2. VOLCANOGENIC DEPOSITS: STIRLING

Stirling (Mindamar) mine site. Glory holes (flooded) with tailings on right.

2.1 INTRODUCTION

Volcanogenic-hosted massive sulphide deposits are widespread, both geographically and geologically, and contribute a major part of the world's base metal supply.

Typically these deposits consist of > 90% iron sulphide, usually as pyrite, but also as pyrrhotite in some deposits. They are generally stratiform, lenticular to sheet-like bodies developed at the contacts between volcanic units or at volcanic-sedimentary interfaces. Typically the deposits are conformable and commonly they are banded; it was only in the 1950s that they were recognized to be syngenetic, submarine sedimentary exhalative, rather than replacement, deposits. The processes of formation of such deposits can be studied today in the deep ocean basins and such research has extended our understanding of the processes involved.

Volcanic-associated massive sulphide deposits show a progression of types based on host rock, palaeotectonic setting and mineralogy. **Cyprus-type** deposits are essentially cupriferous pyritic bodies associated with basic volcanics (ophiolites) which were formed at oceanic or back-arc spreading centres or ridges. **Besshi-type** volcanogenic massive sulphides are associated with the early part of the main calc-alkaline stage of island arc formation and thus occur in mafic volcanics in complex structural settings which are characterized by thick greywacke sequences. They commonly carry zinc in addition to copper. The **Kuroko-type** volcanogenic massive sulphides are associated with the more felsic volcanism characteristic of the late stage of island-arc evolution. They are represented by the copper-zinc-lead ores (+ gold and silver) of the Canadian Shield and may contain barite and gypsum.

Stanton (1978) considered these ores to be part of one continuous spectrum showing a progressive chemical evolution coincident with the evolution of calc-alkaline rocks in island arcs. This view assists explanation of the overlap between the various types. It should be noted that Hutchinson

(1980) suggested that the polymetallic massive sulphides of the Canadian Shield should be assigned to a new class, the **Primitive-type,** which he defined as a variation of the Kuroko-type. Evans (1987) concluded that the confusion in determining the class of volcanogenic deposits may indeed be due to overlapping criteria and supports Stanton's view that they probably represent a continuing spectrum.

Whereas the submarine-hydrothermal origin of these deposits is well established and accepted, the ultimate source of the metals is still open to question. Whether the metals originated from a magmatic source or were leached from the crust by circulating waters is the subject of much debate. However, the processes of emplacement and, of equal importance, preservation of the deposits are widely accepted.

The characteristic features of volcanogenic massive sulphide deposits are well described in the literature and can be most useful in guiding exploration both before and after discovery. The major factor, from an exploration viewpoint, is that such deposits tend to cluster around volcanic domes occurring at irregular intervals along volcanic belts. It should be noted that the Kuroko deposits in Japan are associated with Miocene volcanics and sediments for 800 km of strike. More than 100 occurrences are known along the belt and most are clustered into nine districts. Thus, exploration outward from known centres is not only prudent, but is mandatory for continued discovery.

Within Nova Scotia the Stirling Volcanic Belt of southeastern Cape Breton Island is host to a massive sulphide deposit that has sustained production in the past. The Stirling deposit, described by Miller (1979) as a distal exhalative-sedimentary deposit of the Kuroko type, is used to illustrate this class.

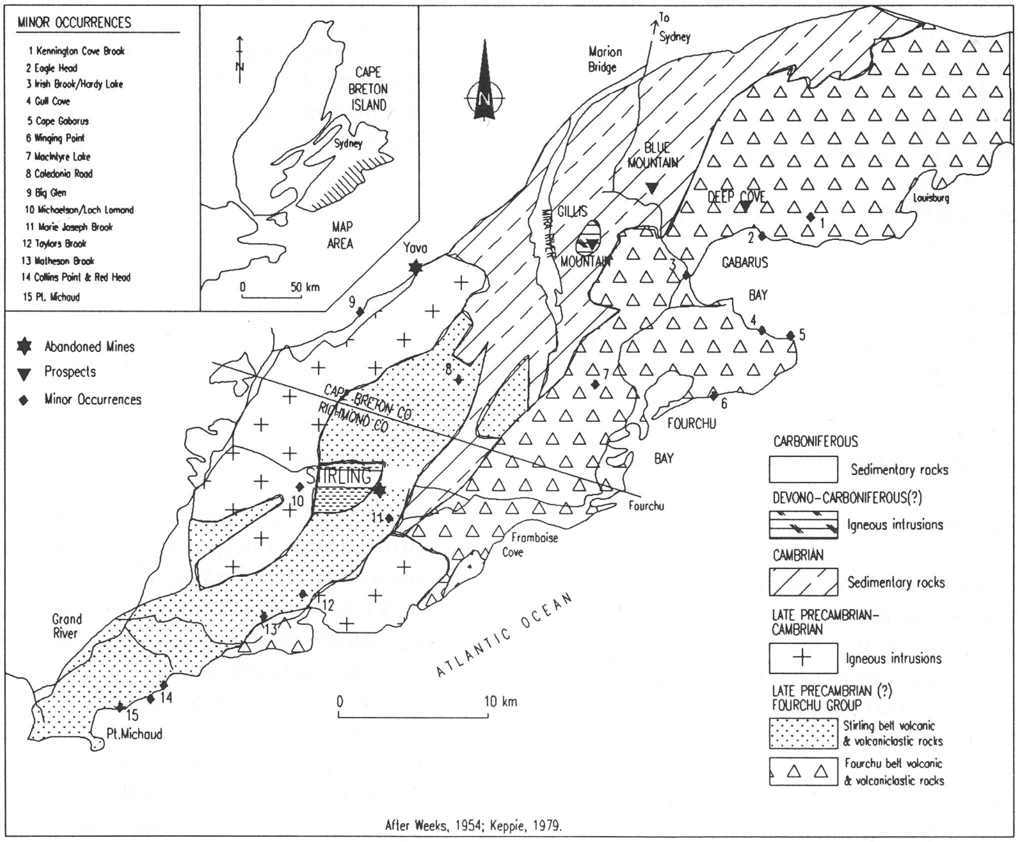

Figure 6. *Geological map of SE Cape Breton Island showing location of the Stirling deposit (Macdonald, 1989).*

2.2 LOCATION

The **Stirling** deposit, also known as the Mindamar Mine, is located in Richmond County, Cape Breton Island at 60° 25' W and 45° 44' N (Fig. 6). The deposit, on NTS map sheet 11F-9C, is situated approximately 72 km southwest of Sydney, from where it is accessed by paved and good secondary gravel roads.

2.3 EXPLORATION HISTORY

Mineralization was first discovered in Copper Brook in the 1890s and a small copper open-pit was mined very briefly in 1904. During investigations for zinc by Barytes Ltd. in 1915, fine-grained Zn-Pb-Cu sulphides were discovered in trenches. The complex metallurgical nature of this ore prevented exploitation at that time but exploration, including diamond-drilling and a small underground exploration program, continued up to 1925 but without success.

In 1927 British Metals, operating as Stirling Mines Ltd., deepened the old shaft to 240 m, carried out an underground development program and installed a 250 tpd mill. Mill capacity was increased to 300 tpd in 1930 but operations ceased in December 1931 due to low metal prices. Upon resumption of operations in 1935, 3400 m of development and 8200 m of diamond-drilling were carried out prior to cessation of operations in 1938.

In 1949 Mindamar Metals Corporation carried out an underground development program of sampling and diamond-drilling. Dome Explorations Ltd. assumed management of the Mindamar operation in 1951, installed a 500 tpd mill which was increased again to 650 tpd in 1954, and sank a new four-compartment shaft to 357 m. This operation continued to April 1956.

Between 1965 and 1969, Keltic Mining Corp. conducted ground geophysics and drilled 2500 m within the limits of the old workings without success. Penarroya then optioned the property from Keltic and drilled three holes without much encouragement.

Cominco staked the ground in 1972 and carried out geological mapping, airborne geophysics (EM-Mag-VLF), ground IP and magnetics, and diamond-drilling. In 1975 St. Joseph Explorations carried out airborne EM and magnetometer surveys and Amax Exploration Inc. conducted a reconnaissance silt and soil survey. Six drill holes (700 m) were drilled by Amax in 1981-82 and minor mineralized zones were was encountered.

In 1979 Cominco re-flew the area and conducted regional stream sediment geochemical and geological mapping surveys. This program revealed a number of outcrops of pyritic chemical sediments enriched in base and precious metal values some distance from the Stirling Mine. In the same year, A. S. Macdonald discovered mineralized chemical sediments to the south at Pt. Michaud Beach.

In 1983 Selco carried out an airborne EM survey over the general area. Falconbridge Ltd. carried out an airborne magnetic and EM survey in 1989 over their claim block located northeast of the mine area. They also completed an orientation lithogeochemistry survey. Diamond-drilling was undertaken by Falconbridge during 1991.

The former mine site and adjacent claims are currently held under Special Licence 4/83 issued to A. Douglas Hunter. Exploration has continued at a slow pace and has included 7456 m in 13 diamond-drill holes and a minor amount of orientation geophysics and lithogeochemistry. Further diamond-drilling was carried out in early 1992.

2.4 EVOLUTION OF MODELS

The first systematic mapping of the area was done by H. Fletcher in 1878, who ascribed the volcanic package to a pre-Silurian group. Matthew (1903) remapped the area and assigned a Cambrian age to the volcanics.

Cairnes (1917), in the first description of the Stirling area, interpreted the mineralization to be a metasomatic replacement of the host "andesitic" rocks and this replacement theory was supported by other authors between 1919 and 1959. Watson's detailed petrological studies (1954,1957 & 1959) interpreted the ore as a replacement phenomenon. Wilband (1962 & 1963) identified a full range of composition from rhyolite to basalt, while Helmstaedt and Tella (1973) indicated a calc-alkaline affinity for the Bourinot Group volcanics.

The emerging recognition that similar deposits elsewhere were volcanogenic in origin caused

Poole (1974) to suggest that the Mindamar deposit at Stirling was of synvolcanogenic derivation with superimposed tectonic, metamorphic and hydrothermal effects.

2.5 REGIONAL GEOLOGY

The rocks of SE Cape Breton Island are part of the Avalon Platform (Poole, 1967), Belt (Rodgers, 1972) or Zone (Williams et al., 1974), which stretches along the southeastern margin of the northern Appalachians from the Avalon Peninsula of SE Newfoundland through Nova Scotia, New Brunswick and into eastern Massachusetts (Helmstaedt and Tella, 1973). Segments of this belt are characterized by late Precambrian (Hadrynian) volcanic and intrusive rocks which have been affected by the Avalonian Orogeny (Rodgers, 1972) or Ganderian Orogeny (Kennedy, 1976).

Weeks (1954) used lithological evidence to suggest a Lower Cambrian age for the host Bourinot Group volcanic-sedimentary rock package in SE Cape Breton Island. Smith (1978) renamed these rocks the Giant Lake Complex, which he correlated with the Fourchu Group of possible Hadrynian age. Miller (1979) proposed a Middle Cambrian age for the group in the Stirling area. Macdonald (1989) agrees that the rocks in the belt may be a time correlative of the Fourchu Group though he sees some significant differences. He refers to this belt as the Stirling Volcanic Belt.

Macdonald (1989) describes the Stirling Volcanic Belt, extending for 50 km along a northeast - southwest direction, as containing a wide variety of metamorphosed volcanic, volcaniclastic and epiclastic rocks which have been intruded by an abundant suite of mafic sheets and by several granitoid plutons and related dyke rocks. Volcanic and pyroclastic rocks (80%) dominate the sequence and the pyroclastic component (50%) appears to increase gradually toward the northeast. Intermediate to mafic lava flows grade into flow breccias and coarse lithic tuffs, and chemical analyses indicate that these lavas are mainly basalts or basaltic andesites. Felsic lavas are also present and are represented by feldspar porphyritic dacites and quartz feldspar porphyritic rhyodacites. A variety of foliated intermediate to felsic tuffs are present throughout the belt but are most abundant in the northeastern part. Doyon and Van Wagoner (1992) recognize a lower unit comprising rhyolite flows, felsic pyroclastic and epiclastic rocks with laminated siltstone, dolomite and minor chert in the northeast part of the belt. This unit is overlain by fine- to coarse-grained epiclastic rocks.

The epiclastic rocks are represented by volcanic wackes which exhibit erosional features and graded bedding and a relatively thick (200-300 m) siltstone sequence with disseminated pyrite. Macdonald (1989) mapped minor carbonate occurrences within the belt and noted that they occur as conformable bands and lenses up to tens of metres thick within tuffs and siltstone or both. The carbonate rock is predominately dolomite with coarse calcite and patches and laminae of "possibly recrystallized chert."

The unconformably overlying sedimentary cover rocks (the Kelvin Lake Formation) comprise a red clastic sequence and have been assigned an early - middle Cambrian age by Smith (1978) and Keppie (1979). Most of these rocks are unmetamorphosed, apart from local hornfelsing, and Macdonald (1989), from field relationships, proposes an early Cambrian age, thereby confirming a Late Precambrian age for the underlying metavolcanic basement.

Macdonald (1989) recognises three phases of deformation in the belt, whereas major structural evidence suggests two phases of folding. Fracture cleavage is present and shear zones, subparallel to the regional strike and dipping steeply, are commonly developed within the metamorphic basement sequence. Two strong sets of joints, subparallel and subperpendicular to the main (D1) structural trends are dominant. Large scale faults, subparallel and slightly oblique to the main structural trends, have a strong vertical displacement and no direct evidence of strike-slip displacement was found by Macdonald. Macdonald's mapping suggests that the Stirling Fault may not extend as far to the southwest as shown by Weeks (1954) and he concludes "it is probably a much less important structure than previously considered."

The Stirling Belt of rocks are predominatly of low metamorphic grade and the evidence suggests conditions transitional into lower greenschist facies. The petrochemistry suggests that the volcanic rocks are consistently calc-alkaline, presumably generated in an orogenic magmatic arc, whereas the intrusive mafic sheets are tholeiitic in composition and may have been generated in a different tectonic setting.

2.6 MINE GEOLOGY

2.6.1 Stratigraphy and Ore Zone Geology

The sulphide bodies at the Stirling Mine occur within a steeply-dipping Mine Volcanic Sedimentary Unit (MVS). Hunter (1984, 1987) has modified Miller's (1979) nomenclature and describes the mine stratigraphy as presented in Figure 7.

The **Middle River Formation**, comprising massively bedded and siliceous clastics, has an apparent faulted relationship with the underlying mine volcanics and sediments. The **Hanging Wall Lapilli Tuff** (HLT) is a pumiceous lapilli tuff with primary features characteristic of hot ash-flow tuffs. The **Crystal Lithic Tuff** (CLT), which forms the hanging wall to the Mine Volcanic Sedimentary Unit, is a fine- to coarse-grained massive tuff. Thin mudstones show bedding and the tuff coarsens toward the base of the unit.

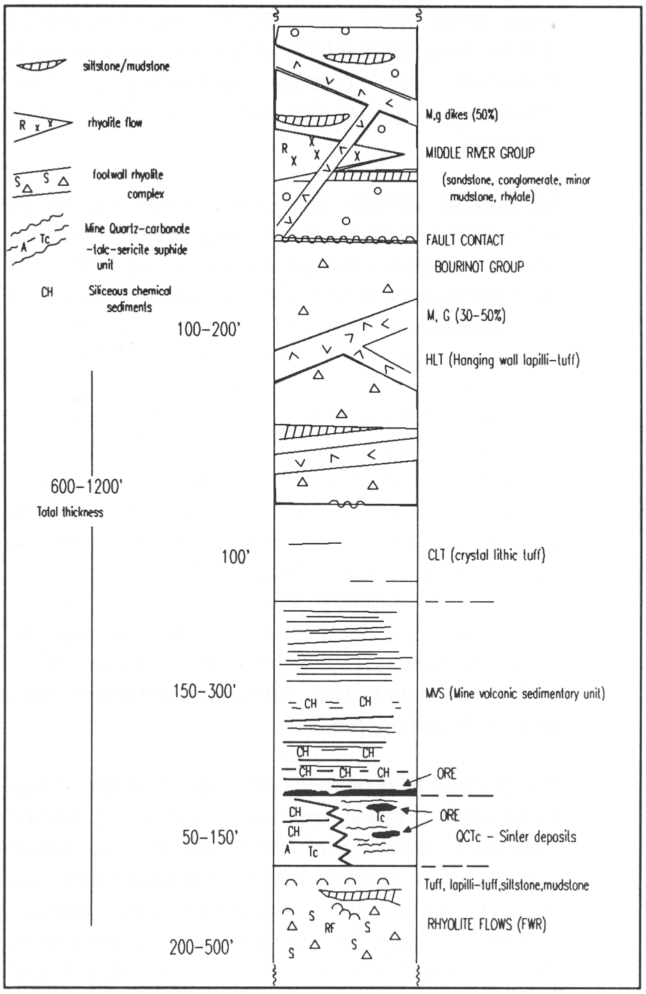

Figure 7. *Stirling deposit - stratigraphic section (after Miller, 1979, and Hunter, 1984 and 1987).*

The **Mine Volcanic Sedimentary Unit** (MVS), the ore host, is a bedded sequence of vari-coloured pyritic mudstone/siltstone and chemical sediments (both cherty and calcareous). The upper part of the unit comprises mudstone and siltstone with minor chert. The rocks become increasingly siliceous with depth and dense, massive chert layers are a significant component of the basal beds of this unit. In the lowermost portion, massive siltstone and sericitic tuffaceous layers with angular chert clasts are interbedded with siliceous chemical sediments. Sedimentary features indicate westward facing beds and abrupt contacts at the base of pyrite-rich layers grade upward through diminishing pyrite content. Soft sediment deformation, slump structures and ripple marks are present, though rare, in the dump material (Miller, 1979).

The **Quartz-Carbonate-Talc Unit** (QCT) is a bedded chemical sediment comprising dolomite, magnesite, quartz, sericite, talc, chlorite, baryte, albite and alunite. The QCT, which in places is highly schistose, hosts the majority of the ore lenses with the remainder in the overlying cherty, calcareous, pyritic mudstone. Talc content varies within the unit and is up to 50% in strongly sheared rock. Talc content up to 80% was reported from the lowest levels of the mine. The massive sulphide lenses occur where the QCT is thickest. Roscoe and Hunter (1976), Roscoe (1986), and Hunter (1984 & 1987) regard the environment as a typical volcanogenic massive sulphide deposit with the highly altered QCT being the product of exhalative activity. Later preferential deformation or 'shearing' was confined to the QCT due to its high clay/mica content (Curtis, 1988)

Richardson (1953) described three large lenticular quartz-carbonate bodies within the Mine Series. Within the quartz-carbonate rock, minor concentrations of sulphides occur as ubiquitous disseminations, isolated blebs, and clasts, or in massive layers 1 to 2 cm thick. Pyrite, sphalerite and chalcopyrite occur as fine-grained disseminations within the quartz-carbonate rock.

Hunter (1984) states that the QCT unit, (the Quartz Carbonate of Miller) and the ore-bearing stratigraphic entity, has been traced for over 4000

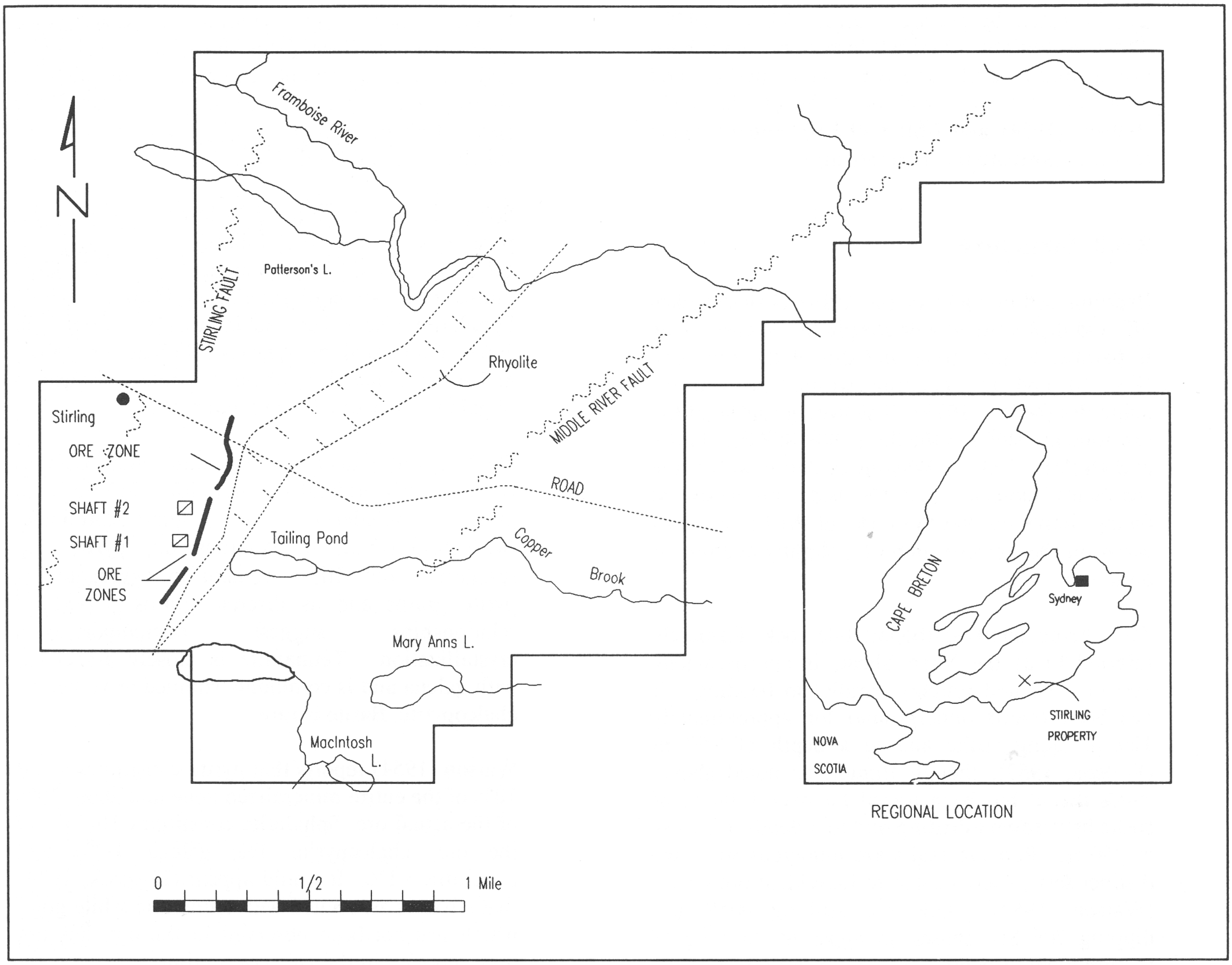

Figure 8. *Stirling deposit - simplified local geology (Hunter, 1984).*

ft. of strike by diamond-drilling. Though generally 50-100 ft. thick it can attain thicknesses of 200 ft. locally.

Small sulphide concentrations have been found within the adjacent volcanic rocks (James and Buffam, 1937).

The stratigraphic footwall rocks are referred to as the **Footwall Rhyolite** (FWR) and comprise predominantly massive felsic flows with minor pyroclastics and siltstones. Some of the flows are intensely fractured and brecciated and exhibit a fracture cleavage. Carbonitization is commonly associated with intense shearing and the rhyolite has been transformed into a quartz-calcite-sericite schist. Narrow zones (10-30 cm) of thin-laminated siltstones, similar in chemical composition to the rhyolites, occur between the rhyolite flows. Intermediate to mafic flows occur in the footwall position to the east of the rhyolites and contain up to 10% magnetite which, locally, has been oxidized to hematite.

Within the mine area **mafic intrusions** account for 30% of the total Mine Series (Richardson, 1953). Miller reports that these intrusions often constitute 50% of the total rock in drill core and that the volume of these intrusives decreases with depth. In fact, the upper levels in the northern part of the mine were uneconomic due to the large volume (30%) of intrusive material. Hunter (1987) reports that only minor intrusives were intersected in his drill program. The major intrusions are sill-like, vary from vertical to near horizontal, and are up to 22 m thick (Watson, 1954). Generally the intrusions are very irregular in form, pinching and swelling laterally and vertically, and locally they can be offset by younger shears (Miller, 1979). These essentially chloritic intrusions have been saussuritized and sheared, and pyrite and magnetite locally constitute 10% of the rock. Watson (1954) and Miller (1979) both conclude that they postdate the mineralization.

2.6.2 Structure

Bedding within rocks of the 'Mine Series' strikes NE and dips vertically or steeply to the east. This is parallel to the strike and dip of the ore zone (Fig. 8) and the banding within the massive sulphides (Miller, 1979). The average strike of the ore zone is 030^{o} and the dip is 80^{o}-85^{o} SE (James and Buffam, 1937). Way-up evidence within the sediments indicates that the beds are westward facing, implying that the rocks of the Mine Series occur on the western limb of a slightly overturned anticline.

The altered quartz-carbonate-talc rock, formerely referred to as the Mine Shear, is approximately 100 m wide and roughly parallel to bedding. It has been traced underground for approximately 120 m along strike and to a depth of 350 m (Watson, 1957), though Hunter, as noted above, states that it has been traced for over 1300 m of strike by diamond-drilling and to a depth in excess of 750 m. Post-ore faults are numerous with two distinct sets closely related to individual ore lenses (Watson, 1957). One set, striking 005^{o} and dipping 70^{o} SE, causes an apparent thinning of the ore zone at depth while a second set, striking parallel to the ore zone and dipping 45^{o} NW, causes a narrowing of the ore zone towards the surface (James and Buffam, 1937). A third set of faults causes apparent horizontal displacements of 15-30 m, and Watson (1957) suggested that the Stirling Fault may dip steeply SE and may truncate the 'Mine Shear'.

2.7 ORE MINERALOGY AND METAL DISTRIBUTION

Miller (1979) describes the sulphide mineralogy as comprising idiomorphic pyrite with, in decreasing abundance, sphalerite, galena, chalcopyrite and tennantite.

Pyrite occurs as ubiquitous fine-grained disseminations throughout the massive sulphides and as the dominant component in distinct, sharply bounded layers. Most pyrite grains have been fractured and locally recemented by sphalerite, galena and chalcopyrite.

Sphalerite is concentrated in layers or lenses that parallel or cross the foliation. Though the sphalerite lenses are elongated the individual grains have an equigranular crystalline texture. Sphalerite also occurs as interstitial material in zones dominated by quartz-carbonate or pyrite, and zones of massive sphalerite contain inclusions of galena, chalcopyrite and tennantite.

Chalcopyrite, galena and tennantite may occur as **(i)** randomly-orientated interstitial infillings to pyrite, sphalerite or quartz-carbonate; **(ii)** inclusions in, or coatings on, pyrite and sphalerite; and **(iii)** a cement to aggregates of pyrite grains and as discrete grains. Textural relationships suggest contemporaneous crystallization. Tennantite is closely associated with galena and is commonly rimmed or veined by chalcopyrite. Barite is rare.

Watson (1954) reports that pyrite constitutes about 10% of the entire mineralized zone and about 20% of the actual ore. Sphalerite constitutes 10-15% of the ore, chalcopyrite 3%, galena 1-2% and tennantite <1%. It would appear (Haycock, 1934) that silver is associated with tennantite while gold, which has not been observed in the ore, has not been reported in the zinc concentrate.

Richardson (1953) noted that individual sulphide lenses within the central "quartz-carbonate" body ranged from 12-120 m long, were up to 18 m wide, averaged generally 6 m for the mineable lenses and contained from 10,000 tons to 500,000 tons of ore. The footwall and hanging wall of the higher grade lenses are abrupt but pyrite mineralization is present in the adjacent enveloping rocks (Weeks, 1924). Laterally the ore lenses terminate gradually with an increase in the pyrite content and also with a decrease in the dip of the lens. In some instances lenses are terminated by cross faults (Richardson, 1953) and intrusions (Watson, 1954; Miller, 1979).

2.8 PRODUCTION DATA

Intermittent operations since the late 1920s have milled 1.06 million tonnes of ore grading 6.3% Zn, 1.5% Pb, 0.8% Cu, 74 g/t Ag and 1.1 g/t Au.

A total of 92,931 tons of Zn concentrate grading 52.4% Zn was produced and represented a recovery rate of 73%. Some 43,486 tons of mixed Pb-Cu concentrates were produced and graded 23.8% Pb (66.5% recovery); 11.31% Cu (63% recovery); 29.96 oz. Ag/ton (56.5% recovery) and 0.379 oz. Au/t (47% recovery). Total metal production over the life of the mine was 48,684 tons zinc, 10,348 tons lead, 4920 tons copper, 1,302,776 ounces silver and 16,492 ounces gold (Roscoe, 1986).

Both the main and north ore zones plunge moderately northward and Curtis (1988) suggests that potential may exist in this direction.

The mine was accessed by two vertical shafts and tracked mining methods were used. The last production phase ended in 1956 when a 650 tpd mill was in operation.

2.9 EXPLORATION TECHNIQUES

Due to the thick overburden cover in the area, outcrop is relatively poor and direct geochemical techniques have not been particularly successful. Hunter (1987), and Falconbridge (1989) on an adjacent property, state that lithogeochemistry is especially useful in locating alteration zones and specially note the marked Na_2O depletion in altered tuff zones.

Geophysics have been widely used and the massive sulphide nature of the deposit has made it a target for airborne methods. Several surveys have been flown but with little response and the deposit is noted as a poor conductor by Mersereau (1988). Miller (1984) reports that the Stirling deposit gives a weak EM response and concludes that the conductive sulphide minerals (pyrite, chalcopyrite, galena) are insulated by sphalerite or gangue, but concludes that weak conductors should not be ignored. Ravenhurst (1987), reporting on a downhole pulse EM survey, confirms the weak conductivity but indicates the presence of off-hole anomalies.

Falconbridge report that airborne magnetics are helpful in mapping and EM data indicate areas requiring follow-up. Ground gravity traverses were also tried over the known mineralization in 1984 but with a lack of response.

2.10 MINERAL SHOWINGS ALONG THE STIRLING BELT

The Stirling Belt extends for some 50 km in a northeast direction in SE Cape Breton Island and mineralization has been recorded from several localities along the trend. Barr et al. (1988) have traced the favourable geological host rock package along strike in both directions from the mine. These showings comprise stratabound to thin stratiform framboidal pyritic exposures, some of which carry elevated Cu, Zn and Au values (Mosher, 1979; Macdonald, 1982).

Doyon and Von Wagner (1992) document a new showing in the Mine Series some 2 km northeast of the mine and Macdonald (1989) describes stratabound to stratiform disseminated pyrite in Mine Series lithologies at Caledonia Road, (occurrence #8, Fig. 6), approximately 11 km northeast of the shaft. Amax, drilling on the claims southwest of the mine, intersected minor Cu and Au values in a chemical sediment in 1981, and Aurion Minerals (pers. comm. 1991) reported an angular massive sulphide boulder in an area approximately 4 km southwest of the shaft. This boulder assayed 12.7% Zn; 4.5% Pb; 0.5% Cu; 6 oz Ag/t and 0.03 oz. Au/t, but no further information as to the source of the boulder is available.

Stratabound, disseminated pyrite mineralization occurs in the Mine Series lithologies at Pt. Michaud Beach, (occurrences 14 & 15, Fig. 6), a distance of 20 km southwest from the mine. Macdonald (1989) also describes massive pyrite lenses and pods occurring at the contact between rhyolite and bedded tuffs immediately southwest of the mine and also at Taylors Brook, (occurrence 12, Fig. 6), some 11 km to the southwest. These massive pyrite pods are several metres long and up to a maximum of 30 cm wide, whereas the disseminated style of mineralization occurs in diffuse zones 1-2 m thick and in excess of 10 m long. Within these zones, local richer stratiform concentrations up to a few centimetres thick occur. Pyrite is the dominant sulphide in both types and sphalerite is present in very small amounts in about 30% of the samples collected by Macdonald. Chalcopyrite is very rare. These observations are confirmed by analyses of some of the pyrites.

2.11 CONCLUSIONS AND EXPLORATION POTENTIAL

Much of SE Cape Breton Island has been affected by at least three periods of folding, two periods of granitoid intrusion and at least four episodes of mineralizing activity. Two of these mineralizing episodes occur within Precambrian - possible Cambrian rocks of the Stirling Belt and Macdonald (1989) describes two types of associated mineralization.

Type 1 mineralization is described as exhalative sedimentary Fe-Zn-Pb-Cu- (Ag,Au) within favourable stratigraphic sequences or interfaces. **Type 2** is contact metasomatic Fe-Zn-Cu mineralization adjacent to the Loch Lomond pluton. Macdonald describes a third type which is associated with the high level stocks and plutons of Devono-Carboniferous age and suggests that favourable host rocks, both volcanic and sedimentary, exist as potential sites of accumulation for more distal deposits related to these events.

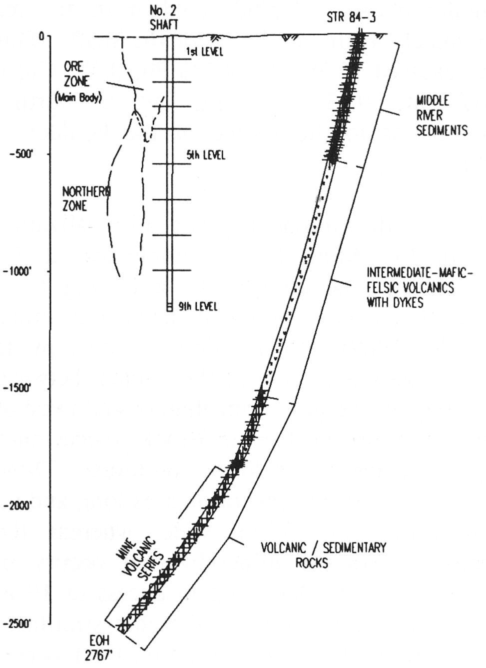

Figure 9. *Stirling deposit - vertical section showing exploration potential at depth (after Hunter, 1987).*

In the immediate vicinity of the old mine, Hunter (1987) has shown the presence of the Mine Series with anomalous base metal values some 600 m below the old workings (Fig. 9). Curtis (1988) confirms this and outlines two main target zones within the immediate mine area. The Mine Volcanic Sediments have been intersected along strike to the north and anomalous base and precious metal values reported. One hole assayed 1.64% Zn/22 m within the quartz-carbonate unit. Another hole in this program intersected the Mine Volcanic sedimentary unit approximatly 600 m below the old workings (Fig. 9) and a 15.5 m section of this, carrying from 5-25% pyrite, is anomalous in zinc (0.34%). It is reported that the Falconbridge drilling in 1991-92 indicated encouraging results along strike from the mine, while drilling by Outokumpu on the mine property in early 1992 also met with encouragement.

Sangster (1972) suggested that the Mindamar deposit bears many similarities with the Kuroko massive sulphides of Japan, and Miller (1979) regards the deposit as distal sedimentary exhalative. Analogies with similar deposits in the Canadian Shield suggest that additional targets will exist along strike and down dip and plunge. Thus, additional prospective horizons will exist where repeated extrusions of felsic volcanics have taken place.

Recent mapping programs have shown the presence of massive and disseminated pyrite with minor base metal values along the total length of the Stirling Volcanic Belt. It is suggested that a further examination of this prospective belt, using modern geophysical and computer techniques, allied with appropriate lithogeochemistry and geochemical methods, followed by diamond-drilling, could be most rewarding.