GEOLOGY OF THE MONTE CRISTO MINING AREA

Thesis by

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Abstract

The Monte Cristo mining area was discovered in the early days of mining in California, and intermittent attempts have been made to work it to the present time.

The gold is localized in lenticular quartz veins replacing fractured country rock along north-south fault zones. Pyrite is the principal ore mineral with magnetite and minor amounts of sphalerite, pyrrhotite, and chalcopyrite also present.

Anorthosite is the principal country rock in the area, apparently intruded into diorite. Hornblendite dikes cut the anorthosite before the time of gold mineralization, and late lamprophyre dikes were injected after the vein quartz. Some pegmatite and late aplite dikes are also present. The area on the whole has undergone little metamorphism.

Several stages and patterns of faulting are present and an attempt was made to work out their relative ages and the ages of the dikes and veins with respect to them.

Joint patterns were mapped but no relation was found between them and the ore control.

Economically the mine is considered a bad risk for any sizeable operation. Small scale mining of high grade ore shoots with a minimum of investment capital is believed to offer the best chance of success. The most favorable aspect of the property is the amount of development work done on the Monte Cristo North area where short crosscuts would open up a possible downward extension of the vein exposed at the surface.

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GEOLOGY OF THE MONTE CRISTO MINING AREA

Introduction

Purpose

Detailed underground mapping of the Monte Cristo mining area was carried out to assess the possibility of the mine becoming a profitable gold producer, and to determine the scale of mining, if any, to be used to exploit the mine with the greatest recovery and profit. The report also serves as a partial requirement for the Master of Science degree at the California Institute of Technology.

History of the Mine

The first record of the discovery of gold reported in Los Angeles county was in 1834[1]. From 1834 to 1838 the San Francisquito, Placerita, Caceta, and Santa Feliciana placers were worked by priests from the San Fernando and San Bueno Ventura missions. The placers of San Gabriel canyon were worked by priests and native Californians until 1848 when gold was discovered at Sutter's mill by Marshall. Reports of work on gold quartz veins in the Mount Gleason area indicate that the Monte Cristo mine was probably discovered very early. The gold recovery from the Monte Cristo mine by amalgamation prior to 1927 was low, according to reports.

The first account of any extensive work in the Monte Cristo area appeared in 1895[2]. The property was divided into four mines, the Dos Robles, Mikado, Monte Carlo and

Monte Cristo. Development at that time included several 5-foot to 30-foot adits, and three shafts, 10 feet to 40 feet deep. The rock was crushed in a four-stamp mill with 600-pound stamps, and a 5-foot Huntington mill. Two of the above mentioned mines were free milling and two produced sulphide ore. Five men were engaged on the property at the time, mainly on development work. The owner in 1895 was R.E. Hudson.

In 1927[1] the Monte Cristo property consisted of ten claims. The development work consisted of two adits and a shaft 133 feet deep. The upper adit was 275 feet long. Four ore shoots, 35 feet by 3 feet, were found and stoped to the surface with a reported recovery of $70,000. The values on the lower adit were reported to be $10.00 per ton. The equipment used at that time was a 6-inch by 12-inch Blake crusher and a 5-foot Huntington mill. The owner in 1927 was F. W. Carlisle.

In 1937[3] Carlisle divided the property into two parts and leased to separate parties. The eastern part, consisting of seventeen claims, was leased to W. W. Hartman. Of four parallel veins on the lease the only one developed was the Monte Cristo vein. The upper adit extended north 425 feet. At 87 feet from the portal a winze was sunk 50 feet. A drift went 60 feet north with a raise to the adit level. The lower adit extended 425 feet north with a 25-foot crosscut west at the face. In the lower tunnel the ore was not oxidized and was reported to assay $14.00 to $18.00 per ton.

A portable compressor was in operation, and five men were working.

The west vein area, leased to W. W. Gilkey and Crouse L. Elgin, is situated 1200 feet west of the Monte Cristo vein. The upper level on this vein consisted of an adit extending north 130 feet. At 40 feet a winze was sunk 30 feet and a small underhand stope, 16 feet by 2½ feet, produced ore valued from $18.00 to $40.00 per ton. Fifty feet below, a crosscut was driven to the vein and a drift along the vein extended north 50 feet. The last 15 feet showed a vein 4 feet to 6 feet wide with 3 feet of quartz and sulphides. In 1937 four men were employed in the lower tunnel.

In the late 1920's* Mr. Carlisle installed a small roasting and cyanide plant to process the ore, but later the ore was shipped to Acton for processing. The Huntington mill was scrapped at this time.

The latest work done, mainly on the west vein in 1939, was under the direction of S. G. Hooper, the present owner.

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* Personal communication from Mr. William Boughman, owner of an adjacent property.

Method of Investigation

All underground mapping in the area was plotted on a scale of 20 feet to the inch. The limited amount of surface mapping was plotted on a scale of 100 feet to the inch except that the vein above the lower workings was plotted at 20 feet to the inch. The different underground areas mapped consist of the Monte Cristo North, Center, and South, the west vein, and the Maynard holdings which are probably a southern extension of the west vein. By far the greatest care and most time was spent on the Monte Cristo North. There an underground transit and tape survey was used for control and the geology was mapped by brunton and tape, referring to transit survey points. In the other locations the mapping was done with brunton and tape, attention being given mainly to the quartz veins.

Surface mapping was done only in the Monte Cristo North area. A transit and stadia line was used for control, and the mapping was done with a plane table and telescopic alidade.

Geography

The Monte Cristo mining area is located on the headwaters of Mill Creek 18 miles southeast of Acton in Los Angeles county. The roads to the mine are suitable for any type of vehicle in dry weather. The hard surfaced Angeles Forest highway passes within two and one-half miles of the mine, and at the Mill Creek picnic grounds, two and one-half miles north of the Hidden Springs service station, a good dirt trail branches off to the mine. The index map (Plate O) shows the relative positions of the above mentioned locations.

The topography is typical of the San Gabriel mountains. Fairly steep V- shaped valleys are the prominent features, with bold outcrops of crystalline rocks locally scarring the landscape. The drainage pattern in the vicinity of the mine consists of short draws entering Mill Creek which flows in a west-southwest direction into Big Tujunga canyon. The stream bottom is covered with coarse gravel and boulders.

The climate in the area is moderately dry, and the stream is dry most of the year. Some very large (6-foot) boulders in the stream bed give evidence of violent rainstorms at times. It is quite likely that most of the precipitation comes from these violent storms. The vegetation consists mainly of yucca, scrub oak and dense prickly underbrush that makes walking in certain areas very difficult. It is worthy of note that the underbrush shows a certain preference for the basic intrusives in the area. The dark rock outcrops everywhere around the mine coincide with a marked increase in the vegetation.

Exposures, in spite of the rugged nature of the topography, are not very plentiful in the immediate mine area. The anorthosite and the basic intrusive both have a mantle of unconsolidated weathered rock fast approaching fine-grained silt. In some spots, in draws and on the tops of ridges, the unbroken rock shows through and serves to mark the different rock types. The pegmatite, where present, appears to be more resistant than the other rock types, and forms rugged outcrops.

Previous Work

The main previous geological literature is a report by William J. Miller(4). Brief mention is made of the Monte Cristo Mines in this report, and the area was mapped on a scale of two miles to the inch.

The State Mineralogist's reports of 1895-96(2), 1927(1), and 1937(3) give brief accounts of the development work completed to those dates.

A magnetometer survey of the vicinity was completed in 1939 by the duPont de Nemours Company in an attempt to determine the extent of the ilmenite deposits in the area.

General Description

Regional Setting

The Monte Cristo mining area is situated near the eastern extremity of an extensive anorthosite intrusive. The contact with the San Gabriel formation is about half a mile east of the mines. The San Gabriel formation, according to Miller(4), consists of a mixture of Placerita metasediments or Rubio metadiorite injected by much Echo granite, and in places cut by later plutonics.

A description of the anorthosite series taken from Miller's report will serve to describe the general features of the intrusive.

"The anorthosite proper, and its genetically associated gabbroic and dioritic facies, occupy large portions of the western San Gabriel Mountains. Most of it occurs in a single large area, the greatest length of which is eighteen miles, extending from the Monte Cristo Mines on the east to Coyote Canyon and Lang on the west, and its greatest width is eight miles along a line running nearly south from Ravenna past the western side of Gleason Mountain.

Lying just northeast of the large body of anorthosite and occupying the middle-northern part of the Tujunga quadrangle, there is a body of about five square miles of dark gabbroic and dioritic rocks, which are classed with some confidence as facies of the anorthosite. This body of dark rock is cut off from the large area of anorthosite by both faulting and the granodiorite intrusive. It is cut irregularly by many large and small dikes of granite or granodiorite." ---

"There are many interesting facies of the anorthosite varying from almost pure, bluish gray to white, coarse grained plagioclase (mainly andesine) through gabbroic and dioritic anorthosite and ilmenite-rich gabbro and diorite to almost pure titaniferous magnetite. These facies are seldom sharply separated from one another, and the delimitation of several facies on the map is intended to be only a rough attempt to indicate the broader areal relations of these facies, numerous minor variations being entirely disregarded. The different facies are quite certainly variants of a single plutonic body."

For the purpose of this report the different plutonic intrusives will not be referred to as anorthosite facies but will be classed as separate rock types, and where possible the various age relations of the different types will be described.

A number of small basic dikes that cut the anorthosite may possibly be much later.

Igneous Rocks

Sodic Anorthosite - This rock is the main country rock in the mining area. It is almost monomineralic as it consists of about 95% sodic andesine. Accessory minerals are biotite, muscovite, diopside, and quartz. The presence of chlorite and epidote suggest that the specimen examined was subjected to hydrothermal alteration at the time of introduction of the gold bearing quartz.

In general the anorthosite is very coarsely crystalline, the individual plagioclase crystals ranging up to nearly an inch in their largest dimension.

The anorthosite is banded in places near the vein and near the diorite contact. The bands consist of thin irregular bands up to an inch wide of plagioclase and dark minerals (biotite, chlorite, and epidote), which give the rock a gneissic appearance. Pyrite and minute veins of calcite, which cut all other minerals, indicate hydrothermal alteration. The writer does not wish to overlook the possibility that the banding is primary, a result of magmatic segregation and later subjected to alteration. The general direction and attitude of the banding in the anorthosite is parallel to the veins.

Hornblendite - Locally dikes of coarsely crystalline hornblendite cut the anorthosite. These dikes are veined by irregular stringers of light gray fine-grained and white aplitic material. The white and gray stringers are not in contact in the dikes observed; hence their age relations were not determined. Both kinds of light colored stringers are probably later intrusives filling fractures in the hornblendite. The hornblendite is almost monomineralic, the only constituents besides hornblende being minor amounts of magnetite, apatite, and zircon.

<u>Diorite</u> - The dark rock 1000 feet to the east of the Monte Cristo vein is slightly schistose at the contact with the anorthosite. The color, dark greenish black, is due to abundant hornblende which makes up about 80% of the rock in some dark specimens. The other minerals are quartz and plagioclase of about the calcic andesine range. The feldspar is in the form of phenocrysts or porphyroblasts, possibly suggesting contact metamorphism. The amount of feldspar varies, in some places making up about 50% of the rock. Accessory minerals are magnetite, sericite, chlorite, and apatite.

A parting or remnant of this rock near the mine was found to be very high in titaniferous magnetite. This body is highly metamorphosed and retains little of its original texture. The hornblende crystals are very coarse.

A specimen of this rock type collected near the lower adit (Plate 1), was found to contain much tremolite altering in part to chlorite. A high percentage of ilmenite in one-fourth inch bands with apatite inclusions is probably of hydrothermal origin.

Pegmatite - The pegmatite in the area occurs as local lenticles or pods in scattered areas in the anorthosite. The chief constituents are large crystals of pink and white feldspars, probably microcline and albite. Large flakes of muscovite are locally prominent. The quartz present is pure white and coarsely crystalline.

Late Lamprophyre Dikes - Relatively fine grained lamprophyre (spessartite) dikes form a late stage of igneous intrusion. In the vicinity of the shaft on the Monte Cristo North surface workings (Plate 2) one of these dikes, nearly horizontal, cuts the vein, and so is very late.

The main constituents are hornblende 50%, epidote 20%, and andesine 20%. The crystals of these minerals do not appear to exceed 3 millimetres in size. Accessory minerals are rutile, chlorite, biotite, and magnetite. A specimen taken near the quartz vein (Plate 1) has significant amounts of zeolite and chlorite, indicating hydrothermal alteration.

Aplite Dikes - Very fine grained aplite dikes consisting chiefly of quartz, albite, and orthoclase occur in the southern part of the area. Accessory minerals are garnet, muscovite, biotite, apatite, andalusite, and a few small grains of magnetite. The aplite was introduced along faults cutting the quartz vein.

Areal Distribution

Anorthosite - The whitish-blue anorthosite trends in a band about 2000 feet wide in a north-south direction, which is also about the strike of the gold veins. The country rock of the mining area is estimated to be about 90% anorthosite.

Hornblendite - The dikes of hornblendite appear as fracture fillings in the vicinity of the vein. Some tension or gash fractures filled with hornblendite lie at small angles to, and terminate against, the vein fracture zone.

Diorite - Diorite is a major intrusive body, giving, with the anorthosite, a dark and light pattern to the region. The anorthosite immediately around the veins contains very little diorite, but diorite is a major constituent both to the east and the west. The hill just west of the West vein appears to be capped by diorite. To the north the diorite converges on the vein from the east. The diorite is older than the anorthosite.

Pegmatite - A large lenticular pegmatite dike, about 300 feet wide, occurs a short distance to the west of the Monte Cristo South tunnels (not shown on any of the maps). Another notable occurance makes numerous pods and lenses to the east of the Monte Cristo North workings. The pegmatite is believed to be later than the anorthosite, but no definite field relations were observed to show the age relations.

Late Lamprophyre Dikes - The late dikes were observed only in the Monte Cristo North area where they cut the vein quartz (Plates 1 and 2). The dike examined was nearly horizontal and filled a fracture which displaced the vein about 3 feet in the vicinity of the shaft on the Monte Cristo North section (Plate 2).

Aplite Dikes - Aplite dikes occur on the Monte Cristo South area and on the Maynard property.

Contact Metamorphism

The country rock in the area, for the most part, shows very little metamorphism, but at the anorthosite-diorite contact, and at the diorite remnants completely surrounded by anorthosite, there are distinct signs of contact metamorphism. Hornblende partly altered to biotite, segregation patches of feldspar in a coarse augen structure, and the locally abundant titaniferous magnetite all indicate a fair degree of metamorphism.

Ore Deposits

Veins - The quartz veins are very lenticular, in many places pinching out in short distances from a widest part and then swelling again along the same or parallel fractures. The lenticular nature suggests that the quartz lenses may have formed along lines of mullion structure, but the fact that the veins are lenticular both vertically and horizontally makes this hypothesis a doubtful one. The maximum vein quartz width encountered was about 3½ feet.

The Monte Cristo North vein, where it is in the vicinity of banding in the anorthosite, is generally parallel to the banding, but in places the banding is twisted and oblique to the vein. This is well illustrated in the south sketch accompanying Plate 3.

The vein quartz, where unfaulted, is hard, white, and crystalline, with local patches of fairly coarse grained pyrite. The sulphides are nowhere continuous, but occur as isolated spots. Much iron stain has apparently resulted from surface waters leaching the pyrite. Most minerals in the area are fairly coarse grained.

The minerals of the vein consist of quartz, pyrite, magnetite, some chalcopyrite, a little sphalerite, pyrrhotite, calcite, and stilbite. The calcite and stilbite are probably a later mineralization stage. Sulphur, in the form of small globules, was found in vugs on the Maynard property. The sulphur is the result of supergene alteration.

The quartz is fairly late, its age being somewhere between that of the two stages of basic dikes. The gold mineralization and accompanying sulphides probably came in with the quartz. The age relations of all the vein minerals could not be determined from the polished sections examined. The following sequence is suggested with the minerals that are in doubtful position followed by a question mark:
quartz - magnetite - pyrite - pyrrhotite ? - sphalerite - chalcopyrite ? - calcite - stilbite ?.

<u>Wall Rock Alteration</u> - The only marked alteration zone along the vein occurs where the vein appears to have replaced dikes of hornblendite. The mineral composition of pyrite, biotite (the chief constituent), chloritoid, chlorite,

epidote, sphene, and limonite indicate hydrothermal alteration. In some areas sericite is present where anorthosite has been replaced.

Calcite and stilbite were found in the walls of the veins. Heulandite has penetrated the spessartite dike near the vein where the dike cuts the vein. This shows that the zeolite mineralization is later than both the vein and the dike. It is believed that calcite was introduced at the same time.

Structural Features

Faults

North-South Faulting - The north-south faulting is the earliest movement in the area. There are indications that it may have occured in three stages or over a prolonged period interrupted by intrusion and hydrothermal replacement along the fault surface.

Early hornblendite dikes at acute angles to the fault surface could be the result of intrusion into tension cracks caused by strike slip faulting, or into subsidiary fractures of normal faulting. Movement after the dike intrusion displaced the dikes and opened a channelway for the emplacement of the quartz.

The last stage of north-south faulting was post-quartz faulting and was probably strike-slip. The last movement on this fault at any rate was strike-slip as evidenced by numerous near-horizontal striations (Plates 3 and 4).

East-West Faulting

Low Angle Faults - East-west low angle faulting was mapped in the Monte Cristo South area (Plates 9 and 10). It could not be determined whether this faulting was normal or reverse. The movement was post-ore and also later than all north-south faulting in the Monte Cristo South area. A blue-gray aplite dike is intruded along this fault plane. Two sub-parallel low angle faults were mapped in the lower tunnel. A possible vein continuation north of the faults with very little lateral displacement indicates no appreciable strike-slip.

High Angle Faults - High angle east-west faults cut off the north-south ore-bearing fault zones in the West vein area (Plate 5) and in the mapped part of the Maynard property (Plates 11 and 12). The presence of aplite along the surface of the low angle faults and its absence on the others might indicate that the low angle displacement occured first. The displacement of the post-ore fault on the Maynard property can be calculated. The similar appearance of the vein on both sides of the fault indicates that the displacement was predominantly strike-slip. The observed lenticular nature of the quartz veins in other parts of the area eliminates the possibility of very much displacement occuring by dip-slip movement. The offset distance measured directly from Plate 11 is 30 feet.

Joints - Attitudes of all joints observed in the Monte Cristo North area were recorded in an attempt to find the age of jointing and the relation, if any, to the ore mineralization.

A set of joints striking northeast and dipping about 60° to the southeast is present in both the upper and lower Monte Cristo North levels. This is the only widespread pattern obvious in the mines. A set of less importance strikes just west of north and dips 40° to the west. Horizontal jointing is locally fairly prominent in the upper Monte Cristo North level (Plate 3).

Miscellaneous joints, often quite prominent where observed but apparently confined to small areas, have a wide range of strike and dip. The joints apparently have no effect on the vein fractures or ore deposition.

Sequence of Geologic Events

1) Anorthosite Intrusion - This was the first event that took place in the immediate vicinity of the mine. The anorthosite intruded diorite, remnants of which are present in the mining area.

2) North-South Faulting - This faulting was apparently strike-slip and was possibly accompanied by many tension fractures.

3) Intrusion of Basic Dikes - A plutonic magma of the composition of hornblende lamprophyre intruded the anorthosite, filling the channelways formed by the faulting and by the tension or subsidiary fractures of stage 2.

4) Recurrent North-South Faulting - A period of faulting, mainly directed along the original north-south fracture, cut the basic dikes in the tension fractures, and sheared the dikes in the north-south fractures.

5) <u>Introduction of Hydrothermal Solutions</u> - The ore bearing solutions came up through the fractures caused by the second period of faulting and deposited quartz and other vein minerals by replacement in the fault zone.

6) <u>Recurrent North-South Faulting</u> - This period of faulting is indicated by finely brecciated quartz and well preserved striations along the fault surface. The three periods of north-south faulting could conceivably be considered to be one prolonged stage with igneous intrusion and hydrothermal mineralization during intervals of quiescence.

7) <u>Horizontal Fracturing</u> - The quartz vein is displaced on a horizontal plane by 3 feet at the shaft on the Monte Cristo North property (Plate 2).

8) <u>Late Basic Intrusion</u> - The only place where a late phase of basic magma intrusion was noticed is the filling of the horizontal fracture mentioned in stage 7. The basic dike is about 8 inches wide.

9) <u>Low Angle East-West Faulting</u> - The amount of displacement on the low angle faulting is unknown. The vein changes in thickness and nature very much in crossing the fault surface, but this may be merely a measure of its lenticular nature. This faulting has not been related to the horizontal fracture of stage 7.

10) <u>Aplite Dike Intrusion</u> - Blue-gray brittle aplite in a zone 4 inches to 12 inches wide has been injected along the fault surface formed in stage 9. Aplite was also found

parallel to the vein in the Maynard property where it apparently entered along the late north-south fault surface.

11) High Angle East-West Faulting - This stage of faulting, as shown in the middle level of the Maynard property (Plate 11), offsets the north-south fractures in a predominantly strike-slip movement. The high angle faulting has not been related to the faulting of stages 7 and 9.

12) Late Hydrothermal Alteration - The stilbite and fine calcite veining the granulated quartz are probably late stages of mineralization, at least as late as the late basic intrusive (stage 8), because heulandite cuts that rock.

Economic Considerations

Pre-ore faulting is apparently the primary factor in quartz vein control. The vein quartz appears to replace both dikes and country rock without preference. Possibly increased surface area resulting from minor facturing and brecciation along the faults is the most favorable condition for the quartz replacement. The solution of all post-ore faults affecting the veins is of course necessary from an economic point of view. The vertical as well as horizontal displacement of lateral faults must be known because the lenticular nature of the ore bodies makes it necessary to find the exact location of a displaced ore body rather than merely the displaced fault surface.

Gold mining in the Monte Cristo area is certain to be a very risky enterprise. The lenticular nature of the gold bearing veins that have been mined are a strong suggestion that other exposed quartz veins are equally lenticular.

The Monte Cristo North lower level (Plate 4) has apparently been driven along the wrong fracture zone. By superimposing Plate 3 over Plate 4 so that the coordinates match it can be seen that the upper level is directly above the quartz showings in the north crosscut, the central crosscut to the west, and the entrance crosscut. These quartz showings have been joined with a dotted line to indicate the possible position of the vein on the lower level. This relation is also shown on the cross section (Plate 13). The position of the vein indicates a possibility of ore not yet touched between the two levels and a still more remote possibility of downward continuation of the ore below the lower level. Further exploration work would be required to determine the validity of this suggestion.

The amount of work done on the gold veins and reference to previous reports indicate that on a small scale operation ore was probably taken out at a profit. The longitudinal section of the Monte Cristo North workings (Plate 13) shows approximately the amount of stoping that has been done in the past. The underhand stope below the upper level is only estimated as to size on figures taken from the literature. An approximate total tonnage of ore mined including that from drifting is 2500 tons.

The tonnage mined in the West vein totals an estimated 1300. This vein appears to have narrowed down at the face to the north and is faulted in the lower level to the south (Plate 6).

Development work in the Monte Cristo South area indicates some ore below the low angle east-west fault. The length of the exposure is discouraging unless ore can be found to the north of the fault.

The Maynard property has 120 feet of fairly well oxidized quartz exposed in the levels mapped. The vein here pinches out, or is cut off by strike slip faulting, at the southern end of the workings. If the vein pinches out the property has fairly limited possibilities, but if the end of the vein is due to faulting further exploration would be warranted. The high value of the assays reportedly taken on the Maynard property indicate spots of high grade ore. The tonnage that could be expected limits any future operations to a very small scale unless more vein is found. An approximate figure for the amount of ore exposed, based on the length and distance between levels and assuming an average width of two feet, would be about 500 tons.

The total exposed vein length in all the underground workings of the several areas that is of possible ore quality totals less than 300 feet. The surface trace of the vein, if studied more carefully, might indicate a little additional length, but the total ore in sight could not be very great. Unless underground exploration uncovers more ore, future mining should be confined to small scale operations and high grade ore only.

Three grab samples taken on the Monte Cristo North and assayed by the Coronado Copper and Zinc Company gave very discouraging results (Plates 2, 3, and 4):

1) Au. - 0.66 oz/ton; Ag. - 0.54 oz/ton
2) Au. - 0.12 oz/ton; Ag. - 4.20 oz/ton
3) 0.24 oz/ton; Ag. - 0.43 oz/ton

Results of assaying two samples on the Maynard property (Plates 11 and 12) were reported to the writer and are as follows:

4) Au. - $496.00 per ton
5) Au. - $ 96.00 per ton

Since nothing of the method of sampling is known the values may not be representative and should not be used to evaluate the property.

One of the main assets of the mine is the amount of development work already done on the Monte Cristo North workings. The downward projection of the vein from the surface should be 30 feet west of the lower drift. If the quartz vein is mineable at this level it could soon be explored by a number of short diamond drill holes drilled west from the tunnel and then could be reached by short crosscuts.

The permanent water supply in the area is adequate for a small mining operation.

Other possible commercial deposits in the area consist of ilmenite and vermiculite, both associated with the metamorphosed diorite.

REFERENCES

1. Tucker, W. B. (1927) Monte Christo gold mines, in Calif. State Mineralogist 23d Report, p. 294.

2. Crawford, J. J. (1896) Gold - Los Angeles County, in Calif. State Mineralogist 13th Report, pp. 203-205.

3. Sampson, R. J. (1937) Monte Christo mine, in Calif. State Mineralogist 33d Report, pp. 186-187.

4. Miller, W. J. (1934) The geology of the western San Gabriel Mountains of California, Univ. Calif. in L. A., Publ. in Mathematical and Physical Sciences, vol. 1, no. 1, pp. 1-114.

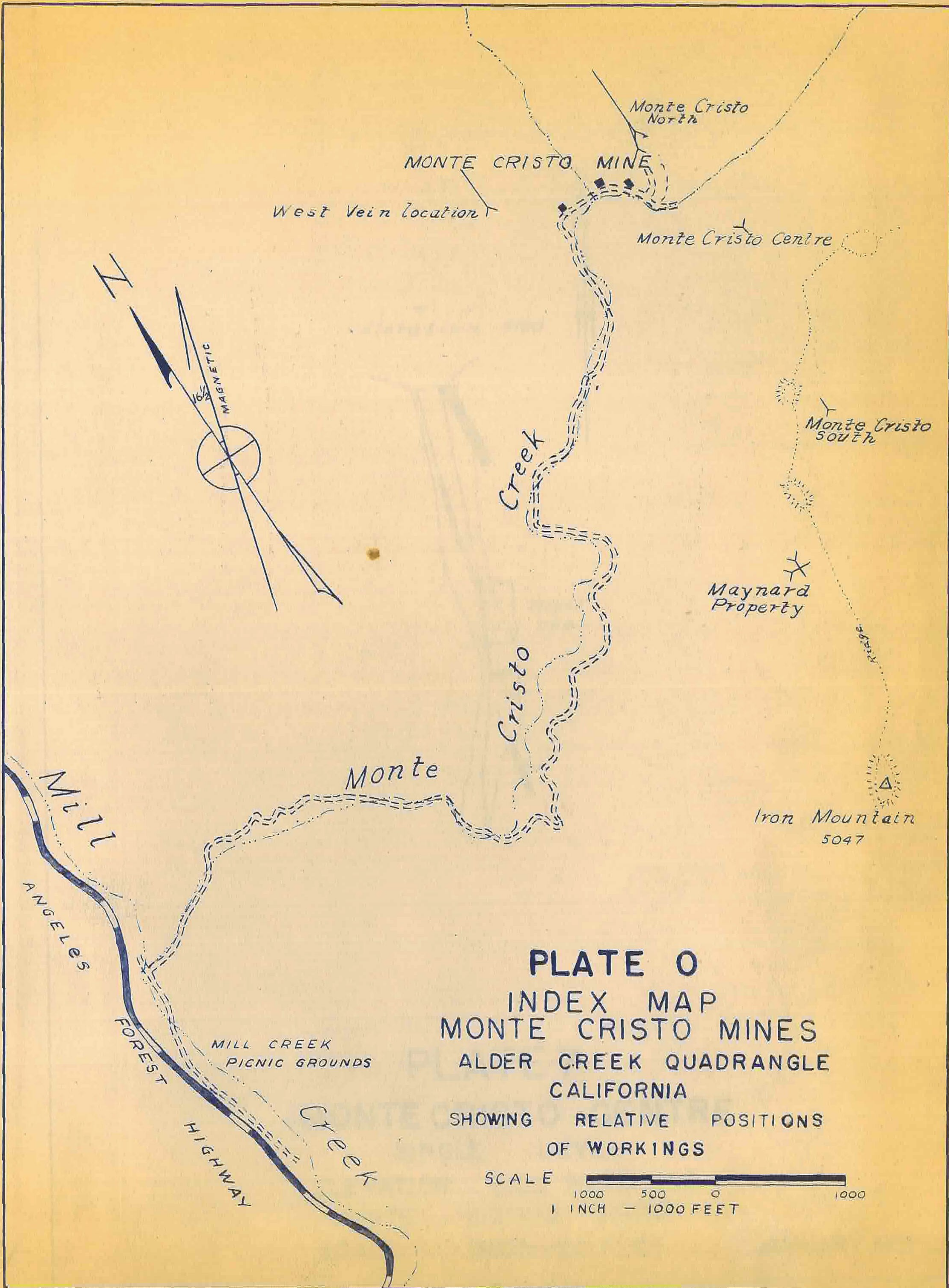

PLATE O
INDEX MAP
MONTE CRISTO MINES
ALDER CREEK QUADRANGLE
CALIFORNIA
SHOWING RELATIVE POSITIONS
OF WORKINGS

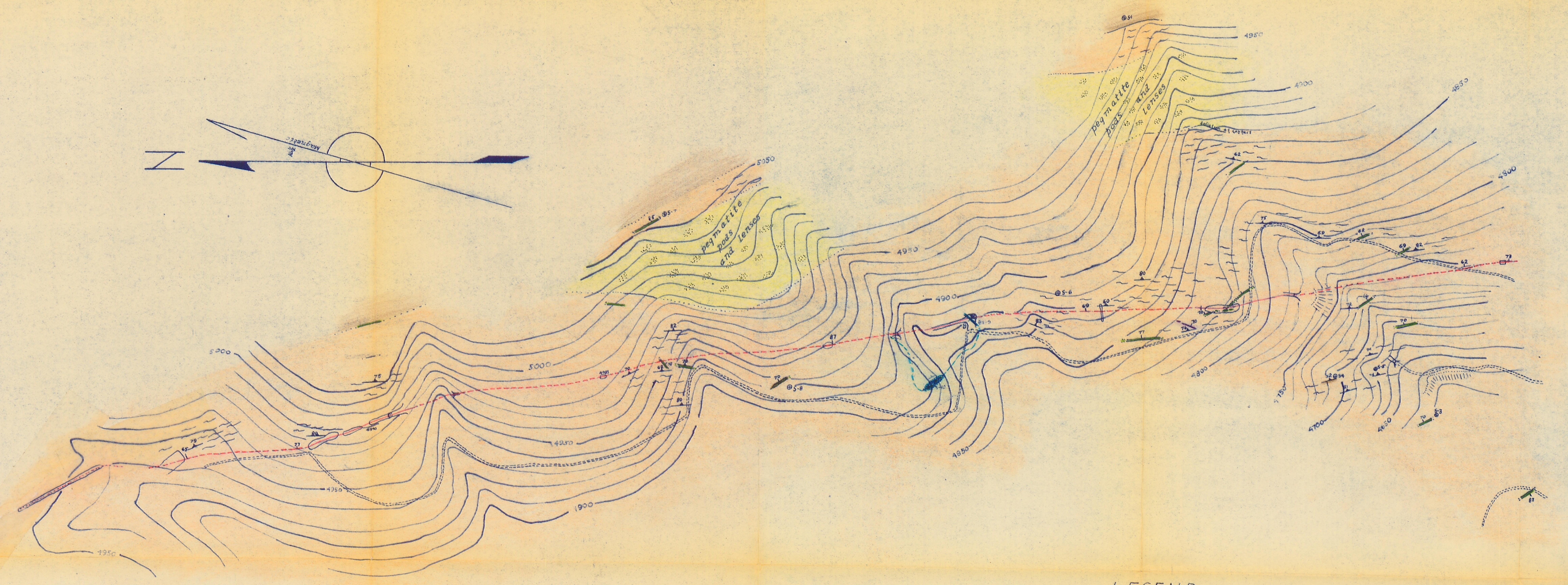

PLATE I

MONTE CRISTO NORTH

SURFACE AREA ALONG THE MONTE CRISTO VEIN

SCALE 1 INCH - 100 FEET OR 1/1200

100 50 0 100

CONTOUR INTEVAL 10'

JANUARY 1951

LEGEND

FOR ALL PLATES

- Pegmatite pods in anorthosite
- Anorthosite
- Banded anorthosite
- Diorite
- Basic dike - hornblendite
- Late basic dike-spessartite
- Quartz Vein
- Shaft
- Prospect pit or trench
- Fractures
- Mine dump
- Portal on index map
- Geologic contact
- Dip and strike of joints
- Vertical joints
- Dip and strike of fractures
- Vertical fractures
- Dip and strike of vein
- Vertical vein
- Dip and strike of foliation
- Vertical foliation
- Stoped area
- Sample locations
- survey station and elevation
- Trail
- Portal

p. 25
Phipps - rt - 1951

PLATE 2

MONTE CRISTO NORTH

SURFACE

COORDINATES ASSUMED FOR
CORRELATION WITH OTHER LEVELS

SCALE - 1 INCH-20 FEET JANUARY 1951

p. 26 Phipps rt. 1951

PLATE 3

MONTE CRISTO NORTH

UPPER LEVEL

COORDINATES ASSUMED FOR CORRELATION

SCALE - 1 INCH - 20 FEET

JANUARY 1951

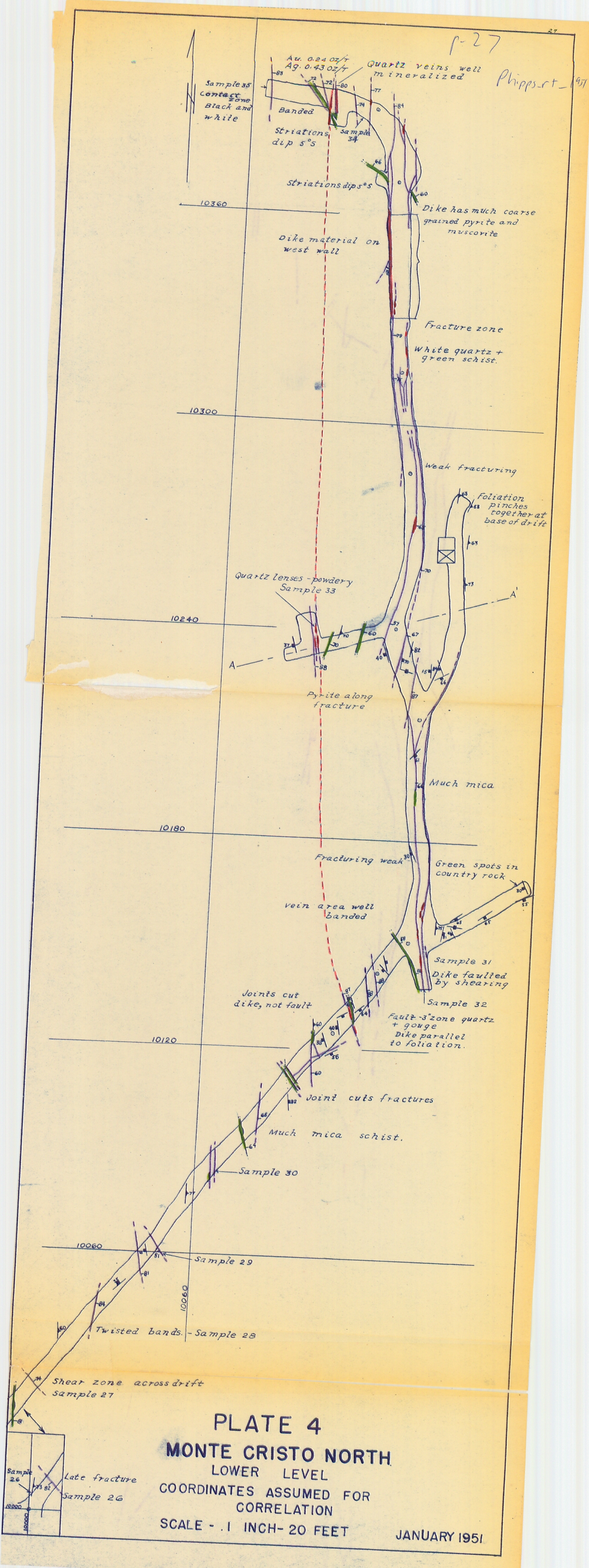

PLATE 4
MONTE CRISTO NORTH
LOWER LEVEL
COORDINATES ASSUMED FOR CORRELATION
SCALE - .1 INCH - 20 FEET

JANUARY 1951

p. 28
Phipps - rt - 1951

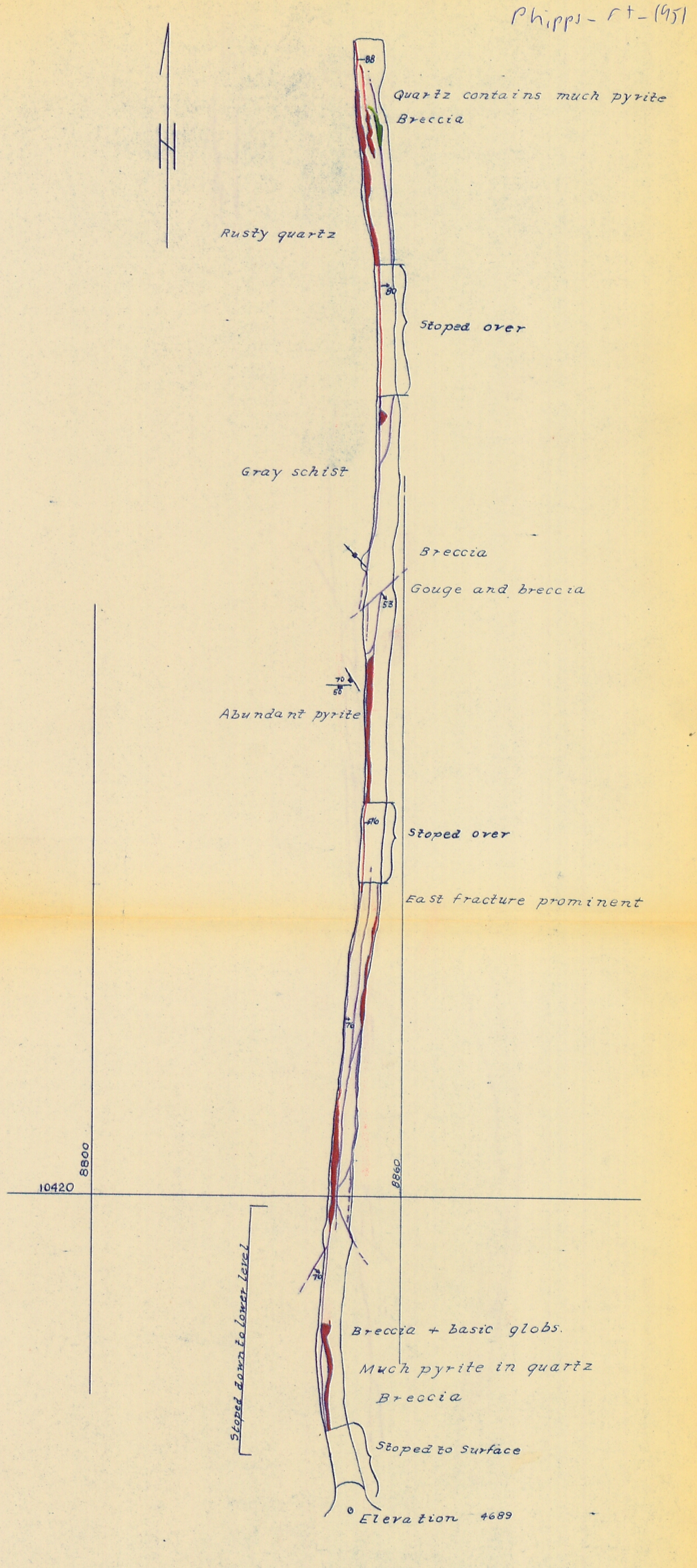

PLATE 5

WEST VEIN

UPPER LEVEL

ELEVATION AND COORDINATES

TIED TO MONTE CRISTO NORTH

SCALE - 1 INCH-20 FEET

JANUARY 1951

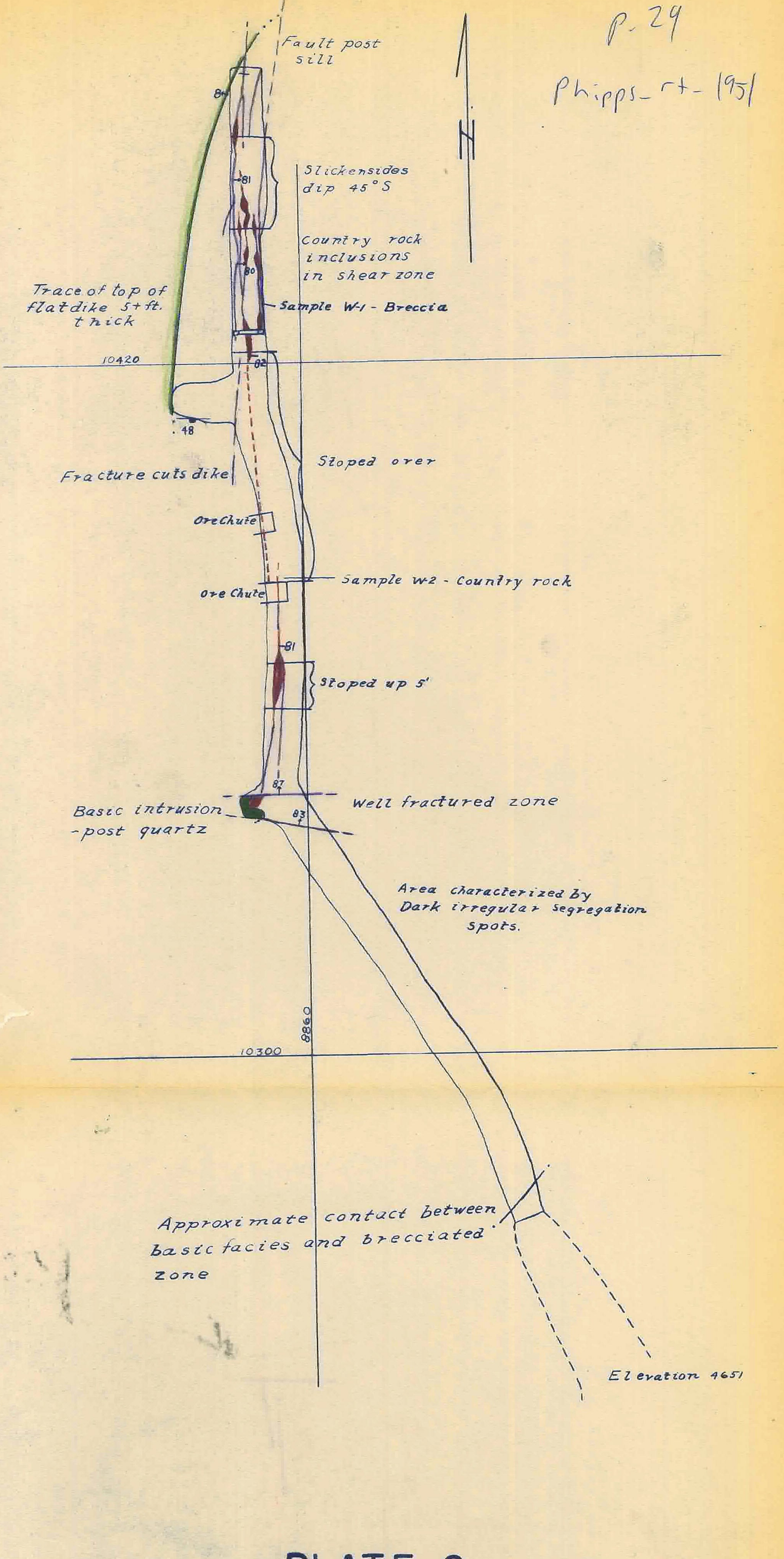

PLATE 6

WEST VEIN

LOWER LEVEL

ELEVATION AND COORDINATES

TIED TO MONTE CRISTO NORTH

SCALE - 1 INCH - 20 FEET

JANUARY 1951

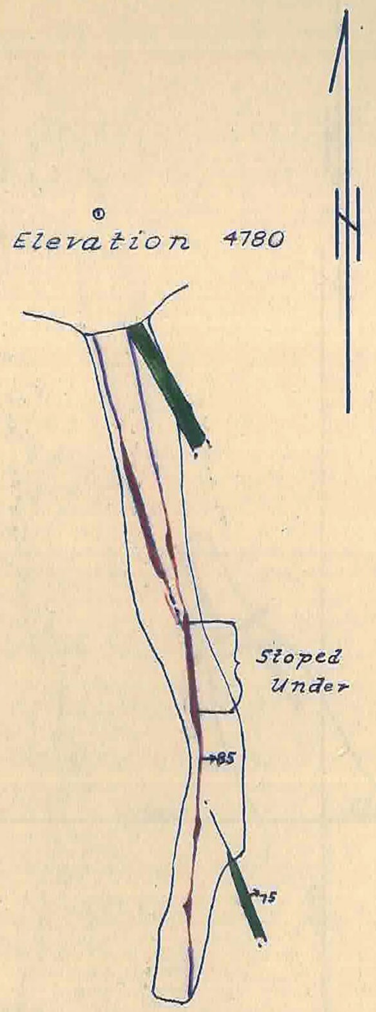

PLATE 7

MONTE CRISTO CENTRE

SINGLE LEVEL

ELEVATION TIED WITH

MONTE CRISTO NORTH

SCALE - 1 INCH-20 FEET JANUARY 1951

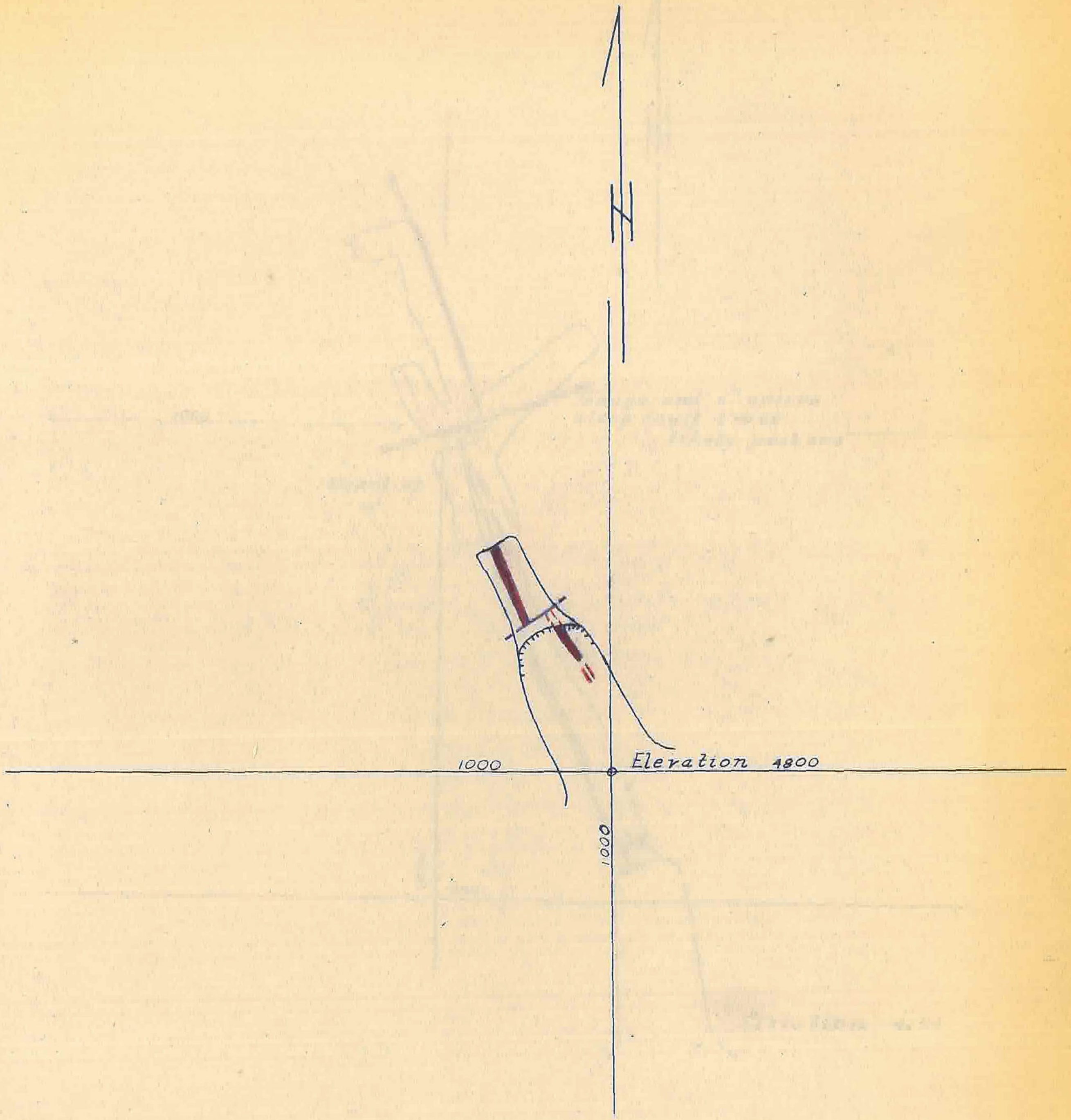

PLATE 8

MONTE CRISTO SOUTH

UPPER LEVEL

COORDINATES ASSUMED FOR
CORRELATION WITH OTHER LEVELS

SCALE – 1 INCH–20 FEET JANUARY 1951

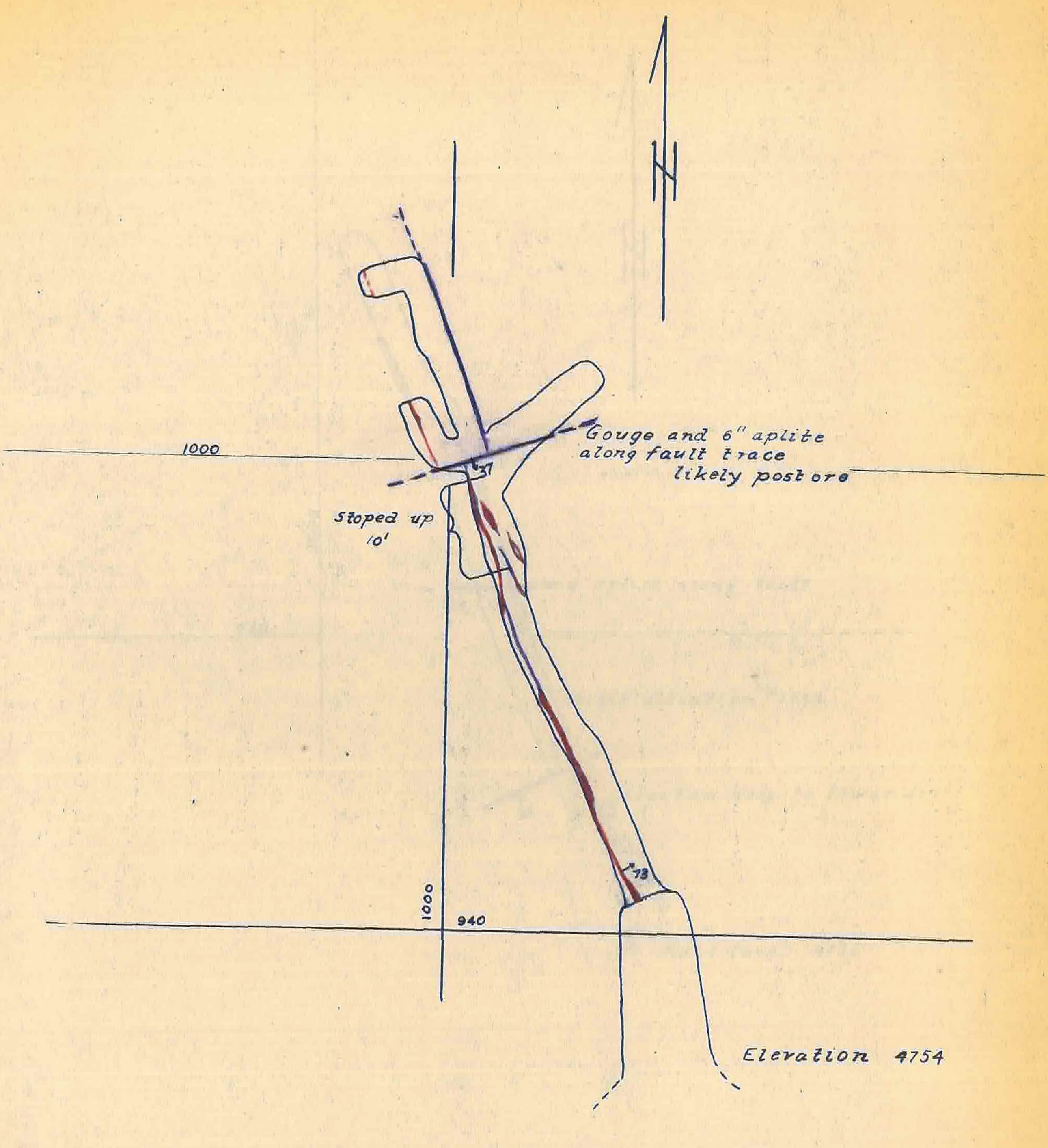

PLATE 9

MONTE CRISTO SOUTH

MIDDLE LEVEL

COORDINATES ASSUMED FOR
CORRELATION WITH OTHER LEVELS

SCALE - 1 INCH - 20 FEET JANUARY 1951

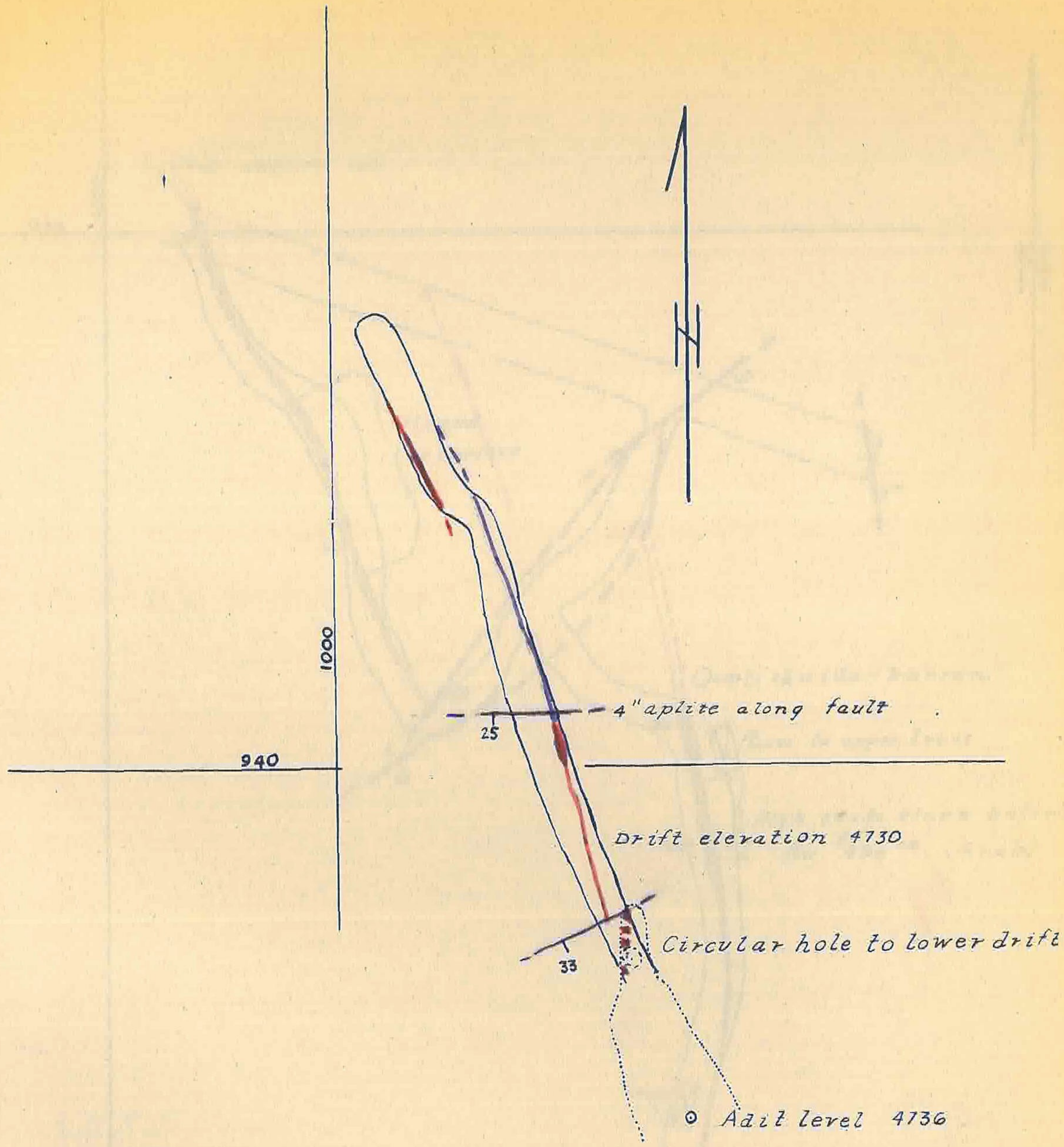

PLATE 10

MONTE CRISTO SOUTH

LOWER LEVEL

COORDINATES ASSUMED FOR CORRELATION WITH OTHER LEVELS

SCALE - 1 INCH-20 FEET JANUARY 1951

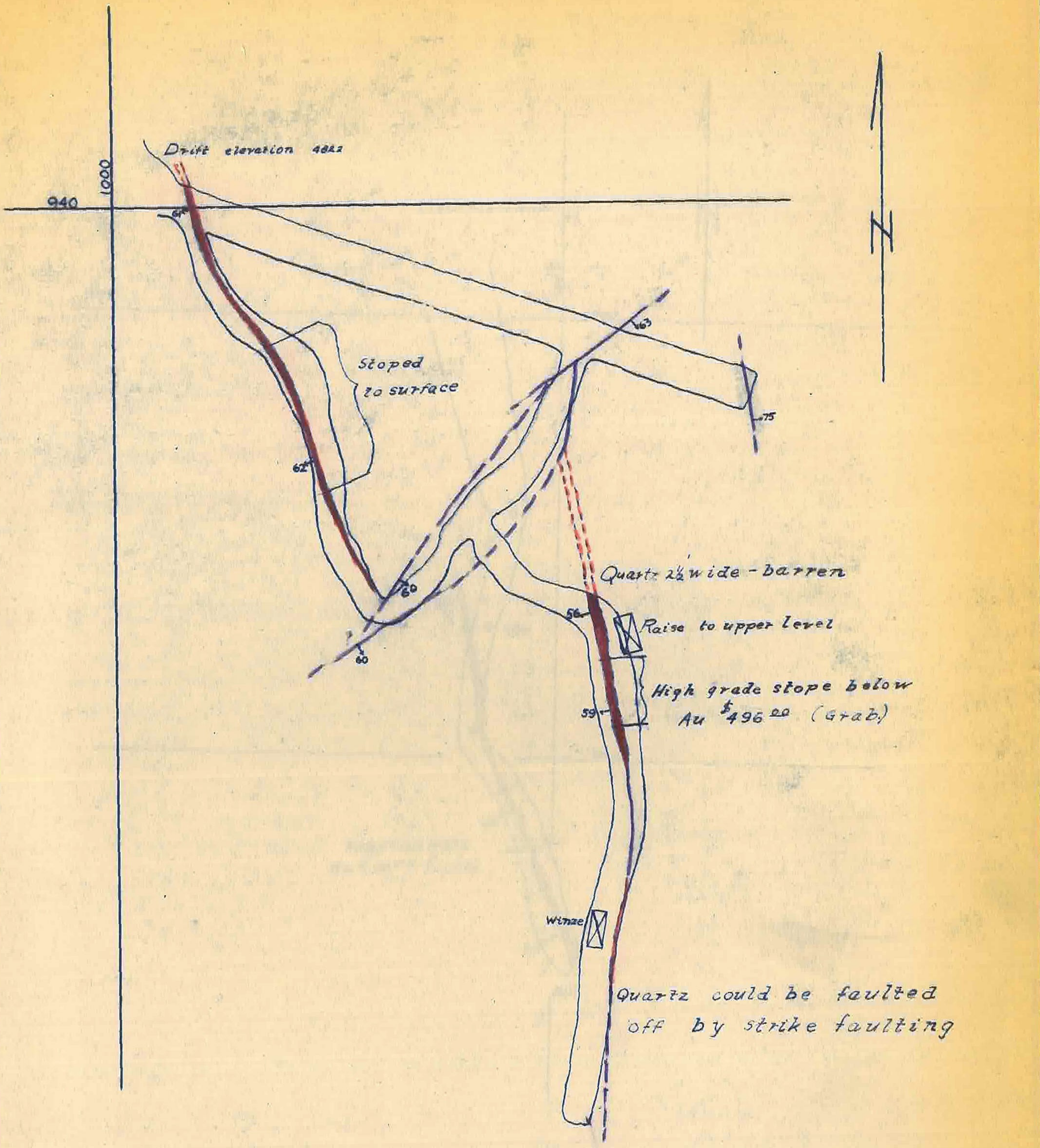

PLATE II

MAYNARD PROPERTY

MIDDLE LEVEL

COORDINATES ASSUMED FOR
CORRELATION WITH LOWER LEVEL

SCALE - 1 INCH=20 FEET   JANUARY 1951

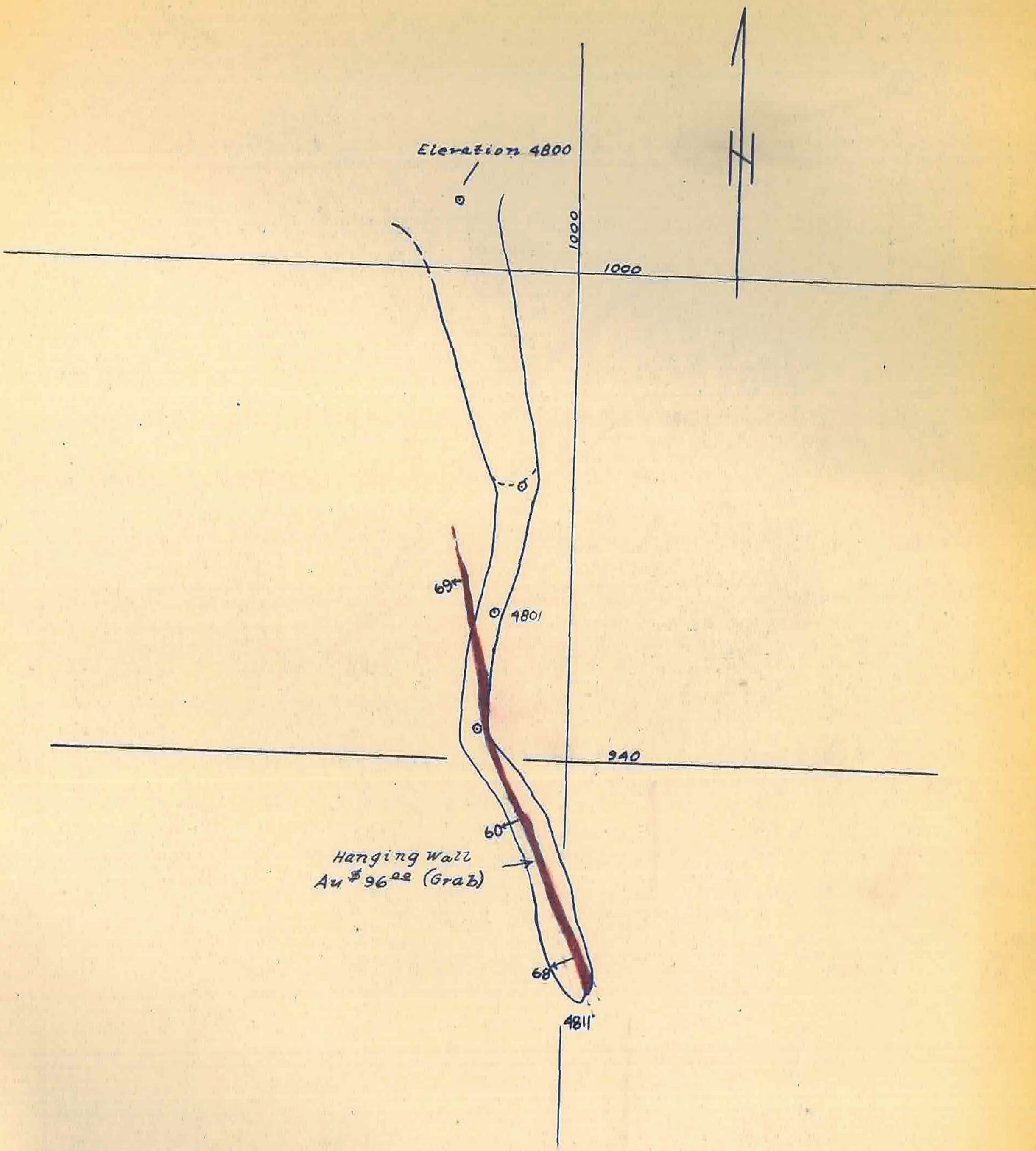

PLATE 12

MAYNARD PROPERTY

LOWER LEVEL

COORDINATES ASSUMED FOR CORRELATION WITH MIDDLE LEVEL

SCALE.- 1 INCH-20 FEET JANUARY 1951