MINNESOTA GEOLOGICAL SURVEY
INFORMATION CIRCULAR 38

ANALYTICAL RESULTS OF THE PUBLIC GEOLOGIC SAMPLE PROGRAM, 1989–1991 BIENNIUM

UNIVERSITY OF MINNESOTA

Minnesota Geological Survey
Priscilla C. Grew, Director

INFORMATION CIRCULAR 38

ANALYTICAL RESULTS OF THE PUBLIC GEOLOGIC SAMPLE PROGRAM, 1989–1991 BIENNIUM

By

G.B. Morey and L.S. Day

Final Report to the Minnesota Department of Natural Resources, Division of Minerals, St. Paul, Minnesota, University of Minnesota Contract Number MNDNR; ORA Number 9005278

University of Minnesota
St. Paul, 1992

ISSN 0544-3105

CONTENTS

ILLUSTRATIONS

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 geologic materials, in part submitted by the general public. This Information Circular summarizes the results of that program during the 1989-1991 biennium. In all, 106 samples were evaluated by Survey geologists as potential candidates. In addition we received 115 written and phone requests for information about the program. In the end, only one public sample (Table 1 and 7) was analyzed for a variety of constituents. Also, 308 samples of Archean to Quaternary age submitted by Survey geologists were analyzed for a variety of major, minor, and trace constituents. Tables within those categories are organized by the geologic age of the material analyzed. In addition, 39 samples of water derived from the Hinckley-Mt. Simon aquifer of southeastern Minnesota were analyzed for their trace-element contents (Table 13), as were 33 samples for the del S_{34} content (Table 14). Effective July 1, 1989, the program was discontinued; this is the last report in this series.

ANALYTICAL PROCEDURES

A variety of analytical services and, consequently, methods were used during the 1989-1991 biennium. The various analytical facilities, their methods, and reported detection limits are summarized below.

I. MINOR-ELEMENT EXPLORATION PACKAGES

Tables 1 and 2; 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	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
Se	ppm	0.5	Inductively Coupled Plasma
Te	ppm	0.5	Inductively Coupled Plasma

Tables 3 and 5; 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	5.	Direct Current Plasma
B	ppm	10.	Direct Current Plasma
S	ppm	100.	X-Ray Fluorescence
Sc	ppm	0.5	Neutron Activation
V	ppm	10.	Direct Current Plasma
Cr	ppm	2.	Neutron Activation
Co	ppm	1.	Inductively Coupled Plasma Spectrometry
Ni	ppm	1.	Inductively Coupled Plasma Spectrometry
Cu	ppm	0.5	Inductively Coupled Plasma Spectrometry
Zn	ppm	0.5	Inductively Coupled Plasma Spectrometry
Ge	ppm	10.	Direct Current Plasma
As	ppm	1.	Neutron Activation
Se	ppm	3.	Neutron Activation
Mo	ppm	1.	Inductively Coupled Plasma Spectrometry
Ag	ppm	0.5	Atomic Absorption
Cd	ppm	1.	Inductively Coupled Plasma Spectrometry
In	ppm	1.	Atomic Absorption
Sn	ppm	10.	X-Ray Fluorescence
Sb	ppm	0.2	Neutron Activation
Cs	ppm	1.	Neutron Activation
La	ppm	0.5	Neutron Activation
Ce	ppm	3.	Neutron Activation
Nd	ppm	5.	Neutron Activation
Sm	ppm	0.1	Neutron Activation
Eu	ppm	0.2	Neutron Activation
Tb	ppm	0.5	Neutron Activation
Yb	ppm	0.2	Neutron Activation
Lu	ppm	0.1	Neutron Activation
Hf	ppm	1.	Neutron Activation
Ta	ppm	1.	Neutron Activation
W	ppm	3.	Neutron Activation
Pb	ppm	2.	Inductively Coupled Plasma Spectrometry
Bi	ppm	3.0	Inductively Coupled Plasma Spectrometry
Th	ppm	1.	Neutron Activation
U	ppm	0.5	Neutron Activation

Tables 4 and 6; X-Ray Assay Laboratories, Limited, Don Mills, Ontario

Element	Value	Detection Limit	Analytical Method
Li	ppm	1.	Inductively Coupled Plasma Spectrometry
Be	ppm	0.5	Inductively Coupled Plasma Spectrometry
B	ppm	2.	Inductively Coupled Plasma Spectrometry
Sc	ppm	0.1	Inductively Coupled Plasma Spectrometry
V	ppm	0.5	Inductively Coupled Plasma Spectrometry
Cr	ppm	1.	Inductively Coupled Plasma Spectrometry
Co	ppm	1.	Inductively Coupled Plasma Spectrometry
Ni	ppm	1.	Inductively Coupled Plasma Spectrometry
Cu	ppm	0.5	Inductively Coupled Plasma Spectrometry
Zn	ppm	0.5	Inductively Coupled Plasma Spectrometry
As	ppm	3.	Inductively Coupled Plasma Spectrometry
Se	ppm	20.	Inductively Coupled Plasma Spectrometry
Sr	ppm	0.1	Inductively Coupled Plasma Spectrometry
Y	ppm	0.1	Inductively Coupled Plasma Spectrometry
Zr	ppm	0.5	Inductively Coupled Plasma Spectrometry
Mo	ppm	1.	Inductively Coupled Plasma Spectrometry
Ag	ppm	0.1	Inductively Coupled Plasma Spectrometry
Cd	ppm	1.	Inductively Coupled Plasma Spectrometry
Sn	ppm	10.	Inductively Coupled Plasma Spectrometry
Sb	ppm	5.	Inductively Coupled Plasma Spectrometry
Ba	ppm	1.	Inductively Coupled Plasma Spectrometry
W	ppm	10.	Inductively Coupled Plasma Spectrometry
Pb	ppm	2.	Inductively Coupled Plasma Spectrometry

II. WHOLE-ROCK ANALYSES

Tables 7-11; X-Ray Assay Laboratories, Limited, Don Mills, Ontario

Constituent	Value	Detection Limit	Analytical Method
SiO_2	%	±1%	X-Ray Fluorescence
Al_2O_3	%	±1%	X-Ray Fluorescence
CaO	%	±1%	X-Ray Fluorescence
MgO	%	±1%	X-Ray Fluorescence
Na_2O	%	±1%	X-Ray Fluorescence
K_2O	%	±1%	X-Ray Fluorescence
Total Fe as Fe_2O_3	%	±1%	X-Ray Fluorescence
MnO	%	±1%	X-Ray Fluorescence
TiO_2	%	±1%	X-Ray Fluorescence
P_2O_5	%	±1%	X-Ray Fluorescence
Cr_2O_3	%	±1%	X-Ray Fluorescence
LOI	%	±1%	X-Ray Fluorescence
H_2O+	%	0.1	Wet Chemical
H_2O-	%	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
Ni	ppm	10.	X-Ray Fluorescence
Cu	ppm	10.	X-Ray Fluorescence
Ag	ppm	0.1	X-Ray Fluorescence
Cd	ppm	1.	X-Ray Fluorescence
Sn	ppm	10.	X-Ray Fluorescence
Sb	ppm	5.	X-Ray Fluorescence
Th	ppm	10.	X-Ray Fluorescence
U	ppm	10.	X-Ray Fluorescence

III. RARE-EARTH ELEMENT ANALYSES

Table 12; X-Ray Assay Laboratories, Limited, Don Mills, Ontario

Element	Value	Detection Limit	Analytical Method
Y	ppm	1.	Inductively Coupled Plasma Spectrometry
La	ppm	.1	Inductively Coupled Plasma Spectrometry
Ce	ppm	.1	Inductively Coupled Plasma Spectrometry
Pr	ppm	.1	Inductively Coupled Plasma Spectrometry
Nd	ppm	.1	Inductively Coupled Plasma Spectrometry
Sm	ppm	.1	Inductively Coupled Plasma Spectrometry
Eu	ppm	.05	Inductively Coupled Plasma Spectrometry
Gd	ppm	.1	Inductively Coupled Plasma Spectrometry
Tb	ppm	.1	Inductively Coupled Plasma Spectrometry
Dy	ppm	.1	Inductively Coupled Plasma Spectrometry
Ho	ppm	.05	Inductively Coupled Plasma Spectrometry
Er	ppm	.1	Inductively Coupled Plasma Spectrometry
Tm	ppm	.1	Inductively Coupled Plasma Spectrometry
Yb	ppm	.1	Inductively Coupled Plasma Spectrometry
Lu	ppm	.05	Inductively Coupled Plasma Spectrometry
Th	ppm	.1	Inductively Coupled Plasma Spectrometry
U	ppm	.1	Inductively Coupled Plasma Spectrometry

IV. TRACE-ELEMENT ANALYSES OF WATER

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

Element	Value	Detection Limit	Analytical Method
Be	ppb	1.	Inductively Coupled Plasma Spectrometry
P	ppb	10.	Inductively Coupled Plasma Spectrometry
Ti	ppb	1.	Inductively Coupled Plasma Spectrometry
V	ppb	2.	Inductively Coupled Plasma Spectrometry
Cr	ppb	1.	Inductively Coupled Plasma Spectrometry
Mn	ppb	1.	Inductively Coupled Plasma Spectrometry
Fe	ppb	2.	Inductively Coupled Plasma Spectrometry
Co	ppb	1.	Inductively Coupled Plasma Spectrometry
Ni	ppb	1.	Inductively Coupled Plasma Spectrometry
Cu	ppb	1.	Inductively Coupled Plasma Spectrometry
Zn	ppb	1.	Inductively Coupled Plasma Spectrometry
Sr	ppb	1.	Inductively Coupled Plasma Spectrometry
Zr	ppb	2.	Inductively Coupled Plasma Spectrometry
Mo	ppb	1.	Inductively Coupled Plasma Spectrometry
Ag	ppb	1.	Inductively Coupled Plasma Spectrometry
Cd	ppb	1.	Inductively Coupled Plasma Spectrometry
Sn	ppb	1.	Inductively Coupled Plasma Spectrometry
Sb	ppb	5.	Inductively Coupled Plasma Spectrometry
W	ppb	20.	Inductively Coupled Plasma Spectrometry
Pb	ppb	5.	Inductively Coupled Plasma Spectrometry
Bi	ppb	10.	Inductively Coupled Plasma Spectrometry

V. STABLE ISOTOPE ANALYSES

Table 14. Krueger Enterprises Inc.; Gechron Latcrie Division, Cambridge, Mass.

CORRECTIONS TO THE 1987-1989 BIENNIUM REPORT

The following corrections should be made to the 1987-1989 biennium report. The complete citation is: Morey, G.B. and McDonald, L.L., 1989, Analytical Results of the Public Geologic Sample Program, 1987-1989 Biennium: Minnesota Geological Survey Information Circular 29, 66 p.

Table 7

p. 39 Sample 6, the sample depth should read 220-235 ft.

p. 40 Samples 24-28, litho stratigraphic description should read "Prosser Formation."

p. 41 Samples 46-54, the well designation and location should read "Minnegasco Kingstrom #1, T.101N., R.24W., sec. 6, BBAAAB."

EXPLANATION OF THE ABBREVIATED T-R-S SYSTEM

A large 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, because 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 "NE1/4SE1/4. . ." system that traditionally has been used in legal land descriptions. In the ABCD system (see example below), A is the northeast quadrant, B the northwest quadrant, C the southwest quadrant, and D the southeast quadrant, and the *largest* quadrant pertaining to a location is given *first*.. For example, the location of a hole in the NE1/4 of the SE1/4 of the SW1/4 of the SW1/4 of the NW1/4 of section 29, Hartford Township, Todd County, would be described as 130-33-29 BCCDA.

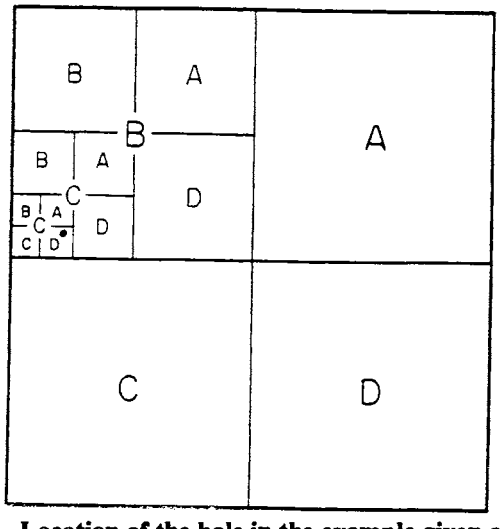

Figure 1. Location of the hole in the example given above.

Table 1. Publicly submitted sample—15-element exploration package

	1
Ag	.088
As	<.923
Au	.002
Cu	157.
Hg	<.092
Mo	.628
Pb	7.39
Sb	.310
Tl	.574
Zn	75.2
Bi	<.231
Cd	.342
Ga	4.54
Se	<.923
Te	<.461

1. GSP-51—Marble, sideritic; unnamed formation, Early Proterozoic:; outcrop sample; T.46N., R.20W., sec. 28, BCBA; Carlton County.

Table 2. Samples of Archean age—15-element exploration package

	1	2	3	4	5	6	7	8
Ag	.832	.105	.05	.039	.114	.193	.104	.362
As	1.97	1.74	3.21	1.23	2.18	3.99	1.15	<.917
Au	.007	.003	.006	.003	.004	.002	.001	.018
Cu	2809	476.	88.1	20.9	46.4	41.6	13.9	591.
Hg	<.092	<.098	<.093	<.097	<.092	<.095	<.094	<.092
Mo	2.86	2.52	.831	.655	.931	.714	1.09	1.14
Pb	1.48	1.41	1.18	3.07	6.47	2.08	7.30	1.11
Sb	.817	.688	.492	.570	.521	.473	.581	.576
Tl	<.462	<.489	<.467	<.484	<.459	<.477	<.472	<.459
Zn	20.0	34.4	45.5	53.2	64.9	92.1	96.6	17.6
Bi	<.231	<.245	<.234	<.242	<.229	<.239	.502	<.229
Cd	.206	<.098	<.093	.199	.102	<.095	.143	<.092
Ga	1.47	3.47	5.02	1.00	.687	7.38	11.1	4.52
Se	<.924	1.26	<.935	<.969	<.917	<.954	<.943	1.46
Te	.520	<.489	<.467	<.484	<.459	<.477	<.472	<.459

Table 2 continued

	9	10	11	12	13	14	15	16
Ag	.082	.201	.373	.871	.131	.065	1.11	.679
As	<.923	<.973	1.05	<.933	<.967	<.942	2.65	4.72
Au	<.0005	<.0005	.001	.002	.002	.003	.003	<.0005
Cu	24.2	56.7	60.2	150.	41.2	4.40	72.7	119.
Hg	<.092	<.097	<.097	<.093	<.097	<.094	<.092	<.097
Mo	.974	.708	3.19	3.47	1.65	.429	5.80	3.04
Pb	4.67	3.46	11.7	5.71	23.2	19.1	689.	51.9
Sb	.365	.345	.410	.324	.361	.500	.672	.464
Tl	1.01	<.486	<.484	<.466	<.484	<.471	<.46	<.486
Zn	49.4	14.3	17.0	34.7	31.8	109.	1525	103.
Bi	.403	<.243	.360	.608	.262	<.235	.499	.403
Cd	<.092	<.097	<.097	.134	<.097	.322	6.28	.594
Ga	5.84	1.39	3.14	3.82	7.74	5.63	3.34	3.89
Se	<.923	<.973	<.967	<.933	<.967	<.942	<.919	<.973
Te	<.461	<.486	<.484	.649	<.484	<.471	1.33	.486

	17	18	19	20	21	22	23	24
Ag	.096	.346	.235	.218	.114	.102	.194	.512
As	<.965	<.931	1.29	3.17	1.91	<.933	<.994	12.1
Au	.002	.01	.001	.005	.025	.012	.001	.001
Cu	29.5	169.	276.	91.4	11.6	26.9	29.3	72.7
Hg	<.097	<.093	<.099	<.093	<.096	<.093	<.099	<.094
Mo	.850	1.61	.564	1.36	38.3	2.20	3.35	7.46
Pb	4.01	4.58	2.40	6.14	6.29	3.90	24.1	165.
Sb	.317	.366	.618	.397	.293	.287	<.249	<.235
Tl	<.483	<.466	<.496	<.466	<.478	<.466	<.497	<.471
Zn	59.5	10.4	17.4	38.1	13.2	69.8	83.0	68.4
Bi	<.241	.507	<.248	<.233	.887	<.233	.483	.999
Cd	<.097	<.093	<.099	<.093	<.096	.155	<.099	.218
Ga	6.87	3.34	2.04	7.70	2.97	4.98	11.1	4.19
Se	<.965	<.931	1.56	<.933	<.956	<.933	<.994	<.942
Te	<.483	<.466	<.496	<.466	<.478	<.466	<.497	<.471

Table 2 continued

	25	26	27	28	29	30	31	32
Ag	.135	.095	.511	.188	.389	.05	.063	.078
As	1.02	1.37	<.984	<.994	1.71	<.931	<.935	<.96
Au	.003	<.0005	.003	.004	.006	.001	<.0005	<.0005
Cu	41.2	36.4	114.	60.9	52.6	87.0	5.93	17.8
Hg	<.094	<.092	<.098	<.099	<.1	<.093	<.093	<.096
Mo	5.29	3.18	3.51	3.72	8.81	7.10	16.6	10.1
Pb	6.34	1.85	4.90	6.29	2.97	1.82	1.17	7.58
Sb	.427	.231	.287	.252	<.25	.308	.236	<.24
Tl	<.468	<.462	<.492	<.497	<.499	<.466	<.467	<.48
Zn	39.2	35.1	34.0	41.7	18.7	26.6	15.6	45.3
Bi	.302	<.231	.406	.278	.314	.362	<.234	<.24
Cd	<.094	<.092	.103	<.099	<.1	<.093	<.093	.159
Ga	5.46	3.11	8.57	4.64	3.83	9.08	3.15	3.32
Se	<.936	<.924	<.984	<.994	1.03	<.391	<.935	<.96
Te	<.468	<.462	.626	<.497	.513	<.466	<.467	<.48

	33	34	35	36	37	38	39	40
Ag	.406	.347	.754	4.61	.508	.181	.233	.317
As	3.34	<.996	10.0	1.35	<.923	<.977	<.928	<.988
Au	.04	.003	.029	.005	.012	<.0005	<.0005	.008
Cu	11.1	57.8	306.	1970	396.	18.5	11.0	613.
Hg	<.093	<.1	<.097	<.092	<.092	<.098	<.093	<.099
Mo	5.23	3.74	4.70	21.9	19.1	5.03	11.1	9.25
Pb	10.4	3.28	35.0	57.8	1.57	5.07	21.1	1.18
Sb	<.233	<.249	<.243	.393	.241	2.71	<.232	.602
Tl	<.466	<.498	<.485	<.46	<.461	<.488	<.464	<.494
Zn	14.1	30.0	36.8	18.3	19.2	97.1	13.5	15.9
Bi	.356	<.249	2.98	76.4	1.23	.549	.708	2.47
Cd	<.093	<.1	<.097	.119	.269	<.098	<.093	.118
Ga	3.29	2.92	6.30	4.63	2.87	13.2	2.00	2.34
Se	1.25	1.30	1.92	2.52	.997	1.08	<.928	1.58
Te	.550	<.498	<.485	.589	1.09	<.488	<.464	<.494

Table 2 continued

	41	42	43	44	45	46	47	48
Ag	.017	.127	.227	.365	.172	.221	10.1	.168
As	<.977	2.27	<.912	3.05	<.942	.970	<.977	4.79
Au	<.0005	.001	.001	.001	.001	.002	.067	.008
Cu	28.2	8.04	333.	118.	53.7	142.	473.	141.
Hg	<.098	<.096	<.091	<.096	<.094	<.094	.154	<.097
Mo	23.6	8.56	4.42	2.17	6.06	5.78	610.	1.97
Pb	10.5	4.44	1.35	3.78	42.3	2.27	63.8	1.64
Sb	<.244	.271	<.228	.369	<.235	<.235	.255	<.242
Tl	<.488	<.479	<.456	<.478	<.471	<.469	.594	<.484
Zn	4.66	21.1	43.0	10.8	16.5	21.5	24.9	76.5
Bi	324.	.814	.434	1.78	8.61	7.51	1938	10.1
Cd	<.098	<.096	<.091	<.096	<.094	<.094	1.72	.187
Ga	1.60	6.93	3.74	2.55	3.21	3.26	1.21	9.73
Se	1.51	<.958	<.912	<.956	<.942	<.938	3.23	<.969
Te	<.488	<.479	<.456	<.478	<.471	<.469	2.75	<.484

	49	50	51	52	53	54	55	56
Ag	.804	.122	.182	.587	.203	1.09	.071	.093
As	97.0	23.1	20.6	10.2	1.94	<.935	<.978	1.11
Au	.016	.003	.001	.012	.001	<.0005	.003	.002
Cu	88.1	163.	16.5	276.	99.6	22.2	27.9	37.7
Hg	.415	.122	.099	<.095	.112	<.093	.112	.106
Mo	8.08	.741	4.85	3.11	4.10	2.01	1.19	1.66
Pb	23.1	1.06	8.36	34.3	2.36	4.88	1.16	1.79
Sb	4.10	<.248	1.54	<.237	<.228	<.234	<.245	<.235
Tl	<.465	<.495	<.459	<.474	<.455	<.467	<.489	<.471
Zn	1504	87.8	100.	33.5	47.5	76.6	100.	66.7
Bi	20.0	1.96	1.33	2.95	.793	.769	.405	.370
Cd	3.32	.159	<.092	<.095	.100	<.093	.138	.117
Ga	11.7	10.5	12.8	5.83	3.84	10.0	7.99	9.41
Se	2.80	<.99	<.917	1.58	<.911	<.935	<.978	<.942
Te	.934	<.495	<.459	<.474	<.455	<.467	<.489	<.471

1. C001A—Carbonate-altered sheared basalt, contains disseminated pyrite and chalcopyrite; unnamed formation, Archean; outcrop sample; T.61N., R.19W., sec. 36, AD; St. Louis County.

2. C002—Meta-quartz gabbro, contains 1-2 percent total pyrite, pyrrhotite, and chalcopyrite; unnamed formation, Archean; outcrop sample; T.62N., R.22W., sec. 11, ABCCC; St. Louis County.

3. C013A—Carbonate-altered metabasalt; unnamed formation, Archean; outcrop sample; T.62N., R.20W., sec. 9, CBDB; St. Louis County.

4. C013D—Sericite-rich fault rock; unnamed formation, Archean; outcrop sample; T.62N., R.20W., sec. 9, CBDB; St. Louis County.

5. C013X—Aphanitic sericite-rich fault rock; unnamed formation, Archean; outcrop sample; T.62N., R.20W., sec. 9, CBDB; St. Louis County.

6. C061—Carbonate-altered tuffaceous wacke, Lake Vermilion Formation, Archean; outcrop sample; T.62N., R.19W., sec. 14, AC center; St. Louis County.

7. C077C—Brecciated, veined aphanitic felsic tuff, contains abundant disseminated pyrite; Lake Vermilion Formation, Archean; outcrop sample; T.61N., R. 18W., sec. 17, DD center; St. Louis County.

8. C507C—Metabasalt containing pyrite, pyrrhotite, chalcopyrite; unnamed formation, Archean; outcrop sample; T.60N., R.21W., sec. 33, ACC; St. Louis County.

9. C543C—Metasedimentary rock cut by tourmaline-rich aplitic granite; Lake Vermilion Formation, Archean; outcrop sample; T.61N. R.20W., sec. 27, DDDAA; St. Louis County.

10. C549C—Hornblende diorite, contains 1-2 percent total pyrite and chalcopyrite; unnamed formation, Archean; outcrop sample; T.61N., R.19W., sec. 36, DAAC; St. Louis County.

11. C550A—Quartz-sericite schist, contains 6-8 percent disseminated pyrite; unnamed formation, Archean; outcrop sample from test pit; T.61N., R.19W., sec. 36, DAAC; St. Louis County.

12. C550B—Quartz-sericite schist, contains 3-5 percent pyrite plus chalcopyrite; unnamed formation, Archean; outcrop sample from test pit; T.61N., R.19W., sec. 36, DAAC; St. Louis County.

13. C550C—Sericitized hornblende diorite near shear zone; unnamed formation, Archean; outcrop sample from test pit; T.61N., R.19W., sec. 36, DAAC; St. Louis County.

14. C550D—Melanocratic biotite-hornblende schist/meta-lamprophyre; unnamed formation, Archean; outcrop sample from test pit; T.61N., R.19W., sec. 36, DAAC; St. Louis County.

15. C550E—Quartz-sericite schist, contains 6-8 percent pyrite, plus minor galena, sphalerite, and chalcopyrite; unnamed formation, Archean; outcrop sample from test pit; T.61N., R.19W., sec. 36, DAAC; St. Louis County.

16. C550F—Quartz-sericite schist, contains 6-7 percent pyrite; unnamed formation, Archean; outcrop sample from test pit; T.61N., R.19W., sec. 36, DAAC; St. Louis County.

17. C565A—Amphibolite-grade potassic (possible altered) metasedimentary rock; unnamed formation, Archean; outcrop sample; T.61N., R.20W., sec. 28, CDDCC; St. Louis County.

18. C578A—Amphibolite-grade sheared rock of mafic to intermediate composition, contains 6-8 percent lineated pyrite; unnamed formation, Archean; outcrop sample; T.60N., R.17W., sec. 7, DADA; St. Louis County.

19. C586A—Sheared, silicified metabasalt, contains 2-4% pyrrhotite plus pyrite; unnamed formation, Archean; outcrop sample; T.60N., R.17W., sec. 9 BAAB; St. Louis County.

20. C588A—Siliceousmetatuff, contains 2-3 percent pyrite; unnamed formation, Archean; outcrop sample; T.60N., R.17W., sec. 4, DCDCC; St. Louis County.

21. C590A—Sheared felsic tuff with brecciated quartz veins, contains disseminated pyrite; unnamed formation, Archean; outcrop sample; T.66N., R.17W., sec. 4, DCDCC; St. Louis County.

22. C067Y—Hornblende, plagioclase and pyrite-bearing flowtop breccia in metabasalt; unnamed formation, Archean; outcrop sample; T.62N., R.19W., sec. 26, BADABB; St. Louis County.

23. C111B—Feldspar porphyry dike with interstitial pyrite; intrudes Lake Vermilion Formation, Archean; outcrop sample; T.61N., R.17W., sec. 9, DDDBBB; St. Louis County.

24. C122B—Magnetite- and pyrite-bearing felsic sill cutting metabasalt; unnamed formation, Archean; outcrop sample; T.62N., R.18W., sec. 14, ABCBDD; St. Louis County.

25. C139A—Silicified tuffaceous wacke with disseminated pyrite; Lake Vermilion Formation, Archean; outcrop sample; T.61N., R. 18W., sec. 16, DDBDDD; St. Louis County.

26. C209A—Chloritic and pyritic metabasalt; unnamed formation, Archean; outcrop sample; T.62N., R.17W., sec. 11, CCCCAD; St. Louis County.

27. C261—Hornblende, plagioclase, garnet, pyrite schist (protolith a mafic tuff or hypabyssal rock); Lake Vermilion Formation, Archean; outcrop sample; T.61A., R.19W., sec. 14, BCDDAA; St. Louis County.

28. C284—Granodiorite containing pyrite and chalcopyrite; unnamed formation, Archean; outcrop sample; T.63N., R.19W., sec. 4, AAAAAA; St. Louis County.

29. C292B—Hornblende, garnet schist with disseminated pyrite and quartz, pyrite veins; Lake Vermilion Formation, Archean; outcrop sample; T.71N., R.19W., sec. 11, DBBBCC; St. Louis County.

30. C294D—Silicified and epidotized metagraywacke cut by veins of quartz, epidote, and pyrite; Lake Vermilion Formation, Archean; outcrop sample; T.61N., R.19W., sec. 24, BCDACB; St. Louis County.

31. C314—Quartz breccia with angular fragments of monzonite, diorite, and felsic tuff; associated with Lost Lake pluton, Archean; outcrop sample; T.61N., R.17W., sec. 5, DDDABD; St. Louis County.

32. C315C—Quartz-carbonate vein in chlorite-ankerite-pyrite schist; unnamed formation, Archean; outcrop sample; T.62N., R.19W., sec. 9, DADDAB; St. Louis County.

33. C590B—Sheared felsic tuff with brecciated quartz vein, contains disseminated pyrite; Lake Vermilion Formation, Archean; outcrop sample; T.60N., R.17W., sec. 4, DCDCC; St. Louis County.

34. C619A—Sheared, pyrite-bearing, amphibolitic pillow basalt; unnamed formation, Archean; outcrop sample; T.60N., R.17W., sec. 7, DACCC; St. Louis County.

35. C649A—Amphibolitic basalt containing 10 percent disseminated pyrite; unnamed formation, Archean; outcrop sample; T.61N., R.17W. sec. 19, CDDAB; St. Louis County.

36. C652B—Meta-quartz wacke, silicified and veined by quartz gossan; Lake Vermilion Formation, Archean; outcrop sample; T.61N., R.18W., sec. 31, BCBCB; St. Louis County.

37. C669E—Sheared granodiorite and pelitic schist wallrock containing pyrite, pyrrhotite, chalcopyrite, possible molybdenite; Lake Vermilion Formation, Archean; outcrop sample; T.60N., R.20W., sec. 22, ABACB; St. Louis County.

38. C679A—Pyritic, epidote-chlorite schist with red-altered feldspar; unnamed formation, Archean; outcrop sample; T.60N., R.19W., sec. 1, CCABD; St. Louis County.

39. C679B—Pyritic, tourmaline-sericite-quartz schist; unnamed formation, Archean; outcrop sample; T.60N., R.19W., sec. 1, CCABD; St. Louis County.

40. C695A—Pyritic, epidote-carbonate-quartz interpillow material from pillow basalt; unnamed formation, Archean; T.60N., R.21W., sec. 33, DBAAC; St. Louis County.

41. C700A–Vein quartz and gossan lining fractures parallel to vein walls in metabasalt; unnamed formation, Archean; T.61N. R.17W., sec. 19, DDBAA; St. Louis County.

42. C702A—Sheared, silicified, feldspar porphyry; unnamed formation, Archean; T.61N., R.17W., sec. 20, DDAAB; St. Louis County.

43. C703B—Sheared, diopside-bearing metabasalt rich in pyrite, chalcopyrite, pyrrhotite, contains minor native copper; unnamed formation, Archean; T.61N., R.17W., sec. 29, BBBBA; St. Louis County.

44. C707A—Sheared, silicified metabasalt; unnamed formation, Archean; T.60N., R.22W., sec. 10, BADC, St. Louis County.

45. C712B—Basalt and brick-red granite, both sheared; unnamed formation, Archean; T.61N, R.18W., sec. 25, AABCD; St. Louis County.

46. MH1—Coarse-grained hornblendite with disseminated chalcopyrite; Giants Range batholith, Archean; outcrop sample, roadcut; T.58N., R.20W., sec. 19, DB center; St. Louis County.

47. MH2—Coarsely recrystallized vein quartz with molybdenite and chalcopyrite; vein cuts hornblendite of MH1, Giants Range batholith, Archean; outcrop sample, roadcut; T.58N., R.20W., sec. 19, DB center; St. Louis County.

48. C8-1-191—Fine-grained, massive metavolcanic rock of intermediate composition containing a .4 in.-thick chert bed with chalcopyrite and pyrrhotite, cut by brittle calcite veins; unnamed formation, Archean; sample depth 191 ft., Humble Oil drill hole Cook-8-1; T. 62N., R.22W., sec. 7, DCDD; St. Louis County.

49. C8-1-217—Dark gray graphite-carbonate-pyrrhotite argillitic iron-formation with diseminated chalcopyrite; unnamed formation, Archean; sample depth 217 ft., Humble Oil drill hole Cook 8-1; T.62N., R.22W., sec. 7, DCDD; St. Louis County.

50. C8-1-235—Fine-grained altered metavolcanic rock of intermediate composition cut by carbonate veins; unnamed formation, Archean; sample depth 235 ft., Humble Oil drill hole Cook 8-1; T.62N., R.22W., sec. 7, DCDD; St. Louis County.

51. C679B—Pyritic, tourmaline-sericite-quartz schist; unnamed formation, Archean; outcrop sample; T.60N., R.19W., sec. 1, CCABD; St. Louis County.

52. C649A—Amphibolitic basalt containing 10 percent disseminated pyrite; unnamed formation, Archean; outcrop sample; T.61N., R.17W. sec. 19, CDDAB; St. Louis County.

53. T185A—Lithic breccia, probably of lamprophyric affinity, disseminated pyrite; outcrop sample; T.61N., R.16W., sec. 11, ABDD; St. Louis County.

54. LL20—Sheared rock in sequence of argillite, lithic wacke, and felsite conglomerate; secondary quartz, disseminated pyrite; outcrop sample; T.62N., R.16W., sec. 33, CDCB; St. Louis County.

55. S809—Carbonate-altered, sheared greenstone with disseminated pyrite; outcrop sample; T.62N., R.14W., sec. 32, ACBB; St.Louis County.

56. S818—Carbonate-altered felsic porphyry with disseminated pyrite; outcrop sample; T.61N., R. 14W., sec. 5, BCBC; St. Louis County.

Table 3. Samples of Archean age—30-element trace-element package
(Some samples also analyzed for Au, Th, and U)

	1	2	3	4	5	6	7	8
Au	–	–	–	–	–	–	–	–
Li	226	2960	85	46	60	60	2460	22
Be	4.2	16.1	<0.5	0.6	2.3	1.6	15.0	<0.5
B	<2	<2	<2	<2	<2	<2	<2	9
Sc	2.6	52.1	1.5	0.1	0.1	0.1	60.2	<0.1
V	1.6	5.3	1.1	2.9	5.0	3.1	9.7	1.9
Cr	3	10	<1	3	5	2	11	1
Co	<1	2	<1	2	3	1	3	<1
Ni	<1	2	<1	<1	<1	<1	1	<1
Cu	3.2	5.8	2.3	1.7	2.3	1.5	8.6	3.2
Zn	29.4	314.	10.1	4.0	4.5	2.7	291.	3.2
As	<3	<3	5	4	<3	<3	<3	4
Se	<20	<20	<20	<20	<20	<20	<20	<20
Sr	36.8	47.4	4.0	1.3	49.2	47.5	43.2	1.0
Y	9.1	1.0	2.4	<0.1	<0.1	<0.1	9.6	<0.1
Zr	4.6	7.5	4.6	<0.5	1.5	1.5	29.1	<0.5
Nb	19.9	357.	24.8	2.2	1.2	0.8	428.	0.9
Mo	2	<1	<1	<1	1	<1	<1	<1
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	<2	<2	<2	<2	<2	<2	<2	<2
In	<1	<1	<1	<1	<1	<1	<1	<1
Sn	12	192	<10	<10	<10	<10	182	<10
Sb	<5	<5	<5	<5	<5	<5	<5	<5
Ba	7	5	3	7	26	19	11	3
La	1.1	<0.5	0.8	<0.5	0.6	0.6	1.8	<0.5
Ce	2	<1	2	<1	<1	<1	6	<1
Ta	4	49	8	3	2	2	68	2
W	<10	17	<10	<10	<10	<10	13	<10
Tl	9	22	<2	<2	36	35	19	<2
Pb	<2	<2	5	10	21	20	180	3
Bi	<3	<3	5	<3	<3	<3	<3	<3
Th	–	–	–	–	–	–	–	–
U	–	–	–	–	–	–	–	–

Table 3 continued

	9	10	11	12	13	14	15	16
Au	–	–	–	–	–	–	–	–
Li	28	55	44	16	20	19	30	1640
Be	0.7	1.3	2.0	1.7	2.1	1.4	0.8	11.5
B	9	6	9	25	15	7	<2	<2
Sc	<0.1	0.2	0.3	0.4	0.3	0.3	0.2	40.3
V	1.5	4.4	4.1	1.1	<0.5	7.0	<0.5	<0.5
Cr	2	4	5	2	2	2	<1	4
Co	<1	<1	2	1	1	2	<1	2
Ni	<1	<1	2	<1	<1	2	<1	<1
Cu	1.0	0.8	2.0	2.6	1.5	1.3	2.9	5.9
Zn	4.9	4.5	7.4	10.3	11.4	5.5	5.3	218.
As	<3	5	<3	6	4	10	<3	<3
Se	<20	<20	<20	<20	<20	<20	<20	<20
Sr	2.4	50.2	60.3	38.3	37.6	44.9	2.0	35.6
Y	1.3	0.5	<0.1	1.4	0.8	0.2	0.4	1.1
Zr	4.7	2.2	1.6	3.4	2.3	1.7	<0.5	8.6
Nb	3.4	8.7	1.2	42.1	45.7	1.5	1.5	286.
Mo	<1	<1	<1	1	<1	<1	<1	<1
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	<2	<2	<2	<2	<2	<2	<2	<2
In	<1	<1	<1	<1	<1	<1	<1	<1
Sn	<10	<10	<10	<10	<10	<10	<10	137
Sb	<5	<5	<5	<5	<5	<5	<5	<5
Ba	4	21	14	25	26	34	4	9
La	<0.5	1.0	<0.5	1.2	1.3	0.6	0.6	1.8
Ce	1	2	<1	3	2	<1	<1	4
Ta	2	5	1	26	17	1	<1	39
W	<10	<10	<10	<10	<10	<10	<10	<10
Tl	<2	34	42	18	19	26	<2	13
Pb	6	22	21	9	15	20	4	<2
Bi	<3	<3	<3	<3	<3	<3	<3	<3
Th	–	–	–	–	–	–	–	–
U	–	–	–	–	–	–	–	–

Table 3 continued

	17	18	19	20	21	22	23	24
Au	–	–	–	–	–	–	–	–
Li	23	34	30	570	37	42	36	40
Be	0.8	0.8	1.0	6.4	0.9	0.7	1.3	1.2
B	4	<2	<2	<2	<2	<2	2	<2
Sc	<0.1	<0.1	0.1	16.1	<0.1	<0.1	0.2	0.1
V	<0.5	0.6	<0.5	<0.5	0.6	<0.5	<0.5	<0.5
Cr	3	<1	<1	9	2	1	2	1
Co	<1	<1	<1	<1	<1	<1	<1	<1
Ni	<1	<1	<1	<1	<1	<1	<1	<1
Cu	1.3	<0.5	1.3	1.7	1.9	1.0	1.9	<0.5
Zn	5.8	7.9	3.2	92.5	4.0	2.3	17.2	4.7
As	<3	7	<3	<3	<3	<3	<3	<3
Se	<20	<20	<20	<20	<20	<20	<20	<20
Sr	1.3	44.5	38.8	29.7	0.6	0.8	45.3	58.2
Y	0.5	<0.1	<0.1	68.5	<0.1	0.3	0.3	0.4
Zr	0.6	0.9	0.9	19.2	<0.5	<0.5	1.2	1.2
Nb	1.0	1.0	<0.5	60.0	<0.5	0.7	0.8	1.6
Mo	<1	1	<1	<1	<1	<1	<1	<1
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	<2	<2	<2	<2	<2	<2	<2	<2
In	<1	<1	<1	<1	<1	<1	<1	<1
Sn	<10	<10	<10	27	<10	<10	<10	<10
Sb	<5	<5	<5	<5	<5	<5	<5	<5
Ba	3	44	32	5	2	2	14	15
La	<0.5	0.6	<0.5	17.1	<0.5	<0.5	0.7	<0.5
Ce	<1	<1	<1	44	<1	<1	1	<1
Ta	<1	<1	<1	4	<1	<1	1	<1
W	<10	<10	<10	<10	<10	<10	<10	<10
Tl	<2	33	33	5	<2	<2	33	43
Pb	<2	24	29	5	<2	<2	13	21
Bi	<3	<3	<3	3	<3	<3	11	<3
Th	–	–	–	–	–	–	–	–
U	–	–	–	–	–	–	–	–

Table 3 continued

	25	26	27	28	29	30
Au	5	16	6	7	5	<1
Li	<10	<10	18	<10	84	12
Be	<5	<5	<5	10	5	<5
B	<10	<10	30	20	<10	650
Sc	42.6	11.2	<0.5	<0.5	21.1	7.4
V	250	80	20	<10	210	<10
Cr	630	67	10	4	80	4
Co	40	11	2	<1	37	1
Ni	94	78	8	<1	57	7
Cu	40.8	5.5	8.7	1.5	108.	4.1
Zn	80.1	84.5	70.3	28.6	128.	14.8
Ge	<10	<10	<10	<10	<10	<10
As	<1	1	2	<1	1	<1
Se	<3	<3	<3	<3	<3	<3
Mo	<1	<1	<1	<1	<1	<1
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	<1	<1	<1	<1	<1	<1
In	<1	<1	<1	<1	<1	<1
Sn	<10	<10	<10	<10	<10	<10
Sb	0.3	0.2	1.1	<0.2	<0.2	0.2
Cs	2	1	9	7	2	15
La	20.8	130.	17.5	5.9	50.6	7.3
Ce	46	328	33	10	101	15
Nd	24	186	11	<5	46	7
Sm	5.7	34.7	1.7	0.2	8.9	1.6
Eu	1.9	9.3	0.4	0.2	2.4	0.2
Tb	0.7	2.3	<0.5	<0.5	0.6	<0.5
Yb	1.7	2.3	0.2	<0.2	1.4	1.3
Lu	0.2	0.2	<0.1	<0.1	0.2	0.2
Hf	3	8	4	2	4	2
Ta	<1	1	<1	3	<1	1
W	<3	<3	<3	<3	<3	<3
Pb	3	12	9	16	5	19
Bi	7	<3	<3	<3	3	<3
Th	3	9	10	6	3	4
U	1.1	2.0	2.3	6.8	0.6	3.9

1. SW-2-1—Pegmatite; unnamed formation, Archean; outcrop sample about 60 m. southwest of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

2. SW-2-2—Pegmatite; unnamed formation, Archean; outcrop sample about 60 m. southwest of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

3. SW-2-3—Pegmatite; unnamed formation, Archean; outcrop sample about 60 m. southwest of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

4. SW-2-4—Pegmatite; unnamed formation, Archean; outcrop sample about 60 m. southwest of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

5. SW-2-5—Pegmatite; unnamed formation, Archean; outcrop sample about 60 m. southwest of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

6. SW-2-6—Pegmatite; unnamed formation, Archean; outcrop sample about 60 m. southwest of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

7. HB-1-1—Pegmatite; unnamed formation, Archean; outcrop sample from Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

8. HB-1-2—Pegmatite; unnamed formation, Archean; outcrop sample from Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

9. HB-1-3—Pegmatite; unnamed formation, Archean; outcrop sample from Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

10. HB-1-4—Pegmatite; unnamed formation, Archean; outcrop sample from Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

11. HB-1-5—Pegmatite; unnamed formation, Archean; outcrop sample from Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

12. HB-2-1—Pegmatite; unnamed formation, Archean; outcrop sample just east of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

13. HB-2-2—Pegmatite; unnamed formation, Archean; outcrop sample just east of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

14. HB-2-3—Pegmatite; unnamed formation, Archean; outcrop sample just east of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

15. HB-2-4—Pegmatite; unnamed formation, Archean; outcrop sample just east of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

16. HB-3-1—Pegmatite; unnamed formation, Archean; outcrop sample just west of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

17. HB-3-2—Pegmatite; unnamed formation, Archean; outcrop sample just west of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

18. HB-3-3—Pegmatite; unnamed formation, Archean; outcrop sample just west of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

19. HB-3-4—Pegmatite; unnamed formation, Archean; outcrop sample just west of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

20. NE-3-1—Pegmatite; unnamed formation, Archean; outcrop along hogback about 30 m. northeast of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

21. NE-3-2—Pegmatite; unnamed formation, Archean; outcrop along hogback about 30 m. northeast of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

22. NE-3-3—Pegmatite; unnamed formation, Archean; outcrop along hogback about 30 m. northeast of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

23, NE-3-4—Pegmatite; unnamed formation, Archean; outcrop along hogback about 30 m. northeast of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

24. NE-3-5—Pegmatite; unnamed formation, Archean; outcrop along hogback about 30 m. northeast of Radar Mine; T.167N., R. 33W., sec. 6, DBA; Lake of the Woods County.

25. C027—Lamprophyre; unnamed formation, Archean; T.63N., R.19W., sec. 29 CAA; St. Louis County.

26. C029—Porphyritic pyroxene syenite; unnamed formation, Archean; T.63N., R.19W., sec. 29 CDD; St. Louis County.

27. CLP-1—Pegmatitic syenite; Coon Lake pluton, Archean; T.61N., R.24W., sec. 20 CAC; Itasca County.

28. C552B—Flourite-bearing granite; unnamed formation, Archean; T.61N, R.18W., sec. 23 CDD; St. Louis County.

29. C564A—Poikilitic pyroxene syenite/lamprophyre; unnamed formation, Archean; T.61N., R.20W., sec. 33 CAA; St. Louis County.

30. C597B—Tourmaline-bearing granitic pegmatite; unnamed formation, Archean; T.60N., R.18W., sec. 9, ACD; St. Louis County.

Table 4. Samples of Early Proterozoic age—23-element trace-element package

	1	2	3	4	5	6	7	8
Li	6	5	6	4	9	7	7	6
Be	2.1	2.8	2.6	2.6	3.2	2.7	3.5	3.5
B	<2	<2	<2	<2	<2	<2	<2	<2
Sc	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
V	8.2	4.3	5.7	<0.5	<0.5	<0.5	4.7	8.6
Cr	16	15	13	11	13	13	15	19
Co	5	10	9	6	11	8	15	15
Ni	6	8	6	3	7	7	9	9
Cu	5.6	<0.5	<0.5	<0.5	0.7	<0.5	<0.5	<0.5
Zn	32.0	41.0	43.6	34.0	39.3	40.2	44.8	47.2
As	4	<3	6	16	15	6	18	<3
Se	<20	<20	<20	<20	<20	<20	<20	<20
Sr	20.5	15.5	8.1	21.1	22.6	20.3	8.2	8.4
Y	2.5	4.5	3.9	4.0	4.3	5.6	5.5	5.2
Zr	10.6	22.7	24.6	17.8	19.2	17.5	26.0	23.0
Mo	<1	<1	<1	<1	<1	<1	<1	<1
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	<2	<2	<2	<2	<2	<2	<2	<2
Sn	<10	13	16	<10	13	15	19	27
Sb	<5	<5	10	8	9	8	7	9
Ba	13	18	16	15	18	16	20	18
W	<10	<10	<10	<10	<10	<10	<10	<10
Pb	14	30	33	28	37	35	36	43

Table 4 continued

	9	10	11	12	13	14	15	16
Li	6	90	<1	2	3	3	3	3
Be	3.2	7.9	1.9	2.0	1.8	2.2	2.1	2.1
B	<2	<2	<2	<2	<2	<2	<2	<2
Sc	<0.1	6.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
V	10.1	165.	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cr	20	46	15	15	15	16	17	19
Co	15	21	4	9	13	10	12	10
Ni	7	16	2	4	5	5	5	6
Cu	<0.5	17.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Zn	47.1	53.7	26.1	39.0	44.4	37.9	43.7	39.7
As	<3	<3	<3	<3	20	9	<3	<3
Se	<20	<20	<20	<20	<20	<20	<20	<20
Sr	7.6	26.8	15.2	8.8	5.7	27.5	12.1	7.8
Y	5.4	16.4	1.1	3.7	3.0	3.2	3.4	3.7
Zr	26.0	88.4	4.9	14.2	19.3	14.6	17.9	15.0
Mo	<1	<1	<1	<1	<1	<1	<1	<1
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	<2	<2	<2	<2	<2	<2	<2	<2
Sn	24	16	<10	24	26	21	28	21
Sb	<5	8	<5	<5	9	5	<5	7
Ba	17	23	4	11	11	14	11	11
W	<10	<10	<10	<10	<10	<10	<10	<10
Pb	44	29	16	31	47	34	43	37

Table 4 continued

	17	18	19	20	21	22	23	24
Li	9	7	17	10	9	3	5	8
Be	2.8	2.0	3.4	4.5	2.7	1.8	2.8	3.2
B	<2	<2	<2	<2	<2	<2	<2	<2
Sc	<0.1	<0.1	<0.1	<0.1	3.5	<0.1	<0.1	<0.1
V	11.8	<0.5	<0.5	7.6	29.0	<0.5	<0.5	9.4
Cr	30	17	24	31	31	7	5	9
Co	19	10	24	21	10	<1	2	13
Ni	8	6	8	9	13	4	<1	14
Cu	<0.5	<0.5	2.8	<0.5	17.7	3.4	<0.5	<0.5
Zn	41.2	34.8	46.2	39.8	43.0	27.1	27.5	48.8
As	<3	<3	<3	<3	5	21	22	40
Se	<20	<20	<20	<20	<20	<20	<20	<20
Sr	13.9	17.0	21.0	24.5	19.2	21.4	19.6	20.9
Y	6.8	3.0	6.2	6.5	8.5	3.8	1.9	4.7
Zr	10.9	9.2	12.5	<0.5	40.3	15.5	9.3	17.2
Mo	<1	<1	<1	<1	<1	1	<1	<1
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	<2	<2	<2	<2	<2	<2	<2	<2
Sn	29	23	1580	29	<10	<10	<10	12
Sb	5	<5	5	6	<5	<5	<5	<5
Ba	14	14	15	77	56	22	14	24
W	<10	<10	<10	<10	<10	<10	<10	<10
Pb	29	26	1070	23	16	21	22	19

Table 4 continued

	25	26	27	28	29	30	31	32
Li	40	10	12	7	7	16	15	6
Be	3.4	2.5	3.2	2.8	2.7	3.0	4.3	2.4
B	<2	<2	<2	<2	<2	<2	<2	<2
Sc	<0.1	<0.1	<0.1	<0.1	2.3	5.7	10.5	0.9
V	24.0	<0.5	20.9	7.0	31.0	64.0	87.8	56.5
Cr	16	7	17	9	18	34	59	26
Co	17	10	13	13	14	17	22	8
Ni	23	5	8	7	9	14	26	<1
Cu	6.1	3.4	3.6	<0.5	12.5	19.3	26.9	9.4
Zn	56.7	35.4	38.2	39.7	42.6	46.0	59.1	26.2
As	34	32	10	5	7	<3	<3	<3
Se	21	<20	<20	<20	<20	<20	<20	<20
Sr	17.9	16.6	13.7	42.8	30.3	17.5	25.5	69.1
Y	5.7	4.3	4.8	3.6	6.8	10.9	11.4	5.4
Zr	27.2	11.6	15.9	17.5	29.7	45.1	63.4	13.4
Mo	<1	<1	<1	<1	<1	<1	<1	<1
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	<2	<2	<2	<2	<2	<2	<2	<2
Sn	21	<10	25	27	19	18	29	13
Sb	<5	<5	<5	19	7	<5	13	<5
Ba	79	48	30	23	73	39	31	28
W	<10	<10	<10	<10	<10	<10	<10	<10
Pb	16	40	17	21	<2	16	4	3

Table 4 continued

	33	34	35	36	37	38	39	40
Li	11	7	2	7	12	7	6	14
Be	2.5	2.0	2.9	1.5	2.2	2.7	1.9	1.8
B	<2	<2	<2	<2	<2	<2	<2	<2
Sc	0.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
V	40.1	6.4	8.5	7.3	2.1	4.0	<0.5	3.1
Cr	18	10	10	11	9	8	7	12
Co	14	4	8	8	5	6	2	12
Ni	9	5	11	5	3	4	<1	11
Cu	11.0	1.7	0.5	<0.5	1.9	1.1	1.7	1.5
Zn	35.0	28.6	33.8	37.6	35.6	31.5	26.9	48.4
As	<3	<3	21	24	<3	<3	<3	<3
Se	<20	<20	<20	<20	<20	<20	<20	<20
Sr	12.7	11.4	6.8	7.0	5.7	16.0	13.3	24.6
Y	6.1	3.4	4.6	4.1	3.5	2.4	2.3	4.9
Zr	24.5	6.9	8.7	6.9	9.5	10.1	8.8	14.2
Mo	<1	<1	<1	<1	<1	<1	<1	<1
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	<2	<2	<2	<2	<2	<2	<2	2
Sn	22	17	28	30	29	30	10	29
Sb	<5	<5	10	<5	<5	9	<5	<5
Ba	16	12	9	13	18	6	10	30
W	<10	<10	<10	<10	<10	<10	<10	<10
Pb	22	20	15	10	15	12	13	9

Table 4 continued

	41	42	43	44	45	46	47	48
Li	5	6	68	255	5	7	7	4
Be	2.3	2.4	29.0	8.1	1.1	2.6	2.6	1.1
B	<2	<2	<2	<2	<2	<2	<2	<2
Sc	<0.1	<0.1	12.6	9.0	1.1	3.4	0.4	<0.1
V	<0.5	<0.5	155.	1150.	22.2	44.1	14.0	2.8
Cr	13	13	90	68	18	25	14	8
Co	9	10	19	17	19	20	18	12
Ni	5	6	36	29	14	16	16	7
Cu	9.1	7.2	56.5	21.5	7.8	14.8	2.1	1.9
Zn	30.1	31.5	106.	101.	29.9	51.6	46.3	33.9
As	13	<3	<3	6	<3	4	13	<3
Se	<20	<20	<20	<20	<20	<20	<20	33
Sr	24.6	21.4	133.	85.3	13.4	19.4	18.8	16.1
Y	2.9	3.1	20.9	22.1	2.7	4.4	2.6	2.6
Zr	7.3	8.5	99.9	48.2	14.8	34.4	22.2	15.8
Mo	4	<1	1	3	<1	<1	<1	<1
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	<2	<2	<2	<2	<2	<2	<2	<2
Sn	13	18	<10	<10	14	16	22	<10
Sb	<5	6	<5	11	13	14	6	<5
Ba	31	40	245	89	26	14	31	23
W	<10	<10	<10	<10	<10	<10	<10	<10
Pb	21	19	9	17	16	32	32	29

Table 4 continued

	49	50	51	52	53	54	55	56
Li	5	4	4	5	5	5	18	21
Be	2.2	2.8	1.4	1.8	0.7	<0.5	<0.5	0.7
B	<2	<2	<2	<2	<2	<2	<2	<2
Sc	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	2.0
V	8.4	3.5	4.2	5.2	6.6	8.0	35.0	47.9
Cr	10	8	7	9	3	4	7	12
Co	20	13	18	15	11	2	9	11
Ni	11	10	12	9	6	5	10	7
Cu	0.8	1.5	3.4	<0.5	1.5	<0.5	0.5	6.8
Zn	43.8	58.9	41.7	42.7	47.8	38.9	49.0	45.2
As	7	6	14	<3	11	16	25	16
Se	<20	<20	<20	<20	<20	<20	<20	<20
Sr	14.6	17.5	9.8	15.9	22.0	72.6	34.8	13.8
Y	4.1	2.7	3.9	5.1	2.6	1.8	3.5	5.8
Zr	16.0	11.4	16.0	13.1	15.8	10.3	27.7	39.0
Mo	<1	1	2	<1	<1	<1	<1	<1
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	<2	<2	<2	<2	<2	<2	<2	<2
Sn	17	23	11	12	<10	<10	11	<10
Sb	7	11	8	15	<5	<5	<5	<5
Ba	24	18	23	24	37	22	60	18
W	<10	<10	<10	<10	<10	<10	<10	<10
Pb	37	49	41	42	34	40	41	38

Table 4 continued

	57	58	59	60	61	62	63	64
Li	10	3	3	3	8	6	3	3
Be	1.9	1.1	1.0	0.7	0.9	1.5	1.1	2.1
B	<2	<2	<2	<2	<2	<2	<2	<2
Sc	<0.1	<0.1	<0.1	1.2	0.6	<0.1	<0.1	<0.1
V	35.2	25.3	23.2	52.0	43.7	7.0	<0.5	2.4
Cr	7	8	8	13	17	10	4	6
Co	15	20	26	10	16	7	12	16
Ni	10	7	12	9	13	2	5	4
Cu	7.5	7.8	10.0	9.4	13.1	2.8	0.9	3.6
Zn	43.5	54.1	40.5	45.0	33.5	42.5	42.7	36.3
As	20	7	39	<3	<3	<3	17	4
Se	<20	<20	<20	<20	<20	<20	28	<20
Sr	11.7	9.5	13.1	10.6	10.4	8.7	15.8	39.5
Y	4.6	3.9	4.1	4.6	3.9	1.2	3.2	4.5
Zr	22.4	20.5	19.9	30.7	21.5	16.5	10.7	11.6
Mo	3	<1	<1	<1	1	<1	2	<1
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Cd	<2	<2	<2	<2	<2	<2	<2	<2
Sn	21	<10	<10	10	16	19	14	20
Sb	<5	13	<5	<5	<5	<5	<5	5
Ba	21	12	13	18	17	8	9	11
W	<10	<10	<10	<10	<10	<10	<10	<10
Pb	46	36	36	36	24	24	39	30

Table 4 continued

	65	66	67	68	69	70	71	72
Li	3	4	4	6	4	5	8	26
Be	1.3	0.8	0.7	2.5	1.7	2.5	3.9	2.3
B	<2	<2	<2	<2	<2	<2	<2	<2
Sc	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.4	0.3
V	6.6	<0.5	<0.5	3.6	<0.5	<0.5	18.9	16.8
Cr	5	7	5	11	13	15	34	81
Co	11	15	15	17	14	25	21	48
Ni	7	10	8	13	2	26	16	<1
Cu	12.2	1.8	10.5	1.8	28.1	3.2	4.3	15.6
Zn	40.5	54.1	36.8	39.6	35.7	92.5	47.0	71.0
As	<3	<3	3	<3	<3	3	<3	11
Se	<20	<20	<20	<20	<20	283	170	109
Sr	13.7	6.6	58.3	33.8	21.4	170.	21.7	27.8
Y	3.5	3.7	3.6	4.0	5.0	11.9	7.1	12.4
Zr	13.6	12.5	11.7	9.5	11.4	19.2	20.9	<0.5
Mo	<1	<1	<1	<1	<1	<1	<1	<1
Ag	<0.5	<0.5	<0.5	<0.5	<0.5	<0.1	<0.1	<0.1
Cd	<2	<2	<2	<2	<2	<1	<1	<1
Sn	15	19	12	28	<10	<10	<10	<10
Sb	<5	<5	<5	<5	<5	8	7	7
Ba	15	11	9	26	28	1470	28	3940
W	<10	<10	<10	<10	<10	<10	<10	<10
Pb	40	46	39	34	34	55	19	34

Table 4 continued

	73	74	75	76	77	78	79	80
Li	536	4	1	<1	<1	<1	4	8
Be	2.1	1.1	<0.5	<0.5	1.6	2.3	1.7	1.8
B	<2	<2	<2	<2	<2	<2	<2	<2
Sc	<0.1	0.3	0.5	<0.1	<0.1	1.7	2.4	0.1
V	151.	39.8	17.9	21.7	14.4	28.8	36.2	1.5
Cr	9	27	16	20	13	41	39	20
Co	22	26	9	30	12	59	42	4
Ni	<1	23	11	14	11	24	25	13
Cu	9.3	4.7	4.0	3.7	9.0	5.0	4.6	<0.5
Zn	38.0	52.0	34.0	53.0	53.5	50.0	57.0	30.0
As	16	<3	5	<3	8	13	22	<3
Se	158	191	22	169	236	188	204	<20
Sr	20.6	11.1	25.8	25.9	34.2	24.5	45.2	27.8
Y	5.5	6.8	5.3	4.5	9.2	4.3	7.2	4.9
Zr	16.5	5.1	<0.5	106	12.9	21.0	33.9	17.6
Mo	<1	<1	<1	<1	<1	<1	<1	<1
Ag	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5
Cd	<1	<1	<1	<1	<1	<1	<1	<1
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sb	6	9	<5	5	10	19	8	<5
Ba	1770	56	55	68	55	101	43	133
W	13	<10	<10	<10	<10	<10	11	<10
Pb	35	34	11	40	34	43	28	10

Table 4 continued

	81	82	83	84
Li	13	15	14	15
Be	3.1	2.2	4.9	2.7
B	<2	<2	<2	<2
Sc	1.3	1.3	4.1	1.7
V	21.8	15.7	23.8	11.8
Cr	49	30	42	35
Co	9	7	16	6
Ni	16	22	27	13
Cu	8.0	4.6	267.	2.6
Zn	53.5	54.0	77.6	50.0
As	3	6	14	<3
Se	<20	<20	<20	<20
Sr	42.9	54.8	82.9	64.9
Y	5.5	6.2	9.3	8.7
Zr	24.2	31.8	31.9	28.7
Mo	<1	<1	<1	<1
Ag	0.2	0.1	0.4	0.2
Cd	<1	<1	<1	<1
Sn	<10	<10	<10	<10
Sb	14	12	8	11
Ba	273	179	162	1220
W	<10	<10	<10	<10
Pb	44	36	16	12

1. 7-800—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 800 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

2. 7-820—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 820 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

3. 7-840—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 840 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

4. 7-875—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 875 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.
5. 7-917—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 917 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

6. 7-925—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 925 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

7. 7-985—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 985 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

8. 7-1045—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1045 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

9. 7-1056—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1056 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

10. 7-1061—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1061 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

11. 7-1085—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1085 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

12. 7-1120—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1120 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

13. 7-1170—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1170 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

14. 7-1220—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1220 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

15. 7-1255—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1255 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

16. 7-1280—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1280 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

17. 7-1294—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1294 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

18. 7-1325—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1325 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

19. 7-1360—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1360 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

20. 7-1373—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1373 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

21. 5-530—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 530 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

22. 5-550—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 550 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

23. 5-580—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 580 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

24. 5-625—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 625 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

25. 5-675—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 675 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

26. 5-691—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 691 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

27. 5-655—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 655 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

28. 5-760—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 760 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

29. 5-844—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 844 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

30. 5-885—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 885 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

31. 5-905—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 905 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

32. 5-914—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 914 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

33. 5-930—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 930 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

34. 5-970—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 970 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

35. 5-1005—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1005 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

36. 5-1013—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1013 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

37. 5-1040—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1040 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

38. 5-1090—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1090 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

39. 5-1115—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1115 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

40. 5-1150—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1150 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

41. 5-1185—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1185 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

42. 5-1195—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1195 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

43. 2-1614—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1614 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

44. 2-1624—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1624 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

45. 2-1645—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1645 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

46. 2-1665—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1665 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

47. 2-1690—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1690 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

48. 2-1715—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1715 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

49. 2-1736—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1736 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

50. 2-1760—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1760 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

51. 2-1790—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1790 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

52. 2-1800—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1800 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

53. 2-1804—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1804 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

54. 2-1810—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1810 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

55. 2-1819—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1819 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

56. 2-1830—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1830 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

57. 2-1860—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1860 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

58. 2-1900—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1900 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

59. 2-1940—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1940 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

60. 2-1980—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1980 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

61. 2-2003—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 2003 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

62. 2-2018—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 2018 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

63. 2-2045—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 2045 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

64. 2-2075—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 2075 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

65. 2-2090—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 2090 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

66. 2-2130—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 2130 ft., IRRRB-2; T58N., R.16W., sec. 22, DB; St. Louis County.

67. 2-2180—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 2180 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

68. 2-2197—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 2197 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

69. 2-2210—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 2210 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

70. A-55—Iron-formation, nongranular, dark greenish gray; Trommald Formation, North Range Group, Early Proterozoic; sample depth 550 ft., drill hole Arko Property (University of Minnesota); T.46N., R.29W., sec. 9, AABA; Crow Wing County.

71. A-273—Iron-formation, nongranular, dark greenish gray; Trommald Formation, North Range Group, Early Proterozoic; sample depth 273 ft., drill hole Arko Property (University of Minnesota); T.46N., R.29W., sec. 9, AABA; Crow Wing County.

72. M-256—Iron-formation, nongranular, laminated red and gray; Trommald Formation, North Range Group, Early Proterozoic; sample depth 256.2 ft., drill hole Merritt Property (University of Minnesota); T.47N., R.29W., sec. 33, CCCB; Crow Wing County.

73. M-287—Iron-formation, nongranular, acmite-bearing; Trommald Formation, North Range Group, Early Proterozoic; sample depth 287 ft., drill hole Merritt Property (University of Minnesota); T.47N., R.29W., sec. 33, CCCB; Crow Wing County.

74. M-325—Iron-formation, nongranular; Trommald Formation, North Range Group, Early Proterozoic; sample depth 325.6 ft., drill hole Merritt Property (University of Minnesota); T.47N., R.29W., sec. 33, CCCB; Crow Wing County.

75. M-382—Iron-formation, nongranular, light gray; Trommald Formation, North Range Group, Early Proterozoic; sample depth 382.0 ft., drill hole Merritt Property (University of Minnesota); T.47N., R.29W., sec. 33, CCCB; Crow Wing County.

76. M-425—Iron-formation, nongranular; Trommald Formation, North Range Group, Early Proterozoic; sample depth 425.1 ft., drill hole Merritt Property (University of Minnesota); T.47N., R.29W., sec. 33, CCCB; Crow Wing County.

77. M-499—Iron-formation, nongranular, dark green; Trommald Formation, North Range Group, Early Proterozoic; sample depth 499.0 ft., drill hole Merritt Property (University of Minnesota); T.47N., R.29W., sec. 33, CCCB; Crow Wing County.

78. M-549—Slate, ferruginous, dark-green; Trommald Formation, North Range Group, Early Proterozoic; sample depth 589.8 ft., drill hole Merritt Property (University of Minnesota); T.47N., R.29W., sec. 33, CCCB; Crow Wing County.

79. M-612—Slate, dark greenish gray; Trommald Formation, North Range Group, Early Proterozoic; sample depth 612.9 ft., drill hole Merritt Property (University of Minnesota); T.47N., R.29W., sec. 33, CCCB; Crow Wing County.

80. 12-385-400—Iron-formation, oxide-facies; unnamed formation at Philbrook, Early Proterozoic; sample depth 385-400 ft., Adams drill hole #12; T.132N., R.32W., sec 5, BAA; Todd County.

81. 15-270-300—Iron-formation, oxide-facies; unnamed formation at Philbrook, Early Proterozoic; sample depth 270-300 ft., Adams drill hole #15; T.132N., R.32W., sec 5, DC; Todd County.

82. 101-332-334—Iron-formation, oxide-facies; unnamed formation at Philbrook, Early Proterozoic; sample depth 332-334 ft., Adams drill hole #101; T.133N., R.32W., sec 32, DC; Todd County.

83. 104-210-215—Iron-formation, oxide-facies; unnamed formation at Philbrook, Early Proterozoic; sample depth 210-215 ft., Adams drill hole #104; T.133N., R.32W., sec 32 DCD; Todd County.

84. A3-332—Iron-formation mixed carbonate-and oxide-facies, disseminated pyrite intercalated with chloritic metasedimentary beds; unnamed formation at Philbrook, Early Proterozoic; sample depth 332 ft., Adams drill hole #A-3; T.133N., R.32W., sec. 32 DCAC; Todd County.

Table 5. Samples of Middle Proterozoic Age—30-element trace-element package
(Some samples also analyzed for Au, Th, and U)

	1	2	3	4	5	6	7	8
Au	<5	<5	<5	<5	<5	<5	<5	<5
Be	3	3	5	4	4	6	4	6
B	<10	25	<10	<10	15	12	18	37
Sc	5.3	29.9	11.9	14.2	1.1	13.1	29.9	30.5
V	35	152	72	152	12	30	99	29
Cr	100	230	23	300	<5	<5	190	<5
Co	88	37	72	95	1	9	59	21
Ni	829	89	187	274	5	6	202	10
Cu	11.5	77.0	89.1	60.8	17.8	36.3	11.2	33.5
Zn	65.1	64.0	111.	117.	145.	254.	80.8	266.
Ge	20	11	23	20	<10	21	34	31
As	<2	<2	<2	<2	<2	6	<2	<2
Se	<3	<3	<3	<3	<3	<3	<3	<3
Br	9	3	3	3	3	2	3	5
Mo	<5	<5	<5	<5	<5	6	<5	<5
Ag	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5
Cd	<1	<1	<1	<1	<1	<1	<1	<1
Sb	<.2	<.2	<.2	<.2	<.2	<.2	<.2	.2
Cs	<1	1	1	<1	1	4	1	2
La	1.1	9.6	9.6	7.4	98.4	64.8	2.9	50.0
Ce	<3	27	25	21	198	141	5	113
Nd	<5	11	7	6	81	66	<5	57
Sm	.3	2.7	2.4	1.9	15.5	13.6	.9	13.1
Eu	.2	1.6	1.1	.8	2.2	3.8	1.8	4.4
Tb	<.5	.5	<.5	<.5	2.6	2.6	<.5	2.5
Yb	.2	1.7	1.4	1.3	7.9	8.4	.8	7.2
Lu	<.05	.22	.21	.18	1.10	1.19	.12	1.00
Hf	.5	2.4	2.2	1.9	16.0	16.0	1.2	11.0
Ta	<1	<1	<1	<1	3	3	<1	2
W	<3	<3	<3	<3	<3	<3	<3	<3
Pb	<2	<2	<2	<2	12	14	<2	3
Th	<1	1	1	1	16	9	1	5
U	<.5	<.5	<.5	<.5	3.5	1.8	<.5	1.0

Table 5 continued

	9	10	11	12	13	14	15	16
Au	<5	<5	<5	<5	<5	<5	<5	<5
Be	3	4	3	5	6	7	3	3
B	19	19	12	40	14	18	20	12
Sc	61.3	24.8	14.6	54.6	40.8	32.1	29.4	23.0
V	234	129	109	525	103	25	245	192
Cr	550	410	310	200	7	7	5	5
Co	51	55	70	85	66	21	39	44
Ni	86	119	183	151	15	8	26	26
Cu	54.3	62.8	58.6	43.6	348.	40.4	64.2	88.1
Zn	91.6	90.2	107.	134.	236.	242.	88.5	97.2
Ge	31	20	<10	28	48	37	38	49
As	<2	<2	<2	<2	<2	<2	<2	<2
Se	<3	<3	<3	<3	<3	<3	<3	<3
Br	3	3	4	4	3	4	3	3
Mo	<5	<5	<5	<5	<5	5	<5	<5
Ag	<.5	<.5	<.5	<.5	<.5	<.5	<.5	<.5
Cd	<1	<1	<1	<1	1	1	<1	<1
Sb	<.2	<.2	<.2	<.2	<.2	<.2	<.2	<.2
Cs	<1	<1	<1	<1	2	4	2	3
La	7.7	9.7	9.6	5.7	29.0	58.8	9.2	10.3
Ce	21	28	25	19	62	120	18	20
Nd	10	9	8	7	33	60	9	8
Sm	2.9	2.4	2.3	2.1	7.1	12.3	2.0	2.1
Eu	.8	.7	.8	.7	2.6	5.1	1.4	1.3
Tb	.5	<.5	<.5	.5	1.3	2.6	<.5	<.5
Yb	2.2	1.5	1.5	1.4	4.3	7.4	1.3	1.3
Lu	.32	.20	.21	.24	.63	1.06	.20	.20
Hf	1.8	2.5	2.5	2.0	6.8	12.0	2.9	2.4
Ta	<1	<1	<1	1	1	3	<1	<1
W	<3	<3	3	<3	<3	<3	<3	<3
Pb	<2	<2	<2	<2	2	4	<2	<2
Th	1	1	1	<1	3	5	1	1
U	<.5	<.5	<.5	<.5	<.5	1.3	.7	.6

Table 5 continued

	17	18	19	20
Au	<5	<5	<5	<5
Be	6	3	4	4
B	16	69	14	<10
Sc	52.3	58.3	69.2	62.1
V	55	253	283	134
Cr	7	<5	<5	<5
Co	36	61	63	60
Ni	12	15	14	18
Cu	179.	540.	526.	597.
Zn	186.	121.	137.	166.
Ge	50	53	55	54
As	<2	<2	<2	<2
Se	<3	<3	<3	<3
Br	2	5	3	3
Mo	5	<5	<5	<5
Ag	<.5	<.5	<.5	<.5
Cd	2	1	1	1
Sb	<.2	<.2	<.2	<.2
Cs	3	3	2	1
La	39.7	13.4	10.1	10.6
Ce	88	27	23	23
Nd	47	13	13	14
Sm	11.1	3.0	3.4	3.5
Eu	3.4	1.6	1.3	1.6
Tb	2.0	.5	.7	.6
Yb	5.4	2.0	2.1	2.3
Lu	.74	.29	.31	.34
Hf	6.4	4.7	2.9	3.1
Ta	2	3	<1	1
W	<3	<3	<3	<3
Pb	<2	<2	<2	<2
Th	2	1	1	1
U	<.5	<.6	<.5	<.5

1. SNA-531—Melatroctolite, medium-grained, laminated; Sonju Lake Intrustion, Middle Proterozoic; sample depth 531 ft. core provided by E. H. Lehmann & Assoc.; T.58N., R.7W., sec. 22 CBAA; Lake County.

2. D281C—Ophitic augite troctolite, coarse-grained, laminated; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 22 DDDBC; Lake County.

3. D290A—Ophitic augite troctolite, medium-to coarse-grained, Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 22 DCCA; Lake County.

4. D291—Ophitic augite troctolite, medium- to coarse-grained, Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 22 ABBBD; Lake County.

5. E234A—Granophyric granite, pink, unnamed formation, Middle Proterozoic; outcrop near Finland Radar Station; T. 57N., R.8W., sec. 21 ADACAB; Lake County.

6. E283—Quartz monzodiorite, coarse-grained, prismatic; unnamed formation, Middle Proterozoic; outcrop near Finland Radar Station; T. 57N., R.8W., sec. 21 ADACAB; Lake County.

7. F222—Oxide-bearing troctolite, coarse-grained, Sonju Lake Intrusion, Early Proterozoic; outcrop sample; T. 58N., R.7W., sec. 21 DB; Lake County.

8. F227—Olivine ferromonzodiorite, apatite-bearing, coarse-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 33 ABDA; Lake County.

9. F299A—Olivine-bearing gabbro, medium- to coarse-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 27 BADDD; Lake County.

10. F299B—Olivine gabbro, medium- to coarse-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 27 ABCBDA; Lake County.

11. F299D—Ophitic olivine gabbro, medium- to coarse-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 27 ABBDB; Lake County.

12. F301D—Olivine-bearing ferrogabbro, medium-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 27 BDAAC; Lake County.

13. F312—Olivine ferrogabbro, apatite-bearing, medium-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 28 CDDCDA; Lake County.

14. F325—Ferromonzodiorite, apatite-bearing, coarse-grained, subprismatic; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 33 ABDB; Lake County.

15. F326—Ferrogabbro, medium- to coarse-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 28 ACCBA; Lake County.

16. F344—Ferrogabbro, medium- to coarse-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 27 CBACCC; Lake County.

17. F390A—Olivine ferromonzodiorite, medium-to coarse-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 33 AABCB; Lake County.

18. F395—Ferrogabbro, olivine-bearing, medium-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 28 DDBBB; Lake County.

19. F397—Ferrogabbro, medium-grained, subprismatic; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 28 DDADA; Lake County.

20. F408—Olivine ferrogabbro, medium-grained, subpikolitic; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 28 DCBDAB; Lake County.

Table 6. Samples of Paleozoic Age—23-element trace-element package (Some samples also analyzed for Th and U)

	1	2	3	4	5	6	7	8
Li	8	7	12	4	17	5	29	15
Be	3.7	1.0	2.9	1.4	3.7	1.4	8.2	3.0
B	16	<2	35	3	11	14	132	16
Sc	3.9	.09	3.8	0.1	6.4	1.8	9.4	3.4
V	31.6	25.1	27.4	4.3	50.6	12.0	104.	9.8
Cr	432	539	248	399	270	308	144	252
Co	12	19	4	2	11	2	28	5
Ni	11	16	<1	7	18	7	55	1
Cu	97.9	66.3	104.	10.0	21.3	10.2	59.8	28.3
Zn	23.2	30.4	13.7	5.0	28.1	6.5	59.6	13.1
As	4	<3	<3	<3	8	<3	12	7
Se	<20	<20	<20	<20	<20	<20	<20	<20
Sr	95.4	89.1	90.4	37.6	92.8	42.9	92.4	254.
Y	20.0	20.9	13.7	5.7	15.9	4.8	15.5	12.2
Zr	87.8	19.1	223.	108.	263.	84.8	166.	157.
Mo	27	40	15	32	17	23	4	17
Ag	<0.1	<0.1	0.9	<0.1	1.2	0.2	0.8	0.3
Cd	<1	<1	<1	<1	<1	<1	<1	<1
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sb	<5	<5	<5	<5	<5	<5	<5	<5
Ba	233	80	863	194	885	244	574	766
W	<10	<10	<10	<10	<10	<10	<10	<10
Pb	2	9	<2	<2	<2	<2	9	<2
Th	–	–	–	–	–	–	–	–
U	–	–	–	–	–	–	–	–

Table 6 continued

	9	10	11	12	13	14	15	16
Li	2	5	9	6	10	9	3	5
Be	2.3	4.8	2.8	0.8	2.6	2.9	1.3	2.9
B	4	<2	72	8	28	21	12	31
Sc	3.0	2.9	2.3	0.9	3.4	2.8	1.0	15.5
V	79.5	214.	32.2	3.8	54.7	25.8	4.3	17.6
Cr	221	142	245	311	364	243	380	79
Co	18	18	8	2	23	5	2	6
Ni	9	19	8	3	19	5	<1	2
Cu	20.0	14.5	21.2	23.0	24.0	30.1	11.0	13.3
Zn	23.8	54.3	16.4	28.3	33.0	23.9	6.0	11.3
As	9	21	<3	<3	5	<3	<3	14
Se	<20	<20	<20	<20	<20	<20	<20	<20
Sr	344.	300.	56.0	53.8	70.0	59.0	73.2	360.
Y	64.0	80.6	13.8	5.9	12.4	8.1	35.0	139.
Zr	16.3	69.3	257.	81.0	176.	125.	54.6	32.4
Mo	16	6	17	24	25	18	30	6
Ag	<0.1	<0.1	1.0	0.2	0.7	0.3	<0.1	<0.1
Cd	<1	<1	<1	<1	<1	<1	<1	<1
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sb	<5	<5	<5	<5	<5	<5	<5	<5
Ba	46	58	464	405	383	548	929	315
W	<10	<10	<10	<10	<10	<10	<10	<10
Pb	18	27	4	<2	2	<2	<2	<2
Th	–	–	–	–	–	–	–	–
U	–	–	–	–	–	–	–	–

Table 6 continued

	17	18	19	20	21	22	23	24
Li	4	20	4	9	2	3	3	9
Be	1.7	5.3	1.8	3.5	0.9	<0.5	<0.5	2.5
B	11	30	8	23	4	5	4	27
Sc	2.0	5.4	4.4	4.9	0.4	0.5	0.7	4.5
V	1.2	45.5	12.4	17.9	4.6	4.4	6.2	42.7
Cr	317	139	233	183	330	272	361	235
Co	2	12	5	7	1	<1	1	5
Ni	<1	11	2	6	<1	6	6	2
Cu	11.3	14.8	10.0	21.7	6.9	8.5	5.6	7.9
Zn	4.7	20.7	5.8	13.7	3.2	6.8	18.6	15.6
As	4	<3	7	<3	<3	<3	5	<3
Se	<20	<20	<20	<20	<20	<20	<20	<20
Sr	107.	168.	129.	193.	53.8	22.4	34.2	60.7
Y	36.0	13.8	40.3	15.0	5.2	2.0	3.3	8.1
Zr	71.3	176.	23.5	180.	23.0	29.5	29.4	179.
Mo	23	7	16	12	24	21	27	16
Ag	0.2	0.6	<0.1	0.3	<0.1	0.4	0.1	<0.1
Cd	<1	<1	<1	<1	<1	<1	<1	<1
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sb	<5	<5	<5	<5	<5	<5	<5	<5
Ba	551	599	468	360	426	33	50	618
W	<10	<10	<10	<10	<10	<10	<10	<10
Pb	4	<2	<2	2	3	6	<2	4
Th	–	–	–	–	–	–	–	–
U	–	–	–	–	–	–	–	–

Table 6 continued

	25	26	27	28	29	30	31	32
Li	4	30	16	2	5	8	2	3
Be	0.7	2.9	4.1	0.7	<0.5	1.0	<0.5	<0.5
B	6	100	69	5	17	21	2	13
Sc	0.9	2.7	6.2	1.9	1.6	1.5	0.7	0.3
V	6.4	29.7	24.8	23.2	18.4	12.5	5.6	5.8
Cr	453	126	123	347	462	383	453	352
Co	2	3	8	8	4	3	2	2
Ni	4	<1	9	15	5	3	8	8
Cu	7.5	3.2	8.1	33.3	16.6	14.6	46.2	10.6
Zn	8.5	15.9	24.0	22.6	8.9	8.9	6.9	7.4
As	<3	<3	11	7	<3	5	4	<3
Se	<20	<20	<20	<20	<20	<20	<20	<20
Sr	25.2	37.1	90.6	206.	84.0	79.2	48.0	29.4
Y	3.3	2.0	16.7	46.1	7.1	4.7	3.4	1.2
Zr	60.2	87.5	108.	26.4	84.9	84.4	65.6	23.4
Mo	30	7	6	26	33	25	34	25
Ag	<0.1	<0.1	0.6	<0.1	<0.1	<0.1	0.2	<0.1
Cd	<1	<1	<1	<1	<1	<1	<1	<1
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sb	<5	<5	<5	<5	<5	<5	<5	<5
Ba	139	528	401	68	280	655	106	111
W	<10	<10	<10	<10	<10	<10	<10	<10
Pb	3	<2	6	15	7	3	7	3
Th	–	–	–	–	–	–	–	–
U	–	–	–	–	–	–	–	–

Table 6 continued

	33	34	35	36	37	38	39	40
Li	14	78	6	78	3	6	6	4
Be	1.7	11.5	1.0	11.3	<0.5	<0.5	1.0	<0.5
B	53	15	5	161	6	2	<2	<2
Sc	4.7	10.7	0.7	7.9	0.7	0.3	3.8	0.2
V	43.0	110.	10.9	158.	14.2	<0.5	8.9	<0.5
Cr	326	168	576	134	303	2	12	2
Co	5	27	2	29	3	<1	3	<1
Ni	2	50	7	68	8	2	<1	<1
Cu	38.5	27.1	16.0	17.4	25.0	1.5	15.6	1.8
Zn	18.8	85.9	7.7	87.2	22.8	15.5	16.4	2.6
As	<3	9	<3	<3	<3	4	<3	<3
Se	<20	<20	<20	<20	<20	<20	<20	<20
Sr	96.7	118.	10.1	57.1	16.5	25.3	119.	39.2
Y	5.0	6.1	4.3	5.4	2.8	3.7	6.0	1.1
Zr	121.	117.	83.2	109.	23.1	17.9	71.2	17.8
Mo	21	2	39	<1	21	<1	<1	<1
Ag	<0.1	0.2	<0.1	<0.1	<1	0.2	0.2	0.2
Cd	<1	<1	<1	0.1	<1	<1	<1	<1
Sn	<10	<10	<10	<10	<10	<10	<10	<10
Sb	<5	<5	<5	12	<5	<5	<5	<5
Ba	882	370	23	212	19	64	600	320
W	<10	<10	<10	<10	<10	<10	<10	<10
Pb	9	6	<2	<2	<2	6	21	<2
Th	–	–	–	–	–	<2	3	<2
U	–	–	–	–	–	<2	<2	2

Table 6 continued

	41	42	43	44	45	46
Li	14	4	7	2	7	3
Be	1.1	1.4	2.6	<0.5	1.9	1.0
B	<2	6	<2	<2	<2	<2
Sc	0.9	3.1	2.4	0.3	2.6	0.2
V	3.5	7.5	15.9	2.9	7.6	<0.5
Cr	9	9	16	3	8	2
Co	<1	2	3	<1	2	<1
Ni	<1	<1	3	2	3	4
Cu	3.0	7.8	6.9	0.7	6.3	3.0
Zn	3.4	12.9	25.4	3.3	3.7	3.4
As	7	13	5	3	6	8
Se	<20	<20	<20	<20	<20	<20
Sr	92.8	58.5	151.	8.7	72.8	26.4
Y	4.4	5.3	5.2	1.3	7.1	3.5
Zr	78.0	81.7	47.6	14.3	27.6	7.4
Mo	<1	<1	<1	<1	<1	<1
Ag	<0.1	<0.1	0.3	0.2	0.2	0.2
Cd	<1	<1	<1	<1	<1	<1
Sn	<10	<10	<10	<10	<10	<10
Sb	<5	<5	<5	<5	<5	<5
Ba	929	541	301	23	405	13
W	<10	<10	<10	<10	<10	<10
Pb	10	8	5	4	14	<2
Th	2	<2	5	<2	3	<2
U	<2	<2	<2	<2	<2	<2

1. Shale; Eau Claire Formation, Cambrian; sample depth 860 ft., ATES BC-1; T.29N., R.23W., sec. 21, CDBBBB; Ramsey County.

2. Sandstone; Mt. Simon Formation, Cambrian; sample depth 865 ft., ATES BC-1; T.29N., R.23W., sec. 21, CDBBBB; Ramsey County.

3. Sandstone; Mt. Simon Formation, Cambrian; sample depth 883 ft., ATES BC-1; T.29N., R.23W., sec. 21, CDBBBB; Ramsey County.

4. Sandstone; Mt. Simon Formation, Cambrian; sample depth 895 ft., ATES BC-1; T.29N., R.23W., sec. 21, CDBBBB; Ramsey County.

5. Sandstone; Mt. Simon Formation, Cambrian; sample depth 904 ft., ATES BC-1; T.29N., R.23W., sec. 21, CDBBBB; Ramsey County.

6. Sandstone; Mt. Simon Formation, Cambrian; sample depth 914 ft., ATES BC-1; T.29N., R.23W., sec. 21, CDBBBB; Ramsey County.

7. Sandstone/shale; Mt. Simon Formation, Cambrian; sample depth 920 ft., ATES BC-1; T.29N., R.23W., sec. 21, CDBBBB, Ramsey County.

8. Sandstone; Eau Claire Formation, Cambrian; sample depth 470 ft., Northern Natural Gas John Pomije Test Well #14, (MGS #337); T.113N., R.23W., sec. 24, CCCDC; Scott County.

9. Fossiliferous/oolitic sandstone; Mt. Simon Formation, Cambrian; sample depth 484 ft., Northern Natural Gas John Pomije, Test Well #14, (MGS #337); T.113N., R.23W., sec. 24, CCCDC; Scott County.

10. Oolitic sandstone; Mt. Simon Formation, Cambrian; sample depth 487 ft., Northern Natural Gas John Pomije, Test Well #14, (MGS #337); T.113N., R.23W., sec. 24, CCCDC; Scott County.

11. Sandstone; Mt. Simon Formation, Cambrian; sample depth 498 ft., Northern Natural Gas John Pomije, Test Well #14, (MGS #337); T.113N., R.23W., sec. 24, CCCDC; Scott County.

12. Sandstone; Mt. Simon Formation, Cambrian; sample depth 519 ft., Northern Natural Gas John Pomije, Test Well #14, (MGS #337); T.113N., R.23W., sec. 24, CCCDC; Scott County.

13 Sandstone; Mt. Simon Formation, Cambrian; sample depth 524 ft., Northern Natural Gas John Pomije, Test Well #14, (MGS #337); T.113N., R.23W., sec. 24, CCCDC; Scott County.

14 Sandstone; Mt. Simon Formation, Cambrian; sample depth 623 ft., Northern Natural Gas John Pomije, Test Well #14, (MGS #337); T.113N., R.23W., sec. 24, CCCDC; Scott County.

15. Sandstone/shale; Mt. Simon Formation, Cambrian; sample depth 875 ft., Minnegasco Williams #4; T.108N., R.22W., sec. 7, ACBBBC; Waseca County.

16. Sandstone; Mt. Simon Formation, Cambrian; sample depth 886 ft., Minnegasco Williams #4; T.108N., R.22W., sec. 7, ACBBBC; Waseca County.

17. Sandstone; Mt. Simon Formation, Cambrian; sample depth 898 ft., Minnegasco Williams #4; T.108N., R.22W., sec. 7, ACBBBC; Waseca County.

18. Sandstone; Mt. Simon Formation, Cambrian; sample depth 918 ft., Minnegasco Williams #4; T.108N., R.22W., sec. 7, ACBBBC; Waseca County.

19. Sandstone; Mt. Simon Formation, Cambrian; sample depth 925 ft., Minnegasco Williams #4; T.108N., R.22W., sec. 7, ACBBBC; Waseca County.

20. Sandstone; Mt. Simon Formation, Cambrian; sample depth 937 ft., Minnegasco Williams #4; T.108N., R.22W., sec. 7, ACBBBC; Waseca County.

21. Sandstone; Mt. Simon Formation, Cambrian; sample depth 950 ft., Minnegasco Williams #4; T.108N., R.22W., sec. 7, ACBBBC; Waseca County.

22. Sandstone; Mt. Simon Formation, Cambrian; sample depth 320 ft., Pan Ocean SQ-8; T.107N., R.31W., sec. 11, BCCBBD; Watonwan County.

23. Sandstone; Mt. Simon Formation, Cambrian; sample depth 356 ft., Pan Ocean SQ-8; T.107N., R.31W., sec. 11, BCCBBD; Watonwan County.

24. Sandstone; Mt. Simon Formation, Cambrian; sample depth 385 ft., Pan Ocean SQ-8; T.107N., R.31W., sec. 11, BCCBBD; Watonwan County.

25. Sandstone; Mt. Simon Formation, Cambrian; sample depth 420 ft., Pan Ocean SQ-8; T.107N., R.31W., sec. 11, BCCBBD; Watonwan County.

26. Regolith; unnamed formation, pre-Cambrian; sample depth 429 ft., Pan Ocean SQ-8; T.107N., R.31W., sec. 11, BCCBBD; Watonwan County.

27. Shale; Eau Claire Formation, Cambrian; sample depth 627 ft., Northern Natural Gas Vermillion #66-9; T.114N., R.18W., sec. 11, BBCBBA; Dakota County.

28. Sandstone; Mt. Simon Formation, Cambrian; sample depth 638 ft., Northern Natural Gas Vermillion #66-9; T.114N., R.18W., sec. 11, BBCBBA; Dakota County.

29. Sandstone; Mt. Simon Formation, Cambrian; sample depth 674 ft., Northern Natural Gas Vermillion #66-9; T.114N., R.18W., sec. 11, BBCBBA; Dakota County.

30. Sandstone; Mt. Simon Formation, Cambrian; sample depth 690 ft., Northern Natural Gas Vermillion #66-9; T.114N., R.18W., sec. 11, BBCBBA; Dakota County.

31. Sandstone; Mt. Simon Formation, Cambrian; sample depth 706 ft., Northern Natural Gas Vermillion #66-9; T.114N., R.18W., sec. 11, BBCBBA; Dakota County.

32. Sandstone; Mt. Simon Formation, Cambrian; sample depth 754 ft., Northern Natural Gas Vermillion #66-9; T.114N., R.18W., sec. 11, BBCBBA; Dakota County.

33. Sandstone; Mt. Simon Formation, Cambrian; sample depth 777 ft., Northern Natural Gas Vermillion #66-9; T.114N., R.18W., sec. 11, BBCBBA; Dakota County.

34. Sandstone; Mt. Simon Formation, Cambrian; sample depth 834 ft., Northern Natural Gas Vermillion #66-9; T.114N., R.18W., sec. 11, BBCBBA; Dakota County.

35. Sandstone; Mt. Simon Formation, Cambrian; sample depth 910 ft., Northern Natural Gas Vermillion #66-9; T.114N., R.18W., sec. 11, BBCBBA; Dakota County.

36. Shale; Mt. Simon Formation, Cambrian; sample depth 917 ft., Northern Natural Gas Vermillion #66-9; T.114N., R.18W., sec. 11, BBCBBA; Dakota County.

37. Sandstone; Mt. Simon Formation, Cambrian; sample depth 926 ft., Northern Natural Gas Vermillion #66-9; T.114N., R.18W., sec. 11, BBCBBA; Dakota County.

38. CJDN 30-20-14-B—Sandstone, medium-grained, iron-stained, Jordan Formation, Cambrian; outcrop sample from 6.6 ft. above top of Norwalk Member; T.30N., R.20W., sec. 14, BBC; Washington County.

39. CJDN 30-20-14-F—Sandstone, very fine to medium-grained, iron-stained, calcareous, Jordan Formation, Cambrian; outcrop sample from 9.2 ft. above top of Norwalk Member; T.30N., R.20W., sec. 14, BBC; Washington County.

40. CJDN 30-20-14-G—Sandstone, very fine to coarse-grained, Jordan Formation, Cambrian; outcrop sample from 12.9 ft. above top of Norwalk Member; T.30N., R.20W., sec. 14, BBC; Washington County.

41. CJDN 30-20-14-J—Sandstone, fine-grained, Jordan Formation, Cambrian; outcrop sample from 32.7 ft. above top of Norwalk Member; T.30N., R.20W., sec. 14, BCB; Washington County.

42. CJDN 30-20-14-L—Sandstone, fine- to medium-grained, calcareous, Jordan Formation, Cambrian; outcrop sample from 42.6 ft. above top of Norwalk Member; T.30N., R.20W., sec. 14, BCB; Washington County.

43. CJDN 112-14-18-O—Dolomitic sandstone, mottled, fine-grained to very fine grained, Coon Valley Member of Jordan Formation, Late Cambrian/Early Ordovician; outcrop sample from 3.3 ft. above base of Coon Valley, County Road 58 roadcut; T.112N., R.14W., sec. 18, DCC; Goodhue County.

44. CJDN 112-13-27-R—Sandstone, mottled, fine- to medium-grained, iron-stained, Jordan Formation, Cambrian; outcrop sample from 26.4 ft. above base of exposed section, County Road 5 roadcut; T.112N., R.13W., sec. 27, DDD; Goodhue County.

45. CJDN 111-11-36-S—Sandstone silty, very fine grained, calcareous, Jordan Formation, Cambrian; outcrop sample from 7.9 ft. above base of exposed section, County Road 30 roadcut; T.111N., R.11W., sec. 36, DCD; Wabasha County.

46. CJDN 103-24-28-T—Sandstone dolomitic, fine- to coarse-grained, Jordan Formation, Cambrian; sample depth 544 ft., Minnegasco core, Schroeder #5; T.103N., R.24W., sec. 28, CDC; Faribault County.

Table 7. Publicly submitted samples—whole-rock and selected trace-element analyses

	1
SiO_2	44.1
Al_2O_3	13.9
CaO	7.54
MgO	4.86
Na_2O	0.18
K_2O	3.82
Fe_2O_3	11.5
MnO	0.25
TiO_2	1.27
P_2O_5	0.14
Cr_2O_3	0.01
LOI	12.7
H_2O+	–
H_2O-	–
C	–
CO_2	–
S	–
FeO	7.7
Cr	–
Rb	96
Sr	155
Y	11
Zr	79
Nb	20
Ba	511
Ni	–
Cu	–
Ag	–
Cd	–
Sn	–
Sb	–
Th	–
U	–

1. GSP-51—Marble, sideritic; unnamed formation, Early Proterozoic; outcrop sample; T.46N., R.20W., sec. 28, BCBA; Carlton County.

Table 8. Samples of Archean age—whole-rock and selected trace-element analyses

	1	2	3	4	5	6
SiO_2	49.2	56.0	62.3	74.5	52.22	74.1
Al_2O_3	9.52	14.1	18.9	14.8	11.7	14.8
CaO	12.3	6.48	0.33	0.08	9.89	0.48
MgO	10.5	2.55	0.35	0.09	7.08	0.27
Na_2O	1.51	3.57	5.32	8.80	4.04	4.57
K_2O	2.40	6.56	9.30	1.08	2.22	5.20
Fe_2O_3	10.2	6.19	2.18	0.51	10.3	0.53
MnO	0.16	0.12	0.05	0.03	0.19	0.02
TiO_2	0.88	0.71	0.18	0.03	0.81	0.05
P_2O_5	0.33	1.03	0.02	0.02	0.45	0.05
Cr_2O_3	–	–	–	–	–	–
LOI	2.39	1.85	0.85	0.16	1.08	0.16
H_2O+	–	–	–	–	–	–
H_2O-	–	–	–	–	–	–
C	–	–	–	–	–	–
CO_2	–	–	–	–	–	–
S	–	–	–	–	–	–
FeO	–	–	–	–	–	–
Cr	–	–	–	–	–	–
Rb	60	120	246	97	67	185
Sr	290	2520	1300	43	1080	153
Y	14	47	<10	<10	<10	31
Zr	84	331	118	36	102	44
Nb	13	24	24	30	21	<10
Ba	697	3710	676	81	985	511
Ni	–	–	–	–	–	–
Cu	–	–	–	–	–	–
Pb	–	–	–	–	–	–
Co	–	–	–	–	–	–
Zn	–	–	–	–	–	–
Mo	–	–	–	–	–	–
Th	–	–	–	–	–	–
U	–	–	–	–	–	–

1. C027—Lamprophyre; unnamed formation, Archean; outcrop sample; T.63N., R.19W., sec. 29, CAA; St. Louis County.

2. C029—Pyroxene syenite, porphyritic; unnamed formation, Archean; outcrop sample; T.63N., R.19W., sec. 29, CDD; St. Louis County.

3. CLP-1—Syonite, pegmatitic, Coon Lake Pluton, Archean; outcrop sample; T.61N., R.24W., sec. 20, CAC; Itasca County.

4. C552B—Tonalite, flourite-bearing; unnamed formation, Archean; outcrop sample; T.61N., R.13W., sec. 23, CDD; St. Louis County.

5. C564A—Lamprophyre/pyroxene syenite, porphyritic; unnamed formation, Archean; outcrop sample; T.61N., R.20W., sec. 33, CAA; St. Louis County.

6. C597B—Pegmatite, granitic, tourmaline-bearing; unnamed formation, Archean; outcrop sample; T.60N., R.18W., sec. 9, ACD; St. Louis County.

Table 9. Samples of Early Proterozoic age—whole-rock and selected trace-element analyses

	1	2	3	4	5	6	7	8
SiO_2	60.9	68.2	68.6	48.3	60.7	58.6	27.0	48.1
Al_2O_3	18.6	13.7	14.5	26.0	16.2	17.9	6.77	20.7
CaO	9.84	5.71	2.88	12.1	2.86	2.89	36.8	18.5
MgO	0.28	1.99	1.92	0.54	3.51	3.26	0.92	0.89
Na_2O	4.43	2.87	3.67	3.12	2.75	3.78	0.06	0.51
K_2O	0.15	0.21	1.61	2.82	0.67	2.62	0.02	0.28
Fe_2O_3	2.49	6.29	5.61	2.85	10.5	8.58	3.82	6.33
MnO	0.04	0.07	0.07	0.04	0.17	0.08	0.23	0.12
TiO_2	1.08	0.61	0.82	0.57	0.97	1.00	0.56	0.70
P_2O_5	2.15	0.03	0.17	2.03	0.04	0.10	0.55	0.81
Cr_2O_3	0.08	0.05	0.04	0.02	0.04	0.03	0.02	0.03
LOI	0.16	0.47	0.39	2.00	1.85	0.70	23.5	3.31
H_2O+	–	–	–	–	–	–	–	–
H_2O-	–	–	–	–	–	–	–	–
C	–	–	–	–	–	–	–	–
CO_2	–	–	–	–	–	–	–	–
S	–	–	–	–	–	–	–	–
FeO	1.9	4.5	4.3	1.0	8.2	6.3	1.6	1.7
Cr	–	–	–	–	–	–	–	–
Rb	19	<10	85	138	53	136	<10	10
Sr	904	429	549	609	187	251	225	629
Y	26	19	35	55	30	23	<10	43
Zr	290	247	320	51	187	161	135	136
Nb	15	15	<10	<10	14	13	<10	26
Ba	<10	70	530	309	147	575	<10	<10
Ni	–	–	–	–	–	–	–	–
Cu	–	–	–	–	–	–	–	–
Pb	–	–	–	–	–	–	–	–
Co	–	–	–	–	–	–	–	–
Zn	–	–	–	–	–	–	–	–
Mo	–	–	–	–	–	–	–	–
Th	–	–	–	–	–	–	–	–
U	–	–	–	–	–	–	–	–

Table 9 continued

	9	10	11	12	13	14	15	16
SiO_2	66.2	72.6	71.3	30.1	30.0	56.3	75.8	61.0
Al_2O_3	12.8	10.2	11.8	3.51	4.48	9.54	4.84	4.39
CaO	6.31	4.12	2.35	18.7	18.3	8.00	4.98	9.70
MgO	2.54	1.88	1.61	7.58	7.48	3.99	1.87	3.86
Na_2O	2.35	2.28	2.74	0.60	0.61	2.24	1.60	0.94
K_2O	0.23	0.18	1.15	0.71	0.86	1.31	0.68	0.78
Fe_2O_3	7.34	6.63	5.62	10.9	10.9	6.08	2.79	5.63
MnO	0.12	0.11	0.09	0.48	0.48	0.20	0.23	0.42
TiO_2	0.72	0.79	0.68	0.21	0.26	0.49	0.28	0.32
P_2O_5	0.05	0.02	0.03	0.16	0.12	0.10	0.22	0.13
Cr_2O_3	0.04	0.04	0.04	<0.01	<0.01	0.01	0.03	0.01
LOI	0.31	0.62	2.08	27.5	27.1	12.3	6.70	13.5
H_2O+	–	–	–	–	–	–	–	–
H_2O-	–	–	–	–	–	–	–	–
C	–	–	–	–	–	–	–	–
CO_2	–	–	–	–	–	–	–	–
S	–	–	–	–	–	–	–	–
FeO	5.5	4.9	4.4	8.9	8.8	4.7	2.2	4.4
Cr	–	–	–	–	–	–	–	–
Rb	16	10	69	43	36	65	40	38
Sr	308	317	433	1130	1090	706	365	577
Y	31	25	10	16	15	<10	<10	35
Zr	218	145	141	11	32	77	37	47
Nb	23	<10	13	19	<10	<10	<10	11
Ba	85	91	469	73	137	247	187	173
Ni	–	–	–	–	–	–	–	–
Cu	–	–	–	–	–	–	–	–
Pb	–	–	–	–	–	–	–	–
Co	–	–	–	–	–	–	–	–
Zn	–	–	–	–	–	–	–	–
Mo	–	–	–	–	–	–	–	–
Th	–	–	–	–	–	–	–	–
U	–	–	–	–	–	–	–	–

Table 9 continued

	17	18	19	20	21	22	23	24
SiO_2	81.2	60.0	65.8	41.3	41.1	45.5	27.2	40.4
Al_2O_3	5.46	15.5	14.3	2.13	3.36	3.22	5.07	3.19
CaO	1.97	2.22	2.48	0.95	1.46	1.21	9.36	1.23
MgO	1.48	3.03	2.16	1.28	1.51	1.38	1.98	1.69
Na_2O	0.84	2.16	4.93	0.55	0.90	1.17	0.14	0.76
K_2O	0.83	2.45	0.84	0.71	0.93	0.65	0.38	1.04
Fe_2O_3	3.66	8.19	5.63	52.9	50.5	46.6	48.2	50.9
MnO	0.09	0.12	0.07	0.04	0.15	0.05	0.32	0.13
TiO_2	0.36	0.79	0.82	0.10	0.14	0.14	0.19	0.14
P_2O_5	0.11	0.15	0.18	0.26	0.30	0.25	0.36	0.34
Cr_2O_3	0.04	0.02	0.04	–	–	–	–	–
LOI	3.39	5.39	3.08	0.16	-0.30	-0.53	7.23	-0.77
H_2O+	–	–	–	–	–	–	–	–
H_2O-	–	–	–	–	–	–	–	–
C	–	–	–	–	–	–	–	–
CO_2	–	–	–	–	–	–	–	–
S	–	–	–	–	–	–	–	–
FeO	2.7	5.6	4.4	–	–	–	–	–
Cr	–	–	–	47	59	51	54	51
Rb	50	108	29	28	36	<10	47	67
Sr	143	137	367	10	17	27	47	38
Y	33	<10	18	<10	<10	<10	<10	<10
Zr	56	129	288	<10	34	48	40	29
Nb	<10	20	<10	<10	25	15	21	19
Ba	251	512	296	269	416	295	232	1330
Ni	–	–	–	–	–	–	–	–
Cu	–	–	–	–	–	–	–	–
Pb	–	–	–	–	–	–	–	–
Co	–	–	–	–	–	–	–	–
Zn	–	–	–	–	–	–	–	–
Mo	–	–	–	–	–	–	–	–
Th	–	–	–	–	–	–	–	–
U	–	–	–	–	–	–	–	–

1. C-1-ZA—Center epidote-plagioclase zone of calc-silicate concretion; unnamed formation, Early Proterozoic; outcrop sample; T.45N., R.20W., sec. 18 DBDB; Pine County.

2. C-1-ZB—Outer amphibole and garnet zone of calc-silicate concretion; unnamed formation, Early Proterozoic; outcrop sample; T.45N., R.20W., sec. 18 DBDB; Pine County.

3. C-1-ZC—Pelitic schist surrounding calc-silicate concretion; unnamed formation, Early Proterozoic; outcrop sample; T.45N., R.20W., sec. 18, DBDB; Pine County.

4. C-2-ZA—Center epidote zone of calc-silicate concretion; unnamed formation, Early Proterozoic; outcrop sample; T.45N., R.20W., sec. 9 CACA; Pine County.

5. C-2-ZB—Outer amphibole and garnet zone of calc-silicate concretion; unnamed formation, Early Proterozoic; outcrop sample; T.45N., R.20W., sec. 9 CACA; Pine County.

6. C-2-ZC—Pelitic schist surrounding calc-silicate concretion; unnamed formation, Early Proterozoic; outcrop sample; T.45N., R.20W., sec. 9 CACA; Pine County.

7. C-3-ZA—Center calcite zone of calc-silicate concretion; unnamed formation, Early Proterozoic; outcrop sample; T.45N., R.20W., sec. 19 AADD; Pine County.

8. C-3-ZB—Epidote zone of calc-silicate concretion, fine-grained; unnamed formation, Early Proterozoic; outcrop sample; T.45N., R.20W., sec. 19 AADD; Pine County.

9. C-3-ZC—Amphibole and garnet zone of calc-silicate concretion, fine-grained; unnamed formation, Early Proterozoic; outcrop sample; T.45N., R.20W., sec. 19 AADD; Pine County.

10. C-3-ZD—Amphibole and garnet zone of calc-silicate concretion, coarse-grained; unnamed formation, Early Proterozoic; outcrop sample; T.45N., R.20W., sec. 19 AADD; Pine County.

11. C-3-ZE—Schist pelitic surrounding calc-silicate concretion; unnamed formation, Early Proterozoic; outcrop sample; T.45N., R.20W., sec. 18 DBDB; Pine County.

12. C-4-ZA—Center zone of dolomite concretion; Thomson Formation, Early Proterozoic; outcrop sample; T.49N., R.17W., sec. 13 DDCC; Carlton County.

13. C-4-ZB—Outer zone of dolomite concretion; Thomson Formation, Early Proterozoic; outcrop sample; T.49N., R.17W., sec. 13 DDCC; Carlton County.

14. C-4-ZC—Slate surrounding dolomite concretion; Thomson Formation, Early Proterozoic; outcrop sample; T.49N., R.17W., sec. 13 DDCC; Carlton County.

15. C-4-ZB—Center zone of dolomite concretion; Thomson Formation, Early Proterozoic; outcrop sample; T.49N., R.16W., sec. 19 BCCC; Carlton County.

16. C-5-ZB—Middle zone of dolomite concretion; Thomson Formation, Early Proterozoic; outcrop sample; T.49N., R.16W., sec. 19 BCCC; Carlton County.

17. C-5-ZC—Outer zone of dolomite concretion; Thomson Formation, Early Proterozoic; outcrop sample; T.49N., R.16W., sec. 19 BCCC; Carlton County.

18. C-5-ZD—Slate surrounding dolomite concretion; Thomson Formation, Early Proterozoic; outcrop sample; T.49N., R.16W., sec. 19 BCCC; Carlton County.

19. C-46ZB—Graywacke surrounding calcite concretion; Thomson Formation, Early Proterozoic; outcrop sample; T.48W., R.16W., sec. 4 CCCB; Carlton County.

20. 12-385-400—Iron-formation, oxide-facies; unnamed formation at Philbrook, Early Proterozoic; sample depth 385-400 ft., Adams drill hole #12; T.132N., R.32W., sec 5, BAA; Todd County.

21. 15-270-300—Iron-formation, oxide-facies; unnamed formation at Philbrook, Early Proterozoic; sample depth 270-300 ft., Adams drill hole #15; T.132N., R.32W., sec 5, DC; Todd County.

22. 101-332-334—Iron-formation, oxide-facies; unnamed formation at Philbrook, Early Proterozoic; sample depth 332-334 ft., Adams drill hole #101; T.133N., R.32W., sec 32, DC; Todd County.

23. 104-210-215—Iron-formation, oxide-facies; unnamed formation at Philbrook, Early Proterozoic; sample depth 210-215 ft., Adams drill hole #104; T.133N., R.32W., sec 32, DCD; Todd County.

24. A3-332—Iron-formation mixed carbonate-and oxide facies, disseminated pyrite; intercalated with chloritic metasedimentary beds; unnamed formation at Philbrook, Early Proterozoic; sample depth 332 ft., Adams drill hole #A-3; T.133N., R.32W., sec. 32, DCAC; Todd County.

Table 10. Samples of Middle Proterozoic age—whole-rock and selected trace-element analyses

	1	2	3	4	5	6	7	8
SiO_2	54.3	56.7	55.0	47.5	49.4	50.0	48.7	49.1
Al_2O_3	13.4	11.4	12.0	16.5	16.6	17.3	13.6	15.0
CaO	6.45	3.68	5.92	10.6	10.3	10.9	8.31	11.0
MgO	3.84	1.38	1.78	6.51	4.14	4.30	5.88	4.80
Na_2O	3.04	3.13	3.13	2.18	2.66	2.96	2.46	2.49
K_2O	1.74	3.44	1.95	0.37	0.65	0.56	0.71	0.55
Fe_2O_3	12.4	14.5	15.5	10.8	12.9	10.7	14.9	12.3
MnO	0.19	0.25	0.23	0.17	0.18	0.15	0.20	0.18
TiO_2	2.17	1.62	2.15	1.31	1.83	1.46	2.14	2.32
P_2O_5	0.23	0.43	0.46	0.13	0.15	0.12	0.21	0.13
Cr_2O_3	–	–	–	–	–	–	–	–
LOI	2.31	2.93	0.77	2.39	0.62	0.77	1.62	0.70
H_2O+	–	–	–	–	–	–	–	–
H_2O-	–	–	–	–	–	–	–	–
C	–	–	–	–	–	–	–	–
CO_2	–	–	–	–	–	–	–	–
S	–	–	–	–	–	–	–	–
FeO	5.4	6.0	8.2	6.3	8.2	6.3	9.0	8.1
Cr	62	73	51	184	106	84	115	138
Rb	83	38	66	23	25	15	44	15
Sr	201	129	177	252	262	296	187	224
Y	45	66	56	13	14	21	27	49
Zr	326	606	504	108	168	110	216	170
Nb	25	44	34	21	35	26	23	13
Ba	444	769	472	154	226	186	257	199
Ni	25	<10	<10	206	33	33	108	35
Cu	171	197	488	93	116	81	164	98
Pb	–	–	–	–	–	–	–	–
Co	–	–	–	–	–	–	–	–
Zn	–	–	–	–	–	–	–	–
Mo	–	–	–	–	–	–	–	–
Th	–	–	–	–	–	–	–	–
U	–	–	–	–	–	–	–	–

Table 10 continued

	9	10	11	12	13	14	15	16
SiO_2	49.3	50.0	46.2	47.7	408	50.1	48.5	46.5
Al_2O_3	11.0	16.7	11.5	17.5	16.9	18.1	16.9	15.1
CaO	8.93	9.66	7.97	10.2	9.33	11.9	8.31	7.75
MgO	5.00	4.49	3.57	6.28	15.5	5.36	8.40	10.9
Na_2O	2.36	2.48	2.58	2.34	1.04	2.83	2.73	2.28
K_2O	0.85	0.90	1.01	0.39	.05	.85	.41	.39
Fe_2O_3	17.2	11.9	18.9	12.7	9.18	8.57	13.9	15.6
MnO	0.28	0.17	0.27	0.17	.12	.12	.18	.19
TiO_2	2.50	1.62	3.75	1.21	.179	1.17	.688	1.10
P_2O_5	0.16	0.17	0.21	0.12	.03	.11	.12	.08
Cr_2O_3	–	–	–	–	–	–	–	–
LOI	1.23	1.70	2.62	1.08	7.23	1.08	.16	.08
H_2O+	–	–	–	–	–	–	–	–
H_2O-	–	–	–	–	–	–	–	–
C	–	–	–	–	–	–	–	–
CO_2	–	–	–	–	–	–	–	–
S	–	–	–	–	–	–	–	–
FeO	9.5	7.7	11.4	8.6	5.4	5.8	10.6	11.8
Cr	111	114	10	67	–	–	–	–
Rb	51	28	53	20	19	22	18	15
Sr	160	254	211	233	250	370	276	231
Y	35	25	34	11	<10	25	16	17
Zr	189	135	205	75	<10	76	81	73
Nb	30	18	25	<10	13	<10	23	11
Ba	293	204	263	138	56	134	150	147
Ni	23	57	12	140	–	–	–	–
Cu	186	155	511	168	–	–	–	–
Pb	–	–	–	–	–	–	–	–
Co	–	–	–	–	–	–	–	–
Zn	–	–	–	–	–	–	–	–
Mo	–	–	–	–	–	–	–	–
Th	–	–	–	–	–	–	–	–
U	–	–	–	–	–	–	–	–

Table 10 continued

	17	18	19	20	21	22	23	24
SiO_2	75.0	59.4	48.0	51.8	49.5	49.7	48.3	45.4
Al_2O_3	12.2	11.6	18.1	11.0	12.2	16.8	17.0	9.78
CaO	.25	3.73	12.1	5.20	13.6	10.3	8.75	11.1
MgO	<.01	.50	8.31	2.03	8.22	7.01	7.98	10.2
Na_2O	3.94	3.78	2.47	2.98	1.93	2.78	2.76	1.50
K_2O	4.80	2.54	.18	2.22	.26	.39	.47	.23
Fe_2O_3	2.34	15.3	9.43	18.4	12.3	11.2	13.3	19.5
MnO	.04	.27	.13	.32	.19	.15	.16	.23
TiO_2	.295	1.17	.512	3.05	1.28	1.03	1.04	2.04
P_2O_5	.03	.33	.04	.67	.07	.11	.11	.07
Cr_2O_3	–	–	–	–	–	–	–	–
LOI	.93	1.16	1.08	2.31	.54	.47	.23	-.15
H_2O+	–	–	–	–	–	–	–	–
H_2O-	–	–	–	–	–	–	–	–
C	–	–	–	–	–	–	–	–
CO_2	–	–	–	–	–	–	–	–
S	–	–	–	–	–	–	–	–
FeO	<.1	7.3	6.8	10.3	8.1	7.9	10.2	12.7
Cr	–	–	–	–	–	–	–	–
Rb	147	85	18	71	<10	16	26	17
Sr	69	178	295	233	167	279	287	119
Y	140	77	13	64	22	21	<10	<10
Zr	608	694	<10	458	80	86	78	49
Nb	38	62	20	70	14	<10	17	16
Ba	1130	886	73	616	98	148	149	83
Ni	–	–	–	–	–	–	–	–
Cu	–	–	–	–	–	–	–	–
Pb	–	–	–	–	–	–	–	–
Co	–	–	–	–	–	–	–	–
Zn	–	–	–	–	–	–	–	–
Mo	–	–	–	–	–	–	–	–
Th	–	–	–	–	–	–	–	–
U	–	–	–	–	–	–	–	–

Table 10 continued

	25	26	27	28	29	30	31	32
SiO_2	46.3	51.6	50.0	49.8	44.8	44.8	45.5	45.6
Al_2O_3	10.4	10.6	18.8	18.8	9.65	11.5	10.3	10.8
CaO	7.44	5.96	11.2	9.81	10.0	9.48	11.1	10.3
MgO	3.33	1.73	3.30	3.46	2.83	4.93	6.06	4.79
Na_2O	2.58	2.87	3.30	3.27	2.40	2.39	2.06	2.47
K_2O	.85	1.65	.40	.54	1.11	.53	.46	.41
Fe_2O_3	23.1	19.9	10.8	11.5	21.5	18.3	19.2	19.8
MnO	.31	.34	.13	.13	.31	.22	.25	.25
TiO_2	4.14	2.59	1.84	1.73	4.41	6.02	4.80	5.82
P_2O_5	.34	.80	.09	.10	1.85	.14	.08	.14
Cr_2O_3	–	–	–	–	–	–	–	–
LOI	.85	2.00	.31	.47	.93	.08	.07	.15
H_2O+	–	–	–	–	–	–	–	–
H_2O-	–	–	–	–	–	–	–	–
C	–	–	–	–	–	–	–	–
CO_2	–	–	–	–	–	–	–	–
S	–	–	–	–	–	–	–	–
FeO	14.2	10.4	6.1	6.5	13.5	12.3	12.2	13.7
Cr	–	–	–	–	–	–	–	–
Rb	26	59	15	35	56	21	33	10
Sr	168	202	332	337	166	178	160	177
Y	45	77	<10	<10	55	21	12	30
Zr	254	486	59	65	237	122	94	112
Nb	32	51	25	36	24	30	14	31
Ba	309	498	142	145	275	157	131	169
Ni	–	–	–	–	–	–	–	–
Cu	–	–	–	–	–	–	–	–
Pb	–	–	–	–	–	–	–	–
Co	–	–	–	–	–	–	–	–
Zn	–	–	–	–	–	–	–	–
Mo	–	–	–	–	–	–	–	–
Th	–	–	–	–	–	–	–	–
U	–	–	–	–	–	–	–	–

1. E189A—Olivine ferrodiorite, coarse-grained, intergranular, granophyric; Blesner Lake diorite, Beaver Bay Complex, Middle Proterozoic; outcrop sample; T.57N., R.6W., sec. 6, CA; Lake County.

2. D203B—Ferro-monzodiorite, coarse-grained, subprismatic; Blesner Lake diorite, Beaver Bay Complex, Middle Proterozoic; outcrop sample; T.57N., R.6W., sec. 7, BB; Lake County.

3. E912—Olivine-oxide gabbro, coarse-grained, subophitic; Beaver River diabase, Beaver Bay Complex, Middle Proterozoic; outcrop sample; T.57N., R.6W., sec. 6, BA; Lake County.

4. E914—Olivine-oxide gabbro, coarse-grained, intergranular; Beaver River diabase, Beaver Bay Complex, Middle Proterozoic; outcrop sample; T.57N., R.6W., sec. 6, AA; Lake County.

5. E201—Olivine diabase, fine-grained, ophitic; Beaver River diabase, Beaver Bay Complex, Middle Proterozoic; outcrop sample; T.57N., R.7W., sec. 27, BB; Lake County.

6. F504—Olivine-oxide gabbro, medium-grained, subophitic; unnamed formation, Beaver Bay Complex, Middle Proterozoic; outcrop sample; T.58N., R.6W., sec. 20, AAB; Lake County.

7. D250B—Quartz monzodiorite, medium-grained; prismatic; Blesner Lake diorite, Beaver Bay Complex, Middle Proterozoic; outcrop sample; T.58N., R.7W., sec. 26, AA; Lake County.

8. H169C—Olivine diabase, medium-grained, ophitic; unnamed formation, Beaver Bay Complex, Middle Proterozoic; outcrop sample; T.58N., R.7W., sec. 1, AB; Lake County.

9. H168C—Ferro-monzodiorite, fine-grained prismatic; unnamed formation, Beaver Bay Complex, Middle Proterozoic; outcrop sample; T.58N., R.7W., sec. 1, BA; Lake County.

10. G108—Olivine-oxide gabbro, coarse-grained, subophitic; unnamed formation, Beaver Bay Complex, Middle Proterozoic; outcrop sample; T.58N., R.7W., sec. 16, DB; Lake County.

11. G130—Orthopyroxene-quartz diorite, medium-grained, intergranular; unnamed formation, Beaver Bay Complex, Middle Proterozoic; outcrop sample; T.58N., R.7W., sec. 15, AC; Lake County.

12. H126—Diorite, medium-grained, subprismatic; unnamed formation, Beaver Bay Complex, Middle Proterozoic; outcrop sample; T.58N., R.7W., sec. 14, AA; Lake County.

13. SNA-531—Melatroctolite, medium-grained, laminated; Sonju Lake Intrustion, Middle Proterozoic; sample depth 531 ft. core provided by E. H. Lehmann & Assoc.; T.58N., R.7W., sec. 22 CBAA; Lake County.

14. D281C—Ophitic augite troctolite, coarse-grained, laminated; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 22 DDDBC; Lake County.

15. D290A—Ophitic augite troctolite, medium- to coarse-grained, Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 22 DCCA; Lake County.

16. D291—Ophitic augite troctolite, medium-t o coarse-grained, Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 22 ABBBD; Lake County.

17. E234A—Granophyric granite, pink, unnamed formation, Middle Proterozoic; outcrop near Finland Radar Station; T. 57N., R.8W., sec. 21 ADACAB; Lake County.

18. E283—Quartz monzodiorite, coarse-grained, prismatic; unnamed formation, Middle Proterozoic; outcrop near Finland Radar Station; T. 57N., R.8W., sec. 21 ADACAB; Lake County.

19. F222—Oxide-bearing troctolite, coarse-grained, Sonju Lake Intrusion, Early Proterozoic; outcrop sample; T. 58N., R.7W., sec. 21 DB; Lake County.

20. F227—Olivine ferromonzodiorite, apatite-bearing, coarse-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 33 ABDA; Lake County.

21. F299A—Olivine-bearing gabbro, medium- to coarse-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 27 BADDD; Lake County.

22. F299B—Olivine gabbro, medium-t o coarse-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 27 ABCBDA; Lake County.

23. F299D—Ophitic olivine gabbro, medium- to coarse-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 27 ABBDB; Lake County.

24. F301D—Olivine-bearing ferrogabbro, medium-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 27 BDAAC; Lake County.

25. F312—Olivine ferrogabbro, apatite-bearing, medium-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 28 CDDCDA; Lake County.

26. F325—Ferromonzodiorite, apatite-bearing, coarse-grained, subprismatic; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 33 ABDB; Lake County.

27. F326—Ferrogabbro, medium- to coarse-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 28 ACCBA; Lake County.

28. F344—Ferrogabbro, medium- to coarse-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 27 CBACCC; Lake County.

29. F390A—Olivine ferromonzodiorite, medium- to coarse-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 33 AABCB; Lake County.

30. F395—Ferrogabbro, olivine-bearing, medium-grained; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 28 DDBBB; Lake County.

31. F397—Ferrogabbro, medium-grained, subprismatic; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 28 DDADA; Lake County.

32. F408—Olivine ferrogabbro, medium-grained, subpikolitic; Sonju Lake Intrusion, Middle Proterozoic; outcrop sample; T. 58N., R.7W., sec. 28 DCBDAB; Lake County.

Table 11. Samples of Quaternary age—whole-rock and selected trace-element analyses

	1	2	3	4	5	6	7	8
SiO_2	71.0	73.4	75.8	66.3	71.5	62.2	66.8	71.0
Al_2O_3	11.1	10.1	8.78	13.2	10.7	8.86	9.56	10.9
CaO	1.23	1.33	1.30	.85	1.62	6.94	3.90	1.80
MgO	1.10	.98	1.01	.98	1.21	3.74	2.49	1.33
Na_2O	1.66	1.72	1.45	.72	1.75	1.55	1.59	1.79
K_2O	2.10	2.01	1.90	.96	2.01	1.87	2.03	2.27
Fe_2O_3	4.12	3.82	3.17	5.69	3.91	3.28	3.97	2.90
MnO	.11	.10	.06	.02	.11	.08	.10	.04
TiO_2	.721	.702	.763	.500	.678	.631	.788	.875
P_2O_5	.17	.16	.08	.07	.19	.16	.13	.11
Cr_2O_3	–	–	–	–	–	–	–	–
LOI	5.08	4.23	4.08	10.4	5.00	10.8	7.93	5.54
H_2O+	–	–	–	–	–	–	–	–
H_2O-	–	–	–	–	–	–	–	–
C	–	–	–	–	–	–	–	–
CO_2	.01	.03	.48	.18	.22	7.19	3.58	.45
S	–	–	–	–	–	–	–	–
FeO	.1	.2	.2	<.1	.2	.3	.3	.5
Cr	81	76	68	93	78	63	70	79
Rb	87	74	79	75	70	64	81	88
Sr	223	225	159	64	244	251	194	215
Y	46	39	27	19	33	40	42	36
Zr	458	492	398	230	492	422	464	451
Nb	31	21	28	19	28	19	27	24
Ba	867	732	755	500	894	669	769	840
Ni	31	25	15	18	33	20	21	17
Cu	15	12	<10	<10	14	13	11	13
Pb	16	<10	<10	13	<10	12	11	15
Co	13	15	14	10	15	13	12	10
Zn	63	61	42	49	63	50	50	52
Mo	<10	<10	<10	<10	<10	<10	<10	<10
Th	<10	<10	<10	<10	<10	<10	<10	<10
U	<10	<10	<10	<10	<10	<10	<10	<10

Table 11 continued

	9	10
SiO_2	67.8	71.6
Al_2O_3	12.4	10.5
CaO	.93	.68
MgO	1.00	.97
Na_2O	1.28	.74
K_2O	1.78	1.13
Fe_2O_3	4.63	4.33
MnO	.03	.02
TiO_2	.812	.645
P_2O_5	.06	.05
Cr_2O_3	–	–
LOI	7.62	8.08
H_2O+	–	–
H_2O-	–	–
C	–	–
CO_2	.02	.01
S	–	–
FeO	.2	<.1
Cr	87	78
Rb	75	76
Sr	148	85
Y	46	19
Zr	443	346
Nb	24	15
Ba	755	614
Ni	16	12
Cu	12	<10
Pb	11	17
Co	11	<11
Zn	49	55
Mo	<10	<10
Th	<10	<10
U	<10	<10

1. 135—Loess; Peoria Loess, Pleistocene; sample depth, 53-57.9 in., drill hole TE-1; T.102N., R.5W., sec. 6, DBB.

2. 138—Loess; Peoria Loess, Pleistocene; sample depth, 74-78.3 in., drill hole TE-1; T.102N., R.5W., sec. 6, DBB.

3. 141—Loess; Peoria Loess, Pleistocene; sample depth, 107.1-109.4 in., drill hole TE-1; T.102N., R.5W., sec. 6, DBB.

4. 143—Loess; Peoria Loess, Pleistocene; sample depth, 120.1-122 in., drill hole TE-1; T.102N., R.5W., sec. 6, DBB.

5. 200—Loess; Peoria Loess, Pleistocene; sample depth, 67.7-75.2 in., drill hole KR-4; T.103N., R.6W., sec. 24, BB.

6. 204—Loess; unleached, Pleistocene; sample depth, 112.6-116.1 in., drill hole KR-4; T.103N., R.6W., sec. 24, BB.

7. 210—Loess; Roxana Loess, Pleistocene; sample depth, 161-166.5 in., drill hole KR-4; T.103N., R.6W., sec. 24, BB.

8. 211—Loess; Roxana Loess, Pleistocene; sample depth, 168.5-171.7 in., drill hole KR-4; T.103N., R.6W., sec. 24, BB.

9. 216—Loess; Roxana Loess, Pleistocene; sample depth, 192.9-197.6 in., drill hole KR-4; T.103N., R.6W., sec. 24, BB.

10. 218—Loess; Roxana Loess, Pleistocene; sample depth, 214.6-219.3 in., drill hole KR-4; T.103N., R.6W., sec. 24, BB.

Table 12 Samples of Early Proterozoic age—selected rare-earth elements

	1	2	3	4	5	6	7	8
Y	26	3	3	5	4	6	5	2
La	16.5	3.7	2.4	3.7	2.3	5.4	4.7	1.4
Ce	30.2	8.1	8.1	9.1	4.8	11.9	8.6	2.8
Pr	4.0	.8	.6	.9	.6	1.4	1.2	.3
Nd	17.5	3.4	2.5	3.6	2.7	5.9	4.3	1.5
Sm	3.5	.6	.5	.7	.3	1.1	.8	.2
Eu	.98	.17	.16	.26	.18	.33	.26	.16
Gd	3.4	.4	.4	.8	.6	1.2	.8	.1
Tb	.5	<.1	<.1	<.1	<.1	<.1	<.1	<.1
Dy	3.1	.4	.4	.7	.5	.9	.7	.2
Ho	.64	.07	.10	.17	.13	.20	.15	.07
Er	1.9	.2	.3	.6	.4	.6	.5	<.1
Tm	.2	<.1	<.1	<.1	<.1	<.1	<.1	<.1
Yb	1.5	.1	.2	.4	.3	.5	.4	<.1
Lu	17	<.05	<.05	.05	<.05	.07	.06	<.05
Th	2.7	1.1	.2	.2	<.1	.6	.9	.3
U	3.6	.2	<.1	<.1	<.1	.1	.4	<.1

	9	10	11	12	13	14	15	16
Y	6	5	5	8	10	4	2	3
La	2.8	4.0	4.6	9.4	15.6	2.8	1.0	1.6
Ce	5.2	6.9	9.9	19.7	31.9	4.9	1.8	2.8
Pr	.6	.8	1.1	2.1	3.7	.6	.2	.3
Nd	2.5	3.5	4.3	9.2	14.3	2.5	.8	1.5
Sm	.5	.5	.9	1.7	2.4	.4	<.1	.3
Eu	.18	.23	.25	.63	.72	.16	<.05	.06
Gd	.6	.7	.9	1.7	2.2	.5	<.1	.2
Tb	<.1	<.1	<.1	.2	.3	<.1	<.1	<.1
Dy	.5	.6	.8	1.3	2.0	.5	.2	.3
Ho	.16	.14	.17	.29	.37	.12	<.05	.06
Er	.6	.4	.5	.9	1.0	.5	<.1	.1
Tm	<.1	.<.1	<.1	<.1	.1	<.1	<.1	<.1
Yb	.3	.3	.4	.7	.9	.3	<.1	.2
Lu	.06	<.05	.06	.11	.10	.05	<.05	<.05
Th	<.1	.5	.5	1.1	2.3	<.1	<.1	<.1
U	<.1	.1	.1	.2	.5	<.1	<.1	<.1

Table 12 continued

	17	18	19	20	21
Y	4	4	8	7	1
La	2.9	2.8	7.7	6.9	.3
Ce	6.2	6.3	16.3	12.4	.7
Pr	.6	.7	1.8	1.2	<.1
Nd	2.6	2.8	7.3	4.8	.3
Sm	.5	.6	1.5	.9	<.1
Eu	.14	.16	.48	.31	<.05
Gd	.6	.7	1.5	1.1	.1
Tb	<.1	<.1	.2	.1	<.1
Dy	.6	.6	1.4	1.0	<.1
Ho	.10	.16	.26	.21	<.05
Er	.3	.4	.8	.6	<.1
Tm	<.1	<.1	<.1	<.1	<.1
Yb	.3	.4	.7	.5	<.1
Lu	.05	.06	.11	.06	<.05
Th	.4	.2	1.0	.6	<.1
U	.1	<.1	.7	.1	<.1

1. 2-1620—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1620 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

2. 2-1655—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1655 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

3. 2-1710—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1710 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

4. 2-1730–Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1730 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

5. 2-1755—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1755 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

6. 2-1860—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1860 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

7. 2-1995—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1995 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

8. 2-2013—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 2013 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

9. 2-2175—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 2175 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

10. 2-2202—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 2202 ft., IRRRB-2; T.58N., R.16W., sec. 22, DB; St. Louis County.

11. 5-620—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 620 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

12. 5-670—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 670 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

13. 5-880—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 880 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

14. 5-970—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 970 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

15. 5-1085—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1085 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

16. 5-1110—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1110 ft., IRRRB-5; T.58N., R.20W., sec. 36, BD; St. Louis County.

17. 7-815—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 815 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

18. 7-980—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 980 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

19. 7-1056—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1056 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

20. 7-1365—Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1365 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

21. 7-1080–Iron-formation; Biwabik Iron Formation, Animikie Group, Early Proterozoic; sample depth 1080 ft., IRRRB-7; T.57N., R.23W., sec. 36, CA; Itasca County.

Table 13. Trace-element analyses of water samples from the Hinckley-Mt. Simon aquifer. Trace-element values for waters from selected wells in the Hinckley-Mt.. Simon aquifer of southeastern Minnesota (Constituents reported in parts per billion)

	1	2	3	4	5	6	7	8
Be	<1	<1	1	1	<1	<1	<1	<1
P	38	<10	<10	<10	53	<10	24	45
Ti	<1	<1	<1	2	<1	<2	6	4
V	<2	<2	<2	<2	<2	<2	<2	<2
Cr	<1	<1	<1	1	<1	<1	>1	2
Mn	57	20	6	24	27	2	33	26
Fe	702	1050	1450	2150	1460	4	1460	1250
Co	<1	<1	<1	<1	<1	<1	<1	1
Ni	<1	<1	<1	<1	<1	<1	<1	<1
Cu	2	10	34	11	4	1	6	4
Zn	63	99	83	84	103	<1	82	146
Sr	165	310	380	535	428	241	491	264
Zr	<2	<2	<2	<2	<2	<2	<2	<2
Mo	<1	<1	<1	2	1	<1	<1	<1
Ag	<1	<1	<1	<1	<1	<1	<1	<1
Cd	<1	<1	<1	<1	<1	<1	<1	<1
Sn	<5	<5	<5	<5	6	<5	<5	<5
Sb	<5	<5	<5	<5	<5	<5	<5	<5
W	<20	<20	<20	<20	<20	<20	<20	<20
Pb	<5	<5	<5	<5	<5	<5	<5	<5
Bi	<10	<10	<10	<10	<10	<10	<10	<10

Table 13 continued

	9	10	11	12	13	14	15	16
Be	<1	1	1	2	<1	1	2	1
P	<10	<10	<10	<10	<10	11	<10	15
Ti	4	12	14	<1	<1	5	<1	<1
V	<2	<2	<2	<2	<2	<2	<2	<2
Cr	<1	<1	<1	<1	<1	<1	<1	<1
Mn	41	47	71	88	7	76	102	25
Fe	1180	518	696	2490	415	1090	757	1820
Co	<1	<1	<1	<1	<1	<1	<1	<1
Ni	<1	<1	<1	<1	1	<1	<1	1
Cu	4	3	3	8	4	5	4	3
Zn	98	90	89	92	89	115	88	92
Sr	603	521	506	603	868	485	452	495
Zr	<2	<2	<2	<2	<2	<2	<2	<2
Mo	<1	2	1	2	<1	1	<1	<1
Ag	<1	<1	<1	<1	<1	<1	<1	<1
Cd	<1	<1	<1	<1	<1	<1	<1	<1
Sn	<5	<5	<5	<5	<5	<5	<5	<5
Sb	<5	<5	<5	<5	<5	<5	<5	<5
W	<20	<20	<20	<20	<20	<20	<20	<20
Pb	<5	<5	<5	<5	<5	<5	<5	<5
Bi	<10	<10	<10	<10	<10	<10	<10	<10

Table 13 continued

	17	18	19	20	21	22	23	24
Be	<1	1	2	2	<1	<1	<1	<1
P	17	11	67	77	28	<10	12	14
Ti	<1	<1	<1	<1	<1	<1	<1	<1
V	<2	<2	<2	<2	<2	<2	<2	<2
Cr	<1	<1	<1	<1	<1	<1	<1	<1
Mn	<1	45	98	100	64	20	18	23
Fe	32	1020	2930	2950	771	474	604	765
Co	<1	<1	1	1	<1	<1	<1	<1
Ni	2	1	<1	3	<1	<1	<1	<1
Cu	2	4	6	6	4	3	5	4
Zn	124	104	104	93	527	522	553	555
Sr	2	517	3730	3770	717	166	663	599
Zr	<2	<2	4	3	<2	<2	<2	<2
Mo	<1	<1	<1	<1	<1	<1	<1	<1
Ag	<1	<1	<1	<1	<1	<1	<1	<1
Cd	<1	<1	<1	<1	<1	<1	<1	<1
Sn	<5	<5	<5	<5	<5	<5	<5	<5
Sb	<5	<5	<5	<5	<5	<5	<5	<5
W	<20	<20	<20	<20	<20	<20	<20	<20
Pb	<5	<5	<5	<5	<5	<5	<5	<5
Bi	<10	<10	<10	<10	<10	<10	<10	<10

Table 13 continued

	25	26	27	28	29	30	31	32
Be	1	<1	<1	<1	<1	<1	<1	1
P	19	<10	12	<10	15	17	22	15
Ti	<1	<1	<1	<1	<1	<1	<1	<1
V	<2	<2	<2	<2	<2	<2	<2	<2
Cr	<1	<1	<1	<1	<1	<1	<1	<1
Mn	39	20	26	<1	14	17	<1	16
Fe	941	1170	749	155	454	801	<2	779
Co	<1	<1	<1	<1	<1	<1	<1	<1
Ni	<1	<1	<1	<1	<1	<1	<1	<1
Cu	5	3	37	2	5	6	<1	3
Zn	517	565	528	574	493	544	,1	550
Sr	753	170	126	3	800	738	15	721
Zr	<2	<2	<2	<2	<2	<2	<2	<2
Mo	<1	<1	<1	<1	<1	<1	<1	<1
Ag	<1	<1	<1	<1	<1	<1	<1	<1
Cd	<1	<1	<1	<1	<1	<1	<1	<1
Sn	<5	<5	<5	<5	<5	<5	<5	<5
Sb	<5	<5	<5	<5	<5	<5	<5	<5
W	<20	<20	<20	<20	<20	<20	<20	<20
Pb	<5	<5	<5	<5	<5	<5	<5	<5
Bi	<10	<10	<10	<10	<10	<10	<10	<10

Table 13 continued

	33	34	35	36	37	38	39
Be	<1	<1	<1	<1	<1	<1	<1
P	<10	<10	<10	10	20	21	<10
Ti	<1	<1	<1	<1	<1	<1	<1
V	<2	<2	<2	<2	<2	<2	<2
Cr	<1	<1	<1	<1	<1	<1	<1
Mn	24	24	1	11	8	22	<1
Fe	678	627	206	769	707	900	3
Co	<1	<1	<1	<1	<1	<1	<1
Ni	<1	<1	1	<1	<1	<1	<1
Cu	2	2	3	2	2	4	2
Zn	496	10	11	9	7	6	<1
Sr	125	132	2	289	1030	2690	2750
Zr	<2	<2	<2	<2	<2	3	<2
Mo	<1	<1	<1	<1	<1	<1	<1
Ag	<1	<1	<1	<1	<1	<1	<1
Cd	<1	<1	<1	<1	<1	<1	<1
Sn	<5	<5	<5	<5	<5	<5	<5
Sb	<5	<5	<5	<5	<5	<5	<5
W	<20	<20	<20	<20	<20	<20	<20
Pb	<5	<5	<5	<5	<5	<5	<5
Bi	<10	<10	<10	<10	<10	<10	<10

1. RA910A—Moundsview 2, 835 ft.; MGS unique number 206716; T.30N., R.23W., sec. 8, BBCACC.
2. RA910B—Fridley 4, 831 ft.; MGS unique number 201158; T.30N., R.24W., sec. 14, DCAABC.
3. RA910C—Brooklyn Park 2, 617 ft.; MGS unique number 203022; T.119N., R.21W., sec. 22, CCBBBB.
4. RA910D—Maple Grove 5, 715 ft.; MGS unique number 122250; T.119N., R.22W., sec. 34, AADBCB.
5. RA910E—Champlin 7, 513 ft.; MGS unique number 416093; T.120N., R.21W., sec. 30, CADDBB.
6. RA910F—Anoka 6, 640 ft.; MGS unique number 224625; T.32N., R.24W., sec. 30, CDDCAB.
7. RA910G—Andover 1, 601 ft.; MGS unique number 171011; T.32N., R.24W., sec. 32, ACCAAD.
8. RA910H—Andover 2, 525 ft.; MGS unique number 415932; T.32N., R.24W., sec. 32, DDBDCC.
9. RA910I—Young America 2, 943 ft.; MGS unique number 132256; T.115N., R.26W., sec. 11, DABAAD.
10. RA910J—Bongards 4, 705 ft.; MGS unique number 218993; T.115N., R.25W., sec. 17, DDA.
11. RA910K—Bongards 4, 705 ft.; MGS unique number 218993; T.115N., R.25W., sec. 17, DDA.
12. RA910L—Chaska 6, 817 ft.; MGS unique number 161435; T.116N., R.23W., sec. 32, AAB.
13. RA910M—Savage 2, 846 ft.; MGS unique number 208816; T.115N., R.21W., sec. 9, CCCBA.
14. RA910N—Jordan 4, 560 ft.; MGS unique number 207994; T.114N., R.23W., sec. 19, DBADBC.
15. RA910O—Arlington 2, 723 ft.; MGS unique number 217801; T.113N., R.27W., sec. 9, DACDBA.
16. RA910P—Henderson 1, 900 ft.; MGS unique number 132296; T.112N., R.26W., sec. 11, AABBB.
17. RA910Q—Distilled water.
18. RA910R—LeHillier 1, 560 ft.; MGS unique number 191916; T.108N., R.27W., sec. 14.
19. RA910S—St. Peter 7, 798 ft.; MGS unique number 433254; T.110N., R.26W., sec. 16, AB.
20. RA910T—St. Peter 7, 798 ft.; MGS unique number 433254; T.110N., R.26W., sec. 16, AB.
21. RA910U—Red Wing 3, 635 ft.; MGS unique number 218623; T.113N., R.14W., sec. 32, ADAADD.
22. RA910V—Owatonna 7, 1325 ft.; MGS unique number 219022; T.107N., R.20W., sec. 15, CDDABA.
23. RA910W—Lanesboro 3, 1070 ft.; MGS unique number 110496; T.103N., R.9W., sec. 19, CABACA.
24. RA910X—Rushford Village 1, 366 ft.; MGS unique number 409470; T.104N., R.8W., sec. 23, DACAAC.
25. RA910Y—Houston 3, 408 ft.; MGS unique number 150341; T.103N., R.6W., sec. 4, BCBC.
26. RA910Z—Hokah 2, 648 ft.; MGS unique number 150345; T.103N., R.4W., sec. 6.
27. RA911A—LaCrescent 2, 591 ft.; MGS unique number 219278; T.104N., R.4W., sec. 10, CBBBBD.

28. RA911B—Distilled water.

29. RA911C—Goodview 2, 455 ft.; MGS unique number 112210; T.107N., R.7W., sec. 17, CCCDAB.

30. RA911D—Goodview 4, 515 ft.; MGS unique number 449410; T.107N., R.7W., sec. 19, BDCACA.

31. RA911E—Goodview 4, 515 ft.; MGS unique number 449410; T.107N., R.7W., sec. 19, BDCACA.

32. RA911F—Winona 13, 516.5 ft.; MGS unique number 219173; T.107N., R.7W., sec. 21, BDBCACC.

33. RA911G—Winona 15, 1072 ft.; MGS unique number 219194; T.107N., R.7W., sec. 33, BBDCAA.

34. RA911H—Winona 15, 1072 ft.; MGS unique number 219194; T.107N., R.7W., sec. 33, BBDCAA.

35. RA911I—Distilled water.

36. RA911J—Inver Grove Heights 6, 1044 ft.; MGS unique number 433259; T.27N., R.22W., sec. 9, DAA.

37. RA911K—Koch Refinery 8, 1004 ft.; MGS unique number 161421; T.115N., R.19W., sec. 24, AABDCA.

38. RA911L—Vermillion 1, 815 ft.; MGS unique number 502689; T.114N., R.18W., sec. 22, BACADB.

39. RA911M—Vermillion 1, 815 ft.; MGS unique number 502689; T.114N., R.18W., sec. 22, BACADB.

Table 14. Stable isotope ratio analyses on sulfates from waters of selected wells developed in the Hinckley-Mt. Simon aquifer of southeastern Minnesota (Reported in del S_{34} per mill)

	1	2	3	4	5	6	7	8
del S_{34}	8.0	3.3	6.6	9.8	-2.4	1.7	6.8	-4.4
	9	**10**	**11**	**12**	**13**	**14**	**15**	**16**
del S_{34}	4.2	20.1	9.3	2.0	7.4	-10.6	-8.6	-0.8
	17	**18**	**19**	**20**	**21**	**22**	**23**	**24**
del S_{34}	-2.3	3.3	-11.0	-9.0	-4.0	-9.0	7.9	-4.5
	25	**26**	**27**	**28**	**29**	**30**	**31**	**32**
del S_{34}	-7.0	-2.6	3.8	-7.1	-5.7	-14.9	-13.2	5.0
	33							
del S_{34}	7.8							

1. Andover 2, 525 ft.; MGS unique number 415932; T.32N., R.24W., sec. 32, DDBDCC.
2. Andover 3, 547 ft.; MGS unique number 431683; T.32N., R.24W., sec. 35, ACDBDC.
3. Anoka 6, 640 ft.; MGS unique number 224625; T.32N., R.24W., sec. 30, CDDCAB.
4. Anoka 4, 657 ft.; MGS unique number 201191; T.31N., R.25W., sec. 1, CBBBAC.
5. Champlin 7, 513 ft.; MGS unique number 416093; T.120N., R.21W., sec. 30, CADDBB.
6. Cambridge 3, 630 ft.; MGS unique number 217868; T.36N., R.23W., sec. 32, ACACBC.
7. Hinckley 2, 452 ft.; MGS unique number 232461; T.41N., R.21W., sec. 24, CDABDC.
8. Big Lake 3, 300 ft.; MGS unique number 163648; T.33N., R.27W., sec. 19, CBCAAB.
9. Anoka 7, 485 ft.; MGS unique number 453792; T.32N., R.24W., sec. 32, DCCDDAD.
10. New Brighton 11, 857 ft.; MGS unique number 509083; T.30N., R.23W., sec. 29, BCABBA.
11. White Bear 2, 970 ft.; MGS unique number 222880; T.30N., R.22W., sec. 36, BCDABC.
12. St. Louis Park 12, 1098 ft.; MGS unique number 206456; T.117N., R.21W., sec. 21, CDBDCD.
13. Inver Grove Heights 6, 1044 ft.; MGS unique number 433259; T.27N., R.22W., sec. 9, DAA.

14. Vermillion 1, 815 ft.; MGS unique number 502689; T.114N., R.18W., sec. 22, BACADB.
15. Chaska 6, 817 ft.; MGS unique number 161435; T.116N., R.23W., sec. 32, AAB.
16. Savage 2, 846 ft.; MGS unique number 208816; T.115N., R.21W., sec. 9, CCCBA.
17. Young America 2, 943 ft.; MGS unique number 132256; T.115., R.26W., sec. 11, DABAAD.
18. Bongards 4, 705 ft.; MGS unique number 218993; T.115N., R.25W., sec. 17, DDA.
19. Jordan 4, 560 ft.; MGS unique number 207994; T.114N., R.23W., sec. 19, DBADBC.
20. Henderson 1, 900 ft.; MGS unique number 132296; T.112N., R.26W., sec. 11, AABBB.
21. Arlington 2, 723 ft.; MGS unique number 217801; T.113N., R.27W., sec. 9, DACDBA.
22. LeHillier 1, 560 ft.; MGS unique number 191916; T.108N., R.27W., sec. 14.
23. Red Wing 3, 635 ft.; MGS unique number 218623; T.113N., R.14W., sec. 32, ADAADD.
24. Lanesboro 3, 1070 ft.; MGS unique number 110496; T.103N., R.9W., sec. 19, CABACA.
25. Rushford Village 1, 366 ft.; MGS unique number 409470; T.104N., R.8W., sec. 23, DACAAC.
26. Houston 3, 408 ft.; MGS unique number 150341; T.103N., R.6W., sec. 4, BCBC.
27. LaCrescent 2, 591 ft.; MGS unique number 219278; T.104N., R.4W., sec. 10, CBBBBD.
28. Winona 6, 484 ft.; MGS unique number 219184; T.107N., R.7W., sec. 23, CACABB.
29. Winona 13, 516.5 ft.; MGS unique number 219173; T.107N., R.7W., sec. 21, BDBCCC.
30. Maple Grove 5, 715 ft.; MGS unique number 122250; T.115N., R.22W., sec. 34, AADBCB.
31. Brooklyn Park 2, 617 ft.; MGS unique number 203022; T.119N., R.21W., sec. 22, CCBBBB.
32. St. Peter 7, 798 ft.; MGS unique number 433254; T.110N., R.26W., sec. 16, AB.
33. Nolte House well, 500 ft.; MGS unique number 441516; T.113N., R.25W., sec. 25, BBADDD.

Analytical results of the public geologic sample program, 1989-1991 biennium.