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GEOLOGY OF GYPO QUARTZ VEIN,
OLIVER, BRITISH COLUMBIA

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INTRODUCTION

Gypo quartz deposit is in the Okanagan Valley near the northern outskirts of Oliver, B.C., about 27 miles south of Penticton (Figure 1). Production of high purity silica was continuous from 1955 when development was taken over by Pacific Silica Company, until August 1968 when the operation was closed due to caving of part of the quarry wall. During this 14-year interval, from 20 to 35 persons were employed annually. Yearly production ranged from a low of 2,500 tons in 1955 to a high of 60,000 tons in 1960. From 1962 to 1966 inclusive, average annual production was about 46,000 tons. At the close of quarrying operations in 1968, more than 20,000 tons of crushed material of variable quality existed in stockpiles at the quarry site and shipments have been made intermittently to the present. Most concentrates produced had a purity of greater than 99 percent silica.

Production has been used mainly as decorative material in the building industry, especially as stucco dash. Small batches of concentrates have been used for a wide variety of purposes, including preparation of special cements, as a flux in the mineral industry, for patio aggregate, as poultry grit, in the production of ferrosilicon and silicon carbide, etc. Although Gypo vein has been quarried principally for quartz, a small amount of by-product fluorite has also been shipped from the deposit.

A number of other, somewhat similar deposits occur in the general area. However, these are considerably smaller than Gypo deposit and were of interest in the past because of their precious metal contents. The nearest deposits of appreciable size are the Standard and Susie veins (Figure 2) both of which have seen temporary reactivation (Summer 1974).

Numerous small quartz veins and veinlets containing minor amounts of pyrite are known throughout the area. Morning Star and Stemwinder deposits of the Fairview Camp (Cockfield, 1935) are in Kobau metasedimentary rocks several miles to the west.

GENERAL GEOLOGY

The area surrounding Gypo deposit is underlain principally by medium-grained intrusive rocks that form what is here called the Oliver Plutonic Complex. This complex includes rocks mapped previously as Oliver Syenite and Oliver Granite (Bostock, 1940). To the south the pluton cuts Kobau metasedimentary rocks of Carboniferous (?) age. On its northern margin the intrusive mass is in contact with Vaseaux Formation that probably is part of the Shuswap Terrane.

Recent work (Figure 2) shows that Oliver pluton is composed almost entirely of quartz monzonite (Richards, 1968). Three distinct phases can be recognized in the field. A central core of massive, medium-grained, garnet-muscovite quartz monzonite is surrounded by a porphyritic quartz monzonite containing about 1 to 5 percent phenocrysts of K-feldspar up to [illegible] inch in maximum dimension. The contact between these units is commonly [illegible] narrow zone of quartz-feldspar pegmatite, a few feet to ten feet in width. However, at Gypo mine and at one locality along the northern margin [illegible] the core, the contact is either sharp or gradational over several feet. [illegible] examination indicates that the predominant mafic mineral in the porphyritic quartz monzonite is hornblende north of the core and biotite to the south.

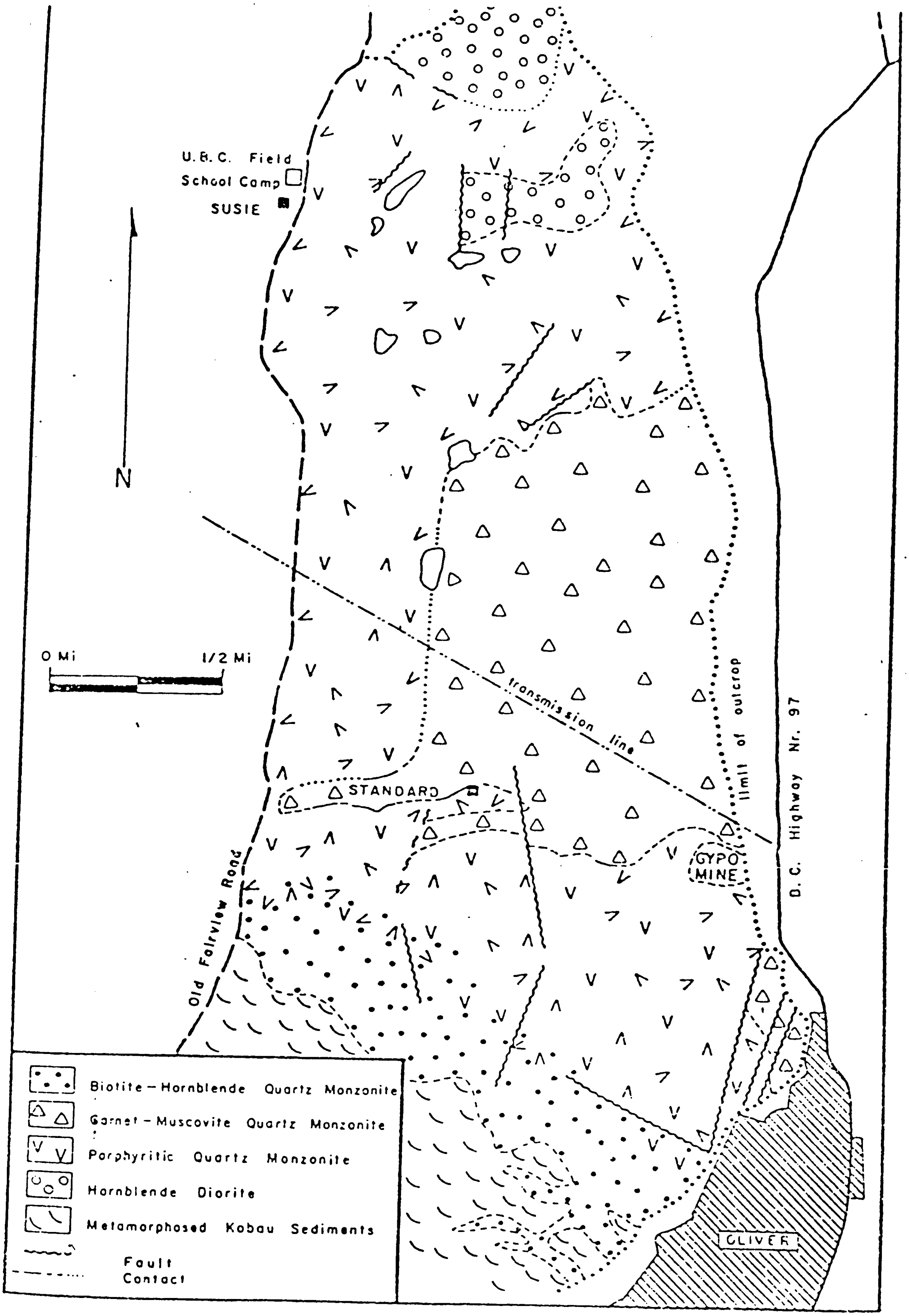
U.B.C. Field School Camp
SUSIE
N
0 Mi
1/2 Mi
transmission line
limit of outcrop
B.C. Highway Nr. 97
STANDARD
GYPO MINE
Old Fairview Road
OLIVER
Biotite – Hornblende Quartz Monzonite
Garnet – Muscovite Quartz Monzonite
Porphyritic Quartz Monzonite
Hornblende Diorite
Metamorphosed Kobau Sediments
Fault
Contact

FIG. 2

present in the southern part of the area. Along the northern margin of the core, a small, fine-grained muscovite-biotite-garnet-bearing dyke cuts both the porphyritic quartz monzonite and the garnet-muscovite quartz monzonite. Numerous dyke-like bodies occur in Kobau metasedimentary rocks along the southern margin of the pluton. Many of these are apophyses of the pluton but some are later dykes.

Quartz veins containing small amounts of sulphides and precious metals are found in the Oliver pluton and surrounding rocks. Within the pluton, large veins with some indicated economic potential are confined to the porphyritic quartz monzonite phase. Quartz veins are cut by lamprophyre dykes that are highly variable in size and occur throughout the region. The largest known lamprophyre body is a near vertical sheet about 50 feet wide that extends from Gypo mine southward for several thousand feet.

In the northern part of the area in Figure 2, are two large masses of medium to coarse-grained, gneissic diorite consisting almost entirely of hornblende and plagioclase in variable proportions. These bodies resemble amphibolitic units of Vaseaux formation to the north and probably represent large, partially assimilated masses of Vaseaux rocks.

The area has been faulted and fractured extensively. Contacts of the three main phases of the pluton have apparent offsets of one-quarter mile or more, especially in the southern part of the area of Figure 2. Most of the region has been affected by hydrothermal alteration. In the northern part of the area where Ca-bearing minerals are most abundant, the dominant alteration product is epidote which occurs in seams up to 1 inch in thickness. In the southern part of the region biotite is the abundant mafic mineral and the most obvious result of regional hydrothermal alteration is chlorite. Whether or not the region has been subjected to more than one period of hydrothermal alteration is not known. However, some of the alteration postdated emplacement of lamprophyre dykes and the development of some faults. Many fault zones appear to be later than alteration effects. The eastern edge of the area under consideration forms the western wall of the Okanagan Valley that has been affected by extensive faulting and close-spaced fracturing. These features have not been studied in detail here but they are one of the latest tectonic events in the area and one might speculate that they are related to the development of the Okanagan Valley, whuch farther north has been shown to be the locus of intense faulting of regional extent (see Little, 1961).

GENERAL FEATURES OF VEIN DEPOSITS IN OLIVER PLUTONIC COMPLEX

Numerous quartz veins occur within the Oliver Plutonic Complex, all of which show a number of features in common. In addition, a few relatively large quartz veins are known in Kobau metasedimentary rocks, such as the Morning Star and Stemwinder deposits of Fairview Camp, that were mined several decades ago for their gold contents. The following general account applies only to those veins within the Oliver Plutonic Complex, some of which are shown in Figure 2.

In general, all veins within the Oliver pluton are characterized by an abundance of quartz, almost to the exclusion of other minerals. Pyrite is, perhaps, the only other mineral common to all veins but in many cases can be observed only with close inspection and forms a negligible proportion of vein material in terms of total volume. Other minerals have been recognized locally, including gold and silver tellurides, galena, sphalerite, and native gold at the Standard deposit. It is occurrences such as the Standard vein that have prompted the limited exploration conducted in the area. Recent high precious metal prices (1974) have led to the re-opening of the Susie and Standard mines.

Quartz in all deposits has been subjected to varying amounts of post-mineralization fracturing, commonly to the extent that original textures are in large part destroyed. However, where relatively undeformed, all deposits show evidence of much of the quartz having been deposited as fairly large crystals, generally an inch or more in cross-section and at least several inches in length. In places these crystals show a rough coxcomb texture. All deposits contain at least some early deposited grey quartz although the bulk of the quartz is generally white. Wallrock alteration is not normally a pronounced feature of most of these deposits but all veins show at least a thin zone of sericitization along their margins. Large veins are restricted to the porphyritic quartz monzonite although smaller veins up to a few inches in width are found in both the core phase and the southern marginal phase. All quartz veins show some evidence of wallrock replacement but in most cases it is clear that the depositional process has been principally one of open space filling. Most veins are very small, about a foot or less in width, and extend laterally for distances of a few feet up to a hundred feet or so. The so-called large veins are variable in thickness, commonly from two to ten feet or more with strike lengths of several hundred to a thousand feet or so. Veins are mostly moderately to steeply dipping with variable strike directions.

In general, the similarity of features of quartz veins associated with the Oliver Plutonic Complex suggest that they have had a common origin that is somehow related to the pluton itself. Many of the features referred to are shown by the Gypo deposit, but on a much grander scale than is general throughout the area.

DETAILED GEOLOGY OF GYPO VEIN

Gypo deposit is a large quartz vein in porphyritic quartz monzonite near the contact with the core phase (Figure 2) The deposit strikes east-west with a southerly dip of 55 to 60 degrees (Figures 4 and 5). It is approximately 150 feet in true thickness at the quarry site and has a known strike length of about 500 feet. A thinner extension from the main vein continues at least another 300 feet to the west. On the hanging wall (south) side, the deposit is bounded by a thin shear zone 2 to 3 inches wide, occupied by gouge. At the west end of this fault, apparent offset is small as is shown by continuity of protusions from the vein on either side of the fault. The movement picture is not at all clear near the quarry entrance. Character of the footwall is in sharp contrast to that of the hanging wall zone. The footwall has been altered intensely for distances up to 100 feet from the vein, forming a greisen consisting predominantly of muscovite with lesser amounts of quartz. Furthermore, abundant relict patches of partially greisenized wallrock occur within the vein near the footwall.

The deposit has been cut by a near-vertical lamprophyre dyke that strikes roughly north-south near the western exposures of the quartz vein.

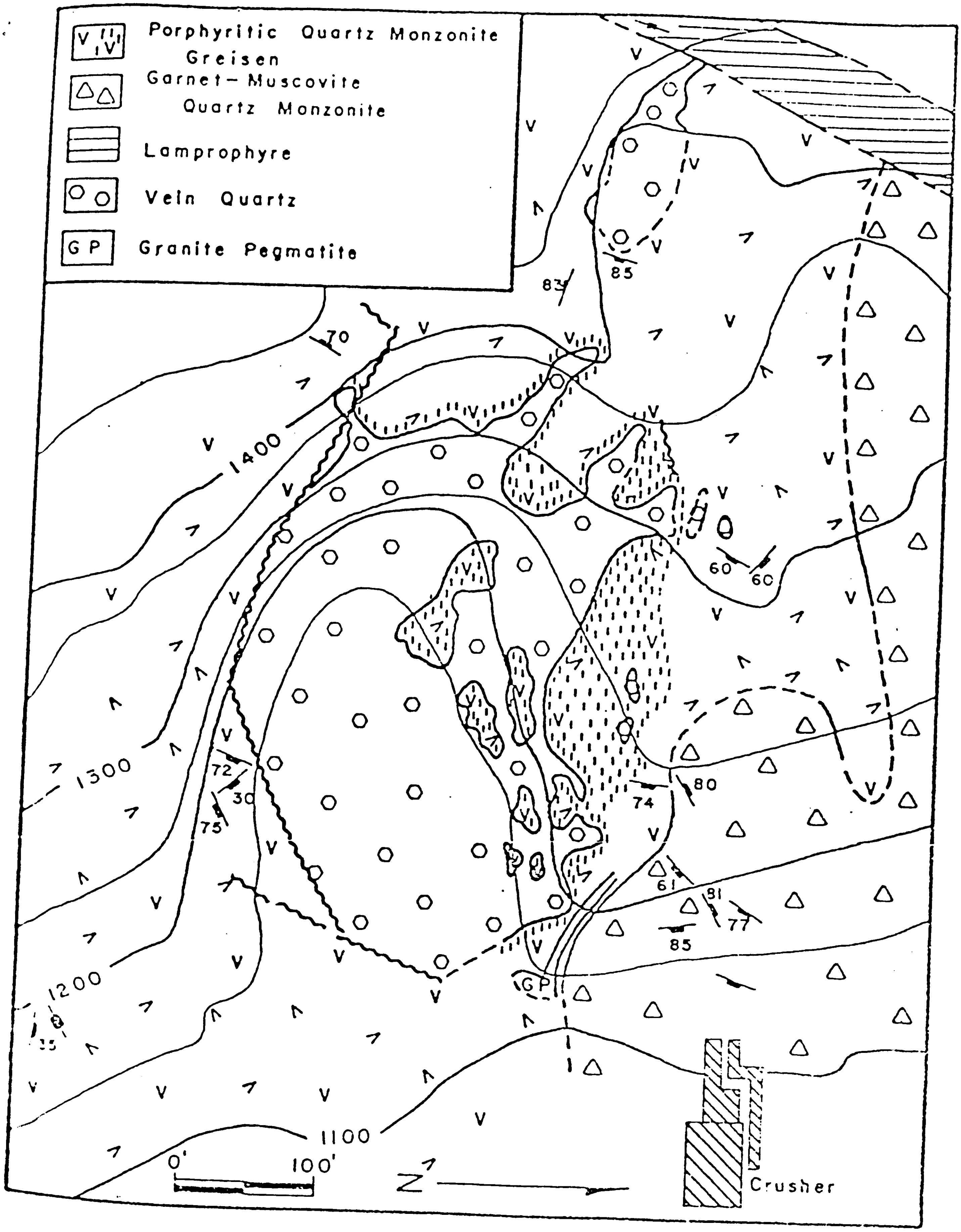
Porphyritic Quartz Monzonite
Greisen
Garnet-Muscovite Quartz Monzonite
Lamprophyre
Vein Quartz
GP
Granite Pegmatite
1400
1300
1200
1100
70
83
85
60
60
72
30
75
74
80
61
81
77
85
35
GP
0'
100'
N
Crusher

FIG. 4

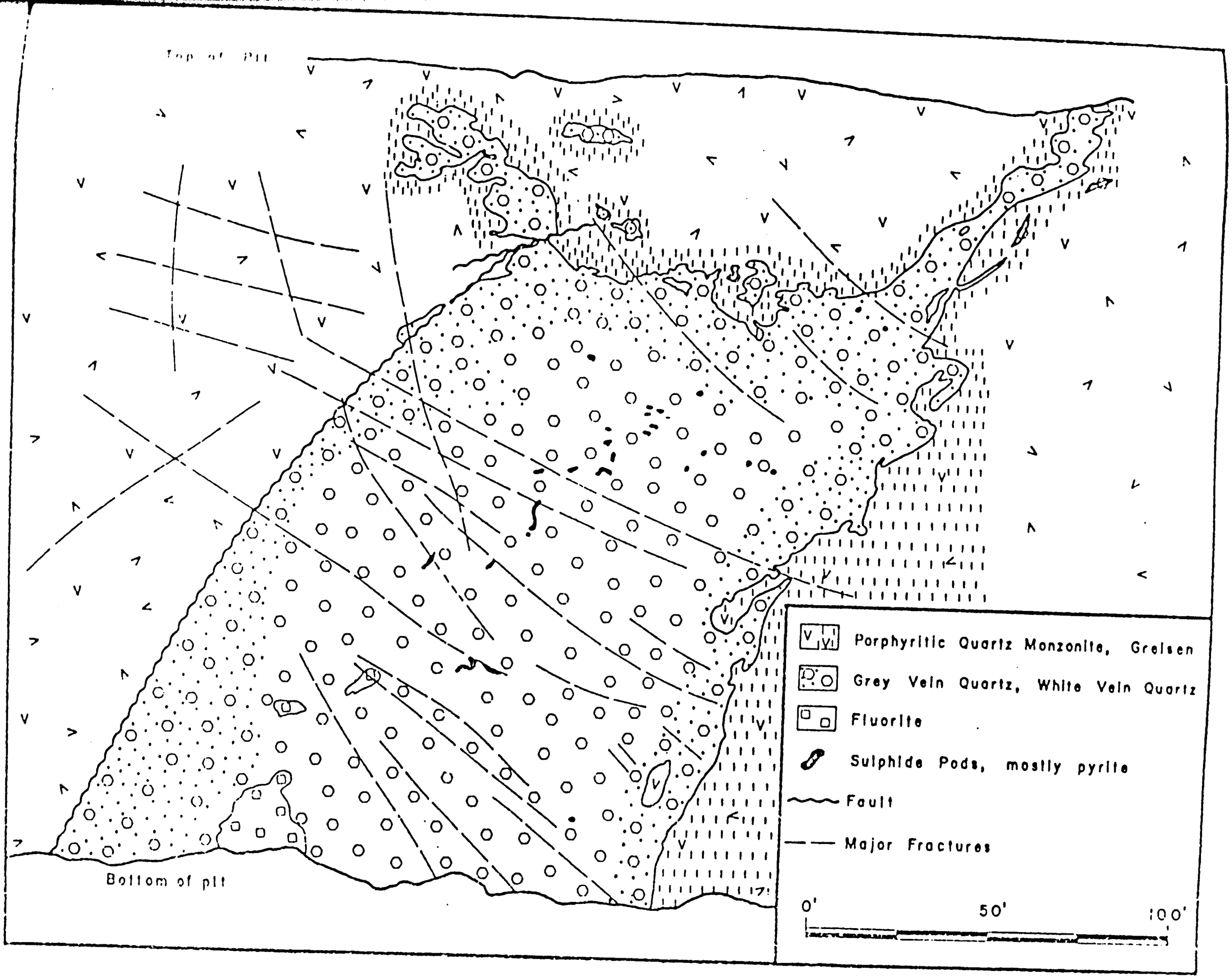
Top of pit
Bottom of pit
Porphyritic Quartz Monzonite, Greisen
Grey Vein Quartz, White Vein Quartz
Fluorite
Sulphide Pods, mostly pyrite
Fault
Major Fractures
0'
50'
100'

FIG.

lamprophyres are common in the general area but this particular dyke is the largest yet found, with a width of about 50 feet and a strike length in excess of 2000 feet. The dyke contains about 45% ferromagnesian minerals (olivine, augite and biotite), in a K-feldspar matrix (35%) with lesser amounts of apatite, plagioclase and magnetite. Heat from this intrusion metamorphose small pods of pyrite in the quartz vein, transforming them to pyrrhotite.

MINERALOGY

Quartz: Three stages of quartz mineralization are recognized in Gypo deposit. Early, stage I, quartz is grey in colour and is confined to country rock, alteration zones and marginal parts of the vein. It is massive in character and the colour fades gradually over a distance of a few feet from the vein wall where it gives way to white quartz (stage II) that makes up more than 95 percent of the vein material. An explanation for the colour difference between these two types of quartz has not been sought in detail at Gypo deposit. Holtby (personal communications, 1972) did a trace element study of white and grey quartz from the nearby Susie deposit and found there that grey quartz had a much higher Mn content than did white quartz. Distributions of the two types are shown in Figure 5.

The white quartz at Gypo deposit is principally in the form of [illegible] crystals up to 1 to 2 feet in diameter and 6 feet in length (see [illegible], 1959) hence the deposit qualifies as a quartz pegmatite. These crystals are observed intact only rarely, in part, because most have been mined but principally because the deposit has been fractured intensively with the production of numerous closely spaced smooth joint surfaces. These joints have given rise to the local name "cleavage quartz" and commonly exhibit a rhombohedral form. We have examined this rhombohedral joint pattern in crystals at the quarry and others now used as decorative pieces in gardens in Oliver. In many cases, the joints parallel rhombohedral crystal faces but this is not the case everywhere. In some crystals as many as six fracture directions are apparent and invariably some of these joints, although not necessarily the best developed, are parallel to rhombohedral crystal faces. Some smooth joints can be traced from vein quartz into adjacent wallrock. Etch tests with hydrofluoric acid suggest the quartz was deposited as the low temperature polymorph.

Small amounts of quartz (stage III) occur as thin, delicate boxworks that cut earlier minerals, especially fluorite.

Fluorite: Apple-green fluorite occurs in a series of irregular pods up to six feet or more in average diameter, distributed sporadically along a zone that is of more or less uniform distance from the hanging wall (see Figure 5). The fluorite is intensively fractured and even fresh looking specimens are extremely friable.

Muscovite: Muscovite occurs in two distinct forms: first, as very coarse-grained books up to one inch in diameter that occur intermixed with vein quartz near the footwall. This variety contrasts with the much more abundant, medium-grained, massive muscovite that is characteristic of altered wallrock.

Sulphides: Sulphides form less than one percent of vein material. They are concentrated in small pods up to a few inches in diameter, restricted to a thin zone in the central part of the vein (see Figure 5). Pyrite is the around the margin of the main vein. These veins are cut by thin seam of muscovite whereas white quartz is not. The implied age relationship is consistent with order of deposition in the main vein. Position of fluorite and sulphides in the paragenetic sequence is less certain. Sulphides are centrally located in small cavities that indicate they were probably one of the last effects of hypogene mineralization. Fluorite distribution pattern suggests that it was deposited for a relatively short period within the interval of white quartz deposition. The stage III quartz that cuts fluorite might simply be a continuation of stage II quartz.

WALLROCK ALTERATION

Field Aspects

Wallrock alteration has been extensive about the Gypo quartz vein, particularly along the footwall side (Figure 5). The host, porphyritic quartz monzonite, has been altered almost completely to a friable mass of muscovite with minor amounts of grey quartz and, in places, a few relict "horses" of host. In detail, these "horses" are also altered by feldspathization upon which has been superimposed intensive muscovite alteration. The resulting alteration product is akin to a greisen, although some common greisen minerals such as topaz and cassiterite have not been recognized. The extensively altered zone grades rather abruptly into wallrock that is [illegible] slightly altered. It was collapse of this greisenized footwall zone in August 1968, that piled debris on the quarry floor and resulted in shutdown of mining operations. Field relations indicate that "greisenization" occurred prior to extensive quartz deposition. The greisen is cut locally by early grey quartz veinlets up to a few inches wide and with sharp contacts. In places, however, such as the quarry entrance, thin replacement seams of muscovite extend through grey quartz and feldspathized zones. One of the striking features of the alteration is its apparent asymmetry - no extensive greisen zone occurs on the hanging wall (south) side of the vein. Further attention will be directed to this peculiarity in a later section.

Useful insight into the alteration processes can be had by invesitgation of small, well defined alteration envelopes about thin grey quartz veins adjacent to the main vein. Such an example is shown diagrammatically in Figure 6, a tracing of a photograph taken on the south side of the quarry entrance. Here, relatively flat-lying quartz veins, each a few inches to one foot in thickness, contain on their lower side a massive muscovite zone. The combined quartz and muscovite zones are surrounded by a pink alteration envelope consisting predominantly of K-feldspar and having a thickness comparable to that of the quartz vein. This alteration zone grades fairly abruptly into relatively unaffected wallrock. In places, one finds thin seams of muscovite a fraction of an inch thick that cut the K-feldspathized zone. These seams are products of metasomatism that extend into otherwise unaltered wallrock, and apparently are fracture-controlled. This relationship establishes relative ages of alteration types-K-feldspathization followed by greisenization. A similar age relation can be seen in the large, intensity greisenized footwall zone where feldspathized masses of wallrock have been replaced irregularly by greisen.

Petrography

Modal analyses of unaltered wallrock and the two extreme types of alteration, based on approximately 1100 points per thin section, are listed in