R. V. KIRKHAM

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GEOLOGY OF THE BRENDA COPPER-MOLYBDENUM DEPOSIT, BRITISH COLUMBIA

Arthur E. Sorogaroli

The Brenda deposit is 14 miles northwest of Peachland, British Columbia, at elevations ranging from 5000 to 5600 feet. The deposit is on a ridge between Peachland Creek and MacDonald Creek. Glacially rounded outcrops are scattered through the rolling, tree-covered topography.

Rice (1948) briefly described the deposit and noted the possibility of a low-grade deposit of large tonnages. In 1957 one of his field assistants, C. Ney returned to the deposit with Kennco (then Northwest Explorations) and produced the most comprehensive and detailed account of the deposit to date. Carr studied the deposit and the surrounding area in 1966 and 1967 and has provided valuable additions to the geology of the area. The present study has been confined to the ore deposit. It is interesting to note that the only differences between this study and Ney's study of 1957 are additions made possible by excavation which provides more and fresher rock faces.

The deposit is presently being prepared for production at a rate of 24,000 tons per day. Approximately 9,000,000 tons of oxidized capping and waste are being removed from the orebody in preparation for production in the fall of 1969. Published reserves are 177,000,000 tons grading 0.183% copper and 0.049% molybdenum. This figure includes 28,000,000 tons grading 0.212% copper and 0.063% molybdenum to be mined in the first three years.

GEOLOGY OF THE DEPOSIT

The Brenda copper-molybdenum deposit is entirely within the Brenda Stock, a composite quartz diorite body of Jurassic age.

Tho stock was intruded into Triassic sedimentary and volcanic rocks of the Nicola Group with the resultant dovelopment of a hornfels zone up to 1500 feet wide.

Carr (1968) recognized five different phases in the Brenda Stock. These include, in sequence, a marginal Medium Quartz Diorite, Speckled Quartz Diorite, Uniform Quartz Diorite, and Porphyritic Quartz Diorite, all of which are gradational to adjacent phases and a predominantly discordant Fine Quartz Diorite phase as shown in Figure 2. The phases occur in bands grossly parallel to the west contact of the stock with Nicola Group rocks.

Several kinds of dykes occur in the area. Those observed within the orebody include: Granophyre, trachyte porphyry, lamprophyre, and andesite.

Granophyre dykes (referred to as aplite-pegmatite by Carr, 1968) with widely varying textures consist of aplite or of graphic intergrowths of quartz and potash feldspar with minor plagioclase and biotite. Some dykes have granophyric borders and aplitic or pegmatitic cores and others have aplitic borders with granophyric cores. Dykes less than 3 inches wide are aplitic throughout.

Most granophyre dykes strike north 50-65°W and dip about 65°NE. Some have EW strikes and dip about 55°N. Pegmatitic phases contain minor quantities of disseminated chalcopyrite and pyrite. All granopyre dykes are cut by mineralized fractures.

Trachyte porphyry dykes, which are few in number, strike northwesterly and have steep dips. They are characterized by tabular feldspar crystals which may comprise "as much as half the rock" (Carr, 1968). Ore structures cut the trachyte dykes.

Lamprophyre dykes with chilled contacts occur partly in faults only in and near the orebody (Carr, 1968 p. 200). They strike NW or WNW and dip steeply southward. The fine-grained dykes characteristically contain needle-like hornblende phenocrysts and calcite-filled vesicles.

Andesite dykes up to two feet wide occur throughout the pit area. Most are tabular and strike northwesterly with steep southerly dips. Dykes with EW or NE strikes are irregular and branching.

Northwesterly striking dykes contain hornblende phenocrysts and were favorable host rocks for alteration and mineralization. These may correspond to the lamprophyre dykes described by Carr. Northeasterly striking dykes are not mineralized or altered and cut ore fractures.

Character of Mineralization

Concentrated mineralization is confined to a zone almost entirely within the Speckled Quartz Diorite Phase. Areas of lower grade mineralization extend into adjacent phases of the stock. Veinlets containing chalcopyrite and/or molybdenite have been observed in all phases of the stock.

Chalcopyrite and molybdenite are the principal sulfides in the deposit and generally are accompanied by minor quantities of pyrite and magnetite. Bornite, galena, and sphalerite are rare constituents. Pyrrhotite has been reported.

Secondary minerals include: limonite, malachite, azurite, manganese oxides, hematite, and ferrimolybdite with rare occurrences of cuprite, covellite, chalcocite, native copper, tenorite (?), and ilsemannite (?).

Primary mineralization is almost entirely confined to fractures - a feature recognized by the earliest workers. Disseminated sulfides are seldom observed, except in altered dyke-rocks and in intensely altered areas.

Structure

The structural features of the deposit include ore fractures, faults, and joints. Joints, other than those which reflect ore fractures, have not been studied in detail. A fracture overlay map produced by C. Ney (1957) as a result of his work provides an excellent outline of the area of most concentrated mineralization.

Ore Fractures:

Ore fractures have been categorized according to the mineralogy of the filling material. These include:

1. Quartz-potash feldspar-chalcopyrite-molybdenite-pyrite.
2. Biotite-chalcopyrite-molybdenite
3. Quartz-molybdenite-pyrite
4. Epidote-magnetite-molybdenite

1. Quartz-Potash Feldspar-Chalcopyrite-Molybdenite-Pyrite

Veins in this category form the bulk of the mineralization in the Brenda deposit. Mineralization within the veins is patchy with some sections rich in chalcopyrite and others rich in molybdenite. The molybdenite generally cuts the chalcopyrite.

There are two ages of veins in this category: an early system as described above and a later system of vuggy veins.

The early veins have the following attitudes:

a) N60-75°E with dips from 55°S through vertical to 80°N: These are the most abundant veins and are remarkably consistent throughout the property.

b) N65-70°W/Vertical

c) N35-45°W/Vertical

All early veins contain rare octahedrons of magnetite disseminated through the chalcopyrite. Pyrite generally occurs as euhedral cubes associated with chalcopyrite. Potash feldspar content varies from less than one percent to as much as 20 percent of some veins. Bornite was observed as a rare constituent of some northeast-striking veins.

Late veins that cut the veins described above generally are vuggy. Such vugs are created by open interstices between euhedral quartz and potash feldspar crystals. Biotite is always present in the veins and some contain radiating groups of epidote crystals. Chalcopyrite is the principal sulfide and is accompanied by minor quantities of molybdenite and pyrite. These veins have the following attitudes:

a) N0-25°W with dips of 80-85°W.

2. Biotite-Chalcopyrite-Molybdenite

Biotite-chalcopyrite-molybdenite veins occupy narrow fractures up to 1/8 inch wide which cut the quartz-potash feldspar-chalcopyrite-molybdenite veins. Minor and sporadically distributed grains of potash feldspar occur throughout.

The veins occur in three orientations which show some differences in distribution.

(a) N10-20°W with dips of 25°E, 70°E to vertical, and 35°W: Veins in this orientation occur throughout the deposit and are the most abundant in this category.

(b) N60-70°W/vertical: These occur principally in the northwest part of the pit.

(c) N45-60°W with dips of 15-25°N: Veins in this orientation have been observed only in the north part of the pit.

3. Quartz-Molybdenite-Pyrite:

Banded veins of quartz-molybdenite with disseminated cubes of pyrite and chalcopyrite on fractures are not common. These veins strike N80°E and dip 75°S to vertical. Most are 1-1/2 to 8 inches in thickness and contain bands of coarse and fine molybdenite. The wall rock adjacent to most veins, contains hydrothermal biotite.

4. Epidote-Magnetite-Molybdenite:

Veins of epidote and magnetite with some molybdenite occur throughout the deposit but they are nowhere abundant. These veins strike N55°W and have vertical dips. The importance and relationship of these veins to other systems is not known.

Faults:

Faults are expressed as shear zones in which the rocks have been intensely altered (argillic). Most faults strike N55 to 90°E and are vertical. Some strike N60-80°W with vertical dips. Both sets of faults exhibit left-lateral movement.

A few faults strike N5°E through north to N15°W and exhibit right-lateral movement. Maximum lateral displacement on all faults appears to be a few tens of feet.

The number of shear zones per unit area appears to increase toward the north.

Alteration

Four phases of alteration have been recognized in the Brenda deposit:

1. Potassic
   a. Potash Feldspar
   b. Biotite

2. Propylitic

3. Argillic (Sericite-Clay)

1. <u>Potassic Alteration:</u>

Two phases of potassic alteration have been recognized; a potash feldspar phase and a biotite phase. Sulfide mineralization accompanies both phases.

a) <u>Potash Feldspar</u>: Potash Feldspar is almost entirely confined to quartz-sulfide veins, but locally, in areas of pre-mineral fracturing, the potash feldspar has replaced part of the host rock adjacent to the veins. Such areas seldom exceed two or three feet in diameter and most are but a few inches in width. Most zones of this kind are elongate parallel to vein walls.

b) <u>Biotite</u>: Biotite shows some overlap with the potash feldspar phase. Biotite forms a minor part of vuggy quartz-potash feldspar-sulfide veins and occurs in veins as previously described. Adjacent to some quartz veins, especially those with high molybdenite content, biotite has replaced the mafic minerals and plagioclase in the host rock for widths ranging from a fraction of an inch to several inches. Locally, in areas of intense fracturing, biotitization of the host rock has been so intense that the hydrothermal biotite forms up to 50 percent of the rock. Such areas generally are irregular in distribution and of unknown size. Most are not exposed for more than a few feet. Andesite dykes have been especially susceptible to biotite alteration.

2. Propylitic Alteration:

Weak to moderate propylitic alteration is irregularly distributed throughout the deposit. Characteristic features of this alteration are: a) chloritization of mafic minerals (hydrothermal and magmatic); and b) the plagioclase becomes waxy in appearance and greenish in color. The alteration has no apparent relation to any mineral phase and probably was developed after most mineralization was emplaced.

3. Argillic Alteration:

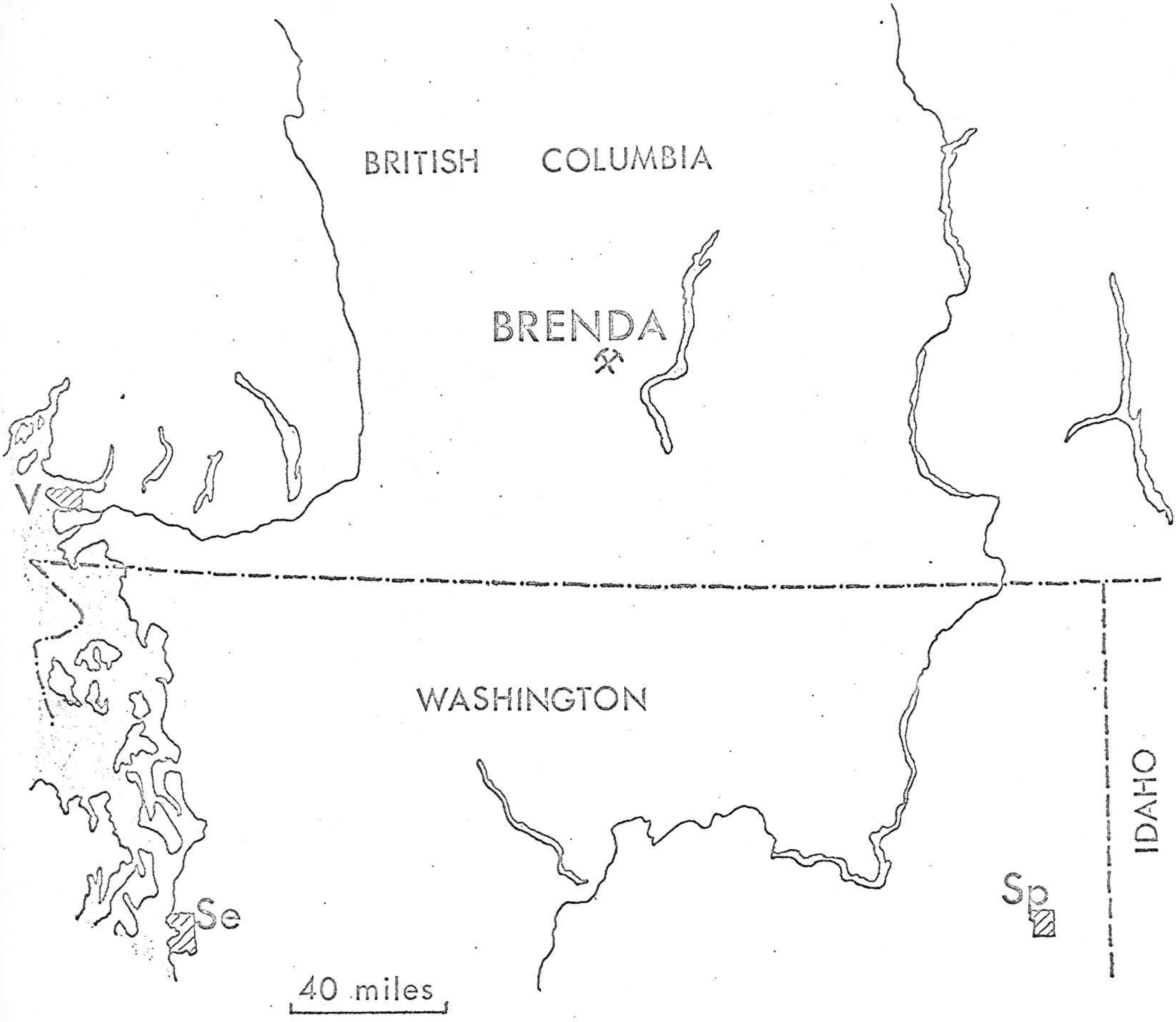
Argillic alteration is locally extreme and is confined to shear zones ranging from a few inches to greater than 30 feet wide. These shear zones have a dominant N70 - 90°E strike with vertical or near-vertical dips. A few narrow zones strike northwesterly and also have vertical dips.

The shear zones cut all phases of mineralization and all other phases of alteration. Molybdenite and other minerals have been smeared on the fractures in many of the northeasterly trending shear zones. Clay and sericite are the characteristic minerals of this alteration assemblage and they impart a light greenish to brownish color to the rock.

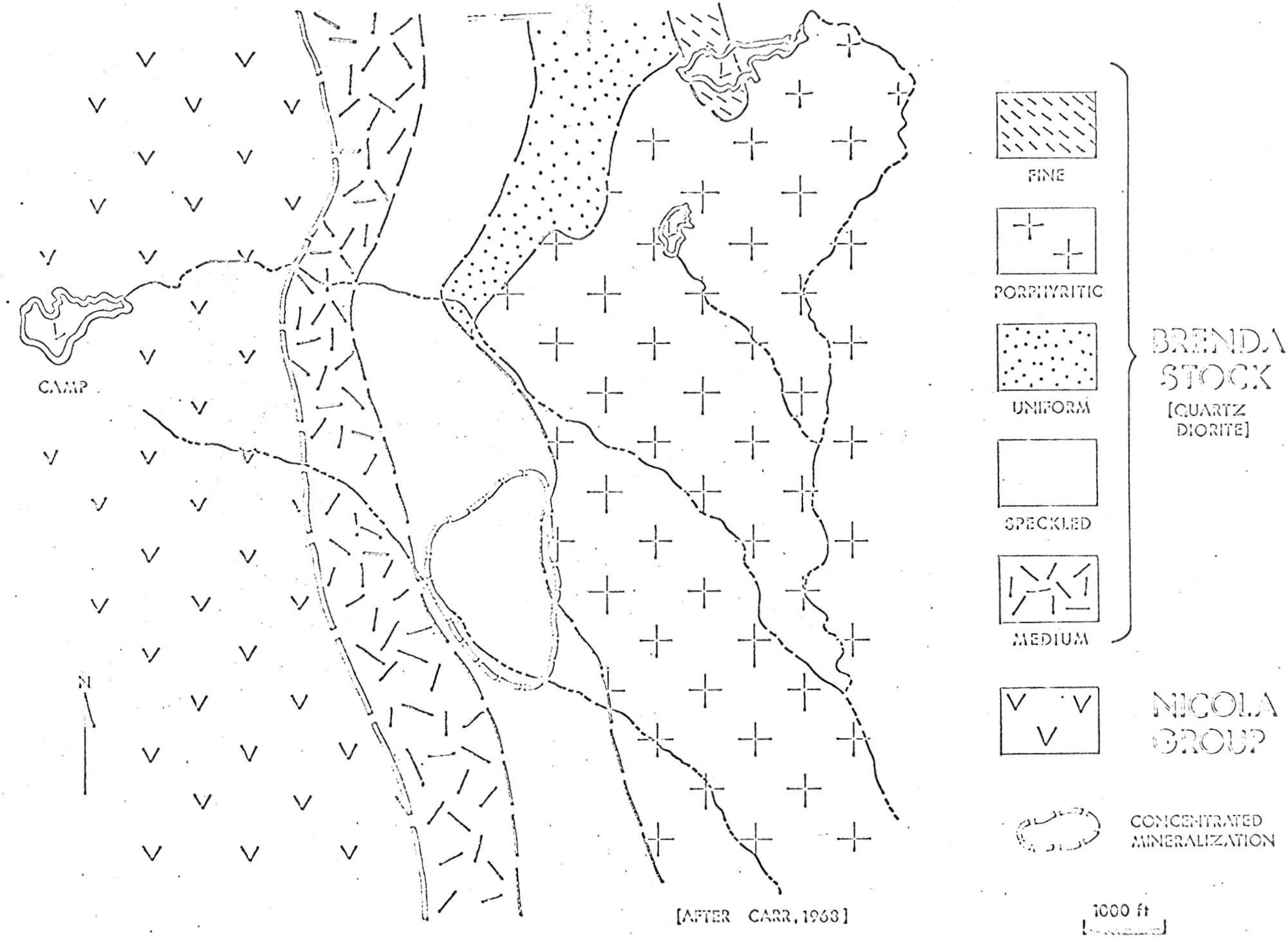
GEOCHEMICAL AND GEOPHYSICAL SURVEYS

The relationship of the zone of concentrated mineralization to geochemical and geophysical anomalies are shown in Figures 3, 4 and 5.

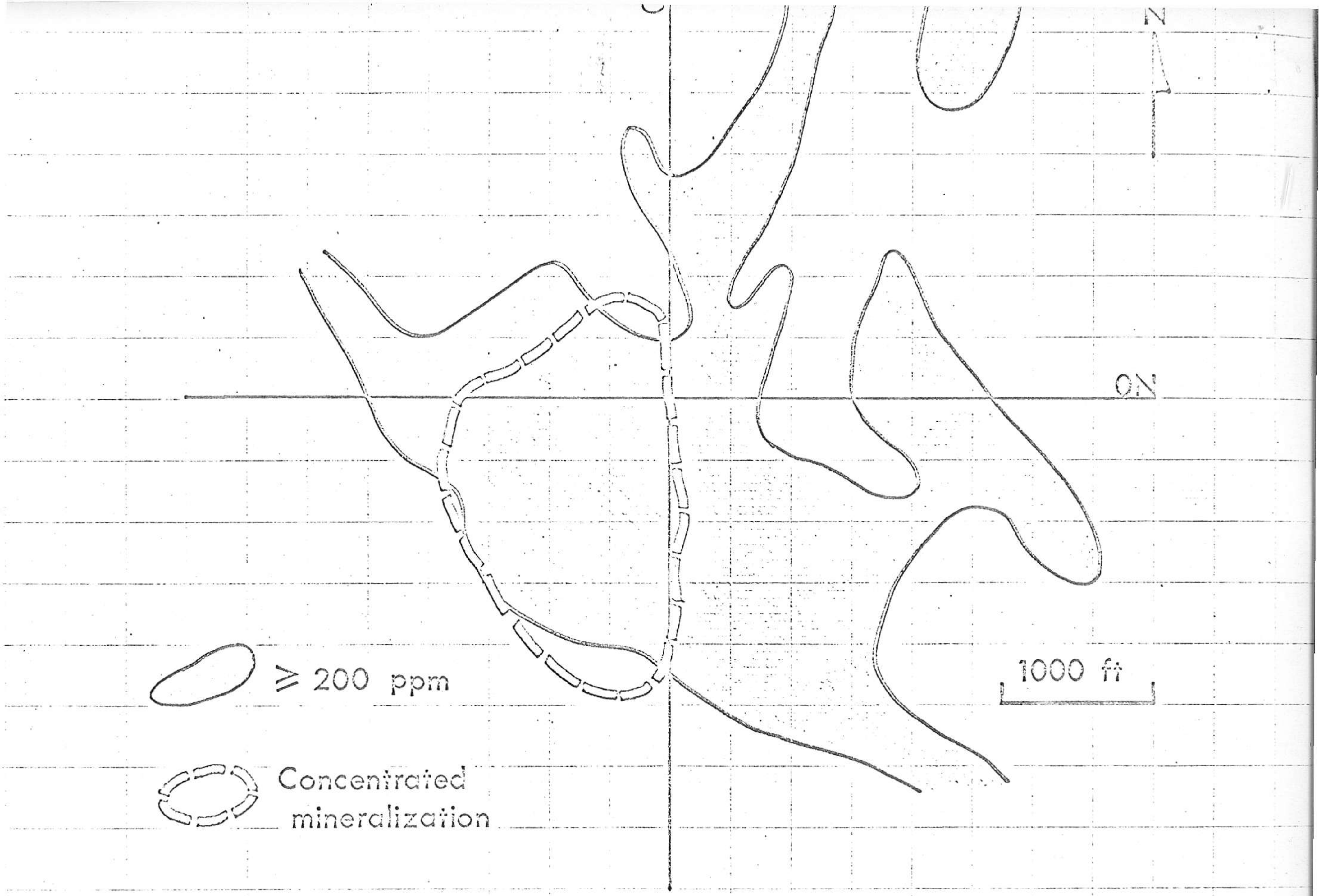
Anomalous total copper values in stream sediments draining the deposit range from 250 to 1340 ppm. Molybdenum anomalies range from 50 to 250 ppm. and have wider distribution than anomalous copper values.



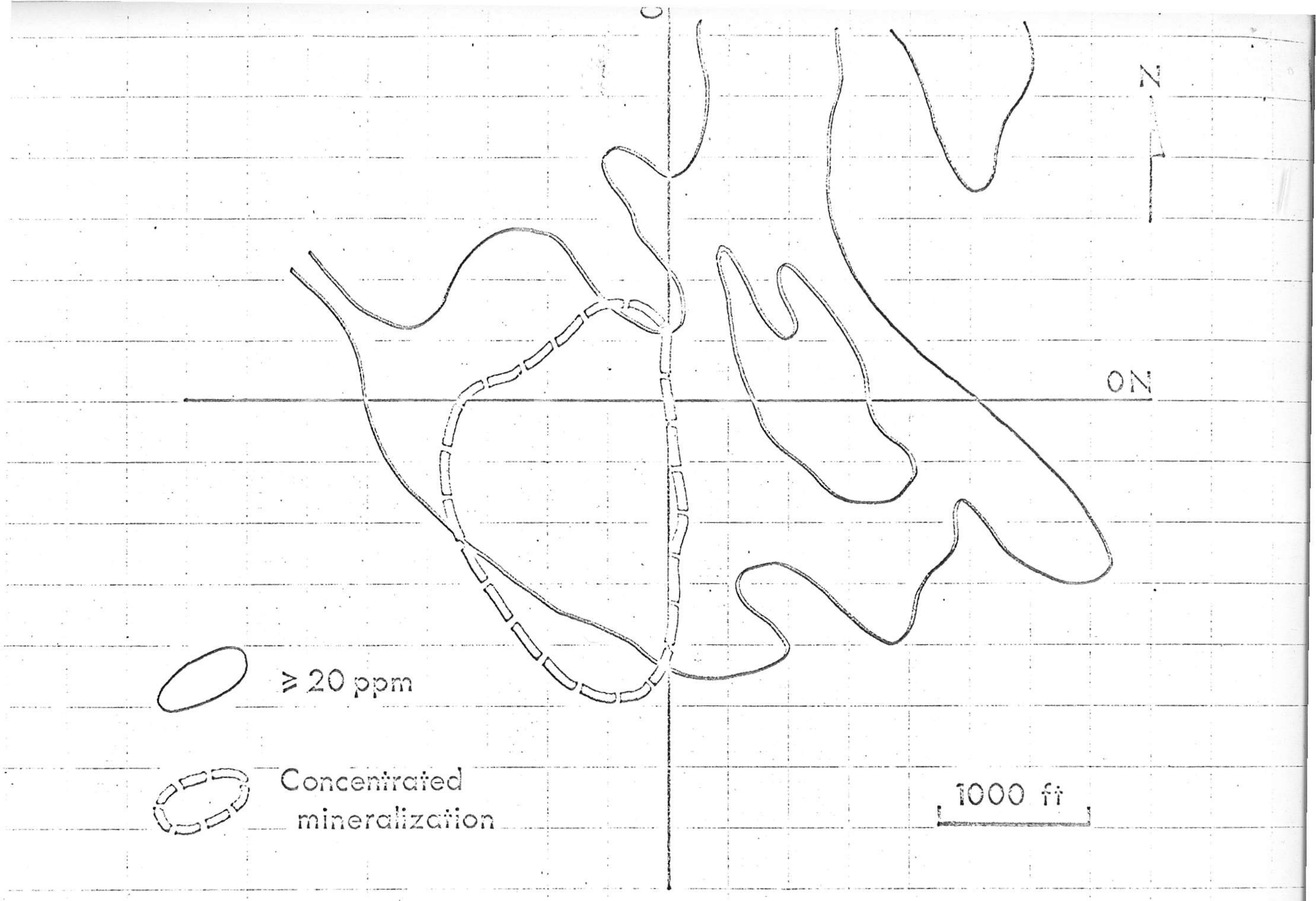
Location – Brenda Deposit



BRENDA DEPOSIT – GENERAL GEOLOGY

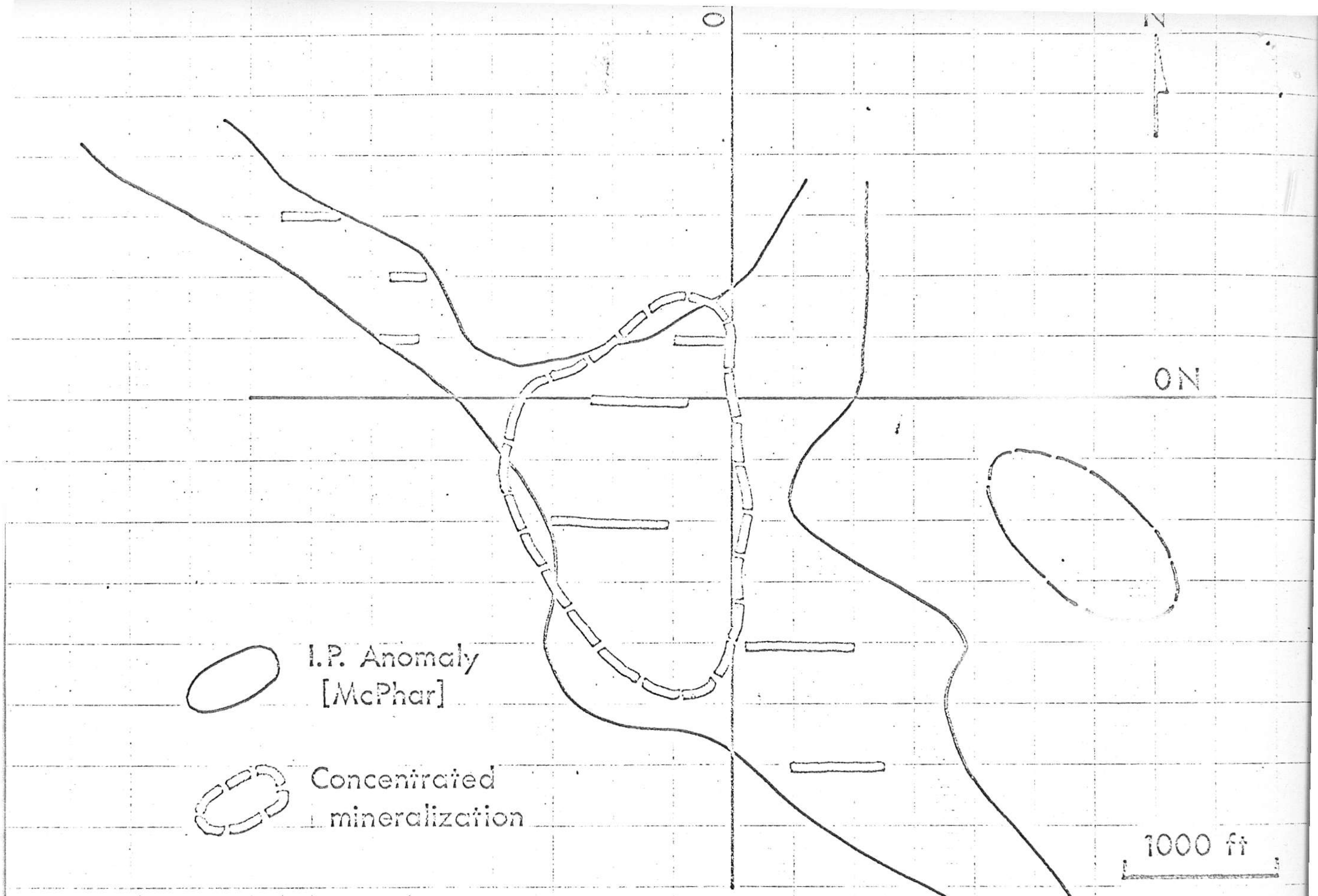


COPPER IN SOIL
BRENDA DEPOSIT



MOLYBDENUM IN SOIL

BRENDA DEPOSIT



I.P. SURVEY

BRENDA DEPOSIT