GEOLOGICAL SURVEY OF CANADA
OPEN FILE 6729

A New Nickel Discovery in the Prince Albert Hills, Melville Peninsula, Nunavut: Implications for Ni-Cu-(PGE) Exploration in the Prince Albert Group

M.G. Houlé, H.L. Gibson, L. Richan, V. Bécu, D. Corrigan, and L. Nadeau

2010

Ressources naturelles Canada
Natural Resources Canada

Canada

GEOLOGICAL SURVEY OF CANADA
OPEN FILE 6729

A New Nickel Discovery in the Prince Albert Hills, Melville Peninsula, Nunavut: Implications for Ni-Cu-(PGE) Exploration in the Prince Albert Group

M.G. Houlé, H.L. Gibson, L. Richan, V. Bécu, D. Corrigan, and L. Nadeau

2010

This publication is available from the Geological Survey of Canada Bookstore (http://gsc.nrcan.gc.ca/bookstore_e.php).
It can also be downloaded free of charge from GeoPub (http://geopub.nrcan.gc.ca/).

Recommended citation
Houlé, M.G., Gibson, H.L., Richan, L., Bécu, V., Corrigan, D., and Nadeau, L., 2010. A New Nickel Discovery in the Prince Albert Hills, Melville Peninsula, Nunavut: Implications for Ni-Cu-(PGE) Exploration in the Prince Albert Group; Geological Survey of Canada, Open File 6729, 22 p.

Open files are products that have not gone through the GSC formal publication process.

A NEW NICKEL DISCOVERY IN THE PRINCE ALBERT HILLS, MELVILLE PENINSULA, NUNAVUT: IMPLICATIONS FOR NI-CU-(PGE) EXPLORATION IN THE PRINCE ALBERT GROUP

Michel G. Houlé[1], Harold L. Gibson[2], Lindsay Richan[2], Valérie Bécu[1], David Corrigan[3], and Léopold Nadeau[1]

[1] Geological Survey of Canada, Québec City, QC
[2] Mineral Exploration Research Centre, Laurentian University, Sudbury, ON
[3] Geological Survey of Canada, Ottawa, ON

Introduction

The Melville Peninsula Project (MPP) is one of a number of geo-mapping projects that were initiated under the Federal Government's Geo-mapping for Energy and Minerals (GEM) Program in 2008. The main purpose of the GEM Program is to provide updated geoscience information to support exploration in the discovery and development of new energy and mineral resources in Canada's arctic.

Specifically, the MPP objectives are to renew and update the public geoscience database for the area, upgrade the knowledge and understanding of the Precambrian geology and Quaternary superficial cover, and to stimulate mineral exploration in the north-central part of the Churchill Province. Limited understanding of the overall geology and significant economic endowment in time-correlative geological units outside of the map area (e.g., Committee Bay, Piling Group), justified a closer examination of the geological setting and mineral potential of the Melville Peninsula.

The present contribution highlights significant results regarding nickel mineralization obtained during geological mapping in the Prince Albert Hills within the western part of the Melville Peninsula in Nunavut.

Geological Setting

The Melville Peninsula is located in the north-central part of the Churchill Province, also referred as the western Churchill Province, which is composed of a collage of polymetamorphic and polydeformed Archean cratons including the Rae and the Hearne cratons. The Archean cratons are in part unconformably overlain by Paleoproterozoic sedimentary sequences and are intruded by various suites of predominantly intra-plate Proterozoic magmatic suites (**Fig. 1**). A widespread tectonothermal reactivation, related to the assembly of the supercontinent Nuna during the interval 1.95 - 1.80 Ga, overprints the Archean and Paleoproterozoic sequences (Corrigan et al., 2009; Nadeau et al., 2010).

Melville Peninsula comprises four contrasting lithotectonic entities (Nadeau et al., 2010) (from north to south; see **Fig. 2**):

1) The northern granulite-facies orthogneiss block;
2) The Prince Albert terrain composed of Neoarchean supracrustal rocks of the Prince Albert Group and granitoid intrusions;
3) The Foxe Fold belt represented by the Paleoproterozoic Penrhyn Group cover sequence; and
4) The Repulse Bay block

Note that the above nomenclature is currently used as a working tool and is subject to change as further information is obtained on the crustal growth history of each of these 'blocks'.

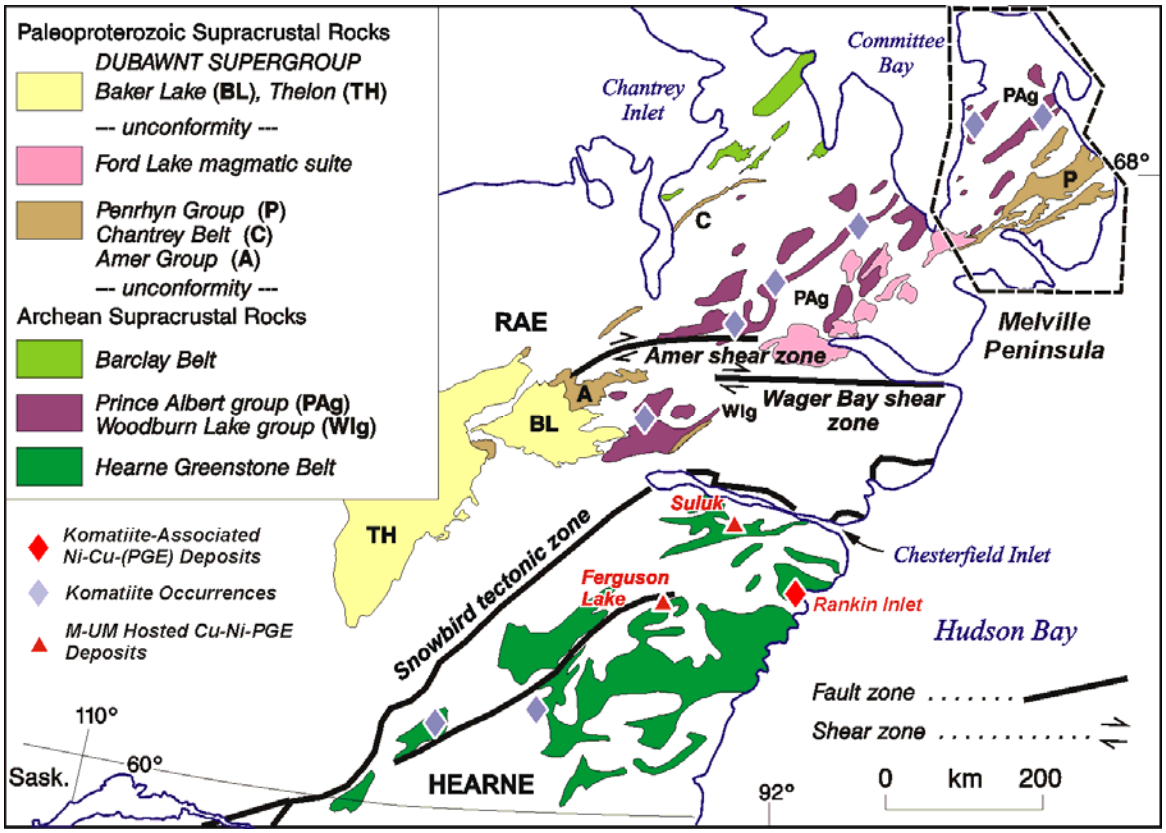


Figure 1. Simplified geology of the Western Churchill Province showing the main komatiite occurrences and Ni-Cu-(PGE) deposits associated with komatiites and mafic and/or ultramafic intrusions (modified from Skulski et al., 2003).

Of specific relevance to this project is the 'classic' Prince Albert Group, which occurs in the Prince Albert Hills in the western part of the Melville Peninsula, as originally defined by Heywood (1967). The Prince Albert Group occurs as several small tectonically dismembered greenstone belt slivers and two large coherent greenstone belts, the Prince Albert greenstone belt and the Roche Bay greenstone belt (**Fig. 2**).

The Prince Albert greenstone belt is characterized by northeast-southwest trending supracrustal successions and extends for over 50 km and up to 10 km wide and can be subdivided into southern and northern portions based on distinctive features such as the abundance of ultramafic rocks. The northern part is characterized by a limited intercalation of highly carbonatized ultramafic rocks within a succession dominated by mafic volcanic rocks with lesser intermediate to felsic volcanic rocks, and sedimentary rocks including banded iron formations. The southern part is characterized by the same lithological associations, but contains less mafic volcanic rocks, more banded iron formations, and a higher proportion of well-exposed ultramafic rocks that exhibit typical structures and textures normally associated with komatiitite lava flows (i.e., spinifex-textured rocks, differentiated flows). However, in many cases, the ultramafic rocks are essentially homogeneous, massive, fine-grained peridotites that are characterized by an olivine meso- to orthocumulate texture.

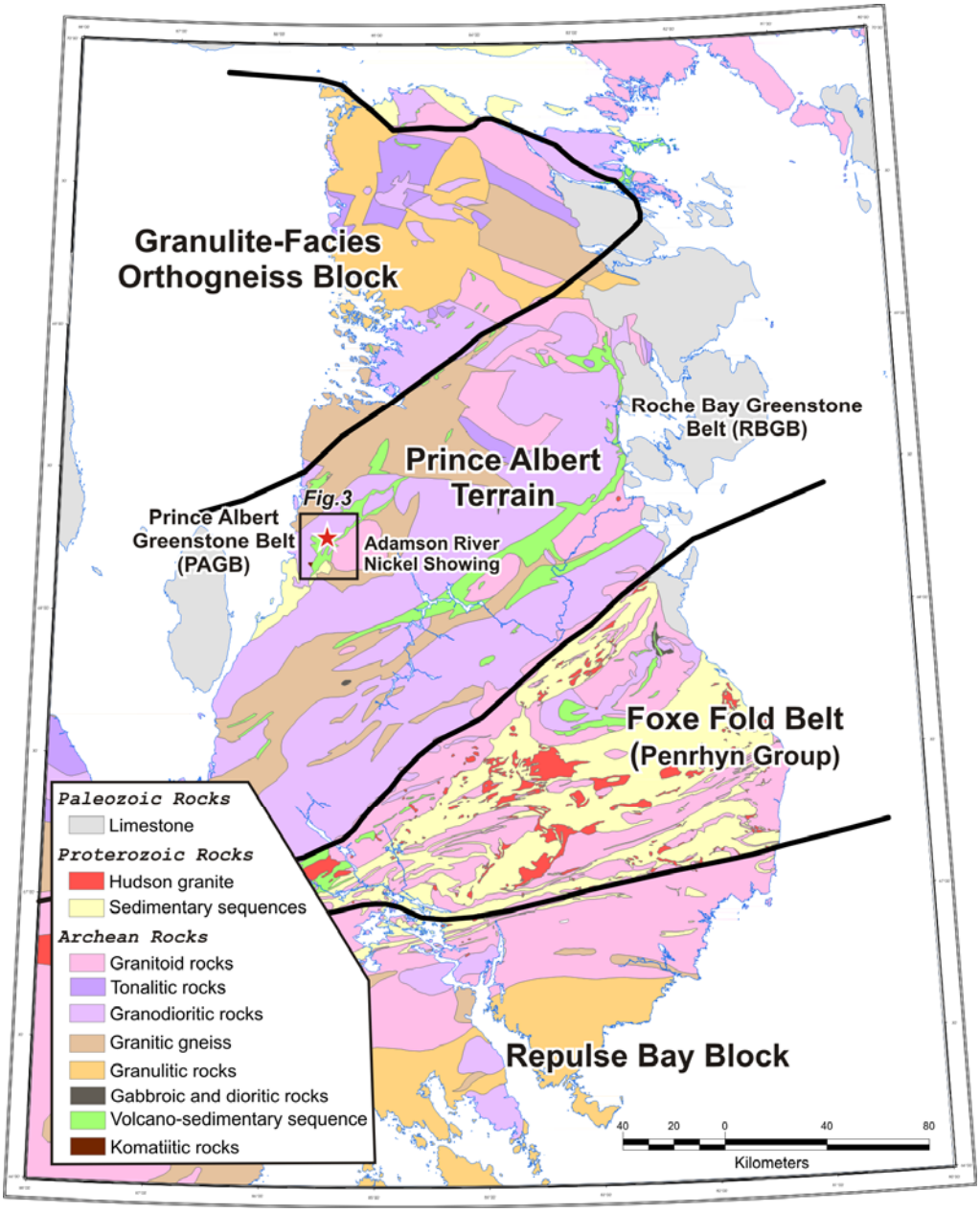


Figure 2. Geological overview of the Melville Peninsula showing the four main lithotectonic entities and the location of the Adamson River nickel showing in the Prince Albert Hills (modified from Skulski, in prep.).

Preliminary Results

Field Investigation

Anomalous nickel values were discovered within a peridotite containing finely disseminated sulfides during a preliminary field investigation in 2009 within the Prince Albert greenstone belt. In 2010, this area was revisited and in mid-July the Adamson River nickel showing was discovered at ~15 km ESE of the Cape Sibbald, on the north side of the Adamson River (**Fig. 3:** 85˚27′46.6″ W; 68˚16′21.5″ N).

The Adamson River Ni-Cu-Co showing is hosted by a relatively thick ultramafic body composed of fine-grained to well-developed cumulate textured peridotite that is subconcordant to supracrustal strata of the Prince Albert Group. Preliminary field work conducted in this area did

not reveal any unequivocal evidence for an extrusive versus intrusive emplacement for the peridotite. However, this peridotite is interpreted to be related to other ultramafic units within the PAGB that outcrop semi-continuously for more than 10 km and contain a well preserved succession of komatiitic rocks that locally exhibit organized units (cumulate-spinifex textured rocks) alternating with thick units of olivine cumulate.

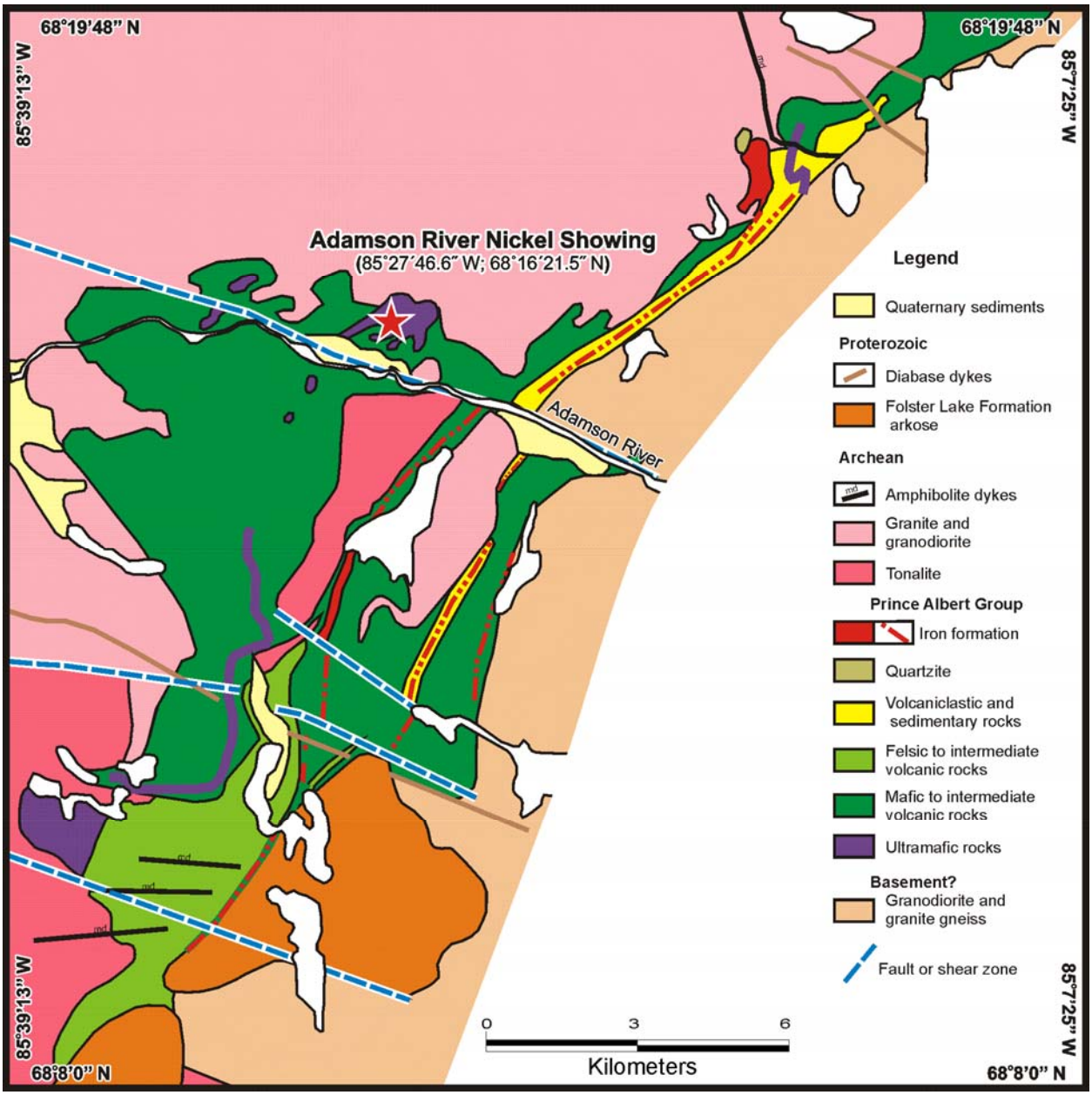


Figure 3. Simplified geological map of the southern part of the Prince Albert Greenstone Belt of the Melville Peninsula showing the main lithologies and the location of the Adamson River nickel showing in the Prince Albert Hills (modified after Frisch, 1982).

The sulfide mineralization is located along the irregular basal contact between the komatiitic peridotite and underlying mafic metavolcanic and gabbroic rocks **(Fig. 4A**). The surface expression of the mineralized zone occurs as several gossanous zones found within small depressions (2 x 3m) over a length strike of ~40 m. The Fe-Ni-Cu sulfide mineralization ranges from massive to disseminated facies, and the mineralogy is essentially characterized by

pyrrhotite, pentlandite, and pyrite (**Figs. 4B, C, D, and E**). The most significant gossanous zone contains semi- to massive sulfides whereas other zones contain disseminated to heavily disseminated sulfides. Disseminated and veinlet sulfides primarily occur stratigraphically above the main mineralized contact, but were also observed locally further away from the contact within the peridotite. The relationship between the semi- to massive sulfide mineralization and disseminated and veinlet sulfide nickel mineralization is uncertain.

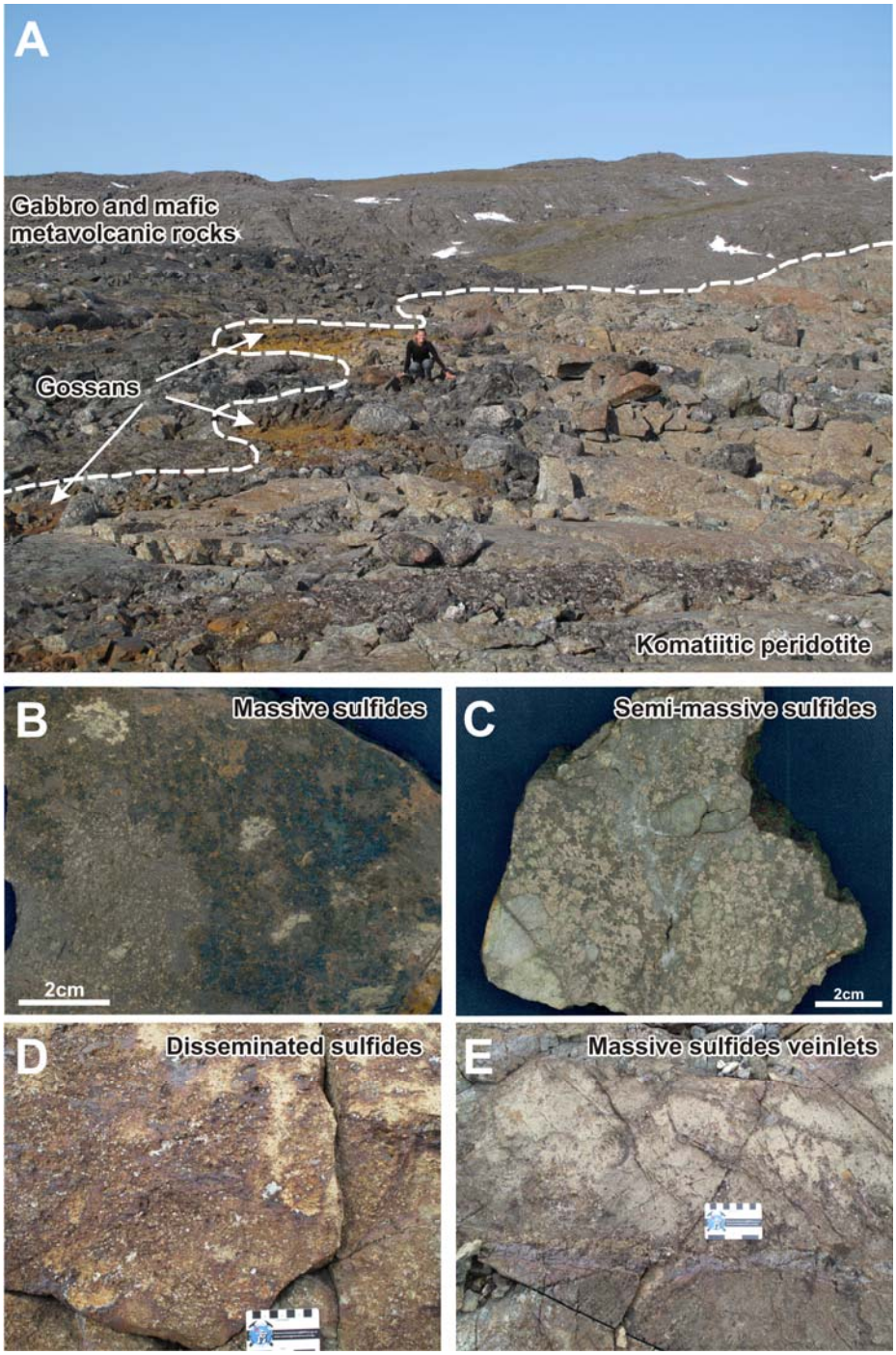


Figure 4. A) Overview of the Adamson River nickel showing within the Prince Albert Group ultramafic rocks in the Prince Albert Hills; B) Massive sulfide mineralization; C) Semi-massive sulfide mineralization that contain numerous fragments of finely disseminated sulfide within komatiitic peridotite; D) Heavily disseminated sulfide within peridotite; E) Vein-like sulfide mineralization hosted within peridotite.

Laboratory Investigations

Preliminary laboratory analyses of several samples from the Adamson River nickel showing were conducted using a mobile X-Ray Fluorescence (XRF) analyzer (Innov-X bench-top X-50 analyzer). The analysis were acquired on rock slabs and on pulverized samples (powders) to not only verify potential heterogeneity related to grain size of the mineralization but also related to the presence of numerous fragments of weakly mineralized ultramafic rocks. The samples were also sent to the Geoscience Laboratory (GeoLabs) at Sudbury, Ontario, to provide an absolute check on the results obtained through the mobile X-Ray Fluorescence analyzer. Preliminary results for nickel are summarized in Table 1 and the detailed analysis for Ni, Cr, Mn, Fe, Co, Cu and Zn are contained in Appendix A.

Table 1. Concentration of nickel within selected grab samples of mineralized peridotite from the Adamson River nickel showing.

Spl ID	Ore textures	Method	n	Nickel (wt %)			
				Low	High	Average	Std Dev
09CXAH 053A01	D$	PXRF	10	0.46%	2.23%	**1.1%**	0.6
		PXRF*	5	0.88%	0.91%	**0.9%**	0.01
		Lab	1	-	-	**0.7%**	
10HUBM 106A01	M$	PXRF	17	7.46%	16.05%	**10.7%**	2.4
		PXRF*	5	9.09%	9.71	**9.4**	0.23
		Lab	1	-	-	**7.3%**	-
10HUBM 106A02	D$	PXRF	10	0.54%	1.24%	**0.9%**	0.21
		PXRF*	5	1.15%	1.21%	**1.2%**	0.02
		Lab	1	-	-	**0.9%**	-
10HUBM 106A04	V$	PXRF	10	0.35%	0.63%	**0.5%**	0.1
		PXRF[1]	2	0.61%	2.06%	**1.3%**	-
		PXRF*	5	1.07%	1.16%	**1.1%**	0.03
		Lab	1	-	-	**0.8%**	-
10HUBM 106A05	SM$	PXRF	10	7.06%	10.28%	**8.4%**	0.86
		PXRF[1]	2	2.32%	2.5%	**2.4%**	-
		PXRF*	5	7.15%	7.31%	**7.3%**	0.08
		Lab	1	-	-	**6.5%**	-
10HUBM 106A06	SM$	PXRF	11	9.13%	18.76%	**13.5%**	2.66
		PXRF[1]	4	0.99%	5.81%	**3.6%**	1.83
		PXRF*	5	7.19%	8.04%	**7.8%**	0.31
		Lab	1	-	-	**6.5%**	-
10HUBM 106A07	M$	PXRF	11	6.17	17.86%	**9.7%**	3.11
		PXRF*	6	7.97%	8.88%	**8.4%**	0.30
		Lab	1	-	-	**8.0%**	-
10HUBM 106A08	SM$	PXRF	11	6.11%	12.09%	**9.5%**	1.87
		PXRF[1]	3	1.94%	5.46%	**3.6%**	1.45
		PXRF*	5	7.71%	8.14%	**7.8%**	0.16
		Lab	1	-	-	**7.0%**	-
10HUBM 106A09	M$	PXRF	10	5.41%	11.4%	**8.8%**	1.87
		PXRF*	5	8.30%	9.05%	**8.8%**	0.26
		Lab	1	-	-	**8.0%**	-

D$: disseminated sulfides, SM$: semi-massive sulfides, M$: massive sulfides, V$: veinlets; PXRF: analysis obtained via a bench top mobile X-Ray Fluorescence analyzer (Innov-X X-50), measurements conducted on thin slabs; PXRF[1]: measurements conducted on clasts or veins on thin slabs; PXRF*: measurements conducted on powder; Lab: geochemical analysis from a certified geochemical laboratories (GeoLabs – Sudbury).

In total, nine selected grab samples taken during the 2009 and 2010 field seasons were analysed with a mobile XRF analyzer to investigate the nickel content of the Adamson River nickel showing. Preliminary analyses confirm the presence of high nickel values within this sulfide mineralization. Results obtained on slabs returned values between 0.46% and 2.23% Ni for disseminated sulfides within the peridotite, between 0.35% and 0.63% Ni for disseminated and sulfide veinlets within the peridotite, between 6% and 18% Ni for semi-massive sulfides, and between 5% and 18% Ni for massive sulfides. However, some samples exhibited more heterogeneity related to the presence of sulfide veinlets within the peridotite or to ultramafic clasts within the semi-massive sulfide. Sulfide veinlets returned values up to 2% Ni, when measurements were taken directly on the mm- to cm-scale veinlets whereas the sulfide clasts returned values as high as 6% Ni. In comparison, the analysis conducted directly on pulverized rock samples (powders) are, on average, generally lower than those obtained from rock slabs, but they show less variation as indicated by lower standard deviations (see **Table 1**). These variations are easily accounted for by the intrinsic heterogeneity of the samples themselves (amount of clasts, sulfide veinlets, etc.) and probably by variations in the mineralogy and modal proportions of sulfide minerals within the Fe-Ni-Cu sulfide mineralization. Results from the Geoscience Laboratory at Sudbury (atomic absorption technique.) have thus far corroborated initial results obtained via the mobile XRF. The nickel content obtained from the Geoscience laboratory are between 0.7% and 0.9% for disseminated sulfides, between 6.5% and 7.0% Ni for semi-massive sulfides, and between 7.3% and 8.0% Ni for massive sulfides samples. These results demonstrate the high nickel content of sulfide mineralization at the Adamson River nickel showing and also indicate the usefulness of a mobile XRF analyzer to estimate nickel grades of magmatic sulfide mineralization. However, further investigations will be needed to better understand nickel grade variation obtained via mobile XRF analyzer on polished slabs and rock powders in comparison to those obtained in a geochemical laboratory.

Implications for Ni-Cu-(PGE)

Early reconnaissance work had been conducted by the GSC in the 70s (Eckstrand, 1975) to determine the potential for magmatic nickel sulfide mineralization within the Prince Albert Group. Despite the fact that only a few nickel occurrences were reported and that the only significant one is associated with a gabbroic intrusion (Bil' showing, Aquitaine Resources), Eckstrand concluded that nickel potential of the Prince Albert Group is significant based on the similarities with Ni-Cu environments in other greenstone belts (e.g., Abitibi) in which ultramafic rocks occurred. Until now, no significant discoveries had been made to support his assumption. However, preliminary results from the newly discovered Adamson River Ni-Cu-Co showing, highlight the possible fertility and thus prospectivity of the Prince Albert Group to host komatiite-associated Ni-Cu-(PGE) mineralization.

Furthermore, this new discovery not only highlights the nickel potential of the Melville Peninsula but also opens new possibilities as to find nickel mineralizations elsewhere within other parts of this semi-continuous, northeast trending, komatiite-bearing greenstone belt successions interpreted as the Prince Albert and Woodburn Lake Groups (Committee Bay and Baker Lake areas, respectively) of the western Churchill Province.

Acknowledgements

This work has been supported by the Melville Peninsula Project of the Geological Survey of Canada under the Federal Government's Geo-mapping for Energy and Minerals (GEM). This contribution also benefits from numerous discussions and the assistance of Pierre Brouillette and

Gabriel Machado. The present manuscript has benefited from careful reviews by Gabriel Machado and Kathleen Lauzière.

References

Corrigan, D., Nadeau, L., Brouillette, P., Tremblay, T., Boutin, M., Wodicka, N., Houlé, M., Spratt, J., Erdmann, S., Clark, D., Partin, C., Day, S., and Kuiper, Y.7, 2009. The GEM-Minerals Program on Melville Peninsula: project summary and preliminary report; 37th Annual Yellowknife Geoscience Abstracts; Northwest Territories Geoscience Office, Yellowknife, NT, YKGSF Abstract Volume 2009, p.8.

Eckstrand, O.R., 1975. Nickel Potential of the Prince Albert Group, N.W.T.; Geological Survey of Canada, Paper 75-01A, p. 253-255.

Frisch, T., 1982. Precambrien Geology of the Prince Albert Hills, western Melville Peninsula, Northwest Territories, Geological Survey of Canada, Bulletin 346, 70 p.

Heywood, W.W., 1967. Geological notes northeastern District of Keewatin and southern Melville Peninsula, District of Franklin, Northwest Territories, Geological Survey of Canada, Paper 66-40, 2 maps, scale 1:506 880 and scale 1:126 720

Nadeau, L., Corrigan, D., Tremblay, T., Brouillette, P., Wodicka, N., Machado, G., Houlé, M., Erdmann, S., Laflamme, C., Richan, L., Rigg, J., Partin, C., Ganderton, N.G., and Kuiper, Y., 2010. The Melville Peninsula geology revisited: a contribution to the GEM Program; 38th Annual Yellowknife Geoscience Abstracts; Northwest Territories Geoscience Office, Yellowknife, NT, YKGSF Abstract Volume 2010.

Skulski, T., in prep. Geological base map: updated from Open File 5577.

Skulski, T., Sandeman, H., Sanborn-Barrie, M., MacHattie, T., Young, M., Carson, C., Berman, R., Brown, J., Rayner, N., Panagapko, D., Byrne, D., and Deyell, C., 2003. Bedrock geology of the Ellice Hills map area and new constraints on the regional geology of the Committee Bay area, Nunavut; Geological Survey of Canada, Current Research 2003-C22, 11 p.

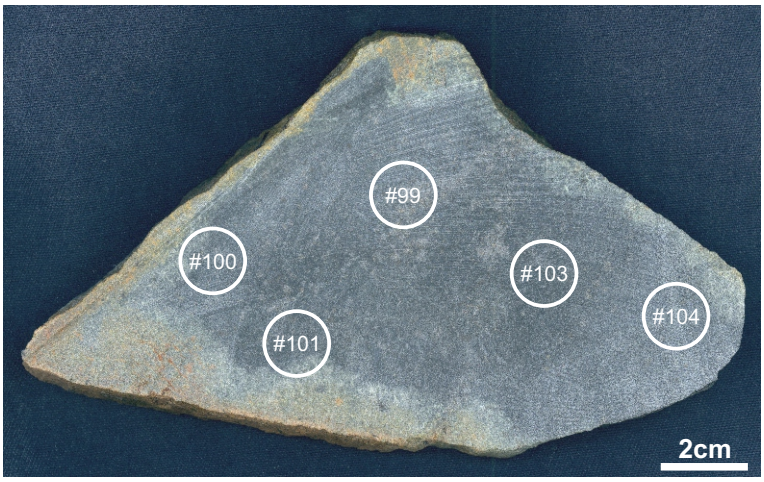
Appendix A

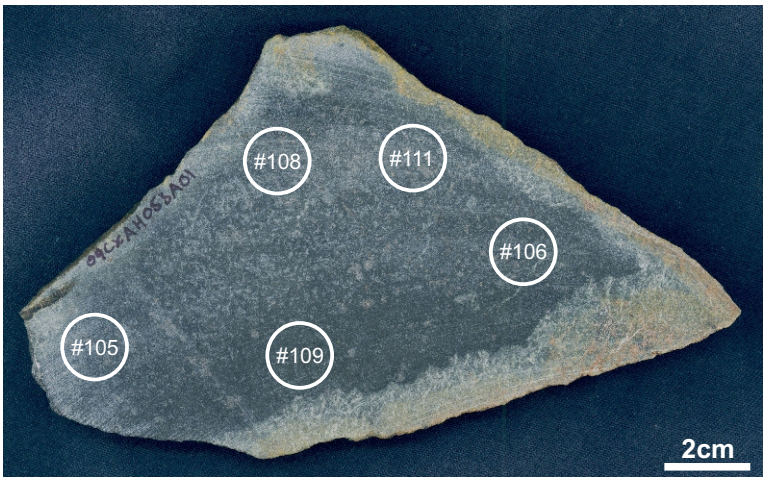
Geochemical analysis for Ni, Cr, Mn, Fe, Co, Cu and Zn
using a mobile X-Ray Fluorescence (XRF) analyzer
(Innov-X bench-top X-50 analyzer)

Abbreviations

Reading Nb: Analysis site; located for rock analysis only
Livetime: Counting time for analysis
Mode: Analysis mode
LE%: Measurements of light elements

Sample: 09CXAH053A01: Disseminated sulfide within peridotite





Sample 09CXAH053A01
X-50 Rock Analysis

Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
99	46.5331	Mining	0.12	0.23	7.72	0.077	2.23	0.051	0.019	89.54	99.987
100	46.0995	Mining	0.2	0.065	6.05	0.055	1	ND	0.013	92.62	100.003
101	47.4384	Mining	0.35	0.13	11.3	ND	1.61	0.046	0.011	86.55	99.997
103	46.5536	Mining	0.15	0.15	8.32	0.067	1.56	0.037	0.011	89.44	99.735
104	45.6679	Mining	0.13	0.078	5.52	ND	0.46	ND	0.006	93.8	99.994
105	45.7219	Mining	0.12	0.086	5.86	0.045	0.36	ND	ND	93.53	100.001
106	46.3501	Mining	0.4	0.078	7.94	0.054	1.33	0.034	0.014	90.14	99.990
108	46.6076	Mining	0.17	0.1	8.27	ND	0.69	ND	ND	90.78	100.010
109	46.2055	Mining	0.14	0.064	5.93	ND	0.58	ND	ND	93.28	99.994
111	46.5547	Mining	0.13	0.13	9.18	ND	1.03	ND	ND	89.51	99.980
		Average	0.19	0.111	7.61	0.060	1.09	0.042	0.012	90.92	100.029
		σ	0.10	0.051	1.82	0.012	0.60	0.008	0.004	2.34	

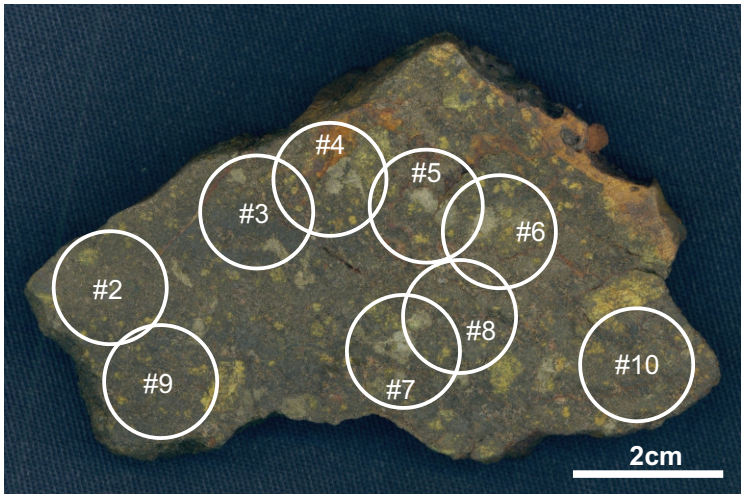
Sample 09CXAH053A01
X-50 Powder Analysis

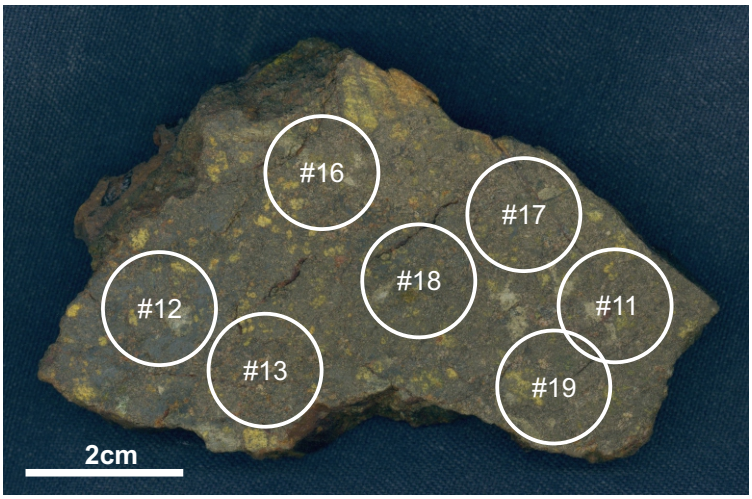
Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
10	46.7943	Mining	0.18	0.083	7.65	ND	0.91	ND	0.009	91.08	99.912
11	47.1635	Mining	0.17	0.079	7.48	ND	0.88	ND	0.008	91.37	99.987
12	46.5661	Mining	0.19	0.077	7.52	0.053	0.9	ND	0.007	91.25	99.997
13	46.5014	Mining	0.19	0.084	7.5	0.055	0.89	ND	ND	91.26	99.979
14	46.4086	Mining	0.2	0.088	7.64	0.058	0.9	ND	0.007	91.1	99.993
		Average	0.19	0.082	7.56	0.055	0.90		0.008	91.21	99.997
		σ	0.01	0.004	0.08	0.003	0.01		0.001	0.12	

Sample 09CXAH053A01
Geo Labs Analysis

			Cr	Mn	Fe	Co %	Ni %	Cu %	Zn	LE	Total
						0.015	0.73	0.003	0.005		

Sample: 10HUBM106A01: Massive sulfides





Sample 10HUBM106A01
X-50 Rock Analysis

Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
2	49.5276	Mining	0.1	0.12	35.52	ND	7.63	ND	ND	56.37	99.740
3	49.1769	Mining	0.084	0.085	33.78	0.2	14.26	ND	ND	51.48	99.889
4	47.4175	Mining	ND	ND	41.85	ND	10.74	2.47	ND	44.81	99.870
5	48.9185	Mining	0.031	0.056	44.57	ND	8.58	0.56	ND	46.07	99.867
6	48.931	Mining	ND	0.054	36.87	0.17	12.16	0.29	ND	50.24	99.784
7	48.9286	Mining	0.12	0.051	41.42	0.17	12.64	ND	ND	45.45	99.851
8	49.1035	Mining	0.075	0.061	40.35	ND	11.77	ND	ND	47.6	99.856
9	49.2841	Mining	0.19	0.086	34.36	0.2	14	ND	ND	51.07	99.906
10	49.6731	Mining	0.085	0.16	29.19	ND	9.5	0.09	ND	60.59	99.615
11	49.5647	Mining	0.043	0.083	37.92	0.14	9.58	0.35	ND	51.67	99.786
12	49.4412	Mining	0.065	0.065	41.51	0.22	7.46	1.08	ND	49.48	99.880
13	49.1671	Mining	0.03	0.07	36.33	0.25	16.05	ND	ND	47.07	99.800
16	49.4834	Mining	0.1	0.16	32.73	ND	10.13	0.23	ND	56.38	99.730
17	49.2114	Mining	0.17	0.085	41.38	ND	8.74	0.086	ND	49.4	99.861
18	49.5045	Mining	0.058	0.072	39.23	ND	9.56	ND	ND	50.95	99.870
19	49.454	Mining	0.079	0.073	41.24	ND	8.86	ND	ND	49.62	99.872
		Average	0.088	0.085	38.02	0.19	10.73	0.645		50.52	100.271
		σ	0.045	0.034	4.01	0.03	2.44	0.753		4.14	

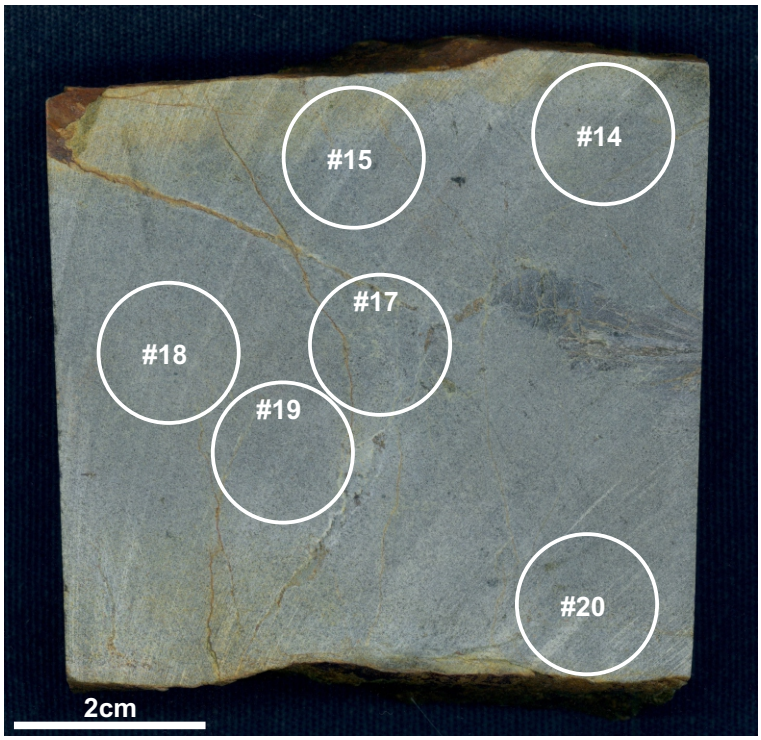
Sample 10HUBM106A01
X-50 Powder Analysis

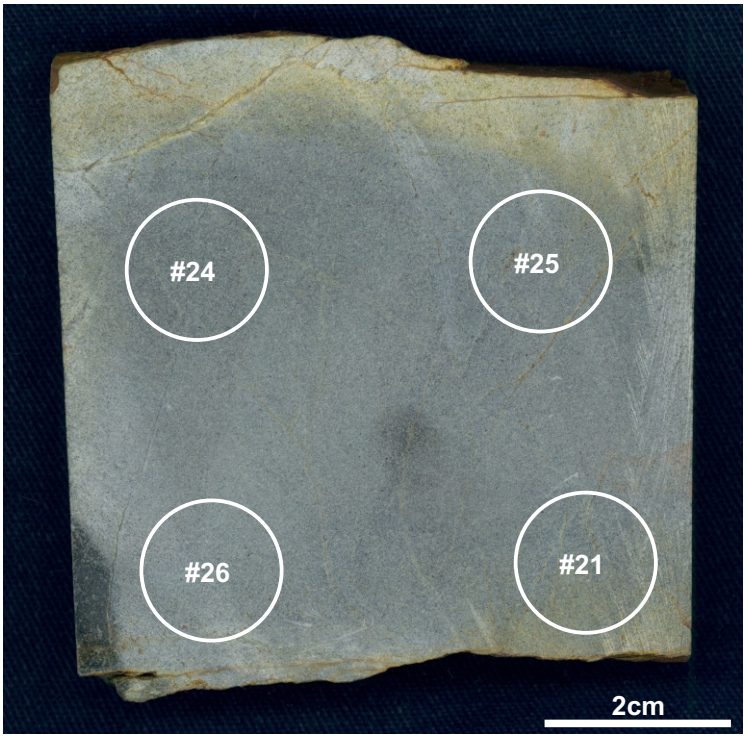
Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
4	48.8508	Mining	0.058	0.064	36.83	0.21	9.09	0.21	ND	53.26	99.722
5	48.4534	Mining	0.059	0.078	37.62	0.23	9.16	0.22	ND	52.35	99.717
6	48.9046	Mining	0.057	0.056	38.69	0.2	9.71	0.26	ND	50.81	99.783
7	48.5346	Mining	0.058	0.081	37.44	0.23	9.5	0.23	ND	52.23	99.769
8	48.8939	Mining	0.065	0.065	37.57	0.19	9.47	0.27	ND	52.11	99.740
		Average	0.059	0.069	37.63	0.21	9.39	0.24		52.15	99.746
		σ	0.003	0.009	0.60	0.02	0.23	0.02		0.78	

Sample 10HUBM106A01
GEO LABS Analysis

			Cr	Mn	Fe	Co %	Ni %	Cu %	Zn	LE	Total
						2.23	7.34	1.81			

Sample: 10HUBM106A02: Disseminated sulfides within a peridotite





Sample 10HUBM106A02
X-50 Rock Analysis

Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
14	48.432	Mining	0.35	0.19	10.24	ND	0.97	0.09	0.017	88	99.857
15	48.0403	Mining	0.22	0.18	7.93	ND	0.6	0.05	0.011	90.81	99.801
17	48.3182	Mining	0.25	0.18	8.73	ND	0.76	0.14	0.014	89.72	99.794
18	48.5867	Mining	0.36	0.17	10.5	ND	1.24	0.072	0.014	87.4	99.756
19	48.0271	Mining	0.2	0.2	7.79	ND	0.54	ND	0.014	91.06	99.804
20	48.2987	Mining	0.3	0.18	10.17	ND	0.84	0.07	0.014	88.22	99.794
21	48.2504	Mining	0.36	0.17	10.32	ND	1.13	0.054	0.015	87.75	99.799
24	48.2608	Mining	0.34	0.18	9.57	ND	0.88	ND	0.016	88.77	99.756
25	47.6702	Mining	0.31	0.17	9.24	ND	0.73	0.029	0.014	89.33	99.823
26	48.2893	Mining	0.29	0.18	9.68	ND	0.94	0.028	0.012	88.67	99.800
		Average	0.30	0.18	9.42		0.86	0.067	0.014	88.97	99.812
		σ	0.06	0.01	0.93		0.21	0.034	0.002	1.18	

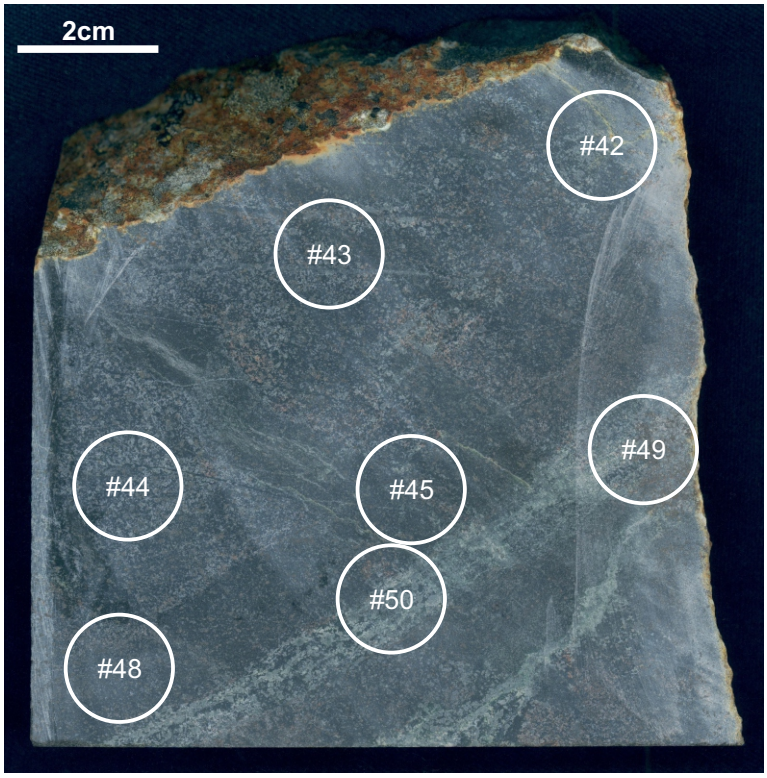
Sample 10HUBM106A02
X-50 Powder Analysis

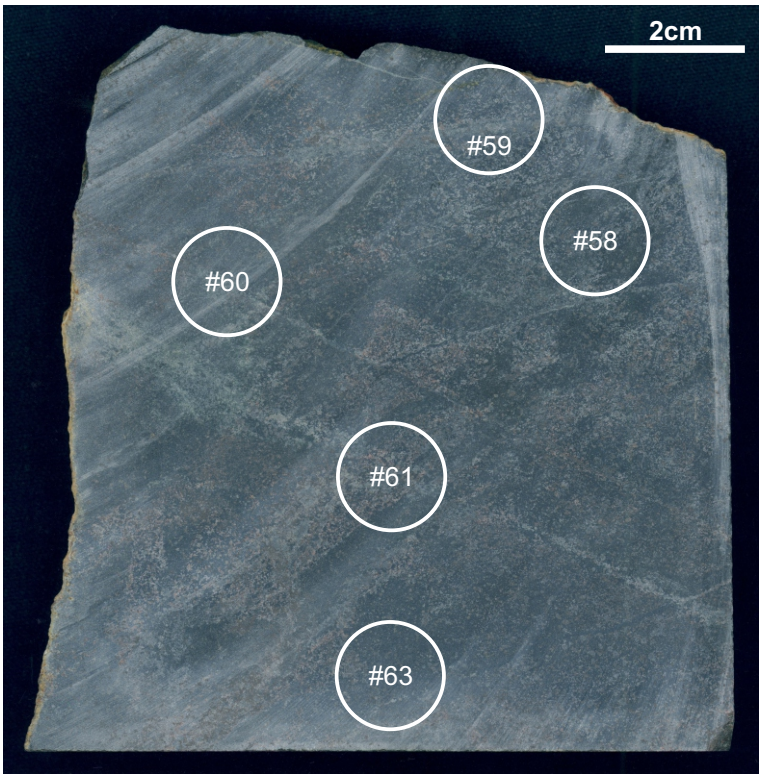
Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
35	48.3321	Mining	0.3	0.16	9.8	ND	1.17	0.09	0.011	88.25	99.781
36	48.3299	Mining	0.28	0.18	9.95	ND	1.18	0.078	0.014	88.13	99.812
37	47.8317	Mining	0.28	0.18	10.03	ND	1.18	0.09	0.013	88.04	99.813
38	48.2715	Mining	0.31	0.19	10.18	ND	1.21	0.085	0.015	87.86	99.850
39	48.533	Mining	0.25	0.16	9.71	ND	1.15	0.083	0.014	88.46	99.827
		Average	0.28	0.17	9.93		1.18	0.085	0.013	88.15	99.817
		σ	0.02	0.01	0.17		0.02	0.005	0.001	0.20	

Sample 10HUBM106A02
Geo Labs Analysis

			Cr	Mn	Fe	Co %	Ni %	Cu %	Zn	LE	Total
						0.023	0.94	0.061	0.010		

Sample: 10HUBM106A04: Disseminated and sulfide veinlets within a peridotite





Sample 10HUBM106A04
X-50 Rock Analysis

Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
42	47.3521	Mining	0.2	0.13	10.26	ND	0.62	ND	0.016	88.64	99.866
43	47.2943	Mining	0.35	0.13	10.47	ND	0.47	ND	0.016	88.42	99.856
44	47.1427	Mining	0.26	0.16	10.41	ND	0.39	ND	0.016	88.62	99.856
45	47.2189	Mining	0.23	0.15	9.81	ND	0.6	ND	0.015	89.1	99.905
48	47.2817	Mining	0.24	0.17	10.53	ND	0.35	ND	0.015	88.53	99.835
58	47.0808	Mining	0.28	0.16	9.4	ND	0.49	ND	0.018	89.51	99.858
59	46.8503	Mining	0.26	0.13	8.12	ND	0.39	ND	0.016	91.08	99.996
60	47.0344	Mining	0.32	0.14	10.16	ND	0.43	ND	0.016	88.83	99.896
61	47.6557	Mining	0.26	0.14	13.25	ND	0.63	ND	0.02	85.6	99.900
63	47.345	Mining	0.27	0.15	10.85	ND	0.45	ND	0.015	88.16	99.895
		Average	0.267	0.15	10.33		0.48		0.016	88.65	99.886
		σ	0.041	0.01	1.22		0.10		0.001	1.28	
49-vein	47.5208	Mining	ND	0.14	9.22	0.09	2.06	0.073	0.016	88.32	99.919
50-vein	47.1097	Mining	0.21	0.12	11.01	ND	0.61	ND	0.016	88.01	99.976
		Average	0.21	0.13	10.12		1.34	0.073	0.016	88.165	100.044

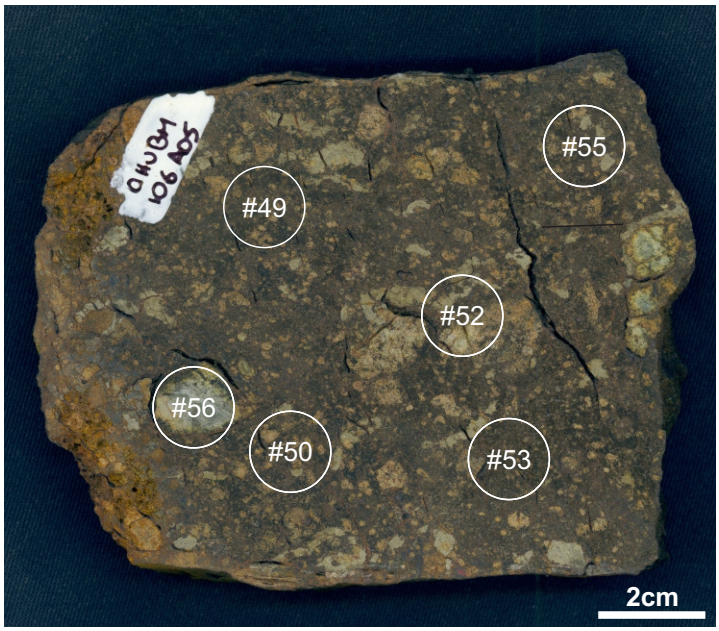
Sample 10HUBM106A04
X-50 Powder Analysis

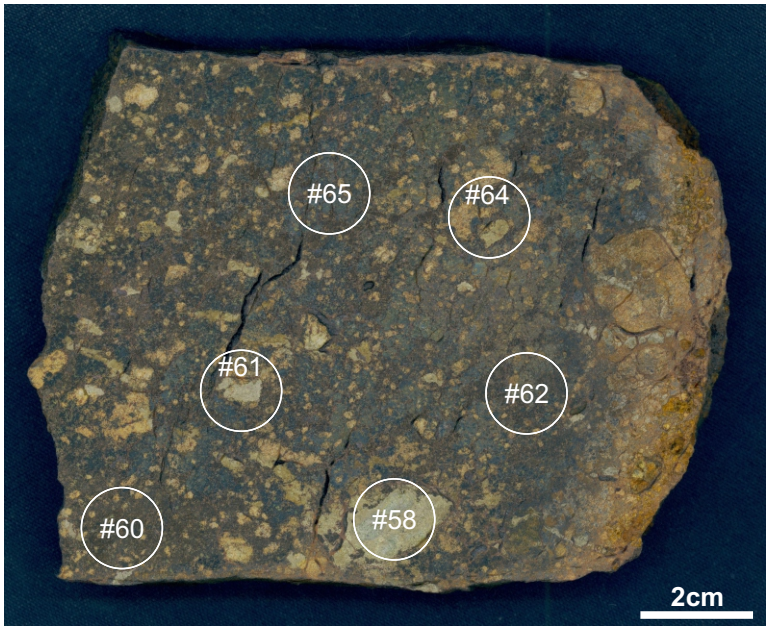
Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
46	47.992	Mining	0.22	0.15	14.48	ND	1.1	ND	0.018	84.02	99.988
47	48.0028	Mining	0.2	0.14	14.56	ND	1.13	0.024	0.017	83.84	99.911
48	48.4204	Mining	0.21	0.16	14.53	ND	1.16	ND	0.019	83.9	99.979
49	47.6092	Mining	0.23	0.14	14.12	ND	1.07	0.031	0.016	84.31	99.917
50	48.0893	Mining	0.19	0.16	14.13	ND	1.1	0.02	0.015	84.38	99.995
		Average	0.21	0.15	14.36		1.11	0.025	0.017	84.09	99.968
		σ	0.01	0.01	0.20		0.03	0.005	0.001	0.22	

Sample: 10HUBM106A04 (continued): Disseminated and sulfide veinlets within a peridotite

Sample 10HUBM106A04 **Geo Labs Analysis**											
			Cr	Mn	Fe	Co %	**Ni %**	Cu %	Zn	LE	Total
						0.019	**0.76**	0.013	0.011		

Sample: 10HUBM106A05: Semi-massive sulfides





Sample 10HUBM106A05
X-50 Rock Analysis

Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
49	49.1888	Mining	0.029	ND	37.87	ND	8.75	ND	ND	53.25	99.899
50	48.9473	Mining	0.058	0.05	38.85	0.19	8.69	0.19	ND	51.86	99.888
52	49.2521	Mining	0.038	ND	38.65	0.36	7.67	0.74	ND	52.34	99.798
53	48.9442	Mining	0.064	0.057	43.52	0.22	8.19	0.088	ND	47.64	99.779
55	49.0665	Mining	0.04	0.055	37.41	0.21	10.28	0.1	ND	51.8	99.895
60	49.0832	Mining	0.2	0.12	40.63	0.19	7.72	0.1	ND	50.85	99.810
61	49.4359	Mining	0.043	0.18	30.42	0.21	7.06	0.33	ND	61.26	99.503
62	48.9204	Mining	0.13	0.081	41.04	0.14	7.9	0.076	ND	50.52	99.887
64	48.5794	Mining	0.031	ND	41.25	ND	8.51	ND	ND	50.09	99.881
65	48.745	Mining	0.033	0.035	40.97	ND	9.12	ND	ND	49.64	99.798
		Average	0.067	0.08	39.06	0.22	8.39	0.232		51.93	99.973
		σ	0.053	0.05	3.37	0.06	0.86	0.223		3.45	
56-clast	49.9252	Mining	0.24	0.28	20.47	ND	2.5	0.19	0.022	75.73	99.432
58-clast	50.2116	Mining	0.12	0.17	31.17	0.32	2.32	0.65	ND	64.88	99.630
		Average	0.18	0.23	25.82	0.32	2.41	0.420	0.022	70.305	99.702

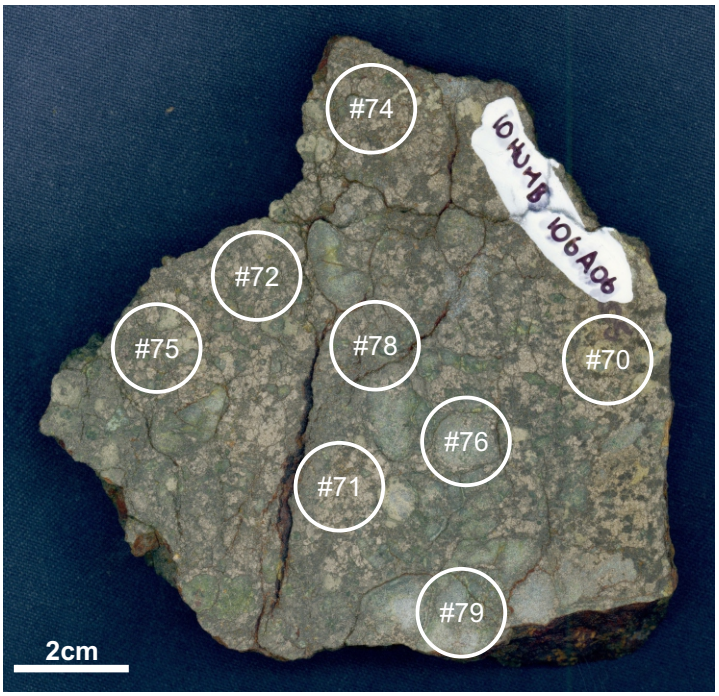
Sample 10HUBM106A05
X-50 Powder Analysis

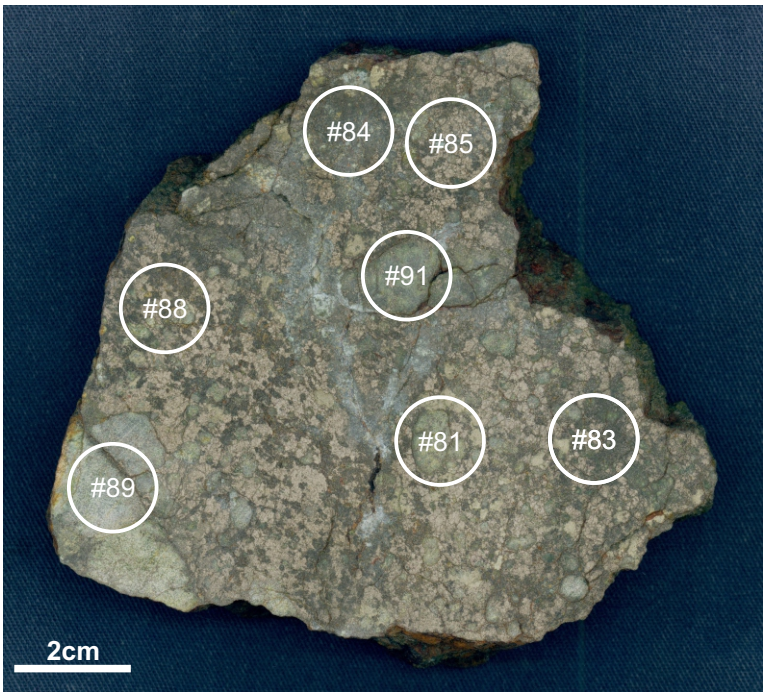
Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
54	48.7387	Mining	0.074	0.074	37.07	0.18	7.37	0.25	ND	54.76	99.778
55	48.5385	Mining	0.054	0.072	36.52	0.16	7.15	0.26	ND	55.55	99.766
56	48.673	Mining	0.044	0.075	36.45	0.15	7.28	0.24	ND	55.56	99.799
57	48.7663	Mining	0.073	0.064	37.07	0.18	7.31	0.27	ND	54.79	99.757
		Average	0.061	0.071	36.78	0.17	7.28	0.26		55.17	99.775
		σ	0.013	0.004	0.29	0.01	0.08	0.01		0.39	

Sample 10HUBM106A05
Geo Labs Analysis

			Cr	Mn	Fe	Co %	Ni %	Cu %	Zn	LE	Total
						0.233	6.54	0.191	0.004		

Sample: 10HUBM106A06: Semi-massive sulfides





Sample 10HUBM106A06
X-50 Rock Analysis

Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
70	49.9395	Mining	ND	0.061	39.03	0.46	9.13	0.54	ND	50.65	99.871
71	47.9067	Mining	0.031	0.032	44.54	0.24	13.74	ND	ND	41.27	99.853
72	49.2976	Mining	0.052	0.046	34.38	0.17	11.89	ND	ND	53.23	99.768
74	48.9338	Mining	0.055	0.045	42.25	0.21	11.2	ND	ND	46.09	99.850
75	48.7605	Mining	0.065	0.057	30.88	0.41	18.76	ND	ND	49.73	99.902
78	49.0788	Mining	0.063	0.062	39.92	ND	12.65	ND	ND	47.17	99.865
81	49.4803	Mining	0.064	0.057	31.15	0.29	13.21	0.62	ND	54.51	99.901
83	49.0451	Mining	0.06	0.055	39.64	0.16	11.82	ND	ND	48.14	99.875
84	48.6368	Mining	ND	0.032	30.01	0.24	15.36	ND	ND	54.19	99.832
85	49.0044	Mining	ND	0.064	35.14	0.19	13.7	ND	ND	50.79	99.884
88	48.9974	Mining	0.071	0.08	25.71	0.47	17.5	ND	ND	56.02	99.851
		Average	0.058	0.054	35.70	0.28	13.54	0.58		50.16	100.375
		σ	0.011	0.014	5.59	0.11	2.66	0.04		4.14	

Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
76-clast	49.9983	Mining	0.047	0.35	25.02	ND	5.81	0.28	0.019	67.97	99.496
79-clast	49.9573	Mining	0.058	0.33	17.12	ND	2.81	0.28	0.022	78.84	99.460
89-clast	49.6112	Mining	ND	0.44	14.52	ND	0.99	0.24	0.022	83.13	99.342
91-clast	49.3128	Mining	0.088	0.3	20.56	ND	4.66	0.22	0.016	73.66	99.504
		Average	0.064	0.36	19.31		3.57	0.26	0.020	75.90	99.467
		σ	0.017	0.05	3.93		1.83	0.03	0.002	5.67	

Sample: 10HUBM106A06 (continued): Semi-massive sulfides

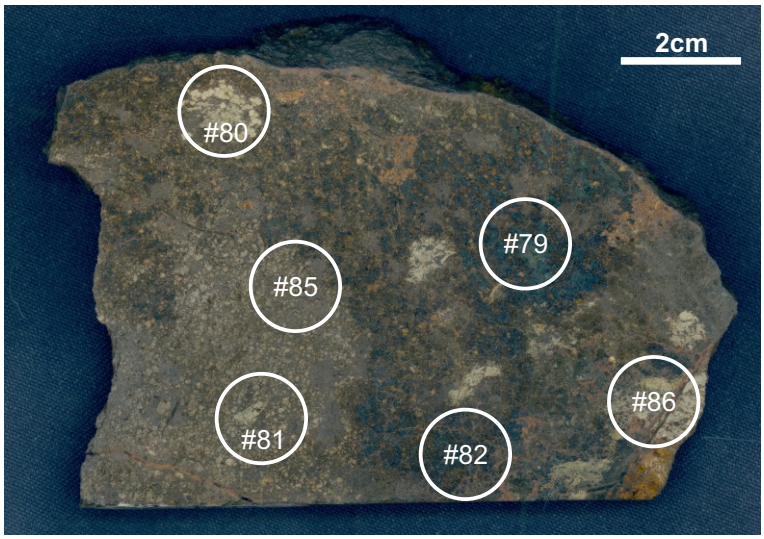
Sample 10HUBM106A06
X-50 Powder Analysis

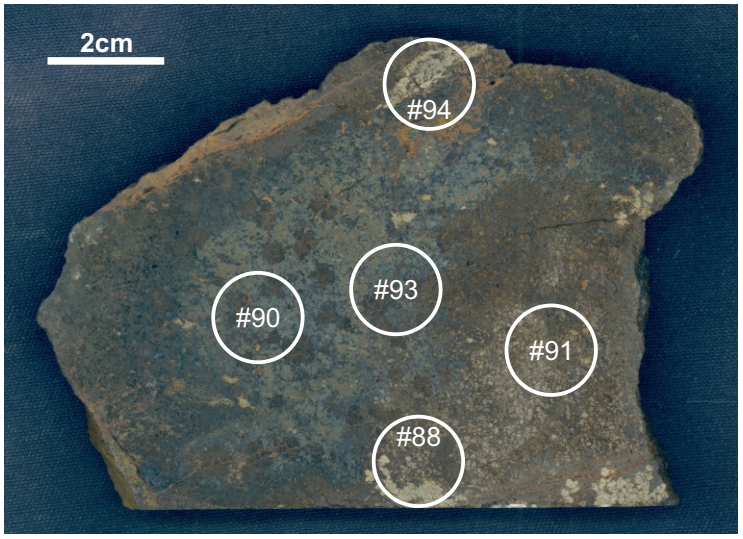
Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
24	49.2705	Mining	0.062	0.085	36.99	0.26	**7.95**	0.42	ND	53.94	99.707
25	49.1993	Mining	0.028	0.084	35.25	0.25	**7.19**	0.41	ND	56.51	99.722
26	49.0647	Mining	0.053	0.1	37.21	0.23	**8.04**	0.44	ND	53.66	99.733
27	48.7619	Mining	0.041	0.11	36.81	0.27	**7.83**	0.44	ND	54.24	99.741
28	48.6514	Mining	0.048	0.088	37.29	0.3	**7.92**	0.46	ND	53.64	99.746
		Average	0.046	0.093	36.71	0.26	**7.79**	0.43		54.40	99.730
		σ	0.011	0.010	0.75	0.02	**0.31**	0.02		1.08	

Sample 10HUBM106A06
Geo Labs Analysis

			Cr	Mn	Fe	Co %	Ni %	Cu %	Zn	LE	Total
						0.204	**6.46**	0.307	0.004		

Sample: 10HUBM106A07: Massive sulfides





Sample 10HUBM106A07
X-50 Rock Analysis

Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
79	49.3248	Mining	ND	ND	45.68	0.16	7.35	ND	ND	46.67	99.860
80	48.637	Mining	ND	ND	39.63	0.57	12.36	1.15	ND	46.15	99.860
81	48.7227	Mining	0.048	ND	48.6	ND	8.01	0.14	ND	43.06	99.858
82	49.5504	Mining	0.059	ND	41.97	0.32	8.45	0.21	ND	48.86	99.869
85	48.3991	Mining	ND	ND	48.86	ND	10.55	ND	ND	40.43	99.840
86	49.4073	Mining	0.073	ND	44.01	0.6	6.91	1.19	ND	47.09	99.873
88	48.1823	Mining	0.027	ND	39.63	0.5	17.86	0.13	ND	41.72	99.867
90	48.654	Mining	0.039	ND	47.07	ND	6.17	0.068	ND	46.52	99.867
91	48.4544	Mining	ND	ND	50.6	ND	8.88	ND	ND	40.36	99.840
93	48.523	Mining	0.1	ND	45.55	0.22	10.86	ND	ND	43.12	99.850
94	48.4962	Mining	0.62	0.038	41.92	0.64	9.62	1.02	ND	46.04	99.898
		Average	0.138	0.038	44.87	0.43	9.73	0.56		44.55	100.306
		σ	0.198	0.000	3.59	0.18	3.11	0.49		2.78	

Sample 10HUBM106A07
X-50 Powder Analysis

Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
68	48.1939	Mining	0.061	ND	44.46	0.34	8.27	0.16	ND	46.58	99.871
69	48.232	Mining	0.062	ND	45.81	0.4	8.88	0.15	ND	44.56	99.862
70	48.1348	Mining	0.056	ND	43.94	0.3	8.23	0.15	ND	47.18	99.856
71	48.6427	Mining	0.057	ND	44.04	0.33	8.34	0.17	ND	46.92	99.857
72	48.4264	Mining	0.061	ND	42.76	0.33	7.97	0.15	ND	48.6	99.871
73	48.0426	Mining	0.053	ND	45.21	0.33	8.66	0.15	ND	45.46	99.863
		Average	0.058		44.37	0.34	8.39	0.16		46.55	99.863
		σ	0.003		0.97	0.03	0.30	0.01		1.28	

Sample 10HUBM106A07
Geo Labs Analysis

			Cr	Mn	Fe	Co %	Ni %	Cu %	Zn	LE	Total
						0.274	7.98	0.074	0.002		

Sample: 10HUBM106A08: Semi-massive sulfides

Sample 10HUBM106A08
X-50 Rock Analysis

Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
24	49.1149	Mining	ND	0.063	35.95	0.2	12.09	ND	ND	51.52	99.823
25	48.7115	Mining	ND	ND	40.41	0.25	11.18	0.084	ND	47.95	99.874
27	49.4291	Mining	0.043	0.069	37.64	0.4	7.38	0.99	ND	53.2	99.722
28	48.3296	Mining	0.027	0.033	43.54	0.22	10.58	ND	ND	45.46	99.860
29	48.4845	Mining	0.09	0.087	37.83	0.17	7.48	0.089	ND	53.99	99.736
37	49.2631	Mining	0.089	0.033	43.01	ND	9.64	ND	ND	47.09	99.862
39	48.6698	Mining	0.045	ND	43.27	ND	10.18	ND	ND	46.37	99.865
40	49.2385	Mining	ND	0.058	40.08	0.33	9.07	0.59	ND	49.77	99.898
41	49.0588	Mining	0.36	0.048	35	0.18	6.11	0.21	ND	57.75	99.658
42	49.0576	Mining	0.046	0.061	37.34	0.29	12.03	ND	ND	50.12	99.887
43	49.4166	Mining	0.043	0.066	35	0.29	8.76	0.66	ND	54.97	99.789
		Average	0.093	0.058	39.01	0.26	9.50	0.44		50.74	100.097
		σ	0.103	0.016	3.09	0.07	1.87	0.34		3.74	
32-clast	50.1841	Mining	0.16	0.32	21.3	ND	1.94	0.31	ND	75.18	99.210
33-clast	49.299	Mining	0.14	0.12	37.99	0.13	5.46	0.21	ND	55.71	99.760
36-clast	49.5117	Mining	0.073	0.11	33.86	ND	3.24	0.2	ND	61.8	99.283
		Average	0.124	0.18	31.05	0.13	3.55	0.24		64.23	99.504
		σ	0.037	0.10	7.10	0.00	1.45	0.05		8.13	

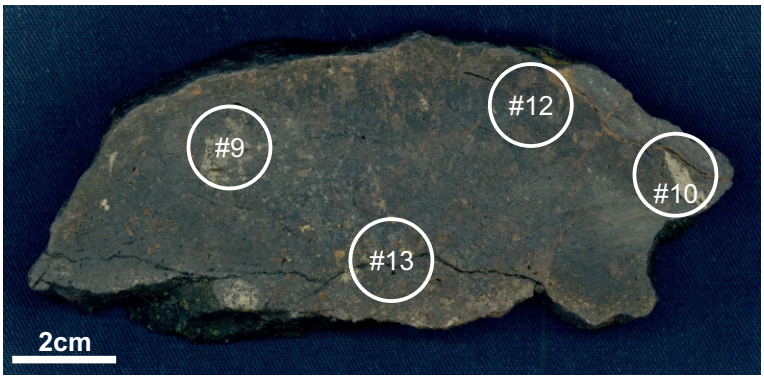
Sample 10HUBM106A08
X-50 Powder Analysis

Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
76	48.7991	Mining	0.09	0.053	37.66	0.23	7.78	0.24	ND	53.73	99.783
77	48.3365	Mining	0.09	0.048	38.37	0.28	8.14	0.25	ND	52.51	99.688
78	48.8879	Mining	0.078	0.052	37.43	0.25	7.71	0.24	ND	53.99	99.750
79	48.3664	Mining	0.078	0.074	37.37	0.27	7.76	0.24	ND	53.94	99.732
80	48.4582	Mining	0.073	0.06	37.53	0.27	7.77	0.23	ND	53.76	99.693
		Average	0.082	0.057	37.67	0.26	7.83	0.24		53.59	99.729
		σ	0.007	0.009	0.36	0.02	0.16	0.01		0.55	

Sample 10HUBM106A08
Geo Labs Analysis

			Cr	Mn	Fe	Co %	Ni %	Cu %	Zn	LE	Total
						0.221	7.05	0.153	0.003		

Sample: 10HUBM106A09: Massive sulfides



Sample 10HUBM106A09
X-50 Rock Analysis

Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
9	49.0363	Mining	ND	ND	41.79	0.85	9.02	0.88	ND	47.34	99.880
10	48.8201	Mining	0.1	ND	44.44	0.37	8.27	0.68	ND	46	99.860
12	48.5806	Mining	0.055	ND	44.6	0.18	11.4	ND	ND	43.62	99.855
13	48.6678	Mining	0.046	ND	43.58	0.32	9.96	0.15	ND	45.82	99.876
15	49.0766	Mining	0.063	ND	45.93	ND	5.41	ND	ND	48.47	99.873
16	48.8394	Mining	0.055	ND	46.89	ND	6.11	ND	ND	46.81	99.865
19	48.7271	Mining	0.04	ND	42.71	0.16	10.3	0.09	ND	46.59	99.890
20	49.1436	Mining	ND	ND	44.08	ND	7.45	ND	ND	48.33	99.860
21	48.4747	Mining	0.04	ND	44.3	0.16	9.65	ND	ND	45.72	99.870
22	48.3513	Mining	ND	ND	45.74	0.26	10.55	0.11	ND	43.2	99.860
		Average	0.057		44.41	0.33	8.81	0.38		46.19	100.176
		σ	0.019		1.44	0.23	1.87	0.33		1.66	

Sample 10HUBM106A09
X-50 Powder Analysis

Reading Nb	Livetime	Mode	Cr %	Mn %	Fe %	Co %	Ni %	Cu %	Zn %	LE %	Total
60	47.9289	Mining	0.069	ND	41.28	0.15	8.3	0.1	ND	50	99.899
61	49.0074	Mining	0.054	ND	42.19	0.21	8.67	0.11	ND	48.64	99.874
62	48.4667	Mining	0.062	ND	42.92	0.23	8.85	0.11	ND	47.71	99.882
63	48.5404	Mining	0.062	ND	43.73	0.26	9.05	0.11	ND	46.64	99.852
64	48.045	Mining	0.078	ND	43.16	0.28	8.94	0.15	ND	47.25	99.858
		Average	0.065		42.66	0.23	8.76	0.12		48.05	99.873
		σ	0.008		0.85	0.04	0.26	0.02		1.17	

Sample 10HUBM106A09
Geo Labs Analysis

			Cr	Mn	Fe	Co %	Ni %	Cu %	Zn	LE	Total
						0.263	7.96	0.067	0.002		