Drill Core Study of Alteration Features
Mooseland, Nova Scotia

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Abstract

The Mooseland gold deposit, situated on the Mooseland-Gegogan Anticline, is a steep tight chevron structure. The deposit consists of mainly stratabound veins in slate or metasiltstone intervals of the metasandstone dominated Goldenville Formation of the Meguma Group. This study involves an interpretation of the 220.5m ML-03-86 diamond drill core, obtained from the west zone of the Mooseland gold deposit. The ML-03-86 drill core has been interpretated into a continuous digital section. The study provides good information on the spatial relationships of features within the Mooseland gold district. Such information seems important in overall understanding of the deposit. The study documents the distribution of lithologies, veining, bleaching, oikocrysts, and sulphides. There are strong spatial relationships between features in the deposit. Outside of the deposit these features are relatively unaccounted for, suggesting a genetic relationship. This study provided information on the character of the deposit. The information presented provides a number of conclusions that help define the Mooseland gold district, with possible analogue for other deposits in the Meguma Group. The study documents the prevalent bleaching alteration in the deposit and its distribution. Arsenopyrite in the Mooseland deposit is veinlet controlled and increases down hole. Bleaching in the deposit is associated with pyrrhotite mineralization. Large oikocrysts are spatially associated varying vein types. The size of oikocrysts varied, based on distance to veins.

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1.0 INTRODUCTION

1.1 Overview of Deposit

The first confirmed bedrock discovery of gold in Nova Scotia occurred at Mooseland in September of 1858 by Captain L'Estrange. Mooseland and Tangier were proclaimed gold districts and surveyed in April of 1861. The total recorded production of gold at Mooseland was recorded at 3,865 oz. (Bates, 1987). A serious attempt by Acadia Minerals and Hecla Mining in the late 1980's was made, with 185 diamond drill holes and the sinking of a 400 ft shaft. There are 60 different deposits in the Meguma Group illustrated in Figure 1.1. and most are found in the Goldenville Formation.

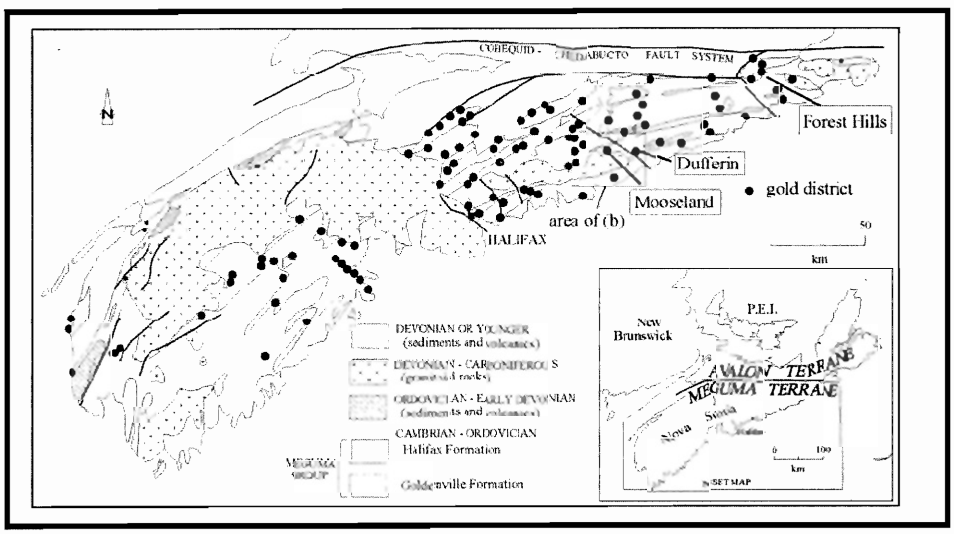

Figure 1.1. Meguma Terrane and gold deposits

The Meguma gold deposits occur in turbidity sequences of interbedded slates, metasiltstones and metasandstones that are of lower Proterozoic age. Turbidites are defined as rocks which were deposited in a turbidity or series of turbidity currents. They can be identified based on their graded beds, moderate sorting, and well developed primary structures of the Bouma cycle (Boyle, 1986). Turbidites form in deepwater marine environments and have a flysch facies (metasandstone, metasiltstone, slate). Often interbedded between turbidity cycles there are small sequences of slate (Boyle, 1986) which can be observed in Figure 4.2. Turbidity sequences are not straight forward and require a detailed examination for understanding.

The mineralogy of most turbidite hosted veins in the gold deposits is simple, and is mainly composed of quartz with carbonate, pyrite, arsenopyrite, tourmaline, feldspar, occasionally scheelite, and native gold (Boyle, 1986). Wall rock alteration effects are minimal, but in some deposits bleaching, arsenopyritization, pyritization, chloritization, tourmalinization, sericitization, and argillization are evident (Boyle, 1986).

During the Acadian Orogeny the Meguma Group was deformed into chevron type folds and metamorphosed to greenschist-amphibolite facies. This was followed by the intrusion of voluminous meta- to peraluminous granites (figure 1.1). Gold mineralization is divided into two categories: vein- quartz and disseminated. Vein quartz mineralization is characterised by abundant auriferous bedding-concordant and discordant veins concentrated in hinge zones and adjacent steep to overturned limbs of folds (Horne, 2003).

There are over 60 known gold occurrences and deposits hosted by the Cambro-Ordovician Meguma Group. Isotopic study of vein minerals indicates that mineralization was from the migrating metamorphic fluids during the late Acadian Orogeny (Kontak and Smith, 1990).

The gold deposits are divided into high grade (~15g/t Au) narrow gold-bearing quartz veins, low grade (0.5-4 g/t Au) slate hosted, and low grade(<0.5 g/t Au) metasandstone hosted. A combination of two or more can occur at any one district. All of the historic production has come from high grade veins up to 200m below surface.

1.2 Models for Meguma Gold Deposits

There are three proposed mechanisms for quartz vein emplacement. Haynes (1986), proposed that quartz veins were sourced from syngenic hydrothermal deposits on the seafloor. Graves and Zentilli 1982, and Henderson 1983, have interpreted that veins were emplaced prior to or during folding and regional metamorphism. Mawer (1987), Faribault (1899), Keppie (1976) and Horne and Culshaw (2001), state that the origin of Meguma gold deposits is attributed to various syn-folding models. The work presented here is not an attempt to answer the question of which theory is correct, but rather to document in detail features of the Mooseland District expressed in a drill hole through the deposit.

The Mooseland deposit has been previously documented and studied (Kontak and Smith (1986), Melvin (1987), Horne et al. (2004). However, complete interpretation of diamond drill core has never been made. Figure 2.1 illustrates the location of the Mooseland deposit within the Goldenville Formation along the Mooseland-Gegogan Anticline. The deposit is situated close to the Musquodoboit Batholith.

1.3 Alteration in Meguma Gold Deposits

Historically, alteration in Meguma gold deposits has not been fully documented. Both Henderson et al. (1991) and Sangster (1990) argue that hydrothermal alteration in Meguma deposits is insufficiently documented. In the past it was generally thought that veining events had little or no effect on wallrock lithology (Boyle, 1986; Kerswill, 1993).

Alteration has been recognized as a feature of the Meguma gold deposits which postdates and retrogresses regional metamorphic minerals and fabrics (Kontak and Smith, 1987). Several alteration types have been documented within the Meguma gold deposits. These types include silicification, carbonatization, sulfidization, sericitization, and tourmalinization (Kontak and Smith, 1987, 1993; Kontak et al., 1990). Of these types, bleaching is most common in Meguma deposits (Kontak and Smith, 1990). Intense hydrothermal alteration produces bleached appearance in metasandstone beds. Bleaching commonly occurs parallel to pressure solution cleavage, where dark maroon areas represent pressure solution cleavage zones and light coloured represent chloritization of biotite (Horne et al. 2003). Within metasandstone the rocks that were initially dark grey, medium grained with equigranular texture become mottled in some areas and silicified throughout in others (Kontak and Smith, 1987). Slates do not allow penetration by hydrothermal fluids and the dark colour of pelites makes silicification hard to recognize (Kontak and Smith, 1987).

Previous work has shown that sulphide alteration is typical of Meguma lode gold deposits and occurs in wallrock next to veins. In the Mooseland deposit arsenopyrite is a common sulphide found in the deposit and it is primarily controlled by wallrock lithology (Horne et al. 2003).

One other alteration feature in this area is defined as oikocrysts. They occur as elliptical shaped, light coloured minerals or mineral aggregates that are well distributed in the slate units (Kontak and Smith, 1990a). Oikocrysts are most likely to comprise quartz-biotite but can consist of arsenopyrite, chlorite, carbonate, ilmenite, rutile, and sphene (Kontak, 1990a). The mineral aggregates have a pronounced down-dip lineation. The long axis is generally 1-2cm with widths of 1-2mm. Oikocrysts occur in the cleavage plane with long axes being perpendicular to the fold hinges. Oikocrysts have been described by Melvin (1987), Kontak and Smith (1990), and Horne (2003). They are interpreted as retrograde porphyroblasts related to contact metamorphism (Kontak and Smith, 1990) or a metasomatic feature that record fold related strain (Horne, 2003). Also, quartz pressure shadows on sulphide minerals show a downdip lineation implying a fold related strain similar to the oikocrysts (Horne, 2003). Recently, oikocrysts have been interpreted as microlithons, where cleavage domains are separated by tabular to lenticular areas (Sutton, 2007).

Oikocrysts are an alteration feature observed in many gold districts that have varying interpretations. They commonly occur in Meguma lode gold deposits but do not occur regionally.

The amount of strain recorded by the oikocrysts varies systematically, with little strain shown in the metasiltstone lithologies and progressively higher strain shown in the slate intervals near cycle boundaries (Horne, 2003). Lack of strain shown by oikocrysts within inner arcs of buckled veins suggests the oikocrysts formed at the same time as veins and predate the folding of the veins (Horne et al, 1996).

Previous work from the Oldham gold district implies that the observed pattern of strain shown by oikocrysts can be explained by the following events: (1) Equant oikocrysts formed and veins were emplaced, (2) Bedding parallel shear resulted in folding of the quartz veins and deformation of the oikocrysts (Horne et al, 1996).

At the Oldham gold district carbonate alteration and oikocrysts are both absent in the area just outside of the veined gold district. This suggests a genetic relationship between the two features and veining (Horne et al, 1996).

Figure 1.3 shows the occurrences of features within a tight limbed Meguma gold deposit which are not present outside of the deposit. Spatial relationships between these features can be determined in the gold districts. In the country rock outside of the gold districts there is no veining, oikocrysts, bleaching, or arsenopyrite and inside the gold districts all are abundant.

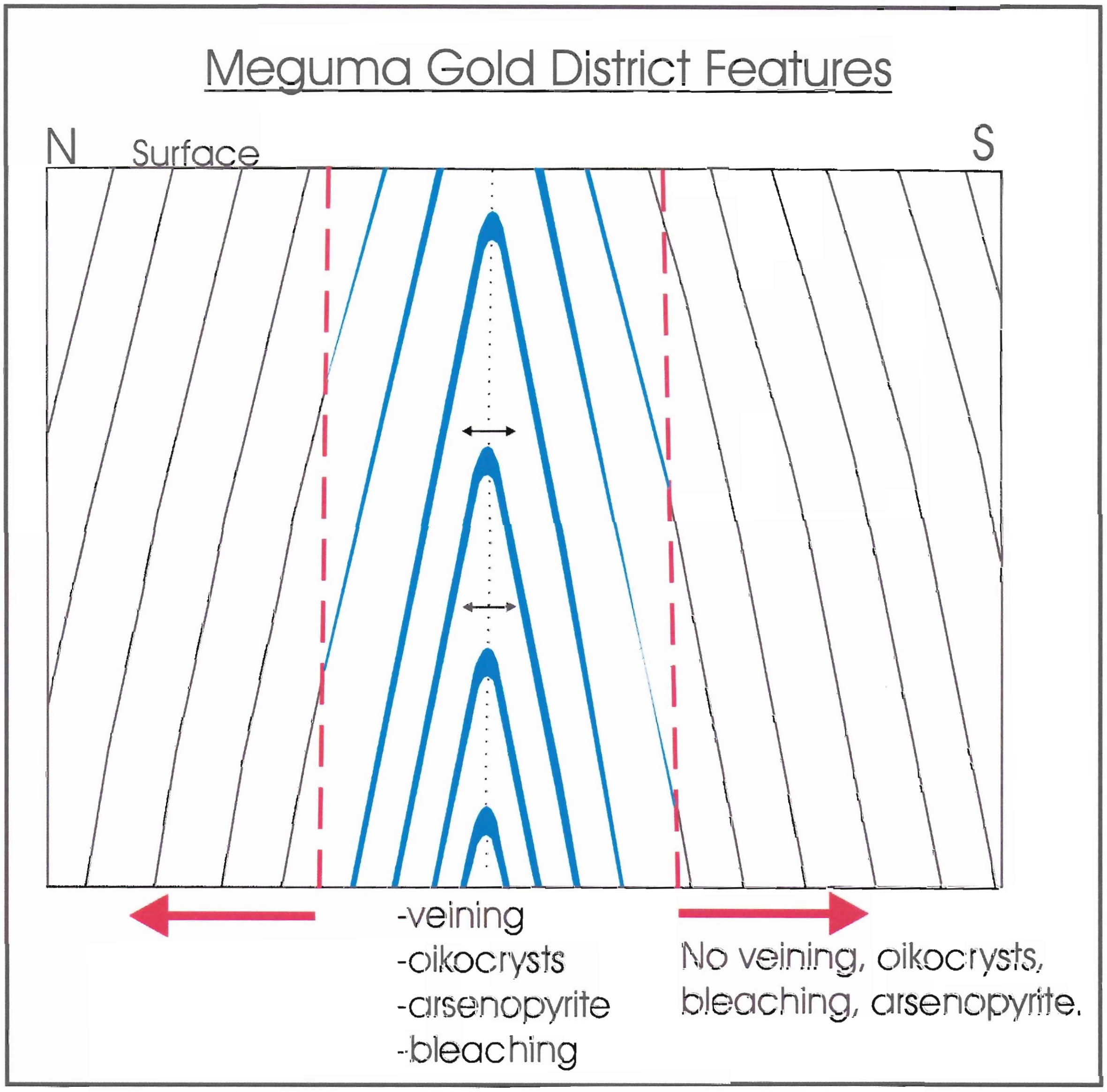

Figure 1.2. Features within the Mooseland gold deposit.

1.4 Objective

A great deal of work has been done on deposits in the past, including mapping, geochemistry, petrography, and isotopic studies. The general features of the deposits have been well understood. However, few studies exist which present good information on the spatial relationships of features. Such information would seem critical in the overall understanding of a deposit.

The objective of this study is to describe a diamond drill core from the Mooseland deposit. Primarily, the investigation is aimed at understanding the distribution of features with relation to vein emplacement. Several features, such as bedding parallel veins, discordant veins, carbonate veins, bleaching, arsenopyrite, pyrrhotite, oikocrysts and pressure solution cleavage have been documented (Horne et al., 2003). However, the distribution and relationships between these features has not yet been systematically evaluated.

2.0 GEOLOGIC SETTING

2.1 Regional Geologic Setting

The Meguma terrane is the most outboard terrane in the Canadian Appalachians and lies south of the Chedabucto-Cobequid fault system (Figure 1.1). The CCFS separates the Meguma terrane from the Avalon terrane. The Acadian fold belt affected the Meguma Group, and overlying White Rock, Kentville, and Torbrook Formations. The belt has a simple geometry with upright local periclinal folds, but mainly horizontal hinges. Axial traces have an average spacing of tens of kilometres in width. The exposed Meguma terrane has a simple geometry that resembles an external foreland fold and thrust belt (Culshaw and Lee, 2006). The Meguma Group has undergone complex post depositional history that includes metamorphism, polyphase deformation, granitic intrusion, and faulting (Melvin, 1987).

The Meguma terrane is composed of Cambrian-Ordovician Goldenville Formation and the overlying Halifax Formation and Devonian-Carboniferous intrusive rocks. The Meguma terrane is overstepped by the unconformable overlying Carboniferous sediments.

The minimum thickness of the Meguma group is estimated at 10km, with thickness of the Goldenville Formation varying between >5500m (Krogh and Keppie, 1990) and ~7000m (Schenk, 1971; Henderson et al., 1986) and the Halifax Formation, between 500-4000m (Krogh and Keppie, 1990) and up to 8000m (Schenk, 1991). The Goldenville Formation consists of turbidite sequences: thick metasandstone units separated by thin slates or metasiltstones. In structural terms it can be characterized as a multilayer.

Previous studies have documented that a significant amount of material has undergone volume loss in the Meguma Terrane (Henderson et al, 1986). Culshaw and Lee (2006) report that 11-18km wavelength folds are interpreted as results from buckling from under the influences of gravity and 4-6km wavelength folds reflect thickness with buckle shortening in the range of 32-44%. Richardson (2000) report that shortening in the Meguma Group, Lahave, Mahone Bay, and Ecum Secum areas is approximately 35% based on balanced structural cross sections.

2.2 Location

The Mooseland property is located in Halifax county, Nova Scotia at latitude 44°56'M; longitude 62°46'W. Access is by the Mooseland Road that crosses the property and connects with Provincial Highway 7 at Tangier. The Mooseland Gold district area is located on figure 2.1, along with the local geologic setting.

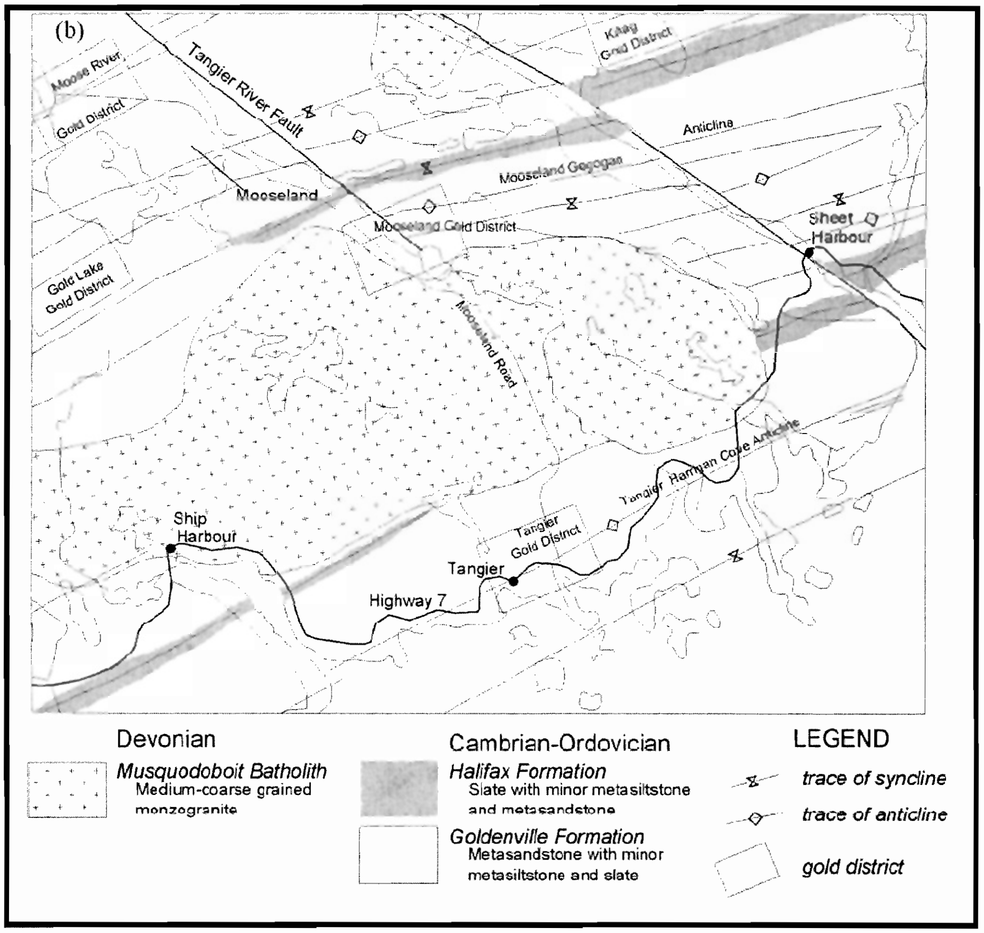

Figure 2.1 Location Map of Mooseland Gold District (Horne et al, 2003).

Drill hole ML-03-86, which is the subject of the study, is shown on figure 2.2. The map is an overview of the west zone of the Mooseland-Gegogan Anticline with diamond drill holes, ML-03-86, ML-03-87, ML-03-88, and ML-03-89 indicated. The grid system used was the Modified Transverse Mercator (MTM) projection, and the ATS77 datum (Covey and Albert, 2004). Coordinates were calculated using the Nova Scotia 3° in the 2004 assessment report by Covey and Albert (2004).

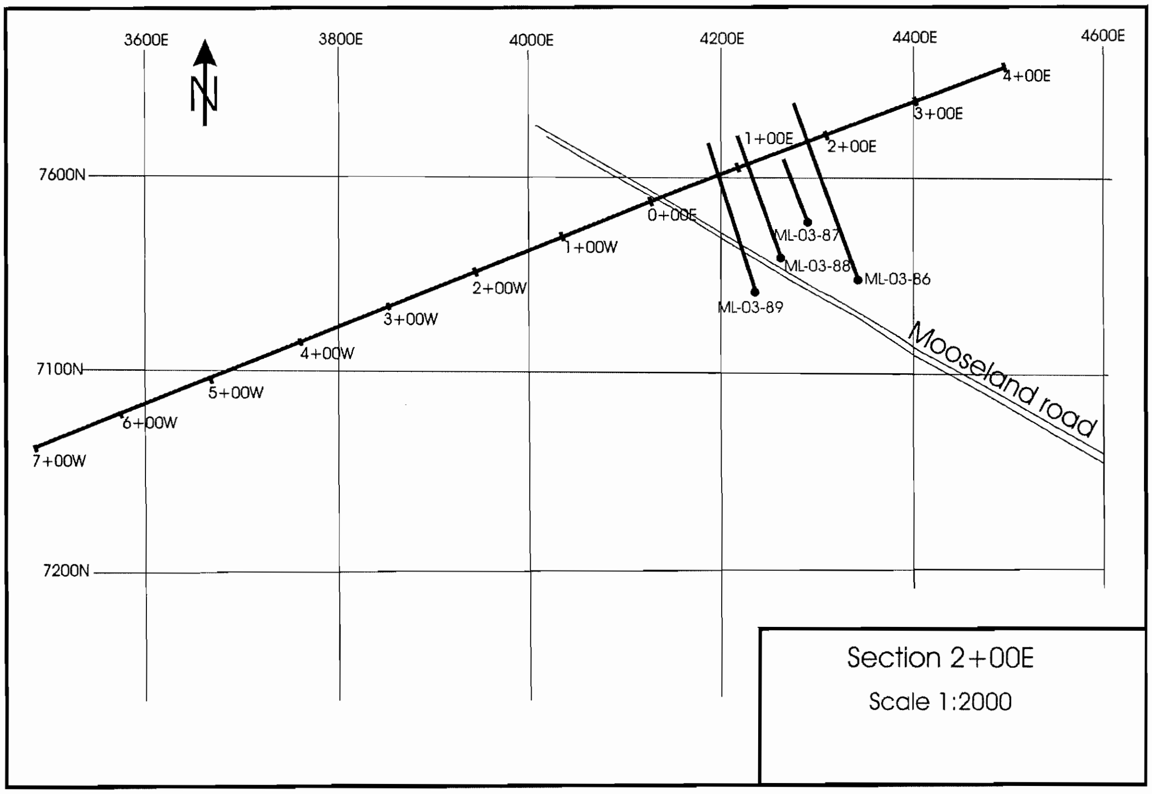

Figure 2.2 Location of Drill Hole ML-03-86

The drill hole information is noted in Table 2.1 on behalf of Azure Resources during there assessment of the Mooseland property (Covey and Albert, 2004).

Hole #	UTM Grid Reference		Bearing	Dip	Grid Coordinates
	N (m)	E (m)			
ML-03-86	4 975 480.7	518 022.4	340^{0}	-45^{0}	1+80E 1+50S

Table 2.1. Drill hole information.

2.2.1 Mooseland Cross Section

Figure 2.3 is a cross section of the Mooseland-Gegogan Anticline. In the cross section the location of drill hole ML-03-86 is shown. Figure 2.3 also shows the main previously recognized bedding concordant veins. They include the Furnace, the Little

North Belt, the Irving Belt, the Cummings Belt, and the Bismark Belt. These belts represent previously worked bedding-parallel veins. The cross section also has the MTM grid projection. The distance from the start of the hole to the hinge is 155.9m and the distance of bedding studied is 192.9m.

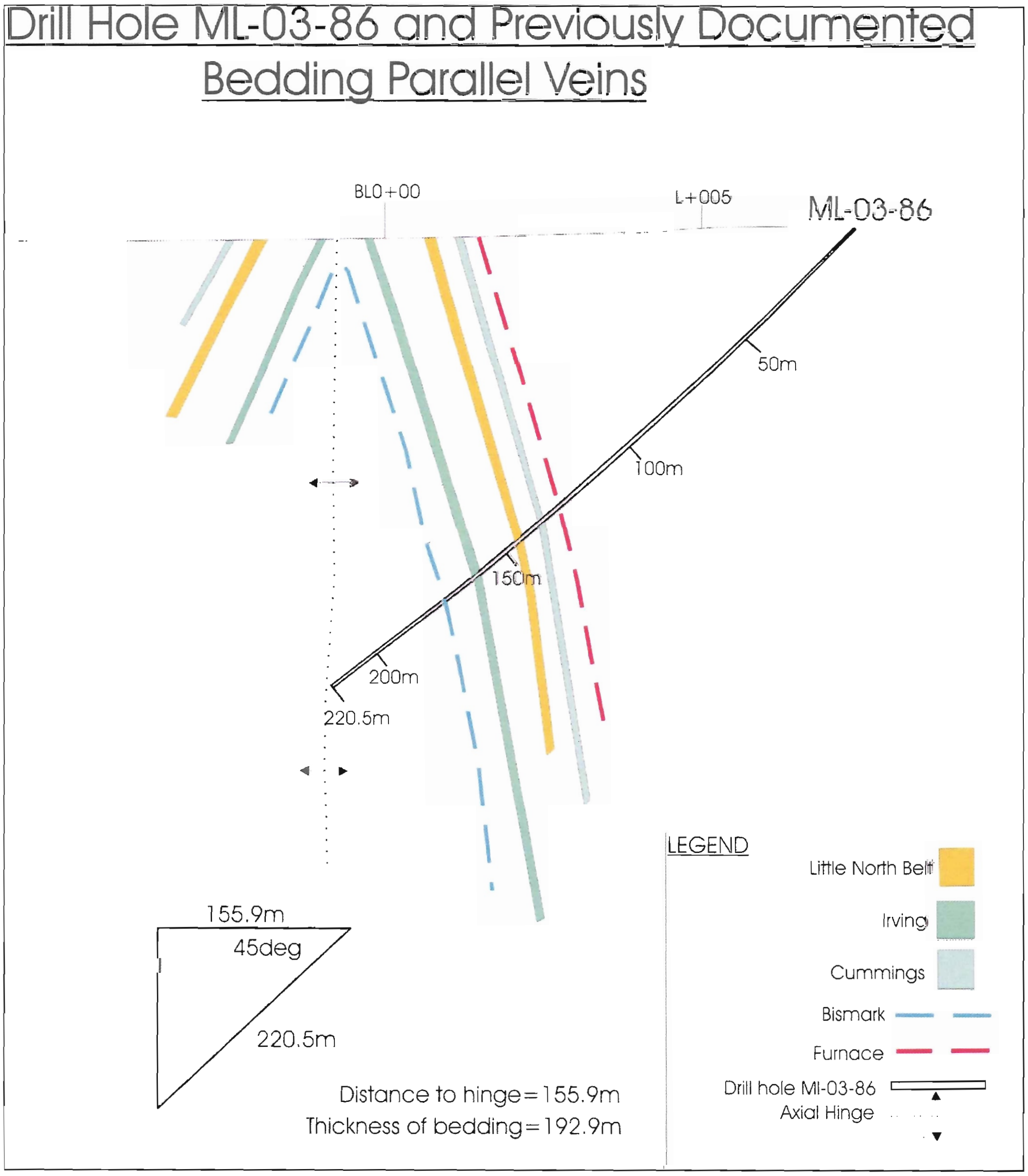

Figure 2.3. Mooseland Cross Section

2.3 Previous Work

The rocks of the Mooseland gold district are composed of metasandstones, metasiltstones, and slates that belong to the Cambro-Ordovician Goldenville Formation of the Meguma Group. The rocks have undergone deformation, greenschist metamorphism and post-tectonic granitoid plutonism (Melvin, 1987).

The Mooseland Gold District is situated along a regional east-west trending anticlinal structure, termed the Mooseland-Gegogan Anticline (Faribault, 1898). The Mooseland deposit is sited directly north of the 370Ma (Reynolds et al., 1981; Keppie and Dallmeyer, 1987) post tectonic Musquodoboit Batholith (Figure 2.1). The Deposit occupies the Axis of an anticline structure (inter-limb 35^{o}) of two dominant lithologic zones, a southern psammite-dominated zone and a northern pelite rich zone (Kontak and Smith, 1990). In the southern zone there are several large massive coarse grained quartz concordant veins. The veins can be classified as saddle reef structures (Horne, 2003). Quartz veins are composite and they contain vug features throughout (Melvin, 1987). The veins along the Mooseland anticline are cross cut by ac and discordant veins. The Northern zone is most recognized by the deformed veins and host rocks. The intense deformation created boudin structures, pods in quartz veins, rotated veins into parallelism and extreme shortening of veins (Kontak and Smith, 1990).

2.3.1 Stratigraphy

Development and distribution of veins are closely related to stratigraphy. The bedding concordant veins occur in the slate-metasiltstone intervals along the Mooseland-Gegogan anticline. The incompetent layers or slate-metasiltstone layers record flexural shear strain during folding and concordant veins should be associated with stratigraphy (Horne 2003). Stratigraphy is characterised by fining upward cycles with metasandstone at the base and slate-metasiltstone at the top. Cycles contain gradational contacts with sharp contacts at the cycle boundaries. Thickness of the cycles ranges from ~12cm to 15m.

There are large-scale stratigraphic differences seen along the Mooseland-Gegogan Anticline. One, thick intervals of metasandstone dominated cycles that include minor slate-metasiltstone, and two, thin intervals of slate-metasiltone dominated cycles that represent large parts of individual cycles. These variations may represent large scale cycles, or megacycles (Horne et al, 2003). Minor bedding concordant veins occur in the slate-metasiltstone dominated intervals of the individual cycles. The main bedding concordant veins occur in the slate-metasiltstone intervals at the tops of the megacycles and represent the mineralized belts.

2.3.2 Veins- Belts

There are six identified vein types at Mooseland; in order of occurrence these are boudined, low-angle deformed, high-angle folded, conjugate, ac, and bedding parallel (Melvin, 1987).

Mineralized zones are located in quartz veins or they occur on vein margins. The gangue minerals chlorite, carbonate, sericite, pyrrhotite, galena, chalcopyrite, and arsenopyrite occur in the vein margins in drill hole ML-03-86 (Covey and Albert, 2004).

The cross section of the Mooseland Anticline seen in figure 2.3 shows previously documented bedding parallel veins. These veins include the Bismark Belt, Irving Belt, Little North Belt and Cummings Belt. They have been documented based on their economic interest and the following is a description of the four main bedding parallel veins.

The Bismark is the lowest belt exposed along the Mooseland anticline. Two bedding concordant veins of the Bismark Belt are exposed along the hinge zone at surface and at lower levels only the upper vein can be seen where it thins down dip. The general structure of the Bismark is classified as a saddle reef (Horne et al, 2003). The veins occur in a slate interval at the highest point of a megacycle. Veins are composite, coarsely laminated and include massive quartz with coarse-grained arsenopyrite. The footwall slate has high concentrations of coarse-medium arsenopyrite grains that form bands parallel to bedding. Fine grained arsenopyrite forms in the metasandstone, adjacent to the vein (Horne et al, 2003).

The Irving belt is a group of two composite bedding concordant veins in a metasiltstone dominated interval near the top of the Irving Megacycle. The exposed area of the decline shows the top concordant vein in contact with the base of a megacycle while the bottom concordant vein is found in the metasiltstone interval.

Between the two composite veins, En Echelon and Spur Veins are seen. The concordant veins include chlorite, and pyrrhotite (Horne et al, 2003).

The Little North Belt includes 3 bedding concordant veins: the Little North footwall vein, the Little North twin vein and the Covey vein (Horne, 2003). In addition, oblique veins and cross veins intersect as well as affect the bedding parallel veins. Oblique veins show no direct relationship with the Mooseland Anticline and the mechanism for their development is not obvious. The kinematics of the oblique veins is not consistent with flexural-folding strain. Flexural folding strain is recorded by bedding concordant veins (Horne, 2003). Within the belt there are bedding parallel movement horizons occurring in millimetre thick clay seams.

The Cummings Belt is a 1.2 m thick interval dominated by metasiltstone, which hosts a thick composite vein. Movement Horizons occur near the footwall and hanging wall defining the walls of the drift. Significant movement defined by a 1-2cm thick clay layer is seen along the footwall of the Cummings Belt. The movement horizon is extensive and continues over long distances in exposed areas (Horne, 2003).

3.0 DIAMOND DRILL HOLE LOGGING

The following is a description of the methods used to interpret a 220.5m diamond drill core and all of its main features to a digital format. The primary work involved each box being digitally photographed. In July of 2006 core photos were taken at the Mooseland site. The pictures were later merged using Adobe Photoshop. An example of a merged core box can be seen in Figure 3.1.

Fig 3.1. Box 15 Photomerge

Box 15 is composed of four merged photographs. Joining edges of the photos are noticeable and can be seen in Figure 3.1. The core boxes were then grouped into three and printed on 48" plotter paper. An example of this can be seen in Figure 3.2

Figure 3.2. Core Box 58-60.

Important features from the core in hand sample were transferred to the 48" width posters. Core was also looked at under a binocular microscope. The interpreted core on the 48" sheets were then transferred into a digital format using CorelDraw 11. An example of this can bee seen in figure 3.3. The dark repetitive lines at the top are shadows from the camera tripod. The bedding parallel vein in box 2 was offset when photos were merged together. Overall, the discrepancies resulting from merging photos did not affect the final interpretation.

Figure 3.3. Core Box 2 and final interpretation

Finally, the digitized interpretations were connected into a continuous section and enlarged for easy interpretation. Results are easily shown when the cross section of drill core ML-03-86 was enlarged.

4.0 FEATURES

4.1 Lithology

The three main lithologies at the Mooseland site were determined to be metasandstone, metasiltstone, and slate. The three lithologies make up the turbidite sequences. They are represented as 3 border colours as shown in Figure 4.1. Also represented are the metasiltstone and slate sequences that occur between the turbidite sequences as light green sequences as light green borders shown in figure 4.2. Conglomerates were located in the core and they are marked by solid black polygons.

4.1.1 Metasandstone

Metasandstone is the dominant lithology at the Mooseland site. The bedding thicknesses range from several centimetres to 12 meters. The metasandstone beds show pressure solution cleavage which is an irregular biotite rich cleavage (Horne, 2003). The colour of the metasandstone ranges from white to light grey to dark grey and they consist of anhedral, equigranular grains of one to two millimetres in width (Melvin, 1987). The major minerals in hand sample are quartz and biotite. Coarse arsenopyrite crystals are euhedral to subhedral in shape (Melvin, 1987). Fine to coarse pyrrhotite crystals occur within the metasandstone and they are aligned within the pressure solution cleavage plane. The metasandstones are marked by red borderlines in appendix A.

4.1.2 Metasiltstone and Slates

The two lithologies average 30% of the host rock in the Mooseland area (Melvin, 1987). Beds vary in thickness from 2cm to 2m. The two lithologies show a steeply dipping, penetrative, slaty cleavage. The slates and siltstones are dominated by biotite and muscovite. The metasiltstones are marked by dark blue lines and the slates are marked by dark green border lines.

4.1.3 Metasiltstone – Slate Sequences

Within the drill core there are frequent occurrences of the metasiltstone – slate sequences. Examples of the sequence can be seen in figure 4.2. These sequences are formed in quiet depositional environments in relatively deep water and they can comprise sequences of shale, carbonaceous shales, bedded cherts, iron formations, and fine grained carbonate rocks (Boyle, 1986). They are marked by the light green lines.

4.2 Cycle Boundaries

The two boundaries encountered in the drill core are turbidite cycle boundaries and megacycle boundaries. The turbidite cycle boundaries are separations between the metasandstone and the metasiltone or slate. The megacycle boundaries are separations which are associated with bedding parallel veins. The turbidite cycle boundaries are represented by dark green lines and the megacycle boundaries are represented by black lines. Both types are represented in figure 4.3.

4.3 Veins

The vein system at Mooseland is strata-bound in the slate or metasiltstone intervals of the metasandstone dominated Goldenville Formation. Discordant veins can be found in the metasandstone, metasiltstone, and slate lithologies. Carbonate veins are abundant throughout. Bedding parallel veins are represented by light blue polygons and discordant veins are represented by dark purple polygons. Both Bedding parallel veins and discordant veins are shown in figure 4.4.

4.4 Sulphides

The two main sulphides represented in core ML-03-86 are arsenopyrite and pyrrhotite. Examples of these are seen in figure 4.5. The general size and shape of the sulphides are represented. The important idea is that they were documented at depth in the core. Although pyrite has some importance it was not documented because it was easily missed. Pyrite occurs on fractures and films in the carbonate veins of the metasandstone. It was generally abundant throughout ML-03-86.

4.5 Bleaching

The bleaching at Mooseland is classified based on their intensities and textures. Figure 4.6 represents the classification scheme for bleaching. The beaching scheme is separated into 10 levels: 100-90%, 90-80%, 80-70%, 70-60%, 60-50%, 50-40%, 40-30%, 30-20%, 20-10%, and 10-0%. The higher percentages represented the highly bleached zones.

4.6 Oikocrysts

Oikocrysts can be classified based on their abundance and size. Figure 4.7 shows a legend which classifies oikocryst shapes into rounded and elongated groups. Each oikocryst was classified based on the length of the long axis. These include elongated oikocryst 3 (1.5cm-2cm), elongated oikocryst 2 (0.5cm-1.5cm), elongated oikocryst 1 (<0.5cm), equant oikocryst 3(0.5cm-0.3cm), equant oikocryst 2(0.3cm-0.2cm), and equant oikocryst 1(<0.2cm).

Figure 4.1 Lithology Legend

Figure 4.2 Siltstone-slate sequences

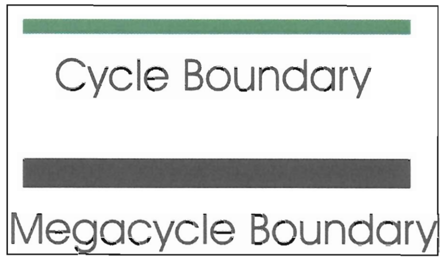

Figure 4.3. Cycle Legend

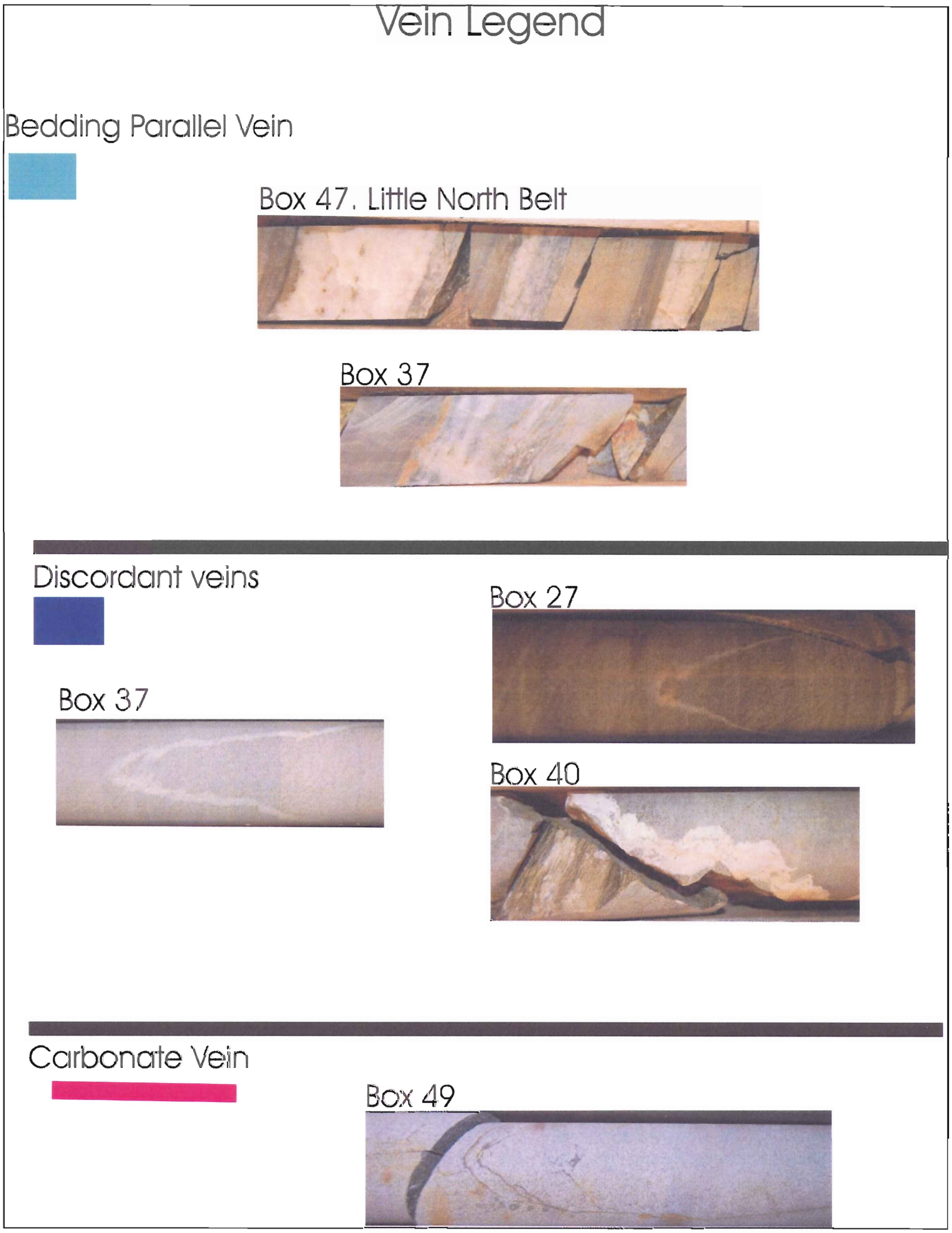

Figure 4.4. Vein legend

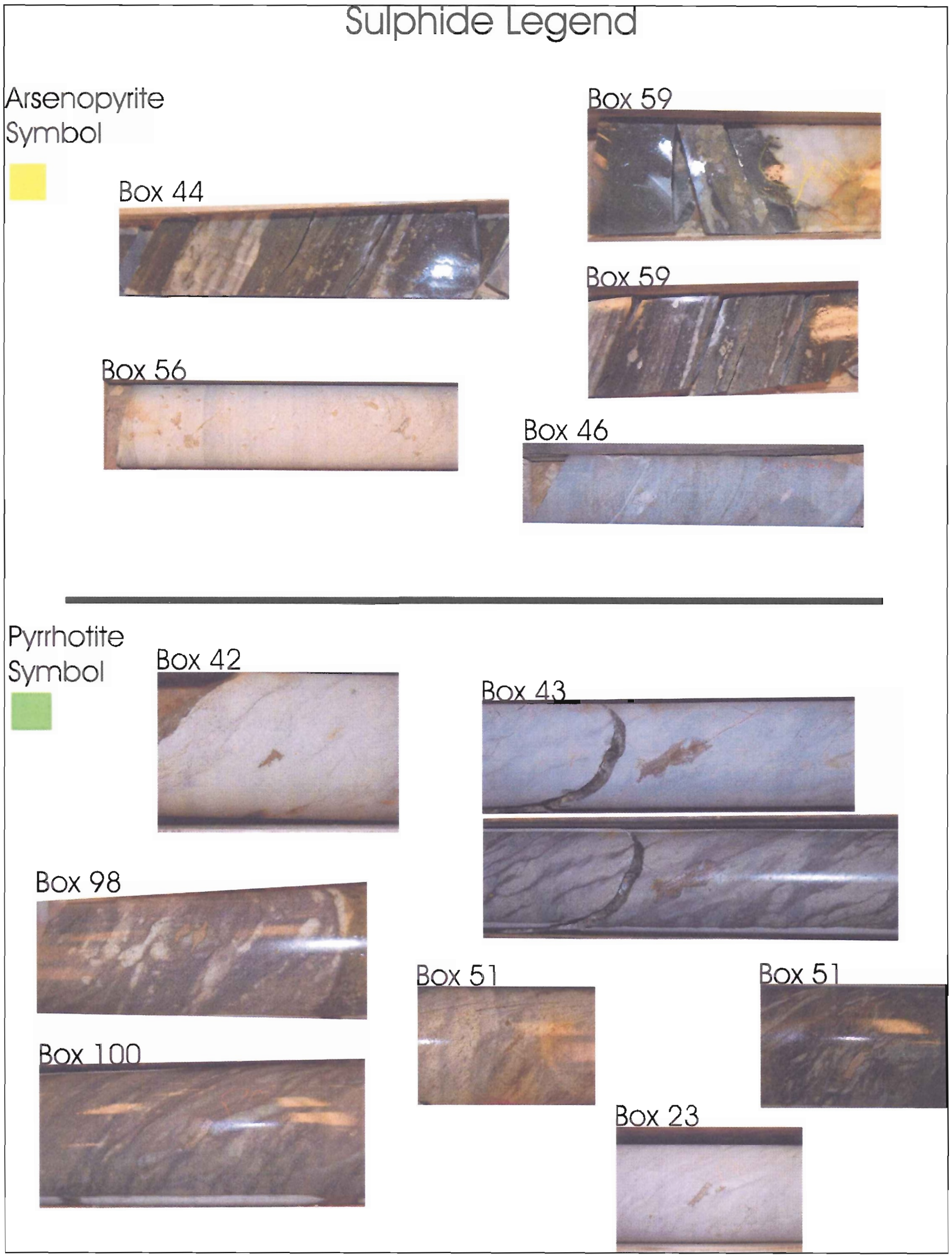

Figure 4.5. Sulphide Legend

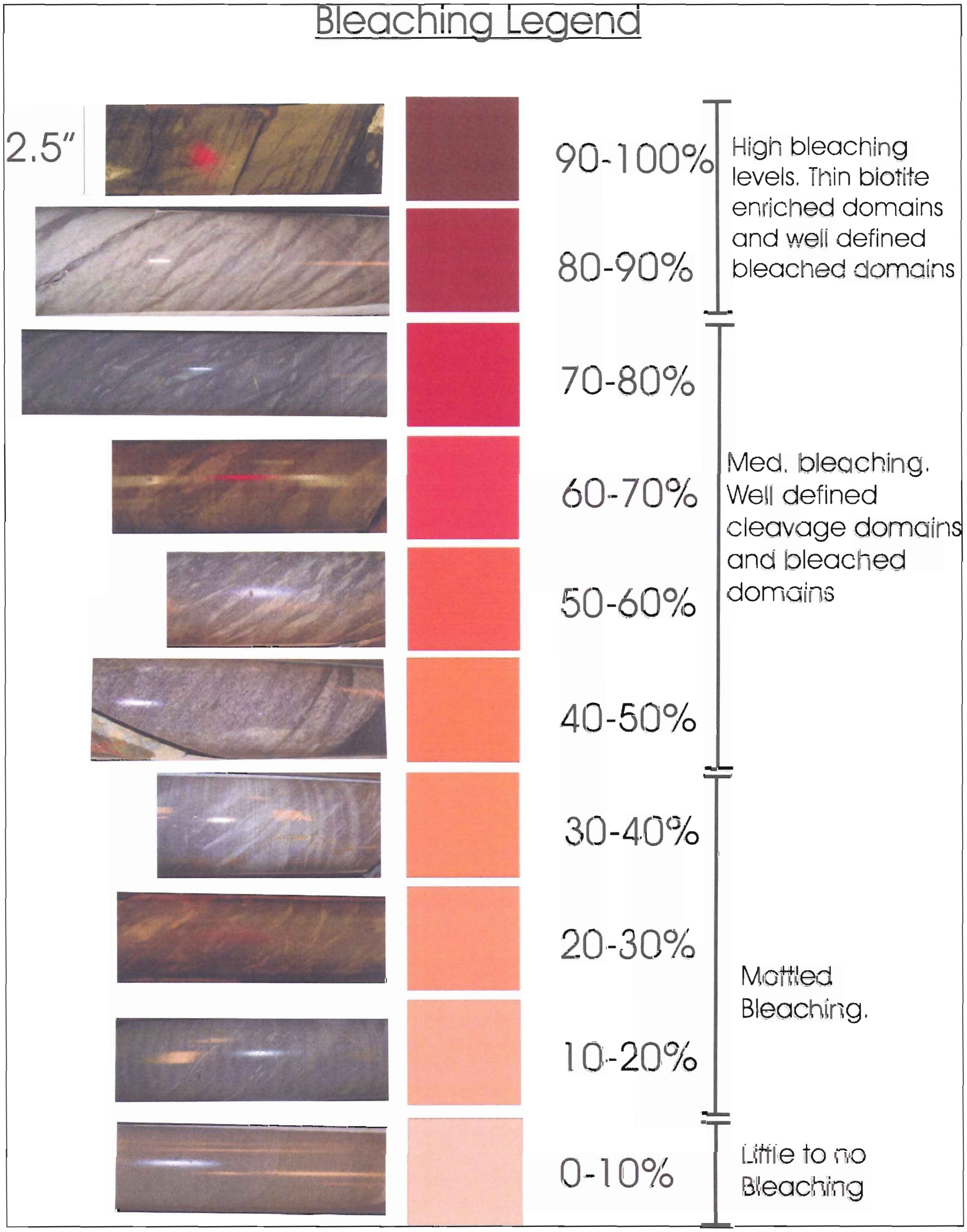

Figure 4.6 Bleaching Legend

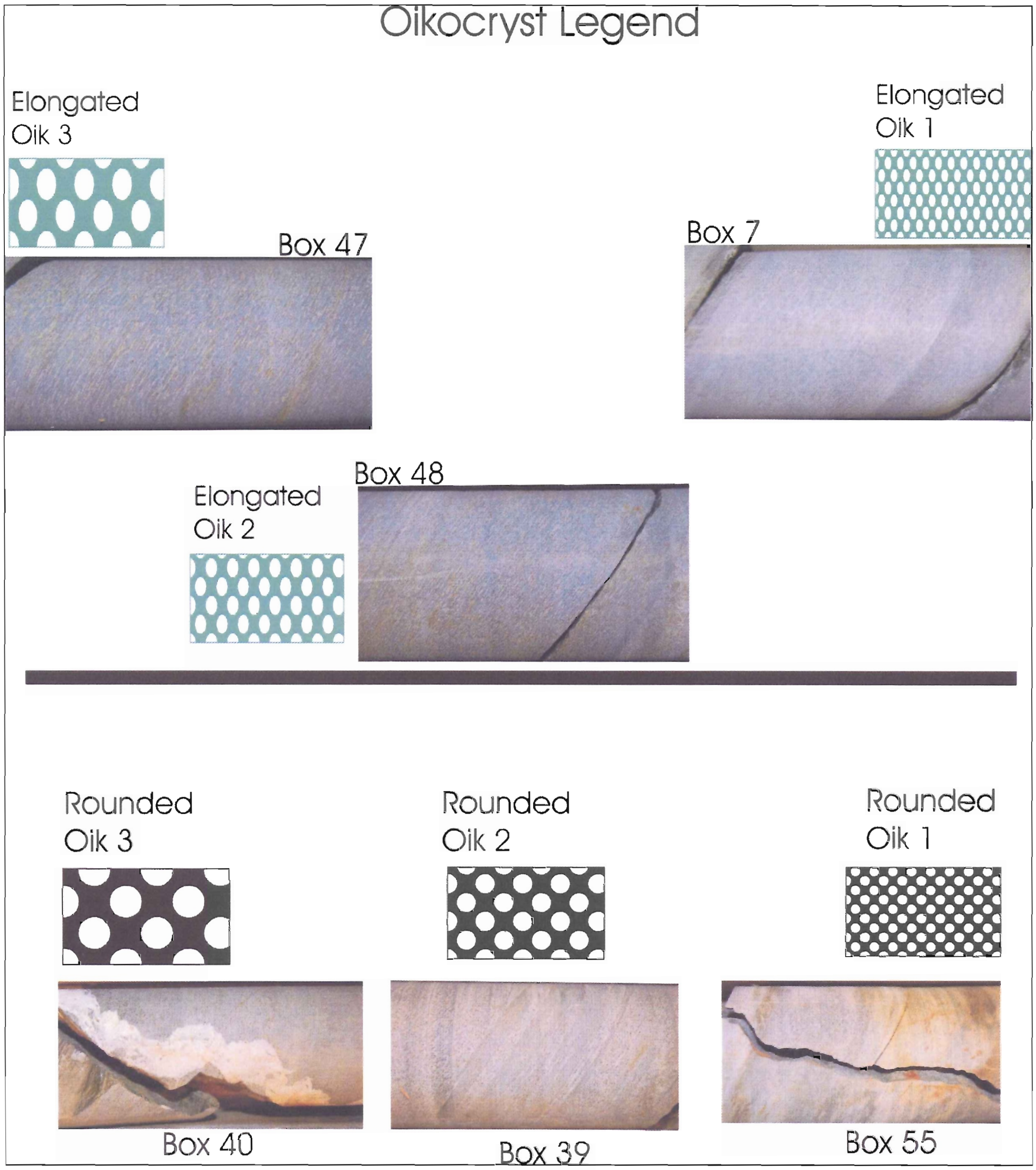

Fig. 4.7 Oikocryst Legend

5.0 RESULTS

Each feature is distributed in different ways. The main features seen all have differences in how they are distributed throughout the hole. This chapter is a review of the feature distribution throughout drill hole ML-03-86.

5.1 Megacycles

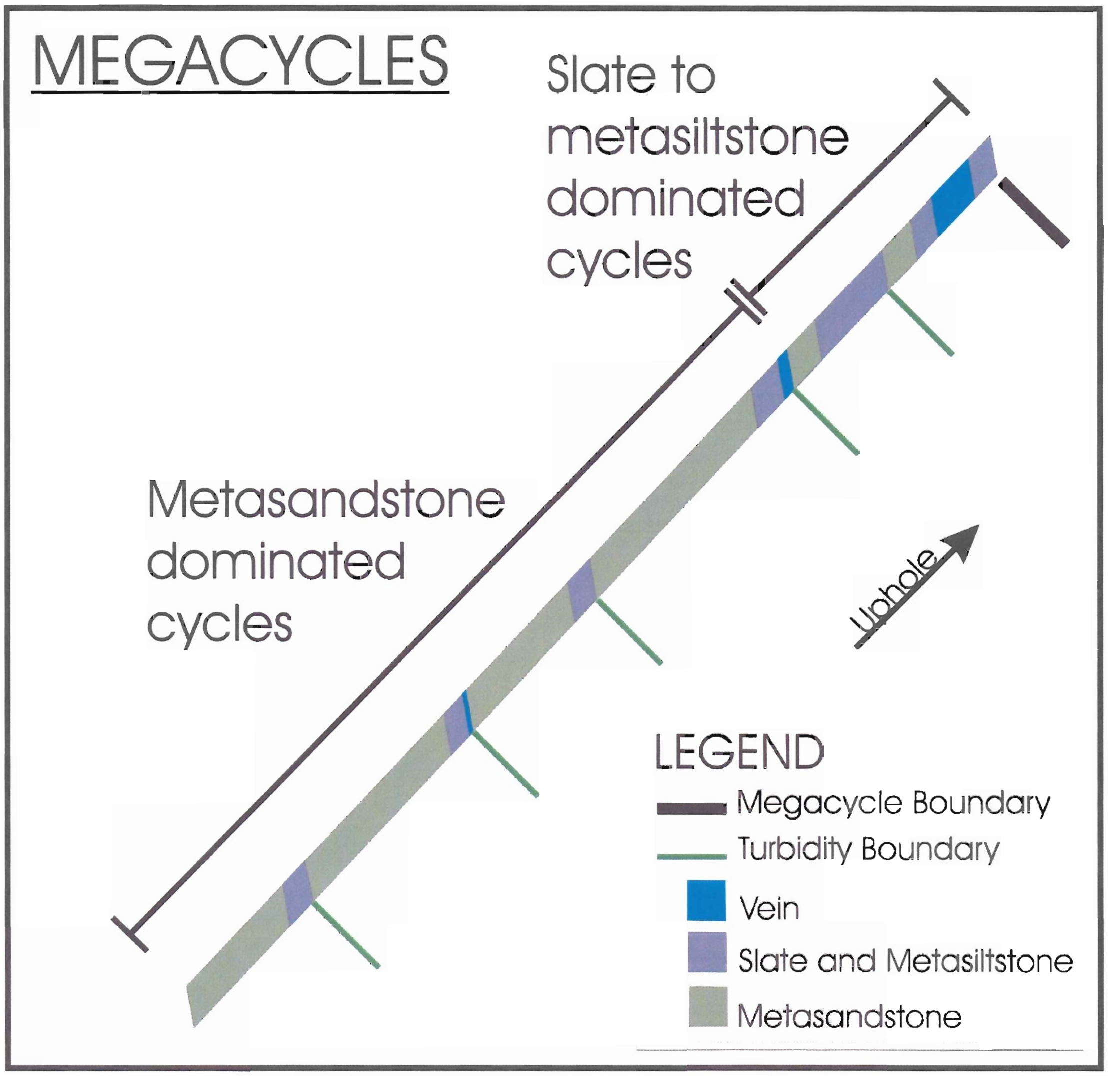

Figure 4.1. Example of a Megacycle Boundary

Figure 4.1 represents a single megacycle. The lower 4 turbidite cycles are metasandstone dominated and the upper 2 turbidite cycles are slate and metasiltstone dominated. The thick bedding parallel vein occurs at the top of the megacycle. 14 megacycles have been identified within the ML-03-86 drill core. Megacycles 1-9 follow the already outlined classification for the megacycle proposed by (Horne et al, 2003). The lower half of the drill core contains more easily defined megacycle boundaries. There are 9 Megacycles in the lower 116.5m. These cycles have clearly defined divisions with predominate metasandstone cycles and predominant metasiltatone-slate cycles.

Megacycle	Length
1	13.3m
2	19.3m
3	8.4m
4	16.0m
5	11.7m
6	6.9m
7	12.3m
8	12.1m
9	16.4m

Table 5.1. Megacycle Lengths

Average Length = 13.0m

The top 104m of the drill core is predominantly metasandstone. Based on this, Megacycle boundaries are hard to establish. There is less veining in the top 104m of the core due to the distance away from the anticline hinge. Bedding Parallel veins were located in the shale-siltstone intervals of megacycles 14, 13, and 11. Although megacycle boundaries do not work for the top 104m of drill core ML-03-86, they were estimated on the interpreted cross section (appendix A).

5.2 Veins

There are 26 bedding parallel veins within the ML-03-86 drill core. There is an abundant amount of discordant veins with varying classifications.
Discordant veins could not be further classified because only one drill core was assessed. Veins that were not bedding parallel had to be classified as discordant. Little interpretation could be made about discordant veins because of the wide range.

Several bedding concordant veins occur, including laminated bedding parallel, en echelon vein arrays, and saddle reef veins (Horne, 2003). The formation of saddle reef veins in chevron folds is well understood. Other deposits in the Meguma are described as flexural folding, saddle reef, such as the Dufferin gold deposit (Horne and Jodrey, 2001; Malcolm 1929).

5.3 Bleaching

Smith and Kontak (1986) and Kontak and Smith (1986) have reported alteration of wall rock associated with quartz vein mineralization in 29 of the 30 gold districts in the eastern Meguma Group. They also report that silification is one of the dominant alteration types with thicknesses of 10mm to tens of meters.

The metasandstone in the drill core has a characteristic alteration which is very noticeable and impressive of all the alteration types. The silification effect is recognized by the bleached white colour and mottled texture. The alteration zones have dominant quartz mineralogy, which gives off the white colour. In some areas the altered zones have a greenish colour which reflects the chloritization of biotite (Horne, 2003).

Metasandstone in the Goldenville has a dark grey - blue or brownish colour with medium-grained equigranular texture, that contrasts with the bleached greywacke (Kontak and Smith, 1986). The bleaching alteration grades from mottled and spotted textures to intensely altered areas. In some cases the bleaching is extreme enough to form fine grained, granular quartz veins (Kontak and Smith, 1986).

Stratigraphy will govern where intense bleaching will occur. The metasandstone bears the intense bleached alteration and truncation occurs as the lithology grades into the metasiltstone and slate. The silification in the metasandstones is easily recognizable and metasiltstones and slates do not provide convincing evidence for levels of bleaching alteration. The dark colour of siltstones and slates makes visual recognition of hydrothermal bleaching difficult.

It is thought that the alteration is strongly controlled by fracture patterns in places which determine the size and intensity of alteration (Kontak and Smith, 1986). Alteration is also thought to have been controlled by hydrothermal fluids circulating though the area from the Musquoidoboit Batholith (Kontak and Smith, 1990).

Bleaching is situated in the metasandstone at tops of cycles and throughout thick metasandstone dominated turbidity cycles. Bleaching alteration is spatially related to metasandstone, pyrrhotite, and arsenopyrite. The relationship between bleaching and arsenopyrite mineralization is minor.

5.3.1 Highly Bleached Sandstones

Within the deposit there are well defined areas where intense hydrothermal alteration is documented. The intensely bleached areas are located throughout ML-03-86 and examples are given in figure 5.1. In the example there are clearly defined domains of biotite rich material and clearly defined areas of silica rich material. Each is a visual representation of intensely bleached areas within ML-03-86 without depths given. During the core lab interpretation the pressure solution cleavage had a reaction to acid that could only be viewed under binocular microscope. This suggests that there is carbonate in the pressure solution cleavage.

The most consistent and intense (80-90%) bleaching in the entire core occurs at depth 214.0m to 220.5m. This area is located in the hinge zone and the strong bleaching suggests that intense deformation has taken place. Intense deformation at the Mooseland site has been documented by Kontak and Smith (1990a), as extreme shortening of veins.

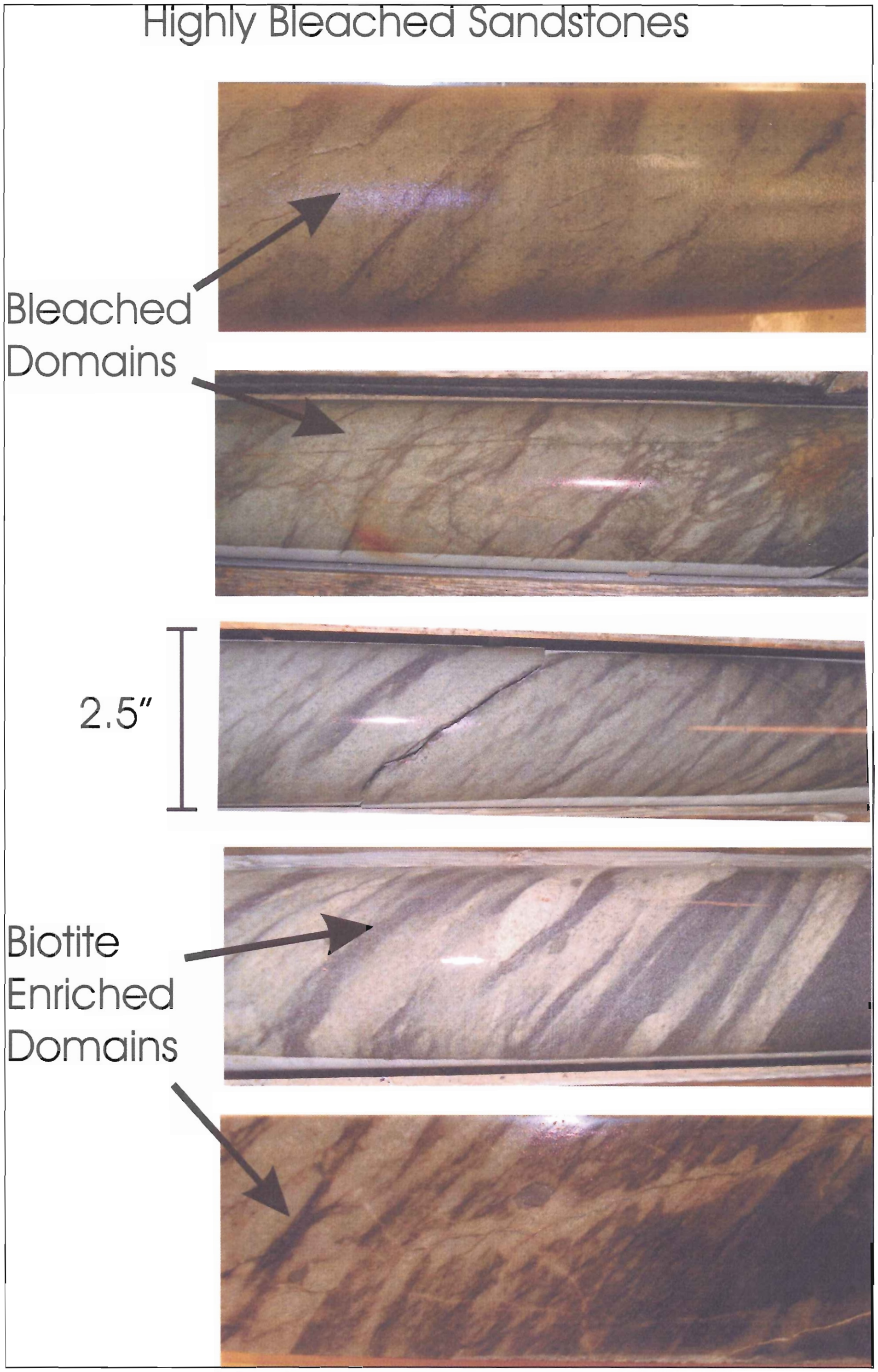

Figure 5.2. Highly Bleached Sandstones

5.3.2 Slate-Metasiltstone Bleaching

Bleaching associated with metasiltstone and shale lithologies is very intense. This is because of the low permeability in these lithologies and the dark colour of pelites. Two examples are seen in figure 5.2. In both of these cases bleaching is near two bedding parallel veins, one, being the Little North belt located 145 meters at depth in the drill core. In this section there is strong bleaching, abundant arsenopyrite, and a bedding parallel vein belt. The other example, seen near BP vein 7 has very strong bleaching and arsenopyrite that grade away from the bedding parallel vein.

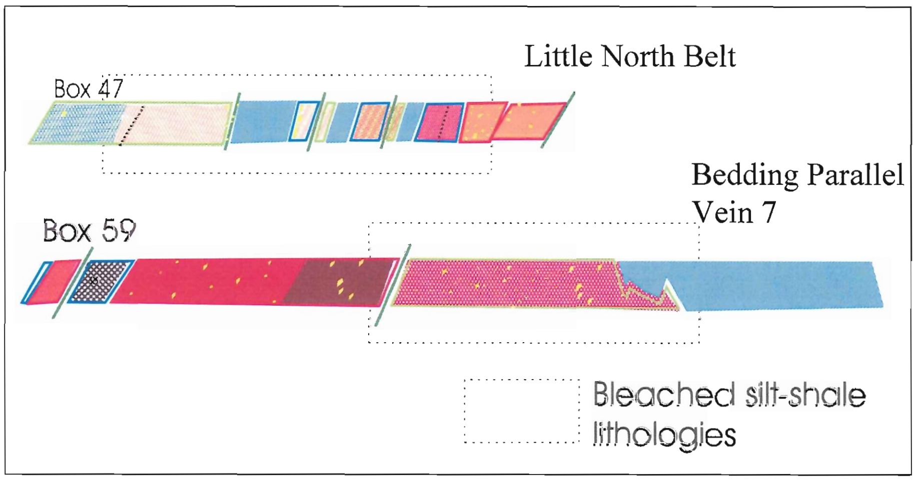

Figure 5.3 Bleached metasiltstone and slate lithologies

5.3.3 Sandstone Tops

It is important to recognize the strongly bleached areas near veins and at tops of sandstone beds. There are many areas in the drill core where bleaching is intense at the tops of the metasandstone beds and decreases in intensity towards the bottom of the metasandstone beds.

5.4 Carbonate Veins

Carbonate veins are widespread in the metasandstone in drill core ML-03-06. The veins were abundant and every vein could not have been represented in appendix A. It must also be noted that abundant, thick carbonate veins are found in the highly bleached areas. A good example can be seen at depth 198.5m.

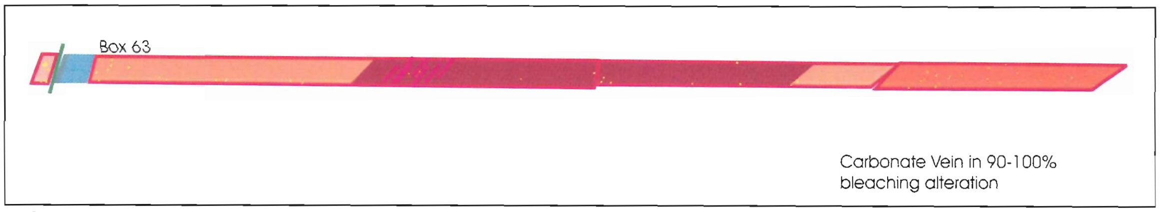

Figure 5.4 carbonate veins in strongly bleached areas

In the example the group of carbonate veins is located at the top of a 90-100% bleaching zone. The carbonate abundance inside and outside of the deposit may be explained by hydrothermal alteration (Macdonald, 1998). Within drill core ML-03-86, carbonate veining is common throughout. In some strongly silicified areas there are several carbonate veins that may have association.

5.5 Oikocrysts

There are 23 different oikocryst zones that are labelled higher than level 1. Most slate within the drill core exhibited oikocrysts that were of level 1 elongate and equant. Generally, the size of the oikocrysts increased down hole and there was strong correlation with size of oikocrysts and veining. All of the oikocryst zones marked above level 1 are shown in Appendix A.

5.6 Pyrrhotite

In the past pyrrhotite was found in irregular concentrations in metasiltstone and slate intervals. It has been found that pyrrhotite is lithologically controlled and it defines a down dip lineation similar to oikocrysts (Horne, 2003). Pyrrhotite also occurs in the metasandstone intervals as disseminated grains and coarse aggregates. Some aggregate pyrrhotite in the metasandstone intervals have rims of arsenopyrite. In documented cases wallrock contains large amounts of pyrrhotite with associated arsenopyrite and chlorite. Pyrrhotite is found throughout the Meguma Group but is more concentrated within the veined areas.

5.6.1 Results of Pyrrhotite

Pyrrhotite locally occurs in anomalous concentrations in metasiltstones and slates (Horne et al, 2003). Within drill core ML-03-86 pyrrhotite mineralization is closely situated in the strongly bleached areas. Mineralization of grains or groups of grains occurs in or less than 0.5m away from the bleached zones. Pyrrhotite zones are seen in areas where strong bleaching has occurred. Pyrrhotite is also seen in 30-40% bleached areas but surrounding rock will only have 0-10% bleaching. 59 different pyrrhotite zones were classified within the ML-03-86 hole and of those, 52 were found in areas of strong bleaching. The seven zones with low bleaching are located near features that may have resulted in its presence.

Four pyrrhotite zones in low bleached areas are associated with discordant veins. This occurs in Boxes 28, 30, 36, and 51 viewable in figure 5.4.

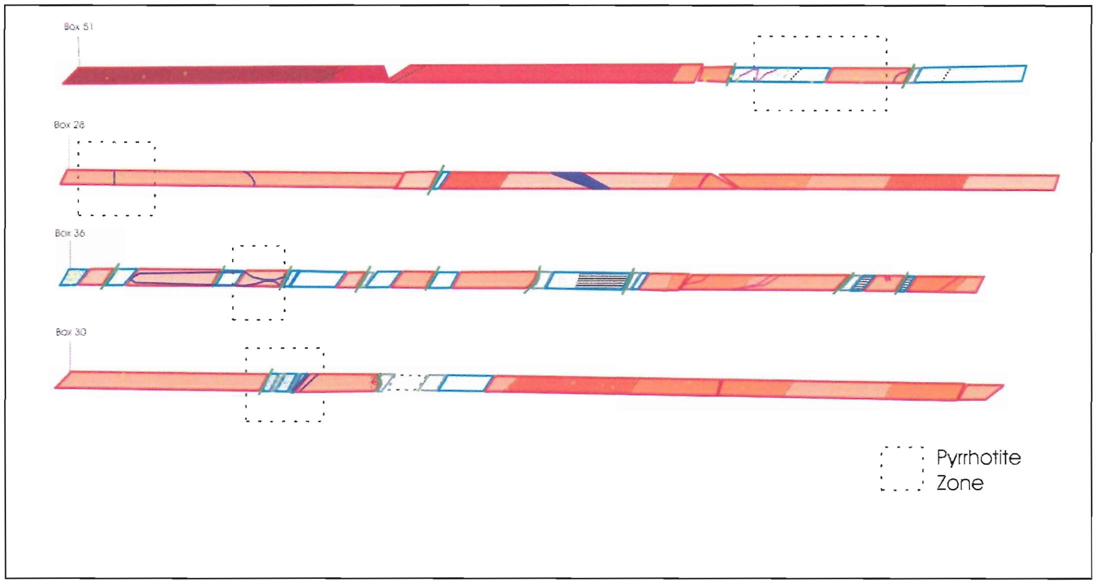

Figure 5.5 Pyrrhotite in a zone of low bleaching.

In Boxes 18, and 29, pyrrhotite mineralization and bleaching occur at the tops of turbidite cycles. These areas may have features that are situated outside of drill core ML-03-86.

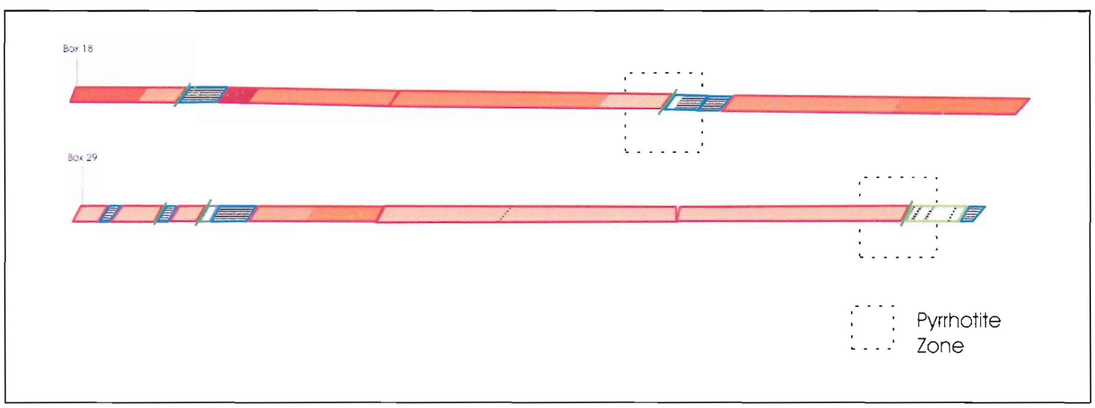

Figure 5.6 Pyrrhotite associated with tops of turbidite cycles

Box 10 contains a pyrrhotite zone in a 10-20% bleached zone. The zone is located in a thick sand sequence with low bleaching throughout and intense bleaching at the top.

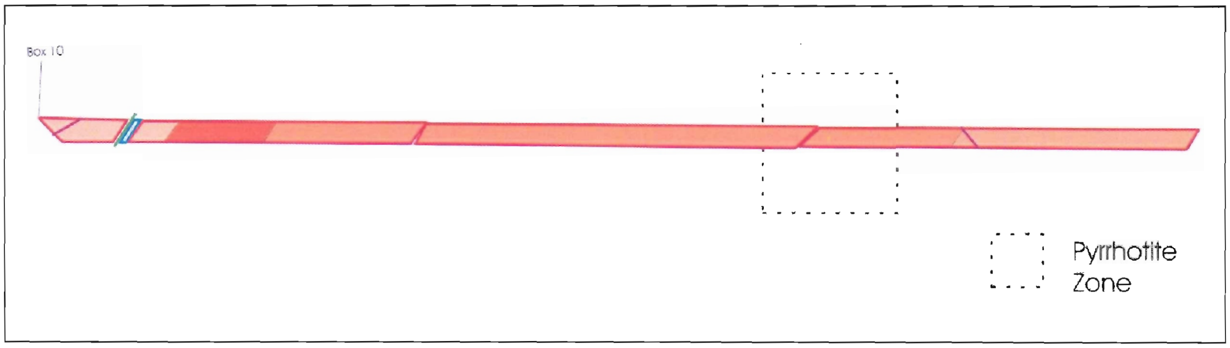

Figure 5.7 Unassociated Pyrrhotite

5.7 Arsenopyrite

Arsenopyrite is common in wallrock adjacent to veins, typical of Meguma deposits. Lithology controls the extent of arsenopyrite, where high concentrations of arsenopyrite found in wallrock metasandstone and metasiltstone and low concentrations are found in wallrock slate. The slates contain fine grained arsenopyrite which could not be observed through binocular microscope.

Arsenopyrite in metasandstone is normally disseminated within the rock with well formed twinned crystals up to 3cm in diameter (Sangster, 1990). Within the slate intervals arsenopyrite is fine grained and occurs in bands parallel to lithology. Overall the arsenopyrite minerals have a lithological control on their size. Arsenopyrite is found close to bedding parallel veins and discordant veins. They have minor association with bleaching alteration. Most arsenopyrite is found at depth where the dominant veins occur. Overall the occurences of arsenopyrite increases down hole.

There are 43 recognized arsenopyrite zones within ML-03-86 and 32 are associated with veining, and 8 are associated with bleaching alteration. The zones associated with veining increase down hole due to the increase in the number of veins. The thick saddle reef veins have the largest accumulations of arsenopyrite. These zones have been previously documented in the Little North Belt, Bismark Belt, and the Cummings Belt (Horne, 2003).

In some cases arsenopyrite is directly associated with bleaching. This Occurs at depths 165.50m, 159.0m, 135.5m, 94.5m, 67.2m, 64.2m, 62.0m, and 53.9m. These examples show that there is a minor relation between arsenopyrite mineralization and bleaching.

5.7.2 Graded Arsenopyrite

Many examples show that arsenopyrite grades away from veins. An example of this is illustrated in Figure 5.7 where the zone is seen near bedding parallel vein 1 at 210.0m.

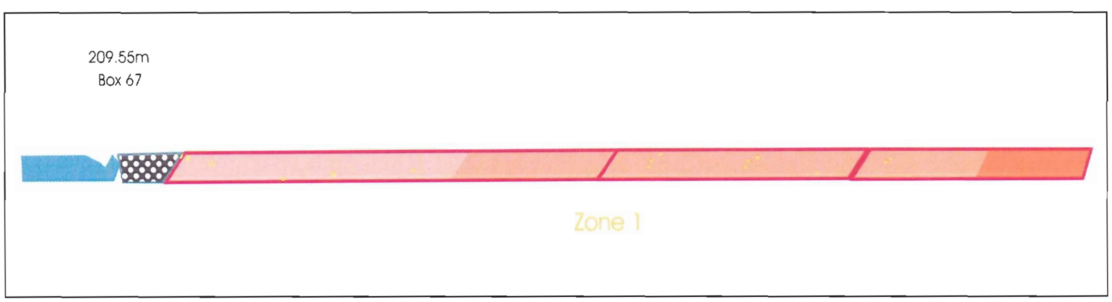

Figure 5.8 Graded Arsenopyrite

Above and below the slate-vein interval you see arsenopyrite grade away from the bedding parallel vein. Many graded arsenopyrite zones occur below the bedding parallel veins.

5.7.3 Pressure Shadows

Quartz pressure shadows on sulphide minerals show a downdip lineation implying fold related strain similar to oikocrysts (Horne, 2003). The pressure shadows were developed in a zone of low stress where the particle boundary is at a high angle to the maximum compressive stress. Silica in solution migrates in the low stress area and precipitate as overgrowths (Twiss and Moore, 1992). Although the pressure solution cleavages were not recorded on the drill core poster they generally increase in abundance downhole.

5.8 Auriferous Veins

Of the 16 samples tested using the sieve-for-metallic assay method, there were 2 that ran over 1 gram/tonne Au. These occurred at depths 137m and 147m and have gold levels of 7.48 g/T and 36.35 g/T (Covey and Albert, 2004). Figure 5.83 illustrates these intervals are where arsenopyrite is abundant at both depths and bleaching alteration is abundant around the 147m depth Little North Belt. There were 2 interpreted sections that had bleaching alteration found in the metasiltstone and slate. These can be located near the Little North Belt at 147m and near bedding parallel vein 7 at 187m. Both of these examples have increased amounts of arsenopyrite grains (Horne, et al. 2003) have shown that gold has a direct relationship with abundant arsenopyrite grains.

The Little North Belt has limited exposure, and elevated assays and visible gold appear to be restricted to the areas where angular veins merge with bedding parallel veins (Horne, 2003).

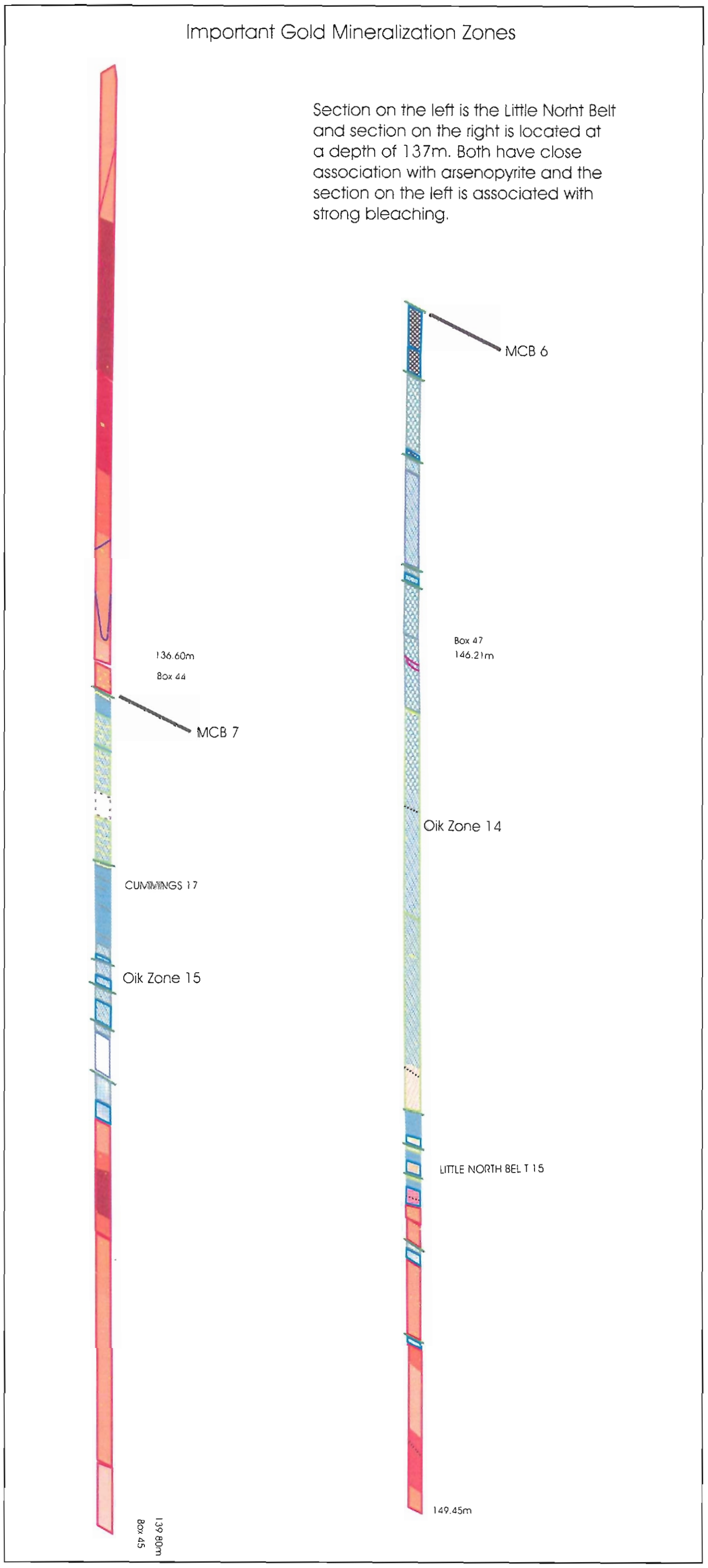

Figure 5.9 Auriferous Veins

5.9 Errors

Core logging requires detailed description and human error is a factor. Most of the core logging was based on the assumption that the core was not tampered with prior to interpretation. Each core box has been inspected twice because of uncertainties at the beginning of the study.

A large problem encountered was the classification between metasiltstone and slate. The two are distinguishable under binocular microscope, but with the presence of oikocrysts, there may be discrepancy. The oikocrysts are generally coarse grained when viewed non-parallel to a cleavage plane and lithologies appear coarser grained then they actually are.

Veins were either classified as concordant or discordant. Discordant veins could not have been further subdivided as there was only one drill-hole interpretation. Bedding concordant veins were based on the facts that they occurred at the top of turbidite cycles and that they were bedding parallel. These bedding parallel veins may have altered their position within the turbidite cycle along the Mooseland-Gegogan Anticline. The nature of the veins outside of the drill hole is ambiguous.

6.0 DISCUSSION

The spatial relationships seen could have only been recognized with this type of evaluation. The relationships are easily interpreted when there is repetition. Overall there are 6 relationships seen within the ML-03-86 drill core: veins to oikocrysts, veins to arsenopyrite, bleaching to pyrrhotite, bleaching to arsenopyrite, veins to bleaching, and bleaching to oikocrysts to lithologies.

6.1 Relationship of Veins and Oikocrysts

Of the 23 recognized oikocryst zones above level 1, only four zones are not recognized with veining. These can be found in zones 19, 16, 13, and 11. This implies that there is a strong relationship between oikocrysts and veining.

6.2 Relationship of Arsenopyrite and Veins

Of the 43 different recognized arsenopyrite zones in drill core ML-03-86, there are 32 different zones that are associated with veining. The bulk of these zones occur in the lower half of the drill hole. This is due to the increased amount of quartz veining. The thick bedding concordant veins near the hinge zone have the strongest presence of arsenopyrite.

Of the 43 recognized arsenopyrite zones, three of the zones were associated with tops of cycles with no veining. This can be seen in zone 21, 23 and 23. All of these are closely situated to cycle tops with no association with quartz veining.

6.3 Relationship of Bleaching and Pyrrhotite

Within drill core ML-03-86 pyrrhotite mineralization is closely situated in the strongly bleached altered areas. Most zones are seen in areas where strong bleaching has occurred. Pyrrhotite is located in 30-40% bleached areas but surrounding rock only has 0-10% bleaching.

Pyrrhotite occurs in the host rocks of many of the deposits. It has similar habits to arsenopyrite and occurs as disseminated ovoid shapes (Sangster, 1990) with the long axis parallel to pressure solution cleavage (Horne, 2003). This type of alteration has been documented in metasandstone lithologies where it is seen to postdate and retrogress regional metamorphic minerals and fabrics (Kontak and Smith, 1990). Alteration, has previously been considered absent within Meguma gold deposits (Boyle 1979, 1989). Silification or bleaching alteration is widespread within the Mooseland gold deposit and the close proximity with pyrrhotite implies that bleaching has association with pyrrhotite mineralization.

Kontak and Smith (1987) have reported that sulphides may be introduced by alteration mechanisms. This study has documented that pyrrhotite has strong connection to bleaching. There is also evidence that pyrrhotite has minor association with discordant veins.

6.4 Relationship of Bleaching and Arsenopyrite

There are 8 recognized areas of arsenopyrite mineralization that occur in strongly bleached areas. The Arsenopyrite mineralization that has occurred is in strong accordance with bleaching. We see this in zones 37, 36, 35, 34, 31, 28, 20, 18 and 16. Pyrrhotite is also seen in some of these areas.

6.5 Relationship of Bleaching and Veins

Within Drill Core ML-03-86 bleaching greater then 50% was spatially related to bedding parallel veins. Of the 28 interpreted bedding parallel veins, 18 had strong bleaching situated less then 0.5m away. Most of the bleached areas were stratigraphically below the bedding parallel veins. An example of this can be seen at the 40 meter drill core depth located in figure 6.1. In this example you can see strong bleaching below the bedding parallel vein and it is situated at the top of a small turbidite cycle. Bleaching below the bedding parallel vein has 60-70% intensity and an associated pyrrhotite zone. Also, at the bottom of box 13 a bedding parallel vein has close proximity to 80-90% bleaching intensity. The bleaching is situated above the bedding parallel vein. There are very few examples of bleaching directly above the bedding parallel veins.

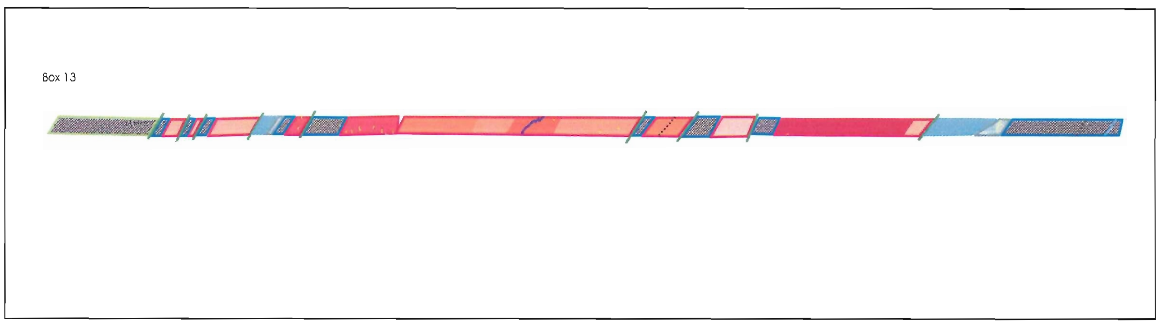

Figure 6.1 Bleaching observed at 40m depth.

The recognition of bleaching and spatial relationship to bedding parallel veins may have implications, but there is no definite relation of the two and further study will be needed.

6.6 Implications

A plausible explaination for bleaching alteration is pressure solution. Volume loss during cleavage development is accomplished by solution and removal of material from folded layers (Twiss and Moore, 2006). Pressure solution in varying lithologies will result in the cleavage domains that are platy mineral rich and quartz rich domains.

Within the metasandstones the pressure solution cleavage that develops have cleavage domains that are concentrated in biotite and bleaching domains that are concentrated in silica. The spacing between pressure solution cleavages is generally on the centimetre scale.

The dissolved material has migrated through metasandstones, by either grain boundary diffusion over short distances or by transport in a fluid flow through pores and fractures over great distances (Twiss and Moore, 1992). This idea of silica rich fluids migrating through fractures is illustrated in figure 6.2. This example can be located at 138.5m in appendix A. This section is located below the Cummings Belt. The example was taken at a metasandstone-metasiltstone gradational contact where a fracture with 100-90% bleaching and arsenopyrite grains are located. This figure shows that silica rich fluids migrated through fractures near bedding parallel veins; however, the relationship between bleaching and veining is inconclusive.

The dissolved material reprecipitates in the bleached zones where it overgrows prexisting assemblages, as described (Kontak, 1990a). A possible explanation is that the dissolved material that migrates will concentrate itself at the tops of the metasandstone beds because it is less dense. Alone, this study focuses on core sample description and the relationships of features within the Mooseland gold deposit. To fully support this idea further studies are needed in Meguma gold deposits.

Bleached Zone at 138.5m Depth

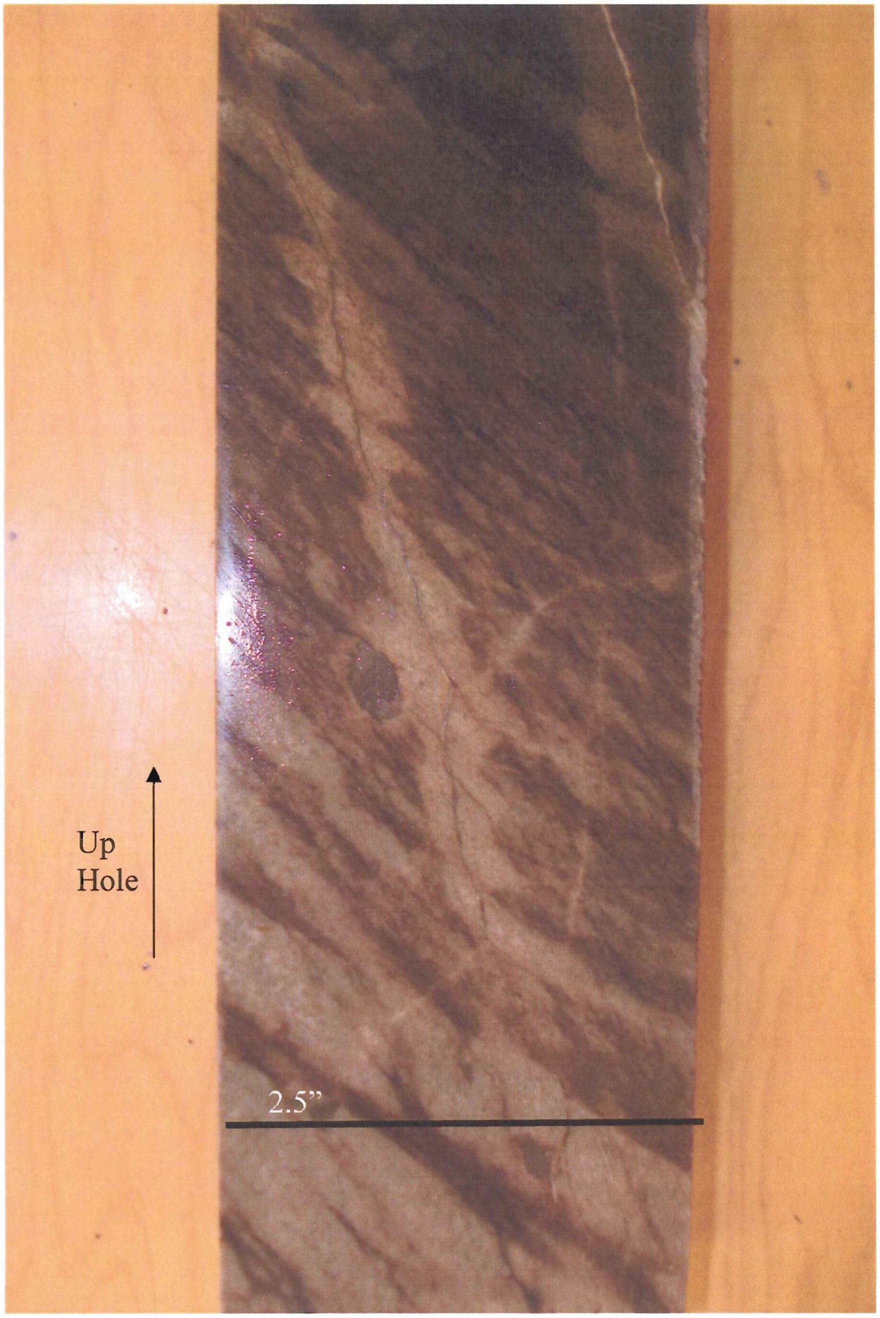

Figure 6.2. Highly bleached area along fracture surface.

The study was done to document features that are present within the Mooseland gold district. All of the documented features are convincing arguments with implications to the origin of the deposit. Outside of the Mooseland Gold district the features of veining, bleaching, sulphides, oikocrysts, are relatively unaccounted for. All of these generally occur together in the deposit where veining occurs.

The debate as to weather alteration is present in the Meguma gold deposits was somewhat addressed in this study. The alteration products have been largely unrecognized and there needs to be more similar studies done on other Meguma gold deposits. Bleaching of wall rock cannot be fully evaluated in this type of study, but the appearance of bleaching throughout a Meguma gold deposit is recognized.

Previous work by Graves and Zentilli (1982) has shown that many bedding parallel veins predate the major folds and are not saddle reef deposits. From this study the bedding parallel veins thicken towards the hinge, which is a characteristic of a saddle reef deposit. Kontak et al, (1990a) stated that hydrothermal alteration is widespread within the Meguma gold deposits. This study documents the widespread nature of bleaching throughout the Mooseland deposit. Kerswill (1987, 1988) interpreted that alteration was not associated with auriferous bedding parallel veins. From this study the silicification alteration is associated with the deposit but there is little correlation with individual gold rich bedding parallel veins.

7.0 CONCLUSION

Few studies have been completed which present an interpreted drill core from a Meguma gold deposit. This study gives more information on the nature of the Mooseland deposit. This study has provided a number of conclusions which helps define the Mooseland gold district as a possible analogue for other deposits within the Meguma Group.

1. This study documents the succession and nature of the turbidite cycles which has important implications for vein emplacement. Within the deposit there were more bedding parallel veins than expected.
2. The study documents the widespread bleaching alteration in the Mooseland gold deposit and how it is distributed. The Mooseland gold deposit has pervasive silica alteration that can have implications for other deposits.
3. Arsenopyrite within the Mooseland deposit is mainly veinlet controlled and generally increased down hole.
4. Bleaching in the Mooseland deposit is clearly associated with pyrrhotite mineralization and there is a minor association with arsenopyrite.
5. Large oikocrysts are spatially associated varying vein types. The size of oikocrysts varied, base on closeness to veins.

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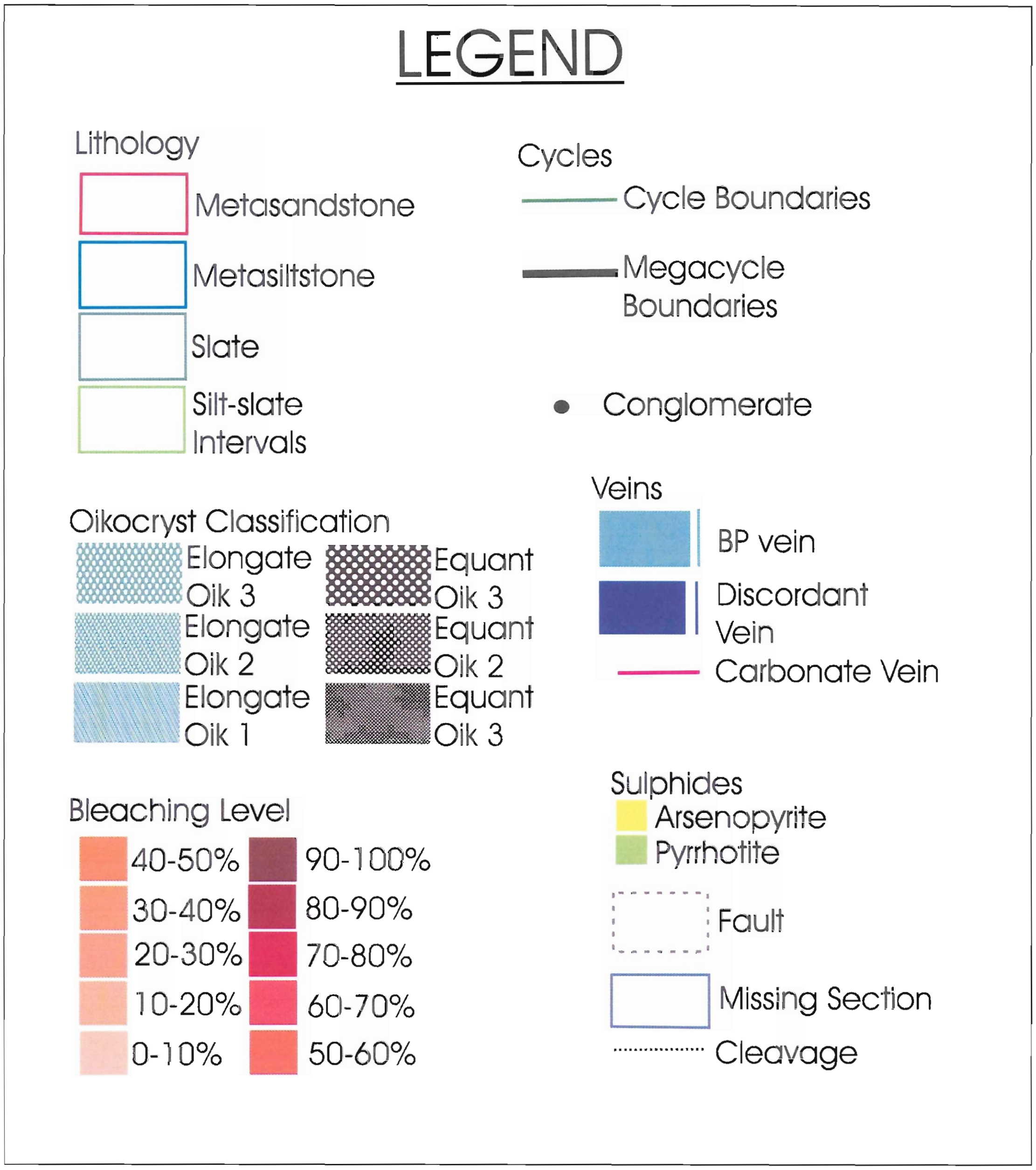
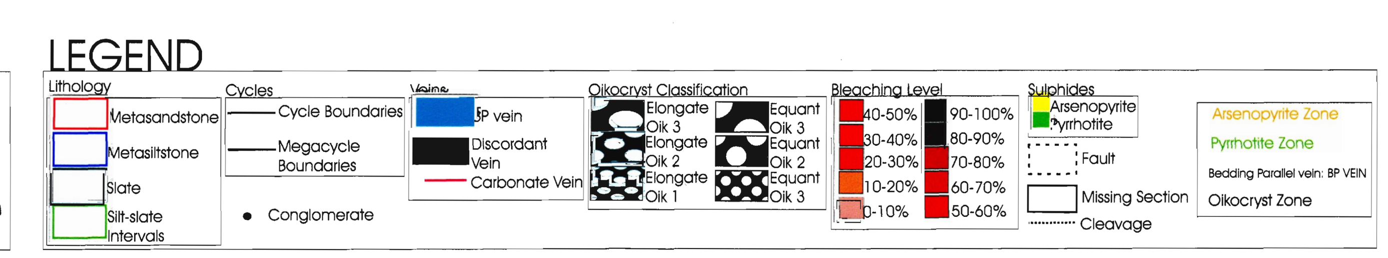
Appendix A: ML-03-86 interpretation



Drill Hole ML-03-86 Interpretation



ML-03-86 interpretation by Bryan Rae
March 2007.

Drill hole provided by Azure Resource Corp.
Drill hole was part of underground exploration program from April 2003 - March 2004.

ML-03-86 core photos: attached on cd.