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TITLE: THE BOSS MOUNTAIN MOLYBDENITE STRINGER ORE

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ABSTRACT

For the past two years an active exploration and research program has taken place at the Boss Mountain mine. The programs have been directed at a zone of low grade molybdenite bearing quartz stringers which encompass the present underground workings. The following report describes the physical characteristics of the stringer ore type and the difficulties in attaining accurate drill results. It discusses the practical methods applied which have achieved greater confidence with grade assessment and how these methods correspond with the metallurgical research being done on an up grading process. The objective of these programs has been to delineate sufficient low grade reserves and to develop a pre-concentration process which will enable us to profitably mine the stringer ore.

INTRODUCTION

In December 1973 the Boss Mountain Mine was reopened after a two year closure forced by low molybdenum prices during 1971. At that time mine reserves forcast a dim future for the mine life time, with an estimated expectancy of only four years production remaining. The only additional economic reserves exploration drilling had located was an area of quartz-molybdenite stringers located near surface, east of the main breccia pipe. An open pit feasibility study was conducted on this zone and concluded that the tonnage was insufficient to warrant the expenditure for open pit expansion. There was however, evidence of other similar mineralized zones in an area surrounding the upper deposit. When all the available drill data, dating back to the first exploration drilling done on the property, was complied a sizable open pit tonnage resulted. But, these preliminary calculations yielded uneconomic grades.

Based on the mining experience with the stringer ore type it was felt the grade could be made economic by implimentation of an up-grading process. In addition the assays on which the grades were based could be improved upon. It was recognized that the earlier drilling had experienced poor recovery of the stringer molybdenite and often assays failed to confirm the logged estimates.

A two phase program was launched in 1975 to investigate the preconcentration concept and to reconstruct the reserve model with more reliable drill data. During the past two years of work on this project much has been achieved towards raising the grade to an economic level and it has been a learning experience for all who participated.

Many people's work has contributed toward our present knowledge of the deposit and it's metallurgical properties. To these people along with my co-workers, management, and many others, my sincere appreciation for their assistance and support.

MINE HISTORY

Boss Mountain Mine is located in the central Cariboo region of British Columbia, approximately sixty miles east of 100 Mile House. The province's first molybdenum was mined from Boss Mountain during 1917 and packed by mule train over the mountain to Lac La Hache, then onto Ottawa where it was analysed and sold to the General Electric Company of Canada for research. During the years that followed the property exchanged owners several times and underwent various exploration studies. The Boss Mountain property was put into production by its present owners as a 1,000 ton per day operation with

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the ore reserves based solely on the Main Breccia pipe.

The mine is presently an underground operating mine processing 1,800 tons of molybdenite ore per day. The operation which commenced in 1965 has actively mined two breccia pipes called the Main Breccia and the South Breccia. Two areas of high quartz-molybdenite stringer concentration were also included as mine ore after production had started. These are referred to as the West Stringer and Southwest Stringer zones.

GENERAL GEOLOGY

The deposit occurs within the Takomkane Batholith which is part of the Quesnel Trough, containing dominantly Lower Mesozoic age volcanic rocks. The batholith, Upper Triassic in age consists of largely; granodiorite, syenodiorite, and porphyritic biotite granodiorite phases. An epizonal quartz monzonite porphyry outcrops to the east of the deposit, Cretaceous in age. The deposit is situated in an old cirque basin with a floor elevation of 5,500 feet and the surrounding ridges climbing steeply on three sides to 6,000 feet elevation.

The younger quartz monzonite porphyry intrusive which underlies the deposit and which terminates the breccia pipes is believed to have created the host environment and subsequent mineralizing fluids. Based on a thesis by Arthur Soregaroli, the breccia pipes were formed by the apparent osillitory action of the intrusive emplacement, along what were formally fault zones in the granodiorite. The breccia pipes occur as steeply dipping lenticular bodies about 1,100 feet in depth, 200 - 400 feet in length and 30 - 100 feet in width. Surrounding the upper breccias are a myraid of molybdenite rich quartz veins called stringers. Alteration zoning typical of porphyry systems is evidenced at the deposit. The most noticable of which is a pyrite-epidote halo occurring as a gossen along the upper ridges.

The molybdenite mineralization occurs in three different forms within the deposit;

(1) As disseminated fine grain mineralization within the quartz matrix of the breccia pipes.

(2) As coarse or fine grain layers hosted by the quartz stringers.

(3) As a fine grain film or paint along fractures, joints and shears. The monzonite and granodiorite do not contain any molybdenite

mineralization. Some of the other minerals present in the deposit in decending order are; pyrite, rutile, magnetite, chalcopyrite and sphalerite. Pyrite is the most abundant mineral present in the deposit.

STRINGER CHARACTERISTICS

In our search for continuing reserves special attention was focused on the stringer ore type. It was noted that the mineralization hosted by the stringers naturally tended to liberate itself from the granodiorite. This phenominon is the result of a very weak bonding between the stringer to the host and a substantial variance in competance of the quartz molybdenite stringer and the host granodiorite. The stringer material is very friable whereas the granodiorite is massive.

Being that the granodiorite contains essentially no molybdenite mineralization, research was done on separating the stringer mineralization after liberation. In the spring of 1974 at a time when the mine was drawing ore from only the two stringer stopes a pre-concentration test was conducted on the mill feed. Samples of the mill feed, which had undergone three stages of crushing, were taken for ten consecutive days. These were screened and analysed to

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determine if the mineralization concentrated at any particular sizing. Results showed a distinct concentration in the finer fraction leaving the coarser material at tailing grades which consisted of 50 percent or more of the total sample weight. These tests showed that if removal of substantial waste rock prior to milling were possible, this could reduce operating and capital costs thereby allowing the mine to draw from the indicated low grade stringer zones.

STRINGER CLASSIFICATION

The most outstanding characteristic between the stringers was that some stringers host coarse grain layers of molybdenite which liberate upon initial impact whereas other generally smaller, and lower grade stringers host the fine grain variety of molybdenite and these are not as prone to easy liberation. Based largely on the liberation properties and their visual differences the following two stringer classifications were designated.

PRIMARY STRINGERS

The primary stringers consist of a quartz vein generally bounded on either side by a layering of coarse grain molybdenite, which varies in thickness along the stringer. In some cases the

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quartz center is absent leaving only a solid seam of mineralization. The bond between the molybdenite and the host granodiorite is very weak and the occurrance of an intergrowth of the molybdenite crystals into the granodiorite is extremely rare. The quartz associated with this type of stringer is generally a white bleached, very friable quartz which breaks upon initial impact or primary crushing. The primary quartz stringer ranges from $\frac{1}{4}$ inch to as much as 3 feet in thickness, but width has no relation to the molybdenite content. These stringers occur as parallel to subparallel swarms called systems. The systems appear to form a horseshoe shape around the known monzonite stock contact and appear to be structurally controlled. The primaries constitute the dominant ore host within the pit area and in total carry the greatest amount of mineralization within the entire deposit.

SECONDARY STRINGERS

The secondary stringers are characterized by a fine grain molybdenite which occurs either along the quartz-granodiorite contact or as a banding within the quartz. The mineralization has a stronger bonding to the granodiorite which requires attrition to remove it.

The host quartz is also different. The secondary stringer quartz is generally clear and much more competant than the primary quartz. The quartz often takes on a gray appearance due to the fine grain mineralization incorporated or disseminated within it. The orientation of the secondaries appears random though they occur with some regularity throughout the entire deposit. The mineral content of the secondaries is much less than the mineralization hosted by the primary stringers. Falling within the same classification is the fracture filled ore type because of the many similarities it has to the secondary stringer type.

DIAMOND DRILLING OF MOLYBDENITE STRINGERS

Diamond drilling of molybdenite properties has often caused considerable difficulties in mineral recovery and consequently resulting grade estimates are questionable. Drill determined reserves of some operating molybdenite mines in B.C. have had to be up-graded as much as 15 percent from original estimates. This applies especially to stringer, vein type, and fracture mineral environments. The Boss Mountain deposit mineral evaluation was quite accurate when assessing the breccia ore but complications arose with the stringer ore type.

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The most evident was poor recovery of the mineralization hosted by the stringer. This can be explained for the lessor competance of the stringer creates a plane of weakness which is prone to breakage upon intersection. Once breakage occurs in coring, the soft, lubricating properties of the molybdenite assist in a smearing of the mineral causing it to escape from the core sample. Molybdenite also floats readily and is consequently easily removed by the sludge water. A seemingly easy solution to the recovery problem is to collect and analyse sludge samples. However, sludge sampling has not proved successful for after penetration of one or more primary stringers the sludges become very erratic and consequently can not be correlated with the core sample. This is believed to be a result of wall erosion or plucking of the molybdenite previously intersected. The most successful solution to the recovery problem has been the use of larger core sizes. During the latest drill program which was designed with and emphasis on grade accuracy, NQ (1 7/8 inch) core size was used and recoveries averaged 98 percent.

CORE HANDLING

Examination of all the older drill logs further disclosed that often assays did not correspond with the visual estimates. In effect many logged stringers did not show in the assay analysis. To overcome this problem several different techniques have been applied over the years in the sampling proceedure. Core was sampled initially in ten foot split lengths, then five foot whole core lengths, then stringers were isolated and assayed separately. Improvements were evidenced by these changes but results still indicated discrepancies.

Based on the stringer characteristics observed; the following core sampling and preparation proceedure was designed for the latest drill program.

(1) Core boxes were lined with plastic strips to prevent molybdenite loss by the sampler. Often flakes of molybdenite are trapped on the bottom of the core box under the dividers.

(2) The core was logged, noting the rock type, alteration, structure, stringer type, stringer width, orientation, mineral content, and the presence of accessory minerals. In order to expose any fine molybdenite-filled fractures the core is broken into 3 or 4 inch lengths by the logger.

(3) The core was sampled in five foot lengths, using core,

ASSAY PROCEEDURE

The greatest changes in the core sampling were made in the sample preparation phase, based on the up-grading test observations. By using the conventional assay preparation of crushing, splitting, pulverizing, blending and finally assaying, it was felt that the probability of the mineralization being lost in the splitting phase was too high. To overcome this we could proportionally concentrate the mineralization by inserting a screening stage after initial crushing. The sample was crushed at a 5/8 inch setting, then screened at 6 mesh and both the oversize and undersize fractions were weighed and assayed. This resulted in a weight split averaging 20% fines, 80% coarse and a mineral distribution where the fines generally hosted twice or more, the amount of mineralization present. A direct correlation between the presence or absence of a primary stringer could be found in the mineral distribution assayed in both fractions. To determine the final intersection grade, a calculation was done by weighted average of both size fractions.

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STRINGER GEOLOGY

The 1975-76 drill programs have been successful in delineating a substantial low-grade tonnage of stringer ore though areas still remain where the full extent of the stringers are not known. As a result of the drilling done a wealth of geological data has greatly added to our understanding of the stringer geology and origin. The primary stringer systems now appear as a continuous structurally controlled zone which closely parallels the monzonite contact and encompasses the breccia pipes. The individual stringer swarms are divided only by what appear to be a series of fault zones which radiate out perpendicular to the stock contact. These fault zones divide the stringer systems into several large blocks and a slight change in the strike of the stringers is evidenced. The stringer systems are bounded to the west by a lamprophyre dyke which forms the hanging wall. Within each block the stringers dip toward the hanging wall, dipping more steeply as they approach the dyke. The greatest molybdenite concentration is found in the stringers directly adjacent to the hanging wall and within the lamprophyre dyke forming the hanging wall. The grade and frequency of the stringers decrease inward toward the breccia pipes.

The lamprophyre dykes appear to be closely related to the primary stringer mineralization. It is felt that the lamprophyre dykes to the north (High Grade Vein) and to the west acted as feeders, along which the mineralizing fluids travelled from depth out into the fractures which now host the primaries. These new findings along with other observations support the concept that the stringer zones were not only part of the latest mineralization phase but that the hosting fractures were formed after the solidification of the breccia pipes and secondary stringers. The ore source of the primary stringer systems originated in an area at depth, different to the mineral source of the breccia pipes. This later mineralizing phase hosted the greatest amount of mineralization and deposited a much coarser grained molybdenite which is not found in the breccia pipes.

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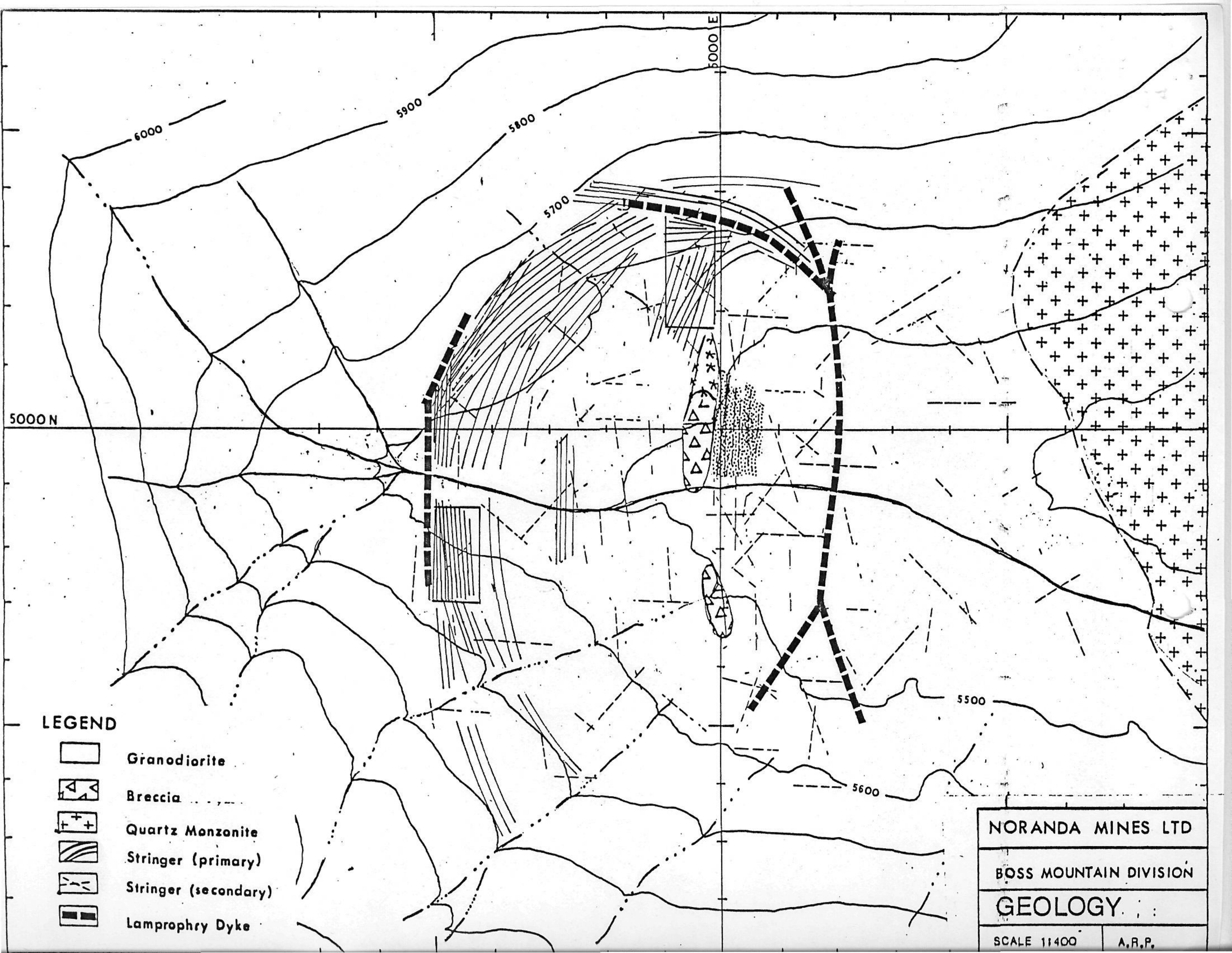
SUMMARY

The geology of the deposit is not fully understood at this time, with still many areas remaining to be explored. However, we have gained considerable confidence in assessing the stringer ore type. By using the described methods of core handling and preparation the older drill indicated assays were improved by an average of 15 percent. The ore reserve model has been extended producing a sizable open pit tonnage reserve. Results of test work done on a suitable preconcentration process indicate that the ore type is amenable to up-grading. To achieve a prolonged lifetime for the Boss Mountain Mine depends largely on the success of our processing technology and the accuracy of the mineral assessment being conducted.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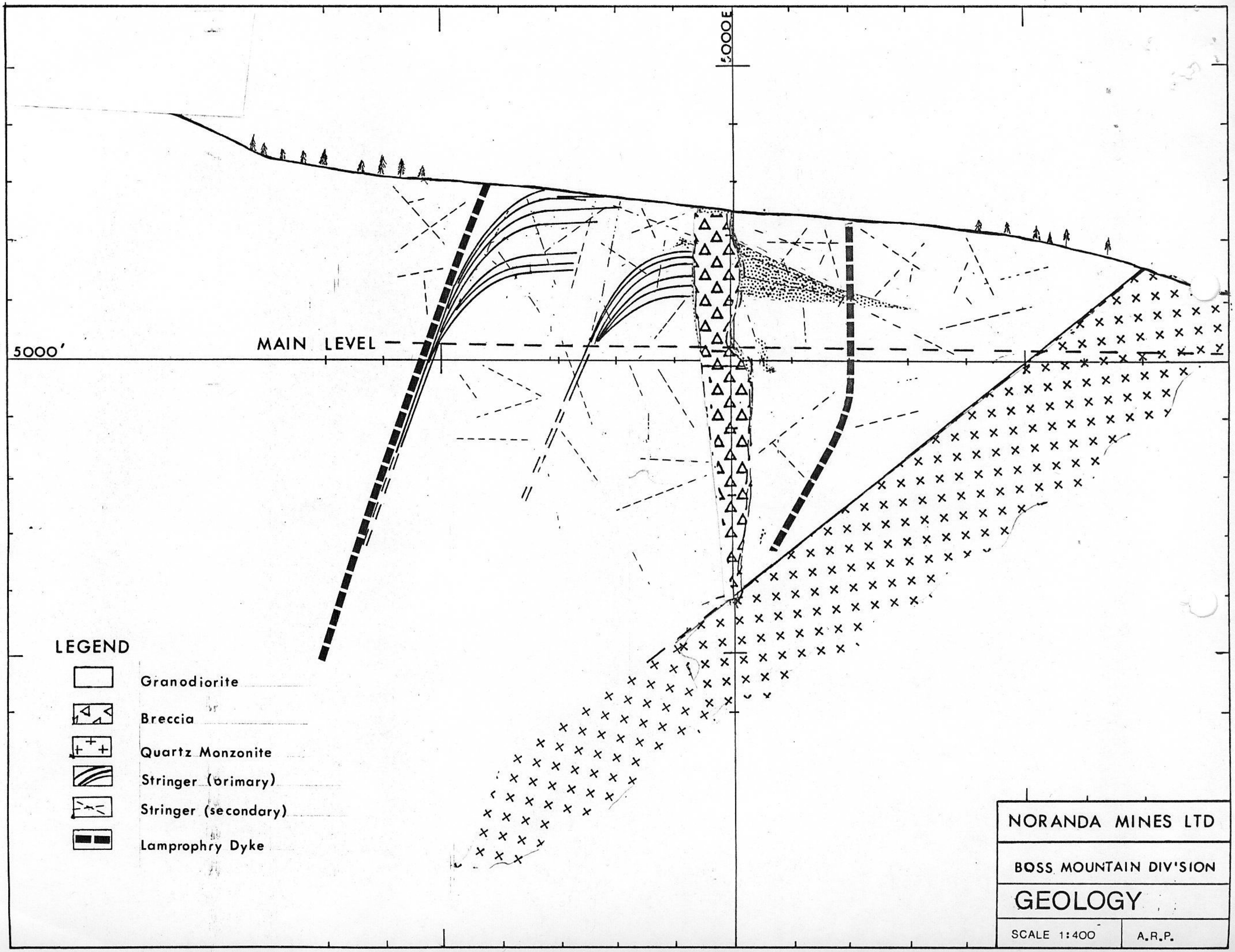
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