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Rapportarkivet

Innlegging av nye rapporter ved: Peter

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Folldal Verk AS		Folldal Verk a.s.		

Tittel

Prospektering Tverrfjellet

Forfatter	Dato År	Bedrift (oppdragsgiver og/eller oppdragstaker)
Jackson	21.01 1983	

Kommune	Fylke	Bergdistrikt	1: 50 000 kartblad	1: 250 000 kartblad
Dovre	Oppland		15193	Røros

Fagområde	Dokument type	Forekomster (forekomst, gruvefelt, undersøkelsesfelt)
Geokjemi		Tverrfjellet

Råstofgruppe	Råstofftype
Malm/metall	Cu, Zn, S

Sammendrag, innholdsfortegnelse eller innholdsbeskrivelse

Rapporten er på engelsk, og konkluderer med.

1. The first priority is to define petrographically and lithographically the alternation features associated with the Tverrfjellet deposit.

2. A rock geochemical survey should be conducted over the whole of the Hjerkinn field, utilizing both surface exposures and diamond drill core from previous exploration.

3. Grid soil geochemistry should be conducted over all of the Turam anomalies extending east of the mine.

RECOMMENDATIONS

1. The first priority is to define petrographically and lithogeochemically the alteration features associated with the Tverrfjellet deposit.

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The stage has been reached in the exploration of the Tverrfjellet area where most of the readily identifiable targets have been tested by drilling. It is at this point that efforts must be redirected towards secondary and tertiary indicators based upon geological concepts. These can then be used to focus further geophysical and geochemical work in order to select areas warranting additional drilling.

The basis and starting point of the geological concept is that the Tverrfjellet deposit is a volcanogenic massive sulfide deposit and as such belongs to a class of deposits which are widespread in occurrence geographically and in geological time. This class of deposits has been very extensively studied and documented in the last twenty years. As a result numerous features have been noted to be common to many of the deposits, some being:

1. Occurrence near volcanic centers.

2. Close association with explosive, more felsic, phase of volcanism common.

3. Most have recognizable alteration zones which result from the passage of the metal bearing solutions through the rocks to the sea floor. As a result the alteration is most pronounced in the stratigraphic footwall although minor alteration can occur in the rocks overlying the sulfides also. This is due to the continued fumarolic activity from the same feeder zone after deposition of the bulk of the sulfides.

4. Metal zonation reflects the volcanic character of the deposits - the copper sulfides (with pyrrhotite) are deposited first in the center of the vent area, with pyrite and sphalerite being deposited further out and

up from the heat center. This results in a copper rich footwall and zinc (pyrite) rich hanging wall. The feeder zone often contains veinlets and stringers of chalcopyrite and pyrrhotite and therefore is often referred to as the "stringer zone". Disseminated pyrite and veinlets of sphalerite are also common to the "stringer zone".

5. Pauses in the volcanic activity often results in the deposition of cherty horizons, sometimes rich in magnetite. These can occur within the sulfide deposit and overlying it, and are indicative of "temporary" pauses in the volcanic activity.

6. The streaming of volcanic gases and liquids through the footwall rocks results in marked chemical changes in these rocks and corresponding changes in the mineralogy. This results in the development of alteration minerals in the footwall feeder zone.

7. In areas where several sulfide deposits are formed in association with the same period of volcanism the brine solutions have similar origin and chemistry. The resulting alteration features are therefore generally quite similar from one deposit to another. (e.g. In one district most of the deposits may have anthophyllite and cordierite as alteration products while in another they may have siderite and garnets. Each district commonly has a characteristic alteration mineral assemblage).

8. An alteration product common to almost all such deposits is chlorite. This is a result of Mg enrichment.

9. These footwall alteration "pipes" are often recognizable over a considerably larger area than the deposit itself and therefore, are useful as guides in prospecting because they present bigger targets. They can often be recognized

visually by the occurrence of particular alteration minerals and they can be indicated chemically by doing whole rock analyses for major elements.

10. The most common chemical changes associated with these feeder zones is the addition of Mg and Fe and the removal or leaching of Na and Ca. Another common feature is the addition of K adjacent to the sulfides, generally present as sericite alteration. Typical alteration zones which can be defined by rock geochemistry have anomalous MgO values of 1-1.5 km in diameter, with the Na_2O and CaO depletion zones generally slightly less. Several case examples are attached.

In the case of Tverrfjellet I would recommend that a petrographic and rock geochemical study be completed on the deposit first to definitely define the type and distribution of rock alteration associated with the feeder zone. This work could be conducted in conjunction with a rock sampling program over the whole Hjerkinn field. The rock sampling would include sampling from previous drill holes. An average of 3-5 samples per km2 if possible, should be collected. Two samples should be collected at every site, one for whole rock analyses and one for possible petrographic examination. Samples should be about 1 kg. each and should be fresh, unweathered rock. It is expected that the sampling could be completed in one summer season, while the preliminary work on the detailing of the Tverrfjellet alteration should take a few months.

It is also considered very important that the person that conducts the mine alteration study also re-examines all of the available drill core from previous exploration drilling.

The combination of the identification of the alteration assemblage and the whole rock geochemistry should be sufficient to define areas where more intensive geophysics and diamond drilling is warranted. I think that a study such as this is essential in order to direct drilling east of the fault, whether it be to locate the offset portion of the orebody or to locate new ore zones.

Jan. 21/83

CONCEPTUAL MODEL- MASSIVE SULPHIDES AND ASSOCIATED ALTERATION ZONES

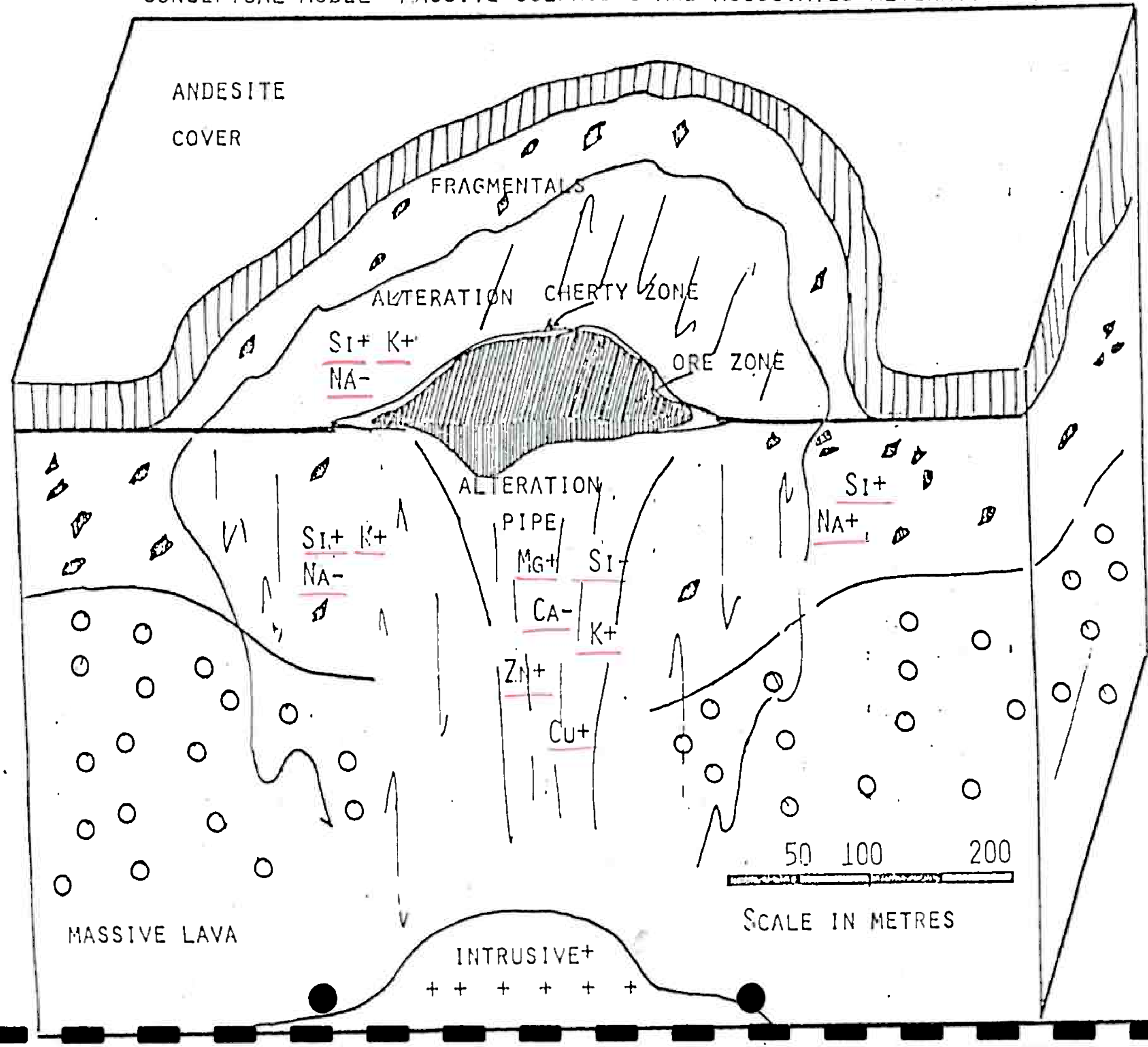


Fig. 1

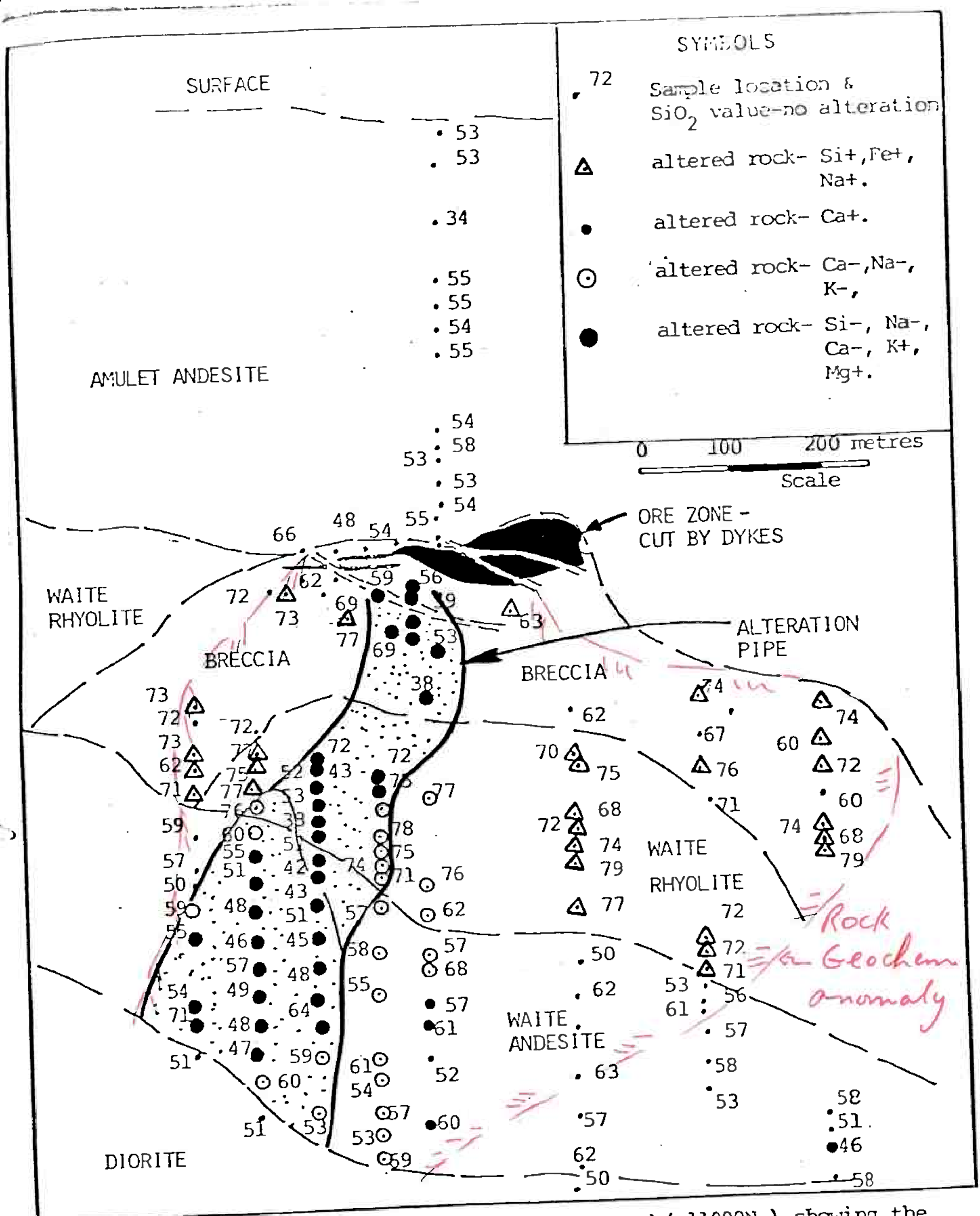


Figure 2 : East Waite Mine section, looking North(11000N) showing the associated major element rock alteration (trace metal anomalies correspond well with more intensly altered areas(alteration pipe)). Geology courtesy of W. L. Bancroft, Noranda Mines Ltd. Raw geochemical data from McConnell,1977.

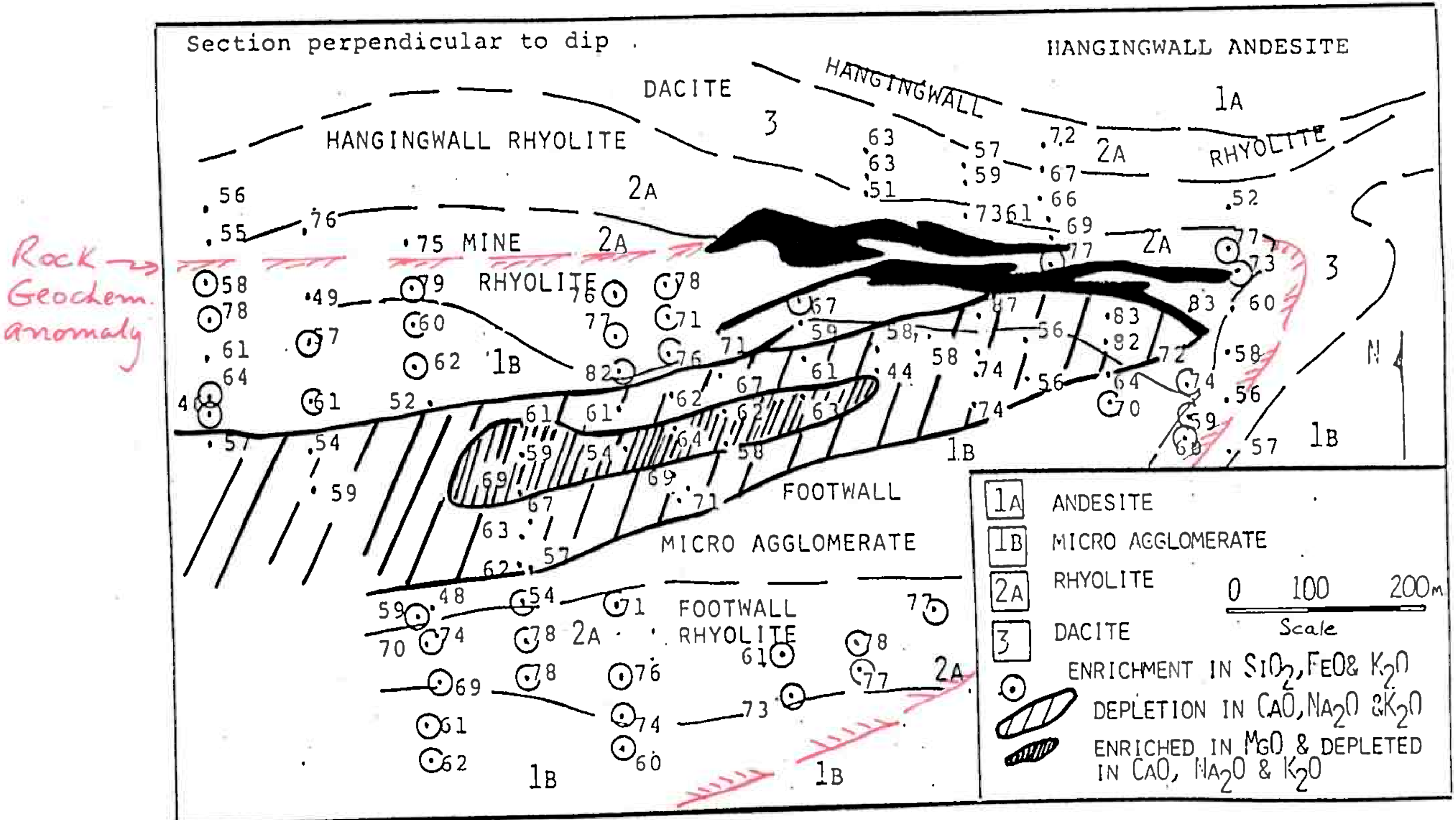


FIGURE 3: ROCK ALTERATION AROUND THE MATTABI MINE, NORTHWEST ONTARIO. (Geology after Franklin et al., 1975. Chemical data from McConnell, 1977)

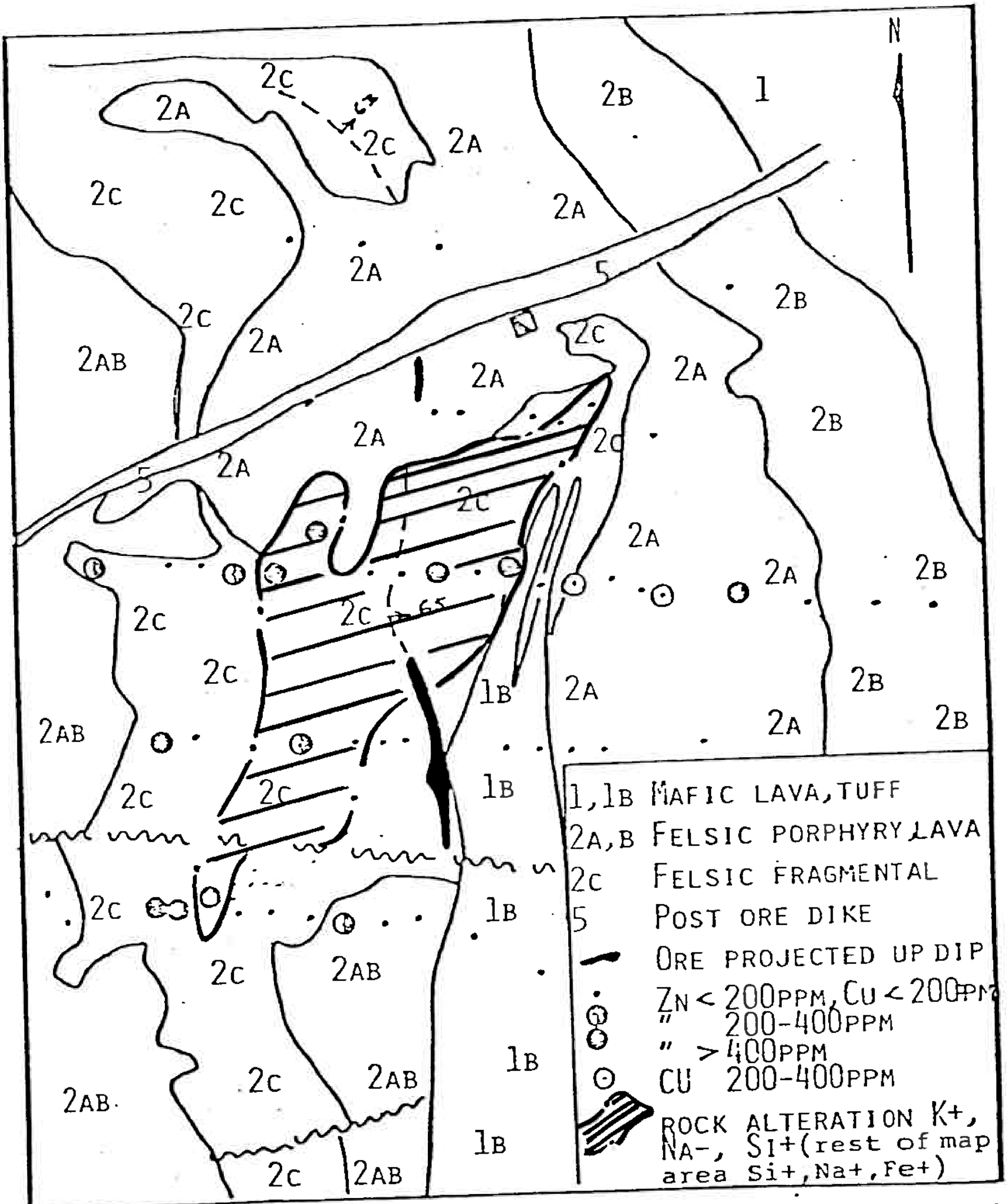
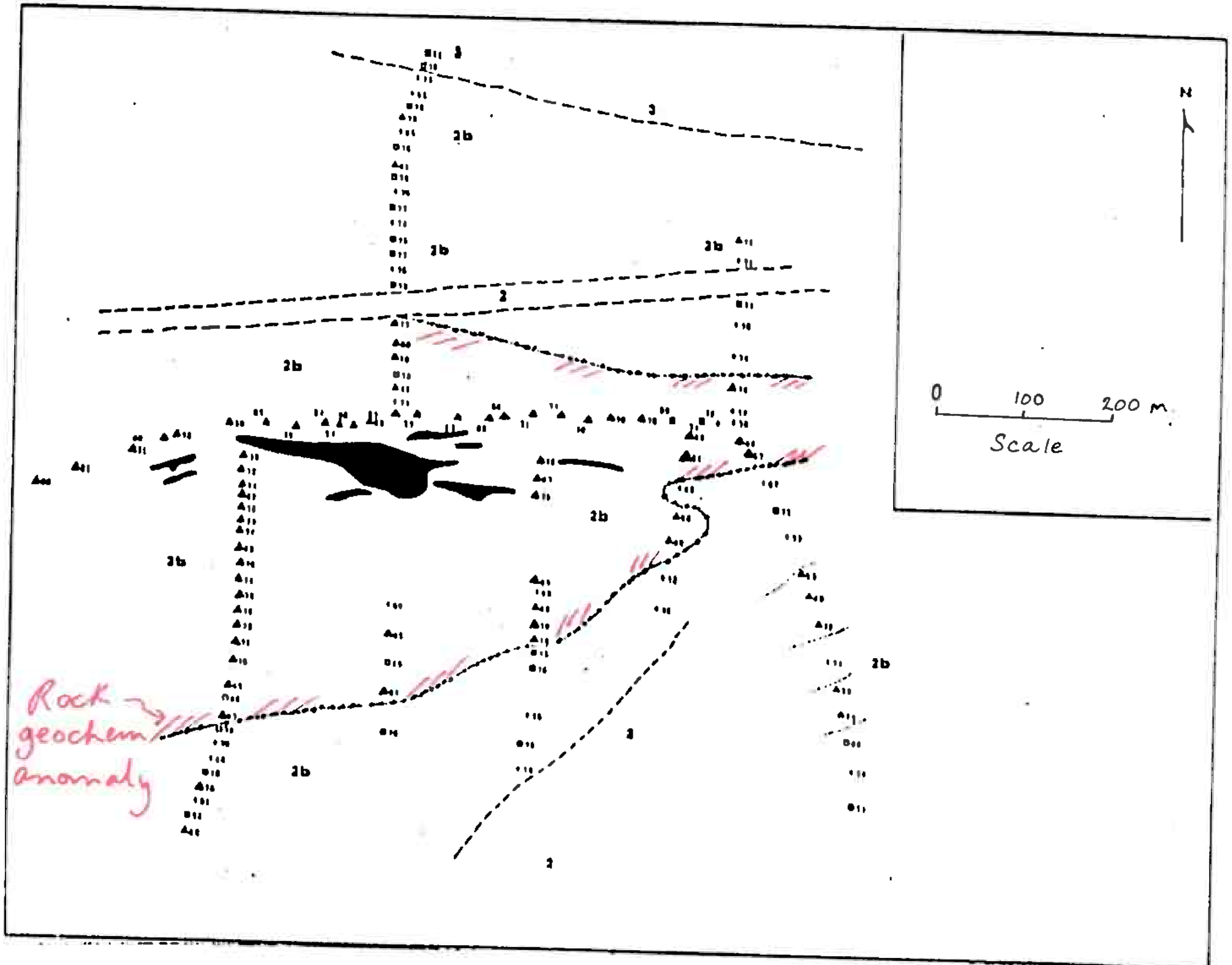


FIGURE 4A. DISTRIBUTION OF ZINC, COPPER AND ROCK ALTERATION AROUND THE DELBRIDGE MASSIVE SULPHIDE DEPOSIT, NORANDA, QUEBEC. ALTERATION IS PERVASIVE OVER ALL THE MAP AREA(SI, NA, & FE ENRICHMENT) WITH INTENSE ALTERATION STRATIGRAPHICALLY BELOW THE ORE ZONE (SHOWS DEPLETION IN NA, & ADDITIONAL ENRICHMENT IN SI AND K). (Geology is after Boldy 1968)



MINES DE POIRIER- PLAN 1150 FT. LEVEL.(2,2B),FELSIC VOLCANIC OR PYROCLASTIC,(3) GRANITE,(SOLID BLACK) MASSIVE SULPHIDE,(DOTTED LINE),OUTLINE OF ANOMALOUS ZONE
+ SAMPLE-UNALTERED, ▫ WEAKLY ALTERED, △ ANOMALOUS, ▲ HIGHLY ALTERED.

FIG 4

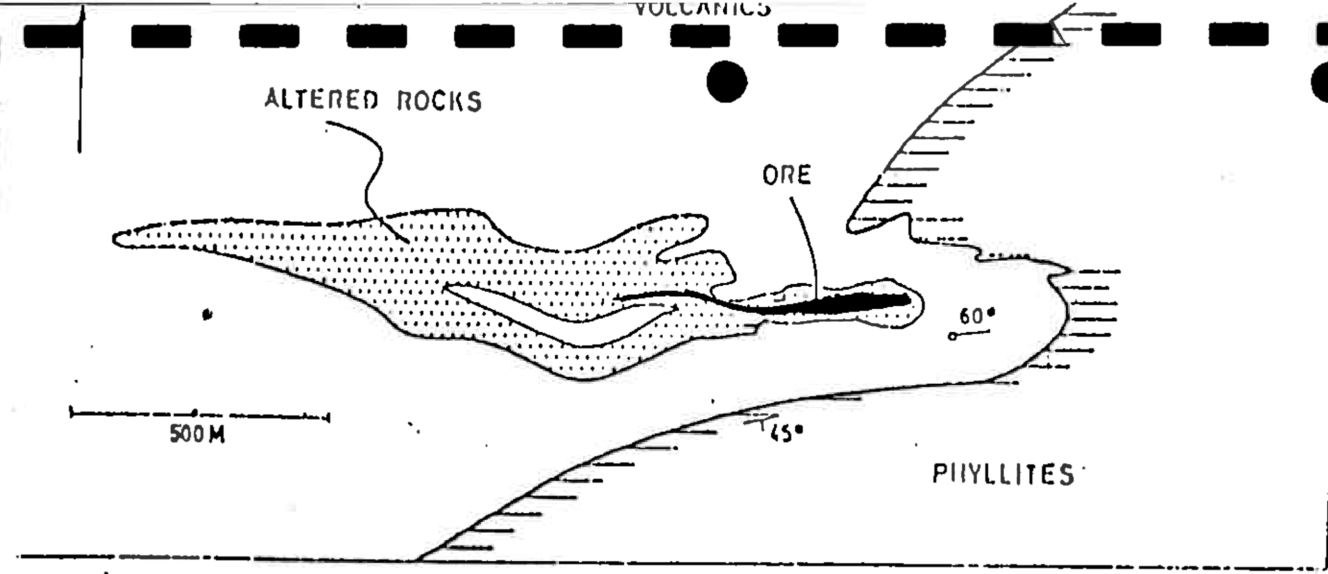


Fig. 1. Position of the Boliden ore in the envelope of altered rocks.

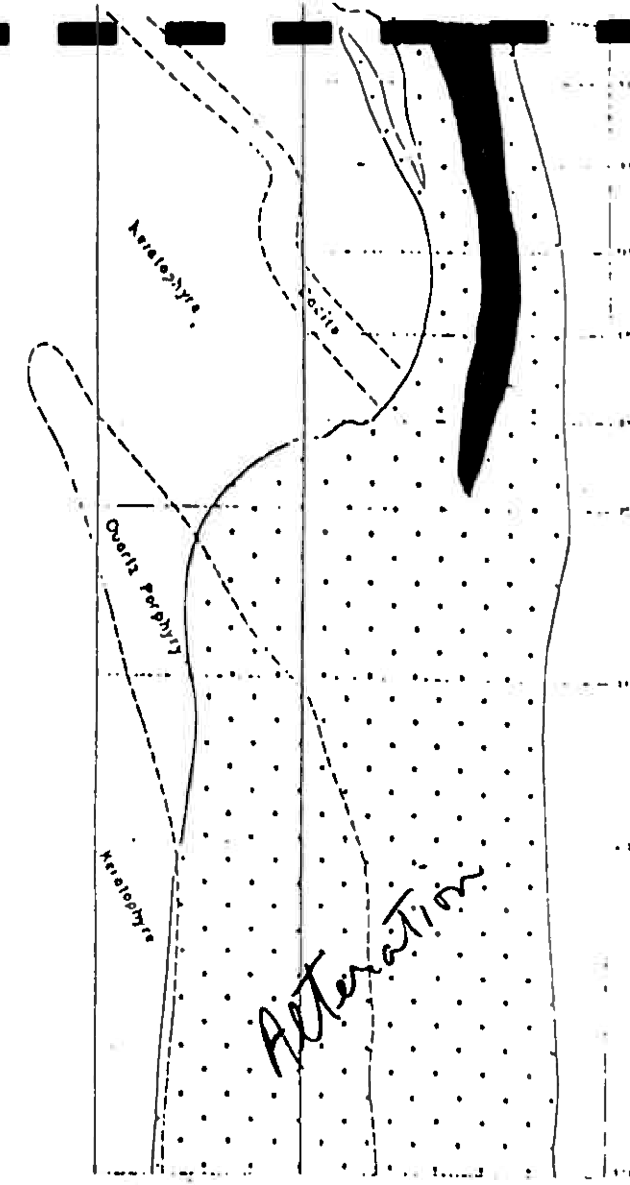


Fig. 2. Vertical cross section of the Boliden ore (black) with altered rocks (dotted). Section looking East.

WALL ROCK ALTERATION AT THE BOLIDEN DEPOSIT, SWEDEN.

(C.A. Nilsson, Economic Geology, Vol. 63, 1968.)

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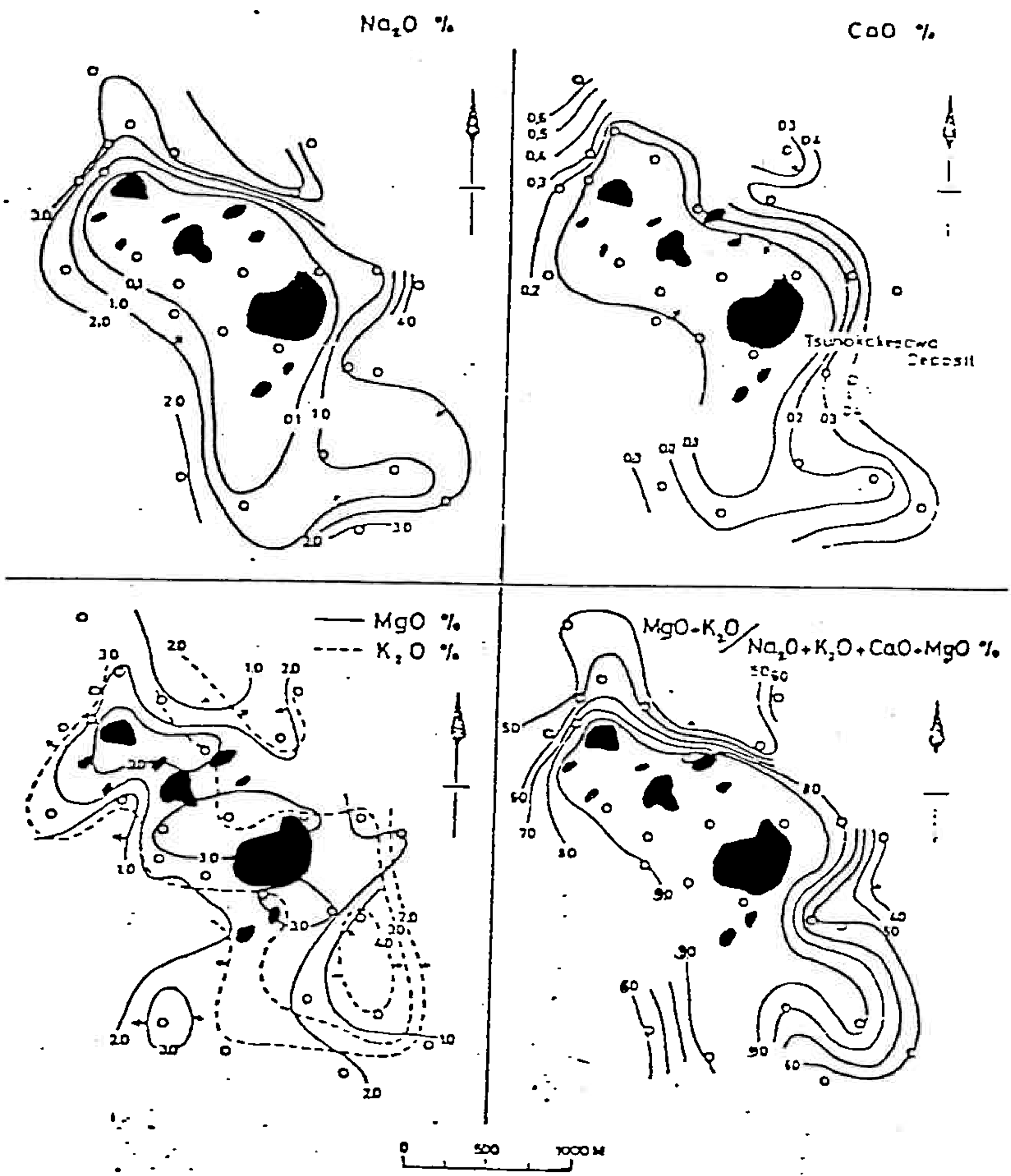

ALTERATION AROUND THE KUROKO DEPOSITS, JAPAN.
(K.Hashimoto, A.I.M.M.G.M. Mem. Tec. XII, 1977)

TABLE 4 — Average Values of Copper, Nickel and Zinc for Different Volcanic Rock Types of Abitibi

ppm	THOLEIITIC SERIES					CALC-ALKALINE SERIES				
	BASALT	ANDESITE	DACITE AND QUARTZ BASALT	RHYODACITE AND DOREITE	RHYOLITE AND DELLANITE	BASALT	ANDESITE	DACITE AND QUARTZ BASALT	RHYODACITE AND DOREITE	THYOLITE AND DELLANITE
Copper	120	93	81	68	15	116	96	55	57	30
Nickel	109	51	45	35	15	117	95	80	65	16
Zinc	99	117	120	80	45	99	85	76	61	48
Number of samples	66	13	10	6	2	47	53	26	22	9

ratio is large, but the spatial extent of this type of anomaly is limited as compared to that characteristic of MgO and Na_2O anomalies. From the 344 samples (pyroclastics and flows) analyzed for our regional study, 59 contain over 65% SiO_2. The four samples collected from the Matagami area are all abnormally high in MgO and deficient in Na_2O. In the Joutel-Poirier mining camp and in Louvicourt township, most of the samples are too rich in MgO and many of them are too low in Na_2O. A sample collected on strike 2 miles east of the former Lyndhurst copper-mine, located in Destor township, is anomalous in MgO.

As a rule, the copper-zinc deposits of Abitibi stratigraphically overlie the rhyolites, which mark the end of a differentiated sequence, or occur within the associated pyroclastic rocks. The extent of the anomalous zones associated with the orebodies is partly related to the original porosity of the surrounding rocks. In that respect, the solutions circulating in porous pyroclastics would produce more extensive chemical anomalies than those solutions circulating along fractures in massive rhyolite. This is illustrated on Figure 19, which is an idealized example where contour lines of the MgO ratio are plotted. The MgO ratio is obtained by dividing the MgO value of the sample by the MgO value on the average curve of Abitibi rocks corresponding to the SiO_2 content of the sample.

An interesting example is in the Norbec area on the property of Lake Dufault Mines Limited in Dufresnoy township. Sakrison (1966) analyzed the diamond drilling core of the upper 75 feet of the Waite rhyolite for major and trace elements. The MgO values are contoured on Figure 20. The contour lines show elongated zones of MgO enrichment that are interpreted to result from the chemical alteration produced by solutions circulating along fractures in the massive rhyolite. It seems evident from Figure 20 that there is a relation between the elongated and extensive zones of chemical alteration and the orebody. By delimiting the altered zones, even if the MgO enrichment is relatively weak, one can eliminate much ground in the search for a copper-zinc deposit and concentrate the exploration work on altered zones.

The $MgO:SiO_2$ diagram for 67 new analyses of volcanic rocks (flows and pyroclastics) from the Joutel-Poirier mining camp is shown on Figure 21. Samples taken underground near the copper zones are the ones most enriched in MgO; these are followed in degree of MgO enrichment by samples taken less than 2000 feet from a base metal mine in this mining camp.

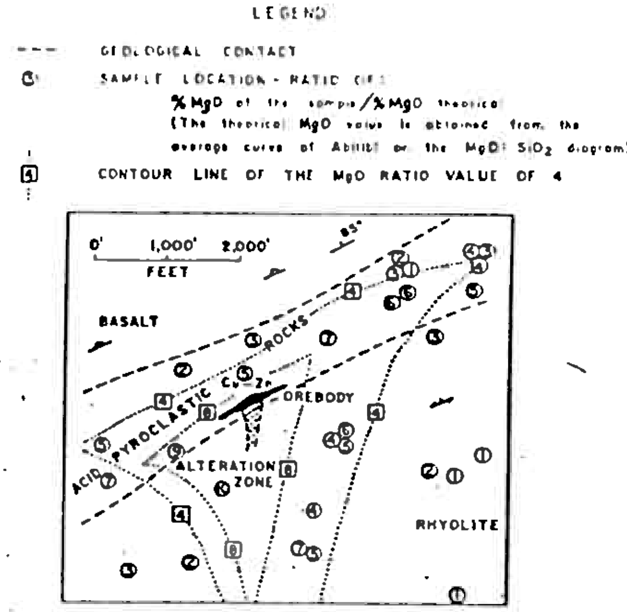

FIGURE 19 — Idealized example of an MgO anomaly

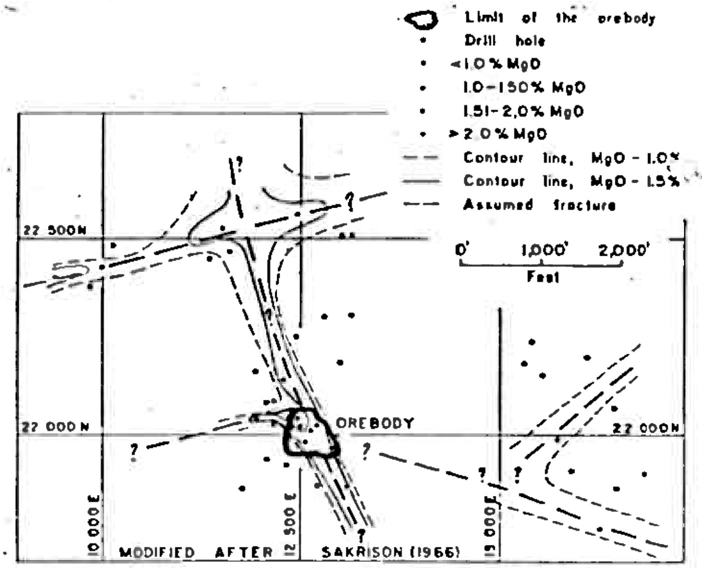

FIGURE 20 — %MgO in the upper part (75 feet) of the Waite rhyolite, Lake Dufault mine, Norbec area.

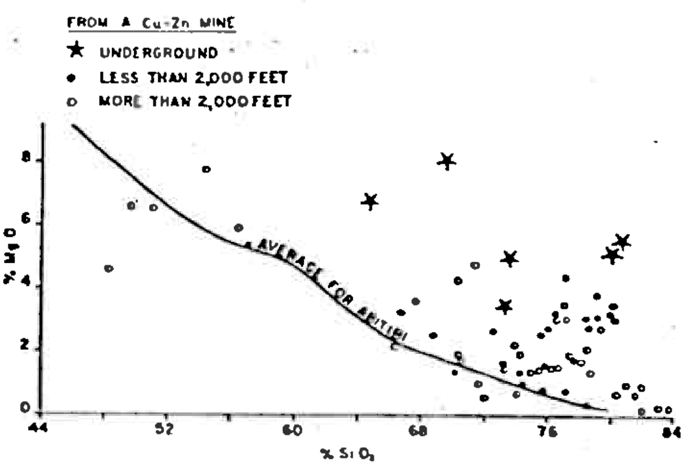

FIGURE 21 — $MgO:SiO_2$ diagram for the Joutel-Poirier area.

TABLE I

DEPOSIT	HOST ROCK TYPE	ORE MINERALOGY	ALTERATION MINERALOGY	GEOCHEMICAL ALTERATION: MINE SCALE <1 KM	GEOCHEMICAL ALTERATION: REGIONAL >1 KM	AGE
• Kuroko, Japan Lambert & Sato (1974)	felsic volcanic	py, cpy, sph, ga, bar	mon, ser, chl, kaol	K+, Mg+, Fe+, Si+ Ca-	ND	Cenozic
• Kuroko, Japan Tatsumi & Clark (1972)	" "	" " "	ser, qtz, cal	Mg+, K+ Na-, Ca-, Fe-	ND	Cenozic
• Buchans, Can. Thurlow et al (1975)	felsic pyroclastics	sph, ga, cpy, (py tet, bo, cov)	chl, ser, qtz	Mg+, Fe+, Si+ Na-, Ca-, K-	ND	Paleozoic
• Heath Steele Can. Wahl et al (1975), Whitehead & Govett (1974)	felsic tuffs	py, sph, ga, cpy	chl, ser	Mg+ Na-, Ca-	ND	Paleozoic
• Brunswick No. 12, Can. Goodfellow (1975)	felsic tuffs	py, sph, ga, po, cpy, tet, bo	chl, ser, qtz	Mg+, Fe+, (Mn, K+) Na-, Ca-	ND	Paleozoic
Key Anacon Can., Saif & McAllister (1978)	Above Brunswick tuffs in Fe rich sediments	ND	ser, chl, carb, qtz	ND	ND	Paleozoic
• Killingdal, Norway Rui (1973)		py, sph, cpy	chl, bio, qtz	Mg+, K+, Mn+ Na-, Ca-, Si-	ND	Paleozoic
• Boliden, Sweden Nillson (1968)	felsic pyroclastics		chl, ser, qtz, andal	Mg+, K+, Al+ Na-. Ca-	ND	Proterozoic
Stull Lake, Canada Studer (1980)	felsic pyroclastics	py, po, cpy, sph, mte	ser, gar, chl, staur, qtz, (cord, anthoph)	Mg+, Fe+ Na-	Fe+, Si+, Na+	Proterozoic
Flin Flon, Can. Koo & Mossman (1975)	quartz porphyry	py, sph, cpy, (arseno, mte, ga, tet, argen)	ser, chl, cal, epidote	Mg+, Fe+, Ca+ Si-, Na-, K-	Si+, Fe+, Na+	Proterozoic
• Mattabi, Can. Franklin et al. (1975)	felsic-intermediate pyroclastics	cpy, py, sph	qtz, carb, ser, chld, chl, andal, gar, kyan, bio	Fe+, Mg+ Na-, Ca-	Si+, Fe+, K+	Archean
Lyon Lake, Can. Harvey & Hinzer (1980)	felsic pyroclastics	sph, py, po, cpy, ga, tet, arseno, mte	chl, carb, gar	Fe+, Mn+, Ca+ Na-	Si+, Fe+, K+	Archean
• South Bay, Can. McConnell (1976)	felsic pyroclastics	py, sph, cpy, po	qtz, ser, chl	Mg+, Fe+ Na-, Ca-	Si+, Fe+, K or Na+, Zr+	Archean
Kidd Creek, Can. Walker et al (1975)	felsic breccia & volcaniclastic seds	py, sph, cpy, ga, po, cassit	ser, chl. qtz, carb, bio, talc, tourm	ND	Si+, K+, Fe+ Zr+	Archean
Canadian Jamieson, Can Mine Staff (1968)	Contact rhyolite & andesite	py, cpy, sph, po	ser, chl, dol, qtz	ND	Si+, K+, Fe+ Zr+,	Archean
• Millenbach, Can. Simmons et al (1973)	mafic volcanics	cpy, py, sph	chl, ser, cord, anthoph	Mg+, Fe+ Na-, Ca-, Si-	Si+, Na+, Fe+	Archean
• Lac Dufault Can. Sakrison (1966)	felsic pyroclastics		chl, ser	Mg+, Fe+, Mn+, Na-, Ca-	Si+, Na+, Fe+	Archean
• East Waite Can. McConnell (1976)	felsic pyroclastics	py, sph, cpy	chl, ser, qtz, cord, anthoph	Mg+, Fe+, Al+ Na-, Ca-, Si-	Si+, Na+, Fe+	Archean
Delbridge Can. Boldy (1968)	felsic pyroclastics		chl, ser	Si+, Mg+, K+ Na-	Si+, Na+, Fe+	Archean
• Mines de Poirier, Can. Descarreaux (1973)	felsic volcanics		chl, ser	Mg+, K+ Na-, Ca-	ND	Archean
Mattagami Lake, Can. Roberts (1975)	rhyodacitic tuffs	py, sph, po, mte, cpy, ga, arseno	ser, chl, epidote, talc, actin, carb	ND	ND	Archean

N.D. = Not Determined