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**ANALYTICAL RESULTS OF THE
PUBLIC GEOLOGIC SAMPLE PROGRAM,
1987-1989 BIENNIUM**

UNIVERSITY OF MINNESOTA

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**ANALYTICAL RESULTS OF THE PUBLIC GEOLOGIC
SAMPLE PROGRAM, 1987-1989 BIENNIUM**

By

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Final Report to the Minnesota Department of Natural Resources, Division of Minerals, St. Paul, Minnesota

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INTRODUCTION

In 1983 the Minnesota Geological Survey, in conjunction with the Minnesota Department of Natural Resources, Division of Minerals, began a geologic sample program involving the chemical analysis of geological materials, in part submitted by the general public. This Information Circular summarizes the results of that program during the 1987-1989 biennium. In all, 166 samples were evaluated by Survey geologists as potential candidates. Of that total, 129 samples were rejected because they were not deemed suitable for analysis and 25 samples were rejected because the submitters were unwilling or unable to provide locations as required by the program. In the end, 4 public samples (Tables 1, 4, and 9) were analyzed for a variety of constituents. Additionally, 326 samples submitted by Survey geologists were analyzed for a variety of major, minor, and trace constituents. The analytical results from 10 other miscellaneous samples were also donated to the Survey during the biennium and are included in this report. Tables within those categories are organized by the geological age of the material analyzed.

ANALYTICAL PROCEDURES

A variety of analytical services and, consequently, methods were used during the 1987-1989 biennium. The various analytical facilities, their methods, and reported detection limits are summarized below.

I. Minor-Element Exploration Packages—Tables 1-8

Tables 1-3; Geochemical Services, Inc., Rocklin, California

Element	Value	Detection Limit	Analytical Method
Ag	ppm	0.025	Inductively Coupled Plasma
As	ppm	1.0	Inductively Coupled Plasma
Au	ppm	0.001 or .005	Fire Assay-Atomic Absorption
Cu	ppm	0.025	Inductively Coupled Plasma
Hg	ppm	0.10	Inductively Coupled Plasma
Mo	ppm	0.10	Inductively Coupled Plasma
Pb	ppm	0.25	Inductively Coupled Plasma
Sb	ppm	1.0	Inductively Coupled Plasma
Tl	ppm	0.5	Inductively Coupled Plasma
Zn	ppm	1.0	Inductively Coupled Plasma
Bi	ppm	0.50	Inductively Coupled Plasma
Cd	ppm	0.25	Inductively Coupled Plasma
Ga	ppm	0.50	Inductively Coupled Plasma
Pd	ppm	0.10	Inductively Coupled Plasma
Se	ppm	0.5	Inductively Coupled Plasma
Te	ppm	0.5	Inductively Coupled Plasma

Tables 4-7; X-Ray Assay Laboratories, Limited, Don Mills, Ontario

Element	Value	Detection Limit	Analytical Method
Au	ppb	1.	Fire Assay-Direct Current Plasma
Li	ppm	10.	Atomic Absorption
Be	ppm	10.	Direct Current Plasma
B	ppm	10.	Direct Current Plasma
S	ppm	100.	X-Ray Fluorescence
V	ppm	10.	Direct Current Plasma
Cr	ppm	2.	Direct Current Plasma
Mn	ppm	2.	Direct Current Plasma
Co	ppm	1.	Inductively Coupled Plasma Spectrometry
Ni	ppm	1.	Direct Current Plasma
Cu	ppm	0.5	Direct Current Plasma
Zn	ppm	0.5	Direct Current Plasma
Ga	ppm	1.	Inductively Coupled Plasma Spectrometry
Ge	ppm	10.	Direct Current Plasma
As	ppm	1.	Flameless Atomic Absorption
Se	ppm	3.	Graphite Furnace Atomic Absorption
Mo	ppm	2.	Inductively Coupled Plasma Spectrometry
Pd	ppm	2.	Fire Assay-Direct Current Plasma
Ag	ppm	0.5	Direct Current Plasma
Cd	ppm	1.	Direct Current Plasma
In	ppm	1.	Inductively Coupled Plasma Spectrometry
Sn	ppm	10.	X-Ray Fluorescence
Sb	ppm	0.2	Flameless Atomic Absorption
Cs	ppm	1.	Inductively Coupled Plasma Spectrometry
La	ppm	2.	Inductively Coupled Plasma Spectrometry
Ce	ppm	1.	Inductively Coupled Plasma Spectrometry
Nd	ppm	0.5	Inductively Coupled Plasma Spectrometry
Sm	ppm	0.5	Inductively Coupled Plasma Spectrometry
Eu	ppm	0.1	Inductively Coupled Plasma Spectrometry
Gd	ppm	0.5	Inductively Coupled Plasma Spectrometry
Dy	ppm	0.5	Inductively Coupled Plasma Spectrometry
Er	ppm	0.5	Inductively Coupled Plasma Spectrometry
Lu	ppm	0.1	Inductively Coupled Plasma Spectrometry
Hf	ppm	1.	Inductively Coupled Plasma Spectrometry
Ta	ppm	1.	Inductively Coupled Plasma Spectrometry
W	ppm	3.	Inductively Coupled Plasma Spectrometry
Pt	ppm	10.	Fire Assay-Direct Current Plasma
Tl	ppm	1.	Inductively Coupled Plasma Spectrometry
Pb	ppm	2.	Direct Current Plasma
Bi	ppm	0.5	Inductively Coupled Plasma Spectrometry
Th	ppm	1.	Inductively Coupled Plasma Spectrometry
U	ppm	0.5	Inductively Coupled Plasma Spectrometry

Table 8; Acme Analytical Laboratories, Limited, analyses by Inductively Coupled Plasma; Au detection limit, 3 ppm.

II. WHOLE-ROCK ANALYSIS—TABLES 9-13

Tables 9-13; X-Ray Assay Laboratories, Limited, Don Mills, Ontario

Constituent	Value	Detection Limit	Analytical Method
SiO ₂	%	± 1%	X-Ray Fluorescence
Al ₂ O ₃	%	± 1%	X-Ray Fluorescence
CaO	%	± 1%	X-Ray Fluorescence
MgO	%	± 1%	X-Ray Fluorescence
Na ₂ O	%	± 1%	X-Ray Fluorescence
K ₂ O	%	± 1%	X-Ray Fluorescence
Total Fe as Fe ₂ O ₃	%	± 1%	X-Ray Fluorescence
MnO	%	± 1%	X-Ray Fluorescence
TiO ₂	%	± 1%	X-Ray Fluorescence
P ₂ O ₅	%	± 1%	X-Ray Fluorescence
Cr ₂ O ₃	%	± 1%	X-Ray Fluorescence
LOI	%	± 1%	X-Ray Fluorescence
Cl	%	50.	X-Ray Fluorescence
H ₂ O+	%	0.1	Wet Chemical
H ₂ O-	%	0.1	Wet Chemical
C	%	0.01	Wet Chemical
CO ₂	%	0.01	Wet Chemical
S	%	0.01	X-Ray Fluorescence
FeO	%	0.1	Wet Chemical
Cr	ppm	10.	X-Ray Fluorescence
Rb	ppm	10.	X-Ray Fluorescence
Sr	ppm	10.	X-Ray Fluorescence
Y	ppm	10.	X-Ray Fluorescence
Zr	ppm	10.	X-Ray Fluorescence
Nb	ppm	10.	X-Ray Fluorescence
Ba	ppm	10.	X-Ray Fluorescence

III. RARE-EARTH ELEMENT ANALYSIS—TABLES 14-15

Table 14. X-Ray Assay Laboratories, Limited, Don Mills, Ontario

Element	Value	Detection Limit	Analytical Method
La	ppm	0.1	Neutron Activation
Ce	ppm	1.	Neutron Activation
Nd	ppm	3.	Neutron Activation
Eu	ppm	0.05	Neutron Activation
Sm	ppm	0.1	Neutron Activation
Tb	ppm	0.1	Neutron Activation
Yb	ppm	0.05	Neutron Activation
Lu	ppm	0.01	Neutron Activation

Table 15. X-Ray Assay Laboratories, Limited, Don Mills, Ontario

Element	Value	Detection Limit	Analytical Method
Y	ppm	1.	Inductively Coupled Plasma Spectrometry
La	ppm	0.1	Inductively Coupled Plasma Spectrometry
Ce	ppm	0.1	Inductively Coupled Plasma Spectrometry
Pr	ppm	0.1	Inductively Coupled Plasma Spectrometry
Nd	ppm	0.1	Inductively Coupled Plasma Spectrometry
Sm	ppm	0.1	Inductively Coupled Plasma Spectrometry
Eu	ppm	0.05	Inductively Coupled Plasma Spectrometry
Gd	ppm	0.1	Inductively Coupled Plasma Spectrometry
Tb	ppm	0.1	Inductively Coupled Plasma Spectrometry
Dy	ppm	0.1	Inductively Coupled Plasma Spectrometry
Ho	ppm	0.05	Inductively Coupled Plasma Spectrometry
Er	ppm	0.1	Inductively Coupled Plasma Spectrometry
Tm	ppm	0.1	Inductively Coupled Plasma Spectrometry
Yb	ppm	0.1	Inductively Coupled Plasma Spectrometry
Lu	ppm	0.05	Inductively Coupled Plasma Spectrometry
Th	ppm	1.	Inductively Coupled Plasma Spectrometry
U	ppm	1.	Inductively Coupled Plasma Spectrometry

EXPLANATION OF THE ABBREVIATED T-R-S SYSTEM

A great majority of townships in Minnesota are north of a zero standard parallel and west of a zero principal meridian. Therefore, every Minnesota township is T.(Y)N., R.(X)W., and, since T. and R. are understood and N. and W. apply to all, a particular township can be specified as Y-X. For example, T.130N., R.33W., the legal description of Hartford Township, would be indicated 130-33-29 in the abbreviated T-R-S system. More precise locations within a legal section can be specified by the ABCD system, which is a simplification of the "NE $\frac{1}{4}$ SE $\frac{1}{4}$. . ." system that traditionally has been used in legal land descriptions. In the ABCD system (see example below), A is the northeast quadrant, B is the northwest quadrant, C is the southwest quadrant, and D is the southeast quadrant, and the *largest* quadrant pertaining to a location is given *first*. For example, the location of a hole is the NE $\frac{1}{4}$ of the SE $\frac{1}{4}$ of the SW $\frac{1}{4}$ of the SW $\frac{1}{4}$ of the NW $\frac{1}{4}$ of section 29, Hartford Township, Todd County, would be described as 130-33-29 BCCDA.

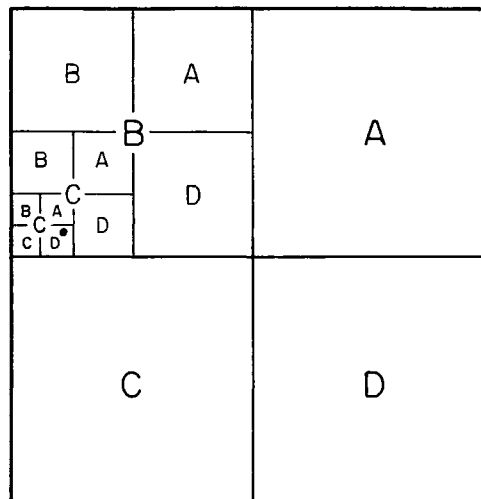


Figure 1. Location of the hole in the example given above.

Table 1. Publicly submitted samples—16-element exploration package

	1	2	3	4
Ag	21.4	.051	.872	1.47
As	1	2.10	4.01	1.30
Au	.210	<.049	.203	<.049
Cu	<10000	94.0	37.0	647.
Hg	--	<.098	<.097	<.098
Mo	181.	3.16	4.70	4.63
Pb	8.	6.91	9.90	12.4
Sb	--	.352	.422	.413
Tl	--	<.489	<.487	<.489
Zn	97.	153.	73.9	41.0
Bi	<2.	.416	<.244	.615
Cd	2.5	.357	.260	.187
Ga	--	3.35	.635	2.63
Pd	--	<.489	<.487	<.489
Se	--	<.978	<.975	<.978
Te	--	<.489	.792	<.489

1. GSP-43—Quartz vein, chalcopyrite-, pyrite-, pyrrhotite- and molybdenite-bearing; unnamed formation, Precambrian; test pit, T.62N., R.22W., sec. 2, S¹/₂ B, Itasca County. Note: this is a correction to the results reported in Minnesota Geological Survey Information Circular 25, p. 5.
2. GSP-48—Pyrite-rich graywacke; Newton Lake Formation, Archean; outcrop sample, T.63N., R.12W., sec. 30, C, St. Louis County.
3. GSP-49—Quartz vein with pyrite; Newton Lake Formation, Archean; outcrop sample, T.63N., R.12W., sec. 30, C, St. Louis County.
4. GSP-50—Granitic gneiss, pyrite-bearing; Vermilion Granitic Complex, Archean; outcrop sample, T.65N., R.18W., sec. 32, A, St. Louis County.

Table 2. Samples of Archean age—16-element exploration package

	1	2	3	4	5	6	7	8
Ag	.096	<.015	.113	.124	.086	.364	.149	.05
As	<.984	1.63	<.926	2.43	.951	1.95	4.35	1.98
Au	<.049	<.049	<.046	<.046	<.047	<.046	<.046	<.048
Cu	110.	277.	239.	95.7	47.6	94.8	122.	9.02
Hg	<.098	<.099	<.093	<.092	<.094	<.091	<.093	<.096
Mo	.595	.395	.637	2.08	1.54	1.07	1.16	3.62
Pb	11.9	22.7	21.2	21.8	10.6	7.79	5.49	4.19
Sb	<.246	<.247	.391	.499	<.236	.288	.462	.239
Tl	<.492	1.81	.624	<.46	<.472	<.455	<.465	<.478
Zn	84.4	262	128	66.7	46.9	100.	94.8	19.6
Bi	<.246	<.247	<.231	<.23	<.236	.302	<.232	<.239
Cd	<.098	<.099	.152	.124	.190	.175	.097	<.096
Ga	2.88	18.0	5.51	3.54	2.01	8.02	6.59	1.04
Pd	<.492	<.493	<.463	<.46	<.472	<.455	<.465	<.478
Se	<.984	<.986	<.926	<.919	<.943	<.911	<.929	<.956
Te	<.492	<.493	<.463	<.46	<.472	<.455	<.465	<.478
	9	10	11	12	13	14	15	16
Ag	.021	.681	3.69	.406	.144	.098	.069	.043
As	<.954	<.949	1.46	20.0	<.94	<.931	7.65	<.992
Au	<.048	<.047	.707	<.048	<.047	<.047	<.046	.003
Cu	18.6	606.	5272	481.	31.5	44.8	125.	7.28
Hg	<.095	<.095	<.095	<.096	<.094	<.093	<.092	<.099
Mo	.941	1.68	2.04	.848	1.57	1.42	.739	.960
Pb	3.29	6.56	6.61	12.4	3.73	10.8	2.82	3.01
Sb	<.239	<.237	<.239	.308	.417	<.233	.360	<.248
Tl	<.477	<.474	<.477	<.481	<.47	<.466	<.458	<.496
Zn	52.4	1564	78.3	68.8	45.7	124	110	78.8
Bi	<.239	.508	<.239	<.24	<.235	<.233	<.229	<.248
Cd	<.095	3.74	.784	.115	<.094	.139	.174	.260
Ga	2.15	6.25	1.71	6.53	2.42	8.55	8.87	3.27
Pd	<.477	<.474	<.477	<.481	<.47	<.466	<.458	<.496
Se	<.954	1.61	.971	<.962	<.94	<.931	<.916	<.992
Te	<.477	1.65	.969	<.481	<.47	<.466	<.458	<.496

Table 2 continued

	17	18	19	20	21	22	23	24
Ag	.340	.161	.436	.03	.267	.193	.057	.037
As	2.28	<.954	<.998	<.952	41.6	187.	3.50	4.34
Au	.007	.007	.004	.001	.002	.001	.003	.002
Cu	159.	158.	641.	6.26	140.	1180.	62.7	52.1
Hg	<.095	<.095	<.1	<.095	<.095	<.094	<.1	<.092
Mo	2.41	.653	.851	.267	.687	.597	.658	.725
Pb	2.08	1.69	.538	.369	3.04	.718	.661	.721
Sb	.350	<.239	<.25	<.238	1.19	.932	.570	.471
Tl	<.475	<.477	<.499	<.476	<.474	<.471	<.499	<.46
Zn	400.	190.	7.85	5.41	57.4	81.1	47.0	106.
Bi	.528	.521	<.25	<.238	<.237	<.235	<.25	<.23
Cd	1.13	.266	<.1	<.095	<.095	.105	<.1	.130
Ga	5.18	7.04	2.22	1.44	1.33	4.42	4.54	5.89
Pd	<.475	<.477	<.499	<.476	<.474	<.471	<.499	<.46
Se	<.951	<.954	<.998	<.952	2.36	2.08	<.998	<.921
Te	<.475	<.477	<.499	<.476	<.474	<.471	<.499	<.46

1. K2-182—Altered and weathered metabasalt, pyritic and hematitic; unnamed formation, Archean; sample depth 182 ft., drill hole KDH-2, T.60N., R.25W., sec. 36, AAB, Itasca County.
2. K2-210—Saprolite; protolith is altered, pillowed metabasalt; unnamed formation, Archean; sample depth 210 ft., drill hole KDH-2, T.60N., R.25W., sec. 36, AAB, Itasca County.
3. K2-258—Metabasalt; pillowed with interpillow "vein" of feldspar, epidote, pyrite, magnetite, calcite, and garnet; unnamed formation, Archean; sample depth 258 ft., drill hole KDH-2, T.60N., R.25W., sec. 36, AAB, Itasca County.
4. K2-454—Metabasalt; relatively unaltered, dark green, pyritic; unnamed formation, Archean; sample depth 454 ft., drill hole KDH-2, T.60N., R.25W., sec. 36, AAB, Itasca County.
5. K2-467—Metabasalt with two vein systems; earlier is folded feldspathic with pyritic wall-rock; later veins are calcite- and epidote-bearing faults lacking sulfides; unnamed formation, Archean; sample depth 467 ft., drill hole KDH-2, T.60N., R.25W., sec. 36, AAB, Itasca County.
6. KIB-13-72—Basalt with sulfide-lined fractures; unnamed formation, Archean; sample depth 71.8-72.5 ft., drill hole KIB-13, T.62N., R.25W., sec. 33, AAB, Itasca County.
7. KIB-13-100—Basalt with sulfide-lined fractures; unnamed formation, Archean; sample depth 100-101 ft., drill hole KIB-13, T.62N., R.25W., sec. 33, AAB, Itasca County.
8. KIB-13-123—Felsic volcanic breccia; unnamed formation, Archean; sample depth 122.7-123.7 ft., drill hole KIB-13, T.62N., R.25W., sec. 33, AAB, Itasca County.
9. KIB-54-239—Metabasalt with minor quartz veining; unnamed formation, Archean; sample depth 239-239.7 ft., drill hole KIB-54, T.150N., R.27W., sec. 17, AAB, Itasca County.
10. KIB-56-87—Slightly sheared metabasalt; unnamed formation, Archean; sample depth 87-87.1 ft., drill hole KIB-56, T.151N., R.28W., sec. 16, AAB, Koochiching County.

11. KIB-57-68—Coarse basalt with sulfides; unnamed formation, Archean; sample depth 68-68.7 ft., drill hole KIB-57, T.151N., R.28W., sec. 1, AAB, Koochiching County.
12. KIB-64-448—Sulfide-bearing phyllite; unnamed formation, Archean; sample depth 448.5 ft., drill hole KIB-64, T.152N., R.30W., sec. 11, AAB, Beltrami County.
13. KIB-68-335—Lineated granodiorite; unnamed formation, Archean; sample depth 335-336 ft., drill hole KIB-68, T.151N., R.32W., sec. 13, AAB, Beltrami County.
14. KIB-69-179—Felsic crystal tuff; unnamed formation, Archean; sample depth 179-179.5 ft., drill hole KIB-69.B, T.153N., R.30W., sec. 19, AAB, Beltrami County.
15. KIB-70-229—Felsic crystal tuff; unnamed formation, Archean; sample depth 229-229.5 ft., drill hole KIB-70, T.151N., R.31W., sec. 24, AAB, Beltrami County.
16. K4-422.5—Carbonate-altered chlorite schist containing fine disseminated pyrite and chalcopyrite, cut by quartz-carbonate-tourmaline vein; unnamed formation, Archean; sample depth 422.5-423 ft., Minnesota Geological Survey drill hole KDH-4, T.148N., R.26W., sec. 11, DDCCB, Itasca County.
17. K4-481.5—Gray siliceous metagraywacke containing 1% or more disseminated pyrite; unnamed formation, Archean; sample depth 481-481.5 ft., Minnesota Geological Survey drill hole KDH-4, T.148N., R.26W., sec. 11, DDCCB, Itasca County.
18. K4-418.5—Metagraywacke containing disseminated pyrite and chalcopyrite, cut by thin chloritic shear containing quartz-carbonate vein; unnamed formation, Archean; sample depth 418.5-419.5 ft., Minnesota Geological Survey drill hole KDH-4, T.148N., R.26W., sec. 11, DDCCB, Itasca County.
19. K5-371.5—Mylonitized gabbro, rich in chlorite, oxides; contains abundant pyrite and red-stained, recrystallized, deformed quartz veins; unnamed formation, Archean; sample depth 371.5-372 ft., Minnesota Geological Survey drill hole KDH-5, T.150N., R.27W., sec. 14, BBABAD, Itasca County.
20. K5-463—Ultramylonite/fault rock containing abundant disrupted quartz vein and pods of felty tonalite; unnamed formation, Archean; sample depth 463-464 ft., Minnesota Geological Survey drill hole KDH-5, T.150N., R.27W., sec. 14, BBABAD, Itasca County.
21. K6-375—Red and green banded fault rock containing discontinuous 3-mm-thick layer of massive pyrite; unnamed formation, Archean; sample depth 375-375.5 ft., Minnesota Geological Survey drill hole KDH-6, T.152N., R.28W., sec. 17, CCDCDD, Koochiching County.
22. K6-382—Green and red striped fault rock containing abundant fine-grained disseminated pyrite and chalcopyrite; unnamed formation, Archean; sample depth 382 ft., Minnesota Geological Survey drill hole KDH-6, T.152N., R.28W., sec. 17, CCDCDD, Koochiching County.
23. K7-419.5—Metadiabase containing cm-thick brittle breccia cemented with carbonate, pyrite, and chalcopyrite; unnamed formation, Archean; sample depth 419.5 ft., Minnesota Geological Survey drill hole KDH-7, T.148N., R.30W., sec. 10, BABAAA, Beltrami County.
24. K76-415—Fine-grained metabasalt containing very abundant fine-grained pyrite along cleavage traces; unnamed formation, Archean; sample depth 415-415.5 ft., Minnesota Geological Survey drill hole KIB-76, T.149N., R.31W., sec. 30, DCCDC, Beltrami County.

Table 3. Samples of Cretaceous age—16-element exploration package

	1	2	3	4	5	6	7	8
Ag	.201	.346	.136	.09	.056	.066	.130	.101
As	16.0	23.4	14.7	15.0	13.3	13.3	22.2	10.1
Au	<.048	.822	<.047	<.049	<.049	<.049	<.049	<.049
Cu	58.3	44.1	28.3	28.2	30.7	29.5	34.2	25.6
Hg	.110	.148	.108	.106	.098	.098	.137	.115
Mo	34.6	14.1	19.4	7.95	3.34	3.03	12.4	9.96
Pb	71.8	16.8	16.7	17.1	19.5	16.9	10.3	6.56
Sb	1.89	.915	1.04	.495	<.244	<.244	.922	.607
Tl	1.40	<.49	<.473	<.49	<.488	<.488	<.487	<.492
Zn	139.	110.	83.8	63.7	72.0	73.1	115.	67.0
Bi	.380	.465	.539	.488	.493	.473	.425	.350
Cd	1.85	.839	1.04	.448	.194	.226	.858	.625
Ga	1.92	3.79	2.58	3.44	4.54	3.27	4.70	2.83
Pd	<.484	<.49	<.473	<.49	<.488	<.488	<.487	<.492
Se	3.70	1.87	1.80	<.98	<.977	<.977	1.92	1.33
Te	<.484	<.49	<.473	<.49	<.488	<.488	<.487	<.492
	9	10	11	12	13	14	15	16
Ag	.114	.114	.054	.056	.05	.055	.04	.079
As	16.3	16.0	11.3	5.78	2.88	3.51	9.27	3.22
Au	<.049	<.048	<.049	<.049	<.047	<.049	<.047	.054
Cu	37.1	28.6	23.1	23.9	16.3	23.7	16.3	24.8
Hg	.130	.119	<.098	.108	<.093	.107	<.093	.182
Mo	14.5	15.5	2.99	3.19	3.96	2.41	1.62	1.04
Pb	12.4	13.1	16.0	7.96	7.52	13.5	12.1	17.5
Sb	.608	.542	<.246	<.244	<.233	<.245	<.234	<.241
Tl	<.488	<.484	<.491	<.488	<.466	<.489	<.467	<.483
Zn	101.	73.7	59.5	46.8	34.0	47.1	56.4	59.2
Bi	.472	.488	.490	.288	.299	.414	.379	.638
Cd	.857	.868	.164	.161	.130	.130	.305	.129
Ga	3.92	3.49	3.78	3.62	2.87	5.15	2.81	5.28
Pd	<.488	<.484	<.491	<.488	<.466	<.489	<.467	<.483
Se	2.03	1.83	<.982	<.977	<.931	<.978	<.935	<.965
T	<.488	<.484	<.491	<.488	<.466	<.489	<.467	<.483

Table 3 continued

	17	18	19	20	21	22	23	24
Ag	.057	.041	.061	.078	.091	.074	.155	.180
As	11.1	6.36	7.58	4.35	6.57	5.99	26.3	10.4
Au	<.048	<.049	<.048	<.048	<.048	<.049	<.049	<.046
Cu	17.3	17.4	21.0	20.4	24.2	32.4	27.6	25.3
Hg	.127	<.097	.148	<.096	.122	.109	.285	.175
Mo	5.50	1.27	.921	1.79	3.62	2.56	14.0	20.3
Pb	13.0	11.1	13.3	6.99	8.17	14.4	14.5	5.51
Sb	<.241	<.244	<.24	<.239	<.24	.452	1.23	1.11
Tl	<.483	<.487	<.481	<.479	<.481	<.485	1.26	1.60
Zn	53.0	37.4	52.5	37.7	47.6	52.8	84.5	62.1
Bi	.534	.411	.435	.392	.398	.345	.577	.326
Cd	.299	<.097	.362	.282	.324	.103	.861	1.28
Ga	3.53	4.01	4.50	3.44	3.76	2.97	3.72	1.59
Pd	<.483	<.487	<.481	<.479	<.481	<.485	<.493	<.463
Se	<.965	<.975	<.962	<.958	<.962	<.971	1.55	1.73
Te	<.483	<.487	<.481	<.479	<.481	<.485	<.493	<.463
	25	26	27	28	29	30	31	32
Ag	.093	.087	.109	.247	.076	.097	.077	.296
As	10.1	15.8	17.3	15.4	12.1	10.9	14.0	14.9
Au	<.047	<.049	<.048	<.048	<.049	<.046	<.049	<.049
Cu	33.9	26.0	30.1	35.8	18.9	22.6	18.0	39.5
Hg	.174	.282	.223	.224	.230	.250	.233	.197
Mo	4.88	5.80	1.32	34.8	2.48	2.58	2.22	41.3
Pb	13.6	13.9	15.9	8.03	17.9	16.9	14.5	7.86
Sb	.615	.605	.541	1.77	.517	.593	.512	2.06
Tl	.535	<.488	<.484	2.22	<.492	.548	.568	2.47
Zn	55.8	55.5	55.6	104.	51.0	57.3	50.1	115
Bi	.375	.380	.853	.443	.505	.525	.502	.522
Cd	.274	.200	.132	1.86	.169	.196	.159	2.26
Ga	3.59	3.74	4.02	2.25	3.89	4.40	4.18	2.43
Pd	<.472	<.488	<.484	<.483	<.492	<.463	<.489	<.488
Se	<.943	<.977	<.969	2.87	<.984	<.926	<.978	3.79
Te	<.472	<.488	<.484	<.483	<.492	<.463	<.489	<.488

Table 3 continued

	33	34	35	36	37	38	39	40
Ag	.075	.083	.071	.079	.075	.077	.297	.208
As	11.6	10.9	15.2	17.5	9.61	11.7	16.9	10.7
Au	<.048	<.05	<.047	<.048	<.047	<.046	<.047	<.047
Cu	18.1	19.9	18.4	19.3	17.5	30.7	40.4	26.1
Hg	.278	.226	.198	.239	.185	.168	.224	.142
Mo	2.41	2.62	.951	4.29	1.64	4.57	38.9	28.6
Pb	16.0	16.3	15.6	14.5	13.4	58.0	7.68	5.42
Sb	.538	.497	.443	.729	.531	.548	2.33	1.79
Tl	.627	.525	.549	.687	.641	<.464	2.52	1.63
Zn	54.1	51.1	55.4	66.2	51.4	74.4	126.	73.9
Bi	.512	.546	.481	.503	.477	.361	.480	.379
Cd	.205	.124	.112	.254	.155	.210	2.36	1.66
Ga	3.60	4.24	4.06	3.89	3.66	2.88	2.17	1.41
Pd	<.48	<.496	<.473	<.475	<.467	<.464	<.466	<.473
Se	<.96	<.992	<.945	<.951	<.935	<.928	3.83	2.78
Te	<.48	<.496	<.473	<.475	<.467	<.464	<.466	<.473
	41	42	43	44	45	46	47	
Ag	.081	.113	.075	.099	.094	.123	.102	
As	16.5	9.48	10.4	11.8	13.5	13.1	14.8	
Au	<.049	<.047	<.046	<.046	<.047	<.046	<.048	
Cu	19.5	13.7	16.8	17.0	18.4	20.8	18.7	
Hg	.233	.213	.229	.342	.278	.247	.301	
Mo	2.88	2.65	2.33	6.91	3.00	13.6	9.07	
Pb	16.2	22.5	9.07	11.2	11.5	9.49	12.2	
Sb	.581	.792	.488	.669	.616	.990	.849	
Tl	.593	.521	.488	.826	.643	.807	.868	
Zn	49.7	47.4	40.0	49.0	53.4	65.3	57.1	
Bi	.534	.674	.522	.638	.543	.430	.513	
Cd	.172	.175	.144	.222	.255	.595	.345	
Ga	3.52	5.31	3.95	4.07	3.86	3.28	3.88	
Pd	<.49	<.472	<.464	<.459	<.472	<.463	<.475	
Se	<.98	<.943	<.928	<.917	<.943	1.03	.951	
Te	<.49	<.472	<.464	<.459	<.472	<.463	<.475	

1. KAP12-1—Shale; unnamed formation, Late Cretaceous; sample depth 300-305 ft., APL-87-12, T.124N., R.48W., sec. 6, ABB, Big Stone County.
2. KAP12-2—Shale; unnamed formation, Late Cretaceous; sample depth 340-345 ft., APL-87-12, T.124N., R.48W., sec. 6, ABB, Big Stone County.

3. KAP12-3—Shale; unnamed formation, Late Cretaceous; sample depth 375-380 ft., APL-87-12, T.124N., R.48W., sec. 6, ABB, Big Stone County.
4. KAP12-4—Shale; unnamed formation, Late Cretaceous; sample depth 410-415 ft., APL-87-12, T.124N., R.48W., sec. 6, ABB, Big Stone County.
5. KAP12-5—Shale; unnamed formation, Late Cretaceous; sample depth 440-445 ft., APL-87-12, T.124N., R.48W., sec. 6, ABB, Big Stone County.
6. KAP12-6—Shale; unnamed formation, Late Cretaceous; sample depth 425-430 ft., APL-87-12, T.124N., R.48W., sec. 6, ABB, Big Stone County.
7. KB03-1—Shale; unnamed formation, Late Cretaceous; sample depth 280-285 ft., DNR OB Well #3, T.123N., R.48W., sec. 4, CCC, Big Stone County.
8. KBO3-2—Shale; unnamed formation, Late Cretaceous; sample depth 315-320 ft., DNR OB Well #3, T.123N., R.48W., sec. 4, CCC, Big Stone County.
9. KBO-3-3—Shale; unnamed formation, Late Cretaceous; sample depth 360-365 ft., DNR OB Well #3, T.123N., R.48W., sec. 4, CCC, Big Stone County.
10. KAP11-1—Shale; unnamed formation, Late Cretaceous; sample depth 190-195 ft., APL-87-11, T.126N., R.45W., sec. 29, BAB, Traverse County.
11. KAP11-2—Shale; unnamed formation, Late Cretaceous; sample depth 225-230 ft., APL-87-11, T.126N., R.45W., sec. 29, BAB, Traverse County.
12. K80-26-1—Shale; unnamed formation, Late Cretaceous; sample depth 265-270 ft., Kerkhoven 80-26, T.122N., R.37W., sec. 21, BDC, Swift County.
13. K80-26-2—Shale; unnamed formation, Late Cretaceous; sample depth 285-290 ft., Kerkhoven 80-26, T.122N., R.37W., sec. 21, BDC, Swift County.
14. K80-26-3—Shale; unnamed formation, Late Cretaceous; sample depth 285-290 ft., Kerkhoven 80-26, T.122N., R.37W., sec. 21, BDC, Swift County.
15. KAP16-1—Shale; unnamed formation, Late Cretaceous; sample depth 175-180 ft., APL-87-16, T.120N., R.40W., sec. 19, BCB, Swift County.
16. KAP16-2—Shale; unnamed formation, Late Cretaceous; sample depth 275-280 ft., APL-87-16, T.120N., R.40W., sec. 19, BCB, Swift County.
17. KAP15-1—Shale; unnamed formation, Late Cretaceous; sample depth 170-175 ft., APL-87-15, T.120N., R.42W., sec. 1, BDA, Swift County.
18. KAP15-2—Shale; unnamed formation, Late Cretaceous; sample depth 205-210 ft., APL-87-15, T.120N., R.42W., sec. 1, BDA, Swift County.
19. KAP15-3—Shale; unnamed formation, Late Cretaceous; sample depth 250-255 ft., APL-87-15, T.120N., R.42W., sec. 1, BDA, Swift County.
20. K80-24-1—Shale; unnamed formation, Late Cretaceous; sample depth 230-235 ft., DeGruff 80-24, T.121N., R.38W., sec. 29, BDA, Swift County.
21. K80-24-2—Shale; unnamed formation, Late Cretaceous; sample depth 300-305 ft., DeGruff 80-24, T.121N., R.38W., sec. 29, BDA, Swift County.
22. KAP17-1—Shale; unnamed formation, Late Cretaceous; sample depth 150-155 ft., APL-87-17, T.119N., R.41W., sec. 5, ADD, Chippewa County.
23. KAP10-1—Shale; unnamed formation, Late Cretaceous; sample depth 155-160 ft., APL-87-10, T.118N., R.43W., sec. 18, DCD, Lac Qui Parle County.

24. KAP10-2—Shale; unnamed formation, Late Cretaceous; sample depth 185-190 ft., APL-87-10, T.118N., R.43W., sec. 18, DCD, Lac Qui Parle County.
25. KAP10-3—Shale; unnamed formation, Late Cretaceous; sample depth 210-215 ft., APL-87-10, T.118N., R.43W., sec. 18, DCD, Lac Qui Parle County.
26. KAP10-4—Lignitic shale; unnamed formation, Late Cretaceous; sample depth 245-250 ft., APL-87-10, T.118N., R.43W., sec. 18, DCD, Lac Qui Parle County.
27. KAP7-1—Shale; unnamed formation, Late Cretaceous; sample depth 150-155 ft., APL-87-7, T.118N., R.44W., sec. 6, DAD, Lac Qui Parle County.
28. KAP7-2—Shale; unnamed formation, Late Cretaceous; sample depth 210-215 ft., APL-87-7, T.118N., R.44W., sec. 6, DCD, Lac Qui Parle County.
29. KAP7-3—Shale; unnamed formation, Late Cretaceous; sample depth 245-250 ft., APL-87-7, T.118N., R.44W., sec. 6, DCD, Lac Qui Parle County.
30. KAP7-4—Shale; unnamed formation, Late Cretaceous; sample depth 285-290 ft., APL-87-7, T.118N., R.44W., sec. 6, DCD, Lac Qui Parle County.
31. KAP6-1—Shale; unnamed formation, Late Cretaceous; sample depth 155-160 ft., APL-87-6, T.118N., R.45W., sec. 15, BCC, Lac Qui Parle County.
32. KAP6-2—Shale; unnamed formation, Late Cretaceous; sample depth 235-240 ft., APL-87-6, T.118N., R.45W., sec. 15, BCC, Lac Qui Parle County.
33. KAP6-3—Shale; unnamed formation, Late Cretaceous; sample depth 260-265 ft., APL-87-6, T.118N., R.45W., sec. 15, BCC, Lac Qui Parle County.
34. KAP6-4—Shale; unnamed formation, Late Cretaceous; sample depth 295-300 ft., APL-87-6, T.118N., R.45W., sec. 15, BCC, Lac Qui Parle County.
35. KAP6-5—Shale; unnamed formation, Late Cretaceous; sample depth 180-185 ft., APL-87-6, T.118N., R.45W., sec. 15, BCC, Lac Qui Parle County.
36. KAP6-6—Shale; unnamed formation, Late Cretaceous; sample depth 210-215 ft., APL-87-6, T.118N., R.45W., sec. 15, BCC, Lac Qui Parle County.
37. KAP3-1—Shale; unnamed formation, Late Cretaceous; sample depth 165-170 ft., APL-87-3, T.119N., R.45W., sec. 29, CCB, Lac Qui Parle County.
38. KAP3-2—Shale; unnamed formation, Late Cretaceous; sample depth 200-205 ft., APL-87-3, T.119N., R.45W., sec. 29, CCB, Lac Qui Parle County.
39. KAP3-3—Shale; unnamed formation, Late Cretaceous; sample depth 235-240 ft., APL-87-3, T.119N., R.45W., sec. 29, CCB, Lac Qui Parle County.
40. KAP3-4—Shale; unnamed formation, Late Cretaceous; sample depth 240-245 ft., APL-87-3, T.119N., R.45W., sec. 29, CCB, Lac Qui Parle County.
41. KAP3-5—Shale; unnamed formation, Late Cretaceous; sample depth 260-265 ft., APL-87-3, T.119N., R.45W., sec. 29, CCB, Lac Qui Parle County.
42. KAP3-6—Shale; unnamed formation, Late Cretaceous; sample depth 285-290 ft., APL-87-3, T.119N., R.45W., sec. 29, CCB, Lac Qui Parle County.
43. K80-12-1—Shale; unnamed formation, Late Cretaceous; sample depth 322-325 ft., DNR 80-12, T.116N., R.46W., sec. 20, BCC, Lac Qui Parle County.
44. K80-12-2—Shale; unnamed formation, Late Cretaceous; sample depth 360-365 ft., DNR 80-12, T.116N., R.46W., sec. 20, BCC, Lac Qui Parle County.

45. K80-12-3—Shale; unnamed formation, Late Cretaceous; sample depth 385-390 ft., DNR 80-12, T.116N., R.46W., sec. 20, BCC, Lac Qui Parle County.
46. K80-12-4—Shale; unnamed formation, Late Cretaceous; sample depth 440-445 ft., DNR 80-12, T.116N., R.46W., sec. 20, BCC, Lac Qui Parle County.
47. K80-12-5—Shale; unnamed formation, Late Cretaceous; sample depth 475-480 ft., DNR 80-12, T.116N., R.46W., sec. 20, BCC, Lac Qui Parle County.

Table 4. Publicly submitted samples—37-element exploration package

	1	2	3	4
Au	1	1	<1	3
Li	20	<10	<10	<10
Be	<5	<5	<5	<5
B	20	20	50	30
Sc	--	--	--	--
V	180	<10	10	<10
Cr	70	4	12	8
Mn	400	20	38	140
Co	26	5	1	3
Ni	57	11	6	13
Cu	34.0	6.5	7.5	48.0
Zn	250.	4.5	7.0	15.0
Ge	<10	<10	<10	<10
As	<1	<1	<1	6
Se	<3	<3	<3	<3
Mo	<2	<2	<2	<2
Ag	<0.5	<0.5	<0.5	<0.5
Cd	<1	<1	<1	<1
In	<1	<1	<1	<1
Sn	<10	<10	<10	49
Sb	0.2	0.2	0.2	1.7
Cs	3	<1	<1	<1
La	2930	34	38	20
Ce	5790	75	96	44
Nd	2300.	27.6	37.8	16.9
Sm	286.	3.8	5.4	2.6
Eu	7.0	0.4	1.0	0.5
Tb	--	--	--	--
Yb	--	--	--	--
Lu	0.5	0.1	0.2	0.2
Hf	27	<1	2	1
Ta	2	<1	<1	<1
W	44	21	15	11
Pb	150	8	6	350
Bi	3.6	<0.5	<0.5	<0.5
Th	1140	10	4	4
U	18.8	0.8	1.3	1.6

1. GSP-47—Microcline-biotite schist containing monazite; Archean migmatite terrane; outcrop sample, T.67N., R.24W., sec. 23, BD, Koochiching County.
2. GSP-48—Sandstone, medium- to coarse-grained, yellow-gray; Mt. Simon Formation, Upper Cambrian; sample depth 500 ft., water well, T.107N., R.7W., sec. 23, ABBABC, Winona County.
3. GSP-49—Sandstone, slightly conglomeratic; with clasts of mafic porphyry; Archean migmatite terrane; outcrop sample, T.67N., R.24W., sec. 23, BD, Koochiching County.
4. GSP-50—Sandstone, medium- to coarse-grained, red; Mt. Simon Formation, Upper Cambrian; sample depth 510 ft., water well T.107N., R.7W., sec. 23, ABBABC, Winona County.

Table 5. Samples of Early Proterozoic age—37-element exploration package

	1	2	3	4	5	6	7	8
Au	4	7	15	27	150	10	9	7
Li	--	--	--	--	--	--	--	--
Be	--	2	4	3	3	--	2	--
B	--	100	270	<10	20	--	130	--
Sc	--	27.8	30.4	5.88	13.3	--	22.7	--
V	--	310	190	990	1900	--	310	--
Cr	--	150.	170.	19.0	83.0	--	130.	--
Mn	--	120	100	50	450	--	34	--
Co	--	14.0	22.0	12.0	25.0	--	16.0	--
Ni	--	73	110	230	220	--	210	--
Cu	--	78.0	120.	2500.	150.	--	87.0	--
Zn	--	73.0	65.0	360.	630.	--	110.	--
Ge	--	<10	<10	<10	<10	--	<10	--
As	--	15	4	180	240	--	2	--
Se	--	<2.0	2.0	98.0	25.0	--	13.0	--
Mo	--	6	6	210	180	--	39	--
Ag	<0.5	<0.5	1.0	6.0	<0.5	<0.5	<0.5	<0.5
Cd	--	<1	<1	2	4	--	<1	--
In	--	--	--	--	--	--	--	--
Sn	--	--	--	--	--	--	--	--
Sb	--	1.6	1.4	94.0	36.0	--	0.8	--
Cs	--	6.2	8.0	<0.2	4.2	--	5.2	--
La	--	36.8	43.0	26.8	33.6	--	33.3	--
Ce	--	61	67	38	39	--	52	--
Nd	--	25	24	32	29	--	21	--
Sm	--	4.47	4.36	6.95	5.41	--	3.81	--
Eu	--	1.30	1.17	2.13	1.52	--	1.05	--
Tb	--	0.6	0.4	0.7	0.7	--	0.4	--
Yb	--	2.20	2.05	3.46	6.45	--	2.62	--
Lu	--	0.37	.035	0.69	1.46	--	0.47	--
Hf	--	3.7	3.5	1.5	1.3	--	2.7	--
Ta	--	0.8	1.0	<0.5	<0.5	--	0.6	--
W	--	6	3	15	7	--	2	--
Pb	--	10	28	34	60	--	18	--
Bi	--	--	--	--	--	--	--	--
Th	--	11.0	14.0	12.0	4.2	--	12.0	--
U	--	8.3	2.9	15.7	38.7	--	8.3	--

Table 5 continued

	9	10	11	12	13	14	15	16
Au	2	7	8	98	51	170	52	240
Li	--	--	--	<10	<10	<10	30	<10
Be	--	--	1	10	10	5	10	5
B	--	--	90	<10	<10	<10	3200	<10
Sc	--	--	22.4	--	--	--	--	--
V	--	--	180	10	3600	280	210	360
Cr	--	--	150	--	52	32	--	70
Mn	--	--	280	--	58	24	--	18
Co	--	--	24.0	31	52	20	112	60
Ni	--	--	85	--	850	230	--	500
Cu	--	--	100.	--	7700.	34000	--	330.
Zn	--	--	180	--	1100.	260.	--	1600.
Ge	--	--	<10	<10	<10	<10	10	<10
As	--	--	2	6	1500	15000	71	1000
Se	--	--	5.0	<3	3	6	<3	<3
Mo	--	--	10	2	332	83	94	78
Ag	<0.5	<0.5	<0.5	--	11.0	5.0	--	<0.5
Cd	--	--	2	--	3	1	--	6
In	--	--	--	<1	<1	<1	<1	<1
Sn	--	--	--	<10	<10	<10	<10	<10
Sb	--	--	5.2	--	200.	260.	--	18.0
Cs	--	--	4.2	<1	<1	<1	<1	<1
La	--	--	35.1	18	29	21	305	95
Ce	--	--	61	35	44	29	537	122
Nd	--	--	27	19.3	42.9	29.4	258.	90.8
Sm	--	--	5.12	3.5	8.3	5.6	39.2	14.2
Eu	--	--	1.56	0.8	2.0	1.4	8.5	3.1
Tb	--	--	0.7	--	--	--	--	--
Yb	--	--	2.73	--	--	--	--	--
Lu	--	--	0.50	0.2	0.4	0.5	1.1	0.5
Hf	--	--	3.9	<1	2	<1	15	<1
Ta	--	--	<0.5	1	2	<1	1	1
W	--	--	1	978	2540	1990	1120	1930
Pb	--	--	26	--	10	50	--	36
Bi	--	--	--	2.2	<0.5	<0.5	6.6	0.8
Th	--	--	9.0	2	20	7	69	8
U	10.2	9.9	9.8	1.1	15.3	7.0	12.6	24.3

Table 5 continued

	17	18	19	20	21	22	23	24
Au	350	160	180	17	2	74	36	--
Li	10	10	<10	<10	10	<10	10	20
Be	5	5	5	5	5	5	10	5
B	40	20	30	40	40	490	380	2800
Sc	--	--	--	--	--	--	--	--
V	1800	2100	2100	200	10	160	100	180
Cr	70	64	76	10	2	--	--	--
Mn	460	400	140	460	280	--	--	--
Co	33	17	23	4	1	240	100	--
Ni	270	190	230	56	3	--	--	--
Cu	48.0	36.0	.33.0	38.0	12.0	--	--	--
Zn	1300.	120.	300.	290.	26.0	--	--	--
Ge	<10	<10	<10	<10	<10	20	<10	30
As	320	280	320	88	20	6	18	6
Se	<3	<3	<3	<3	<3	<3	<3	--
Mo	215	245	214	24	10	29	160	--
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	--	--	--
Cd	5	<1	1	1	<1	--	--	--
In	<1	<1	<1	<1	<1	<1	<1	--
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sb	40.0	40.0	40.0	8.1	4.1	--	--	--
Cs	6	5	6	<1	<1	2	<1	--
La	32	34	33	3	3	479	198	--
Ce	42	44	43	5	7	862	354	--
Nd	30.5	30.3	30.2	2.8	2.5	359.	157.	--
Sm	5.3	4.9	5.2	0.7	<0.5	56.4	24.2	--
Eu	1.4	1.1	1.4	0.3	0.3	12.2	5.4	--
Tb	--	--	--	--	--	--	--	--
Yb	--	--	--	--	--	--	--	--
Lu	0.9	0.3	1.0	0.2	0.1	1.8	0.9	--
Hf	2	2	2	<1	<1	16	7	--
Ta	<1	<1	<1	<1	<1	<1	2	--
W	30	14	11	<10	<10	642	1230	--
Pb	72	50	64	20	2	--	--	--
Bi	2.2	0.8	1.5	<0.5	<0.5	3.8	8.3	--
Th	5	3	6	<1	<1	129	55	--
U	74.6	9.7	81.3	8.2	3.2	25.5	21.1	--

Table 5 continued

	25	26	27
Au	--	72	--
Li	<10	10	<10
Be	5	10	10
B	1700	800	120
Sc	--	--	--
V	120	70	80
Cr	--	--	--
Mn	--	--	--
Co	182	207	--
Ni	--	--	--
Cu	--	--	--
Zn	--	--	--
Ge	<10	<10	20
As	5	6	2900
Se	<3	<3	--
Mo	17	10	--
Ag	--	--	--
Cd	--	--	--
In	<1	<1	--
Sn	<10	<10	<10
Sb	--	--	--
Cs	<1	<1	--
La	1000	285	--
Ce	1900	530	--
Nd	837.	225.	--
Sm	126.	35.6	--
Eu	28.4	7.7	--
Tb	--	--	--
Yb	--	--	--
Lu	2.7	1.1	--
Hf	31	12	--
Ta	2	2	--
W	1600	1170	--
Pb	--	--	--
Bi	6.9	5.8	--
Th	243	75	--
U	52.0	13.9	--

1. 47-19-15—Slate, graphitic; unnamed metavolcanic and metasedimentary formation, Early Proterozoic; outcrop sample, T.47N., R.19W., sec. 15, CBA, Carlton County.

2. AB-2-103—Phyllite, graphitic; Thomson Formation, Early Proterozoic; sample depth 103 ft., drill hole AB-2, T.47N., R.19W., sec. 7, CBB, Carlton County.
3. AB-24A-423—Slate, graphitic; unnamed graphitic schist and slate formation, Early Proterozoic; sample depth 423 ft., drill hole AB-24A, T.45N., R.28W., sec. 2, CDB, Crow Wing County.
4. AB-27-210—Argillite, graphitic; unnamed metavolcanic and metasedimentary formation, Early Proterozoic; sample depth 209-218 ft., drill hole AB-27, T.47N., R.26W., sec. 19, DDD, Aitkin County.
5. Arrow 1—Slate, graphitic-brecciated; Thomson Formation, Early Proterozoic; outcrop sample, T.48N., R.18W., sec. 32, BCB, Carlton County.
6. EL-1-22—Slate, graphitic; unnamed metavolcanic and metasedimentary formation, Early Proterozoic; sample depth 21.7-22.9 ft., drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
7. EL-1-57—Slate, graphitic; unnamed metavolcanic and metasedimentary formation, Early Proterozoic; sample depth 56.2-57.2 ft., drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
8. EL-1-74—Slate, graphitic; unnamed metavolcanic and metasedimentary formation, Early Proterozoic; sample depth 73.7-74.7 ft., drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
9. EL-1-121—Slate, graphitic; unnamed metavolcanic and metasedimentary formation, Early Proterozoic; sample depth 120.5-121.6 ft., drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
10. EL-1-188—Slate, graphitic; unnamed metavolcanic and metasedimentary formation, Early Proterozoic; sample depth 188-189 ft., drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
11. LV-3-385—Argillite, graphitic; Virginia Formation, Early Proterozoic; sample depth 385 ft., drill hole LV-3, T.139N., R.28W., sec. 2, ABA, Cass County.
12. AB-2-103—Sulfide split; sample depth 103 ft., drill hole AB-2, T.47N., R.19W., sec. 7, CBB, Carlton County.
13. AB-27-210—Sulfide split; sample depth 210 ft., drill hole AB-7, T.47N., R.26W., sec. 19, DDD, Carlton County.
14. AB-27-210S—Sulfide split; sample depth 210 ft., drill hole AB-27, T.47N., R.26W., sec. 19, DDD, Carlton County.
15. AB-24A-423—Sulfide split; sample depth 423 ft., drill hole AB-24A, T.45N., R.28W., sec. 2, CDB, Crow Wing County.
16. Arrow 1—Sulfide split; outcrop sample, T.48N., R.18W., sec. 32, BCB, Carlton County.
17. Arrow 2—Sulfide split; brecciated graphitic slate; outcrop sample, T.48N., R.18W., sec. 32, BCB, Carlton County.
18. Arrow 3—Sulfide split; brecciated graphitic slate; outcrop sample, T.48N., R.18W., sec. 32, BCB, Carlton County.
19. Arrow 4—Sulfide split; brecciated graphitic slate; outcrop sample, T.48N., R.18W., sec. 32, BCB, Carlton County.
20. Arrow 5—Sulfide split; quartz vein, massive, pyrite- and hematite-bearing; outcrop sample, T.48N., R.18W., sec. 32, BCB, Carlton County.
21. Arrow 6—Sulfide split; sheared granular quartz with pyrite, hematite, and some slate; outcrop sample, T.48N., R.18W., sec. 32, BCB, Carlton County.

22. EL-1-22—Sulfide split; drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
23. EL-1-57—Sulfide split; drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
24. EL-1-74—Sulfide split; drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
25. EL-1-121—Sulfide split; drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
26. EL-1-188—Sulfide split; drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
27. LV3-385—Sulfide split, drill hole LV-3, T.139N., R.28W., sec. 2, ABA, Cass County.

Table 6. Samples of Cretaceous age—37-element exploration package

	1	2	3	4	5	6	7	8
Au	<4	<2	<1	5	<2	<1	<1	<1
Li	<10	<10	<10	<10	<10	<10	20	60
Be	<5	<5	<5	5	<5	<5	<5	<5
B	50	120	130	150	150	170	180	150
Sc	8.0	16.7	16.5	19.5	19.5	20.7	20.3	20.3
V	40	110	110	130	120	140	150	140
Cr	22	72	76	90	96	100	100	100
Mn		470	210	200	210	220	230	190
Co	10	24	20	22	21	22	23	23
Ni	8	34	32	39	39	42	43	42
Cu	6.0	16.0	15.0	20.0	21.0	22.0	21.0	20.0
Zn	28.0	84.0	73.0	110.	87.0	85.0	87.0	88.0
Ge	<10	<10	20	<10	20	<10	10	<10
As	13	40	35	21	17	19	24	37
Se	<3	<3	<3	<3	<3	<3	<3	<3
Mo	<2	<2	<2	2	<2	<2	<2	<2
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	<1	<1	<1	<1	<1	<1	<1	<1
In	<1	<1	<1	<1	<1	<1	<1	<1
Sn	<10	18	<10	<10	<10	<10	<10	<10
Sb	0.6	0.4	0.4	0.4	0.3	<0.2	0.4	0.5
Cs	3	7	7	9	9	10	10	10
La	24.8	51.7	50.0	54.6	52.0	53.2	51.2	52.5
Ce	42	92	88	96	91	96	94	94
Nd	19	44	38	37	47	41	43	42
Sm	3.0	6.9	7.4	7.2	6.9	6.9	6.8	6.8
Eu	0.7	1.4	1.7	1.7	1.3	1.3	1.2	1.3
Tb	<0.5	0.8	0.9	0.6	0.6	0.6	0.6	0.7
Yb	1.3	3.2	3.4	3.5	2.8	2.7	2.9	2.8
Lu	0.2	0.5	0.5	0.4	0.4	0.4	0.4	0.4
Hf	1	6	7	5	4	3	4	4
Ta	<1	<1	1	1	<1	1	<1	1
W	<3	<3	<3	<3	<3	<3	<3	<3
Pb	<2	14	12	16	16	14	14	14
Bi	<3	<3	<3	<3	<3	<3	<3	<3
Th	3	12	12	14	13	13	13	14
U	1.9	3.2	2.6	3.6	2.3	2.5	2.7	2.9

Table 6 continued

	9	10	11	12	13	14	15	16
Au	<1	<1	<2	<1	<2	<1	110	2
Li	100	90	100	60	80	80	50	<10
Be	<5	<5	<5	<5	5	<5	<5	<5
B	180	180	170	170	150	180	170	140
Sc	19.9	20.3	21.1	20.1	20.74	20.6	20.5	18.1
V	150	150	150	150	140	190	160	190
Cr	100	100	110	100	86	92	84	82
Mn	160	130	150	160	360	170	200	140
Co	21	26	24	27	24	20	20	20
Ni	42	46	41	48	50	67	46	92
Cu	22.0	24.0	25.0	24.0	26.0	31.0	26.0	38.0
Zn	100	110.	110.	120.	100.	230.	92.0	140.
Ge	<10	10	10	<10	10	<10	<10	<10
As	16	21	28	28	35	41	25	36
Se	<3	<3	<3	<3	<3	<3	<3	3
Mo	<2	<2	<2	<2	<2	13	2	20
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	<1	<1	<1	<1	<1	2	2	3
In	<1	<1	<1	<1	<1	<1	<1	<1
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sb	0.5	0.3	0.3	0.3	0.4	0.8	0.3	1.0
Cs	9	10	10	9	8	9	9	9
La	52.0	55.6	58.8	54.5	50.3	61.3	50.9	42.9
Ce	96	97	118	95	94	113	92	78
Nd	36	39	46	41	35	57	39	30
Sm	6.9	7.1	7.9	6.9	6.9	9.4	6.4	5.6
Eu	1.8	1.5	1.4	1.7	1.6	2.2	1.5	1.6
Tb	0.7	1.1	1.1	0.9	0.8	1.2	0.6	<0.5
Yb	2.7	3.1	3.3	3.2	2.7	3.2	3.0	2.0
Lu	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.4
Hf	4	4	4	4	4	3	4	3
Ta	1	1	1	1	<1	<1	1	<1
W	<3	<3	<3	<3	<3	<3	<3	<3
Pb	16	16	16	16	12	10	16	10
Bi	<3	<3	<3	<3	<3	<3	<3	<3
Th	13	14	14	14	12	12	14	11
U	2.6	3.3	2.8	0.9	3.4	7.5	3.9	7.3

Table 6 continued

	17	18	19	20	21	22	23	24
Au	<1	3	<2	<3	<1	<1	<1	4
Li	<10	<10	<10	<10	<10	<10	<10	<10
Be	<5	<5	<5	5	<5	10	<5	<5
B	140	100	120	180	160	70	170	160
Sc	16.4	7.8	12.8	21.2	20.7	21.0	20.5	19.4
V	200	460	90	150	140	100	140	130
Cr	78	48	68	86	100	8	96	110
Mn	150	130	240	180	150	--	220	140
Co	20	15	14	19	21	14	23	26
Ni	87	120	26	41	45	5	46	59
Cu	36.0	45.0	27.0	23.0	24.0	4.0	23.0	26.0
Zn	140.	160	61.0	92.0	120.	38.0	110.	130.
Ge	<10	10	<10	10	10	10	<10	<10
As	40	44	10	20	19	17	42	24
Se	3	7	<3	<3	<3	<3	<3	<3
Mo	25	50	<2	<2	<2	<2	<2	3
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	2	3	<1	<1	<1	<1	<1	<1
In	<1	<1	<1	<1	<1	<1	<1	<1
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sb	1.6	4.5	0.3	0.4	0.4	0.3	0.3	0.6
Cs	10	4	4	10	10	2	9	10
La	39.6	21.5	44.4	53.6	56.2	61.7	55.0	52.2
Ce	71	38	82	95	100	139	97	87
Nd	29	17	32	40	45	82	41	31
Sm	5.4	3.3	6.2	6.7	6.9	13.3	6.8	5.8
Eu	1.2	0.8	1.7	2.1	1.6	4.0	1.7	1.5
Tb	0.6	<0.5	1.0	0.7	<0.5	2.2	1.1	0.7
Yb	2.1	1.1	2.4	2.7	2.9	4.1	3.0	2.6
Lu	0.4	0.3	0.4	0.5	0.5	0.6	0.4	0.4
Hf	3	1	7	3	4	1	4	4
Ta	<1	<1	<1	<1	1	<1	1	1
W	<3	<3	<3	<3	3	<3	3	<3
Pb	8	6	10	22	20	<2	20	24
Bi	<3	<3	<3	<3	<3	<3	<3	<3
Th	10	5	12	14	14	3	13	14
U	9.6	11.4	2.5	3.0	2.8	2.3	2.5	2.7

Table 6 continued

	25	26	27	28	29	30	31	32
Au	<2	2	<2	<1	3	4	1	<1
Li	<10	<10	<10	<10	<10	<10	<10	<10
Be	<5	<5	<5	<5	<5	<5	<5	<5
B	110	80	60	10	10	150	150	140
Sc	13.2	7.2	6.1	2.6	1.4	20.0	18.0	16.5
V	260	320	210	80	160	150	110	110
Cr	70	42	32	16	36	94	84	72
Mn	140	150	140	220	190	190	220	200
Co	18	13	12	8	8	19	18	17
Ni	90	84	80	29	36	59	44	37
Cu	33.0	41.0	36.0	12.0	21.0	31.0	21.0	20.0
Zn	140.	170.	130.	46.0	100.	130.	91.0	77.0
Ge	10	<10	<10	<10	<10	<10	<10	<10
As	25	21	19	14	6	18	15	16
Se	4	5	5	<3	<3	<3	<3	<3
Mo	28	36	40	14	13	11	<2	<2
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	3	3	1	<1	<1	<1	<1	<1
In	<1	<1	<1	<1	<1	<1	<1	<1
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sb	3.7	3.7	3.5	1.1	0.6	0.5	0.5	0.4
Cs	6	3	3	1	<1	9	8	7
La	34.7	21.9	17.5	17.0	6.0	50.7	53.8	58.9
Ce	62	35	30	25	9	86	101	101
Nd	24	19	14	10	<5	38	38	41
Sm	4.5	3.0	2.2	1.7	0.7	6.2	7.0	7.4
Eu	1.2	0.7	0.6	0.4	0.3	1.2	1.8	1.6
Tb	0.6	<0.5	<0.5	<0.5	<0.5	0.7	0.9	0.8
Yb	1.8	1.3	0.9	1.2	0.4	2.9	3.6	3.7
Lu	0.3	0.3	0.1	0.1	<0.1	0.4	0.5	0.5
Hf	3	2	1	<1	<1	4	6	8
Ta	1	<1	<1	<1	<1	1	1	2
W	<3	<3	<3	<3	<3	<3	<3	<3
Pb	12	6	<2	<2	<2	18	12	16
Bi	<3	<3	<3	<3	<3	<3	<3	<3
Th	9	4	3	1	1	13	14	14
U	9.1	11.0	13.8	16.6	6.5	4.9	2.8	3.3

Table 6 continued

	33	34	35	36	37	38	39
Au	2	<1	19	<1	<1	2	<1
Li	<10	<10	<10	<10	<10	<10	<10
Be	<5	<5	5	<5	<5	<5	<5
B	180	140	30	170	120	60	40
Sc	24.1	15.3	7.3	8.6	17.6	15.7	12.3
V	160	110	30	30	110	110	40
Cr	120	74	<2	2	74	44	18
Mn	140	460	--	84	170	420	--
Co	26	15	7	8	27	19	62
Ni	59	31	<1	9	38	23	21
Cu	25.0	19.0	2.0	3.5	22.0	14.0	25.0
Zn	100.	64.0	20.0	74.0	81.0	57.0	49.0
Ge	10	10	<10	10	<10	<10	<10
As	25	16	4	12	19	11	3
Se	<3	<3	<3	<3	<3	<3	<3
Mo	<2	<2	<2	<2	<2	<2	<2
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	<1	<1	<1	<1	<1	<1	<1
In	<1	<1	<1	<1	<1	<1	<1
Sn	10	<10	<10	11	<10	<10	<10
Sb	<0.2	0.3	<0.2	1.3	0.5	<0.2	<0.2
Cs	9	5	2	<1	5	1	1
La	69.5	51.4	15.6	90.4	69.5	27.6	20.3
Ce	116	104	31	160	140	55	66
Nd	54	35	12	60	53	19	12
Sm	8.8	7.2	2.5	9.6	10.0	3.5	1.8
Eu	2.4	1.9	0.8	1.2	2.5	0.7	0.6
Tb	1.6	1.0	<0.5	1.3	1.6	<0.5	<0.5
Yb	3.3	3.4	1.5	2.3	4.5	1.8	0.6
Lu	0.5	0.5	0.2	0.4	0.7	0.3	0.1
Hf	4	8	2	8	8	18	7
Ta	<1	1	<1	3	2	1	<1
W	<3	<3	<3	<3	<3	<3	<3
Pb	24	14	<2	30	16	10	<2
Bi	<3	<3	<3	<3	<3	<3	<3
Th	20	14	3	41	17	11	3
U	3.1	3.1	1.2	6.1	4.1	2.2	0.7

1. K288-01—Speckled claystone; unit 6, Late Cretaceous; sample depth 116 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.

2. K288-02—Silty claystone; unit 6, Late Cretaceous; sample depth 127 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
3. K288-03—Silty claystone; unit 5, Late Cretaceous; sample depth 134 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
4. K288-04—Claystone; unit 5, Late Cretaceous; sample depth 144 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
5. K288-05—Sandy claystone; unit 5, Late Cretaceous; sample depth 149 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
6. K288-06—Claystone; unit 5, Late Cretaceous; sample depth 153 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
7. K288-07—Claystone; unit 5, Late Cretaceous; sample depth 158 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
8. K288-08—Claystone; unit 5, Late Cretaceous; sample depth 163 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
9. K288-09—Claystone; unit 5, Late Cretaceous; sample depth 168 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
10. K288-15—Claystone; unit 5, Late Cretaceous; sample depth 193 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
11. K288-16—Claystone; unit 5, Late Cretaceous; sample depth 198 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
12. K288-17—Claystone; unit 5, Late Cretaceous; sample depth 203 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
13. K288-18—Claystone; unit 5, Late Cretaceous; sample depth 208 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
14. K288-19—Calcareous claystone; unit 4, Late Cretaceous; sample depth 213 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
15. K288-20—Calcareous claystone; unit 4, Late Cretaceous; sample depth 218 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
16. K288-21—Calcareous claystone; unit 4, Late Cretaceous; sample depth 221 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
17. K288-22—Calcareous claystone; unit 4, Late Cretaceous; sample depth 226 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
18. K288-26—Limy claystone; unit 3, Late Cretaceous; sample depth 242 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
19. K288-34—Clayey siltstone; unit 2, Late Cretaceous; sample depth 282 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
20. K288-10—Claystone; unit 5, Late Cretaceous; sample depth 173 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
21. K288-11—Claystone; unit 5, Late Cretaceous; sample depth 178 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
22. K288-12—Silty marl; unit 5, Late Cretaceous; sample depth 183 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.

23. K288-13—Claystone; unit 5, Late Cretaceous; sample depth 183.5 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
24. K288-14—Claystone; unit 5, Late Cretaceous; drill hole 189 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
25. K288-23—Calcareous claystone; unit 4, Late Cretaceous; sample depth 236 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
26. K288-24—Calcareous claystone; unit 4, Late Cretaceous; sample depth 236 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
27. K288-25—Limy claystone; unit 3, Late Cretaceous; sample depth 241 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
28. K288-27—Shaley calcarenite; unit 3, Late Cretaceous; sample depth 246 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
29. K288-28—Shaley calcarenite; unit 3, Late Cretaceous; sample depth 251 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
30. K288-29—Claystone; unit 2, Late Cretaceous; sample depth 256 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
31. K288-30—Claystone; unit 2, Late Cretaceous; sample depth 260 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
32. K288-31—Claystone; unit 2, Late Cretaceous; sample depth 265 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
33. K288-32—Claystone; unit 2, Late Cretaceous; sample depth 270 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
34. K288-33—Sandy claystone; unit 2, Late Cretaceous; sample depth 275 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
35. K288-35—Nodule; unit 2, Late Cretaceous; sample depth 284 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
36. K288-36—Claystone; unit 2, Late Cretaceous; sample depth 290 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
37. K288-37—Claystone; unit 2, Late Cretaceous; sample depth 302 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
38. K288-38—Organic clayey sandstone; unit 2, Late Cretaceous; sample depth 304 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
39. K288-39—Saprolith; pre-Cretaceous; sample depth 306 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.

Table 7 continued

	57	58	59	60
Au	--	--	--	--
Li	14	19	20	32
Be	1.6	1.3	1.4	2.0
B	5	7	4	9
Sc	3.5	4.4	4.5	6.2
V	19.5	25.1	21.6	40.1
Cr	23	32	26	44
Mn	--	--	--	--
Co	3	3	3	6
Ni	15	12	16	21
Cu	15.2	5.8	9.7	7.9
Zn	17.5	18.8	16.5	21.1
Ge	--	--	--	--
As	<3	7	6	13
Se	<20	<20	<20	<20
Mo	<1	<1	<1	<1
Ag	<0.5	<0.5	<0.5	<0.5
Cd	<2	<2	<2	<2
In	--	--	--	--
Sn	<10	<10	<10	<10
Sb	<5	<5	<5	<5
Cs	--	--	--	--
La	--	--	--	--
Ce	--	--	--	--
Nd	--	--	--	--
Sm	--	--	--	--
Eu	--	--	--	--
Tb	--	--	--	--
Yb	--	--	--	--
Lu	--	--	--	--
Hf	--	--	--	--
Ta	--	--	--	--
W	<10	<10	<10	<10
Pb	<2	<2	<2	<2
Bi	--	--	--	--
Th	--	--	--	--
U	--	--	--	--

1. 622—Limestone; Cedar Valley Formation, Devonian; insoluble residue; sample depth 150-160 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.

2. 623—Limestone; Maquoketa Formation, Ordovician; insoluble residue; sample depth 165-185 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
3. 624—Limestone; Maquoketa Formation, Ordovician; insoluble residue; sample depth 185-200 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
4. 625—Limestone; Maquoketa Formation, Ordovician; insoluble residue; sample depth 200-210 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
5. 626—Limestone; Maquoketa Formation, Ordovician; insoluble residue; sample depth 210-220 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
6. 627—Limestone; Dubuque Formation, Ordovician; insoluble residue; sample depth 226-235 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
7. 628—Limestone; Stewartville Formation, Galena Group, Ordovician; insoluble residue; sample depth 235-250 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
8. 629—Limestone; Stewartville Formation, Galena Group, Ordovician; insoluble residue; sample depth 250-265 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
9. 630—Limestone; Stewartville Formation, Galena Group, Ordovician; insoluble residue; sample depth 265-280 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
10. 631—Limestone; Stewartville Formation, Galena Group, Ordovician; insoluble residue; sample depth 280-295 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
11. 632—Limestone; Stewartville Formation, Galena Group, Ordovician; insoluble residue; sample depth 295-310 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
12. 633—Limestone; Stewartville Formation, Galena Group, Ordovician; insoluble residue; sample depth 310-325 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
13. 634—Limestone; Stewartville Formation, Galena Group, Ordovician; insoluble residue; sample depth 325-240 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
14. 635—Limestone; Stewartville Formation, Galena Group, Ordovician; insoluble residue; sample depth 340-350 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
15. 636—Limestone; Prosser Formation, Galena Group, Ordovician; Insoluble residue; sample depth 350-370 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
16. 637—Limestone; Prosser Formation, Galena Group, Ordovician; insoluble residue; sample depth 370-390 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
17. 638—Limestone; Prosser Formation, Galena Group, Ordovician; insoluble residue; sample depth 390-410 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
18. 639—Limestone; Prosser Formation, Galena Group, Ordovician; insoluble residue; sample depth 410-430 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
19. 640—Limestone; Cummingsville Formation, Galena Group, Ordovician; insoluble residue; sample depth 430-450 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
20. 641—Limestone; Cummingsville Formation, Galena Group, Ordovician; insoluble residue; sample depth 450-470 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
21. 642—Limestone; Cummingsville Formation, Galena Group, Ordovician; insoluble residue; sample depth 470-485 ft., Albert Lea #7, T.102N., R.21W., sec. 5, DABBA, Freeborn County.
22. 643—Limestone; Stewartville Formation, Galena Group, Ordovician; insoluble residue; sample depth 136-156 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.

23. 644—Limestone; Stewartville Formation, Galena Group, Ordovician; insoluble residue; sample depth 156-176 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
24. 645—Limestone; Stewartville Formation, Galena Group, Ordovician; insoluble residue; sample depth 176-206 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
25. 646—Limestone; Stewartville Formation, Galena Group, Ordovician; insoluble residue; sample depth 226-256 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
26. 647—Limestone; Stewartville Formation, Galena Group, Ordovician; insoluble residue; sample depth 256-276 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
27. 648—Limestone; Stewartville Formation, Galena Group, Ordovician; insoluble residue; sample depth 276-296 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
28. 649—Limestone; Stewartville Formation, Galena Group, Ordovician; insoluble residue; sample depth 296-326 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
29. 650—Limestone; Cummingsville Formation, Galena Group, Ordovician; insoluble residue; sample depth 326-356 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
30. 651—Limestone; Cummingsville Formation, Galena Group, Ordovician; insoluble residue; sample depth 356-386 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
31. 652—Limestone; Cummingsville Formation, Galena Group, Ordovician; insoluble residue; sample depth 386-406 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
32. 653—Limestone; Platteville Formation, Ordovician; insoluble residue; sample depth 446-456 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
33. 654—Limestone; Prairie du Chien Group, Ordovician, insoluble residue; sample depth 546-566 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
34. 655—Limestone; Prairie du Chien Group, Ordovician; insoluble residue; sample depth 566-586 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
35. 656—Limestone; Prairie du Chien Group, Ordovician; insoluble residue; sample depth 586-606 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
36. 657—Limestone; Prairie du Chien Group, Ordovician; insoluble residue; sample depth 606-636 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
37. 658—Limestone; Prairie du Chien Group, Ordovician; insoluble residue; sample depth 656-676 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
38. 659—Limestone; Prairie du Chien Group, Ordovician; insoluble residue; sample depth 676-696 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
39. 660—Limestone; Prairie du Chien Group, Ordovician; insoluble residue; sample depth 696-716 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
40. 661—Limestone; Prairie du Chien Group, Ordovician; insoluble residue; sample depth 716-736 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
41. 662—Limestone; Prairie du Chien Group, Ordovician; insoluble residue; sample depth 736-756 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.

42. 663—Limestone; Prairie du Chien Group, Ordovician; insoluble residue; sample depth 756-776 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
43. 664—Limestone; Prairie du Chien Group, Ordovician; insoluble residue; sample depth 776-796 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
44. 665—Limestone; Prairie du Chien Group, Ordovician; insoluble residue; sample depth 796-816 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
45. 666—Limestone; Prairie du Chien Group, Ordovician; insoluble residue; sample depth 816-836 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
46. 713—Limestone; St. Lawrence Formation, Cambrian; insoluble residue; sample depth 684 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
47. 714—Limestone; St. Lawrence Formation, Cambrian; insoluble residue; sample depth 710 ft., drill hole Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
48. 715—Limestone; St. Lawrence Formation, Cambrian; insoluble residue; sample depth 726-729 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault, County.
49. 716—Limestone; St. Lawrence Formation, Cambrian; insoluble residue; sample depth 726-729 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
50. 717—Limestone; St. Lawrence Formation, Cambrian; insoluble residue; sample depth 736-740 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
51. 718—Limestone, shaley; Eau Claire Formation, Cambrian; insoluble residue; sample depth 1099-1100 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
52. 719—Limestone, shaley; Eau Claire Formation, Cambrian; insoluble residue; sample depth 1109-1119 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
53. 720—Limestone, shaley; Eau Claire Formation, Cambrian; insoluble residue; sample depth 1119-1120 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
54. 721—Limestone, shaley; Eau Claire Formation, Cambrian; insoluble residue; sample depth 1128 ft., Minnegasco KT-4, T.101N., R.24W., sec. 21, CCBDDC, Faribault County.
55. 722—Limestone; Platteville Formation, Ordovician; insoluble residue; sample depth 200-201 ft., Minnegasco Kingstrom #4, T.101N., R.24W., sec. 6, BBAAAA, Faribault County.
56. 723—Limestone; Platteville Formation, Ordovician; insoluble residue; sample depth 202-203 ft., Minnegasco Kingstrom #4, T.101N., R.24W., sec. 6, BBAAAA, Faribault County.
57. 724—Limestone, shaley; Eau Claire Formation, Cambrian; insoluble residue; sample depth 740-750 ft., Pan Oceanic SQ-5, T.102N., R.36W., sec. 11, DDDCDD, Jackson County.
58. 725—Limestone, shaley; Eau Claire Formation, Cambrian; insoluble residue; sample depth 759-769 ft., Pan Oceanic SQ-5, T.102N., R.36W., sec. 11, DDDCDD, Jackson County.
59. 726—Limestone, shaley; Eau Claire Formation, Cambrian; insoluble residue; sample depth 778-788 ft., Pan Oceanic SQ-5, T.102N., R.36W., sec. 11, DDDCDD, Jackson County.
60. 727—Limestone, shaley; Eau Claire Formation, Cambrian; insoluble residue; sample depth 798-807 ft., Pan Oceanic SQ-5, T.102N., R.36W., sec. 11, DDDCDD, Jackson County.

Table 8. Samples of Archean age—donated analyses

	1	2	3	4	5	6	7	8
Au	--	--	--	--	--	--	--	--
Ba	219	192	385	481	396	291	208	126
Be	--	--	--	--	--	--	--	--
B	6	4	2	11	4	2	2	2
Sc	--	--	--	--	--	--	--	--
V	45	43	76	107	83	72	73	74
Cr	82	81	127	143	124	105	99	122
Mn	385	313	456	641	505	490	502	520
Co	12	11	18	23	18	13	15	14
Ni	38	39	54	72	56	46	48	60
Cu	29	26	57	78	51	44	45	32
Zn	55	48	88	116	86	73	82	49
Ge	--	--	--	--	--	--	--	--
As	4	2	4	6	4	2	3	2
Se	--	--	--	--	--	--	--	--
Br	--	--	--	--	--	--	--	--
Mo	--	--	--	--	--	--	--	--
Ag	.1	.1	.1	.1	.1	.1	.1	.1
Cd	.1	1	1	1	1	1	1	1
Sb	2	2	2	2	2	2	2	2
Cs	--	--	--	--	--	--	--	--
La	29	29	41	34	32	31	27	28
Ce	--	--	--	--	--	--	--	--
Nd	--	--	--	--	--	--	--	--
Sm	--	--	--	--	--	--	--	--
Eu	--	--	--	--	--	--	--	--
Tb	--	--	--	--	--	--	--	--
Yb	--	--	--	--	--	--	--	--
Lu	--	--	--	--	--	--	--	--
Hf	--	--	--	--	--	--	--	--
Ta	--	--	--	--	--	--	--	--
W	1	1	1	1	1	1	1	1
Ir	--	--	--	--	--	--	--	--
Pb	12	7	9	10	4	8	6	4
Th	11	11	14	11	9	9	8	7
U	5	5	5	5	5	5	5	5
Rb	--	--	--	--	--	--	--	--
Sr	46	56	30	27	25	31	18	22

Table 8 continued

	9	10
Au	--	--
Ba	37	23
Be	--	--
B	4	2
Sc	--	--
V	77	79
Cr	103	113
Mn	543	577
Co	16	16
Ni	66	74
Cu	40	30
Zn	25	33
Ge	--	--
As	5	4
Se	--	--
Br	--	--
Mo	--	--
Ag	.1	.1
Cd	1	1
Sb	2	2
Cs	--	--
La	28	27
Ce	--	--
Nd	--	--
Sm	--	--
Eu	--	--
Tb	--	--
Yb	--	--
Lu	--	--
Hf	--	--
Ta	--	--
W	1	1
Ir	--	--
Pb	8	9
Th	7	7
U	5	5
Rb	--	--
Sr	13	14

1. MGS-3A-1—Greenstone; Archean; sample depth 239-240 ft., drill hole 1986-CUSMAP-3A, T.158N., R.28W., sec. 35, ADDDD, Koochiching County.
2. MGS-3A-2—Greenstone; Archean; sample depth 240-241 ft., drill hole 1986-CUSMAP-3A, T.158N., R.28W., sec. 35, ADDDD, Koochiching County.
3. MGS-3A-3—Greenstone; Archean; sample depth 241-242 ft., drill hole 1986-CUSMAP-3A, T.158N., R.28W., sec. 35, ADDDD, Koochiching County.
4. MGS-3A-4—Greenstone; Archean; sample depth 242-243 ft., drill hole 1986-CUSMAP-3A, T.158N., R.28W., sec. 35, ADDDD, Koochiching County.
5. MGS-3A-5—Greenstone; Archean; sample depth 243-244 ft., drill hole 1986-CUSMAP-3A, T.158N., R.28W., sec. 35, ADDDD, Koochiching County.
6. MGS-3A-6—Greenstone; Archean; sample depth 244-245 ft., drill hole 1986-CUSMAP-3A, T.158N., R.28W., sec. 35, ADDDD, Koochiching County.
7. MGS-3A-7—Greenstone; Archean; sample depth 245-246 ft., drill hole 1986-CUSMAP-3A, T.158N., R.28W., sec. 35, ADDDD, Koochiching County.
8. MGS-3A-8—Greenstone; Archean; sample depth 246-247 ft., drill hole 1986-CUSMAP-3A, T.158N., R.28W., sec. 35, ADDDD, Koochiching County.
9. MGS-3A-9—Greenstone; Archean; sample depth 247-248 ft., drill hole 1986-CUSMAP-3A, T.158N., R.28W., sec. 35, ADDDD, Koochiching County.
10. MGS-3A-10—Greenstone; Archean; sample depth 248-249 ft., drill hole 1986-CUSMAP-3A, T.158N., R.28W., sec. 35, ADDDD, Koochiching County.

Table 9. Publicly submitted samples—whole-rock analyses.

	1	2	3	4
SiO ₂	47.4	96.9	84.3	77.5
Al ₂ O ₃	18.6	0.83	7.04	1.36
CaO	1.90	0.11	0.79	8.46
MgO	5.14	<0.1	0.02	0.44
Na ₂ O	3.35	<0.1	<0.1	<0.1
K ₂ O	5.62	0.64	5.70	1.06
Total Fe as Fe ₂ O ₃	11.7	0.59	0.36	3.08
MnO	--	--	--	--
TiO ₂	1.70	0.05	0.12	0.08
P ₂ O ₅	0.83	0.02	0.03	0.07
Cr ₂ O ₃	--	--	--	--
LOI	1.08	0.77	0.39	-2.61
H ₂ O+	--	--	--	--
H ₂ O-	--	--	--	--
C	--	--	--	--
CO ₂	--	--	--	--
S	--	--	--	--
FeO	7.7	--	--	--
Cr	--	--	--	--
Rb	247	20	60	22
Sr	309	16	150	217
Y	146	35	<10	<10
Zr	1110	38	72	55
Nb	<10	11	<10	13
Ba	1230	155	3240	129
Cl	--	--	--	--

1. GSP-47—Microcline-biotite schist containing monazite; Archean migmatite terrane; outcrop sample, T.67N., R.24W., sec. 23, BD, Koochiching County.
2. GSP-48—Sandstone, medium- to coarse-grained, yellow-gray; Mt. Simon Formation, Upper Cambrian; sample depth 500 ft., water well, T.107N., R.7W., sec. 23, ABBABC, Winona County.
3. GSP-49—Sandstone; slightly conglomeratic with clasts of mafic porphyry; Archean migmatite terrane; outcrop sample, T.67N., R.24W., sec. 23, BD, Koochiching County.
4. GSP-50—Sandstone, medium- to coarse-grained, red; Mt. Simon Formation, Upper Cambrian; sample depth 510 ft., water well, T.107N., R.7W., sec. 23, ABBABC, Winona County.

Table 10. Samples of Early Proterozoic age—whole-rock analyses

	1	2	3	4	5	6	7	8
SiO ₂	65.6	56.9	52.2	33.4	37.3	57.6	48.8	52.8
Al ₂ O ₃	13.6	20.2	21.5	0.62	5.26	17.9	15.9	23.7
CaO	0.04	0.03	0.02	0.11	0.18	0.02	0.04	0.04
MgO	2.39	2.34	1.83	<0.01	0.42	1.98	1.65	2.02
Na ₂ O	0.04	0.14	0.36	0.55	0.34	0.17	0.24	0.21
K ₂ O	3.23	5.44	5.42	0.17	1.84	5.98	5.42	7.91
Total Fe as Fe ₂ O ₃	9.01	5.67	9.96	12.1	21.3	5.38	10.4	4.37
MnO	0.06	--	--	--	--	<0.01	--	<0.01
TiO ₂	0.51	0.99	1.00	0.48	0.34	0.74	0.68	0.84
P ₂ O ₅	0.04	0.04	0.04	0.23	0.16	0.02	0.04	0.05
Cr ₂ O ₃	--	--	--	--	--	--	--	--
LOI	5.08	7.62	7.70	49.0	32.7	9.85	17.2	8.31
H ₂ O+	2.4	2.2	2.6	2.2	1.5	1.7	1.3	1.9
H ₂ O-	0.3	0.2	0.1	1.7	0.7	0.2	0.1	0.2
C	0.81	--	--	--	--	--	--	--
CO ₂	<0.01	<0.01	0.18	<0.01	<0.01	<0.01	<0.01	0.06
S	0.72	0.57	1.91	3.94	10.6	1.96	3.70	0.81
FeO	3.4	2.8	3.4	1.2	0.8	1.6	2.2	1.5
Cr	108	--	--	--	--	171	--	183
Rb	106	186	238	<10	84	174	181	216
Sr	16	33	99	162	17	29	20	37
Y	<10	27	<10	<10	57	16	32	22
Zr	121	132	133	43	36	79	91	95
Nb	28	<10	21	13	20	<10	20	13
Ba	604	660	442	369	354	956	790	1260
Cl	<50	<50	<50	700	100	<50	<50	<50

Table 10 continued

	9	10	11	12	13	14	15	16
SiO ₂	45.3	53.8	61.6	2.70	12.0	9.87	11.4	3.85
Al ₂ O ₃	26.7	17.3	16.2	0.91	0.40	0.20	8.72	1.13
CaO	<0.01	0.06	0.49	0.06	0.04	0.10	0.17	0.31
MgO	2.34	1.88	2.81	0.32	0.18	0.17	2.57	0.16
Na ₂ O	0.28	0.26	1.69	<0.01	0.06	0.01	0.11	<0.01
K ₂ O	8.69	5.69	3.62	0.05	0.03	0.02	0.59	0.33
Total Fe as Fe ₂ O ₃	7.32	11.1	7.24	61.8	55.7	50.4	43.6	57.6
MnO	<0.01	0.02	--	0.01	--	--	0.01	--
TiO ₂	0.94	0.74	0.80	0.39	1.64	0.17	12.9	0.77
P ₂ O ₅	0.03	0.05	0.17	0.04	0.43	0.14	0.15	0.30
Cr ₂ O ₃	--	--	--	--	--	--	--	--
LOI	8.31	9.23	5.00	33.1	28.7	33.1	19.7	34.3
H ₂ O+	2.3	1.4	2.7	--	--	--	--	--
H ₂ O-	0.3	0.1	0.2	--	--	--	--	--
C	--	--	--	--	--	--	--	--
CO ₂	0.27	<0.01	0.15	--	--	--	--	--
S	1.28	3.12	0.69	--	--	--	--	--
FeO	2.8	3.1	4.1	0.7	4.1	7.3	6.5	0.8
Cr	191	158	--	74	--	--	246	--
Rb	237	151	144	<10	<10	<10	<10	<10
Sr	41	25	74	<10	10	<10	<10	<10
Y	17	21	36	<10	<10	<10	<10	38
Zr	136	113	150	<10	22	<10	259	<10
Nb	31	22	14	37	43	36	236	35
Ba	1600	943	654	179	219	367	130	244
Cl	<50	<50	<50	--	--	--	--	--

Table 10 continued

	25	26	27
SiO ₂	7.33	7.84	8.49
Al ₂ O ₃	5.28	4.77	3.12
CaO	0.11	0.32	3.39
MgO	1.02	0.80	0.57
Na ₂ O	0.03	<0.01	0.08
K ₂ O	0.89	0.91	0.56
Total Fe as Fe ₂ O ₃	49.2	52.2	41.6
MnO	0.12	0.06	0.02
TiO ₂	10.3	4.79	10.9
P ₂ O ₅	0.31	0.30	2.64
Cr ₂ O ₃	--	--	--
LOI	25.7	28.3	23.8
H ₂ O+	--	--	--
H ₂ O-	--	--	--
C	--	--	--
CO ₂	--	--	--
S	--	--	--
FeO	7.4	1.6	1.4
Cr	192	175	83
Rb	<10	<10	<10
Sr	<10	<10	35
Y	106	<10	<10
Zr	791	167	2060
Nb	275	112	170
Ba	230	259	193
Cl	--	--	--

1. 47-19-15—Slate, graphitic; unnamed metavolcanic and metasedimentary formation, Early Proterozoic; outcrop sample, T.47N., R.19W., sec. 15, CBA, Carlton County.
2. AB-2-103—Phyllite, graphitic; Thomson Formation, Early Proterozoic; sample depth 103 ft., drill hole AB-2, T.47N., R.19W., sec. 7, CBB, Carlton County.
3. AB-24A-423—Slate, graphitic; unnamed graphitic schist and slate formation, Early Proterozoic; sample depth 423 ft., drill hole AB-24A, T.45N., R.28W., sec. 2, CDB, Crow Wing County.
4. AB-27-210—Argillite, graphitic; unnamed metavolcanic and metasedimentary formation, Early Proterozoic; sample depth 209-218 ft., drill hole AB-27, T.47N., R.26W., sec. 19, DDD, Aitkin County.
5. Arrow 1—Slate, graphitic-brecciated; Thomson Formation, Early Proterozoic; outcrop sample, T.48N., R.18W., sec. 32, BCB, Carlton County.

6. EL-1-22—Slate, graphitic; unnamed metavolcanic and metasedimentary formation, Early Proterozoic; sample depth 21.7-22.9 ft., drill hole 1, T.46N., R.20W., sec. 8, Carlton County.
7. EL-1-57—Slate, graphitic; unnamed metavolcanic and metasedimentary formation, Early Proterozoic; sample depth 56.2-57.2 ft., drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
8. EL-1-74—Slate, graphitic; unnamed metavolcanic and metasedimentary formation, Early Proterozoic; sample depth 73.7-74.7 ft., drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
9. EL-1-121—Slate, graphitic; unnamed metavolcanic and metasedimentary formation, Early Proterozoic; sample depth 120.5-121.6 ft., drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
10. EL-1-188—Slate, graphitic; unnamed metavolcanic and metasedimentary formation, Early Proterozoic; sample depth 188-189 ft., drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
11. LV-3-385—Argillite, graphitic; Virginia Formation, Early Proterozoic; sample depth 385 ft., drill hole LV-3, T.139N., R.28W., sec. 2, ABA, Cass County.
12. AB-2-103—Sulfide split; sample depth 103 ft., drill hole AB-2, T.47N., R.19W., sec. 7, CBB, Carlton County.
13. AB-27-210—Sulfide split; sample depth 210 ft., drill hole AB-7, T.47N., R.26W., sec. 19, DDD, Carlton County.
14. AB-27-210S—Sulfide split; sample depth 210 ft., drill hole AB-27, T.47N., R.26W., sec. 19, DDD, Carlton County.
15. AB-24A-423—Sulfide split; sample depth 423 ft., drill hole AB-24A, T.45N., R.28W., sec. 2, CDB, Crow Wing County.
16. Arrow 1—Sulfide split; outcrop sample, T.48N., R.18W., sec. 32, BCB, Carlton County.
17. Arrow 2—Sulfide split; brecciated graphitic slate; outcrop sample, T.48N., R.18W., sec. 32, BCB, Carlton County.
18. Arrow 3—Sulfide split; brecciated graphitic slate; outcrop sample, T.48N., R.18W., sec. 32, BCB, Carlton County.
19. Arrow 4—Sulfide split; brecciated graphitic slate; outcrop sample, T.48N., R.18W., sec. 32, BCB, Carlton County.
20. Arrow 5—Sulfide split; quartz vein, massive, pyrite- and hematite-bearing; outcrop sample, T.48N., R.18W., sec. 32, BCB, Carlton County.
21. Arrow 6—Sulfide split; sheared granular quartz with pyrite, hematite, and some slate; outcrop sample, T.48N., R.18W., sec. 32, BCB, Carlton County.
22. EL-1-22—Sulfide split; drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
23. EL-1-57—Sulfide split; drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
24. EL-1-74—Sulfide split; drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
25. EL-1-121—Sulfide split; drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
26. EL-1-188—Sulfide split; drill hole 1, T.46N., R.20W., sec. 8, D, Carlton County.
27. LV3-385—Sulfide split, drill hole LV-3, T.139N., R.28W., sec. 2, ABA, Cass County.

Table 11. Samples of Cretaceous age—whole-rock analyses

	1	2	3	4	5	6	7	8
SiO ₂	13.9	59.5	62.9	56.4	55.8	52.5	51.6	52.3
Al ₂ O ₃	5.35	17.4	16.7	19.9	21.0	22.3	22.0	22.2
CaO	37.1	0.85	0.73	0.65	0.85	1.03	1.30	0.91
MgO	1.42	1.25	1.12	1.32	1.39	1.46	1.46	1.45
Na ₂ O	0.09	0.26	0.32	0.31	0.27	0.31	0.26	0.30
K ₂ O	0.70	2.45	2.32	2.71	2.66	2.73	2.68	2.78
Total Fe as Fe ₂ O ₃	6.44	6.83	5.84	6.53	6.29	6.81	7.07	6.84
MnO	0.27	--	--	--	--	--	--	--
TiO ₂	0.21	0.92	0.89	0.98	0.92	0.89	0.89	0.90
P ₂ O ₅	0.34	0.23	0.21	0.13	0.14	0.15	0.15	0.13
Cr ₂ O ₃	--	--	--	--	--	--	--	--
LOI	33.4	10.4	9.16	11.2	11.1	12.0	12.5	12.2
H ₂ O+	2.0	5.6	5.8	6.8	7.0	7.6	7.6	7.1
H ₂ O-	0.6	1.9	1.8	1.9	2.1	2.4	2.3	2.4
C	--	--	--	--	--	--	--	--
CO ₂	32.8	0.21	0.02	<0.01	0.22	0.53	0.89	0.20
S	--	--	--	--	--	--	--	--
FeO	4.6	0.9	0.7	0.7	1.0	1.4	1.3	0.9
Cr	--	--	--	--	--	--	--	--
Rb	36	186	138	178	184	192	182	203
Sr	173	108	92	100	136	147	156	153
Y	17	<10	41	42	47	37	41	24
Zr	<10	262	282	176	190	147	134	142
Nb	<10	19	38	38	30	36	14	22
Ba	94	413	419	488	457	419	362	423
Cl	100	<50	<50	<50	<50	50	<50	<50

Table 11 continued

	9	10	11	12	13	14	15	16
SiO ₂	53.2	53.6	53.1	52.9	47.0	47.0	52.3	44.8
Al ₂ O ₃	22.0	22.5	22.5	21.6	19.8	20.4	21.4	19.4
CaO	1.02	1.08	1.18	1.33	3.07	4.54	1.16	5.79
MgO	1.44	1.38	1.37	1.39	1.54	1.27	1.35	1.28
Na ₂ O	0.33	0.37	0.41	0.41	0.38	0.39	0.42	0.40
K ₂ O	2.75	2.91	2.91	2.80	2.54	2.56	2.68	2.56
Tot Fe as Fe ₂ O ₃	6.63	5.56	5.94	6.86	9.72	6.38	7.31	6.29
MnO	--	--	--	--	--	--	--	--
TiO ₂	0.92	0.95	0.97	0.93	0.82	0.78	0.93	0.74
P ₂ O ₅	0.12	0.15	0.16	0.14	0.16	0.33	0.12	0.12
Cr ₂ O ₃	--	--	--	--	--	--	--	--
LOI	11.9	11.5	11.4	11.8	15.0	16.2	12.5	18.6
H ₂ O+	7.2	7.2	7.3	6.9	7.2	8.3	--	9.0
H ₂ O-	2.2	2.0	1.9	1.8	1.7	2.0	--	2.0
C	--	--	--	--	--	--	--	--
CO ₂	0.79	0.49	0.49	1.05	3.96	2.71	0.33	3.83
S	--	--	--	--	--	--	--	--
FeO	1.6	1.2	1.2	1.8	3.3	1.2	0.6	1.4
Cr	--	--	--	--	--	--	--	--
Rb	192	201	212	189	176	174	180	168
Sr	152	193	198	184	182	267	193	230
Y	38	14	30	22	34	62	31	17
Zr	148	145	151	147	121	101	135	109
Nb	23	29	31	38	42	28	25	20
Ba	386	412	406	360	336	362	366	309
Cl	<50	<50	50	<50	50	50	<50	<50

Table 11 continued

	17	18	19	20	21	22	23	24
SiO ₂	41.5	26.8	70.0	51.3	53.8	13.6	53.9	52.9
Al ₂ O ₃	17.4	8.97	14.0	22.4	22.2	5.34	22.0	23.0
CaO	9.31	22.5	0.49	1.07	0.85	4.94	0.84	1.10
MgO	1.29	1.28	0.88	1.38	1.43	3.75	1.47	1.49
Na ₂ O	0.37	0.34	0.58	0.34	0.35	0.26	0.39	0.40
K ₂ O	2.39	1.55	1.86	2.73	2.89	0.71	2.88	2.97
Total Fe as Fe ₂ O ₃	6.30	3.81	352	7.19	6.20	40.1	6.09	5.83
MnO	--	--	--	--	--	0.37	--	--
TiO ₂	0.63	0.32	0.80	0.89	0.93	0.26	0.93	0.94
P ₂ O ₅	0.15	0.16	0.08	0.11	0.14	1.39	0.13	0.11
Cr ₂ O ₃	--	--	--	--	--	--	--	--
LOI	20.8	30.1	8.16	12.7	11.3	28.5	11.3	11.3
H ₂ O+	8.6	8.6	4.9	--	--	2.7	6.2	--
H ₂ O-	1.9	2.3	1.2	--	--	0.6	1.9	--
C	--	--	--	--	--	--	--	--
CO ₂	6.56	16.5	0.36	0.46	0.32	27.4	1.01	0.40
S	--	--	--	--	--	--	--	--
FeO	1.7	1.5	1.3	1.0	1.1	34.4	2.2	1.1
Cr	--	--	--	--	--	--	--	--
Rb	169	79	111	196	192	51	199	204
Sr	279	476	107	177	170	147	164	185
Y	25	19	26	19	26	40	21	23
Zr	67	31	275	126	146	12	169	127
Nb	13	16	31	29	19	40	25	38
Ba	288	476	397	426	511	265	483	493
Cl	50	150	150	50	<50	100	100	50

Table 11 continued

	25	26	27	28	29	30	31	32
SiO ₂	40.2	22.6	20.4	5.69	4.09	49.6	58.5	60.5
Al ₂ O ₃	14.0	7.69	6.77	1.94	1.21	19.6	17.9	17.2
CaO	12.8	29.3	29.4	44.8	47.7	2.17	0.74	0.56
MgO	1.38	1.15	1.23	1.03	0.99	1.67	1.48	1.31
Na ₂ O	0.39	0.31	0.35	0.18	0.20	0.67	0.64	0.64
K ₂ O	1.98	1.15	1.13	0.35	0.32	2.95	2.73	2.72
Total Fe as Fe ₂ O ₃	6.09	3.22	3.37	2.28	0.84	6.90	6.78	6.18
MnO	--	--	--	--	--	--	--	--
TiO ₂	0.57	0.26	0.22	0.05	0.04	0.79	0.92	0.91
P ₂ O ₅	0.13	0.22	0.16	1.12	0.22	0.13	0.12	0.15
Cr ₂ O ₃	--	--	--	--	--	--	--	--
LOI	22.2	32.6	33.6	39.2	43.6	15.6	10.1	9.77
H ₂ O+	6.8	5.9	6.0	2.1	3.7	6.7	5.0	5.1
H ₂ O-	2.1	2.1	1.7	0.6	0.4	2.7	1.8	1.6
C	--	--	--	--	--	--	--	--
CO ₂	9.04	21.0	22.0	34.9	37.3	0.90	0.15	<0.01
S	--	--	--	--	--	--	--	--
FeO	0.9	0.8	0.7	0.4	0.3	1.1	0.8	1.0
Cr	--	--	--	--	--	--	--	--
Rb	127	45	55	15	<10	194	178	165
Sr	328	436	641	673	830	212	159	158
Y	14	<10	<10	29	<10	20	43	29
Zr	84	28	11	<10	<10	119	227	312
Nb	24	<10	11	12	<10	24	29	25
Ba	245	105	118	32	65	437	471	513
Cl	150	150	200	100	150	100	50	<50

Table 11 continued

	33	34	35	36	37	38	39
SiO ₂	51.6	62.9	26.5	47.7	62.8	72.4	61.9
Al ₂ O ₃	24.6	14.8	2.66	21.8	16.8	12.2	19.6
CaO	0.68	0.75	3.46	1.27	0.34	0.23	0.41
MgO	1.75	1.04	3.67	2.02	1.01	0.40	0.27
Na ₂ O	0.68	0.55	0.20	1.47	0.53	0.20	0.07
K ₂ O	2.88	1.90	0.40	1.35	2.21	0.63	0.23
Total Fe as Fe ₂ O ₃	5.64	6.22	37.4	9.25	6.14	5.07	6.18
MnO	--	--	0.46				0.40
TiO ₂	0.88	0.84	0.28	0.40	1.21	1.67	0.62
P ₂ O ₅	0.12	0.14	0.12	0.15	0.06	0.03	0.06
Cr ₂ O ₃	--	--	--	--	--	--	--
LOI	11.5	10.6	25.0	14.6	9.08	7.08	10.3
H ₂ O+	--	--	1.2	6.0	5.4	4.3	6.6
H ₂ O-	--	--	0.3	7.7	1.1	0.5	0.2
C	--	--	--	--	--	--	--
CO ₂	0.09	1.26	26.8	0.23	0.05	<0.01	3.06
S	--	--	--	0.27	0.03	--	0.01
FeO	--	2.1	32.7	2.5	1.6	1.7	4.7
Cr	--	--	--	--	--	--	--
Rb	209	109	34	31	131	45	27
Sr	223	117	31	380	112	25	<10
Y	14	32	<10	31	41	14	<10
Zr	138	294	88	265	302	850	297
Nb	33	33	20	32	37	25	26
Ba	433	372	273	546	456	259	120
Cl	50	100	<50	150	50	150	152

1. K288-01—Speckled claystone; unit 6, Late Cretaceous; sample depth 116 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
2. K288-02—Silty claystone; unit 6, Late Cretaceous; sample depth 127 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
3. K288-03—Silty claystone; unit 5, Late Cretaceous; sample depth 134 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
4. K288-04—Claystone; unit 5, Late Cretaceous; sample depth 144 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
5. K288-05—Sandy claystone; unit 5, Late Cretaceous; sample depth 149 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
6. K288-06—Claystone; unit 5, Late Cretaceous; sample depth 153 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.

7. K288-07—Claystone; unit 5, Late Cretaceous; sample depth 158 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
8. K288-08—Claystone; unit 5, Late Cretaceous; sample depth 163 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
9. K288-09—Claystone; unit 5, Late Cretaceous; sample depth 168 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
10. K288-15—Claystone; unit 5, Late Cretaceous; sample depth 193 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, Lac Qui Parle County.
11. K288-16—Claystone; unit 5, Late Cretaceous; sample depth 198 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
12. K288-17—Claystone; unit 5, Late Cretaceous; sample depth 203 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
13. K288-18—Claystone; unit 5, Late Cretaceous; sample depth 208 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
14. K288-19—Calcareous claystone; unit 4, Late Cretaceous; sample depth 213 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
15. K288-20—Calcareous claystone; unit 4, Late Cretaceous; sample depth 218 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
16. K288-21—Calcareous claystone; unit 4, Late Cretaceous; sample depth 221 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
17. K288-22—Calcareous claystone; unit 4, Late Cretaceous; sample depth 226 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
18. K288-26—Limy claystone; unit 3, Late Cretaceous; sample depth 242 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
19. K288-34—Clayey siltstone; unit 2, Late Cretaceous; sample depth 282 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
20. K288-10—Claystone; unit 5, Late Cretaceous; sample depth 173 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
21. K288-11—Claystone; unit 5, Late Cretaceous; sample depth 178 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
22. K288-12—Silty marl; unit 5, Late Cretaceous; sample depth 183 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
23. K288-13—Claystone; unit 5, Late Cretaceous; sample depth 183.5 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
24. K288-14—Claystone; unit 5, Late Cretaceous; drill hole 189 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
25. K288-23—Calcareous claystone; unit 4, Late Cretaceous; sample depth 236 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
26. K288-24—Calcareous claystone; unit 4, Late Cretaceous; sample depth 236 ft., drill hole KWF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
27. K288-25—Limy claystone; unit 3, Late Cretaceous; sample depth 241 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.

28. K288-27—Shaley calcarenite; unit 3, Late Cretaceous; sample depth 246 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
29. K288-28—Shaley calcarenite; unit 3, Late Cretaceous; sample depth 251 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
30. K288-29—Claystone; unit 2, Late Cretaceous; sample depth 256 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
31. K288-30—Claystone; unit 2, Late Cretaceous; sample depth 260 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
32. K288-31—Claystone; unit 2, Late Cretaceous; sample depth 265 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
33. K288-32—Claystone; unit 2, Late Cretaceous; sample depth 270 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
34. K288-33—Sandy claystone; unit 2, Late Cretaceous; sample depth 275 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
35. K288-35—Nodule; unit 2, Late Cretaceous; sample depth 284 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
36. K288-36—Claystone; unit 2, Late Cretaceous; sample depth 290 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
37. K288-37—Claystone; unit 2, Late Cretaceous; sample depth 302 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
38. K288-38—Organic clayey sandstone; unit 2, Late Cretaceous; sample depth 304 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.
39. K288-39—Saprolith; pre-Cretaceous; sample depth 306 ft., drill hole KNF-288, T.119N., R.45W., sec. 29, CC, Lac Qui Parle County.

Table 12 continued

	17	18	19	20	21	22
SiO ₂	60.3	53.6	49.2	63.4	49.1	48.4
Al ₂ O ₃	12.1	12.4	15.4	12.5	14.1	16.2
CaO	0.93	6.00	11.1	2.46	8.29	9.75
MgO	1.18	3.49	5.75	2.64	3.26	3.78
Na ₂ O	4.08	3.19	2.66	3.84	3.34	3.86
K ₂ O	3.76	1.91	0.63	2.99	1.27	0.70
Total Fe as Fe ₂ O ₃	13.3	13.8	11.9	7.77	15.3	12.4
MnO	0.23	0.19	0.17	0.19	0.21	0.16
TiO ₂	1.20	2.40	1.55	1.21	3.17	2.06
P ₂ O ₅	0.21	0.35	0.18	0.21	0.26	0.19
Cr ₂ O ₃	--	--	--	--	--	--
LOI	1.77	1.85	0.62	2.00	0.93	2.23
H ₂ O+	--	--	--	--	--	--
H ₂ O-	--	--	--	--	--	--
C	--	--	--	--	--	23.1
CO ₂	--	--	--	--	--	--
S	--	--	--	--	--	--
FeO	0.8	3.0	8.0	0.8	4.7	2.8
Cr	32	59	216	43	41	99
Rb	182	58	33	94	51	38
Sr	151	197	236	205	270	702
Y	95	54	21	75	62	28
Zr	731	373	142	519	260	144
Nb	62	41	11	45	37	35
Ba	1030	563	196	1310	397	245
Cl	--	--	--	--	--	--

1. A194B—Basalt, porphyritic; ophitic matrix; North Shore Volcanic Group, Middle Proterozoic; outcrop sample, T.56N., R.8W., sec. 34, Lake County.
2. A200—Basalt, ophitic; North Shore Volcanic Group, Middle Proterozoic; outcrop sample, T.56N., R.8W., sec. 34, Lake County.
3. A288B—Gabbro, granophyritic, coarse-grained, prismatic; Middle Proterozoic; outcrop sample, T.56N., R.7W., sec. 17, Lake County.
4. A313—Ferrogabbro, medium-grained, laminated; Middle Proterozoic; outcrop sample, T.56N., R.7W., sec. 28, Lake County.
5. A314—Gabbro, coarse-grained, prismatic; Middle Proterozoic; outcrop sample, T.56N., R.7W., sec. 28, Lake County.
6. A386A—Gabbro, coarse-grained, intergranular; Middle Proterozoic; outcrop sample, T.56N., R.7W., sec. 1, Lake County.

7. A420—Olivine gabbro, medium-grained, laminated; Middle Proterozoic; outcrop sample, T.56N., R.7W., sec. 17, Lake County.
8. B-309-C—Olivine gabbro, coarse-grained; Middle Proterozoic; outcrop sample, T.56N., R.7W., sec. 3, Lake County.
9. B349—Diabase, fine, intergranular; Middle Proterozoic; outcrop sample, T.56N., R.7W., sec. 10, Lake County.
10. B-355A—Felsite, flow-banded; North Shore Volcanic Group, Middle Proterozoic; outcrop sample, T.56N., R.7W., sec. 10, Lake County.
11. B-373—Diabase, ophitic; Middle Proterozoic; outcrop sample, T.56N., R.7W., sec. 2, Lake County.
12. B-401—Diabase, ophitic; Middle Proterozoic; outcrop sample, T.56N., R.7W., sec. 2, Lake County.
13. C-217A—Basalt, ophitic; North Shore Volcanic Group, Middle Proterozoic; outcrop sample, T.55N., R.8W., sec. 1, Lake County.
14. C299B—Diabase, fine, intergranular; Middle Proterozoic; outcrop sample, T.56N., R.8W., sec. 4, Lake County.
15. C309—Gabbro, very coarse-grained; granophyre-replacement; Middle Proterozoic; outcrop sample, T.56N., R.8W., sec. 3, Lake County.
16. C368—Basalt, porphyritic, ophitic; matrix; Middle Proterozoic; outcrop sample, T.56N., R.8W., sec. 8, Lake County.
17. C389—Granodiorite, medium-grained, equigranular; Middle Proterozoic; outcrop sample, T.56N., R.7W., sec. 29, Lake County.
18. C420—Gabbro, medium-grained, prismatic; Middle Proterozoic; outcrop sample, T.56N., R.7W., sec. 3, Lake County.
19. C478—Gabbro, olivine, medium-grained, subophitic; Middle Proterozoic; outcrop sample, T.56N., R.8W., sec. 11, Lake County.
20. C502—Granodiorite, medium-grained, granophyric; Middle Proterozoic; outcrop sample, T.56N., R.7W., sec. 3, Lake County.
21. C505C—Gabbro, coarse-grained, intergranular; Middle Proterozoic; outcrop sample, T.56N., R.7W., sec. 1, Lake County.
22. C505D—Gabbro, coarse-grained, ophitic, altered; Middle Proterozoic; outcrop sample, T.56N., R.7W., sec. 1, Lake County.

Table 13. Samples of Archean age—whole-rock analyses

	1	2	3	4	5	6
SiO ₂	64.2	58.2	50.5	81.7	50.3	48.5
Al ₂ O ₃	16.3	15.9	16.1	7.22	13.9	13.1
CaO	4.10	5.93	5.61	5.96	9.74	9.83
MgO	1.61	6.14	8.15	0.34	5.68	5.14
Na ₂ O	5.77	4.01	3.75	0.38	2.84	2.61
K ₂ O	2.58	0.37	0.74	0.33	0.30	0.35
Total Fe as Fe ₂ O ₃	3.03	7.51	10.7	2.48	14.7	17.2
MnO	0.08	0.16	0.19	0.04	0.19	0.28
TiO ₂	0.36	0.50	0.71	0.28	1.70	1.50
P ₂ O ₅	0.15	0.08	0.32	0.05	0.14	0.13
Cr ₂ O ₃	--	--	--	--	--	--
LOI	1.70	1.39	3.47	1.08	0.85	1.54
H ₂ O+	1.1	1.2	3.3	0.3	1.1	1.3
H ₂ O-	--	--	--	--	--	--
C	--	--	--	--	--	--
CO ₂	0.31	0.01	0.22	0.31	0.08	0.03
S	0.03	--	0.01	0.05	0.03	0.27
FeO	0.9	5.4	7.4	0.2	10.7	9.8
Cr	127	139	177	32	137	64
Rb	97	17	28	31	16	39
Sr	1600	189	92	175	103	293
Y	<10	11	21	26	34	30
Zr	88	75	73	216	76	75
Nb	<10	<10	<10	13	24	14
Ba	1080	203	302	135	88	99
Cl	--	--	--	160	550	--

1. KIB-68-339—Lineated granodiorite; unnamed formation, Archean; sample depth 339-339.5 ft., drill hole KIB-68, T.151N., R.32W., sec. 13, DB, Beltrami County.
2. KIB-54-243—Lineated amygdaloidal basalt; unnamed formation, Archean; sample depth 243 ft., drill hole KIB-54, T.150N., R.27W., sec. 17, CA, Itasca County.
3. KIB-13-84—Massive basalt; unnamed formation, Archean; sample depth 84 ft., drill hole KIB-13, T.62N., R.25W., sec. 33, CB, Itasca County.
4. KIB-13-120—Quartz, feldspar-phyric felsic volcanic fragment; unnamed formation, Archean; sample depth 120 ft., drill hole KIB-13, T.62N., R.25W., sec. 33, CB, Itasca County.
5. KIB-57-74—Diabase; unnamed formation, Archean; sample depth 73.6-74 ft., drill hole KIB-57, T.151N., R.28W., sec. 1, CB, Koochiching County.

6. K2-454—Metabasalt, relatively unaltered, dark green, pyritic; unnamed formation, Archean; sample depth 454 ft., drill hole KDH-2, T.60N., R.25W., sec. 36, AAB, Itasca County.

Table 14. Philbrook pluton, Early Proterozoic—selected rare-earth elements

	1	2	3	4	5	6	7
Y	15	32	84	95	48	46	9
La	17.8	36.3	92.7	92.1	49.3	48.1	13.3
Ce	45.6	93.4	248	234	114	115	27.9
Pr	6.8	14.4	36.5	34.4	17.7	15.7	3.4
Nd	30.4	67.7	173	174	75.6	81.2	14.3
Sm	6.0	12.9	33.4	32.8	14.4	13.9	2.4
Eu	1.69	3.59	8.32	8.38	4.02	3.75	1.62
Gd	6.0	11.5	30.7	28.4	14.7	14.0	2.5
Tb	0.7	1.3	3.5	3.9	1.7	1.8	0.3
Dy	3.6	7.3	17.8	19.6	8.9	8.5	1.7
Ho	0.74	1.49	3.72	3.76	1.97	1.61	0.34
Er	1.6	3.4	8.2	10.0	5.6	4.4	1.1
Tm	0.3	0.5	1.0	1.1	0.8	0.6	0.2
Yb	1.1	2.3	5.3	6.6	4.9	2.7	1.0
Lu	0.18	0.35	0.77	0.81	0.75	0.40	0.19
Th	<1	<1	1	<1	2	1	<1
U	<1	<1	<1	<1	<1	<1	<1

1. PB-1-57—Fe-Ti oxide rock; Philbrook pluton, Early Proterozoic; sample depth 57-63 ft., Adams drill hole 1, T.132N., R.32W., sec. 3, BBB, Todd County.
2. PB-3-72—Fe-Ti oxide-apatite rock; Philbrook pluton, Early Proterozoic; sample depth 72-83 ft., Adams drill hole 3, T.132N., R.32W., sec. 3, BBB, Todd County.
3. BB-3-132—Actinolitic Fe-Ti oxide-apatite rock; Philbrook pluton, Early Proterozoic; sample depth 132-136 ft., Adams drill hole 3, T.132N., R.32W., sec. 3, BBB, Todd County.
4. PB-5-208—Fe-Ti oxide-apatite rock; Philbrook pluton, Early Proterozoic; sample depth 208-213 ft., Adams drill hole 5, T.132N., R.32W., sec. 3, BBB, Todd County.
5. PB-8-55—Fe-Ti oxide-apatite-chalcopyrite-bearing hornblendite; Philbrook pluton, Early Proterozoic; sample depth 55-60 ft., Adams drill hole 8, T.132N., R.32W., sec. 3, BBB, Todd County.
6. PBI-2-88—Carbonate vein and altered apatitic ferrodiorite; Philbrook pluton, Early Proterozoic; sample depth 29.5 ft., Minnesota Geological Survey drill hole PBI-2-88, T.132N., R.32W., sec. 3, BAAAA, Todd County.
7. PB-DC-DG—Deuterically altered pegmatitic diorite; Philbrook pluton, Early Proterozoic; outcrop sample, T.132N., R.32W., sec. 34, BDBB, Todd County.

Table 15. Miscellaneous samples—selected rare-earth elements

	1	2	3	4	5	6	7	8
La	3.7	7.0	28.7	129	29.6	119	10.9	53.8
Ce	6	10	53	258	52	206	16	27
Nd	3	4	22	128	22	80	7	22
Sm	0.4	0.7	4.1	21.1	3.9	13.4	1.8	2.9
Eu	0.39	0.75	0.92	4.44	0.96	1.11	0.62	1.23
Tb	<1	<1	0.4	1.6	0.3	0.5	0.2	0.4
Yb	0.06	0.12	1.33	3.11	1.51	0.38	0.17	1.33
Lu	0.01	0.03	0.21	0.49	0.25	0.06	0.03	0.20
	9	10	11	12	13	14	15	16
La	48.3	11.3	16.3	47.5	37.1	64.7	2.3	128
Ce	36	14	17	79	59	88	4	157
Nd	27	6	23	32	33	34	<3	67
Sm	4.8	1.0	5.3	6.2	6.8	5.6	0.3	10.2
Eu	2.18	0.53	1.91	2.31	2.69	2.09	0.20	4.04
Tb	0.8	<0.1	0.7	1.2	1.4	1.1	<0.1	1.5
Yb	3.34	0.46	2.29	4.77	4.39	2.92	0.32	4.80
Lu	0.49	0.08	0.33	0.72	0.65	0.42	0.05	0.68
	17	18	19	20				
La	71.0	29.4	4.3	19.5				
Ce	102	69	9	86				
Nd	50	18	3	19				
Sm	7.9	3.0	0.5	3.5				
Eu	2.63	1.27	0.20	1.31				
Tb	1.1	0.6	<0.1	0.7				
Yb	3.20	1.68	0.71	2.30				
Lu	0.45	0.23	0.13	0.33				

1. P-1-89—Migmatite; Pearl Lake, Archean; outcrop sample, T.167N., R.21W., sec. 16, ABD, Crow Wing County.
2. P-2-149—Migmatite; Pearl Lake, Archean; outcrop sample, T.167N., R.21W., sec. 16, BBA, Crow Wing County.
3. P-2-239—Migmatite; Pearl Lake, Archean; outcrop sample, T.167N., R.21W., sec. 16, BBA, Crow Wing County.
4. P-3-69—Migmatite; Pearl Lake, Archean; outcrop sample, T.167N., R.21W., sec. 16, BAD, Crow Wing County.
5. P-3-178—Migmatite; Pearl Lake, Archean; outcrop sample, T.167N., R.21W., sec. 16, BAD, Crow Wing County.

6. P-3-226—Migmatite; Pearl Lake, Archean; outcrop sample, T.167N., R.21W., sec. 16, BAD, Crow Wing County.
7. P-3-481—Migmatite; Pearl Lake, Archean; outcrop sample, T.167N., R.21W., sec. 16, BAD, Crow Wing County.
8. 142-420—Iron-formation, manganese-bearing, upper ore zone; Animikie Group, Early Proterozoic; sample depth 420 ft., drill hole U.S. Steel 18142, T.138N., R.26W., sec. 21, CA, Crow Wing County.
9. 127-350—Iron-formation, manganese-bearing, upper ore zone; Animikie Group, Early Proterozoic; sample depth 420 ft., drill hole U.S. Steel 18127, T.138N., R.26W., sec. 21, BC, Crow Wing County.
10. 127-400—Iron-formation, manganese-bearing, upper ore zone; Animikie Group, Early Proterozoic; sample depth 400 ft., drill hole U.S. Steel 18127, T.138N., R.26W., sec. 21, BC, Crow Wing County.
11. 572-246—Iron-formation, manganese-bearing, lower ore zone; Animikie Group, Early Proterozoic; sample depth 246 ft., drill hole U.S. Steel 572, T.138N., R.26W., sec. 20, DB, Crow Wing County.
12. 572-275A—Iron-formation, manganese-bearing, lower ore zone; Animikie Group, Early Proterozoic; sample depth 275 ft., drill hole U.S. Steel 18572, T.138N., R.26W., sec. 20, DB, Crow Wing County.
13. 572-275B—Iron-formation, manganese-bearing, lower ore zone; Animikie Group, Early Proterozoic; sample depth 275 ft., drill hole U.S. Steel 18572, T.138N., R.26W., sec. 20, DB, Crow Wing County.
14. 572-293—Iron-formation, oolitic-pisolitic; Animikie Group, Early Proterozoic; sample depth 293 ft., drill hole U.S. Steel 18572, T.138N., R.26W., sec. 20, DB, Crow Wing County.
15. 709-345—Iron-formation, granular; Animikie Group, Early Proterozoic; sample depth 345 ft., drill hole U.S. Steel 18709, T.138N., R.21W., sec. 21, BA, Crow Wing County.
16. 709-425—Iron-formation, oolitic; Animikie Group, Early Proterozoic; sample depth 425 ft., drill hole U.S. Steel 18709, T.138N., R.21W., sec. 21, BA, Crow Wing County.
17. 711-330—Iron-formation, granular; Animikie Group, Early Proterozoic; sample depth 330 ft., drill hole U.S. Steel 18711, T.138N., R.26W., sec. 21, CB, Crow Wing County.
18. 142-675—Quartzite, Pokegama Quartzite; Animikie Group, Early Proterozoic; sample depth 675 ft., drill hole U.S. Steel 18142, T.138N., R.26W., sec. 21, CA, Crow Wing County.
19. 572-325—Iron-formation, slaty; Animikie Group, Early Proterozoic; sample depth 325 ft., drill hole U.S. Steel 18572, T.138N., R.26W., sec. 20, DB, Crow Wing County.
20. 709-450—Quartzite, Pokegama Quartzite; Animikie Group, Early Proterozoic, sample depth 450 ft., drill hole U.S. Steel 18709, T.138N., R.26W., sec. 21, BA, Crow Wing County.

