GEOCHEMICAL ANALYSES OF BEDROCK SAMPLES FROM DRILL HOLES ON AND NEAR RED LAKE INDIAN RESERVATION LANDS, NORTHERN MINNESOTA

by

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Introduction

This report presents the geochemical analyses of rock samples collected from diamond drill-core during the mineral resource assessment study of the Red Lake Indian Reservation located in the Bimidji, Minnesota 1° x 2° topographic quadrangle. Table 1 contains the digitized drill-hole locations and table 2 contains the results of the geochemical analyses.

Diamond drill core was obtained from the Minnesota Department of Natural Resources Core Library (MDNR), Hibbing, Minnesota. The core was sampled from areas covered by glacial deposits which constituted most of the northern part of the Bimidji 1° x 2° quadrangle. Drill core samples are numbered by using the drill hole identification numbers that correspond to those used by the MDNR, followed by the depth of the sample in feet.

Sampling

Drill core typically was sampled by halving or quartering short intervals (usually 6-15 cm) using a diamond saw. Sample locations were digitized from points transferred to 1:24,000-scale 7.5' or 1:100,000-scale quadrangles from location maps provided to the MDNR after mineral exploration leases lapsed. The locations are reported to the nearest second of latitude and longitude.

Analytical Methods

Major elements were determined on most samples by J.S. Mee and D.F. Siems by quantitative wavelength dispersive X-ray fluorescence (WDXRF) (Taggart and others, 1987). Loss on ignition was determined by a gravimetric method (Jackson and others, 1987). Certain trace elements were determined by energy-dispersive X-ray fluorescence (EDXRF) using methods similar to those of Johnson and King (1987). Rare-earth element (REE) contents were determined using instrumental neutron activation analysis (INAA) (Baedecker and McKown,

1987) by J.N. Grossman and P.A. Baedecker. J.N. Grossman also provided the digital data retrieval that was used to compile this report. Multi-element analyses by ICP-AES (Lichte and others, 1987) were provided by D.L. Fey. Gold concentrations were determined by a combination of fire assay and graphite furnace atomic absorption spectrometry (see Wilson and others, 1987) to extend the detection limits to 0.002 ppm using a sample size of 10-15 g. Arsenic concentrations were determined by hydride-AAS, and tellurium by flame AAS. Analyses were provided by M.W. Doughten, J.R. Gillison, and A.H. Love.

Data Tables

The data tables contain blanks where elements were not determined. Samples with concentrations below detection limits are shown as the negative of the detection limit. Constituent FETO3 is total iron calculated as Fe_2O_3. Laboratory numbers are USGS laboratory identification numbers. Principle analytical methods for a given constituent are given in the column headings. Footnotes explain variations in analytical methods for certain samples.

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Baedecker, P.A. and McKown, D.M., 1987, Instrumental neutron activation analysis of geochemical samples, in P.A. Baedecker, ed.: Methods for Geochemical Analysis, USGS Bulletin 1770, p. H1-H14.

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Table 2. Drill hole locations in decimal degrees.

drill hole	county	latitude	longitude
BIA-1	BELTRAMI	47.8754	95.1356
BID-3	BELTRAMI	47.7856	94.6475
C1-83	BELTRAMI	47.8559	94.7093
CON-1	BELTRAMI	47.9113	94.5578
IAP-1	BELTRAMI	47.8072	94.5975
JAN-1	BELTRAMI	47.8016	94.5834
LOK-1	BELTRAMI	47.8297	94.7855
PLO-1	BELTRAMI	47.8147	94.5947
PLO-2	BELTRAMI	47.8154	94.5968
RL-28	BELTRAMI	47.7834	94.6511
RL-39	BELTRAMI	47.9608	94.5304
SDE-1	BELTRAMI	47.8441	94.6421
TIT-1	BELTRAMI	47.8049	94.5929
TIT-2	BELTRAMI	47.8022	94.5928
TIT-3	BELTRAMI	47.8019	94.5908
VAN-2	BELTRAMI	47.8058	94.5715

variables:	SIO2	TIO2	AL2O3	FETO3	MNO	MGO	CAO	NA2O	K2O	P2O5	LOI (925C)
units:	WT.%	WT.%	WT.%	WT.%	WT.%	WT.%	WT.%	WT.%	WT.%	WT.%	WT.%
analytical method	WDXRF	WDXRF	WDXRF	WDXRF	WDXRF	WDXRF	WDXRF	WDXRF	WDXRF	WDXRF	GRAV
W-254528 TIT-1-506	68.8	0.25	15.60	3.23	0.40	0.38	3.51	5.26	0.75	0.06	1.96
W-254529 JAN-1-382.5	49.5	1.67	13.00	16.70	2.50	5.69	7.23	3.36	0.26	0.15	1.89
W-254530 VAN-2-404	70.3	0.44	15.50	3.15	0.40	1.05	1.30	4.64	1.69	0.10	1.52
W-254531 IAP-1-275	72.8	0.38	14.10	2.67	0.50	1.51	2.95	2.55	0.81	0.09	2.32
W-254532 TIT-3-553	47.0	0.97	13.80	14.50	2.50	7.49	12.30	1.17	0.09	0.08	2.04
W-254533 BID-3-524	51.6	0.79	12.10	11.00	2.10	7.67	11.10	3.05	0.39	0.09	0.96
W-254534 C1-83-522	57.1	0.85	12.70	6.85	1.50	3.78	10.00	4.02	0.05	0.11	3.56
W-254535 CON-1-665	58.7	0.54	13.00	6.06	1.50	3.13	3.95	2.01	2.43	0.15	8.59
W-254536 BID-3-348	97.4	0.04	0.87	0.69	0.10	0.03	0.19	0.32	0.03	-0.05	0.31
W-254537 PLO-1-780	49.3	0.96	15.20	9.77	2.00	9.03	9.08	2.48	1.18	0.11	2.09
W-254538 PLO-2-341	50.9	1.44	14.00	14.50	2.00	4.76	8.92	3.89	0.56	0.16	0.52
W-254539 IAP-1-376	43.2	0.88	12.70	12.10	1.90	4.06	14.30	0.77	0.15	0.07	10.80
W-254540 VAN-2-518	63.5	0.48	16.30	4.35	0.80	0.72	7.44	2.17	1.09	0.11	2.90
W-254541 RL-28-622	50.2	0.81	12.90	9.27	2.20	8.95	10.50	2.58	0.41	0.08	2.62
W-254542 RL-28-697	48.2	0.34	6.38	11.70	1.80	19.00	7.27	0.36	3.99	-0.05	0.49
W-254544 RL-28-617	49.2	0.78	12.20	12.30	2.90	8.91	10.60	2.01	0.34	0.08	1.66
W-254546 RL-28-598	48.0	0.72	11.30	9.46	2.50	7.80	16.00	1.49	0.21	0.08	3.66
W-254548 IAP-1-486	51.6	1.49	21.20	8.85	1.20	2.98	5.73	1.02	1.38	0.07	5.05
W-254549 LOK-1-602	51.9	0.79	12.10	12.20	1.90	9.14	8.59	3.28	0.37	0.08	1.19
W-254550 BIA-1-233		0.01	0.79	13.73	0.97	0.20	1.36	0.03	0.02	0.48	
W-254551 SDE-1-585		0.10	14.17	3.58	0.05	0.53	0.24	2.29	2.53	0.07	
W-254552 BIA-1-248		0.12	4.53	47.19	0.18	0.17	0.08	0.01	0.01	-0.01	
W-254553 BIA-1-261		0.05	2.46	41.47	0.17	0.12	0.07	0.01	0.01	0.01	
W-254554 TIT-2-523		0.10	13.60	2.86	0.36	0.53	6.58	4.45	0.57	0.05	
W-254543 BIA-1-235		-0.01	0.11	12.16	0.26	0.15	0.43	0.01	0.02	0.27	
W-254545 VAN-2-470		0.37	14.73	4.43	0.94	1.99	6.99	2.83	1.16	0.07	
W-254547 RL-39-733		0.85	11.71	7.58	1.55	1.00	7.83	2.70	1.93	0.07	
analytical note:		1	1	1	1	1	1	1	1	1	

1) W-254550, W-254551, W-254552, W-254553, W-254554, W-254543, W-254545, and W-254547 analyses by ICP-AES
2) W-254550, W-254551, W-254553, W-254554, W-254543, W-254545, and W-254547 analyses by ICP-AES
3) W-254551, W-254545, W-254547 by EDXRF; W-254550, W-254553, W-254543, W-254554 by ICPAES
4) W-254550, W-254551, W-254553, W-254554, W-254543, W-254545, and W-254547 analyses by AAS; W-254552 by INAA
5)W-254528, W254529, W-254530, W-254531, W-254532, W-254533, W254534, W-254535 by ICP-AES
6)W-254528, W254529, W-254530, W-254531, W-254532, by INAA
7) W-254550, W-254551, W-254552, W-254553, W-254554, W-254543, W-254545, and W-254547 analyses by EDXRF
Sn less than 2 ppm; Ag less than 5 ppm; Bi less than 10ppm in all samples by ICPAES

variables:	LI	SC	SC	V	CR	CO	NI	CU	ZN	GA	AS	RB	SR
units:	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
analytical method	ICP-AES	ICP-AES	ICP-AES	ICP-AES	INAA	INAA	INAA	ICP-AES	INAA	ICP-AES	INAA	INAA	INAA
W-254528 TIT-1-506	12	3	3	34	54	11	33	15	51	14	-0.6	17	210
W-254529 JAN-1-382.5	15	50	48	440	45	46	-70	77	133	20	-0.9	10	140
W-254530 VAN-2-404	24	12	11	74	150	9	37	9	21	15	0.9	57	210
W-254531 IAP-1-275	17	7	7	48	149	10	52	11	28	15	-0.9	23	280
W-254532 TIT-3-553	20	41	38	280	204	51	98	110	78	18	-1.1	-5	270
W-254533 BID-3-524	7	39	35	250	537	48	120	100	88	17	2.4	16	440
W-254534 C1-83-522	8	41	38	250	765	58	300	99	69	15	55.0	-4	170
W-254535 CON-1-665	11	14	14	100	203	21	69	29	103	16	40.0	80	340
W-254536 BID-3-348	-2	-2	1	4	11	11	39	55	632	-4	1.4	-1	18
W-254537 PLO-1-780	45	41	38	250	456	42	200	84	75	17	-0.6	93	170
W-254538 PLO-2-341	9	49	44	370	17	40	40	82	79	24	-0.8	23	350
W-254539 IAP-1-376	33	39	35	260	122	47	58	130	76	17	4.1	7	300
W-254540 VAN-2-518	18	13	12	85	143	15	65	30	49	20	0.7	34	360
W-254541 RL-28-622	25	41	38	260	892	62	200	110	100	16	-0.8	21	180
W-254542 RL-28-697	57	19	18	150	2290	90	640	19	120	10	0.5	148	19
W-254544 RL-28-617	27	39	37	240	653	56	160	260	110	14	-0.4	15	100
W-254546 RL-28-598	7	36	34	220	782	53	140	140	92	16	-0.8	10	131
W-254548 IAP-1-486	72	41	41	300	122	67	130	140	57	21	25.0	51	194
W-254549 LOK-1-602	9	39	36	250	614	50	110	120	97	15	12.0	14	206
W-254550 BIA-1-233	-2	-2	-2	4	7		5	12	26	-4	0.8	8	39
W-254551 SDE-1-585	5	4	4	23	7		17	13	108	12	16.0	89	211
W-254552 BIA-1-248	6	6	5	30	31	9	43	23	10	10	2.9	16	13
W-254553 BIA-1-261	4	4	4	16	28		9	11	8	-4	1.9	81	14
W-254554 TIT-2-523	8	5	5	32	52		26	14	24	12	-0.2	20	230
W-254543 BIA-1-235	-2	-2	-2	-2	11		4	7	6	-4	0.4	-5	14
W-254545 VAN-2-470	13	12	12	65	164		53	32	727	17	0.3	38	321
W-254547 RL-39-733	21	20	20	200	46		69	100	62	16	0.9	59	259
analytical note:	1	1	2		2		2		3		4	2	5

variables:	Y	ZR	NB	MO	CD	Cd/P	SB	TE	CS	BA	LA	CE	ND
units:	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPM
analytical method	ICP-AES	INAA	ICP-AES	ICP-AES	ICP-AES	ICP-AES	INAA	INAA	INAA	INAA	INAA	INAA	INAA
W-254528 TIT-1-506	2	68	-4	-2	-2		0.07		1.60	130	1.5	2.9	1.3
W-254529 JAN-1-382.5	30	150	6	-2	-2		-0.13		0.42	76	6.2	16.0	10.0
W-254530 VAN-2-404	7	86	-4	-2	-2		0.14		0.92	280	6.7	14.0	7.0
W-254531 IAP-1-275	4	107	-4	-2	-2		0.10		1.10	220	2.9	5.9	3.3
W-254532 TIT-3-553	16	-110	4	-2	-2		0.13		-0.28	38	2.9	7.9	5.5
W-254533 BID-3-524	15	65	-4	-2	-2		-0.23		0.47	220	6.2	12.0	7.6
W-254534 C1-83-522	18	66	-4	-2	-2		6.30		-0.20	22	4.0	10.0	6.2
W-254535 CON-1-665	7	138	-4	-2	-2		0.56		2.90	670	27.5	51.9	22.0
W-254536 BID-3-348	-2	16	-4	-2	3		0.09		0.10	27	1.2	2.6	1.3
W-254537 PLO-1-780	14	78	8	-2	-2		-0.22		2.90	270	11.5	23.5	12.0
W-254538 PLO-2-341	44	158	8	7	-2		0.14		0.45	160	8.9	22.2	16.0
W-254539 IAP-1-376	15	61	-4	-2	-2		0.55		0.27	130	2.8	8.1	4.9
W-254540 VAN-2-518	6	94	-4	-2	-2		0.13		1.90	230	6.6	13.7	7.6
W-254541 RL-28-622	17	58	6	-2	-2		-0.13		1.20	84	4.7	12.0	7.4
W-254542 RL-28-697	7	21	-4	-2	-2		-0.07		24.00	210	1.1	4.7	3.4
W-254544 RL-28-617	16	56	5	3	2		-0.09		0.94	59	3.5	9.6	6.9
W-254546 RL-28-598	15	48	4	-2	-2		-0.08		0.41	54	5.3	12.0	6.8
W-254548 IAP-1-486	11	70	8	-2	-2		0.29		1.50	150	2.6	6.9	-12.0
W-254549 LOK-1-602	16	56	-4	-2	-2		0.43		0.59	75	5.2	11.0	6.3
W-254550 BIA-1-233	6	-10	-4	-2	-2	0.04				28	-2.0	-4.0	
W-254551 SDE-1-585	5	121	-4	-2	-2	0.53		0.03		504	10.0	20.0	
W-254552 BIA-1-248	5	26	-4	7	3		0.67		-0.20	16	6.6	14.0	7.0
W-254553 BIA-1-261	-2	-10	-4	5	-2	0.06				15	5.0	9.0	
W-254554 TIT-2-523	-2	50	-4	-2	-2	0.03		0.42		205	-2.0	-4.0	
W-254543 BIA-1-235	3	-10	-4	-2	-2	0.05				17	-2.0	-4.0	
W-254545 VAN-2-470	7	81	-4	-2	3	3.20		0.02		314	7.0	12.0	
W-254547 RL-39-733	14	75	-4	-2	-2	0.11		0.06		708	10.0	18.0	
analytical note:		6								7	2	2	

variables:	SM	EU	TB	YB	LU	HF	TA	AU	AU	PB	TH	U	Ag/P
units:	PPM	PPM	PPM	PPM	PPM	PPM	PPM	PPB	PPB	PPM	PPM	PPM	PPM
analytical method	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	INAA	ICP-AES	INAA	INAA	ICP-AES
W-254528 TIT-1-506	0.41	0.15	0.06	0.30	0.04	1.54	0.09	-5		4	0.23	-0.30	
W-254529 JAN-1-382.5	4.12	1.20	0.90	4.00	0.55	2.97	0.39	-8		-4	0.46	-0.30	
W-254530 VAN-2-404	1.88	0.63	0.23	0.74	0.12	2.31	0.16	-6		10	0.99	0.20	
W-254531 IAP-1-275	0.94	0.34	0.14	0.55	0.08	1.85	0.15	-6		5	0.91	0.20	
W-254532 TIT-3-553	2.23	0.78	0.43	1.90	0.28	1.50	0.20	-4		-4	0.27	-0.30	
W-254533 BID-3-524	2.31	0.66	0.43	1.70	0.26	1.60	0.22	-5		-4	0.96	-0.21	
W-254534 C1-83-522	2.40	0.76	0.52	2.10	0.30	1.70	0.23	-5		6	0.34	-0.40	
W-254535 CON-1-665	4.22	0.95	0.40	1.30	0.20	3.37	0.42	-8		7	6.52	1.40	
W-254536 BID-3-348	0.33	0.20	0.05	0.20	0.03	0.20	0.04	-2		29	0.28	0.28	
W-254537 PLO-1-780	2.94	0.90	0.44	1.70	0.25	1.90	0.68	-6		-4	1.90	-0.40	
W-254538 PLO-2-341	5.66	1.53	1.17	5.41	0.77	4.08	0.45	-8		-4	0.83	-0.40	
W-254539 IAP-1-376	2.18	0.76	0.47	1.80	0.25	1.30	0.17	-3		-4	0.48	-0.30	
W-254540 VAN-2-518	1.84	0.55	0.21	0.79	0.11	2.34	0.17	-6		4	1.00	0.32	
W-254541 RL-28-622	2.42	0.88	0.48	1.60	0.23	1.67	0.22	-7		-4	0.86	0.28	
W-254542 RL-28-697	0.90	0.24	0.17	0.67	0.09	0.58	0.09	-3		-4	0.32	0.22	
W-254544 RL-28-617	2.14	0.66	0.45	1.80	0.24	1.70	0.21	-10		-4	0.88	0.22	
W-254546 RL-28-598	2.21	0.68	0.44	1.70	0.22	1.50	0.19	-5		-4	0.89	0.31	
W-254548 IAP-1-486	1.82	0.66	0.37	1.60	0.22	2.20	0.30	-8		-4	0.39	-0.30	
W-254549 LOK-1-602	2.20	0.64	0.45	1.70	0.23	1.60	0.21	-7		-4	1.50	0.38	
W-254550 BIA-1-233									-2	-4			
W-254551 SDE-1-585									5	12			0.33
W-254552 BIA-1-248	1.45	0.49	0.25	1.10	0.17	0.93	0.16	-1		-4	1.30	0.58	
W-254553 BIA-1-261									10	-4			
W-254554 TIT-2-523									10	6			0.07
W-254543 BIA-1-235									-2	-4			0.08
W-254545 VAN-2-470									-2	13			0.08
W-254547 RL-39-733									4	5			0.08
analytical note:													

variables:	Sample Description
units:	
analytical method	
W-254528 TIT-1-506	metarhyolite tuff
W-254529 JAN-1-382.5	metabasalt flow rock
W-254530 VAN-2-404	metarhyolite flow rock
W-254531 IAP-1-275	metarhyolite breccia
W-254532 TIT-3-553	metabasalt flow rock
W-254533 BID-3-524	metabasalt flow rock
W-254534 C1-83-522	altered metabasalt
W-254535 CON-1-665	graywacke
W-254536 BID-3-348	graphitic metachert
W-254537 PLO-1-780	metabasalt flow
W-254538 PLO-2-341	metabasalt flow
W-254539 IAP-1-376	metabasalt
W-254540 VAN-2-518	metarhyolite flow
W-254541 RL-28-622	serpentinized pyroxenite
W-254542 RL-28-697	serpentinized pyroxenite
W-254544 RL-28-617	coarse spinifex-textured metabasalt
W-254546 RL-28-598	spinifex-textured metabasalt
W-254548 IAP-1-486	metabasalt flow
W-254549 LOK-1-602	metabasalt flow
W-254550 BIA-1-233	quartz vein in iron-formation
W-254551 SDE-1-585	sulfide-mineralized fault breccia
W-254552 BIA-1-248	hematitic iron-formation
W-254553 BIA-1-261	quartz vein in hematitic iron-formation
W-254554 TIT-2-523	quartz-pyrite vein in metarhyolite
W-254543 BIA-1-235	quartz vein in hematitic iron-formation
W-254545 VAN-2-470	quartz vein in metarhyolite breccia
W-254547 RL-39-733	quartz vein in graywacke
analytical note:	