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Chemical Data for Precipitate Samples

Andrea L. Foster[1] and Randolph A. Koski[1]

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[1]U.S. Geological Survey, Menlo Park, Calif.

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CHAPTER E. Chemical Data for Precipitate Samples

By Andrea L. Foster and Randolph A. Koski

During studies of sulfide oxidation in coastal areas of Prince William Sound in 2005, precipitate samples were collected from onshore and intertidal locations near the Ellamar, Threeman, and Beatson mine sites (chapter A, fig. 1; table 7). The precipitates include jarosite and amorphous Fe oxyhydroxide from Ellamar, amorphous Fe oxyhydroxide from Threeman, and amorphous Fe oxyhydroxide, ferrihydrite, and schwertmannite from Beatson. Precipitates occurring in the form of loose, flocculant coatings were harvested using a syringe and concentrated in the field by repetitive decanting. Thicker accumulations were either scraped gently from rocks using a stainless steel spatula or were scooped directly into receptacles (polyethylene jars or plastic heavy-duty zippered bags). Most precipitate samples contain small amounts of sedimentary detritus. With three jarosite-bearing samples from Ellamar, an attempt was made to separate the precipitate from the heavy-mineral fraction of the sediment. In this procedure, the sample was stirred in a graduated cylinder containing deionized water. The jarosite-rich suspension was decanted onto analytical filter paper and air dried before analysis.

Eleven precipitate samples from the three mine sites were analyzed in laboratories of the U.S. Geological Survey (USGS) in Denver, Colorado (table 8). Major and trace elements were determined by inductively coupled plasma-mass spectrometry following multiacid (HCl-HNO_3-$HClO_4$-HF) digestion (Briggs and Meier, 2002), except for mercury, which was analyzed by cold-vapor atomic absorption spectroscopy (Brown and others, 2002a). X-ray diffraction (XRD) analyses were performed on powdered samples (<200 mesh) by S. Sutley of the USGS. Additional details regarding sample preparation and detection limits are found in Taggert (2002). Discussions of the precipitate chemistry and associated microbial communities are presented in Koski and others (2008) and Foster and others (2008), respectively.

Table 7. Locations and descriptions of precipitate samples.

[n.r. = not recorded; n.d. = not determined; Albite = $NaAlSi_3O_8$; Clinochlore = $(Mg_5Al)(Si,Al)_4O_{10}(OH)_8$; Ferrihydrite = $Fe_5O_7(OH)_4 \bullet H_2O$; Goethite = α-FeOOH; Hematite = Fe_2O_3; Illite = $(K,H_3O)(Al,Mg,Fe)_2(SiAl)_4O_{10}(OH)_2 \bullet H_2O$; Jarosite = $(KFe_3(SO_4)_2(OH)_6$; Muscovite = $KAl_3Si_3O_{10}(OH)_2$; Pyrite = FeS_2; Quartz = SiO_2; Schwertmannite = $Fe_{16}O_{16}(SO_4)_3(OH)_{10} \bullet 10H_2O$]

Sample number	Mine site	Latitude	Longitude	Description	Mineralogy (XRD)
05PWSE201P	Ellamar	60º53.683′	-146°42.095′	Green and orange crust, sediment surface near low tide line	Major: Amorphous Fe oxyhydroxide Minor: Quartz Trace: Jarosite
05PWE209P	Ellamar	60º53.679′	-146°42.085′	Yellow-green precipitate, pit in intertidal zone	Major: Jarosite Trace: Quartz, pyrite
05PWSE303P	Ellamar	60º53.682′	-146°42.079′	Yellow-green precipitate, pit excavated in gravel and sand above high tide line	n.d.
05PWSE304P	Ellamar	60º53.686′	-146°42.078′	Sticky greenish precipitate, pit excavated in gravel and sand above high tide line	Major: Jarosite Minor: Quartz Trace: Muscovite, clinochlore
05PWST303P	Threeman	60º51.180′	-146°32.257′	Orange coating on cobbles in pit 2 excavated in beach gravel	Major: Amorphous Fe oxyhydroxide Minor: Goethite Trace: Quartz, albite, clinochlore, muscovite, hematite
05PWST310P	Threeman	n.r.	n.r.	Dark red flocculent, pool at base of tailings pile	n.d.
05PWSB201P	Beatson	60º02.959′	-147°54.253′	Brown precipitate, seep below lower dump	Major: Amorphous Fe oxyhydroxide, quartz Minor: Albite, clinochlore Trace: Muscovite, illite
05PWSB202P	Beatson	60º03.402′	-147°53.795′	Yellow-brown to orange precipitate, Girwood seep	n.d.
05PWSB203P	Beatson	60º03.026′	-147°54.168′	Red-brown precipitate, seep below old house	Major: Schwertmannite
05PWSB204P	Beatson	60º02.960′	-147°54.181′	Brown precipitate, drainage below mill site concrete foundation	Major: Quartz Minor: Albite, clinochlore Trace: Muscovite, illite
05PWSB306P	Beatson	60º02.826′	-147°54.301′	Orange precipitate, coating stream bed below upper mine dump	Major: Ferrihydrite Minor: Schwertmannite

Table 8. Chemical data for precipitate samples.

[[a] concentrated jarosite precipitate (see text for details); ICPMS = Inductively coupled plasma-mass spectrometry; CVAA = Cold-vapor atomic absorption spectrometry; n.a. = not analyzed]

Sample numbers			05PWS-E201P	05PWS-E209P [a]	05PWS-E303P [a]	05PWS-E304P [a]	05PWS-T303P-1	05PWS-T310P	05PWS-B201P	05PWS-B202P	05PWS-B203P	05PWS-B204P	05PWS-B306P
Mine site			Ellamar	Ellamar	Ellamar	Ellamar	Threeman	Threeman	Beatson	Beatson	Beatson	Beatson	Beatson
Element	Method	Units											
Al	ICPMS	wt%	n.a.	1.43	2.56	3.67	4.82	11.8	6.67	n.a.	3.09	5.66	3.4
Ca	ICPMS	wt%	0.497	0.0255	1.35	0.0396	0.0336	1.66	0.247	0.474	0.133	0.2	0.012
Fe	ICPMS	wt%	12	28	37	20	20	3.7	16	11	20	8.9	44
K	ICPMS	wt%	0.356	n.a.	0.454	2.2	4.28	0.277	1.13	0.061	0.4	1.1	0.0102
Mg	ICPMS	wt%	0.553	0.061	0.808	0.253	0.0942	0.869	1.27	0.134	1.84	1.83	0.0053
Na	ICPMS	wt%	0.699	0.275	0.577	1.61	1.35	0.625	0.646	0.264	0.265	0.789	0.0039
P	ICPMS	wt%	0.11	0.06	0.2	0.075	0.041	0.28	0.077	0.03	0.053	0.055	0.02
Ti	ICPMS	wt%	0.06	0.082	0.15	0.16	0.21	0.24	0.14	0.012	0.09	0.21	<0.004
Ag	ICPMS	mg/kg	<3	7.3	<3	3.6	3.8	<3	3.09	<3	4.8	5.9	3.6
As	ICPMS	mg/kg	73	160	53	110	70	5.7	110	26	74	110	9.4
Ba	ICPMS	mg/kg	134	320	202	361	259	133	602	125	355	697	4
Be	ICPMS	mg/kg	2.3	0.34	0.49	0.71	0.79	1.1	1.9	35	0.54	1	0.88
Bi	ICPMS	mg/kg	0.30	5.0	0.11	0.61	0.88	0.25	2.3	0.08	2.6	3.4	0.07
Cd	ICPMS	mg/kg	0.53	0.15	0.12	0.04	0.02	1.3	2.1	31	0.46	1.3	0.14
Ce	ICPMS	mg/kg	29	8	12	22	20	14	38	139	16	31	10
Co	ICPMS	mg/kg	17	6.6	11	1.2	0.38	113	29	141	5	9	0.39
Cr	ICPMS	mg/kg	37	16	43	41	38	94	76	8.3	42	76	118
Cs	ICPMS	mg/kg	0.43	0.87	0.89	2.2	2.1	1.1	4.1	0.16	0.98	3	0.03
Cu	ICPMS	mg/kg	26900	1440	989	626	422	4750	10700	52300	8000	7240	2000
Ga	ICPMS	mg/kg	4.2	15	5.4	12	10	9.2	13	2.1	8.8	15	4.4
Hg	CVAA	mg/kg	0.41	2.7	0.3	1.6	0.43	0.27	1.0	n.a.	0.56	0.67	0.09
La	ICPMS	mg/kg	11.1	4.2	7	11	9.9	6.2	21	68	8.8	17	3
Li	ICPMS	mg/kg	12	5.9	15	23	14	9	29	1	14	26	<0.2
Mn	ICPMS	mg/kg	105	16	463	59	8.6	1360	2140	12000	365	583	13
Mo	ICPMS	mg/kg	10	5.5	12	3.1	5.3	1.4	2.7	2.6	1.2	1.5	0.67
Nb	ICPMS	mg/kg	3.3	2.4	3.6	5.1	6.1	4.2	4.4	< 2	2.6	6.5	<2
Ni	ICPMS	mg/kg	9.2	1.6	16	2.4	<1	56	28	47	9.1	12	1.2

Table 8. (cont.)

Sample numbers			05PWS-E201P	05PWS-E209P [a]	05PWS-E303P [a]	05PWS-E304P [a]	05PWS-T303P-1	05PWS-T310P	05PWS-B201P	05PWS-B202P	05PWS-B203P	05PWS-B204P	05PWS-B306P
Mine site			Ellamar	Ellamar	Ellamar	Ellamar	Threeman	Threeman	Beatson	Beatson	Beatson	Beatson	Beatson
Element	Method	Units											
Pb	ICPMS	mg/kg	143	986	13	185	42	8.9	917	3770	909	365	309
Rb	ICPMS	mg/kg	8.6	21	16	44	53	7.2	43	1.4	15	37	0.25
Sb	ICPMS	mg/kg	2.2	4.1	0.45	2.7	3.2	0.22	19	0.48	11	20	0.79
Sc	ICPMS	mg/kg	6.8	3.8	6.8	8.1	9.7	13	12	8.6	6.4	12	2.8
Sr	ICPMS	mg/kg	167	57	262	180	131	89	92	105	38	86	1.5
Th	ICPMS	mg/kg	0.98	1.4	1.8	2.8	1.9	2	4.8	0.4	2.5	4.3	9.2
Tl	ICPMS	mg/kg	0.4	0.74	0.1	1.1	2	0.1	0.56	0.04	0.3	0.52	0.009
U	ICPMS	mg/kg	39	0.54	3.2	0.74	0.85	2.1	1.9	17	0.59	1.1	0.94
V	ICPMS	mg/kg	91	50	99	94	97	65	100	3.9	56	112	<0.4
Y	ICPMS	mg/kg	33	1.5	9.1	3.7	3.1	18	27	252	5.8	8.6	11
Zn	ICPMS	mg/kg	3260	150	389	40	32	529	704	23400	332	762	185