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TERRITORY OF ALASKA

DEPARTMENT OF MINES

JUNEAU, ALASKA

REPORT ON AN EXPERIMENTAL MAGNETOMETER SURVEY OF SCHEELITE DEPOSITS IN THE GILMORE DOME AREA, FAIRBANKS DISTRICT, ALASKA

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INTRODUCTION

During an examination of scheelite deposits in the Gilmore Dome and Tungsten Hill areas in the Fairbanks district in the summer of 1942, it was noted that significant amounts of moderately magnetic minerals occur both in the ore and in barren amphibolite zones close to the ore.[1] Because overburden makes surface prospecting slow and expensive in these areas an experimental magnetometer survey was subsequently run to determine if information could thereby be obtained concerning the location of scheelite deposits, or of areas favorable to ore deposition.

The Gilmore Dome area was selected for the survey, because in this area a zone of scheelite had been partially exposed by prospecting and thus something was known of structure and conditions of ore deposition. This area lies about 15 miles northeast of Fairbanks, on a dome-shaped hill at the heads of Gilmore, Monte Cristo and Yellow Pup Creeks (Fig.1).

GEOLOGY

The geology of the area has already been described.[2,3] Briefly stated, scheelite mineralization occurs in one and possibly several horizons of limestone and calcareous schist. These horizons are members of the pre-Cambrian schist that is the predominant bedrock of the Fairbanks district. They apparently occur in irregular lenticular masses rather than in continuous beds, but their structure is similar to that of the enclosing quartz mica and quartzite schists.

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[1] Joesting, H.R. and Anderson, Eskil. Preliminary Report on Scheelite deposits in the Fairbanks district. In preparation

[2] Prindle, L.M. and Katz, J.F., Geology of the Fairbanks District, U.S. Geol. Survey Bull. 525, 1913.

[3] Joesting, H.R., Strategic Mineral Occurrences in Interior Alaska, Terr. Dept. of Mines, Pamphlet No. 2, 1943, pp. 31-36

Mineralization was effected by hydrothermal solutions expelled from an underlying intrusion of porpyritic granite. The solutions contained principally tungsten, silica and iron, whidh were deposited in the calcareous rocks by replacement processes. The position and form of these replacement deposits were thus determined by the structure of the calcareous rocks. Scheelite is also found in quartz stringers in the granite and in the non-calcareous schist, and sparsely disseminated in parts of the granite; but so far as is known these occurrences are not of economic importance. A geologic map of the Gilmore Dome area is shown in Fig. 1.

Magnetic Minerals in the Ore and in Associated Rocks

Moderately magnetic minerals--principally pyroxenes, hornblende and garnet--constitute about 34 per cent by weight of the high-grade scheelite ore found on Gilmore Dome.[1] Moderately magnetic hornblende and pyroxenes are the chief constituants of the nearby barren amphibolite zones.

All of the minerals in the ore are of identical origin; they were deposited mainly by replacing calcite and to some extent by replacing earlier formed replacement minerals. Little is known, however, of the origin of the amphibolite zones, because there has been little opportunity to examine them in place. They apparently occur in or close to calcareous horizons, although this statement is supported only by the almost invariable association of amphibolite float with float from the replaced calcareous horizons. The amphibolite has been dynamically metamorphosed and has a slightly schistose structure. Since the ore has not been similarly metamorphosed, the amphibolite is considered to be older than the ore and is probably contemporaneous with the calcareous horizons with which it is associated.

On Gilmore Dome the only amphibolite that could be observed in place occurs in a 1-4 foot zone along the lower boundary of the calcareous horizon in which the ore is found. Most of the replacement and consequent mineralization took place along and outward from joints, seams and other favorable channels in the calcareous rock and along its contact with the amphibolite.

FIELD PROCEDURE

A Schmidt-type vertical field balance was used for the magnetic survey. Its sensitivity was set at 34.4 gammas per scale division as tetermined with a Helmholtz coil, and its mean temperature coefficient as determined under field conditions was + 0.17 scale divisions per

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[1] Joesting, H.R., Report on Magnetic and Non-Magnetic Gangue in Scheelite Ore from Clearly Hill Mines Property, Gilmore Dome, Fairbanks District, Alaska, Feb.6, 1943. Unpublished report on file at Terr. Dept. of Mines, Juneau.

degree centigrade.

Since only one instrument was available for the survey, diurnal and base station corrections were determined simultaneously by reoccuyping base stations at hourly intervals. Magnetograms from the College Observatory of the Carnegie Institution were used as an additional check against sudden chances in the earth's field and against large changes in the constants of the magnetometer.

Because the significant anomalies in the Gilmore Dome area are relatively large, a high degree of precision was not required in measuring them. The procedure followed was to orient and level the balance fairly carefully and then obtain two check readings in each of the two orientations of the instrument.

After applying temperature, diurnal and base corrections, the maximum discrepancy at any station as determined by a large number of check readings was about 25 gammas, while the mean discrepancy, disregarding the sign, was about 4.5 gammas. These discrepancies and the corresponding errors are insignificant compared to the magnitude of the anomalies that were measured. Because of the small area covered by the survey, latitude and longitude corrections were not applied.

Preceeding the magnetometer survey, lines were laid out as shown in Fig. 1 and in Plate 1. Lines 1 to 7 are 450 to 550 feet apart, with magnetometer stations 100 and 200 feet apart on each line. Lines A,B,C and D were run along roads and trails. Stations are 100 feet apart on Lines A and B, and 100 to 500 feet apart on Lines C and D. Lines with stations 25 feet apart were also laid out along prospect pits that cross the ore zone. (Fig.2 and Plate I).

The various lines were located by planetable surveys or were run along patented claim lines. Stations on all lines were measured with a 100 foot steel tape and were marked with stakes. All lines except C and D are parts of closed traverses, with maximum errors of closure about 1:600.

A total of 8 days was required for 2 men to lay out the lines and mark the stations. About half of this time was spent brushing out lines through a moderately thick growth of alders, willows and small spruce that covers parts of the area. The total length of the lines was about 8 miles.

A total of 9 days was required for one man to complete the magnetometer survey. In all, 518 magnetometer stations were occupied, of which 408 were new stations and 110 were base and check stations. The rate at which stations were occupied varied between 5 and 13 in one hour, or between 40 and 72 in 7 hours; and depended mainly on the type of ground covering. Considerable delay was caused at times by a 1-2 foot layer of moss which made it difficult to level the instrument, but no difficulty was experienced where the moss was thinner.

A total of about 6 hours was lost because of small to moderate magnetic disturbances on several mornings. Some additional time was lost because of the unusual amount of rain, which fell about half of the time while the field work was being done.

PRESENTATION OF MAGNETIC DATA

Results of the magnetometer survey are shown in Plate I and in Figs. 3 to 14. Plate I is a map of the Gilmore Dome area showing lines of equal vertical magnetic intensity. Figs. 3 to 13 show profiles along the various magnetometer lines, while Fig. 14 shows the relation between magnetic profiles and the ore as exposed in prospect pits.

INTERPRETATION OF MAGNETIC DATA

Bedrock structure is revealed in a general way by the magnetic map showing lines of equal vertical intensity (Plate I). To determine structural conditions in more detail would require closer spacing of magnetometer stations. According to the configurations of the anomalies, the rocks strike N70E to E and dip N. Several structural irregularities are indicated by irregularities in the long axes of the anomalies, particularly along Line 6 and between Lines 3 and 4. Corresponding irregularities may be anticipated in the ore zone.

Several zones of moderately magnetic rock, presumably amphibolite, are indicated by relatively large elongated positive anomalies both north and south of the ore zone. The presence of the magnetic zone 600 feet north of the ore zone was not known prior to the survey. Except for an offset at Line 6, this zone is continuous across the whole area. It apparently ends just west of Line 1, but its eastern extremity was not reached. To determine its full extent would require an extension of the survey. The presence of amphibolite zones south of the ore zone was indicated by float prior to the survey. Their positions are indicated by elongated positive anomalies of small areal extent. Apparently these zones are discontinuous and irregular.

A relatively small positive anomaly was found a few feet south of the ore zone as shown in Fig. 14. This anomaly is associated with the footwall zone of amphibolite and with the magnetic minerals in the ore. Ore was not encountered at the top of bedrock in pits 1 and 7 (Figs.1 and 14), but because the magnetic profiles indicate that conditions here are similar to those where ore was found, it is probable that ore will also be found at shallow depths in these pits.

Magnetic conditions in the northern part of the area are relatively uniform, as shown in Plate I and Figs. 3 to 6. These uniform conditions indicate the absence of magnetic zones in the schist and also of associated calcareous horizons and replacement deposits.

Although less uniform than in the northern part of the area, magnetic conditions are also comparatively uniform in the extreme southern part. Garnetiferous replacement zones with sparse disseminations of scheelite are encountered here. These zones give rise to minor positive anomalies which could be traced by detailed measurements.

Magnetic profiles over granite-schist contacts are shown in Figs. 12 and 13. The magnetic field is more uniform and of smaller magnitude over the granite than over the schist, but it is doubtful if these minor differences can be used to trace the contact. Along the lines of the traverses the magnetic mineral content of the granite is less than that of the schist, consequently a lower vertical intensity over the granite was anticipated. In the area between Melba and Monte Cristo Creeks, on the other hand, the intrusive is more basic and consists of hornblende granite and quartz diorite. Because of their higher content of magnetic minerals the vertical intensity over these rocks may be higher than over the schist. The quartz mica schists and quartzite schists which comprise the bulk of the country rock in the Gilmore Dome area were little altered by the granitic intrusion, as indicated by the absence of significant anomalies over the contacts crossed in Lines C and D.

The extent of the known commercial scheelite deposit on Gilmore Dome is apparently governed by the extent of the calcareous horizon in which it occurs. This horizon, largely replaced by ore, has been traced by prospecting 800 feet along the surface and 150 feet underground along its dip. The maximum depth to which it can extend, and hence the maximum depth at which mineable ore may be anticipated, depends on the depth at which granite is encountered.

On the surface the nearest granite-schist contacts are only 300 to 500 feet lower than the ore on the summit of Gilmore Dome. Evidence of the approximate depth of the contact beneath the sumit is afforded by magnetic data. According to computations, the magnetic zone 600 feet north of the ore dips north at about 45 degrees and extends to vertical depths of 600 to 800 feet. It is assumed that the magnetic zone does not continue into the granite, consequently the granite contact along this zone should lie at depths greater than 600 to 800 feet. These computations are based on inadequate data and hence give results that are only approximate, nevertheless they indicate that the configuration of the contact is irregular and is updomed both north and south from the magnetic zone. It is unlikely, therefore, that the depth of the granite under the ore zone is considerably less than 600 feet.

More detailed interpretation will be possible when more magnetic data are available and when there is more opportunity to correlate them with bedrock conditions as determined by prospecting. Following this correlation, interpretation may be extended to adjacent areas where conditions are unknown.

CONCLUSIONS

Because of marked differences in the magnetic properties of the rocks associated with the scheelite ore, the magnetic map of the

Gilmore Dome area furnishes information concerning structure and the location of areas favorable to mineralization. It is also apparently possible, because of the magnetic minerals in the ore and in the subjacent amphibolite zone, to trace the ore zone beyond its present known limits by detailed magnetic measurements. Other ore zones could probably be similarly traced after magnetic anomalies are correlated with becrock conditions.

Little information was furnished by the experimental survey of the position and attitude of granite-schist contacts adjacent to the mineralized area, although significant anomalies may be associated with the more basic differentiates of the intrusive which occur nearby.

Indirect evidence concerning the depth of the granite contact under the summit of Gilmore Dome was furnished by computing the approximate vertical depth to which a magnetic zone extends. These computations, together with measurements of the elevation of the contact at the surface, indicate that the contact is highly irregular and that the maximum vertical depth to which the replacement ore zone can extend is considerably less than 600 feet.

RECOMMENDATIONS

Detailed magnetic measurements should be made to determine the probable limits of the known ore zone and of all scheelite prospects in the area. Additional measurements should also be made to determine bedrock structure in more detail, since the position and attitude of the ore zones are determined by structure. Since it is apparent that the replacement deposits are confined to magnetically disturbed areas, the survey should be extended to determine the limits of these areas.

ACKNOWLEDGMENTS

Thanks are due to Dr. E.H. Bramhall of the Carnegie Institution for furnishing daily magnetograms and for predicting magnetic conditions with considerable success. The assistance of Eskil Anderson and Fred Maldeis of the Territorial Department of Mines, who laid out the magnetometer lines under adverse weather conditions, and of Kenneth Wier of the U. S. Bureau of Mines, who prepared the figures used in this report, is also gratefully acknowledged.

Henry R. Joesting
Assoc. Mining Engineer
Territorial Department of Mines
May 1, 1943

TERRITORY OF ALASKA

DEPARTMENT OF MINES

College, Alaska
June 24, 1943

Mr. B. D. Stewart
Commissioner of Mines
Juneau, Alaska

Dear Mr. Stewart:

Enclosed is the report on the Gilmore Dome magnetometer survey, which I have finally been able to correct. Because of the difficulty in getting typing done here I am sending it as is. Please let me know if you want a better copy made here.

Copies of maps accompanying the report have been given to Ed Hoch who is stationed on Gilmore Dome for the Bureau of Mines. If Sanford wants a copy of the report perhaps he could have it done in Juneau and I could send him copies of the maps and figures.

According to the request in your recent letter I asked Jessen and the News-Miner to submit bids on Pamphlets 1 and 2. Jessen's bid, as stated in my telegram of June 22, was:

200	copies	$532.50
300	"	584.37
500	"	821.25
1000	"	983.12

For each additional cut add $12.00 to the above totals

Reduction for each page under 60: $9.00

Increase for each page over 60: $14.00

Delivery: 60 days after receipt of corrected proofs.

These prices seem excessive to me. The News-Miner wants several more days to get in their bid. If it is equally high please let me know if the $200.00 that I offered will be enough to permit us to do anything.

My reasons for wanting to contribute this money are that the reports were written for early publication and I would like to see them through; also, money over actual needs means little nowadays; and furthermore, this sum will about cancel the recent raise in salary, allowing for increased taxes.

We are now spending a few days in the office for the purpose of working up some magnetometer and planetable survey notes. We expect to return to the field about the end of the week. I have been keeping up on other prospecting around here, but so far nothing important has been found.

Sincerely

Henry R. Joesting

Henry R. Joesting

Encl.