MINING SOCIETY OF NOVA SCOTIA
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Some Geological Aspects of the Mindamar Mine, Stirling, Richmond County, N. S.

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ABSTRACT

The mineral deposit of Mindamar Metals Corporation occurs in a northeasterly striking shear zone that is sub-parallel to several major faults. The shear is parallel to a steeply to vertically dipping series of acidic volcanics. Rhyolite tuff in the shear is replaced by carbonate and quartz which form at least two large lenticular bodies. Within the carbonate bodies, the ore shoots, which range from 7 to 20 per cent combined zinc, lead, and copper, lie along several steep veins. The position of the orebodies within the veins is determined by several factors of which the most apparent is the presence of inclusions of unreplaced rhyolite tuff adjacent to the veins.

The workings of the previous operators are in a carbonate body 1,000 feet long and up to 150 feet wide. Surface drilling has revealed an additional ore-bearing carbonate body along strike to the north, and ore grade material, as yet undefined in outline, to the south.

INTRODUCTION AND ACKNOWLEDGMENTS

THIS PAPER outlines the geology and discusses the geological problems of the Mindamar mine. It is impossible to acknowledge the contributions of ideas of all the geologists who have worked in the area. Among the more important contributors are K. DeP. Watson, W. S. James, B.S.W. Buffam, and L. J. Weeks, and John MacPherson, the resident geologist at the mine.

A mineralogical and chemical study of the ore and country rock is being carried on by Dr. Watson at the University of California, Los Angeles.

GENERAL INFORMATION

The Mindamar mine is on Cape Breton Island, forty miles southwest of Sydney (Figure 1). The nearest railway stations are at St. Peters, which is thirty-two miles southwest of the mine, and at Sydney. Good gravel-surfaced roads connect the mine to the railways.

The mine is producing at the rate of 600 tons a day of ore containing zinc, lead, copper, and minor amounts of silver and gold. At the present time the mill feed averages 9 per cent combined metals, of which zinc makes up 7 per cent and lead and copper each 1 per cent.

GENERAL GEOLOGY

The ore being mined by Mindamar occurs in a shear zone parallel to a northeasterly striking, vertically dipping, series of rocks consisting of rhyolite tuff, rhyolite, minor more basic flow rocks, and diorite (Figure 2). In the vicinity of the mine, these rocks have been termed the *Mine Series*. They belong to the Bourinot group, which has been assigned by L. J. Weeks to the Middle Cambrian. At the latitude of the mine, the Bourinot group is bounded on the northwest by the Stirling fault and extends eastward for two miles. The group extends southward for three miles, where it

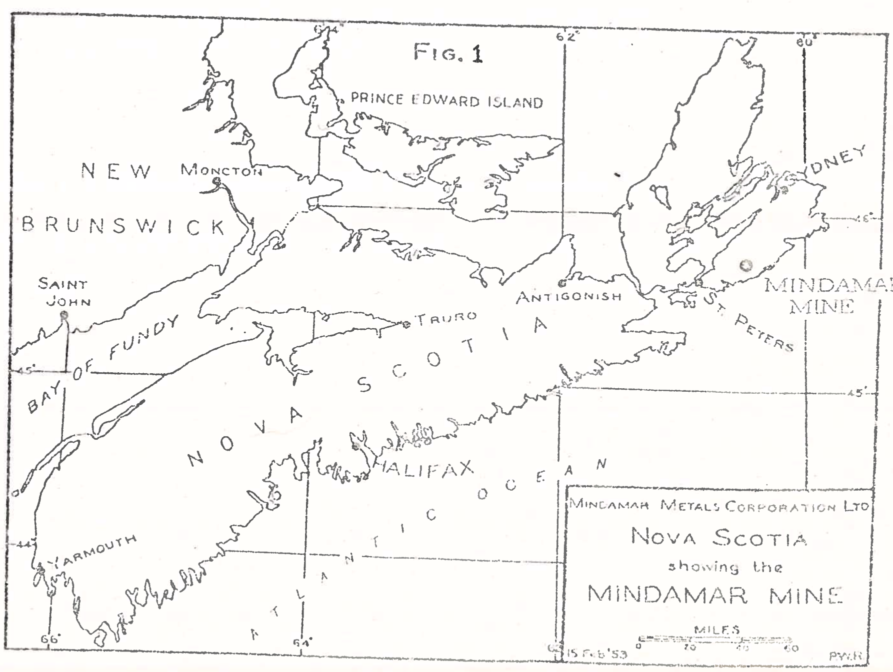

Figure 1.

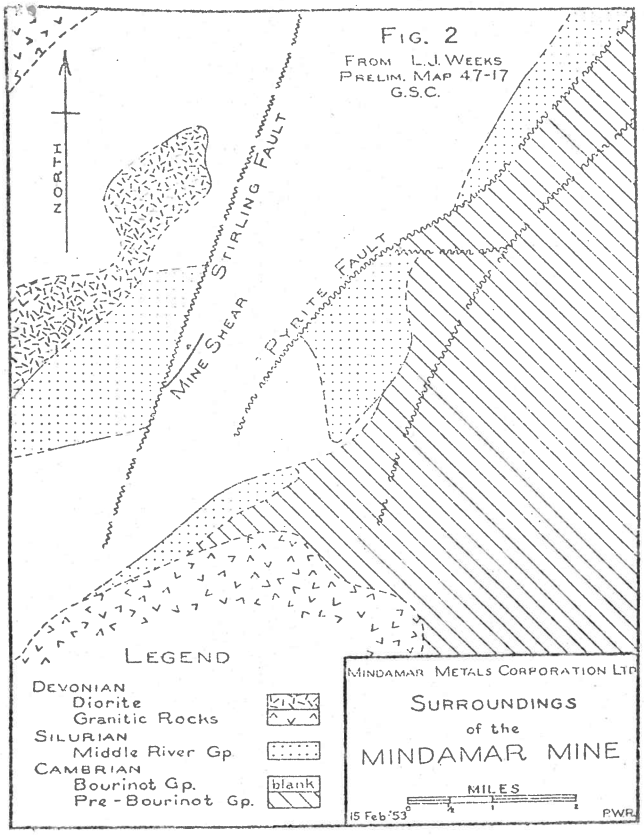

Figure 2.

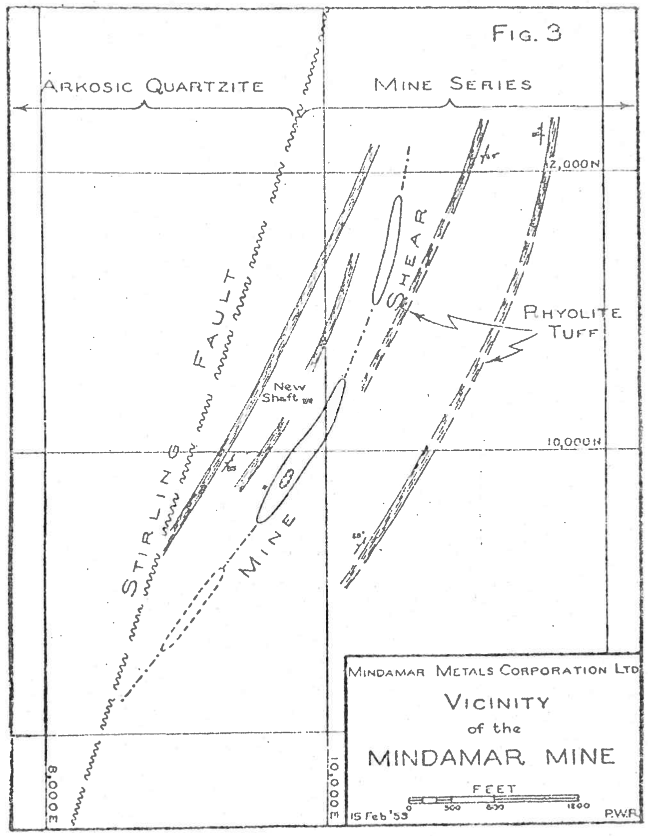

Figure 3.

is cut off by granite, and northward for at least six miles.

Arkosic quartzites and fine arkosic conglomerates lie to the west of the Stirling fault. These rocks are part of the Middle River group, of Silurian or Devonian age.

The mineralized shear in which the ore deposits occur has been named the *Mine Shear*. It is subparallel to the Stirling fault and, at the mine, is one-eighth of a mile east of it. The Mine shear meets the Stirling fault half a mile south of the mine.

The Mine series is foliated parallel to the Mine shear. The foliation is especially well developed in some of the rhyolite tuff. Mapping of foliation directions in surface outcrops allows close predictions of projected positions of the Mine shear. This relationship has been of considerable use when planning exploration drilling along strike from the mine.

Another parallel fault, termed the *Pyrite Fault*, apparently cuts the Mine series three-quarters of a mile east of the Mine shear. To the north, the Pyrite fault forms a boundary between Bourinot and Middle River rocks. Although the fault itself was not seen at the latitude of the mine, a brook outcrop exposes a fifty-foot zone of scattered pyrite crystals on the southward projection of the known fault. Consequently, it is assumed that the Pyrite fault continues southward.

The Mine Series

The Mine series consists of rhyolite tuff, rhyolite, minor more basic flows, and diorite (Figure 3). The rhyolite tuff varies in colour from light tan to almost white. The foliation varies in intensity from indistinct to prominent. The rhyolite tuff is relatively easily replaced by carbonate and quartz which are, usually in turn, partially replaced by ore minerals. As a result, almost all the ore occurs in altered and replaced rhyolite tuff of the Mine shear.

The rhyolite varies in colour from light tan to deep pink. It is usually porphyritic, with quartz or quartz and feldspar phenocrysts. It contains occasional minute blebs of chalcopyrite but is seldom heavily replaced by carbonate and ore minerals.

The diorite dykes vary in character from massive, medium grained, and fresh to sheared and chloritized. Fractures in the diorite are often coated with soft, moist hematite. The major diorite dykes, with few exceptions, are parallel or subparallel to the Mine shear. In the vicinity of the mine, the dykes make up about one-third of the volume of the Mine series.

The Mine Shear

The ore occurs in the Mine shear within one of more large, lenticular carbonate-quartz bodies. The workings of the previous operators are confined to the central body, which is 1,000 feet long and up to 150 feet wide. The top of the body is truncated by the present surface. Drilling to a depth of 700 feet has proved the presence of ore, but investigation to date has not been carried deeper. Consequently, the shape and dimensions of the bottom of the body are still unknown.

The northern carbonate zone is at least 800 feet long and up to 80 feet wide. The zone tops about 200 feet below the present surface. Above the carbonate zone, the Mine shear is made up of sericitized rhyolite tuff, chloritized diorite, and talc schist. The downward extension of this zone has not been explored below a depth of 600 feet. The first working to reach the northern ore is just advancing along it at present. Apparently, the ore is more continuous than in the central carbonate zone and is of excellent grade. The first stope in this body will average 15 to 20 per cent combined metals.

Drilling to the south of the present mine has encountered further ore-grade material. A series of holes penetrating to the 400-foot horizon revealed that the Mine shear is not of ore grade down to that depth. However, there is a slight increase of grade with depth. Using the experience gained from the northern ore zone which, as previously stated, tops below the surface, a hole was drilled to test the Mine shear at a depth of 600 feet. It encountered a 30-foot carbonate zone containing 10 per cent combined metals across 10 feet. Apparently, then, there is another ore-bearing carbonate zone to the south of the mine. This ore tops about 450 to 500 feet below the surface. Further surface drilling in the southern ore was reserved for the future since the extraction of ore at this depth will have to await the completion of deep levels being driven at present. Also, at a deeper level, the ore may be continuous from the present mine to the southern ore intersection and further expensive surface drilling may be found to be unnecessary.

Between the three carbonate zones, the Mine shear consists of talc schist, chloritized diorite, and sheared and sericitized rhyolite tuff. There are occasional boat-shaped 'carbonate zones' up to a few feet long which are often fairly well mineralized with sphalerite, galena, and chalcopyrite.

The Main or Central Carbonate Zone

The workings of the old Stirling mine were confined to the central, outcropping carbonate zone. This zone contains numerous ore shoots which vary in length from 40 to 400 feet and in width up to 60 feet. It has been found that the many old stopes and still unmined orebodies can be correlated along surfaces which are termed 'veins'. Apparently there are between five and ten veins and part of the work at present is concerned with the drawing of longitudinal sections along each of the veins in order to outline all the ore shoots in this carbonate body.

At least three of the veins lie close to the northwestern side of the carbonate zone. These veins contain most of the important orebodies in the old part of the mine. The adjacent side of the carbonate zone is very irregular and is bounded by large intersecting faults which possibly affected ore deposition.

The factors controlling the position of the ore shoots in the veins are not completely known as yet. However, it is known that inclusions of unreplaced rhyolite tuff in the carbonate zone are very important. One large inclusion lies between two veins and the ore is very rich and wide in the parts of the veins adjacent to the inclusion. Another favourable condition is the presence of small, irregular, chloritized diorite dykes. Those parts of the carbonate zone that are free of dykes are usually also free of ore. A third factor is the attitude of the veins. Normally they are parallel to the walls of the carbonate zone. A few turn sharply, and, at such places, the grade changes abruptly. One vein, particularly, changes from an average grade of 10 per cent combined metals to a grade of 20 per cent. In this high-grade ore, the lead equals the zinc in quantity and the silver increases markedly.

The two main ways that the orebodies terminate are also of interest. In one, the quantity of ore minerals decreases slowly. This is accompanied by an increase in the amount of pyrite and often by a decrease in the dip of the vein. In the other, the ore improves in grade up to a cross fracture, beyond which the carbonate is of sub-ore grade or even barren.

Conclusions

The ore of the Mindamar mine is in a shear zone that is closely related to the Stirling fault. The Stirling fault is a major structure extending at least three miles. There are other major faults in the area which are parallel to the Stirling fault and which cut similar rocks.

The Mine shear may be a branch of the Stirling fault, or the Stirling fault may have truncated the Mine shear. It is not known whether the Mine shear was carbonatized and mineralized before or after movement occurred on the Stirling fault. However, it is apparent that the Stirling fault has truncated a series of rocks at a small angle to the strike of the members. One of the rock types in the truncated series, the rhyolite tuff, is relatively incompetent and one section of beds of it has given rise to the Mine shear. This shear varies greatly in width. The country rocks, which are predominantly rhyolite and diorite, include beds of rhyolite tuff both east and west of the Mine shear. These beds, also, are sheared and may be mineralized.

From this brief recapitulation it is apparent that Mindamar has two major exploration programmes to follow. One is to extend exploration along the Mine shear to find additional ore-bearing carbonate bodies beyond the new bodies already found. The other it to examine the area for additional mineralized shears in the parallel beds of rhyolite tuff.

Annual Meeting of C. I. C.

THERE WAS a very large and representative attendance at the thirty-sixth annual meeting of the Chemical Institute of Canada held in Windsor, Ont., on June 4th to 6th. At the four technical sessions, upwards of ninety papers were presented, necessitating, of course, two or more simultaneous sessions each day. The papers ranged over the entire chemical field — physical, organic, agricultural, analytical, biochemistry, chemical engineering, rubber chemistry, and protective coatings — and one session was devoted to papers on chemical education.

At the opening session, presentation of the Palladium Medal, C.I.C.'s highest award, was made to Dr. E. W. R. Steacie, O.B.E., President of the National Research Council of Canada and a former President C.I.C. At this session, also, the Leroy Egerton Westman Memorial Lecture was delivered by Dr. George Granger Brown, Dean of the College of Engineering, University of Michigan, Ann Arbor.

Dr. J. W. T. Spinks, M.B.E., Dean of the College of Graduate Studies and Head of the Department of Chemistry, University of Saskatchewan, was elected C.I.C. President for the ensuing year, and Mr. E. R. Rowzee, Vice-President and Manager of the Polymer Corporation, Limited, Sarnia, Ont., was named Vice-President.