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REPORT FOR THE STANDARD SLAG COMPANY
ON A MAGNETIC AND GEOLOGIC EXAMINATION
OF THE MINNESOTA IRON DEPOSIT
DOUGLAS COUNTY, NEVADA

By

E. L. Stephenson
Consulting Geophysicist

Reno, Nevada
April 1952

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Illustrations

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Minn-Nevada Copper Mines Co.
13 Claims
Sec. 19, T.14N., R.24E.

INTRODUCTION

The examinations that form the basis of this report were made for The Standard Slag Company on the Minnesota group of claims, in the Buckskin mining district, northeastern Douglas County, Nevada. This property produced copper in the period 1913-18, and it has been called the Minnesota copper property or the Minnesota-Nevada mine, but as it also contains a large deposit of iron ore that is now being mined, it is referred to herein as the Minnesota iron deposit. The property is reached by way of the Campbell Ranch road, which extends west from the main highway about midway between Wabuska and Yerington.

The deposit is located on a prominent knob, one of the foothills of the Pine Nut Range, on unsurveyed land. The iron ore consists chiefly of magnetite that replaces limestone or shale, or both, along a contact zone between Triassic sedimentary rocks and intrusive igneous rocks. The zone is extensively faulted, and much of the exposed iron ore occurs in relatively small fault blocks or slices.

The present field work included detailed topographic mapping by plane table and alidade, geologic mapping, and magnetometer surveying. The purpose was to prepare a topographic base map for mining purposes, to map the general geology, and, by means of the magnetometer, to determine the extent of the ore indicated by the outcrops and to locate buried extensions or new bodies under cover. The field work was done during the first part of April 1952. Magnetic measurements were made with a standard Askania vertical magnetometer, having a sensitivity of approximately 30 gammas per scale division.

The magnetometer readings were made on a grid that covers nearly the entire main hill. In addition to anomalies associated with the outcrops, the readings show a major positive anomaly on the top and upper north part of the hill, in an area of outcropping massive limestone, and a smaller anomaly on the northwest flank of the hill, in an area of limestone and granodiorite. These anomalies indicate buried masses of magnetite that may be of commercial grade, and drilling is recommended in the area of the larger anomaly.

GEOLOGY

The general geology of the Minnesota iron deposit is shown on the accompanying geologic map, which includes the geology within the area of the magnetometer grid. The rocks include limestones, shales, and volcanic rocks of Triassic age, and intrusive igneous rocks of probable Cretaceous age. These ages are based on the similarity of the rocks to those described by Knopf 1/ in the Yerington district to the east. The age of the iron ore is not known. It may be genetically associated with the Cretaceous intrusions, or it may be of Tertiary age. Considering the faulting and other relationships within the mineralized zone, the former possibility seems most likely.

The uppermost sedimentary rock is a massive light gray limestone, which caps the main hill and the northeast spur on which the 0-point of the magnetometer grid is located. Blocks of this limestone also occur on the lower north flank of the hill. The limestone is highly fractured, altered, and in part recrystallized, and it shows no recognizable bedding. On the top and west flank of the hill, particularly in the area of the major magnetic anomaly, the limestone contains large amounts of greenish yellow chloropal, a hydrated silicate of ferric iron. The massive limestone is the host rock for at least part of the iron ore, and all of the ore may have been formed by replacement of this rock.

The massive limestone is underlain by a series of dark gray, fine-grained limestones and blocky silt shales. For the most part these

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1/ Knopf, Adolph, Geology and ore deposits of the Yerington district, Nevada: U.S. Geol. Survey Prof. Paper 114, 1918.

rocks are not well exposed, and their attitudes could not be determined. They have been mapped chiefly on the basis of float. The series also may contain altered volcanic rocks. The areal associations and the blocky appearance of some of the broken ore suggest that part of the iron ore may have been formed by replacement of these lower rocks.

On the east flank of the hill there is a rather broad band of dense, very fine-grained, white rock that appears to underlie the limestone-shale series. This rock tentatively is classified as a felsite belonging in the Triassic sequence, in accordance with Knopf's section in the Yerington district, where he describes a dense white rock of volcanic origin, classified as soda rhyolite-felsite, underlying the limestones and shales of the Star Peak group and overlying the volcanic andesite of the Koipato series. The rock contains rather large amounts of white quartz, and it might possibly be an aplite belonging with the intrusive rocks. It has no apparent association with the iron ore.

The intrusive igneous rocks include three distinct varieties. Along the east side of the hill the mineralized zone contains large masses of a dark gray, fine-grained, highly altered igneous rock that is classified as andesite porphyry. The rock is composed of phenocrysts of altered plagioclase feldspar and a considerable amount of biotite and other ferromagnesian minerals, in a dense, dark gray groundmass. The white phenocrysts give the rock a characteristic speckled appearance. The andesite porphyry is so softened that it may be dug without shooting, and it therefore is considered to be the earliest intrusive rock, now greatly altered by the later intrusions. It is rather intimately associated with the iron ore, a condition that may be due to faulting and to its location along the contact zone, or that may be due to a genetic association. The andesite porphyry contains disseminated fine magnetite.

The most prominent igneous rock in the area is a fresh appearing granodiorite. It occupies a large area in the southeast part of the magnetic grid, and a long tongue or band cuts entirely through the main mineralized zone in the vicinity of the 200S line and extends into the northwest corner of the grid. It also outcrops in a small area in the west central part of the grid and in the extreme southwest corner, and the presence of float in a number of localities suggests that it may be more extensive than the map indicates. In addition to much plagioclase, the granodiorite contains rather numerous crystals of pink orthoclase. It also contains minor disseminated fine magnetite, and it might possibly be the parent rock of the iron ore.

The third igneous rock is a medium-to fine-grained gray quartz monzonite. Within the magnetic grid it appears only as a poorly exposed narrow band in the northeast part. It is fairly fresh in appearance, and it probably is of about the same age as the grandiorite. It seems to have no direct association with the iron ore.

The detailed geologic structure in the mapped area is very difficult to determine, especially because of the lack of recognizable bedding in the massive limestone, and the poor exposures of the other Triassic rocks. The entire rock complex is very extensively faulted, and a number of the contacts shown on the map doubtless are fault contacts, although only a few faults could be mapped locally. It seems probable that the main block of massive limestone dips at moderate angles to the west, but the general pattern suggests that the sedimentary rocks may be part of a badly faulted fold, and that the dips may vary widely.

The sedimentary blocks and possibly the intrusive andesite porphyry may be parts of a roof pendant in the granodiorite. On this basis, and considering the distribution of the iron outcrops and the magnetic findings, the iron ore may have been formed by partial replacement of a large foundered block of sedimentary rocks, and the contact zone, so-called, may not extend to any great depth. The depth probably is as great, however, as it would be feasible to mine. Whatever the detailed structure may be, the iron mineralization occurs along a well-defined broad zone, and the magnetometer survey has outlined clearly those areas within which exploration and development must be concentrated.

MAGNETOMETER SURVEY

Plan of the survey

The magnetometer measurements were made on a grid covering essentially all of the main hill, the limits being determined by the magnetic readings. The outline of the grid and the 0-point and base line are shown on the topographic and geologic maps, and the detailed plan is shown on the magnetic map. The 0-point is on the top of the limestone-capped northeast spur, and from this point the base line was projected on a bearing of approximately N. 21° W. Magnetometer traverses at right angles to the base line were run at 100-foot intervals for distances of 200 feet north of the 0-point and 800 feet south. On all of these lines, magnetometer stations were occupied at intervals of 25 feet within the anomaly zone, and at intervals of 50 feet on the borders.

All of the lines extend 200 feet east of the base line except 800S, which starts at the base line. On the west, the three northernmost lines run to 800W, but, because of the width of the main magnetic anomaly, the rest of the lines extend to 900W. For field reference, the traverses are staked and marked on the base line and at 200E, 300W, 600W, and 800W. Field locations for drilling or other development work should be made in reference to these stakes.

Results of the survey

The results of the magnetometer survey are shown on the magnetic map, which is contoured on an interval of 5,000 gammas. In order to emphasize the magnetic pattern, areas showing vertical magnetic intensities above +15,000 gammas are colored yellow, and areas above +25,000 gammas are colored orange. Within the orange areas nearly all of the readings actually are above the maximum range of the instrument, or in excess of +26,000 gammas. An uncolored transparent print of the magnetic map also is furnished, which may be superimposed on the geologic map for direct comparison of the magnetic anomalies and the geology.

As shown by the readings on the borders of the grid, all of the country rocks are magnetically neutral, and there is little or no magnetic contrast at the formational boundaries. The limestones, however, are erratically impregnated with disseminated magnetite, which tends to raise the level of magnetic intensity and to produce local minor variations.

In the central part of the grid a broad, mainly positive anomalous zone covers nearly the entire main hill, and magnetically there is no narrow contact zone. The general positive zone is broken in the vicinity of the 200S line by the transverse band of intrusive granodiorite. North of this neutral band the magnetic curves of the 0 and 100S traverses are extremely variable, showing alternating high and low readings associated with the individual small blocks and pods of ore. The readings indicate that there is no single large mass of ore in the north flank of the hill, and the very sharp negative borders of the individual local anomalies strongly suggest that none of the blocks extend to any great depth. Most of these blocks probably are fault slices off the north end of the main body.

The 100N and 200N lines show mainly the broad, strongly negative borders of the general positive zone, except for one narrow positive band that projects northward between 300W and 400W. This anomaly narrows and weakens greatly on the 200N line, and the curve suggests a general lack of mineralization to the north.

West of the tongue of granodiorite, the 100S line shows a strong positive anomaly that approaches a maximum of +25,000 gammas, centering at 640W. Northward the anomaly extends with rapidly diminishing strength through 625W on the 0 line and 600W on the 100N line. To the south it is joined to the west part of the major positive zone by a broad high shoulder on the 200S curve. This anomaly indicates a sizable mass of magnetic material, at least some of which probably is of ore grade, associated with the northwestward projecting wedge of limestone. The trend of the anomaly suggests that the limestone probably extends northward at no great depth beneath the granodiorite. Calculations based on the 100S curve indicate a probable depth of 50 to 75 feet to the top of the magnetic material, and the 0 curve indicates depths on the order of 75 to 100 feet. The actual depths may be somewhat less than these figures.

South of the transverse band of granodiorite a major positive anomaly covers the entire upper part of the hill, extending from 200S through 800S. The anomaly, and in particular the east edge, trends about with the grid, or about N. 20° W. It reaches its maximum width on the 500S and 600S lines, the +5,000-gamma closure extending from 300W to a little beyond 900W. The highest part of the anomaly is nearly square, roughly extending from 250S to 650S and from 300W to 700W. The anomaly is decidedly asymmetrical, with a very steep edge and negative border on the east and a more gradual slope on the west, indicating a general westerly dip of the magnetic body.

The northeast part of the positive crest occurs over the main outcrops of iron ore shown on the geologic map. On the 300S line the crest is divided into several distinct bands, separated by relatively low readings. The main negative break, which extends to the 200S and 400S lines, occurs directly over the narrow band of limestone on the 200S and 300S lines. The present main working bench is cut in the granodiorite, and the face now is advancing in ore into the north ends of the positive bands on either side of this negative anomaly. The magnetic readings indicate that the split may narrow and that the ore bands probably merge at depth to the south. The 300S line also shows a northeasterly positive extension associated with the other large outcrop of ore, but the curve suggests that this mass, lying between the 200S and 300S lines, may have no great depth extent.

The 400S and 500S traverses both show broad maximum zones, on the order of 250 to 300 feet wide, within which all readings are beyond the range of the magnetometer. The 400S line shows the south end of the split noted above, and also a minor positive anomaly associated with the narrow slice of ore near 200W. The 500S line shows a single, broad, solid peak. The 600S line also shows a broad area of very high readings, including several that are off scale, but it also shows a branching or splitting into separate bands, similar to the findings on the 300S line. The 700S and 800S curves show broad, smooth peaks of medium to low intensity, indicating increasing depth and a dying out of magnetite mineralization to the south.

The crest of the main positive anomaly occurs chiefly over the massive gray limestone, but the anomaly indicates a large underlying mass of highly magnetic material. In view of the magnetic strength and the geologic associations, it seems likely that much of this material may be of commercial grade. The great width of off scale readings precludes direct depth calculations, but the strength of the readings and the steep borders of the anomaly suggest that the top of the body is at fairly shallow depth. The geologic findings and the asymetry of the anomaly suggest a bed of material dipping to the west, but, again, the very high intensity appears to demand a large thickness or depth extent of magnetite. The anomaly may represent a mass that plunges or rakes to the west and south and that has the general form of a large ore shoot. Arbitrary tonnage calculations based on either the +15,000-gamma contour or the +25,000-gamma contour give high figures, on the order of 500,000 to 800,000 tons to a depth of 50 feet below the top of the body. Although it seems almost certain that not all of the material within this area is ore, and although all of the mass might be of submarginal grade, both the tentative figures and the anomaly itself suggest a possible high yield. Drilling will be necessary to more fully evaluate this magnetic zone.

RECOMMENDATIONS

For further immediate development of the Minnesota iron deposit, drilling definitely is warranted within the area of the major magnetic anomaly, which indicates that the main center of mineralization lies under cover south of the present mining benches. As the mining is in the beginning stage, and as the drill findings may suggest modifications of the general program, it would be well to proceed with test drilling as soon as may be practicable. At the present stage, and until more is learned concerning the nature and attitude of the material underlying the anomaly, only a few key test holes are recommended. Plans for any more extensive drilling program will depend to a very large extent upon the findings in the first holes.

It is recommended that the first holes be drilled on the 400S traverse line, which is near the center of the anomaly and yet is not too far south of the present main bench and cut. Assuming a general westerly dip or rake, it is recommended that inclined diamond drill holes be drilled from the west, and that they be oriented parallel to the traverse line. In order to first test the zone at reasonably shallow depths, it is suggested that the first hole be located at 500W. At this location a hole inclined at -45° will reach a vertical depth of 100 feet under the east edge of the hill crest, or beneath 400W, and a vertical depth of 150 to 170 feet beneath the main iron outcrop shown on the geologic map, if it is necessary to drill that far. Taking the east edge or base of this outcrop, however, and assuming a westerly dip of 40°, the bottom of the ore would be found at the 100-foot vertical depth, or at a hole depth of 150 feet. Assuming a westerly dip of 70°, the base would be at a vertical depth of 150 feet and a hole depth of 215 feet. Considering the various factors involved, especially the possibility of splits, it is suggested that this first hole arbitrarily be drilled to a hole depth of at least 200 feet.

Since early information is needed regarding the attitude of a possible ore body, it is recommended that the second hole be drilled at 600W in the 400S line. At this location a hole inclined at -45° will reach a vertical depth of 230 feet beneath the east edge of the crest (400W). At a dip of 40° for the body, the hole depth would be about 200 feet, and at a dip of 70° the hole depth would be about 300 feet. Assuming that a recognizable base or east edge is encountered, these two holes will give the general attitude and thickness of the mineralized zone, as well as the depths to the top.

Tentatively, this same layout of two holes can be repeated on the 500S line. On this line, again using the known outcrop as a guide, a hole located at 500W and inclined at -45° would reach a vertical depth of 65 to 75 feet beneath the crest of the hill. At an assumed dip of 40° the hole depth to the base of the zone would be 200 feet and the vertical depth would be 125 feet. At a dip of 70°, the hole depth would be 265 feet and the vertical depth would be 150 feet. A similar hole located at 600W would reach a vertical depth of 200 feet beneath the crest of the hill. At an assumed dip of 40° the hole depth would be

235 feet and the vertical depth 210 feet, and at a dip of 70° the hole depth would be 350 feet and the vertical depth 270 feet.

It is recognized that the buried body most likely is not a single uniform bed, and that the assumed ideal conditions most probably will not be found, but the general program outlined is believed to be the most feasible one for the first test holes. Locations and angles may be changed somewhat, if it is desired to reach other depths or to test other localities, and of course plans for each succeeding hole may be changed by findings in preceding holes. The first holes, however, should be drilled within the crest area of the positive anomaly.

At this stage of development no drilling is recommended in the anomaly zone on the northwest flank of the hill, since the anomaly is smaller and is well outside of the present mining area. At some later date, however, it also may prove desirable to test the northwest anomaly.

Reno, Nevada
April 1952

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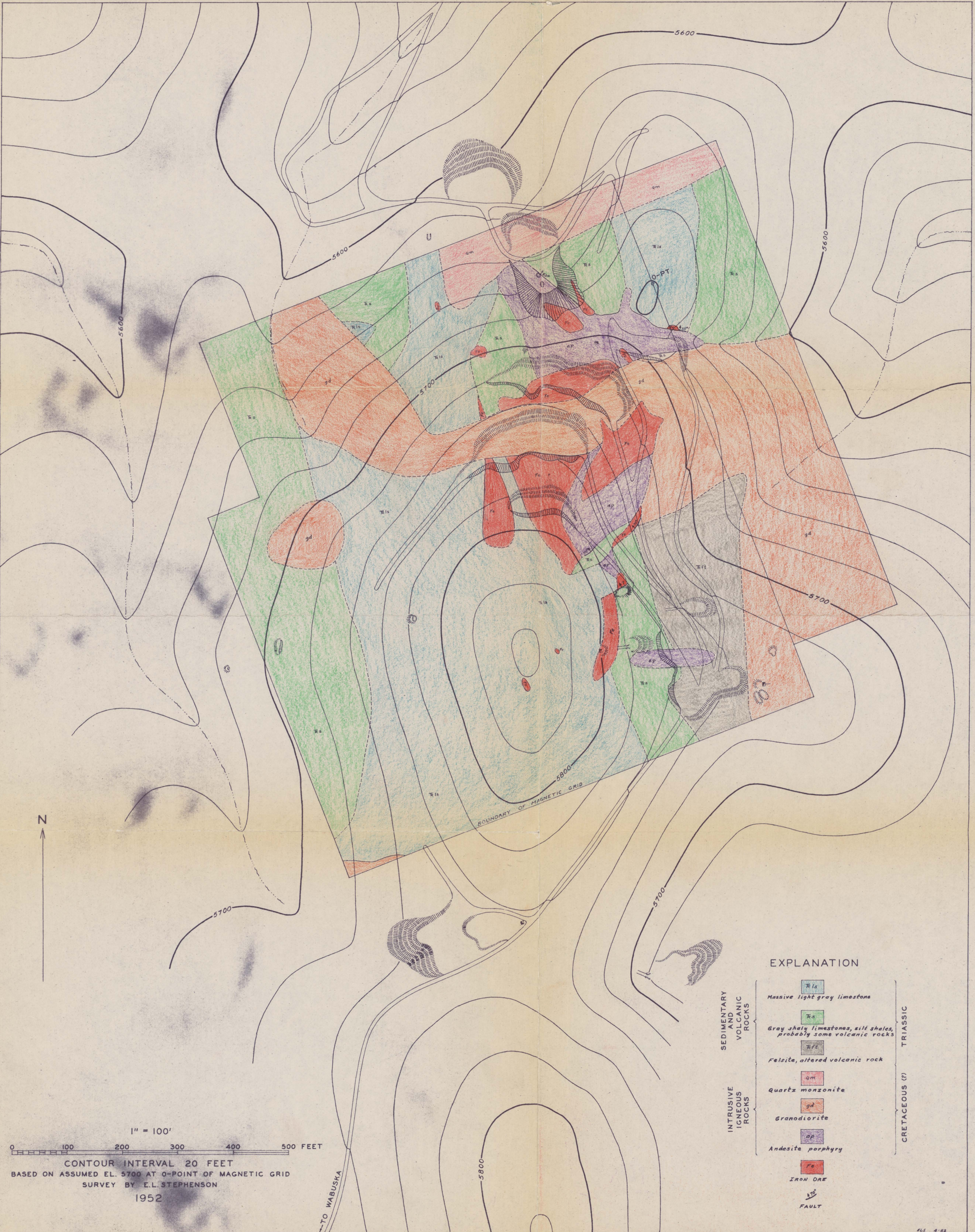
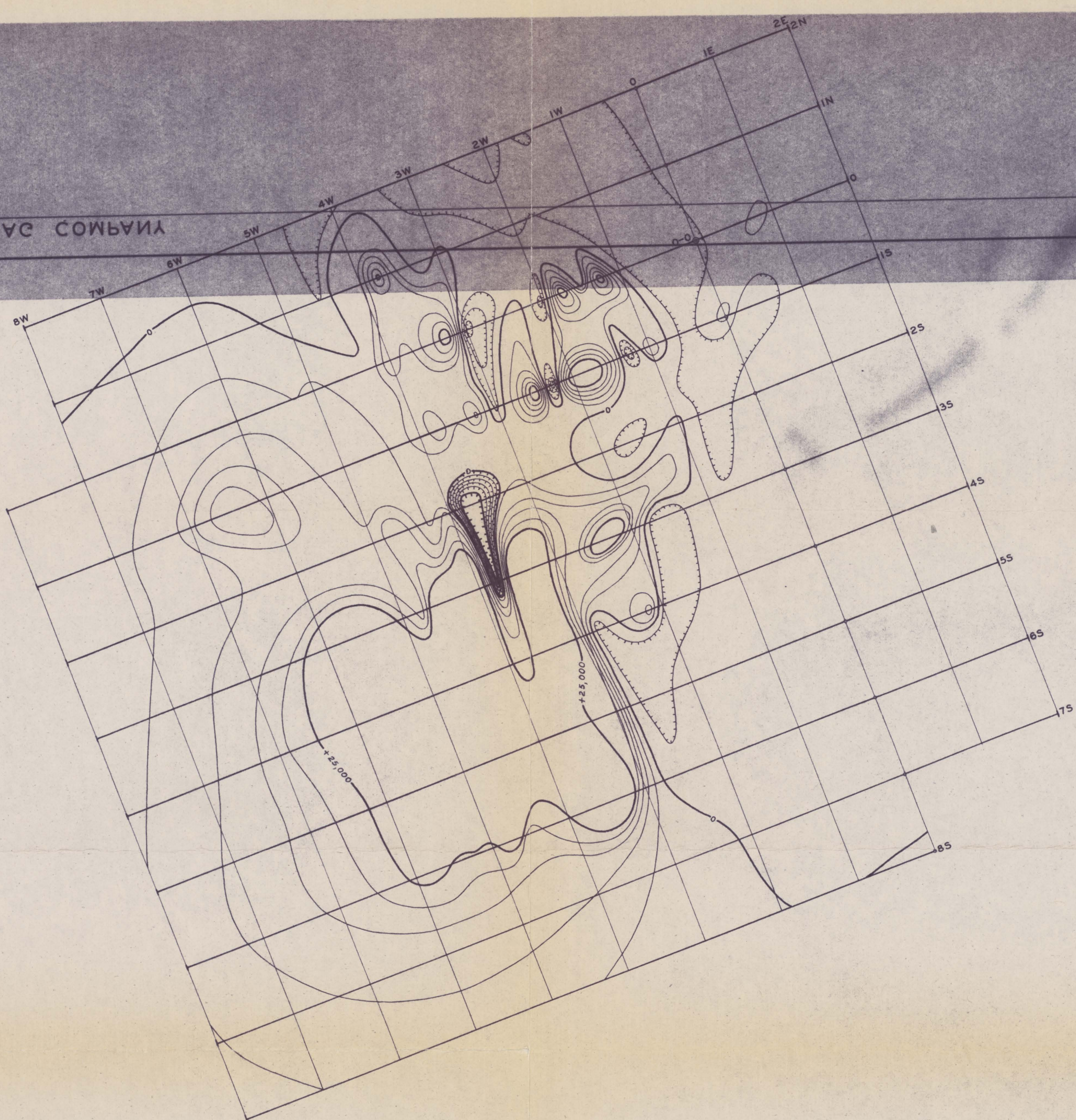
THE STANDARD SLAG COMPANY



GEOLOGIC MAP OF MAGNETIC GRID NO. 1, MINNESOTA IRON DEPOSIT, DOUGLAS COUNTY, NEVADA

0770 0007

0770 0008 #2



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ABOVE 25,000 GAMMAS (OFF SCALE)

ABOVE 15,000 GAMMAS

MAGNETOMETER TRAVERSE

1" = 100'

0 100 200 300 400 500 FEET

CONTOUR INTERVAL 5000 GAMMAS

SURVEY BY E. L. STEPHENSON

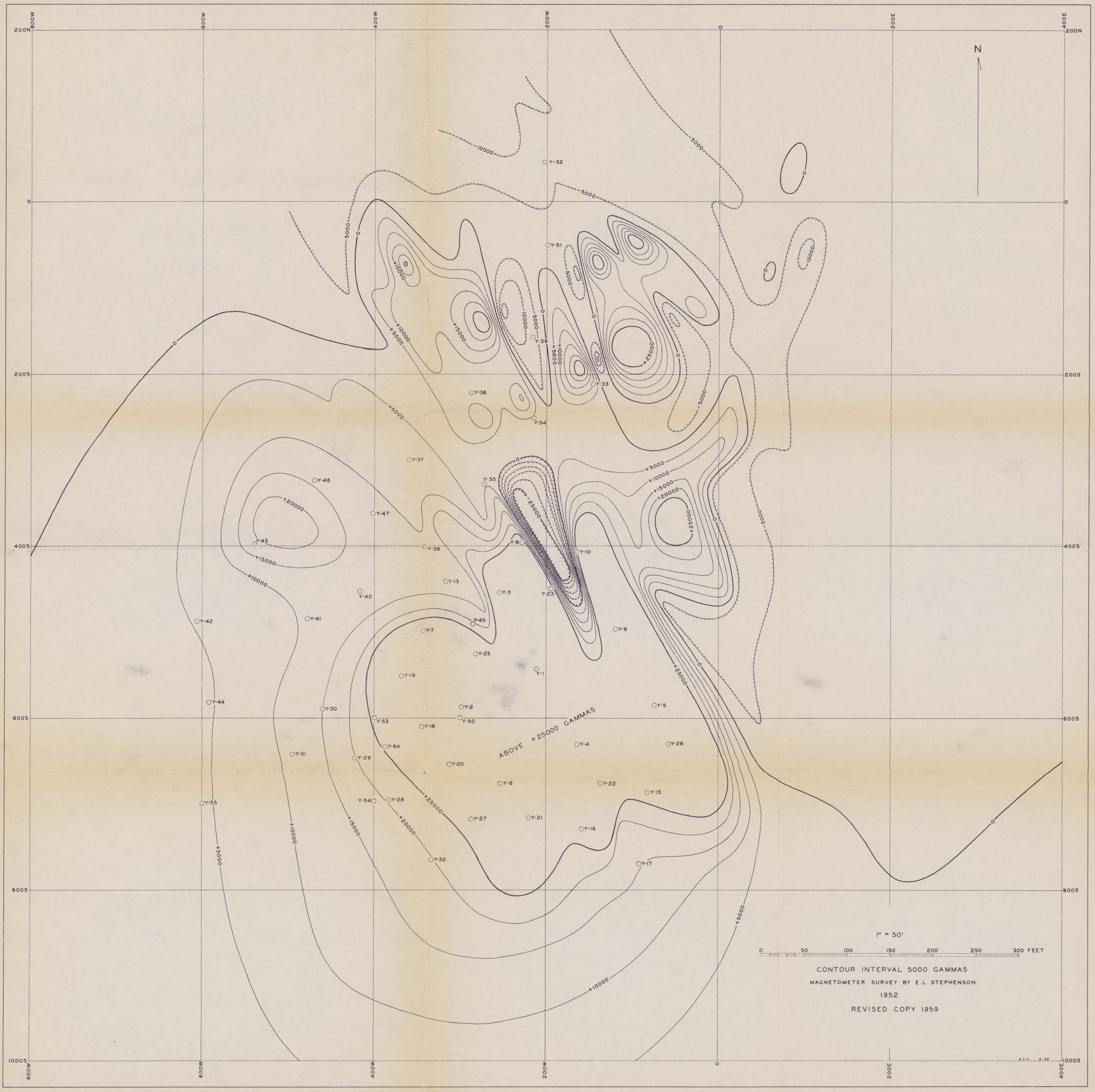
1952

MAGNETIC MAP OF GRID NO. 1, MINNESOTA IRON DEPOSIT, DOUGLAS COUNTY, NEVADA

0770 0008 #3

0770 0008 #4

THE STANDARD SLAG COMPANY



MAGNETIC MAP OF THE MINNESOTA IRON DEPOSIT, BUCKSKIN MINING DISTRICT, DOUGLAS COUNTY, NEVADA