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TERRITORY OF ALASKA

DEPARTMENT OF MINES

PE 43-3

MAGNETIC EXPLORATION OF THE CAPE MOUNTAIN PLACER TIN DEPOSITS

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by

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INTRODUCTION

The Territorial Department of Mines maintains a staff of mining engineers who are available to prospectors and mine operators for consultation, examinations, and other types of assistance with a view toward helping create new mining production in Alaska. In line with this program, the Department did some geophysical exploration work for the Zenda Gold Mining Company at the suggestion of C. L. Sainsbury, U. S. Geological Survey member of the Alaskan DMEA Field Team. The company is prospect-drilling the creeks for placer tin content on a DMEA participating loan, and it was hoped that the magnetic work would outline the buried channels, or paystreaks carrying the tin, so that the drilling could be restricted to the areas where placer concentration was indicated and prevent wasting time and money drilling in barren areas. The work was done during July 1 to 9, 1953, by James A. Williams and Robert H. Saunders, Associate Mining Engineers of the Department of Mines. The instruments used in the magnetic measurements were Askania and Wilson-Hull vertical magnetometers of the Schmidt magnetic field balance type. Saunders drafted the accompanying maps and profiles, and Williams is the writer of the report.

Since this report is concerned primarily with the geophysical work, other parts of the report are not so detailed as they would be if it were written on an examination of the property for its geological and economic possibilities. Further details on most of the subjects treated here with the exception of the magnetic survey can be obtained from various U. S. Geological Survey Bulletins and reports, and from R. I. 4345 written by H. E. Heide and R. S. Sanford of the Federal Bureau of Mines as a result of their churn drilling program on the creeks concerned in 1943.

SUMMARY

At the suggestion of a DMEA Field Team member, a magnetometer survey was made of three creeks in the Cape Mountain placer tin area to determine if such a means could be used to delimit the buried placer channels and thus speed up the prospect drilling program of the Zenda Gold Mining Company being done on a DMEA participating loan. The area is one of lime - stone through which granite has intruded to form Cape Mountain, and the tin is apparently the result of contact action. Subsequent erosion has created placer deposits of the tin, and then buried them to various depths.

The plan was to run magnetic traverses over or near drill hole lines and determine if the resulting magnetic profiles could be related to the known amounts of tin concentrate or depths to bedrock. If interpretations to this effect could be made, then the exploration could be carried ahead to ground not yet drilled, and by means of the resulting data, the drilling could be directed to within the limits of the channels, eliminating future drilling of barren ground.

The work on Boulder and Goodwin Creeks was a failure. Significant anomalies that could be related to known features were not obtained. Further work on Cape Creek might have shown up a difference between channel and bedrock profiles, but the drilling on Cape Creek had already been finished. The failure of the project is considered largely due to a deficiency of magnetite in the placer concentrations.

ACKNOWLEDGMENTS

Acknowledgment and appreciation are due Mr. Glenn Adams, foreman, and the other men at the Zenda camp on Boulder Creek for their very courteous hospitality and cooperation in assisting the project. The writer also wishes to acknowledge the large scale maps and drilling information made available by the Federal Bureau of Mines which helped in planning, surveying, and plotting the magnetic traverses.

LOCATION

The Cape Mountain placer tin area lies just to the east and northeast of Cape Mountain and includes four main creeks, Boulder, Granite, Goodwin, and Cape, that head in the slopes of the Mountain. The district is on the western tip of the Seward Peninsula at approximate geographical coordinates of 167°58' west longitude and 65°35' north latitude. It is in the Teller Quadrangle, and Nome lies about 105 airline miles to the southeast. Wales Village, an Eskimo community, lies on the western side of Cape Mountain, something like six miles from the placer ground. The location of the area can be seen on Plates I and II.

OWNERSHIP

The placer claims on the various creeks are owned by several companies, partnerships, and individuals. Some of them are held by Zenda Gold Mining Company, and the rest that are included in the ground being prospected are under lease or option to the company.

PHYSICAL FEATURES

Cape Mountain is an outstanding peak in the otherwise low area, rising to a height of 2300 feet. Its slopes are steep, but the top and slopes are rounded from erosion and many granite outcrops are visible.

The placer creeks are steep near their heads, but quickly reduce in gradient downstream at the base of the mountain. They are shallow and normally carry very little water. The hills between the creeks are well rounded and have fairly easy slopes except where the limestone outcrops in many places. A view of Boulder Creek and Cape Mountain may be seen in Figure 1. Limestone float is abundant. The pass from south-flowing Cape and Goodwin Creeks over to Granite and Boulder Creeks, which flow into Lopp Lagoon, is at a low elevation--not over 300 or 400 feet. In valley bottoms and where the country is relatively flat, the ground is covered with typical soggy Alaskan moss with permafrost underlying it. Trees are non-existent. Game that can be taken on land is nil.

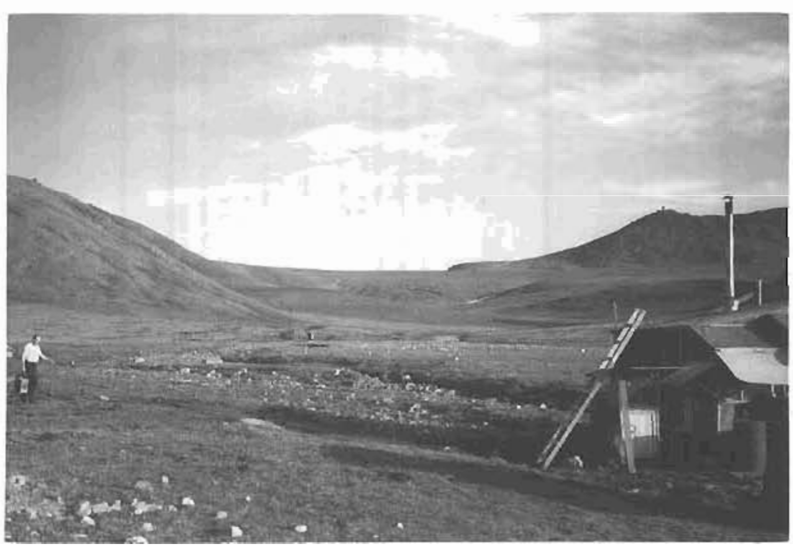


Figure 1. Boulder Creek, looking upstream from camp. Drill is in left center of picture. Cape Mountain is at upper right with Army structure on top.

The beach near the mouth of Cape Creek is favorable for lightering equipment and supplies ashore in good weather. A well-maintained road goes up Cape Creek and continues to upper Goodwin Gulch. Travel must be performed by tractor or foot from this point over to Granite and Boulder Creeks. A flight strip which will handle DC-3's is located on top of the ridge between Cape and Lagoon Creeks, and another is at Wales Village. Frequent flights with small planes are made from Nome by two airlines, mostly to service the Army installation located on the southeast slope of Cape Mountain. Meals and radio communication service can be obtained at this installation. A shelter cabin is maintained by the Alaska Road Commission at the beach, and two other buildings that remain (this was once Tin City) are being used as warehouses. The Zenda camp is composed of small buildings on skids that are moved from creek to creek as necessary.

CLIMATE

The weather in the Cape Mountain area, like that of much of Seward Peninsula, is characterized by sudden changes and strong winds, with apparently somewhat colder temperatures prevailing there than at Nome. Fog and rain come and go rapidly in the summer, but the total rainfall is probably not great. In the area where the work was done, a high wind was nearly always blowing, about half the time from the north and the rest of the time from the south. The weather is violent in the winter with temperatures to minus forty or fifty degrees. The Bering Sea is frozen from November to June.

GEOLOGY

The area is one of limestone and occasional schist through which granite intruded, forming the body that is now Cape Mountain. The contact follows roughly the base of the mountain, and is apparently the cause of the tin mineralization, which is in the form of cassiterite. In place, the tin appears partly as a replacement in limestone, partly in the granite near the contact, and more rarely in quartz veins.1/ In the erosion that followed the intrusion, and which brought the surrounding limestone country to a lower level than the granite, the cassiterite was carried from the contact and deposited in concentrations along the creek channels. Later erosion has buried these placer deposits to various depths.

The placer gravels vary in size from fine to large boulders, and are partly frozen. The cassiterite is in nuggets from about the size of a match head or smaller to as large as several inches in diameter, but these large nuggets are not numerous. In addition to the tin, the concentrate also carries magnetite, garnet, pyrite, and other heavy minerals. However, the magnetite content is low because of an unusually low percentage of magnetite in the granite, which seems to be typical of the granites in the tin-bearing areas of western Seward Peninsula.

MAGNETIC METHODS

The magnetic measurements taken were of the vertical component of the magnetic field at each station or point. The magnetometer used in taking the field measurements was a vertical Askania Schmidt-type field balance. A second instrument of the same type, but of a different and much earlier manufacture, was used as a base instrument with an adapted and connected recording microammeter for recording the diurnal changes and other magnetic disturbances. The recorder was energized by a pair of large storage batteries. Both magnetometers were equipped with temperature-compensated magnetic systems. All of this equipment is owned by the Department of Mines.

1/ Edward Steidtmann and S. H. Cathcart, Geology of the York Tin Deposits, Alaska: U. S. Geological Survey Bull. 733, 1922, p. 104.

It was intended that the use of the base instrument and recording setup would eliminate the necessity of making frequent base-station checks with the field instrument to detect the diurnal changes and magnetic storms. This would speed up the progress of the survey considerably, since much time and walking would be saved; and would increase the accuracy of the results, because upon later checking the recorded changes, the exact amount of adjustment to make for each measurement or reading taken would be known. Troubles developed shortly after the start, however, that could not be corrected in the field, and the use of the recording setup had to be abandoned. In the first place, the range of the recorder as set at the time was too small for operation in far northern latitudes where the vertical component fluctuates over a large amplitude. At the close of the first half-day's work, it was found that the recorder had been off-scale for over two hours, so the afternoon's work had to be repeated. In the second place, secondary base-station checks made with the field instrument to check against the variations of the base instrument and recorder showed that the two instruments, and hence the recorder, were not agreeing. Although this particular type of recorder is not as well adapted to Alaskan work as it was earlier thought it would be, it is probable that the above difficulties can be solved by a person reasonably skilled in handling and repairing instruments who has the available time to experiment and make adjustments.

Continuing the survey with the one instrument, a second primary base sufficiently distant from possible artificial magnetic interference was selected and given an arbitrary vertical intensity value of 200 gammas. This base was used as a check point from which the relative intensity of a secondary base was established. Check readings were taken at one of these two bases at the start and finish of each portion of the magnetic work on Boulder Creek each day, and every hour in between, to detect changes in the earth's field and in the instrument. When fluctuations were found to have occurred, they were treated as linear changes with time, and readings taken in the interim were adjusted accordingly. Intensity values for each station were calculated in relation to the arbitrarily-chosen intensity of the primary base.

For the magnetic surveys on Goodwin and Cape Creeks, one of the stations on each creek was chosen as a base, and hourly repeat readings were made at that station for base checks. The three bases on the three creeks were not "tied in" as the walking time between them was too great for accurate results unless repeated several times, and it was not necessary in the first place. Thus, the intensity values shown on the profiles are not relative from one creek to another.

The magnetometer was properly calibrated for sensitivity with magnets of known strength while at the Boulder Creek camp, and the sensitivity was 25.0 gammas per scale division. Readings and results of calculations are recorded in Field Books No's. W-1 and W-3.

Work was postponed several times because of the interference of high winds with the proper operation of the instrument.

PROCEDURE

The problem was to locate the placer concentrations, or ancient channels that were likely to be the locations of the concentrations. If the channels could be located, then the placer prospect drilling could be confined to the channels. Thus, the tin content of the paystreaks could be found more quickly because the drilling beyond the limits of the channel would be eliminated. It was considered possible that a magnetic survey would reveal the locations of the concentrations or channels, either by high anomalies caused by the magnetite content of the concentrates or by a distinctive pattern of readings indicating relative distances to bedrock. The method of attacking the problem was to run the magnetic traverses perpendicularly across the known channels and as near drill hole lines as practical in order to attempt to correlate the resulting magnetic profiles with the known geologic conditions contained in the drilling information furnished by the Bureau of Mines and the drillers. If the profiles could be interpreted as indications of the concentrations or channels, then these deductions could be used in interpreting the results obtained from magnetic traverses over ground where the drilling had not yet been done.

Accordingly, five traverses were laid out (Brunton and tape) across Boulder Creek as shown on Plate III, three of them in close proximity to drill hole lines, and Lines B and C added to learn if the profiles of the five parallel lines at approximately equal distance would make an indication worth studying. Although assurance had been given that all casing had been pulled, magnetometer stations on Boulder and Cape Creeks were located sufficiently distant from the drill holes to minimize the effect of any steel that might possibly have remained in the holes. Drill holes were used as stations on Goodwin Creek, but anomalies were within a range of eleven gammas there. Surface elevations on Boulder Creek were obtained with the use of a borrowed Bureau of Mines transit. Other physical data were obtained from Bureau of Mines maps.

When the results of the magnetic survey appeared unsuccessful on Boulder Creek, a trip was made over to Goodwin Creek where two traverses were run at Drill Hole Lines 1 and 2. No good indications were obtained there, so the equipment was carried on over to Cape Creek where the profile obtained at Line 17 appeared successful. Two more traverses on Cape Creek showed that the apparent success was only coincidental or accidental. The project was abandoned at this point. Results will be discussed in the following section. Locations of the traverses can be seen on Plates III, IV, and V, and the resulting magnetic profiles are shown on Plate VI.

RESULTS

A study of the magnetic profiles on Plate VI reveals almost immediately that with one exception there is no relation or coincidence between the amounts of concentrates, as obtained by drilling, and the high magnetic anomalies. The one exception is Line 17 on Cape Creek where two of the three highest readings were obtained over the only two points where drilling revealed significant amounts of tin concentrates. However, subsequent traverses on Lines 4 and 4A of Cape Creek showed no repeat of this occurrence, even though much larger amounts of concentrates are reported on the latter two lines than on Line 17. In fact, the lowest anomaly on Cape Creek was found over the point of highest concentration (Line 4A, Hole 14). So it must be assumed that the high on Line 17 was caused by something other than the concentrate. It should be noted here that relative amounts of concentrate do not necessarily indicate relative amounts of magnetic material in the concentrate, for the magnetite content, percentage-wise, may vary considerably.

It does appear, however, in the Cape Creek profiles, that the greatest breaks or fluctuations, might usually occur over the channel. Two or three more traverses on Cape Creek would have settled that point, but since Cape Creek was already "drilled out", and similar profiles were not obtained on the other creeks, it would have served no useful purpose.

The Goodwin Creek profiles are quite flat, not varying over 11 gammas, of which two or three might have been caused by the difficult operating conditions. Little possibility of useful indications exists here.

In studying the profiles resulting from the traverses across Boulder Creek, one should first notice that because of some abnormally high anomalies, the magnetic profile vertical scale in gammas is only one-fifth as great on Lines D and E as on the others. Therefore, the height of the anomalies on these two lines should be increased by five times to show their proper size relative to the size of the anomalies in the upper three lines. It was hardly worth the space required to do this on paper.

Profiles on Lines A, D, and E show no recognizable characteristics that can be related to quantities of reported concentrates or depth to bedrock. On line A, from a high anomaly at Station 8, the magnetic intensity drops fairly steadily going across the channel until an apparent low point on the western slope is reached. On lines D and E, the profiles also drop at a fairly even rate as they progress from the east to the west side of the channel, but in these cases, the profiles are interrupted on the west bank by the high anomalies that are caused by something with greater attraction than any feature of placer geology. The profiles of Lines B and C are of a greater irregularity where they cross the channel, but not having any subsurface data here, no deductions or conclusions can be drawn.

The two very high anomalies on Lines D and E are of interest, but not from a placer standpoint. Since no anomalies even beginning to approach the size of these two were found over the known buried channel, it could only be assumed that these highs were caused by some bedrock feature. Since the drill was working near Station 29 of Line D where the highest anomaly was found, it was decided to drill this location to insure that nothing of importance was ignored. Hole 45 was put down at Station 29, but no tin was found and no change in bedrock was noted. The cause of the anomaly apparently lies deep in the bedrock. It might be a contact zone containing magnetite.

Using a straight-edge on Plate III will show that if a straight line is drawn across the points of highest intensity in Lines D and E, Stations 21 and 29, that this line will intersect Line C at Station 12 where the highest anomaly in that line is located. This point also lines up on a straight line with Stations 8 and 10 of Lines A and B, the points of highest intensity in those two traverses. The two straight lines connecting the five anomalies intersect at Station 12, Line C, with a change of direction of about 35° at the intersection. This fact may or may not be significant. It could indicate a continuation of the hypothetical contact zone. Since the matter has nothing to do with the placer problem, it is idle to pursue it further.

CONCLUSIONS

The magnetic survey to locate the position and extent of the buried placer channels of the Cape Mountain placer tin area was not successful. The anomalies obtained over points of known placer concentration had no recognizable relation to the reported amounts of concentrate, and the channel anomalies were not distinquishable from the bedrock anomalies with the possible exception of the traverses on Cape Creek. No pattern of anomalies could be discerned that indicated relative depths of bedrock.

Probably the main reason for the failure is the deficiency of magnetite in the concentrate, which is caused by a like deficiency in the granite of the area that was eroded to form the bulk of the placer material. It is well known that the success of magnetic surveys for placer channels depends on sufficient magnetite in the paystreaks and small associated bedrock anomalies. Joesting places the required magnetite content of the concentrate at around eight per cent. 2/ It is believed that in the area concerned, the bedrock anomalies are sufficiently small, with a few exceptions, to allow for a generally successful magnetic exploration project if the magnetite were in greater abundance.

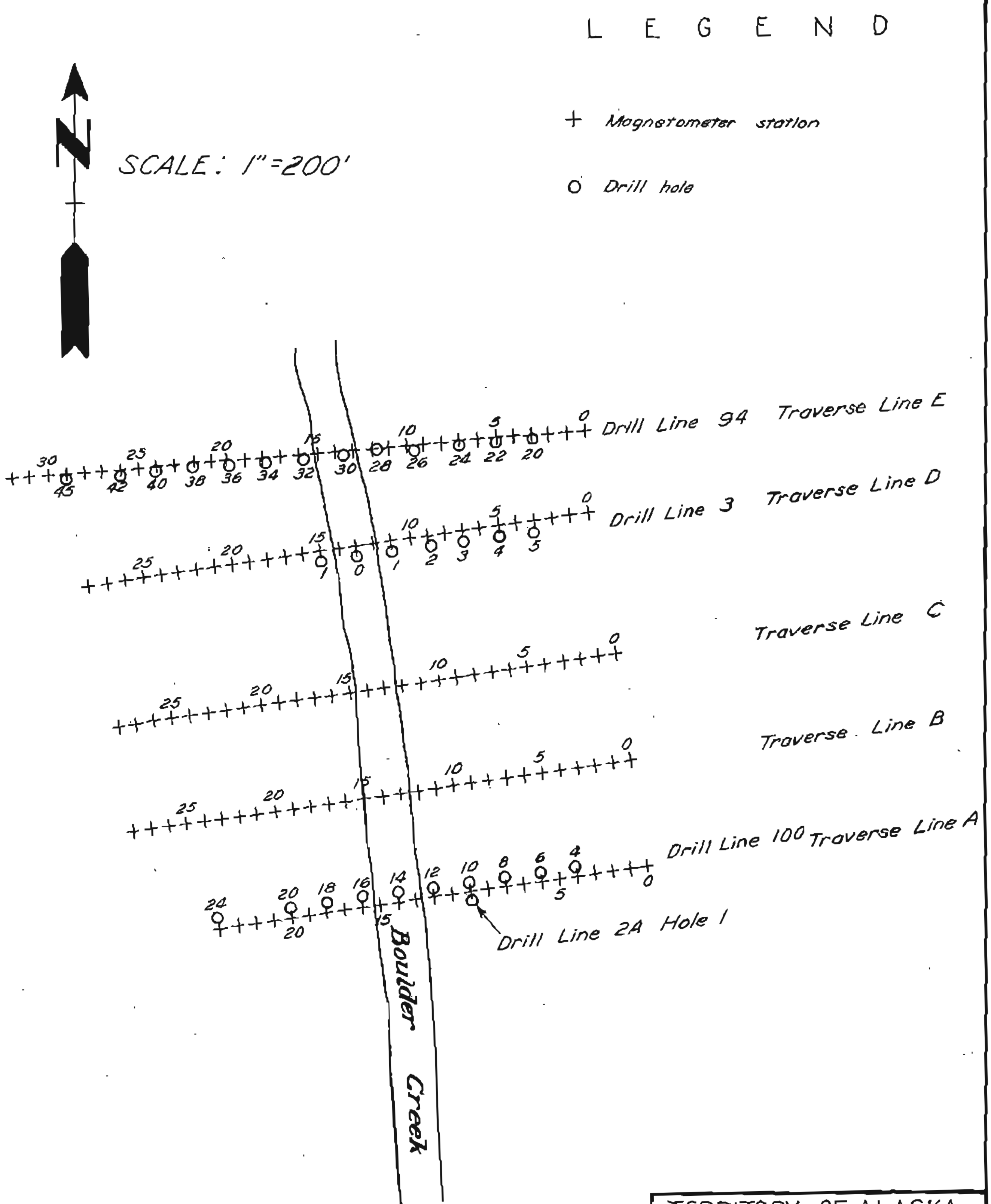
The very high anomalies on Traverses D and E at Boulder Creek are due to conditions deep in the bedrock, and are not caused by a placer feature.

James A. Williams
Associate Mining Engineer

2/ Henry R. Joesting: Magnetometer and Direct-current Resistivity Studies in Alaska. A.I.M.E. Tech. Pub. 1284. (1941), p. 2.


168°
166°
164°
162
160°
158°
156°
66°
64°
ARCTIC CIRCLE
Kotzebue
Kotzebue Sound
Kobuk River
Selawik River
Koyukuk River
Cape Prince of Wales
Plate II
SEWARD
PENINSULA
Teller
Nome
Norton Bay
NORTON
SOUND
St. Michael
YUKON RIVER
TERRITORY OF ALASKA
DEPARTMENT OF MINES
SEWARD PENINSULA
VICINITY MAP
Scale: 1" = 40 mi.
R.H. Saunders
Terr. Dept. of Mines
November
1953

PLATE I



TERRITORY OF ALASKA
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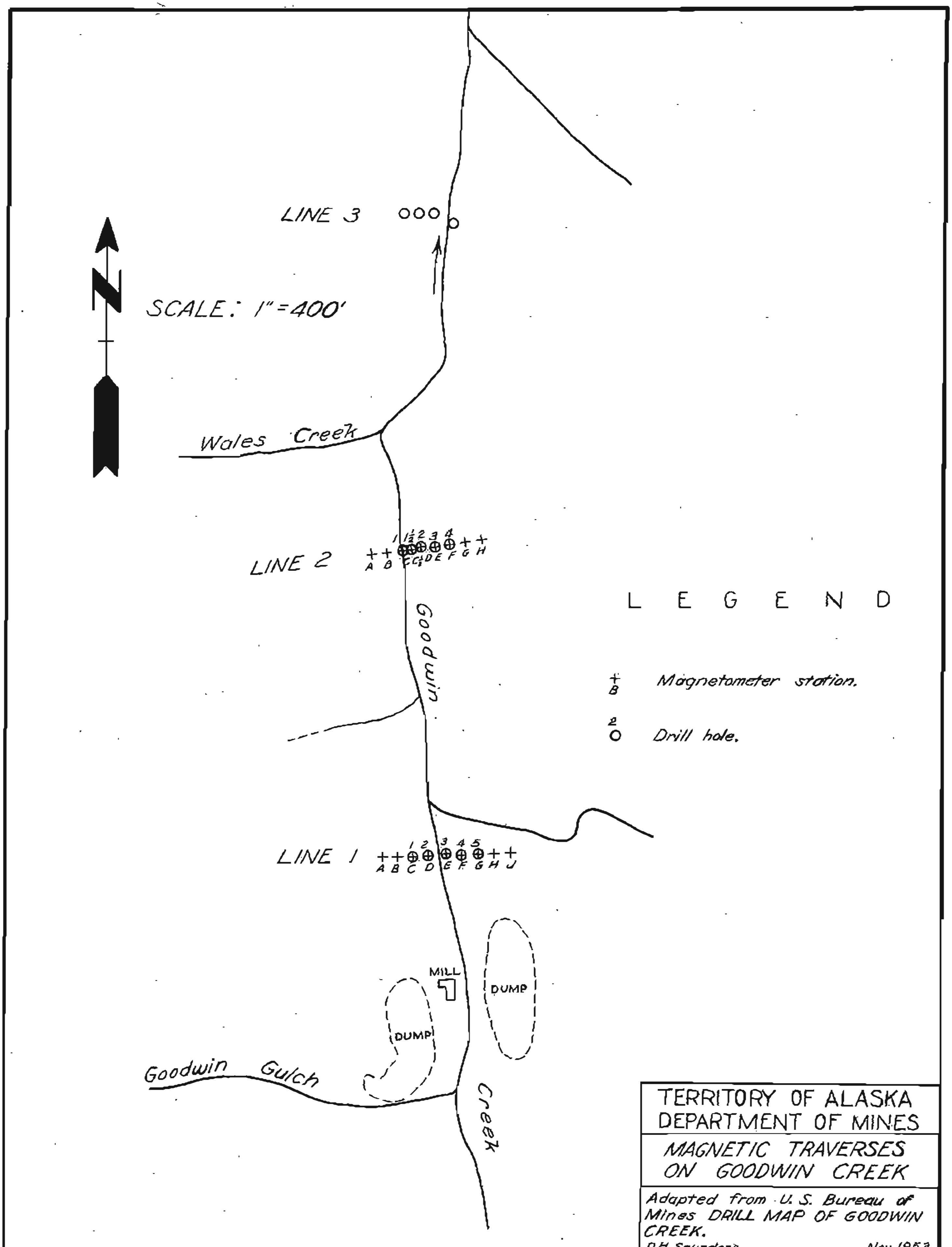
MAGNETIC TRAVERSES
ON BOULDER CREEK

Adapted from U.S. Bureau of Mines DRILL MAP OF BOULDER CREEK.

R.H. Saunders Dec. 1953

PLATE III



TERRITORY OF ALASKA
DEPARTMENT OF MINES

MAGNETIC TRAVERSES
ON GOODWIN CREEK

Adapted from U. S. Bureau of Mines DRILL MAP OF GOODWIN CREEK.

R.H. Saunders Nov. 1953

PLATE IV