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Notes on Field Work in the Copper-Nickel  
Prospect Area, Lake County, Minnesota

by

G. M. Schwartz and J. M. Harris

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NOTES ON FIELD WORK IN THE COPPER-NICKEL PROSPECT AREA,  
LAKE COUNTY, MINNESOTA

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Introduction

In 1951 announcement was made of the discovery of copper-nickel sulphides about 10 miles south of Ely, Minnesota. Preliminary data gathered on the deposit in 1951 was summarized in an article by Schwartz and Davidson.

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/ Geologic Setting of the Copper-Nickel Prospect in the Duluth Gabbro near Ely, Minnesota. Mining Engineering, July, 1952, pp. 699-702.

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During the summer of 1952 a field party consisting of J. Merle Harris and Charles Jahren spent two months mapping the outcrops along the base of the gabbro from Section 7, T. 61 N., R. 11 W. on Birch Lake to Section 19, T. 62 N., R. 10 W. Wherever sulphides could be detected in the outcrops samples were collected for assay. In all 30 samples collected during the 1952 field season were assayed with the results shown in the following tables.

Maps showing all available geologic data along the base of the Duluth gabbro have been compiled and may be inspected at the office of the Minnesota Geological Survey, Pillsbury Hall, University of Minnesota, Minneapolis.

### Summary of Geology

A somewhat detailed description of the geology to the copper-nickel prospects was published in Mining Engineering of July 1952.

The nickel-copper sulphides occur near the base of the gabbro in northern Lake County. This is about the midpoint along the base of the huge gabbro intrusive which extends from Duluth northeastward as a great crescent-shaped mass that intersects the shore of Lake Superior near Hovland 130 miles to the northeast. The width in the central part is about 30 miles and the estimated thickness is about 50,000 feet. The gabbro magma segregated into rock types such as olivine gabbro, gabbro, troctolite, anorthosite and granite. These rock types occur in bands so that various kinds of rock may be observed within a short distance across the strike and the sulphides are known to occur in olivine gabbro, gabbro and anorthositic gabbro.

The sulphides occur disseminated in the silicates and as small interstitial masses. The disseminations are most numerous in the plagioclase but also occur in pyroxene and olivine. The larger areas of sulphide are frequently associated with biotite but each occurs without the other. The sulphides include chalcopyrite, cubanite, pentlandite, pyrrhotite and a minute amount of bornite. There are a few tiny veinlets of sulphide but most of the sulphide grains are intergrown in the silicates in such a manner that their contemporaneous crystallizations seem certain.

In many cases the gabbro near the base is found to be considerably finer grained than that farther away. Probably most of the finer variety occurs within a quarter of a mile from the gabbro-granite contact. In much of the area mapped thus far, the exact location of the contact is obscure because it lies beneath the South Kawishiwi River or because of lack of outcrops. Fine-grained, primary gabbro was difficult to distinguish

in the field from hornfels inclusions. One such instance is in a roadside outcrop on Spruce Road where the Singing Waters Road leads off to the north. There occurs a peculiar kind of hornfels which splits into angular blocks, is very fine textured, and shows striking lineation with alternately light and dark gray bands no more than one-sixteenth of an inch thick. The original rock was apparently a shale or a slate. This outcrop is especially interesting because its upper part contains sulfides. (See sample #M-3608).

The majority of the sulfide-bearing rocks were deeply weathered and generally occurred in outcrops that were low, inconspicuous and often situated in low ground, along water courses or swampy areas. Often these outcrops were so much weathered as to make classification of the variety of the gabbro difficult. This leads to the speculation that perhaps the topography may reflect, in a negative way, the presence of sulfides. It is probable that weathering and erosion, both pre- and post-glacial, proceeded more rapidly where the sulfides were more abundant. Two deep bays off the south side of the South Kawishiwi River, one about  $\frac{1}{4}$  mile and the other about  $\frac{1}{2}$  mile southwest of the Halfway Ranger Station, have low sulfide-bearing outcrops on each bank. (See samples #M-3610, 11, 12, 13, 18, 24, 25, 26).

There were a few exceptions to the observations of the above paragraph. There are sulfide-bearing outcrops on the east side of Lampi Road a few paces off Spruce Road, and another about  $\frac{1}{8}$  mile east of this point on Spruce Road, which are rather conspicuous and composed of anorthositic gabbro, only slightly weathered. (See samples #M-3600, M-3601, and M-3647).

In a few places granite outcrops and gabbro outcrops were found close together. In SW $\frac{1}{4}$  NW $\frac{1}{4}$  Sec. 26, T. 62 N., R. 11 W. just north of the Gabbro Trail, the two are found about 50 feet apart. The granite here is finer in texture than usual and the gabbro contains sulfides. (See samples #M-3627

and M-3616). In SW $\frac{1}{4}$  NE $\frac{1}{4}$  Sec. 19, 61 N., 10 W. about 150 ' north of the intersection of Spruce Road and Filson Creek the two are about 45 feet apart.

At the other places, outcrops occur which apparently represent an intimate intermingling of gabbro and granite. Several of these occur along the Gabbro Trail in NW $\frac{1}{4}$  SE $\frac{1}{4}$  Sec. 24, T. 61 N., R. 11 W. Another is in NE $\frac{1}{4}$ , NW $\frac{1}{4}$  Sec. 19, T. 61 N., R. 10 W. about 200 feet north of the Gabbro Trail. An outcrop at the water's edge on Birch Lake where the shore is intersected by the north-south 40-line in the west half of Sec. 24, 61 N., 12 W. is also of this type.

Another interesting feature in the gabbro is the occasional occurrence of inclusions of iron formation along or near the gabbro-granite contact. These inclusions are presumed to be of the Biwabik Iron Formation inasmuch as they are generally quite magnetic and this is its position stratigraphically on the Mesabi Iron Range some 20 miles to the southwest. Several old test pits are found in these inclusions on the west side of the deep bay on Birch Lake, SE $\frac{1}{4}$  SW $\frac{1}{4}$  Sec. 24, T. 61 N., R. 12 W. Three more of these inclusions form roadside outcrops on the north side of Spruce Road a little over  $\frac{1}{4}$  mile southwest of the Singing Waters Road, NW $\frac{1}{4}$  SW $\frac{1}{4}$  Sec. 26, T. 62 N., R. 11 W. They are quite close together and may, in fact, be one mass underground. At numerous other places local magnetic anomalies suggest either more of these inclusions than show through the cover or large quantities of magnetite in the gabbro. Magnetite is found in the gabbro both disseminated and also concentrated to form a prominent constituent of numerous basic pematite dikes.

SAMPLES FROM LAKE COUNTY

Township 61 and 62 N      Range 10 and 11 W

<u>Minn. G.S. No.</u>	<u>Location</u>		<u>Fe</u>	<u>Cu</u>	<u>Ni</u>
M - 3600	NW $\frac{1}{4}$	NW $\frac{1}{4}$ Sec. 25 - 62N - 11W	10.40	0.81	0.15
M - 3601	NW $\frac{1}{4}$	NW $\frac{1}{4}$ Sec. 25 - 62N - 11W	10.72	0.60	0.12
M - 3603	SE $\frac{1}{4}$	SW $\frac{1}{4}$ Sec. 6 - 61N - 11W	11.45	0.37	0.11
M - 3606	NW $\frac{1}{4}$	SE $\frac{1}{4}$ Sec. 27 - 62N - 11W	9.04	0.18	0.06
M - 3608	SW $\frac{1}{4}$	NE $\frac{1}{4}$ Sec. 26 - 62N - 11W	9.06	0.23	0.03
M - 3610	SW $\frac{1}{4}$	SW $\frac{1}{4}$ Sec. 33 - 62N - 11W	6.22	0.91	0.04
M - 3611	SW $\frac{1}{4}$	SW $\frac{1}{4}$ Sec. 33 - 62N - 11W	7.43	0.44	0.08
M - 3612	SW $\frac{1}{4}$	SW $\frac{1}{4}$ Sec. 33 - 62N - 11W	5.81	0.25	0.08
M - 3613	NE $\frac{1}{4}$	SW $\frac{1}{4}$ Sec. 33 - 62N - 11W	9.04	0.54	0.10
M - 3615	NW $\frac{1}{4}$	NE $\frac{1}{4}$ Sec. 33 - 62N - 11W	10.98	0.39	0.07
M - 3616	SW $\frac{1}{4}$	NW $\frac{1}{4}$ Sec. 26 - 62N - 11W	10.50	0.10	0.03
M - 3617	NW $\frac{1}{4}$	NE $\frac{1}{4}$ Sec. 33 - 62N - 11W	9.21	0.44	0.19
M - 3618	SE $\frac{1}{4}$	SE $\frac{1}{4}$ Sec. 32 - 62N - 11W	7.93	0.41	0.08
M - 3619	NW $\frac{1}{4}$	NE $\frac{1}{4}$ Sec. 5 - 61N - 11W	11.38	0.32	0.09
M - 3621	SW $\frac{1}{4}$	NW $\frac{1}{4}$ Sec. 5 - 61N - 11W	9.21	0.59	0.15
M - 3622	NW $\frac{1}{4}$	SW $\frac{1}{4}$ Sec. 5 - 61N - 11W	8.47	0.58	0.13
M - 3623	NW $\frac{1}{4}$	SW $\frac{1}{4}$ Sec. 5 - 61N - 11W	10.82	0.72	0.21
M - 3624	NE $\frac{1}{4}$	SW $\frac{1}{4}$ Sec. 33 - 62N - 11W	8.75	0.43	0.11
M - 3625	NE $\frac{1}{4}$	SW $\frac{1}{4}$ Sec. 33 - 62N - 11W	8.89	0.55	0.12
M - 3628	SE $\frac{1}{4}$	SW $\frac{1}{4}$ Sec. 6 - 61N - 11W	11.63	0.34	0.15
M - 3633	SW $\frac{1}{4}$	SW $\frac{1}{4}$ Sec. 24 - 62N - 11W	8.72	0.46	0.05
M - 3634	SE $\frac{1}{4}$	SW $\frac{1}{4}$ Sec. 24 - 62N - 11W	5.34	0.47	0.18
M - 3636	NW $\frac{1}{4}$	SW $\frac{1}{4}$ Sec. 19 - 62N - 10W	5.00	0.38	0.07
M - 3637	SW $\frac{1}{4}$	NE $\frac{1}{4}$ Sec. 26 - 62N - 11W	8.16	0.22	0.07
M - 3638	SE $\frac{1}{4}$	NE $\frac{1}{4}$ Sec. 26 - 62N - 11W	8.80	0.64	0.14
M - 3639	SE $\frac{1}{4}$	NE $\frac{1}{4}$ Sec. 26 - 62N - 11W	7.19	0.43	0.17
M - 3641	SW $\frac{1}{4}$	NW $\frac{1}{4}$ Sec. 19 - 62N - 10W	9.12	0.98	0.13
M - 3642	SW $\frac{1}{4}$	NW $\frac{1}{4}$ Sec. 19 - 62N - 10W	9.69	0.34	0.18
M - 3645	SW $\frac{1}{4}$	NW $\frac{1}{4}$ Sec. 19 - 62N - 10W	8.23	0.12	0.05
M - 3647	NE $\frac{1}{4}$	NW $\frac{1}{4}$ Sec. 25 - 62N - 11W	4.51	0.43	0.09

## Description of Location of Outcrops Sampled

M. G. S. Number	Location	Fe	Cu	Ni
M - 3600	NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 25 - 62N - 11W. (On Lampi Road at Spruce Road).	10.40	0.81	0.15
M - 3601	NW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 25 - 62N - 11W. (About 50' S. of #3600, described above).	10.72	0.60	0.12
M - 3603	SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 6 - 61N - 11W. (On the east side of the deep bay on the west side of Birch Lake. This outcrop is at water's edge and about 500' W. from the mouth of the bay).	11.45	0.37	0.11
M - 3606	NW $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 27 - 62N - 11W. (ON Balsam Bay road about 150' N. of intersection with Gabbro Trail).	9.04	0.18	0.06
M - 3608	SW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 26 - 62N - 11W. (On Spruce Road at point where Singing Waters road leads off).	9.06	0.23	0.03
M - 3610	SW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 33 - 62N - 11W. (About 150' SW of Exp. Forest stake marked "Plot 57" - on E. edge of bay about $\frac{1}{2}$ mile SW of Halfway Ranger Station).	6.22	0.91	0.04
M - 3611	SW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 33 - 62N - 11W. (About 300' S. of #3610 described above).	7.43	0.44	0.08
M - 3612	SW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 33 - 62N - 11W. (About 275' SE of #3610 described above).	5.81	0.25	0.08
M - 3613	NE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 33 - 62N - 11W. (On E. edge of tip of bay about $\frac{1}{4}$ mi. SW of Halfway Ranger Station).	9.04	0.54	0.10
M - 3615	NW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 33 - 62N - 11W. (In the S. Kawishiwi River Camp Grounds between the pavillion and the water's edge).	10.98	0.39	0.07
M - 3616	SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 26 - 62N - 11W. (Near intersection of Gabbro Trail and small creek about $\frac{1}{2}$ mile W. of Singing Waters road).	10.50	0.10	0.03
M - 3617	NW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 33 - 62N - 11W. (About 75' SW of #3615 described above).	9.21	0.44	0.19
M - 3618	SE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 32 - 62N - 11W. (About 200' NE of the N. corner of Lot #8. Summer Home Sites).	7.93	0.41	0.08
M - 3619	NW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 5 - 61N - 11W. (On shore directly N. of Lot #18. Summer Home Sites).	11.38	0.32	0.09
M - 3621	SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 5 - 61N - 11W. (About 75' NW of E. corner of Lot #34. Summer Home Sites).	9.21	0.59	0.15

<u>M. G. S.</u> <u>Number</u>	<u>Location</u>	<u>Fe</u>	<u>Cu</u>	<u>Ni</u>
M - 3622	N <sup>w</sup> $\frac{1}{4}$ S <sup>w</sup> $\frac{1}{4}$ Sec. 5 - 61N - 11W. (An extensive outcrop, the sulfide bearing portion of which is near water level - about 50' N. of the N. corner of Lot #36 Summer Homes Sites).	8.47	0.58	0.13
M - 3623	N <sup>w</sup> $\frac{1}{4}$ S <sup>w</sup> $\frac{1}{4}$ Sec. 5 - 61N - 11W. (An outcrop extending some 300' NE along shore from M.C. - W. line Sec. 5. M. C. is directly N. of the N. corner Lot #43 - Summer Home Sites - tag on large red pine).	10.82	0.72	0.21
M - 3624	NE $\frac{1}{4}$ S <sup>w</sup> $\frac{1}{4}$ Sec. 33 - 62N - 11W. (About 200' SW of the Wood Storage Shed near Lake States Office at Halfway Ranger Station - below the bluff and near the water).	8.75	0.43	0.11
M - 3625	NE $\frac{1}{4}$ S <sup>w</sup> $\frac{1}{4}$ Sec. 33 - 62N - 11W. (On the point of shore where the first deep bay begins less than $\frac{1}{4}$ mi. SW of the boathouse at Halfway Ranger Station).	8.89	0.55	0.12
M - 3628	SE $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 6 - 61N - 11W. (See M - 3603. A small, low-lying outcrop near water level on the W. side of the deep bay on the W. side of Birch Lake. Outcrop is about 300' N. of deepest point of bay and about 150' S. of small creek which enters the bay from the West).	11.63	0.34	0.15
M - 3633	SW $\frac{1}{4}$ S <sup>w</sup> $\frac{1}{4}$ Sec. 24 - 62N - 11W. (Outcrop crosses the W. line of Sec. 24 about $3\frac{1}{2}$ tallies N. of the section corner, which corner is about $\frac{1}{4}$ mi. N. of Spruce road).	8.72	0.46	0.05
M - 3634	SE $\frac{1}{4}$ S <sup>w</sup> $\frac{1}{4}$ Sec. 24 - 62N - 11W. (About 200' S. of intersection of Spruce road with center line of Sec. 24).	5.34	0.47	0.18
M - 3636	NW $\frac{1}{4}$ SW $\frac{1}{4}$ Sec. 19 - 62N - 10W. (About 600' south of $\frac{1}{4}$ corner on W. line of Sec. 19 - $\frac{1}{4}$ corner marked with A1 tag).	5.00	0.38	0.07
M - 3637	SW $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 26 - 62N - 11W. (On Spruce road about 1/8 mile E of Singing Waters Road).	8.16	0.22	0.07
M - 3638	SE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 26 - 62N - 11W. (On Spruce road about 3/8 mi. E. of Singing Waters road).	8.80	0.64	0.14
M - 3639	SE $\frac{1}{4}$ NE $\frac{1}{4}$ Sec. 26 - 62N - 11W. (On Spruce road about 300' E. of #3638, described above).	7.19	0.43	0.17
M - 3641	SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 19 - 62N - 10W. (On Spruce road about 150 ft. E. of the $\frac{1}{4}$ corner W. line Sec. 19).	9.12	0.98	0.13



<u>M. G. S.</u> <u>Number</u>	<u>Location</u>	<u>Fe</u>	<u>Cu</u>	<u>Ni</u>
M - 3642	SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 19 - 62N - 10W. (About 600' E. of $\frac{1}{4}$ corner on W. line of Sec. 19 - $\frac{1}{4}$ corner marked with A1 tag. This is about 200' S. of Spruce road).	9.69	0.34	0.18
M - 3645	SW $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 19 - 62N - 10W. (On Gabbro Trail about $\frac{1}{4}$ mile NE of yellow tag on trail which in turn is about 550' N. of $\frac{1}{4}$ corner on W. line Sec. 19).	8.23	0.12	0.05
M - 3647	NE $\frac{1}{4}$ NW $\frac{1}{4}$ Sec. 25 - 62N - 11W. (On Spruce road about 500 ft. E. of Lempi Road).	4.51	0.43	0.09