

HIGHLIGHTS



- Disseminated Cu-Ni mineralization might contain economic concentrations of metals
- Disseminated Cu-Ni mineralization probably generated by magmatic process
- Massive and disseminated Cu-Ni mineralization are chemically different and appear zoned
- Cu:Ni ratio zonation might be useful to explore for massive/higher grade mineralization

Exploration for Disseminated Nickel-Copper Mineralization

Introduction

This study was initiated to determine the nature and extent of disseminated sulphide mineralization in Loveland Township drill hole L-13 where substantial Cu-Ni-PGE results were obtained from a massive sulphide sample collected at 320 feet (Table 1). If disseminated Cu-Ni-PGE sulphide mineralization contains substantial amounts of metal, exploration for such deposits might; (1) require a different geophysical strategy than the one used to look for massive sulphide mineralization and (2) uncover large, low-grade Cu-Ni deposits.

Relevant Exploration History

Hollinger Consolidated Gold Mines Ltd (Hollinger) explored for Cu-Ni mineralization in Loveland Township using ground magnetic, VLF-EM 16, and Turam geophysical surveys, as well as geological mapping. Weak coincident magnetic (100γ) and VLF-EM anomalies but no Turam EM anomaly (Bosschart 1964) occurs in the area east of Enid Creek between survey lines 14+00 feet and 24+00 feet (426 and 732 m) south and was tested by drill holes L-11 and L-13 (MacKenzie 1964, 1966, 1967).

Diamond-drill hole L-13 (454210E; 5389684N) was drilled to test the down dip extent of a mineralized intercept, grading 0.38% Cu over 45 feet (13.7 m), encountered in drill hole L-11 (MacKenzie 1966). Core from L-13 was sampled intermittently by MacKenzie with one half of the 26 samples collected from 1-foot (0.3 m) or 2-foot (0.6 m) lengths. The drill log indicates that most samples collected from the drill core were only assayed for Ag, Au and Cu; however, only "NIL" values were reported.

Drill Core Geology

Diamond-drill hole L-13 crosscut 4 chemically different rock units classified as andesite, basalt, "Icelandite" (Fe-rich andesite), and rhyolite (Setterfield and Tykajlo 1994). It also intersected disseminated sulphide mineralization between 200 and 350 feet (for metric equivalents see Tables 1 and 2) that was estimated visually to contain 0.1 to 8.0% pyrrhotite and minor chalcopyrite. Stringer and massive mineralization were documented in 4 locations between 300 and 365 feet where samples collected by MacKenzie had lengths up to 2 feet. The log lacks detail but does indicate that the rocks are volcanic in origin and that geological contacts dip 70° NE.

Sampling and Analytical Details

Telescoped diamond-drill core, consisting of samples 2 inches (5 cm) in length, collected every 5 feet (approximately 1.5 m) from drill hole L-13 and donated to the Timmins District Core Library for assessment credit, was used for this study. Core samples used for the study were collected

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from 200 to 350 feet, and submitted to GeoLabs in Sudbury to determine the concentration of the following elements by inductively coupled plasma mass spectrometry (ICP-MS, method IML-100, aqua regia leachate): Ag, As, Au, Bi, Cd, Co, Cu, Hg, In, Ir, Mo, Ni, Pb, Pd, Pt, Rh, Sb, Se, Sn, Te, Ti and Zn; and sulphur content using method IRC-100. The Au, Ir, Pd, Pt and Rh content of the sample taken at 320 feet was determined using the IMP-200 (nickel sulphide fire assay) method. The IML-100 method costs 80% less than the IMP-200 method. Selected analytical results are provided in Table 1.

Results and Discussion

Massive sulphide collected at 320 feet (97.5 m) contained 21,290 ppm Ni; 1,926 ppm Cu; 1,480 ppm Co; 2.06 ppm Pd and 0.32 ppm Pt (see Table 1). Disseminated sulphide Cu-Ni mineralization between 225 and 315 feet (69.6 and 96 m) contains an average of 0.19% Cu plus Ni (0.108% Cu and 0.086% Ni) (see Table 1) and 0.130 ppm Au + PGEs (Au, Pd, Pt and Rh) over 95 feet (29m). Average Pd content of 0.099 ppm accounts for 75% of the total Au + PGEs. Iridium content is less than the detection limit (0.003 ppm) for all samples. The average cobalt content, 78 ppm, is only 3 times the crustal concentration (Wedepohl 1995).

The average Cu:Ni ratio is 1.8 from 200 to 275 feet and 0.5 from 280 to 315 feet. A massive sulphide sample collected at 320 feet has a Cu:Ni ratio of 0.09. The increase in Cu:Ni ratios from 0.09 to 0.5 and then to 1.8, upward in the drill hole, indicates that the sulphide mineralization is zoned with nickel-rich mineralization near the base changing to copper-rich near the top. The samples with a Cu:Ni ratio of 1.8 correspond only with "Icelandite" (3 locations) and those with a Cu:Ni ratio of 0.5 correspond to basalt, andesite and rhyolite (5 locations). The correlation of Cu:Ni ratios of 1.8 with only "Icelandite" and Cu:Ni ratios of 0.5 with basalt, andesite and rhyolite, could indicate that base metal deposition is controlled by host rock composition. The Cu:Ni ratio zonation present in the disseminated and massive mineralization might be useful as a vector toward massive sulphides when exploring disseminated mineralization.

The Pd:Pt ratios that range from 3.3 to 16.9 and average 11.4 were determined for 13 samples that had measurable Pd or Pt concentrations. There is no obvious zonation in Pd:Pt ratios comparable to those seen in the Cu:Ni ratios. The high Pd:Pt ratio (>5) in drill hole L-13, the absence of measurable Ir, as well as Bi, Se and Te contents that are 1, 13 and 44 times respectively average crustal abundance (Wedepohl 1995) are interpreted to indicate they were deposited by a Bushveld Complex-like magmatic process (Godel, Barnes and Maier 2007).

The samples between 225 and 315 feet, a 100-foot (30.5 m) interval, contains an average of 0.5% sulphur (see Table 1) consistent with the estimated pyrrhotite content. The 100-foot (30.5 m) mineralized zone has a calculated true width of 85 feet (25.9 m) because drill hole L-13 dips 55° SW and geological contacts dip 70° NE.

Given that only 2-inch (5 cm) lengths of core samples were available, it is difficult to be certain that the sample at 320 feet represents a 5-foot (1.5 m) length intercept of massive sulphide because the drill log is unclear on that point. Comments of "local stringers of pyrrhotite" and "massive pyrrhotite" in the drill log near sample 320 feet are interpreted to indicate that massive or semi-massive sulphide mineralization was encountered.

The 100-foot (30.5 m) intercept (Table 2 - marked by vertical line) contained metals worth a total of US\$46.43 (C\$60.83) per tonne on November 5, 2018. If the 60% greater specific gravity of massive pyrrhotite compared to disseminated sulphide samples (4.6 versus 2.9 g/cc) is considered, it will increase the estimate of total metal value to nearly US\$60.00 per tonne. If the sample collected at 320 feet only represents a 2.5-foot zone of massive sulphides, the metal value estimate of the 100-foot (30.5 m) intercept will be only US\$35.41 per tonne (not taking specific gravity into account). A mineralized zone with a true width of 85 feet (25.9 m) containing US\$46.43 of metal per tonne would be comparable to an intercept containing 1.17 g/t of gold. Such a deposit would have a higher grade than the 0.97 g/t gold mined at the Detour Gold Mine in 2017 (Detour Gold Corporation, news release, January 16, 2018) or the estimated 1.07 g/t gold grade of reserves in the Goldcorp Century Pit Project (Goldcorp Inc., Investor Day 2018 presentation, January 16, 2018). Such metal values are comparable in value to the proven nickel reserve (0.32% Ni) in the geologically different Dumont deposit in Quebec (Staples et.al. 2013) and could trigger a paradigm shift toward open pit mining of disseminated Cu-Ni mineralization.

The average PGE content of the 100' (25.9 m) intercept accounts for 18.4% of the total dollar value.

Table 1. Geochemistry of Loveland diamond drill core L-13.

DDH Feet	DDH Metres	S %	Cu ppm	Ni ppm	Co ppm	Au ppm	Pd ppm	Pt ppm	Rh ppm	Bi ppm	Se ppm	Te ppm	Cu+Ni %	Cu:Ni ratio	Pd:Pt ratio
200	61.0	0.003	0.6	2	0.03	0.002	0.02	0.005	0.003	0.02	0.2	0.02			
205	62.5	0.01	38	181	33	0.014	bdl	0.005	0.005	0.02	bdl	0.02	0.02	0.21	
210	64.0	0.12	164	181	30	0.011	bdl	bdl	0.009	0.03	0.3	0.04	0.03	0.91	
215	65.5	0.09	52	197	29	0.008	bdl	bdl	bdl	bdl	0.2	bdl	0.02	0.26	
220	67.1	0.08	27	353	43	0.002	bdl	bdl	0.004	0.02	0.4	0.02	0.04	0.08	
225	68.6	0.03	267	134	21	0.005	bdl	bdl	0.007	bdl	bdl	0.02	0.04		
230	70.1	1.04	2179	1157	113	0.010	0.05	bdl	0.003	0.05	2.5	0.25	0.33	1.99	
235	71.6	0.23	1040	236	31	0.006	bdl	0.005	0.01	0.02	0.8	0.11	0.13	1.88	
240	73.2	0.24	461	353	34	0.003	0.02	0.006	0.006	0.03	0.9	0.1	0.08	4.41	3.3
245	74.7	2.23	3671	2477	181	0.050	0.21	0.017	0.007	0.13	5.9	0.80	0.61	1.31	12.1
250	76.2	2.26	5351	2427	140	0.095	0.16	0.010	0.007	0.06	5.4	0.52	0.78	1.48	16.0
255	77.7	0.12	353	283	52	0.007	0.04	0.005	0.007	0.02	0.5	0.07	0.06	1.25	8.0
260	79.2	0.24	510	388	42	0.004	0.09	0.007	bdl	0.05	0.7	0.2	0.09	1.31	12.9
265	80.8	0.28	638	357	39	0.003	0.13	0.009	0.015	0.07	0.9	0.26	0.10	1.79	14.4
270	82.3	0.12	585	279	41	0.002	0.03	bdl	0.003	bdl	0.4	0.06	0.09	2.10	
275	83.8	0.03	140	315	42	bdl	bdl	bdl	bdl	bdl	0.2	0.02	0.05	0.44	
280	85.3	0.78	2681	1367	154	0.031	0.19	0.013	0.007	0.06	2.9	0.49	0.40	1.96	15.2
285	86.9	0.17	390	833	82	0.008	0.08	0.009	0.003	0.03	0.6	0.12	0.12	0.47	8.9
290	88.4	0.23	783	602	59	0.004	0.16	0.01	0.009	0.04	0.9	0.27	0.14	1.30	16.0
295	89.9	0.01	34	285	44	bdl	0.03	bdl	0.005	bdl	bdl	0.03	0.03	0.12	
300	91.4	0.11	167	412	55	0.003	0.03	0.006	bdl	0.04	0.6	0.12	0.06	0.41	5.0
305	93.0	0.05	217	352	50	0.002	bdl	bdl	0.01	0.02	0.2	0.03	0.06	0.62	
310	94.5	0.03	143	544	65	0.002	0.02	bdl	0.005	0.02	0.2	0.05	0.07	0.26	
315	96.0	0.12	265	884	82	0.005	0.14	0.016	0.005	0.07	0.5	0.21	0.11	0.30	8.4
320	97.5	1.25	941	2774	185	0.004	0.22	0.013	0.022	0.13	3.8	0.47	0.37	0.34	16.9
325	99.1	28.33	1926	21290	1480	0.014	2.055	0.317	0.016	1.77	33.4	7.33	2.32	0.09	6.5
330	100.6	0.03	182	45	9	0.002	bdl	bdl	0.006	bdl	bdl	0.02	0.02	4.04	
335	102.1	0.02	54	43	11	bdl	bdl	bdl	0.014	bdl	bdl	bdl	0.01	1.26	
340	103.6	0.03	34	54	21	0.002	bdl	bdl	bdl	bdl	bdl	bdl	0.01	0.63	
345	105.2	0.01	48	46	19	bdl	bdl	bdl	bdl	bdl	bdl	bdl	0.01	1.04	
350	106.7	0.01	71	51	20	bdl	bdl	bdl	0.006	bdl	bdl	bdl	0.01	1.39	
		0.02	151	34	14	bdl	bdl	bdl	0.006	bdl	bdl	bdl	0.02	4.49	

Abbreviations: bdl = below detection limit

Table 2. Value of metals in Loveland diamond drill core L-13.

		Cu	Ni	Co	Au	Pd	Pt	Rh	
\$/lb-g		2.816	5.502	27.33	39.54	35.14	26.52	31.37	
Feet	Metres	Cu	Ni	Co	Au	Pd	Pt	Rh	Total
		\$	\$	\$	\$	\$	\$	\$	\$
200	61.0	0.24	2.20	1.99	0.55	0.00	0.13	0.16	5.26
205	62.5	1.02	2.19	1.83	0.42	0.00	0.00	0.28	5.73
210	64.0	0.32	2.39	1.77	0.32	0.00	0.00	0.00	4.80
215	65.5	0.17	4.28	2.61	0.08	0.00	0.00	0.13	7.27
220	67.1	1.66	1.63	1.28	0.20	0.00	0.00	0.22	4.98
225	68.6	13.53	14.03	6.80	0.40	1.76	0.00	0.09	36.61
230	70.1	6.46	2.86	1.89	0.24	0.00	0.13	0.31	11.89
235	71.6	2.86	4.28	2.06	0.12	0.70	0.16	0.19	10.37
240	73.2	22.79	30.04	10.91	1.96	7.20	0.45	0.22	73.57
245	74.7	33.22	29.44	8.40	3.76	5.62	0.27	0.00	80.71
250	76.2	2.19	3.43	3.10	0.28	1.41	0.13	0.22	10.76
255	77.7	3.17	4.71	2.51	0.16	3.16	0.19	0.00	13.89
260	79.2	3.96	4.33	2.34	0.12	4.57	0.24	0.47	16.03
265	80.8	3.63	3.38	2.46	0.08	1.05	0.00	0.09	10.70
270	82.3	0.87	3.82	2.52	0.00	0.00	0.00	0.00	7.21
275	83.8	16.64	16.58	9.28	1.23	6.68	0.33	0.22	50.96
280	85.3	2.42	10.10	4.95	0.32	2.81	0.24	0.09	20.93
285	86.9	4.86	7.30	3.55	0.16	5.62	0.27	0.28	22.04
290	88.4	0.21	3.46	2.64	0.00	1.05	0.00	0.16	7.52
295	89.9	1.04	5.00	3.34	0.12	1.05	0.16	0.00	10.70
300	91.4	1.35	4.27	2.98	0.08	0.00	0.00	0.31	8.99
305	93.0	0.89	6.60	3.90	0.08	0.70	0.00	0.16	12.33
310	94.5	1.64	10.72	4.94	0.20	4.74	0.42	0.16	22.82
315	96.0	5.84	33.65	11.17	0.16	7.73	0.34	0.69	59.58
320	97.5	11.96	258.24	89.17	0.55	72.21	8.41	0.50	441.05
325	99.1	1.13	0.55	0.54	0.08	0.00	0.00	0.19	2.49
330	100.6	0.34	0.52	0.67	0.00	0.00	0.00	0.44	1.97
335	102.1	0.21	0.66	1.28	0.08	0.00	0.00	0.00	2.22
340	103.6	0.30	0.56	1.14	0.00	0.00	0.00	0.00	1.99
345	105.2	0.44	0.62	1.20	0.00	0.00	0.00	0.19	2.45
350	106.7	0.93	0.41	0.83	0.00	0.00	0.00	0.19	2.35

31.73

46.43

31.31

133.95

All metal prices are bid values obtained from London Metals Exchange, Kitco and Metals Bulletin on November 5, 2018

Recommendations

Core containing disseminated Cu-Ni mineralization with less than 5% sulphides should be analyzed using a multi-element ICP-MS analytical package containing both base metals and PGEs. Zonation of Cu:Ni ratios should be assessed and used to search for nearby massive Cu-Ni mineralization.

Attention should be paid to weak magnetic and VLF anomalies near known Cu-Ni mineralization. Such anomalies might be tested using induced polarization to identify both disseminated and thin massive sulphide zones.

Conclusions

- Hollinger drill hole L-13 has an average Cu plus Ni content of 0.19 weight % over 100-foot (30.5 m) core length or 85 feet (25.9 m) true width
- Cu:Ni ratio zonation is present in the disseminated mineralized zone and might be useful as a vector pointing toward massive sulphide mineralization
- The Pd:Pt ratio, absence of measurable Ir, and total Bi, Se and Te content indicate a magmatic process
- The total metal value in the disseminated zone is estimated to be US\$46.43 per tonne and would be comparable to 1.17 g/t of gold (November 5, 2018 metal values)
- Average Au + PGE content in the disseminated zone accounts for 18.4% of total metal value

Cautionary Statement

Analytical results for the 5 cm (2-inch) length core samples collected are interpreted to represent 1.5 m (5-foot) intervals of core. This assumption is thought to be valid for most samples. If it is not correct for the sample collected at 320 feet, the value of the 100-foot (30.5 m) intercept could be overestimated.

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