Department of Energy
Carlsbad Field Office
P. O. Box 3090
Carlsbad, New Mexico 88221

JUL 10 2007

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Mr. Juan Reyes, Director
U.S. Environmental Protection Agency
Office of Radiation and Indoor Air
Room 507
1310 L St, NW
Washington, DC 20005

Subject: Chemical Analysis of the MagChem 10 WTS 60 as supplied to the Waste Isolation Pilot Plant

Dear Mr. Reyes:

I am writing in response to your questions pertaining to the efficacy of the Magnesium Oxide (MgO) supplied to the Waste Isolation Pilot Plant (WIPP), and am including information provided by the vendor (Martin Marietta). Martin Marietta's stated goal is to provide an industrial source of MgO with a constant 98 to 98.5 % by weight of MgO. They have been using the current manufacturing process and feedstocks since the 1960's with excellent reliability of the MgO product.

The attached documents demonstrate the stability of the product, in terms of both the stability of the feedstock and of statistical data on the composition of the product. The MgO supplied to the WIPP is produced by Martin Marietta from two properties, and from two feedstocks: deep brines produced from the Filer sandstone and Dolime from a quarry in Ohio. Attachment 1 describes the Filer sandstone and the brine produced from it. A stratigraphic column for Michigan including this sandstone is appended to this attachment. Attachment 2 gives information on the chemistry of the brine feed, while Attachment 3 gives chemistry of the Dolime feed from the Woodville, OH quarry. Attachment 4 gives a statistical summary of the chemistry of the product (MagChem 10 WTS 60) for two one year periods (2005 and 2006-7). A summary of the information provided by Martin Marietta follows:

1. **Brine Source**

- **Brine Source for MagChem 10 WTS 60**
  The Filer Sandstone in the state of Michigan is the source of the brine feed stock used in the production of MagChem 10 WTS 60. Attachment 1 describes the Filer Sandstone, which is found at a depth of 1,774 to 2,120 feet below sea level. A stratigraphic column for Michigan is appended to this attachment. The brine reservoir extends over 300 square miles, with an average thickness of approximately 70 feet. Martin Marietta operates over a 40 square mile area of the brine

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reservoir and has the ability to expand operations six miles north and south of its current locations. Martin Marietta estimates the lifetime of their brine sources as 50+ years.

- **Brine Feed Chemistry Summary 2004-2007**
  Attachment 2 is a summary of the brine feed chemistry, including the concentrations of $CaCl_2$, $MgCl_2$ and NaCl in grams/liter along with the pH and specific gravity of the brines. These data were collected over a three and a half year timeframe. These results show standard deviations for $MgCl_2$ ranging from 3 to 5 grams/liter on annual average concentrations of 107 – 110 gm/liter. Martin Marietta mixes brines from several wells to maintain uniformity of the concentrations in the brine feedstock.

2. **Dolime Feed Chemistry Summary 2004-2007**
   - A second Martin Marietta property in the state of Ohio produces the Dolime, which is also used in the production of MagChem 10 WTS 60. The Woodville, OH quarry covers approximately 1500 acres. Production of dolime has been ongoing since 1960 with the current reserves covering approximately 500 acres. Attachment 3 shows that the average MgO concentration in the Dolime is 40.4% by weight over 333 data points with a standard deviation of 0.214%. These data points were gathered over the time period from January 23, 2004 through June 7, 2007. Martin Marietta estimates the lifetime of their dolomitic lime sources as 45+ years with additional reserves available at non-secured locations.

3. **Statistical Summary MagChem 10 WTS 60 Final Product**
   - Martin Marietta performed an assay of the final MgO product for the WIPP, denoted as MagChem 10 WTS 60. These assay results are for June 1, 2006 through May 31, 2007 and for December 1, 2004 through December 1, 2005. As shown in Attachment 4, the weight percent of Magnesium (as MgO) on an ignited basis is 98.4788% and 98.4808%, respectively, for the two time periods. The corresponding standard deviation is 0.085% and 0.083%, respectively. It follows that:
     a) The purity of MagChem 10 WTS 60 has not varied significantly within each of the 12 month periods.
     b) The purity of MagChem 10 WTS 60 has not varied significantly from December 2004 through December 2005 to the latest 12 month period.

   These values also indicate that Martin Marietta has been successful in maintaining the MgO purity within their stated goal (98% to 98.5% by weight) for the manufacturing process over a multi-year period.

Trace contaminants of Fe, Si, and Al are the largest contributors to the unreactive phases in MagChem 10 WTS 60. All of the Fe, Si, and Al come from the dolime with a trace amount of Si from the solid fuel burned in the kiln. The rotary kiln process used for the manufacture of the MgO for product MagChem 10 WTS 60 has remained unchanged since production began in 1969. The same raw materials are used and the chemistry has remained consistent from 1969 to the present. There are no plans for any modifications to the system that would have any impact on the current MagChem 10 WTS 60 quality.

We believe that the attached information provides supportable evidence for the stability of the feed stock and finished product chemistry for MagChem 10 WTS 60, along with the vendors' ability to maintain this level of quality throughout the expected operational period of the WIPP.

If you have any additional questions, please contact me at 505-234-7457.

Sincerely,

Russell Patterson
Compliance Certification Manager

Enclosures

cc w/enclosures
T. Peake – EPA *ED
C. Byrum – EPA ED
R. Lee – EPA ED
J. Fox – PMS ED
CBFO M & RC

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D. Kessel – SNL ED
S. Kouba – WRES ED
N. Elkins – LANL ED
*ED denotes electronic distribution

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Attachment 1: Brine Source MagChem 10 WTS 60

The brine used in Martin Marietta's process is produced from the Filer Sandstone, a reservoir rock.

The Filer sandstone is a north-south trending elongated lens of sandstone believed to be of eolian origin and probably represents sand dune and related near shore deposits during Devonian time (approximately 400 million years ago). Evidence of eolian deposition includes the presence of frosted, abraded sand grains typical of wind transported sandstones.

The Filer has been described as a gray to white, angular to rounded, fine to medium-grained, porous and permeable sandstone. The Filer exhibits great variability in its cementation and varies from consolidated to unconsolidated and friable. Cementing constituents include dolomite, limestone, and silica. The Filer contains black carbonaceous partings, dolomite partings, and a minor amount of anhydrite. Reservoir quality is variable both vertical and laterally in addition to the lenticularity exhibited by the Filer.

The Filer ranges in thickness from zero to greater than 100 feet, and averages approximately 70 feet in thickness in Martin Marietta Magnesia Specialties wells. In the Martin Marietta area of operations, the depth to the top of the sandstone ranges from -1,774 feet measured from sea level to -2,120 feet measured from sea level. (Roughly 1/2 mile below ground level.)

The Filer sandstone reservoir containing commercial quantities of brine extends over 300 square miles through Manistee, Mason, Lake, and Oceana counties. Martin Marietta operates over a 40 square mile area of the reservoir of which roughly 25% has been depleted during 50+ years of operations. In addition, the company owns sites for future wells in areas extending 6 miles south and 6 miles north of the present area of operations.

The brine is a naturally occurring liquid solution of salts residing in the sandstone and consists primarily of Calcium Chloride ($CaCl_2$) and Magnesium Chloride ($MgCl_2$) with minor amounts of Sodium Chloride (NaCl), Potassium Chloride (KCl), and Strontium Chloride ($SrCl_2$). Concentration of the $MgCl_2$ is approximately 10% on a mass basis.

The producing wells have varying concentrations of $MgCl_2$, therefore the consistency of the raw brine feed to the process is controlled by selecting combinations of wells to provide consistent $MgCl_2$ concentrations to the process.

Attachment 2

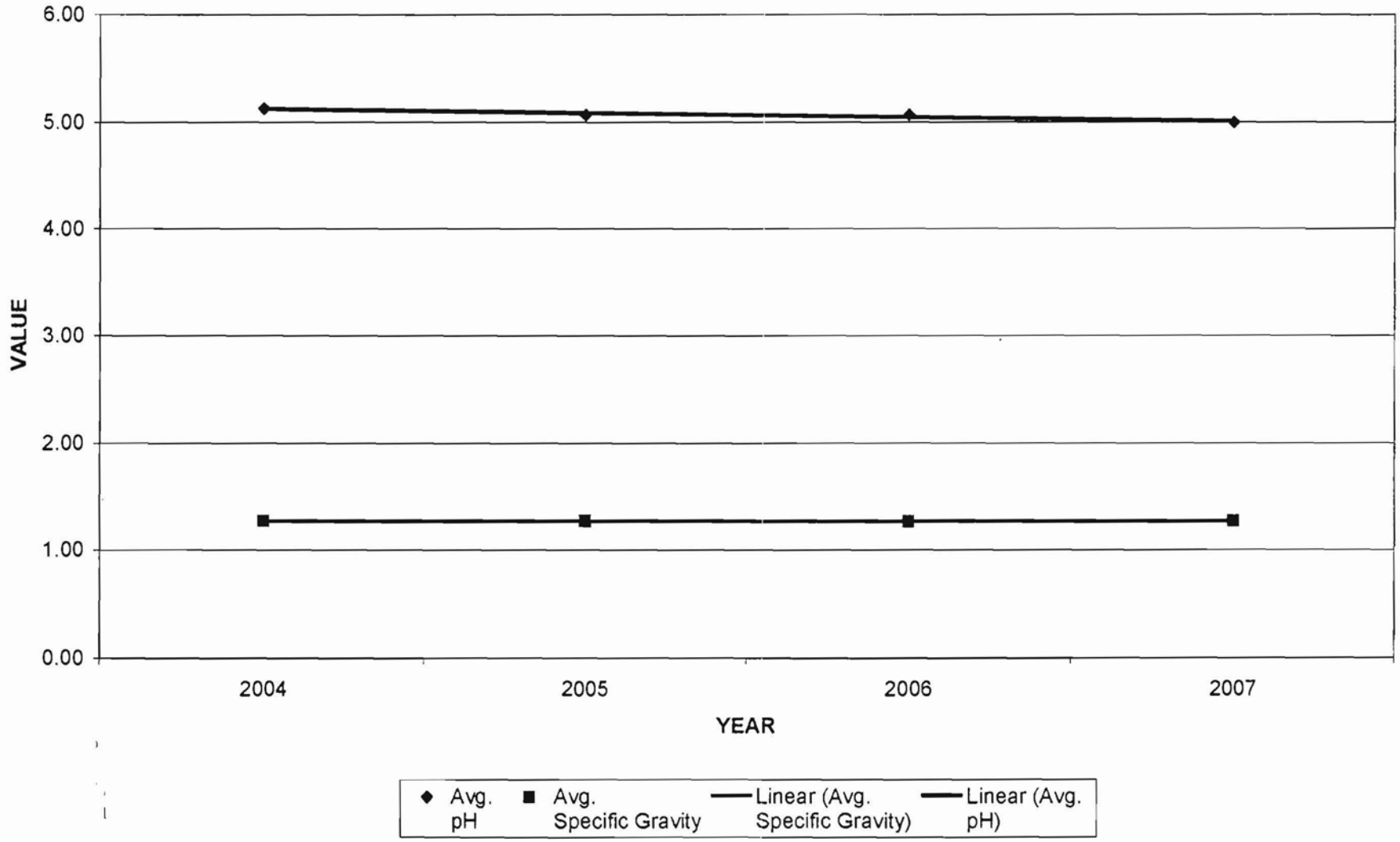
Brine Feed Chemistry Summary 2004-2007 ANALYSIS of "C" HEAD TANK BRINE 2004 - 2007

	CaCl2	MgCl2	NaCl	pH	Specific Gravity
2004:					
Average:	208	108	44	5.13	1.272
Std. Dev.:	5	5	1	0.12	0.004
Variance:	21	27	2	0.02	0.00002
Max:	216	135	50	5.52	1.280
Min:	197	99.2	41.3	4.97	1.261
2005:					
Average:	211	110	45	5.07	1.271
Std. Dev.:	4	3	1	0.16	0.002
Variance:	16	7	1	0.02	0.000004
Max:	219	119	47	5.70	1.280
Min:	196	105	41	4.84	1.267
2006:					
Average:	210	107	45	5.07	1.265
Std. Dev.:	5	4	1	0.08	0.004
Variance:	20	15	2	0.01	0.00001
Max:	222	115	48	5.26	1.275
Min:	198	99	42	4.88	1.258
2007:	(Through 6/14/07)				
Average:	208	108	44	5.00	1.270
Std. Dev.:	5	3	2	0.05	0.002
Variance:	26	7	3	0.003	0.000004
Max:	220	113	47	5.11	1.272
Min:	198	103	42	4.86	1.263

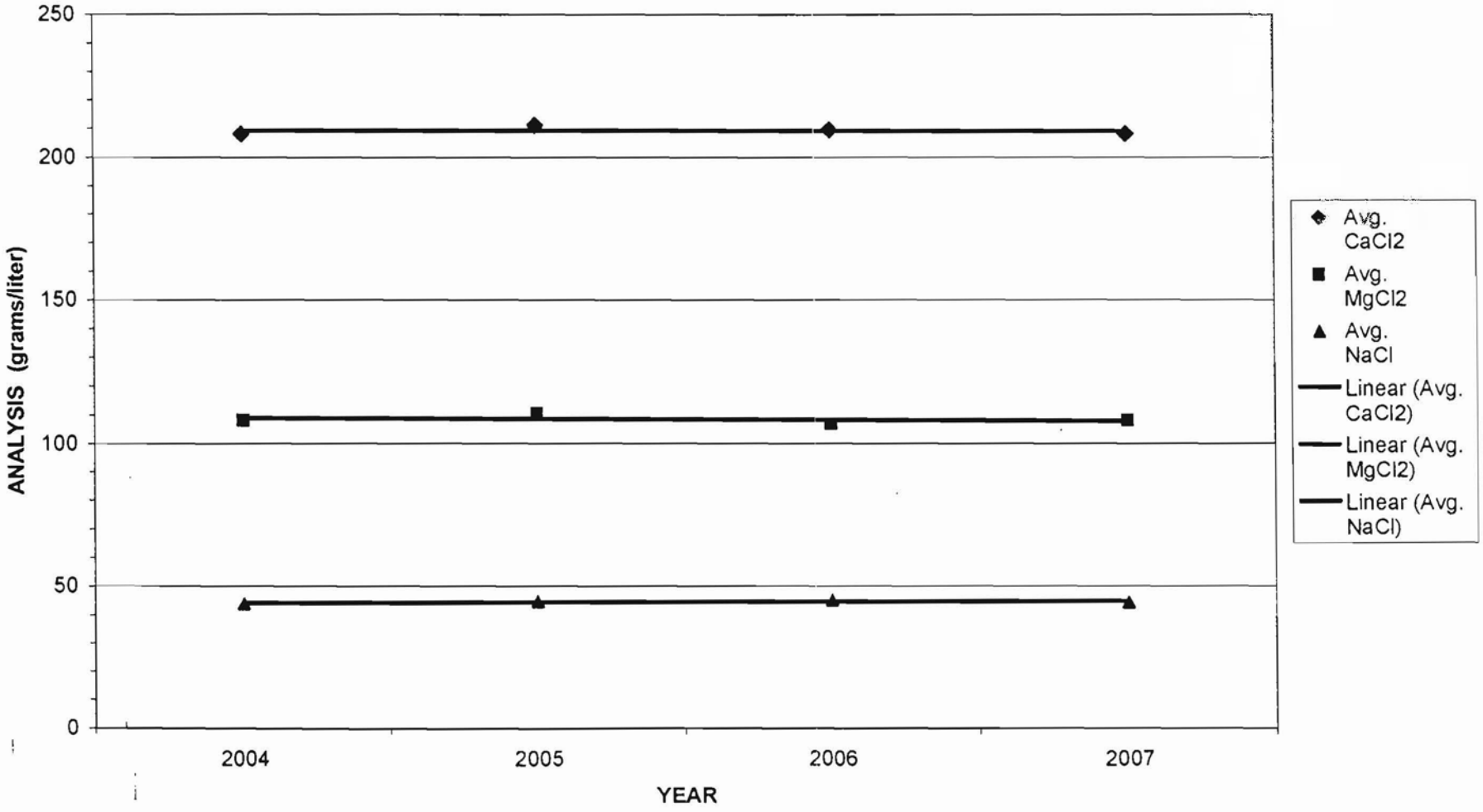
Averages

	Avg. CaCl2	Avg. MgCl2	Avg. NaCl	Avg. pH	Avg. Specific Gravity
2004	208	108	44	5.13	1.272
2005	211	110	45	5.07	1.271
2006	210	107	45	5.07	1.265
2007	208	108	44	5.00	1.270

Attachment 2: Brine Feed Chemistry Summary 2004 - 2007
ANALYSIS of "C" HEAD TANK BRINE 2004 - 2007
pH & Sp. Gr.



Attachment 2: Brine Feed Chemistry Summary 2004 - 2007
ANALYSIS of "C" HEAD TANK BRINE 2004 - 2007
SALTS



Attachment 3: Dolime Feed Chemistry Summary
2004-2007

LOAD DATE	CAO	MGO	SIO2	FE2O3	AL2O3
23-Jan-04	56.5	40.4	0.27	0.14	0.10
23-Jan-04	56.8	41.2	0.33	0.15	0.08
30-Jan-04	56.5	40.2	0.49	0.24	0.12
31-Jan-04	56.4	40.5	0.27	0.12	0.07
10-Feb-04	58.2	40.3	0.35	0.18	0.12
11-Feb-04	58.2	40.3	0.32	0.17	0.11
18-Feb-04	58.4	40.5	0.37	0.16	0.13
18-Feb-04	58.4	40.5	0.25	0.15	0.09
22-Feb-04	58.3	40.4	0.27	0.13	0.10
24-Feb-04	58.3	40.4	0.25	0.13	0.08
04-Mar-04	58.4	40.5	0.26	0.16	0.09
04-Mar-04	58.4	40.5	0.25	0.14	0.09
08-Mar-04	58.3	40.4	0.35	0.14	0.10
10-Mar-04	58.3	40.4	0.32	0.14	0.11
14-Mar-04	58.2	40.3	0.41	0.23	0.14
16-Mar-04	58.2	40.3	0.45	0.20	0.16
06-Apr-04	58.3	40.4	0.38	0.18	0.11
06-Apr-04	58.3	40.4	0.34	0.18	0.11
14-Apr-04	58.5	40.5	0.38	0.17	0.11
13-Apr-04	58.5	40.5	0.32	0.15	0.09
18-Apr-04	58.4	40.4	0.33	0.16	0.11
18-Apr-04	58.4	40.4	0.26	0.09	0.07
28-Apr-04	58.3	40.5	0.37	0.19	0.12
29-Apr-04	58.3	40.5	0.28	0.12	0.10
03-May-04	58.2	40.3	0.28	0.14	0.08
03-May-04	58.2	40.3	0.29	0.14	0.09
09-May-04	58.2	40.3	0.32	0.13	0.10
09-May-04	58.2	40.3	0.37	0.18	0.11
16-May-04	58.2	40.3	0.20	0.13	0.07
16-May-04	58.2	40.3	0.33	0.16	0.11
23-May-04	58.2	40.3	0.34	0.19	0.12
24-May-04	58.2	40.3	0.45	0.26	0.15
30-May-04	58.0	40.2	0.41	0.14	0.15
31-May-04	58.0	40.2	0.47	0.23	0.14
23-Jun-04	58.3	40.4	0.44	0.18	0.15
23-Jun-04	58.3	40.4	0.43	0.17	0.14
08-Jul-04	57.8	40.1	0.44	0.16	0.14
08-Jul-04	57.8	40.1	0.29	0.09	0.10
14-Jul-04	58.0	40.2	0.32	0.14	0.12
14-Jul-04	58.4	40.4	0.29	0.11	0.10
20-Jul-04	58.1	40.2	0.56	0.25	0.17
22-Jul-04	58.1	40.2	0.51	0.20	0.14
26-Jul-04	58.3	40.3	0.39	0.16	0.13
27-Jul-04	58.4	40.4	0.41	0.17	0.14
04-Aug-04	58.3	40.4	0.60	0.24	0.21
04-Aug-04	58.4	40.5	0.43	0.20	0.13
12-Aug-04	58.2	40.3	0.34	0.13	0.12
12-Aug-04	58.3	40.4	0.34	0.13	0.10
15-Aug-04	58.1	40.3	0.21	0.13	0.07
16-Aug-04	58.1	40.3	0.40	0.23	0.15
23-Aug-04	58.4	40.5	0.36	0.19	0.12

LOAD DATE	CAO	MGO	SIO2	FE2O3	AL2O3
25-Aug-04	58.4	40.5	0.44	0.21	0.12
02-Sep-04	58.4	40.4	0.26	0.10	0.10
02-Sep-04	58.3	40.3	0.27	0.17	0.10
09-Sep-04	58.3	40.4	0.45	0.18	0.13
10-Sep-04	58.3	40.4	0.27	0.09	0.10
13-Sep-04	58.3	40.4	0.38	0.18	0.14
18-Sep-04	58.3	40.4	0.33	0.15	0.10
23-Sep-04	58.6	40.5	0.37	0.19	0.10
30-Sep-04	58.6	40.5	0.32	0.16	0.10
04-Oct-04	58.2	40.3	0.31	0.17	0.09
04-Oct-04	58.2	40.3	0.34	0.16	0.08
15-Oct-04	58.5	40.5	0.40	0.20	0.11
15-Oct-04	58.5	40.5	0.43	0.20	0.15
20-Oct-04	58.6	40.6	0.24	0.14	0.08
20-Oct-04	58.4	40.4	0.35	0.20	0.11
25-Oct-04	58.1	40.3	0.29	0.21	0.10
26-Oct-04	58.6	40.6	0.34	0.12	0.14
31-Oct-04	58.1	40.2	0.28	0.18	0.08
31-Oct-04	58.1	40.2	0.38	0.23	0.11
10-Nov-04	58.7	40.6	0.17	0.13	0.06
10-Nov-04	58.7	40.6	0.23	0.18	0.08
15-Nov-04	58.2	40.3	0.27	0.13	0.08
15-Nov-04	58.6	40.6	0.22	0.13	0.07
22-Nov-04	58.4	40.4	0.26	0.16	0.09
21-Nov-04	58.2	40.3	0.35	0.15	0.09
01-Dec-04	58.2	40.3	0.39	0.12	0.09
29-Nov-04	58.5	40.5	0.28	0.14	0.09
05-Dec-04	58.6	40.6	0.23	0.13	0.08
07-Dec-04	58.1	40.3	0.38	0.19	0.11
17-Dec-04	58.1	40.3	0.20	0.14	0.08
17-Dec-04	58.3	40.5	0.25	0.20	0.09
21-Dec-04	58.4	40.5	0.31	0.19	0.11
21-Dec-04	58.3	40.4	0.31	0.20	0.13
25-Dec-04	57.7	40.0	0.23	0.14	0.08
29-Dec-04	58.5	40.5	0.36	0.16	0.13
06-Jan-05	58.5	40.5	0.31	0.18	0.11
06-Jan-05	58.3	40.4	0.26	0.15	0.09
07-Jan-05	58.1	40.2	0.29	0.12	0.08
09-Jan-05	58.2	40.3	0.27	0.14	0.07
21-Jan-05	58.4	40.5	0.24	0.14	0.08
21-Jan-05	58.6	40.6	0.27	0.18	0.10
26-Jan-05	58.4	40.4	0.26	0.17	0.09
26-Jan-05	58.5	40.5	0.31	0.22	0.12
30-Jan-05	58.5	40.5	0.33	0.20	0.13
02-Feb-05	58.1	40.2	0.30	0.15	0.09
07-Feb-05	58.6	40.6	0.29	0.15	0.10
06-Feb-05	58.4	40.5	0.32	0.15	0.11
15-Feb-05	58.6	40.6	0.31	0.17	0.11
17-Feb-05	58.4	40.5	0.24	0.15	0.09
20-Feb-05	58.0	40.2	0.15	0.08	0.05
21-Feb-05	58.1	40.2	0.18	0.10	0.07
27-Feb-05	58.5	40.5	0.29	0.17	0.10
03-Mar-05	58.3	40.4	0.30	0.16	0.10
10-Mar-05	57.9	40.1	0.25	0.15	0.10
11-Mar-05	57.9	40.1	0.24	0.13	0.09

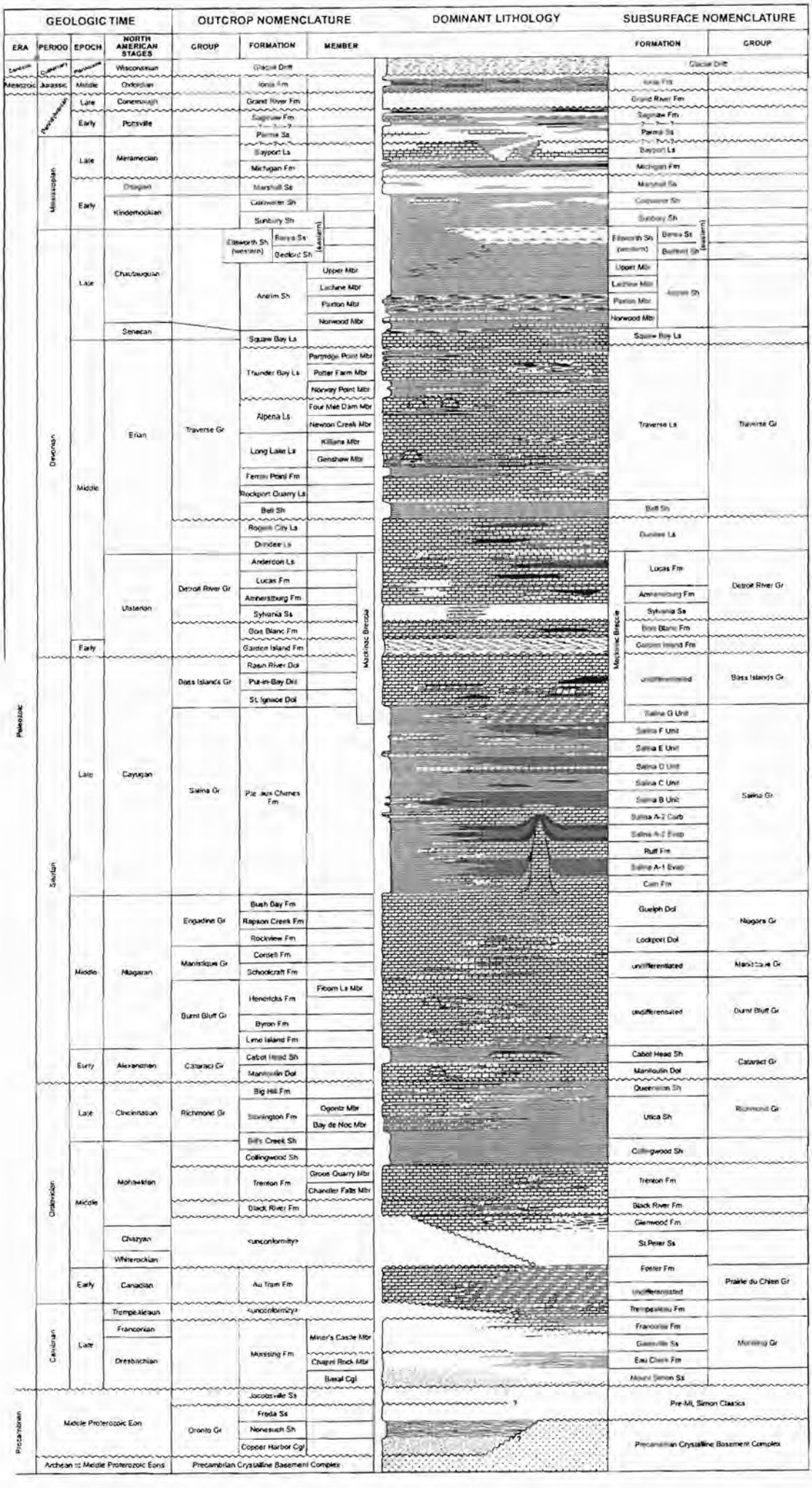
LOAD DATE	CAO	MGO	SIO2	FE2O3	AL2O3
18-Mar-05	58.2	40.3	0.39	0.19	0.13
18-Mar-05	58.3	40.4	0.35	0.16	0.11
20-Mar-05	58.5	40.5	0.30	0.17	0.10
20-Mar-05	58.4	40.5	0.30	0.16	0.10
30-Mar-05	58.1	40.2	0.33	0.15	0.13
30-Mar-05	57.9	40.1	0.29	0.14	0.12
05-Apr-05	58.7	40.7	0.23	0.12	0.09
07-Apr-05	58.3	40.4	0.26	0.10	0.07
13-Apr-05	58.2	40.3	0.22	0.11	0.06
13-Apr-05	58.2	40.3	0.24	0.11	0.06
22-Apr-05	58.4	40.5	0.32	0.09	0.09
22-Apr-05	58.4	40.4	0.36	0.08	0.08
24-Apr-05	57.7	39.9	0.28	0.12	0.10
26-Apr-05	58.4	40.4	0.30	0.14	0.10
06-May-05	58.4	40.4	0.22	0.11	0.07
06-May-05	58.3	40.4	0.25	0.14	0.08
10-May-05	58.0	40.1	0.30	0.14	0.09
12-May-05	58.5	40.5	0.27	0.13	0.08
16-May-05	58.3	40.4	0.32	0.18	0.11
16-May-05	58.1	40.3	0.29	0.14	0.10
21-May-05	58.2	40.3	0.16	0.11	0.06
25-May-05	57.8	40.0	0.20	0.12	0.08
02-Jun-05	58.6	40.6	0.34	0.15	0.09
02-Jun-05	58.4	40.4	0.46	0.22	0.13
09-Jun-05	57.6	39.9	0.35	0.17	0.12
10-Jun-05	58.2	40.3	0.35	0.13	0.08
13-Jun-05	57.7	40.0	0.27	0.16	0.10
13-Jun-05	57.6	39.9	0.37	0.13	0.15
21-Jun-05	58.2	40.3	0.32	0.16	0.09
22-Jun-05	58.4	40.5	0.35	0.16	0.11
25-Jun-05	58.2	40.3	0.31	0.16	0.10
29-Jun-05	58.5	40.5	0.24	0.13	0.07
11-Jul-05	58.6	40.6	0.19	0.10	0.07
11-Jul-05	58.1	40.3	0.27	0.13	0.08
13-Jul-05	58.6	40.6	0.26	0.15	0.09
13-Jul-05	57.9	40.1	0.25	0.14	0.08
17-Jul-05	58.3	40.5	0.30	0.17	0.12
18-Jul-05	57.6	40.0	0.21	0.10	0.08
23-Jul-05	58.5	40.5	0.27	0.15	0.10
24-Jul-05	58.6	40.6	0.22	0.14	0.08
05-Aug-05	58.4	40.4	0.36	0.18	0.03
05-Aug-05	58.4	40.5	0.32	0.18	0.20
10-Aug-05	58.0	40.2	0.33	0.15	0.11
15-Aug-05	58.6	40.6	0.31	0.19	0.12
15-Aug-05	58.6	40.6	0.32	0.19	0.12
25-Aug-05	57.8	40.1	0.38	0.17	0.12
25-Aug-05	58.3	40.4	0.28	0.15	0.11
30-Aug-05	58.2	40.3	0.38	0.19	0.12
31-Aug-05	57.6	39.9	0.25	0.10	0.06
07-Sep-05	58.4	40.4	0.41	0.19	0.14
07-Sep-05	58.5	40.5	0.31	0.17	0.12
13-Sep-05	57.7	40.0	0.25	0.10	0.08
15-Sep-05	58.2	40.3	0.36	0.19	0.13
21-Sep-05	58.4	40.4	0.41	0.16	0.09
21-Sep-05	58.1	40.3	0.35	0.16	0.11

LOAD DATE	CAO	MGO	SIO2	FE2O3	AL2O3
28-Sep-05	58.5	40.5	0.32	0.14	0.10
28-Sep-05	58.5	40.5	0.27	0.15	0.09
05-Oct-05	58.5	40.5	0.34	0.14	0.10
05-Oct-05	58.2	40.3	0.31	0.14	0.10
10-Oct-05	58.5	40.5	0.37	0.11	0.16
11-Oct-05	58.3	40.4	0.37	0.13	0.17
18-Oct-05	58.1	40.2	0.34	0.17	0.12
19-Oct-05	58.1	40.2	0.51	0.19	0.14
22-Oct-05	57.8	40.0	0.33	0.18	0.11
23-Oct-05	58.4	40.4	0.39	0.14	0.09
02-Nov-05	58.6	40.6	0.27	0.15	0.09
02-Nov-05	58.4	40.4	0.28	0.14	0.08
10-Nov-05	58.3	40.4	0.33	0.16	0.14
08-Nov-05	58.5	40.5	0.33	0.19	0.12
17-Nov-05	58.6	40.6	0.21	0.13	0.08
15-Nov-05	58.0	40.2	0.29	0.14	0.11
20-Nov-05	58.2	40.3	0.16	0.06	0.04
21-Nov-05	57.7	40.0	0.18	0.10	0.06
29-Nov-05	58.4	40.4	0.39	0.19	0.14
29-Nov-05	58.4	40.4	0.28	0.20	0.10
04-Dec-05	57.2	39.6	0.15	0.07	0.04
05-Dec-05	57.7	39.9	0.27	0.11	0.08
16-Dec-05	58.3	40.4	0.35	0.21	0.14
16-Dec-05	58.4	40.4	0.27	0.15	0.10
24-Dec-05	58.6	40.6	0.34	0.19	0.11
25-Dec-05	58.2	40.3	0.43	0.16	0.10
05-Jan-06	58.4	40.5	0.26	0.20	0.09
05-Jan-06	58.4	40.5	0.36	0.19	0.11
10-Jan-06	58.6	40.6	0.24	0.16	0.09
11-Jan-06	57.9	40.1	0.32	0.17	0.11
17-Jan-06	58.4	40.4	0.44	0.23	0.15
18-Jan-06	57.6	39.9	0.27	0.27	0.10
24-Jan-06	58.4	40.4	0.35	0.09	0.24
01-Feb-06	57.9	40.1	0.35	0.11	0.13
01-Feb-06	58.1	40.3	0.31	0.23	0.14
08-Feb-06	58.7	40.7	0.21	0.12	0.08
08-Feb-06	58.4	40.5	0.37	0.25	0.12
15-Feb-06	57.6	39.9	0.42	0.22	0.14
16-Feb-06	58.1	40.2	0.36	0.20	0.14
20-Feb-06	58.0	40.2	0.47	0.33	0.18
20-Feb-06	58.4	40.4	0.46	0.33	0.18
26-Feb-06	58.0	40.1	0.23	0.17	0.08
26-Feb-06	58.3	40.4	0.32	0.20	0.11
08-Mar-06	58.3	40.4	0.14	0.11	0.05
09-Mar-06	58.6	40.6	0.21	0.13	0.07
18-Mar-06	58.3	40.4	0.18	0.09	0.06
19-Mar-06	58.4	40.5	0.18	0.10	0.06
23-Mar-06	58.0	40.2	0.23	0.11	0.07
26-Mar-06	58.7	40.6	0.24	0.14	0.07
29-Mar-06	58.5	40.5	0.37	0.18	0.13
29-Mar-06	58.6	40.6	0.31	0.17	0.11
07-Apr-06	58.4	40.4	0.32	0.17	0.12
06-Apr-06	58.5	40.5	0.22	0.13	0.08
09-Apr-06	58.7	40.7	0.19	0.14	0.07
09-Apr-06	58.1	40.2	0.18	0.24	0.07

LOAD DATE	CAO	MGO	SIO2	FE2O3	AL2O3
16-Apr-06	58.3	40.4	0.42	0.17	0.10
28-Apr-06	58.7	40.6	0.22	0.12	0.08
28-Apr-06	58.5	40.5	0.21	0.13	0.07
04-May-06	58.6	40.6	0.27	0.13	0.08
05-May-06	58.0	40.2	0.23	0.12	0.07
08-May-06	57.5	39.8	0.24	0.11	0.07
08-May-06	58.4	40.4	0.39	0.21	0.13
15-May-06	57.6	39.9	0.26	0.15	0.08
15-May-06	58.6	40.6	0.22	0.14	0.08
24-May-06	58.6	40.6	0.28	0.14	0.08
24-May-06	57.8	40.0	0.30	0.18	0.09
30-May-06	57.6	39.9	0.31	0.18	0.11
30-May-06	58.6	40.6	0.31	0.15	0.09
04-Jun-06	58.4	40.5	0.22	0.11	0.08
04-Jun-06	58.5	40.5	0.23	0.12	0.08
15-Jun-06	58.5	40.5	0.32	0.16	0.08
16-Jun-06	58.5	40.5	0.15	0.08	0.05
20-Jun-06	58.6	40.5	0.40	0.17	0.13
20-Jun-06	58.6	40.6	0.32	0.13	0.09
27-Jun-06	58.3	40.4	0.32	0.21	0.11
27-Jun-06	58.1	40.2	0.28	0.16	0.09
07-Jul-06	57.6	39.9	0.21	0.17	0.07
07-Jul-06	58.7	40.7	0.18	0.12	0.06
12-Jul-06	58.4	40.4	0.28	0.20	0.11
12-Jul-06	58.5	40.5	0.20	0.12	0.07
20-Jul-06	58.3	40.4	0.29	0.11	0.11
20-Jul-06	58.7	40.7	0.14	0.08	0.06
27-Jul-06	58.0	40.2	0.19	0.13	0.07
27-Jul-06	58.1	40.2	0.16	0.11	0.06
09-Aug-06	58.0	40.2	0.26	0.14	0.09
09-Aug-06	58.1	40.3	0.28	0.14	0.09
18-Aug-06	58.6	40.6	0.28	0.15	0.11
18-Aug-06	58.4	40.5	0.31	0.15	0.11
22-Aug-06	57.8	40.0	0.27	0.17	0.09
22-Aug-06	58.5	40.5	0.29	0.19	0.10
31-Aug-06	57.8	40.1	0.27	0.13	0.10
31-Aug-06	58.1	40.3	0.26	0.13	0.09
04-Sep-06	57.0	39.5	0.21	0.13	0.08
07-Sep-06	58.6	40.6	0.24	0.18	0.09
11-Sep-06	58.5	40.5	0.25	0.15	0.08
11-Sep-06	57.8	40.0	0.23	0.14	0.07
15-Sep-06	58.6	40.6	0.16	0.13	0.06
15-Sep-06	58.5	40.5	0.48	0.17	0.07
25-Sep-06	57.2	39.6	0.33	0.10	0.17
25-Sep-06	58.7	40.7	0.16	0.07	0.09
02-Oct-06	58.0	40.2	0.28	0.16	0.07
02-Oct-06	58.4	40.5	0.27	0.14	0.08
09-Oct-06	58.7	40.7	0.24	0.12	0.09
09-Oct-06	58.7	40.6	0.25	0.12	0.11
12-Oct-06	57.7	40.0	0.23	0.08	0.14
12-Oct-06	57.8	40.0	0.19	0.13	0.06
22-Oct-06	58.7	40.6	0.19	0.09	0.06
22-Oct-06	58.2	40.3	0.24	0.10	0.07
29-Oct-06	58.1	40.3	0.23	0.11	0.08
29-Oct-06	58.2	40.3	0.28	0.12	0.11

LOAD DATE	CAO	MGO	SIO2	FE2O3	AL2O3
04-Nov-06	58.0	40.2	0.23	0.12	0.08
09-Nov-06	57.9	40.1	0.15	0.11	0.06
12-Nov-06	58.2	40.3	0.14	0.09	0.05
12-Nov-06	58.0	40.1	0.16	0.09	0.06
23-Nov-06	58.6	40.5	0.24	0.10	0.08
23-Nov-06	58.6	40.6	0.21	0.11	0.08
30-Nov-06	57.8	40.0	0.17	0.09	0.06
30-Nov-06	58.1	40.3	0.39	0.17	0.15
01-Dec-06	58.6	40.6	0.34	0.17	0.09
02-Dec-06	58.4	40.4	0.28	0.10	0.05
13-Dec-06	58.5	40.5	0.29	0.18	0.10
13-Dec-06	58.2	40.3	0.32	0.14	0.09
22-Dec-06	58.2	40.3	0.24	0.10	0.08
20-Dec-06	58.5	40.5	0.28	0.16	0.10
26-Dec-06	58.4	40.5	0.29	0.18	0.10
26-Dec-06	58.6	40.6	0.29	0.19	0.09
02-Jan-07	58.7	40.7	0.26	0.08	0.08
02-Jan-07	57.5	39.8	0.31	0.08	0.06
09-Jan-07	58.2	40.3	0.17	0.09	0.07
07-Jan-07	57.7	40.0	0.23	0.10	0.08
18-Jan-07	58.6	40.6	0.12	0.07	0.05
19-Jan-07	57.9	40.1	0.12	0.06	0.03
23-Jan-07	58.2	40.3	0.30	0.21	0.09
25-Jan-07	58.6	40.6	0.19	0.16	0.07
27-Jan-07	58.4	40.5	0.33	0.15	0.11
28-Jan-07	58.0	40.2	0.32	0.15	0.09
06-Feb-07	58.3	40.4	0.32	0.11	0.08
06-Feb-07	58.6	40.6	0.34	0.12	0.09
16-Feb-07	57.8	40.0	0.30	0.18	0.10
16-Feb-07	58.5	40.5	0.35	0.22	0.13
22-Feb-07	58.2	40.3	0.31	0.15	0.12
22-Feb-07	58.3	40.4	0.34	0.20	0.13
01-Mar-07	58.5	40.5	0.31	0.16	0.11
02-Mar-07	58.5	40.5	0.34	0.20	0.12
06-Mar-07	57.9	40.1	0.25	0.12	0.09
06-Mar-07	57.8	40.0	0.41	0.19	0.12
17-Mar-07	58.6	40.6	0.28	0.15	0.10
17-Mar-07	58.7	40.6	0.24	0.14	0.09
20-Mar-07	58.4	40.5	0.25	0.17	0.11
20-Mar-07	58.6	40.6	0.29	0.15	0.09
27-Mar-07	58.5	40.5	0.42	0.19	0.12
28-Mar-07	58.6	40.6	0.43	0.17	0.11
03-Apr-07	58.3	40.4	0.79	0.13	0.11
03-Apr-07	58.5	40.5	0.39	0.15	0.12
13-Apr-07	58.4	40.4	0.27	0.11	0.10
13-Apr-07	58.5	40.5	0.23	0.10	0.08
18-Apr-07	58.3	40.3	0.46	0.28	0.22
17-Apr-07	58.1	40.2	0.44	0.24	0.18
27-Apr-07	58.4	40.5	0.44	0.23	0.17
27-Apr-07	58.5	40.5	0.37	0.19	0.15
04-May-07	57.5	39.9	0.37	0.16	0.14
05-May-07	57.8	40.0	0.24	0.11	0.08
11-May-07	58.5	40.5	0.24	0.10	0.09
12-May-07	58.5	40.5	0.22	0.11	0.08
14-May-07	57.7	40.0	0.39	0.24	0.14

LOAD DATE	CAO	MGO	SIO2	FE2O3	AL2O3
14-May-07	58.5	40.5	0.24	0.18	0.10
25-May-07	58.7	40.6	0.18	0.09	0.06
25-May-07	58.6	40.6	0.25	0.12	0.09
29-May-07	58.5	40.5	0.16	0.10	0.06
31-May-07	58.3	40.4	0.27	0.13	0.10
07-Jun-07	58.8	40.7	0.16	0.12	0.08
07-Jun-07	58.1	40.3	0.23	0.13	0.10
AVERAGE	58.2	40.4	0.30	0.15	0.10
STD DEV	0.355	0.214	0.085	0.042	0.030
DATA POINTS	333	333	333	333	333



STRATIGRAPHIC NOMENCLATURE FOR MICHIGAN

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Geological Survey Division
Harold Fitch, State Geologist
and
Michigan Basin Geological Society

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2000

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Academia: Dr. Aureal T. Cross, Michigan State University; Dr. Robert H. Dott, Jr., University of Wisconsin; Mr. William D. Everhart, Ph.D. Candidate, Michigan Technological University.

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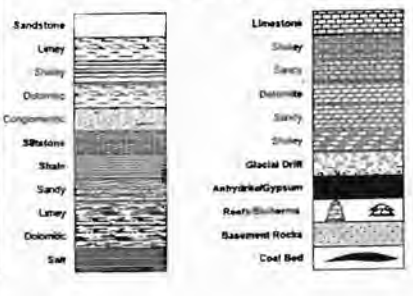
A complete listing of all contributors will be found in the Stratigraphic Lexicon for Michigan, of which this column is an integral part.

RELATED TERM CORRELATION

STRATIGRAPHIC POSITION	RELATED TERMS
Ionia Fm	Jurassic Red Beds
Michigan Fm	Clare Dolomite, Brown Lime, Gray Dolomite, Gray Sandstone, Stray-Gray Sandstone, Stray-Gray-Gray Sandstone, Triple Gray
Coldwater Sh	Coldwater Red Rock, Speckled Dolomite, Wire Sand
Antrim Sh	Charlton Black Shale Member, Elbow, Chagrin Black Shale Member, Upper Black Shale, Light Member, Lower Black, Lower Antrim, Middle Antrim, Middle Gray Antrim, Dark Antrim, Middle Gray Shale, Unit 1A, Unit 1B, Unit 1C, Chagrin Creek Gray Shale Member
Dundee Ls	Reed City Member/Dolomite/Anhydrite
Lucas Fm	Three Sandstone, Homer Member, Jurd Member, Massive Salt/Anhydrite, Sour Zone, Big Anhydrite, Richfield Zone/Member/Sandstone, Big Salt
Amherstburg Fm	Flint Sandstone, Meadow Member, Black Lime
St. Ignace Dolomite	Salina H Unit
Salina B Unit	Big Salt, B Salt
Ruff Formation	Salina A-1 Carbonate, Rabbit Ears Anhydrite
Cain Fm	Salina A-0 Carbonate
Guelph Dolomite	Brown Niagara, Niagaran Reef, Pinnacle Reef, Engadine Dolomite
Lockport Dolomite	Gray Niagara, White Niagara
Burnt Bluff Gr	Clinton Formation
Trenton Fm	Cap Dolomite
Black River Fm	Van Wert Zone, Shanty Peak, Black River Shale
Glenwood Fm	Goodwell Unit, Zone of Unconformity
St. Peter Sandstone	Bryggert Sandstone, Jordan Sandstone, Knox Sandstone, Massive Sand
Prairie du Chien Gr	Fusion Formation, New Richmond Sandstone, Lower Knox Carbonate, St. Lawrence Formation, T-PDC, Oneota Dolomite, Breccia Shale
Trempealeau Fm	Lodi Formation
Galesville Ss	Dresbach Sandstone
Pre-Mt. Simon Clastics	Precambrian "Red Beds"

LEGEND



Attachment 4: Statistical Summary MagChem 10 WTS 60

Statistical Summary of MagChem 10 WTS 60 From Martin Marietta for 06/01/2006 through 05/31/2007

	Chloride, as Cl, %	Iron , as Fe_2O_3, %	Loss On Ignition, %	Magnesium, as MgO, (on ignited basis) %	Aluminum , as Al_2O_3, %	Silicon, as SiO_2, %	Sulfur, as SO_3, %	Calcium , as CaO, %
Count	146	146	145	146	146	146	146	146
Average	0.0016589	0.154306	0.142414	98.4788	0.133954	0.347812	0.000341781	0.903901
2 Std. Dev	0.0183789	0.0292273	0.128398	0.169459	0.0139122	0.0883279	0.00282362	0.106868
Minimum	0	0.0842	0.01	98.0999	0.1069	0.1537	0	0.6221
Maximum	0.1052	0.1981	0.5	98.9057	0.1782	0.4271	0.011	1.1349
Average + Std. Dev	0.0200378	0.183533	0.270811	98.6483	0.147866	0.43614	0.0031654	1.01077
Average - Std. Dev	-0.01672	0.125079	0.0140163	98.3094	0.120042	0.259484	-0.00248184	0.797033

Statistical Summary of MagChem 10 WTS 60 From Martin Marietta for 12/01/2004 through 12/01/2005

	Chloride, as Cl, %	Iron , as Fe_2O_3, %	Loss On Ignition, %	Magnesium, as MgO, (on ignited basis) %	Aluminum , as Al_2O_3, %	Silicon, as SiO_2, %	Sulfur, as SO_3, %	Calcium , as CaO, %
Count	166	166	166	166	166	166	166	166
Average	0.000495783	0.161958	0.166084	98.4808	0.125189	0.348902	0	0.903758
2 Std. Dev	0.00913727	0.0223242	0.118695	0.166225	0.0235845	0.0754838	0	0.112036
Minimum	0	0.1331	0.06	98.2362	0.0996	0.24	0	0.7236
Maximum	0.0583	0.1961	0.34	98.7065	0.1988	0.5175	0	1.0581
Average + Std. Dev	0.00963305	0.184283	0.28478	98.647	0.148773	0.424386	0	1.01579
Average - Std. Dev	-0.00864148	0.139634	0.0473889	98.3146	0.101604	0.273419	0	0.791723