75	25.97	26.74	26.34	26.00	26.09	25.70
Cr2O3	0.02	0.02	0.00	0.00	0.02	0.03	0.01	0.00	0.00	0.00	0.00	0.00
FeO	0.12	0.20	0.15	0.14	0.16	0.09	0.18	0.32	0.13	0.15	0.23	0.06
MgO	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MnO	0.02	0.04	0.02	0.03	0.02	0.01	0.03	0.05	0.00	0.00	0.00	0.00
CaO	7.73	8.64	7.57	8.61	8.77	8.63	7.55	8.68	8.11	7.99	7.85	7.52
Na2O	6.97	6.45	6.26	6.53	6.03	6.60	7.19	6.26	6.90	6.72	7.03	7.17
K2O	0.21	0.21	0.21	0.22	0.16	0.17	0.26	0.16	0.30	0.27	0.28	0.26
SO3	0.02	0.01	0.00	0.01	0.00	0.02	0.02	0.03	0.02	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.01	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.89	100.48	99.35	100.31	99.40	100.58	100.58	99.48	100.97	100.34	100.98	100.65
Cations Recalculated on the Basis of 8O												
Si	2.64	2.60	2.67	2.59	2.59	2.59	2.64	2.58	2.62	2.64	2.63	2.66
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.36	1.40	1.34	1.41	1.42	1.40	1.36	1.42	1.38	1.36	1.36	1.34
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.37	0.41	0.36	0.41	0.42	0.41	0.36	0.42	0.38	0.38	0.37	0.36
Na	0.60	0.56	0.54	0.56	0.53	0.57	0.62	0.55	0.59	0.58	0.60	0.62
K	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.01
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.98	4.99	4.94	4.99	4.97	4.99	5.00	4.99	5.00	4.98	4.99	4.99
%Ab	61	57	59	57	55	57	62	56	60	59	61	62
%An	38	42	40	42	44	42	36	43	39	39	38	36
%Or	1	1	1	1	1	1	1	1	2	2	2	1

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Sample:	CB15-63 (Granodiorite)						CB15-34 (Ulla Gneiss)					
Mineral:	Plagioclase											
No.	190	191	196	197	198	199	690	691	692	693	694	695
Wt%												
SiO2	59.60	61.16	61.02	60.50	60.65	58.96	58.44	59.76	59.83	60.08	59.03	57.93
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	26.00	24.91	24.42	24.93	24.78	25.51	26.02	25.07	25.26	24.62	25.88	26.34
Cr2O3	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01
FeO	0.15	0.08	0.10	0.09	0.11	0.09	0.00	0.09	0.08	0.07	0.08	0.31
MgO	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
MnO	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01
CaO	7.59	6.47	6.19	6.83	6.44	7.31	7.93	7.17	7.09	6.57	7.93	8.44
Na2O	7.10	7.66	6.87	6.79	7.80	6.60	6.69	6.12	6.96	7.32	6.67	6.56
K2O	0.31	0.34	0.47	0.36	0.34	0.32	0.22	0.27	0.32	0.31	0.19	0.27
SO3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.04	0.00
Cl	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
F	0.00	0.00	0.03	0.00	0.03	0.04	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.75	100.62	99.10	99.51	100.16	98.82	99.31	98.49	99.56	98.96	99.83	99.86
Cations Recalculated on the Basis of 8O												
Si	2.64	2.70	2.73	2.70	2.70	2.66	2.63	2.69	2.67	2.70	2.64	2.60
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.36	1.30	1.29	1.31	1.30	1.36	1.38	1.33	1.33	1.30	1.36	1.39
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.36	0.31	0.30	0.33	0.31	0.35	0.38	0.35	0.34	0.32	0.38	0.41
Na	0.61	0.66	0.60	0.59	0.67	0.58	0.58	0.53	0.60	0.64	0.58	0.57
K	0.02	0.02	0.03	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.01	0.02
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.99	4.99	4.94	4.95	5.00	4.97	4.98	4.92	4.97	4.98	4.97	5.00
%Ab	62	67	65	63	67	61	60	60	63	66	60	58
%An	36	31	32	35	31	37	39	39	35	33	39	41
%Or	2	2	3	2	2	2	1	2	2	2	1	2

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Sample:	CB15-34 (Ulla Gneiss)				CB15-42 (Augen Gneiss)							
Mineral:	Plagioclase											
No.	696	697	698	699	74	75	76	77	78	102	103	104
Wt%												
SiO2	59.36	59.30	59.88	60.55	60.29	60.33	61.18	61.25	60.45	61.55	60.40	61.48
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	25.68	25.37	24.79	24.62	24.84	24.73	24.38	24.37	24.41	24.11	24.81	24.68
Cr2O3	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FeO	0.17	0.12	0.13	0.09	0.01	0.02	0.05	0.06	0.05	0.00	0.00	0.00
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MnO	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CaO	7.52	7.22	6.71	6.32	6.32	6.41	5.95	5.90	6.09	5.55	6.34	6.05
Na2O	6.71	6.77	7.07	6.90	7.98	7.62	7.96	8.13	7.17	7.70	7.38	8.12
K2O	0.29	0.31	0.35	0.31	0.13	0.12	0.14	0.19	0.18	0.15	0.12	0.17
SO3	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	99.73	99.09	98.96	98.78	99.59	99.23	99.66	99.90	98.35	99.05	99.04	100.50
Cations Recalculated on the Basis of 8O												
Si	2.65	2.66	2.69	2.72	2.69	2.70	2.72	2.72	2.72	2.75	2.70	2.72
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.35	1.34	1.31	1.30	1.31	1.30	1.28	1.28	1.30	1.27	1.31	1.29
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.36	0.35	0.32	0.30	0.30	0.31	0.28	0.28	0.29	0.27	0.30	0.29
Na	0.58	0.59	0.62	0.60	0.69	0.66	0.69	0.70	0.63	0.67	0.64	0.70
K	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.97	4.97	4.97	4.94	5.00	4.98	4.98	4.99	4.95	4.96	4.96	4.99
%Ab	61	62	64	65	69	68	70	71	67	71	67	70
%An	38	36	34	33	30	31	29	28	32	28	32	29
%Or	2	2	2	2	1	1	1	1	1	1	1	1

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Sample:	CB15-42 (Augen Gneiss)							Sample:	CB15-63 (Granodiorite)			
Mineral:	Plagioclase							Mineral:	K-Feldspar			
No.	105	106	121	122	123	124	125	192	193	194	195	200
Wt%												
SiO2	61.32	62.11	61.53	59.77	60.73	61.03	61.02	65.24	64.99	64.92	64.93	64.12
TiO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.05
Al2O3	24.90	24.18	24.00	24.48	24.81	24.69	24.70	18.69	18.66	18.38	18.67	18.53
Cr2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02
FeO	0.02	0.00	0.07	0.03	0.05	0.08	0.01	0.03	0.02	0.06	0.16	0.04
MgO	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
MnO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
CaO	6.24	5.59	5.62	6.39	6.55	6.46	6.39	0.09	0.06	0.05	0.05	0.06
Na2O	7.43	7.70	7.62	6.81	6.92	7.82	7.09	0.77	0.62	0.70	0.62	0.77
K2O	0.17	0.13	0.21	0.25	0.17	0.21	0.11	15.66	15.71	15.71	15.60	15.33
SO3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Total	100.08	99.70	99.06	97.81	99.22	100.29	99.35	100.48	100.07	99.84	100.04	98.95
Cations Recalculated on the Basis of 8O												
Si	2.72	2.75	2.75	2.71	2.71	2.71	2.72	2.99	2.99	3.00	2.99	2.99
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.30	1.26	1.26	1.31	1.31	1.29	1.30	1.01	1.01	1.00	1.01	1.02
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00
Mg	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.30	0.27	0.27	0.31	0.31	0.31	0.30	0.00	0.00	0.00	0.00	0.00
Na	0.64	0.66	0.66	0.60	0.60	0.67	0.61	0.07	0.06	0.06	0.06	0.07
K	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.92	0.92	0.93	0.92	0.91
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	4.96	4.95	4.96	4.95	4.94	4.99	4.94	4.99	4.99	4.99	4.99	5.00
%Ab	68	71	70	65	65	68	66	7	6	6	6	7
%An	31	28	29	34	34	31	33	0	0	0	0	0
%Or	1	1	1	2	1	1	1	93	94	93	94	93

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Sample:	CB15-42 (Augen Gneiss)											
Mineral:												
No.	201	202	203	204	205	69	70	71	72	73	97	98
Wt%												
SiO2	64.20	64.17	63.92	64.07	64.53	65.14	64.88	65.30	64.16	63.88	64.63	64.60
TiO2	0.03	0.03	0.07	0.07	0.04	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Al2O3	18.60	18.48	18.40	18.54	18.28	18.64	18.64	18.71	18.35	18.57	18.58	18.72
Cr2O3	0.00	0.00	0.01	0.00	0.02	0.02	0.00	0.01	0.01	0.01	0.00	0.00
FeO	0.03	0.02	0.05	0.03	0.00	0.02	0.01	0.02	0.02	0.02	0.00	0.00
MgO	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MnO	0.00	0.01	0.02	0.01	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.00
CaO	0.07	0.04	0.04	0.05	0.05	0.05	0.03	0.06	0.05	0.05	0.03	0.03
Na2O	0.77	0.80	0.59	0.75	0.76	0.94	0.80	0.92	0.77	1.03	0.81	0.82
K2O	15.31	15.41	15.71	15.66	15.69	15.23	15.61	15.06	13.86	14.74	15.42	15.38
SO3	0.01	0.00	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.04	0.03	0.06	0.06	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	99.06	98.98	98.86	99.21	99.43	100.06	99.97	100.07	97.22	98.31	99.47	99.55
Cations Recalculated on the Basis of 8O												
Si	2.99	2.99	2.99	2.98	3.00	3.00	2.99	3.00	3.01	2.99	2.99	2.99
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Al	1.02	1.01	1.01	1.02	1.00	1.01	1.01	1.01	1.02	1.02	1.01	1.02
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	0.07	0.07	0.05	0.07	0.07	0.08	0.07	0.08	0.07	0.09	0.07	0.07
K	0.91	0.92	0.94	0.93	0.93	0.89	0.92	0.88	0.83	0.88	0.91	0.91
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	5.00	5.00	5.01	5.01	5.01	4.99	5.00	4.98	4.93	4.99	4.99	4.99
%Ab	7	7	5	7	7	9	7	8	8	10	7	7
%An	0	0	0	0	0	0	0	0	0	0	0	0
%Or	93	92	94	93	93	91	93	91	92	90	92	92

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Sample:	CB15-42 (Augen Gneiss)									CB15-28 (Granodiorite)			
Mineral:	K-Feldspar									Biotite			
No.	99	100	101	116	117	118	119	120		640	641	642	643
Wt%													
SiO2	64.16	63.99	64.86	64.88	64.98	65.00	65.25	64.84		36.81	36.80	36.64	36.31
TiO2	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00		3.38	3.44	3.42	3.35
Al2O3	18.58	18.51	18.74	18.49	18.47	18.59	18.50	18.54		15.72	15.61	15.50	15.36
Cr2O3	0.00	0.00	0.00	0.01	0.00	0.00	0.02	0.01		3.38	3.44	3.42	3.35
FeO	0.00	0.00	0.00	0.00	0.02	0.04	0.01	0.00		18.23	17.88	18.08	17.42
MgO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		11.62	11.50	11.65	11.43
MnO	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00		0.34	0.34	0.31	0.31
CaO	0.03	0.00	0.01	0.03	0.03	0.02	0.02	0.03		0.03	0.03	0.03	0.10
Na2O	0.57	0.79	0.88	1.03	0.79	0.69	0.74	0.84		0.04	0.03	0.04	0.07
K2O	15.77	15.34	14.62	14.90	15.54	15.89	15.66	15.46		9.69	9.85	10.02	9.19
SO3	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00		0.05	0.05	0.06	0.08
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01		0.06	0.07	0.07	0.06
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.18	0.16	0.20	0.16
Total	99.11	98.63	99.12	99.35	99.85	100.25	100.20	99.73		96.09	95.73	95.96	93.79
Cations Recalculated on the Basis of 8O									Cations Recalculated on the Basis of 11O				
Si	2.99	2.99	3.00	3.00	3.00	2.99	3.00	3.00		2.78	2.79	2.78	2.79
Ti	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.19	0.20	0.19	0.19
Al	1.02	1.02	1.02	1.01	1.00	1.01	1.00	1.01		1.40	1.39	1.38	1.39
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
Fe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		1.15	1.13	1.15	1.12
Mg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		1.31	1.30	1.32	1.31
Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.02	0.02	0.02	0.02
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.01
Na	0.05	0.07	0.08	0.09	0.07	0.06	0.07	0.08		0.01	0.00	0.01	0.01
K	0.94	0.91	0.86	0.88	0.92	0.93	0.92	0.91		0.93	0.95	0.97	0.90
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.01	0.01	0.01	0.01
F	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.04	0.04	0.05	0.04
Total	5.00	5.00	4.96	4.98	4.99	5.00	4.99	4.99		7.84	7.84	7.87	7.80
%Ab	5	7	8	9	7	6	7	8					
%An	0	0	0	0	0	0	0	0	%Ann	47	47	47	46
%Or	95	93	92	90	93	94	93	92	%Phl	53	53	53	54

Continued→

Sample:	CB15-28 (Granodiorite)						CB15-63 (Granodiorite)					
Mineral:	Biotite											
No.	644	645	646	647	648	649	44	45	46	47	48	69
Wt%												
SiO2	36.84	37.00	41.07	36.83	36.32	36.81	36.45	36.00	36.30	36.56	36.23	36.59
TiO2	3.37	3.53	1.27	3.35	3.23	3.26	3.85	3.92	3.95	3.96	3.97	4.01
Al2O3	15.57	15.61	13.43	15.63	15.59	15.70	15.56	15.11	15.08	15.16	15.46	15.27
Cr2O3	3.37	3.53	1.27	3.35	3.23	3.26	0.05	0.00	0.01	0.03	0.04	0.06
FeO	17.74	18.08	17.51	18.11	17.94	18.09	18.33	17.94	17.90	17.87	18.11	18.10
MgO	11.62	11.77	8.88	11.50	11.87	11.70	12.36	11.97	11.77	12.08	12.11	12.03
MnO	0.34	0.34	0.51	0.33	0.33	0.32	0.12	0.10	0.11	0.10	0.12	0.13
CaO	0.04	0.01	11.59	0.02	0.08	0.02	0.01	0.01	0.02	0.07	0.10	0.04
Na2O	0.05	0.06	1.37	0.03	0.05	0.05	0.05	0.10	0.09	0.07	0.08	0.07
K2O	10.01	10.01	2.00	9.88	9.53	9.94	9.53	9.76	9.91	9.81	9.77	10.26
SO3	0.04	0.04	0.07	0.07	0.04	0.03	0.09	0.09	0.06	0.12	0.10	0.11
Cl	0.05	0.06	0.09	0.07	0.06	0.06	0.01	0.01	0.02	0.02	0.01	0.02
F	0.20	0.16	0.11	0.15	0.17	0.17	0.09	0.08	0.11	0.14	0.17	0.17
Total	95.82	96.64	97.91	95.94	95.15	96.12	96.46	95.03	95.27	95.93	96.20	96.78
Cations Recalculated on the Basis of 11O												
Si	2.79	2.78	2.98	2.79	2.77	2.78	2.74	2.75	2.77	2.76	2.73	2.75
Ti	0.19	0.20	0.07	0.19	0.18	0.18	0.22	0.22	0.23	0.22	0.23	0.23
Al	1.39	1.38	1.15	1.39	1.40	1.40	1.38	1.36	1.35	1.35	1.38	1.35
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	1.12	1.14	1.06	1.15	1.14	1.14	1.15	1.15	1.14	1.13	1.14	1.14
Mg	1.31	1.32	0.96	1.30	1.35	1.32	1.38	1.36	1.34	1.36	1.36	1.35
Mn	0.02	0.02	0.03	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01
Ca	0.00	0.00	0.90	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.00
Na	0.01	0.01	0.19	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
K	0.97	0.96	0.19	0.95	0.93	0.96	0.91	0.95	0.96	0.94	0.94	0.98
S	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.01
Cl	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
F	0.05	0.04	0.03	0.04	0.04	0.04	0.02	0.02	0.03	0.03	0.04	0.04
Total	7.86	7.85	7.59	7.84	7.86	7.86	7.83	7.84	7.84	7.84	7.86	7.87
%Ann	46	46	52	47	46	46	45	46	46	45	46	46
%Phl	54	54	48	53	54	54	55	54	54	55	54	54

Continued→

Sample:	CB15-63 (Granodiorite)									CB15-34 (Ulla Gneiss)		
Mineral:	Biotite											
No.	70	71	73	74	80	81	82	83	84	650	651	652
Wt%												
SiO2	36.48	36.34	37.03	36.30	36.77	36.39	37.11	36.27	36.22	36.38	36.74	36.43
TiO2	4.05	3.77	3.69	3.69	4.04	4.05	3.95	4.04	4.03	2.80	2.77	2.98
Al2O3	15.38	15.58	15.78	15.42	15.44	15.23	15.52	15.33	15.22	15.44	15.68	15.47
Cr2O3	0.06	0.06	0.04	0.06	0.05	0.10	0.06	0.02	0.03	2.80	2.77	2.98
FeO	18.17	18.18	18.46	18.28	18.38	18.36	18.63	18.52	18.49	16.73	16.89	16.58
MgO	12.03	12.18	12.25	12.18	11.96	11.71	12.13	11.86	11.86	12.91	13.19	12.63
MnO	0.14	0.15	0.19	0.13	0.14	0.16	0.13	0.12	0.14	0.19	0.12	0.14
CaO	0.02	0.03	0.09	0.04	0.04	0.03	0.01	0.01	0.00	0.09	0.04	0.01
Na2O	0.08	0.09	0.10	0.07	0.09	0.08	0.05	0.04	0.05	0.02	0.00	0.02
K2O	10.26	10.10	10.03	9.76	10.12	10.11	10.14	10.14	9.98	9.31	9.64	9.62
SO3	0.16	0.09	0.11	0.09	0.08	0.19	0.09	0.12	0.11	0.10	0.08	0.06
Cl	0.03	0.03	0.03	0.02	0.03	0.02	0.03	0.02	0.02	0.21	0.20	0.20
F	0.16	0.19	0.23	0.16	0.19	0.18	0.14	0.09	0.09	0.15	0.08	0.08
Total	96.94	96.69	97.93	96.12	97.24	96.53	97.90	96.53	96.20	94.28	95.35	94.14
Cations Recalculated on the Basis of 11O												
Si	2.74	2.73	2.75	2.74	2.75	2.74	2.76	2.74	2.74	2.78	2.78	2.79
Ti	0.23	0.21	0.21	0.21	0.23	0.23	0.22	0.23	0.23	0.16	0.16	0.17
Al	1.36	1.38	1.38	1.37	1.36	1.35	1.36	1.36	1.36	1.39	1.40	1.39
Cr	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Fe	1.14	1.14	1.15	1.16	1.15	1.16	1.16	1.17	1.17	1.07	1.07	1.06
Mg	1.35	1.37	1.36	1.37	1.33	1.32	1.34	1.33	1.34	1.47	1.49	1.44
Mn	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ca	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Na	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00
K	0.98	0.97	0.95	0.94	0.97	0.97	0.96	0.98	0.96	0.91	0.93	0.94
S	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.00
Cl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.03
F	0.04	0.04	0.05	0.04	0.05	0.04	0.03	0.02	0.02	0.04	0.02	0.02
Total	7.87	7.89	7.88	7.87	7.87	7.86	7.85	7.85	7.85	7.87	7.87	7.85
%Ann	46	46	46	46	46	47	46	47	47	42	42	42
%Phl	54	54	54	54	54	53	54	53	53	58	58	58

Continued→

Sample:	CB15-34 (Ulla Gneiss)							CB15-42 (Augen Gneiss)				
Mineral:	Biotite											
No.	653	654	655	656	657	658	659	111	112	113	114	115
Wt%												
SiO2	35.02	36.24	36.13	36.04	35.84	35.97	35.57	36.42	36.20	36.39	36.28	36.61
TiO2	3.09	2.94	3.27	2.66	2.65	2.92	2.83	3.17	3.22	3.05	3.01	3.02
Al2O3	14.93	15.31	15.50	15.41	15.61	15.44	15.34	15.88	15.83	16.11	15.89	15.98
Cr2O3	3.09	2.94	3.27	2.66	2.65	2.92	2.83	0.03	0.02	0.03	0.01	0.05
FeO	16.23	16.48	16.98	16.77	17.03	17.01	16.87	20.66	20.47	20.68	20.65	21.11
MgO	12.05	12.62	12.42	12.73	12.71	12.50	12.45	9.12	9.13	9.10	9.22	8.99
MnO	0.14	0.14	0.17	0.14	0.15	0.13	0.14	0.56	0.52	0.58	0.60	0.63
CaO	0.14	0.02	0.02	0.03	0.08	0.02	0.09	0.02	0.01	0.02	0.03	0.02
Na2O	0.03	0.00	0.00	0.03	0.01	0.02	0.02	0.08	0.06	0.07	0.07	0.09
K2O	8.54	9.31	9.49	9.21	8.90	9.43	9.01	9.97	10.06	10.02	9.87	9.86
SO3	0.07	0.08	0.08	0.08	0.04	0.07	0.06	0.07	0.10	0.09	0.16	0.11
Cl	0.22	0.17	0.21	0.20	0.22	0.22	0.21	0.10	0.11	0.13	0.12	0.12
F	0.09	0.08	0.09	0.11	0.13	0.09	0.08	0.46	0.43	0.44	0.35	0.42
Total	90.48	93.37	94.34	93.35	93.27	93.74	92.58	96.32	95.94	96.49	96.09	96.80
Cations Recalculated on the Basis of 11O												
Si	2.78	2.79	2.76	2.78	2.77	2.77	2.77	2.79	2.78	2.78	2.78	2.79
Ti	0.18	0.17	0.19	0.15	0.15	0.17	0.17	0.18	0.19	0.17	0.17	0.17
Al	1.40	1.39	1.40	1.40	1.42	1.40	1.41	1.43	1.43	1.45	1.44	1.44
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	1.08	1.06	1.09	1.08	1.10	1.10	1.10	1.32	1.32	1.32	1.32	1.35
Mg	1.43	1.45	1.42	1.46	1.46	1.43	1.45	1.04	1.05	1.04	1.05	1.02
Mn	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.04	0.03	0.04	0.04	0.04
Ca	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Na	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
K	0.87	0.91	0.93	0.91	0.88	0.93	0.90	0.97	0.99	0.98	0.97	0.96
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01
Cl	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.01	0.01	0.02	0.02	0.02
F	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.11	0.10	0.11	0.08	0.10
Total	7.82	7.83	7.85	7.86	7.86	7.87	7.85	7.92	7.92	7.92	7.90	7.91
%Ann	43	42	43	42	43	43	43	56	56	56	56	57
%Phl	57	58	57	58	57	57	57	44	44	44	44	43

Continued→

Sample:	CB15-42 (Augen Gneiss)									
Mineral:	Biotite									
No.	116	117	128	129	130	131	132	133	134	135
Wt%										
SiO2	36.31	36.88	35.93	36.38	36.64	36.22	35.97	35.96	36.01	36.75
TiO2	3.01	2.73	2.94	2.72	2.83	2.72	2.77	2.85	2.87	2.62
Al2O3	16.74	16.59	15.81	16.32	16.15	16.27	16.11	15.96	15.88	16.50
Cr2O3	0.00	0.04	0.03	0.03	0.04	0.06	0.04	0.03	0.05	0.04
FeO	18.75	20.56	20.63	20.89	21.00	20.91	20.82	20.87	20.85	20.50
MgO	9.56	9.46	8.98	9.35	9.35	9.25	9.13	9.37	9.37	9.71
MnO	0.76	0.61	0.52	0.58	0.58	0.54	0.58	0.58	0.53	0.59
CaO	0.01	0.00	0.04	0.03	0.02	0.04	0.03	0.04	0.05	0.03
Na2O	0.06	0.06	0.10	0.15	0.13	0.09	0.11	0.10	0.10	0.09
K2O	9.95	9.74	9.54	9.75	9.68	10.12	10.02	9.28	9.24	10.01
SO3	0.10	0.09	0.09	0.11	0.10	0.07	0.11	0.12	0.16	0.12
Cl	0.12	0.11	0.11	0.11	0.14	0.12	0.12	0.15	0.14	0.13
F	0.41	0.46	0.38	0.42	0.44	0.40	0.43	0.45	0.41	0.48
Total	95.58	97.10	94.90	96.63	96.86	96.60	96.02	95.52	95.45	97.33
Cations Recalculated on the Basis of 11O										
Si	2.77	2.79	2.79	2.77	2.79	2.77	2.77	2.77	2.78	2.78
Ti	0.17	0.16	0.17	0.16	0.16	0.16	0.16	0.17	0.17	0.15
Al	1.51	1.48	1.45	1.47	1.45	1.47	1.46	1.45	1.44	1.47
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	1.20	1.30	1.34	1.33	1.34	1.34	1.34	1.35	1.34	1.30
Mg	1.09	1.07	1.04	1.06	1.06	1.05	1.05	1.08	1.08	1.09
Mn	0.05	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Na	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.01	0.01
K	0.97	0.94	0.94	0.95	0.94	0.99	0.98	0.91	0.91	0.97
S	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.01
Cl	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02
F	0.10	0.11	0.09	0.10	0.10	0.10	0.10	0.11	0.10	0.11
Total	7.89	7.90	7.89	7.92	7.92	7.94	7.95	7.91	7.90	7.94
%Ann	52	55	56	56	56	56	56	56	56	54
%Phl	48	45	44	44	44	44	44	44	45	46

Sample:	CB15-04 (Haroya Migmatitic garnet-amphibolite gneiss)									
Mineral:	Hornblende									
No.	957	958	959	960	961	962	963	964	965	966
Wt%										
SiO2	41.25	41.22	40.79	40.67	40.28	40.47	39.92	41.01	39.80	41.13
TiO2	1.21	1.68	1.54	1.53	1.25	1.32	1.36	1.17	1.42	1.35
Al2O3	13.14	13.05	13.51	13.70	13.54	14.20	14.51	14.04	14.81	13.48
Cr2O3	0.03	0.02	0.04	0.04	0.04	0.02	0.02	0.00	0.01	0.03
FeO	16.01	15.28	15.30	15.86	15.72	15.70	15.61	15.42	16.16	15.13
MgO	0.12	0.12	0.10	0.09	0.09	0.10	0.11	0.12	0.11	0.12
MnO	10.28	10.45	10.25	9.98	10.31	9.83	9.84	10.33	9.58	10.81
CaO	11.08	11.44	11.25	11.47	10.79	11.30	11.46	11.16	11.04	11.15
Na2O	1.67	1.69	1.78	1.70	1.55	1.68	1.72	1.73	1.85	1.69
K2O	1.40	1.33	1.44	1.47	1.29	1.44	1.36	1.35	1.59	1.32
SO3	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.06	0.06	0.07	0.07	0.07	0.08	0.08	0.07	0.08	0.06
F	0.02	0.02	0.02	0.02	0.05	0.06	0.06	0.07	0.03	0.03
Total	96.23	96.35	96.07	96.57	94.94	96.13	96.01	96.41	96.46	96.26
Cations Recalculated on the Basis of 23O										
Si	6.29	6.27	6.23	6.19	6.22	6.18	6.11	6.23	6.08	6.25
Ti	0.14	0.19	0.18	0.17	0.14	0.15	0.16	0.13	0.16	0.15
Al	2.36	2.34	2.43	2.46	2.47	2.56	2.62	2.51	2.67	2.41
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	2.04	1.94	1.95	2.02	2.03	2.01	2.00	1.96	2.07	1.92
Mg	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
Mn	2.34	2.37	2.33	2.27	2.37	2.24	2.25	2.34	2.18	2.45
Ca	1.81	1.86	1.84	1.87	1.78	1.85	1.88	1.81	1.81	1.81
Na	0.49	0.50	0.53	0.50	0.46	0.50	0.51	0.51	0.55	0.50
K	0.27	0.26	0.28	0.29	0.26	0.28	0.26	0.26	0.31	0.26
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cl	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
F	0.01	0.01	0.01	0.01	0.03	0.03	0.03	0.03	0.01	0.01
Total	15.80	15.77	15.81	15.82	15.80	15.83	15.86	15.82	15.88	15.79

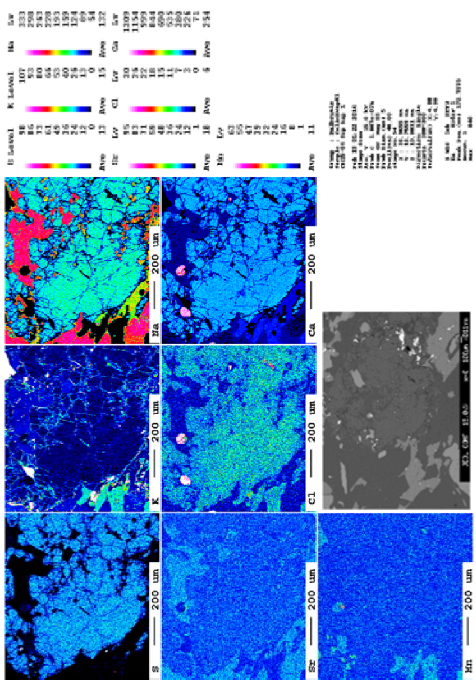
Sample:	CB15-63 (Granodiorite)											
Mineral:	Hornblende											
No.	58	57	56	55	54	680	681	682	683	684	685	686
Wt%												
SiO2	41.52	41.57	41.59	41.84	40.78	42.29	41.56	40.99	41.97	42.44	42.00	43.06
TiO2	1.40	1.26	1.26	1.53	1.54	1.07	1.22	1.25	1.10	1.02	0.95	1.00
Al2O3	13.32	13.54	13.53	13.07	13.22	12.44	13.60	13.52	13.16	12.42	12.26	12.39
Cr2O3	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
FeO	16.99	16.80	17.13	17.04	16.92	15.45	15.50	15.81	15.80	15.05	16.07	15.04
MgO	0.20	0.23	0.23	0.23	0.21	0.30	0.29	0.30	0.31	0.30	0.30	0.27
MnO	9.65	9.80	9.60	9.90	9.71	10.25	9.48	9.56	9.75	10.26	9.90	10.34
CaO	12.12	12.16	12.01	12.29	12.33	11.71	11.69	11.84	11.52	11.98	11.64	11.94
Na2O	1.39	1.29	1.34	1.35	1.34	1.34	1.27	1.39	1.37	1.18	1.29	1.16
K2O	1.99	2.00	2.03	1.78	2.00	1.67	1.95	1.91	1.80	1.62	1.63	1.63
SO3	0.05	0.02	0.02	0.02	0.04	0.02	0.04	0.06	0.03	0.05	0.05	0.07
Cl	0.03	0.03	0.02	0.02	0.02	0.23	0.27	0.30	0.27	0.27	0.26	0.25
F	0.02	0.07	0.04	0.01	0.04	0.01	0.03	0.02	0.02	0.00	0.01	0.00
Total	98.68	98.73	98.78	99.08	98.13	96.71	96.82	96.86	97.04	96.51	96.31	97.08
Cations Recalculated on the Basis of 23O												
Si	6.23	6.23	6.24	6.25	6.17	6.42	6.31	6.25	6.36	6.44	6.42	6.48
Ti	0.16	0.14	0.14	0.17	0.17	0.12	0.14	0.14	0.12	0.12	0.11	0.11
Al	2.36	2.39	2.39	2.30	2.36	2.23	2.44	2.43	2.35	2.22	2.21	2.20
Cr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fe	2.13	2.11	2.15	2.13	2.14	1.96	1.97	2.01	2.00	1.91	2.05	1.89
Mg	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.03
Mn	2.16	2.19	2.15	2.21	2.19	2.32	2.15	2.17	2.20	2.32	2.26	2.32
Ca	1.95	1.95	1.93	1.97	2.00	1.90	1.90	1.93	1.87	1.95	1.91	1.93
Na	0.40	0.37	0.39	0.39	0.39	0.40	0.37	0.41	0.40	0.35	0.38	0.34
K	0.38	0.38	0.39	0.34	0.39	0.32	0.38	0.37	0.35	0.31	0.32	0.31
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01
Cl	0.01	0.01	0.00	0.00	0.00	0.06	0.07	0.08	0.07	0.07	0.07	0.06
F	0.01	0.03	0.02	0.00	0.02	0.00	0.01	0.01	0.01	0.00	0.00	0.00
Total	15.82	15.84	15.83	15.80	15.88	15.77	15.78	15.86	15.79	15.73	15.77	15.68

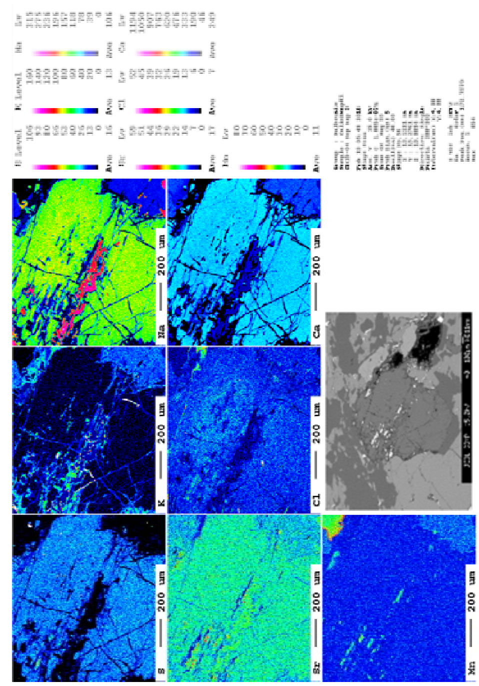
Sample:	CB15-34 (Ulla Gneiss)				CB15-42 (Augen Gneiss)		
Mineral:	Hornblende				Garnet		
No.	687	688	689		79	80	81
Wt%							
SiO2	41.11	40.98	40.53		38.70	37.75	38.35
TiO2	1.06	1.26	1.26		0.07	0.07	0.04
Al2O3	13.40	13.37	14.12		21.11	21.63	20.54
Cr2O3	0.00	0.00	0.00		0.02	0.04	0.06
FeO	15.44	15.78	15.80		19.39	20.60	19.87
MgO	0.28	0.30	0.27		1.60	1.52	1.29
MnO	9.81	9.55	9.30		8.19	8.43	9.66
CaO	11.89	11.61	11.46		11.81	10.51	10.64
Na2O	1.33	1.39	1.37		0.01	0.01	0.03
K2O	1.94	1.90	2.08		0.02	0.06	0.11
SO3	0.03	0.05	0.05		0.00	0.00	0.01
Cl	0.29	0.29	0.31		0.00	0.01	0.00
F	0.00	0.05	0.00		0.02	0.01	0.02
Total	96.51	96.44	96.48		100.93	100.64	100.60
Cations Recalculated on the Basis of 23O					Cations Recalculated on the Basis of 12O		
Si	6.28	6.27	6.20		3.03	2.98	3.04
Ti	0.12	0.14	0.14		0.00	0.00	0.00
Al	2.41	2.41	2.55		1.95	2.01	1.92
Cr	0.00	0.00	0.00		0.00	0.00	0.00
Fe	1.97	2.02	2.02		1.27	1.36	1.32
Mg	0.04	0.04	0.03		0.19	0.18	0.15
Mn	2.23	2.18	2.12		0.54	0.56	0.65
Ca	1.95	1.90	1.88		0.99	0.89	0.90
Na	0.40	0.41	0.41		0.00	0.00	0.00
K	0.38	0.37	0.40		0.00	0.01	0.01
S	0.00	0.00	0.00		0.00	0.00	0.00
Cl	0.07	0.07	0.08		0.00	0.00	0.00
F	0.00	0.03	0.00		0.00	0.00	0.00
Total	15.85	15.86	15.85		7.99	8.01	8.01
				%Pyr	6.25	5.97	5.04
				%Alm	42.44	45.45	43.61
				%Gro	33.15	29.74	29.90
				%Sp	18.16	18.84	21.45

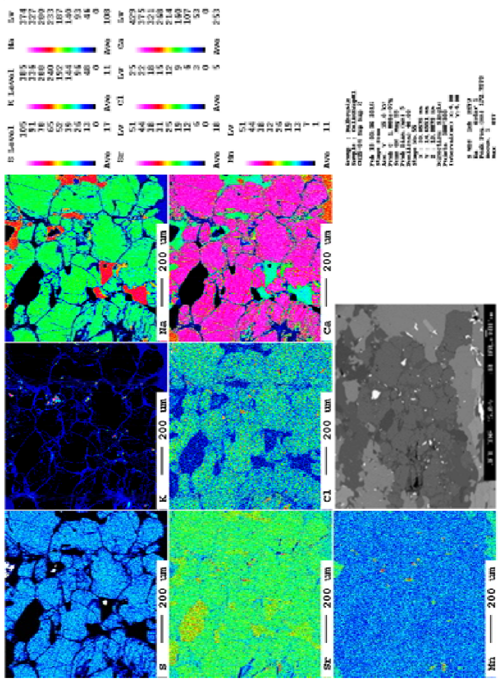
Appendix B: X-ray Maps

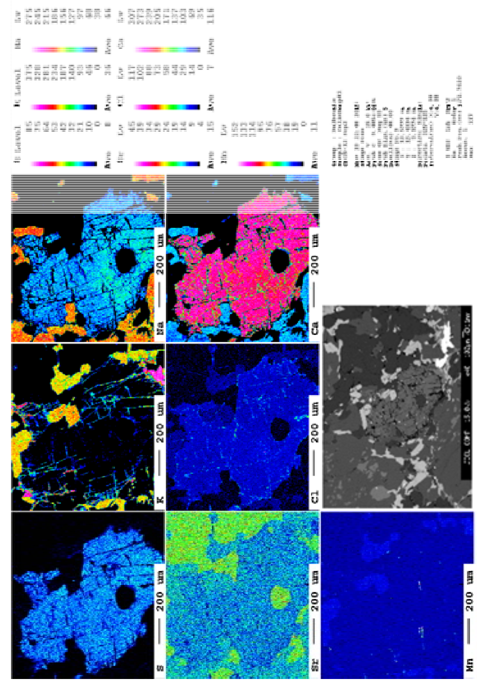
Additional x-ray maps for scapolite-bearing lithologies are presented in this appendix. Maps are organized by sample number, with the lithology indicated in parentheses above the maps. X-ray maps are accompanied by BSE images for context.

CB15-04 (Harøya garnet amphibolite gneiss) and CB15-12 (Type 1 Pegmatite)

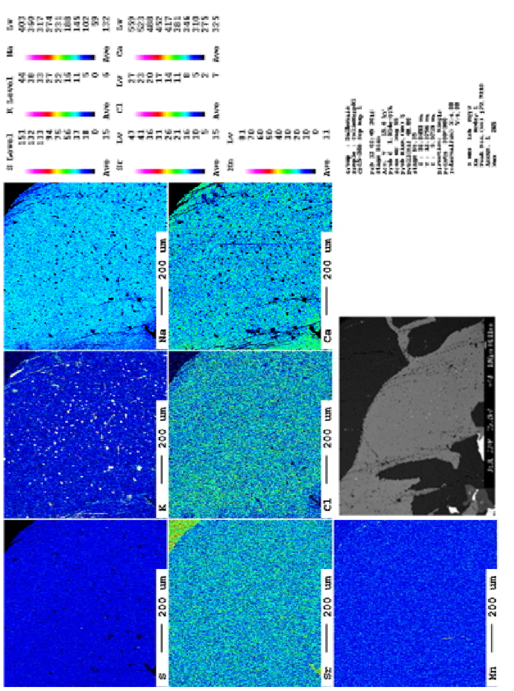


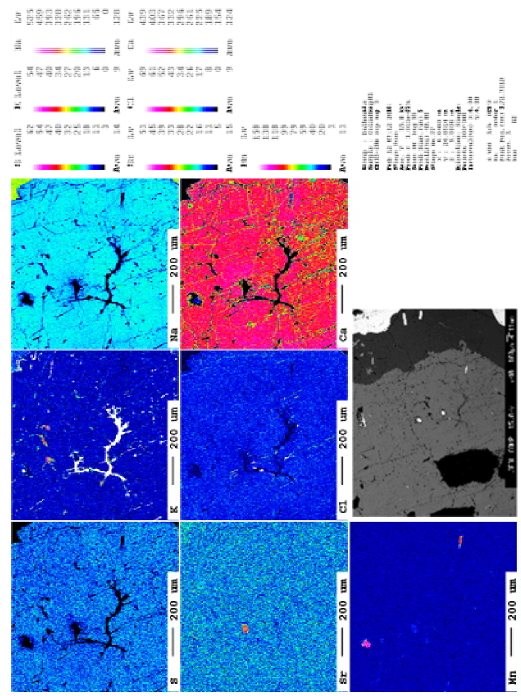


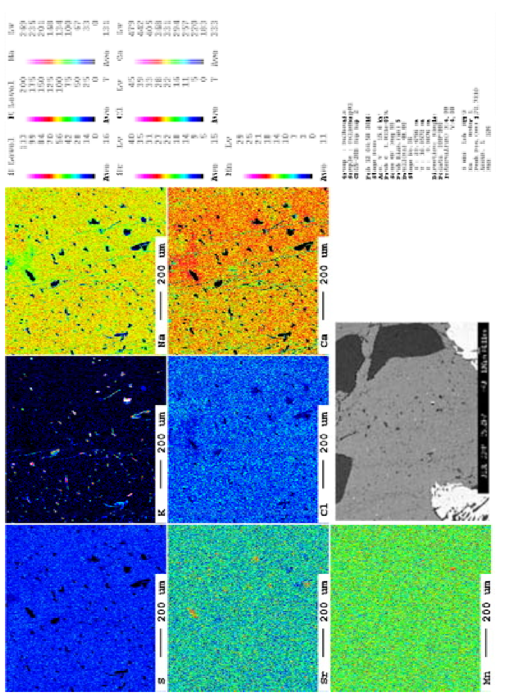




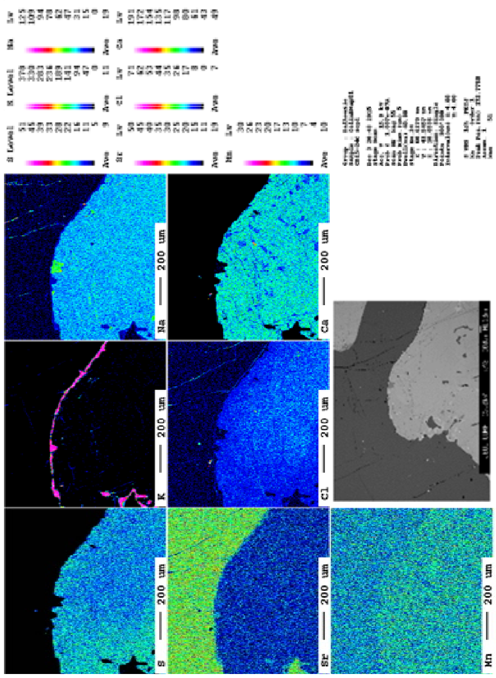
CB15-20 (Type 1 Pegmatite)

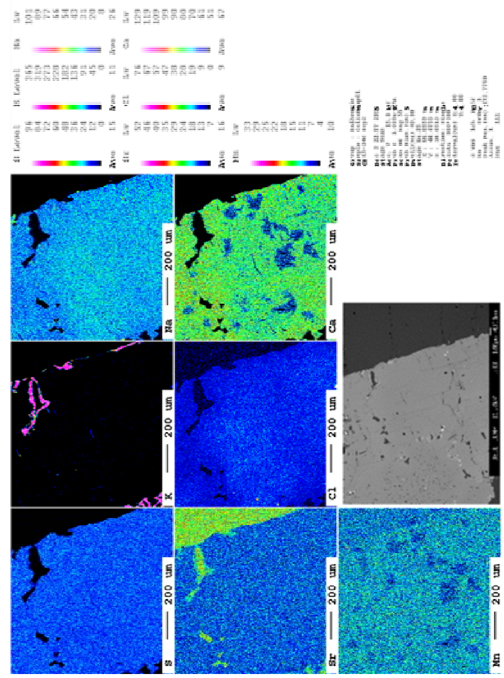


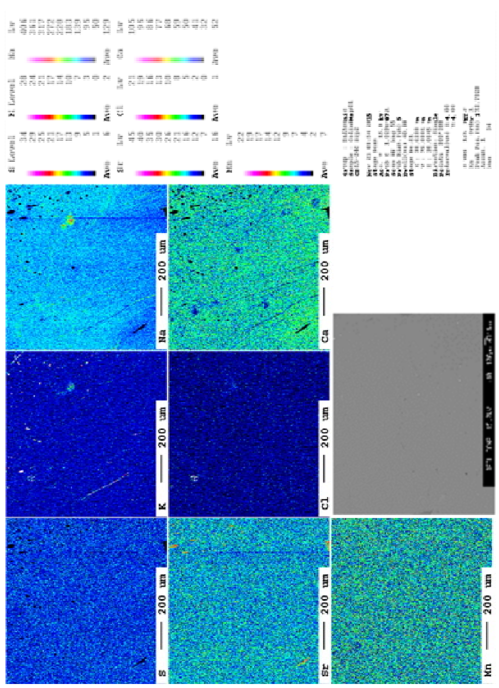


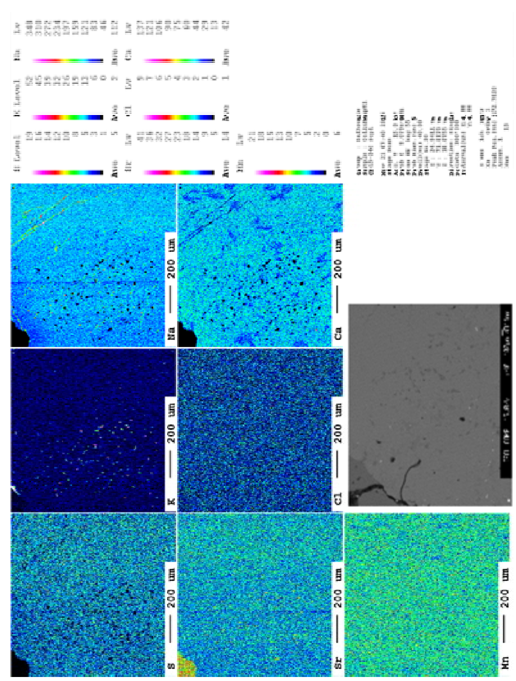


CB15-24 (Type 1 Pegmatite)

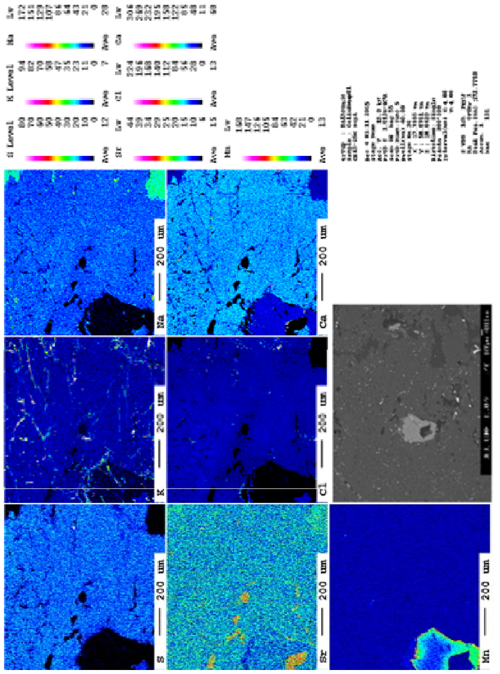


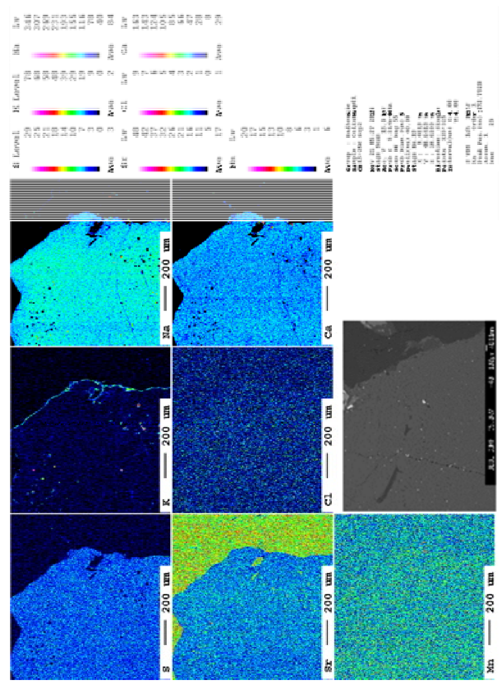


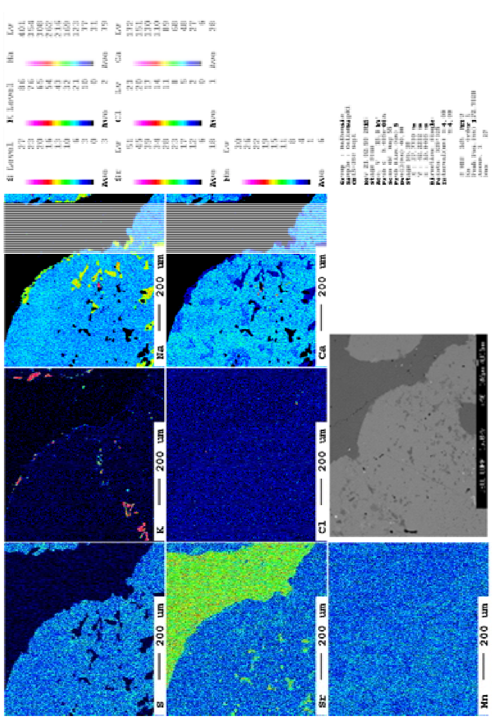


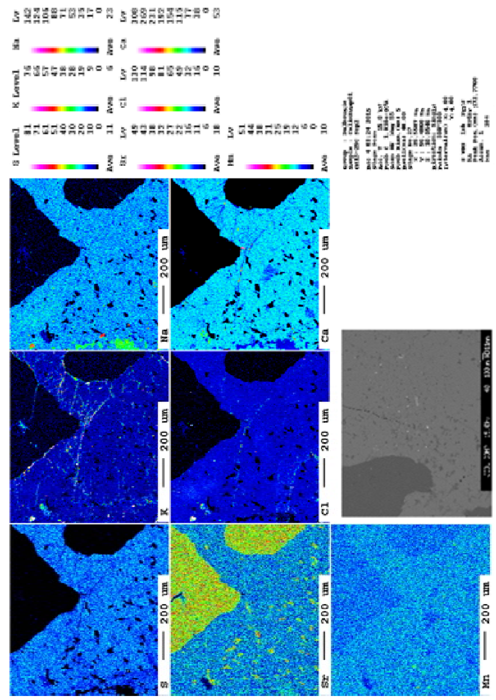


CB15-25 (Type 1 Pegmatite)

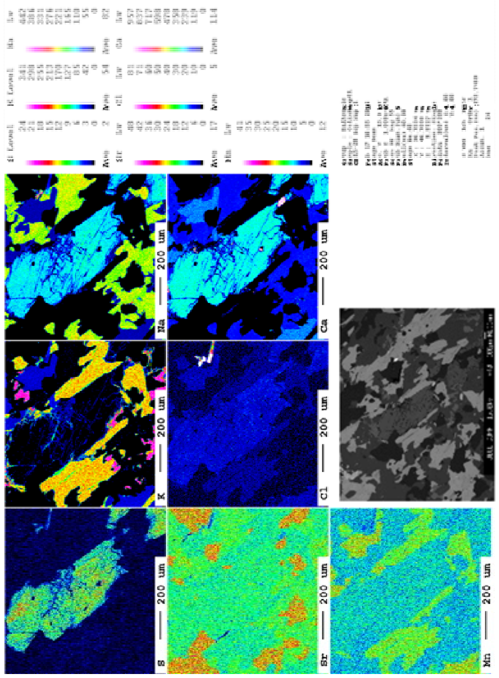


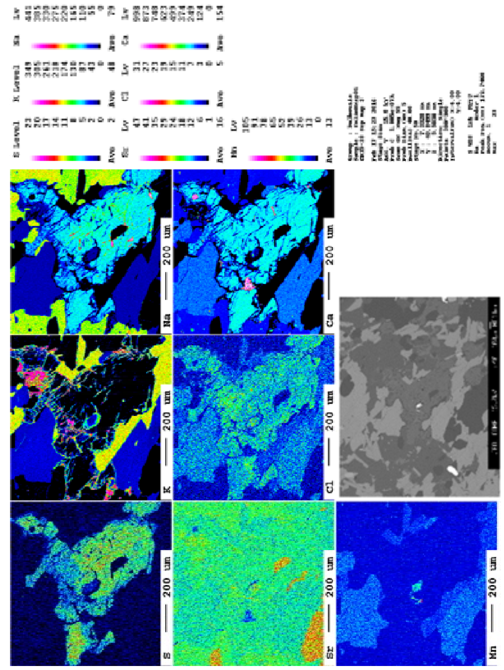


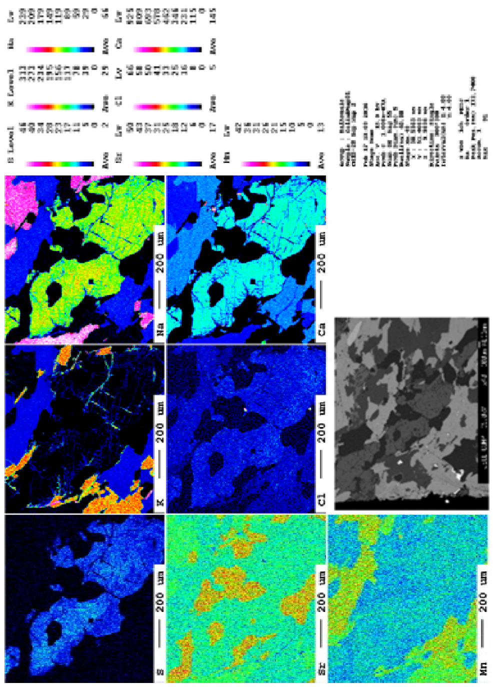




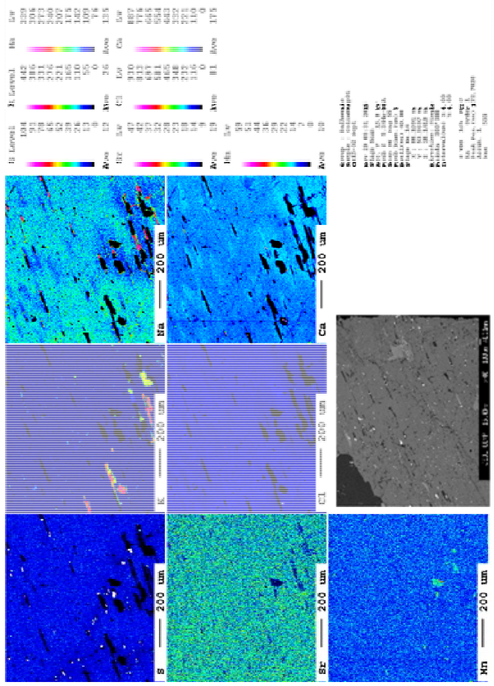
CB15-28 (Granodiorite)

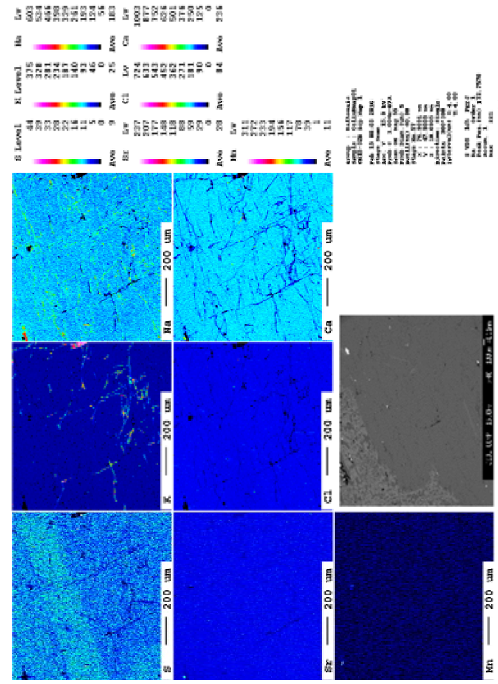


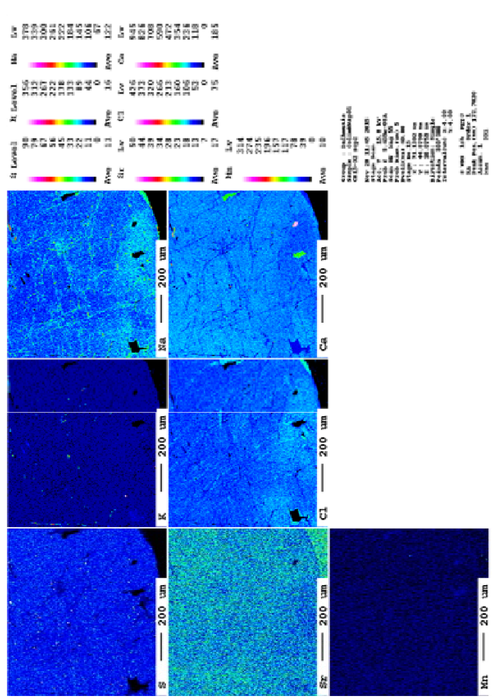


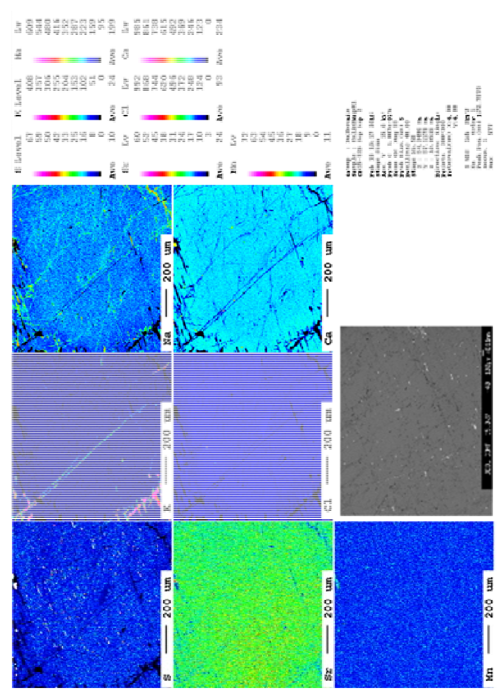


CB15-32 (Type 2 Pegmatite)

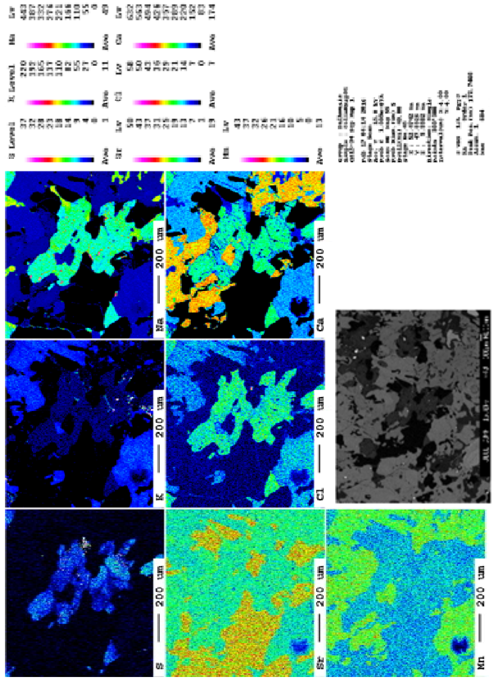


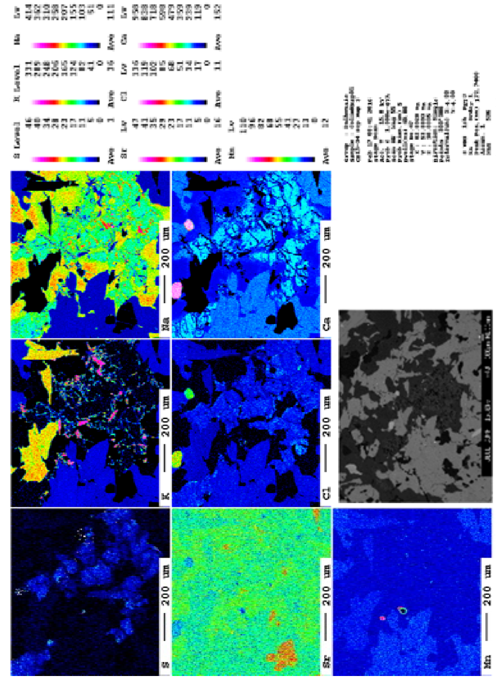


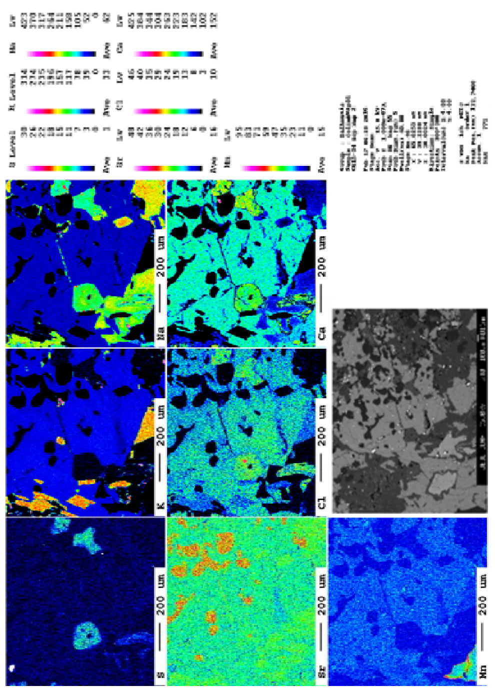




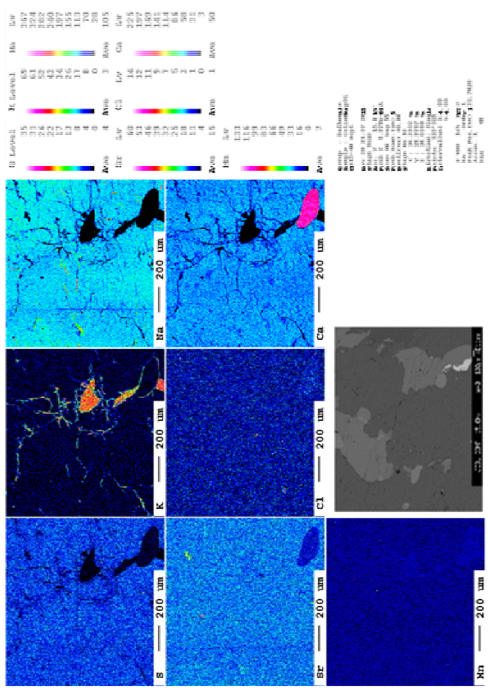
CB15-34 (Ulla Gneiss)

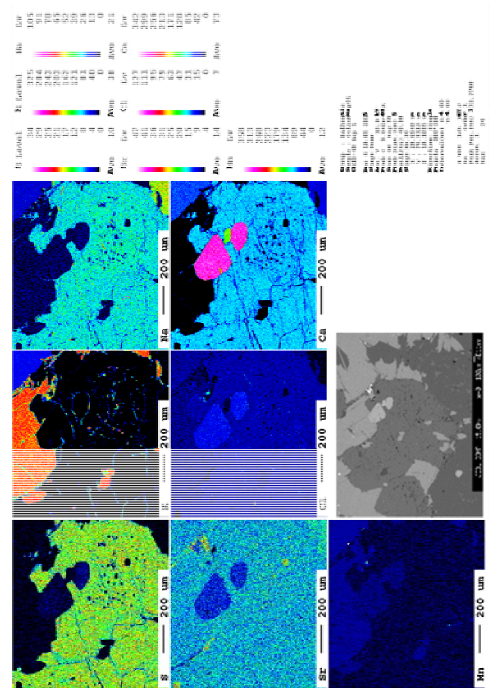


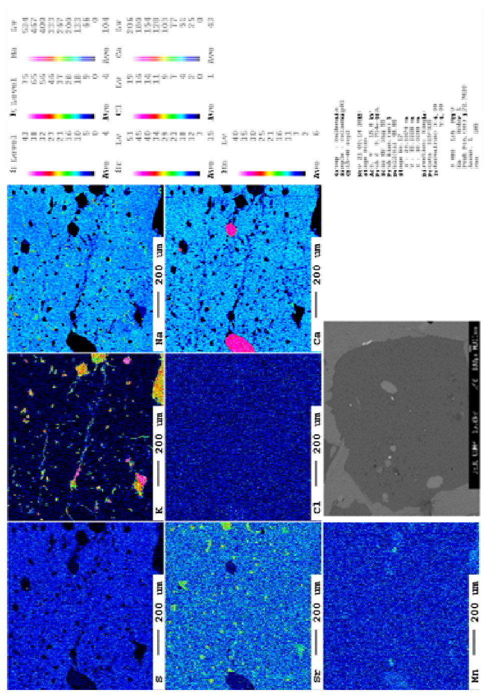


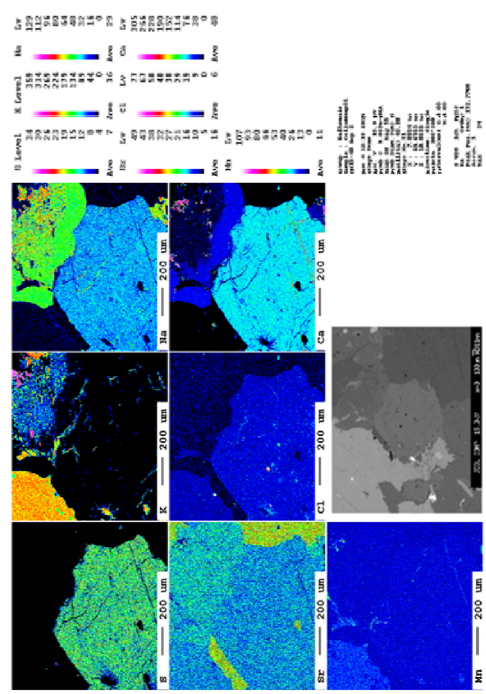


CB15-40 (Type 1 Pegmatite)

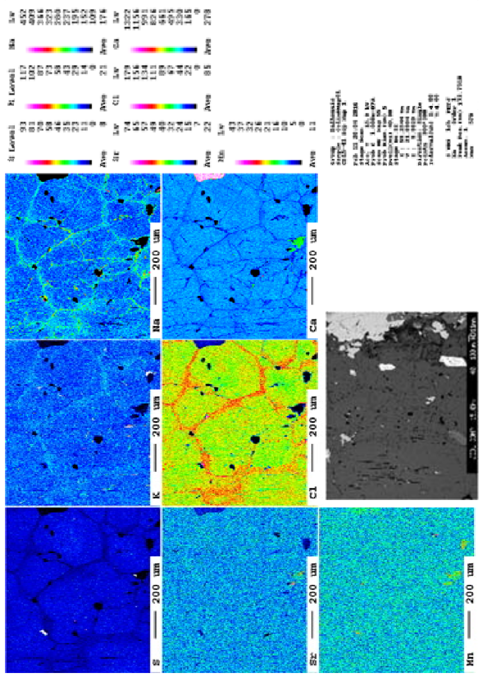


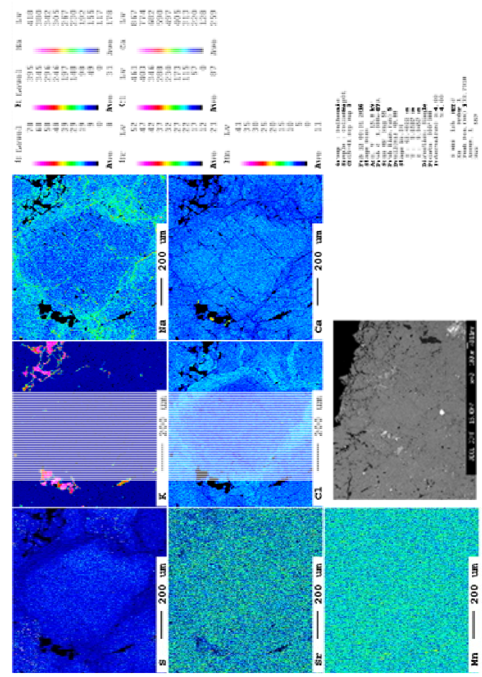


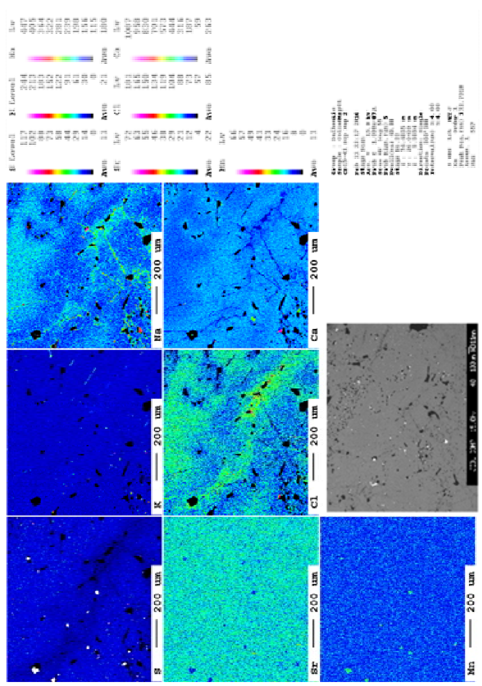




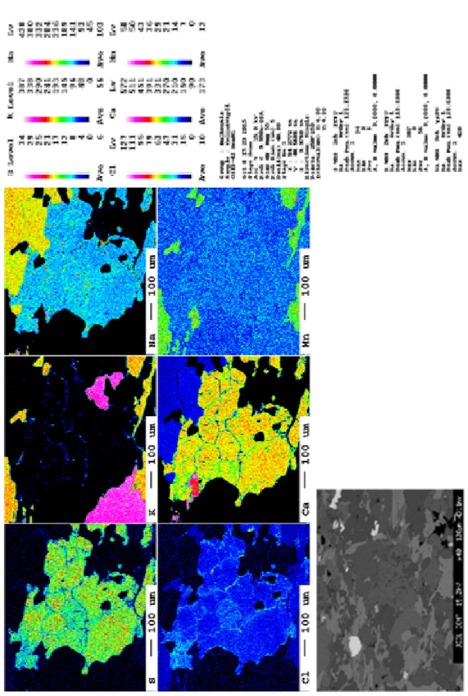
CB15-41 (Type 2 Pegmatite)

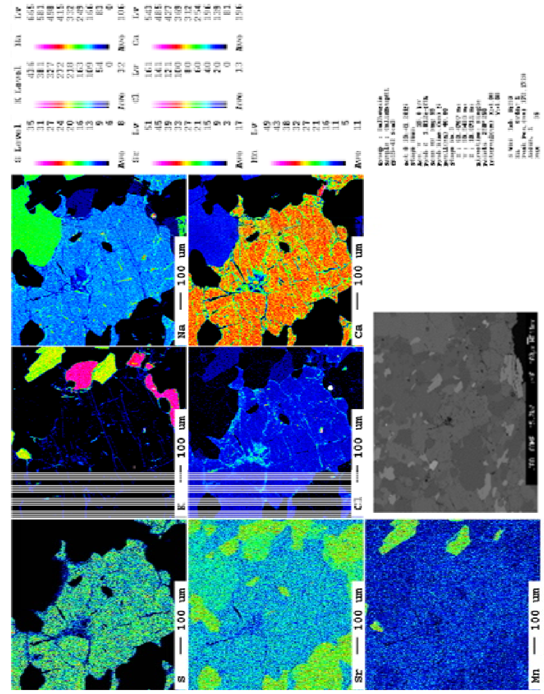


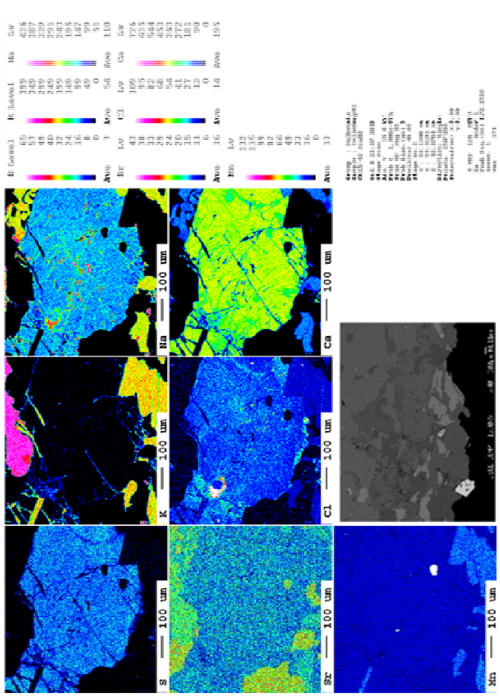


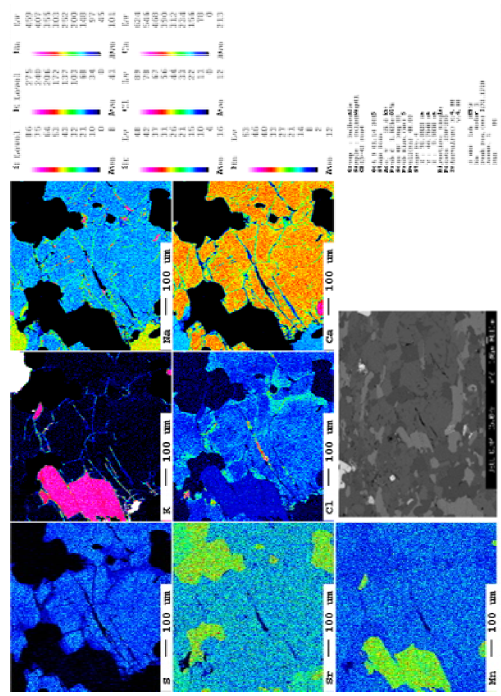


CB15-42

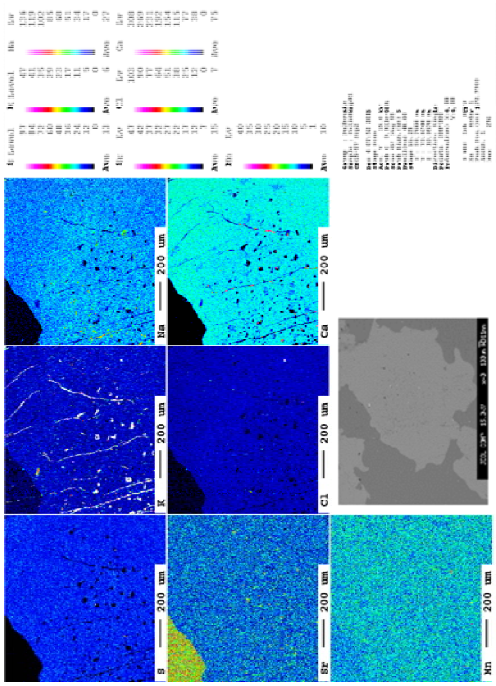


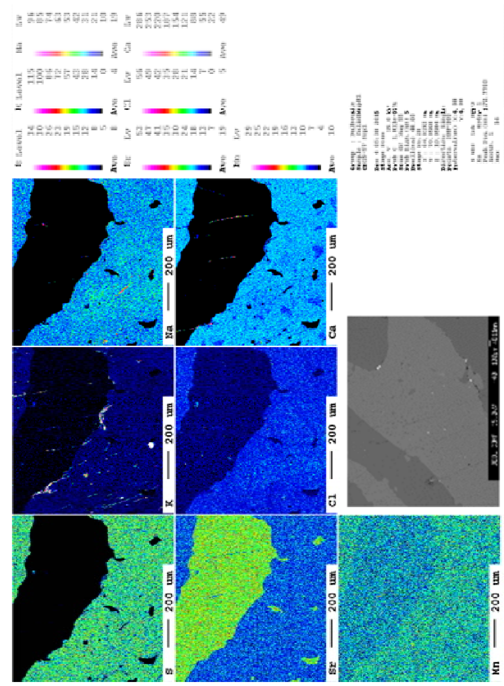


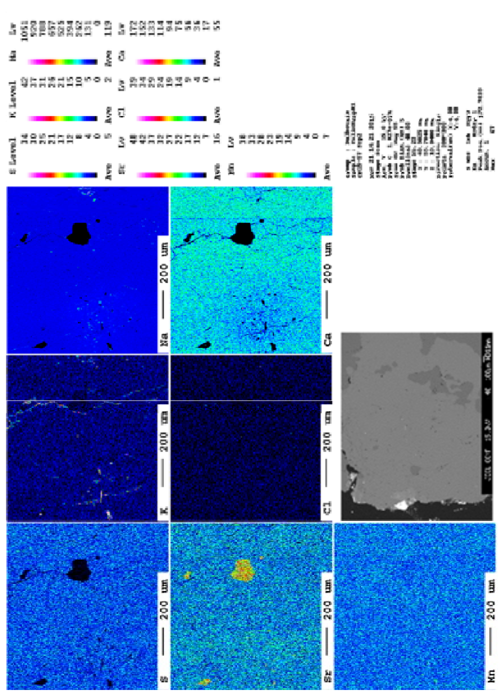


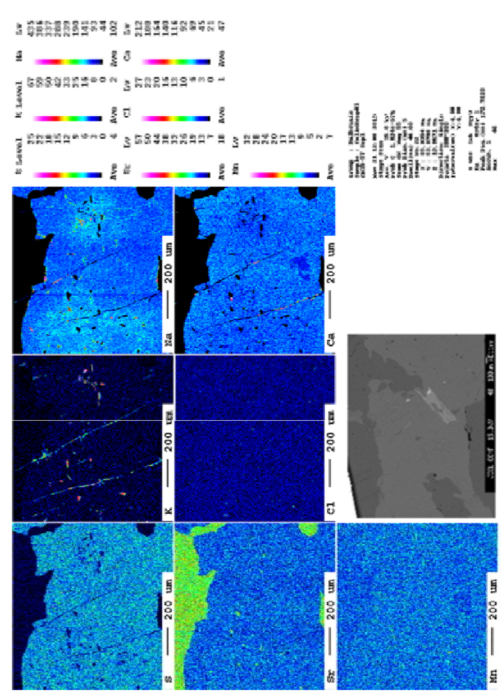


CB15-57 (Type 1 Pegmatite)

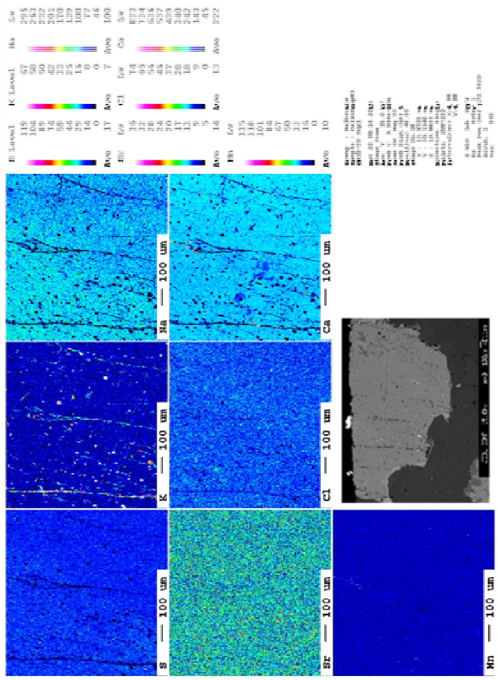


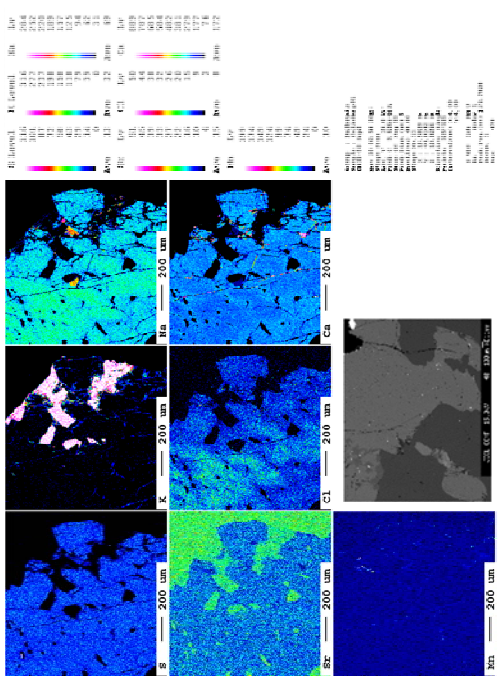




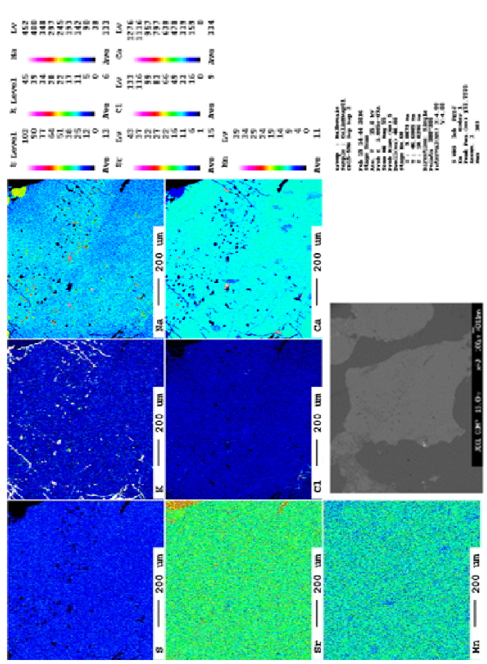


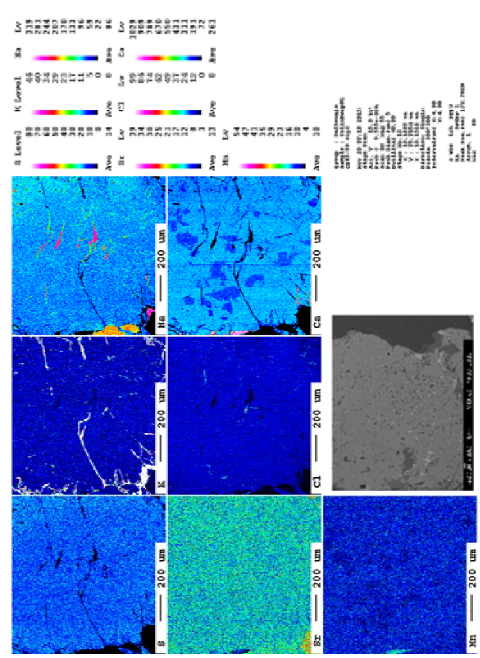
CB15-58 (Type 1 Pegmatite)

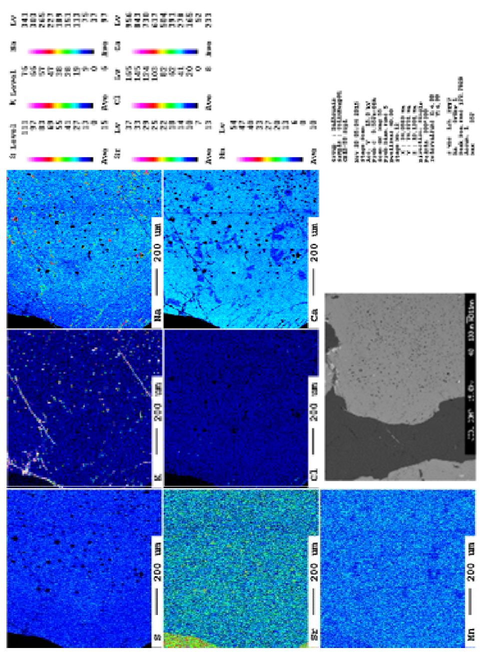


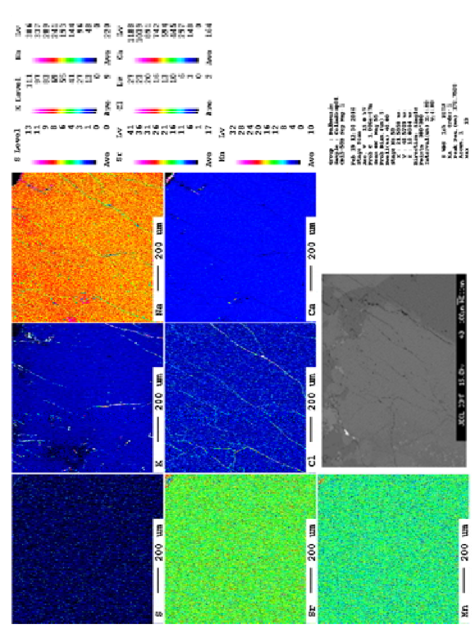


CB15-59 (Type 1 Pegmatite)

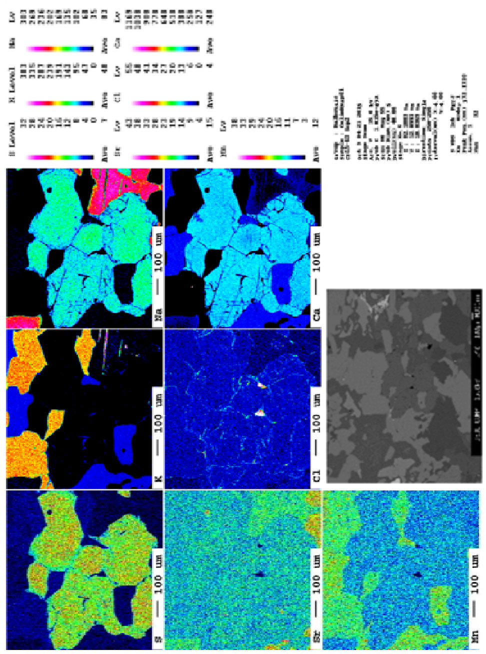


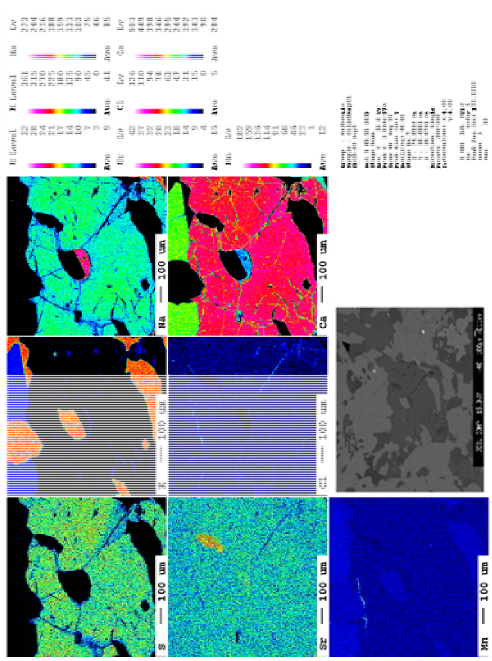


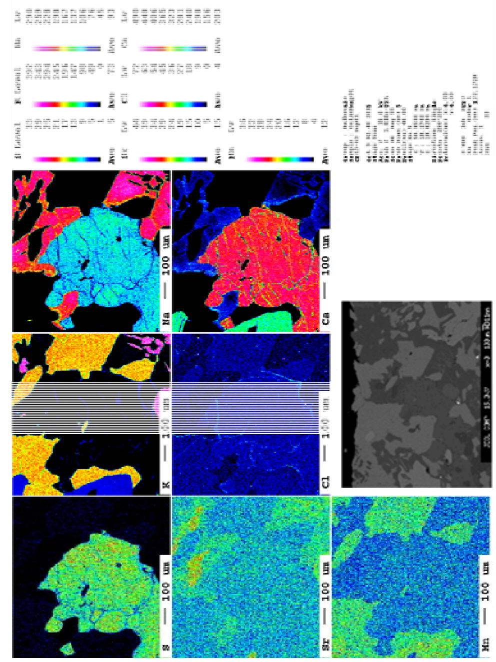




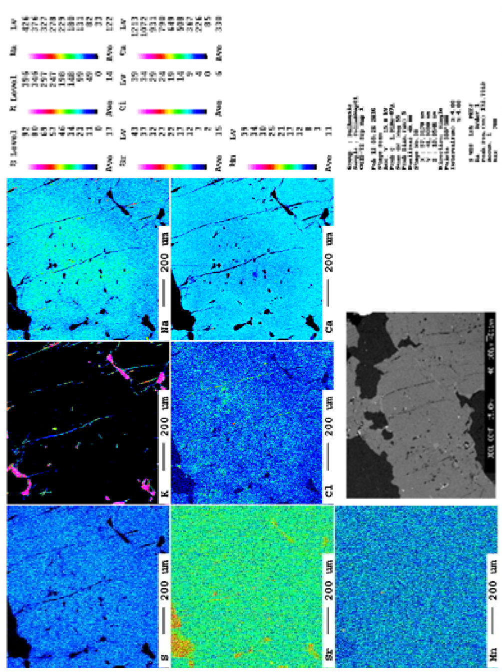
CB15-63 (Granodiorite)

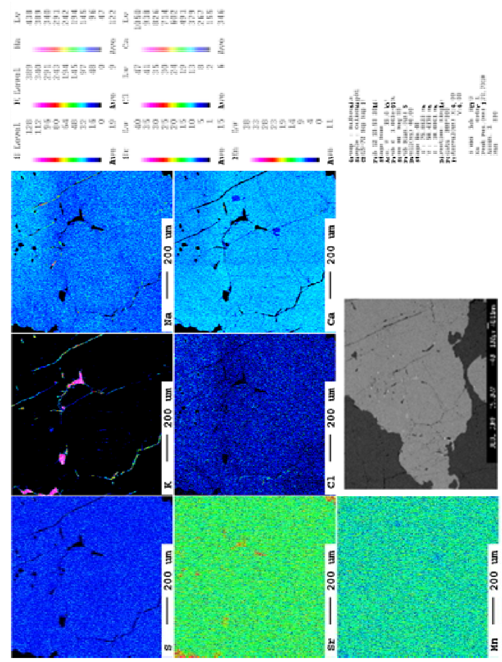


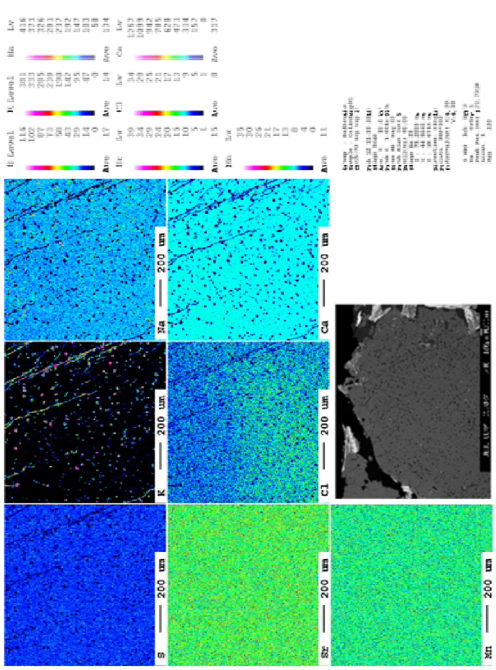




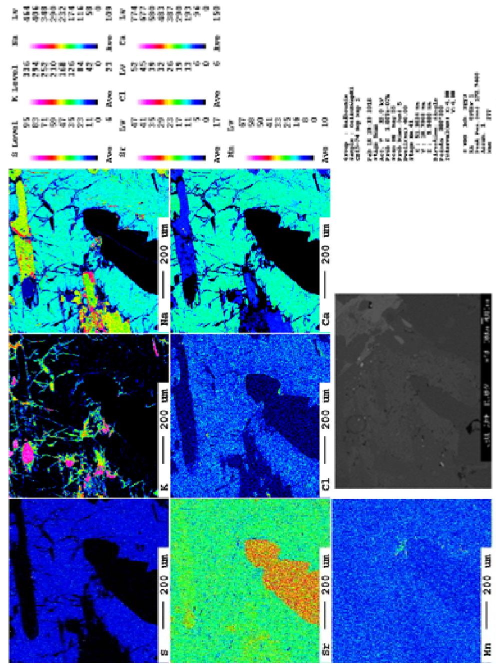
CB15-72 (Type 1 Pegmatite)

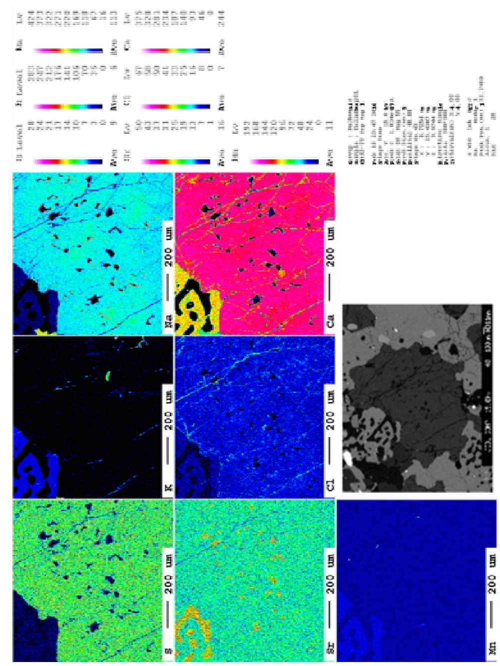


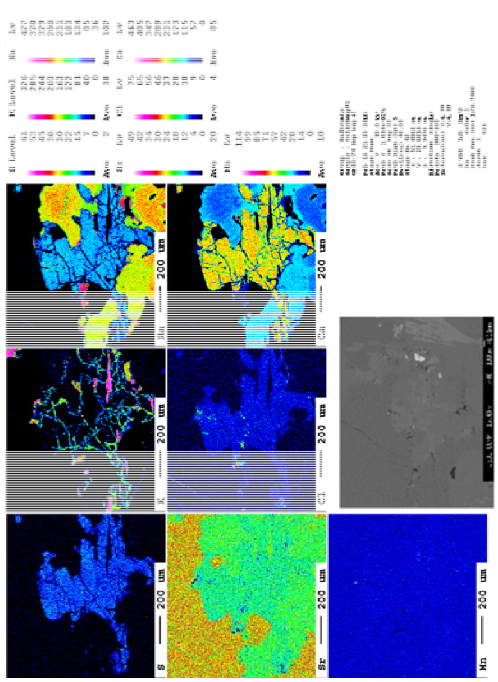


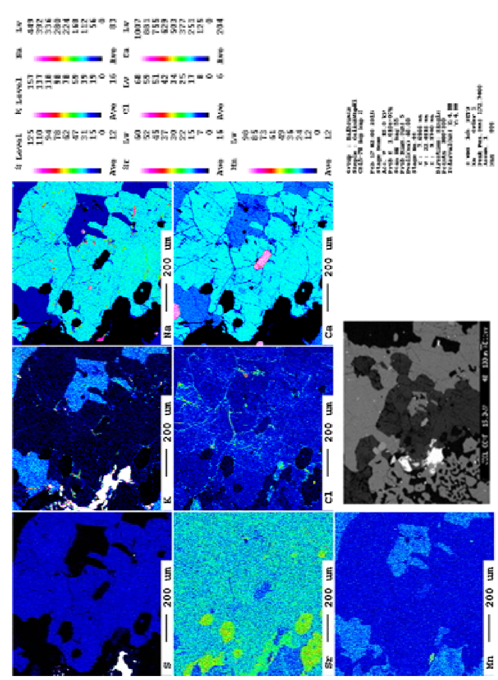


CB15-74 and 78 (Type 1 Pegmatite)

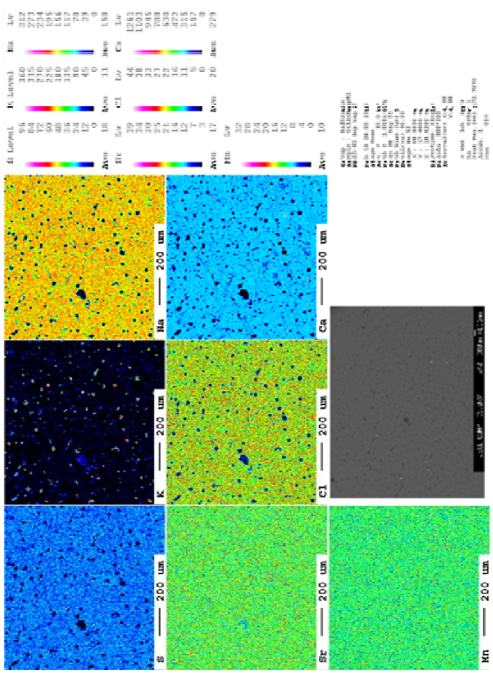


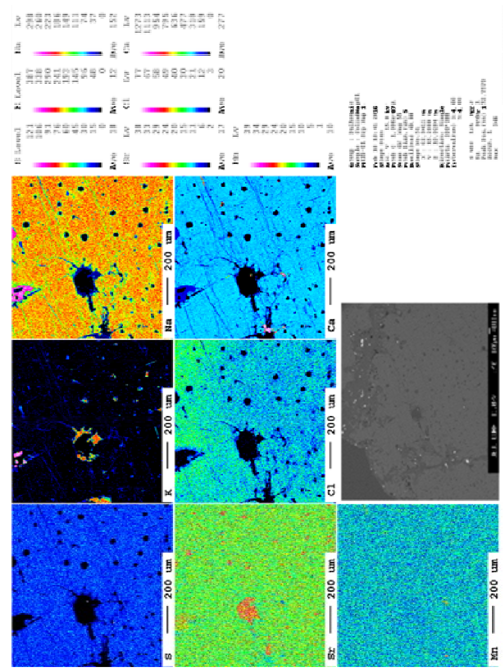


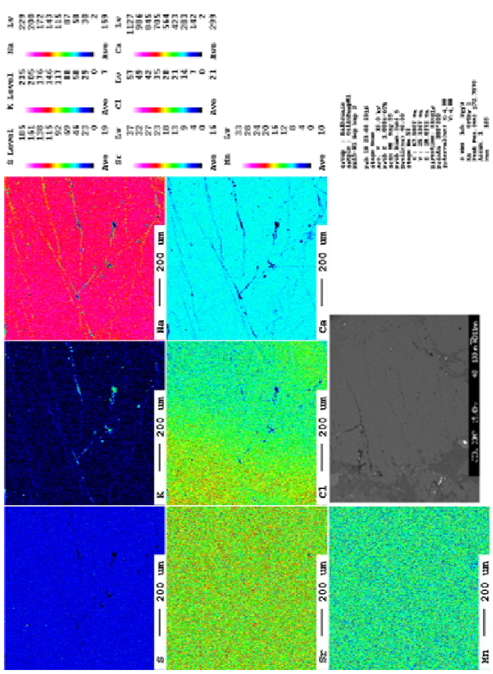




PR15-01 (Type 3 Pegmatite)







Appendix C: Titanite Chemistry and Geothermometry

EPMA analyses of titanite, as well as results for the Zr-in-Titanite, Hornblende-Plagioclase, and Two-Feldspar geothermometry are presented in the tables below.

Sample:	CB15-25														
Zone	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	MB	MB	MB
No.	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Wt%															
SiO2	30.14	30.24	30.11	28.53	30.19	30.22	30.24	30.06	30.20	30.27	30.20	30.17	30.38	30.43	30.42
TiO2	35.33	35.30	35.20	33.59	35.74	35.75	35.49	35.25	35.64	35.93	35.71	35.29	35.20	35.08	35.25
Al2O3	1.60	1.67	1.73	1.68	1.63	1.64	1.64	1.62	1.67	1.68	1.61	1.74	2.30	2.25	2.16
FeO	0.86	0.79	0.90	0.78	0.71	0.75	0.74	0.71	0.73	0.78	0.70	0.82	0.61	0.59	0.63
CaO	28.20	27.93	27.91	26.76	28.33	28.26	28.10	27.99	28.12	28.28	28.16	28.04	28.41	28.19	28.60
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.00	0.00	0.00	0.06	0.00	0.03
F	0.21	0.21	0.19	0.17	0.11	0.16	0.17	0.18	0.25	0.23	0.24	0.19	0.26	0.25	0.23
La2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.07	0.03	0.15	0.09	0.00	0.04	0.07	0.03	0.03	0.08	0.09	0.03	0.06	0.02	0.07
Sm2O3	0.03	0.00	0.06	0.02	0.11	0.00	0.00	0.02	0.01	0.03	0.00	0.10	0.00	0.00	0.02
Eu2O3	0.03	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.05	0.01	0.04	0.03	0.03
Gd2O3	0.13	0.11	0.11	0.17	0.04	0.01	0.00	0.01	0.00	0.02	0.00	0.15	0.00	0.03	0.07
Dy2O3	0.07	0.05	0.14	0.06	0.01	0.09	0.07	0.04	0.02	0.00	0.10	0.10	0.00	0.03	0.00
ThO2	0.00	0.06	0.04	0.06	0.03	0.00	0.00	0.00	0.07	0.06	0.02	0.00	0.04	0.00	0.01
UO2	0.05	0.08	0.04	0.04	0.03	0.00	0.04	0.07	0.00	0.03	0.00	0.00	0.05	0.07	0.02
Total	96.61	96.37	96.49	91.88	96.87	96.85	96.50	95.98	96.69	97.29	96.78	96.55	97.30	96.86	97.43
Cations Recalulated on the basis of 5O															
Si	1.02	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.03	1.02
Ti	0.90	0.90	0.90	0.90	0.91	0.91	0.90	0.90	0.91	0.91	0.91	0.90	0.89	0.89	0.89
Al	0.06	0.07	0.07	0.07	0.06	0.07	0.07	0.07	0.07	0.07	0.06	0.07	0.09	0.09	0.09
Fe	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Ca	1.03	1.02	1.02	1.02	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.03
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.03	0.02	0.03	0.02	0.03	0.03	0.02
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.07	3.06	3.06	3.06	3.05	3.06	3.06	3.06	3.06	3.06	3.06	3.06	3.07	3.07	3.07

Continued→

Sample:	CB15-25														
Zone	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	LB
No.	26	27	28	29	30	31	32	33	34	60	61	62	63	64	35
Wt%															
SiO2	30.22	30.41	30.28	30.39	30.50	30.39	30.23	30.11	30.26	30.58	30.49	30.68	30.32	30.21	30.48
TiO2	35.07	34.94	35.18	35.04	35.06	35.05	35.22	35.32	35.43	35.69	35.08	35.31	35.39	35.67	35.35
Al2O3	2.17	2.12	2.15	2.11	1.94	1.91	1.92	1.72	1.65	1.64	1.83	1.90	1.66	1.60	2.15
FeO	0.59	0.64	0.61	0.61	0.63	0.67	0.69	0.75	0.77	0.74	0.61	0.67	0.78	0.78	0.69
CaO	28.39	28.29	28.48	28.26	28.21	28.21	28.32	28.49	28.44	28.10	28.19	28.18	28.20	28.30	28.37
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.00	0.00	0.01
F	0.24	0.31	0.26	0.29	0.24	0.27	0.25	0.21	0.23	0.20	0.26	0.22	0.21	0.17	0.23
La2O3	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.09	0.14	0.02	0.06	0.01	0.07	0.09	0.04	0.05	0.00	0.01	0.05	0.06	0.02	0.00
Sm2O3	0.00	0.00	0.03	0.05	0.00	0.00	0.00	0.00	0.08	0.10	0.00	0.00	0.02	0.00	0.00
Eu2O3	0.03	0.08	0.04	0.03	0.01	0.00	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.03
Gd2O3	0.05	0.03	0.00	0.00	0.09	0.18	0.11	0.16	0.05	0.03	0.03	0.04	0.11	0.00	0.04
Dy2O3	0.00	0.01	0.01	0.02	0.00	0.00	0.07	0.06	0.14	0.03	0.10	0.17	0.03	0.00	0.05
ThO2	0.02	0.05	0.00	0.00	0.00	0.00	0.00	0.10	0.01	0.06	0.03	0.02	0.02	0.00	0.00
UO2	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.02	0.11	0.06	0.00	0.00	0.00	0.04	0.00
Total	96.78	96.91	96.94	96.77	96.58	96.65	96.79	96.92	97.17	97.19	96.51	97.14	96.72	96.73	97.30
Cations Recalulated on the basis of 5O															
Si	1.02	1.03	1.02	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ti	0.89	0.89	0.89	0.89	0.89	0.89	0.90	0.90	0.90	0.91	0.90	0.90	0.91	0.91	0.89
Al	0.09	0.08	0.09	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.09
Fe	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Ca	1.03	1.02	1.03	1.02	1.02	1.02	1.03	1.03	1.03	1.02	1.02	1.02	1.02	1.02	1.02
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.07	3.08	3.07	3.07	3.06	3.07	3.07	3.07	3.07	3.06	3.06	3.06	3.06	3.06	3.07

Continued→

Sample:	CB15-25														
Zone	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
No.	36	37	38	39	40	41	42	43	44	45	46	55	56	57	58
Wt%															
SiO2	30.34	30.30	30.36	30.45	30.29	30.39	30.38	30.40	30.43	30.57	30.44	30.17	30.54	30.54	30.50
TiO2	35.19	35.48	35.32	34.94	35.10	34.75	35.06	35.31	35.33	35.33	35.63	35.34	35.20	35.46	35.38
Al2O3	2.04	2.09	2.16	2.14	2.08	2.14	1.99	2.06	1.98	2.05	2.00	2.06	2.00	2.07	1.99
FeO	0.66	0.61	0.59	0.57	0.55	0.61	0.58	0.64	0.57	0.62	0.66	0.68	0.70	0.67	0.62
CaO	28.63	28.74	28.40	28.37	28.65	28.65	28.54	28.47	28.35	28.60	28.63	28.28	28.41	28.33	28.49
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
ZrO2	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.01	0.02	0.02	0.00	0.00	0.00	0.00
F	0.27	0.32	0.24	0.27	0.29	0.23	0.30	0.30	0.28	0.29	0.27	0.25	0.28	0.27	0.23
La2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.05	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.05	0.00	0.00	0.11	0.01	0.00	0.00	0.11	0.00	0.00	0.02	0.07	0.01	0.02	0.00
Sm2O3	0.00	0.00	0.00	0.00	0.09	0.04	0.00	0.06	0.00	0.00	0.00	0.09	0.02	0.00	0.06
Eu2O3	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.01	0.01	0.02	0.00	0.00	0.00	0.00	0.02
Gd2O3	0.00	0.00	0.09	0.11	0.00	0.00	0.10	0.00	0.00	0.00	0.08	0.08	0.00	0.01	0.08
Dy2O3	0.08	0.04	0.02	0.01	0.00	0.00	0.08	0.00	0.02	0.01	0.00	0.06	0.10	0.03	0.12
ThO2	0.00	0.00	0.00	0.01	0.06	0.04	0.09	0.00	0.06	0.00	0.00	0.04	0.00	0.00	0.05
UO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.03	0.09	0.00	0.00
Total	97.14	97.44	97.06	96.87	97.00	96.76	96.98	97.27	96.93	97.43	97.65	97.03	97.25	97.33	97.44
Cations Recalulated on the basis of 5O															
Si	1.02	1.02	1.02	1.03	1.02	1.03	1.03	1.02	1.03	1.03	1.02	1.02	1.03	1.02	1.02
Ti	0.89	0.90	0.89	0.89	0.89	0.88	0.89	0.89	0.90	0.89	0.90	0.90	0.90	0.90	0.90
Al	0.08	0.08	0.09	0.09	0.08	0.09	0.08	0.08	0.08	0.08	0.08	0.06	0.07	0.07	0.07
Fe	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02
Ca	1.03	1.03	1.02	1.03	1.04	1.04	1.03	1.03	1.02	1.03	1.03	1.03	1.02	1.02	1.02
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.03	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.07	3.08	3.07	3.07	3.08	3.07	3.08	3.07	3.07	3.07	3.07	3.07	3.06	3.06	3.06

Continued→

Sample:	CB15-25	CB15-40											
Zone	LB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB
No.	59	65	66	67	68	69	70	71	72	73	74	75	76	109
Wt%														
SiO2	30.43	29.23	29.22	28.90	29.19	29.31	29.28	29.12	28.93	28.93	29.06	28.75	29.01	29.40
TiO2	35.07	35.10	35.22	35.52	35.28	35.61	35.29	34.88	35.36	35.21	35.13	35.31	34.97	35.35
Al2O3	2.10	1.33	1.38	1.34	1.40	1.39	1.32	1.41	1.37	1.40	1.37	1.39	1.42	1.41
FeO	0.55	0.83	0.81	0.82	0.87	0.89	0.85	0.92	0.86	0.79	0.81	0.82	0.83	0.69
CaO	28.25	27.14	27.30	27.18	27.02	27.05	27.00	27.24	27.03	27.19	27.26	27.31	27.06	27.24
SrO	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.15	0.10	0.09	0.15	0.09	0.06	0.14	0.11	0.16	0.07	0.10	0.07	0.11	0.07
La2O3	0.00	0.00	0.01	0.05	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.00	0.18	0.28	0.19	0.10	0.09	0.19	0.22	0.23	0.11	0.09	0.22	0.19	0.19
Sm2O3	0.05	0.04	0.04	0.14	0.06	0.05	0.00	0.09	0.17	0.07	0.10	0.11	0.10	0.00
Eu2O3	0.00	0.04	0.03	0.00	0.03	0.02	0.07	0.05	0.06	0.05	0.00	0.06	0.10	0.01
Gd2O3	0.11	0.18	0.25	0.17	0.17	0.15	0.16	0.19	0.21	0.14	0.20	0.13	0.18	0.23
Dy2O3	0.02	0.22	0.21	0.21	0.14	0.20	0.19	0.16	0.12	0.19	0.22	0.08	0.27	0.16
ThO2	0.00	0.01	0.02	0.00	0.09	0.07	0.08	0.00	0.05	0.06	0.00	0.00	0.00	0.00
UO2	0.00	0.00	0.01	0.01	0.00	0.00	0.02	0.03	0.00	0.07	0.03	0.00	0.00	0.00
Total	96.70	94.33	94.81	94.60	94.39	94.85	94.51	94.39	94.48	94.25	94.32	94.22	94.19	94.73
Cations Recalulated on the basis of 5O														
Si	1.02	1.02	1.02	1.02	1.03	1.02	1.02	1.03	1.02	1.03	1.03	1.03	1.02	1.01
Ti	0.91	0.91	0.90	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.89	0.90	0.93
Al	0.06	0.06	0.07	0.09	0.09	0.09	0.09	0.08	0.09	0.08	0.08	0.08	0.08	0.05
Fe	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Ca	1.03	1.02	1.02	1.02	1.02	1.03	1.03	1.02	1.03	1.02	1.02	1.02	1.03	1.02
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.01	0.03	0.02	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.05	3.06	3.06	3.07	3.07	3.07	3.07	3.08	3.07	3.07	3.06	3.07	3.07	3.05

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Sample:	CB15-40														
Zone	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	MB	MB	MB	MB
No.	110	111	112	113	114	115	116	117	118	119	120	77	78	79	80
Wt%															
SiO2	29.56	29.56	29.49	29.39	29.40	29.52	29.49	29.08	29.48	29.57	29.51	29.11	28.87	28.96	28.83
TiO2	35.36	35.14	34.95	35.16	35.10	35.29	35.03	34.80	35.49	35.31	35.20	35.37	35.50	35.41	35.24
Al2O3	1.54	1.42	1.38	1.42	1.40	1.21	1.24	1.29	1.23	1.01	1.15	1.36	1.39	1.36	1.40
FeO	0.85	0.83	0.86	0.81	0.83	0.82	0.87	0.85	0.88	0.92	0.86	0.79	0.78	0.80	0.85
CaO	27.00	27.15	27.22	26.85	26.82	27.08	27.08	27.17	27.13	27.28	27.23	27.47	27.48	27.54	27.15
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.15	0.13	0.10	0.06	0.08	0.13	0.15	0.12	0.15	0.13	0.13	0.10	0.12	0.19	0.10
La2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.05
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.24	0.31	0.23	0.10	0.19	0.15	0.23	0.25	0.20	0.14	0.21	0.12	0.20	0.16	0.19
Sm2O3	0.06	0.10	0.05	0.13	0.00	0.05	0.00	0.00	0.00	0.00	0.03	0.06	0.08	0.04	0.07
Eu2O3	0.03	0.04	0.01	0.01	0.03	0.05	0.05	0.05	0.01	0.01	0.01	0.00	0.00	0.00	0.02
Gd2O3	0.21	0.19	0.17	0.27	0.11	0.23	0.12	0.06	0.07	0.00	0.07	0.03	0.13	0.08	0.17
Dy2O3	0.26	0.13	0.16	0.16	0.24	0.12	0.05	0.24	0.23	0.12	0.09	0.18	0.19	0.18	0.16
ThO2	0.05	0.03	0.00	0.00	0.04	0.00	0.09	0.00	0.00	0.03	0.02	0.02	0.00	0.00	0.03
UO2	0.00	0.00	0.00	0.00	0.05	0.02	0.00	0.02	0.03	0.05	0.00	0.05	0.02	0.01	0.00
Total	95.22	94.96	94.58	94.32	94.25	94.60	94.32	93.87	94.83	94.51	94.44	94.61	94.72	94.64	94.22
Cations Recalulated on the basis of 5O															
Si	1.00	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.03	1.02	1.02	1.02	1.02	1.02	1.02
Ti	0.94	0.92	0.92	0.91	0.91	0.92	0.92	0.92	0.92	0.92	0.92	0.90	0.90	0.89	0.89
Al	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.07	0.07	0.09	0.08
Fe	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.02	0.02
Ca	1.02	1.01	1.00	1.01	1.01	1.00	1.00	1.01	1.01	1.02	1.01	1.03	1.03	1.02	1.03
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.03
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.05	3.04	3.05	3.05	3.05	3.03	3.04	3.04	3.05	3.05	3.05	3.07	3.07	3.07	3.07

Continued→

Sample:	CB15-40														
Zone	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB
No.	81	82	83	84	85	86	87	88	121	122	123	124	125	126	127
Wt%															
SiO2	28.31	28.81	28.48	28.75	28.34	28.72	28.69	28.47	29.35	29.37	29.43	29.25	29.24	29.34	29.09
TiO2	35.03	35.13	35.16	35.07	34.67	34.86	35.27	35.05	35.58	35.73	35.42	35.60	35.60	35.50	35.29
Al2O3	1.43	1.46	1.34	1.38	1.37	1.37	1.43	1.41	1.10	1.08	1.24	1.08	1.05	0.97	1.12
FeO	0.79	0.67	0.77	0.77	0.81	0.79	0.74	0.84	0.73	0.78	0.69	0.72	0.72	0.81	0.80
CaO	27.21	27.05	27.20	27.05	26.86	26.86	26.86	26.90	27.59	27.61	27.07	27.63	27.43	27.12	27.04
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
F	0.11	0.14	0.17	0.18	0.12	0.13	0.08	0.11	0.10	0.20	0.10	0.13	0.13	0.14	0.09
La2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.10	0.13	0.12	0.15	0.22	0.09	0.29	0.17	0.13	0.01	0.15	0.04	0.03	0.08	0.14
Sm2O3	0.00	0.09	0.05	0.04	0.00	0.11	0.04	0.14	0.10	0.06	0.00	0.01	0.12	0.11	0.04
Eu2O3	0.04	0.03	0.01	0.00	0.01	0.02	0.06	0.03	0.00	0.03	0.05	0.01	0.00	0.00	0.04
Gd2O3	0.11	0.11	0.21	0.17	0.14	0.18	0.18	0.08	0.00	0.12	0.16	0.07	0.16	0.11	0.05
Dy2O3	0.29	0.11	0.13	0.15	0.10	0.20	0.20	0.12	0.15	0.07	0.20	0.02	0.11	0.20	0.08
ThO2	0.02	0.00	0.01	0.00	0.04	0.00	0.00	0.00	0.03	0.00	0.00	0.03	0.00	0.00	0.01
UO2	0.00	0.03	0.00	0.00	0.02	0.00	0.05	0.01	0.08	0.00	0.00	0.00	0.00	0.00	0.00
Total	93.39	93.70	93.57	93.64	92.64	93.27	93.84	93.27	94.89	94.97	94.45	94.54	94.53	94.33	93.79
Cations Recalulated on the basis of 5O															
Si	1.02	1.02	1.03	1.02	1.03	1.03	1.02	1.03	1.03	1.02	1.02	1.01	1.02	1.01	1.01
Ti	0.90	0.89	0.89	0.89	0.88	0.89	0.89	0.90	0.92	0.92	0.93	0.93	0.92	0.93	0.93
Al	0.08	0.09	0.09	0.08	0.09	0.08	0.08	0.08	0.04	0.05	0.05	0.04	0.05	0.04	0.04
Fe	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02
Ca	1.03	1.02	1.03	1.04	1.04	1.03	1.03	1.02	1.01	1.01	1.02	1.02	1.01	1.03	1.02
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.01	0.01	0.01	0.02	0.01	0.01	0.01
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.08	3.07	3.07	3.08	3.07	3.08	3.07	3.07	3.05	3.05	3.05	3.06	3.04	3.05	3.05

Continued→

Sample:	CB15-40														
Zone	MB	MB	MB	MB	MB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
No.	128	129	130	131	132	97	98	99	100	101	102	103	104	105	106
Wt%															
SiO2	29.10	29.06	29.08	29.25	29.33	28.43	29.20	29.34	29.21	29.25	29.28	28.96	29.17	28.53	28.45
TiO2	35.42	35.45	35.47	35.20	35.54	34.39	35.16	35.25	35.56	35.07	35.05	34.94	34.94	34.53	34.93
Al2O3	1.16	1.16	1.18	1.17	1.13	1.54	1.52	1.62	1.58	1.58	1.54	1.52	1.59	1.64	1.61
FeO	0.87	0.83	0.87	0.78	0.85	0.57	0.57	0.56	0.56	0.54	0.56	0.59	0.51	0.57	0.53
CaO	27.11	27.09	27.11	27.40	27.38	27.32	27.46	27.69	27.84	27.70	27.58	27.58	27.82	27.41	27.53
SrO	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.00	0.00	0.00	0.04	0.00	0.00	0.01	0.00	0.03	0.00	0.00	0.03	0.02	0.02	0.00
F	0.09	0.10	0.06	0.18	0.10	0.15	0.16	0.13	0.22	0.19	0.17	0.07	0.13	0.14	0.22
La2O3	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.14	0.14	0.14	0.05	0.05	0.01	0.06	0.08	0.03	0.00	0.02	0.00	0.00	0.00	0.04
Sm2O3	0.00	0.03	0.00	0.09	0.05	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Eu2O3	0.06	0.04	0.02	0.02	0.07	0.00	0.00	0.03	0.01	0.02	0.00	0.00	0.01	0.00	0.00
Gd2O3	0.00	0.10	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.01	0.13	0.04	0.02
Dy2O3	0.09	0.01	0.10	0.15	0.11	0.06	0.10	0.06	0.09	0.02	0.00	0.01	0.02	0.08	0.00
ThO2	0.00	0.00	0.00	0.01	0.04	0.00	0.00	0.03	0.02	0.03	0.00	0.00	0.00	0.03	0.05
UO2	0.04	0.03	0.06	0.00	0.00	0.02	0.00	0.01	0.03	0.02	0.00	0.03	0.00	0.00	0.01
Total	94.03	94.03	94.24	94.25	94.62	92.42	94.18	94.74	95.11	94.49	94.13	93.72	94.30	92.93	93.28
Cations Recalulated on the basis of 5O															
Si	1.02	1.02	1.01	1.01	1.01	1.03	1.02	1.01	1.01	1.01	1.01	1.01	1.02	1.01	1.01
Ti	0.93	0.93	0.93	0.93	0.93	0.89	0.90	0.92	0.92	0.92	0.92	0.91	0.92	0.92	0.91
Al	0.04	0.05	0.05	0.05	0.05	0.08	0.08	0.06	0.06	0.07	0.06	0.06	0.06	0.06	0.07
Fe	0.02	0.02	0.03	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Ca	1.01	1.01	1.01	1.01	1.01	1.03	1.03	1.04	1.02	1.02	1.03	1.03	1.03	1.03	1.04
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.02	0.01	0.01	0.01	0.01	0.03	0.03	0.02	0.02	0.01	0.02	0.02	0.02	0.01	0.01
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.04	3.04	3.04	3.04	3.04	3.07	3.07	3.06	3.05	3.05	3.06	3.06	3.06	3.05	3.06

Continued→

Sample:	CB15-40													
Zone	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
No.	107	108	141	142	143	144	145	146	147	148	149	150	151	152
Wt%														
SiO2	28.77	28.62	30.32	30.49	30.30	30.53	30.22	30.35	30.22	30.22	30.32	30.17	30.25	30.25
TiO2	35.14	35.49	35.97	35.67	36.86	36.53	36.49	36.48	36.41	36.06	35.84	35.51	35.38	35.48
Al2O3	1.24	1.23	1.78	1.76	1.17	1.12	1.10	1.14	1.14	1.66	1.59	1.76	1.77	1.76
FeO	0.77	0.75	0.65	0.58	0.71	0.77	0.71	0.70	0.76	0.58	0.55	0.60	0.62	0.58
CaO	27.17	27.13	28.34	28.18	28.07	28.13	27.93	28.14	28.10	28.46	28.18	28.16	27.94	28.12
SrO	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.00	0.04	0.06	0.00	0.02	0.00	0.00	0.00	0.03	0.00	0.01	0.01	0.04	0.02
F	0.17	0.12	0.23	0.20	0.13	0.18	0.13	0.11	0.15	0.15	0.15	0.13	0.20	0.14
La2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.06	0.11	0.08	0.04	0.04	0.05	0.02	0.00	0.13	0.01	0.00	0.00	0.03	0.08
Sm2O3	0.06	0.00	0.03	0.00	0.03	0.00	0.07	0.02	0.01	0.00	0.00	0.06	0.00	0.00
Eu2O3	0.03	0.04	0.00	0.05	0.00	0.02	0.00	0.00	0.03	0.00	0.00	0.00	0.05	0.00
Gd2O3	0.00	0.04	0.05	0.04	0.02	0.00	0.05	0.04	0.00	0.00	0.07	0.00	0.15	0.00
Dy2O3	0.06	0.11	0.00	0.03	0.02	0.02	0.09	0.02	0.06	0.03	0.07	0.04	0.10	0.11
ThO2	0.00	0.02	0.00	0.01	0.06	0.00	0.02	0.04	0.00	0.04	0.03	0.01	0.00	0.00
UO2	0.00	0.00	0.00	0.09	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.06
Total	93.41	93.65	97.40	97.05	97.36	97.31	96.76	97.00	96.98	97.14	96.74	96.40	96.44	96.55
Cations Recalulated on the basis of 5O														
Si	1.01	1.00	1.02	1.02	1.02	1.03	1.02	1.03	1.02	1.02	1.02	1.02	1.02	1.02
Ti	0.92	0.92	0.92	0.93	0.91	0.90	0.93	0.92	0.93	0.92	0.92	0.91	0.91	0.90
Al	0.07	0.07	0.05	0.05	0.07	0.07	0.05	0.04	0.04	0.05	0.05	0.07	0.06	0.07
Fe	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Ca	1.04	1.04	1.02	1.02	1.02	1.02	1.01	1.01	1.01	1.02	1.02	1.03	1.02	1.02
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.02	0.02	0.02	0.01	0.02	0.02	0.01	0.02	0.01	0.01	0.02	0.02	0.02	0.01
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.06	3.07	3.05	3.04	3.06	3.06	3.04	3.05	3.04	3.04	3.05	3.05	3.05	3.05

Continued→

Sample:	CB15-27														
Zone	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB	HB
No.	169	170	171	172	173	174	175	176	177	178	207	208	209	210	211
Wt%															
SiO2	29.64	29.89	30.19	29.94	29.72	30.20	29.98	29.93	30.18	29.93	30.03	29.84	29.92	29.85	29.98
TiO2	34.85	36.10	35.62	35.94	36.00	36.15	36.27	36.03	36.11	35.94	35.90	35.84	35.87	35.98	35.57
Al2O3	1.42	1.16	1.34	1.18	1.28	1.09	1.14	1.19	1.22	1.19	1.37	1.40	1.38	1.38	1.43
FeO	0.93	0.69	0.80	0.74	0.81	0.78	0.77	0.76	0.81	0.82	0.70	0.77	0.80	0.70	0.78
CaO	26.62	27.71	27.40	27.68	27.23	27.32	27.39	27.33	27.26	27.29	27.68	27.76	27.71	27.39	27.62
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
F	0.11	0.08	0.12	0.10	0.14	0.11	0.10	0.09	0.10	0.12	0.15	0.13	0.18	0.09	0.14
La2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.03	0.07	0.00	0.00	0.00	0.02	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.70	0.22	0.30	0.17	0.26	0.16	0.14	0.22	0.30	0.29	0.19	0.19	0.13	0.12	0.13
Sm2O3	0.18	0.02	0.01	0.00	0.00	0.00	0.00	0.09	0.12	0.01	0.05	0.05	0.05	0.09	0.08
Eu2O3	0.03	0.06	0.03	0.00	0.06	0.05	0.08	0.06	0.06	0.05	0.04	0.05	0.04	0.12	0.08
Gd2O3	0.22	0.10	0.20	0.04	0.04	0.13	0.07	0.21	0.13	0.22	0.11	0.12	0.03	0.11	0.00
Dy2O3	0.31	0.09	0.13	0.07	0.07	0.03	0.09	0.13	0.17	0.13	0.03	0.02	0.00	0.13	0.08
ThO2	0.01	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.10	0.00	0.01
UO2	0.01	0.08	0.08	0.03	0.00	0.01	0.11	0.08	0.02	0.00	0.06	0.00	0.00	0.10	0.00
Total	94.97	96.20	96.16	95.86	95.56	95.98	96.14	96.12	96.51	95.93	96.24	96.19	96.15	96.01	95.83
Cations Recalulated on the basis of 5O															
Si	1.03	1.02	1.03	1.02	1.03	1.02	1.02	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ti	0.90	0.90	0.91	0.93	0.91	0.92	0.93	0.93	0.93	0.93	0.93	0.92	0.92	0.92	0.92
Al	0.07	0.07	0.06	0.05	0.05	0.05	0.05	0.04	0.05	0.05	0.05	0.05	0.06	0.06	0.06
Fe	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Ca	1.02	1.02	0.99	1.01	1.00	1.01	1.00	1.00	1.00	1.00	1.01	1.01	1.01	1.01	1.01
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.02	0.02	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.02	0.01	0.02	0.01	0.02
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.06	3.05	3.04	3.04	3.04	3.04	3.04	3.03	3.03	3.03	3.05	3.05	3.05	3.05	3.05

Continued→

Sample:	CB15-27														
Zone	HB	HB	HB	HB	HB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB
No.	212	213	214	215	216	179	180	181	182	183	184	185	186	187	188
Wt%															
SiO2	30.05	29.96	30.03	29.95	30.01	30.00	29.89	29.98	29.91	30.11	30.04	30.05	30.10	30.00	30.08
TiO2	36.11	35.97	35.84	36.01	35.86	35.97	35.94	36.01	35.85	36.35	36.86	36.86	36.90	35.94	35.92
Al2O3	1.40	1.42	1.38	1.38	1.43	1.27	1.28	1.28	1.26	1.28	0.76	0.86	0.84	1.40	1.25
FeO	0.71	0.75	0.80	0.75	0.71	0.79	0.75	0.82	0.81	0.76	0.53	0.51	0.47	0.76	0.77
CaO	27.42	27.67	27.61	27.63	27.84	27.83	27.90	27.68	27.69	27.75	27.75	27.79	27.86	27.83	27.68
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.00	0.00	0.00	0.00	0.03	0.01	0.01	0.00	0.00	0.00	0.02	0.03	0.04	0.00	0.03
F	0.10	0.13	0.12	0.14	0.09	0.11	0.12	0.09	0.16	0.11	0.11	0.12	0.12	0.14	0.16
La2O3	0.00	0.03	0.00	0.00	0.00	0.00	0.12	0.01	0.00	0.00	0.00	0.00	0.07	0.03	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.28	0.17	0.22	0.19	0.11	0.15	0.15	0.19	0.08	0.08	0.17	0.23	0.09	0.17	0.09
Sm2O3	0.00	0.04	0.04	0.01	0.00	0.11	0.00	0.00	0.01	0.05	0.09	0.03	0.06	0.00	0.04
Eu2O3	0.00	0.00	0.08	0.06	0.06	0.04	0.00	0.03	0.04	0.01	0.04	0.02	0.06	0.08	0.07
Gd2O3	0.06	0.11	0.09	0.00	0.18	0.02	0.06	0.08	0.05	0.00	0.00	0.00	0.07	0.01	0.00
Dy2O3	0.05	0.17	0.08	0.02	0.09	0.00	0.05	0.07	0.06	0.00	0.04	0.10	0.09	0.07	0.07
ThO2	0.00	0.02	0.00	0.00	0.00	0.01	0.00	0.01	0.06	0.04	0.00	0.02	0.00	0.00	0.00
UO2	0.00	0.00	0.00	0.05	0.08	0.10	0.04	0.06	0.00	0.02	0.00	0.00	0.04	0.05	0.06
Total	96.13	96.39	96.24	96.12	96.45	96.36	96.25	96.27	95.90	96.51	96.35	96.58	96.75	96.41	96.15
Cations Recalulated on the basis of 5O															
Si	1.02	1.02	1.02	1.02	1.02	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ti	0.92	0.91	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.93	0.94	0.94	0.94
Al	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.03	0.03	0.03
Fe	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01
Ca	1.00	1.01	1.00	1.01	1.01	0.99	1.00	1.01	1.02	1.01	1.01	1.01	1.01	1.01	1.01
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.04	3.05	3.04	3.05	3.04	3.03	3.04	3.04	3.05	3.04	3.05	3.04	3.03	3.03	3.04

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Sample:	CB15-27														
Zone	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB
No.	217	218	219	220	221	222	223	224	225	226	245	246	247	248	249
Wt%															
SiO2	30.18	30.19	30.13	30.23	30.11	30.02	30.05	30.19	30.05	29.98	29.74	29.83	29.72	29.82	29.90
TiO2	35.83	35.90	35.83	35.96	35.83	36.01	35.90	35.79	35.62	35.89	35.54	35.49	35.90	35.52	35.57
Al2O3	1.57	1.54	1.50	1.49	1.41	1.50	1.50	1.47	1.76	1.52	1.24	1.28	1.26	1.32	1.30
FeO	0.63	0.69	0.68	0.72	0.70	0.74	0.75	0.69	0.69	0.70	0.77	0.70	0.78	0.65	0.70
CaO	28.18	27.76	27.91	27.79	27.79	28.28	27.69	28.15	27.92	27.74	27.64	27.79	27.60	27.98	27.81
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.02	0.00	0.00	0.04	0.04
F	0.17	0.15	0.14	0.12	0.11	0.19	0.14	0.12	0.20	0.22	0.17	0.10	0.12	0.14	0.13
La2O3	0.00	0.01	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.11	0.13	0.06	0.08	0.14	0.16	0.15	0.10	0.12	0.04	0.17	0.13	0.09	0.11	0.03
Sm2O3	0.05	0.00	0.00	0.06	0.00	0.09	0.06	0.04	0.06	0.00	0.00	0.00	0.00	0.00	0.10
Eu2O3	0.00	0.02	0.00	0.00	0.00	0.02	0.00	0.04	0.06	0.00	0.03	0.04	0.04	0.00	0.03
Gd2O3	0.00	0.04	0.07	0.12	0.09	0.02	0.10	0.02	0.01	0.00	0.06	0.03	0.04	0.00	0.00
Dy2O3	0.10	0.07	0.00	0.07	0.06	0.09	0.05	0.06	0.13	0.07	0.05	0.03	0.01	0.00	0.01
ThO2	0.02	0.00	0.00	0.00	0.00	0.03	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.01	0.00
UO2	0.02	0.00	0.09	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	96.80	96.43	96.34	96.59	96.27	97.09	96.34	96.69	96.55	96.06	95.35	95.39	95.50	95.53	95.57
Cations Recalulated on the basis of 5O															
Si	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.01	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ti	0.92	0.92	0.91	0.92	0.91	0.92	0.92	0.92	0.92	0.91	0.91	0.91	0.92	0.92	0.93
Al	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05
Fe	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Ca	1.01	1.01	1.02	1.01	1.01	1.01	1.01	1.02	1.01	1.02	1.02	1.02	1.02	1.02	1.01
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.02	0.01	0.01
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.04	3.04	3.05	3.05	3.05	3.04	3.04	3.06	3.05	3.05	3.05	3.05	3.05	3.05	3.04

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Sample:	CB15-27														
Zone	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	LB	LB	LB	LB
No.	255	256	257	258	259	265	266	267	268	269	270	189	190	191	192
Wt%															
SiO2	29.74	29.62	29.97	29.98	29.97	29.54	29.53	29.45	29.24	29.53	29.50	30.36	30.06	29.74	30.10
TiO2	35.36	35.15	35.53	35.45	35.65	34.80	34.85	34.92	34.98	35.22	34.89	36.02	36.19	35.84	36.07
Al2O3	1.50	1.53	1.61	1.57	1.67	1.44	1.45	1.42	1.48	1.36	1.33	1.33	1.21	1.24	1.34
FeO	0.52	0.65	0.66	0.60	0.64	0.80	0.87	0.75	0.76	0.72	0.76	0.73	0.66	0.64	0.76
CaO	27.73	27.87	27.78	27.74	27.78	27.13	27.16	27.42	27.34	27.05	27.05	27.88	27.65	28.01	27.97
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
F	0.18	0.11	0.13	0.14	0.12	0.19	0.12	0.15	0.19	0.17	0.14	0.13	0.13	0.11	0.12
La2O3	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.03	0.00	0.00	0.02	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.07	0.07	0.05	0.13	0.06	0.09	0.24	0.22	0.17	0.36	0.27	0.06	0.05	0.12	0.08
Sm2O3	0.03	0.00	0.02	0.00	0.03	0.09	0.05	0.01	0.02	0.11	0.00	0.00	0.00	0.00	0.00
Eu2O3	0.00	0.03	0.00	0.03	0.01	0.06	0.04	0.07	0.05	0.00	0.01	0.02	0.02	0.03	0.01
Gd2O3	0.08	0.00	0.06	0.12	0.00	0.15	0.07	0.09	0.08	0.19	0.05	0.02	0.10	0.04	0.02
Dy2O3	0.05	0.00	0.03	0.00	0.13	0.08	0.05	0.11	0.13	0.04	0.00	0.07	0.00	0.09	0.01
ThO2	0.04	0.02	0.00	0.03	0.06	0.00	0.00	0.07	0.02	0.02	0.01	0.02	0.01	0.01	0.00
UO2	0.06	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.04	0.08	0.05	0.02	0.00	0.00	0.08
Total	95.33	95.03	95.78	95.71	96.06	94.32	94.49	94.60	94.42	94.80	93.99	96.61	96.04	95.83	96.54
Cations Recalulated on the basis of 5O															
Si	1.01	1.02	1.02	1.02	1.02	1.02	1.02	1.03	1.02	1.02	1.02	1.02	1.02	1.03	1.02
Ti	0.92	0.90	0.91	0.91	0.91	0.90	0.90	0.91	0.91	0.91	0.91	0.92	0.92	0.92	0.93
Al	0.05	0.07	0.06	0.06	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.05	0.05	0.05
Fe	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.02
Ca	1.03	1.03	1.02	1.03	1.02	1.02	1.03	1.01	1.01	1.02	1.02	1.01	1.01	1.01	1.01
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.02	0.03	0.02	0.01	0.01	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.01
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.06	3.07	3.05	3.05	3.05	3.06	3.06	3.05	3.05	3.05	3.06	3.05	3.05	3.04	3.04

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Sample:	CB15-27														
Zone	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
No.	193	194	195	196	197	198	227	228	229	230	231	232	233	234	235
Wt%															
SiO2	29.91	29.87	29.88	29.99	30.04	29.94	30.38	30.11	30.24	30.05	30.31	30.06	30.04	30.22	30.26
TiO2	35.95	36.10	35.96	35.71	36.24	35.96	35.91	35.82	35.85	35.76	35.86	35.71	35.84	36.03	35.78
Al2O3	1.34	1.29	1.33	1.17	1.17	1.24	1.64	1.56	1.54	1.54	1.58	1.60	1.58	1.58	1.57
FeO	0.71	0.68	0.74	0.69	0.70	0.78	0.62	0.60	0.63	0.62	0.60	0.61	0.58	0.64	0.54
CaO	27.93	27.85	27.61	27.48	27.87	27.65	28.15	27.97	27.98	28.05	28.12	28.24	28.17	28.39	28.15
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.00	0.00	0.00	0.02	0.00	0.03	0.02	0.00	0.02	0.04	0.00	0.01	0.01	0.00	0.02
F	0.14	0.12	0.16	0.07	0.18	0.13	0.19	0.11	0.13	0.19	0.17	0.17	0.18	0.14	0.17
La2O3	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.06	0.06	0.19	0.17	0.12	0.15	0.03	0.12	0.07	0.01	0.08	0.00	0.00	0.02	0.00
Sm2O3	0.03	0.00	0.00	0.09	0.07	0.02	0.00	0.00	0.00	0.00	0.06	0.06	0.00	0.00	0.01
Eu2O3	0.01	0.00	0.05	0.05	0.00	0.04	0.01	0.01	0.00	0.02	0.00	0.01	0.02	0.00	0.00
Gd2O3	0.00	0.08	0.05	0.10	0.08	0.04	0.00	0.00	0.05	0.00	0.00	0.07	0.02	0.06	0.07
Dy2O3	0.01	0.00	0.02	0.07	0.06	0.10	0.00	0.00	0.03	0.00	0.02	0.12	0.02	0.04	0.03
ThO2	0.00	0.05	0.00	0.00	0.00	0.05	0.01	0.03	0.00	0.00	0.00	0.03	0.00	0.00	0.00
UO2	0.00	0.03	0.05	0.00	0.00	0.04	0.05	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.06
Total	96.03	96.07	95.99	95.57	96.43	96.12	96.90	96.28	96.48	96.20	96.74	96.66	96.40	97.05	96.58
Cations Recalulated on the basis of 5O															
Si	1.02	1.02	1.02	1.02	1.02	1.03	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02
Ti	0.92	0.92	0.92	0.92	0.92	0.92	0.91	0.92	0.91	0.91	0.91	0.91	0.91	0.91	0.91
Al	0.05	0.05	0.05	0.05	0.05	0.05	0.07	0.06	0.07	0.06	0.06	0.06	0.06	0.06	0.06
Fe	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Ca	1.03	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.02	1.02	1.02	1.02	1.02	1.03	1.02
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.05	3.05	3.05	3.04	3.05	3.03	3.06	3.05	3.05	3.05	3.05	3.05	3.05	3.06	3.06

Continued→

Sample:	CB15-27														
Zone	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
No.	236	250	251	252	253	254	260	261	262	263	264	271	272	273	274
Wt%															
SiO2	30.30	29.86	29.73	29.78	29.60	29.74	29.94	30.03	29.82	29.95	29.96	29.64	29.41	29.66	29.47
TiO2	35.86	35.10	35.30	35.08	35.78	34.91	35.34	35.52	35.06	35.11	35.01	35.11	35.29	34.79	34.39
Al2O3	1.60	1.51	1.58	1.57	1.33	1.79	1.58	1.55	1.61	1.65	1.69	1.47	1.74	1.72	1.72
FeO	0.56	0.66	0.57	0.45	0.62	0.57	0.51	0.48	0.60	0.61	0.63	0.59	0.65	0.61	0.62
CaO	28.15	27.83	28.10	27.97	28.07	28.03	27.98	28.18	27.87	27.90	28.00	27.57	27.72	27.61	27.60
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.01	0.02	0.00	0.00	0.01	0.01	0.01	0.04	0.00	0.01	0.03	0.06	0.00	0.01	0.00
F	0.17	0.16	0.20	0.22	0.19	0.25	0.18	0.10	0.17	0.18	0.21	0.19	0.20	0.23	0.22
La2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.00	0.07	0.03	0.05	0.05	0.04	0.00	0.07	0.04	0.12	0.05	0.05	0.00	0.01	0.12
Sm2O3	0.02	0.02	0.00	0.05	0.00	0.00	0.02	0.00	0.00	0.06	0.00	0.08	0.00	0.05	0.00
Eu2O3	0.00	0.05	0.01	0.00	0.03	0.00	0.00	0.02	0.00	0.03	0.01	0.00	0.02	0.01	0.03
Gd2O3	0.00	0.13	0.00	0.05	0.04	0.00	0.20	0.00	0.08	0.00	0.15	0.00	0.00	0.07	0.02
Dy2O3	0.00	0.05	0.00	0.05	0.09	0.02	0.05	0.02	0.00	0.01	0.00	0.04	0.00	0.07	0.00
ThO2	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.15	0.03	0.07	0.02	0.00	0.00
UO2	0.06	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.07	0.00	0.02	0.02	0.00
Total	96.66	95.39	95.43	95.19	95.73	95.27	95.75	95.96	95.18	95.70	95.75	94.79	94.97	94.79	94.09
Cations Recalulated on the basis of 5O															
Si	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.02	1.03	1.02	1.01
Ti	0.91	0.91	0.92	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.91	0.92	0.91	0.91	0.91
Al	0.06	0.05	0.05	0.06	0.06	0.06	0.06	0.07	0.06	0.06	0.07	0.06	0.05	0.06	0.07
Fe	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02
Ca	1.02	1.03	1.02	1.02	1.03	1.03	1.02	1.01	1.02	1.03	1.03	1.00	1.01	1.02	1.02
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.02
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.05	3.05	3.05	3.05	3.06	3.06	3.05	3.05	3.05	3.05	3.06	3.05	3.05	3.05	3.06

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Sample:	CB15-27		CB15-20											
Zone	LB	LB	HB	HB	HB	HB	HB	MB	MB	MB	MB	MB	MB	MB
No.	275	276	305	306	307	308	309	285	286	287	288	289	290	291
Wt%														
SiO2	29.55	29.60	30.04	29.87	30.01	30.07	30.01	30.17	30.26	30.05	29.99	26.56	30.33	30.04
TiO2	34.83	34.69	35.14	34.99	34.81	35.09	35.22	35.42	35.27	35.30	35.28	32.08	35.35	35.21
Al2O3	1.72	1.74	1.55	1.56	1.74	1.72	1.74	1.72	1.77	1.73	1.72	1.65	1.78	1.77
FeO	0.59	0.65	0.92	0.76	0.61	0.51	0.58	0.59	0.59	0.53	0.51	0.60	0.49	0.49
CaO	27.67	27.44	27.06	26.94	27.55	27.40	27.59	27.72	27.59	27.73	27.70	25.19	27.84	27.73
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
ZrO2	0.00	0.09	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.01	0.01	0.03	0.02	0.00
F	0.22	0.20	0.13	0.13	0.18	0.18	0.19	0.18	0.22	0.21	0.19	0.15	0.20	0.14
La2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.02	0.05	0.00	0.04	0.00	0.06	0.06	0.04	0.00	0.00	0.00	0.00	0.02	0.00
Sm2O3	0.12	0.00	0.07	0.06	0.09	0.03	0.07	0.00	0.09	0.00	0.00	0.00	0.03	0.00
Eu2O3	0.01	0.01	0.08	0.03	0.04	0.01	0.02	0.02	0.01	0.00	0.00	0.05	0.00	0.03
Gd2O3	0.05	0.00	0.24	0.28	0.04	0.17	0.03	0.00	0.13	0.00	0.07	0.02	0.14	0.02
Dy2O3	0.00	0.04	0.11	0.16	0.05	0.10	0.18	0.02	0.03	0.04	0.04	0.04	0.00	0.07
ThO2	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.03	0.00	0.00	0.00	0.00
UO2	0.00	0.03	0.10	0.00	0.04	0.00	0.00	0.03	0.00	0.01	0.04	0.00	0.06	0.06
Total	94.68	94.46	95.39	94.79	95.09	95.26	95.66	95.83	95.86	95.58	95.46	86.32	96.18	95.49
Cations Recalulated on the basis of 5O														
Si	1.02	1.02	1.03	1.03	1.03	1.03	1.03	1.02	1.02	1.03	1.03	1.03	1.03	1.01
Ti	0.90	0.90	0.88	0.88	0.91	0.91	0.90	0.90	0.90	0.91	0.90	0.91	0.91	0.91
Al	0.07	0.07	0.10	0.10	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Fe	0.02	0.02	0.02	0.01	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02
Ca	1.02	1.03	1.01	1.02	0.99	1.00	1.01	1.02	1.02	1.01	1.01	1.01	1.01	1.02
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.03	0.02	0.03	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.06	3.07	3.07	3.06	3.04	3.04	3.05	3.06	3.06	3.05	3.05	3.05	3.05	3.06

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Sample:	CB15-20														
Zone	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB
No.	292	293	294	318	319	320	321	322	323	324	335	336	337	338	339
Wt%															
SiO2	30.08	30.27	30.11	29.93	29.95	29.78	30.09	30.04	29.86	29.94	29.70	29.84	29.95	29.88	29.72
TiO2	35.36	35.29	35.46	35.44	35.06	35.33	35.37	35.66	35.34	35.59	34.92	34.66	35.16	35.25	35.22
Al2O3	1.82	1.80	1.77	1.78	1.93	1.78	1.72	1.70	1.71	1.76	1.89	1.96	1.82	1.87	1.92
FeO	0.53	0.51	0.48	0.55	0.53	0.53	0.50	0.46	0.51	0.49	0.47	0.41	0.59	0.51	0.48
CaO	27.59	27.58	27.82	27.81	27.78	27.73	27.79	27.93	27.83	27.88	28.22	28.04	28.01	28.17	28.00
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.05	0.00	0.01
F	0.16	0.21	0.16	0.14	0.20	0.19	0.16	0.19	0.21	0.18	0.20	0.16	0.22	0.20	0.16
La2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.07	0.03	0.02	0.04	0.08	0.04	0.03	0.06	0.06	0.00	0.00	0.00	0.07	0.02	0.00
Sm2O3	0.00	0.02	0.00	0.00	0.01	0.03	0.01	0.06	0.00	0.03	0.00	0.00	0.00	0.00	0.00
Eu2O3	0.03	0.01	0.01	0.02	0.07	0.00	0.03	0.04	0.01	0.00	0.00	0.00	0.00	0.04	0.01
Gd2O3	0.02	0.00	0.06	0.08	0.05	0.09	0.02	0.00	0.00	0.06	0.00	0.07	0.11	0.00	0.07
Dy2O3	0.02	0.06	0.14	0.00	0.09	0.08	0.05	0.10	0.10	0.03	0.09	0.00	0.08	0.04	0.00
ThO2	0.00	0.00	0.01	0.02	0.00	0.02	0.09	0.03	0.00	0.00	0.04	0.02	0.00	0.00	0.00
UO2	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00
Total	95.62	95.69	95.97	95.76	95.70	95.52	95.79	96.20	95.54	95.93	95.46	95.12	95.98	95.89	95.52
Cations Recalulated on the basis of 5O															
Si	1.03	1.03	1.03	1.03	1.03	1.02	1.02	1.02	1.03	1.02	1.03	1.03	1.02	1.02	1.02
Ti	0.90	0.90	0.91	0.90	0.91	0.91	0.90	0.91	0.91	0.91	0.88	0.88	0.90	0.89	0.90
Al	0.07	0.07	0.07	0.07	0.07	0.07	0.08	0.07	0.07	0.07	0.10	0.10	0.08	0.08	0.07
Fe	0.01	0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.01	0.01	0.02
Ca	1.01	1.02	1.01	1.01	1.01	1.02	1.02	1.02	1.01	1.02	1.02	1.02	1.04	1.03	1.02
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.05	3.05	3.05	3.05	3.05	3.05	3.06	3.06	3.05	3.05	3.07	3.08	3.07	3.06	3.06

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Sample:	CB15-20														
Zone	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB	MB
No.	340	341	342	343	344	367	368	369	370	371	377	378	379	380	381
Wt%															
SiO2	29.92	30.00	29.79	29.85	30.15	29.92	29.73	29.75	29.90	30.01	30.06	30.03	30.03	29.87	30.06
TiO2	35.50	35.15	35.30	35.32	34.69	34.85	35.00	35.45	35.35	35.32	35.64	35.53	35.85	35.16	35.20
Al2O3	1.81	1.87	1.88	1.89	2.31	1.99	2.04	1.96	2.06	2.02	1.84	1.85	1.78	1.86	2.01
FeO	0.49	0.53	0.53	0.48	0.49	0.51	0.54	0.54	0.51	0.52	0.55	0.49	0.47	0.47	0.56
CaO	28.21	28.10	28.26	27.96	28.18	28.08	28.03	27.87	28.28	28.07	28.11	28.38	28.08	28.39	28.30
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.00	0.03	0.01	0.02	0.00	0.00	0.00	0.03	0.02	0.01	0.01	0.01	0.04	0.01	0.01
F	0.15	0.16	0.19	0.18	0.28	0.16	0.25	0.28	0.20	0.23	0.19	0.17	0.10	0.21	0.23
La2O3	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.00	0.00	0.00	0.02	0.00	0.04	0.03	0.12	0.00	0.05	0.00	0.00	0.07	0.00	0.06
Sm2O3	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
Eu2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.02	0.06	0.00	0.01	0.00	0.00
Gd2O3	0.00	0.05	0.17	0.11	0.10	0.15	0.00	0.00	0.01	0.05	0.05	0.00	0.06	0.00	0.03
Dy2O3	0.07	0.00	0.02	0.04	0.00	0.10	0.07	0.10	0.00	0.00	0.11	0.01	0.03	0.00	0.00
ThO2	0.05	0.00	0.02	0.03	0.07	0.02	0.04	0.00	0.04	0.08	0.00	0.00	0.09	0.00	0.00
UO2	0.00	0.04	0.04	0.00	0.00	0.06	0.00	0.00	0.00	0.01	0.00	0.00	0.04	0.00	0.02
Total	96.14	95.85	96.13	95.83	96.16	95.82	95.63	95.98	96.31	96.33	96.53	96.40	96.60	95.88	96.38
Cations Recalulated on the basis of 5O															
Si	1.02	1.02	1.02	1.02	1.01	1.03	1.03	1.02	1.02	1.01	1.02	1.02	1.02	1.02	1.02
Ti	0.90	0.91	0.91	0.90	0.90	0.87	0.87	0.89	0.90	0.91	0.88	0.89	0.91	0.91	0.91
Al	0.08	0.08	0.07	0.08	0.08	0.11	0.11	0.08	0.08	0.08	0.10	0.09	0.07	0.07	0.07
Fe	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.01	0.02	0.01	0.01
Ca	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.02	1.03	1.03	1.02	1.03	1.02
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.02	0.02	0.02	0.02	0.02	0.04	0.03	0.02	0.03	0.03	0.03	0.03	0.02	0.02	0.01
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.06	3.06	3.06	3.06	3.06	3.09	3.08	3.06	3.07	3.07	3.07	3.07	3.06	3.06	3.05

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Sample:	CB15-20														
Zone	MB	MB	MB	MB	MB	MB	LB	LB	LB	LB	LB	LB	LB	LB	LB
No.	382	383	384	385	386	387	295	296	297	298	299	300	301	302	303
Wt%															
SiO2	30.04	29.98	30.18	30.22	30.22	29.98	30.35	30.47	30.29	30.28	30.03	29.94	30.18	29.91	30.18
TiO2	35.58	35.46	35.32	35.86	35.05	35.33	34.16	34.24	34.27	34.04	34.74	34.84	34.38	34.68	34.50
Al2O3	1.96	1.96	1.85	1.84	2.04	2.04	2.57	2.58	2.64	2.67	2.13	2.27	2.39	2.39	2.42
FeO	0.51	0.50	0.49	0.49	0.53	0.50	0.63	0.53	0.64	0.75	0.53	0.53	0.55	0.56	0.56
CaO	28.03	28.15	28.20	28.24	28.11	28.32	27.78	27.88	27.89	27.81	27.95	27.69	27.83	27.80	27.77
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.01	0.04	0.00	0.00	0.00	0.06	0.04	0.01	0.00	0.03	0.00	0.04	0.00	0.01	0.00
F	0.20	0.22	0.24	0.15	0.15	0.21	0.23	0.30	0.25	0.33	0.16	0.23	0.31	0.27	0.25
La2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.00	0.00	0.06	0.04	0.00	0.00	0.00
Sm2O3	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.04	0.03	0.06
Eu2O3	0.02	0.01	0.04	0.02	0.01	0.00	0.03	0.00	0.05	0.00	0.00	0.03	0.06	0.00	0.00
Gd2O3	0.00	0.09	0.10	0.00	0.00	0.00	0.05	0.05	0.00	0.09	0.07	0.00	0.00	0.00	0.00
Dy2O3	0.00	0.00	0.01	0.02	0.00	0.02	0.00	0.07	0.05	0.05	0.00	0.07	0.04	0.07	0.06
ThO2	0.00	0.02	0.03	0.06	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.06
UO2	0.00	0.04	0.05	0.00	0.04	0.00	0.04	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Total	96.36	96.36	96.41	96.83	96.10	96.37	95.77	96.06	95.97	95.94	95.60	95.59	95.65	95.60	95.75
Cations Recalulated on the basis of 5O															
Si	1.02	1.02	1.02	1.02	1.02	1.02	1.03	1.02	1.03	1.03	1.03	1.03	1.02	1.02	1.03
Ti	0.90	0.90	0.91	0.90	0.90	0.91	0.90	0.91	0.87	0.87	0.88	0.87	0.89	0.89	0.88
Al	0.07	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.10	0.10	0.11	0.11	0.09	0.09	0.10
Fe	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Ca	1.04	1.03	1.02	1.02	1.02	1.02	1.01	1.01	1.01	1.01	1.01	1.01	1.02	1.01	1.02
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.02	0.03	0.02	0.02	0.03	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.02	0.02	0.03
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.07	3.07	3.06	3.06	3.06	3.05	3.05	3.05	3.07	3.07	3.07	3.08	3.06	3.06	3.07

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Sample:	CB15-20														
Zone	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
No.	304	325	326	327	328	329	330	331	332	333	334	345	346	347	348
Wt%															
SiO2	30.15	30.20	29.95	29.99	30.13	30.23	30.20	30.21	30.14	30.22	30.29	29.86	29.94	30.12	30.32
TiO2	34.42	34.26	34.01	34.12	33.99	33.88	34.12	34.06	34.24	34.25	34.34	34.58	34.63	34.41	34.14
Al2O3	2.45	2.64	2.61	2.68	2.65	2.72	2.69	2.67	2.57	2.46	2.42	2.38	2.52	2.66	2.68
FeO	0.50	0.58	0.58	0.58	0.60	0.64	0.64	0.61	0.64	0.53	0.58	0.50	0.53	0.56	0.65
CaO	27.91	27.83	27.92	27.74	28.08	27.81	27.90	27.94	27.84	27.94	28.16	28.13	28.09	28.12	28.24
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.08	0.00	0.00	0.01
F	0.22	0.25	0.30	0.30	0.32	0.26	0.30	0.25	0.30	0.25	0.31	0.24	0.28	0.31	0.31
La2O3	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.02	0.06	0.02	0.00	0.02	0.00	0.02	0.04	0.02	0.00	0.03	0.01	0.05	0.00	0.00
Sm2O3	0.01	0.04	0.03	0.02	0.01	0.04	0.04	0.00	0.00	0.02	0.04	0.00	0.00	0.01	0.00
Eu2O3	0.02	0.04	0.03	0.06	0.01	0.01	0.00	0.01	0.00	0.00	0.00	0.02	0.00	0.03	0.00
Gd2O3	0.05	0.02	0.02	0.10	0.13	0.03	0.01	0.06	0.04	0.09	0.07	0.01	0.00	0.00	0.08
Dy2O3	0.02	0.04	0.10	0.04	0.04	0.02	0.08	0.03	0.04	0.04	0.10	0.01	0.03	0.01	0.01
ThO2	0.03	0.06	0.03	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.04	0.00	0.00	0.07
UO2	0.00	0.00	0.00	0.05	0.00	0.08	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00
Total	95.70	95.92	95.49	95.56	95.83	95.60	95.86	95.76	95.74	95.77	96.21	95.74	95.96	96.10	96.36
Cations Recalulated on the basis of 5O															
Si	1.02	1.02	1.02	1.03	1.02	1.02	1.03	1.03	1.03	1.03	1.03	1.02	1.02	1.02	1.02
Ti	0.89	0.91	0.91	0.88	0.88	0.88	0.87	0.87	0.87	0.87	0.88	0.91	0.89	0.89	0.89
Al	0.10	0.07	0.07	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.08	0.09	0.10	0.10
Fe	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.02
Ca	1.02	1.02	1.02	1.01	1.02	1.02	1.03	1.02	1.02	1.02	1.02	1.02	1.03	1.03	1.02
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.03	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.07	3.06	3.05	3.07	3.08	3.08	3.08	3.07	3.08	3.07	3.08	3.06	3.07	3.07	3.08

Continued→

Sample:	CB15-20														
Zone	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
No.	349	350	351	352	353	354	355	356	357	358	372	373	374	375	376
Wt%															
SiO2	30.23	30.08	30.25	30.09	30.28	30.15	30.10	30.12	30.13	30.28	30.16	29.93	29.98	30.02	30.16
TiO2	34.08	34.28	34.07	34.19	34.26	34.07	34.28	34.36	33.91	34.12	34.32	34.27	34.54	34.53	35.00
Al2O3	2.69	2.62	2.69	2.69	2.74	2.68	2.52	2.61	2.71	2.70	2.33	2.38	2.46	2.40	2.33
FeO	0.65	0.62	0.57	0.61	0.64	0.60	0.48	0.58	0.57	0.65	0.63	0.59	0.59	0.65	0.49
CaO	28.14	28.08	28.32	28.19	28.41	28.29	28.35	28.45	28.11	28.23	27.98	28.38	28.13	28.22	28.43
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.01	0.03	0.05	0.00	0.03	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.07	0.02	0.00
F	0.32	0.31	0.34	0.31	0.35	0.31	0.32	0.32	0.34	0.32	0.30	0.21	0.23	0.25	0.26
La2O3	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.02	0.08	0.00	0.03	0.07	0.00	0.04	0.00	0.01	0.02	0.01	0.00	0.03	0.00	0.01
Sm2O3	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.02
Eu2O3	0.03	0.00	0.00	0.02	0.00	0.01	0.02	0.00	0.00	0.00	0.04	0.00	0.00	0.04	0.00
Gd2O3	0.03	0.00	0.05	0.03	0.04	0.03	0.06	0.12	0.00	0.06	0.00	0.00	0.00	0.00	0.02
Dy2O3	0.05	0.06	0.02	0.00	0.00	0.00	0.04	0.00	0.01	0.00	0.01	0.06	0.12	0.06	0.08
ThO2	0.06	0.02	0.07	0.00	0.02	0.00	0.01	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.01
UO2	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.04
Total	96.17	96.04	96.38	96.03	96.69	96.02	96.11	96.43	95.64	96.24	95.70	95.76	96.06	96.09	96.73
Cations Recalulated on the basis of 5O															
Si	1.02	1.03	1.03	1.02	1.03	1.02	1.02	1.02	1.02	1.02	1.01	1.02	1.03	1.02	1.02
Ti	0.88	0.87	0.87	0.88	0.87	0.87	0.87	0.87	0.88	0.88	0.90	0.90	0.88	0.88	0.88
Al	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.08	0.08	0.09	0.10	0.10
Fe	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.02	0.02	0.02
Ca	1.02	1.03	1.02	1.02	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.02	1.02	1.04	1.03
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F	0.03	0.03	0.03	0.03	0.04	0.03	0.04	0.03	0.03	0.03	0.02	0.03	0.03	0.02	0.02
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.08	3.08	3.08	3.08	3.09	3.08	3.09	3.08	3.08	3.08	3.06	3.06	3.08	3.07	3.07

Continued→

Sample:	CB15-20											
Zone	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB	LB
No.	388	389	390	391	392	393	394	395	396	397	398	399
Wt%												
SiO2	30.23	30.09	30.03	30.02	29.92	30.24	30.27	30.45	30.32	30.19	30.43	30.28
TiO2	34.77	34.51	34.98	35.16	34.93	34.98	34.88	35.47	35.20	34.36	34.42	34.35
Al2O3	2.45	2.43	2.46	2.46	2.44	2.41	2.27	2.29	2.36	2.22	2.45	2.46
FeO	0.57	0.59	0.60	0.58	0.55	0.56	0.51	0.58	0.53	0.55	0.57	0.58
CaO	28.16	28.04	28.31	28.15	28.19	28.11	28.25	28.04	28.18	28.15	28.12	28.27
SrO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ZrO2	0.00	0.07	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.02	0.03	0.00
F	0.22	0.22	0.30	0.21	0.22	0.27	0.26	0.20	0.23	0.31	0.26	0.24
La2O3	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00
Ce2O3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd2O3	0.10	0.09	0.00	0.02	0.00	0.11	0.07	0.00	0.02	0.05	0.00	0.00
Sm2O3	0.09	0.00	0.01	0.00	0.01	0.01	0.05	0.02	0.00	0.01	0.09	0.08
Eu2O3	0.05	0.00	0.02	0.02	0.00	0.00	0.02	0.00	0.00	0.02	0.00	0.00
Gd2O3	0.10	0.01	0.00	0.00	0.08	0.13	0.00	0.09	0.04	0.05	0.07	0.10
Dy2O3	0.05	0.07	0.03	0.00	0.05	0.01	0.00	0.01	0.01	0.00	0.07	0.00
ThO2	0.00	0.00	0.07	0.07	0.00	0.06	0.00	0.03	0.02	0.02	0.00	0.00
UO2	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Total	96.72	96.03	96.73	96.60	96.29	96.77	96.49	97.09	96.83	95.83	96.40	96.27
Cations Recalulated on the basis of 5O												
Si	1.03	1.02	1.02	1.02	1.02	1.01	1.01	1.02	1.02	1.02	1.02	1.03
Ti	0.89	0.90	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.90	0.89	0.88
Al	0.08	0.08	0.10	0.10	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09
Fe	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02
Ca	1.02	1.03	1.02	1.02	1.03	1.02	1.02	1.02	1.02	1.01	1.02	1.03
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Zr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.03
F	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.03	0.03	0	0	0
La	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ce	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Eu	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
U	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	3.06	3.06	3.07	3.07	3.08	3.07	3.07	3.07	3.07	3.06	3.06	3.08

Zr-in-Titanite Thermomoetry

Sample	P (GPa)	2σ	$aTiO_2$	2σ	$aSiO_2$	2σ	ppm Zr (ttn)	ppm Zr 2σ	T (^oC)	2σ
20_T2_HB3	1	0.1	0.75	0.25	1	0	230	36	773.45	41.15
20_T2_HB4	1	0.1	0.75	0.25	1	0	120	36	738.94	45.30
20_T2_HB5	1	0.1	0.75	0.25	1	0	177	36	759.28	42.01
20_T2_HB6	1	0.1	0.75	0.25	1	0	250	36	778.05	41.03
20_T2_HB7	1	0.1	0.75	0.25	1	0	250	36	778.05	41.03
20_T2_HB8	1	0.1	0.75	0.25	1	0	240	36	775.79	41.08
20_T2_HB9	1	0.1	0.75	0.25	1	0	230	36	773.45	41.15
20_T2_HB10	1	0.1	0.75	0.25	1	0	250	36	778.05	41.03
20_T2_MB2	1	0.1	0.75	0.25	1	0	140	36	746.91	43.64
20_T2_MB3	1	0.1	0.75	0.25	1	0	170	36	757.13	42.23
20_T2_MB4	1	0.1	0.75	0.25	1	0	180	36	760.18	41.93
20_T2_MB5	1	0.1	0.75	0.25	1	0	170	36	757.13	42.23
20_T2_MB6	1	0.1	0.75	0.25	1	0	100	36	729.67	48.01
20_T2_MB7	1	0.1	0.75	0.25	1	0	150	36	750.52	43.06
20_T2_MB8	1	0.1	0.75	0.25	1	0	90	36	724.39	50.02
20_T2_MB9	1	0.1	0.75	0.25	1	0	130	36	743.06	44.37
20_T2_MB10	1	0.1	0.75	0.25	1	0	110	36	734.49	46.48
20_T2_LB2	1	0.1	0.75	0.25	1	0	90	36	724.39	50.02
20_T2_LB3	1	0.1	0.75	0.25	1	0	80	36	718.55	52.71
20_T2_LB4	1	0.1	0.75	0.25	1	0	110	36	734.49	46.48
20_T2_LB5	1	0.1	0.75	0.25	1	0	150	36	750.52	43.06
20_T2_LB6	1	0.1	0.75	0.25	1	0	120	36	738.94	45.30
20_T2_LB7	1	0.1	0.75	0.25	1	0	110	36	734.49	46.48
20_T2_LB8	1	0.1	0.75	0.25	1	0	130	36	743.06	44.37
20_T2_LB9	1	0.1	0.75	0.25	1	0	110	36	734.49	46.48
20_T2_LB10	1	0.1	0.75	0.25	1	0	150	36	750.52	43.06
20_T2_LB11	1	0.1	0.75	0.25	1	0	100	36	729.67	48.01
20_T3_MB1	1	0.1	0.75	0.25	1	0	160	36	753.91	42.60
20_T3_MB2	1	0.1	0.75	0.25	1	0	150	36	750.52	43.06
20_T3_MB3	1	0.1	0.75	0.25	1	0	180	36	760.18	41.93
20_T3_MB4	1	0.1	0.75	0.25	1	0	160	36	753.91	42.60
20_T3_MB5	1	0.1	0.75	0.25	1	0	140	36	746.91	43.64
20_T3_MB6	1	0.1	0.75	0.25	1	0	150	36	750.52	43.06
20_T3_MB7	1	0.1	0.75	0.25	1	0	140	36	746.91	43.64
20_T3_MB8	1	0.1	0.75	0.25	1	0	110	36	734.49	46.48
20_T3_MB9	1	0.1	0.75	0.25	1	0	140	36	746.91	43.64
20_T3_MB10	1	0.1	0.75	0.25	1	0	150	36	750.52	43.06
20_T3_LB1	1	0.1	0.75	0.25	1	0	100	36	729.67	48.01
20_T3_LB2	1	0.1	0.75	0.25	1	0	130	36	743.06	44.37
20_T3_LB3	1	0.1	0.75	0.25	1	0	110	36	734.49	46.48
20_T3_LB4	1	0.1	0.75	0.25	1	0	140	36	746.91	43.64
20_T3_LB5	1	0.1	0.75	0.25	1	0	150	36	750.52	43.06
20_T3_LB6	1	0.1	0.75	0.25	1	0	120	36	738.94	45.30
20_T3_LB7	1	0.1	0.75	0.25	1	0	130	36	743.06	44.37
20_T3_LB8	1	0.1	0.75	0.25	1	0	110	36	734.49	46.48
20_T3_LB9	1	0.1	0.75	0.25	1	0	120	36	738.94	45.30
20_T3_LB10	1	0.1	0.75	0.25	1	0	160	36	753.91	42.60
20_T3_LB11	1	0.1	0.75	0.25	1	0	140	36	746.91	43.64
20_T3_LB12	1	0.1	0.75	0.25	1	0	130	36	743.06	44.37
20_T3_LB13	1	0.1	0.75	0.25	1	0	140	36	746.91	43.64
20_T3_LB14	1	0.1	0.75	0.25	1	0	170	36	757.13	42.23
20_T3_LB15	1	0.1	0.75	0.25	1	0	150	36	750.52	43.06
27_T4_LB1	1	0.1	0.75	0.25	1	0	210	36	768.49	41.35
27_T4_LB2	1	0.1	0.75	0.25	1	0	210	36	768.49	41.35
27_T4_LB3	1	0.1	0.75	0.25	1	0	220	36	771.02	41.24
27_T4_LB4	1	0.1	0.75	0.25	1	0	230	36	773.45	41.15
27_T4_LB5	1	0.1	0.75	0.25	1	0	220	36	771.02	41.24

Continued →

Sample	P (GPa)	2σ	aTiO$_2$	2σ	aSiO$_2$	2σ	ppm Zr (ttn)	ppm Zr 2σ	T (^{o}C)	2σ
27_T4_LB6	1	0.1	0.75	0.25	1	0	150	36	750.52	43.06
27_T4_LB7	1	0.1	0.75	0.25	1	0	190	36	763.08	41.69
27_T4_LB8	1	0.1	0.75	0.25	1	0	140	36	746.91	43.64
27_T4_LB9	1	0.1	0.75	0.25	1	0	140	36	746.91	43.64
27_T4_HB1	1	0.1	0.75	0.25	1	0	170	36	757.13	42.23
27_T4_HB2	1	0.1	0.75	0.25	1	0	200	36	765.84	41.50
27_T4_HB3	1	0.1	0.75	0.25	1	0	200	36	765.84	41.50
27_T4_MB1	1	0.1	0.75	0.25	1	0	200	36	765.84	41.50
27_T4_MB2	1	0.1	0.75	0.25	1	0	190	36	763.08	41.69
27_T4_MB3	1	0.1	0.75	0.25	1	0	200	36	765.84	41.50
27_T4_MB4	1	0.1	0.75	0.25	1	0	160	36	753.91	42.60
27_T4_MB5	1	0.1	0.75	0.25	1	0	190	36	763.08	41.69
27_T4_MB6	1	0.1	0.75	0.25	1	0	180	36	760.18	41.93
27_T4_MB7	1	0.1	0.75	0.25	1	0	140	36	746.91	43.64
27_T4_MB8	1	0.1	0.75	0.25	1	0	230	36	773.45	41.15
27_T4_MB9	1	0.1	0.75	0.25	1	0	180	36	760.18	41.93
27_T4_MB10	1	0.1	0.75	0.25	1	0	220	36	771.02	41.24
27_T2_HB1	1	0.1	0.75	0.25	1	0	210	36	768.49	41.35
27_T2_HB2	1	0.1	0.75	0.25	1	0	200	36	765.84	41.50
27_T2_HB3	1	0.1	0.75	0.25	1	0	160	36	753.91	42.60
27_T2_HB4	1	0.1	0.75	0.25	1	0	190	36	763.08	41.69
27_T2_HB5	1	0.1	0.75	0.25	1	0	150	36	750.52	43.06
27_T2_HB6	1	0.1	0.75	0.25	1	0	180	36	760.18	41.93
27_T2_HB7	1	0.1	0.75	0.25	1	0	170	36	757.13	42.23
27_T2_HB8	1	0.1	0.75	0.25	1	0	170	36	757.13	42.23
27_T2_HB9	1	0.1	0.75	0.25	1	0	140	36	746.91	43.64
27_T2_HB10	1	0.1	0.75	0.25	1	0	170	36	757.13	42.23
27_T2_MB1	1	0.1	0.75	0.25	1	0	120	36	738.94	45.30
27_T2_MB2	1	0.1	0.75	0.25	1	0	180	36	760.18	41.93
27_T2_MB3	1	0.1	0.75	0.25	1	0	140	36	746.91	43.64
27_T2_MB4	1	0.1	0.75	0.25	1	0	170	36	757.13	42.23
27_T2_MB5	1	0.1	0.75	0.25	1	0	160	36	753.91	42.60
27_T2_MB6	1	0.1	0.75	0.25	1	0	140	36	746.91	43.64
27_T2_MB7	1	0.1	0.75	0.25	1	0	150	36	750.52	43.06
27_T2_MB8	1	0.1	0.75	0.25	1	0	170	36	757.13	42.23
27_T2_MB9	1	0.1	0.75	0.25	1	0	160	36	753.91	42.60
27_T2_MB10	1	0.1	0.75	0.25	1	0	150	36	750.52	43.06
27_T2_LB1	1	0.1	0.75	0.25	1	0	190	36	763.08	41.69
27_T2_LB2	1	0.1	0.75	0.25	1	0	170	36	757.13	42.23
27_T2_LB3	1	0.1	0.75	0.25	1	0	160	36	753.91	42.60
27_T2_LB4	1	0.1	0.75	0.25	1	0	170	36	757.13	42.23
27_T2_LB5	1	0.1	0.75	0.25	1	0	170	36	757.13	42.23
27_T2_LB6	1	0.1	0.75	0.25	1	0	150	36	750.52	43.06
27_T2_LB7	1	0.1	0.75	0.25	1	0	180	36	760.18	41.93
27_T2_LB8	1	0.1	0.75	0.25	1	0	200	36	765.84	41.50
27_T2_LB9	1	0.1	0.75	0.25	1	0	170	36	757.13	42.23
27_T2_LB10	1	0.1	0.75	0.25	1	0	170	36	757.13	42.23

Hornblende-Plagioclase Thermometry

Mineral	No.	Mineral	No.	P(Gpa)	T(°C)
Hbl	362	Plg	314	1.0	776
SiO2	39.93	XAb	0.604		
TiO2	1.56	X An	0.381		
Al2O3	12.40				
FeO*	15.95				
MgO	9.87				
MnO	0.27				
CaO	11.99				
Na2O	1.65				
K2O	1.76				
F	0.10				
Cl	0.04				
Total	95.52				

2-Feldspar Geothermometry

Sample	Alkali Feldspar Composition - in Weight Percent								Plagioclase Compositions - in Weight Percent								Eqn 27a	Eqn 27b	Eqn 27a	Eqn 27b
CB15-27 Ex1	SiO2	Al2O3	FeOt	MgO	CaO	Na2O	K2O	total	SiO2	Al2O3	FeOt	MgO	CaO	Na2O	K2O	total	at 0.5 Gpa T(C)	at 0.5 Gpa T(C)	at 1.0 Gpa T(C)	at 1.0 Gpa T(C)
	64.43	18.55	0.01	0.00	0.01	0.67	15.31	98.98	61.10	24.31	0.07	0.01	6.14	8.28	0.22	100.11	481.8975363	453.5558496	483.0334667	455.4564802
	64.65	18.42	0.02	0.01	0.04	0.69	15.15	98.98	61.86	23.51	0.11	0.00	5.17	8.78	0.29	99.72	550.6	507.5	552.1	509.6
	64.50	18.26	0.01	0.00	0.02	0.88	14.92	98.59	62.69	22.98	0.11	0.01	4.56	9.12	0.18	99.65	520.9	483.6	522.2	485.7
	64.69	18.18	-0.01	0.00	0.02	0.77	15.01	98.66	62.66	23.03	0.10	0.01	4.65	9.09	0.17	99.70	499.0	465.8	500.2	467.8
	64.90	18.29	0.01	0.00	0.02	0.84	15.01	99.07	61.39	23.79	0.13	0.01	5.90	8.35	0.31	99.89	536.3	496.5	537.8	498.5
	64.19	18.29	0.03	0.00	0.07	0.79	15.04	98.42	62.16	23.20	0.12	0.00	5.08	8.70	0.33	99.59	604.3	550.4	606.1	552.7
	64.64	18.29	0.06	0.00	0.01	0.71	15.28	98.99	61.88	23.49	0.07	0.01	5.21	8.80	0.15	99.62	487.2	457.4	488.3	459.3
	64.90	18.21	0.00	0.00	0.02	0.69	14.95	98.77	62.91	22.74	0.07	0.00	4.42	9.18	0.21	99.52	508.3	472.4	509.6	474.4
	64.16	18.27	0.00	0.00	0.06	0.73	15.06	98.27	62.76	23.18	0.09	0.01	4.68	9.06	0.19	99.96	575.4	527.2	577.1	529.4
	65.17	18.43	0.02	0.00	0.01	0.62	15.29	99.53	60.18	24.71	0.10	0.00	6.82	7.88	0.16	99.84	443.9	422.0	444.8	423.7

Sample	Alkali Feldspar Composition - in Weight Percent								Plagioclase Compositions - in Weight Percent								Eqn 27a	Eqn 27b	Eqn 27a	Eqn 27b
CB15-27 Ex2	SiO2	Al2O3	FeOt	MgO	CaO	Na2O	K2O	total	SiO2	Al2O3	FeOt	MgO	CaO	Na2O	K2O	total	at 0.5 Gpa T(C)	at 0.5 Gpa T(C)	at 1.0 Gpa T(C)	at 1.0 Gpa T(C)
	64.35	18.08	0.04	0.00	0.03	0.39	15.54	98.44	61.86	23.01	0.19	0.00	5.16	8.48	0.44	99.15	504.9	471.4	506.2	473.4
	64.20	18.14	0.03	0.00	0.03	0.37	15.43	98.19	63.02	22.22	0.12	0.00	4.27	8.96	0.54	99.12	479.5	449.9	480.7	451.8
	64.40	18.14	0.04	0.00	0.03	0.29	15.73	98.62	62.67	22.58	0.13	0.00	4.45	8.90	0.46	99.18	465.8	439.3	466.8	441.1
	64.38	18.12	0.04	0.00	0.04	0.32	15.92	98.82	62.15	23.15	0.09	0.01	4.97	8.69	0.43	99.48	496.3	465.4	497.5	467.3
	64.30	18.23	0.03	0.00	0.03	0.31	15.81	98.72	61.43	23.38	0.10	0.00	5.34	8.48	0.45	99.17	484.1	455.2	485.2	457.1
	64.12	18.20	0.03	0.00	0.03	0.33	15.75	98.47	61.70	23.27	0.10	0.00	5.13	8.49	0.40	99.09	477.2	449.5	478.4	451.4
	64.35	18.18	0.03	0.00	0.02	0.34	15.72	98.64	60.53	24.01	0.12	0.01	6.18	8.00	0.38	99.22	478.9	451.1	480.0	453.0
	64.53	18.12	0.01	0.00	0.05	0.39	15.68	98.78	61.22	23.53	0.09	0.00	5.53	8.33	0.45	99.14	530.2	492.4	531.6	494.4
	64.39	18.09	0.02	0.01	0.06	0.28	15.53	98.37	62.43	22.92	0.10	0.00	4.68	8.87	0.42	99.41	514.3	478.5	515.6	480.5
	63.98	18.15	0.01	0.00	0.04	0.27	15.58	98.02	62.96	22.57	0.10	0.00	4.64	8.93	0.41	99.62	482.1	452.6	483.3	454.5

Sample	Alkali Feldspar Composition - in Weight Percent								Plagioclase Compositions - in Weight Percent								Eqn 27a	Eqn 27b	Eqn 27a	Eqn 27b
CB15-40 Ex1	SiO2	Al2O3	FeOt	MgO	CaO	Na2O	K2O	total	SiO2	Al2O3	FeOt	MgO	CaO	Na2O	K2O	total	at 0.5 Gpa T(C)	at 0.5 Gpa T(C)	at 1.0 Gpa T(C)	at 1.0 Gpa T(C)
	65.13	18.18	0.04	0.01	0.06	0.82	15.35	99.59	60.44	25.10	0.11	0.00	7.07	7.90	0.24	100.87	617.4	562.1	619.3	564.5
	64.64	18.53	0.03	0.01	0.06	0.74	14.84	98.83	60.94	24.72	0.14	0.01	6.38	8.17	0.25	100.60	604.5	549.2	606.3	551.5
	65.68	18.34	0.03	0.00	0.05	0.83	15.20	100.14	60.55	25.03	0.11	0.00	6.85	7.79	0.36	100.69	607.9	553.0	609.7	555.3
	65.27	18.56	0.05	0.00	0.06	0.88	15.04	99.86	60.29	25.19	0.11	0.00	7.10	7.68	0.32	100.68	630.4	570.6	632.3	573.0
	64.22	18.08	0.04	0.01	0.07	0.49	15.17	98.08	60.30	24.94	0.11	0.00	6.89	7.78	0.29	100.30	588.3	537.9	590.0	540.2
	64.31	18.28	0.05	0.01	0.09	0.57	15.38	98.69	59.62	25.49	0.10	0.00	7.55	7.56	0.22	100.54	624.4	568.1	626.3	570.5
	64.24	18.31	0.01	0.00	0.04	0.36	15.76	98.72	61.33	24.54	0.14	0.00	6.33	8.07	0.36	100.76	520.3	485.2	521.7	487.2
	65.25	18.42	0.01	0.01	0.03	0.75	15.23	99.71	60.78	24.54	0.12	0.00	6.56	7.94	0.40	100.34	557.1	513.3	558.6	515.5
	64.74	18.39	0.01	0.01	0.04	0.79	14.98	98.95	59.47	25.54	0.11	0.00	7.71	7.42	0.38	100.62	596.0	543.8	597.8	546.1
	65.29	18.64	0.04	0.01	0.06	0.80	15.32	100.16	60.31	25.25	0.12	0.00	7.16	7.76	0.26	100.86	617.9	562.0	619.7	564.4
	65.04	18.46	0.04	0.00	0.04	0.91	15.06	99.56	60.60	24.90	0.09	0.00	6.80	7.78	0.31	100.48	600.2	547.6	602.0	549.9
	65.11	18.54	0.02	0.00	0.03	0.64	15.49	99.83	60.25	24.88	0.10	0.00	6.84	7.69	0.29	100.06	548.9	507.6	550.3	509.7

Sample	Alkali Feldspar Composition - in Weight Percent								Plagioclase Compositions - in Weight Percent								Eqn 27a	Eqn 27b	Eqn 27a	Eqn 27b
CB15-40 Ex2	SiO2	Al2O3	FeOt	MgO	CaO	Na2O	K2O	total	SiO2	Al2O3	FeOt	MgO	CaO	Na2O	K2O	total	at 0.5 Gpa T(C)	at 0.5 Gpa T(C)	at 1.0 Gpa T(C)	at 1.0 Gpa T(C)
	65.05	18.45	0.05	0.00	0.02	0.99	14.81	99.38	60.15	25.43	0.05	0.00	7.37	7.78	0.21	100.98	569.6	523.3	571.2	525.5
	64.52	18.52	0.04	0.01	0.03	0.99	14.54	98.65	59.89	25.36	0.07	0.00	7.01	7.81	0.17	100.30	584.0	533.9	585.7	536.2
	64.73	18.46	0.09	0.00	0.02	0.84	14.94	99.09	60.50	25.06	0.06	0.00	6.78	8.03	0.22	100.64	549.2	507.2	550.7	509.4
	63.27	18.31	0.04	0.00	0.12	0.69	15.01	97.44	60.39	24.62	0.12	0.00	6.56	7.95	0.27	99.91	649.1	587.5	651.2	590.0
	65.00	18.48	0.03	0.00	0.02	1.12	15.04	99.70	61.06	24.57	0.12	0.01	6.12	8.17	0.27	100.32	556.3	514.1	557.9	516.2
	65.18	18.37	0.05	0.00	0.03	0.87	15.18	99.68	60.57	24.72	0.09	0.00	6.63	8.03	0.19	100.23	568.3	522.8	569.9	525.0
	64.64	18.41	0.06	0.00	0.02	0.78	15.12	99.03	60.36	24.88	0.14	0.00	6.78	7.89	0.32	100.37	524.1	487.7	525.5	489.7
	64.63	18.43	0.05	0.00	0.04	0.78	14.92	98.85	60.99	24.53	0.09	0.00	6.22	8.18	0.31	100.31	578.3	529.3	579.9	531.5

Appendix D: Geochronology

U-Pb geochronology results are presented in the figure below for CKHB (Fig. AD1a, b), Hondo Canyon (Fig. AD1c, d), and Bear Lake (aka Troy Hill; Fig. AD1e, f). U-Pb and Sm-Nd ata for these standards are presented in the tables below. Accepted U-Pb ages and $^{143}Nd/^{144}Nd$ ratios for each standard is as follows: CKHB - 94±2 Ma, 0.512668 ± 7 (2SD) (Fischer, pers. comm., 2017); Hondo Canyon - 34±5 Ma, 0.512211±9 (2SD) (Fischer *et al.*, 2011); Bear Lake – will be the subject of an upcoming paper (Fischer *et al.* in prep.), *ca.* 1050 Ma (Fischer, pers. comm, 2017)

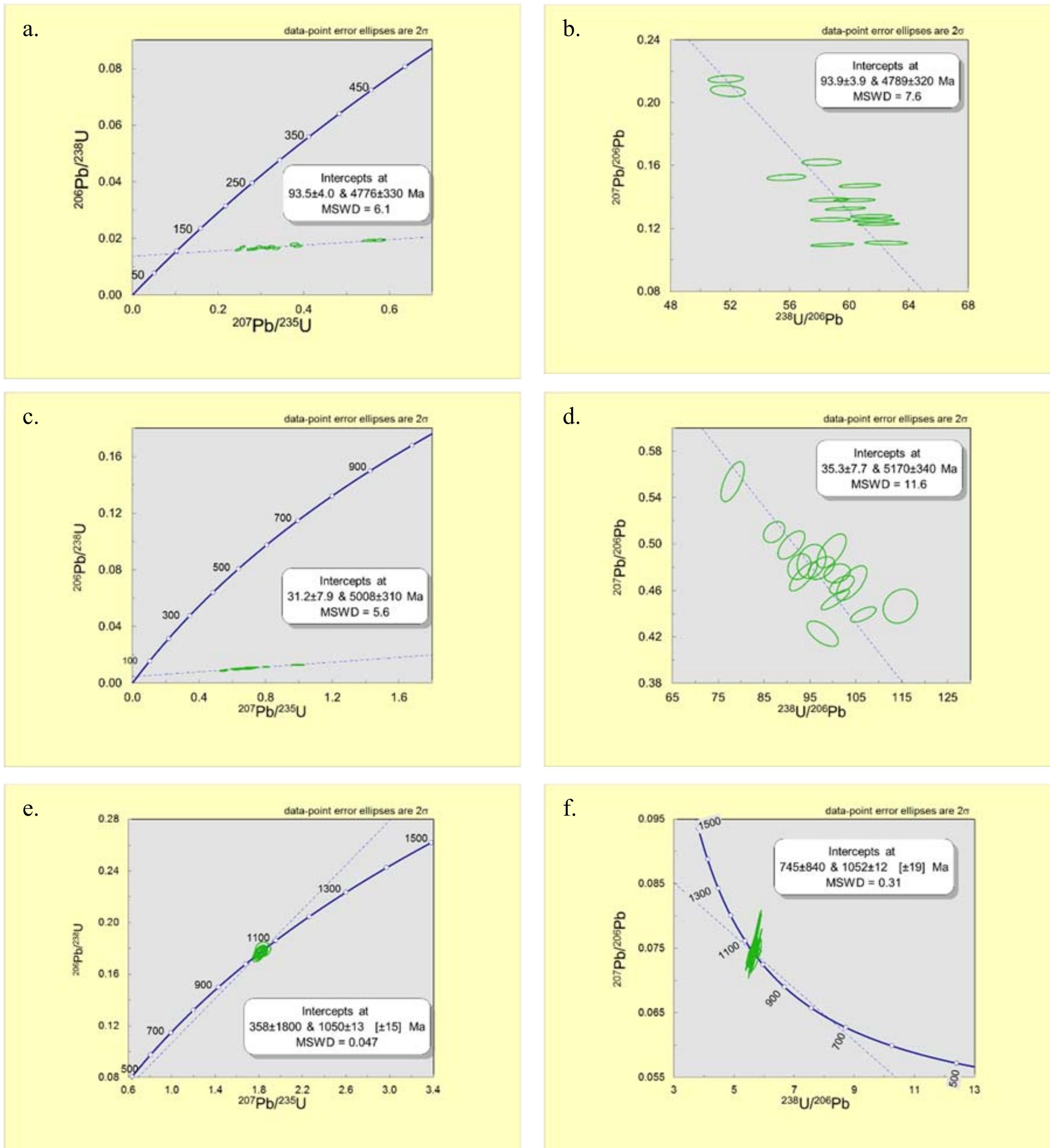

Figure AD1: Wetherill (left) and Terra-Wasserberg (right) plots of U-Pb ages for titanite standards. Accepted ages are reported in the text. a, b) CKHB – lower intercept ages of 93.5±4.0 Ma and 93.9±3.9 Ma. c, d) Hondo Canyon – lower intercept ages of 31.2±7.9 Ma and 35.3±7.7 Ma. e, f) Bear Lake – concordant ages of 1050±13 Ma and 1052±12 Ma.

Titanite Standards U-Pb Data

Grain/Analysis Number	$^{207}Pb/^{235}U$	±2σ %	$^{206}Pb/^{238}U$	±2σ%	Error Correlation	$^{206}Pb/^{238}U$	±2σ %	$^{207}Pb/^{206}Pb$	±2σ%	Error Correlation	$^{206}Pb/^{238}U$ Age (Ma)	±2σ	$^{207}Pb/^{235}U$ Age (Ma)	±2σ	$^{207}Pb/^{206}Pb$ Age (Ma)	±2σ
CKHB - 1	0.3239	0.0063	0.017051	0.00032	0.3195	58.64759	1.100653	0.13835	0.00098	0.34492	109.0	2.0	284.9	4.8	2206.7	4.3
CKHB - 2	0.3057	0.0058	0.016738	0.00031	0.25396	59.74429	1.106508	0.13273	0.00082	0.47933	107.0	1.9	270.7	4.5	2134.4	2.5
CKHB - 3	0.5532	0.013	0.01929	0.00036	0.52347	51.84033	0.967471	0.2074	0.0028	-0.25207	123.2	2.3	445.1	8.8	2885.3	-
CKHB - 4	0.2737	0.0052	0.016136	0.0003	0.54884	61.97323	1.152204	0.12287	0.00071	0.40296	103.2	1.9	245.6	4.2	1998.3	2.6
CKHB - 5	0.2867	0.0055	0.016265	0.0003	0.47368	61.48171	1.134	0.12789	0.00077	0.22005	104.0	1.9	255.8	4.4	2069.2	5.6
CKHB - 6	0.3167	0.0061	0.016565	0.00031	0.39777	60.36825	1.129741	0.1381	0.00089	0.22812	105.9	2.0	279.2	4.7	2203.5	6.3
CKHB - 7	0.2571	0.0051	0.01699	0.00034	0.6743	58.85815	1.177856	0.1096	0.00077	0.44558	108.6	2.1	232.4	4.2	1792.8	2.6
CKHB - 8	0.2816	0.0053	0.016222	0.0003	0.38216	61.64468	1.14002	0.12523	0.00074	0.47921	103.7	1.9	251.8	4.2	2032.1	2.3
CKHB - 9	0.3357	0.0065	0.016471	0.00031	0.30105	60.71277	1.142672	0.147	0.001	0.37904	105.3	1.9	293.7	4.9	2311.3	4.0
CKHB - 1_1	0.3783	0.0079	0.01793	0.00034	0.28575	55.77245	1.057592	0.1523	0.0016	0.28475	114.6	2.1	325.2	5.8	2371.9	8.8
CKHB - 2_1	0.3858	0.0082	0.0172	0.00032	0.41735	58.13953	1.081666	0.1619	0.0016	0.055035	109.9	2.0	330.7	6.0	2475.6	65.0
CKHB - 3_1	0.2465	0.0053	0.016007	0.0003	0.57352	62.47267	1.17085	0.1109	0.001	-0.16701	102.4	1.9	223.4	4.3	1814.2	-
CKHB - 4_1	0.2952	0.0058	0.01702	0.00032	0.20857	58.75441	1.104666	0.12567	0.00087	0.10275	108.8	2.0	262.5	4.5	2038.3	15.6
CKHB - 5_1	0.5764	0.012	0.01934	0.00036	0.36728	51.70631	0.962475	0.215	0.0019	0.22903	123.5	2.3	461.3	7.5	2943.6	13.3
Hondo Canyon - 1	0.6925	0.022	0.010024	0.00026	0.35223	99.76057	2.587565	0.4938	0.012	0.62164	64.3	1.7	533.6	13.0	4222.8	28.0
Hondo Canyon - 2	0.7126	0.023	0.01049	0.00028	0.67327	95.32888	2.544527	0.4848	0.012	0.20873	67.3	1.8	544.9	14.0	4195.6	93.3
Hondo Canyon - 3	0.6268	0.02	0.009607	0.00025	0.26826	104.0908	2.708722	0.4662	0.012	0.64975	61.6	1.6	493.7	12.0	4137.7	26.7
Hondo Canyon - 4	0.9928	0.032	0.0128	0.00034	0.12407	78.125	2.075195	0.5538	0.014	0.63485	82.0	2.1	699.1	16.0	4391.2	31.9
Hondo Canyon - 5	0.5443	0.017	0.008721	0.00023	0.099997	114.6657	3.024094	0.4467	0.012	0.18146	56.0	1.5	440.6	11.0	4074.3	109.5
Hondo Canyon - 1	0.732	0.018	0.011	0.00029	0.59896	90.90909	2.396694	0.499	0.01	0.60782	70.5	1.9	556.7	10.0	4238.3	23.9
Hondo Canyon - 2	0.646	0.018	0.00991	0.00023	0.68469	100.9082	2.341966	0.4744	0.0067	0.20661	63.6	1.5	504.0	11.0	4163.6	52.7
Hondo Canyon - 3	0.6879	0.016	0.01069	0.00028	0.10082	93.54537	2.450206	0.472	0.01	0.7704	68.6	1.8	531.2	10.0	4156.1	18.5
Hondo Canyon - 4	0.6097	0.013	0.00995	0.00025	0.038885	100.5025	2.525189	0.4523	0.0071	0.84687	63.8	1.6	482.8	8.4	4092.8	11.9
Hondo Canyon - 5	0.5605	0.012	0.00938	0.0002	0.44793	106.6098	2.27313	0.4394	0.0054	0.65972	60.2	1.3	451.8	8.1	4049.7	11.8
Hondo Canyon - 6	0.6232	0.014	0.00981	0.00021	0.15453	101.9368	2.182133	0.465	0.0062	0.55993	63.0	1.3	491.0	8.4	4133.9	16.2
Hondo Canyon - 7	0.678	0.018	0.01026	0.00025	0.52632	97.46589	2.3749	0.479	0.0081	0.45477	65.8	1.6	525.3	11.0	4177.8	26.5
Hondo Canyon - 8	0.802	0.018	0.01147	0.00025	0.16386	87.18396	1.900261	0.5103	0.0074	0.3181	73.5	1.6	596.8	10.0	4271.2	35.8
Hondo Canyon - 9	0.625	0.028	0.01023	0.00029	0.88978	97.75171	2.771065	0.4228	0.009	-0.60782	65.6	1.9	481.0	17.0	3992.2	-
Hondo Canyon - 10	0.716	0.021	0.01079	0.00024	0.04966	92.67841	2.061429	0.4802	0.0091	0.2136	69.2	1.5	541.7	9.0	4181.5	68.9
BearLake - 1	1.791	0.034	0.17593	0.0032	0.43469	5.684079	0.103388	0.07419	0.00039	0.35689	1044.5	18.0	1041.3	12.0	1046.6	1.7
BearLake - 2	1.8147	0.034	0.17794	0.0033	0.2199	5.619872	0.104224	0.07442	0.00043	0.60799	1055.5	18.0	1050.3	12.0	1052.9	1.0
BearLake - 3	1.817	0.035	0.17698	0.0033	0.34536	5.650356	0.105358	0.07429	0.00045	0.42919	1050.2	18.0	1050.9	12.0	1049.4	1.6
BearLake - 4	1.795	0.035	0.1747	0.0033	0.13672	5.724098	0.108126	0.07439	0.00056	0.95886	1037.4	18.0	1042.2	13.0	1052.1	0.8
BearLake - 5	1.8374	0.035	0.17833	0.0033	0.089762	5.607581	0.103768	0.0746	0.00059	0.971	1057.6	18.0	1058.4	12.0	1057.7	0.9
BearLake - 6	1.8355	0.034	0.17815	0.0033	0.099961	5.613247	0.103978	0.07431	0.00046	0.68568	1056.6	18.0	1057.5	12.0	1049.9	1.0
BearLake - 1_1	1.781	0.034	0.17344	0.0032	0.31242	5.765683	0.106378	0.07423	0.00049	0.65189	1030.7	18.0	1037.8	12.0	1047.7	1.1
BearLake - 2_1	1.821	0.034	0.17751	0.0033	0.18053	5.633485	0.104729	0.07423	0.00047	0.90637	1053.1	18.0	1052.1	12.0	1047.7	0.7
BearLake - 3_1	1.82	0.035	0.177	0.0033	0.13199	5.649718	0.105334	0.07441	0.00057	0.83626	1050.9	18.0	1051.9	13.0	1052.6	1.0
BearLake - 4_1	1.827	0.035	0.1781	0.0034	0.2067	5.614823	0.107189	0.07425	0.00051	0.97565	1056.3	18.0	1054.0	13.0	1048.3	0.7
BearLake - 5_1	1.799	0.034	0.1758	0.0033	0.022025	5.688282	0.106777	0.07442	0.00058	0.94417	1043.8	18.0	1044.3	13.0	1052.9	0.9
BearLake - 6_1	1.813	0.035	0.17696	0.0033	0.091491	5.650995	0.105381	0.07426	0.00052	0.87197	1050.1	18.0	1049.0	13.0	1048.5	0.8
BearLake - 7	1.814	0.035	0.1774	0.0034	0.1638	5.636979	0.108037	0.07458	0.00066	0.9735	1052.2	18.0	1049.3	13.0	1057.2	1.0
BearLake - 9	1.815	0.035	0.1771	0.0033	0.20065	5.646527	0.105215	0.07423	0.00052	0.74148	1050.9	18.0	1049.5	13.0	1047.7	1.0
BearLake - 10	1.807	0.034	0.17675	0.0033	0.30003	5.657709	0.105632	0.07429	0.00048	0.6165	1048.9	18.0	1047.7	13.0	1049.4	1.1
BearLake - 9	1.775	0.059	0.17457	0.0045	-0.021782	5.728361	0.147664	0.07405	0.002	0.75705	1037.1	24.0	1032.6	22.0	1042.8	3.8
BearLake - 11	1.824	0.057	0.17865	0.0046	-0.37506	5.597537	0.144129	0.07446	0.0019	0.98604	1059.4	25.0	1053.1	20.0	1054.0	2.7
BearLake - 12	1.8269	0.057	0.1784	0.0045	-0.39664	5.605381	0.141391	0.07449	0.0019	0.95952	1058.1	25.0	1054.7	20.0	1054.8	2.8
BearLake - 13	1.7885	0.056	0.1751	0.0045	-0.09517	5.711022	0.146771	0.07428	0.0018	0.97648	1040.0	24.0	1041.1	20.0	1049.1	2.6
BearLake - 14	1.8378	0.057	0.1793	0.0046	0.070082	5.577245	0.143086	0.07429	0.0018	0.86216	1063.3	25.0	1059.1	20.0	1049.4	3.0
BearLake - 15	1.787	0.056	0.1745	0.0045	-0.56375	5.730659	0.147782	0.0771	0.0027	0.99279	1035.6	26.0	1040.3	21.0	1123.8	3.8
BearLake - 16	1.8046	0.056	0.17607	0.0045	-0.11633	5.679559	0.145158	0.07411	0.0018	0.90055	1045.3	25.0	1046.9	20.0	1044.5	2.8
BearLake - 17	1.789	0.056	0.1749	0.0046	-0.62227	5.717553	0.150376	0.0771	0.0031	0.99464	1038.5	25.0	1040.5	20.0	1123.8	4.4

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Grain/Analysis Number	207Pb/235U	±2σ %	206Pb/238U	±2σ%	Error Correlation	206Pb/238U	±2σ %	207Pb/206Pb	±2σ%	Error Correlation	206Pb/238U Age (Ma)	±2σ	207Pb/235U Age (Ma)	±2σ	207Pb/206Pb Age (Ma)	±2σ
BearLake - 18	1.82	0.057	0.17779	0.0046	-0.53632	5.624613	0.145527	0.0755	0.0024	0.99122	1054.6	25.0	1051.8	20.0	1081.8	3.4
BearLake - 19	1.819	0.057	0.1765	0.0045	-0.44676	5.665722	0.144452	0.0737	0.002	0.98748	1047.8	25.0	1051.8	21.0	1033.3	2.8
BearLake - 20	1.8606	0.058	0.18009	0.0046	-0.43078	5.552779	0.141833	0.07406	0.002	0.99018	1067.3	25.0	1066.5	20.0	1043.1	2.8
BearLake - 21	1.775	0.056	0.1742	0.0045	-0.60701	5.740528	0.148292	0.0746	0.0028	0.99527	1034.7	25.0	1035.8	20.0	1057.7	4.0
BearLake - 22	1.79	0.057	0.1756	0.0046	-0.68537	5.694761	0.149179	0.0755	0.0033	0.99586	1042.1	26.0	1040.3	20.0	1081.8	4.7
BearLake - 23	1.816	0.057	0.176	0.0046	-0.74963	5.681818	0.148502	0.0758	0.0037	0.99561	1044.4	26.0	1050.0	20.0	1089.8	5.2
BearLake - 24	1.824	0.057	0.1768	0.0046	-0.75851	5.656109	0.147161	0.0748	0.0036	0.99763	1048.9	26.0	1053.6	21.0	1063.1	5.1
BearLake - 1	1.8092	0.036	0.17668	0.0032	0.52477	5.65995	0.102512	0.0743	0.00033	0.30764	1048.7	17.0	1048.1	13.0	1049.6	1.7
BearLake - 2	1.817	0.037	0.17723	0.0032	0.11958	5.642386	0.101877	0.07439	0.00043	0.57438	1051.6	18.0	1050.9	13.0	1052.1	1.1
BearLake - 3	1.804	0.039	0.1762	0.0033	0.2645	5.675369	0.106292	0.07427	0.00059	0.29046	1045.7	17.0	1045.9	14.0	1048.8	3.2
BearLake - 4	1.823	0.038	0.1779	0.0033	0.56178	5.621135	0.104271	0.07448	0.00048	0.33874	1055.4	18.0	1052.5	14.0	1054.5	2.2
BearLake - 5	1.8101	0.036	0.17687	0.0031	0.37498	5.65387	0.099095	0.07419	0.00028	0.48523	1049.8	17.0	1048.9	13.0	1046.6	0.9
BearLake - 6	1.8153	0.036	0.17685	0.0031	0.24289	5.654509	0.099118	0.07443	0.00029	0.34505	1049.6	17.0	1050.8	13.0	1053.2	1.3
BearLake - 7	1.8091	0.037	0.17653	0.0032	0.32724	5.66476	0.102686	0.07432	0.00041	0.47334	1047.8	17.0	1048.0	13.0	1050.2	1.3
BearLake - 8	1.82	0.037	0.17761	0.0032	0.34437	5.630314	0.101441	0.07406	0.00047	0.3945	1053.7	18.0	1052.0	13.0	1043.1	1.8
BearLake - 9	1.8015	0.036	0.17606	0.0032	0.16084	5.679882	0.103235	0.07435	0.0004	0.54565	1045.2	17.0	1046.0	13.0	1051.0	1.1
BearLake - 10	1.828	0.037	0.17823	0.0033	0.27634	5.610728	0.103885	0.07438	0.00043	0.49572	1057.0	18.0	1054.6	13.0	1051.8	1.3
BearLake - 11	1.8169	0.036	0.17736	0.0032	0.20119	5.63825	0.101728	0.0743	0.00037	0.57456	1052.4	17.0	1051.1	13.0	1049.6	0.9
BearLake - 12	1.8097	0.036	0.17648	0.0032	0.22801	5.666364	0.102745	0.07437	0.00034	0.60396	1047.6	17.0	1048.5	13.0	1051.5	0.8

Titanite Standards Sm-Nd

Grain/Analysis Number	Duration(s)	TotalNdBeam	$^{147}Sm/^{144}Nd$	±2σ	$^{143}Nd/^{144}Nd$	±2σ	$^{145}Nd/^{144}Nd$	±2σ	$^{148}Nd/^{144}Nd$	±2σ	$^{150}Nd/^{144}Nd$	±2σ	Age (Ma)	$^{143}Nd/^{144}Nd$	$\varepsilon Nd_{(initial)}$	$\varepsilon Nd_{(present)}$	±2σ
CKHB - 1	66.149	5.28	0.11244	0.00055	0.51271	0.00004	0.3484	0.000022	0.241599	0.000045	0.23649	0.00005	400	0.5124155	5.836154	1.5605798	0.78125
CKHB - 2	66.11	7.06	0.1197	0.0011	0.512691	0.000049	0.34843	0.000022	0.241617	0.00004	0.236499	0.000036	400	0.5123775	5.093803	1.1899421	0.957031
CKHB - 3	66.109	4.5	0.11828	0.00026	0.512711	0.000056	0.348429	0.000036	0.241581	0.00004	0.236474	0.000049	400	0.5124012	5.5569707	1.580087	1.09375
CKHB - 4	66.12	4.35	0.12347	0.00065	0.512694	0.000049	0.348388	0.000031	0.241572	0.000052	0.236424	0.00007	400	0.5123706	4.9595518	1.2484638	0.957031
CKHB - 5	66.12	2.9	0.12234	0.00029	0.512643	0.000068	0.348412	0.000028	0.241639	0.000061	0.236517	0.000057	400	0.5123225	4.0214831	0.2535942	1.328125
CKHB - 6	66.107	6.17	0.11457	0.00043	0.512656	0.000042	0.348429	0.000022	0.24161	0.000047	0.236511	0.000045	400	0.5123559	4.6727592	0.5071884	0.820313
CKHB - 7	66.109	2.83	0.12163	0.00039	0.512632	0.00009	0.348458	0.000055	0.241589	0.000094	0.2365	0.00014	400	0.5123134	3.8430041	0.0390145	1.757813
CKHB - 8	66.095	8.07	0.11214	0.00021	0.512681	0.00003	0.348391	0.000022	0.241602	0.000022	0.236472	0.000038	400	0.5123873	5.2852214	0.9948696	0.585938
CKHB - 9	66.125	5.87	0.11218	0.00036	0.512657	0.000034	0.348394	0.000022	0.241568	0.000037	0.236468	0.000032	400	0.5123632	4.8145321	0.5266957	0.664063
CKHB - 1_1	66.239	5.26	0.11844	0.00037	0.512699	0.000041	0.348402	0.000026	0.241585	0.000041	0.236445	0.000046	400	0.5123888	5.3144652	1.346	0.800781
CKHB - 2_1	66.318	4.29	0.11075	0.00036	0.512696	0.000061	0.348397	0.000025	0.24159	0.000038	0.23645	0.000054	400	0.5124059	5.6492205	1.2874783	1.191406
CKHB - 3_1	66.199	3.45	0.11815	0.00089	0.512689	0.000058	0.348417	0.000033	0.241575	0.000051	0.236463	0.000062	400	0.5123795	5.1340304	1.1509276	1.132813
CKHB - 4_1	66.282	12.07	0.13311	0.00023	0.512681	0.00003	0.348417	0.000018	0.241595	0.000023	0.236481	0.000034	400	0.5123323	4.212627	0.9948696	0.585938
CKHB - 5_1	66.241	5.56	0.11368	0.0002	0.512736	0.000057	0.348427	0.000028	0.241595	0.00004	0.236424	0.000053	400	0.5124382	6.2804261	2.0677682	1.113281
Hondo Canyon - 1	60.12	28.1	0.11407	0.00034	0.512244	0.000031	0.348409	0.000018	0.241574	0.000017	0.236448	0.000018	400	0.5119452	-3.3467092	-7.529797	0.605469
Hondo Canyon - 2	56.002	40	0.1087	0.002	0.512244	0.000016	0.348413	0.000011	0.241564	0.000013	0.236426	0.000019	400	0.5119593	-3.0720392	-7.529797	0.3125
Hondo Canyon - 3	66.103	30.7	0.11314	0.00069	0.512228	0.000023	0.348413	0.000016	0.241575	0.000012	0.236457	0.000015	400	0.5119316	-3.6115695	-7.841913	0.449219
Hondo Canyon - 4	66.111	45.6	0.1443	0.00029	0.512228	0.000022	0.348401	0.000011	0.241571	0.000015	0.236442	0.000015	400	0.51185	-5.2053721	-7.841913	0.429688
Hondo Canyon - 5	66.125	24.5	0.11772	0.00078	0.512244	0.000019	0.348401	0.000013	0.241587	0.000016	0.236452	0.000017	400	0.5119356	-3.5334031	-7.529797	0.371094
Hondo Canyon - 1	21.284	31	0.1232	0.0022	0.512265	0.000076	0.348352	0.000053	0.241582	0.000045	0.236439	0.000053	400	0.5119423	-3.4036367	-7.120145	1.484375
Hondo Canyon - 2	33	28.4	0.1168	0.001	0.512224	0.000035	0.348387	0.000028	0.241572	0.000034	0.236408	0.000026	400	0.5119181	-3.8768821	-7.919942	0.683594
Hondo Canyon - 4	32.858	21.8	0.1114	0.0012	0.512209	0.000078	0.348398	0.000071	0.241582	0.000034	0.236439	0.000043	400	0.5119172	-3.8935795	-8.212551	1.523438
Hondo Canyon - 5	66.113	24.3	0.11437	0.00056	0.512236	0.000024	0.348409	0.000019	0.241599	0.000018	0.236464	0.000029	400	0.5119364	-3.5182684	-7.685855	0.46875
Hondo Canyon - 6	48.074	29.9	0.11156	0.00078	0.512228	0.000028	0.348399	0.000028	0.241601	0.000039	0.236437	0.000039	400	0.5119358	-3.5307541	-7.841913	0.546875
Hondo Canyon - 7	21.323	27.9	0.1182	0.0017	0.512226	0.000039	0.348404	0.000021	0.241636	0.000052	0.236468	0.000061	400	0.5119164	-3.909437	-7.880928	0.761719
Hondo Canyon - 8	32.825	36.6	0.11066	0.00032	0.512208	0.000035	0.348391	0.000021	0.241584	0.000031	0.236452	0.000029	400	0.5119181	-3.8752561	-8.232058	0.683594
Hondo Canyon - 9	39.273	41.1	0.12005	0.00048	0.512229	0.000032	0.348392	0.000022	0.241567	0.000018	0.236437	0.000012	400	0.5119145	-3.9454823	-7.822406	0.625
Hondo Canyon - 10	32.954	37.9	0.1093	0.002	0.512251	0.00002	0.348377	0.000023	0.241566	0.000022	0.236432	0.00002	400	0.5119647	-2.9660409	-7.393247	0.390625
BearLake - 1	66.203	6.37	0.13232	0.00036	0.51235	0.000051	0.348413	0.000023	0.241577	0.00003	0.236456	0.000047	400	0.5120034	-2.2103372	-5.462029	0.996094
BearLake - 2	66.115	5.63	0.13301	0.00035	0.512344	0.000041	0.348414	0.000022	0.241651	0.000023	0.236548	0.000032	400	0.5119956	-2.3627908	-5.579073	0.800781
BearLake - 3	66.278	5.21	0.13401	0.00022	0.512336	0.000033	0.348411	0.000021	0.241613	0.00003	0.236518	0.000039	400	0.511985	-2.5701542	-5.735131	0.644531
BearLake - 4	66.122	4.63	0.13394	0.00011	0.512378	0.000043	0.348438	0.000031	0.241609	0.000042	0.236502	0.000046	400	0.5120272	-1.746448	-4.915826	0.839844
BearLake - 5	66.267	5.73	0.13283	0.00012	0.512336	0.000035	0.348404	0.000034	0.241594	0.000035	0.236441	0.000059	400	0.5119881	-2.5097984	-5.735131	0.683594
BearLake - 6	66.116	5.43	0.13329	0.00024	0.512378	0.000035	0.348414	0.000022	0.241554	0.000035	0.236435	0.000033	400	0.5120289	-1.7132012	-4.915826	0.683594
BearLake - 1_1	66.184	5.49	0.13235	0.00018	0.512342	0.000049	0.348391	0.00003	0.241598	0.000041	0.23642	0.000047	400	0.5119953	-2.3680861	-5.618087	0.957031
BearLake - 2_1	66.207	5.7	0.1324	0.00033	0.512336	0.000043	0.3484	0.000031	0.241588	0.000038	0.236444	0.000032	400	0.5119892	-2.4878043	-5.735131	0.839844
BearLake - 3_1	66.25	5.87	0.13246	0.00011	0.512334	0.000046	0.348395	0.000027	0.241572	0.000032	0.236462	0.000049	400	0.511987	-2.5299269	-5.774145	0.898438
BearLake - 4_1	66.247	5.55	0.13309	0.00014	0.512359	0.000042	0.348406	0.000029	0.241579	0.000038	0.23643	0.000043	400	0.5120104	-2.0739807	-5.286464	0.820313
BearLake - 5_1	66.29	4.73	0.133914	0.000098	0.512333	0.000055	0.348418	0.000033	0.241553	0.000049	0.236416	0.000043	400	0.5119822	-2.6238243	-5.793652	1.074219
BearLake - 6_1	66.294	4.95	0.13376	0.0001	0.512326	0.000038	0.348414	0.000023	0.241601	0.00003	0.236455	0.000046	400	0.5119756	-2.752635	-5.930203	0.742188
BearLake - 7	66.251	4.79	0.13215	0.00011	0.512363	0.000052	0.348382	0.000031	0.241568	0.000043	0.236439	0.00005	400	0.5120168	-1.9477934	-5.208435	1.015625
BearLake - 9	66.158	4.39	0.13248	0.00014	0.51232	0.00004	0.348379	0.000029	0.241578	0.000045	0.236413	0.000047	400	0.511973	-2.8043251	-6.047247	0.78125
BearLake - 10	66.124	4.43	0.132851	0.00009	0.512324	0.000062	0.348394	0.000041	0.241567	0.000057	0.236439	0.000058	400	0.511976	-2.7451942	-5.969218	1.210938
BearLake - 9	66.138	5.93	0.13319	0.00062	0.512344	0.000038	0.348411	0.000034	0.241605	0.000029	0.236467	0.00004	400	0.5119951	-2.3719976	-5.579073	0.742188
BearLake - 11	66.419	7.37	0.13282	0.00034	0.512354	0.00005	0.348415	0.000038	0.241576	0.000036	0.236471	0.000042	400	0.5120061	-2.1578045	-5.384	0.976563
BearLake - 12	66.403	6.79	0.13302	0.0003	0.512339	0.000043	0.3484	0.000023	0.241569	0.000036	0.236443	0.000041	400	0.5119906	-2.4609363	-5.676609	0.839844
BearLake - 13	66.121	5.99	0.13299	0.00017	0.512341	0.000047	0.348409	0.000018	0.241592	0.00004	0.236467	0.000041	400	0.5119926	-2.4203482	-5.637594	0.917969
BearLake - 14	66.418	6.43	0.13305	0.00014	0.512356	0.000045	0.348399	0.000028	0.241564	0.000024	0.236424	0.000032	400	0.5120075	-2.1305151	-5.344986	0.878906
BearLake - 15	66.144	5.27	0.13271	0.00026	0.51234	0.00004	0.348404	0.000026	0.241612	0.00003	0.236469	0.000031	400	0.5119924	-2.4255533	-5.657102	0.78125
BearLake - 16	66.148	5.58	0.1333	0.00028	0.512358	0.000034	0.348407	0.000033	0.241576	0.000043	0.236436	0.000042	400	0.5120088	-2.1042488	-5.305971	0.664063
BearLake - 17	66.099	4.35	0.13274	0.00016	0.512312	0.000047	0.348396	0.000027	0.24163	0.000058	0.236484	0.000058	400	0.5119643	-2.9738383	-6.203305	0.917969

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Grain/Analysis Number	Duration(s)	TotalNdBeam	$^{147}Sm/^{144}Nd$	±2σ	$^{143}Nd/^{144}Nd$	±2σ	$^{145}Nd/^{144}Nd$	±2σ	$^{148}Nd/^{144}Nd$	±2σ	$^{150}Nd/^{144}Nd$	±2σ	Age (Ma)	$^{143}Nd/^{144}Nd$	$\varepsilon Nd_{(initial)}$	$\varepsilon Nd_{(present)}$	±2σ
BearLake - 18	66.096	4.7	0.13346	0.00021	0.512361	0.000054	0.348421	0.000043	0.241597	0.000047	0.236465	0.000057	400	0.5120114	-2.0538522	-5.247449	1.054688
BearLake - 19	66.155	7.22	0.13282	0.00036	0.512332	0.000044	0.348397	0.000033	0.241575	0.000028	0.236463	0.000035	400	0.5119841	-2.5873941	-5.81316	0.859375
BearLake - 20	66.281	7.79	0.13302	0.00041	0.512345	0.000038	0.348408	0.000023	0.241602	0.000021	0.236477	0.000033	400	0.5119966	-2.3437755	-5.559565	0.742188
BearLake - 21	66.114	3.9	0.13334	0.00023	0.512339	0.000072	0.348416	0.000047	0.241567	0.000062	0.236438	0.00007	400	0.5119897	-2.477304	-5.676609	1.40625
BearLake - 22	66.347	3.7	0.13281	0.00019	0.512371	0.00006	0.348404	0.000034	0.241604	0.000048	0.236437	0.000057	400	0.5120231	-1.8253373	-5.052377	1.171875
BearLake - 23	66.179	3.67	0.13287	0.00013	0.512341	0.000058	0.34841	0.000044	0.241598	0.000059	0.236467	0.000056	400	0.511993	-2.4142103	-5.637594	1.132813
BearLake - 24	66.19	3.78	0.13315	0.00014	0.512349	0.000062	0.348401	0.000028	0.241551	0.000038	0.236434	0.000052	400	0.5120002	-2.2723176	-5.481536	1.210938
BearLake - 1	66.115	9.13	0.13338	0.00014	0.512337	0.00003	0.348428	0.000024	0.241602	0.000039	0.236398	0.000029	400	0.5119876	-2.5184035	-5.715623	0.585938
BearLake - 2	66.12	9.24	0.13264	0.00032	0.512329	0.000037	0.348436	0.000029	0.241623	0.000046	0.236387	0.000033	400	0.5119816	-2.6367677	-5.871681	0.722656
BearLake - 3	66.113	10.71	0.13324	0.00039	0.51237	0.000038	0.348406	0.00003	0.241568	0.000021	0.236414	0.000032	400	0.512021	-1.8668582	-5.071884	0.742188
BearLake - 4	66.2	10.9	0.13282	0.00031	0.512337	0.000035	0.348406	0.000018	0.241585	0.000025	0.236434	0.000028	400	0.5119891	-2.4897601	-5.715623	0.683594
BearLake - 5	66.233	8.24	0.13349	0.00026	0.512342	0.000032	0.348404	0.000024	0.241573	0.000028	0.23648	0.000027	400	0.5119923	-2.4263959	-5.618087	0.625
BearLake - 6	66.101	7.8	0.13343	0.00027	0.512344	0.000035	0.348423	0.000026	0.24159	0.000047	0.23647	0.000041	400	0.5119945	-2.3842734	-5.579073	0.683594
BearLake - 7	66.197	10.78	0.13256	0.00017	0.51232	0.000025	0.348385	0.000023	0.24159	0.000023	0.236452	0.00002	400	0.5119728	-2.808417	-6.047247	0.488281
BearLake - 8	66.1	8.8	0.132985	0.000078	0.51237	0.00004	0.348379	0.000022	0.241568	0.000023	0.236453	0.000036	400	0.5120217	-1.8538152	-5.071884	0.78125
BearLake - 9	66.163	8.03	0.13354	0.00014	0.512344	0.000039	0.348418	0.000035	0.241596	0.000044	0.236488	0.000056	400	0.5119942	-2.3898998	-5.579073	0.761719
BearLake - 10	66.34	9.48	0.13277	0.0002	0.512356	0.000038	0.348393	0.000015	0.241566	0.000038	0.236489	0.000033	400	0.5120082	-2.1161934	-5.344986	0.742188
BearLake - 11	66.233	7.69	0.13259	0.00018	0.512326	0.000051	0.348399	0.000024	0.2416	0.000044	0.236538	0.000046	400	0.5119787	-2.6927907	-5.930203	0.996094
BearLake - 12	66.31	8.38	0.13256	0.00013	0.512367	0.000036	0.348385	0.000025	0.241584	0.000023	0.23648	0.000043	400	0.5120198	-1.8906573	-5.130406	0.703125

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