

THE STRATIGRAPHY, STRUCTURAL GEOLOGY AND GEOCHEMISTRY
OF THE FOX LAKE MASSIVE SULFIDE DEPOSIT

A Thesis
Presented to
The Faculty of Graduate Studies
University of Manitoba

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

by

Philip Eugene Olson

August 1987 ©

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PHILIP EUGENE OLSON

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ABSTRACT

The Fox Mine was a Proterozoic copper-zinc, volcanogenic massive sulfide deposit located in northwestern Manitoba. It was hosted by tholeiitic and calc-alkaline, sodic series volcanic and associated sedimentary rocks. The area has undergone middle amphibolite grade metamorphism.

The deposit comprised two major massive sulfide lenses, produced by separate hydrothermal vents. Both displayed typical metal zonation with lowermost copper-rich stringer ore, central massive copper-rich ore and uppermost stratified zinc rich ore. The lenses were laterally continuous with altered felsic metavolcanic rocks. The western extension is obscured by thick accumulations of siltstones and pyritic mudstones. A thin horizon of iron formation coincides with the eastern extension.

The structural evolution of the Fox Mine area involved subvolcanic plutonism, early isoclinal folding (F1), tight E-trending shear folding (F2) followed by a period of faulting and shearing (D3) that segmented and offset the sequence of strata.

The orebody occurred on the overturned limb of an early, sub-horizontally plunging, isoclinal fold. Altered felsic metavolcanic rocks 800 meters south of the mine constitute a similar geological environment. They represent a detached, folded (F2) repetition of the favorable stratigraphy.

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IN MEMORIAM

FOX MINE (1970-1985)

On the 29th of November, 1985, milling operations at the Fox Mine ceased. Ore milled to closure totalled 11,958,182 tonnes grading 1.82% copper and 1.78% zinc. With many fond memories, I bid adieu to an old 'friend' and respectfully submit this thesis.

ACKNOWLEDGEMENTS

This study of the Fox Lake massive sulfide deposit was a co-operative venture undertaken by the author in conjunction with the University of Manitoba. The project was funded by Sherritt Gordon Mines Limited and the Manitoba Department of Energy and Mines, Mineral Resources Division. Implementation of this program was facilitated through the efforts of Mr. I. M. Plummer, Dr. W.D. McRitchie and Dr. W.C. Brisbin.

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**Maps contained in back jacket.

CHAPTER I

INTRODUCTION

1.1 BACKGROUND, LOCATION AND ACCESS

In his economic assessment of the Dunphy Lakes area, M. S. Stanton (1949) made the following innocuous statement in the final paragraph of his report:

"About 1,000 feet northwest of Fox Lake, a sparse dissemination of fine pyrrhotite occurs in a small exposure of recrystallized dark-grey very impure garnetiferous quartzite. A magnetic anomaly was also noted in the immediate vicinity. No surface workings were observed" (p. 34).

Twelve years later, exploration crews in the employment of Sherritt Gordon Mines Limited confirmed the existence of a massive sulfide deposit approximately 300 meters northwest of Fox Lake. By July of 1965, diamond drill crews had outlined 11,153,636 tonnes of ore grading 1.74% copper and 2.35% zinc. Feasibility studies based on these drill results culminated in a production decision and in May of 1970, the first ore was shipped at Sherritt Gordon's Fox Mine.

For the next fifteen years, production levels at the Fox Mine were maintained near its design capacity of 2,750 tonnes per day. Published mining reserves dated December 31, 1984, included 632,893 tonnes averaging 1.802% copper and 2.418% zinc.

These reserves were exhausted by routine mine production during 1985. The final ore was processed on November 29th. Tonnage milled to closure totalled 11,958,182 tonnes grading

1.82% copper and 1.78% zinc.

The study to which this thesis pertains, was initiated in 1984 as a geological and geochemical assessment of the Fox Lake massive sulfide deposit prior to the cessation of mining operations. Although the final draft of this thesis was not available prior to closure, preliminary results were released in the Manitoba Department of Energy and Mines, 1984 Report of Activities.



Plate 1: The Fox Mine as viewed from the south, with milling complex on the left and headframe on the right.

Fox Mine (Plate 1) is located in northwestern Manitoba, 20 kilometers east of the Saskatchewan provincial boundary, 45 kilometers southwest of the Lynn Lake townsite and 800 air kilometers northwest of Winnipeg (Figure 1). All weather access to the mine from Lynn Lake is possible via Provincial Highway #396. Lynn Lake is accessible by scheduled aircraft

service and Provincial Highway #396 by way of Thompson and by a branch-line of the Canadian National Railway via Cranberry Portage.

1.2 PREVIOUS WORK

The earliest geological map to include the Fox Mine area was the work of D. L. Downie in 1935. It was published as Geological Survey of Canada Map #343A covering the Granville Lake Map Sheet (West Half) on a scale of one inch equals four miles.

The next published geological work providing coverage of the Fox Mine area was by M. S. Stanton. It was released in 1949 as Manitoba Department of Mines and Natural Resources Report #48-4. This publication included the first detailed map (inch to half mile) for the Dunphy Lakes segment of the Granville Lake Mining District. In this report, Stanton separated the rocks of the Dunphy Lakes area into the Wasekwan and Sickie Series, consistent with the nomenclature of Norman (1933) and Bateman (1945). Meta- volcanic and volcanoclastic rocks composed the former group; immature, presumably younger metasedimentary rocks composed the latter. Significantly, Stanton noted several occurrences of coarse garnet-actinolite-cordierite-chlorite rock that he interpreted as hybrids resulting from impregnation by granitic material. Stanton did not elaborate on the structure of the Dunphy Lakes area. He cited the paucity of minor structures and facing direction indicators as limiting factors.

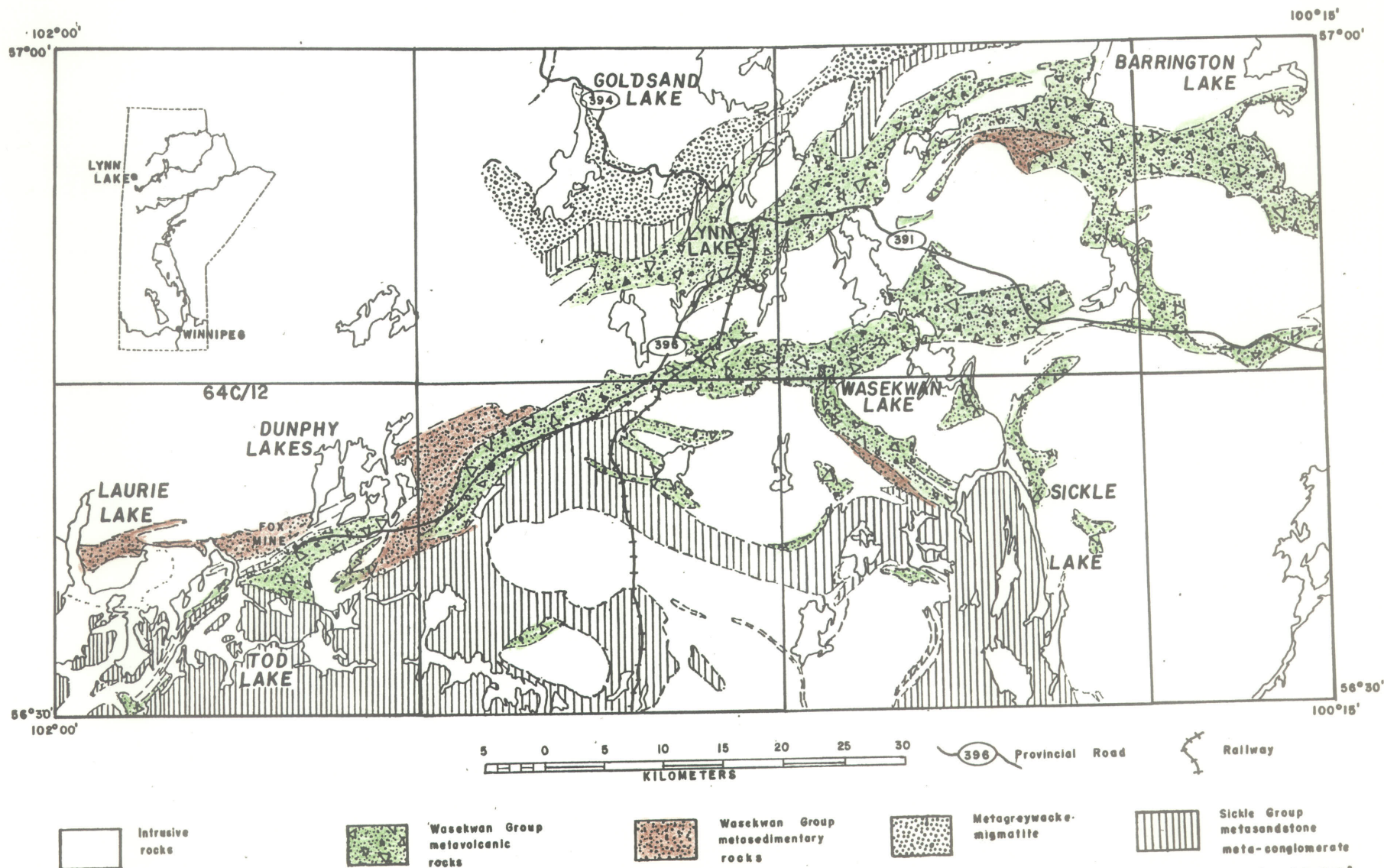


FIGURE 1: LOCATION MAP WITH SIMPLIFIED GEOLOGY (modified from Gilbert et al., 1980)

Aspects of Stanton's report and geological map were incorporated into G.C. Milligan's (1960) geological compilation of the Lynn Lake District. This report amplified the lithological and structural complexities of the district.

The first descriptions of the Fox Lake orebody were included in the field excursions of the 24th International Geological Congress (Glass, 1972). At this time, the Fox Lake deposit was described as a steeply dipping, tabular, massive sulfide lens enveloped in alteration and apparently conformable with the enclosing Wasekwan Series host rocks. Included in the hangingwall lithologies was a sliver of Sickie Series arkose. Based on the apparent symmetrical disposition of ore minerals and alteration assemblages, the orebody was interpreted as an epigenetic hydrothermal replacement deposit, modified by subsequent metamorphism (Glass, 1972).

A more detailed study of the ore petrology and the distribution of alteration lithologies similarly concluded the orebody was of epigenetic hydrothermal origin (Obinna, 1974). A study by Turek et al., (1976) of trace metal and major element distributions around the Fox Lake orebody did not reveal any large-scale dispersion patterns.

In 1976-77, the Fox Mine area was remapped by the Manitoba Department of Energy and Mines, Mineral Resources Division, as part of a regional updating programme in northwestern Manitoba. Aspects of this programme included geological mapping (Zwanzig, 1978; Gilbert et al., 1980), mineral deposit

evaluations (Lustig, 1979; Gale et al., 1980) and geochronological studies (Clark, 1980).

These studies clarified the regional setting of the Lynn Lake Greenstone Belt (Figure 1), more precisely defined the relative ages of many of the metavolcanic and metasedimentary rocks (Clark, 1980) and provided a framework with which to make stratigraphic correlations (Clark, 1980; Gilbert et al., 1980). The Fox Lake deposit was described as a volcanogenic massive sulfide for the first time (Lustig, 1979). Aspects of this thesis were incorporated into a report on the massive sulfide deposit potential of Manitoba (Gale et al., 1980).

1.3 SCOPE OF THE PRESENT STUDY

The present study is a geological and geochemical investigation of the Fox Lake massive sulfide deposit, prompted by the imminent exhaustion of the deposit's mineable reserves. It encompasses surface and underground observations made by the author during the past ten years, while in the employ of Sherritt Gordon Mines Limited. Objectives of the petrological and structural observations made during this study included; refining the orebody's stratigraphic position, establishing the lateral extent of alteration and determining the effects produced by subsequent deformational events.

The boundaries of the surface area mapped for this study approximate a square, three kilometers to a side. The Fox Lake massive sulfide deposit is centrally located within the map area (see Map 1). This ground is currently held under

production leases by Sherriitt Gordon Mines Limited.

Surface mapping was done on a scale of one inch equals two hundred feet using existing mine grid cut-lines. These cut-lines had a longitudinal spacing of two hundred feet and were tied into latitudinal baselines every two thousand feet. The longitudinal component of this grid was oriented $N030^{\circ} W$, perpendicular to the strike of the deposit. Surface geology was plotted on mylars traced from Airquest Surveys' originals on a scale of one inch to four hundred feet. A geological plan map of the study area is included in the back jacket of this thesis as Map 1.

Underground mapping for this study focused on the lower-most operating level of the mine. A geological plan of 2800 Level is cited as Map 2. It also reposes in the back jacket. This level was mapped in its entirety by the author on a scale of one inch equals twenty feet with geological features referenced to survey stations and plotted on a traced copy of the mine surveyor's level plan. A simplified geological plan of 2100 Level is included within the text as Figure 3, to emphasize particular structural aspects and to provide a reference map for some of the geochemical samples listed in Appendix II.

In areas of limited exposure, extensive use has been made of surface and underground diamond drill core. Approximately 10,000 feet (3000 meters) of drill core were relogged by the author for this study. Cross sections of these holes are

included as Appendix I with collar locations plotted on Maps 1 and 2. Additionally, two drill holes collared near the 2000 Level shaft station are plotted in plan and included in the back jacket of this thesis as Map 3.

This report summarizes the whole rock geochemistry of 863 samples from the study area and listed in Appendix II. Major elements are listed as weight percent oxides. Trace elements (Cr, Zr, Rb, Sr, Nb and Y) for 201 of these samples are included as Appendix III. Except where noted, all analyses were performed by X-ray Assay Laboratories.

The analyses were used to characterise the lithologies of the Fox Mine area. Ratios of select major oxides and normative minerals from 160 samples were compared in a chemical classification of the metavolcanic rocks. A trace element classification of the metavolcanic rocks was attempted using 80 samples. The latter population is a subset of the former and both are listed in Appendix IV. Thin sections for 120 of the 863 whole rock samples were made by Coots Petrographic Limited. Geochemical and petrographic studies were done while the author was attending the University of Manitoba in Winnipeg.

CHAPTER II

ROCK TYPES OF THE FOX MINE AREA

2.1 REGIONAL SETTING

The Fox Mine area occurs within the Churchill Structural Province. It is situated near the western end of the more southerly of two metavolcanic belts (Fig. 1) that constitute the Lynn Lake Greenstone Belt (Gilbert et al., 1980). Whole rock Rb/Sr dating of samples from the Lynn Lake Greenstone Belt has yielded Aphebian ages for deposition, intrusion and metamorphism (Clark, 1980).

The metamorphosed volcanic, volcanoclastic and sedimentary rocks within this belt have been assigned to the Wasekwan Group (Bateman, 1945; Milligan, 1960; Gilbert et al., 1980). This group has been complexly folded, faulted and intruded by mafic to felsic plutonic rocks. The Wasekwan Group and early intrusions are overlain unconformably by a group of younger metamorphosed feldspathic sandstones and conglomerates assigned to the Sickie Group (Norman, 1933; Campbell, 1969; McRitchie, 1974; Gilbert et al., 1980). The terms 'Sickie Series and Wasekwan Series' of Norman (1933) and Bateman (1945), respectively, have been replaced by the terms 'Sickie Group and Wasekwan Group'. The nomenclature revision was proposed by Campbell (1969). It has been adopted by all subsequent authors. The preferred 'Group' ranking is used throughout the remaining text.

The Aphebian metamorphic gradient for the western end of the Lynn Lake Greenstone Belt increased towards the southwest and achieved amphibolite facies conditions in the Fox Mine area (Zwanzig, 1977; Gilbert et al., 1980).

The Lynn Lake Greenstone Belt constitutes a segment of a larger belt of metamorphosed volcanic and sedimentary rocks that extends from La Ronge, Saskatchewan in the southwest to Partridge Breast Lake in northern Manitoba (Gilbert et al., 1980). It is bounded on the south by the Kiseynew Sedimentary Gneiss Belt and the north by the Southern Indian Gneiss Belt. These belts comprise amphibolites, paragneisses and migmatites and have been interpreted as stratigraphic equivalents of the Wasekwan and Sickle Groups formed in different depositional environments (Gilbert et al., 1980).

The Kiseynew Sedimentary Gneiss Belt is bounded along its southern margin by the Flin Flon Greenstone Belt. This greenstone belt is divided into an Amisk Group that comprises metavolcanic rocks and a Missi Group that contains immature metasedimentary rocks (Bailes, 1971; McRitchie, 1974).

In many respects, the Lynn Lake and Flin Flon Greenstone Belts are analagous. An older sequence of metavolcanic rocks paired with a younger group of metasedimentary rocks characterize these greenstone belts. Both belts possess Aphebian ages of deposition, sedimentation and intrusion (Sangster, 1972; Bell et al., 1975; Clark, 1980) and host volcanogenic massive sulfide deposits (Gale et al., 1980; Gale, 1983).

2.2 LOCAL SETTING

The Fox Mine area exhibits the topography and physiography typical of the Canadian Shield. The area displays little relief and rocks are poorly exposed, yielding about two percent outcrop. It is dominated by shallow lakes and muskegs dotted with black spruce. Intermittently exposed, pine studied ridges disrupt an otherwise monotonous landscape.

Principal outcrop areas include two east-northeasterly trending ridges that flank the depression formerly occupied by Poki Lake; a small domal rise west of Fox Lake and isolated outcrops along the southwest shore of Fox Lake and between Fox and Snake Lakes. Although obscured by the scale of mapping (1:4800), most of these exposures occur on or near major lineaments. Markedly linear muskegs, shorelines and outcrop ridges are manifestations of a structurally controlled topography worn down by glaciation. A similar interpretation is offered for the unexposed breaks along outcrop ridges.

Diamond drill holes have been cored in some poorly exposed areas (see Appendix I, Maps 1 and 3). Cores from drill holes FS-23, FS-35, FS-28 and FS-29 provide bedrock coverage for the eastern and western extensions of the ore horizon. Cores from drill holes FS-33, FS-34, UF-1886 and UF-2039 provide similar coverage for the poorly exposed eastern margin of the tailings disposal area. Trends from ground and airborne geophysical surveys were used to extrapolate geological contacts from exposed to unexposed areas.

A complete and intact stratigraphic section has not been recognized within the boundaries of the Fox Mine area. Poly-phase deformation (see Chapter V) has resulted in repetitions of some lithologies and conspicuous absences of others. The degree of exposure is not great and only limited top direction indicators were observed. In spite of these problems it has been possible to interpret a stratigraphic sequence which is consistent with the observed relationships among rock types and the observed structural evidence. It is presented in Figure 2. The ensuing discussion addresses the rock types of the Fox Mine area in an order that is interpreted to be from oldest to youngest. For previously stated reasons, this ranking may be described as tenuous at best. Structural complexities are reflected in stratigraphic uncertainties.

The oldest rock types (Units 1 to 4) in the map area are predominantly metavolcanic rocks and have been assigned to the Wasekwan Group. Within this group, the porphyritic mafic metavolcanic rocks (Unit 1) are interpreted to be lowermost. This unit is areally extensive and lithologically diverse. It is overlain by the felsic metavolcanic rocks (Unit 2) that are interpreted to host the Fox Lake massive sulfide deposit. They are in turn overlain by the metasedimentary rocks (Unit 3). The contact between the latter rock units is found only in drill core along the western extension of the ore horizon (see DDH FS-28, Appendix I).

SICKLE GROUP

Unit 13

(60 m) arkosic meta-sandstone	⑤
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WASEKWAN GROUP

(200 m) APHYRIC MAFIC METAVOLCANIC ROCKS (informally known as the Tod Lake basalt ⁽¹⁾ ; includes massive and pillowed flows)	④
(150 m) METASEDIMENTARY ROCKS (includes feldspathic mudstones and siltstones, with intercalated felsic tuff and amphibolite)	③
(300 m) FELSIC METAVOLCANIC ROCKS (informally known as the Snake Lake dacite ⁽¹⁾ ; includes massive porphyritic and aphyric flows of rhyolitic to dacitic composition, dacitic tuff, altered rocks of dacitic composition and sulfide lenses)	②
(1500 m) PORPHYRITIC MAFIC METAVOLCANIC ROCKS (informally known in part as the Fox Lake porphyritic basalt and in part as the Fox Mine succession ⁽¹⁾ ; includes an upper sequence of porphyritic massive and pillowed basalt flows, aphyric pillowed basalt and andesite flows and flow breccias and iron formation and a lower sequence of porphyritic massive and pillowed basalt flows, autoclastic breccia, volcaniclastic and derived sedimentary rock)	①

FIGURE 2:

ROCK UNITS ENCOUNTERED IN THE FOX MINE AREA ARRANGED IN STRATIGRAPHIC ORDER.

NOTE (1): Informal rock names from Gilbert et al, 1980.

Aphyric mafic metavolcanic rocks (Unit 4) constitute the uppermost unit of the Wasekwan Group. It comprises aphyric, massive and pillowed basalts exposed along the east-trending ridge north of the mine and mill complex. Similar aphyric massive flow rocks are a minor component of the porphyritic mafic metavolcanic unit.

The Wasekwan Group is overlain by the Sickie Group. A thin sliver of arkosic meta-sandstone (Unit 5) is the sole representative of this latter group. Within the map area, it overlies the metavolcanic rocks with apparent conformability.

Treatment of the intrusive rocks (Units 6 to 9) follows the description of the Sickie Group. No stratigraphic order is implied for these rock types. Most (Units 6, 7 and 9) occur as relatively small, sill-like bodies and are interpreted to be synvolcanic. The hornblende tonalite - quartz diorite (Unit 8) is a much larger plutonic body. Its age of emplacement is less certain.

Rock names that indicate the mode of primary deposition have been used where possible in the ensuing discussion. Although frequently omitted, the prefix meta- is implied for all rock types in the Fox Mine area.

2.3 WASEKWAN GROUP

2.3.1 PORPHYRITIC MAFIC METAVOLCANIC ROCKS (UNIT 1)

Flow comprising hornblende-phyric, massive and pillowed basalts (1a-b) with subordinate amounts of aphyric basalts (1c) and aphyric andesites (1d) outcrop in the southeastern

half of the map area. These flow rocks are interpreted to be the oldest rock types in the map area and to constitute the basal portion of the stratigraphic section. A lower contact was not observed. The thickness of the porphyritic basalts is a speculative subject without this contact. They have an exposed thickness in excess of 1,500 meters within the map area. The porphyritic mafic metavolcanic rocks represent a thick accumulation of flows and flow breccias with a minor component of derived sedimentary rock. These rock types constitute the lowermost two-thirds of the total stratigraphic succession. Considering their areal extent, the porphyritic mafic metavolcanic rocks are poorly exposed.

Principal outcrop areas of this unit include a discontinuous ridge that parallels the north arm of Snake Lake; the southeast shoreline of Fox Lake; the peninsulas separating Fox and Jam Lakes and the well exposed ridge southeast of the mine and mill complex. Most outcrops are small (1m to 25m) and lichen covered. Only segments of individual flows are exposed on most outcrops.

The porphyritic mafic metavolcanic rocks are diverse lithologically. Eight subdivisions of this unit have been recognized within the map area. These subdivisions include massive basalt (1a), pillowed basalt (1b), volcanoclastic and derived sedimentary rock (1g), aphyric basalt (1c), aphyric andesite (1d), autoclastic breccia (1e) and iron formation (1f). Altered porphyritic mafic metavolcanic rocks (1h) is

the subunit term applied to altered rocks of unit 1 without distinguishing the protolith. Altered andesites and basalts are most commonly encountered in the stratigraphic section directly beneath the massive sulfide deposit or its strike projection.

These subunits are not uniformly distributed. The map area underlain by the porphyritic mafic metavolcanic rocks can be divided into two subareas based on the relative proportions of constituent subunits. The boundary separating these subareas coincides with the lineament defined by the northern shores of Jam and Fox Lakes.

Exposures in the southern subarea most commonly reveal portions of individual flows that comprise pillowed basalt (1b) with subordinate massive basalt (1a) and minor volcaniclastic and derived sedimentary rock (1g). The northern subarea comprises pillowed basalt (1b) and aphyric andesite (1d) in subequal proportions. Autoclastic breccia (1e), aphyric basalt (1c) and iron formation (1f) are minor constituents of this subarea. Subarea constituent rock types are contrasted in Table 1.

In addition to these two exposed subareas, subunits of the porphyritic mafic metavolcanic rocks were encountered in drill core, where intersections are interpreted to be structural repetitions. Descriptions of these rock types are included in this section; the structural processes responsible for these repetitions are discussed in Chapter V.

TABLE 1

SUBUNIT COMPARISON OF THE PORPHYRITIC MAFIC METAVOLCANIC ROCKS BY SUBAREA

PARAMETER	SUBAREA 1	SUBAREA 2
Location	Southeast of Fox/Jam Lakes	Northwest of Fox/Jam Lakes
Area	3.32 square kilometers	0.35 square kilometers
Principal rock type(s) as percentage of area	Porphyritic pillowed and massive basalt (1a-b) - 80%	Pillowed basalt (1b) - 40% Aphyric andesite (1d) - 30%
Subordinate rock type(s) as percentage of area	Aphyric basalt and andesite (1c-d) - 15% Volcaniclastic and derived sedimentary rocks (1g) - 5%	Autoclastic breccia (1e) - 15% Aphyric basalt (1c) - 10% Iron formatin (1f) - 5%

2.3.1.1 Massive basalt (1a)

The subunit term, massive basalt (1a), is used for hornblende phyrlic, massive flow rocks of basaltic composition in which the relationships with other subunits are obscure or absent. It includes compositionally and texturally similar autoclastic breccias and subvolcanic sills. Where cross cutting relationships are not observed (in drill core), the intrusive rocks are indistinguishable from massive flow rocks.

Outcroppings of massive basalt (1a) are restricted to subarea 1 (southeast corner of map area), where they are uniformly distributed and represent approximately 40% of the recorded exposures. Thicknesses of individual massive flows vary from a few meters to several tens of meters. Further discussion of the massive basalt (1a) is deferred to the ensuing subsection where it is reviewed in the context of individual flow composition and morphology.

2.3.1.2 Pillowed basalt (1b)

Individual flow units that contain pillowed segments are described in this thesis as pillowed basalts (1b). This subunit includes approximately 80% and 40% of the outcrops in subareas 1 and 2, respectively. Exposures of the pillowed basalt are uniformly distributed throughout subarea 1. In subarea 2, they are confined to a 100 to 150 meter thick zone that parallels P.R. #396. As summarized in Table 2, significant morphological differences exist between the pillowed basalts from these two subareas.

TABLE 2

COMPARISON OF PILLOWED BASALTS (1b) BY SUBAREA

PARAMETER	SUBAREA 1	SUBAREA 2
Exposures of pillowed basalt as percentage of total exposures	80%	40%
Pillowed flow constituents as percentage of individual flow:		
- Massive basalt	20 to 60%	5 to 20%
- Pillowed basalt	20 to 60%	40 to 80%
- Pillow breccia	0 to 20%	10 to 30%
Phenocryst content		
- Type	Cummingtonite pseudomorphs	Hornblende pseudomorphs
- Percentage	5%	3 to 4%
- Size	5 millimeters	2 to 8 millimeters
Pillows		
- Shape	Spheroidal to ellipsoidal	Amoeboid to loaf-like
- Size (diameter)	20 to 80 centimeters	30 to 110 centimeters
Vesicles/amygdules	Rare	Common; quartz-carbonate

Observations of complete flow units with exposed upper and lower contacts are rare. Where exposed, these contacts have chilled margins and appear parallel. This implies individual flows can be regarded as tabular bodies at least for outcrop scale intervals. Most frequently, flow morphologies are reconstructions from groups of outcrops. Criteria for establishing flow directions and lateral continuity of individual flows have not been recognized in this subunit.

The pillowed basalts (1b) are morphologically diverse. Flows commonly show upward internal gradations from massive basalt through pillowed basalt to pillow breccia. Proportions of constituent rock types vary from flow to flow and within individual flows.

Flows in subarea 1 comprise subequal proportions of massive basalt (including autoclastic breccia) and pillowed basalt with minor pillow breccias. Thicknesses vary from 20 to 40 meters. Flows in subarea 2 contain voluminous pillowed segments with subordinate amounts of massive basalt and pillow breccia. Structural disruptions are evident in this subarea. Estimated flow thicknesses vary from 10 to 30 meters.

The shapes and sizes of individual pillows also show considerable variation. In subarea 1, they vary from subspheroidal to ellipsoidal and range from 15 to 80 centimeters in their greatest dimension. These pillows are convex upwards and locally serve as facing direction indicators. In subarea 2, the shapes of individual pillows are more irregular,

varying from amoeboid to flattened loaf-like forms. Pillow diameters range from 30 to 110 centimeters. Pillows with downward extending lobes locally provide facing indicators.

Pillows in subarea 1 are poorly vesiculated with massive cores (Plate 2). They appear molded together with little or no interpillow hyaloclastite or sediment. Pillow selvages are coarsely recrystallized and vary in thickness from 0.5 to 2.0 centimeters. Pillows in subarea 2 have highly vesiculated, altered cores (Plate 3). Vesicles are commonly infilled by quartz and/or carbonate. Pillow selvages vary in thickness from 0.2 to 2.0 centimeters and interpillow sediment is an essential component. Thin rimmed, isolated amoeboid pillows totally enclosed in thick accumulations of unstratified hyaloclastite are common.

The phenocryst contents of pillowed basalts also vary by subarea. According to Gilbert et al. (1980), original pyroxene phenocrysts have been pseudomorphed by aggregates or subrounded clusters of amphibole with an average diameter of 5 millimeters. Pillowed flows in subarea 1 contain approximately five volume percent phenocrysts that are uniform in size and have been pseudomorphed by cummingtonite. The estimated phenocryst content of subarea 2 pillowed basalts is from 3 to 4%. Compared to subarea 1, this lower percentage reflects the contribution of hyaloclastite to the pillow breccia segments. Phenocryst size is also more variable in subarea 2, with diameters ranging from 2 to 8 millimeters.



Plate 2: Ellipsoidal pillow with massive core and coarsely recrystallized rim. From pillowed basalt (1b) of subarea 1. Location - 71260E x 6680N.



Plate 3: Loaf-like pillows with altered, vesiculated cores and thin selvages. From pillowed basalt (1b) of subarea 2. Location - 69920E x 8720N.

The pillow basalts possess porphyritic to glomeroporphyritic, seriate textures. In thin section, porphyritic aggregates of cummingtonite (Plate 4) or hornblende (Plate 5) are seen to be enclosed in a fine-grained, felted groundmass of plagioclase feldspar with either cummingtonite or hornblende. The amphiboles constitute 50 to 90% of individual sections. Minor constituents include plagioclase, biotite, quartz, calcite and sphene. Accessory minerals include epidote, sericite, magnetite and pyrrhotite.

2.3.1.3 Aphyric basalt (1c)

Several outcrops in subarea 2 consist of medium fine- to fine-grained, greenish-black, weakly foliated, aphyric basalt (1c). The exposures are situated on the ridge south of P.R. #396 and to the south and east of the pillow basalt (1b). Similar rock types were encountered by underground drifting near the shaft station on 2100 Level (Fig. 3) and by the ramp access to 2800 Level (Map 2). These exposures suggest this subunit is laterally continuous with a minimum thickness in excess of 30 meters. The aphyric basalt constitutes 5 to 10% of the rock volume of subarea 2. Exposures of the aphyric basalt are not sufficient to detail the distribution of this subunit. On some outcrops, entrail-like trains of epidote outline lobes within this subunit (Plate 46). Quartz-filled amygdules occur near lobe margins. Amorphous epidote blobs occupy the core regions of some pillowlike lobes.

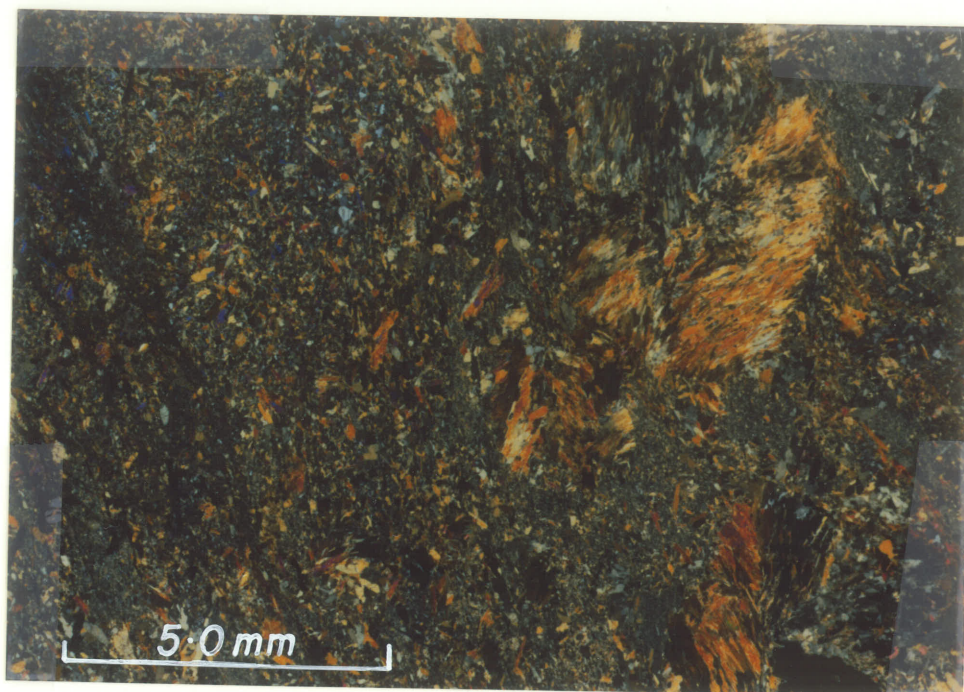


Plate 4: Porphyritic seriate texture in pillowed basalt(lb). Felted groundmass of cummingtonite and plagioclase encloses cummingtonite clot. Cross nicols. From DDH UF-1886 @ 2413'(736m).

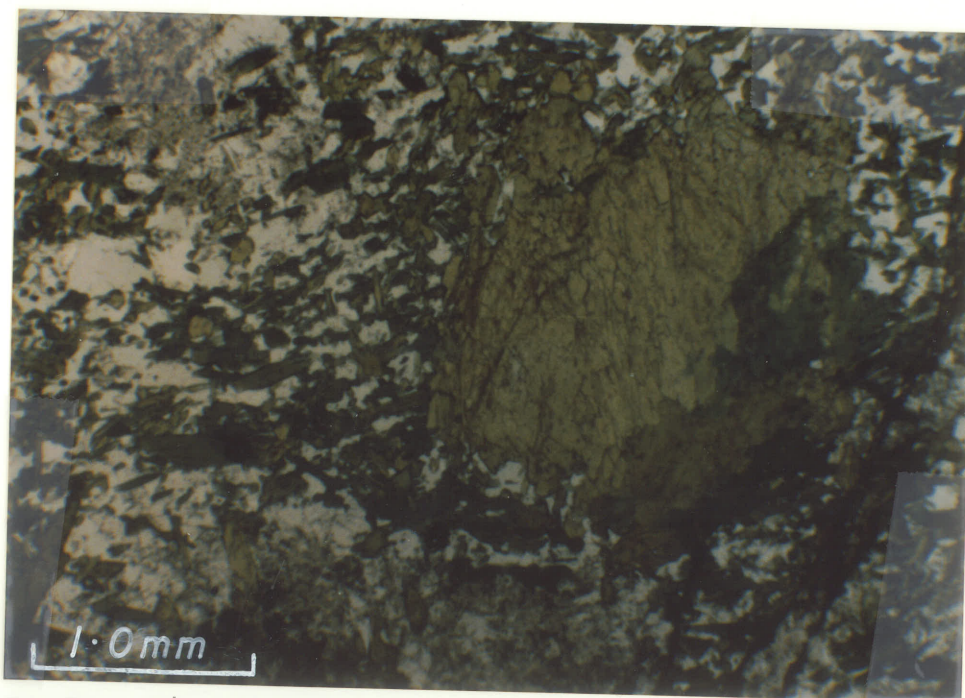
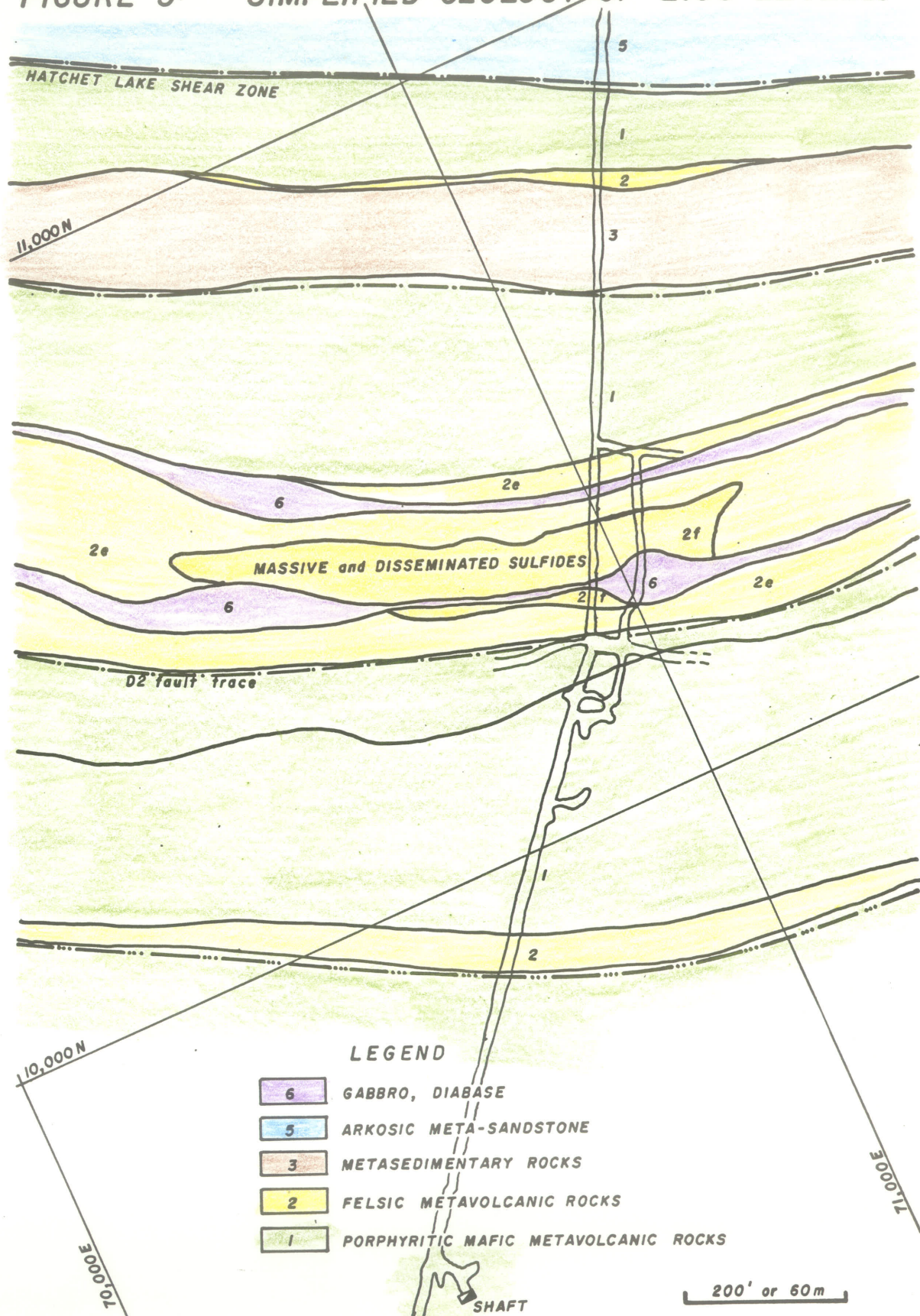


Plate 5: Hornblende- and plagioclase-phyric pillowed basalt (lb). Groundmass is fine-grained amphibole and plagioclase. Plane polars. From UF-1886 @ 113'(35m).

FIGURE 3: SIMPLIFIED GEOLOGY OF 2100 LEVEL²⁵



The aphyric basalt (1c) has a subidioblastic texture. Sections comprise subequal proportions of skeletal hornblende and plagioclase. Minor phases include diopside, quartz, epidote and calcite. Accessories include sericite and pyrite.

2.3.1.4 Aphyric andesite (1d)

Flows of aphyric andesite (1d) constitute approximately 40% of the rock volume in subarea 2, but less than 5% of subarea 1. Exposures of this subunit define a northward thickening wedge. It has a maximum thickness of 200 meters on the eastern end of the ridge south of the mine complex, the principal outcrop area for the aphyric andesite. Lesser occurrences are encountered on the peninsula separating Jam and Fox Lakes; and drill core intersections along strike of the orebody (FS-23, FS-28 and FS-35).

Thicknesses of individual aphyric andesite flows vary from less than 5 meters to greater than 20 meters. Approximately two thirds of this subunit consists of pillowed flow rocks. The remainder comprises subequal portions of massive andesite and andesite breccia with a minor tuffaceous component. Rock types are laterally and vertically intergradational within individual flows (Plate 6). Where present, massive aphyric andesite occurs towards the base of flows that have voluminous, pillowed central portions. Pillow lavas commonly grade upwards into pillow breccias. Breccias contain isolated pillows and pillow fragments in an unstratified hyaloclastite matrix. Individual pillow size decreases upwards.



Plate 6: One complete flow within the aphyric andesite (1d) from subarea 1. Flow comprises massive andesite at the base (top left), pillowed andesite in the centre and andesite pillow breccia at the top (bottom right). Pillow size decreases and amount of hyaloclastite increases upwards. Location - 71060E x 5940N.

Primary features, notably pillows and amygdules, are well preserved in the aphyric andesite and yield flow and facing direction indicators in several locations. In general, pillows are elongate and relatively large, varying from 40 to 250 centimeters in their greatest dimension (Plate 7). Some possess reentrant selvedges and rounded terminations that suggest a southwest component of flow direction. Pillows of the aphyric andesite commonly contain quartz- or carbonate-filled amygdules that range in size from a few millimeters (Plate 8) to several centimeters (Plate 7). Amygdules may account for up to 5% of a pillow's volume.



Plate 7: Elongate pillows with well-defined selvages, conspicuous interpillow sediment and raised amygdules. Blunt pillow terminations indicate facing direction (to left in photo). From aphyric andesite (ld) in subarea 1. Location - 71060E x 5890N.



Plate 8: Small amygdules concentrated near pillow margins. From aphyric andesite (ld) in subarea 2. Note also tightly folded quartz vein below lens cap. Location - 72350E x 8500N.

Pillow structures and the internal arrangement of rock types within individual aphyric andesite flows commonly yield facing directions. Internal shelves with convex roofs (Plate 9), downward tonguing pillow lobes, and flows that grade from massive andesite at the base upwards into pillowed andesite and pillow breccia (Plate 6) indicate the facing direction of flows in several locations. Early folding has resulted in local reversals of facing directions.

Outcrops of the aphyric andesite are bleached and mottled. Both fresh and weathered surfaces are greyish-white to greenish-grey in colour. In general, pillows are light coloured with darker cores and rims. Massive portions of flows are a similar pale, greyish-white. Pillow breccias comprise pale white pillows and pillow fragments enclosed in a greenish-grey to greenish-brown matrix (Plate 10). The amount of matrix material is variable. Pillows in subarea 1 are separated by 4 to 6 centimeters of hyaloclastite. Pillows in subarea 2 commonly have little or no interstitial hyaloclastite.

Massive flow segments and the interiors of pillows and pillow fragments are similar mineralogically and texturally. All are weakly foliated and comprise essential amphibole (0 - 70%) and plagioclase (30 - 50%). Plagioclase occurs as aggregates of polygonized grains (0.03 - 0.1 mm) intergrown with weakly aligned blades and rhombs of hornblende and cumingtonite (0.04 - 0.1 mm). High proportions of the latter amphibole result in a pale, felsic-looking rock.



Plate 9: Internal shelf showing secondary epidote replacement in a large, subspheroidal pillow. In aphyric andesite (ld) from subarea 2. Location - 72150E x 8970N.



Plate 10: Pale white, cummingtonite-rich, pillow fragments in a recrystallized [garnet biotite schist] hyaloclastite matrix. In aphyric andesite (ld) from subarea 2. Location - 72600E x 8890N.

Pillow margins are finer-grained, but otherwise similar to pillow interiors. Interpillow matrix material is coarsely recrystallized and schistose. Essential minerals include lepidoblastic biotite (0.02 - 0.1 mm) with subordinate granoblastic plagioclase. Micaceous foliae are overgrown by large garnet porphyroblasts (up to 2 cm). Pillow breccias comprise matrix hyaloclastite and flow fragments. They have textural and mineralogical features characteristic of both components. The amphiboles (cummingtonite and hornblende) and plagioclase are essential mineral constituents (Plate 11). Minor and accessory minerals include biotite, garnet, quartz, epidote, chlorite, sphene, pyrrhotite and magnetite.

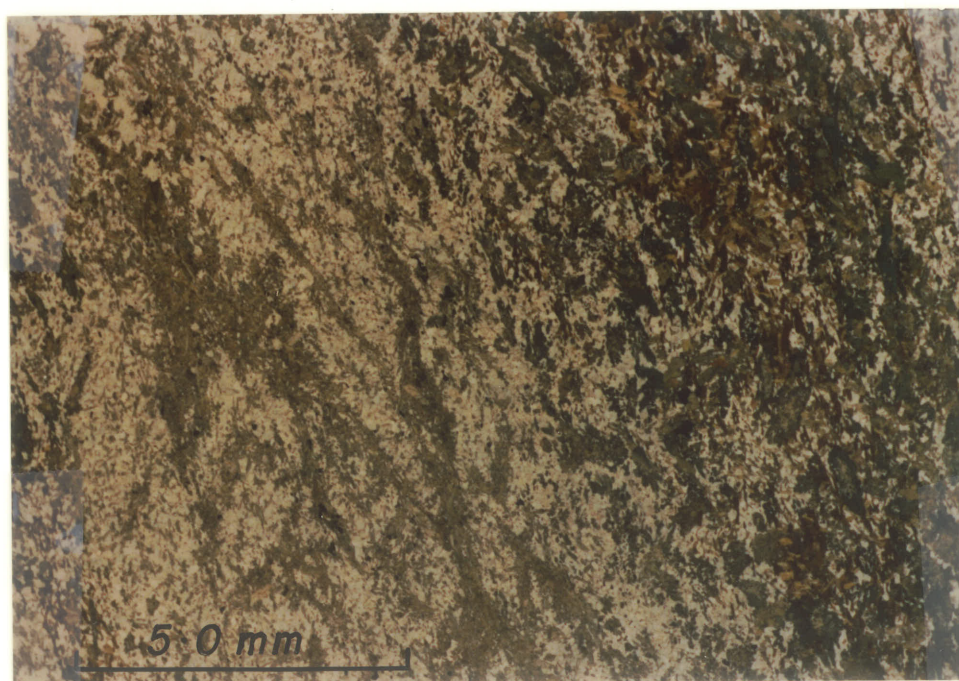


Plate 11: Zoned amphibole poikiloblasts overprinting foliation defined by biotite laths. In aphyric andesite (1d) from subarea 2. Plane polarized light. DH FS-35 @ 508' (155m).

2.3.1.5 Autoclastic breccia (1e)

Exposures of the autoclastic breccia (1e) are restricted to subarea 2. Numerous small, isolated outcrops (250 meters south of the headframe) indicate this subunit has an areal extent in excess of 200 x 300 meters. Exposures of the autoclastic breccia along the ridge southeast of the mine complex reveal this subunit to be laterally discontinuous and irregular in shape. It constitutes 10 to 15% of subarea 2.

Exposures of the autoclastic breccia east of the main outcrop area are spatially associated with the aphyric basalt (1c). Subunit contacts are not transitional; most are knife-sharp structural discontinuities (Plate 12). The autoclastic breccia is bounded on the west by the pillowed basalt (1b). Outcrop patterns suggest these subunits interdigitate, but contacts are not exposed. It also occurs near the 2100 Level crusher station (Plate 15), where it overlies the alteration zone, but is separated by a fault.

The easternmost outcrop of autoclastic breccia interdigitates with pillowed flows of aphyric andesite (Plate 13). Distinctions between aphyric andesite pillow breccias and the autoclastic breccia are based on fragment morphology. Pillow breccias contain visible pillow fragments. Fragments of the autoclastic breccia are aphyric, fine-grained, pale grey, elongate and irregularly shaped (Plate 14). The size of these fragments varies from 4 to 25 centimeters in their greatest dimension. They are enclosed in a garnet mica schist matrix.



Plate 12: Knife-sharp contact between autoclastic breccia (le) and aphyric basalt (lc). Fragment curvature indicates sinistral component of movement on structurally discontinuous surface. Location - 71415E x 8675N.



Plate 13: Elongate, pale grey flow fragments in a mica schist matrix. From autoclastic breccia (le). Location - 72410E x 8545N.



Plate 14: Aphyric, pale greyish fragments enclosed in a garnet mica schist matrix. Large fragment above lens cap appears folded. In autoclastic breccia (le). Location - 72410E x 8545N.



Plate 15: Pale grey, angular fragments in garnet mica schist matrix. Note late, low angle fault surfaces. In autoclastic flow breccia (le). Location: 2100 Level - 70910E x 10150N.

2.3.1.6 Iron formation (lf)

Occurrences of iron formation are restricted to subarea 2. The only known outcrop is located 200 meters north of the headframe. The other occurrences are known only from drill core. Iron formation intersections include DDH's FS-23@623' (190m), FS-28@175' (53m), FS-33@100' (30m) and @410' (125m) and FS-34@500' (152m). The maximum recorded thickness is 15 meters. In FS-33, the presence of iron formation coincides with the contact between the porphyritic mafic metavolcanic rocks (Unit 1) and the overlying felsic metavolcanic rocks (Unit 2). Elsewhere the stratigraphic position occupied by the iron formation is less clear. It may be transgressive. Drill intersections suggest the iron formation occurs as lenses of limited lateral continuity.

The iron formation is banded, but alternating layers are irregularly spaced. Discontinuous, isoclinally folded cherty layers (1 - 2 cm) alternate with thick, coarse-grained, dark apple-green mafic layers (5 - 10 cm) of unusual composition (Plate 16), including essential hedenbergite, minor andradite garnet and accessory gahnite (zincian spinel), pyrrhotite and chalcopryrite. Megacrystic major constituents show segregation banding. Magnetite is the principal iron mineral (up to 40%), most commonly occurring as disseminated grains (0.01 - 0.05 mm) in irregular zones approximately coincident with the mafic layers. Large blebs (up to 5 mm) are less common.



Plate 16: Discontinuous, isoclinally folded layers of chert in magnetiferous iron formation (1f). Location - 71210E x 10205N.

2.3.1.7 Volcaniclastic and derived sedimentary rock (1g)

Three small outcrop areas on or near the boundary separating subareas 1 and 2 comprise reworked volcanic and sedimentary rocks. As indicated on Map 1, outcrop locations include; the southwest corner of the map area, the peninsula between Jam and Fox Lakes and north of Snake Lake. This subunit (1g) constitutes less than 5% of the porphyritic mafic metavolcanic rocks.

There is no apparent continuity between outcrop areas. Constituent rock types occur as thin, discontinuous intercalations within the massive and pillowed basalts (1a-b) near their contact with the felsic metavolcanic rocks (Unit 2). Comparable rock types have not been recognized in subarea 2.

Constituent rock types include epiclastic breccia, thick bedded, heterolithic conglomerate and thin-bedded mafic siltstone (hyalotuff?). Conglomeratic clasts are well-rounded, vary in size (2 - 20 cm), locally fine upwards and are matrix supported. Clasts in the breccia are subrounded, small (0.5 to 5 cm), poorly sorted and more abundant than the enclosing matrix. Breccia matrix and clasts contain prominent porphyroblasts of cummingtonite (3 - 5 mm). Clasts in the conglomerate are hornblende-phyric. Conglomerate and siltstone matrices are finely comminuted and do not contain phenocrysts. Primary sedimentary features consistently indicate northwest facing directions. Petrographic studies were not done for this subunit.

2.3.1.8 Altered porphyritic mafic metavolcanic rocks (1h)

At several locations within the porphyritic mafic metavolcanic rocks, there are irregular, coarse-grained zones in which original subunit features have been modified, but are still recognizable (Plate 17). The zones are schistose and contain radiating bundles or bladed porphyroblasts of amphibole (0.5 - 10 cm) and sieve-textured cordierites, in addition to biotite laths and garnet porphyroblasts. Less commonly, they comprise felted masses of magnesian chlorite overprinted by large tremolite prisms. The zones possess crosscutting relationships (Plate 18), which indicates formation by post-depositional processes. These processes are interpreted to be hydrothermal alteration.

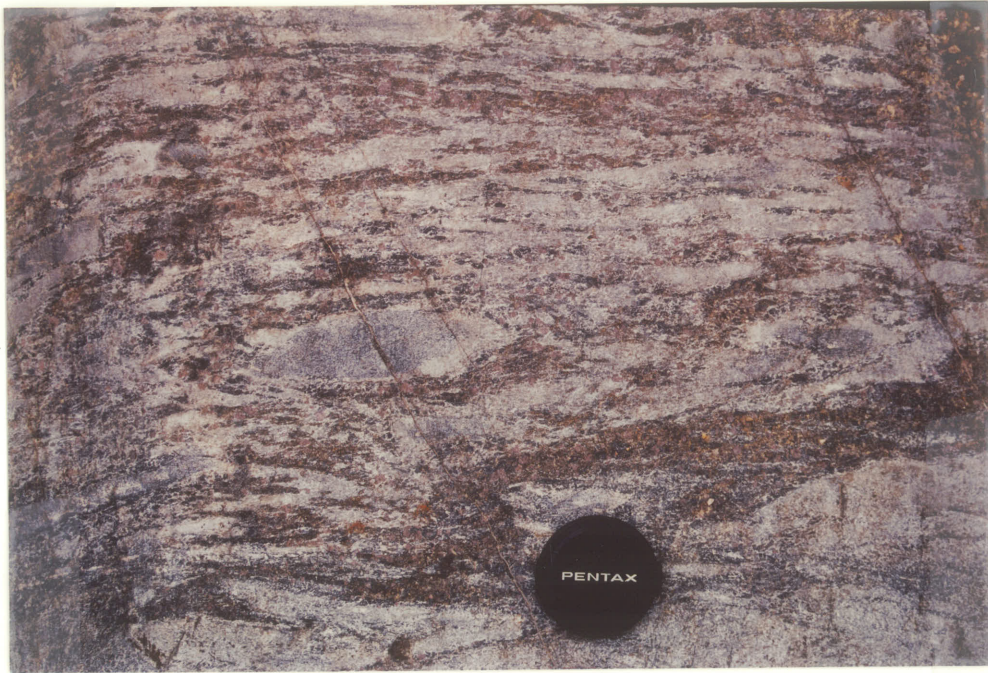


Plate 17: Weakly altered pillow breccia of the aphyric andesite (ld → h). Clast/matrix boundaries are more diffuse and coarser grained than in unaltered samples. Location - 72090E x 9095N.



Plate 18: Aphyric basalt (lc) with crosscutting alteration. Reconstituted host rock is a coarse-grained anorthophyllite schist (lh). Location - 71195E x 10150N.

Occurrences of altered porphyritic mafic metavolcanic rocks (exclusive of the zone enclosing the orebody) are found either in drill core intersections (DDH's including FS-23@490' (149m) and 1260' (384m), FS-35@865' (264m), FS-28@38' (12m) and 560' (171m), and UF-1886@2450' (747m) or outcrops in subarea 2. Alteration in subarea 1 is known only from drill intersections. Cored intervals of altered rock are short (up to 3 meters) and randomly distributed. The effects of hydrothermal alteration as observed in drill core and on outcrops in subarea 2 are registered as irregularly spaced, crosscutting zones or semi-conformable lenses of coarsely recrystallized magnesian mineral assemblages with schistose textures. Altered intervals are encountered more frequently with proximity to ore. Alteration assemblages are more prevalent in the pillow breccias and autoclastic breccias (ld-e). This association suggests either preferential susceptibility to alteration processes or the proximity of a hydrothermal source.

Altered porphyritic mafic metavolcanic rocks underlie the massive sulfide deposit and occur along the strike projection to the east and west. Most rock types in the alteration zone that envelopes the Fox Lake orebody belong to other rock units. Further discussion of alteration rock types and processes is deferred to Chapter III (The Alteration Zone).

2.3.2 FELSIC METAVOLCANIC ROCKS (UNIT 2)

Felsic metavolcanic rocks overlie the porphyritic mafic metavolcanic rocks. Subdivisions of this unit, based on primary features, include massive porphyritic dacite (2a), massive aphyric dacite (2b), massive porphyritic rhyolite (2c), dacitic tuff (2d), altered dacite (2e) and sulfides (2f). Approximately 8 to 10% of the exposures in the map area are felsic metavolcanic rocks. This value is similar to the proportion of felsic rocks in the stratigraphic section.

Exposures of these felsic rocks occur in three distinct clusters.

The southernmost group of felsic metavolcanic rocks occupies the wedge-shaped tract between Fox and Jam Lakes and the tailings disposal area (see Map 1). These felsic rocks are bounded on the north and southeast by porphyritic mafic metavolcanic rocks. Facing direction indicators in both mafic and felsic rocks consistently place the felsic rocks stratigraphically above the porphyritic mafic rocks. The basal portion of this outcrop area comprises massive porphyritic and aphyric dacites (2a-b). Massive porphyritic rhyolite (2c) and dacitic tuff (2d) are exposed in the upper portion. Thickness estimates for the rock column exposed in this area range from 200 to 400 meters.

The middle outcrop area of felsic metavolcanic rocks is located 200 meters south of P.R. #396 near the bend in the south access road. This segment is composed entirely of da-

citic tuff (2d) and has an exposed thickness of less than 10 meters, but the shape and extent are unknown.

The northernmost exposures of felsic rocks straddle P.R. #396, approximately 300 meters east of the mine. These outcrops are the exposed segment of an east-trending belt that comprises dacitic tuff (2d) and massive porphyritic rhyolite (2c). As indicated by drill intersections, this belt of felsic rocks maintains a constant thickness of 30 to 40 meters and hosts the Fox Lake massive sulfide deposit.

Primary features used in subdividing the felsic metavolcanic rocks include phenocryst content, textures and gross morphology. Massive felsic rocks occur as either thin, locally disrupted, laterally continuous flows or thick flows with no apparent lateral continuity. Foliated, tuffaceous rocks are commonly associated with these flow rocks. Coarser grain size, schistose appearance and the presence of amphibole asterisms differentiate altered felsic rocks from unaltered ones. The boundary between these rock types is somewhat arbitrary.

2.3.2.1 Massive porphyritic dacite (2a)

Low relief, flat domal outcrops of massive porphyritic dacite (2a) are exposed in the southernmost belt of felsic rocks. They outcrop 50 meters north of the isthmus that separates Fox and Jam Lakes. With the exception of a fault-bounded northern margin, these outcrops define the areal extent of this subunit. From these exposures, the massive

porphyritic dacite has an estimated thickness of 100 meters and a lateral extent of less than 200 meters.

Exposed surfaces are patchy, lichen-covered and weather pinkish-grey. The colour is imparted by hematized microfractures that disrupt and polygonize an otherwise massive, pale greyish-white quartzofeldspathic matrix (Plate 19). Inconspicuous white feldspar phenocrysts (1 to 3 mm) are common in this subunit. Vesicles are rare.

A thin zone (2 - 3 m), in which the massive porphyritic dacite occurs as broken, angular blocks (10 - 40 cm), defines the eastern or lower margin of this subunit (Plate 20) and a coarse-grained, discontinuous, magnetiferous garnet amphibolite layer defines the upper contact. The blocks are greyish white and enclosed in a fine-grained, brownish-grey, foliated matrix. Thick accumulations of dacitic tuff (2d) mark the southern limit of this subunit, but the contact between these rock types is not exposed.

The massive porphyritic dacite are fine-grained (0.01 - 0.06 mm) with porphyritic textures, in thin section. Both plagioclase and quartz occur as phenocrysts. Principal mineral constituents include plagioclase (60%) and quartz (30%) as polygonized matrix aggregates. Biotite, as ragged laths (0.1 - 0.2 mm), is the principal mafic constituent. Minor phases include muscovite, garnet and chlorite.



Plate 19: Massive porphyritic dacite (2a) polygonized by fracture network. Near upper flow contact where garnet porphyroblasts and disseminated magnetite grains are evident, but feldspar phenocrysts are indistinguishable from matrix. Location - 70930E x 6980N.



Plate 20: Basal portion of massive porphyritic dacite (2a). Large angular blocks separated by fine-grained reworked material. Location - 71275E x 7170N.

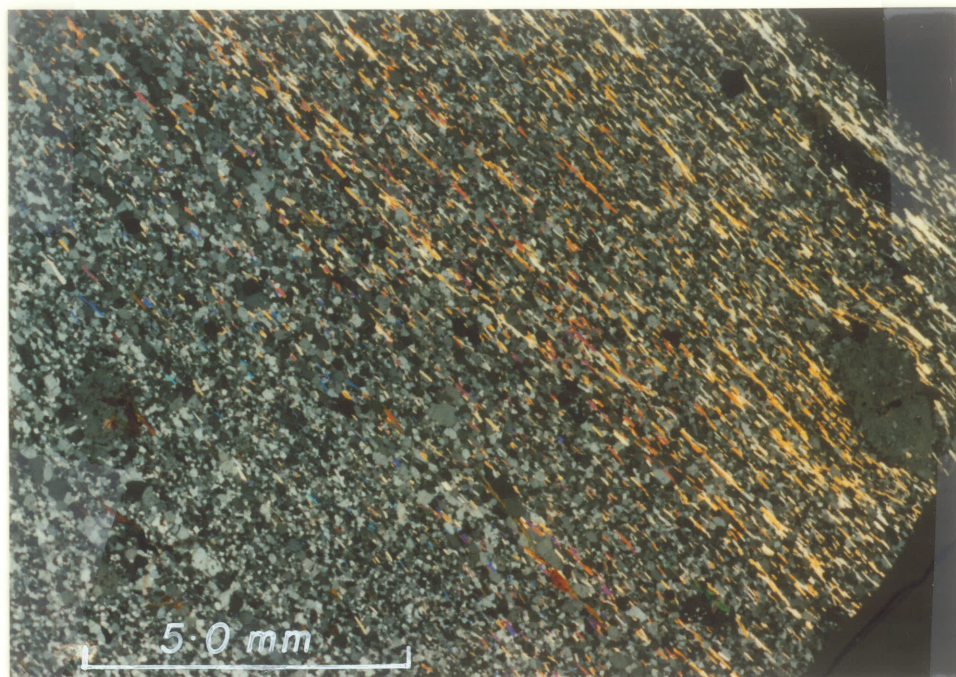


Plate 21: Plagioclase phenocryst in matrix of polygonized plagioclase and quartz with muscovite laths defining foliation. In massive porphyritic dacite (2a). Cross nicols. Location - UF-1886@1428' (435m).

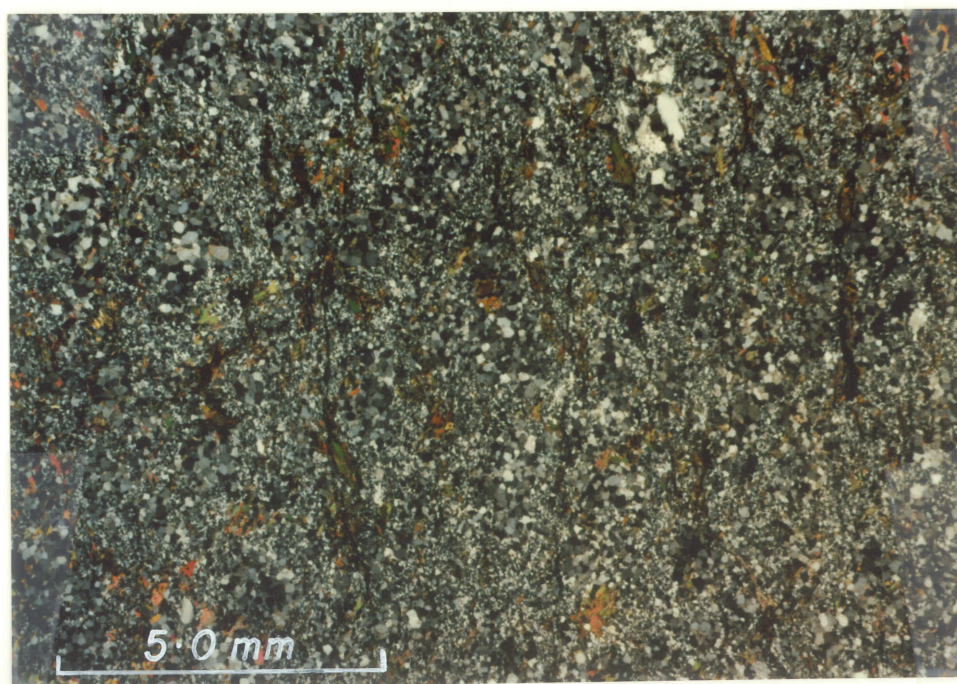


Plate 22: Strained quartz phenocryst and plagioclase aggregates replacing original phenocrysts in massive porphyritic dacite (2a). Cross nicols. Location - FS-34@515' (157m).

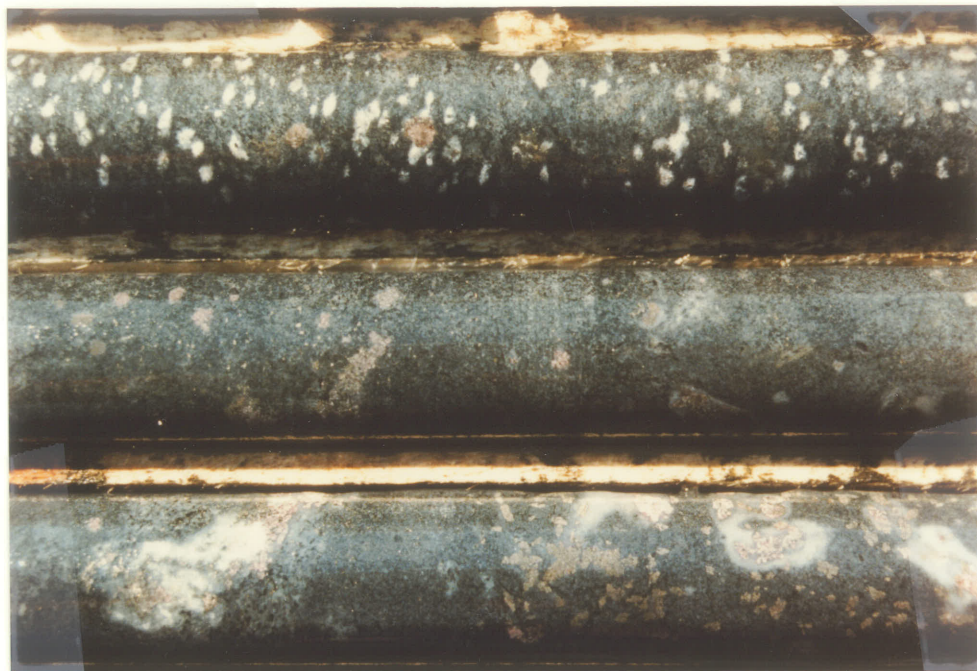


Plate 23: Cored segment near upper contact of massive porphyritic dacite (2a), showing fibrolite porphyroblasts (top), garnet and staurolite porphyroblasts (bottom). Location - UF-1886@1319' (402m).

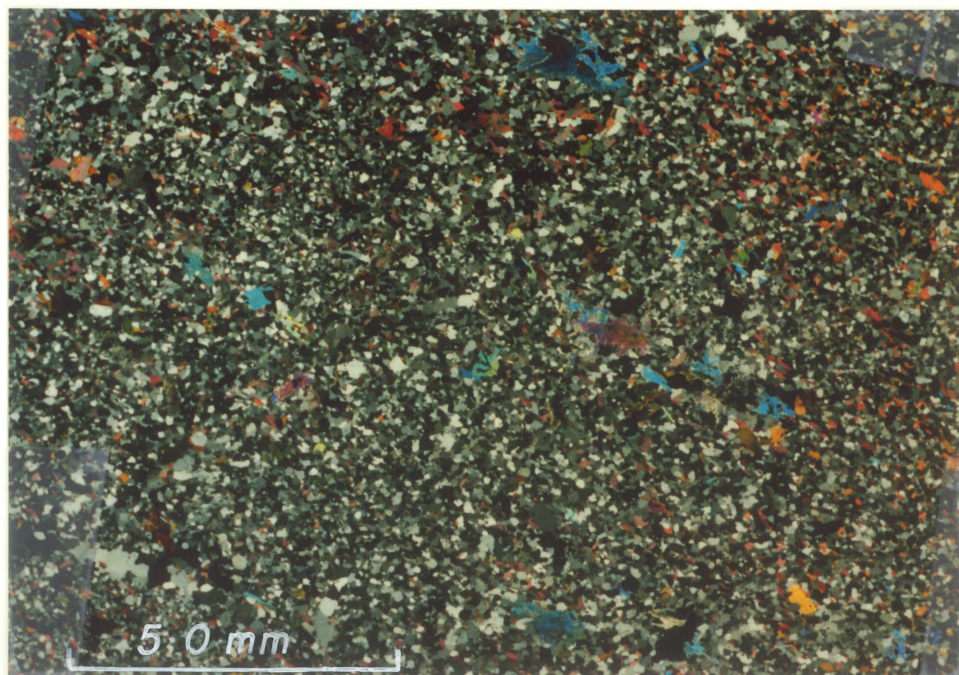


Plate 24: Replacement of fibrolite porphyroblast by muscovite. In massive porphyritic dacite. Cross nicols. Location - UF-1886@1319' (402m).

The phenocryst content varies, but averages one percent. The dacites contain either quartz or plagioclase phenocrysts or both, indicating this subunit is a composite of several lesser flows. Plagioclase phenocrysts vary in size from 1 to 4 millimeters and show varying degrees of deformation. Some show only marginal granulation along grain boundaries (Plate 21). Others are completely replaced by fine-grained polygonized aggregates (Plate 22). Matrix grains and phenocrysts of plagioclase are locally altered to sericite or saussurite. Quartz occurs as microphenocrysts (0.1 - 0.3 mm) and highly strained larger phenocrysts (0.8 - 2.0 mm).

Minor and accessory minerals include cummingtonite, magnetite, apatite, tourmaline and pyrrhotite. Porphyroblastic garnet (2.0 mm to 2.0 cm), poikiloblastic staurolite (2.0 mm to 5 mm), fibrolite knots (up to 1 cm), cordierite poikiloblasts (5.0 mm to 2.0 cm) and asterisms of anthophyllite (up to 10 cm) occur within restricted segments of this subunit (Plates 23 and 24).

Porphyroblastic mineral phases occur in bands or zones near the contacts of the massive flow rocks. Many (notably cordierite and anthophyllite) occur in discordant, crosscutting zones that are related to alteration processes. Others (sillimanite) occur in discrete zones that seemingly reflect primary compositional differences. The alignment of these latter zones is conformable with primary layering observed in adjacent rock types.

2.3.2.2 Massive aphyric dacite (2b)

Massive aphyric dacite (2b) outcrops intermittently along the western margin of the massive porphyritic dacite. Exposures are small and isolated. The aphyric dacite has an estimated thickness of 30 meters, but its shape is not known because its contacts are not exposed. It appears confined to the southern outcrop area and constitutes approximately one percent of the stratigraphic section.

Except for the absence of phenocrysts, the massive aphyric dacite is petrographically similar to the massive porphyritic dacite. It consists of fine-grained (0.03 - 0.08 mm) polygonized matrix grains of plagioclase, quartz and minor biotite as ragged laths that define a weak foliation. Minor constituents include chlorite as replacements on biotite and late muscovite laths. Accessory minerals include magnetite, epidote and porphyroblastic garnet (with depletion haloes).

2.3.2.3 Massive porphyritic rhyolite (2c)

A single outcrop is the only surficial expression of the massive porphyritic rhyolite (2c). It is located 300 meters east of the mine on the south side of P.R.#396, in the northernmost felsic outcrop belt. Other occurrences of the massive porphyritic rhyolite are known only from drill core (FS-33, UF-1886 and UF-2039). These cored intervals come from intersections in the southernmost felsic outcrop area. The surface exposure and drill intersections indicate this sub-unit is discontinuous, but laterally extensive, with a maxi-

mum thickness of less than 20 meters. The estimated average thickness is only 5 to 10 meters. This subunit constitutes less than 1% of the stratigraphic section and occurs near the top of the felsic metavolcanic rocks (Unit 2).

The solitary outcrop of this subunit is small and has no exposed contacts. The weathered surface is ivory white, massive and pitted. Pitting has resulted from the preferential weathering of randomly oriented amphibole porphyroblasts in a resistant, fine-grained, quartzofeldspathic matrix. Plagioclase and quartz phenocrysts both occur in this subunit, but are not abundant (1%). Only smoky-grey quartz microphenocrysts are evident on the weathered surface.

Relict textures are not apparent in the massive porphyritic rhyolite. The rock is a fine-grained, poorly foliated to massive, quartzofeldspathic gneiss. Quartz and untwinned plagioclase, in subequal proportions, are the principal mineral constituents. Both occur as polygonized, mosaic matrix grains (0.02 - 0.06 mm) and phenocrysts. Plagioclase phenocrysts are large (0.5 to 3.0 mm) and ovoid. Quartz occurs as strained microphenocrysts (0.08 - 1.0 mm). Anthophyllite, as bladed porphyroblasts and asterisms (1.0 mm to 2.0 cm), is the principal mafic constituent (Plate 25). It is locally retrogressed to chlorite. Minor constituents include biotite and orthoclase. The former occurs as small, weakly aligned laths; the latter as polygonized matrix grains. Accessory minerals include porphyroblastic garnet, epidote and pyrite.

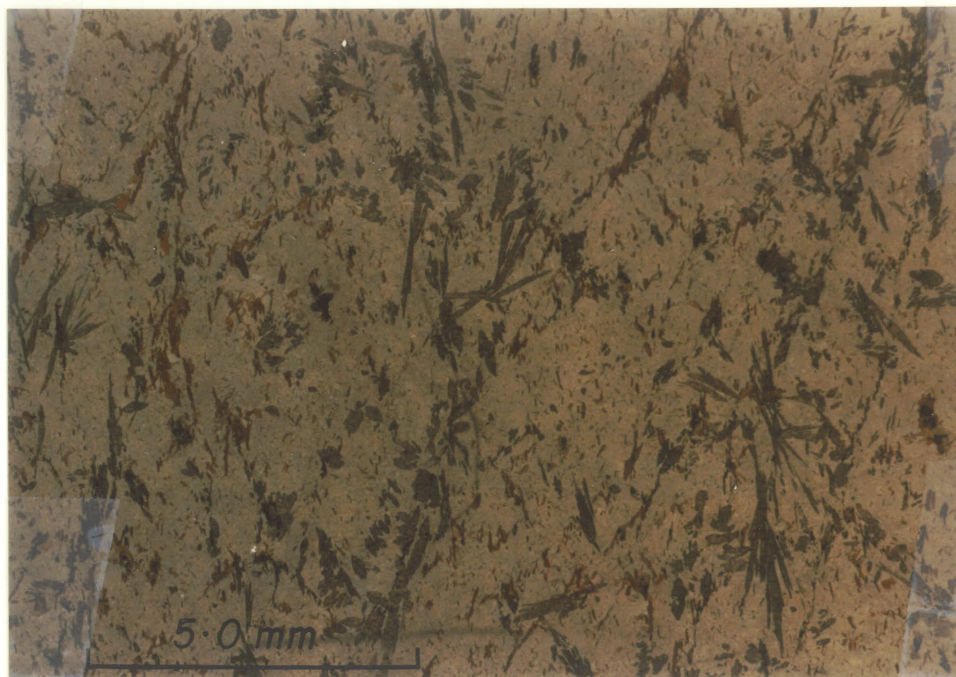


Plate 25: Anthophyllite prisms overprinting weak biotite foliation in massive porphyritic rhyolite (2c). Plane polarized light. Location - FS-35 @ 1020' (311m).

2.3.2.4 Dacitic tuff (2d)

Dacitic tuffs (2d) are the most voluminous and laterally extensive subunit of the felsic metavolcanic rocks. They are exposed in all three felsic rock outcrop areas, but subunit thickness is markedly different in each area. It attains a maximum thickness in excess of 100 meters in the southern outcrop area. With a thickness of less than 10 meters, these tuffs are thinnest in the central area. Dacitic tuffs in the northern outcrop area have an average thickness of 30 meters. Outcrop patterns and drill core intersections indicate this subunit is laterally extensive, but locally discontinuous. Thickness variations and local absences have resulted from structural deformation.

Dacitic tuffs constitute approximately five percent of the stratigraphic section. Field relationships indicate this subunit occurs as tabular, sheetlike bodies that lie above the massive porphyritic and aphyric dacites (2a-b), but below the massive porphyritic rhyolite (2c).

Outcrops of dacitic tuff are cream- white to buff colored on weathered surfaces. Fresh surfaces are greyish brown. This subunit is generally fine-grained, foliated and compositionally layered (Plate 26). Where observed, compositional layering is essentially parallel to primary layering.

Two foliations are evident in some thin sections. Both are lepidoblastic schistositities defined by aligned biotite laths (Plate 27). Foliae of the early schistosity are more continuous and contain aligned trains of small garnet porphyroblasts. Essential constituents includes subequal amounts of quartz and untwinned plagioclase that occur as xenoblastic polygonized matrix grains (0.03 - 0.1 mm) and rare phenocrysts (1 - 3 mm). Minor minerals include biotite, garnet, hornblende and cummingtonite-anthophyllite. Hornblende occurs as relict skeletal grains. The white amphiboles occur as compositionally zoned rhombs and acicular grains (0.5 - 3.0 mm) overprinting both mica and quartzofeldspathic layers. The mafic minerals constitute 10 to 20% of individual sections. Accessory mineral phases include chlorite, calcite, epidote, sphene, apatite, tourmaline, magnetite, pyrrhotite and pyrite.



Plate 26: Weathered surface of the dacitic tuff (2d) showing late (S_2) foliation crosscutting the (S_1) foliation and layering. Location - 72410E x 9160N.

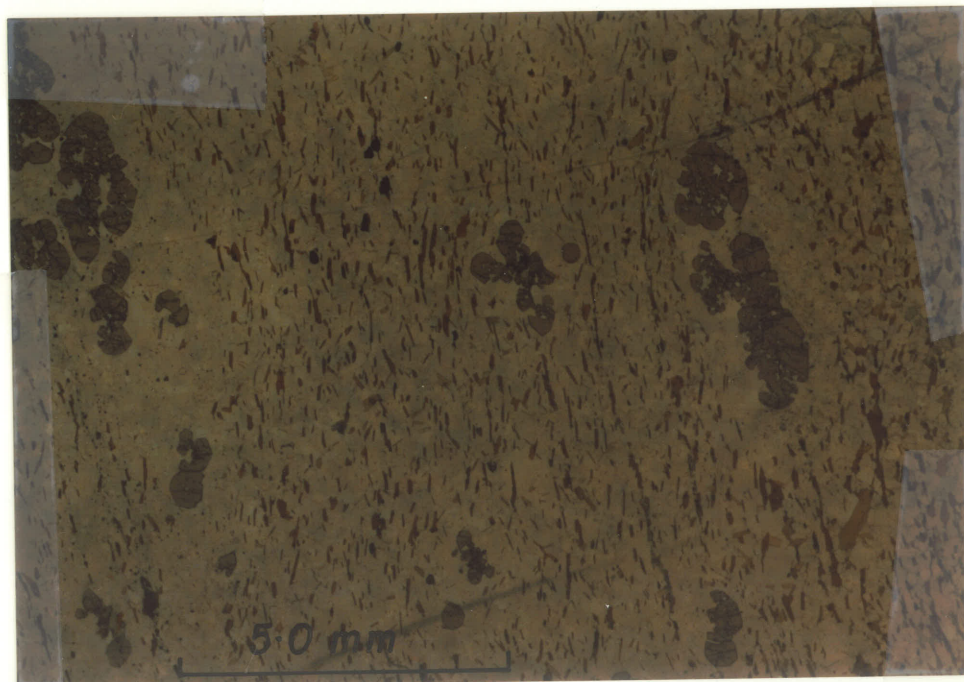


Plate 27: Photomicrograph of the dacitic tuff (2d), showing two penetrative foliations (S_1 and S_2) defined by aligned biotite laths. Trains of garnet porphyroblasts are aligned in the early foliation. Plane polars. Location: UF-1886 @ 1319' (402m).

2.3.2.5 Altered dacite (2e)

Coarse-grained schists containing magnesian-rich mineral assemblages occur as irregular lenses and anastomosing vein networks within most felsic metavolcanic subunits. Most commonly, these zones are irregular in shape and crosscut the host strata. Conformable lenses are rare. These zones resulted from post-depositional processes. The attendant mineralogical and textural transformations indicate these pods and lenses are part of a metamorphosed hydrothermal alteration zone.

Visibly altered felsic rocks occur as discordant lenses, patches and stringers of coarse-grained schists that contain porphyroblastic cummingtonite (Plate 28), anthophyllite and cordierite (Plate 29). Less conspicuous alteration is manifested in medium-grained schists that contain aligned laths of biotite and sericite with porphyroblastic garnet, cordierite and/or staurolite. Porphyroblastic schists are rare in massive dacites (2a-b) but common in the dacitic tuff (2d).

Coarse magnesian schists are encountered more frequently with proximity to the massive sulfide deposit. The mineral assemblages indicate metamorphism of chemically modified, hydrothermally altered protoliths. Mineralogical changes effected by alteration processes are most evident in rock types of the alteration envelope and are discussed in Chapter III (The Alteration Zone).

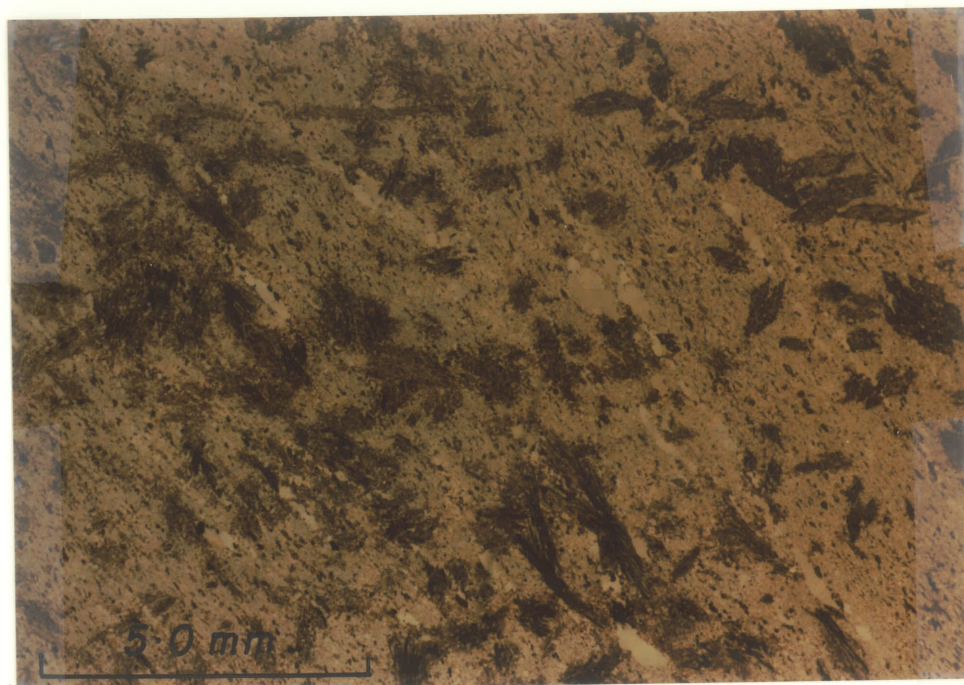


Plate 28: Photomicrograph of cummingtonite rhombs and prisms overprinting early foliation (S_1) in the dacitic tuff (2d). Plane polarized light. Location - DDH FS-34 @ 94' (29m).

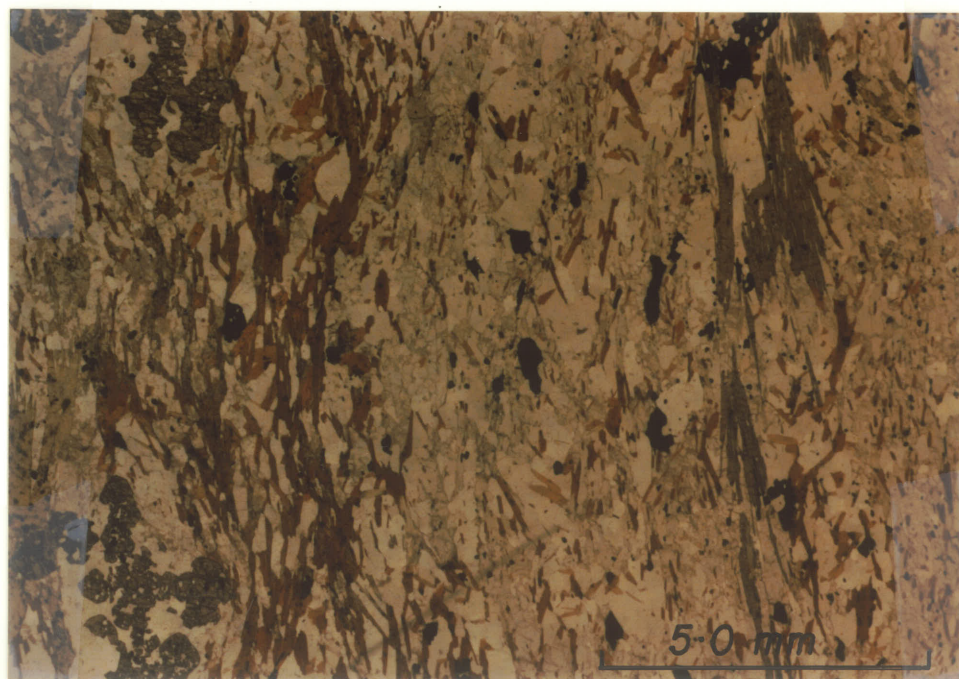


Plate 29: Photomicrograph of cordierite anthophyllite schist. In altered dacite (2e). Plane polarized light. Location - DDH UF-1886@662' (202m).

2.3.2.6 Sulfides (2f)

Most rock types in the Fox Mine area contain sulfides as accessory minerals. Finely disseminated pyrrhotite and pyrite are ubiquitous. Heavily disseminated and semi-massive sulfides are less common. Occurrences include sulfidic mudstone bands in the metasedimentary rocks (Unit 3) and a rusty gossan zone with heavily disseminated sulfides (2f) hosted by cordierite anthophyllite gneiss (2e) exposed in the southwest part of the map area (71400E x 7000N). The Fox Lake orebody is the only known massive sulfide occurrence. Rocks with elevated sulfide contents occur within a restricted segment of the stratigraphic section. This segment straddles the boundary between the felsic metavolcanic rocks (Unit 2) and the metasedimentary rocks (Unit 3).

Major concentrations of sulfide minerals are restricted to a 200 meter thick, east-trending zone that includes the Fox Lake massive sulfide deposit. The sulfide content decreases with increasing distance from the orebody. The ore horizon position is denoted by disseminated pyrrhotite with specks of chalcopyrite 350 meters beyond the ore limits. The sulfide occurrence 800 meters south of the mine is interpreted as a structural repetition of the main sulfide horizon. Evidence supporting this interpretation includes host rock similarity, sulfide mineralogy and intersecting trends. These aspects are discussed more fully in the ensuing chapters.

2.3.3 METASEDIMENTARY ROCKS (UNIT 3)

Metasedimentary rocks (Unit 3) occur as four east-trending, sheet-like bodies in the northern half of the map area. Only the two northernmost segments are exposed on surface. One outcrops 500 meters north of the mine complex in the explosives' storage area, where it has an exposed thickness in excess of 150 meters. The other body outcrops along the shore of Dunphy Lake and is at least 75 meters thick.

The locations of the remaining metasedimentary tracts are known from underground workings and drill core intersections. The more northerly segment, informally known as the slatey sediments, subcrops 100 meters north of the orebody. The thickness of this zone varies from 120 meters near the western boundary of the map area to less than one meter near the eastern boundary. The remaining zone occurs on the west side of the orebody and is wedge-shaped. The metasedimentary rocks (Unit 3) constitute 7% of the Fox Mine stratigraphic section, but only 3 to 4% of the exposed bedrock.

The metasedimentary rocks comprise 75% feldspathic siltstones (3a) with 20% intercalated mudstones (3b) and subordinate felsic tuffs (3c). Layering ranges from fine laminations (2 - 5 mm) to very thick bands (up to 5 meters). Compositional differences between adjacent layers result in a pronounced colour banding on weathered outcrop surfaces (Plate 30). Minor folding and crenulation of the layering are a conspicuous, diagnostic feature of the metasedimentary rocks.

The feldspathic siltstones (3a) are thick bedded (30 - 100 cm), homogeneous, with very thin laminae (1 mm). Layering is defined by segregation into quartzofeldspathic and biotite-rich layers. Opaque mineral trains are aligned parallel to layering. Small biotite laths define a late, cross-cutting lepidoblastic schistosity. Quartz, plagioclase and biotite are essential minerals in the siltstone. Sections comprise fine-grained (0.03 to 0.1 mm) quartz (50%) and plagioclase (30%) as polygonized matrix aggregate with subordinate, rusty-brown, lepidoblastic biotite (Plate 31). Minor constituents include porphyroblastic staurolite, garnet, cummingtonite and sillimanite. Accessory minerals include apatite, scapolite, graphite, pyrrhotite and pyrite.

Feldspathic mudstones (3b) are very fine-grained (0.01 - 0.05 mm), micaceous (up to 25%) and locally sulfide-rich, but otherwise texturally and mineralogically similar to the siltstones. Restricted segments within the feldspathic mudstones contain semi-massive to massive pyrrhotite with minor pyrite, chalcopyrite and sphalerite. More typically, pyrrhotite occurs as finely disseminated grains.

Felsic tuffs occur as thin (0.5 to 5 meters), continuous lenses within the siltstones and mudstones. In outcrop they are fine-grained, laminated and whitish-grey in colour. Rare layers contain lapilli-sized fragments. The tuffs are petrographically similar to the dacitic tuffs (2d) of the underlying felsic metavolcanic rocks (Unit 2).

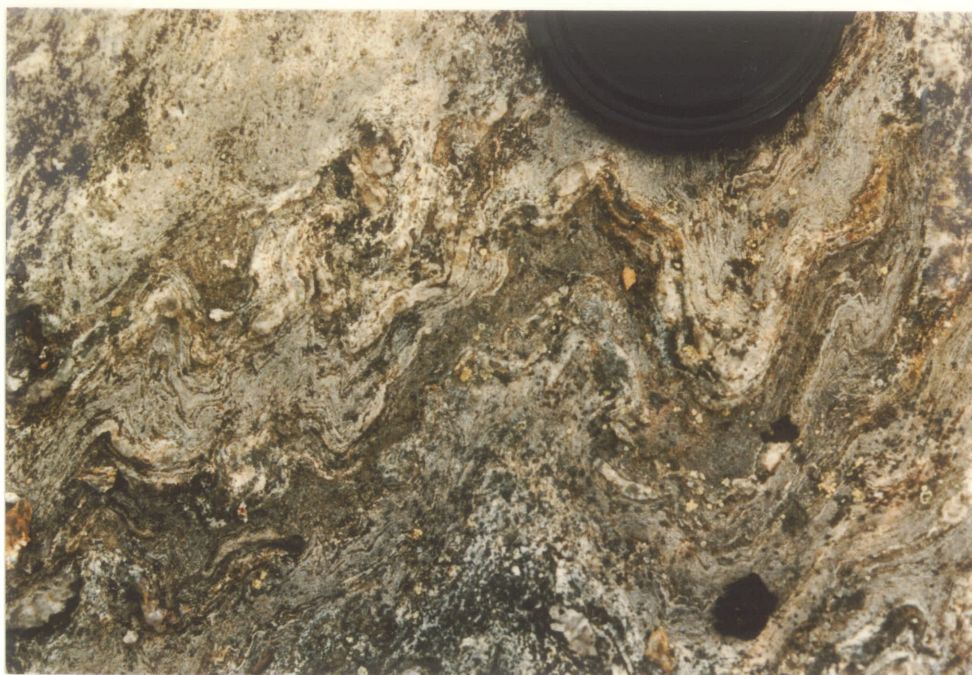


Plate 30: Intercalated feldspathic siltstone (3a) and mudstone (3b) layers in folded, laminated metasedimentary rocks (3). Location - 71060E x 11610N.

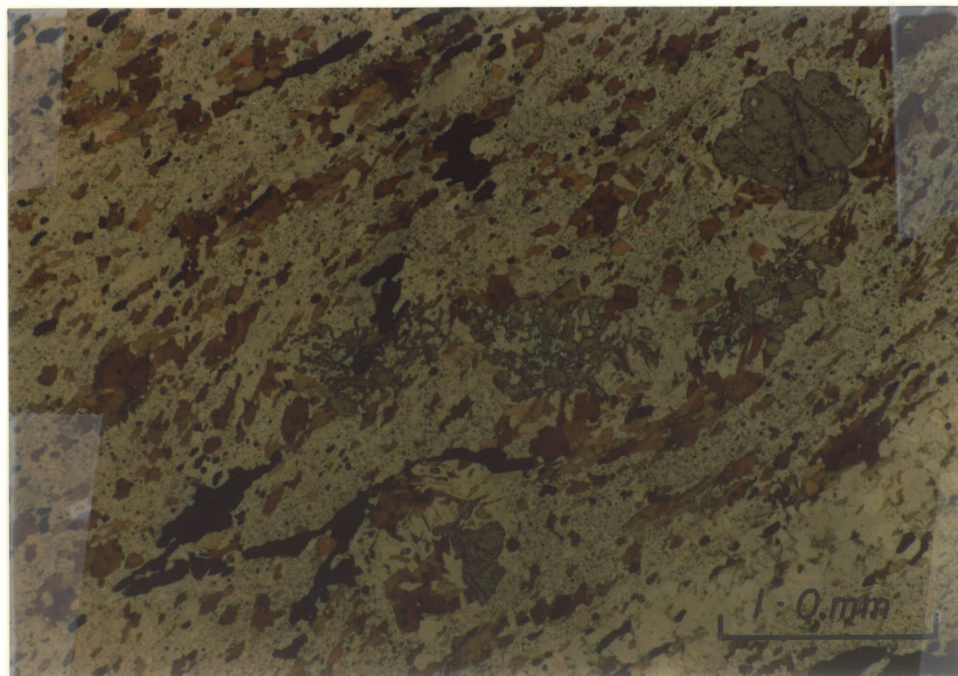


Plate 31: Porphyroblasts of staurolite and garnet in a fine-grained feldspathic siltstone (3a). Staurolite internal surfaces are discordant with external surfaces. Opaque minerals outline minor folds. Plane polarized light. Location - DDH FS-28 @ 742' (226m).

2.3.4 APHYRIC MAFIC METAVOLCANIC ROCKS (UNIT 4)

Aphyric mafic metavolcanic rocks (4) outcrop as a well defined, easterly trending ridge 350 meters north of the mine complex. This unit has an exposed thickness of 200 meters. Both upper and lower contacts are unexposed. Samples from outcrops along the ridge show remarkable mineralogical and compositional homogeneity. Aphyric basalts constitute 9% of the stratigraphic section.

The aphyric mafic metavolcanic rocks consist of massive basalt (4a) and pillowed basalt (4b). Approximately 40% of this unit comprises pillowed flows, but individual flow units have not been discriminated. Individual pillows show extreme flattening. Length to width ratios exceed 10:1 in both plan and cross section (Plate 32). In general, these pillows are poorly vesiculated with thin selvages and very little inter-pillow sediment. Secondary replacement of pillow cores by epidote is common.

Outcrop surfaces of these basalts are medium- to medium fine-grained, dark greenish-black and well foliated (Plate 33). The foliation is a nematoblastic schistosity defined by rodded hornblende. Late cross-cutting calcite veins are very common. Segregated subidioblastic hornblende (60%) and xenoblastic plagioclase (30%) are the principal mineral constituents of this rock type (Plate 34). Biotite, epidote, calcite and diopside are minor constituents. Magnetite and ilmenite are the most common accessory minerals.



Plate 32: Highly deformed pillows with epidotized cores and cross-cutting calcite veins. In aphyric mafic meta-volcanic rocks (4). Location - 70880E x 10600N.



Plate 33: Medium grained, dark green, well foliated aphyric basalt (4) cut by carbonate-filled veins and late fractures. Location - 71200E x 10500N.

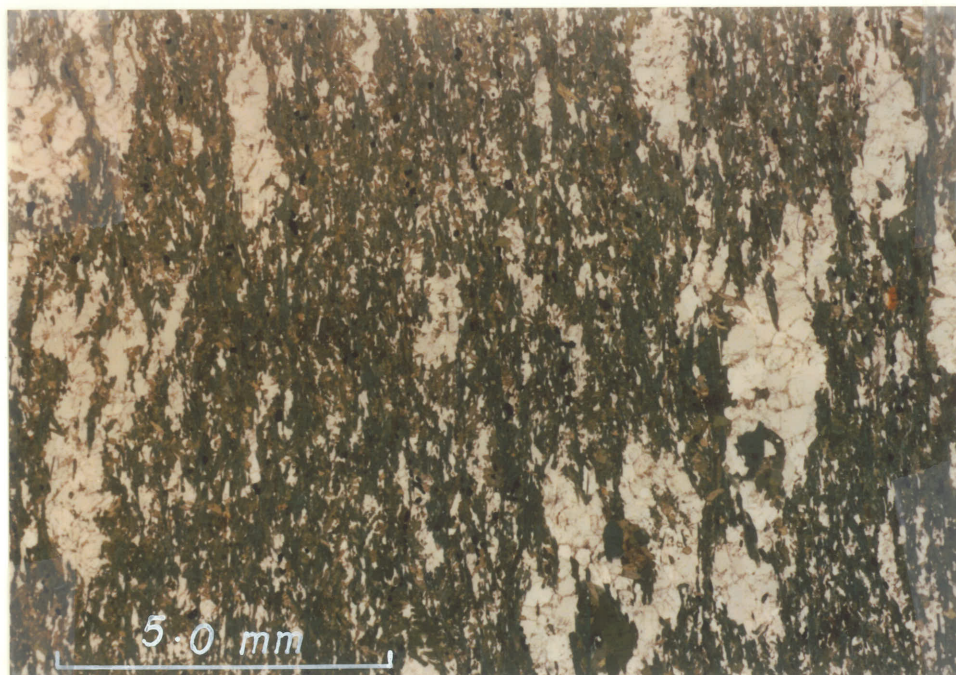


Plate 34: Photomicrograph of the massive basalt (4a), containing folded, subidioblastic hornblende and xenoblastic plagioclase. In aphyric mafic metavolcanic rocks (4). Plane polarized light. Location - 71205E x 10500N.

2.4 SICKLE GROUP

2.4.1 ARKOSIC META-SANDSTONE (UNIT 5)

The Sickle Group arkosic meta-sandstone (Unit 5) outcrops 335 meters north of the mine buildings. This east-trending unit has an exposed thickness of 60 meters. Both upper and lower contacts are drift covered. Drill core intervals indicate this unit maintains constant thickness down dip, but thins to both the east and west. The arkosic meta-sandstone constitutes the uppermost 3% of the Fox Mine stratigraphic section and is the only known occurrence of the Sickle Group within the map area.

The arkosic meta-sandstone is a gritty rock with promin-

ent angular quartz grains and subordinate intercalations of fine-grained, yellowish-grey phyllite, that occur as discontinuous lenses (2 to 30 cm). Subrounded to ovoid clasts (to 5 cm) of granite and quartz are common in the sandy layers. Irregularly shaped phyllitic clasts are less common.

The arkosic meta-sandstone varies in colour from smoky-grey to pale greyish-pink. The grain size is also variable. The phyllitic lenses are very fine-grained (0.02 - 0.05 mm); sandstone segments are much coarser grained (0.3 - 2.0 mm). This unit is well foliated and contains a number of primary sedimentary structures including bedding, graded bedding and rarely, cross-bedding (Plate 35). These structures yield rare, but consistent, south facing directions. Pseudocross-bedding, produced by late shearing, is prominent in the sandy layers.

The principal mineral constituents of the arkosic meta-sandstone are quartz (60 - 80%) and plagioclase (10 - 20%). Quartz porphyroclasts (0.2 - 0.5 mm) are elongate and highly strained (Plate 36). Plagioclase grains are small and commonly sericitized. Minor constituents include muscovite, biotite and orthoclase. Mylonitic fabrics are most prominent along the southern contact of the arkosic meta-sandstone. Cored samples from the northern contact contain large, relatively undeformed quartz porphyroclasts (up to 2 mm), in a finer grained matrix of unstrained quartz, unaltered plagioclase and lepidoblastic micas.

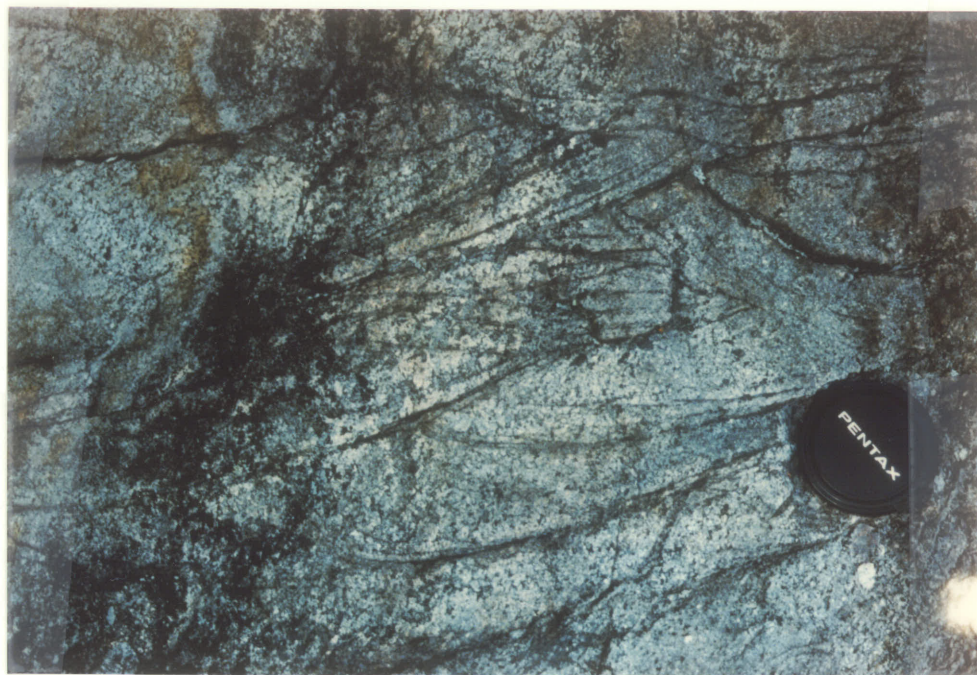


Plate 35: Cross-bedding that yields a south-facing direction for the Sickie Group arkosic meta-sandstone (Unit 5). Location - 71170E x 10400N.

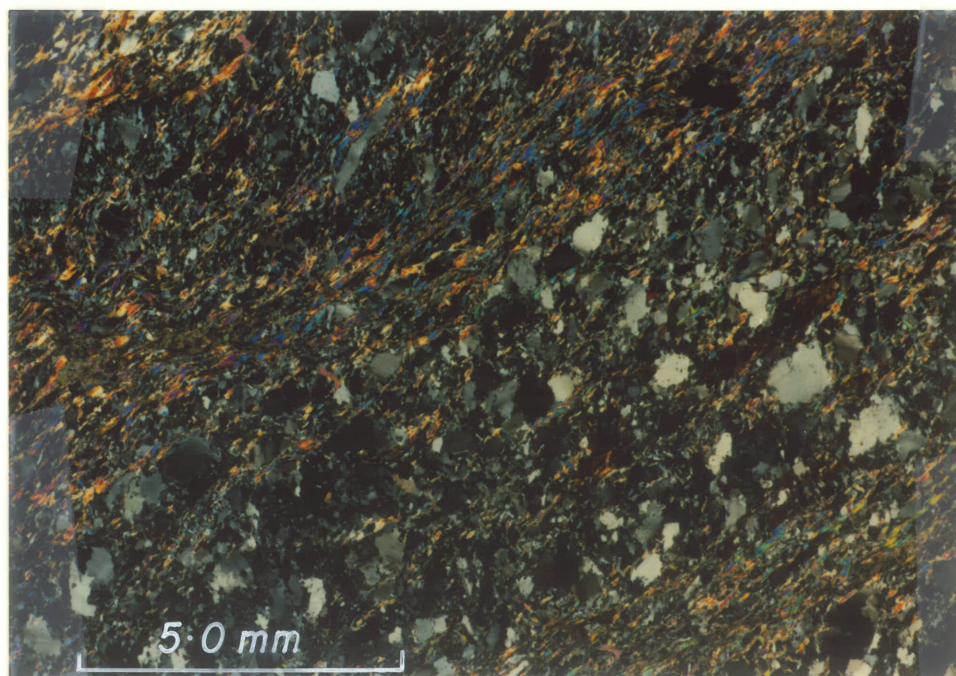


Plate 36: Photomicrograph of mylonitized south contact of the Sickie Group arkosic meta-sandstone (Unit 5). Dextral movement is indicated by the S-C fabric. Cross nicols. Location: DDH UF-1911 @ 168' (51m).

2.5 INTRUSIVE ROCKS

Intrusive rocks that range in composition from gabbro to granite outcrop within the map area. Smaller bodies, including diabase dikes or sills (Unit 6), quartz-eye porphyry dikes (Unit 7) and a solitary biotite leucogranite sill (Unit 9), appear sill-like and aligned with the regional foliation. Larger intrusive bodies tend to be massive, less regular in shape and include gabbro (Unit 6) and hornblende tonalite - quartz diorite (Unit 8).

Most intrusions preceded structural deformation, but the relative ages of the different types are not well documented. Stratigraphic order is not implied by the numerical ranking on Map 1. Most appear spatially isolated and crosscutting relationships between intrusive rocks of different compositions have not been observed in the map area.

2.5.1 GABBRO, DIABASE (UNIT 6)

Intrusive rocks of gabbroic composition outcrop north of the tailings area and along both the north and south flanks of the exposed ridge southeast of the mine. The outcrops by the tailings area are tightly clustered. The size and shape of this body are not apparent. Exposures along the north flank of the ridge by the mine define a thin (less than 40 meters), east-trending intrusive body. Outcrops along the south flank provide almost continuous exposure of a gabbroic body with an average thickness of 70 meters for most of its 350-meter strike length.

In all three outcrop areas, the gabbro appears massive, coarse-grained and greenish-black in colour. Subidioblastic hornblende (60%) and xenoblastic plagioclase (30%) are the principal mineral constituents. Minor constituents include biotite, chlorite, quartz, calcite and magnetite. Secondary replacements by quartz and calcite are common along cross-cutting veins.

Diabase dikes or sills that are compositionally and mineralogically similar to the gabbroic bodies described above, ramify the alteration zone that envelopes the Fox Lake massive sulfide deposit. These dikes are fine-grained, massive and dark green in colour. They occur along the strike projection of the north flank gabbro. As exposed underground, the diabase dikes appear boudinaged. They pinch and swell in both cross-section and plan view (Fig. 3). Cross-cutting relationships and altered contacts (Plate 43) indicate the dikes were emplaced after ore deposition, but before development of the regional foliation.

2.5.2 QUARTZ-EYE PORPHYRY (UNIT 7)

The quartz-eye porphyry is a quartz-phyric intrusive rock of dacitic composition. It is exposed in a small cluster of outcrops northeast of the tailings area and on the ridge southeast of the mine. Outcrops and drill core intervals indicate this unit is easterly trending and convoluted with a thickness from 5 to 100 meters.

The quartz-eye porphyry is coarse-grained, bone-white

and well foliated. Raised quartz phenocrysts result in extraordinarily rough outcrop surfaces. Aligned quartz aggregates and biotite laths define the foliation. A ribbon mylonite longitudinally traverses the porphyry as a 50 to 200 centimeter band and resembles a silicified margin.

The quartz-eye porphyry comprises quartz porphyroclasts (0.5 to 3.0 mm) in a matrix of medium fine-grained quartz, altered plagioclase and biotite. Both porphyroclastic and matrix quartz grains are strained with mortared rims. Xenoblastic plagioclase grains are sericitized and lepidoblastic biotites are almost totally altered to chlorite (penninite). Cataclastic fabrics and retrogressive mineral assemblages are most pronounced adjacent to the ribbon mylonites (Plate 51).

2.5.3 HORNBLENDE TONALITE - QUARTZ DIORITE (UNIT 8)

Hornblende tonalite - quartz diorite (Unit 8) is the most voluminous intrusive rock in the map area. This unit outcrops between the explosives storage area and Dunphy Lake. It is intruded into the metasedimentary rocks (Unit 3) and appears as a tabular, east-trending body approximately 500 meters thick. Xenoliths of the metasedimentary rocks occur along both margins. Thin dikes of basic feldspar porphyry, encountered in underground workings, are mineralogically and texturally similar to the hornblende tonalite.

In outcrop, the hornblende tonalite is massive, medium coarse-grained and pale greyish-white in colour. This rock type has a seriate texture with conspicuous, dark green horn-

blende phenocrysts (1.0 to 5.0 mm) in a finer-grained matrix of xenoblastic plagioclase and subidioblastic hornblende. Minor constituents include lepidoblastic biotite and xenoblastic quartz. Tourmaline (schorlite) is a prominent accessory mineral, occurring as idiomorphic grains on late fractures.

In drill hole FS-34, from 680' to 1315' (207m to 401m), fine-grained, greyish-brown, weakly foliated rocks of unknown origin, but similar composition to the hornblend tonalite. It is possible these rocks are feldspathic siltstones (3a) or dacitic tuffs (2d) that were metasomatically altered by a proximal tonalitic intrusion.

2.5.4 BIOTITE LEUCOGRANITE (UNIT 9)

A thin, doubly tapered lense of biotite leucogranite is exposed in outcrops 320 meters north and 670 meters east of the headframe. The maximum thickness of this lense is approximately 40 meters and the eastern extension is defined by a 70 centimeter segment encountered in DDH FS-23@132' (40m). The biotite leucogranite does not appear related to any of the larger intrusive bodies exposed within the map area.

Outcrops of the leucogranite are massive, medium fine-grained and white in colour. Textures in this rock type are cataclastic. Subidioblastic quartz and plagioclase grains with mortared rims are the principal mineral constituents. Partially chloritized, ragged lepidoblastic biotite and xenoblastic microcline are minor constituents.

CHAPTER III

THE ALTERATION ZONE

3.1 LOCATION AND EXTENT

The Fox Lake massive sulfide deposit is enveloped by an east-trending, steep north-dipping alteration zone. As outlined by diamond drilling, this envelope has a surface strike length of 1500 meters with tapered margins and a down dip projection in excess of 1500 meters. The width of this zone (including sulfides) varies from 60 meters on surface to more than 90 meters on 2800 (850m) Level. The shape of this envelope is analagous to an inverted soda bottle that has been extremely flattened.

3.2 LITHOLOGICAL DESCRIPTIONS

The alteration zone associated with the massive sulfide deposit comprises four mineralogically and texturally distinct lithologies. Lithological proportions and dispositions vary markedly (see Map 2 - 2800 Level). As traversed from south to north, altered rock types include quartz-sericite schist (2eQSS), quartz-biotite gneiss (2eQBG), cordierite-anthophyllite gneiss (2eCAG) and coarse mica schist (2eCMS).

3.2.1 Quartz-sericite schist (2eQSS)*

Quartz-sericite schist most commonly defines the upper stratigraphic contact of the alteration zone. On both 2100

* Footnote: The alphanumeric code for lithologies of the alteration zone combines a subunit identifier with a mineralogical descriptor. For example, 2eQSS designates an altered dacite (2e) described as a (Q)uartz-(S)ericite (S)chist.

Level (Fig. 3) and 2800 Level (Map 2) quartz-sericite schist marks the contact between altered and host rocks. Similar lenses also occur near the lower alteration zone contact, particularly on the west end of the orebody. Most commonly, the lenses are thin and disjointed, with average thicknesses of less than three meters. Lenses' strike lengths rarely exceed 40 meters and in total they constitute less than one percent of the alteration zone.

The appearance of the quartz-sericite schist is unique. In drill core and exposed faces underground, it is fine-grained and schistose with a pearly lustre. Thin brown and lime-green intercalations (10 - 20 cm) contain biotite and fuchsite (chrome-bearing muscovite), respectively.

In thin section, the quartz-sericite schist displays mylonitic to lepidoblastic-polygonized textures. Grain size variations reflect the degree of post-deformational annealing (Plate 37). Quartz, as polygonized aggregates (0.03 - 0.25 mm), is the principal mineral constituent. Lepidoblastic muscovite or sericite (0.01 - 0.4 mm) is the other essential constituent. Minor constituents include biotite, cordierite and sillimanite. Accessory minerals include disseminated pyrite, pyrrhotite and rarely chalcopyrite.

3.2.2 Quartz-biotite gneiss (2eQBG)

The principal occurrence of quartz-biotite gneiss is a 20-meter thick, stratiform layer near the upper alteration contact. This layer extends the breadth of the alteration

zone with only local disruptions. A second, less continuous quartz-biotite gneiss layer with a thickness of approximately ten meters occurs near the lower alteration contact. Both upper and lower quartz-biotite gneiss lenses thin towards the margins of the alteration zone. Together they represent 30% of the alteration zone volume; 35 to 40% in the upper levels of the mine, but less than 25% in the lower levels.

Where exposed underground, the quartz-biotite gneiss appears medium-grained, granular, greyish-brown and well foliated. Contacts tend to be gradational, diffuse and interdigitated. Quartz-sericite schist lenses (10 - 40 cm) regularly occur within the quartz-biotite gneiss especially near the contacts. Contacts with the cordierite-anthophyllite gneiss are equally diffuse.

Quartz, as polygonized, matrix grains (0.1 - 0.5 mm), is the principal mineral constituent (60%) of the quartz-biotite gneiss. Aligned biotite laths (0.2 - 0.5 mm) constitute up to 25% of some sections and define the foliation. Minor constituents include altered, polygonized, idioblastic plagioclase, and sericite. Accessory minerals include cordierite, anthophyllite, staurolite, sillimanite, chlorite, garnet and the opaques. Where porphyroblastic, the accessories commonly assume major constituent proportions. Pyrrhotite, pyrite, chalcopyrite and hematite, in order of decreasing abundance, make up 15 percent of individual sections.

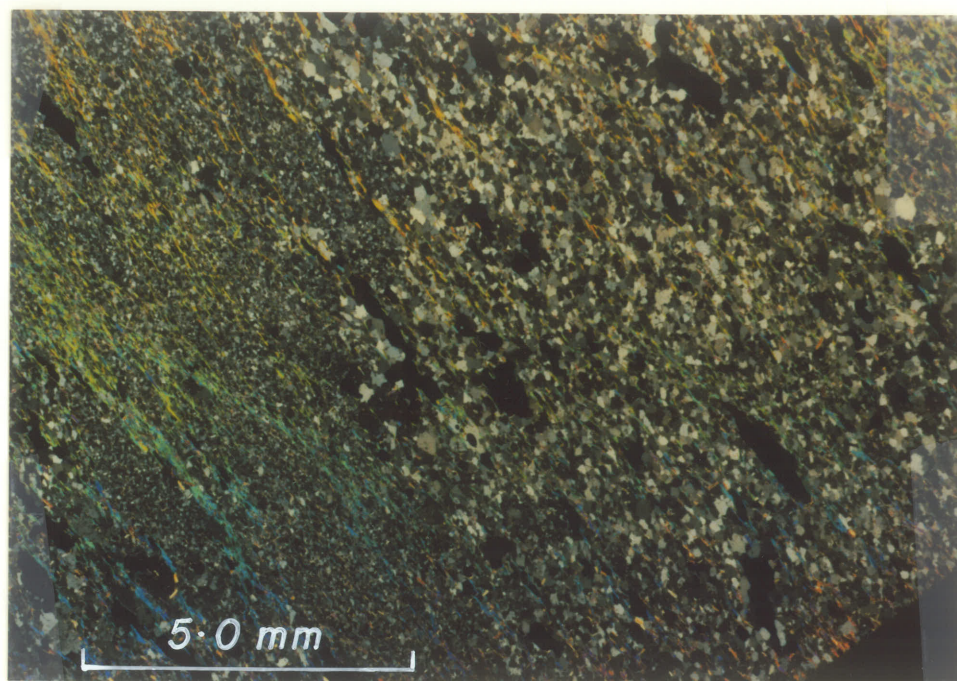


Plate 37: Photomicrograph of the quartz-sericite schist (2eQSS). Grain size differences reflect varying degrees of recrystallization. Cross nicols. Location: 2800 Level - 70875E x 10520N.

3.2.3 Cordierite-anthophyllite gneiss (2eCAG)

Cordierite-anthophyllite gneiss constitutes 10 to 15% of the rock volume in the upper levels of the mine and 30 to 40% in the lower levels and an estimated 30% of total volume of altered rock. Where encountered underground, the cordierite-anthophyllite gneiss lacks well-defined boundaries. It occurs as intercalations in both the quartz-biotite gneiss and coarse mica schist. Contacts between the cordierite-anthophyllite gneiss and the other altered rock types are irregular, transitional and diffuse. The position of this rock type on level plans and cross-sections has been fixed somewhat arbitrarily.

Medium-grained, greyish-brown, well-foliated cordierite-anthophyllite gneiss with thin biotite laminae occurs above the sulfide lenses and is gradational into the quartz biotite gneiss. Medium-grained, pale greyish-white, weakly foliated cordierite-anthophyllite gneiss occurs along the margins, and is transitional into, diabase dikes (Unit 6). The most extensive intervals of cordierite-anthophyllite gneiss occur near the lower alteration zone contact. In these intervals, the gneiss is ramified by anastomosing networks of coarse mica schist.

In drill core and underground drifts, the cordierite-anthophyllite gneiss appears mineralogically and texturally diverse. Most commonly, it is a very coarse-grained, porphyroblastic schist with porphyroblastic or poikiloblastic mineral phases so large (10 - 15 cm), they totally obscure the schistosity (Plate 38).

Textures in the cordierite-anthophyllite gneiss is dominated by porphyroblastic minerals. Fist-sized cordierite poikiloblasts and porphyroblastic anthophyllite asterisms are principal mineral constituents (Plate 39). Xenoblastic quartz grains occur as inclusions in cordierite poikiloblasts and as rare, polygonized matrix aggregates (0.05 - 0.1 mm) with plagioclase and ragged biotite laths. Other minor constituents are cummingtonite, phlogopite, talc and chlorite. Staurolite, garnet, magnetite, pyrite, pyrrhotite and chalcopyrite occur as accessory minerals.

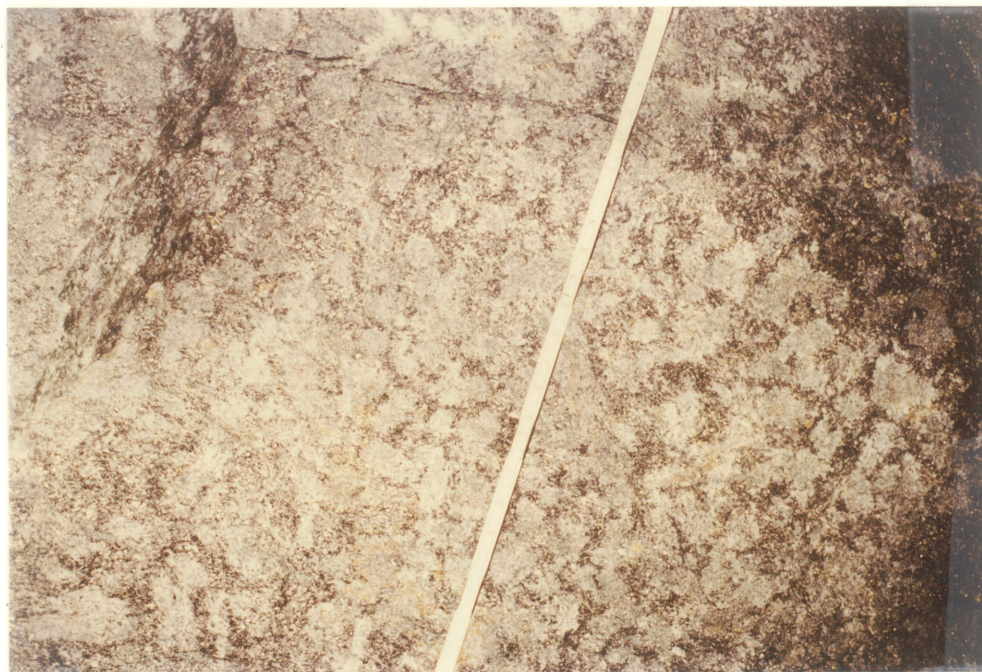


Plate 38: Large poikiloblasts of cordierite in underground exposure of quartz-biotite gneiss. Scale is in tenths of inches. Location: 2800 Level - 70875 x 10520N.

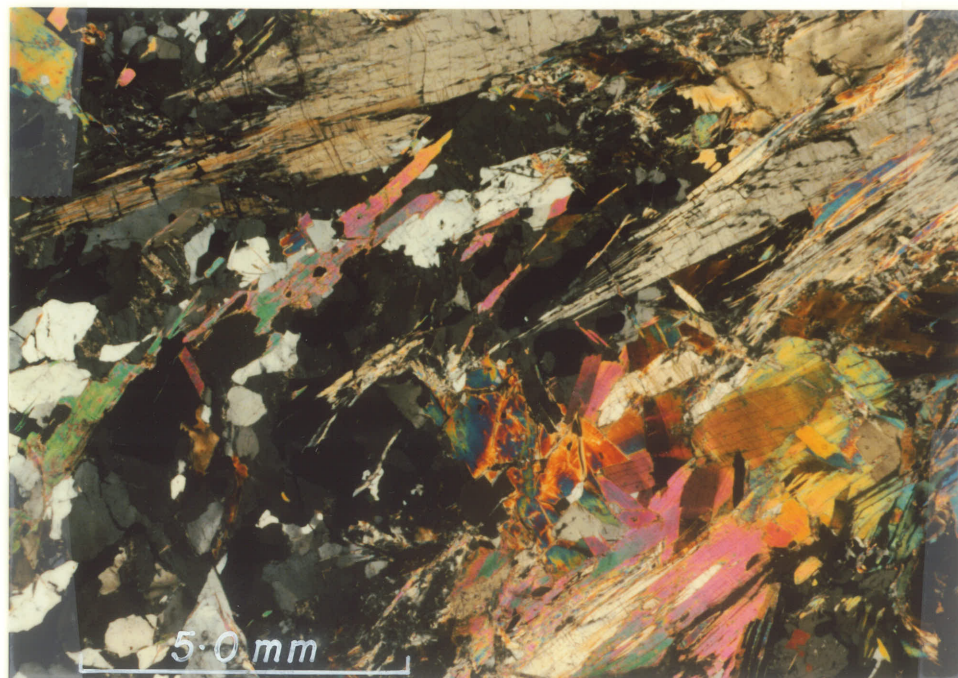


Plate 39: Large acicular blades of anthophyllite with phlogopite and cordierite. In cordierite-anthophyllite gneiss. Cross nicols. Location: 2800 Level - 70928E x 10640N.

3.2.4 Coarse mica schist (2eCMS)

Coarse mica schist constitutes up to 30% of the altered rock volume below the 2000 Level, but is virtually absent in the upper levels of the mine. Most commonly, mica schist is encountered stratigraphically beneath the massive sulfide lenses, near the lower contact of the alteration zone. Less extensive, patchy intervals appear intermittently above the sulfides. Occurrences of coarse mica schists vary from thin crosscutting veins and stockworks (10 to 30 cm) to thick tabular bodies comprising vein networks (5 to 20 meters). Regarded en masse, the coarse mica schist resembles a flattened funnel, wedged beneath the massive sulfide lenses. Quartz-biotite gneiss (2eQBG) defines the funnel margins.

The mica schist is very coarse-grained and schistose. The fabric is dominated by interpenetrative platy minerals with several preferred orientations. The micas are kinked, partially replaced and intergrown. Most are related to a single, anastomosing foliation.

Coarse mica schist colour is a function of the principal mineral constituent, which varies from biotite (Plate 40) to phlogopite (Plate 41), talc or chlorite. The platy, hydrous minerals result in rock types that are black, rusty-bronze, pearly-grey or green in colour, respectively. The occurrence of chlorite and talc schists at depth in the core of the coarse mica schist is the only spatial association observed for these rock types.

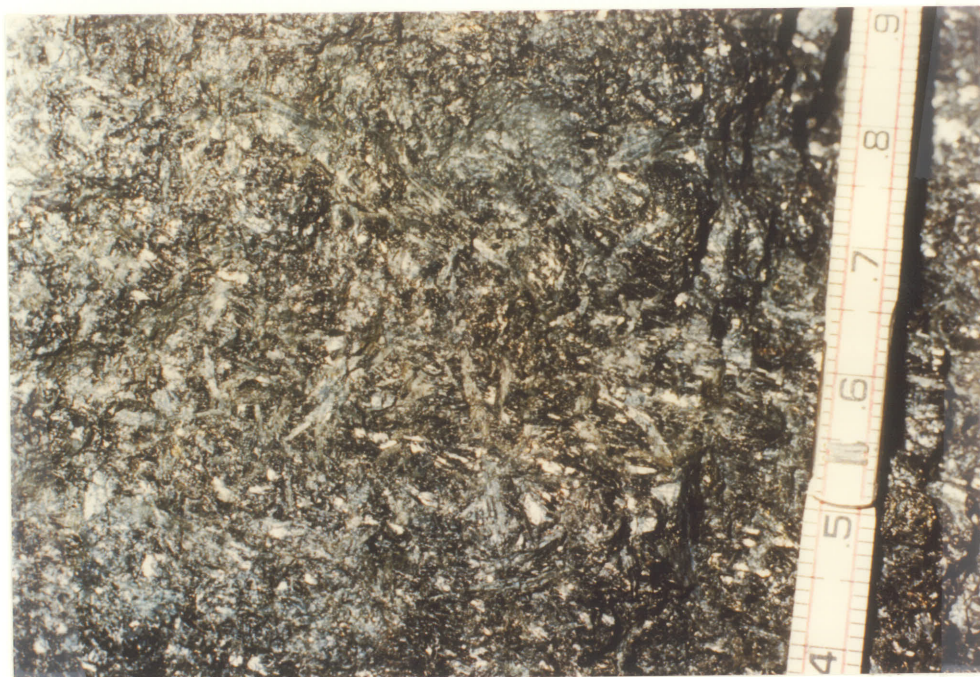


Plate 40: Very coarse-grained, interpenetrative biotite laths in the coarse mica schist (2eCMS). Location: 2800 Level - 70960E x 10620N.

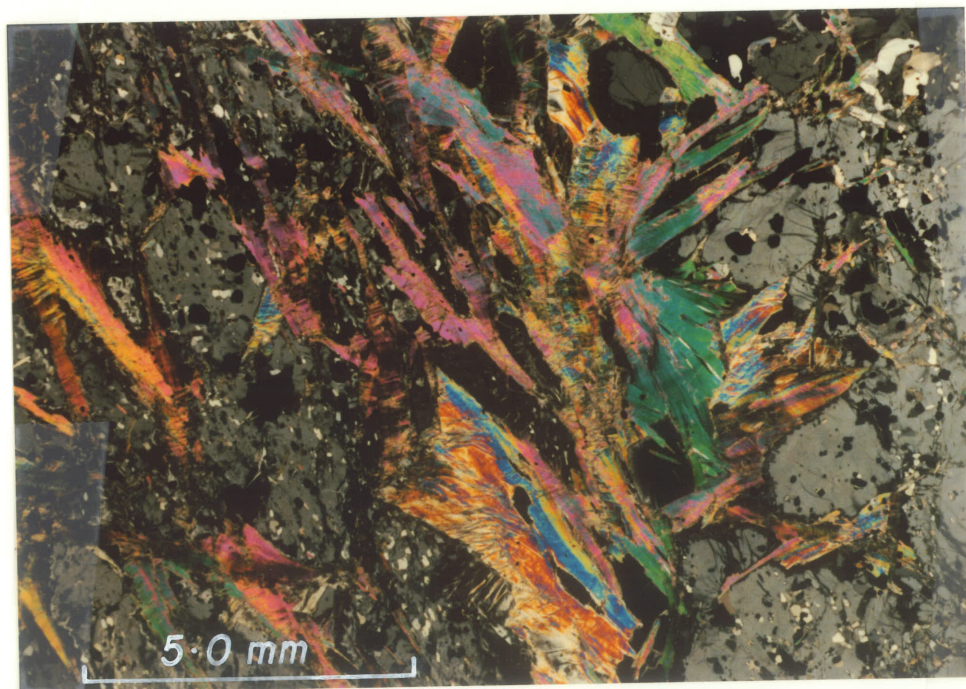


Plate 41: Large cordierite poikiloblasts overprinting kinked phlogopite laths. In coarse mica schist (2eCMS). Cross nicols. Location: 2800 Level - 70893E x 10550N.

Minor mineral constituents of the coarse mica schist include quartz, cummingtonite, anthophyllite and cordierite. The latter minerals are typically porphyroblastic or poikiloblastic (Plate 42). Accessory minerals include sillimanite, staurolite, muscovite, pyrrhotite, pyrite, chalcopyrite, and magnetite.

The sulfide minerals occur as large blebs and stringers, measurable in tens of centimeters. The sulfide content of the coarse mica schist commonly exceeds fifteen percent and contains economically extractable quantities of chalcopyrite with gangue pyrrhotite. The sphalerite content in the mica schist rarely exceeds one percent.

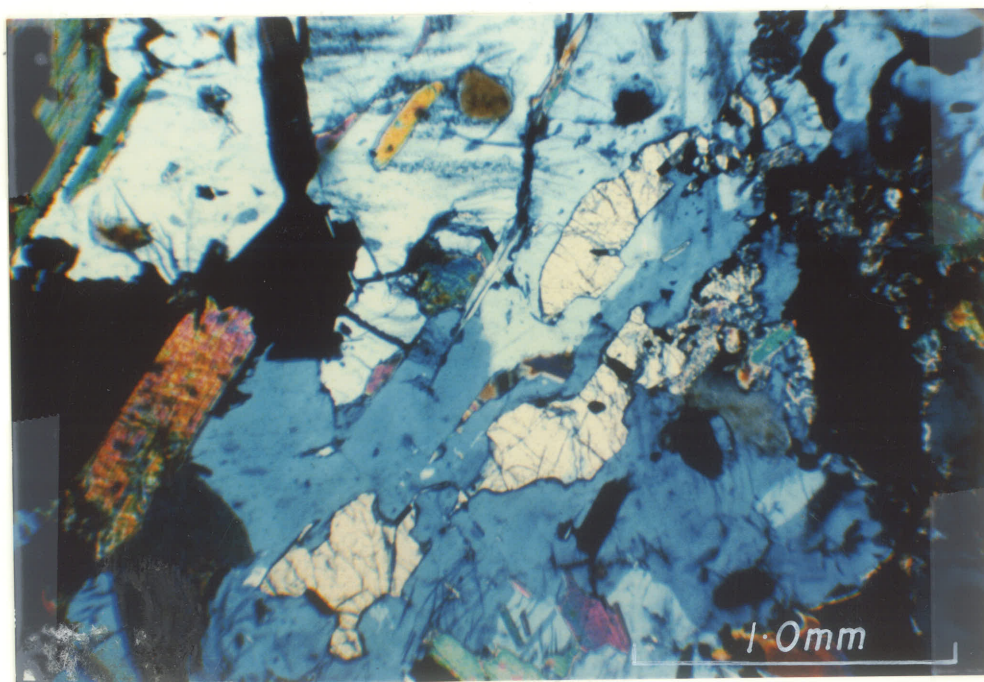


Plate 42: Photomicrograph of staurolite and fibrolite inclusions in a cordierite poikiloblast. From the coarse mica schist (2eCMS). Cross nicols. Location: 2800 Level - 70900E x 10660N.

3.2.5 Other constituents of the alteration envelope

The lithologies discussed in the preceding sub-sections account for two-thirds of the alteration envelope by volume. The remaining third comprises diabase dikes (Unit 6) and disseminated to massive sulfides (Subunit 2f).

Diabase dikes constitute approximately twenty volume percent of the alteration envelope and are more prevalent in the upper levels of the mine. They longitudinally traverse the alteration envelope and appear sill-like, crosscutting the sulfide lenses and alteration rock types at acute angles. The dikes are boudinaged and commonly have altered margins (Plate 43). The petrography of this rock type is described in Chapter II (subsection 2.5.1).



Plate 43: Altered diabase sill or dike margin (Unit 6). Anthophyllite asterisms in matrix of cummingtonite and plagioclase. Location: 2800 Level - 70670E x 10690N.

Disseminated, semi-massive and massive sulfide lenses account for fifteen volume percent of the alteration envelope and are the principal constituents of the ore zone. The ore zone comprises two sulfide lenses, informally known as the main zone and the west lens. Further discussion of the ore lenses and constituent rock types is deferred to the ensuing chapter.

3.3 ZONING OF THE ALTERATION ROCK TYPES

The alteration zone enveloping the Fox Lake massive sulfide deposit strikes $N070^{\circ}E$ and dips $-70^{\circ}NW$. It comprises schists and gneisses that show consistent spatial relationships.

Their present configuration indicates the deposit is south-facing and overturned (Fig. 4a). Quartz-biotite gneiss (2eQBG) outlines the margins and coarse mica schist (2eCMS) with stringer sulfides occupies the cores of two flattened, funnel-shaped bodies that lie to the north of the two main massive sulfide lenses in the lower levels of the mine. These zones are deformed and metamorphosed hydrothermal conduits beneath the massive sulfide lenses (Fig. 4b).

Altered rock types on the south side of the deposit are almost as voluminous as those on the north. Unmineralized coarse mica schist (2eCMS) interlayered with, and marginally above, the main sulfide lens suggests that hydrothermal processes remained operative for some time after the termination of sulfide deposition from the main lens vent.

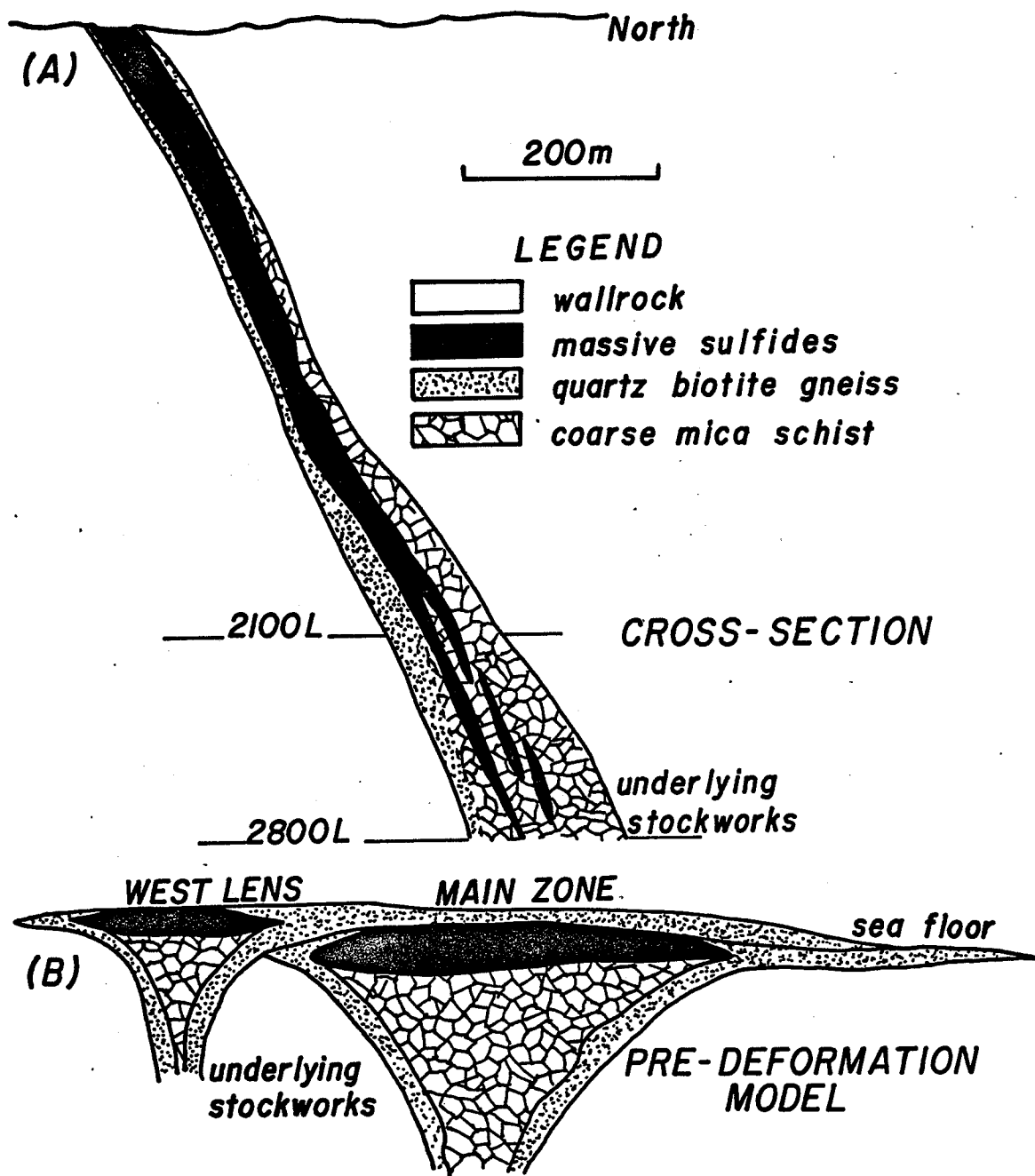


FIGURE 4: (A). SIMPLIFIED CROSS-SECTION THROUGH THE MAIN ORE ZONE. PRESENT DISPOSITION OF ALTERATION, STOCKWORK AND MASSIVE SULFIDES IS CONSISTENT WITH AN OVERTURNED DEPOSIT ATTENUATED DOWN DIP. (B). CONCEPTUAL MODEL FOR THE TWO ORE LENSES THAT COMPOSED THE FOX LAKE DEPOSIT. THE WEST LENS HAD A SEPARATE STOCKWORKS AND WAS STRATIGRAPHICALLY HIGHER THAN THE MAIN ZONE.

Cordierite-anthophyllite gneiss (2eCAG) intercalated with quartz-biotite gneiss (2eQBG) occurs as thick, blanket-like accumulations (30 m) that mantle the main sulfide lens (main zone). These altered gneisses are lateral equivalents of the west lens massive sulfides. Their distribution indicates that hydrothermal fluids from the west lens vent migrated laterally and interacted with the material being deposited above the main zone. The quartz-biotite gneiss layer overlying the west lens is thin (4 m).

A thin, semi-continuous band of quartz-sericite schist (2eQSS) marks the southern contact of the altered sequence that overlies the main sulfide lens (see Map 2 - 2800 Level). A second segment transects the hydrothermal conduit beneath the west lens (north of the sulfide zone). Textures in the schist are mylonitic to blastomylonitic and the traces coincide with zones of movement and ductile deformation. These shear traces define the margins of the alteration envelope, indicating the present shape of alteration zone is in part structurally controlled.

3.4 ALTERED ROCK TYPES EXTERNAL TO THE ALTERATION ENVELOPE

Outcrops 1000 meters south of the mine complex comprise rock types that are texturally and mineralogically similar to those of the alteration envelope. These altered rock types occur within the felsic metavolcanic rocks (Unit 2) and were described in the previous chapter as altered dacites (2e).

The alteration zone enveloping the Fox Lake massive sul-

fide deposit strikes N070°E. Outcrops of the felsic metavolcanic rocks 800 meters south of the deposit indicate this unit strikes N010°W, but is folded. Surface and underground diamond drill holes (FS-33, UF-1886 and UF-2039) indicate the lower contact trends to the northwest. Projections of this trend intersect the strike projection of the alteration envelope 1000 meters west of the orebody. Zonal continuity has been obscured by subsequent structural deformation. The discussion of deformational mechanisms is deferred to Chapter V (STRUCTURAL GEOLOGY, METAMORPHISM AND INTRUSIVE SEQUENCE).

CHAPTER IV

THE ORE ZONE

4.1 LOCATION AND EXTENT

As alluded to in the previous chapter, the Fox Lake ore-body comprised two massive sulfide lenses, informally known as the main zone and the west lens. Neither lens outcropped, but stripping operations related to surface pillar recovery (Plate 46) partially exposed both. The two bodies abutted on surface and had a combined strike length of 425 meters. The curvilinear trace of this zone was located 20 to 65 meters north of the mine buildings, where it dipped away from the mine complex at -070°NW on a strike of $\text{N}075^{\circ}\text{E}$. The thickness of the ore lenses varied from 5 to 45 meters.

The ore zone separated into two lenses 200 meters below surface, near the 630 Sublevel (Fig. 5). The separation distance between the west lens and the main zone increased with depth, to a maximum lateral separation of 150 meters on the 2100 Level (640m). The strike length of the west lens averaged 75 meters from the 630 Sublevel to the 2100 Level, where it dissipated into a series of low grade, discontinuous sulfide stringers.

The main ore zone was a tabular body that extended from surface to below the 2800 Level (850m). Its strike length decreased with depth, to less than 125 meters on 2800 Level. Drill indicated tonnage below 2800 Level proved insufficient to warrant further mining.

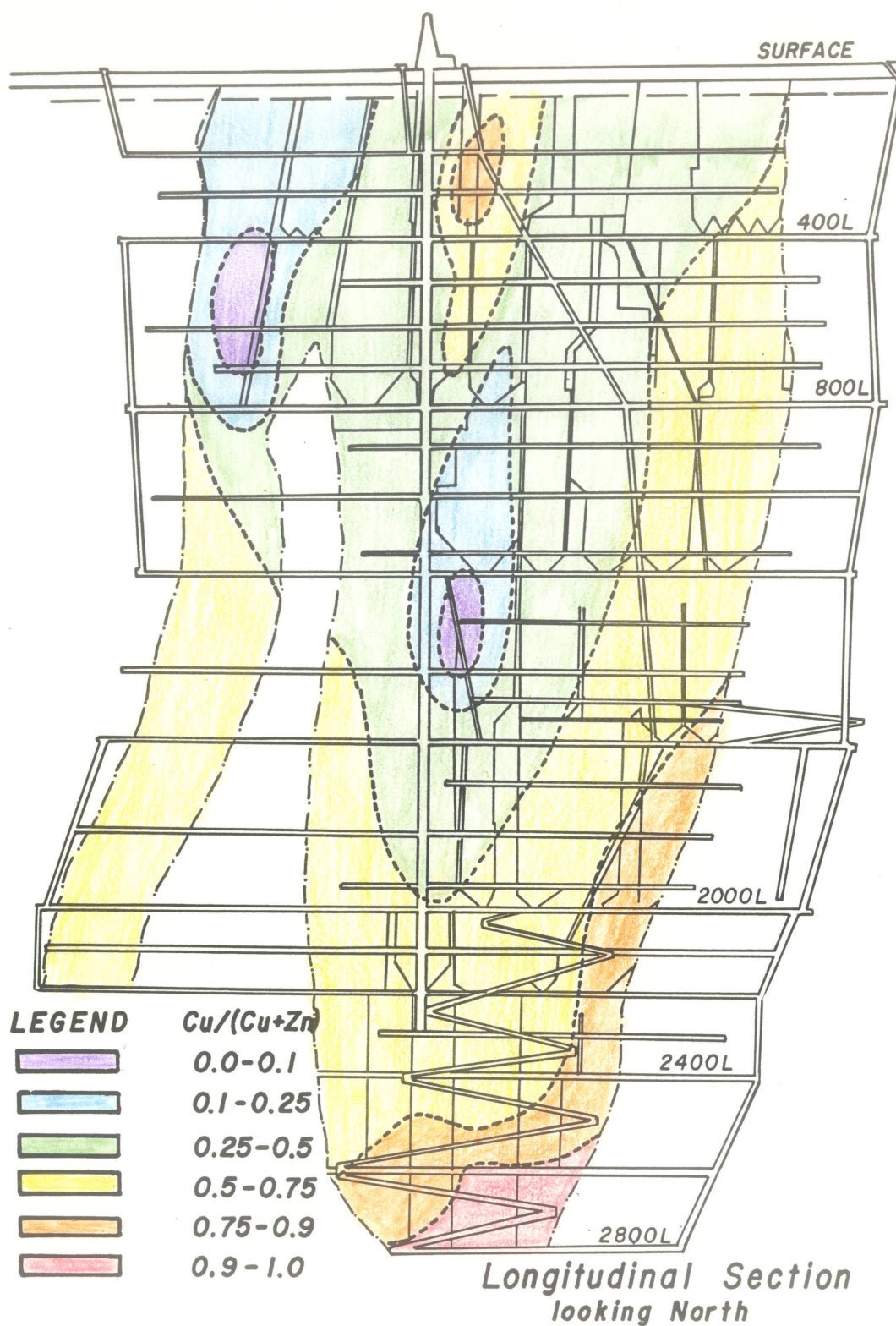


FIGURE 5: $\text{Cu}/(\text{Cu}+\text{Zn})$ RATIOS FOR THE
FOX LAKE MASSIVE SULFIDE DEPOSIT

4.2 ORE TYPES AND DISTRIBUTION

Massive sulfide deposits commonly display metal zoning. Volcanic-associated deposits are characterized by stratiform zinc-rich ore overlying stratiform and/or stockwork copper-rich ore (Sangster, 1972; Lydon, 1985). Metal distributions in the Fox Lake massive sulfide deposit exhibited this characteristic zonation.

Upper level stopes (surface to 350m), particularly those on the west end of the orebody, comprised zinc-rich massive sulfides. Copper content increased to the east. In general, these stopes had $\text{Cu}/(\text{Cu}+\text{Zn})$ ratios of less than 0.5 (Fig. 5). Copper-rich massive and semi-massive sulfides with lesser, but still significant zinc values dominated the intermediate stoping levels (350m to 700m). Copper-rich stringer sulfides stratigraphically underlying the massive sulfides were encountered only in the lowermost mining levels (700m to 850m). In this region, the $\text{Cu}/(\text{Cu}+\text{Zn})$ ratio approached unity.

The principal ore type in the upper levels was a medium-grained, banded sphalerite-rich massive sulfide, which was most prevalent in stopes on the western end of the orebody where zinc grades commonly exceeded 4.50%. Principal gangue minerals included granular pyrite (60%) and quartz (30%). Minor and accessory minerals included biotite, magnetite, arsenopyrite and hematite. Upper level stopes on the east end of the orebody contained up to thirty volume percent fine-grained pyritic cherts. These cherty layers were centrally

disposed within the massive sulfides and contained up to ten percent chalcopyrite.

The most important ore type in the central stoping areas of the mine was a massive, granular, medium-grained chalcopyrite- and sphalerite-bearing massive sulfide. The zone averaged 1.50% copper and 2.50% zinc, but chalcopyrite and sphalerite contents varied markedly. Granular pyrite (55%) and quartz (25%) were the principal gangue minerals, but pyrrhotite was an important minor constituent (10 - 15%), most prevalent on the east side of the orebody in the lower stoping blocks. Accessory minerals included magnetite, arsenopyrite, tetrahedrite and cubanite. Pyritic cherts with disseminated chalcopyrite were a minor constituent in these stoping areas.

Ore types in the lower stoping levels included massive, semi-massive and stringer sulfides. Massive sulfides were most common along the southern ore contact. They comprised medium-grained, rarely banded, granular pyritic sulfides containing sphalerite and subordinate chalcopyrite, along with crosscutting mobilized stringers of chalcopyrite and pyrrhotite that enhanced the copper values. The host rock for the semi-massive and stringer sulfides was typically the coarse mica schist (2eCMS). Stockwork mineralization comprised large blebs, veinlets and stringers of coarse-grained chalcopyrite with subordinate pyrrhotite. Stockwork sulfides were most common on the north side of the ore zone. They were only encountered in the lower levels of the mine.

4.3 SULFIDE RECRYSTALLIZATION AND MOBILITY

Silicate mineral assemblages indicate that temperature and pressure conditions reached the medium grade (or middle amphibolite facies) of metamorphism (see Chapter V). The temperature and pressure conditions achieved during amphibolite grades of metamorphism are sufficient to promote the recrystallization of chalcopyrite, sphalerite, pyrrhotite, and pyrite (Barnes, 1979). Petrographic studies indicate all the sulfide minerals have been recrystallized. The occurrence of coarse-grained chalcopyrite and pyrrhotite blebs and veinlets crosscutting medium-grained, granular pyritic massive sulfide ores indicates mobilization during metamorphism of the Fox Lake massive sulfide deposit.

4.4 LATERAL FACIES EQUIVALENTS

Fine-grained, low grade to barren massive sulfides comprising essential pyrite and quartz occur on both the eastern and western margins of the Fox Lake massive sulfide deposit. These low grade sulfide zones are not persistent laterally. Field observations and drill core intersections [DDH FS-23@ 560' (171m)] indicate a thin, segmented layer of banded iron formation occurs in lieu of massive sulfides on the eastern extension of the ore horizon. Drill core [DDH FS-28@718' (219m)] from the western extension of the ore horizon contains pyritic mudstones directly above a thin layer of alteration. In a drill hole 1000 feet (305m) to the west, the altered rock types are no longer recognizable and the pyritic

mudstones are more voluminous (DDH FS-29).

Similar facies transitions have been recorded elsewhere. Lateral transitions from massive sulfides into iron formation have been recorded at a number of massive sulfide deposits. Changes in the oxidation-reduction potential of the hydrothermal fluid is a commonly cited cause for these transitions (Hutchinson, 1975). Transitions from massive sulfides into sulfide-bearing mudstones and tuffs have been recorded for a comparable number of deposits (Ohmoto and Takahashi, 1983). These transitions appear related to influxes of clastic sediment into a restricted depositional basin.

It is both beyond the scope of this thesis and beyond the limits of available information to establish the details of ore-forming processes which have been established in many other deposits around the world. It is clear, however, that many of the features of the Fox Lake orebody are features that characterize volcanogenic massive sulfide deposits elsewhere, especially those of the Canadian Shield. Consequently the same genesis has been interpreted for the Fox orebody.

CHAPTER V

STRUCTURAL GEOLOGY, METAMORPHISM AND INTRUSIVE SEQUENCE

5.1 GENERAL STATEMENT

Faulting and shearing were the most common manifestations of deformation in the metavolcanic and metasedimentary rocks of the Fox Mine area. Zwanzig (1977) described the area as "a patchwork of fault-blocks" with no apparent stratigraphic continuity between blocks. Lustig (1979) subdivided the Fox Mine area into four fault-separated blocks. He added that an earlier fault or fold phase was indicated by the discordance of lithological contacts and regional foliation.

Evidence presented in the ensuing sections indicates that late deformational events involved shearing and faulting with attendant middle amphibolite grade metamorphism and were superimposed on an early tight to isoclinal folding event at comparable metamorphic grade. The late events may be related to the emplacement of tonalitic plutons to the north. Figure 6 summarizes the deformational events and intrusive sequence.

5.2 STRUCTURAL ELEMENTS

Primary sedimentary and volcanic structures are abundant in the Fox Mine area. Some provide facing directions of the host strata. Mesoscopic and microscopic penetrative structural elements manifested by post-depositional processes include foliations, lineations, minor folds, faults, shears, and joints. These features are widespread and imply an evolution involving at least four deformational events.

FIGURE 6: STRUCTURAL EVOLUTION OF THE FOX MINE AREA

EVENT	CHARACTERISTICS	FOLDING	FABRIC	METAMORPHISM
D4	late N- and NW- trending joints, faults and open fractures, crosscutting, significant offset not observed			
I2	emplacement of tonalite-quartz diorite plutons and related feldspar porphyry dikes			
D3	late movement on E-trending shear surfaces some sinistral and/or dextral offset coupled with uplift of footwall blocks		S₃ local S-C mylonite	M₃ local retrograde
D2	main stage development of E-trending (070°) shear foliation, transposition and overprint of early foliation S₁ and layering S₀ , initiation of E-trending faults	F₂ E shear folding	S₂ axial planar schistosity	M₂ mid-Amphibolite grade
	initial development of E-trending shear foliation, attendant dislocation and folding			
D1	produced N- to ENE-trending, steeply dipping, subhorizontally plunging isoclinal folds	F₁ folds layering S₀	S₁ bedding parallel schistosity	M₁ mid-Amphibolite grade
I1	emplacement of quartz-eye porphyry as subvolcanic sills, emplacement of gabbroic plutons and related diabase dikes, penecontemporaneous with volcanism and sedimentation		S₀ primary layering	M₀ hydrothermal alteration

5.2.1 Primary structures

Primary sedimentary layering (S_0) is recognizable in most sedimentary units within the map area. Alternating magnetiferous calc-silicate and cherty layers in the iron formation (subunit lf), alternating layers of mud and silt in the meta-sedimentary rocks (Unit 3) and phyllitic lenses in the arkosic meta-sandstone (Unit 5) are examples of bedding or primary sedimentary layering. Graded bedding occurs within the sedimentary rocks derived from the porphyritic mafic metavolcanics (subunit lg), where it indicates the sequence is north facing. Graded bedding and cross-bedding are recognizable in the arkosic meta-sandstone (Unit 5) and yield south facing directions (Plate 35).

Primary volcanic structures include pillowed flows, flow breccias and rare tuffaceous layering. Pillowed flows are common in both the porphyritic and aphyric mafic metavolcanic rocks (Units 1 & 4). Pillow structures in the porphyritic mafic metavolcanics are well preserved, yield facing directions in several locations (Plates 6 & 9) and rarely, flow directions (Plate 7). In the south (subarea 1) facing directions are most commonly to the northwest. Facing directions in the north (subarea 2) are commonly to the south or southwest. Facing directions observed in pillow structures indicate local reversals of the host sequence particularly in the south and central portions of the map area. Flow and facing direction indicators were not observed in the deformed pillow

structures of the aphyric mafic metavolcanic rocks.

The location of flow breccias within some porphyritic basalt flows (subunits 1a-e) and massive porphyritic dacites (subunit 2a) yield facing directions. They corroborate the northwest facing direction yielded by pillow structures in subarea 1. Facing direction indicators have not been observed in the tuffaceous and reworked sedimentary horizons within the porphyritic mafic metavolcanics (subunit 1g) and felsic metavolcanics (subunit 1d).

The orientations of most primary sedimentary and volcanic features vary systematically throughout the map area, tending towards parallelism with the regional foliation. Bedding in the southernmost outcrops has a northerly strike direction ($N020^{\circ}E$) and dips at moderate angles to the west. The strike changes to north-northwest ($N010^{\circ}W$) and dips steeply to the west (locally to the east) in the south-central part of the map area. Along the ridge south of the mine complex, primary layering has a northeasterly strike ($N040^{\circ}E$) and steep northerly dips. Primary features in the northern half of the map area, are aligned with an east-northeast strike ($N070^{\circ}E$) and dip steeply to the northwest.

5.2.2 Foliations

In addition to bedding, three penetrative planar elements or foliations are recognized within the map area. Textures, orientations, mineral alignments and segregations distinguish the foliations. Parallel alignment of the micas and amphi-

boles defines the first and second foliations. They are distinguished by different orientations and mineral assemblages. The alignment of chlorite and sericite defines the third.

The first foliation (S_1) is the planar element most frequently encountered in the little enclave of felsic metavolcanic rocks that outcrop in the south half of the area. It is defined by the alignment of elongate clasts, fragments and mineral grains, notably biotite and hornblende. This foliation developed during an early period of tight to isoclinal folding (F_1) and is essentially parallel to bedding throughout the map area. Slight discordance between the first foliation (S_1) and bedding (S_0) is apparent in some southern locations, appearing as an alignment of mineral grains at an acute angle to the primary compositional layering.

The first foliation is overprinted and obscured by the second foliation throughout most of the map area. Where recognized, S_1 strikes to the northeast and dips moderately to the northwest. The strike direction is more northerly where it has been deflected onto late shear surfaces.

The second foliation (S_2) is the most commonly observed planar element in the map area. The orientation of this feature shows little variation. Strike directions are to the east-northeast and dips are steep to the northwest. It is an axial planar schistosity related to F_2 shear folds. It is defined by the parallel alignment of biotite, muscovite and rodded hornblende and is overprinted by weakly aligned white

amphiboles. Local zones contain mylonitic textures with marginally granulated and strained quartz grains.

The third foliation (S_3) is restricted to narrow, east-northeasterly trending zones in the central portion of the map area. It is characterized by retrograde mineral assemblages and mylonitic textures. It is superimposed on the second foliation, striking $N070^{\circ}E$ and dipping steeply to the northwest. Aligned mineral phases include chlorite, muscovite (sericite) and strained quartz grains (see Plate 49).

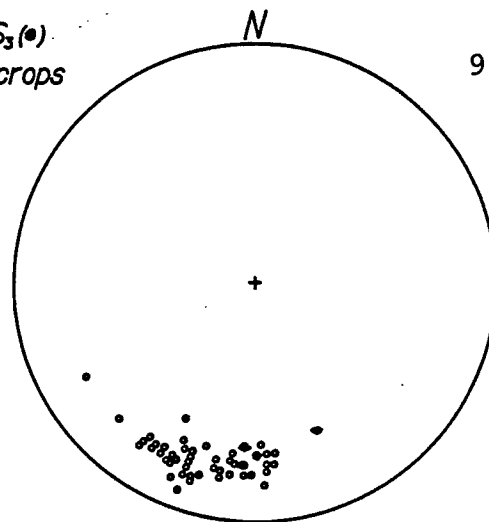
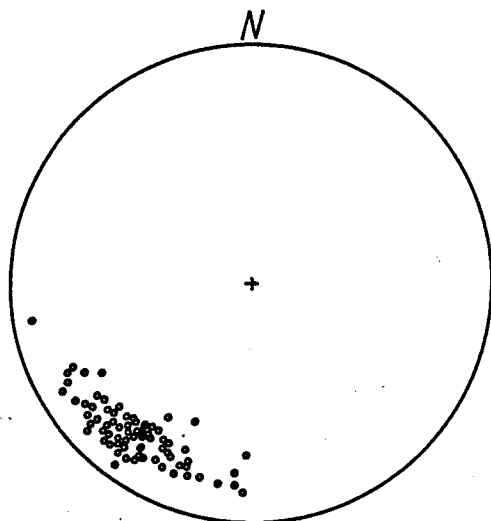
Bedding and foliations within the map area are commonly co-planar and indistinguishable. Bedding and the first foliation are best preserved in the south half of the map area where they are folded about the F_2 axial planar. The second foliation is axial planar to the F_2 folds and has a constant orientation throughout the map area. These relationships are illustrated on equal area diagrams (Fig. 7).

5.2.3 Lineations

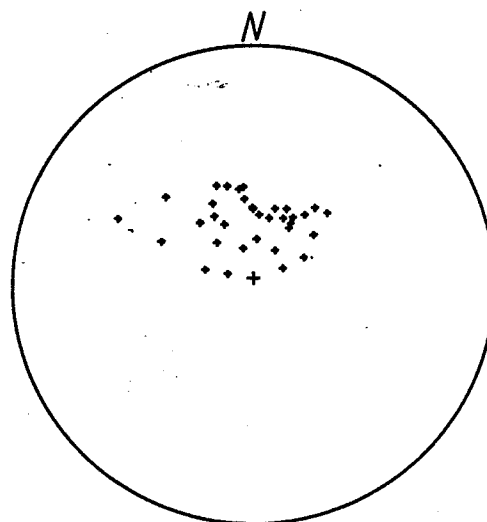
Linear elements observed in the map area include minor fold axes, preferred orientations of elongate minerals (hornblende or biotite) and rodding (amygdules, clasts, fragments, and quartz segregations). Trends of the lineations vary from northwest to northeast ($N035^{\circ}W$ to $N025^{\circ}E$) with steep plunges (65° to 75°). Most parallel the plunge of the F_2 folds, are contained within the S_2 plane and interpreted as a product of the second deformation. Criteria to distinguish reoriented early (L_1) lineations was not observed.

(A) Poles $\perp S_2(\bullet)$ and $\perp S_3(\bullet)$
as measured from outcrops
north of the orebody.

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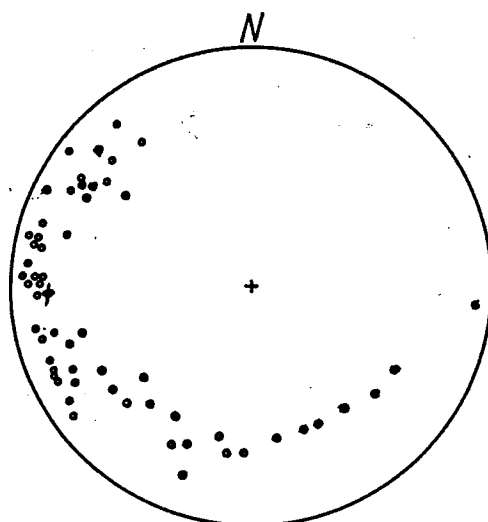


(B) Poles $\perp S_2(\bullet)$ as measured on
outcrops south of the orebody.



(C) Poles $\perp S_0(\bullet)$ and $\perp S_1(\bullet)$
as measured from outcrops
north of Jam Lake.

(E) Lineations associated with S_1 and S_2
for the entire map area.



(D) Poles $\perp S_0(\bullet)$ and $\perp S_1(\bullet)$
as measured from outcrops
west of Fox Lake.

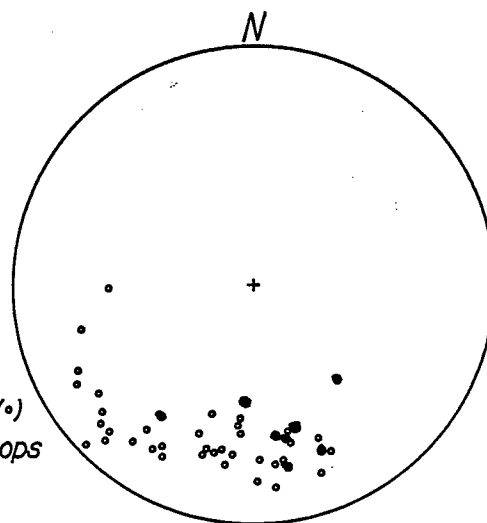


FIGURE 7: EQUAL AREA DIAGRAMS FOR
STRUCTURAL ELEMENTS OF THE FOX MINE AREA

5.2.4 Folds

Minor folds with different styles and orientations, rock sequence distribution and local facing direction reversals reflect two periods of folding. Both events were early in the structural evolution of the Fox Mine area.

The earliest folds are rootless isoclinal folds in the porphyritic mafic metavolcanics (Unit 1). Small intrafolial folds with east-trending axial planes occur in the aphyric andesite (Plate 16) and the banded iron formation (Plate 26). Megascopic features provide indirect evidence of the early fold phase. Inwardly dipping primary layering in the meta-sedimentary and felsic metavolcanic rocks west and south of the mine and opposing facing directions in pillow structures and flow units in the porphyritic mafic metavolcanics on the peninsulas between Fox and Jam Lakes indicate the presence of an early tight to isoclinal fold phase with subhorizontal fold axes (F1).

Evidence of the second fold phase (F2) is more abundant. Minor folds with east-trending axial planes and steep north-plunging axes occur in the three lowermost units of the local stratigraphic section. Axial planes and fold axes parallel the host rock foliation and mineral lineation, respectively. Minor folds are most common in the feldspathic siltstone and mudstone (subunits 3a-b) that outcrop near the explosives' storage area. Most are small (amplitudes less than 20 cm), parasitic, similar folds that most frequently have Z-shaped

symmetry (Plate 44) and an S_2 axial planar foliation (Plate 45). Minor drag folds with similar orientations occur in the autoclastic breccia (subunit 1e) and aphyric basalt (subunit 1c) of the porphyritic mafic metavolcanics (Plate 46). The folds are asymmetric (typically Z-shaped) with axial traces corresponding to local discontinuities (Plate 47).

Rock sequences with minor folds of opposing vergence and changes in the orientations of earlier foliations are further evidence of an east-trending fold phase. Sinistral offset along east-trending shear surfaces has resulted in large scale drag folds in the felsic metavolcanics. The early foliation (S_1) was deformed (drag folded) about the shear surfaces (see Map 1). Minor folds observed in the feldspathic siltstones and mudstones near the powder magazines and along the south shore of Dunphy Lake have similar orientations, but opposing vergence. The minor folds indicate the presence of a major F2 fold closure to the west. The hornblende tonalite intrusion is coincident with the axial trace of this fold.

5.2.5 Faults and shear zones

The orientations and fabrics of planar structural elements that offset or displace strata indicate at least two periods of faulting and/or shearing. Movement related to the early event (D2) was confined to narrow east-trending shears or shear zones that were parallel to the regional foliation and F2 fold planes. Movement on the late faults involved brittle offset on north- and northeast-trending surfaces.



Plate 44: Minor folds (F2) in the feldspathic siltstone (subunit 3a) with Z-shaped asymmetry. Location - 71030E x 11625N.



Plate 45: Photomicrograph of a minor F2 fold defined by segmented layer of opaque minerals (pyrrhotite). In the feldspathic siltstone (subunit 3a). Plane polarized light. Location: DDH FS-28 @ 742' (226m).



Plate 46: Minor fold (F2) in the autoclastic breccia (subunit 1e) with Z-shaped asymmetry. Note discontinuity parallel to axial trace. Location - 71400E x 8750N.

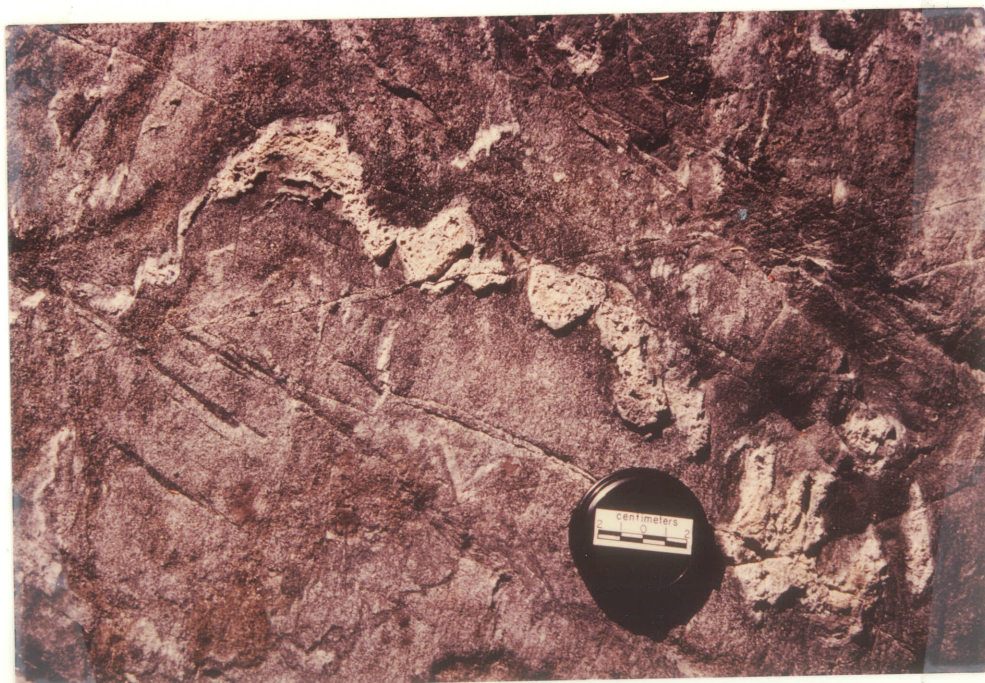


Plate 47: Open folding (F2) of an epidote layer in the aphyric basalt (subunit 1c). Location - 71205E x 8755N.

Field information, subsurface observations and drill data indicate at least two generations of planar discontinuities, one coinciding with the development of S_3 , and the other much later cross-cutting and producing minor offset on all earlier structures.

The early faults (D3) have the same orientation as the S_2 foliation. They represent restricted zones of extreme development of S_2 along which discrete dislocations have modified the disposition of lithologies, occurring in a zone approximately one kilometer wide in which S_2 is best developed. The northeastern limit of the zone is contact between the hornblende tonalite and the metasedimentary rocks. Its southwestern limit coincides with the contact between the mafic and felsic metavolcanic rocks just west of Fox Lake. The faults display retrograde mineral assemblages, mylonitic textures with well-developed S-C fabrics and are interpreted as the later stage of a continuous deformational process.

The northernmost planar discontinuity coincides with the southern contact of the arkosic meta-sandstone (Unit 5) and is hereafter referred to as the Hatchet Lake shear zone (Map 1). Continuous for several kilometers, it was a zone of ductile shear that produced downward movement of the hangingwall in the plunge direction of the F2 minor fold axes and mineral lineation (L_2) as determined from mylonitic S-C petrofabrics.

A second east-trending fault north of the mine coincides with the contact of the metasedimentary rocks (Unit 3) and

the autoclastic breccia (subunit 1e). Its presence is indicated by fault gouge or protomylonitic textures (Plate 48) in DDH FS-23@431' (131m).

The best-exposed fault coincides with the southern margin of the alteration zone. In the lower levels of the mine, its trace coincides with a thin layer of quartz-sericite schist (2eQSS). Textures in this quartz-sericite schist range from mylonitic to blastomylonitic. Crown pillar stripping operations exposed the fault on surface (Plate 49) where it is east-trending with slickensides that indicate downward movement of the hangingwall block.

The presence of at least six faults or thin shear zones south of the orebody is indicated from drill core intersections. Cored intervals reveal mylonitic textures and retrograde mineral assemblages. These faults are assumed to have orientations similar to those north of the orebody. Comparable mineral assemblages indicate the faults were produced by a single, late deformational event. Drag folds, slickensides and mylonitic textures indicate the main sense of movement was in the direction of the regional lineation with the hangingwall moving down relative to the footwall. Absolute displacements are not known, but juxtaposed rock sequences suggest considerable movement. The minor structures indicate both sinistral and dextral offset accompanied the normal movement on these surfaces.

The most recent structural elements observed in the Fox

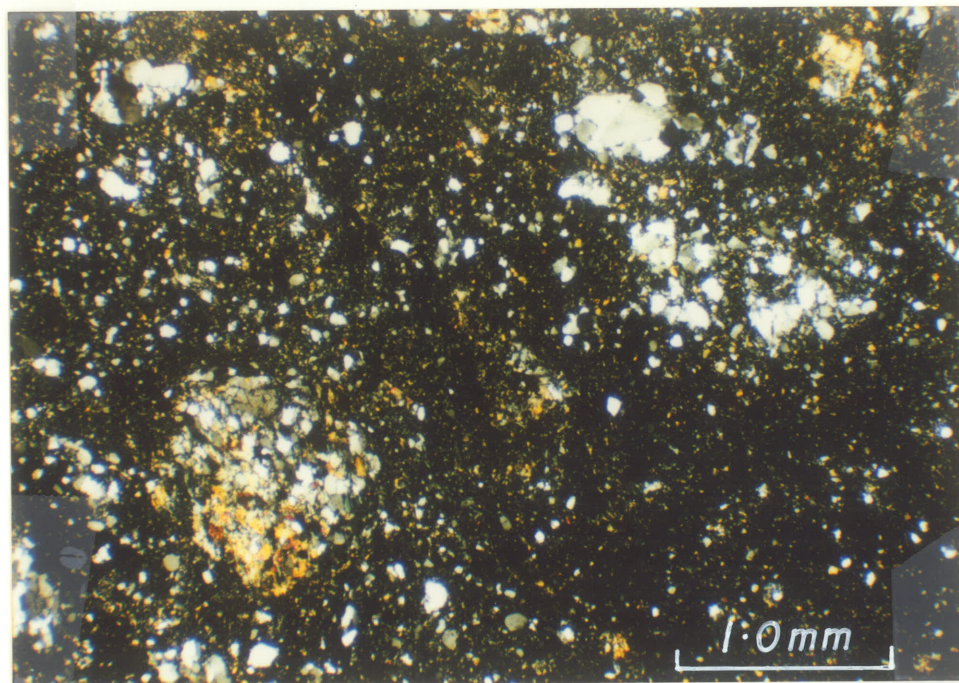


Plate 48: Photomicrograph of protomylonite from a D2 fault in aphyric andesite (subunit 1d). Plane polarized light. In DDH FS-28@431' (131m).



Plate 49: Fault surface defining southern ore contact. Slickensides indicate downward movement of the hanging-wall block (left in photo). Viewed from northwest. Location - 70800E x 9600N.

Mine area are north- and northwest-trending faults (D4) with moderate westerly and southeasterly dips, respectively. Displacements on these faults are poorly documented. They possess insufficient offsets to warrant inclusion at the scale of mapping. Joints with similar orientations to the late faults are prominent in the gabbro southeast of the mine.

5.3 DEFORMATIONAL EVENTS AND INTRUSIVE SEQUENCE

The structural evolution of the Fox Mine area included a minimum of four deformational events as deduced from major and minor structures. It comprised an early isoclinal fold-forming event (D1) followed by a period of moderate to tight shear folding (D2) with attendant development of the S penetrative foliation, faulting (D3) and the development of local retrograde mylonitic textures and finally, a late period of brittle faulting (D4). As indicated by field relations, most intrusive rocks (I1) were emplaced prior to deformation. The hornblende tonalitic pluton (I2) to the north was intruded between the third and fourth deformational events. Figure 6 summarizes these events. Structural types and orientations suggest an overlapping of some events.

5.3.1 Early intrusions (I1).

The emplacement of small intrusive bodies including the gabbro, diabase dikes (Unit 6), quartz-eye porphyry (Unit 7) and biotite leucogranite (Unit 9) predated deformation in the Fox Mine area. Most occur as lenticular bodies elongate in the direction of the regional foliation, possess foliations

comparable to their extrusive counterparts and are regarded as subvolcanic sills and dikes. Emplacement of these bodies may have provided the energy for hydrothermal processes.

5.3.2 First deformational event - D1

The first recognizable deformational episode manifested itself in tight to isoclinal folds with steeply dipping limbs and detached closures with sub-horizontal axes. Axial traces of major F1 folds are northeast to east-trending, reflecting transposition during subsequent deformational events.

The early isoclines folded the primary layering (S_0) and were coeval with development of the bedding parallel first foliation (S_1). Depending on rock composition, the foliation is either a lepidoblastic schistosity marked by biotite laths or a nematoblastic schistosity defined by hornblende prisms and rods. The presence of staurolite and sillimanite in the early foliation indicate that middle amphibolite grade of metamorphism was achieved during the first deformation. The early foliation (S_1) observed in the felsic metavolcanics (Unit 2) and rare intrafolial folds in the porphyritic mafic metavolcanics (Unit 1) are minor structures produced during the first deformational event.

5.3.3 Second deformational event - D2

The second deformational event resulted in the development of the penetrative foliation (S_2) in the central zone of the map area and numerous, moderate to tight minor folds with east-trending axial surfaces and axes parallel to S_2 and L_2 ,

respectively. These folds are common in the metasedimentary rocks but rare in the mafic metavolcanics (Plates 46 & 47). Major fold axial traces (F2) indicated by minor fold structures are located on Map 1.

Minor folds (F2) in the two northernmost metasedimentary belts have opposing vergence and indicate the presence of a major fold closure to the west. The orientations of minor fold axes suggest it is either an overturned anticline or a reclined fold. Minor folds and sequence facing directions provide evidence of a synclinal F2 closure in the felsic rocks north of Jam Lake.

Common orientations for planar and linear minor elements produced by folding and shearing suggest these processes were contemporaneous. The second deformational event is recognized by a pronounced east-trending shear foliation (S_2) that dips steeply to the north. This foliation is either a lepidoblastic or nematoblastic schistosity, depending on rock composition. Aligned biotite and muscovite laths or hornblende rods define the foliation. Garnet, cordierite, anthophyllite and cummingtonite are post-tectonic mineral phases associated with this foliation and indicate middle amphibolite grade metamorphism.

5.3.4 Third deformational event - D3

The third deformational event is regarded as a late stage extension of the second event during which an east-trending set of fault surfaces and mylonites were propagated. The

Hatchet Lake shear zone is interpreted as a major dislocation associated with this event. The amount of displacement on this surface is not known, but appears considerable. Lesser shears and faults that parallel this surface are interpreted to be sympathetic structures. Minor structures indicate the hangingwall block moved down plunge relative to the footwall block, with either sinistral (Plate 12) or dextral (Plate 46) offset.

Fault and shear surfaces associated with the third deformational event have the same orientation as the S_2 foliation, but offset the axial surfaces of D2 folds and are defined by the retrograde minerals, sericite and chlorite.

5.3.5 Late intrusions (I2)

Emplacement of the hornblende tonalite - quartz diorite (Unit 8) constitutes the second intrusive event. The hornblende tonalite was intruded into a homoclinal sequence of feldspathic siltstones and mudstones (Unit 3). Its location coincides with the axial trace of a major F2 overturned anticlinal or reclined fold. It is crosscut by late, brittle faults indicating emplacement occurred between the third and fourth deformational events.

5.3.6 Fourth deformational event - D4

The fourth deformational event is recognized by north- and northwest-trending open faults and joints with moderate dips. These structural discontinuities result in minor offsets of the foliation and earlier faults.

5.4 METAMORPHISM

Mineral assemblages and textures indicate the Fox Mine area has experienced at least three periods of metamorphism imposed on rocks, some of which had undergone primary hydrothermal alteration. The first period was associated with early isoclinal folding (D1) and achieved middle amphibolite grade. The second was related to shear folding and development of the main regional foliation (D2). It also attained middle amphibolite grade, but at slightly lower pressures. The last recognizable metamorphic event was related to the development of localized shear zones (D3) and produced retrograde mineral assemblages.

5.4.1 Hydrothermal Alteration

The Fox Lake massive sulfide deposit is underlain by two inverted, cone-shaped zones of hydrothermal alteration. The distributions of coarsely recrystallized, hydrous mineral assemblages that preserve the stockworks' gross morphologies are the most substantive evidence of hydrothermal activity. Alkali metasomatism, discussed in Chapter VII, defines a broad, less conspicuous geochemical halo around the deposit. Hydrothermal mineral assemblages and fabrics have been masked by subsequent periods of higher grade metamorphism.

5.4.2 Early Middle Amphibolite Grade Metamorphism (M1)

Evidence of early amphibolite grade metamorphism is confined to the belt of felsic metavolcanics (Unit 2) north of Jam Lake and poorly preserved relicts elsewhere. Indicative

mineral assemblages include small biotite laths aligned in a quartzose matrix and defining the weak, lepidoblastic schistosity (S_1), late poikiloblastic staurolite and garnet, and fibrolite masses. In the absence of K-feldspar, the latter minerals indicate medium amphibolite grade of metamorphism. The attendant weak foliation is north-trending and steeply dipping. Sillimanite knots (or fibrolite masses) are elongate in this foliation, but show late growth of randomly oriented needles (Plate 50). Staurolite and garnet are post-tectonic minerals and poikiloblastically include the oriented quartz and biotite grains. Coexisting sillimanite and staurolite indicate elevated pressures.

Amphibole-rich layers in the felsic metavolcanic rocks contain segregations of poikiloblastic hornblende alternating with finer-grained, plagioclase-quartz bands. The layers are aligned in the early schistosity indicating that hornblende crystallized during the first metamorphic event. Elsewhere, the imprint of subsequent metamorphic events has camouflaged the early medium grade event. Staurolite poikiloblasts with internal S-surfaces discordant to external S-surfaces indicate the presence of two amphibolite grade foliations (Plate 31). Evidence of the early event is also provided by sillimanite and staurolite inclusions in cordierite poikiloblasts.

5.4.3 Late Middle Amphibolite Grade Metamorphism (M2)

The early middle amphibolite grade event was followed by a second period of middle amphibolite grade metamorphism (M2)

that involved comparable temperatures, but somewhat lower pressures. Field relationships, mineral assemblages and textures indicate it was associated with the development of east-trending folds (D2) and the regional foliation (S_2). Mineral assemblages and textures recorded in the field and observed petrographically, developed during the second event.

Fabrics include a lepidoblastic schistosity produced by the alignment of large biotite or ragged muscovite laths and a nematoblastic schistosity defined by the alignment of hornblende rods and prisms. They define the regional foliation (S_2) and are distinguished from earlier fabrics by the presence of strained, mylonitic textures or zoned amphiboles aligned in the foliation (Plate 51) and late, acicular, white amphiboles that overprint the foliation. The resultant foliation contains restricted zones with a strong preferred orientation (shear surfaces) that traverse more extensive zones in which the foliation is anastomosing and possesses several weakly developed orientations.

Middle amphibolite grade metamorphism is indicated by aligned syn-tectonic biotite and hornblende and post-tectonic overgrowths of garnet, cordierite, cummingtonite and anthophyllite (Plate 52). Late growth of the white amphiboles is indicated by acicular crystals and fascicular aggregates that overprint the S_2 foliation. Inclusions of sillimanite and staurolite in cordierite porphyroblasts indicate lower pressure conditions prevailed during the second event.

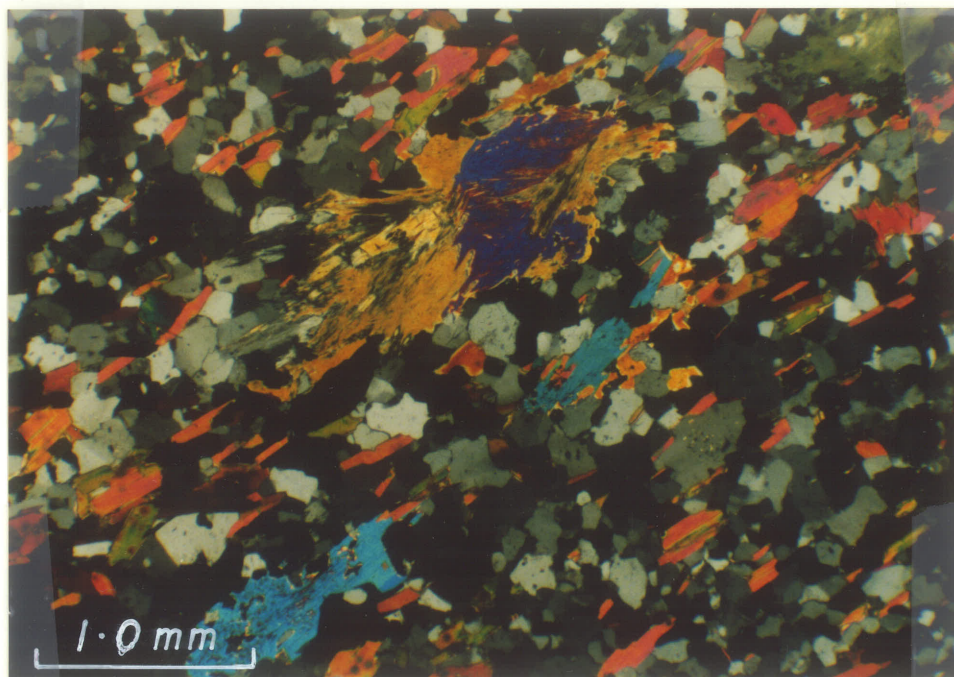


Plate 50: Fibrolite mass or knot partially replaced by muscovite. Lepidoblastic schistosity is defined by biotite laths. In the felsic metavolcanics (Unit 2). Cross nicols. Location - DDH UF-1886 @ 1319' (402m).

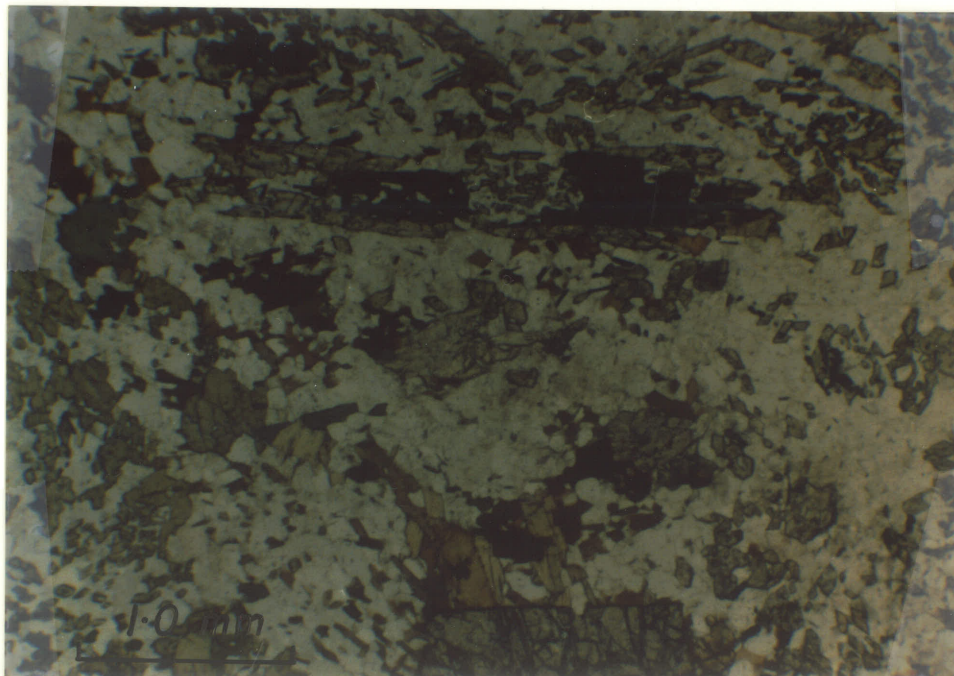


Plate 51: Zoned amphibole with hornblende core and cummingtonite rim aligned in a nematoblastic schistosity (S_2). Note also the late garnet porphyroblast. From the autoclastic breccia (subunit 2e). Plane polarized light. Location - DDH FS-35 @ 508' (155m).

5.4.4 Retrograde Metamorphism (M3)

Retrograde metamorphism is associated with local, east-trending fault or shear surfaces (D3) aligned parallel to the regional foliation (S_2). Petrographic investigations indicate that the fault traces located on Map 1 are thin (1 - 3m) sheet-like zones. The Hatchet Lake shear zone possesses greenschist grade mineral assemblages and mylonitic textures. Lesser, sympathetic shears and fault splays have greenschist mineral assemblages and cataclastic textures. Mineral assemblages in these zones include sericite, chlorite (penninite), epidote and strained quartz grains that show marginal nucleation (Plate 53).

An absence of cross-cutting relationships suggests these surfaces (S_3) are a late, retrogressive stage in the development of the regional foliation.

5.4.5 Metamorphic Temperature and Pressure Conditions

Stable mineral assemblages indicate the Fox Mine area experienced three metamorphic events. The first two events had overlapping stability fields in the middle amphibolite grade. Mineral assemblages indicate the third event was of greenschist grade. The stability field of the early middle amphibolite grade event as indicated by coexisting biotite, hornblende, garnet, staurolite, and sillimanite in the absence of K-feldspar is defined by curves 1, 3 and the granite solidus on Figure 8. Temperatures of this field range from 540°C to 650°C and pressures range from 0.22 GPa to 0.64 GPa.

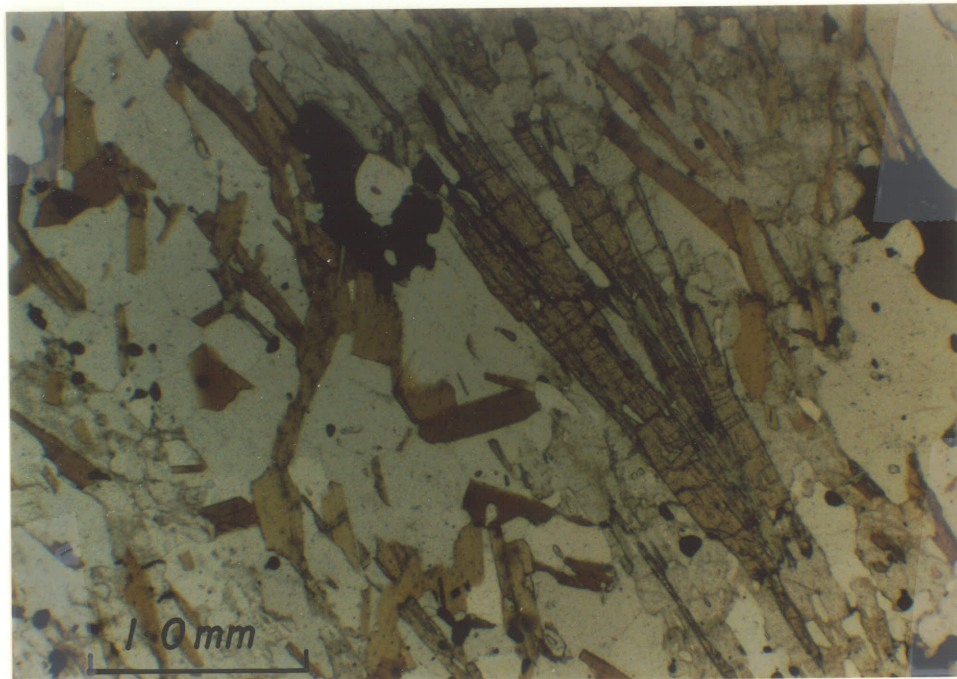


Plate 52: Fascicular anthophyllite aggregate and pinnitized cordierite overprinting the S₂ lepidoblastic schistosity. In altered felsic metavolcanic rocks (subunit 2e). Plane polarized light. From UF-1886 @ 662' (202m).

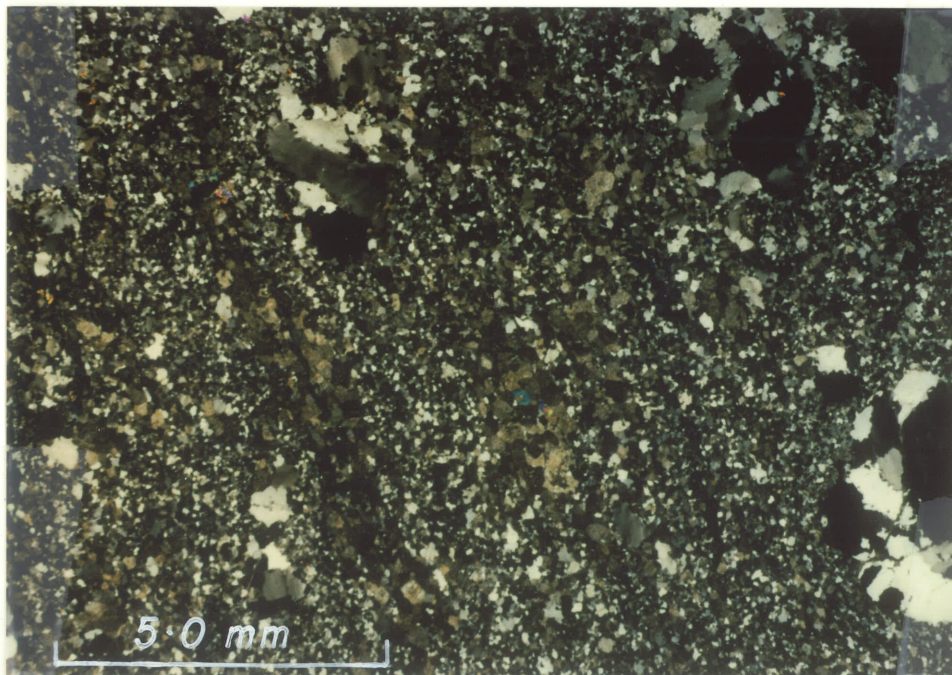


Plate 53: Augen mylonite with large strained quartz porphyroclast with finer matrix grains of penninite and sericite. From quartz-eye porphyry. Cross polars. From FS-28 @ 1193' (364m).

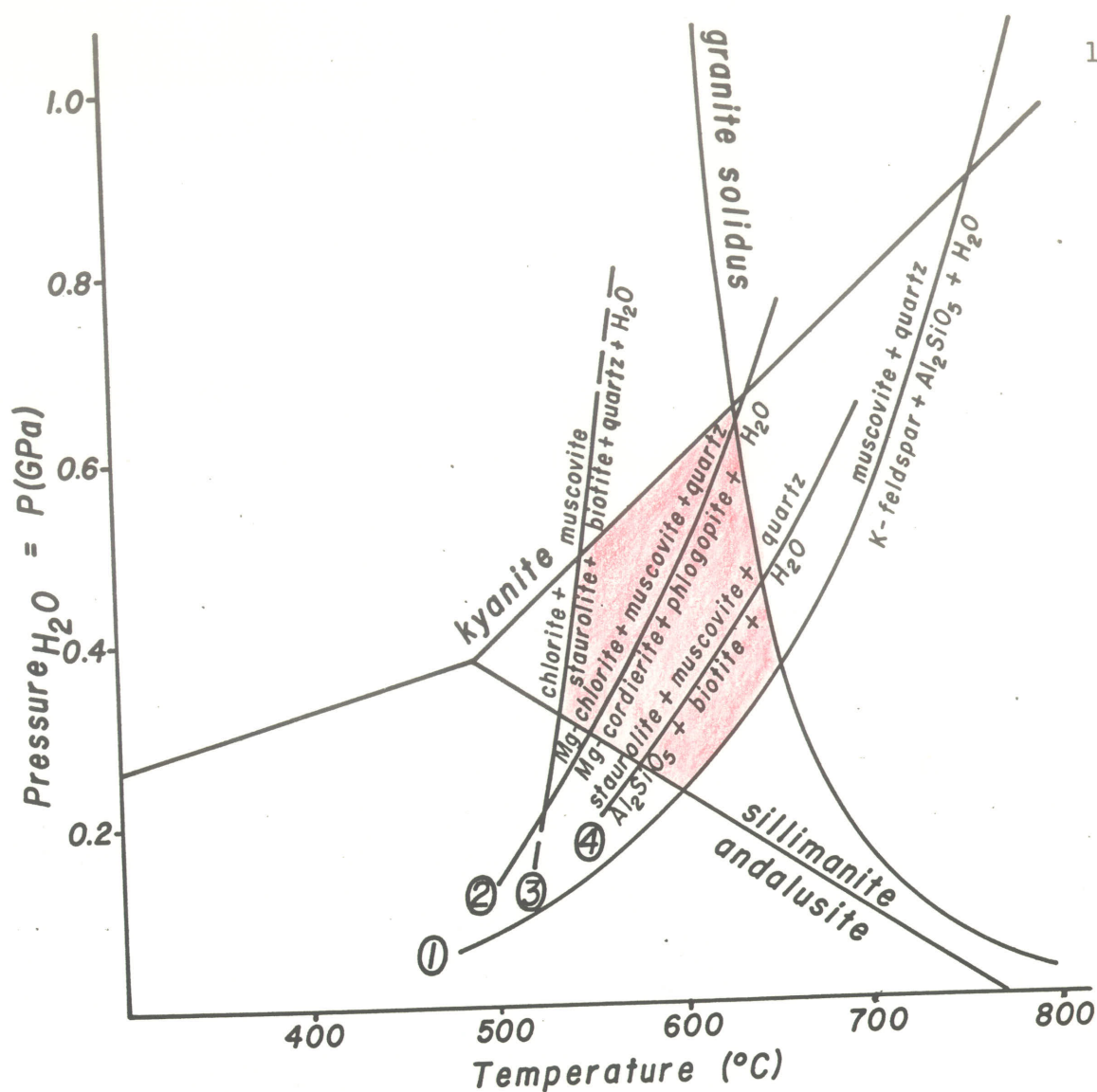


FIGURE 8: PRESSURE-TEMPERATURE CONDITIONS EFFECTED DURING METAMORPHISM OF THE FOX MINE AREA (SHADED).

Al_2SiO_5 polymorphs' stability field boundaries are from Holdaway, 1971; curves ①, ② and ④ are from Greenwood, 1976; curve ③ is from Hoschek, 1969; and granite solidus curve is from Winkler, 1974.

Coexisting garnet, cordierite and phlogopite (not in the presence of biotite) establish the lower stability limit of the second middle amphibolite grade metamorphic event as indicated by curve 2 on Figure 8. The upper stability limit is defined by the granite solidus. Similar temperatures at slightly lower pressure are indicated by mineral assemblage stability fields.

Distinguishing between the first and second metamorphic events is complicated by similarities of textures and mineral assemblages. The lack of cross-cutting relationships makes distinctions more tenuous. Marked differences in orientation from adjacent outcrops, the incompatibility of sillimanite and cordierite (Reinhardt, 1968) and zoned amphiboles aligned in the regional foliation serve to distinguish between these events.

The Fox Mine lithologies contain markedly different mineral assemblages. The mafic metavolcanic rocks possess the simplest mineralogies comprising hornblende, more rarely cummingtonite, and plagioclase. Mineral assemblages from the felsic metavolcanic rocks and the metasedimentary rocks are more complex and provide the best indicators of metamorphic grade. Occurrences of phlogopite, cordierite and sillimanite are restricted to the felsic metavolcanics. Staurolite occurs in both metasedimentary and metavolcanic rocks. Table 3 summarizes the relationships of metamorphic minerals to deformational events.

TABLE 3

METAMORPHIC MINERALS RELATED TO DEFORMATIONAL EVENTS

Event	D1			D2			D3		
	early	mid	late	early	mid	late	early	mid	late
Quartz	x				x				
Plagioclase	x				x				
Biotite	x				x				
Hornblende	x			x					
Sillimanite		x							
Staurolite		x							
Garnet		x				x			
Cummingtonite						x			
Anthophyllite						x			
Cordierite						x			
Muscovite						x			
Chlorite	x							x	
Epidote								x	
								x	
S formed	S ₁			S ₂			S ₃		
S deformed	S ₀			S ₀ , S ₁			S ₀₋₂		

CHAPTER VI

STRATIGRAPHIC MODEL OF THE FOX MINE AREA

6.1 GENERAL STATEMENT

The segment of the Lynn Lake greenstone belt exposed in the Fox Mine area consists primarily of Wasekwan Group mafic metavolcanic rocks. Successively younger metavolcanic rocks in the southern half of the area are more evolved chemically. Upwards through the volcanic pile, they become more felsic and include andesites, dacites and minor rhyolites.

Derived feldspathic metasedimentary rocks lie atop the metavolcanic rocks in the southern half of the map area and at the base of a second sequence that includes aphyric mafic metavolcanic rocks and Sickle Group arkosic metasandstone in the northern half. The two areas are separated by the east-northeast trending Hatchet Lake shear zone and the felsic metasedimentary rocks provide some semblance of continuity between the two blocks.

Stratigraphic relationships have been obscured by subsequent structural deformations. Late faulting (D3) superimposed on early isoclinal folds (D1) and tight shear folds (D2) resulted in differential repetitions of stratigraphic segments. The present lithostructural configuration of the Fox Mine area, as viewed in a simplified cross-section (Fig. 9) evidences the structurally replicated terrain. A stratigraphic model with faulting and folding removed is shown in Figure 10.

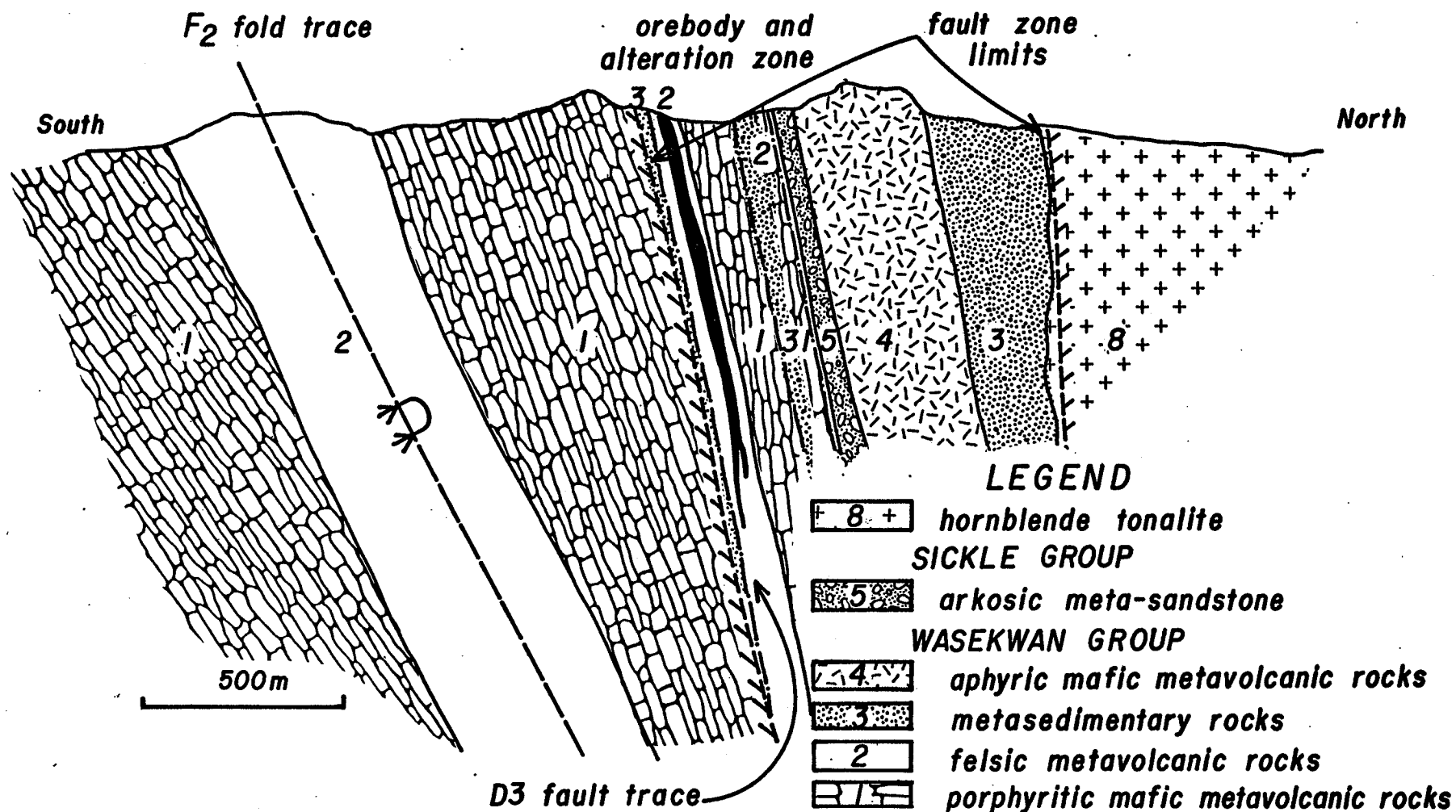


FIGURE 9: SIMPLIFIED CROSS-SECTION OF THE FOX MINE AREA, SHOWING STRATIGRAPHIC REPETITIONS OF AN OVERTURNED F₂ FOLD LIMB.

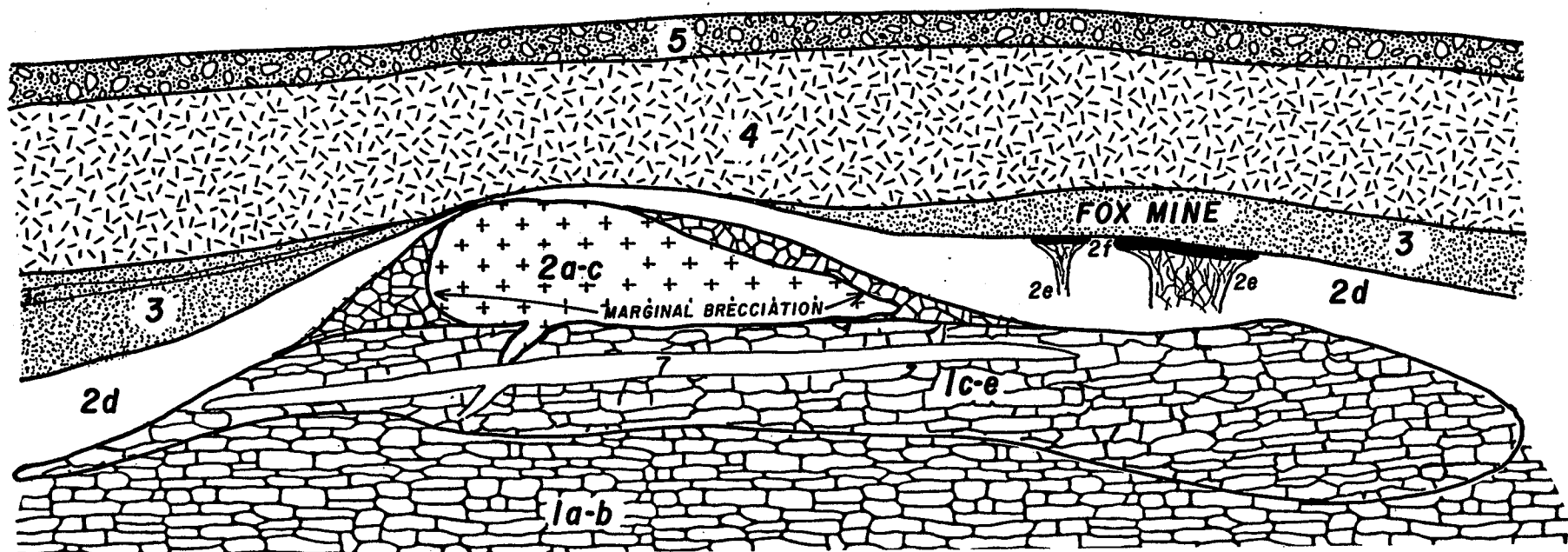


FIGURE 10: STRATIGRAPHIC MODEL OF THE FOX MINE AREA.

7. Continued uplift and shallow water deposition of arkosic sandstone, Unit 5.
6. Uplift followed by the extrusion of laterally extensive aphyric basalt flows, Unit 4.
5. Marginal sedimentation, Unit 3, with minor intermittent felsic volcanism(3c).
4. Hydrothermal activity, modifying felsic host rock(2e) with attendant sulfide deposition(2f).
3. Onset of felsic volcanism, Unit 2, including local doming of rhyolite and dacite flows (2a-c), deposition of laterally extensive dacite tuffs(2d), and subvolcanic intrusions(7).
2. Late stage transition to intermediate volcanism, extrusion of local andesite flows(1c-e).
1. Build-up of mafic platform, subaqueous extrusion of Unit 1 - porphyritic massive and pillowed basalt flows(1a-b).

(modified from Gilbert et al, 1982)

6.2 STRATIGRAPHIC DEVELOPMENT OF THE FOX MINE AREA

The lowermost unit in the Fox Mine stratigraphic section is the porphyritic mafic metavolcanic rocks (Unit 1). It consists of an upper and a lower sequence and has an exposed thickness in excess of 1500 meters.

The lower sequence comprises massive and pillowed amphibole-phyric basalt flows and flow breccias, informally referred to as the Fox Lake porphyritic basalt*. Poorly vesiculated pillows with massive cores and minor interpillow sediment indicate these flows were extruded into a deep water, submarine environment. A reworked conglomeratic horizon near the top of this sequence suggests accumulations of porphyritic basalt built-up into shallow depths of water.

The upper sequence is more diverse and comprises aphyric and porphyritic basalts and aphyric andesites. Individual flows contain massive, pillowed and autobrecciated portions. Extrusion into shallow depths of water is indicated by large, vesiculated pillows with abundant interpillow sediment. This sequence is informally known as the Fox Mine succession*.

The shift from deep submarine to shallow water extrusion is further evidence of volcanic pile build-up. The upper sequence is wedge-shaped and thins to the south, the indicated flow direction observed in pillow structures.

* Footnote: Informal rock unit nomenclature from Gilbert et al., (1980) is included to facilitate stratigraphic comparisons.

The porphyritic mafic metavolcanic rocks are overlain by the felsic metavolcanic rocks (Unit 2), but contact relationships are poorly exposed. In the southwest, the felsic metavolcanic rocks directly overlie the lower sequence porphyritic basalts (1a-b). South of the mine (subarea 2), facing directions observed in pillow structures indicate the felsic metavolcanic rocks overlie the upper sequence basalts and andesites (1c-e) with an iron formation marking the contact.

The felsic metavolcanic rocks outcrop as three detached segments. An irregular, oblate body west of Fox Lake and north of Jam Lake constitutes the greatest accumulation. This body is not laterally continuous and comprises massive aphyric, quartz- and feldspar-phyric rocks of rhyodacitic to dacitic composition and the margins are mantled by coarse autoclastic breccias of similar composition. This body is interpreted to be a series of subaqueous felsic flows.

The discontinuous oblate felsic body is flanked by thin flows and tuffaceous horizons. These rock types are laterally persistent and traverse the map area. Evidence of hydrothermal activity is most pronounced near the upper contact of the thin felsic horizons, indicating that alteration was a relatively late primary process.

The felsic metavolcanic rocks are overlain by the meta-sedimentary rocks (Unit 3). True stratigraphic order is pre-

served only along the western extension of the ore horizon. Elsewhere relationships are obscured by late faults with surfaces essentially parallel to primary layering. The metasedimentary rocks comprise felspathic siltstones and mudstones with minor intercalated felsic tuffs. Fine laminations and sulfidic horizons indicate this unit was deposited in a deep water, reducing environment.

Four outcrop areas or belts of metasedimentary rocks provide continuity between apparently unrelated stratigraphic segments above and below the Hatchet Lake shear zone. This unit has a maximum exposed thickness of 150 meters near the explosives' storage area, where it is interpreted to be the lowermost unit in a south-facing, overturned stratigraphic slice.

Aphyric mafic metavolcanic rocks (Unit 4) overlie the metasedimentary rocks between the powder magazines and the mine complex. This unit is 200 meters thick, longitudinally traverses the map area and comprises massive and pillowed flows. Poorly vesiculated pillows with little interpillow sediment suggest these flows were extruded into a moderate to deep submarine environment.

The aphyric mafic metavolcanic rocks are overlain by a 60 meter thick sliver of Sickle Group arkosic meta-sandstone (Unit 5). The presence of quartz and granitic clasts, graded bedding and cross-bedding indicate deposition of this unit took place in a high energy, shallow water environment. In

its present position, the arkosic meta-sandstone is overturned and south-facing.

CHAPTER VII

GEOCHEMISTRY

7.1 GENERAL STATEMENT

The Fox Lake massive sulfide deposit was not exposed on surface. It subcropped along the axis of an east-trending longitudinal trough-like depression. The terrain 100 meters to the north and south of the deposit's surface trace is not exposed. Ore and host rock characteristics are known only from drill core and underground workings.

Information from underground mapping and drill core logging indicates the Fox Lake massive sulfide deposit is contained within a series of fault-bounded slices that comprise mafic to felsic metavolcanic rocks with subordinate metasedimentary rocks. The immediate host rocks are light-coloured, siliceous, visibly altered and lack recognizable primary features (see Chapter III). Recognizable flows and breccias of andesitic composition (54 - 60% SiO_2) occur along the north and south flanks of the alteration envelope.

Stratigraphic ambiguities, the probability of structural repetitions and the lack of sufficient exposure prompted petrological and petrochemical investigations of drill core samples. The petrography of the Fox Mine rock types was presented in Chapter II.

Petrochemical investigations of the Fox Mine area include 863 whole rock analyses of surface (244), underground (39) and drill core samples (580) and are listed in Appendix

II. The list includes several samples from each rock type described in Chapter II. The surface and underground samples (2100 Level) were collected by Dr. J. Fox. Sample locations for these analyses are included in Appendix IV. Drill core samples are from surface (prefixed FS-) and the 2000, 2100 and 2800 Levels underground (prefixed UF-). Drill hole collar locations are plotted on Maps 1, 2 and 3. Cross sections are included in Appendix I.

All samples (863) were analysed for the major oxides - SiO_2 , Al_2O_3 , CaO , MgO , Na_2O , K_2O , Fe_2O_3 , MnO , TiO , P_2O_5 and LOI (loss on ignition) and are listed as weight percent oxide in Appendix II. Ferrous iron (as weight percent oxide) and trace element analyses (Cr, Sr, Rb, Nb, Y, and Zr in ppm) were obtained for 201 of these samples and are listed in Appendix III. With the exception of samples from UF-2153 (2800 Level) which were analysed by Chemex Laboratories Ltd., all analytical work was performed by X-ray Assay Laboratories Limited. Precision and detection limits for these analyses are included in Appendix II.

The principal objective of these investigations was further refine the metavolcanic rock subdivisions established by field mapping. Of the total number of samples analysed, 160 were used to chemically classify the metavolcanic rocks. The samples listed in Appendix IV were selected to provide the broadest compositional spectrum of metavolcanic rocks. The reduction involved the elimination of altered and metasedi-

mentary rock samples and resulted in a more manageable population. Classification of the Fox Mine metavolcanic rocks follows the procedures outlined by Irvine and Baragar (1971).

The presence of an alteration zone enveloping the Fox Lake deposit was introduced and discussed earlier (Chapter III). Field mapping indicates the alteration is localized within the felsic metavolcanic rocks. This interpretation was tested by a chemical classification (Figs. 11-15). An alkali ratio diagram (Fig. 16) was used to measure the spatial extent of the primary hydrothermal alteration halo.

To assess and counter potential problems associated with major element mobilities, a second classification using supposedly immobile minor and trace elements was constructed. Eighty samples used in the chemical classification diagrams that were also analysed for trace elements (niobium, ytterium and zirconium) are plotted on trace element diagrams (Figs. 17-19).

7.2 MAJOR ELEMENT INVESTIGATIONS

Following the procedures outlined by Irvine and Baragar (1971), 160 metavolcanic rock samples from the Fox Mine area have been classified chemically. Diagrams generated by the classification process used major element ratios (expressed as anhydrous weight percent oxide) and major element ratios recast as normative minerals. Only minimal adjustments were required to prepare chemical data prior to classification. Proportions of FeO, Fe₂O₃ and TiO₂ indicated no adjustment

was necessary to the ferric/ferrous iron ratio. Samples have been recalculated to anhydrous proportions, assuming H_2O and CO_2 were the only constituents lost on ignition. Although several metavolcanic rocks were porphyritic, none had phenocryst contents sufficient to warrant corrections.

Samples selected for this study were taken within a one kilometer radius of the Fox Lake massive sulfide deposit. Analyses from visibly altered samples were avoided, with a few notable exceptions. One sample from FS-35 and four from FS-28 contained visible alteration and have been included in this study to maintain continuity along the extensions of the ore horizon. These samples are denoted by an asterisk (*) in Appendix IV. Their locations on the various diagrams are discussed in the appropriate sub-sections.

The ensuing chemical classification is based on primary field subdivisions and includes five rock groups. The porphyritic mafic metavolcanic rocks (Unit 1) are divided into basalts (1a-c) represented by filled circles (●) and andesites (1d-e) by open circles (○). The felsic metavolcanic rocks (Unit 2) are divided into dacites (2a, b and d) represented by open triangles (Δ) and rhyolites (2c) by open squares (□). The aphyric mafic metavolcanic rocks (Unit 4) are represented by crosses (+).

7.2.1 Alkalies-Silica Diagram

An alkalies-silica diagram (Figure 11) is a weight percent plot of $(Na_2O + K_2O)$ versus SiO_2 . It is used to distin-

guish alkaline and subalkaline volcanic rocks with the field boundary from Irvine and Baragar (1971). Metavolcanic rocks from the Fox Mine area ranging in composition from basalt to rhyolite plot below the boundary line in the subalkaline field.

With the exception of the aphyric mafic metavolcanic rocks (Unit 4), most rock groups show a wide range of alkali and silica contents. Andesites with anomalously high silica contents (up to 70%) are from an interval immediately below the projected position of the alteration zone. Altered samples from FS-28 and FS-35 have lower alkali contents (notably Na_2O) than their unaltered counterparts (dacites) and plot marginally closer to the abscissa on the alkalies-silica diagram.

7.2.2 AFM Diagram

A ternary diagram for the Fox Mine metavolcanic rocks, where $A = \text{Na}_2\text{O} + \text{K}_2\text{O}$, $F = \text{FeO} + \text{Fe}_2\text{O}_3$ and $M = \text{MgO}$ (in weight percent oxide), is presented in Figure 12. The field boundary separating the tholeiitic and calc-alkaline suites is from Irvine and Baragar (1971). The metavolcanic rocks of basaltic and andesitic composition possess elevated iron contents and correspondingly low alkalies. Most lie well within the tholeiitic suite. Rocks of dacitic and rhyolitic composition straddle the field boundary, suggesting the existence of a suite association that includes both the tholeiitic basalt and calc-alkali series.

FIGURE 11:

ALKALIES-SILICA DIAGRAM

APPLIED TO SAMPLES OF FOX MINE METAVOLCANIC ROCKS

(Field boundaries from Irvine and Baragar, 1971)

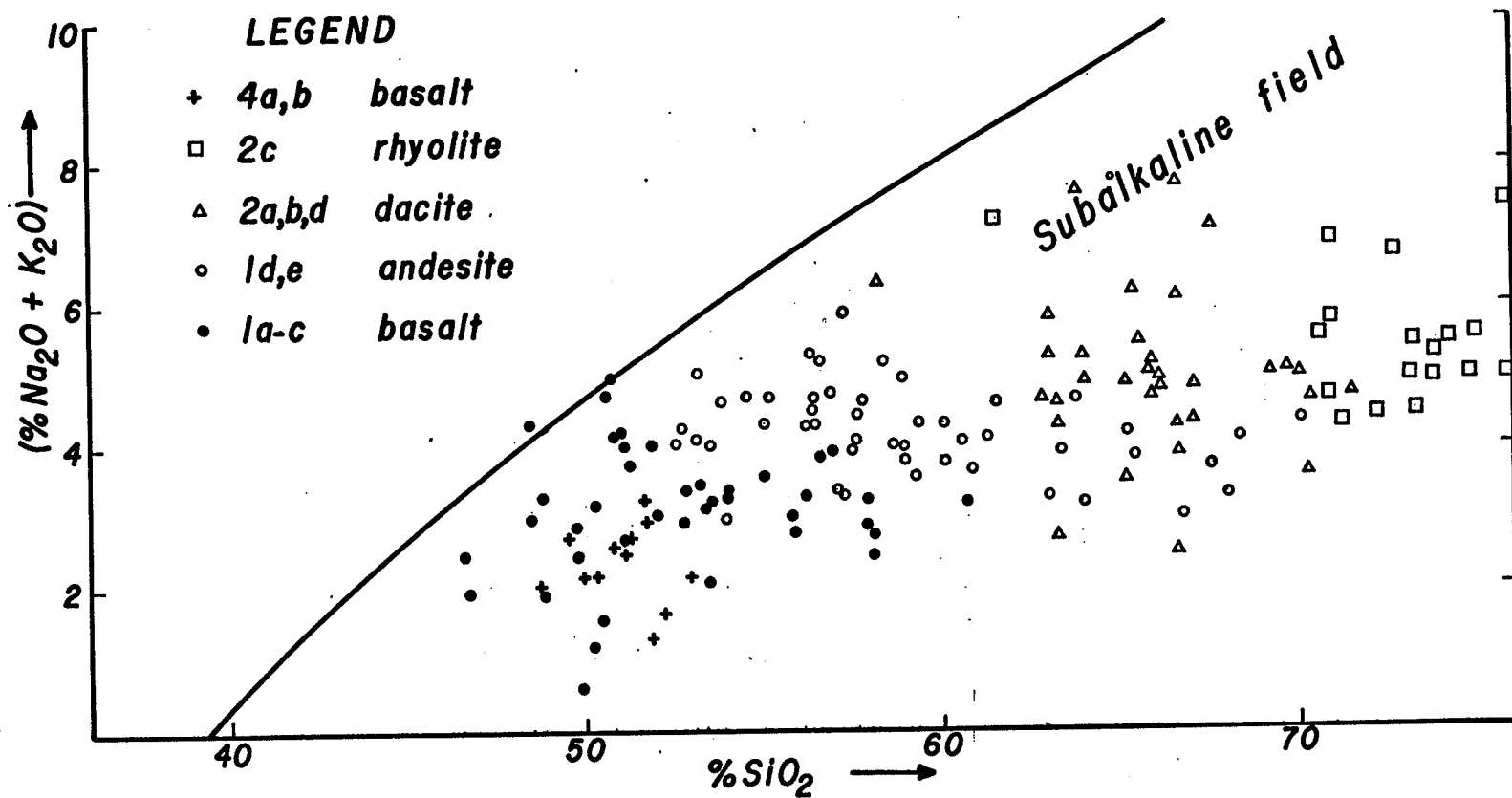


FIGURE 12

AFM DIAGRAM

APPLIED TO SAMPLES OF FOX MINE METAVOLCANIC ROCKS
(Field boundaries from Irvine and Baragar, 1971)

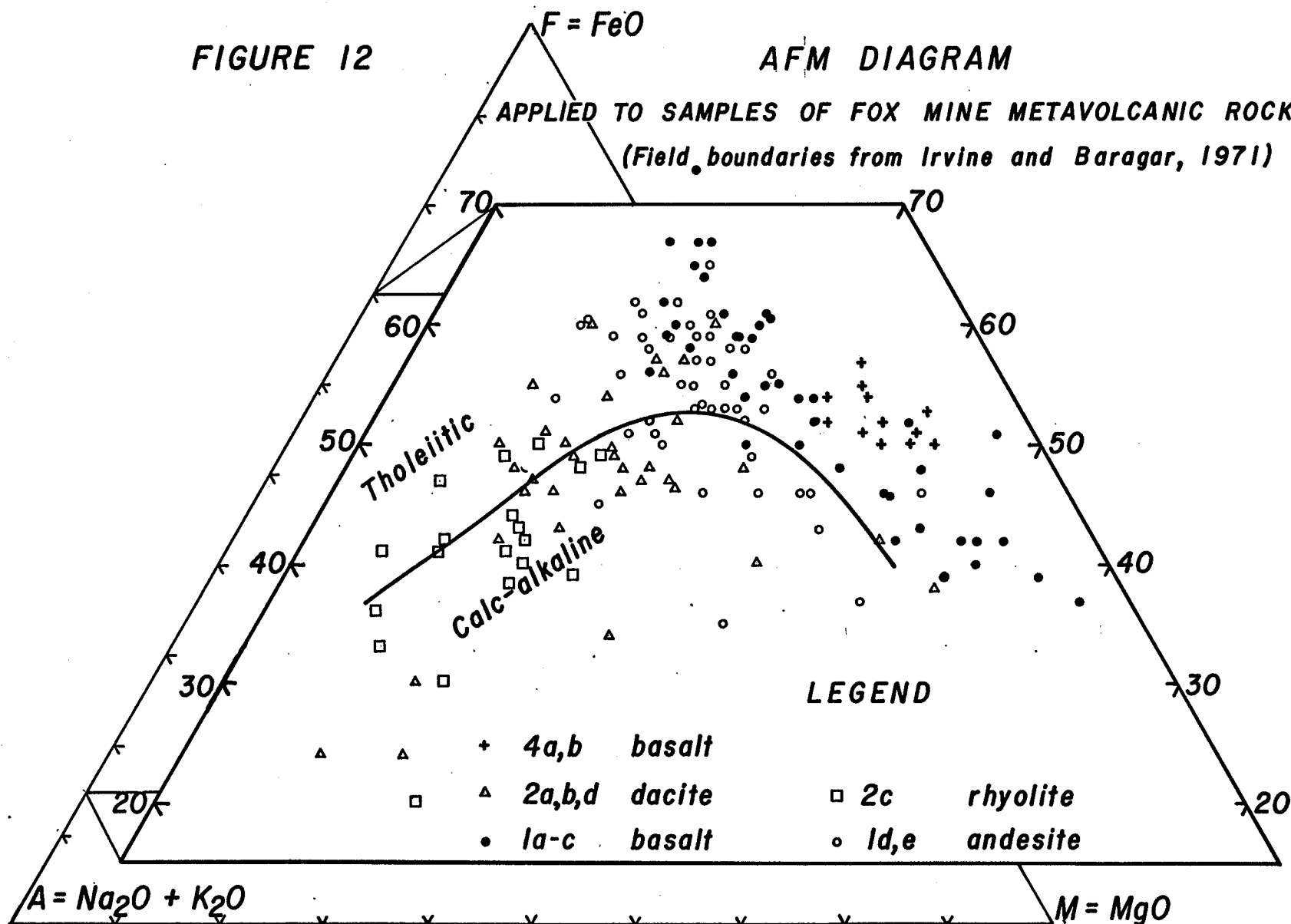
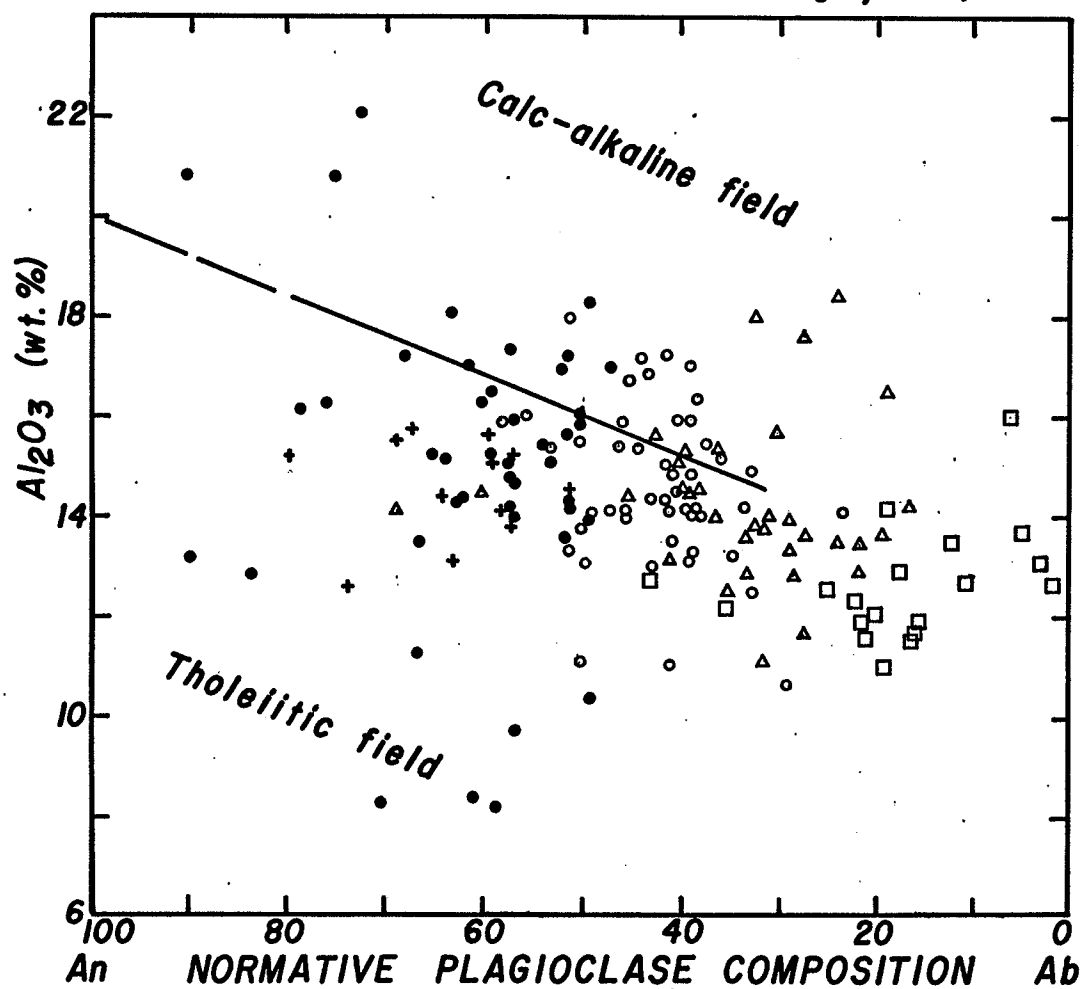


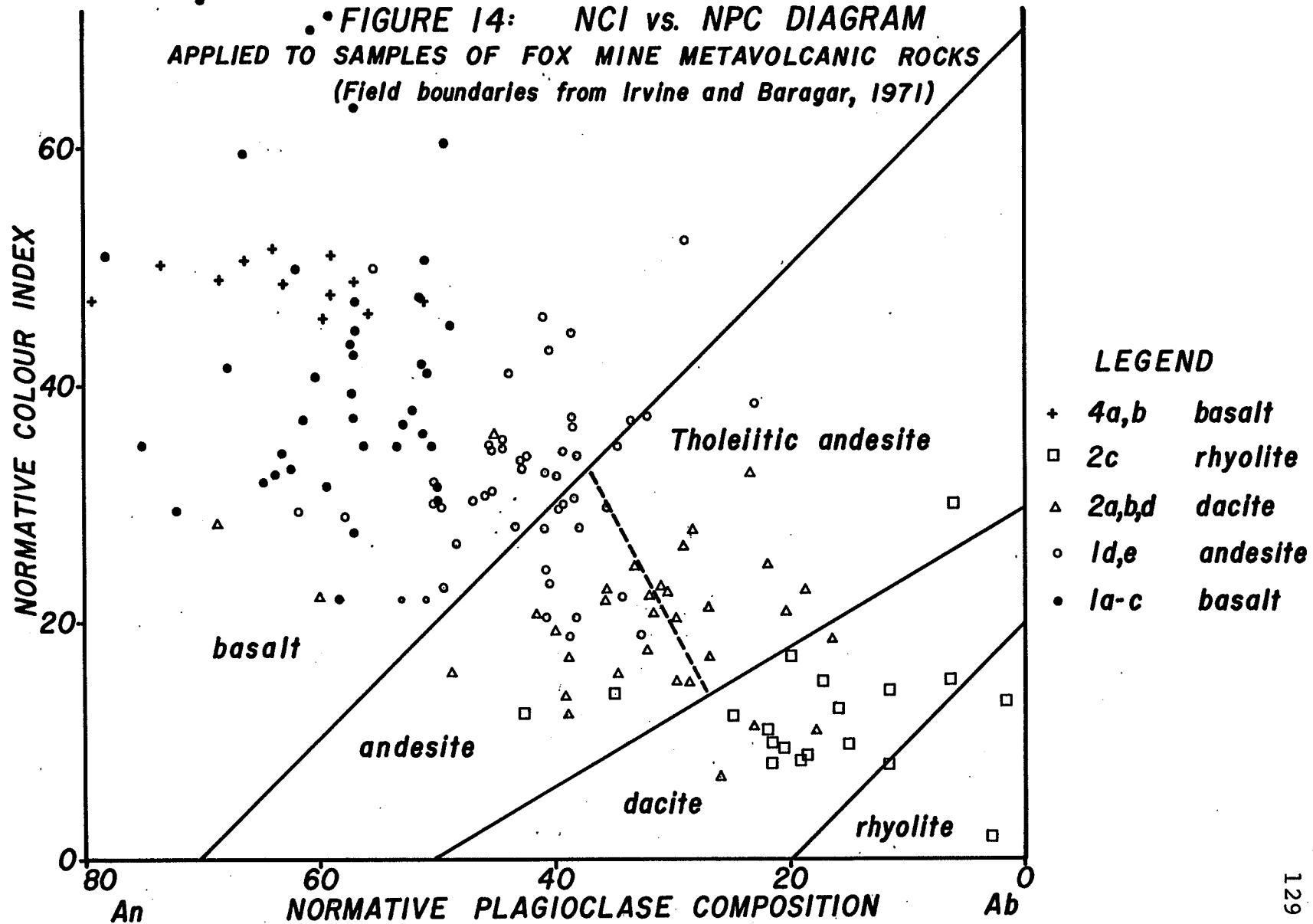
FIGURE 13: Al_2O_3 vs. NPC DIAGRAM
APPLIED TO SAMPLES OF FOX MINE METAVOLCANIC ROCKS
(Field boundaries from Irvine and Baragar, 1971)

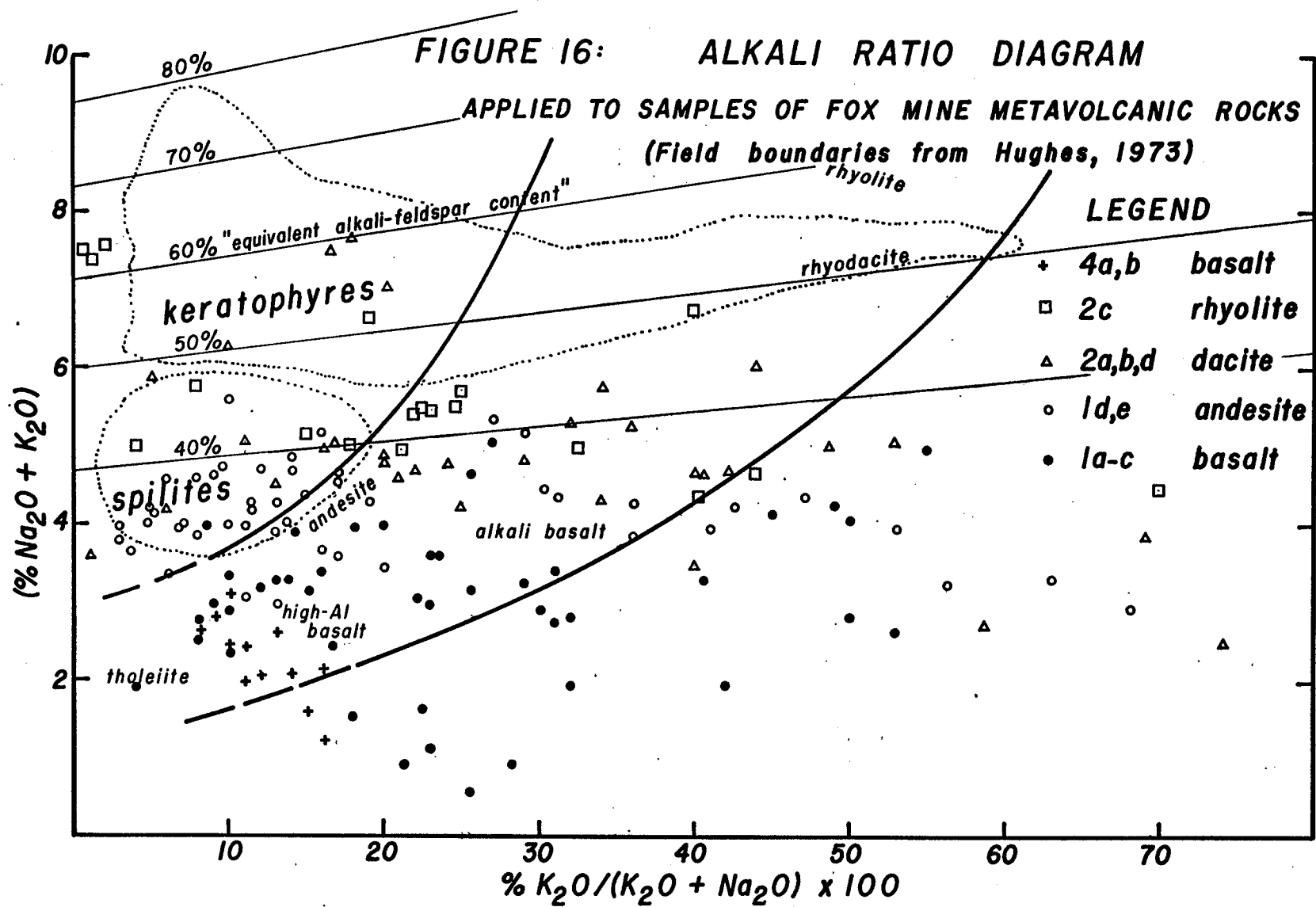


LEGEND

- + 4a,b basalt
- 2c rhyolite
- △ 2a,b,d dacite
- 1d,e andesite
- 1a-c basalt

FIGURE 14: NCI vs. NPC DIAGRAM
APPLIED TO SAMPLES OF FOX MINE METAVOLCANIC ROCKS
(Field boundaries from Irvine and Baragar, 1971)





Two altered dacites from FS-28 and an altered andesite from FS-35 plot amidst the tholeiitic basalts. The incongruous locations of these samples reflect their low sodium contents.

7.2.3 Alumina versus NPC Diagram

Figure 13 is a plot of alumina content (weight % Al_2O_3) versus normative plagioclase composition for the metavolcanic rock samples of the Fox Mine area. The field boundary separating the calc-alkaline and tholeiitic fields is from Irvine and Baragar (1971). Similar to the AFM diagram, rhyolites and dacites on the Al_2O_3 vs. NPC diagram straddle the field boundary. Unlike the AFM diagram, andesites and basalts show a similar spread. Several samples of andesite and basalt have alumina contents (16 to 18%) more typical of the calc-alkaline series. The dichotomy of values indicates a tholeiitic basalt - calc-alkaline series association.

7.2.4 NCI versus NPC Diagram

The Fox Mine metavolcanic rocks have been subdivided into basalts, andesites, dacites and rhyolites on a normative colour index versus normative plagioclase content diagram (Fig. 14). Normative mineral compositions used in the creation of this diagram reflect oxide contents in weight percent. Field boundaries are from Irvine and Baragar (1971) and apply to subalkaline volcanic rocks.

Recast and plotted as a function of normative mineralogy, Fox Mine samples fall within compositional fields that differ

from those established by field mapping. Rocks described in the field or in core as rhyolites, dacites and andesites plot within the normative compositional domains of dacites, andesites and basalts, respectively. A recognized shortcoming of this diagram is the dependency of the normative plagioclase composition on Na_2O which is sensitive to the effects of hydrothermal alteration. Visibly altered samples from FS-28 described in core as dacites plot within the basalt field on the NCI vs. NPC diagram.

7.2.5 An-Ab'-Or Diagram

The An-Ab'-Or diagram is a ternary plot of the normative feldspar content projected through albite. With field boundaries from Irvine and Baragar (1971), this diagram is used to distinguish K-poor, "average" and K-rich volcanic suites. The Fox Mine samples projected onto this diagram (Fig. 15) are widely scattered and occur within all three subdivisions. Sample density is highest along the An-Ab' tieline, indicating the predominance of the K-poor or sodic series.

Samples projecting onto the K-rich field include basalts from the upper part of Unit 1 and visibly altered dacites along strike from the orebody. The dependence of this diagram on sodium content makes it sensitive to changes imposed by hydrothermal alteration.

7.2.6 Alkali Ratio Diagram

The Fox Mine metavolcanic rock samples are plotted on an alkali ratio diagram (Fig. 16). This diagram is used to dis-

tinguish hydrothermally altered volcanic rocks from unaltered "normal" volcanic rocks. The spilite and keratophyre fields and normal volcanic rock boundaries are from Hughes (1973).

Approximately half (78/160) the samples fall within the normal volcanic rock envelope or igneous spectrum. Few correlate with compositional fields indicated by surface mapping and core logging. Of the Fox Mine samples that plot outside the normal igneous spectrum, 44 lie above the normal rock envelope and 38 fall below it. The former group fall within the spilite and keratophyre field boundaries and suggest enrichment in Na_2O . The latter group includes the visibly altered dacites from FS-28 and the altered andesite from FS-35. These samples show an apparent enrichment in K_2O or a depletion of Na_2O .

7.3 TRACE ELEMENT INVESTIGATIONS

The use of immobile and trace elements in classifying volcanic rocks has been advocated by some authors to overcome the problems associated with major element mobility (Floyd and Winchester, 1975; Winchester and Floyd, 1977). Immobile minor and trace element contents have been used to establish suite associations and to classify rock types in a variety of volcanic terrains (Frater, 1983; Holm et al., 1985; Greenough and Papezik, 1985).

The universality of trace element immobility has been questioned by several authors (Humphris and Thompson, 1978; Finlow-Bates and Stumpfl, 1983; Kalogeropoulos, 1983; Ludden

et al., 1983). Results of their studies indicate all trace elements are mobile given the right physical conditions.

Classification of the Fox Mine metavolcanic rocks was attempted using supposedly immobile trace elements. Whole rock analyses for 201 Fox Mine rock samples had complementary analyses for six trace elements including chromium, rubidium, strontium, yttrium, zirconium and niobium. These analyses (listed in Appendix III in parts per million) are the first five elements in the fifth row (Rb, Sr, Y, Zr & Nb) and the sixth in the fourth row (Cr) of the periodic table. Of these six elements, rubidium and strontium are deemed to be relatively mobile because they possess similar ionic radii and charges, and substitute for potassium and calcium, respectively. By implied mobility, these elements have been precluded from immobile trace element studies. Fluctuations in chromium content correspond to rock type changes recognized in core, but a satisfactory classification mechanism using chromium was not apparent. Combinations of the remaining three trace elements plus titania (weight % oxide) were used in a trace element classification of the Fox Mine metavolcanic rocks.

7.3.1 Zr/TiO₂ versus Nb/Y Diagram

Classification of the Fox Mine metavolcanic rocks using trace element ratios is given in Figure 17. Field boundaries are from Floyd and Winchester (1978). On this diagram, TiO₂, zirconium, yttrium and niobium (all in ppm) are plotted as

ratios on logarithmic scales.

Few samples occur within the compositional domains indicated by the major element classification and field mapping. Over half (49/80) plot within the alkali basalt domain. None plot in the rhyolite field. Rock samples logged as rhyolite plot as dacite or trachyandesite. Dacites plot as andesites and alkali basalts. Andesites plot as subalkaline and alkali basalts.

The poor correlation between the field and trace element classification suggests either totally erroneous field subdivisions or trace element mobility. Rock samples showing the worst correlation contain both visible alteration and anomalously low trace element contents and indicate trace element mobility. The diagram suggests at least some mobility of both zirconium and yttrium.

7.3.2 TiO_2 versus Zr Diagram (logarithmic)

Figure 18 is a logarithmic plot of TiO_2 (weight percent oxide) versus zirconium (in ppm). Field boundaries are from Pearce (1980). This diagram is used to distinguish arc lavas and within plate lavas.

Most Fox Mine metavolcanic rocks fall within the arc lavas domain, but a significant number possess anomalously low Zr contents and plot along the ordinate. Petrographic studies indicate these rock samples are altered. The low zirconium contents are interpreted as evidence of mobility.

7.3.3 TiO_2 versus Zr Diagram

Figure 19 is a plot of TiO_2 (wt. %) versus Zr (in ppm) using linear scales. This diagram amplifies the anomalously low zirconium values in altered samples described in the preceding sub-section. In addition, trends shown in this diagram suggest limited titanium mobility in some rock types, particularly the andesites and basalts.

7.4 GEOCHEMICAL SUMMARY

Field mapping indicated that mafic metavolcanic rocks with subordinate intermediate and felsic metavolcanic rocks constitute over 90% of the Fox Mine stratigraphic section. Ambiguities in the position of the ore horizon within stratigraphy indicated further refinements to the field classification of metavolcanic rocks were warranted. A chemical classification following the procedures of Irvine and Baragar (1971) was performed on 160 metavolcanic rock samples from the Fox Mine area to test and/or refine field subdivisions.

Diagrams in the preceding sections indicate the Fox Mine metavolcanic rocks include sodic or K-poor series basalts, andesites, dacites and rhyolites of calc-alkaline and tholeiitic suite association. Sample locations within the compositional fields of these diagrams show a wide range of values. Broad compositional fields reflect the high proportion of breccias within the volcanic pile and/or incipient hydrothermal alteration. The chemical classification results in a more mafic suite of metavolcanic rocks than was indicated by

field mapping. Its dependence on the Na_2O content in normative feldspars and hence its sensitivity to hydrothermal alteration compromises the integrity of this classification.

The existence of alkali metasomatism is evident on the alkali ratio plot (Fig. 17). This diagram suggests local enrichments (spilitization) and depletions (primary alteration zone).

Attempts to classify the metavolcanic rocks using trace elements proved untenable. Several trace elements (notably yttrium and zirconium) were demonstrably mobile. Trends illustrated on the trace element diagrams suggested TiO_2 was one of the more immobile constituents in most Fox Mine metavolcanic rocks.

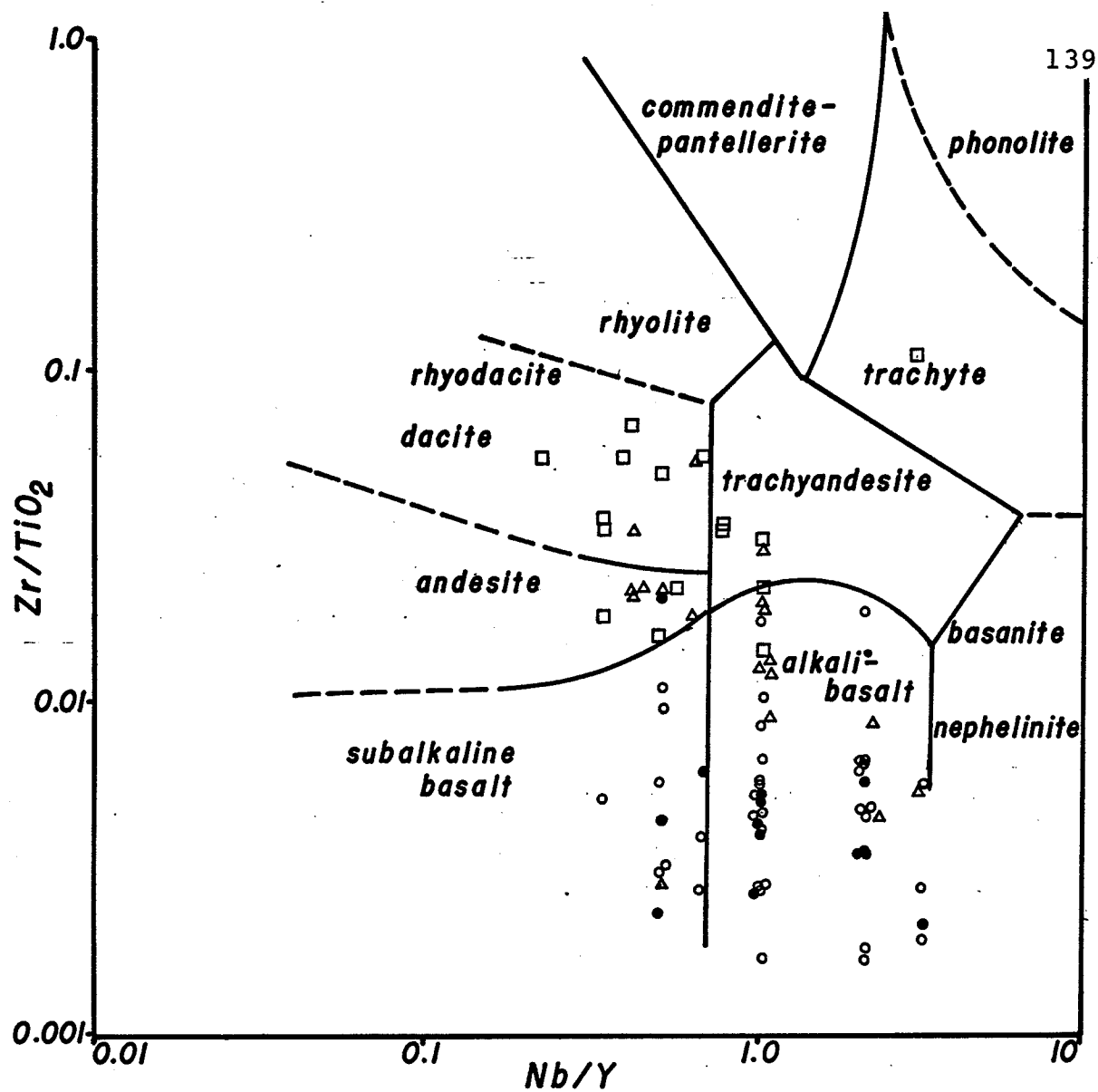


FIGURE 17: (Zr/TiO₂) vs. (Nb/Y) DIAGRAM

APPLIED TO SAMPLES OF FOX MINE METAVOLCANIC ROCKS
(Field boundaries from Floyd and Winchester, 1978)

LEGEND

- | | | | | |
|----|--------|--------|---|----------|
| na | 4a,b | basalt | | |
| △ | 2a,b,d | dacite | □ | 2c |
| | | | | rhyolite |
| • | 1a-c | basalt | ○ | 1d,e |
| | | | | andesite |

na = not available

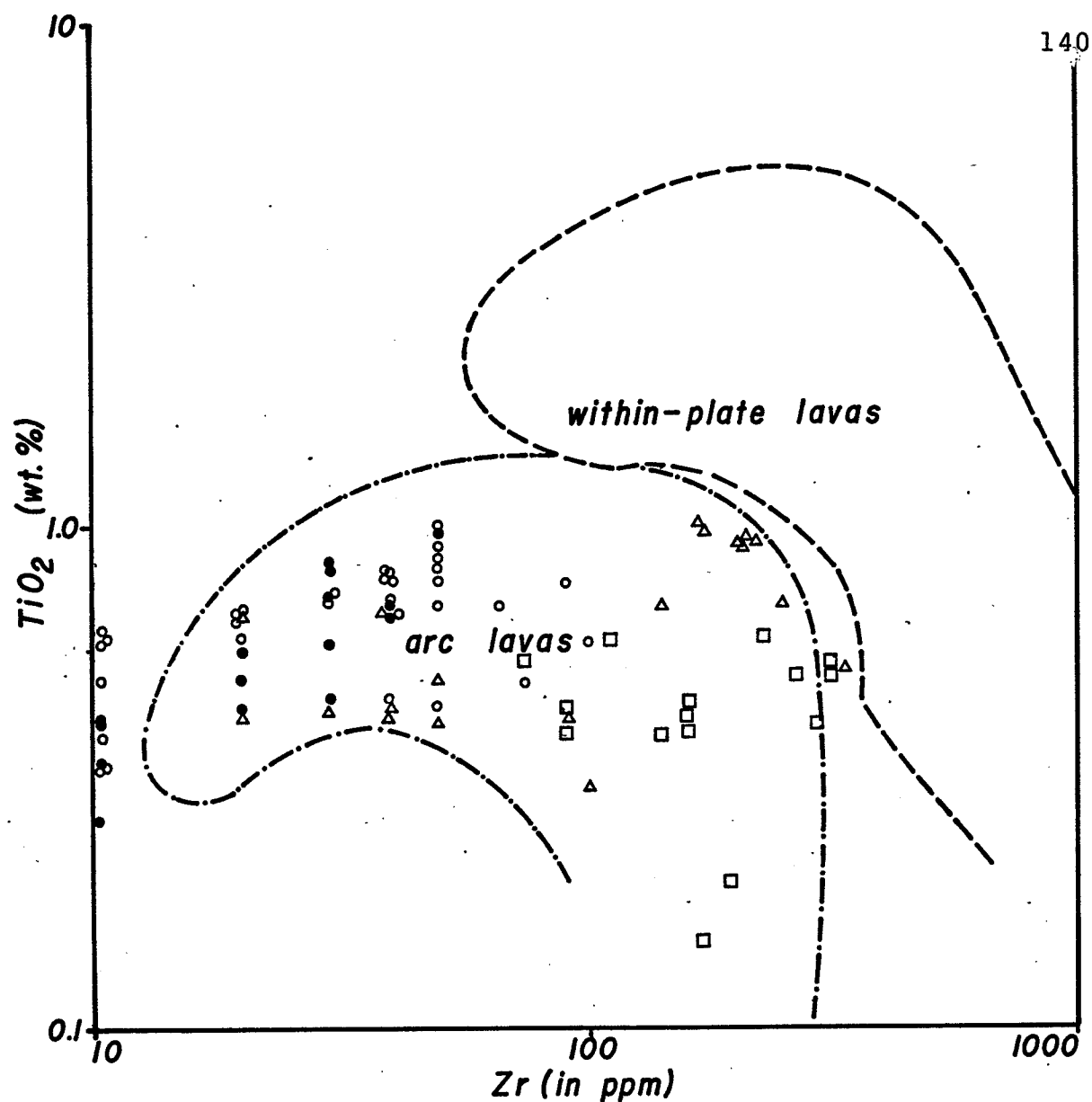


FIGURE 18: TiO_2 /Zr LOGARITHMIC DIAGRAM
APPLIED TO SAMPLES OF FOX MINE METAVOLCANIC ROCKS
 (Field boundaries from Pearce, 1980)

LEGEND

- | | | | | |
|--------------------|--------|--------|---|---------------|
| na | 4a,b | basalt | | |
| Δ | 2a,b,d | dacite | □ | 2c rhyolite |
| • | 1a-c | basalt | ○ | 1d,e andesite |
| na = not available | | | | |

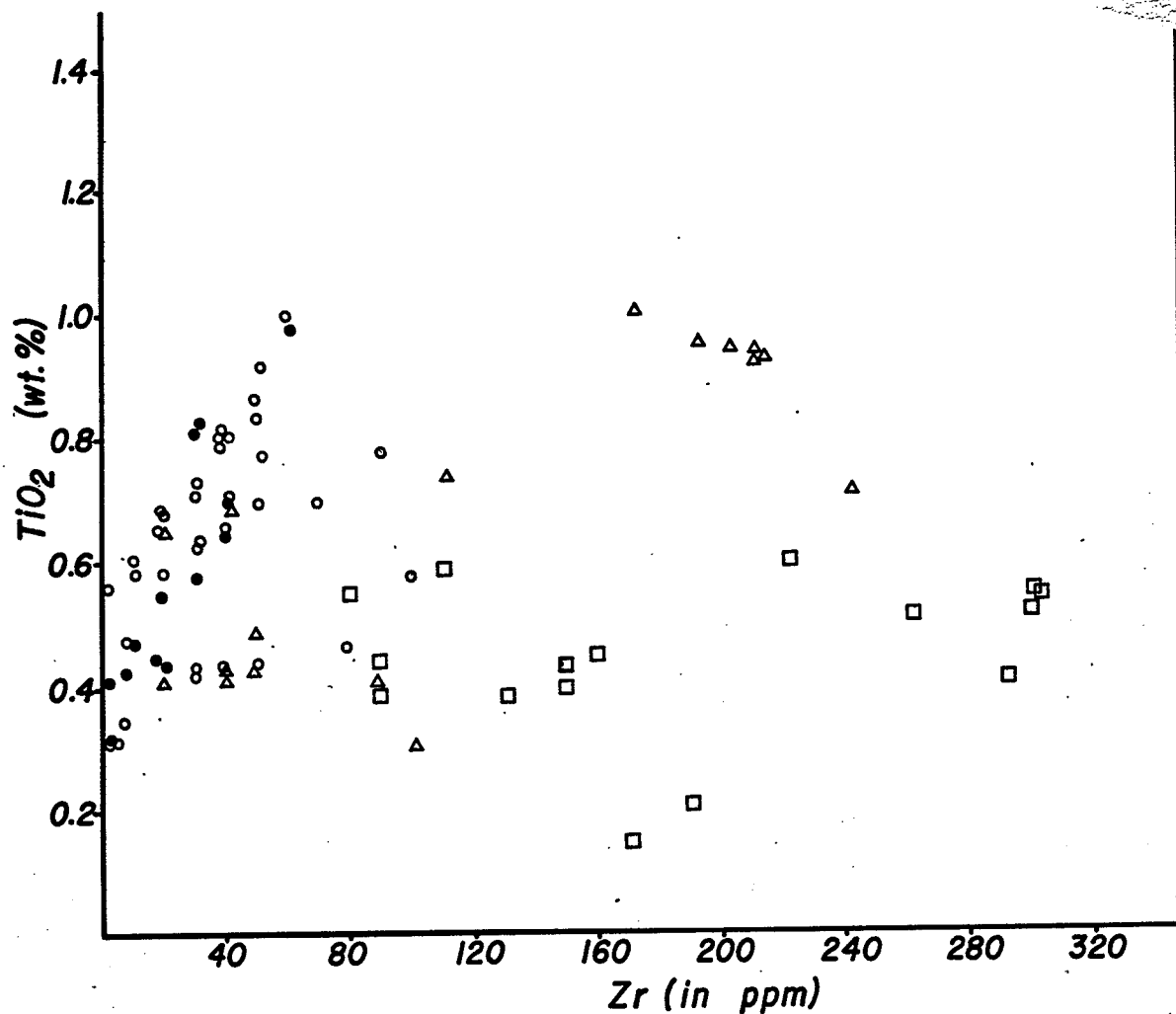


FIGURE 19: TiO_2 /Zr DIAGRAM
APPLIED TO SAMPLES OF FOX MINE METAVOLCANIC ROCKS

LEGEND

- na 4a,b basalt
- 2c rhyolite
- △ 2a,b,d dacite
- 1d,e andesite
- 1a-c basalt
- na = not available

CHAPTER VIII

DISCUSSION AND CONCLUSIONS

8.1 DISCUSSION

The Fox Mine area occurs within the Churchill Structural Province and is situated on the more southerly of two meta-volcanic belts that constitute the Lynn Lake Greenstone Belt (Gilbert et al., 1980). This study has shown that the rock types within the map area are predominantly metavolcanic and metavolcaniclastic rocks of the Wasekwan Group and that a thin, in-faulted sliver of arkosic meta-sandstone is the sole representative of the Sickle Group. The lithological distribution within the map area has been modified by late faulting superimposed on an early phase of folding. Deformational processes resulted in local repetitions of some strata and the juxtaposition of different segments of the stratigraphic sequence.

Significant departures from the stratigraphic sequence as established by Gilbert et al. (1980), were prompted upon recognition of the structural style. Facing directions from pillow structures and the laws of superposition indicate the porphyritic mafic metavolcanics (informally known as the Fox Lake porphyritic basalt) are the lowermost rock unit in the map area. The porphyritic basalts represent a thick accumulation of pillowed flows and breccias and constitute a platformal sequence. They are interpreted to be part of an ancient shield volcano (Gilbert et al., 1980).

In the previous interpretation of the Fox Mine area (Gilbert et al., 1980), the orebody was continuous with a thin felsic metavolcanic belt that was contained within a north-facing sequence of porphyritic to aphyric basalts and andesites, informally known as the Fox Mine succession. This interpretation also had a thick belt of felsic metavolcanic rocks (Snake Lake dacites) separating the Fox Mine succession from the basal porphyritic mafic metavolcanics (Fox Lake basalts).

Evidence presented in this study indicates that the geologic setting of the orebody is much more complicated and that the stratigraphy is different to that interpreted previously. The aphyric/porphyritic basalts and andesites of the Fox Mine succession lie directly upon the porphyritic basalts (Fox Lake basalts). They constitute an intermediate step in the transition from mafic to felsic volcanism. The basalt and andesites are overlain by extrusive rocks of rhyolitic and dacitic composition (the Snake Lake dacites). The felsic rocks outcrop in three separate locations within the map area, but constitute a single unit that has been segmented by late faulting.

The felsic metavolcanic rocks (Unit 2) are overlain by the metasedimentary rocks (Unit 3). The deposition of feldspathic siltstones and mudstones is coincident with the termination of economic sulfide deposition. These rock types are encountered only on the west side of the orebody, where they

occupy fault-juxtaposed limbs of an early tight fold. The D3 fault trace and F1 fold axial trace are essentially coplanar.

Rock types encountered in the northern portion of the map area include metasedimentary rocks (Unit 3), aphyric metavolcanic rocks (Unit 4 - informally known as the Tod Lake basalt) and the sliver of Sickie Group arkosic metasandstone (Unit 5). The Hatchet Lake shear zone is coincident with the southern contact of the arkosic metasandstone divides the map area into two lithostructural domains. The amount of movement on this shear zone is unknown.

Metamorphism in the Fox Mine area twice reached amphibolite grade conditions. The first metamorphic episode was related to early folding. The second was related to a period of shearing and faulting, during which the main foliation developed. Local overprinting of the shear foliation (S_2) by faulted related, retrogressive mineral assemblages was observed. Amphibolite grade metamorphism is implied for all rock types in the study area and especially those for which the prefix meta- has been omitted.

Evidence presented in this study indicates that the Fox Lake massive sulfide deposit is hosted by the felsic metavolcanic rocks. It occurs on the south-facing overturned limb of an early tight to isoclinal fold structure. Cross-cutting alteration stockworks stratigraphically underlying the massive sulfide lenses are zoned with coarse mica schist cores and quartz-biotite gneiss (with sericite) peripheries. These

rock types are altered and reconstituted felsic flow rocks.

Initial interpretations of the Fox Lake massive sulfide orebody concluded it was an epigenetic hydrothermal deposit modified by subsequent metamorphic events (Glass, 1972; Obinna, 1974; Turek et al., 1976). Lustig (1979) pointed out similarities between the Fox orebody and other volcanogenic massive sulfide deposits. This association was restated by other authors (Gale et al., 1980; Gale, 1983). A volcanogenic massive sulfide origin is consistent with the results of this study.

The alteration envelope associated with the Fox Lake deposit is laterally continuous for approximately 1500 meters to the east and west of the ore limits. The eastward continuation of the alteration zone involves a facies change with a thin zone of banded iron formation (subunit 2f) occurring in the same stratigraphic position as the massive sulfides at the mine. This iron formation is truncated by felsic intrusions 3000 meters east of the orebody. A westward continuation of the ore horizon and alteration zone is obscured by accumulations of feldspathic siltstones and mudstones (subunits 3a-b).

The Fox Lake massive sulfide deposit is morphologically, mineralogically and chemically similar to volcanogenic massive sulfide deposits described elsewhere (Franklin et al., 1979). The massive sulfides of the Fox orebody are interpreted to be the products of chemical precipitation from hy-

drothermal exhalations debouched onto a Proterozoic seafloor. This activity was coincident with felsic volcanism. The sulfides were deposited during an intervening period of volcanic quiescence. Deposition of siltstones and mudstones was coincident with the termination of sulfide deposition. Volcanism in the area progressed from mafic (Unit 1) to felsic (Unit 2). It was interrupted by a period of sedimentation (Unit 3) and then reverted back to mafic volcanism (Unit 4).

The Fox orebody comprises two stratiform massive sulfide lenses. Although the original shapes of these bodies are not known, subsequent deformations have certainly resulted in extension along strike and down dip. Flattening and attenuation of the Fox orebody and alteration zone have resulted in a thin sheet- or blanket-like deposit. Sulfides are laterally transitional into oxides and 3000 meters along the strike projection to both the east and west, no evidence exists of either sulfide deposition or attendant alteration. Similar alteration is encountered in Unit 2e, on the north-facing limb of the segmented fold.

The hydrothermal system responsible for sulfide precipitation produced ferromagnesian enrichments and alkali depletions in underlying stockwork and lateral 'sheet-like' alteration zones. These haloes are an order of magnitude larger than the orebody and represent better exploration targets.

8.2 CONCLUSIONS

Investigations of the stratigraphy, structure and

geochemistry of the Fox Mine area have led to the following conclusions:

1. The Fox orebody is a Proterozoic volcanogenic massive sulfide deposit.
2. The deposit comprises two discrete massive sulfide lenses, each with its own stockwork zone.
3. The massive sulfide lenses are stratiform with stringer sulfides in the underlying stockwork zone. Ore lenses show conventional metal zonation with zinc sulfides lying stratigraphically above copper sulfides.
4. Massive sulfide deposition was contemporaneous with a period of felsic volcanism that occurred between two episodes of intermediate volcanism.
5. The massive sulfide ores are laterally transitional into banded iron formation.
6. The massive sulfide lenses are south-facing and occur on the overturned north limb of an early isoclinal fold.
7. The early fold (F1) was flattened and subsequently segmented by late faults (D3), resulting in the juxtaposition of different parts of the stratigraphic sequence.
8. The Wasekwan Group aphyric mafic metavolcanic rocks (Unit 4) and the Sickle Group arkosic metasandstone are from a different depositional environment and have been introduced into the Fox Mine stratigraphy by faulting.
9. Volcanism in the Fox Mine area was subalkaline, of

the K-poor tholeiitic and calc-alkaline suites and included basalts, andesites, dacites and minor rhyolites.

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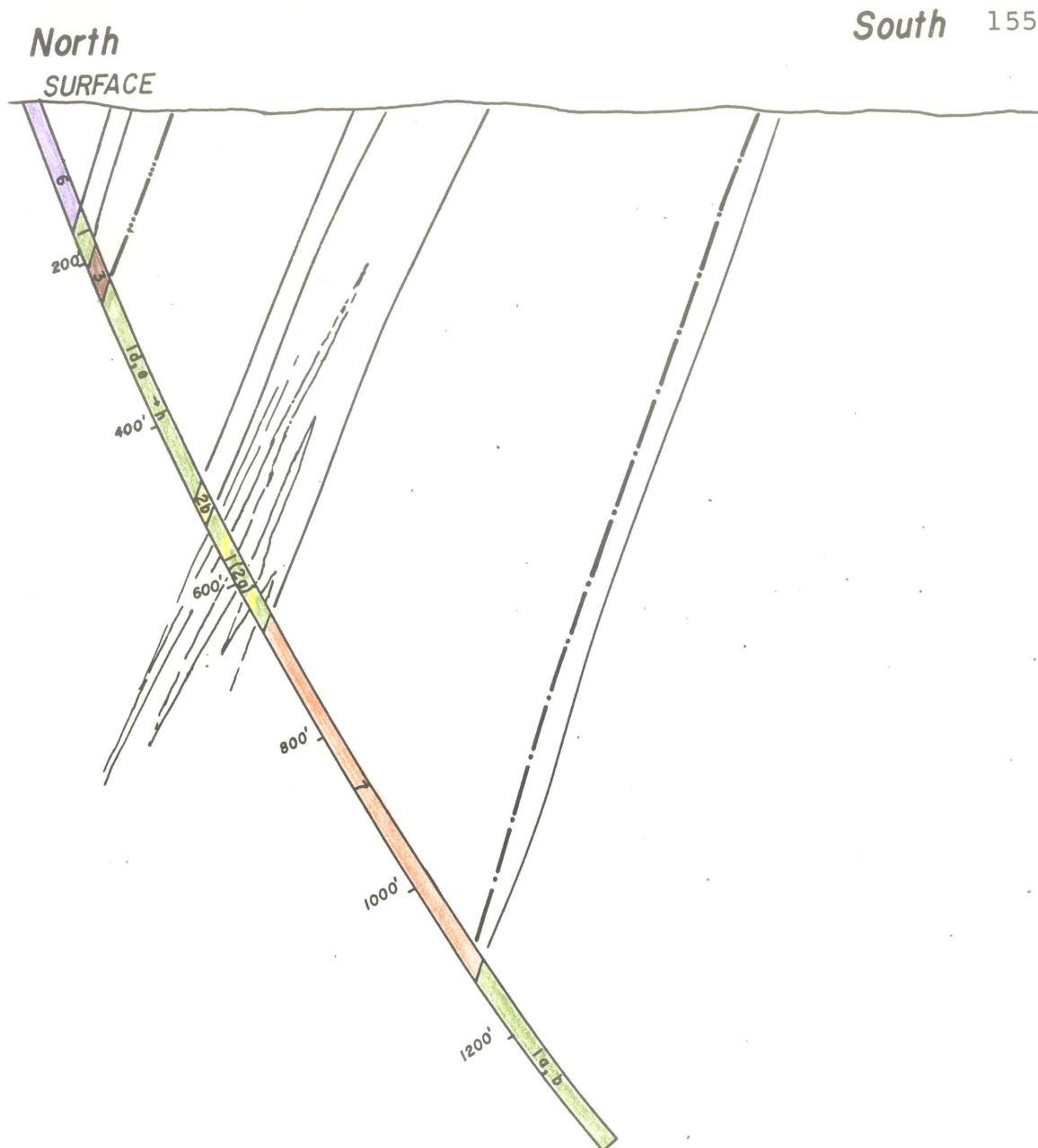
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APPENDIX I

DIAMOND DRILL HOLES
PLOTTED IN CROSS SECTION

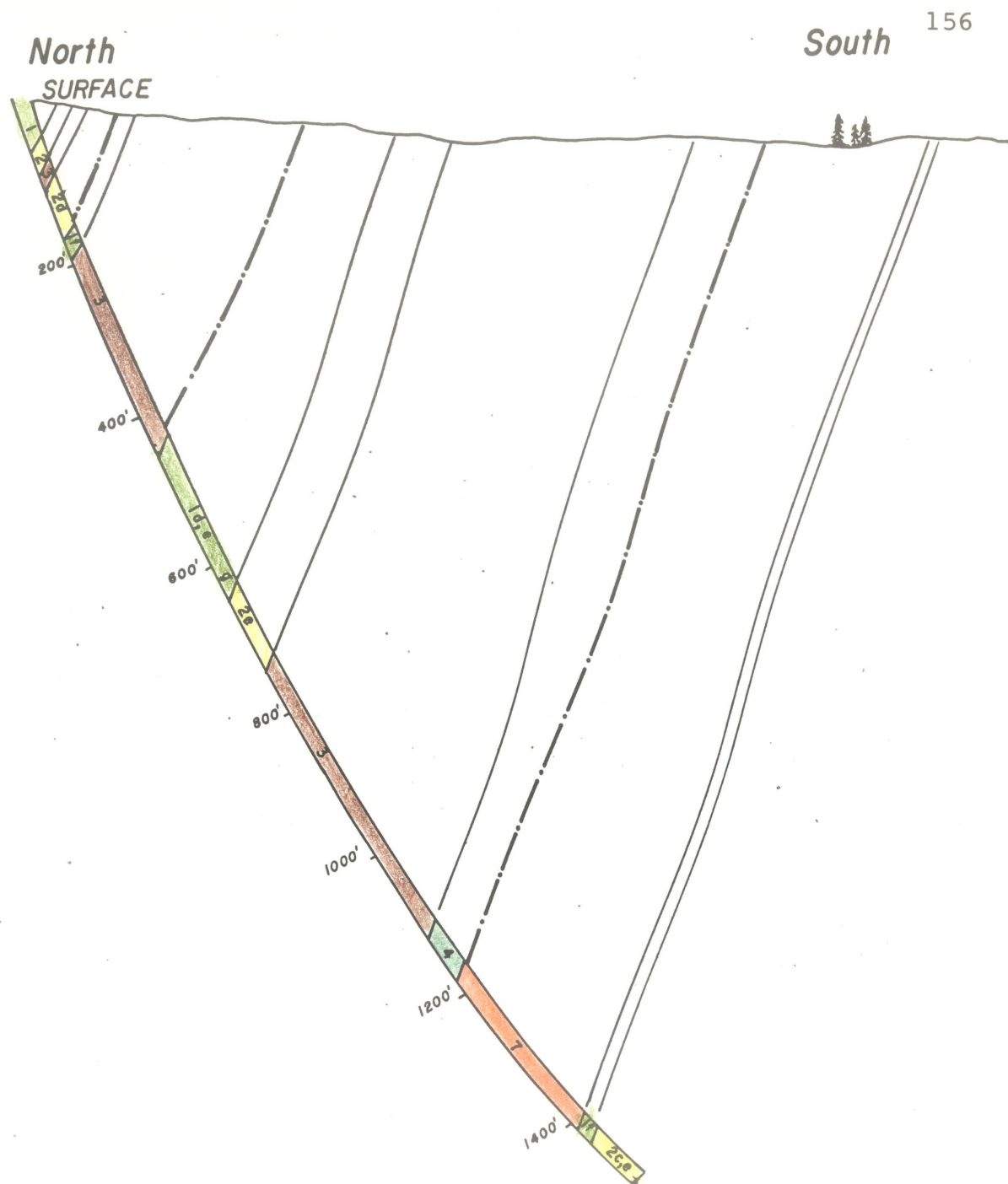


DIAMOND DRILL HOLE FS-23

Collar co-ordinates - 74,030 E x 9,460 N

Strike - N 180° E Dip - 075° S Scale - 1 inch = 200 feet

Rock code at end of appendix.

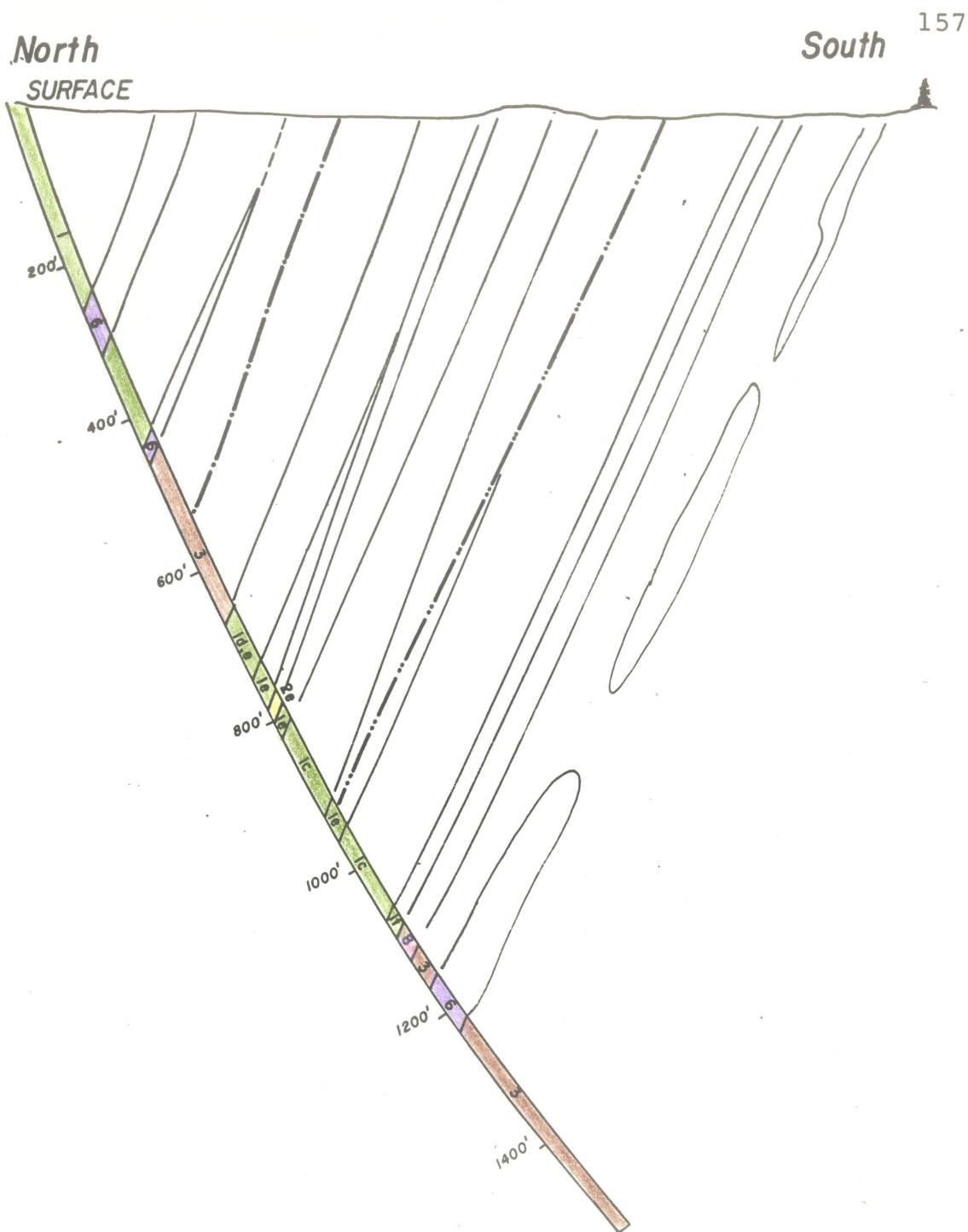


DIAMOND DRILL HOLE FS-28

Collar co-ordinates - 69,000E x 10,600N

Strike - N 180°E Dip - 075°S Scale - 1 inch = 200 feet

Rock code at end of appendix.

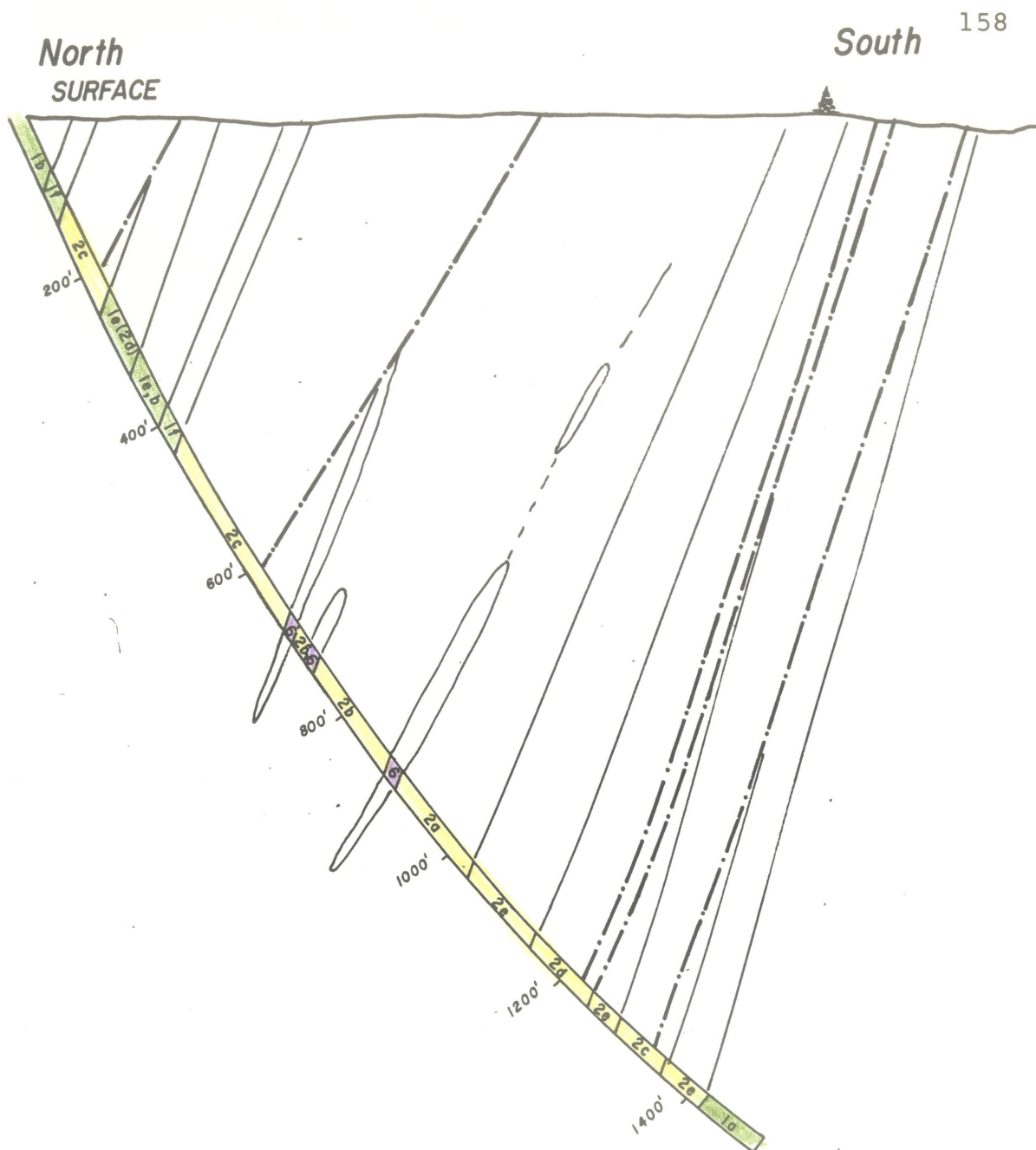


DIAMOND DRILL HOLE FS-29

Collar co-ordinates - 68,000E x 10,800N

Strike - N 180°E Dip - 070°S Scale - 1 inch = 200 feet

Rock code at end of appendix.

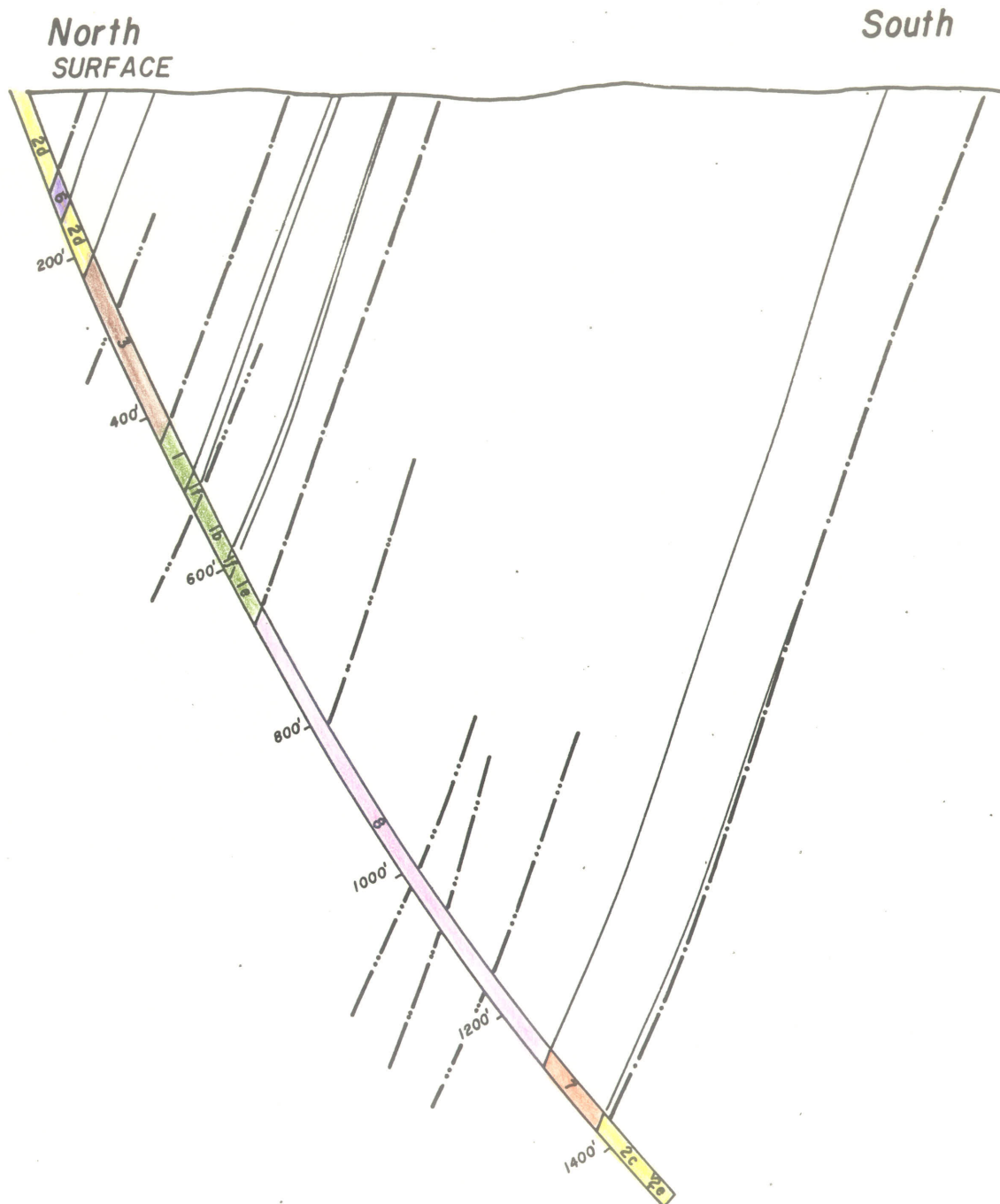


DIAMOND DRILL HOLE FS-33

Collar co-ordinates - 69,600 E x 8,000 N

Strike - N 180° E Dip - 070° S Scale - 1 inch = 200 feet

Rock code at end of appendix.

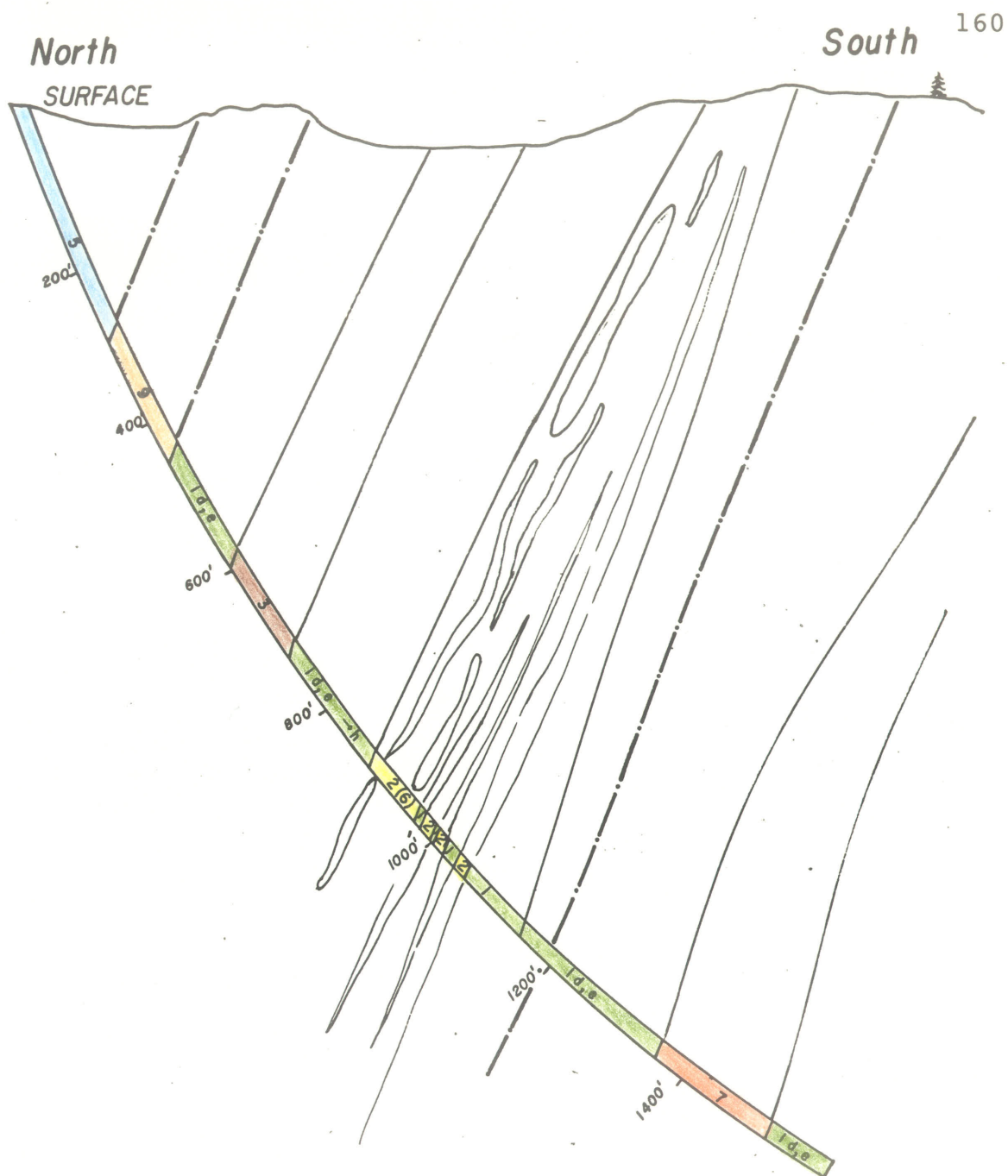


DIAMOND DRILL HOLE FS-34

Collar co-ordinates - 67,600E x 9,600N

Strike - N 180°E Dip - 075° S Scale - 1 inch = 200 feet

Rock code at end of appendix.

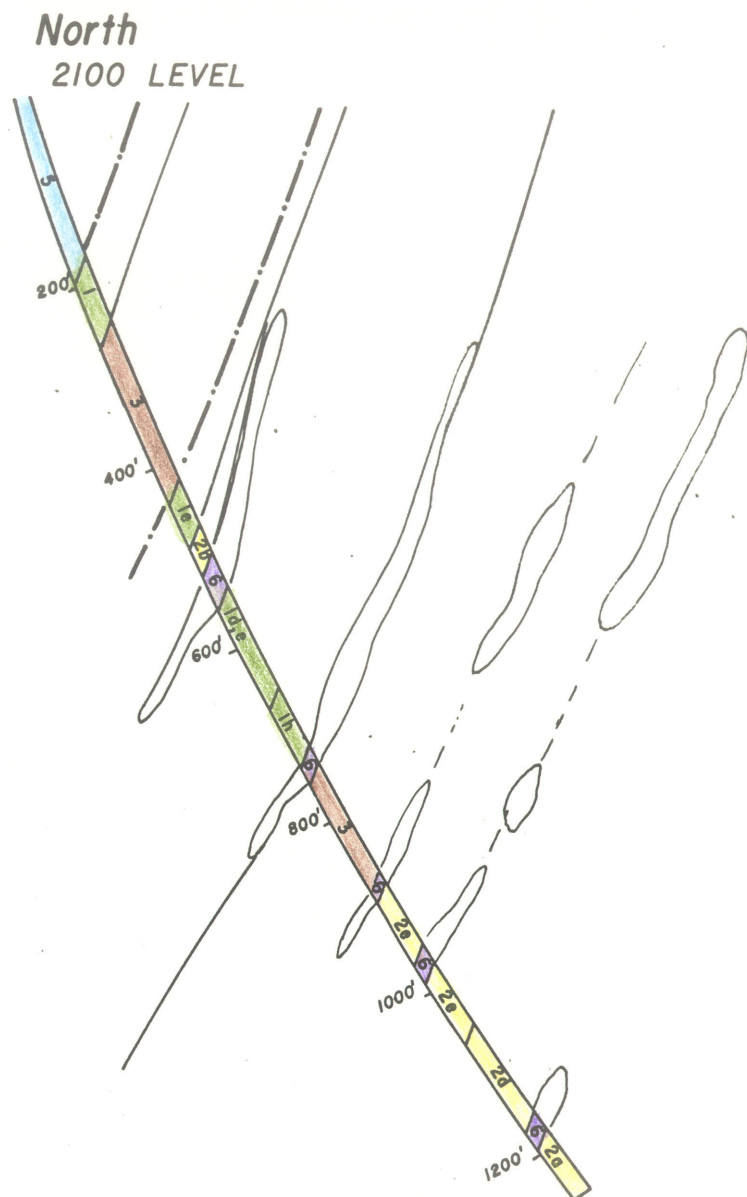


DIAMOND DRILL HOLE FS-35

Collar co-ordinates - 72,600E x 10,000N

Strike - N 180°E Dip - 070°S Scale - 1 inch = 200 feet

Rock code at end of appendix.

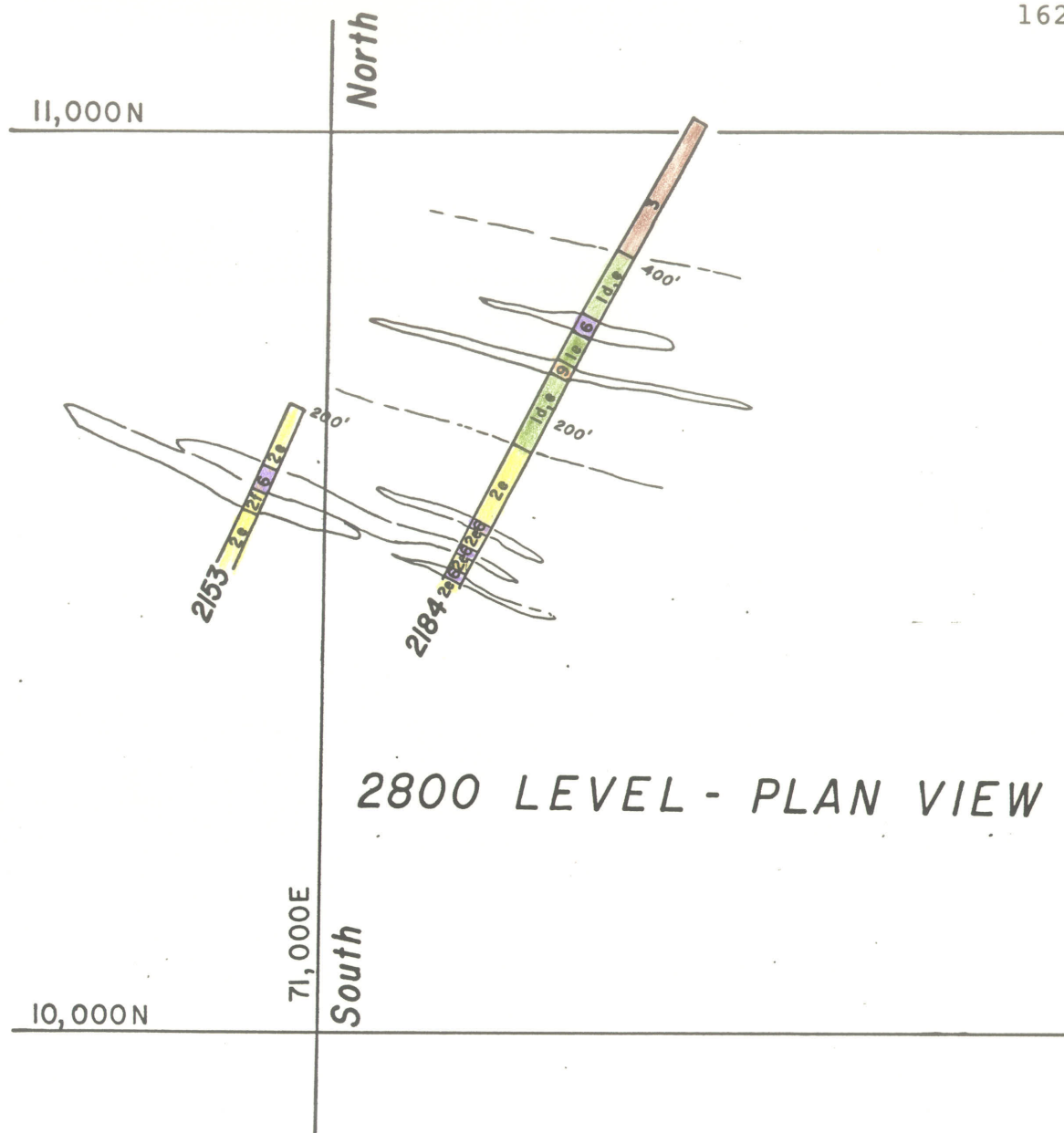


DIAMOND DRILL HOLE UF-1911

Collar co-ordinates - 70,382E x 11,420N

Strike - N208°E Dip- 076°S Scale- 1 inch = 200 feet

Rock code at end of appendix.



DIAMOND DRILL HOLE UF-2153

Collar co-ordinates- 70,883E x 10,511N

Strike - N025°E Dip - 0°N Scale - 1 inch = 200 feet

DIAMOND DRILL HOLE UF-2184

Collar co-ordinates - 71,128E x 10,505N

Strike - N027°E Dip - 0°N

Rock code at end of appendix.

ROCK CODE LEGEND

PRECAMBRIAN (APHEBIAN)

INTRUSIVE ROCKS

- 9 biotite granite
- 8 hornblende tonalite, quartz diorite
- 7 quartz-eye porphyry
- 6 gabbro, diabase

SICKLE SERIES

- 5 arkosic meta-sandstone

WASEKWAN SERIES

- 4 APHYRIC MAFIC METAVOLCANIC ROCKS
4a massive basalt; 4b pillowed basalt
- 3 METASEDIMENTARY ROCKS
3a feldspathic mudstone; 3b feldspathic siltstone; 3c felsic tuff
- 2 FELSIC METAVOLCANIC ROCKS
2a massive porphyritic dacite; 2b massive dacite; 2c massive porphyritic rhyolite; 2d dacitic tuff; 2e altered dacite; 2f sulfides
- 1 PORPHYRITIC MAFIC METAVOLCANIC ROCKS
1a massive basalt; 1b pillowed basalt; 1c aphyric basalt; 1d aphyric andesite; 1e autoclastic breccia; 1f iron formation; 1g volcanoclastic and derived sedimentary rock; 1h altered porphyritic mafic metavolcanic rock

SYMBOLS

- Geological contact (defined, approximate)
- .-.-.-.- Fault (defined, approximate)
- ↕ ↗ ↘ Axial trace of anticline (normal, overturned)
- * * * Axial trace of syncline (normal, overturned)

APPENDIX II

WHOLE ROCK ANALYSES
OF SELECTED FOX MINE ROCK SAMPLES

DETERMINATIONS AND LIMITS
(as given by X-ray Assay Laboratories)

UNITS	METHOD	DETECTION LIMITS
SiO ₂ %	XRF	0.010
Al ₂ O ₃ %	XRF	0.010
CaO %	XRF	0.010
MgO %	XRF	0.010
Na ₂ O %	XRF	0.010
K ₂ O %	XRF	0.010
Fe ₂ O ₃ %	XRF	0.010
MnO %	XRF	0.010
TiO ₂ %	XRF	0.010
P ₂ O ₅ %	XRF	0.010

and LOI equals loss on ignition.

INSTRUMENT STABILITY (PRECISION)
(10 replicate analyses)

	Mean (%)	SD (%)	Mean (%)	SD (%)
SiO ₂	39.5	0.06	65.1	0.07
Al ₂ O ₃	2.92	0.01	18.8	0.03
CaO	1.20	0.005	0.01	0.005
MgO	34.8	0.08	0.01	0.005
Na ₂ O	0.13	0.01	2.56	0.03
K ₂ O	0.02	0.005	12.9	0.02
Fe ₂ O ₃	8.52	0.015	0.12	0.005
MnO	0.13	0.00	0.00	0.00
TiO ₂	0.12	0.005	0.03	0.00
P ₂ O ₅	0.04	0.00	0.02	0.00

*Note: Mean is the arithmetic mean.
SD is the standard deviation.

WHOLE ROCK ANALYSES

FTG.	CODE	SiO ₂	Al ₂ O ₃	CaO	MgO	Na ₂ O	K ₂ O	Fe ₂ O ₃	MnO	TiO ₂	P ₂ O ₅	LOI	SUM
-----DIAMOND DRILL HOLE FS-23-----													
15	9	70.4	13.7	1.98	0.39	6.98	0.21	3.14	0.03	0.36	0.07	0.85	98.2
40	6	52.3	14.5	5.94	4.87	4.08	1.16	14.8	0.11	1.10	0.10	0.31	99.2
66	6	49.6	13.6	8.59	3.35	3.95	0.75	15.1	0.18	2.65	0.26	1.08	99.1
88	6	46.1	13.6	9.11	5.74	2.27	0.84	19.0	0.22	2.71	0.08	0.31	100.1
102	6	48.8	16.2	8.60	6.11	3.75	0.32	13.1	0.17	1.18	0.12	0.54	98.9
123	6	52.6	16.4	6.22	5.30	4.83	1.01	11.4	0.13	0.82	0.08	0.47	99.3
148	1d	58.3	16.3	4.75	3.05	5.20	0.43	9.05	0.12	0.68	0.07	0.23	98.2
164	1d	57.5	14.2	7.03	4.38	3.01	0.43	10.4	0.16	0.72	0.07	0.54	98.4
185	3	74.6	12.7	1.72	0.24	6.55	0.20	1.08	0.02	0.25	0.02	1.08	98.5
219	5c	84.3	7.61	1.32	0.20	3.51	0.67	0.90	0.02	0.17	0.02	1.00	99.7
235	1d	54.7	14.8	3.87	6.43	3.54	0.86	12.1	0.20	0.63	0.03	0.96	98.2
237	1d	56.0	15.5	7.66	3.42	4.19	1.11	8.40	0.15	0.74	0.02	1.93	99.1
257	1d	52.6	16.9	5.32	5.68	4.12	0.92	11.0	0.17	0.76	0.03	0.77	98.3
285	1d	55.8	14.4	6.12	3.58	2.98	0.70	13.3	0.19	1.29	0.21	1.08	99.7
300	1c	49.7	14.6	6.43	7.48	3.04	0.42	15.2	0.18	1.28	0.14	0.93	99.4
362	1d	54.6	17.3	6.36	4.17	2.77	2.10	9.15	0.10	0.62	0.06	1.85	99.0
390	1d	53.3	13.8	10.8	1.96	2.76	1.53	8.23	0.14	0.43	0.05	5.00	98.1
490	1h	58.4	13.7	2.43	7.14	1.75	2.05	9.49	0.15	0.43	0.06	2.77	98.4
512	2d	66.2	12.2	4.26	1.41	6.44	0.26	5.60	0.10	0.47	0.12	1.47	98.5
522	1c	44.9	14.7	10.2	7.64	2.90	1.46	12.1	0.22	0.90	0.08	3.62	98.7
572	2d	62.7	13.3	4.48	1.90	4.78	0.58	8.71	0.16	0.48	0.16	1.00	98.3
580	1c	46.4	16.1	11.8	5.72	2.16	1.91	12.4	0.24	0.41	0.02	3.00	100.2
618	1e	58.3	12.5	6.11	3.13	5.27	0.30	10.5	0.18	0.42	0.10	1.47	98.3

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
645	7	67.5	13.9	3.65	1.48	3.20	2.08	5.07	0.07	0.34	0.06	1.31	98.7
998	7	66.9	13.9	3.38	1.48	3.69	1.83	5.16	0.08	0.32	0.06	1.31	98.1
1112	1e	51.1	17.5	5.61	5.27	2.86	1.96	12.2	0.13	0.59	0.06	1.00	98.4
1128	1b	51.6	10.8	6.49	10.2	1.80	1.96	12.4	0.22	0.90	0.16	1.54	98.1
1160	1b	52.3	12.4	6.38	8.87	3.87	0.72	11.6	0.23	1.02	0.18	1.00	98.5
1184	1b	51.6	10.6	7.09	11.8	2.56	0.49	12.0	0.25	0.77	0.15	1.16	98.5
1210	1b	47.7	10.0	7.56	14.9	1.82	0.31	12.9	0.23	0.71	0.14	2.47	98.8
1230	1b	48.5	15.8	6.58	7.06	4.23	0.80	11.6	0.21	0.54	0.08	2.77	98.2
1262	1h	44.1	9.33	3.18	24.0	0.34	0.04	11.9	0.17	0.55	0.14	5.00	98.7
1340	1g	51.9	12.4	11.0	7.58	3.37	0.78	9.62	0.23	0.78	0.15	1.62	99.4

-----DIAMOND DRILL HOLE FS-28-----

18	1d	51.9	17.1	5.32	5.73	4.01	1.03	11.9	0.16	0.97	0.09	1.15	99.3
38	1h	44.6	12.0	7.25	17.4	0.75	0.32	10.6	0.17	0.58	0.18	3.85	97.8
62	3a	62.3	15.2	4.22	2.39	1.23	2.63	9.44	0.14	0.68	0.15	0.77	99.2
78	3a	62.2	15.0	5.84	2.51	3.14	0.69	7.88	0.13	0.50	0.13	1.00	99.1
107	3a	60.9	17.1	7.69	1.73	2.39	0.67	6.57	0.13	0.65	0.07	1.00	98.9
132	3b	55.0	15.5	11.2	2.37	2.69	0.47	7.77	0.19	0.59	0.07	3.31	99.1
188	3b	54.8	15.2	10.4	4.18	2.36	0.52	9.16	0.18	0.76	0.08	2.08	99.7
221	3b	59.7	13.8	9.17	1.38	3.66	0.79	3.80	0.13	0.71	0.09	4.92	98.1
239	3a	59.9	14.6	6.32	2.13	4.30	1.20	7.38	0.12	0.53	0.12	0.54	97.1
287	3c	68.1	12.2	2.76	1.55	2.62	1.54	6.55	0.09	0.49	0.13	1.62	97.7
319	3a	65.6	14.1	2.20	1.61	3.83	2.29	6.39	0.08	0.71	0.19	0.85	97.9
334	3b	56.3	14.9	3.76	3.60	3.81	0.88	12.8	0.21	1.23	0.22	0.92	98.7
363	3b	48.5	17.8	9.61	6.42	2.71	0.47	11.0	0.19	0.83	0.11	0.92	98.6
379	3c	74.1	11.2	3.29	0.86	2.16	1.61	3.33	0.08	0.36	0.10	1.08	98.2

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
406	5b	53.1	17.4	3.59	2.91	4.25	1.83	12.5	0.15	0.83	0.17	0.92	97.6
426	3a	65.4	13.8	4.00	1.37	2.14	1.68	6.98	0.11	0.65	0.13	1.15	97.4
463	1d	56.9	14.9	8.15	2.93	2.33	2.13	7.13	0.13	0.46	0.07	3.23	98.3
510	1d	51.6	16.5	9.01	2.95	2.54	1.17	10.2	0.16	0.60	0.05	2.54	97.4
532	1d	56.2	16.4	3.71	5.32	3.29	0.98	10.7	0.24	0.62	0.09	2.00	99.5
586	2e	64.0	13.5	5.57	1.30	2.20	2.58	5.51	0.10	0.45	0.09	2.62	98.0
612	6	51.7	14.3	8.06	6.71	2.23	0.46	10.7	0.26	0.66	0.06	2.54	97.7
624	6	49.6	14.6	7.15	5.97	2.40	0.66	13.0	0.23	1.23	0.16	2.92	97.9
648	2e	61.9	14.3	4.58	4.79	0.40	2.27	5.70	0.06	0.44	0.08	2.69	97.2
728	3b	56.7	14.9	4.71	2.23	1.75	1.39	12.1	0.19	0.78	0.21	3.46	98.5
789	3b	55.0	15.1	4.87	3.01	2.27	2.19	12.9	0.17	0.80	0.17	1.38	97.8
812	3a	59.5	14.2	3.61	2.04	2.27	2.07	12.6	0.11	0.72	0.15	1.85	99.0
866	3a	60.4	15.1	2.25	2.05	3.22	2.61	10.2	0.10	0.67	0.13	2.15	98.8
888	3a	62.1	14.3	2.47	1.99	3.00	2.09	10.6	0.08	0.55	0.11	2.46	99.8
911	3a	64.1	13.7	2.62	1.69	3.09	1.50	8.92	0.10	0.59	0.10	2.69	99.1
936	3a	63.9	13.2	2.61	2.04	2.89	1.29	9.56	0.10	0.48	0.12	1.23	97.5
978	3a	60.0	15.1	4.52	2.25	1.88	2.67	9.09	0.12	0.77	0.19	0.77	97.4
1003	3c	66.2	13.4	3.70	1.25	2.44	2.31	6.33	0.10	0.49	0.11	1.15	97.5
1038	3a	59.7	15.8	3.21	2.31	4.55	0.87	10.0	0.13	0.72	0.17	0.85	98.3
1091	3a	57.5	15.1	5.69	1.80	1.33	2.38	9.82	0.12	0.65	0.12	2.85	97.4
1117	3c	63.3	12.9	5.94	2.00	2.60	0.56	8.66	0.14	0.44	0.15	2.62	99.3
1134	3b	54.6	15.5	7.29	4.30	3.69	0.51	11.8	0.19	0.80	0.11	0.62	99.3
1181	6	49.0	19.8	7.09	5.14	2.81	2.60	11.7	0.18	0.64	0.10	1.62	100.7
1239	3b	53.4	18.8	4.25	2.59	4.63	2.18	9.21	0.14	0.54	0.13	1.54	97.4
1248	7	66.6	13.9	3.26	1.59	3.87	1.45	4.78	0.11	0.30	0.05	1.46	97.4

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
1263	7	67.6	13.9	2.94	1.47	4.11	1.44	4.21	0.09	0.29	0.06	1.54	97.6
1289	7	69.4	12.8	1.69	2.63	3.11	1.68	4.66	0.05	0.29	0.05	0.69	97.0
1313	7	66.9	14.1	1.88	2.94	3.95	1.87	5.10	0.07	0.29	0.05	1.77	99.0
1333	7	66.9	13.7	3.11	1.76	3.91	1.68	5.10	0.09	0.33	0.06	0.77	97.4
1364	4	50.2	16.3	11.7	6.22	2.77	0.92	8.79	0.17	0.46	0.09	1.46	99.0
1383	7	66.7	14.1	3.45	1.88	3.57	1.61	4.97	0.07	0.33	0.05	0.69	97.4
1407	7	66.6	14.4	3.60	2.06	3.88	1.63	5.63	0.10	0.35	0.06	0.54	98.8
1435	2c	71.4	12.6	3.23	1.04	1.82	2.74	4.61	0.11	0.36	0.08	0.38	98.4
1453	2c	70.8	12.7	2.08	0.95	4.85	0.32	4.69	0.09	0.36	0.08	0.92	97.8
1469	2c	70.3	13.3	2.26	0.69	5.56	0.21	3.81	0.08	0.38	0.08	1.23	97.9

-----DIAMOND DRILL HOLE FS-29-----

38	5	82.5	8.85	0.33	0.63	0.19	2.91	1.42	0.01	0.18	0.02	1.46	98.5
63	1b	52.0	12.9	8.45	7.50	3.19	1.08	9.92	0.20	1.01	0.20	1.54	97.9
107	1b	46.1	12.6	12.8	7.81	2.78	0.43	10.8	0.16	1.05	0.16	2.77	97.5
162	1b	44.8	11.9	14.5	9.42	1.09	1.69	11.3	0.22	0.93	0.15	2.00	98.0
188	1b	48.2	12.1	14.3	6.52	2.67	0.17	10.2	0.19	0.93	0.12	2.85	98.2
210	1h	47.5	10.5	7.48	16.6	1.22	0.37	10.9	0.17	0.72	0.12	1.62	97.2
229	1h	48.0	10.4	5.18	18.1	1.27	0.43	11.6	0.17	0.72	0.13	2.31	98.3
247	6	53.9	14.3	5.04	3.34	2.82	1.83	14.1	0.20	1.76	0.23	0.54	97.9
289	6	49.5	13.7	9.52	7.10	3.17	0.42	12.0	0.19	0.78	0.11	0.69	97.2
312	3b	50.8	13.2	5.89	4.31	2.98	1.10	15.6	0.19	2.14	0.64	1.00	97.8
328	3a	55.7	17.3	5.39	2.70	4.21	2.34	7.47	0.14	0.81	0.38	1.31	97.8
366	3a	59.3	15.1	4.23	2.40	3.37	1.05	10.5	0.15	0.76	0.28	0.38	97.5
391	3c	66.7	12.9	4.81	1.56	0.92	1.80	7.08	0.12	0.54	0.14	1.08	97.7
437	6	51.4	13.9	7.21	6.77	3.19	0.24	13.4	0.19	0.89	0.17	0.46	97.8

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
462	3a	60.7	14.5	4.21	1.82	1.64	1.88	8.95	0.07	0.67	0.14	2.54	97.1
478	3a	58.1	16.0	2.29	1.92	3.85	2.56	10.2	0.07	0.64	0.10	2.08	97.8
524	3a	61.8	15.1	5.09	2.09	2.15	1.63	8.01	0.11	0.71	0.15	1.15	97.9
539	3b	55.5	14.9	4.59	3.97	3.16	0.73	15.6	0.22	1.38	0.19	0.08	100.2
569	3b	48.6	19.7	8.98	4.42	4.24	1.40	8.78	0.14	0.81	0.12	2.54	99.7
599	3a	64.4	15.0	2.50	1.71	3.36	1.81	7.45	0.11	0.65	0.15	0.85	97.9
607	3b	56.9	16.1	1.87	2.21	2.48	2.44	13.1	0.10	0.74	0.12	2.46	98.6
637	3c	67.6	14.4	3.46	1.65	3.23	1.23	6.39	0.07	0.51	0.14	0.69	99.4
696	3a	64.3	14.0	4.22	2.24	1.40	2.72	7.19	0.09	0.48	0.07	1.31	98.0
707	2b	61.9	13.8	6.95	1.50	1.31	1.37	7.92	0.12	0.57	0.09	2.38	97.9
744	1e	55.2	15.6	6.94	2.49	2.29	1.89	10.1	0.13	0.51	0.07	1.92	97.1
787	1c	50.9	14.0	9.85	7.32	2.28	0.23	12.5	0.21	0.81	0.12	0.23	98.4
845	1c	50.0	13.7	10.5	6.99	2.17	0.21	11.8	0.21	0.77	0.11	0.69	97.2
875	1c	51.9	13.8	10.4	6.79	2.45	0.22	12.5	0.22	0.84	0.12	0.77	100.0
942	1e	60.2	15.1	5.28	2.89	3.29	1.31	9.26	0.17	0.75	0.16	0.77	99.1
970	1c	48.9	14.4	9.23	5.89	2.87	0.31	14.9	0.23	1.26	0.22	0.54	98.7
990	1c	50.3	13.8	7.43	6.63	3.03	0.27	14.3	0.23	1.10	0.18	0.46	97.8
1002	6	49.3	18.1	11.2	4.91	2.82	0.22	9.85	0.17	0.70	0.11	0.46	97.8
1006	6	48.6	15.0	8.61	7.61	2.84	0.49	12.9	0.19	0.85	0.13	0.92	98.2
1008	3a	62.4	15.3	3.12	2.46	3.94	1.08	8.97	0.12	0.74	0.16	0.46	98.7
1040	3a	66.0	13.5	2.24	1.75	4.48	0.42	7.89	0.10	0.55	0.10	1.15	98.2
1082	3a	61.0	15.0	3.76	2.25	1.95	2.17	10.8	0.11	0.63	0.14	1.54	99.3
1100	3b	58.1	14.9	4.06	2.26	1.77	2.25	13.0	0.12	0.70	0.15	2.23	99.5
1122	3b	56.9	14.7	3.47	1.75	3.19	1.61	13.2	0.05	0.66	0.10	1.77	97.4
1144	3a	59.0	14.2	4.95	3.14	3.87	0.35	12.5	0.19	1.24	0.27	0.15	100.0

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
1162	6	50.2	14.0	8.54	5.33	3.30	0.31	13.9	0.21	1.28	0.13	0.38	97.5
1215	7	66.6	14.7	2.80	1.86	4.24	1.71	5.19	0.09	0.34	0.06	0.92	98.5
1291	7	68.4	13.7	1.35	3.32	3.83	1.18	5.48	0.08	0.31	0.06	2.15	99.8
1302	3a	63.7	13.5	3.18	2.00	2.38	1.82	9.25	0.10	0.55	0.09	1.15	97.8
1340	3a	64.1	14.9	3.33	1.79	2.93	1.74	9.35	0.11	0.66	0.13	0.85	99.9
1601	3b	59.0	15.7	5.47	1.70	3.26	1.43	8.67	0.11	0.64	0.13	1.54	97.6

-----DIAMOND DRILL HOLE UF-1911-----

42	5	79.1	10.9	0.99	0.86	2.19	1.99	3.41	0.03	0.41	0.10	1.23	101.2
87	5	76.4	12.3	1.25	0.71	2.31	2.80	2.53	0.02	0.28	0.08	1.00	99.7
120	5	78.9	11.9	1.28	0.71	2.17	2.41	2.28	0.02	0.26	0.06	0.92	101.0
127	5	84.5	6.72	0.81	0.40	1.25	1.34	2.97	0.04	0.23	0.05	1.00	99.3
168	5	73.0	12.5	1.11	0.89	2.32	2.52	3.42	0.03	0.38	0.10	0.92	97.2
193	1d	54.8	16.9	7.37	5.33	2.75	0.63	10.8	0.18	0.93	0.10	0.85	100.7
208	1d	52.9	16.0	10.9	4.24	2.30	0.29	9.74	0.20	0.86	0.10	0.31	97.8
245	3a	64.8	15.8	4.24	2.03	5.03	0.29	7.37	0.07	0.70	0.22	0.46	101.0
276	3a	58.1	15.9	5.30	2.86	3.25	1.16	7.74	0.09	0.73	0.21	1.77	97.1
282	3a	59.7	15.4	4.31	2.90	2.48	1.59	11.3	0.16	1.03	0.15	0.62	99.6
317	3b	51.7	13.7	2.03	3.86	4.06	1.16	18.5	0.05	0.52	0.13	2.46	98.2
330	8	57.6	15.6	6.37	6.67	3.98	0.39	6.75	0.08	0.73	0.19	0.54	98.8
342	3b	49.1	2.43	4.77	3.63	0.27	0.26	32.9	0.05	0.14	0.06	4.46	98.1
361	3a	59.5	15.4	2.53	2.05	3.85	2.40	8.81	0.09	0.66	0.12	2.08	97.5
392	3a	57.1	15.8	4.05	3.73	3.73	1.74	9.08	0.12	0.80	0.14	1.15	97.5
443	6	45.6	16.3	8.78	6.68	3.15	0.23	13.9	0.22	1.69	0.16	0.31	97.0
459	1d	58.0	13.7	7.00	4.56	2.68	0.44	7.54	0.13	0.37	0.05	0.77	95.2
492	1c	49.3	16.5	9.14	7.38	3.67	0.19	11.4	0.17	0.91	0.21	0.15	99.1

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
507	1d	55.5	16.8	7.22	5.19	3.63	0.56	9.69	0.17	0.44	0.04	0.31	99.5
543	1e	60.0	14.6	5.21	3.23	3.51	0.45	9.82	0.13	0.59	0.07	0.31	98.0
570	1d	54.4	18.2	7.61	2.82	3.37	0.31	9.75	0.10	0.58	0.08	0.46	97.7
661	1d	59.5	13.4	8.16	1.00	3.04	1.36	6.70	0.18	0.43	0.09	3.38	97.2
694	1h	63.8	15.6	6.13	1.98	3.35	0.57	6.83	0.08	0.50	0.09	0.46	99.4
715	1h	57.8	15.7	6.39	5.28	4.61	0.48	6.34	0.11	0.71	0.19	0.54	98.1
745	2e	65.1	12.8	1.19	3.36	2.49	2.50	7.59	0.02	0.37	0.07	3.46	99.0
769	2e	63.4	13.1	2.87	5.83	1.97	2.01	6.91	0.03	0.36	0.05	1.92	98.5
795	2e	60.5	14.9	1.63	8.40	0.85	0.67	8.79	0.12	0.40	0.06	3.85	100.2
811	2e	61.0	14.6	1.21	6.97	0.95	1.66	8.35	0.08	0.39	0.06	4.38	99.6
825	3b	46.4	10.2	2.49	1.52	2.32	1.08	28.0	0.11	0.56	0.09	5.38	98.2
850	2e	61.4	16.0	3.59	3.08	3.38	0.91	8.40	0.07	0.44	0.07	1.69	99.0
886	2e	64.1	10.6	2.38	7.96	2.99	0.26	7.89	0.04	0.29	0.05	2.23	98.8
920	2e	62.7	13.2	0.40	9.84	0.76	0.97	9.09	0.10	0.35	0.06	1.92	99.4
936	2e	68.1	11.0	0.35	10.0	0.38	0.49	7.34	0.08	0.29	0.05	1.46	99.5
970	6	50.4	15.0	10.7	7.40	2.04	0.25	10.7	0.18	0.72	0.08	0.85	98.3
1019	2e	63.2	16.1	2.26	3.46	1.82	2.04	5.94	0.04	0.41	0.05	3.38	98.7
1043	2e	67.0	14.9	4.93	0.72	2.94	1.40	3.48	0.03	0.39	0.08	1.31	97.2
1073	3a	59.0	14.9	7.49	2.07	2.15	1.26	7.65	0.11	0.55	0.07	2.00	97.2
1094	2b	63.9	14.8	4.81	1.71	3.68	0.66	8.32	0.12	0.49	0.09	0.38	98.9
1124	2b	63.3	13.9	6.73	1.31	1.88	0.76	7.73	0.12	0.49	0.10	1.31	97.7
1146	2b	68.2	13.5	4.54	1.43	2.56	1.16	6.41	0.08	0.49	0.11	0.23	98.8
1167	2b	66.1	12.9	7.14	0.74	3.46	0.59	5.45	0.12	0.44	0.09	0.31	97.4
1186	6	45.5	15.2	11.0	7.62	2.00	0.72	12.6	0.21	1.48	0.14	1.15	97.5
1222	2a	65.6	16.5	2.79	1.44	4.85	1.63	4.86	0.06	0.36	0.06	0.54	98.7

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
1232	2a	64.7	16.2	3.60	1.94	4.63	1.38	3.75	0.05	0.39	0.08	0.54	97.2
1264	2a	66.9	15.9	3.03	1.91	5.56	0.46	3.42	0.06	0.38	0.08	0.46	98.2
1270	6	47.6	13.0	9.33	9.27	2.34	0.45	14.1	0.40	0.48	0.13	0.54	97.6

-----DIAMOND DRILL HOLE UF-2153 (ANALYSED BY CHEMEX LABS)-----

4	2e	62.9	13.6	1.41	4.54	0.55	2.10	10.3	0.05	0.30	0.03	3.95	96.6
20	2e	55.6	13.8	0.71	5.44	0.91	1.76	14.6	0.04	0.33	0.02	6.00	94.8
24	2e	48.1	13.2	2.31	8.87	1.26	0.74	16.5	0.06	0.40	0.03	6.15	92.6
28	6	43.6	16.4	11.7	7.54	0.89	0.91	12.5	0.19	1.28	0.07	3.95	95.3
31	2e	58.6	14.0	2.03	6.90	0.93	1.49	11.0	0.05	0.43	0.03	3.05	94.5
40	2e	59.3	13.6	0.80	7.73	0.50	1.02	9.47	0.05	0.32	0.04	5.40	95.4
50	2e	55.6	13.4	0.57	12.4	0.35	0.48	8.82	0.05	0.33	0.04	6.80	96.2
60	2e	56.5	14.2	0.48	9.70	0.37	1.34	8.82	0.08	0.35	0.04	6.45	96.7
63	2e	56.9	13.6	2.81	4.44	0.62	0.74	12.4	0.12	0.35	0.03	6.50	94.8
66	2e	46.0	11.5	11.2	7.28	0.38	0.33	11.3	0.31	0.32	0.03	6.45	91.7
71	2e	57.5	12.7	3.15	4.69	0.73	1.06	12.5	0.10	0.32	0.03	5.50	94.5
75	2f	23.1	0.76	1.64	0.93	0.03	0.03	47.2	0.04	0.13	0.01	19.8	79.5
80	2f	14.3	0.15	0.52	0.09	0.00	0.01	52.1	0.01	0.02	0.01	26.9	78.4
87	2f	23.1	0.15	0.09	0.09	0.00	0.00	48.0	0.00	0.02	0.01	25.1	82.4
92	2f	14.5	0.19	0.18	0.05	0.00	0.01	52.9	0.00	0.03	0.02	26.5	78.5
94	2f	32.1	1.70	2.31	0.77	0.07	0.01	41.5	0.02	0.07	0.02	17.1	83.2
98	6	50.3	15.1	11.2	7.03	1.71	0.06	10.2	0.20	0.78	0.10	2.05	95.7
105	6	51.3	14.9	10.5	6.91	1.81	0.06	10.5	0.18	0.77	0.10	0.14	94.0
116	6	51.1	14.5	11.3	6.70	2.64	0.10	10.2	0.16	0.73	0.07	1.70	96.1
124	6	53.5	14.0	6.79	8.84	2.20	0.05	8.55	0.26	0.60	0.04	3.10	95.5
127	2e	41.1	13.8	1.51	11.6	0.57	0.39	16.6	0.18	0.32	0.04	7.45	88.6

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
132	2e	48.8	13.0	1.83	7.66	0.87	0.79	13.8	0.13	0.35	0.02	5.10	88.2
137	2e	28.2	9.63	0.78	3.55	0.78	0.97	38.3	0.09	0.28	0.02	10.3	81.4
143	2e	38.5	6.42	0.67	1.94	0.58	0.59	29.5	0.06	0.18	0.01	7.10	76.6
149	6	50.9	16.2	4.85	4.10	3.45	0.95	13.4	0.14	0.52	0.06	2.30	92.9
153	2e	53.0	8.31	0.55	1.49	0.86	0.48	22.0	0.03	0.23	0.02	6.30	86.7
157	2e	49.4	11.1	0.81	8.16	0.61	0.88	15.3	0.08	0.32	0.01	3.95	86.0
162	2e	60.5	8.88	0.67	6.47	0.47	0.32	14.2	0.07	0.27	0.03	2.75	90.3
165	6	56.0	14.7	5.33	5.02	2.47	0.14	13.7	0.17	1.07	0.14	0.90	94.5
167	2e	62.2	9.63	0.36	6.32	0.33	0.52	14.3	0.06	0.23	0.03	2.50	92.2
172	2e	42.6	12.6	2.18	8.47	0.63	0.49	23.7	0.12	0.40	0.03	7.00	91.1
177	2e	36.1	14.2	3.97	9.95	0.95	0.98	23.3	0.08	0.43	0.02	6.95	89.9
182	2e	42.8	10.6	5.33	10.1	1.52	0.29	22.2	0.14	0.42	0.02	5.05	91.8
187	2e	54.5	8.50	4.03	6.75	1.11	0.14	18.7	0.13	0.27	0.02	4.45	93.0
192	2e	50.9	9.26	2.52	6.23	0.82	0.23	20.7	0.10	0.28	0.02	5.95	90.8
195	2e	56.3	10.6	6.97	2.74	0.54	1.17	14.3	0.03	0.32	0.02	5.10	93.8
198	2e	58.0	14.7	13.7	2.07	0.62	0.84	6.41	0.06	0.35	0.05	2.35	97.2
200	2e	56.7	16.2	6.44	2.75	3.37	0.92	10.2	0.03	0.43	0.05	3.60	97.6

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18	1c	50.1	15.4	12.8	4.10	1.03	1.06	11.3	0.21	0.67	0.10	2.08	98.8
40	1c	51.7	16.4	9.44	5.47	3.48	0.44	10.3	0.21	0.61	0.06	0.54	98.7
60	1c	47.1	16.8	11.6	5.83	2.60	1.62	10.7	0.19	0.50	0.06	1.16	98.3
80	1c	54.6	16.6	7.24	4.09	4.41	0.20	10.1	0.15	0.69	0.08	0.62	98.7
100	1c	62.5	12.2	8.71	1.42	1.24	0.46	10.4	0.17	0.60	0.11	0.77	98.6
120	1c	53.9	16.0	8.87	3.87	3.08	0.15	11.1	0.21	0.70	0.10	0.00	98.0
140	1c	50.5	15.7	14.1	4.38	3.05	0.29	8.01	0.22	0.46	0.07	2.85	99.6

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
160	1c	50.1	17.7	11.0	5.08	3.60	0.34	9.99	0.20	0.58	0.05	1.00	99.7
180	1c	47.1	16.8	13.8	5.69	1.92	1.31	9.88	0.22	0.50	0.06	2.15	99.4
200	1c	53.8	17.2	9.25	3.42	4.28	0.25	9.91	0.19	0.76	0.09	0.77	100.0
220	2c	72.8	11.0	2.57	1.68	0.94	2.42	5.75	0.09	0.39	0.05	1.54	99.2
240	2c	74.1	11.3	1.74	1.46	1.19	2.46	5.66	0.07	0.41	0.05	0.85	99.3
260	2c	72.1	11.8	2.23	1.81	1.74	2.23	6.62	0.06	0.43	0.06	0.54	99.6
280	2c	71.2	11.8	1.47	1.53	1.52	2.82	6.63	0.06	0.43	0.06	1.00	98.6
300	2d	64.1	12.7	4.47	2.13	3.09	1.02	8.18	0.14	0.92	0.22	1.93	99.0
320	2d	63.0	13.4	2.51	1.97	3.92	1.35	8.10	0.12	0.93	0.22	1.93	97.4
340	2d	67.8	12.5	1.43	2.71	2.14	2.42	6.76	0.12	0.66	0.12	1.16	97.9
360	1e	54.0	13.8	4.83	6.34	4.12	0.21	12.8	0.20	1.48	0.18	0.31	98.3
380	1e	51.6	14.6	6.06	5.11	3.56	0.40	13.9	0.21	1.53	0.18	0.62	97.8
400	2c	69.9	11.5	2.60	0.86	3.15	1.04	6.80	0.11	0.47	0.06	0.70	97.2
420	2c	69.8	11.5	2.58	1.01	3.05	1.07	6.96	0.12	0.46	0.06	0.70	97.2
440	2c	73.1	11.5	1.24	2.01	3.49	1.54	6.40	0.11	0.43	0.05	0.54	100.3
460	2c	71.9	12.1	1.71	1.23	3.94	1.42	6.43	0.09	0.43	0.05	0.08	99.4
480	2c	73.1	11.4	1.84	0.85	3.87	1.04	5.57	0.09	0.34	0.03	0.15	98.3
500	2c	73.7	11.6	1.35	1.15	4.19	1.26	5.03	0.06	0.33	0.02	0.23	99.0
510	2c	72.8	11.6	1.36	1.02	3.93	1.47	5.25	0.06	0.32	0.02	0.47	98.3
540	2c	69.3	11.7	3.10	1.64	1.93	1.85	5.77	0.10	0.67	0.11	1.00	97.3
580	2c	67.0	12.3	2.52	2.57	2.05	2.10	7.03	0.17	0.68	0.12	1.00	97.5
580	2c	69.3	12.4	1.61	1.88	3.55	1.87	5.88	0.08	0.66	0.12	0.62	98.0
600	2a	67.3	12.5	2.60	2.53	2.66	2.01	6.72	0.12	0.70	0.11	0.70	97.9
620	2a	68.6	11.2	1.88	2.31	2.67	1.82	6.88	0.08	0.76	0.17	0.70	97.1
640	2a	64.0	13.3	3.04	3.21	4.42	0.57	8.31	0.14	0.95	0.17	0.16	98.3

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
660	2a	65.9	12.6	1.75	3.78	2.87	1.41	9.52	0.16	0.90	0.29	0.62	99.8
680	2c	69.6	12.2	1.33	1.56	4.18	1.15	6.31	0.13	0.53	0.07	0.77	97.9
700	2a	67.3	12.5	1.69	1.92	3.35	2.22	6.57	0.13	0.66	0.12	0.62	97.1
720	2a	63.1	13.3	2.34	1.81	4.02	1.66	9.54	0.05	0.62	0.19	0.85	97.5
740	6	50.7	14.1	7.40	5.92	3.27	0.15	14.6	0.26	1.98	0.22	0.16	98.7
760	2c	70.4	10.0	1.20	3.63	1.94	1.21	7.31	0.09	0.43	0.07	0.85	97.2
780	6	55.0	16.1	5.13	4.92	4.61	0.13	9.56	0.13	1.13	0.20	0.77	97.7
800	2a	66.8	12.2	1.86	2.94	3.22	1.16	8.08	0.07	0.55	0.08	0.77	97.7
820	2a	64.6	13.3	1.95	2.21	4.25	1.61	8.65	0.03	0.88	0.20	0.31	98.0
840	6	45.9	16.8	1.83	9.03	2.41	1.33	19.2	0.24	0.32	0.05	2.08	99.1
860	6	46.8	14.4	5.96	6.81	2.01	2.18	16.6	0.24	2.13	0.22	0.62	97.9
880	6	48.3	14.4	5.49	6.55	1.83	2.46	15.8	0.19	2.13	0.26	0.62	98.1
900	6	58.6	13.7	1.96	6.09	2.73	1.88	10.9	0.10	1.15	0.22	0.77	98.1
920	6	63.5	13.0	1.95	2.77	2.83	1.90	10.6	0.16	0.91	0.19	0.47	98.2
940	6	59.0	12.4	4.86	4.22	3.14	0.29	10.9	0.20	1.00	0.66	1.00	99.0
960	6	55.4	14.5	3.74	4.72	5.03	0.39	13.3	0.17	1.17	0.35	0.54	99.4
980	6	51.2	14.2	4.58	5.24	3.75	1.57	14.5	0.15	1.59	0.21	1.16	98.1
1000	6	66.4	11.9	4.00	2.93	3.66	0.32	7.71	0.13	0.91	0.16	0.77	98.9
1020	6	52.3	18.8	3.35	2.41	6.61	1.11	10.8	0.07	0.83	0.14	1.77	98.2
1040	6	50.7	15.1	4.04	5.22	3.11	3.06	13.6	0.16	1.72	0.20	0.85	97.7
1060	6	47.9	16.2	7.16	5.73	3.79	1.24	12.8	0.24	1.75	0.30	0.85	98.0
1080	6	53.2	14.2	6.70	4.36	3.64	0.84	13.1	0.25	1.63	0.22	0.54	98.7
1100	6	53.7	14.2	4.03	5.89	4.02	0.81	13.3	0.20	1.52	0.21	0.47	98.4
1140	6	53.8	14.4	4.91	5.43	4.10	0.79	12.5	0.18	1.55	0.21	0.39	98.2
1160	6	52.2	14.4	5.70	5.17	3.81	0.50	14.8	0.21	1.68	0.23	0.08	98.7

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
1180	6	46.4	15.9	6.96	8.20	2.96	1.66	14.0	0.23	0.61	0.09	1.00	98.0
1200	6	57.3	14.6	3.14	4.04	4.03	1.70	10.4	0.12	0.89	0.21	2.23	98.6
1220	6	55.1	14.2	6.00	4.37	4.30	0.15	12.0	0.18	1.53	0.19	0.54	98.5
1220	6	58.1	13.4	2.91	4.19	3.12	1.28	12.8	0.09	1.08	0.33	0.54	97.8
1240	6	64.8	12.5	3.78	2.57	3.72	0.35	8.77	0.12	0.89	0.19	0.77	98.4
1240	6	47.1	17.7	13.9	9.46	1.11	0.16	6.19	0.10	0.20	0.03	1.31	97.2
1260	2c	69.9	12.3	1.28	1.59	4.23	1.34	5.51	0.04	0.51	0.05	0.85	97.6
1280	2c	69.9	12.0	0.98	1.84	4.14	1.02	6.03	0.06	0.50	0.04	1.00	97.4
1300	2c	69.7	11.7	1.06	1.71	3.77	0.67	7.10	0.09	0.50	0.06	1.00	97.3
1320	2c	70.6	11.6	0.86	1.47	2.87	1.29	7.12	0.08	0.49	0.04	0.70	97.2
1340	2c	68.5	12.9	1.98	1.79	3.84	0.75	6.33	0.15	0.53	0.25	1.23	98.2
1360	2c	71.3	12.1	1.29	1.28	4.37	0.60	5.45	0.15	0.51	0.03	0.85	97.9
1380	2a	65.7	12.2	2.40	2.27	2.50	2.03	8.11	0.05	0.76	0.26	1.62	97.8
1400	2a	64.6	12.6	2.28	2.00	3.68	1.14	9.20	0.08	0.85	0.19	1.08	97.8
1420	2a	64.9	13.3	2.59	2.53	2.00	2.17	7.45	0.25	0.58	0.13	1.70	97.6
1430	2c	70.3	15.9	1.83	0.31	6.23	1.53	1.50	0.04	0.13	0.07	0.39	98.2
1460	2a	64.5	13.1	0.68	2.85	2.10	2.17	10.9	0.27	0.56	0.11	0.47	97.7
1480	2c	69.5	13.2	1.19	1.70	1.47	2.25	7.70	0.20	0.95	0.23	1.00	99.4
1500	2c	69.9	12.0	0.83	1.52	1.23	2.85	7.06	0.17	0.50	0.06	1.16	97.3
1520	2a	67.8	12.6	2.01	1.63	3.17	1.22	7.12	0.15	0.53	0.08	1.62	97.9
1540	2c	74.4	10.2	1.52	1.10	3.06	1.20	4.42	0.08	0.43	0.06	0.47	97.0
1560	2a	62.4	13.6	1.25	2.77	3.03	2.53	10.2	0.29	0.72	0.13	1.23	98.1
1580	2a	66.1	12.5	1.79	2.23	2.55	2.08	7.66	0.18	0.55	0.10	2.00	97.7

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
1600	2c	68.1	12.1	1.81	2.11	3.14	1.56	7.17	0.15	0.51	0.07	1.08	97.8
1620	2c	69.0	12.2	0.85	1.77	4.13	1.37	6.73	0.11	0.53	0.02	1.62	98.0
1630	2c	69.9	11.4	0.37	2.44	0.00	1.98	9.60	0.25	0.51	0.10	1.16	97.7
1660	1c	42.8	18.2	12.1	10.3	1.20	0.42	10.4	0.15	0.22	0.00	1.77	97.5
1670	1c	42.0	12.4	11.3	13.2	0.70	0.19	16.0	0.19	0.68	0.00	1.39	98.2
1700	1c	41.7	15.4	12.0	11.9	1.21	0.35	12.8	0.17	0.12	0.00	2.31	98.1
1720	1c	39.9	19.1	9.76	12.3	1.30	0.44	11.2	0.17	0.07	0.01	3.31	98.1
1740	1c	41.9	14.5	18.6	9.29	0.92	0.28	6.46	0.15	0.19	0.00	5.70	98.0
1760	1c	48.6	14.4	14.6	11.1	0.63	0.10	7.23	0.14	0.25	0.00	1.00	98.1
1780	1c	48.2	15.9	14.2	10.1	1.43	0.28	5.69	0.12	0.19	0.00	1.00	97.2
1800	1c	44.9	22.3	14.0	8.34	1.19	0.32	5.19	0.11	0.12	0.00	0.62	97.1
1820	1c	48.3	11.2	12.1	13.7	1.60	0.20	8.31	0.15	0.59	0.18	1.08	97.4
1840	1c	42.2	19.7	14.1	9.12	1.25	0.81	5.61	0.09	0.13	0.00	4.77	97.8
1860	1c	44.3	20.1	15.9	8.82	0.66	0.26	5.68	0.10	0.11	0.00	1.16	97.2
1880	1c	48.2	12.8	14.8	12.8	0.44	0.15	7.59	0.14	0.24	0.00	0.62	97.9
1900	1c	47.4	13.7	14.9	12.4	0.68	0.26	6.82	0.14	0.21	0.00	1.47	98.0
1920	1c	44.8	16.8	16.8	10.5	0.53	0.19	5.35	0.12	0.11	0.00	2.16	97.3
1960	1c	44.2	18.2	14.2	11.1	1.00	0.54	6.95	0.13	0.15	0.00	0.70	97.2
1980	1c	44.4	21.2	14.0	9.60	1.50	0.18	5.32	0.11	0.08	0.01	0.54	97.0
2000	1c	49.3	14.5	12.6	11.2	2.23	0.12	6.22	0.12	0.21	0.00	0.47	97.1
2020	1c	45.7	22.0	10.1	8.13	3.14	0.89	5.30	0.10	0.12	0.00	1.47	97.0
2040	1c	46.0	13.6	15.3	10.5	1.16	0.16	7.09	0.17	0.30	0.01	2.85	97.2
2060	1e	56.1	16.7	6.40	3.82	2.89	1.63	7.17	0.10	0.79	0.13	3.47	99.1
2080	2c	70.1	14.1	2.22	1.69	1.08	2.75	3.97	0.09	0.40	0.02	2.16	98.6
2100	2c	72.8	12.4	3.76	1.85	0.30	2.11	3.22	0.13	0.27	0.02	1.00	97.9

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
2120	2d	66.2	12.8	5.41	1.99	0.00	2.02	7.76	0.24	0.82	0.20	1.00	98.4
2140	2c	75.2	12.7	1.65	1.30	0.03	3.22	2.61	0.08	0.19	0.01	1.39	98.4
2160	2a	60.7	17.5	3.87	1.40	3.69	2.20	5.86	0.10	0.81	0.08	1.31	97.4
2180	2a	67.6	14.0	2.87	1.55	2.51	2.37	5.22	0.16	0.56	0.08	1.62	98.5
2200	2c	70.6	11.9	2.74	1.51	2.13	1.72	4.85	0.12	0.50	0.07	1.39	97.5
2220	1e	56.4	14.2	5.87	5.81	0.51	1.61	10.6	0.35	1.45	0.12	0.47	97.3
2240	1c	48.3	12.8	13.8	4.29	0.88	1.18	10.5	0.30	1.25	0.10	4.31	97.6
2280	1c	49.4	13.8	8.02	6.75	0.70	0.93	13.2	0.26	1.77	0.17	3.23	98.3
2300	1c	49.3	16.8	6.86	8.08	2.26	1.46	11.7	0.22	0.87	0.17	1.47	99.1
2310	2a	65.6	17.2	3.47	0.94	5.50	1.41	2.82	0.07	0.27	0.09	1.00	98.4
2340	2a	61.3	17.8	3.30	1.73	6.06	1.21	4.38	0.05	0.49	0.08	2.23	98.6
2360	1c	49.2	12.7	9.46	8.83	2.02	0.78	12.3	0.19	0.94	0.15	0.93	97.5
2380	1c	46.2	14.3	7.07	9.19	2.09	2.00	13.7	0.19	1.16	0.19	1.00	97.1
2400	1b	48.1	7.89	10.1	16.8	0.84	0.25	12.1	0.22	0.50	0.09	0.93	97.8
2420	1b	48.7	7.83	11.5	15.0	1.23	0.27	11.9	0.22	0.56	0.10	0.70	97.9
2440	1b	46.9	8.05	13.4	13.6	1.10	0.79	12.2	0.27	0.53	0.10	1.16	98.0
2460	1b	48.2	8.34	9.20	15.7	1.46	0.31	12.2	0.23	0.61	0.11	0.85	97.2

-----SURFACE SAMPLES COLLECTED BY DR. J.S. FOX ** LOC. = LOCATION-----

1	2c	75.7	11.8	2.26	0.52	2.11	2.20	2.83	0.05	0.29	0.06	1.38	99.2
2	1d	58.1	14.9	5.74	5.34	3.37	0.39	10.5	0.19	0.72	0.09	0.46	99.8
3	1d	54.4	14.0	8.71	4.63	2.28	0.70	12.7	0.27	0.93	0.12	1.85	100.6
4	2c	72.4	11.6	2.01	0.90	3.29	1.22	5.97	0.13	0.48	0.11	0.77	98.8
5	1d	63.8	13.3	5.00	3.25	2.84	0.28	11.5	0.26	1.08	0.30	0.31	101.9
6	1d	56.8	14.0	5.44	4.12	3.72	0.29	13.9	0.22	0.89	0.22	0.38	99.9
7	1d	54.0	15.2	5.27	4.19	4.26	0.36	14.3	0.23	0.98	0.23	0.77	99.8

LOC.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
8	2c	72.1	12.1	2.21	0.79	2.97	1.52	6.47	0.10	0.39	0.09	0.46	99.2
9	1d	57.8	14.2	5.67	3.99	3.41	0.51	12.8	0.24	0.69	0.06	0.15	99.5
10	1d	58.4	14.6	4.55	4.94	3.75	0.67	12.6	0.20	0.75	0.08	0.85	101.3
11	----	64.3	11.8	6.93	1.83	0.18	1.84	9.69	0.19	0.72	0.09	1.92	99.5
12	1b	49.1	11.7	10.7	9.59	1.38	0.74	16.0	0.27	0.46	0.06	1.69	101.6
13	2d	63.3	14.7	5.66	1.71	3.20	0.87	7.84	0.19	0.67	0.17	1.46	99.7
14	1e	52.1	11.8	6.42	2.77	2.56	0.43	20.1	0.38	2.18	0.97	0.38	100.0
15	1e	54.3	13.0	6.42	1.98	2.71	0.30	17.1	0.33	1.95	0.68	0.08	98.9
16	1e	56.5	14.9	4.54	3.35	4.20	0.71	12.7	0.20	1.32	0.22	0.77	99.3
17	2d	63.8	14.2	2.06	1.81	5.62	0.30	8.15	0.13	0.59	0.12	0.69	97.5
18	6	49.6	13.8	7.92	6.38	3.19	0.68	15.0	0.29	2.19	0.21	0.62	99.9
19	1e	57.5	13.7	4.13	5.47	2.77	0.71	12.6	0.22	0.90	0.15	0.62	98.8
20	1d	55.2	15.7	5.86	4.81	4.32	0.26	11.9	0.20	0.58	0.05	0.38	99.3
21	----	63.3	12.6	5.84	1.70	0.45	1.89	8.79	0.16	0.73	0.09	3.00	98.6
23	1d	58.3	13.7	6.22	3.07	3.09	0.58	12.0	0.23	0.73	0.09	1.46	99.5
24	1d	58.6	13.9	5.71	3.28	3.72	0.26	11.5	0.21	0.71	0.08	0.85	98.8
25	7	69.7	13.7	2.10	1.88	3.79	1.49	4.08	0.08	0.27	0.05	1.08	98.2
26	7	69.0	14.7	2.57	1.68	3.57	1.78	4.22	0.10	0.26	0.05	1.00	98.9
27	2c	75.2	11.1	1.43	0.74	4.50	0.38	4.63	0.09	0.37	0.10	0.92	99.5
28	7	69.7	13.2	2.34	1.56	4.09	1.06	4.40	0.08	0.30	0.06	0.62	97.4
29	1d	57.3	14.8	5.26	4.21	3.91	0.26	13.3	0.30	0.94	0.26	0.31	100.8
30	7	67.5	14.7	2.04	1.81	3.08	2.65	4.51	0.11	0.31	0.05	1.31	98.1
31	1d	55.1	14.8	3.54	5.63	3.98	0.23	14.9	0.26	0.93	0.23	0.08	99.6
32	1d	54.2	13.9	4.53	5.82	2.40	0.33	16.0	0.33	0.85	0.22	0.69	99.3
33	7	68.7	13.8	2.50	2.27	3.09	1.86	3.55	0.11	0.30	0.08	0.85	97.1

LOC.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
34	1d	58.5	13.4	5.20	2.84	3.60	0.27	12.1	0.24	0.96	0.28	0.38	97.7
34	2c	74.5	12.0	2.07	0.89	3.64	0.83	3.36	0.07	0.23	0.05	1.23	98.8
35	6	49.4	15.3	9.06	7.94	2.77	0.83	10.7	0.31	0.50	0.08	1.00	97.8
36	2d	67.2	12.0	2.56	1.57	4.31	0.34	7.41	0.13	0.73	0.23	0.54	97.0
36	1e	54.3	16.1	5.58	3.09	3.63	1.47	12.1	0.18	1.35	0.25	0.46	98.4
37	6	47.6	18.0	9.21	5.21	2.59	0.75	12.9	0.21	0.51	0.07	1.31	98.4
37	6	47.9	17.0	8.18	7.32	2.78	2.09	10.7	0.20	0.47	0.11	0.92	97.7
38	1b	51.5	17.6	6.09	5.47	4.29	0.55	10.4	0.18	0.72	0.10	1.00	97.9
38	1e	59.3	19.5	2.25	3.23	1.98	2.23	9.35	0.08	1.00	0.19	1.31	100.4
39	6	50.9	14.8	10.8	9.07	2.59	0.24	9.84	0.18	0.72	0.07	0.46	99.7
40	1c	54.6	15.2	4.32	7.17	1.81	1.37	13.1	0.33	0.73	0.10	2.08	100.8
40	2d	67.7	16.4	3.62	1.49	3.53	1.94	2.87	0.05	0.54	0.07	1.46	99.7
41	2c	74.1	10.9	2.78	2.40	2.68	0.59	5.52	0.10	0.29	0.07	1.15	100.6
41	1e	58.3	17.6	7.76	2.80	1.95	1.55	6.76	0.13	0.57	0.33	2.00	99.8
42	1e	58.2	13.7	4.96	4.05	3.09	0.50	11.9	0.19	0.95	0.15	0.85	98.6
43	1c	52.0	21.1	10.7	4.49	2.56	1.13	5.70	0.11	0.42	0.09	1.38	99.7
43	1e	57.2	14.8	6.66	3.55	3.69	0.24	12.0	0.22	0.84	0.08	1.15	100.6
44	1e	59.5	14.4	5.44	3.45	3.90	0.43	11.6	0.20	0.83	0.10	0.85	100.6
45	1d	59.1	15.1	5.36	4.54	4.55	0.47	9.95	0.19	0.49	0.07	1.38	101.1
46	1d	58.3	14.7	6.24	4.72	3.88	0.38	9.45	0.18	0.45	0.08	1.15	99.6
46	2c	72.4	12.8	0.78	0.11	3.50	4.99	1.51	0.05	0.13	0.02	1.31	97.5
47	1d	53.2	18.4	8.09	4.27	3.98	0.37	9.56	0.16	0.87	0.26	0.62	99.7
47	1d	59.9	14.3	4.45	4.06	3.78	0.78	9.90	0.17	0.58	0.09	1.38	99.4
48	1d	59.7	16.0	3.08	3.99	2.61	3.00	7.54	0.09	0.71	0.15	1.08	98.0
48	6	52.7	13.9	1.42	8.23	2.76	0.25	18.0	0.39	0.74	0.15	1.15	99.7

LOC.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
49	2c	71.6	12.2	1.74	1.70	4.63	0.20	4.82	0.11	0.30	0.08	1.15	98.5
50	1d	53.2	15.3	5.36	5.75	3.71	0.22	14.7	0.69	0.87	0.24	0.38	100.5
51	1d	58.3	13.4	5.00	3.84	3.63	0.20	12.9	0.24	1.32	0.27	0.54	99.6
52	2b	65.3	12.9	3.34	2.29	4.31	0.39	9.02	0.17	0.96	0.27	0.46	99.4
53	2c	72.8	14.2	1.68	0.22	5.06	1.44	1.43	0.06	0.06	0.04	1.46	98.5
54	2c	71.4	11.6	2.73	0.66	3.31	1.27	5.11	0.12	0.52	0.12	1.62	98.5
55	1e	59.8	13.3	3.21	5.33	2.93	0.25	13.6	0.23	1.33	0.20	0.31	100.4
56	6	51.0	17.4	9.40	4.32	3.78	0.63	10.2	0.22	0.47	0.07	1.38	98.9
57	6	48.8	16.6	12.7	8.65	1.56	0.29	9.37	0.18	0.70	0.07	0.23	99.2
58	6	48.1	14.8	11.3	9.08	2.11	0.54	10.3	0.20	0.82	0.07	1.31	98.6
59	1e	57.3	14.3	4.14	4.61	3.56	0.85	12.0	0.17	1.17	0.18	1.08	99.4
60	6	50.5	14.6	11.1	7.47	1.81	0.28	12.2	0.22	0.89	0.08	1.00	100.1
61	7	70.7	14.8	2.19	2.13	2.49	1.14	4.78	0.08	0.35	0.07	1.15	99.9
62	1d	57.3	14.5	3.53	4.09	2.69	0.45	14.5	0.50	0.76	0.18	0.92	99.3
63	1d	54.9	15.3	5.45	4.75	3.70	0.23	13.5	0.28	0.92	0.22	0.46	99.6
64	2c	73.0	12.3	1.54	1.09	4.95	0.20	4.48	0.13	0.28	0.06	0.23	98.2
64	6	48.0	15.9	13.7	4.64	2.42	2.13	5.65	0.17	0.68	0.11	4.00	97.4
65	1d	59.1	14.4	5.69	4.13	3.11	0.82	8.82	0.17	0.50	0.08	1.23	98.1
65	1d	59.5	18.0	5.31	1.62	4.73	1.12	5.93	0.12	0.55	0.27	0.69	97.8
66	1e	58.7	14.0	5.14	4.88	3.34	0.47	11.7	0.21	0.64	0.08	0.46	99.5
67	1e	56.4	14.6	9.47	2.33	1.72	0.51	10.2	0.18	0.66	0.08	2.23	98.3
68	6	52.4	17.6	12.4	2.15	0.72	0.57	8.92	0.15	0.67	0.12	1.62	97.3
69	6	50.8	14.8	8.45	6.38	3.45	0.28	12.7	0.24	1.16	0.12	1.08	99.4
70	2d	68.7	11.7	6.64	1.12	2.25	0.30	5.47	0.14	0.40	0.10	1.15	97.9
71	6	54.8	12.6	6.93	2.98	1.93	0.44	16.5	0.26	1.86	0.16	0.46	98.9

LOC.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
72	1e	56.8	14.9	7.01	2.72	2.31	0.70	11.7	0.18	0.68	0.08	1.85	98.9
72	1e	56.5	14.9	5.22	4.56	3.97	0.27	12.2	0.20	0.77	0.07	0.46	99.2
72	6	48.8	14.9	8.57	5.44	2.39	0.29	15.3	0.21	2.72	0.21	0.92	99.8
73	1e	58.9	16.4	5.27	3.47	5.36	0.39	7.98	0.14	0.52	0.10	0.62	99.2
74	1d	56.5	14.0	7.10	3.46	3.26	0.77	12.7	0.21	0.78	0.09	0.92	99.8
75	2c	73.3	11.3	1.94	1.03	3.24	1.07	6.09	0.12	0.37	0.08	0.00	98.5
75	2c	73.1	11.5	1.98	1.04	3.43	1.10	6.00	0.11	0.37	0.08	0.08	98.8
76	7	68.9	11.8	3.74	1.58	2.17	1.38	7.98	0.17	0.56	0.11	0.69	99.1
77	7	64.0	14.6	3.99	2.42	4.35	0.92	8.37	0.13	0.43	0.08	0.69	100.0
78	1c	48.8	15.8	7.66	6.17	3.28	0.37	13.9	0.24	0.73	0.14	1.15	98.2
79	1d	57.0	14.2	3.59	4.80	3.82	0.20	14.2	0.38	0.84	0.20	-0.62	98.6
80	6	50.9	13.9	10.8	7.39	1.68	0.62	12.0	0.23	0.79	0.07	1.00	99.5
81	1e	55.8	14.3	3.59	5.79	3.81	0.33	14.7	0.24	1.43	0.22	-0.08	100.1
81	2c	73.4	13.4	1.67	1.96	2.82	1.38	3.80	0.06	0.30	0.07	0.38	99.2
82	1e	53.9	14.7	4.36	5.64	4.20	0.37	14.3	0.25	1.64	0.20	-0.23	99.4
83	2d	61.9	12.6	3.13	3.63	3.94	0.26	11.7	0.17	1.19	0.34	0.54	99.4
84	2d	62.1	13.1	3.18	3.22	3.90	0.59	11.5	0.23	1.13	0.33	-0.69	98.6
85	6	48.9	16.1	8.98	6.18	3.00	0.97	12.2	0.25	0.69	0.09	0.38	97.7
86	1d	59.8	13.6	5.42	3.23	3.20	0.33	10.9	0.40	0.83	0.21	-0.08	97.9
87	2c	73.6	11.8	2.49	1.68	2.39	1.26	3.69	0.10	0.26	0.06	0.23	97.6
88	2b	60.6	14.9	5.23	4.29	2.76	1.34	8.29	0.15	0.52	0.10	0.77	98.9
88	2b	60.2	14.9	6.33	4.16	2.69	1.12	7.92	0.16	0.48	0.10	0.69	98.8
89	1e	61.5	13.5	4.10	2.66	2.78	0.89	11.3	0.19	1.14	0.34	-0.15	98.3
90	2d	62.3	13.5	4.43	2.69	3.74	0.51	11.0	0.22	1.18	0.31	-0.69	99.2
91	2d	65.7	12.4	2.11	2.74	4.39	0.72	8.67	0.16	0.87	0.21	0.69	98.7

LOC.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
92	2d	64.4	12.7	3.50	3.16	3.25	0.81	9.02	0.16	0.92	0.20	0.23	98.4
93	1b	48.9	16.8	10.3	4.41	2.75	0.83	11.1	0.26	0.79	0.09	1.77	98.1
95	2d	61.6	15.2	3.46	3.03	5.20	0.21	10.0	0.21	0.71	0.15	0.00	99.8
96	1c	47.0	15.5	10.5	9.96	2.64	0.28	11.1	0.22	0.46	0.05	0.77	98.5
97	1c	46.1	16.5	8.53	6.57	2.43	0.51	15.8	0.28	0.85	0.18	0.92	98.6
98	2d	60.6	14.8	4.00	4.39	4.45	0.33	11.0	0.18	0.83	0.22	-0.08	100.6
99	1c	50.6	16.2	7.21	7.01	3.66	0.45	12.6	0.25	0.55	0.10	0.85	99.3
100	7	68.8	13.1	3.81	2.19	3.74	0.56	6.45	0.17	0.35	0.06	0.31	99.5
101	7	68.0	13.2	3.59	2.13	3.79	0.63	6.68	0.16	0.35	0.06	0.69	99.3
102	7	63.2	14.6	4.49	2.73	3.99	0.85	7.57	0.17	0.43	0.08	0.85	99.0
103	1c	51.6	15.4	7.04	6.92	3.04	0.32	13.5	0.24	0.70	0.14	0.46	99.3
104	7	65.0	14.0	5.48	2.48	3.45	0.42	6.30	0.12	0.37	0.08	1.08	98.8
105	1e	57.8	12.9	3.73	4.61	3.74	0.37	14.3	0.25	1.16	0.25	-0.15	99.0
106	1e	55.3	15.7	3.83	4.60	4.51	0.58	12.9	0.20	0.78	0.13	1.08	99.6
107	7	60.3	15.3	5.29	1.80	0.62	2.86	9.94	0.20	0.60	0.20	1.31	98.4
108	1c	51.8	15.0	7.51	5.62	3.57	0.32	13.1	0.25	0.67	0.13	0.31	98.3
109	2d	61.1	15.0	3.11	1.66	3.36	0.87	10.5	0.20	0.67	0.19	1.46	98.1
110	1e	53.4	15.1	3.76	2.15	4.07	0.28	18.2	0.30	1.85	0.66	-0.08	99.6
111	2d	62.1	11.3	3.56	3.80	3.63	0.29	12.7	0.23	0.78	0.07	0.08	98.5
112	1e	55.2	13.8	7.47	3.68	3.14	0.54	12.7	0.28	0.82	0.11	0.69	98.3
113	1c	52.9	19.7	3.83	2.87	5.90	1.58	7.33	0.12	1.08	0.64	1.92	97.9
114	2c	71.5	11.9	1.87	0.65	2.17	2.33	5.53	0.11	0.31	0.08	1.15	97.6
115	1e	55.5	13.5	6.77	3.42	2.89	0.52	14.5	0.27	1.16	0.34	0.46	99.2
116	6	46.6	12.3	8.87	5.82	1.93	0.37	19.5	0.31	3.06	0.18	0.38	99.2
117	2d	62.5	11.4	4.36	2.66	1.65	0.73	11.8	0.14	0.73	0.13	1.46	97.5

LOC.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
118	6	54.4	13.6	6.65	3.82	2.12	0.61	15.1	0.28	1.60	0.18	0.15	98.4
119	2d	60.1	15.1	1.92	2.23	3.53	1.30	9.28	0.12	0.47	0.07	3.62	97.8
119	2d	66.6	13.0	3.02	1.50	2.09	1.77	7.28	0.12	0.48	0.09	2.23	98.2
119	2d	58.6	14.6	2.62	1.87	2.68	2.98	9.07	0.10	0.74	0.14	4.77	98.2
120	2d	63.5	13.7	2.79	1.80	2.86	1.62	8.21	0.12	0.61	0.12	3.31	98.7
120	2d	60.5	13.6	3.68	1.53	2.80	1.29	9.44	0.10	0.61	0.13	4.38	98.1
121	2d	55.6	14.4	7.22	2.83	0.73	1.75	11.1	0.26	0.79	0.11	2.62	97.4
121	2d	62.8	15.2	2.80	2.88	3.66	1.05	8.10	0.10	0.41	0.07	0.69	97.8
122	2d	67.2	13.5	2.89	1.76	3.91	0.98	6.68	0.12	0.56	0.11	1.00	98.6
122	2d	63.9	13.7	3.30	2.34	4.04	0.59	9.09	0.14	0.60	0.12	0.38	98.2
124	2d	67.4	11.9	4.60	1.46	1.89	0.80	7.09	0.11	0.38	0.08	1.46	97.2
124	2d	65.9	12.5	5.12	1.23	1.36	1.09	7.98	0.09	0.39	0.08	2.62	98.3
125	1e	58.5	15.2	8.78	1.38	3.31	1.86	7.02	0.15	0.39	0.07	0.92	97.6
125	1e	58.0	14.9	9.38	1.33	3.44	1.85	7.01	0.16	0.38	0.07	1.00	97.5
126	2d	61.8	14.9	3.42	2.35	4.73	0.85	8.14	0.13	0.70	0.21	0.92	97.7
126	2d	62.7	14.5	3.21	2.09	4.27	0.78	9.27	0.13	0.77	0.23	0.69	98.7
127	2d	66.6	14.0	2.48	1.48	4.05	1.31	6.53	0.08	0.53	0.13	0.77	98.0
128	1c	50.7	13.7	6.53	5.43	3.82	0.57	14.8	0.21	1.13	0.12	0.54	97.5
129	9	58.7	14.7	5.72	2.79	6.21	0.34	6.06	0.12	0.60	0.07	2.46	97.8
130	9	61.8	14.4	4.49	2.52	6.38	0.37	5.50	0.08	0.54	0.02	1.77	97.9
131	9	55.9	14.8	5.86	5.43	5.67	0.87	6.60	0.11	0.60	0.03	1.77	97.7
132	4	48.7	14.0	10.5	7.63	2.36	0.24	11.8	0.20	0.93	0.08	0.85	97.3
133	4	49.1	14.5	9.53	6.07	2.44	0.35	13.1	0.21	1.11	0.09	1.00	97.5
134	4	48.6	13.5	10.2	7.44	2.17	0.26	12.8	0.22	1.07	0.10	0.92	97.2
135	4	51.2	13.0	9.58	6.96	1.83	0.34	13.3	0.21	1.22	0.11	0.69	98.4

LOC.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
136	4	50.0	14.9	11.9	7.54	1.06	0.20	10.8	0.18	0.80	0.08	0.92	98.5
137	9	61.3	15.3	4.82	3.43	4.18	2.00	4.83	0.09	0.60	0.25	0.85	97.7
138	4	47.4	14.2	12.0	7.77	1.78	0.29	11.1	0.20	0.82	0.07	1.46	97.1
139	4	50.1	14.3	12.0	8.23	1.38	0.24	11.1	0.19	0.82	0.08	1.23	99.7
140	4	47.9	15.3	10.0	8.36	2.44	0.22	12.1	0.19	1.03	0.10	0.77	98.4
141	4	48.5	13.3	9.99	8.22	2.26	0.24	12.7	0.23	1.06	0.09	0.77	97.3
142	4	48.0	13.7	11.6	7.00	1.88	0.26	12.5	0.20	1.12	0.10	1.31	97.6
143	4	49.2	14.6	10.6	6.21	2.55	0.25	11.7	0.17	1.14	0.09	0.46	97.1
144	4	46.4	15.0	11.5	8.40	1.76	0.22	12.1	0.22	0.85	0.07	0.77	97.3
145	8	60.3	15.3	3.93	3.79	3.91	2.30	5.01	0.10	0.55	0.22	1.69	97.1
146	3a	63.6	14.6	2.65	2.64	2.83	2.18	6.65	0.10	0.66	0.16	1.62	97.8
147	8	55.6	16.3	6.54	5.33	3.49	1.74	6.43	0.13	0.85	0.41	1.15	97.9
148	8	61.3	15.4	4.89	3.97	4.05	2.29	5.65	0.09	0.57	0.26	1.00	98.9
149	3c	73.3	11.7	2.67	0.78	3.05	1.41	3.69	0.09	0.30	0.05	0.92	98.0
150	3a	63.4	15.4	4.11	1.72	2.44	1.63	6.70	0.12	0.99	0.27	1.38	98.1
151	4	49.3	14.6	10.8	7.18	2.32	0.35	11.5	0.17	0.86	0.07	0.62	97.8
152	4	49.6	14.1	10.4	6.68	2.80	0.32	11.9	0.19	1.10	0.10	0.77	97.9
153	4	47.3	14.5	9.88	8.56	2.36	0.23	13.6	0.23	1.18	0.10	0.54	98.4
154	4	48.0	13.6	12.3	7.17	1.30	0.35	10.9	0.23	0.79	0.08	2.62	97.8
155	5	76.5	10.9	0.93	0.99	2.36	1.69	3.35	0.05	0.37	0.09	1.15	98.4
155	5	78.0	9.66	0.90	0.74	2.23	1.55	2.38	0.04	0.27	0.07	1.38	97.2
156	4	51.1	14.1	10.9	4.86	2.28	0.29	10.2	0.18	1.09	0.10	2.15	97.2
157	4	50.1	14.5	10.7	5.70	1.83	0.34	11.6	0.16	1.06	0.10	1.31	97.4
157	4	49.8	14.3	11.0	5.81	2.26	0.35	11.7	0.18	1.13	0.09	1.31	97.8
158	4	48.3	15.2	10.8	7.06	1.92	0.26	12.5	0.18	1.11	0.09	0.85	98.2

LOC.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
159	3b	49.3	18.0	9.49	4.64	2.82	0.38	11.3	0.18	1.10	0.18	0.38	97.8
160	3b	51.7	16.7	8.66	4.96	3.09	1.07	8.29	0.17	0.94	0.24	1.62	97.4
161	4	49.0	14.9	10.9	7.15	1.96	0.43	10.8	0.18	0.85	0.08	1.31	97.6
162	4	48.9	14.5	10.7	6.99	2.11	0.34	12.6	0.19	1.10	0.10	0.69	98.2
163	4	48.1	14.3	10.6	7.68	2.19	0.30	12.7	0.23	1.15	0.10	0.85	98.2
164	1c	48.7	17.4	9.74	3.50	2.14	2.65	11.6	0.19	0.71	0.10	1.00	97.7
165	1c	51.0	16.2	10.3	3.95	2.36	0.65	11.1	0.23	0.63	0.10	0.85	97.4
166	1c	52.1	16.5	8.71	4.26	2.82	0.42	11.8	0.23	0.71	0.13	0.15	97.8
167	1c	51.1	16.1	10.3	4.72	2.78	0.32	10.1	0.19	0.54	0.09	0.92	97.2
168	1c	49.8	12.9	10.6	7.48	2.41	0.73	11.0	0.29	0.98	0.27	1.08	97.6
169	1c	46.7	15.4	11.4	9.04	1.82	0.37	11.1	0.20	0.75	0.08	1.00	97.8
170	1c	48.6	14.8	6.51	8.51	2.03	1.29	12.2	0.17	1.01	0.09	2.77	98.0
171	1c	45.7	13.7	13.4	6.76	2.33	0.63	10.0	0.21	0.75	0.09	4.08	97.7
172	1c	51.2	15.1	4.54	4.98	3.77	0.66	15.5	0.19	1.61	0.23	0.92	98.6
173	7	66.5	12.7	2.28	1.14	2.84	2.17	8.00	0.10	0.41	0.13	0.92	97.3
174	1e	56.5	13.9	6.50	3.70	3.12	0.32	12.0	0.23	0.72	0.19	0.38	97.5
175	2d	61.6	14.9	5.43	3.95	2.78	0.34	7.20	0.16	0.45	0.09	0.62	97.5
176	2d	61.5	14.7	3.26	3.52	3.33	1.38	8.40	0.14	0.44	0.07	0.54	97.3
177	2d	67.2	13.6	3.13	3.05	4.11	0.79	4.62	0.12	0.37	0.09	0.92	98.0
178	2d	64.4	12.9	6.37	2.30	2.56	0.37	7.38	0.17	0.63	0.23	1.00	98.3
179	1e	51.9	14.2	11.0	4.07	1.78	0.99	11.5	0.21	0.97	0.08	4.23	100.9
180	1c	49.5	16.3	7.32	4.35	3.11	0.78	14.5	0.20	0.71	0.06	1.38	98.2
181	1e	54.8	15.2	8.37	2.96	2.82	0.45	13.1	0.21	0.73	0.08	0.38	99.0
182	1d	54.0	15.3	6.05	3.55	3.09	0.68	12.7	0.19	0.66	0.06	1.00	97.3
183	1c	50.2	15.4	12.7	1.80	1.34	0.63	11.7	0.22	0.64	0.07	3.15	97.8

LOC.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
184	1d	54.6	13.5	8.60	2.71	1.81	0.81	12.1	0.21	0.64	0.08	2.08	97.1
185	1d	52.8	14.7	9.32	2.47	2.66	0.80	13.3	0.22	0.73	0.08	1.62	98.7
186	1d	55.2	14.7	8.10	2.77	1.86	0.89	12.2	0.20	0.68	0.08	0.92	97.6
187	1d	55.4	14.8	6.83	3.35	2.23	0.90	12.6	0.21	0.70	0.08	2.15	99.1
188	1e	58.7	12.7	7.24	2.43	1.36	1.75	10.0	0.13	0.58	0.07	3.08	98.0
189	1e	62.0	12.5	6.79	1.35	2.36	1.31	8.28	0.16	0.60	0.07	2.54	98.0
190	1e	61.3	15.1	5.18	0.95	2.73	2.60	6.71	0.13	0.54	0.08	1.92	97.2
191	2e	65.8	15.3	0.73	1.97	0.43	3.52	5.50	0.05	0.41	0.09	3.54	97.3
192	2e	32.0	16.1	2.27	12.5	0.26	1.39	25.5	0.12	0.36	0.02	8.77	99.2
193	1e	53.0	20.7	0.46	9.60	0.68	0.41	10.5	0.18	0.65	0.05	3.23	99.4
194	1e	58.6	16.0	2.96	2.31	2.90	2.58	9.71	0.12	0.58	0.11	2.08	98.0
195	1e	59.5	16.6	5.28	4.13	2.86	1.39	8.85	0.14	0.47	0.06	1.46	100.7
197	1e	53.9	15.3	9.26	6.19	1.91	1.12	6.93	0.14	0.70	0.22	1.38	97.1
198	8	61.7	13.8	6.11	2.79	1.39	1.06	9.42	0.16	0.65	0.08	1.00	98.2
199	1c	50.0	17.7	7.14	5.89	3.17	0.44	11.3	0.19	0.49	0.04	1.15	97.5
200	1c	49.8	18.0	8.70	5.47	2.40	0.82	10.3	0.18	0.46	0.05	1.23	97.5
201	1c	52.1	11.8	15.3	2.42	2.56	0.19	7.74	0.19	0.49	0.07	5.62	98.5
202	1e	55.8	15.7	9.70	1.96	4.09	1.44	6.48	0.15	0.44	0.07	3.92	99.8
203	3a	68.8	12.6	5.08	0.89	3.16	0.38	3.93	0.09	0.38	0.09	1.77	97.2
204	3a	63.6	14.7	4.23	1.92	3.43	1.12	8.44	0.12	0.50	0.10	1.23	99.4
206	5	79.0	9.97	0.94	0.73	1.28	2.20	2.58	0.05	0.28	0.08	1.08	98.1
207	5	74.8	11.3	1.28	0.84	2.44	1.85	3.30	0.06	0.34	0.09	1.15	97.5
208	4	48.6	17.4	8.11	5.66	2.06	1.33	10.4	0.17	1.34	0.09	3.08	98.2
209	4	49.5	15.1	11.4	6.54	2.33	0.25	10.7	0.18	0.94	0.07	1.00	97.9
210	4	49.1	17.3	11.4	5.95	2.53	0.39	9.91	0.15	1.01	0.09	1.23	99.1

LOC.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
211	3a	61.3	16.2	6.81	2.59	3.90	0.86	6.56	0.12	0.96	0.25	1.69	101.2
212	3b	52.8	17.8	8.59	5.05	3.01	0.44	8.17	0.16	0.69	0.28	0.92	97.9
213	3b	53.8	15.0	6.67	3.88	3.05	0.65	13.7	0.19	1.01	0.21	1.15	99.3
214	3c	72.1	12.9	2.68	0.96	3.94	1.18	2.32	0.06	0.23	0.07	1.00	97.5
214	3c	70.1	13.6	2.52	0.74	4.31	1.14	3.86	0.09	0.36	0.09	1.85	98.7
215	3a	60.5	16.0	5.04	2.45	2.64	1.66	7.30	0.17	0.91	0.37	1.38	98.3
216	3b	58.8	15.1	6.16	4.35	3.78	0.57	7.17	0.12	0.78	0.24	1.08	98.2
217	3a	61.3	15.3	5.32	2.24	3.10	1.31	7.35	0.17	0.95	0.40	0.77	98.1
217	3b	55.8	16.0	7.44	3.51	3.17	0.97	8.99	0.22	0.96	0.24	1.08	98.3
218	3c	68.6	13.3	3.23	1.31	3.84	0.71	6.17	0.14	0.52	0.11	0.69	98.6
219	3a	61.9	14.9	6.18	2.88	2.90	0.78	6.86	0.16	0.73	0.22	0.92	98.5
220	3b	56.5	15.6	7.09	3.88	3.50	0.67	7.41	0.15	0.98	0.22	1.08	97.1
221	4	50.5	15.0	12.9	5.35	1.61	0.31	9.24	0.16	0.87	0.08	1.08	97.0
222	4	46.7	14.6	12.4	8.70	1.06	0.31	12.8	0.21	1.00	0.08	0.69	98.6
223	4	49.9	13.5	9.86	8.04	2.15	0.26	12.0	0.19	1.05	0.09	0.85	97.9
224	4	45.6	15.2	9.82	8.93	2.30	0.26	12.9	0.24	1.07	0.09	0.85	97.3
225	5	76.1	10.1	1.35	0.87	2.77	1.53	3.16	0.05	0.33	0.08	0.85	97.2
226	5	78.5	9.25	1.35	0.98	1.80	1.73	2.65	0.08	0.27	0.07	0.85	97.5
227	5	78.1	10.3	1.23	0.69	1.79	2.09	2.06	0.05	0.33	0.07	0.85	97.6
228	8	57.4	17.9	5.68	1.90	7.22	0.50	4.56	0.07	0.62	0.39	1.69	98.0
229	8	56.2	15.3	5.31	5.78	5.01	1.25	5.99	0.11	0.66	0.19	1.38	97.2
229	8	57.2	15.3	6.13	6.00	4.43	0.97	6.12	0.12	0.67	0.18	0.85	97.9
230	1e	53.0	14.7	5.09	5.45	3.92	0.60	15.2	0.19	0.64	0.11	0.77	99.7
231	8	55.4	15.8	6.32	6.53	4.20	0.74	6.76	0.12	0.72	0.18	1.46	98.3
232	4	49.3	14.0	10.4	7.81	2.22	0.35	11.9	0.21	1.04	0.10	0.85	98.2

LOC.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
233	4	51.5	13.5	9.52	8.29	2.24	0.34	11.5	0.17	0.86	0.07	0.62	98.5
234	3b	54.2	17.0	7.38	3.74	3.15	1.36	8.47	0.12	0.81	0.19	0.92	97.4
235	3b	57.1	15.3	8.27	3.16	3.23	1.45	5.85	0.11	0.77	0.23	2.08	97.5
236	3a	63.3	14.7	3.50	1.84	3.44	1.82	6.75	0.13	0.93	0.39	1.85	98.6
237	3b	59.7	14.5	6.56	2.15	3.11	0.99	8.37	0.17	0.94	0.37	1.77	98.6
238	3a	60.2	16.4	6.05	1.83	4.02	1.12	5.78	0.09	1.35	0.40	1.00	98.2
239	4	50.5	14.6	11.7	5.82	2.27	0.24	11.1	0.18	1.14	0.11	1.69	99.4
240	4	50.1	14.2	9.75	8.47	2.15	0.32	11.8	0.20	0.92	0.08	1.00	99.0
241	4	48.7	14.9	11.0	8.09	1.90	0.27	11.9	0.19	0.86	0.08	0.85	98.8
242	4	48.6	15.1	12.1	4.26	1.71	0.74	10.5	0.15	1.20	0.11	3.62	98.0
243	3a	67.5	14.3	5.95	1.03	2.64	0.93	1.86	0.04	1.15	0.11	1.62	97.1
244	3b	55.8	16.7	8.28	3.06	3.32	0.99	6.61	0.14	1.02	0.32	2.00	98.3
245	3b	51.5	13.0	7.61	4.07	2.60	0.60	17.8	0.24	1.58	0.21	0.69	100.0
246	8	57.0	14.2	6.96	6.38	3.46	1.11	7.07	0.13	0.64	0.28	0.85	98.0
246	8	57.0	14.3	6.94	6.55	3.54	1.15	6.75	0.13	0.64	0.30	1.00	98.3
247	4	49.8	14.3	10.5	8.33	2.03	0.26	11.8	0.19	0.95	0.08	0.69	98.9
249	3a	64.2	15.8	4.92	1.59	3.77	0.93	4.50	0.08	0.86	0.26	1.31	98.2
250	3b	55.7	15.7	5.80	4.53	4.09	1.05	7.65	0.15	0.89	0.22	1.54	97.3
251	3c	74.1	12.8	1.20	0.69	2.84	2.59	2.03	0.05	0.21	0.06	1.00	97.5
252	3a	63.8	16.1	2.91	2.70	3.67	2.26	5.45	0.06	0.58	0.16	0.77	98.4
253	3c	77.4	11.2	3.33	0.58	2.33	0.59	1.37	0.04	0.46	0.17	0.77	98.2
254	5	75.0	11.6	1.09	0.76	2.27	2.68	3.05	0.05	0.30	0.08	0.77	97.6
255	1c	50.4	13.2	10.2	10.5	2.64	0.25	9.67	0.29	0.45	0.06	0.77	98.3
256	1e	55.7	14.7	8.28	3.82	2.01	0.40	11.0	0.23	0.73	0.08	1.15	98.1
257	1e	58.5	14.2	8.15	2.26	2.30	0.80	9.69	0.24	0.93	0.15	1.31	98.6

LOC.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
258	1e	54.4	15.9	7.07	3.22	3.22	0.54	11.7	0.23	0.90	0.13	0.92	98.2
259	1e	54.0	12.2	5.46	3.44	2.99	0.20	13.8	0.16	2.44	0.74	2.85	98.3

-----DIAMOND DRILL HOLE FS-23-----

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO	P2O5	LOI	SUM
24	6	50.6	13.2	6.72	4.60	3.91	0.69	16.7	0.16	1.82	0.18	1.00	99.6
75	6	43.6	13.7	8.14	4.45	2.60	1.33	20.5	0.23	3.81	0.08	0.62	99.1
162	1d	57.2	15.9	5.86	4.27	4.18	0.40	11.1	0.16	0.87	0.09	0.31	100.4
292	1c	48.8	16.3	7.06	8.90	2.88	0.17	13.6	0.18	0.66	0.09	0.85	99.5
377	1d	52.5	17.4	6.02	4.90	2.42	2.54	12.2	0.14	0.58	0.07	1.23	100.0
467	2d	63.8	12.5	6.47	1.42	3.63	0.99	8.06	0.19	0.66	0.12	2.16	100.0
514	2d	60.2	13.3	6.05	2.82	7.17	0.09	7.95	0.14	0.55	0.20	1.85	100.4
546	1c	48.4	12.7	10.6	11.0	1.62	1.20	10.5	0.16	0.25	0.03	2.08	98.8
627	1c	50.5	13.6	10.5	7.13	3.46	0.42	10.5	0.25	0.37	0.03	2.54	99.4
635	2c	72.5	11.6	1.91	1.83	5.01	0.38	5.61	0.09	0.38	0.09	0.47	99.9
1113	8	68.8	12.7	3.80	2.21	2.47	2.12	5.22	0.09	0.42	0.11	1.47	99.5
1136	1b	47.8	9.29	7.51	14.6	1.36	1.36	13.8	0.27	0.84	0.14	1.93	99.1
1168	1b	51.0	10.1	6.99	13.0	1.97	0.86	12.6	0.27	0.81	0.14	1.16	99.1
1237	1b	49.0	10.9	9.98	12.2	1.20	1.34	10.9	0.19	0.65	0.16	2.39	99.1
1268	1b	52.3	13.5	5.15	9.63	2.78	0.53	12.5	0.20	0.96	0.19	2.16	100.0
1274	1h	47.1	7.32	6.83	22.2	0.17	0.02	10.5	0.17	0.44	0.12	4.39	99.6

-----DIAMOND DRILL HOLE FS-28-----

18	1c	53.3	16.6	6.75	5.41	4.06	0.57	10.9	0.20	0.92	0.10	0.70	99.6
30	1c	52.4	16.4	6.86	5.09	3.78	0.77	12.0	0.20	1.00	0.12	0.85	99.5
70	3a	62.5	15.1	4.73	2.27	1.16	2.79	9.40	0.15	0.68	0.19	0.85	99.9

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
112	3a	60.3	18.7	6.22	2.12	3.77	1.08	6.30	0.11	0.77	0.08	0.54	100.0
140	3a	59.5	17.4	6.89	2.40	3.22	1.09	7.84	0.13	0.69	0.07	0.70	100.0
155	3b	56.2	18.2	4.68	3.90	4.88	0.95	8.68	0.09	0.49	0.07	0.54	98.7
223	3b	55.6	16.5	9.91	1.86	4.56	0.93	5.12	0.14	0.83	0.10	4.00	99.6
237	3c	66.3	14.0	3.47	1.77	3.14	2.85	5.66	0.10	0.78	0.22	1.16	99.5
267	3a	59.6	15.7	3.65	2.45	3.04	2.44	10.1	0.12	0.76	0.16	1.93	100.0
285	3a	68.0	14.8	0.23	2.34	0.43	3.48	5.24	0.02	0.43	0.07	4.62	99.7
320	3a	68.3	14.0	2.85	1.69	3.71	1.92	5.91	0.10	0.74	0.18	0.70	100.2
395	3c	71.4	12.4	3.71	1.23	2.53	1.26	5.40	0.09	0.52	0.11	1.47	100.2
467	1d	56.0	15.3	9.82	2.87	2.28	1.57	7.88	0.17	0.44	0.07	3.23	99.7
492	2d	64.7	13.7	4.96	1.26	2.36	2.63	7.01	0.16	0.43	0.09	2.16	99.5
522	1d	54.2	18.0	6.41	3.99	3.61	1.46	9.94	0.16	0.63	0.07	1.16	99.7
532	1e	54.8	16.9	3.72	5.42	3.07	1.32	11.9	0.34	0.68	0.08	1.39	99.7
533	1e	53.9	16.8	2.98	6.51	2.67	1.51	13.2	0.36	0.68	0.08	1.39	100.1
547	1e	56.1	17.2	4.91	3.87	4.61	0.46	10.0	0.20	0.63	0.07	0.31	98.4
648	2d	64.2	14.1	3.11	5.00	1.16	2.59	6.38	0.05	0.43	0.08	3.00	100.1
662	2e	64.6	13.7	2.47	6.69	0.63	1.79	7.20	0.08	0.41	0.08	1.93	99.6
672	2e	61.2	14.1	1.63	8.99	1.11	1.57	8.09	0.08	0.41	0.08	1.93	99.6
726	2e	61.1	15.3	3.55	1.86	2.74	1.81	10.8	0.11	0.74	0.15	1.47	99.7
733	3b	56.1	12.8	4.74	2.60	0.90	1.03	17.1	0.18	2.69	0.45	1.00	99.7
771	3a	64.3	15.2	3.43	1.73	3.70	1.32	8.48	0.09	0.65	0.14	0.62	99.7
772	3a	65.2	14.0	2.57	1.92	2.86	2.16	9.76	0.09	0.58	0.14	1.00	100.3
773	3a	63.6	14.7	2.91	1.84	3.29	2.09	9.38	0.09	0.62	0.12	1.16	99.9
817	3a	60.1	15.4	2.60	2.12	3.40	2.42	10.9	0.08	0.79	0.16	2.08	100.1
915	3a	63.7	14.2	2.38	1.95	3.30	2.08	9.51	0.10	0.59	0.10	1.31	99.3

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
1020	3b	56.6	15.9	3.39	3.49	2.78	1.13	12.0	0.16	0.84	0.18	3.08	99.6
1052	2d	65.4	14.9	3.09	2.00	3.78	1.35	7.32	0.10	0.64	0.13	1.47	100.2
1098	2e	54.1	15.2	3.54	2.22	2.15	2.56	16.0	0.12	0.95	0.24	3.31	100.4
1160	2e	57.8	13.3	4.84	4.91	3.10	0.16	13.9	0.24	1.24	0.29	0.08	99.9
1469	2c	72.0	13.7	2.18	0.75	6.41	0.13	3.44	0.08	0.42	0.08	1.16	100.4

DIAMOND DRILL HOLE FS-33

59	1c	48.9	16.7	6.56	6.13	3.14	1.17	14.0	0.24	0.70	0.14	1.16	98.9
94	1f	70.8	1.59	7.69	0.42	0.01	0.01	19.5	0.25	0.05	0.43	-0.38	100.4
108	1f	53.5	7.03	5.15	4.83	0.28	0.20	26.0	0.30	0.23	1.04	0.93	99.5
110	1f	44.1	1.63	10.8	0.84	0.02	0.04	41.9	0.25	0.05	0.80	-0.61	99.8
134	2c	73.2	11.8	2.29	1.01	4.43	0.79	5.09	0.07	0.54	0.13	0.93	100.4
134	2b	57.5	17.9	6.05	2.63	5.59	0.63	8.18	0.13	0.69	0.08	0.39	99.8
157	1e	57.0	15.4	7.53	3.65	3.49	0.39	11.1	0.18	0.82	0.10	0.47	100.2
157	2c	73.8	11.8	2.23	0.63	4.12	1.34	4.72	0.12	0.53	0.13	0.54	100.1
192	2c	75.2	13.0	1.98	0.23	7.34	0.16	0.59	0.02	0.20	0.05	1.08	99.9
237	2c	75.8	10.7	2.47	1.44	4.11	0.84	3.07	0.05	0.15	0.03	1.16	99.9
280	1e	57.1	16.1	5.19	4.98	4.29	0.80	9.46	0.16	0.72	0.09	0.62	99.5
328	1c	51.8	14.5	9.48	5.66	2.32	1.03	12.4	0.22	0.58	0.13	0.77	98.9
350	1c	51.1	16.2	6.61	4.56	3.57	1.34	12.9	0.23	0.71	0.10	2.00	99.4
398	1c	47.9	15.5	12.7	3.36	2.16	1.76	11.3	0.17	0.49	0.06	4.39	99.8
411	1f	50.9	1.79	11.1	0.72	0.01	0.01	33.8	0.38	0.07	1.10	-0.38	99.5
430	2b	69.7	12.3	2.61	2.01	2.71	1.93	7.47	0.15	0.52	0.12	0.70	100.3
570	2c	70.0	11.8	1.18	2.47	2.56	1.74	7.16	0.31	0.41	0.06	1.70	99.5
760	2a	62.5	13.7	3.36	3.53	3.29	1.88	8.70	0.14	0.95	0.17	1.16	99.5
775	2a	61.6	13.4	3.19	4.35	3.55	1.65	9.43	0.18	1.00	0.17	0.85	99.4

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
852	2a	62.0	13.6	3.80	3.56	3.80	1.92	8.84	0.17	0.94	0.17	1.00	99.9
886	2a	65.5	13.5	2.92	2.67	3.34	2.65	7.27	0.12	0.71	0.16	0.85	99.8
1024	2c	68.7	12.5	1.66	2.72	4.15	1.26	5.84	0.09	0.60	0.13	1.54	99.3
1141	2b	64.6	13.2	2.31	3.15	4.24	1.19	9.08	0.12	0.93	0.33	0.62	99.8
1232	2c	72.9	12.6	0.21	1.24	0.79	8.64	1.98	0.02	0.09	0.10	0.77	99.4
1252	2d	63.6	13.2	1.32	3.67	2.04	1.35	11.8	0.32	0.94	0.18	1.70	100.2
1262	2d	64.5	13.3	1.97	3.90	4.03	0.84	8.81	0.15	0.92	0.29	0.93	99.7
1325	2c	72.2	12.3	1.27	1.94	3.27	1.58	4.93	0.14	0.51	0.10	1.47	99.8
1358	2c	78.7	9.87	0.43	1.53	4.60	0.29	2.77	0.03	0.19	0.03	1.23	99.8
1472	1c	45.8	21.9	12.3	6.89	2.24	0.20	8.68	0.18	0.44	0.04	0.77	99.5
1488	1c	45.5	20.6	12.2	8.03	1.84	0.08	10.0	0.15	0.24	0.04	0.77	99.5

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62	2d	60.9	15.8	2.77	2.08	4.72	0.98	10.9	0.12	0.77	0.15	0.85	100.1
353	2d	67.2	13.7	4.16	1.43	1.96	2.46	6.96	0.10	0.60	0.13	1.31	100.1
488	1b	49.3	16.4	11.3	5.99	2.63	0.48	11.9	0.26	0.56	0.08	1.08	100.0
628	1e	57.6	13.1	7.87	4.80	3.60	0.11	10.6	0.22	0.66	0.16	0.47	99.2
685	8	57.9	15.8	6.22	4.17	5.23	1.83	6.35	0.11	0.65	0.11	1.23	99.7
733	8	57.1	16.1	3.10	5.39	5.28	2.61	7.21	0.08	0.76	0.15	1.23	99.0
744	8	57.4	16.2	4.30	4.69	4.49	0.56	6.75	0.09	0.72	0.14	1.39	96.8
778	8	57.5	16.4	5.52	4.30	4.70	1.48	5.88	0.09	0.58	0.10	2.15	98.8
782	8	59.3	15.9	3.95	4.15	5.30	1.41	5.98	0.08	0.70	0.13	1.70	98.7
869	8	64.0	15.5	2.33	2.82	6.60	1.57	4.69	0.06	0.51	0.11	1.16	99.4
901	8	61.6	15.9	2.81	3.57	5.76	1.57	5.54	0.08	0.55	0.11	1.39	99.0
920	8	62.8	15.2	3.31	3.53	6.53	1.39	5.37	0.08	0.51	0.10	0.70	99.6
1045	8	61.7	15.0	3.80	3.62	5.91	1.54	5.37	0.10	0.52	0.10	1.77	99.5

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
1133	8	61.2	15.6	4.47	3.87	5.51	1.70	5.59	0.09	0.52	0.11	0.70	99.4
1180	8	62.0	15.4	5.01	3.57	5.12	1.14	5.47	0.09	0.53	0.11	1.08	99.6
1207	8	61.9	15.6	4.31	3.77	5.63	1.39	5.59	0.09	0.53	0.11	0.70	99.7
1244	8	61.7	15.5	4.62	3.78	5.59	1.18	5.65	0.09	0.53	0.10	1.23	100.1
1291	8	65.0	16.3	3.15	1.97	6.35	1.38	3.47	0.05	0.40	0.08	1.47	99.7
1488	2c	71.2	13.3	1.33	1.08	5.27	1.26	4.21	0.03	0.38	0.09	1.08	99.3
1540	2c	68.9	13.8	1.70	1.00	3.98	2.65	4.71	0.02	0.42	0.10	2.00	99.4

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248	5	81.3	8.55	1.77	0.95	2.82	1.10	2.01	0.04	0.16	0.05	0.93	99.7
285	1e	55.3	10.4	10.6	8.37	3.36	0.53	8.05	0.19	0.47	0.06	1.77	99.3
290	1e	55.1	13.7	7.94	6.24	5.07	0.59	7.21	0.12	0.59	0.03	2.16	98.9
380	9	59.5	15.2	5.20	2.63	6.85	0.26	6.50	0.09	0.35	0.06	2.08	98.8
399	9	71.0	13.0	4.42	0.21	6.89	0.48	1.26	0.04	0.26	0.02	2.47	100.1
463	1e	56.4	15.6	5.19	3.78	5.70	1.31	9.55	0.08	0.66	0.05	1.62	100.0
477	1e	56.8	15.6	5.06	4.43	6.66	1.14	8.11	0.08	0.65	0.08	1.62	100.3
497	1e	54.5	16.6	4.24	3.91	5.78	1.84	10.5	0.06	1.08	0.08	1.39	100.0
528	1c	51.3	14.1	6.32	4.53	3.96	0.38	16.3	0.23	1.29	0.11	0.70	99.3
546	1c	50.8	14.0	5.46	5.81	4.19	0.53	16.0	0.23	1.28	0.11	0.39	98.8
552	2d	62.0	10.9	6.83	2.40	1.82	2.05	11.2	0.22	0.78	0.30	1.47	100.0
564	6	48.0	13.3	8.88	3.90	3.46	0.50	16.1	0.30	2.56	0.22	1.31	98.6
580	2d	67.4	10.7	5.13	2.45	2.26	1.99	6.17	0.10	0.44	0.06	2.85	99.6
593	3a	75.9	9.89	2.99	0.80	2.36	1.48	3.13	0.03	0.43	0.07	1.62	98.7
630	3b	47.1	14.6	3.85	2.05	3.04	1.34	21.8	0.10	0.73	0.09	4.54	99.3
729	6	48.7	17.2	9.29	6.10	3.42	0.95	10.5	0.18	0.99	0.20	1.16	98.7
751	2d	67.0	12.3	5.90	1.38	3.84	0.19	7.06	0.15	0.65	0.13	1.31	100.0

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
771	2d	64.7	13.2	4.77	2.11	3.96	0.22	9.99	0.14	0.74	0.12	-0.07	99.9
793	2d	66.8	12.9	4.91	1.62	3.52	0.13	8.73	0.13	0.70	0.12	0.47	100.1
810	1d	55.8	15.6	6.67	4.10	2.98	1.33	10.5	0.18	0.57	0.07	1.00	98.8
830	2d	66.9	13.3	1.49	3.34	1.21	2.08	9.76	0.10	0.44	0.07	0.93	99.7
838	1d	55.1	17.0	5.88	3.92	3.82	1.43	10.9	0.15	0.61	0.07	0.85	99.8
845	1d	59.6	14.6	5.56	2.57	3.72	0.75	9.93	0.16	0.59	0.08	0.93	98.8
847	1d	59.9	14.0	4.59	4.43	3.00	0.60	12.1	0.24	0.59	0.07	0.31	99.9
863	6	49.4	16.0	8.40	8.45	0.41	1.25	13.4	0.28	0.91	0.08	1.54	100.2
865	1g	52.0	15.5	1.98	11.1	0.90	1.95	13.2	0.21	0.48	0.05	2.08	99.5
870	2d	62.6	14.8	4.61	2.92	3.94	0.65	8.57	0.16	0.70	0.13	0.93	100.1
878	6	54.2	12.7	5.27	2.34	3.48	0.09	18.0	0.28	2.07	0.84	-0.07	99.3
892	6	49.2	13.1	6.92	4.97	3.17	0.10	17.4	0.26	3.11	0.20	0.31	98.8
904	2c	69.0	10.8	7.52	1.67	3.49	0.05	5.56	0.11	0.30	0.09	1.23	99.9
918	6	51.8	12.8	8.97	4.72	3.29	0.13	14.7	0.23	2.16	0.24	0.93	100.0
929	2c	69.5	12.5	3.65	1.31	2.60	2.01	6.23	0.07	0.59	0.18	0.93	99.6
957	2d	60.3	14.2	4.54	5.58	3.59	0.47	9.27	0.20	0.78	0.20	0.77	99.9
964	1a	52.0	14.0	9.10	9.21	2.77	0.38	9.76	0.31	0.43	0.08	1.00	99.2
984	1a	51.8	14.6	10.1	7.59	3.85	0.12	9.65	0.19	0.33	0.04	1.39	99.8
1013	1a	47.8	14.3	6.71	10.2	2.11	0.23	15.1	0.29	0.41	0.05	1.08	98.4
1020	2c	69.3	13.4	0.78	2.99	5.18	0.47	5.35	0.09	0.45	0.12	0.62	98.8
1037	2c	72.2	12.3	2.94	1.80	4.78	0.21	4.24	0.07	0.39	0.10	0.93	100.0
1068	1a	49.1	13.6	7.44	8.15	2.00	2.00	14.9	0.17	0.34	0.03	1.23	99.1
1083	1a	51.5	13.9	10.3	7.33	3.72	0.48	10.8	0.14	0.34	0.04	1.16	99.8
1087	2c	71.3	12.7	2.40	2.30	7.41	0.05	2.60	0.05	0.44	0.09	0.70	100.1
1102	1g	52.6	3.85	18.4	9.84	1.77	0.05	11.2	0.24	0.14	0.01	1.85	100.0

FIG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
1160	1e	53.9	15.7	6.77	3.95	3.47	0.80	13.5	0.20	0.81	0.07	0.77	100.0
1195	---	62.5	14.8	10.6	0.80	0.01	2.59	7.03	0.09	0.25	0.05	1.54	100.3
1224	1d	56.9	13.3	7.10	2.68	2.38	1.76	11.7	0.18	0.81	0.10	2.54	99.5
1254	1d	58.3	13.6	7.07	2.68	3.65	0.56	11.2	0.23	0.84	0.12	1.47	99.8
1287	1d	54.9	13.9	7.39	4.06	4.19	0.45	11.9	0.19	0.79	0.08	2.54	100.4

 DIAMOND DRILL HOLE UF-1911

168	5	80.1	9.83	1.10	0.61	2.33	2.11	2.02	0.03	0.24	0.06	1.00	99.5
169	5	73.4	12.7	1.20	1.06	2.48	3.19	3.83	0.04	0.49	0.12	1.23	99.8
188	1e	54.4	15.8	8.58	4.94	3.30	0.73	7.99	0.16	0.89	0.11	2.39	99.3
192	1e	54.7	16.3	6.98	5.09	3.01	0.54	10.6	0.17	0.95	0.11	0.77	99.3
238	3a	59.9	17.1	5.94	2.49	3.91	1.54	6.86	0.08	0.86	0.36	1.23	100.3
258	3a	64.0	13.8	6.26	1.64	1.47	1.86	8.73	0.15	0.57	0.14	1.31	100.0
292	3b	55.5	16.5	7.06	4.01	1.59	2.39	9.42	0.11	1.12	0.12	1.85	99.7
330	8	57.0	15.3	8.26	6.40	3.71	0.29	6.27	0.11	0.69	0.18	1.00	99.4
557	1e	52.2	17.9	8.18	5.44	1.84	1.72	10.6	0.16	0.48	0.06	0.93	99.6
574	1e	57.2	16.6	6.01	3.35	4.04	0.52	10.7	0.17	0.63	0.07	0.47	99.8
1057	2d	66.2	15.1	4.96	1.59	3.82	0.94	6.02	0.08	0.40	0.08	0.85	100.1
1094	2d	64.7	14.2	5.05	1.63	3.58	1.13	7.33	0.11	0.49	0.08	1.39	99.7
1097	2d	67.3	13.3	5.61	1.43	2.94	0.82	6.45	0.10	0.46	0.08	1.39	99.9
1228	2d	65.1	16.0	4.33	2.10	5.13	1.49	3.58	0.06	0.40	0.08	1.62	99.9
1263	2d	63.2	13.8	4.75	0.96	3.84	1.21	8.25	0.05	0.41	0.09	3.47	100.1
1265	6	45.8	11.6	11.1	11.4	1.52	0.23	15.8	0.39	0.48	0.20	0.85	99.5

 DIAMOND DRILL HOLE UF-2184

16	6	57.3	14.6	5.51	2.89	4.11	0.43	12.8	0.19	0.79	0.08	0.54	99.3
32	6	59.7	13.5	4.87	2.82	4.31	0.24	12.2	0.18	0.73	0.08	0.77	99.4

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
73	2e	60.3	14.3	5.77	2.62	4.64	0.15	10.3	0.18	0.75	0.09	0.54	99.7
99	1e	57.5	14.1	6.15	3.28	3.47	0.64	12.2	0.21	0.74	0.08	0.93	99.3
110	1e	58.0	14.7	5.52	2.99	4.33	0.26	11.5	0.19	0.76	0.07	1.62	100.0
119	6	50.3	14.8	7.96	7.95	2.58	0.13	11.4	0.28	0.98	0.09	2.54	99.1
139	2e	56.6	14.5	2.13	4.68	1.33	1.45	12.9	0.09	0.41	0.06	5.93	100.1
144	1e	59.7	14.5	5.16	3.00	4.10	0.56	10.6	0.21	0.95	0.10	1.23	100.1
148	1e	55.9	14.1	6.94	2.11	2.79	2.04	11.9	0.21	1.19	0.23	2.00	99.5
158	1e	55.8	12.9	10.7	1.93	0.40	2.43	10.5	0.20	0.75	0.09	3.54	99.3
159	1h	61.4	12.1	0.25	5.24	0.24	2.30	10.6	0.06	0.34	0.06	7.54	100.2
179	6	47.3	14.4	9.32	10.8	1.76	0.84	10.9	0.21	0.71	0.07	2.31	98.7
199	1d	54.0	17.2	9.69	2.35	2.51	2.75	7.45	0.13	0.54	0.06	3.16	99.9
202	1d	55.3	15.4	11.4	3.00	1.97	2.17	6.67	0.14	0.64	0.08	2.54	99.4
212	1h	64.9	13.0	4.54	1.55	3.46	1.20	8.30	0.13	0.70	0.13	1.16	99.1
220	1d	54.8	16.9	6.49	4.01	3.62	2.12	7.89	0.17	0.70	0.22	1.85	98.8
228	1d	54.9	15.8	8.46	2.38	2.62	1.52	10.1	0.17	0.75	0.09	1.85	98.7
240	1d	57.3	14.4	6.45	4.19	3.87	0.28	11.8	0.20	0.65	0.08	0.70	100.0
262	8	57.5	15.3	6.76	6.54	4.32	0.63	6.25	0.09	0.72	0.20	1.47	99.9
267	8	66.3	14.3	2.62	3.19	3.27	1.83	5.91	0.07	0.34	0.07	2.00	100.0
282	1d	63.6	12.8	8.38	0.83	2.75	1.18	6.66	0.16	0.41	0.10	3.16	100.1
297	1c	49.4	16.9	8.92	5.50	2.90	1.75	11.0	0.23	0.81	0.10	1.31	98.9
301	1d	62.5	13.0	8.98	1.08	2.59	1.30	6.59	0.15	0.41	0.09	3.23	100.0
318	1c	50.3	17.5	9.06	6.02	3.86	0.20	10.8	0.18	0.86	0.12	0.77	99.7
340	2d	63.6	14.0	8.14	1.47	1.05	2.29	7.19	0.10	0.44	0.08	1.47	99.9
350	2d	64.5	15.6	5.71	1.62	2.84	1.15	7.30	0.09	0.52	0.09	0.77	100.2
377	2d	60.6	14.0	6.40	3.52	2.15	1.31	9.79	0.14	0.55	0.06	1.31	99.9

FIG.	CODE	SiO ₂	Al ₂ O ₃	CaO	MgO	Na ₂ O	K ₂ O	Fe ₂ O ₃	MnO	TiO ₂	P ₂ O ₅	LOI	SUM
392	2d	63.9	15.7	3.31	1.62	5.93	0.64	6.92	0.12	0.42	0.12	0.77	99.5
398	2d	61.3	15.1	3.81	3.44	3.95	0.85	9.97	0.12	0.55	0.06	0.23	99.4
410	1d	56.4	14.5	5.07	4.24	4.49	0.32	11.7	0.36	0.86	0.22	0.39	98.6
417	3b	52.7	14.9	10.3	3.96	1.03	1.92	8.16	0.16	0.60	0.08	4.77	98.6
437	3a	57.7	14.7	4.10	4.38	4.19	0.18	13.4	0.24	0.96	0.24	0.23	100.4
452	3a	58.3	14.8	3.93	2.47	2.96	1.62	11.2	0.09	0.66	0.12	3.62	99.8
485	1d	55.7	13.8	3.51	4.90	4.58	0.43	12.9	0.32	0.83	0.20	1.31	98.5
502	3a	66.3	14.4	3.09	1.00	4.52	1.62	5.73	0.03	0.41	0.08	2.16	99.4
548	3a	64.4	12.2	1.08	3.37	0.35	1.11	16.5	0.18	0.74	0.17	0.23	100.4
558	3a	63.4	14.7	6.87	3.67	1.25	1.43	6.77	0.12	0.67	0.10	0.70	99.7
-----DIAMOND DRILL HOLE UF-2184 CHECK SAMPLE-----													
318	1c	50.1	17.4	9.05	6.03	3.89	0.20	10.7	0.18	0.85	0.12	1.00	99.6
-----DIAMOND DRILL HOLE FS-35 CHECK SAMPLE-----													
838	1d	55.0	17.1	5.95	3.98	3.89	1.40	11.0	0.15	0.62	0.07	0.93	100.1
-----DIAMOND DRILL HOLE UF-2039-----													
42	1c	54.0	15.8	8.61	5.03	4.14	0.21	9.83	0.17	0.83	0.12	0.62	99.4
64	1c	46.3	18.2	10.6	4.91	2.40	2.49	11.7	0.20	0.80	0.08	1.54	99.2
88	1c	47.2	17.6	10.4	5.01	3.60	0.70	12.4	0.24	0.84	0.10	0.70	98.7
114	1e	57.9	13.7	6.64	3.98	3.72	0.36	10.6	0.17	0.88	0.12	0.47	98.6
143	2c	71.3	11.3	0.80	1.83	3.96	0.87	7.47	0.14	0.38	0.04	0.70	98.7
164	2c	73.1	11.0	2.01	0.88	3.33	1.07	5.28	0.10	0.41	0.07	1.00	98.3
238	2d	62.3	17.1	4.00	2.11	5.07	1.56	5.36	0.09	0.38	0.10	0.47	98.5
264	6	53.4	14.1	4.76	5.09	4.33	0.76	13.6	0.23	1.54	0.17	0.62	98.5
363	2a	68.6	12.3	2.76	2.02	3.50	1.27	6.88	0.10	0.73	0.14	0.31	98.5
383	6	54.6	13.8	4.23	6.31	3.71	0.85	12.2	0.17	1.46	0.17	0.85	98.4

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
397	6	52.7	14.7	2.43	8.08	3.04	1.13	14.9	0.27	1.84	0.18	0.47	99.8
452	2a	69.3	12.0	1.57	1.83	3.84	1.53	6.29	0.11	0.55	0.10	1.08	98.2
503	2d	59.4	14.1	1.06	6.28	2.77	1.19	12.2	0.17	0.96	0.23	1.16	99.5
643	2c	71.3	11.3	1.37	1.95	3.72	0.91	6.46	0.10	0.43	0.04	0.47	98.0
666	6	50.5	13.9	9.65	10.6	2.56	0.31	9.76	0.16	0.75	0.14	0.62	98.9
746	2c	71.6	11.6	2.02	1.65	2.91	1.24	6.82	0.18	0.43	0.06	0.31	98.9
901	2c	74.6	10.9	1.01	1.39	2.74	1.75	4.60	0.06	0.31	0.02	1.08	98.5
966	6	54.5	13.8	6.46	5.31	2.80	0.42	11.5	0.19	1.48	0.17	0.23	98.1
1033	6	53.0	13.7	2.30	5.53	1.98	1.38	18.0	0.19	1.46	0.16	0.85	98.5
1047	2c	71.3	10.7	1.92	1.75	3.08	1.39	6.42	0.09	0.58	0.10	1.00	98.3
1092	6	56.0	14.4	2.35	6.13	2.58	1.28	14.4	0.24	1.61	0.17	0.54	99.7
1146	2c	72.7	11.0	1.56	1.42	3.67	1.56	5.05	0.10	0.51	0.10	1.16	98.9
1168	2c	72.2	11.3	1.84	1.16	3.59	1.41	6.13	0.09	0.49	0.09	0.62	98.9
1186	2c	71.7	11.3	1.17	1.40	3.50	2.45	5.52	0.07	0.51	0.08	1.39	99.1
1223	2c	72.0	11.5	2.72	1.00	3.18	1.26	6.04	0.09	0.55	0.11	0.70	99.2
1293	2c	72.7	11.5	1.64	1.26	4.06	1.19	5.31	0.07	0.56	0.09	0.77	99.2
1302	2c	70.4	11.6	2.12	1.58	3.46	0.99	7.55	0.10	0.48	0.06	0.47	98.8
1307	2c	71.3	11.4	3.19	1.91	3.43	0.51	6.13	0.12	0.47	0.06	0.39	98.9
1314	6	50.2	15.4	10.0	6.31	3.37	0.37	11.9	0.20	0.83	0.07	0.39	99.0
1327	2a	68.8	12.0	1.95	2.14	4.07	0.96	7.40	0.08	0.75	0.18	0.62	98.9
1339	2a	66.9	12.4	2.01	1.88	4.08	1.15	8.06	0.10	0.82	0.22	1.31	98.9
1346	6	49.3	13.7	9.48	8.24	2.44	0.72	13.1	0.21	0.77	0.20	0.85	99.0
1357	2c	72.6	11.6	1.64	1.16	4.26	0.76	6.20	0.09	0.34	0.03	0.62	99.3
1383	2c	73.6	10.7	1.89	1.88	2.21	2.03	5.57	0.09	0.32	0.02	0.47	98.8
1407	2c	71.7	11.2	2.87	0.96	2.90	1.48	5.78	0.11	0.32	0.03	1.39	98.7

FTG.	CODE	SiO2	Al2O3	CaO	MgO	Na2O	K2O	Fe2O3	MnO	TiO2	P2O5	LOI	SUM
1443	2c	72.5	11.2	3.02	1.00	2.76	2.09	4.70	0.10	0.31	0.03	1.54	99.2
1498	2c	71.0	11.4	2.04	1.12	3.94	1.10	6.71	0.11	0.42	0.06	0.93	98.8
1514	2c	71.0	11.7	1.48	1.26	4.29	1.46	6.72	0.09	0.42	0.06	0.47	99.0
1562	2c	74.3	11.2	1.35	1.01	4.19	1.23	5.78	0.08	0.34	0.03	0.47	99.9
1576	6	49.0	15.0	8.04	4.51	3.41	1.92	13.5	0.23	0.95	0.12	1.54	98.1
1599	2c	72.9	11.2	2.11	1.09	4.23	1.01	5.93	0.09	0.34	0.04	0.85	99.8
1626	1c	48.8	15.9	6.84	9.74	2.73	2.88	10.1	0.27	0.54	0.04	1.00	98.8
1632	2d	64.4	9.08	4.90	3.13	1.31	0.96	13.1	0.35	0.29	0.14	0.62	98.3
1639	1c	49.1	14.4	9.92	9.60	2.17	1.87	9.02	0.26	0.47	0.05	1.54	98.3
1652	2d	68.2	9.98	2.31	2.64	0.69	1.57	13.2	0.25	0.30	0.08	0.39	99.6

APPENDIX III

TRACE ELEMENTS(in ppm), TiO₂ AND FeO CONTENTS

FOR 201 DRILL CORE SAMPLES(1984)

(as analysed by X-ray Assay Laboratories)

UNITS	METHOD	DETECTION LIMITS
Cr	XRF	10.000 PPM
Sr	XRF	10.000 PPM
Rb	XRF	10.000 PPM
Nb	XRF	10.000 PPM
Y	XRF	10.000 PPM
Zr	XRF	10.000 PPM
FeO %	WET	0.10
TiO ₂ %	XRF	0.010

INSTRUMENT STABILITY (PRECISION)

(10 replicate analyses)

	Mean(ppm)	SD(ppm)	Mean(ppm)	SD(ppm)
Rb	210	10	200	10
Sr	260	10	4400	40
Y	130	10	50	10
Zr	280	10	11500	40
Nb	10	10	980	20
Cr	3300	10	0	0

*Note: Mean is the arithmetic mean.
SD is the standard deviation.

Regarding the FeO determinations, at the detection limit the precision is +/- the detection limit, at 10x the D.L. it is +/- 10 - 20% and at 100x the D.L. it is better than 5%.

TRACE ELEMENTS, TiO₂ AND FeO

SAMPLE	Cr	Rb	Sr	Y	Zr	Nb	TiO ₂	FeO
23-24	50	10	50	40	90	20	1.82	13.3
23-75	50	40	180	20	30	40	3.81	16.2
23-162	70	30	220	10	50	10	0.87	8.9
23-292	150	10	100	30	40	20	0.66	11.0
23-377	50	30	130	<10	10	30	0.58	9.7
23-467	90	20	160	20	20	10	0.66	6.2
23-514	70	20	310	20	80	10	0.55	6.3
23-546	1340	40	170	10	<10	20	0.25	8.3
23-627	690	20	160	10	10	10	0.37	8.3
23-635	140	10	100	40	130	30	0.38	4.7
23-1113	120	60	150	20	90	10	0.42	4.3
23-1136	980	40	40	10	30	20	0.84	10.8
23-1168	940	40	150	10	30	20	0.81	10.5
23-1237	1070	30	190	<10	40	20	0.65	8.5
23-1268	660	30	300	30	60	20	0.96	11.4
23-1274	2060	10	30	10	20	20	0.44	8.6
28-18	90	20	180	30	50	10	0.92	9.1
28-30	200	30	180	10	60	30	1.00	10.0
28-70	80	70	100	20	100	20	0.68	7.8
28-112	80	20	240	20	80	10	0.77	5.1
28-140	70	30	230	10	50	20	0.69	6.2
28-155	110	30	210	<10	60	10	0.49	7.3
28-223	50	30	210	10	50	10	0.83	4.4
28-237	60	90	140	30	110	<10	0.78	4.7

SAMPLE	Cr	Rb	Sr	Y	Zr	Nb	TiO2	FeO
28-267	110	50	190	20	100	20	0.76	9.0
28-285	200	50	<10	30	40	<10	0.43	0.9
28-320	100	40	180	20	120	10	0.74	4.8
28-395	150	20	190	30	80	30	0.52	4.7
28-467	120	50	180	10	30	20	0.44	6.1
28-492	90	70	70	10	30	20	0.43	5.6
28-522	70	50	100	10	30	20	0.63	7.8
28-532	140	30	70	<10	20	10	0.68	9.1
28-533	90	30	30	10	20	10	0.68	9.8
28-547	80	10	120	<10	30	10	0.63	8.5
28-648	100	30	50	<10	40	20	0.43	4.8
28-662	170	30	40	<10	20	20	0.41	5.7
28-672	370	30	30	<10	40	<10	0.42	6.4
28-726	120	50	90	10	110	10	0.74	8.8
28-733	120	20	120	30	200	40	2.69	14.5
28-771	110	30	190	30	110	30	0.65	6.7
28-772	80	60	100	20	130	40	0.58	8.0
28-773	120	60	100	20	120	20	0.62	7.7
28-817	100	70	140	40	110	20	0.79	9.2
28-915	110	70	80	20	100	30	0.59	8.0
28-1020	100	20	180	30	90	10	0.84	10.2
28-1052	120	40	150	20	160	30	0.64	6.0
28-1098	110	60	60	30	120	20	0.95	13.4
28-1160	90	10	40	40	80	10	1.24	11.6
28-1469	150	20	180	50	200	20	0.42	2.7

SAMPLE	Cr	Rb	Sr	Y	Zr	Nb	TiO2	FeO
33-59	90	10	200	20	40	20	0.70	11.0
33-94	150	20	<10	20	<10	10	0.05	9.6
33-108	110	10	<10	<10	10	10	0.23	17.7
22-110	100	<10	10	<10	<10	30	0.05	18.9
33-134	120	20	40	80	300	30	0.54	3.2
33-134A	40	40	240	<10	40	30	0.69	6.1
33-157	70	20	260	10	40	10	0.82	7.8
33-157A	140	30	110	90	300	20	0.53	3.5
33-192	140	10	120	30	190	20	0.20	0.5
33-237	130	30	90	10	170	30	0.15	2.2
33-280	90	20	130	10	40	10	0.72	7.5
33-328	100	20	260	<10	30	10	0.58	8.8
33-350	50	40	280	<10	30	10	0.71	9.3
33-398	50	30	140	20	20	20	0.49	8.4
33-411	110	10	50	<10	<10	40	0.07	17.0
33-430	140	40	110	60	300	40	0.52	5.6
33-570	140	20	80	50	290	20	0.41	5.7
33-760	110	40	190	30	190	30	0.95	6.0
33-775	100	30	130	50	170	30	1.00	7.3
33-852	110	40	130	50	200	20	0.94	6.3
33-866	110	70	100	50	240	20	0.71	5.1
33-1024	110	30	100	60	220	20	0.60	4.5
33-1141	100	20	120	40	210	20	0.93	6.6
33-1232	180	120	<10	10	30	20	0.09	1.1
33-1252	120	40	70	50	210	20	0.94	9.4

SAMPLE	Cr	Rb	Sr	Y	Zr	Nb	TiO2	FeO
33-1262	100	20	70	70	210	30	0.92	7.0
33-1325	140	30	130	60	260	30	0.51	4.1
33-1358	140	20	50	120	330	30	0.19	2.2
33-1472	100	<10	260	20	20	10	0.44	6.1
33-1488	70	10	240	10	<10	10	0.24	9.3
34-62	120	20	230	30	130	10	0.77	9.1
34-353	130	50	70	20	120	30	0.60	5.6
34-488	60	<10	200	<10	20	20	0.56	8.8
34-628	100	30	220	10	40	10	0.66	7.8
34-685	160	40	370	20	60	20	0.65	4.8
34-733	360	90	250	10	120	30	0.76	5.4
34-744	260	10	410	20	90	20	0.72	3.3
34-778	230	50	400	20	70	10	0.58	3.9
34-782	210	30	450	20	120	30	0.70	3.9
34-869	170	40	290	10	90	10	0.51	3.6
34-901	190	60	300	40	90	30	0.55	3.5
34-920	180	40	260	20	120	10	0.51	3.8
34-1045	180	40	220	20	100	10	0.52	3.9
34-1133	160	40	400	10	90	10	0.52	4.3
34-1180	180	30	530	10	90	20	0.53	3.9
34-1207	160	30	450	<10	90	20	0.53	4.0
34-1244	180	50	610	<10	90	10	0.53	4.0
34-1291	120	40	350	<10	90	10	0.40	2.6
34-1488	160	20	140	40	150	40	0.38	3.3
34-1540	140	60	140	30	150	10	0.42	2.9

SAMPLE	Cr	Rb	Sr	Y	Zr	Nb	TiO2	FeO
35-248	210	40	160	<10	40	20	0.16	1.6
35-285	790	<10	370	10	80	20	0.47	5.4
35-290	390	10	310	30	100	30	0.59	5.6
35-380	90	10	160	60	230	30	0.35	5.1
35-399	140	20	150	30	340	20	0.26	1.1
35-463	70	60	110	10	30	20	0.66	7.6
35-477	60	50	150	10	30	20	0.65	6.3
35-497	50	50	130	10	50	<10	1.08	8.3
35-528	40	10	170	30	50	20	1.29	13.2
35-546	50	<10	240	20	60	10	1.28	13.1
35-552	90	40	150	40	90	20	0.78	8.6
35-564	40	10	140	30	120	30	2.56	12.5
35-580	130	40	140	<10	40	10	0.44	4.9
35-593	160	40	110	10	20	20	0.43	2.6
35-630	90	50	100	10	60	20	0.73	18.7
35-729	80	30	260	20	40	20	0.99	8.6
35-751	110	20	270	20	20	10	0.65	5.5
35-771	80	20	150	30	30	20	0.74	8.1
35-793	100	<10	220	20	50	20	0.70	6.9
35-810	80	40	90	<10	<10	20	0.57	8.6
35-830	140	40	20	20	50	20	0.44	7.7
35-838	60	30	140	10	10	20	0.61	8.9
35-845	90	20	140	20	20	<10	0.59	7.9
35-847	90	20	60	10	10	10	0.59	10.4
35-863	100	30	100	20	30	30	0.91	11.3

SAMPLE	Cr	Rb	Sr	Y	Zr	Nb	TiO2	FeO
35-865	120	30	50	<10	10	30	0.48	11.3
35-870	230	20	120	20	70	<10	0.70	7.7
35-878	80	20	130	50	230	40	2.07	15.5
35-892	60	20	140	40	100	40	3.11	14.7
35-904	90	10	130	20	100	20	0.30	4.2
35-918	130	20	110	20	100	40	2.16	11.9
35-929	100	50	60	30	110	<10	0.59	5.2
35-957	90	30	120	10	50	20	0.78	8.2
35-964	870	30	120	10	10	30	0.43	7.9
35-984	860	10	100	<10	<10	20	0.33	7.8
35-1013	750	<10	70	20	<10	10	0.41	12.2
35-1020	110	10	70	40	160	30	0.45	4.6
35-1037	140	20	110	30	90	30	0.39	4.2
35-1068	870	50	140	<10	<10	10	0.34	12.0
35-1083	540	20	220	30	<10	20	0.34	8.3
35-1087	90	10	110	20	90	10	0.44	2.4
35-1102	30	<10	90	20	20	10	0.14	9.5
35-1160	70	30	320	10	40	10	0.81	10.4
35-1195	80	40	420	30	70	10	0.25	1.3
35-1224	50	50	80	10	40	20	0.81	8.8
35-1254	80	<10	150	20	50	10	0.84	8.8
35-1287	50	10	130	10	40	20	0.79	9.0
1911-168	210	60	180	10	50	10	0.24	1.6
1911-169	160	90	190	30	160	20	0.49	3.0
1911-188	100	20	180	20	40	20	0.89	6.4

SAMPLE	Cr	Rb	Sr	Y	Zr	Nb	TiO2	FeO
1911-192	110	20	180	20	60	10	0.95	8.8
1911-238	100	30	200	30	90	30	0.86	5.3
1911-258	110	40	140	20	90	20	0.57	6.8
1911-292	80	60	190	30	50	10	1.12	7.3
1911-330	320	20	740	20	110	20	0.69	4.9
1911-557	120	50	280	10	<10	10	0.48	5.1
1911-574	70	20	130	10	30	20	0.63	8.7
1911-1057	100	30	160	20	50	20	0.40	4.7
1911-1094	110	40	110	20	50	10	0.49	5.8
1911-1097	110	20	160	10	60	10	0.46	4.9
1911-1228	140	20	100	<10	80	10	0.40	2.9
1911-1263	150	40	140	20	80	40	0.41	7.1
1911-1265	590	20	30	10	<10	20	0.48	11.8
2184-16	60	30	90	10	40	10	0.79	9.9
2184-32	110	<10	130	10	40	<10	0.73	9.7
2184-73	90	<10	120	10	20	20	0.75	7.8
2184-99	90	20	180	30	30	20	0.74	9.3
2184-110	70	10	90	20	20	20	0.76	9.0
2184-119	230	10	70	<10	40	10	0.98	9.4
2184-139	190	50	60	10	30	10	0.41	6.8
2184-144	100	20	70	20	40	<10	0.95	8.4
2184-148	70	40	80	40	90	30	1.19	9.0
2184-158	70	50	70	10	20	20	0.75	7.6
2184-159	180	50	<10	10	10	10	0.34	1.8
2184-179	550	30	80	<10	30	20	0.71	8.4

SAMPLE	Cr	Rb	Sr	Y	Zr	Nb	TiO2	FeO
2184-199	80	40	170	20	10	20	0.54	5.9
2184-202	130	20	170	<10	<10	20	0.64	5.2
2184-212	120	10	100	20	30	10	0.70	6.8
2184-220	110	50	180	10	100	20	0.70	6.4
2184-228	70	40	130	10	20	10	0.75	8.1
2184-240	70	10	160	10	10	20	0.65	9.2
2184-262	310	20	710	10	130	20	0.72	5.2
2184-267	120	40	120	20	110	20	0.34	4.7
2184-282	120	40	210	10	40	10	0.41	5.4
2184-297	60	40	120	20	50	30	0.81	8.9
2184-301	80	50	170	<10	40	20	0.41	4.9
2184-318	90	10	280	10	60	10	0.86	8.3
2184-340	100	50	120	10	50	10	0.44	5.5
2184-350	120	20	210	20	40	10	0.52	5.8
2184-377	90	30	100	10	30	30	0.55	7.6
2184-392	80	20	180	40	190	20	0.42	5.5
2184-398	100	20	150	10	30	20	0.55	8.3
2184-410	80	20	110	40	40	10	0.86	9.5
2184-417	70	50	150	10	20	30	0.60	7.1
2184-437	80	10	80	30	70	30	0.96	11.3
2184-452	110	40	170	30	110	10	0.66	10.4
2184-485	90	20	110	<10	40	10	0.83	11.1
2184-502	150	50	150	10	90	10	0.41	5.0
2184-548	170	40	<10	30	100	30	0.74	13.4
2184-558	120	30	70	30	50	10	0.67	5.2

SAMPLE	Cr	Rb	Sr	Y	Zr	Nb	TiO2	FeO
2184-318*	90	10	270	20	40	20	0.85	8.2
35-838*	70	50	160	<10	30	20	0.62	8.8

*CHECK SAMPLES

APPENDIX IV

LIST OF SAMPLES
USED IN THE CHEMICAL AND TRACE ELEMENT CLASSIFICATIONS
OF THE FOX MINE METAVOLCANIC ROCKS

**The samples included in the following list were used in the chemical classification of the Fox Mine metavolcanics.

Surface samples - locations are given in Appendix V:

3, 6, 7, 8, 10, 16, 17, 19, 20, 23, 24, 31, 32, 83, 84, 93, 96, 103, 108, 121, 122, 134, 135, 136, 138, 139, 140, 141, 142, 143, 144, 151, 152, 255, 256, 257, 258 and 259.

Underground samples - locations are given in Appendix V:

164, 165, 166, 175, 176, 177, 178, 180, 181, 182, 183, 184, 185, 186, 187, 188 and 189.

Diamond drill hole UF-1886 - sample numbers correspond to footages down the hole:

160, 180, 280, 300, 480, 500, 620, 640, 660, 840, 960, 980, 1060, 1620, 1670, 1700, 1860, 1880, 2180, 2310, 2340, 2380, 2400, 2420 and 2440.

**The following list of samples (80) were used in both the chemical classification and the trace element classification of the Fox Mine metavolcanic rocks. Visibly altered samples are indicated by an asterisk(*).

Diamond drill hole UF-1911 - sample numbers correspond to footages down the hole:

1057 and 1094.

Diamond drill hole FS-23 - sample numbers correspond to footages down the hole:

162, 467, 514, 627, 635, 1136, 1168, 1237 and 1268.

Diamond drill hole FS-28 - sample numbers correspond to footages down the hole:

18, 30, 467, 492, 522, 532, 533, 648, 662(*), 672(*) and 726(*) .

Diamond drill hole FS-33 - sample numbers correspond to footages down the hole:

59, 134, 134, 157, 157, 192, 237, 280, 328, 350, 398, 430, 570, 760, 775, 852, 886, 1024, 1141, 1252, 1262, 1325, 1472 and 1488.

Diamond drill hole FS-34 - sample numbers correspond to footages down the hole:

488, 628, 1291, 1488 and 1540.

Diamond drill hole FS-35 - sample numbers correspond to footages down the hole:

285, 290, 552, 580, 751, 771, 793, 810, 830, 838, 845, 847, 865(*), 870, 904, 929, 957, 964, 984, 1013, 1020, 1037, 1068, 1083, 1087, 1160, 1224, 1254 and 1287.

APPENDIX V

CO-ORDINATE LOCATIONS
OF SURFACE AND 2100 LEVEL SAMPLES
(as listed in Appendix II)

LOCATION OF SURFACE AND 2100 LEVEL SAMPLES

SAMPLE	EASTING	NORTHING	SAMPLE	EASTING	NORTHING
1	72510	8180	2	72520	8220
3	72510	8260	4	72530	8390
5	72510	8440	6	72500	8520
7	72500	8560	8	72520	8580
9	72510	8800	10	72515	8870
11	72510	8955	12	72500	9015
13	72510	9120	14	72530	9160
15	72600	9150	16	72600	9100
17	72210	9190	18	72280	9140
19	72200	9120	20	72205	9080
21	72195	9040	22	72210	8980
23	72220	8940	24	72210	8870
25	72185	8720	26	72215	8735
27	72285	8760	28	72230	8665
29	72210	8630	30	72300	8635
31	72160	8590	32	72200	8565
33	72215	8545	34	72200	8500
35	72220	8460	36	72200	8370
37	72160	8300	38	72240	8210
39	72160	8200	40	71980	9165
41	72020	9140	42	71980	9125
43	72010	9080	44	71995	8915
45	71920	8795	46	71985	8765
47	71880	8740	48	72015	8680

SAMPLE	EASTING	NORTHING	SAMPLE	EASTING	NORTHING
49	72005	8640	50	72000	8620
51	72010	8510	52	72000	8435
53	72120	8385	54	72065	8360
55	72035	8310	56	71970	8220
57	71865	8130	58	71800	8300
59	71850	8395	60	71790	8555
61	71820	8595	62	71820	8660
63	71825	8685	64	71790	8715
65	71780	8880	66	71820	9020
67	71780	9080	68	71700	9100
69	71805	9120	70	71760	9170
71	71810	9160	72	71635	9120
73	71585	9000	74	71550	8990
75	71600	8890	76	71545	8920
77	71530	8840	78	71570	8780
79	71580	8685	80	71605	8595
81	71555	8540	82	71640	8420
83	71615	8390	84	71550	8395
85	71600	8235	86	71480	8660
87	71370	8600	88	71335	8590
89	71380	8520	90	71435	8465
91	71395	8445	92	71405	8410
93	71425	8325	94	71410	8265
95	71450	8705	96	71440	8785
97	71400	8805	98	71360	8710

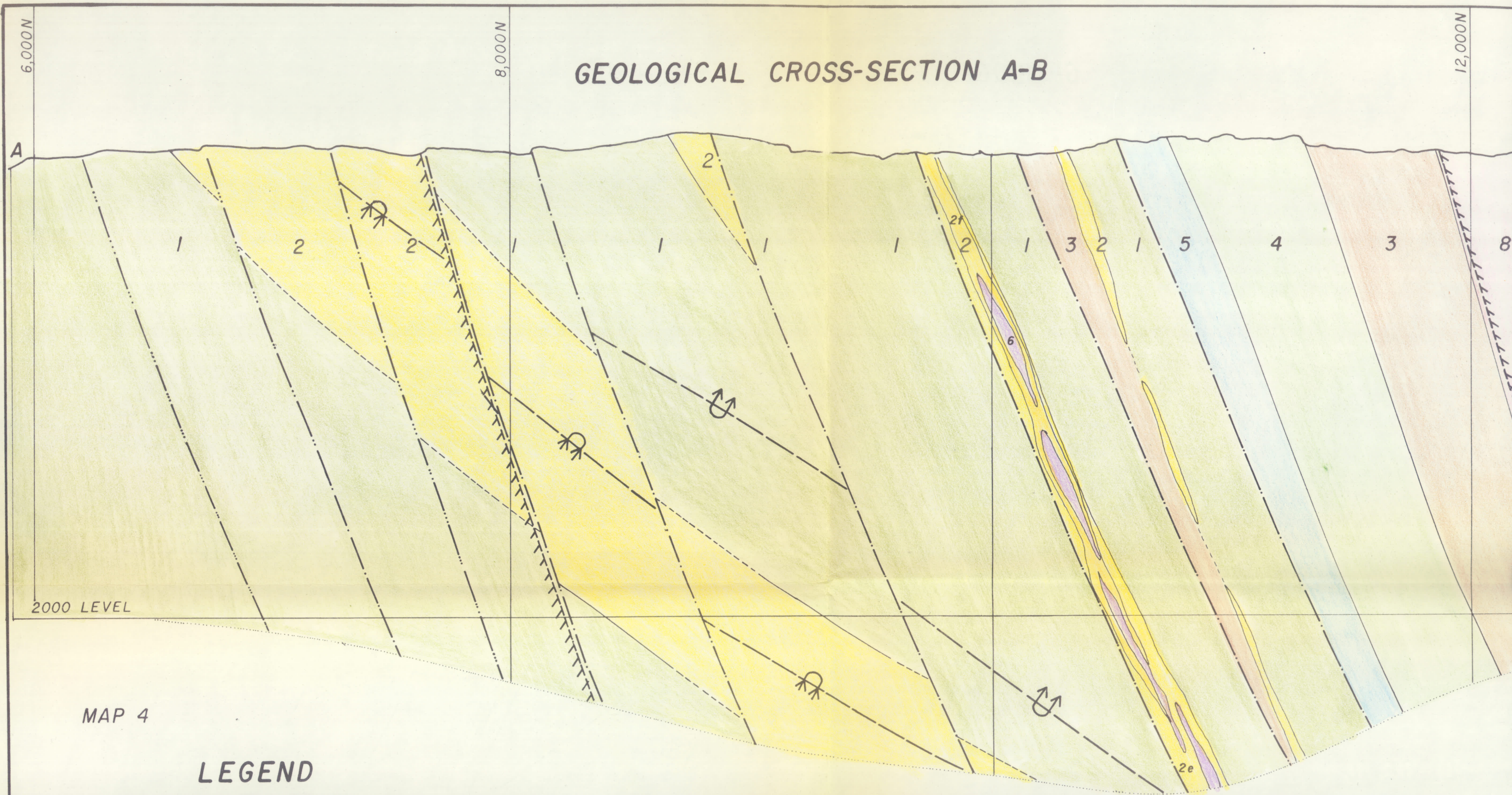
SAMPLE	EASTING	NORTHING	SAMPLE	EASTING	NORTHING
99	71340	8730	100	71365	8845
101	71310	8880	102	71185	8920
103	71200	8765	104	71200	8650
105	71210	8480	106	71165	8390
107	71000	8690	108	71040	8810
109	70940	8730	110	72430	9070
111	72760	9040	112	72960	8920
113	73000	8900	114	73090	8780
115	73175	8800	116	72280	9235
117	72240	9280	118	72140	9240
119	72000	9270	120	72010	9300
121	72030	9320	122	72090	9235
123	72120	9310	124	71620	9210
125			126	72350	9165
127	72400	9165	128	72770	9470
129	72620	9640	130	72960	9650
131	72640	9700	132	72665	9980
133	72620	10125	134	72600	10200
135	72560	10290	136	72560	10560
137	72580	11740	138	72430	10720
139	72435	10545	140	72400	10360
141	72360	10240	142	72200	10300
143	72185	10500	144	72200	10680
145	72200	11400	146	72175	11480
147	72140	11550	148	72170	11700

SAMPLE	EASTING	NORTHING	SAMPLE	EASTING	NORTHING
149	72000	11080	150	72000	11030
151	72000	10800	152	72010	10580
153	72000	10370	154	71980	10275
155	71800	10120	156	71790	10380
157	71780	10810	158	71810	11070
159	71790	11220	160	71640	11210
161 ?	71590	10590	162	71550	10750
163	71600	10550	164 ?	71440	9510
165	70450	9535	166	70470	9565
167	70500	9610	168	70520	9645
169	70550	9680	170	70570	9710
171	70590	9740	172	70615	9785
173	70650	9830	174	70660	9840
175	70670	9855	176	70680	9870
177	70690	9885	178	70715	9910
179	70740	9950	180	70765	9985
181	70790	10030	182	70815	10060
183	70840	10090	184	70850	10125
185	70905	10135	186	70920	10150
187	70930	10165	188	70930	10180
189	70935	10190	190	70920	10210
191	70930	10235	192	70950	10290
193	70960	10330	194	71025	10480
195	71040	10525	196	71060	10580
197	71075	10625	198	71095	10665

SAMPLE	EASTING	NORTHING	SAMPLE	EASTING	NORTHING
199	70110	10710	200	71130	10760
201	71160	10840	202	71170	10870
203	71180	10895	204	71185	10905
205	71190	10920	206	71350	10210
207	71375	10305	208	71400	10410
209	71390	10510	210	71340	11100
211	71420	11235	212	71420	11260
213	71390	11360	214	71385	11430
215	71375	11530	216	71375	11580
217	71280	11600	218	71135	11620
219	71150	11590	220	71170	11430
221	71160	11250	222	71170	11080
223	71200	10770	224	71190	10570
225	71140	10400	226	71170	10265
227	71170	10150	228	71180	10035
229	71210	9945	230	70990	9960
231	70950	10630	232	70920	10965
233	70970	11150	234	71020	11475
235	71040	11570	236	70970	11630
237	70975	11670	238	70920	11550
239	73020	9985	240	73015	10190
241	72950	10380	242	72990	10600
243	73000	10635	244	73000	10700
245	73000	10730	246	73040	11570
247	73370	10200	248	73425	10530

SAMPLE	EASTING	NORTHING	SAMPLE	EASTING	NORTHING
249	73440	10990	250	73390	11115
251	73430	11175	252	73830	11100
253	73840	10700	254	73820	9860
255	70240	8970	256	70045	8680
257	70120	8480	258	69870	8740
259	68245	10145			

GEOLOGICAL CROSS-SECTION A-B



MAP 4

LEGEND

INTRUSIVE ROCKS

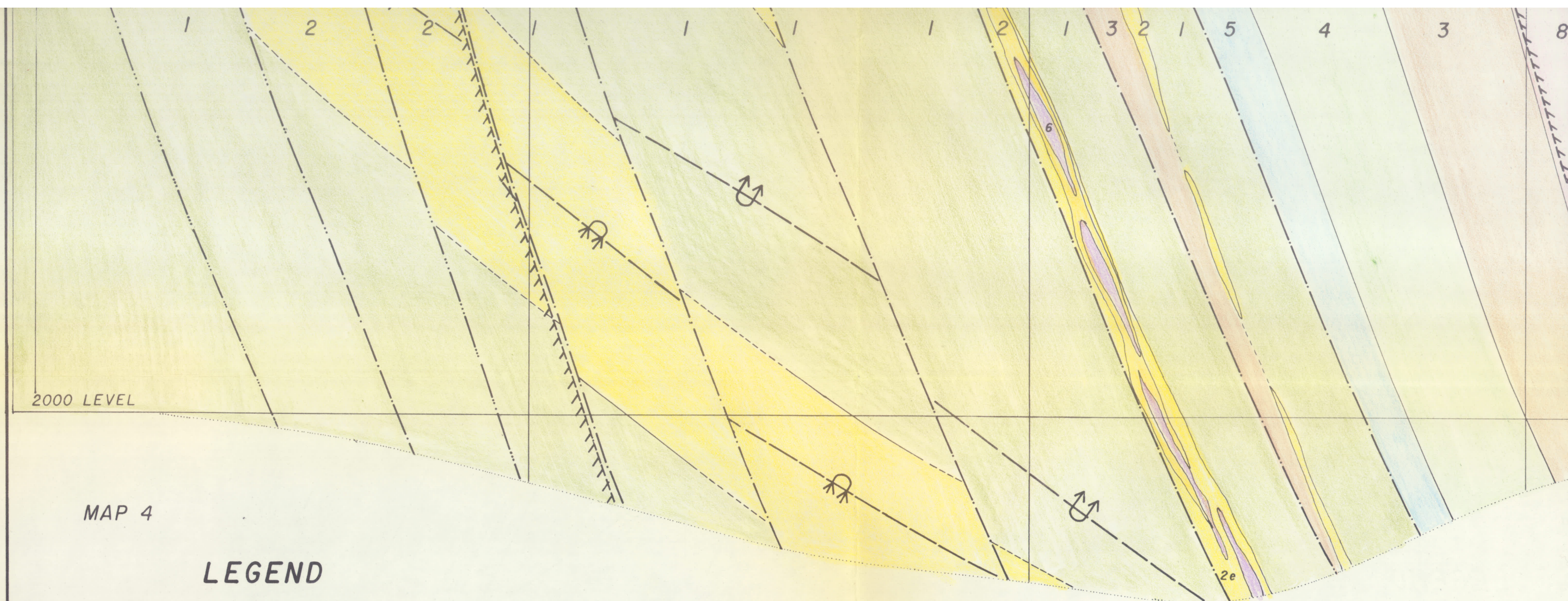
9	LEUCOGRANITE
8	HORNBLENDE TONALITE, QUARTZ DIORITE

WASEKWAN GROUP

4	APHYRIC MAFIC METAVOLCANIC ROCKS
3	METASEDIMENTARY ROCKS

SYMBOLS

	Contact (defined)
	Fault trace (defin



2000 LEVEL

MAP 4

LEGEND

INTRUSIVE ROCKS

- 9 LEUCOGRANITE
- 8 HORNBLLENDE TONALITE, QUARTZ DIORITE
- 7 QUARTZ-EYE PORPHYRY
- 6 GABBRO, DIABASE

SICKLE GROUP

- 5 ARKOSIC META-SANDSTONE

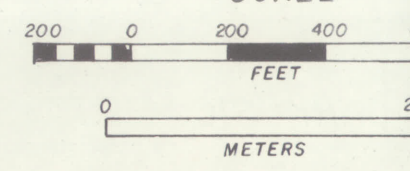
WASEKWAN GROUP

- 4 APHYRIC MAFIC METAVOLCANIC ROCKS
- 3 METASEDIMENTARY ROCKS
- 2 FELSIC METAVOLCANIC ROCKS
(includes 2e altered dacite, 2f sulfides)
- 1 PORPHYRITIC MAFIC METAVOLCANIC ROCKS

SYMBOLS

- Contact (defined)
- Fault trace (defined)
- Fault zone limit
- Axial trace (overtu)

SCALE



FOX MINE

GEOLOGY BY P.E. OLSON

GEOLOGICAL CROSS-SECTION A-B

8,000

12,000

B



LEGEND

USIVE ROCKS

LEUCOGRANITE

HORNBLENDE TONALITE, QUARTZ DIORITE

WASEKWAN GROUP

4

APHYRIC MAFIC METAVOLCANIC ROCKS

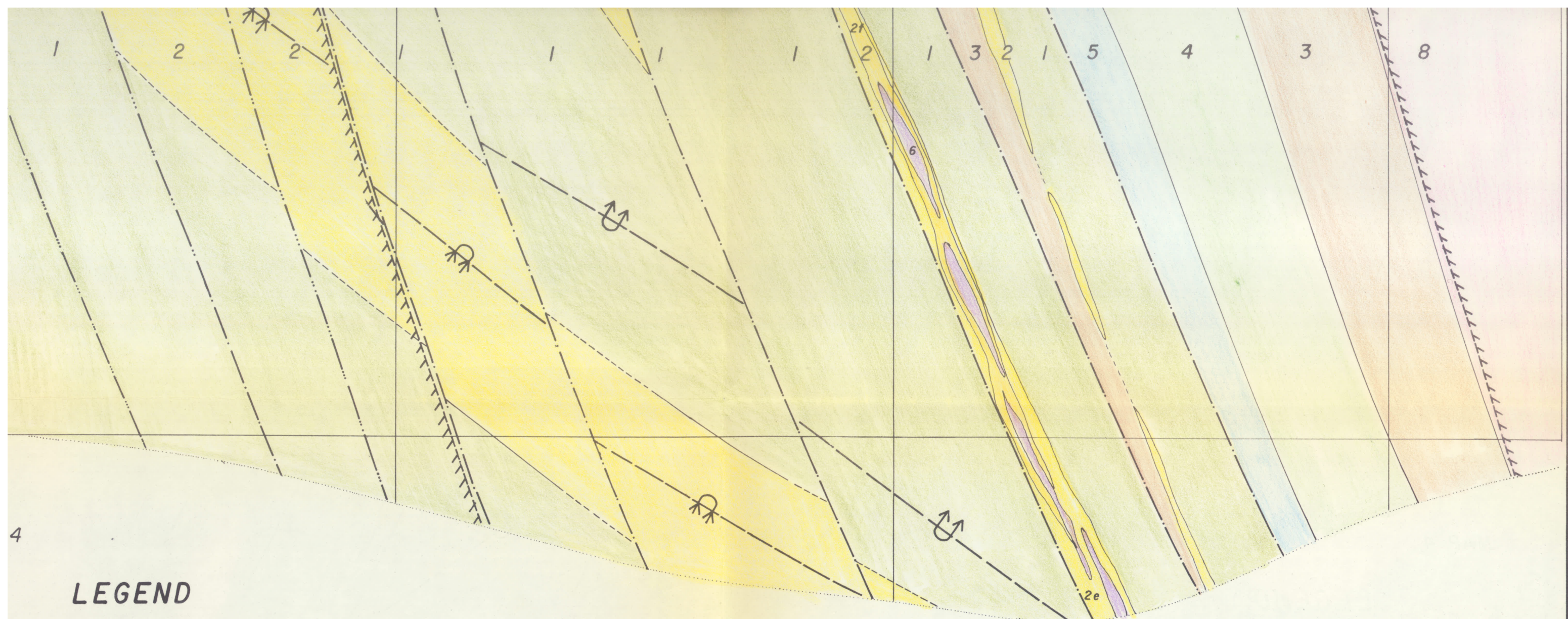
3

METASEDIMENTARY ROCKS

SYMBOLS

Contact (defined inferred)

Fault trace (defined inferred)



LEGEND

USIVE ROCKS

LEUCOGRANITE

HORNBLende TONALITE, QUARTZ DIORITE

QUARTZ-EYE PORPHYRY

GABBRO, DIABASE

LE GROUP

ARKOSIC META-SANDSTONE

WASEKWAN GROUP

4

APHYRIC MAFIC METAVOLCANIC ROCKS

3

METASEDIMENTARY ROCKS

2

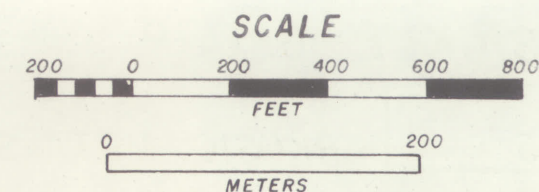
FELSIC METAVOLCANIC ROCKS
(includes 2e altered dacite, 2f sulfides)

1

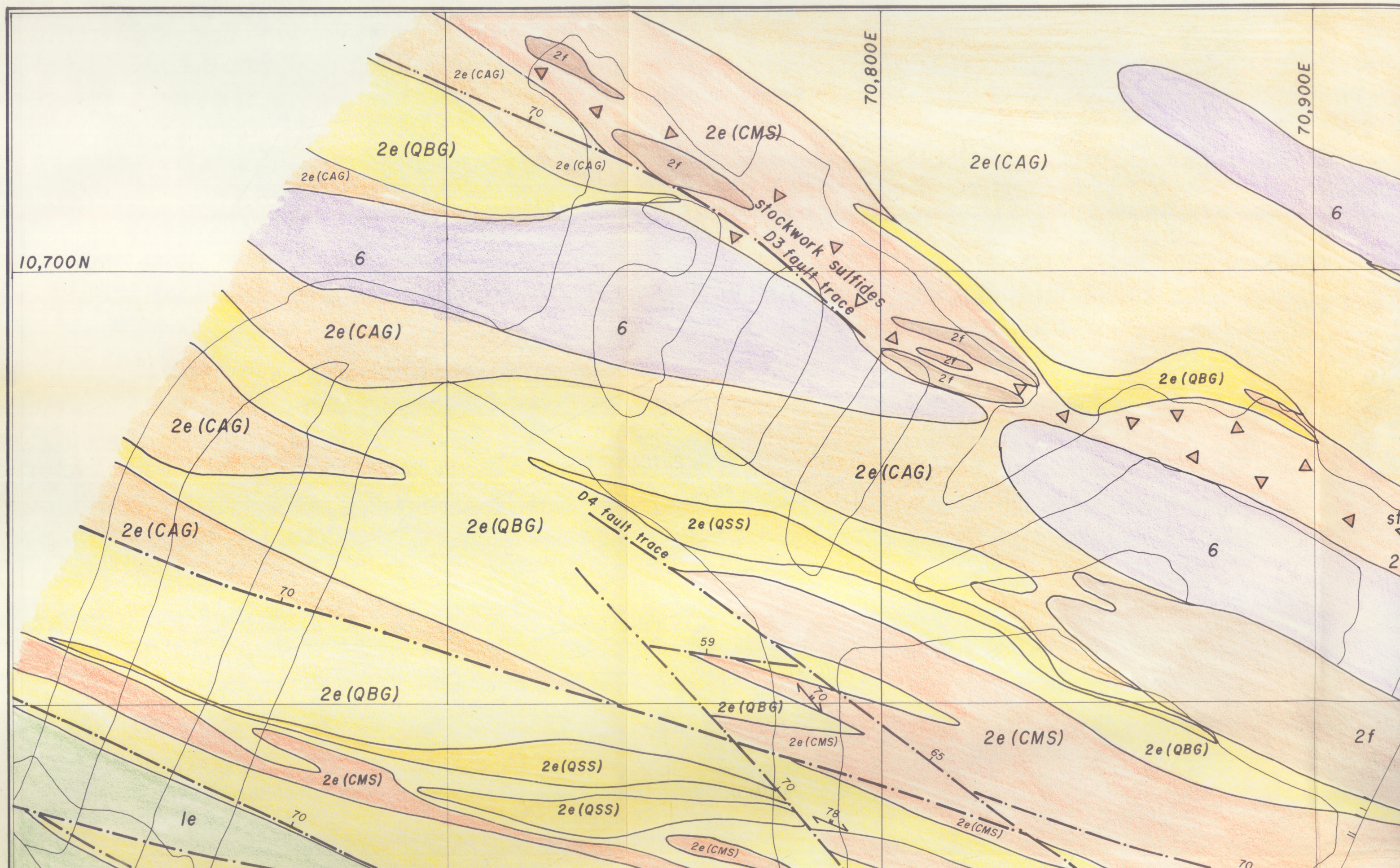
PORPHYRITIC MAFIC METAVOLCANIC ROCKS

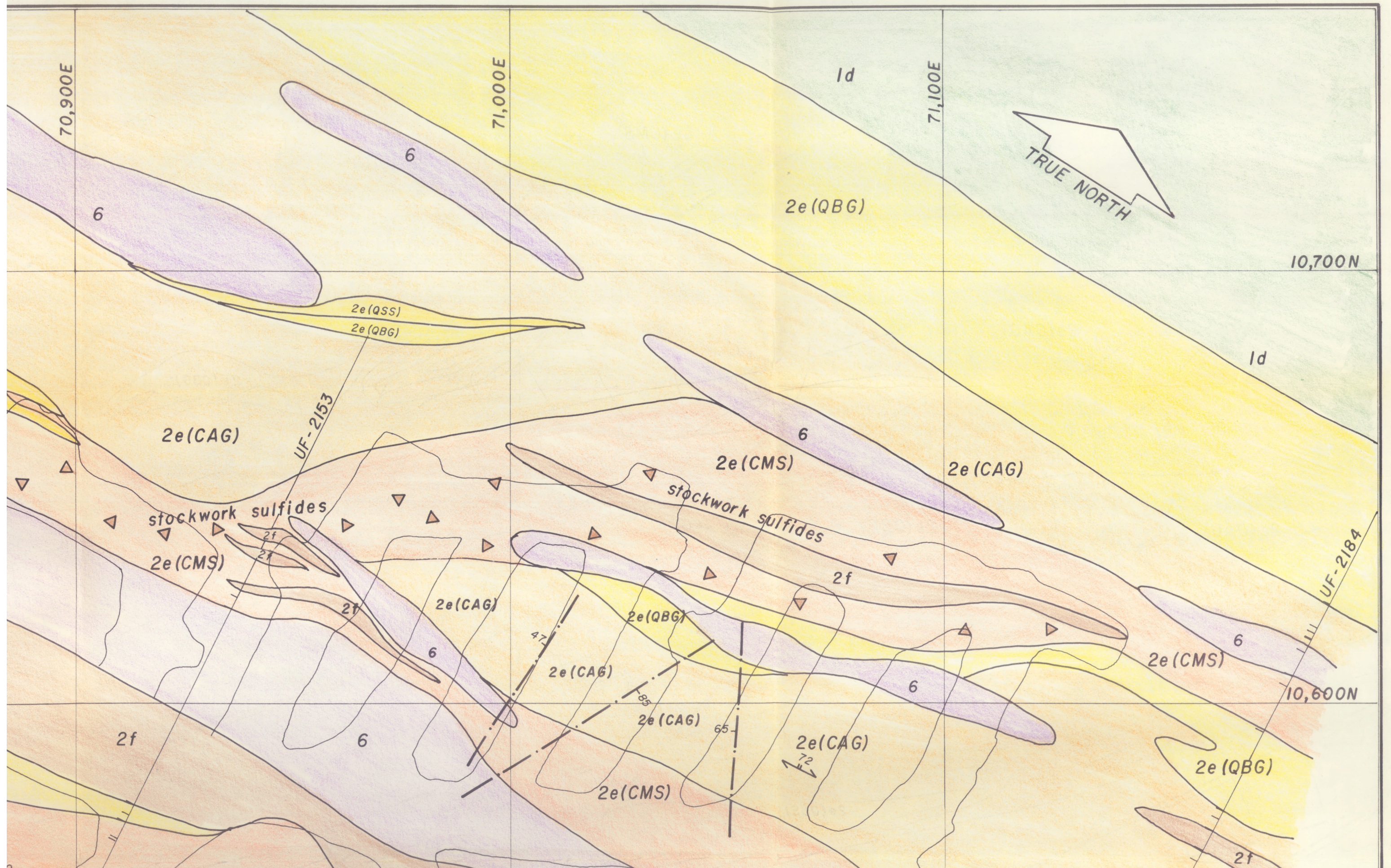
SYMBOLS

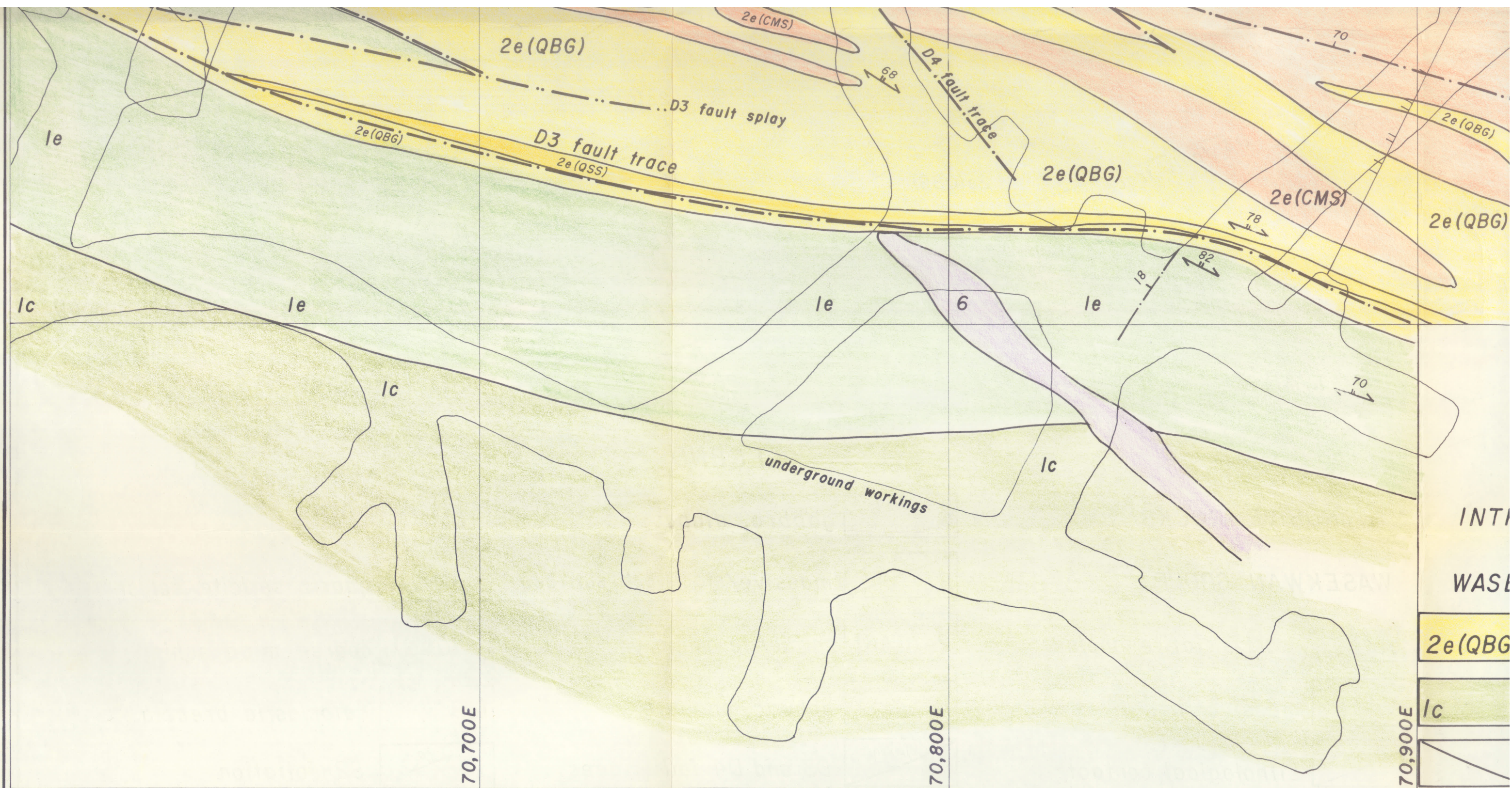
- Contact (defined inferred)
- Fault trace (defined inferred)
- Fault zone limits
- Axial trace (overtuned syncline)



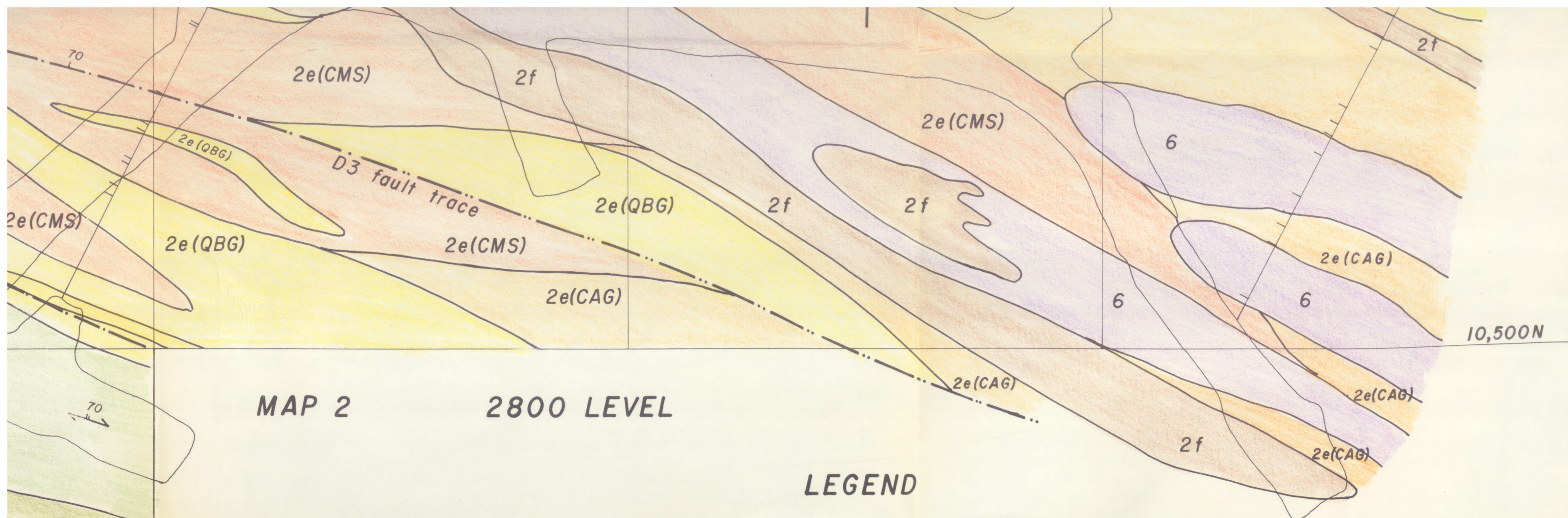
FOX MINE







FOX MINE GEOLOGY



MAP 2

2800 LEVEL

LEGEND

INTRUSIVE ROCKS

WASEKWAN GROUP

2e(QBG) quartz biotite gneiss

1c massive basalt

Lithological contact

6 gabbro, diabase

2f massive/stockwork sulfides

2e(CAG) cordierite anthophyllite gneiss

1d aphyric andesite

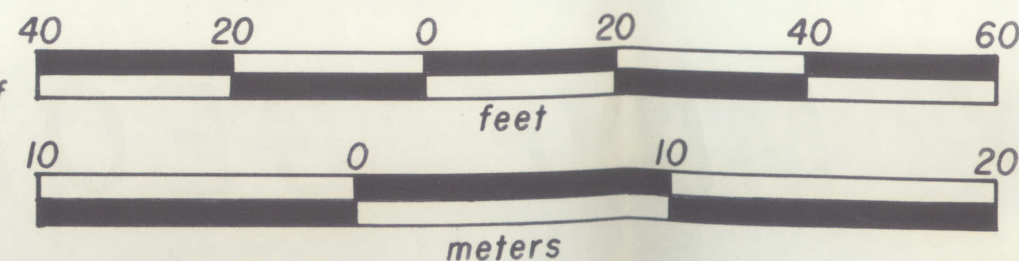
D3 and D4 fault traces

2e(QSS) quartz sericite schist

2e(CMS) coarse mica schist

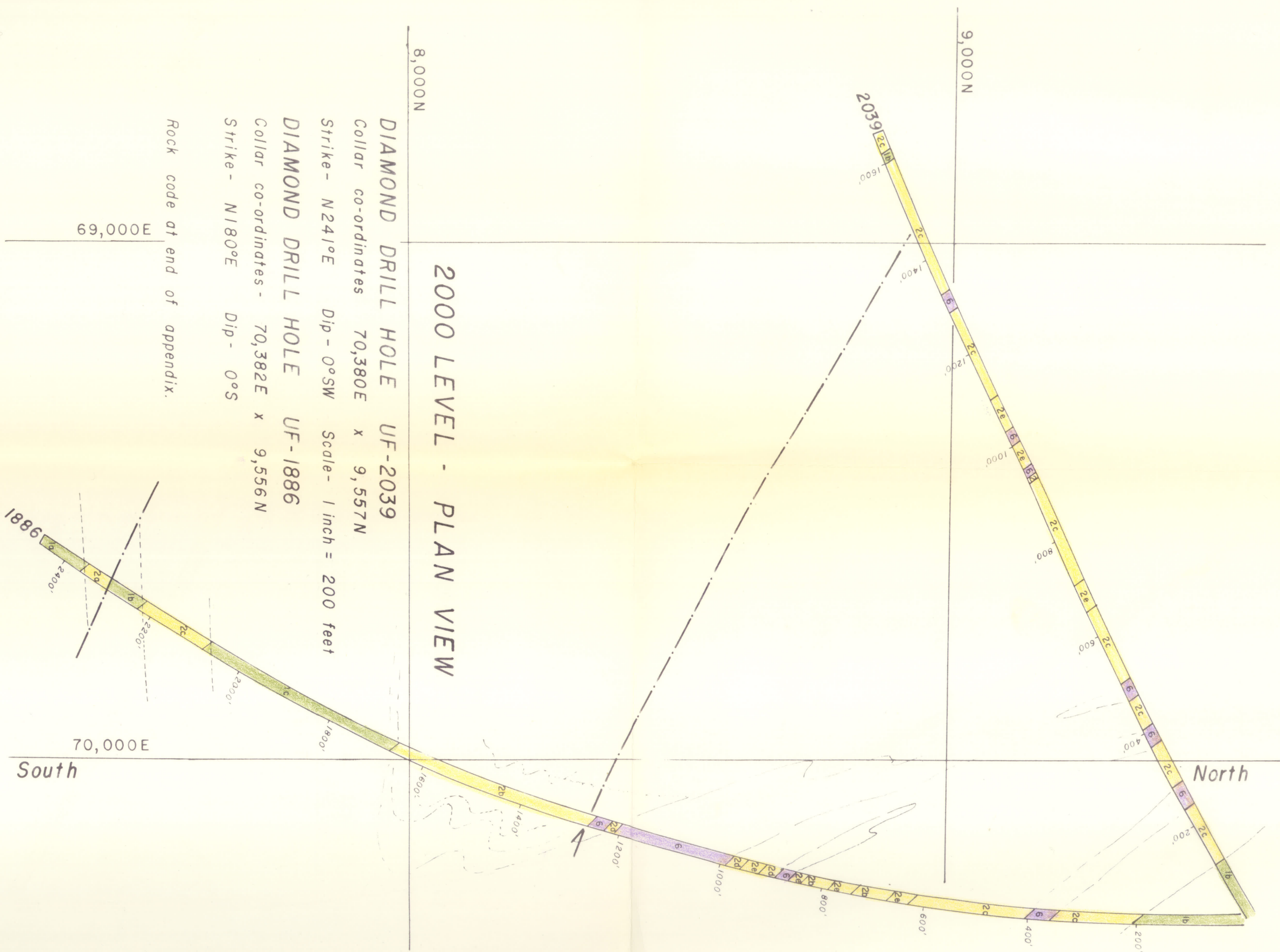
1e autoclastic breccia

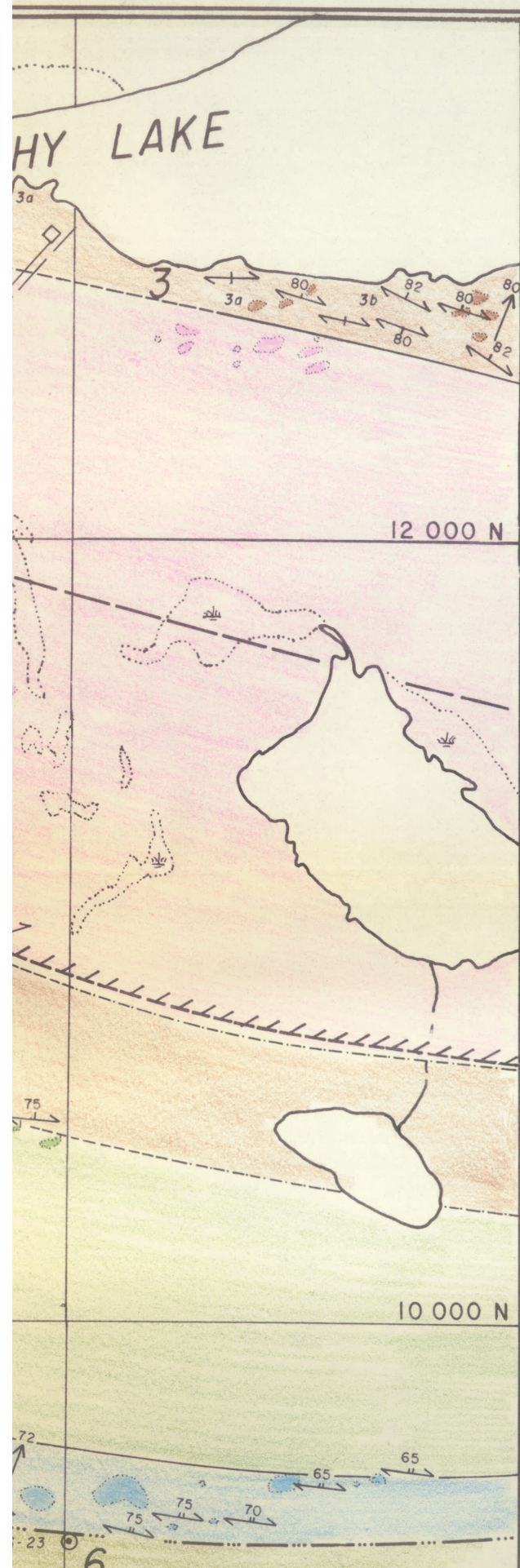
S2 foliation



Rock types listed on Map 2 are subdivisions of Unit 1 (PORPHYRITIC MAFIC METAVOLCANIC ROCKS) and Unit 2 (FELSIC METAVOLCANIC ROCKS). The latter rock types constitute an alteration envelope.

Geology by P.E. Olson, 1984.



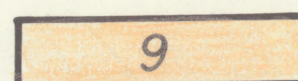


FOX MINE GEOLOGY

LEGEND

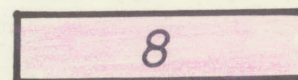
PRECAMBRIAN (APHEBIAN)

INTRUSIVE ROCKS



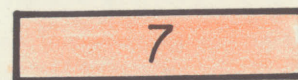
9

LEUCOGRANITE



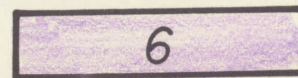
8

HORNBLENDE TONALITE, QUARTZ DIORITE



7

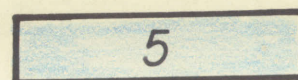
QUARTZ-EYE PORPHYRY



6

GABBRO, DIABASE

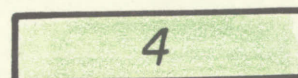
SICKLE GROUP



5

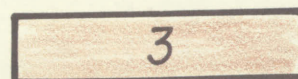
ARKOSIC META-SANDSTONE

WASEKWAN GROUP



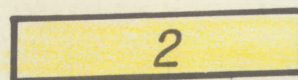
4

APHYRIC MAFIC METAVOLCANIC ROCKS:
4a massive basalt; 4b pillowed basalt



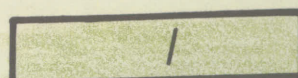
3

METASEDIMENTARY ROCKS:
3a feldspathic mudstone; 3b feldspathic siltstone; 3c felsic tuff



2

FELSIC METAVOLCANIC ROCKS:
2a massive porphyritic dacite; 2b massive aphyric dacite; 2c massive
porphyritic rhyolite; 2d dacitic tuff; 2e altered dacite; 2f sulfides



1

PORPHYRITIC MAFIC METAVOLCANIC ROCKS:
1a massive basalt; 1b pillowed basalt; 1c aphyric basalt; 1d aphyric

TRUE NORTH

68 000 E

70 000 E

72 000 E

000 N

000 N

D3 HATCHET LAKE SHEAR ZONE

FS-34

FS-29

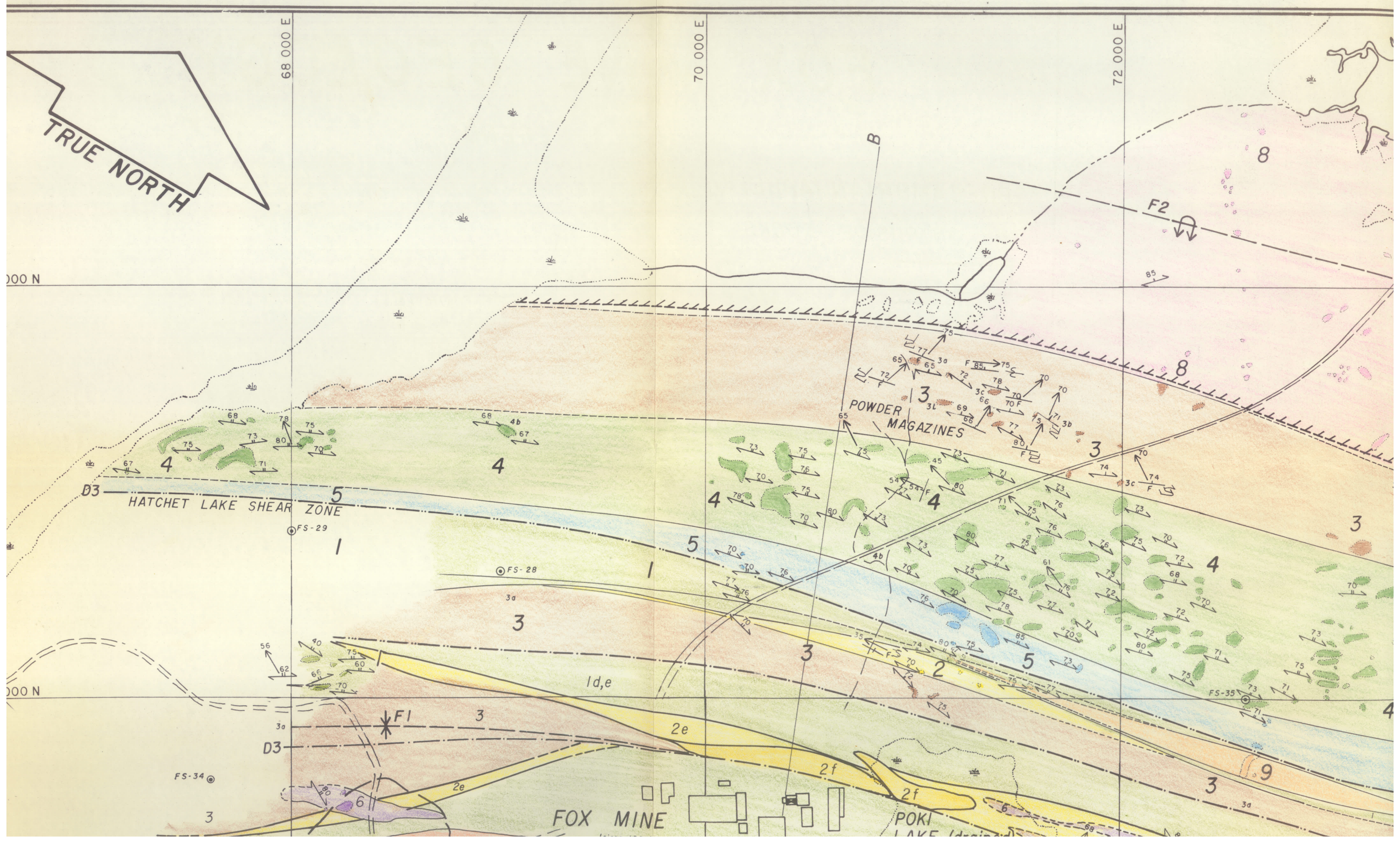
FS-28

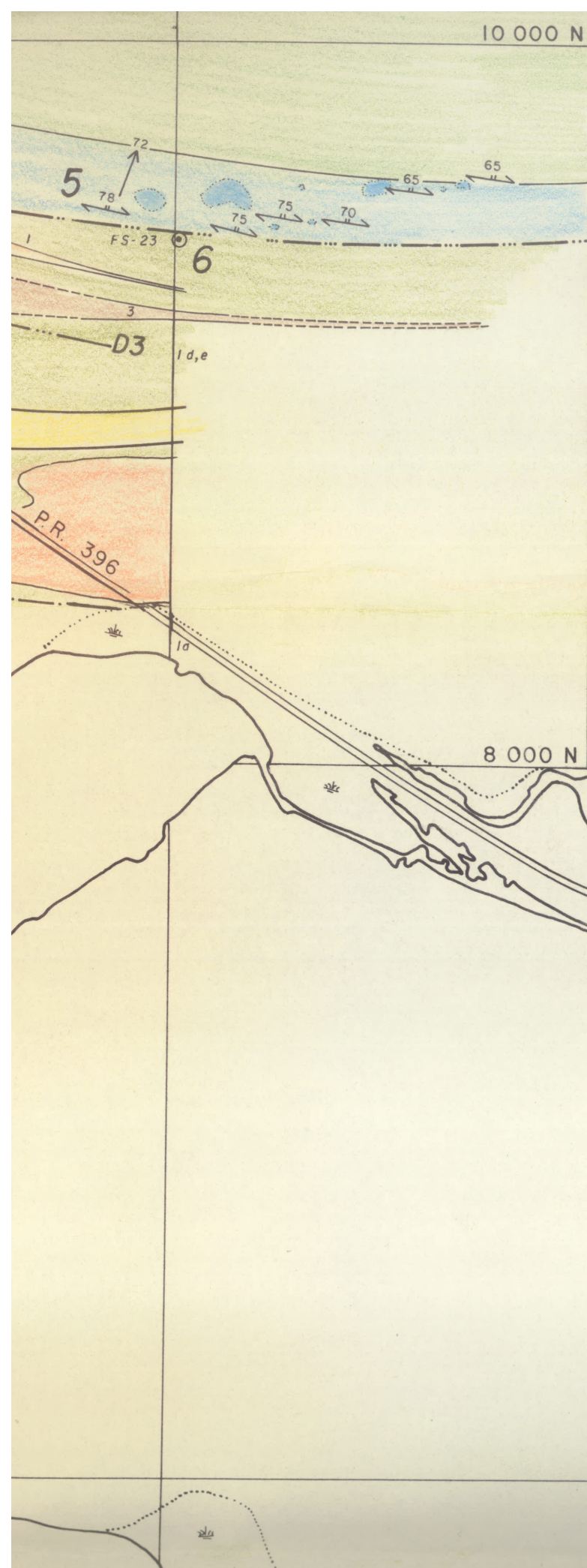
FS-35

FOX MINE

POKI LAKE

POWDER
MAGAZINES





2

FELSIC METAVOLCANIC ROCKS:

2a massive porphyritic dacite; 2b massive aphyric dacite; 2c massive porphyritic rhyolite; 2d dacitic tuff; 2e altered dacite; 2f sulfides

1

PORPHYRITIC MAFIC METAVOLCANIC ROCKS:

1a massive basalt; 1b pillowed basalt; 1c aphyric basalt; 1d aphyric andesite; 1e autoclastic breccia; 1f iron formation; 1g volcaniclastic and derived sedimentary rock; 1h altered porphyritic mafic metavolcanic rock

Stratigraphic order is implied for Units 1 (Oldest) to 5 (Youngest), inclusive. No stratigraphic order is implied for unit subdivisions. Where not obscured by metamorphism, subdivision terminology is that of primary rock types. Though unstated, the prefix meta- is implied for all rock types.

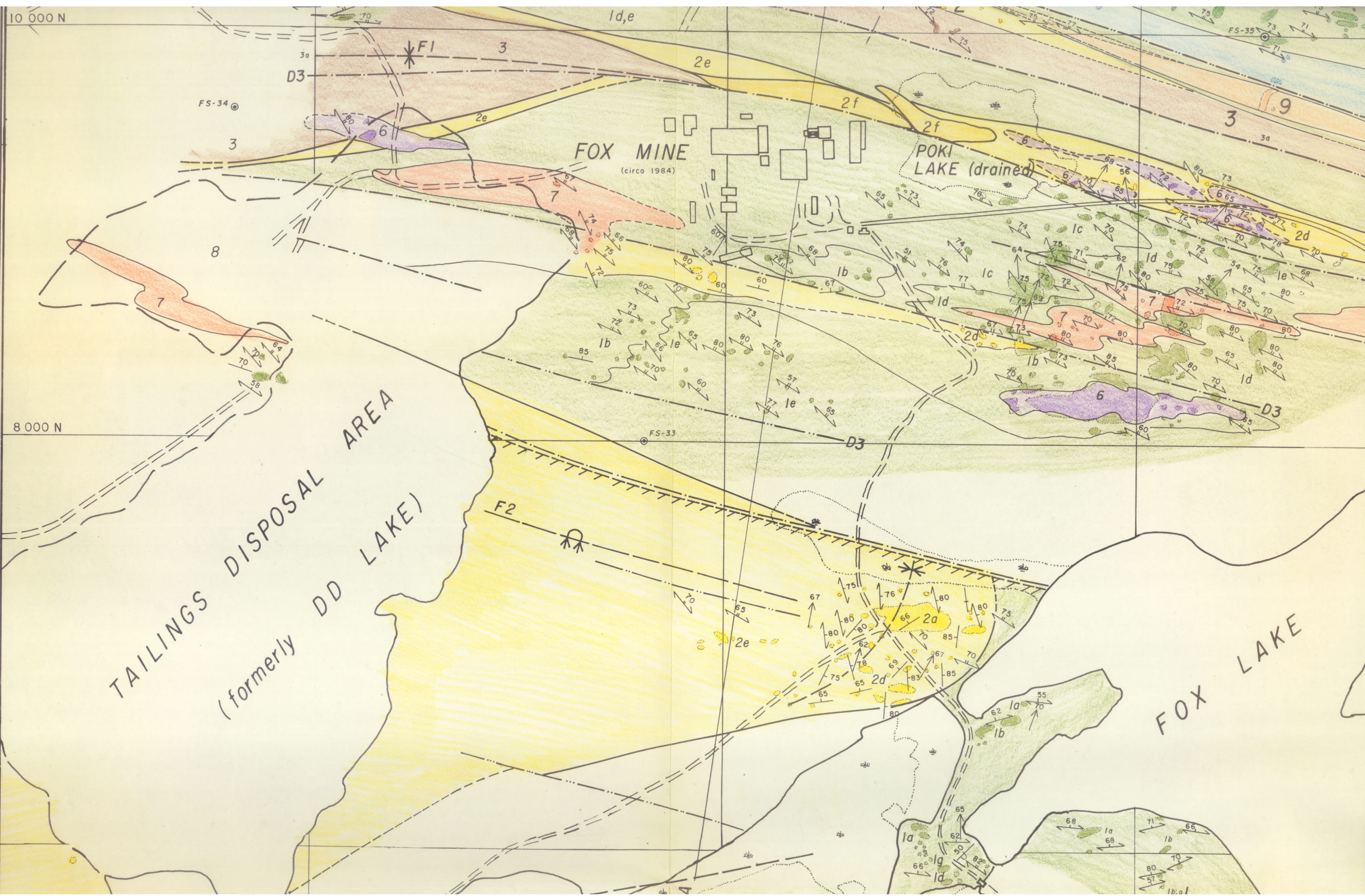
MAP 1

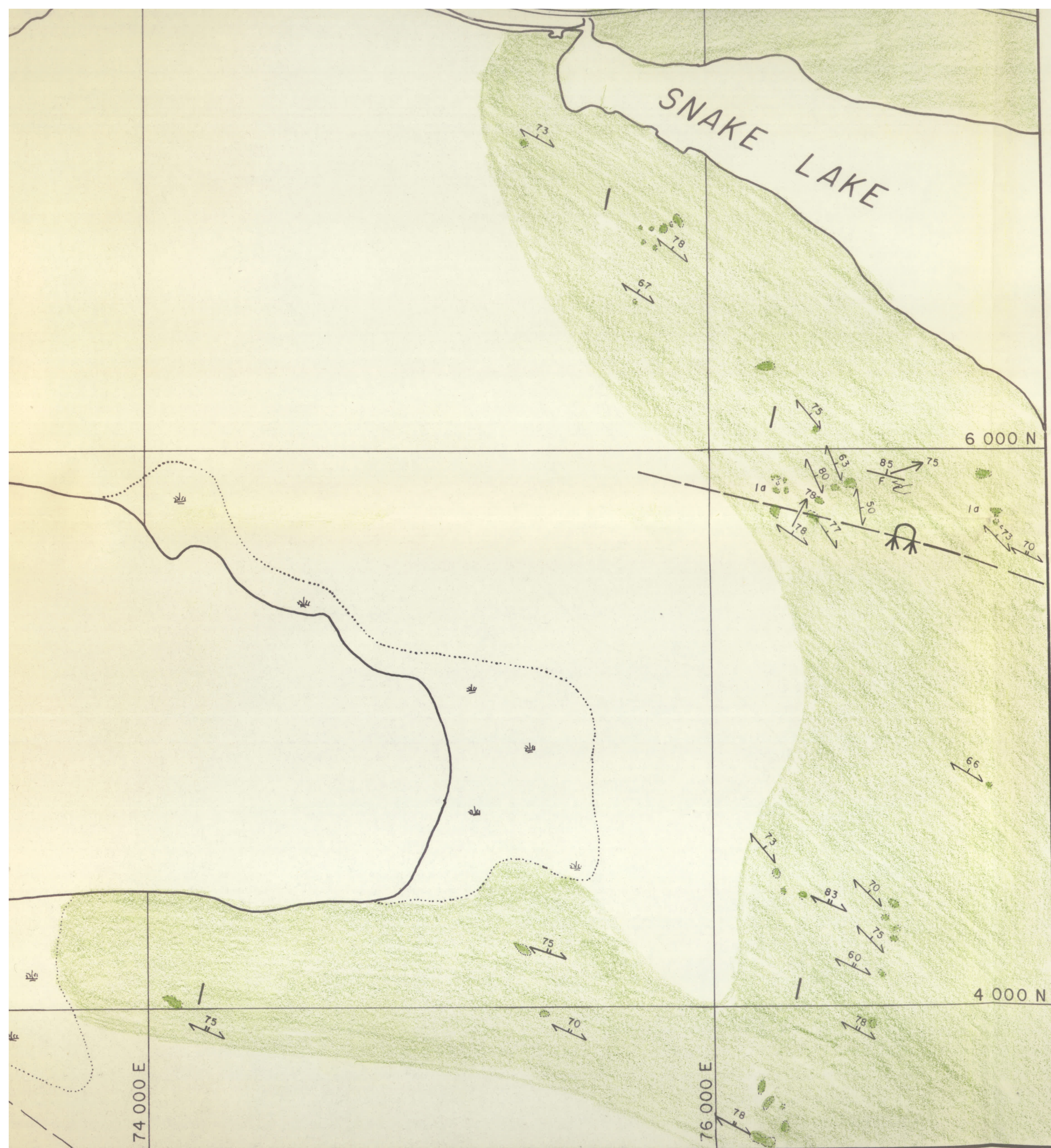
SYMBOLS

	Area of outcrop		Muskeg
	Geological contact (defined, approximate, inferred)		Buildings, shaft
	Fault (defined, approximate, inferred)		Diamond drill hole (collar location)
	Axial trace of anticline (normal, overturned)		Provincial road
	Axial trace of syncline (normal, overturned)		Access road, trail
	Minor fold axis (plunge and trend)		Mineral lineation (plunge and trend)
	Minor fold axial plane (strike and dip)		Bedding (strike and dip) tops; unknown, known, overturned
	Minor fold asymmetry (S-shaped, Z-shaped)		First generation foliation (strike and dip)
	Fault zone (approximate limit)		Second generation foliation (strike and dip)

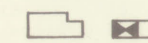
10 000 N

8 000 N





Geological contact (defined, approximate, inferred)



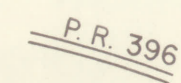
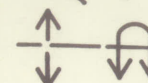
Buildings, shaft

Fault (defined, approximate, inferred)



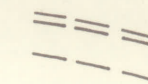
Diamond drill hole (collar location)

Axial trace of anticline (normal, overturned)



Provincial road

Axial trace of syncline (normal, overturned)



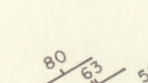
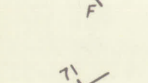
Access road, trail

Minor fold axis (plunge and trend)



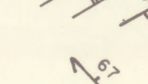
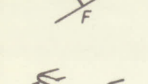
Mineral lineation (plunge and trend)

Minor fold axial plane (strike and dip)



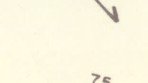
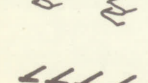
Bedding (strike and dip) tops; unknown, known, overturned

Minor fold asymmetry (S-shaped, Z-shaped)

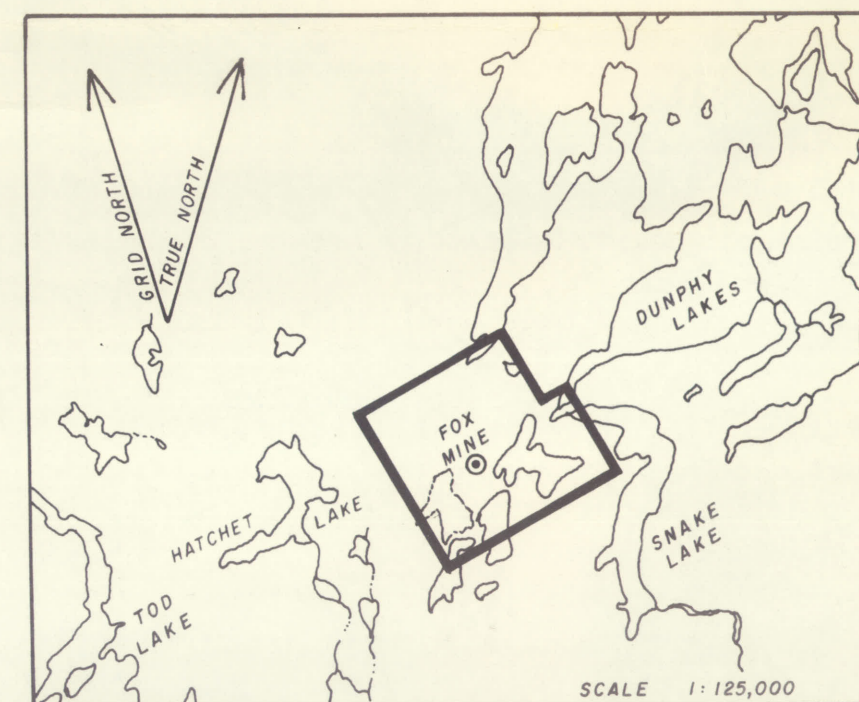


First generation foliation (strike and dip)

Fault zone (approximate limit)

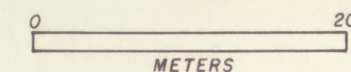
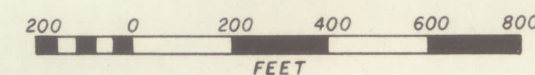


Second generation foliation (strike and dip)



KEY MAP

SCALE



GEOLOGY BY P. E. OLSON 1984

TAILINGS DISPOSAL
(formerly DD LAKE)

FOX LAKE

JAM LAKE

