SUPPLEMENTARY FILES FOR:

REDOX-CONTROLLED CHALCOPHILE ELEMENT GEOCHEMISTRY OF THE POLARIS ALASKAN-TYPE MAFIC-ULTRAMAFIC COMPLEX, BRITISH COLUMBIA, CANADA

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Supplementary File S1: Base and precious metal concentrations in the soluble rock portion

Table S1. Base and precious metal concentrations (ppm) within soluble (non-silicate/oxide) components of the Polaris intrusion

Sample	DMI18-20-11	DMI18-20-12	DMI18-26-6	UM 158504	UM 158521	UM 158495	DMI18-21-3	DMI18-26-12
Lithology	ol. cpxite	ol. cpxite	ol. cpxite	ol. cpxite	ol. cpxite	ol. cpxite	listwanite	hbl'dite
Ag	0.36	0.87	0.49	0.28	0.55	1.08	<0.2	0.38
As	*<0.7*	*<0.7*	1.7	*<0.7*	*<0.7*	*<0.7*	59	6.2
Au	0.011	0.008	0.024	0.003	0.004	0.028	0.006	0.006
Bi	0.03	0.08	0.04	*<0.02*	0.05	0.08	0.02	0.02
Cd	0.03	0.08	0.06	0.05	0.14	0.17	0.13	<0.02
Co	57	58	70	331	271	121	52	104
Cu	681	1988	1289	2614	3723	3386	55	1964
Hg	0.1	*<0.08*	*<0.08*	*<0.08*	*<0.08*	*<0.08*	0.3	0.1
In	0.004	0.006	0.026	0.005	0.008	0.011	0.065	0.049
Ir	*<0.003*	0.008	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*
Mo	0.49	0.29	0.19	0.10	0.14	0.11	0.25	0.13
Ni	212	555	119	700	1272	475	232	55
Pb	0.6	2.1	0.5	0.3	2.8	2.3	3.0	1.3
Pd	0.28	0.15	0.04	0.11	0.03	0.08	0.08	0.05
Pt	0.125	0.117	0.038	0.079	0.041	0.04	0.062	0.067
Rh	0.026	0.019	0.008	0.013	0.004	0.010	0.013	0.008
Sb	*<0.009*	*<0.009*	0.01	0.01	0.05	0.01	42	0.08
Se	0.8	2.4	0.8	5.4	5.2	3.3	0.2	3.8
Sn	*<0.06*	*<0.06*	0.2	0.8	*<0.06*	0.1	*<0.06*	0.5
Te	0.04	0.12	0.09	0.03	0.05	0.15	*<0.02*	0.14
Tl	0.002	0.007	0.051	0.004	0.005	0.006	0.013	0.020
Zn	21	21	19	22	19	20	50	68

Sample	DMI18-26-13	UM 158658	UM 132836	DMI18-21-5	DMI18-27-6	DMI18-26-3C	DMI18-25-5	DMI18-29-12A
Lithology	hbl'dite	hbl'dite	hbl'dite	gab-dir	gab-dir	gab-dir	gab-dir	gab-dir
Ag	*<0.2*	0.26	0.20	0.20	0.28	*<0.2*	*<0.2*	*<0.2*
As	1.5	7.7	*<0.7*	*<0.7*	*<0.7*	0.7	*<0.7*	1.4
Au	0.003	*<0.002*	*<0.002*	0.007	0.005	0.002	*<0.002*	0.002
Bi	*<0.02*	0.03	*<0.02*	0.03	*<0.02*	*<0.02*	*<0.02*	*<0.02*
Cd	0.09	0.05	0.02	0.11	0.12	0.02	0.10	0.08
Co	53	73	18	35	26	26	23	24
Cu	433	738	198	393	288	138	182	105
Hg	0.1	*<0.08*	*<0.08*	*<0.08*	*<0.08*	*<0.08*	*<0.08*	*<0.08*
In	0.033	0.043	0.026	0.013	0.024	0.017	0.035	0.027
Ir	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*	*<0.003*
Mo	0.12	0.21	0.12	0.82	0.20	0.35	0.14	0.15
Ni	20	46	34	33	4	31	17	77
Pb	0.4	1.1	0.4	2.5	1.3	1.5	0.7	0.2
Pd	0.02	*<0.02*	0.08	0.02	*<0.02*	0.02	0.02	*<0.02*
Pt	0.008	0.007	0.035	*<0.005*	*<0.005*	0.005	*<0.005*	0.005
Rh	0.019	0.021	0.006	0.009	0.015	0.004	0.014	0.004
Sb	0.03	0.67	0.09	0.11	0.01	0.06	0.03	0.12
Se	1.5	5.9	0.7	3.5	1.8	1.0	0.4	0.4
Sn	0.3	0.6	0.3	0.3	1.3	1.3	0.3	0.2
Te	0.03	0.11	0.02	0.21	0.4	0.15	*<0.02*	0.03
Tl	0.007	0.008	0.017	0.063	0.007	0.004	0.025	0.007
Zn	52	33	25	90	31	41	50	24

Numbers in italics are lower detection limits for individual elements.

Supplementary File S2: Data quality and uncertainty

Whole-rock geochemical data were acquired at the Ontario Geoscience Laboratories (Sudbury, ON) in 2019. Prior to submission, obvious alteration and macroscopic veining were removed from fist-sized samples using a diamond-studded lapidary saw at the BCGS rock preparation facility. The samples were crushed and pulverized in an agate mill at the Ontario Geoscience Laboratories. Major element oxides, including Cr_2O_3 were determined by wavelength-dispersive X-ray fluorescence spectrometry (WD-XRFS). Total CO_2 and S concentrations of the samples were determined by infrared absorption, following sample combustion. Trace element concentrations of bulk rock samples were analyzed using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) following closed vessel multi-acid dissolution, whereas PGE + Au concentrations were quantified using NiS fire assay. Concentrations of precious and base metals in the easily soluble (sulphide) mineral fraction were determined by ICP-MS following a modified aqua regia dissolution.

Table S2-1: Major element concentrations (wt.%) of reference materials and duplicate samples (XRF)

DL		*0.04*	*0.01*	*0.002*	*0.02*	*0.01*	*0.002*	*0.01*	*0.006*	*0.02*	*0.01*	*0.002*		
QL		*0.132*	*0.033*	*0.007*	*0.066*	*0.033*	*0.007*	*0.033*	*0.020*	*0.066*	*0.033*	*0.007*		
Sample	**Batch**	**SiO_2**	**TiO_2**	**Cr_2O_3**	**Al_2O_3**	**Fe_2O_3**	**MnO**	**MgO**	**CaO**	**Na_2O**	**K_2O**	**P_2O_5**	**LOI**	**Total**
Certified reference materials														
UB-N	18-0361	39.83	0.09	0.333	2.87	8.25	0.124	35.27	1.213	0.13	BQL	0.009	12.37	100.51
UB-N	18-0079	39.60	0.10	0.336	2.89	8.29	0.124	35.45	1.211	0.14	BQL	0.012	12.37	100.55
UB-N(24)	18-0079	39.60	0.10	0.336	2.89	8.29	0.124	35.45	1.211	0.14	BQL	0.012	12.37	100.54
UB-N(40)	18-0079	39.87	0.11	0.337	2.93	8.49	0.128	35.76	1.256	0.14	BQL	0.019	12.37	101.45
Cert.		39.43	0.11	0.336	2.9	8.34	0.12	35.21	1.2	0.1	0.02	0.04	12.06	
%RSD		*0.37*	*8.16*	*0.52*	*0.87*	*1.30*	*1.60*	*0.57*	*1.81*	*3.64*	-	*32.64*	*0.00*	
Rel. Diff.		*1.1*	*18.2*	*0.9*	*1.0*	*1.8*	*6.7*	*1.6*	*4.7*	*40.0*	*0.0*	*77.5*	*2.6*	
WPR-1a	19-0079	37.56	0.58	0.469	4.98	16.29	0.181	25.44	3.52	0.13	0.19	0.069	9.78	99.20
Cert.		37.69	0.588[a]	0.471	4.95	16.21	0.178	25.24	3.54	0.067[a]	0.188	0.069	8.42	
Rel. Diff.		*0.4*	*1.4*	*0.3*	*0.6*	*0.5*	*1.6*	*0.8*	*0.5*	*92.9*	*1.1*	*-0.6*	*16.2*	
CHR-Bkg		15.18	0.16	27.926	13.10	14.21	0.147	23.38	BQL	BQL	BQL	0.013	4.80	
CHR-Bkg		15.13	0.15	27.983	13.37	14.45	0.152	23.43	BQL	BQL	BQL:	0.022	4.80	
Cert.		15.27	0.14	29.05	12.91	13.87	0.14	23.47	-	-	0.02	-	5.25	
%RSD		0.23	4.56	0.14	1.44	1.18	2.36	0.15	-	-	-	36.37	0.00	
Rel. Diff.		*0.9*	*14.3*	*3.9*	*3.6*	*4.2*	*8.6*	*0.4*	-	-	-	-	*8.6*	
In-house standards														
OKUM-1	18-0361	44.47	0.37	0.346	8.05	11.81	0.182	21.40	7.855	1.16	0.05	0.024	4.55	100.28
OKUM-1	19-0079	44.34	0.38	0.356	8.08	11.92	0.184	21.62	7.826	1.17	0.06	0.025	4.79	100.75
Cert.		44.20	0.375	0.3650	8.00	11.90	0.1830	21.50	7.76	1.120	0.053	0.0214	4.77	100.0
%RSD		0.21	1.9	2.0	0.26	0.66	0.77	0.72	0.26	0.61	12.9	2.9	3.6	
Rel. Diff.		*0.6*	*1.3*	*5.2*	*0.8*	*1.0*	*0.8*	*0.5*	*0.6*	*1.2*	*4.5*	*16.8*	*4.6*	
QS-1	18-0361	51.05	0.75	0.01	14.31	6.43	0.102	3.61	8.07	0.18	4.37	0.154	10.94	100.04
Cert.		50.80	0.748	0.0093	14.30	6.460	0.1020	3.650	7.95	0.125	4.420	0.153	11.30	100.0
Rel. Diff.		*0.5*	*0.3*	*7.5*	*0.1*	*0.5*	*0.0*	*1.1*	*1.5*	*44.0*	*1.1*	*0.7*	*3.2*	0.0
XCB-1(24)	19-0079	38.60	0.25	11.060	15.55	12.70	0.180	10.29	6.970	1.60	0.53	0.016	2.05	99.86
XCB-1(40)	19-0079	38.77	0.26	11.111	15.64	12.86	0.186	10.30	6.966	1.58	0.55	0.022	2.05	100.35
%RSD		0.31	*2.77*	*0.33*	*0.41*	*0.89*	*2.32*	*0.07*	*0.04*	*0.89*	*2.62*	*22.33*	*0.00*	
Duplicate samples														
27-6	18-0361	43.09	1.20	BDL	20.04	12.51	0.181	4.21	11.512	3.22	0.88	0.660	2.93	100.27
27-6_DUP	18-0361	43.20	1.21	BDL	20.08	12.55	0.181	4.23	11.563	3.22	0.88	0.663	2.95	100.73
%RSD		0.18	0.59		0.14	0.23	0.00	0.34	0.31	0.00	0.00	0.32	0.48	
18-7	19-0079	34.28	0.04	2.472	0.51	11.17	0.170	41.15	0.168	BDL	BQL	BQL	10.93	100.92
18-7_DUP	19-0079	34.11	0.04	2.449	0.50	11.10	0.168	40.97	0.168	BDL	BQL	BQL	10.98	100.51
%RSD		*0.35*	*0.00*		*1.4*	*0.44*	*0.84*	*0.31*	*0.00*	-	-	-	0.32	
32-11(24)		11.95	0.44	40.029	6.74	17.02	0.179	19.24	1.773	BDL	BQL	0.009	2.06	99.47
32-11_ DUP(24)		11.96	0.44	40.171	6.73	16.95	0.175	19.20	1.766	BDL	BQL	0.007	2.04	99.47
%RSD		*0.1*	*0.0*	*0.3*	*0.1*	*0.3*	*1.6*	*0.1*	*0.3*	-	-	*17.7*	*0.7*	

DL – detection limit; QL – quantification limit; Cert. - certified concentration or preferred in-house value; RSD- relative standard deviation given as 100 x (standard deviation of a population/mean of population); Rel. Diff. –relative difference between measured and certified concentration normalized to the certified value in %. Where an SRM was analyzed multiple times, the greatest relative difference is given; [a]Provisional value only; [b]Informational value, only. Numbers in parentheses next to sample/standard numbers indicate the factor of dilution.

Major elements

Following ignition, samples were fused in a borate flux to produce glass beads that were analyzed using the XRF-M01 analytical packages. Samples DMI18-10-9 and DMI18-32-11 contain >5 wt.% Cr_2O_3 and, consequently, had to be diluted by factors of 7x and 24x respectively, prior to analysis. Based on the analysis of two duplicate samples, two in-house standards (OKUM-1, QS-1, XCB-1; Hargreaves, 2015), and three certified reference materials (serpentinites UB-N (Govindaraju and de la Roche, 1969) and WPR-1a (NRCAN, 2012) and chromitite CHR-Bkg (Potts et al., 1992)), the uncertainty in measurement of most major element oxides whose abundance exceeds the quantification limit (defined as 3.3 times the detection limit), is <5 % relative at a 95% confidence interval (Table S2-1). The exceptions are TiO_2, Na_2O and P_2O_5, which have relative uncertainties of ≤20%, ≤45%, and ≤78% at low concentrations (<0.2 wt. % for TiO_2 and Na_2O, and <0.02 wt.% for P_2O_5, respectively), based on reproducibility of the running in-house averages and certified values.

Table S2-2: Trace element concentrations (ppm) of reference materials and duplicate samples (XRF)

DL		*12*	*14*	*9*	*12*	*8*	*8*	*5*	*10*	*0.004*
QL		*39.6*	*46.2*	*29.7*	*39.6*	*26.4*	*26.4*	*16.5*	*33*	*0.013*
Sample	**Batch**	**Co**	**Cu**	**Ni**	**Pb**	**Sr**	**V**	**Zn**	**Zr**	**BaO***
Certified reference materials										
UB-N	18-0361	104	51	1960	BQL	BQL	57	81	BDL	BQL
UB-N	18-0079	107	48	1966	BQL	BQL	60	82	BDL	BQL
UB-N(24)	18-0079	-	-	-	-	-	-	-	-	BDL
UB-N(40)	18-0079	-	-	-	-	-	-	-	-	BQL
Cert.		100	28	2000	13	9	75	85	4	<0.004
%RSD		*2.0*	*4.3*	*0.2*	-	-	*3.6*	*0.9*	-	-
Rel. Diff.		*7.0*	*82.1*	*2.0*	-	-	*24.0*	*4.7*	-	-
WPR-1a	18-0079	232	3058	4371	BQL	BQL	137	178	47	BQL
Cert.		*213*	*2990*	*4390*	*7.92*	*19.5*	*135*	*160*	*41.8*[a]	*0.008*
Rel. Diff.		*8.9*	*2.3*	*0.4*	-	-	*1.5*	*11.3*	-	-
In-house standards										
OKUM-1	19-0079	99	48	902	BDL	BQL	166	71	BQL	BDL
Cert.		92	52	925	-	-	178	69	-	<0.004
Rel. Diff.		*7.6*	*7.7*	*2.5*	-	-	*6.7*	*2.9*	-	-
Duplicate samples										
27-6	18-0361	BQL	335	BDL	BDL	645	284	85	41	*0.021*
27-6_DUP	18-0361	BQL	342	BDL	BDL	644	281	86	41	0.021
%RSD		-	*1.5*	-	-	*0.11*	*0.75*	*0.83*	*0.00*	*0.00*
18-7	19-0079	137	BDL	1930	BDL	BDL	45	79	BDL	BQL
18-7_DUP	19-0079	137	BDL	1903	BDL	BDL	43	77	BDL	BDL
%RSD		*0.00*	-	*1.00*	-	-	*3.21*	*1.81*	-	-

*Concentrations for BaO are in wt.%.

Minor and Trace elements by WD-XRFS

Trace element concentrations (Table S2-2) were determined by the XRF-M02 method on glass beads. Based on analysis of certified reference materials UB-N and WPR-1a, In-house standard OKUM-1 and two duplicate samples, the uncertainty in measurement of Co and Ni is comparable to that by ICP-MS following multi-acid digestion (see below); however at concentrations near the quantification limit, the uncertainty in Cu measurement may be as high as 80%. Consequently, trace element analyses by ICP-MS are used wherever detection limits permit.

Table S2-3: Measured volatile element concentrations (wt.%) of reference materials and duplicate samples

DL		*0.023*	*0.003*	*DL*		*0.023*	*0.003*
QL		*0.077*	*0.010*	*QL*		*0.077*	*0.010*
Sample	**Batch**	**CO_2**	**S**	**Sample**	**Batch**	**CO_2**	**S**
In-house standards				**In-house standards**			
FER-4	18-0361	5.076	0.106	**MRB-29**	18-0361	0.591	0.017
FER-4	19-0079	5.034	0.107	**MRB-29**	19-0079	0.589	0.016
Cert.		4.97	0.111	**MRB-29**	19-0079	0.579	0.013
%RSD		*0.6*	*0.7*	Cert.		0.591	0.015
Rel. Diff.		*2.1*	*4.5*	*%RSD*		*1.1*	*13.6*
PR-1	18-0361	1.092	0.798	*Rel. Diff.*		*2.0*	*13.3*
PR-1	19-0079	1.063	0.777	**WPR-1a**	19-0079	0.685	1.677
PR-1	19-0079	1.057	0.774	**WPR-1a**	19-0079	0.702	1.846
Cert.		1.060	0.792	Cert.		*0.550*[d]	*1.768*
%RSD		*0.4*	*1.7*	*%RSD*		*1.7*	*6.8*
Rel. Diff.		*3.0*	*2.3*	*Rel. Diff.*		-	*5.1*
SU-1a	18-0361	0.149	9.262	**Duplicate samples**			
Cert.		0.208[c]	9.30[c]	**27-6**	18-0361	0.078	2.352
Rel. Diff.		-	-	**27-6_DUP**	18-0361	0.086	2.378
TLS-1	18-0361	0.384	1.790	*%RSD*		*6.9*	*0.8*
TLS-1	19-0079	0.380	1.853	**21-3**	18-0361	25.406	0.884
Cert.		0.370	1.83	**21-3_DUP**	18-0361	25.856	0.98
%RSD		*0.7*	*2.4*	*%RSD*		*1.2*	*7.3*
Rel. Diff.		*3.8*	*2.2*	**Blank samples**			
MRB-11	18-0361	20.837	0.105	BLANK #1	18-0361	BDL	BDL
MRB-11	18-0361	20.834	0.105	BLANK #2	18-0361	BDL	BDL
MRB-11	19-0079	20.890	0.105	BLANK #3	18-0361	BDL	BDL
MRB-11	19-0079	20.566	0.082	BLANK #4	18-0361	BDL	BDL
Cert.		20.1	0.092	BLANK #5	19-0079	BDL	BDL
%RSD		*0.7*	*11.6*	BLANK #6	19-0079	BDL	BDL
Rel. Diff.		*3.9*	*14.1*	BLANK #7	19-0079	BDL	BDL

[c]"Certified" CO_2 and S values for sample SU-1a are based on averages of 2 and 3 measurements, respectively, reported by Hargreaves (2014); [d]The CO_2 concentration of reference sample WPR-1a, as reported in the certificate of analysis, is for informational value only.

Volatile elements

Concentrations of carbon and sulphur, expressed as total CO_2 and total S, were determined by the IRC-100 analytical method. Uncertainties in concentrations of CO_2 and S are <10% and <15% relative, respectively, at a 95% confidence interval (Table S2-3), based on analyses of two duplicate samples and six in-house standards (Hargreaves, 2014). The CO_2 concentrations of standard materials SU-1a and WPR-1a are not well characterized (Hargreaves, 2014); subsequently the large discrepancy between the measured and "certified" values can not be confidently attributed to analytical error. Analyses of seven blank samples yielded CO_2 and S concentrations that were below the detection limit.

Trace elements by ICP-MS

Samples were dissolved using the closed vessel, multi-acid digestion (method SOL-CAIO) that is designed to dissolve most of the refractory silicate phases (e.g. chromite, zircon). Trace element concentrations in the solution were measured by ICP-MS (analytical package IMC-100) and generally have relative uncertainties ≤10% at a 95% confidence interval (Table S2-4), based on measurements of three duplicate samples, one in-house standard (MRB-29; Hargreaves, 2017), two United States Geological Survey (USGS)-certified andesitic (AGV-2), and basaltic (BHVO-2) standard reference materials , and serpentinite WPR-1a. Notably, the uncertainty in Sc may be as high as ≤40% relative.

Table S2-4: Trace element concentrations (ppm) of reference materials and duplicate samples analyzed by ICP-MS following closed vessel multi-acid digestion.

DL		*0.8*	*0.04*	*0.47*	*0.013*	*0.12*	*0.13*	*3*	*0.013*	*1.4*	*0.009*	*0.007*	*0.0031*	*0.04*	*0.009*	*0.14*	*0.0025*	*0.0018*	*0.1*	*0.4*	*0.002*	*0.08*	*0.028*
QL		*2.64*	*0.132*	*1.551*	*0.0429*	*0.396*	*0.429*	*9.9*	*0.0429*	*4.62*	*0.0297*	*0.0231*	*0.0102*	*0.132*	*0.0297*	*0.462*	*0.0083*	*0.0059*	*0.33*	*1.32*	*0.0066*	*0.264*	*0.0924*
Sample	**Batch**	**Ba**	**Be**	**Bi**	**Cd**	**Ce**	**Co**	**Cr**	**Cs**	**Cu**	**Dy**	**Er**	**Eu**	**Ga**	**Gd**	**Hf**	**Ho**	**In**	**La**	**Li**	**Lu**	**Mo**	**Nb**
Certified reference materials																							
AGV-2	18-0361	1138	2.1	BDL	0.07	70.12	16.56	17	1.17	50.4	3.618	1.94	1.519	20.98	4.58	5.31	0.710	0.043	39.5	10.4	0.235	1.89	13.44
Cert.		1140	2.3	-	-	68	16	17	1.16[b]	53	3.6	1.79[b]	1.54	20	4.69[a]	5.08[b]	0.71[b]	-	38	11[b]	0.25[b]	-	15
Rel. Diff.		*0.2*	*8.7*	-	-	*3.1*	*3.5*	*0.0*	-	*4.9*	*0.5*	-	*1.4*	*4.9*	-	-	-	-	*3.9*	-	-	-	*10.4*
BHVO-2	19-0079	125.5	0.91	BDL	0.099	35.02	39.64	263	0.094	122	5.236	2.53	2.026	20.17	5.87	4.36	0.996	0.083	14.3	3.9	0.277	3.78	16.75
Cert.		*130*	-	-	-	*38*	*45*	*280*	-	*127*	-	-	-	*21.7*	*6.3[b]*	*4.1*	*1.04[b]*	-	*15*	*5[b]*	*0.28[b]*	-	*18[b]*
Rel. Diff.		*3.5*	-	-	-	*7.8*	*11.9*	*6.1*	-	*3.9*	-	-	-	*7.1*	-	*6.3*	-	-	*4.7*	-	-	-	-
WPR-1a	19-0079	65.7	0.21	BDL	0.540	9.37	>187	3155	2.31	2799	1.548	0.868	0.479	6.93	1.64	1.18	0.319	0.089	3.9	23.4	0.110	0.85	3.63
WPR-1aDUP	19-0079	67.7	0.20	BDL	0.494	9.08	>187	3086	2.23	2760	1.552	0.923	0.476	6.62	1.57	1.14	0.321	0.086	3.8	23.1	0.118	0.85	3.55
Cert.		70.6	0.2[b]	0.122	0.598	9.69	213	3220[a]	2.38	2990	1.624	0.886	0.497	7.04	1.76	1.142	0.322	0.0889[a]	4.04	25.6	0.121	0.9[b]	3.88[a]
%RSD		*2.1*	*3.4*	-	*6.3*	*2.2*	-	*1.6*	*2.5*	*1.0*	*0.2*	*4.3*	*0.4*	*3.2*	*3.1*	*2.4*	*0.3*	*2.6*	*1.8*	*0.9*	*5.0*	*0.0*	*1.6*
Rel. Diff		*6.9*	-	-	*17.4*	*6.3*	-	-	*6.5*	*7.7*	*4.7*	*4.2*	*4.3*	*6.0*	*10.9*	*3.3*	*0.9*	-	*5.9*	*9.8*	*9.1*	-	-
In-house standards																							
MRB-29	18-0361	294.9	1.03	BDL	0.103	49.39	54.89	301	0.245	176.9	5.315	2.84	1.841	19.82	5.942	4.33	1.018	0.079	22.5	10.6	0.364	0.79	12.82
MRB-29	18-0079	280.2	0.91	0.02	0.103	46.06	46.11	256	0.238	145.9	5.384	2.93	1.933	19.26	5.75	4.55	1.055	0.074	20.7	9.8	0.353	0.73	12.22
Cert.		289	1.05	BDL	0.117	47.9	50.5	276	0.24	152	5.23	2.77	1.89	19.2	5.95	4.42	1.000	0.076	21.5	10.1	0.349	0.86	12.6
%RSD		3.6	8.7	-	0.0	4.9	12.3	11.4	2.0	13.6	0.9	2.3	3.4	2.0	2.3	3.5	2.5	4.9	5.9	5.5	2.2	5.6	3.4
Rel. Diff		3.0	13.3	-	12.0	3.8	8.7	9.1	2.1	16.4	2.9	5.8	2.6	3.2	3.4	2.9	5.5	3.9	4.7	5.0	4.3	15.1	3.0
Duplicate samples																							
26-3C	18-0361	112.7	0.67	BDL	0.124	15.37	43.06	171	0.269	140.7	3.416	2.095	1.170	19.42	3.724	0.72	0.718	0.109	6.0	6.4	0.257	0.44	3.21
26-3C_DUP	18-0361	120.7	0.60	BDL	0.122	15.34	44.39	174	0.263	143.8	3.663	2.100	1.138	19.17	3.937	0.72	0.792	0.107	6.2	6.1	0.259	0.60	3.17
%RSD		*4.8*	*7.8*	-	*1.1*	*0.1*	*2.2*	*1.2*	*1.6*	*1.5*	*4.9*	*0.2*	*1.9*	*0.9*	*3.9*	*0.0*	*6.9*	*1.2*	*2.3*	*3.4*	*0.5*	*21.8*	*1.0*
158495	18-0361	1.9	0.05	BDL	0.166	1.75	177.1	845	BQL	>2900	1.456	0.707	0.328	4.70	1.357	0.32	0.265	0.037	0.4	3.2	0.069	BQL	BQL
158495_DUP	18-0361	2.4	0.06	BDL	0.163	1.59	180.1	868	BQL	>2900	1.282	0.684	0.353	4.61	1.299	0.30	0.243	0.042	0.4	3.2	0.064	BQL	BQL
%RSD		*16.4*	*12.9*	-	*1.3*	*6.8*	*1.2*	*1.9*	-		*9.0*	*2.3*	*5.1*	*1.4*	*3.1*	*4.6*	*6.3*	*8.0*	*0.0*	*0.0*	*5.3*	-	-
Blank samples																							
BLANK#1	18-0361	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BLANK#2	19-0079	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Table S2-4: Trace element concentrations (ppm) of reference materials and duplicate samples analyzed by ICP-MS following closed vessel multi-acid digestion. (cont.)

DL		*0.06*	*0.7*	*0.18*	*0.014*	*0.11*	*0.04*	*1.1*	*0.026*	*0.16*	*0.6*	*0.007*	*0.0023*	*0.018*	*7*	*0.002*	*0.0019*	*0.011*	*0.8*	*0.05*	*0.05*	*0.009*	*1.8*	*6*
QL		*0.198*	*2.31*	*0.594*	*0.0462*	*0.363*	*0.132*	*3.63*	*0.0858*	*0.528*	*1.98*	*0.0231*	*0.0076*	*0.0594*	*23.31*	*0.0066*	*0.00627*	*0.0363*	*2.64*	*0.165*	*0.165*	*0.0297*	*5.94*	*19.8*
Sample	**Batch**	**Nd**	**Ni**	**Pb**	**Pr**	**Rb**	**Sb**	**Sc**	**Sm**	**Sn**	**Sr**	**Ta**	**Tb**	**Th**	**Ti**	**Tl**	**Tm**	**U**	**V**	**W**	**Y**	**Yb**	**Zn**	**Zr**
Certified reference materials																								
AGV-2	19-0361	32.5	19.7	12.88	8.61	66.41	0.46	13.2	5.86	1.92	666.8	0.805	0.649	6.273	6024	0.27	0.269	1.964	125.7	0.51	19.47	1.73	90.3	230
Cert.		30	19	13	8.3	68.6	0.6[b]	13	5.7[b]	2.3[b]	658	0.89[b]	0.64[b]	6.1	6160	0.27[b]	0.26[b]	1.88	120	-	20	1.6	86	230
Rel. Diff.		*8.3*	*3.7*	*0.9*	*3.7*	*3.2*	-	*1.5*	-	-	*1.3*	-	-	*2.8*	*2.2*	-	-	*4.5*	*4.8*	-	*2.7*	*8.1*	*5.0*	*0*
BHVO-2	19-0079	23.33	109.8	1.55	5.06	8.64	0.14	30.5	5.58	1.61	358.4	1.056	0.888	1.202	15525	0.019	0.331	0.401	311.8	0.21	24.79	2.05	95.8	171
Cert.		*25.0*	*119*	-	-	*9.8*	-	*32*	*6.2*	*1.9[b]*	*389*	*1.4[b]*	*0.9[b]*	*1.2[b]*	-	-	-	-	*317*	-	*26*	*2.0[b]*	*103*	*172*
Rel. Diff.		*6.7*	*7.7*	-	-	*11.8*	-	*4.7*	*10.0*	-	*7.9*	-	-	-	-	-	-	-	*1.6*	-	*4.7*	-	*7.0*	*0.6*
WPR-1a	19-0079	6.42	>4100	7.70	1.37	6.86	2.89	10.5	1.47	0.96	18.6	0.223	0.262	0.639	3223	0.076	0.120	0.332	137.5	0.35	8.02	0.739	151	45
WPR-1aDUP	19-0079	6.28	4018	7.16	1.30	7.06	2.91	15.4	1.55	0.92	18.5	0.219	0.263	0.601	3243	0.068	0.117	0.301	135.5	0.35	7.70	0.770	157	42
Cert.		6.26	4390	7.92	1.362	7.06	3.13	17.3	1.617	1.16[a]	19.5	0.242[a]	0.269	0.64	3527	0.0752[a]	0.126	0.2[b]	135	0.4[b]	8.39	0.790	160	41.8[a]
%RSD		*1.6*	-	*5.1*	*4.0*	*2.0*	*0.5*	*26.8*	*3.8*	*3.0*	*0.4*	*1.3*	*0.2*	*4.3*	*0.4*	*7.9*	*1.9*	*6.9*	*1.0*	*0.0*	*2.9*	*2.9*	*2.9*	*4.9*
Rel. Diff		*2.6*	-	*9.6*	*4.6*	*2.8*	*7.7*	*39.3*	*9.2*	-	*5.1*	-	*2.6*	-	*8.6*	-	*7.0*	-	*1.9*	-	*8.2*	*6.5*	*5.8*	-
In-house standards																								
MRB-29	18-0361	28.32	116.6	5.17	6.48	15.53	0.06	35.1	6.58	2.23	331.2	0.716	0.846	2.504	12175	0.068	0.381	0.628	342.7	0.21	28.8	2.47	111	174
MRB-29	19-0079	26.99	106	4.79	6.21	14.91	0.08	32.3	5.78	2.38	296.5	0.797	0.901	2.511	11838	0.072	0.388	0.621	319.7	0.21	25.58	2.42	104	175
Cert.		27.8	111	4.9	6.44	14.6	0.062	32.4	6.16	2.6	305	0.799	0.875	2.56	11440	0.068	0.381	0.632	307	0.212	26.8	2.39	109	173
%RSD		*3.4*	*6.7*	*5.4*	*3.1*	*2.9*	*20.2*	*5.9*	*9.1*	*4.6*	*7.8*	*7.6*	*4.4*	*0.2*	*2.0*	*4.0*	*1.3*	*0.8*	*4.9*	*0.0*	*8.4*	*1.4*	*4.8*	*0.4*
Rel. Diff		*2.9*	*5.0*	*5.5*	*3.6*	*6.4*	*29.0*	*8.3*	*6.8*	*14.2*	*8.6*	*10.4*	*3.3*	*2.2*	*6.4*	*5.9*	*1.8*	*1.7*	*11.6*	*0.9*	*7.5*	*3.3*	*4.9*	*1.2*
Duplicate samples																								
26-3C	18-0361	12.25	42.1	1.68	2.542	6.32	BQL	43.0	3.20	1.09	779.4	0.146	0.595	0.096	6346	0.023	0.272	0.033	>370	BDL	19.82	1.76	119.4	19
26-3C_DUP	18-0361	12.62	43.9	1.39	2.466	6.17	BQL	41.3	3.51	0.83	773.1	0.150	0.592	0.101	6462	0.023	0.309	0.033	>370	BDL	19.40	1.84	121.9	18
%RSD		*2.1*	*3.0*	*13.4*	*2.1*	*1.7*	-	*2.9*	*6.6*	*19.2*	*0.6*	*1.9*	*0.4*	*3.6*	*1.3*	*0.0*	*9.0*	*0.0*	-	-	*1.5*	*3.1*	*1.5*	*3.8*
158495	18-0361	2.28	595	2.79	0.414	BQL	BDL	>63	0.956	BDL	56.8	BDL	0.224	BDL	2450	0.009	0.098	BDL	270.2	BDL	6.50	0.551	41.4	7
158495_DUP	18-0361	2.24	617	2.69	0.425	BQL	BDL	>63	0.921	BQL	52.8	BDL	0.204	BDL	2524	BQL	0.090	BDL	275.6	BDL	6.68	0.542	42.0	7
%RSD		*1.3*	*2.5*	*2.6*	*1.9*	-	-	-	*2.6*	-	*5.2*	-	*6.5*	-	*2.1*	-	*6.3*	-	*1.4*		*1.9*	*1.2*	*1.0*	*0*
Blank samples																								
BLANK#1	18-0361	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
BLANK#2	19-0079	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL

Gold and platinum group elements

Comparison of multiple NiS assay analyses of replicate, duplicate, and certified reference samples prepared by the Ore Research and Exploration Pty Ltd. (Melbourne, Australia) suggest that the uncertainties in the measured concentrations are ≤15% relative, at the 95% confidence interval (Table S2-5). At concentrations ≤1 ppb, the uncertainty in Ru is ≤30%.

Table S2-5: Precious element concentrations (ppb) of reference materials and duplicate samples analyzed by NiS assay

DL		*0.4*	*0.01*	*0.12*	*0.17*	*0.04*	*0.08*
QL		*1.32*	*0.033*	*0.396*	*0.561*	*0.132*	*0.264*
Sample	**Batch**	**Au**	**Ir**	**Pd**	**Pt**	**Rh**	**Ru**
Certified reference materials							
WPR-1a	19-0079	57.0	22.1	595	434	26.6	50.2
Cert.		50[b]	20[b]	614	452	30[b]	60[b]
Rel. Diff.		*14.0*	-	*3.1*	*4.0*	-	-
OREAS45f	19-0010	16.9	1.18	56.0	36.2	3.30	2.73
OREAS45f	19-0010	17.2	1.23	57.1	37.0	3.31	2.76
Cert.		19.3	1.45[a]	56.6	38.1	-	-
% RSD		*1.2*	*2.9*	*1.4*	*1.5*	*0.2*	*0.8*
Rel. Diff.		*12.4*	*18.6[a]*	*1.1*	*5.0*	-	-
OREAS683	18-0079	193	49.6	856	1773	148	257
OREAS683	18-0079	196	49.8	860	1777	149	257
OREAS683	18-0079	194	50.3	860	1776	149	258
Cert.		195	50	858	1723	146	252
% RSD		*0.8*	*0.7*	*0.3*	*0.1*	*0.4*	*0.2*
Rel. Diff.		*1.0*	*0.8*	*0.2*	*3.1*	*2.1*	*2.4*
OREAS681	18-0079	47.1	12.1	239	510	33.6	65.7
OREAS681	18-0079	47.5	12.2	239	513	33.7	66.8
OREAS681	18-0079	48.5	11.9	236	507	33.2	64.6
OREAS681	18-0079	47.5	12.3	238	512	33.7	66.1
OREAS681	18-0079	47.7	12.2	239	511	33.9	66.5
Cert.		47	11	238	496	32	63
% RSD		*1.1*	*1.2*	*0.5*	*0.5*	*0.8*	*1.3*
Rel. Diff.		*3.2*	*11.8*	*0.8*	*3.4*	*5.9*	*6.0*
OREAS682	18-0079	71.0	21.7	445	856	63.1	117
OREAS682	18-0079	71.6	21.7	441	853	62.8	117
OREAS682	18-0079	71.7	21.4	441	848	62.6	116
OREAS682	18-0079	70.9	21.7	441	861	62.9	117
OREAS682	18-0079	69.8	21.5	443	850	63.3	117
Cert.		72	20	440	820	60	112
% RSD		*1.1*	*0.7*	*0.4*	*0.6*	*0.4*	*0.4*
Rel. Diff.		*3.1*	*8.5*	*1.1*	*5.0*	*5.5*	*4.5*
OREAS13b	18-0079	198	18.4	130	203	40.8	74.6
Cert.		201	17.9	134	204	43	78
Rel. Diff.		*1.5*	*2.8*	*3.0*	*0.5*	*5.1*	*4.4*
Duplicate samples							
PJV-3	18-0361	31039	0.30	4.99	5.78	0.46	0.70
PJV-3	18-0361	30001	0.31	4.56	5.23	0.57	0.95
PJV-3	18-0361	31302	0.34	4.61	5.57	0.50	1.07
PJV-3	18-0361	30986	0.31	5.09	5.73	0.48	0.67
PJV-3	18-0361	30377	0.30	4.95	5.97	0.48	0.82
% RSD		*1.7*	*5.3*	*4.9*	*4.9*	*8.6*	*20.0*
26-13	18-0361	2.1	0.05	14.3	13.9	BQL	BDL
26-13_REP	18-0010	2.0	0.05	15.9	14.4	0.14	BDL
26-13_DUP	18-0010	2.0	0.05	14.9	14.1	0.15	BDL
% RSD		*2.8*	*0.00*	*5.4*	*1.8*	*7.1*	-
26-6	18-0361	22.0	0.34	63.0	62.9	0.27	BQL
26-6_DUP	18-0361	20.2	0.34	61.1	56.5	0.25	BQL
% RSD		*6.0*	*0.0*	*2.2*	*7.6*	*5.4*	-
158495	18-0361	31.0	0.21	90.9	33.6	0.94	BQL
158495_DUP	18-0361	29.9	0.22	81.8	32.8	0.91	BQL
% RSD		*2.6*	*3.3*	*7.5*	*1.7*	*2.3*	*6.7*
17-3	18-0079	0.6	1.73	0.76	0.82	0.67	6.01
17-3_DUP	18-0079	0.6	1.73	0.81	0.79	0.65	5.95
% RSD		*0.0*	*0.0*	*4.5*	*2.6*	*2.1*	*0.7*
Blank samples							
BLANK #1	18-0010	BDL	BDL	BDL	BDL	BDL	BDL
BLANK #2	18-0361	BDL	0.04	BDL	BDL	BDL	BDL
BLANK #3	18-0079	BDL	0.01	BDL	BDL	BDL	BDL

Partial Digestion – Base and Precious Metals

Base and precious metal concentrations in the sulphide fraction of sulphide-bearing samples were determined by ICP-MS following sample dissolution in aqua regia, as per the IML-101 analytical method. For elements exceeding the quantification limit, the reproducibility of precious and base metal concentrations in partial digestions is generally ≤20% relative, at a 95% confidence interval (Table S2-6). Exceptions are Pt, Sb, and Au, which deviate by up to 40 % relative from the certified values of in-house standard RAFT-2 (Hargreaves, 2018) and the certified reference material WPR-1a.

Table S2-6: Minor and trace element concentrations (ppm) of reference materials and duplicate samples analyzed by ICP-MS following partial aqua regia digestion

DL		0.2	0.7	0.002	0.02	0.02	0.03	0.6	0.08	0.002	0.003	0.06	2	0.2	0.02	0.005	0.003	0.009	0.2	0.06	0.02	0.0006	2
QL		0.66	2.31	0.0066	0.066	0.066	0.099	1.98	0.264	0.0066	0.0099	0.198	6.6	0.66	0.066	0.0165	0.0099	0.0297	0.66	0.198	0.066	0.0020	6.6
Sample	**Batch**	**Ag**	**As**	**Au**	**Bi**	**Cd**	**Co**	**Cu**	**Hg**	**In**	**Ir**	**Mo**	**Ni**	**Pb**	**Pd**	**Pt**	**Rh**	**Sb**	**Se**	**Sn**	**Te**	**Tl**	**Zn**
Certified reference materials																							
WPR-1a	19-0361	1.05	10.3	0.037	0.14	0.64	210	2906	BDL	0.071	BQL	0.85	4303	7.1	0.61	0.279	0.017	1.82	7.1	0.7	1.13	0.076	132
Cert.		1.02	9.3	0.05[b]	0.122	0.598	213	2990	BDL	-	0.02[b]	0.9[b]	4390	7.92	0.614	0.452	0.03[b]	3.13	7.7[a]	1.16[a]	0.958	0.0752[a]	160
Rel. Diff.		*2.9*	*10.8*	-	*14.8*	*7.0*	*1.4*	*2.8*	-	-	-	-	*2.0*	*10.4*	*0.7*	*38.3*	-	*41.9*	-	-	*18.0*	-	*17.5*
In-house standards																							
RAFT-2	18-0361	1.1	81.9	0.013	5.2	2.74	41.1	597	BQL	0.1	BQL	3.22	864	98.1	BQL	BQL	0.02	1.4	7.8	3.2	2.47	0.27	116
Cert.		1.1	82.0	0.018	5.0	2.50	41.0	620	BQL	0.1	BQL	3.10	880	100.0	BQL	BQL	0.02	1.3	8.0	3.0	2.30	0.28	118
Rel. Diff		*0.0*	*0.1*	*27.8*	*4.0*	*9.6*	*0.2*	*3.7*	-	*2.0*	-	*3.9*	*1.8*	*1.9*	-	-	*10.0*	*7.7*	*2.5*	*6.7*	*7.4*	*3.2*	*1.7*
Duplicate samples																							
21-5	18-0361	BQL	BDL	0.007	BQL	0.11	35.0	393	BDL	0.013	BDL	0.82	33	2.5	0.02	BDL	BQL	0.11	3.5	0.3	0.21	0.063	90
21-5_DUP	18-0361	BQL	BDL	BQL	BQL	0.12	36.6	411	BDL	0.016	BDL	0.72	36	2.4	0.02	BQL	0.012	0.11	3.3	0.3	0.18	0.060	94
%RSD		-	-	-	-	*6.1*	*3.2*	*3.12*	-	*14.6*	-	*9.2*	*6.1*	*2.9*	-	-	-	*0.0*	*4.2*	*0*	*10.9*	*3.4*	*3.1*
158658	19-0079	BQL	7.7	BDL	BQL	BQL	73.2	738	BDL	0.04	BDL	0.21	46	1.1	BDL	BQL	BDL	0.67	5.9	0.6	0.11	0.01	33
158658_DUP	19-0079	BQL	7.7	BQL	BQL	BQL	76.6	766	BQL	0.05	BQL	0.22	47	1.0	BQL	BQL	BQL	0.69	5.9	0.5	0.12	0.01	36
%RSD		-	*0.0*	-	-	-	*3.2*	*2.6*	-	*13.4*	-	*3.3*	*1.5*	*6.7*	-	-	-	*2.1*	*0.0*	*12.9*	*6.1*	*15.7*	*6.1*
Blank samples																							
BLANK#1		BDL	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*	*0.002*	BDL	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*	*0.006*	*0.01*	*BDL*	*BDL*	*BDL*	*BDL*	*BDL*

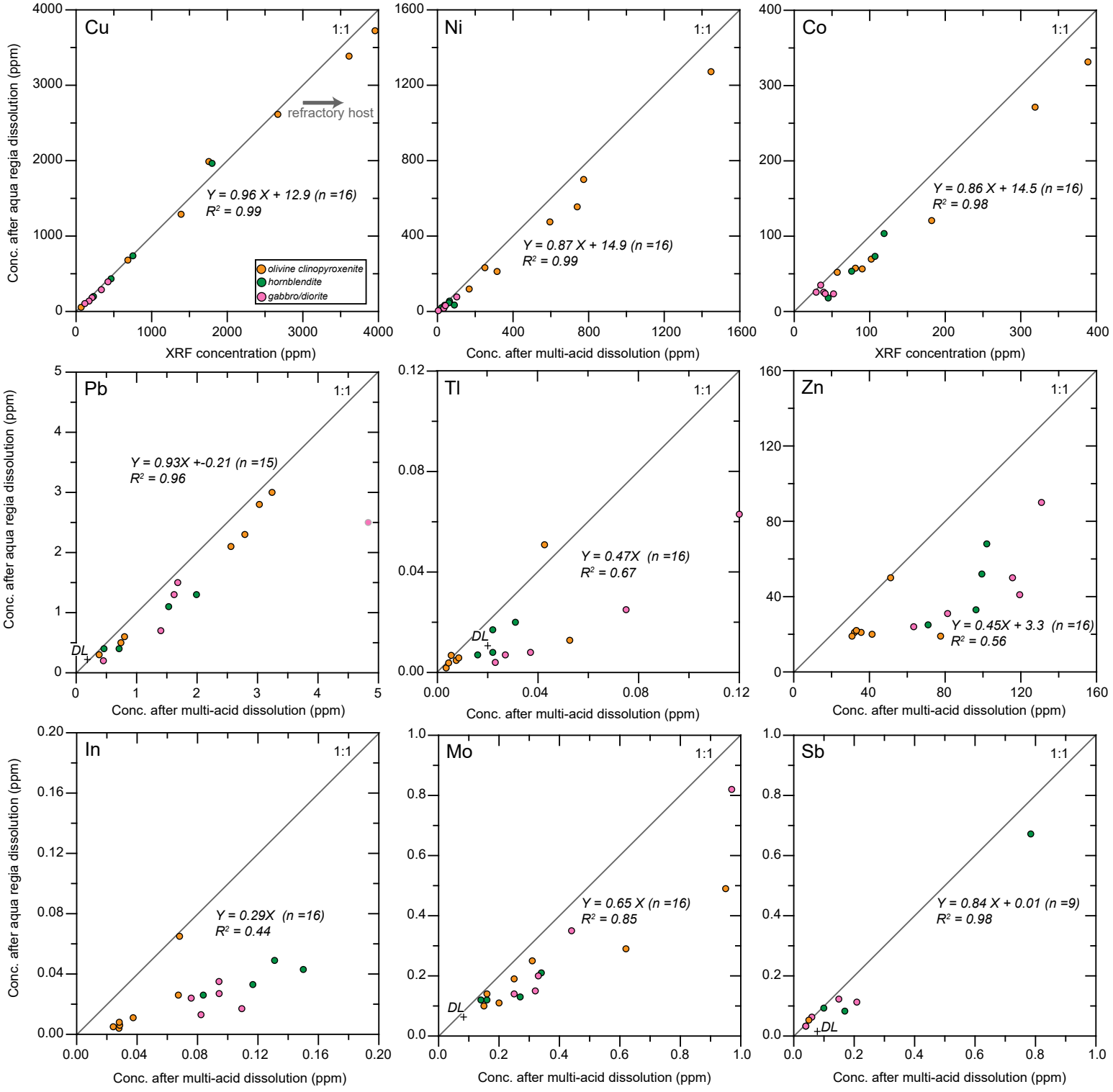
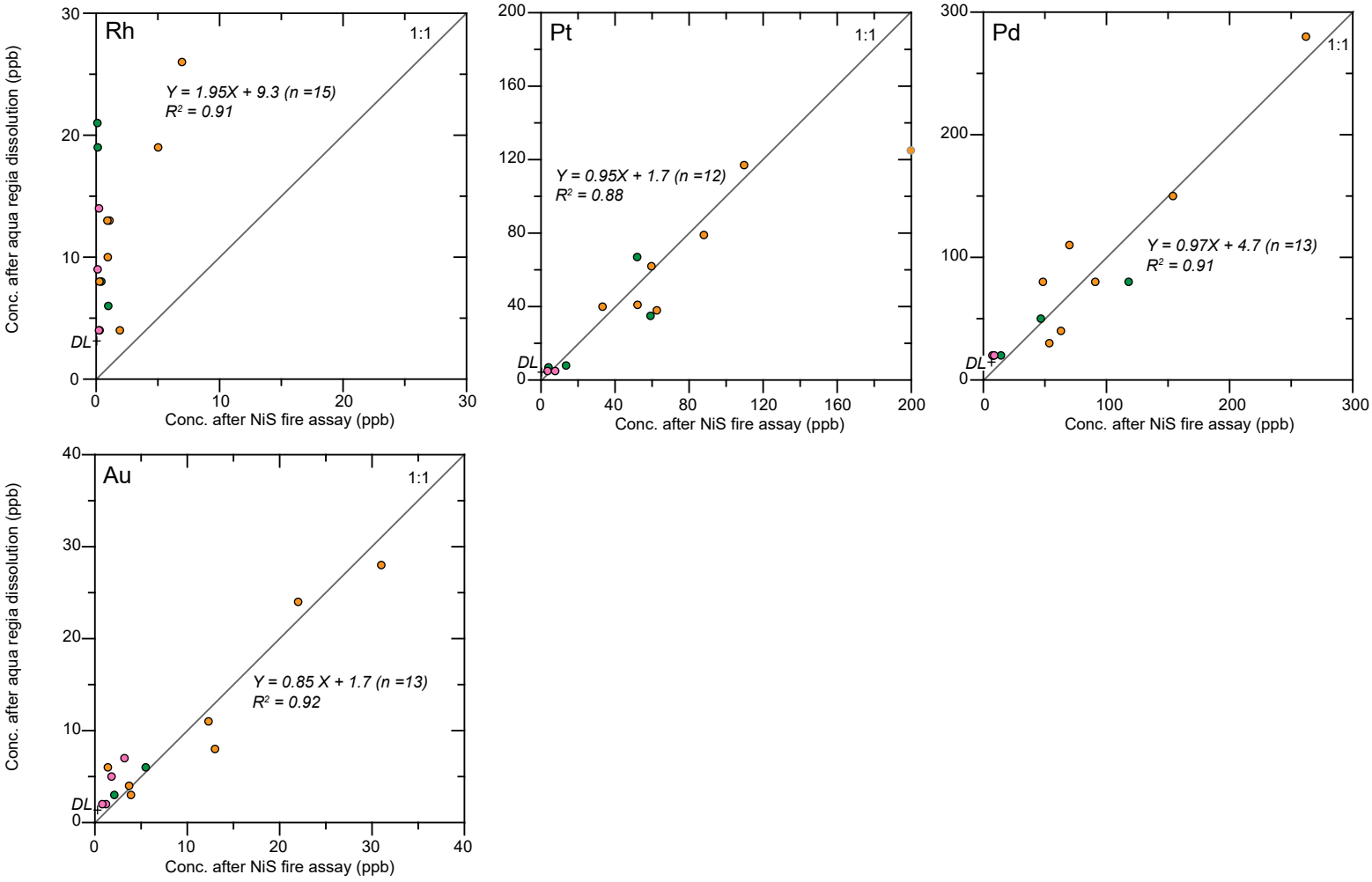


Figure S2-1. Base and precious metal concentrations measured by ICP-MS following aqua regia dissolution compared to concentrations measured following closed-vessel multi-acid dissolutions and NiS fire assay. Shown for refrence are lines of equival concentrations (1:1) and results of linear regression. Points with grey outlines (in Pb and Pt plots) were excluded from regression. Concentrations of precious metals (Rh, Pt, Pd, and Au) are in ppb. Where appropriate, detection limits (DL) are shown.


Rh
1:1
Y = 1.95X + 9.3 (n =15)
R² = 0.91
DL
Conc. after aqua regia dissolution (ppb)
Conc. after NiS fire assay (ppb)
Pt
1:1
Y = 0.95X + 1.7 (n =12)
R² = 0.88
DL
Conc. after NiS fire assay (ppb)
Pd
1:1
Y = 0.97X + 4.7 (n =13)
R² = 0.91
DL
Conc. after NiS fire assay (ppb)
Au
1:1
Y = 0.85 X + 1.7 (n =13)
R² = 0.92
DL
Conc. after aqua regia dissolution (ppb)
Conc. after NiS fire assay (ppb)

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Supplementary File S3: Chalcophile element modelling

Table S3-1: Compilation of published chalcophile element compositions of primitive arc volcanic rocks

Sample	Location	Source	MgO (wt.%)	Ni (ppm)	Ir (ppb)	Ru (ppb)	Rh (ppb)	Pt (ppb)	Pd (ppb)	Au (ppb)	Cu (ppm)
AMG6103	Lesser Antilles	1	15.28	404	0.06	0.060	-	3.81	2.65	-	86
AMG6078	Lesser Antilles	1	14.47	379	0.13	0.070	-	3.91	1.87	-	96
GD14	Lesser Antilles	1	14.41	432	0.12	0.190	-	3.39	1.50	-	87
GD10	Lesser Antilles	1	14.15	435	0.08	0.210	-	2.54	1.82	-	80
GD11	Lesser Antilles	1	14.06	429	0.06	0.230	-	2.18	1.87	-	81
ND-03-01	Tonga Arc	2	14.00	148	0.13	0.137	-	21.00	21.20	-	91
GD8	Lesser Antilles	1	13.86	421	0.06	0.200	-	1.88	1.23	-	78
GD12	Lesser Antilles	1	13.66	390	0.09	0.150	-	3.73	2.84	-	95
GD16	Lesser Antilles	1	13.55	379	0.06	0.170	-	3.43	3.99	-	108
AMG6157	Lesser Antilles	1	12.79	359	0.32	0.070		5.08	4.47	-	53
68638	New Hebrides	3	10.70	146	0.05	0.050	0.15	4.60	3.07	-	250
GD5	Lesser Antilles	1	10.49	244	0.05	0.070	-	1.84	3.70	-	79
ND-04-01	Tonga Arc	2	10.10	132	0.14	0.107	-	8.41	14.30	-	87
1975, NV	Kamchatka Arc	4	9.80	110	0.36	0.190	0.50	14.60	8.41	2.85	155
1941C	Kamchatka Arc	4	9.00	143	0.52	0.340	0.29	5.81	8.09	2.67	159
TOL-4	Kamchatka Arc	5	9.00	143	0.52	0.340	0.29	5.81	8.09	2.67	159
1941A	Kamchatka Arc	4	8.80	165	0.76	0.540	0.32	6.37	7.55	2.93	170
1941B	Kamchatka Arc	4	8.80	132	0.72	0.480	0.33	6.00	7.80	2.85	166
TOL-1	Kamchatka Arc	5	8.80	165	0.76	0.540	0.32	6.37	7.55	2.93	170
TOL-2	Kamchatka Arc	5	8.80	132	0.72	0.480	0.33	6.00	7.80	2.85	166
ND-02-01	Tonga Arc	2	8.05	64	0.05	0.023	-	7.91	10.70	-	108
2013C	Kamchatka Arc	4	7.90	89	0.41	0.250	0.37	5.66	7.98	2.73	166
MD3	Pual Ridge	6	7.83	-	0.07	0.288	0.19	2.80	7.61	3.84	103
MD3-p	Pual Ridge	6	7.83	-	0.14	0.638	0.39	7.61	10.40	3.84	103
GD21	Lesser Antilles	1	7.15	64	0.02	0.040	-	3.15	7.60	-	75
MD101A	Pual Ridge	6	7.01	-	0.04	0.092	0.22	3.40	13.00	4.73	109
MD101A-p	Pual Ridge	6	7.01	-	0.09	0.125	0.27	5.71	12.70	4.73	109
MEDIAN				165	0.12	0.190	0.29	5.08	7.60	2.89	103
2.5 pct				433	0.76	0.572	0.46	16.68	16.54	4.73	196
97.5 pct				64	0.04	0.034	0.16	1.87	1.41	2.67	67

[1] Woodland *et al.* (2002); [2] Dale *et al.* (2012); [3] Park *et al.* (2012); [4] Zelenski *et al.* (2016); [5] Zelenski *et al.* (2017); [6] Park *et al.* (2013).

Table S3-2: Mineral-melt partition coefficients used in trace element modeling

Element	$D_i^{olivine\text{-}melt}$	Source	$D_i^{chromite\text{-}melt}$	Source	$D^{Sulphide\text{-}Silicate}$	Source	$D^{MSS\text{-}Sulphide}$	Source
Ni	8	*1*	4.7	*5*	*1000*	*8*	-	-
Ir	2.7	*2*	472	*5*	*1.5 x 10^6*	*8,9*	*8.2*	*8,9*
Ru	2.19	*3*	2448	*5*	-	-	-	-
Rh	2.59	*3*	641	*5*	-	-	-	-
Pt	0.01	*3*	0.0001	*Estimated from 5*	-	-	-	-
Pd	0.01	*3*	0.0001	*Estimated from 5*	*5 x 10^5*	*8*	*0.06*	*8,9*
Au	0.0024	*2*	0.076	*6*	-	-	-	-
Cu	0.028	*4*	0.2	*7*	*1000*	*8,9*	-	-

[1]Matzen *et al.* (2017); [2]Brenan *et al.* (2005); [3]Brenan *et al.* (2003); [4]Portnyagin *et al.* (2017); [5]Park *et al.* (2012); [6]Righter *et al.* (2004); [7]Liu *et al.* (2015); [8]Barnes and Ripley (2016); [9]Duran *et al.*, (2017).

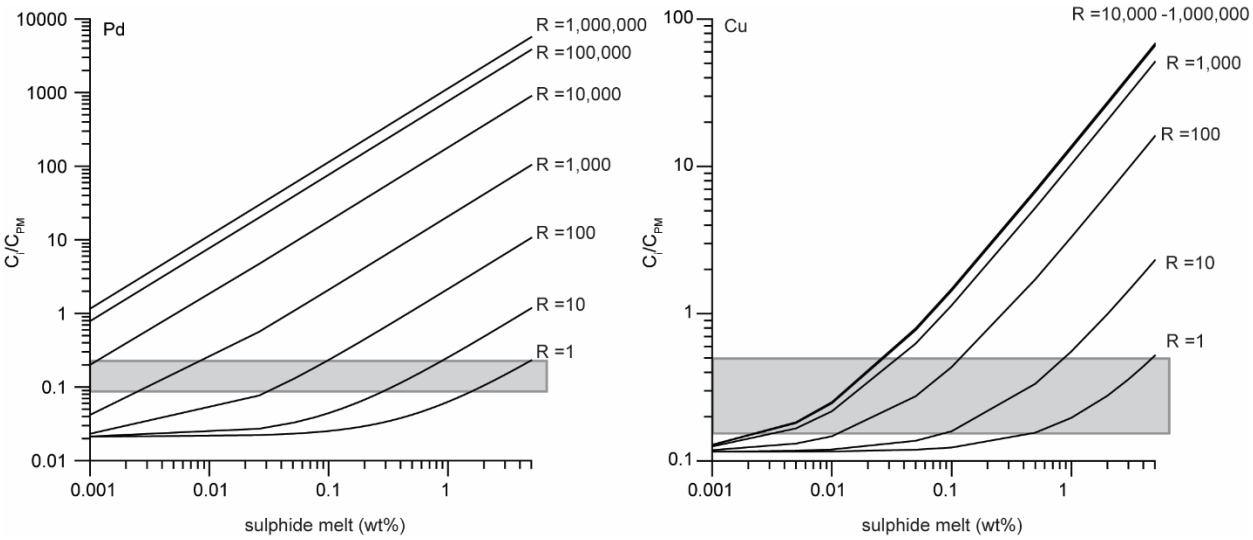

Figure S3-1. Mass balance model of Primitive mantle-normalized concentrations of Pd and Cu in dunite as a function of R factor and sulphide melt abundance (wt.%). The models assume minimum $D^{sul/sil}$ values for Pd (57,000) and Cu (330) compiled by Barnes and Ripley (2016). Unless unreasonably large ratios of immiscible sulphide:silicate (low R factors) are assumed, the amount of trapped sulphide melt in dunite is vanishingly small.

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Supplementary File S4: S-normalized binary variation diagrams

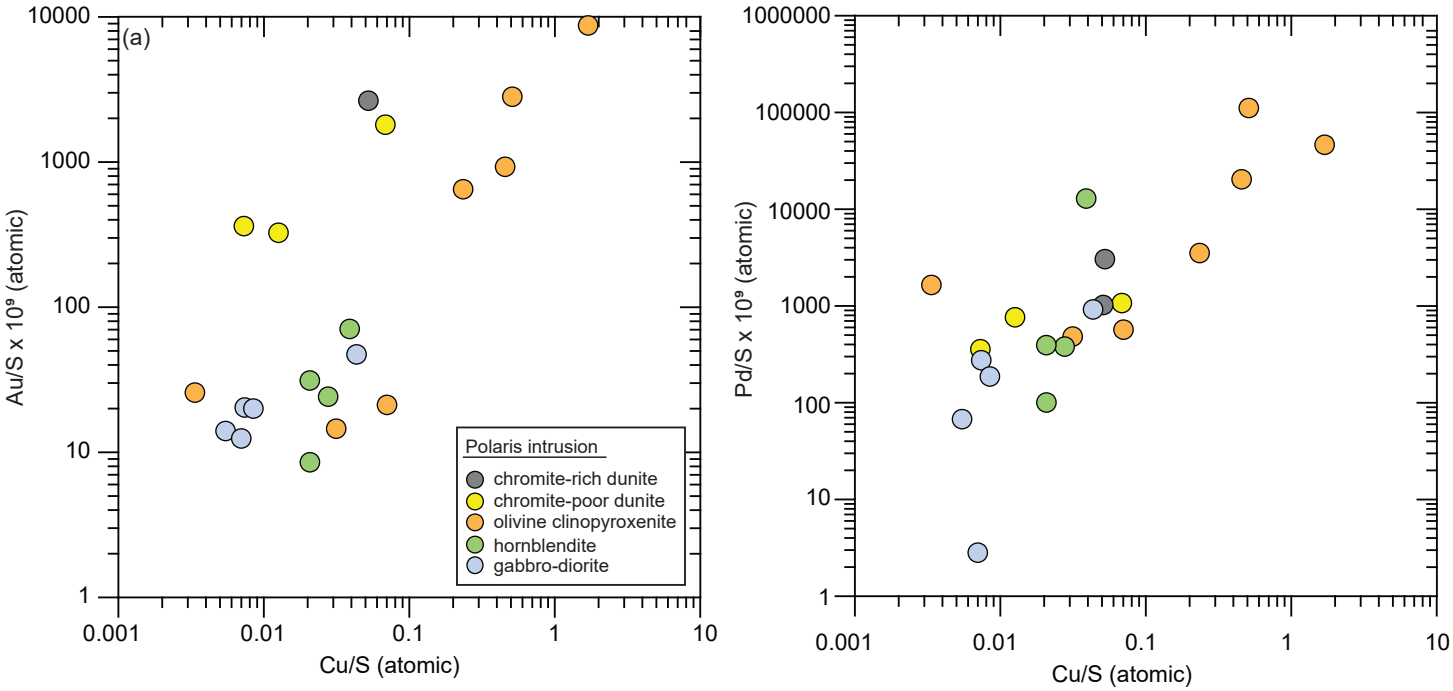

Figure S4-1: Atomic Au/S and Pd/S vs Cu/S showing the broad positive correlations between PPGE and Au tenors with sulphide Cu content.