Battelle
Columbus Laboratories

CHAIN OF CUSTODY RECORD

Form No. _____

Proj. No.	Project Title
G486111-T3	Source Determination Study

SAMPLERS: (Signature) G. Headington / D. Conner / B. Headington

PO# 191648

DATE	TIME	SAMPLE I.D.	GROUND WATER	ISOTOPES	INORGANIC CHLORIDE	PERCHLORATE ISOTOPES	Container No.	Number of Containers	Remarks
02 JUN 05	1340	GARFIELD	X	X	X			3	
02 JUN 05	1052	SUNSET	X	X	X			3	
02 JUN 05	1530	~~BINGHAM~~ GH BANGHAM	X	X	X			3	
03 JUN 05	0930	LFWC-2	X	X	X			3	
03 JUN 05	1330	~~LFWC~~ (GH) LAWC-3	X	X	X			3	
05 JUN 05	1130	MW 1	X	X	X			3	

INORGANIC CHLORIDE SAMPLES UNFILTERED

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
[signature]	6-6-2005 16:00	[signature]		6/7/05 10:10am	
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks Sent to: University of ILLINOIS CHICAGO	

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Battelle
Columbus Laboratories

CHAIN OF CUSTODY RECORD

Form No. 1 of 1

Proj. No.	Project Title
G486111-T3	Source Determination Study

SAMPLERS: (Signature) G. Heedington / D. Conner / B. Heedington / S. Serpa

PO # 191648

DATE	TIME	SAMPLE I.D.	SAMPLE TYPE (√) Perchlorate Isotopes	Container No.	Number of Containers	Remarks
02JUN05	~~0952~~ 1254	SUNSET	X	1		Column #30
02JUN05	~~1340~~ 1615	GARFIELD	X	1		Column #63
02JUN05	1530	BANGHAM	X	1		Column #31
03JUN05	0930	LFWC-2	X	1		Column #29
03JUN05	1330	LAWC-3	X	1		Column #28

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Sam Serpa	6-16-05 18:00	Leslie Patt		6/17/05 1:30pm	
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks	
				Sent to: University of Illinois Chicago	

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Columbus Laboratories

CHAIN OF CUSTODY RECORD

Form No. _____

Proj. No.: G486111-T3

Project Title: Source Determination Study

SAMPLERS: (Signature) D. Lomel

PO # 191648

DATE	TIME	SAMPLE I.D.	Groundwater	Isotopes	Inorganic Chloride	Perchlorate Isotopes	Container No.	Number of Containers	Remarks
7/19/2005	12:30	MW-25-5	X	✓	◆				Inorganic Chloride samples are not filtered in the field, please filter in the lab.
7/19/2005	14:00	MW-25-4	X	✓	X				
7/19/2005	15:10	MW-25-3	X	✓	X				
7/19/2005	16:15	MW-25-2	X	✓					
7/19/2005	17:30	MW-25-1	X	✓	X				
7/20/2005	0900	MW-19-5	X	✓					
7/20/2005	1100	MW-19-4	X	✓					
7/20/2005	1210	MW-19-3	X	✓					
7/20/2005	1400	MW-19-2	X	✓					
7/20/2005	1500	MW-19-1	X	✓					
7/21/2005	0915	MW-18-5	X	✓					
7/21/2005	1030	MW-18-4	X	✓					
7/21/2005	1245	MW-18-3	X	✓					
7/21/2005	1630	MW-18-2	X	✓					
7/21/2005	1500	MW-18-1	X	✓					

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
[signature]	7/21/05 17:00	[signature]			
Relinquished by: (Signature)	**Date/Time**	**Received by: (Signature)**	**Relinquished by: (Signature)**	**Date/Time**	**Received by: (Signature)**
Relinquished by: (Signature)	**Date/Time**	**Received for Laboratory by: (Signature)**	**Date/Time**	**Remarks**	
				To: University of Illinois Chicago	

Battelle
The Business of Innovation

CHAIN OF CUSTODY RECORD

Form No. _____

@ 614 . 424 . 3754
F 614 458 3754
Tom Shi

Proj. No.	Project Title
6486111-T3	Source Determination Study

SAMPLERS: (Signature) D. Lowney

DATE	TIME	SAMPLE I.D.	Groundwater Isotopes	Inorganic Chloride Isotope	Container No.	Number of Containers	Remarks
8/15/05	09:30	MW-17-5	X✓				PO#: 191648
8/15/05	10:45	MW-17-4	X✓				
8/15/05	12:45	MW-17-3	X✓	X			
8/15/05	13:45	MW-17-2	X✓				
8/15/05	15:30	MW-17-1	X✓				

note - arrived unlabeled but in same bag as labeled water samples

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
	8-16-05 16:00				
Relinquished by: (Signature)	**Date/Time**	**Received by: (Signature)**	**Relinquished by: (Signature)**	**Date/Time**	**Received by: (Signature)**
Relinquished by: (Signature)	**Date/Time**	**Received for Laboratory by: (Signature)**	**Date/Time**	**Remarks**	
				To: University of Illinois Chicago	

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Columbus Laboratories

Form No. _____

CHAIN OF CUSTODY RECORD

Proj. No.: G466111-T3

Project Title: Source Determination Study

SAMPLERS: (Signature) D. Conner

PO#: 191648

DATE	TIME	SAMPLE I.D.		Groundwater Isotopes	Inorganic Chloride Isotope	Container No.	Number of Containers	Remarks
7/25/2005	09:00	MW-24-4	✓	X	X			
7/25/2005	10:30	MW-24-3	✓	X	X			
7/25/2005	12:00	MW-24-2	✓	X	X			
7/25/2005	13:15	MW-24-1	✓	X	X			
7/25/2005	15:30	MW-24-5	✓	X	X			
7/26/2005	08:30	MW-21-5	✓	X	X			
7/26/2005	10:30	MW-21-4	✓	X	X			
7/26/2005	12:15	MW-21-3	✓	X	X			
8/1/05	0857	MW-20-5	✓	X	X			
8/1/05	1050	MW-20-4	✓	X	X			
8/1/05	1230	MW-20-3	✓	X	X			
8/1/05	1407	MW-20-2	✓	X	X			
8/1/05	1608	MW-20-1	✓	X	X			
		MW-21-1	✓	X	X			
		MW-21-2	✓	X	X			

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
M. Wolfe	8/3/05 1700				

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)

Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks
				To: University of Illinois Chicago

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CHAIN OF CUSTODY RECORD

Form No. _____

Proj. No.: G486111-T3

Project Title: Source Determination Study

SAMPLERS: (Signature) D. Lanner

PO#: 191648

SAMPLE TYPE (√): Perchlorate (Resin Column)

DATE	TIME	SAMPLE I.D.	Perchlorate (Resin Column)	Container No.	Number of Containers	Remarks
8-10-05	12:30	MW-24-2	X			
8-11-05	17:00	MW-24-1	X			
8-12-05	15:12	MW-25-4	X			
8-14-05	14:00	MW-19-2	X			
8-27-05	07:35	MW-25-3	X			
8-30-05	08:27	MW-25-2	X			
9-8-05	17:05	MW-17-3	X			
9-10-05	0735	MW-25-1	X			

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
	9-12-05 16:00				
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks	
				To: Univ. of Illinois Chicago	

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Battelle
Columbus Laboratories

CHAIN OF CUSTODY RECORD

Form No. _____

Proj. No.	Project Title
G486111-T3	Source Determination Study

SAMPLERS: (Signature) Mike Wolfe

PO# 191648

DATE	TIME	SAMPLE I.D.	Organic Chloride Isotope															Container No.	Number of Containers	Remarks
9/13/05	1055	mw-25-2	X	✓														1	1	

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Mike Wolfe	9/13/05 1200				
Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks: To: University of Illinois Chicago	

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CHAIN OF CUSTODY RECORD

Form No. _____

Proj. No. G486111-T3

Project Title: JPL Source Determination Study

SAMPLERS: (Signature) David J. Conner

DATE	TIME	SAMPLE I.D.	SAMPLE TYPE (√) Perchlorate Isotopes	Container No.	Number of Containers	Remarks
2/9/06	12:45	JPL-MW-16	X		8	1L Poly non-preserved

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
	2-9-06 1430	AB			

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)

Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks

Page _____ of _____

Shiao, Tien

From: Neil C Sturchio [sturchio@uic.edu]
Sent: Friday, February 17, 2006 12:27 PM
To: Shiao, Tien
Cc: Fields, Keith A; Sass, Bruce M; Ohart, Carolyn J
Subject: Re: QA/QC Procedures and BackUp for the Perchlorate, Groundwater,and Inorganic Chloride Results
Importance: High
Attachments: final data for JPL isotope project 2.17.06.xls; BATELLE chlorides 1.13.06.xls

Tien,

Attached are two spreadsheets.

One spreadsheet contains the final results for H and O isotopes in water, Cl isotopes in chloride, and Cl and O isotopes in perchlorate. For the perchlorate data, there are two changes from the preliminary spreadsheet that I brought to Columbus on Feb. 3: (1) a typo for the d18O value of MW25-4 such that the preliminary reported value of -17.8 is revised to the corrected value of -17.2, and (2) the perchlorate data initially reported for MW-1 belongs instead to LFWC-2 (which I recall that we realized when I was at the meeting in Columbus). Analytical precisions are stated at the bottom of the spreadsheet.

Also attached is another copy of the Cl isotope data spreadsheet for chloride that contains the QA/QC data for the chloride isotope analyses. This is exactly the same spreadsheet that I sent to you on January 13. Note that the QA/QC data is listed at the bottom of the spreadsheet - the samples named "CBN..." are samples of our reference seawater chloride that were prepared and run alongside the JPL samples, using exactly the same procedures and materials as used to prepare the JPL chloride samples.. The mean and standard deviation of the delta-37-Cl value for these 5 seawater chloride samples is +0.01 +/- 0.08 per mil. This means that the measurements are precise to within 0.1 per mil, as we stated, and our value for seawater chloride agrees perfectly with the accepted value of 0.00 per mil.

I will get the procedural descriptions and QA/QC results (standard values) for waters and perchlorates to you by later today, or possibly tomorrow. Unfortunately our lab manager (Linnea Heraty) has been on vacation for over a week, but she is supposed to return today and be in the lab for a while tomorrow. So, I may need to consult with her tomorrow to find all of the relevant QA/QC results and latest procedural documentation.

-Neil

At 09:14 AM 2/17/2006 -0500, you wrote:

> Dear Dr. Sturchio,
>
> Keith Fields, the project manager for the JPL/NASA project, is going to California to present the isotope results to the client on Monday (02/17/06). It would help us out to receive the QC back up for all results UIC helped us analyze, the QA/QC procedures including the procedure to extract the high sulfate concentrations from our samples, and the final perchlorate isotope results (were the results presented on 02/03/06 final?).

Final Data Report -- Battelle/JPL waters
University of Illinois at Chicago/Environmental Isotope Geochemistry Laboratory
17-Feb-06

		H_2O			chloride	perchlorate		
OurLabID	Sample ID	δ^2H	$\delta^{18}O$	δ^2H	$\delta^{37}Cl$	$\delta^{18}O$	$\Delta^{17}O$	$\delta^{37}Cl$
W-118	MW-25-5	-48.0	-7.4	-48.0				
W-119	MW-25-4	-44.8	-6.7	-44.8	0.13	-17.2	0.99	2.19
W-120	MW-25-3	-46.1	-6.9	-46.1	0.11	-16.8	2.01	0.06
W-121	MW-25-2	-46.2	-6.8	-46.2	0.12	-16.3	2.00	0.18
W-122	MW-25-1		-7.0		-0.02	-18.7	0.83	2.05
W-123	MW-19-5	-50.4	-7.4	-50.4				
W-124	MW-19-4	-50.5	-7.2	-50.5				
W-125	MW-19-3	-46.9	-7.1	-46.9				
W-126	MW-19-2	-54.0	-7.8	-54.0	0.18	-18.2	0.17	0.48
W-127	MW-19-1	-52.8	-7.7	-52.8				
W-128	MW-18-5	-44.2	-6.7	-44.2				
W-129	MW-18-4	-42.3	-6.9	-42.3				
W-130	MW-18-3	-48.7	-7.0	-48.7				
W-131	MW-18-2	-46.9	-6.8	-46.9				
W-132	MW-18-1	-49.8	-7.5	-49.8				
W-133	MW-24-4	-44.0	-6.9	-44.0				
W-134	MW-24-3	-43.7	-6.8	-43.7				
W-135	MW-24-2	-45.6	-7.0	-45.6	0.03			
W-136	MW-24-1	-47.3	-6.7	-47.3	0.03			0.3
W-137	MW-24-5	-46.7	-7.0	-46.7				
W-138	MW-21-5	-62.1	-8.3	-62.1				
W-139	MW-21-4	-57.9	-8.1	-57.9				
W-140	MW-21-3	-60.0	-8.1	-60.0				
W-141	MW-20-5	-48.4	-7.3	-48.4				
W-142	MW-20-4	-51.6	-7.5	-51.6				
W-143	MW-20-3	-45.5	-6.8	-45.5				
W-144	MW-20-2	-47.7	-7.2	-47.7				
W-145	MW-20-1	-51.1	-7.7	-51.1				
W-146	MW-21-1	-58.3	-7.9	-58.3				
W-147	MW-21-2	-57.4	-8.2	-57.4				
W-148	MW-17-5	-55.2	-7.9	-55.2				
W-149	MW-17-4	-52.0	-7.5	-52.0				
W-150	MW-17-3	-51.0	-7.5	-51.0	0.17	-21.8	0.12	
W-151	MW-17-2	-55.6	-7.7	-55.6				
W-152	MW-17-1	-49.1	-7.5	-49.1				
W-153	LAWC-3	-47.0	-7.4	-47.0	0.01	-20.4	-0.3	0.21
W-154	Garfield	-45.7	-6.9	-45.7	0.01	-15.0	1.74	
W-155	Sunset	-48.4	-6.9	-48.4	0.08	-17.8	-0.06	0.27
W-156	Bangham	-52.6	-7.5	-52.6	0.03	-10.2	1.27	-3.01
W-157	LFWC-2	-48.4	-7.3	-48.4	0.06	-13.4	-0.13	1.1
W-158	MW-1	-42.7	-6.5	-42.7	0.06			
	MW-16					-21.7	0.028	
	Attacama desert 1					-8.4	8.95	
	Attacama desert 2					-9.3	8.93	
	Attacama desert 3					-4.2	9.57	
	Attacama desert 4					-7.6	9.25	
	Las Vegas Wash 1					-15.8	0.04	
	Las Vegas Wash 2					-14.5	0	

std dev of δ^2H values is +/- 1.3 per mil (water)
std dev of $\delta^{18}O$ values is +/- 0.2 per mil (water) and +/- 0.3 per mil (perchlorate)
std dev of $\delta^{37}Cl$ values is +/- 0.1 per mil (chloride) and +/- 0.3 per mil (perchlorate)

UIC Environmental Isotope Geochemistry Laboratory
Client: Battelle Memorial Institute/JPL project
Report Date: 1/13/2006 (with additional duplicate analyses)
Subject: Results of $^{37}Cl/^{35}Cl$ analyses of dissolved chloride in groundwater samples

DATE	SPEC#	ID1	ID2	UMOL	comment	$\delta^{37}Cl$ SMOC	
9/20/2005	L-6245	J-276	Bangham	129.8		0.03	
9/20/2005	L-6233	J-273	Garfield	131.4		0.01	
9/20/2005	L-6230	J-277	Sunset	125.4		0.08	
9/23/2005	L-6267	J-275	LFWC-2	91		0.06	
9/20/2005	L-6217	J-274	LWAC-3	115.5		0.01	instrument duplicate
9/20/2005	L-6221	J-274	LWAC-3	115.5		0.01	
9/20/2005	L-6239	J-272	MW1	126.2		0.05	instrument duplicate
9/20/2005	L-6242	J-272	MW1	126.2		0.07	
10/11/2005	L-6352	J-287	MW-17-3 A	82.6		0.19	method duplicate
10/11/2005	L-6358	J-284	MW-17-3 B			0.15	
9/20/2005	L-6224	J-286	MW-19-2	125.7		0.18	instrument duplicate
9/20/2005	L-6227	J-286	MW-19-2	125.7		0.18	
9/20/2005	L-6248	J-281	MW-24-1	129.1		0.03	instrument duplicate
9/23/2005	L-6257	J-281	MW-24-1	129.1		0.03	
9/23/2005	L-6264	J-280	MW-24-2	126.9		0.03	
9/20/2005	L-6236	J-285	MW-25-1	128.1		-0.02	
10/11/2005	L-6349	J-288	MW-25-2 A			0.15	method duplicate
10/11/2005	L-6355	J-288	MW-25-2 B	48.5		0.09	
9/23/2005	L-6270	J-284	MW-25-3	200	impure gas	-2.47	rerun in duplicate
10/11/2005	L-6346	J-284	MW-25-3 A	59.4		0.01	
10/11/2005	L-6343	J-284	MW-25-3 B	65.1		0.20	
9/23/2005	L-6261	J-283	MW-25-4		impure gas	-0.23	rerun in duplicate
11/16/2005	L-7684	J-283	MW-25-4 A	58.4		0.17	
11/16/2005	L-7687	J-283	MW-25-4 A	58.4		0.18	
11/16/2005	L-7690	J-283	MW-25-4 B	49.6		0.09	
11/16/2005	L-7693	J-283	MW-25-4 B	49.6		0.08	
11/16/2005	L-7696	J-283	MW-25-4 B	49.6		0.08	

Note: analytical precision of $\delta^{37}Cl$ values is +/- 0.1 per mil
Cl isotope ratios reported relative to SMOC = standard mean ocean chloride

9/20/2005	L-6214	J-2	CBN LP55E	-0.02	REFERENCE SEAWATER
10/11/2005	L-6337	J-2	CBN J2-7 AB	0.08	REFERENCE SEAWATER
9/23/2005	L-6273	J-2	CBN J2-2 NM	-0.04	REFERENCE SEAWATER
10/11/2005	L-6340	J-2	CBN J2-4 NM	-0.08	REFERENCE SEAWATER
10/11/2005	L-6361	J-2	CBN J2-8 AB	0.10	REFERENCE SEAWATER

0.01	0.08	REFERENCE SEAWATER
mean	std dev	

DATE	SPEC#	ID1	ID2	UMOL	d52	d37Cl SMOC	AVG	STDV	V
9/20/2005	L-6214	J-2	LP55E CBN	17.7	-6.139	-0.02	0.00	0.02	5.5
9/20/2005	L-6215	J-2	LP55E CBN	17.7	-6.114	0.01			5.5
9/20/2005	L-6216	J-2	LP55E CBN	17.7	-6.109	0.01			5.5
10/11/2005	L-6337	J-2	CBN J2-7 AB	78.7	-6.038	0.08	0.09	0.01	5
10/11/2005	L-6338	J-2	CBN J2-7 AB	78.7	-6.028	0.09			5
10/11/2005	L-6339	J-2	CBN J2-7 AB	78.7	-6.019	0.10			5
9/23/2005	L-6273	J-2	J2-2 NM	65.4	-6.160	-0.04	-0.03	0.01	5
9/23/2005	L-6274	J-2	J2-2 NM	65.4	-6.140	-0.02			5
9/23/2005	L-6275	J-2	J2-2 NM	65.4	-6.141	-0.02			5
10/11/2005	L-6340	J-2	CBN J2-4 NM		-6.200	-0.08	-0.08	0.00	5
10/11/2005	L-6341	J-2	CBN J2-4 NM		-6.194	-0.07			5
10/11/2005	L-6342	J-2	CBN J2-4 NM		-6.194	-0.07			5
10/11/2005	L-6361	J-2	CBN J2-8 AB	69.6	-6.019	0.10	0.10	0.00	5
10/11/2005	L-6362	J-2	CBN J2-8 AB	69.6	-6.016	0.10			5
10/11/2005	L-6363	J-2	CBN J2-8 AB	69.6	-6.022	0.10			5
11/15/2005	L-7659	J-2	LP51A CBN	11.5	-6.036	0.085	0.08	0.00	4
11/15/2005	L-7660	J-2	LP51A CBN	11.5	-6.039	0.082			4
11/15/2005	L-7661	J-2	LP51A CBN	11.5	-6.033	0.088			4
11/14/2005	L-7620	J-2	J2-5 CBN	77.0	-6.259	-0.138	-0.14	0.00	4
11/14/2005	L-7621	J-2	J2-5 CBN	77.0	-6.261	-0.140			4
11/14/2005	L-7622	J-2	J2-5 CBN	77.0	-6.254	-0.133			4
11/15/2005	L-7659	J-2	LP51A CBN 4V	11.5	-6.036	0.085	0.08	0.00	4
11/15/2005	L-7660	J-2	LP51A CBN 4V	11.5	-6.039	0.082			4
11/15/2005	L-7661	J-2	LP51A CBN 4V	11.5	-6.033	0.088			4
11/15/2005	L-7662	J-2	LP51A CBN 2V	11.5	-6.041	0.080	0.08	0.00	2
11/15/2005	L-7663	J-2	LP51A CBN 2V	11.5	-6.042	0.079			2
11/15/2005	L-7664	J-2	LP51A CBN 2V	11.5	-6.038	0.083			2
11/16/2005	L-7681	J-2	J-2B AB CBN	47.6	-6.015	0.106	0.11	0.00	
11/16/2005	L-7682	J-2	J-2B AB CBN	47.6	-6.013	0.108			
11/16/2005	L-7683	J-2	J-2B AB CBN	47.6	-6.012	0.109			
					-6.089	**0.031**		0.08326722	

DATE	SPEC#	ID1	ID2	UMOL	d52	d37Cl SMOC	AVG	STDV	V
9/20/2005	L-6239	J-272	MW1	126.2	-6.078	0.04	0.05	0.01	5
9/20/2005	L-6240	J-272	MW1	126.2	-6.067	0.05			5
9/20/2005	L-6241	J-272	MW1	126.2	-6.061	0.06			5
9/20/2005	L-6242	J-272	MW1	126.2	-6.062	0.06	0.07	0.01	5
9/20/2005	L-6243	J-272	MW1	126.2	-6.054	0.07			5
9/20/2005	L-6244	J-272	MW1	126.2	-6.050	0.07			5
9/20/2005	L-6233	J-273	Garfield	131.4	-6.109	0.01	0.01	0.00	5
9/20/2005	L-6234	J-273	Garfield	131.4	-6.116	0.00			5
9/20/2005	L-6235	J-273	Garfield	131.4	-6.107	0.01			5
9/20/2005	L-6217	J-274	LWAC-3	115.5	-6.111	0.01	0.01	0.00	5.5
9/20/2005	L-6218	J-274	LWAC-3	115.5	-6.112	0.01			5.5
9/20/2005	L-6219	J-274	LWAC-3	115.5	-6.120	0.00			5.5
9/20/2005	L-6221	J-274	LWAC-3	115.5	-6.119	0.00	0.01	0.00	5.5
9/20/2005	L-6222	J-274	LWAC-3	115.5	-6.112	0.01			5.5
9/20/2005	L-6223	J-274	LWAC-3	115.5	-6.111	0.01			5.5
9/23/2005	L-6267	J-275	LFWC-2	91	-6.064	0.06	0.06	0.00	5
9/23/2005	L-6268	J-275	LFWC-2	91	-6.062	0.06			5

9/23/2005	L-6269	J-275	LFWC-2	91	-6.070	0.05			5
9/20/2005	L-6245	J-276	Bangham	129.8	-6.092	0.03	0.03	0.00	5
9/20/2005	L-6246	J-276	Bangham	129.8	-6.096	0.02			5
9/20/2005	L-6247	J-276	Bangham	129.8	-6.093	0.03			5
9/20/2005	L-6230	J-277	Sunset	125.4	-6.044	0.08	0.08	0.00	5
9/20/2005	L-6231	J-277	Sunset	125.4	-6.039	0.08			5
9/20/2005	L-6232	J-277	Sunset	125.4	-6.035	0.09			5
9/23/2005	L-6264	J-280	MW-24-2	126.9	-6.087	0.03	0.03	0.00	5
9/23/2005	L-6265	J-280	MW-24-2	126.9	-6.083	0.04			5
9/23/2005	L-6266	J-280	MW-24-2	126.9	-6.089	0.03			5
9/20/2005	L-6248	J-281	MW-24-1	129.1	-6.092	0.03	0.03	0.00	5
9/20/2005	L-6249	J-281	MW-24-1	129.1	-6.096	0.02			5
9/20/2005	L-6250	J-281	MW-24-1	129.1	-6.093	0.03			5
9/23/2005	L-6257	J-281	MW-24-1	129.1	-6.093	0.03	0.03	0.00	5
9/23/2005	L-6258	J-281	MW-24-1	129.1	-6.097	0.02			5
9/23/2005	L-6259	J-281	MW-24-1	129.1	-6.096	0.02			5
9/23/2005	L-6261	J-283	MW-25-4		-6.348	-0.23	-0.23	0.00	5
9/23/2005	L-6262	J-283	MW-25-4		-6.348	-0.23			5
9/23/2005	L-6263	J-283	MW-25-4		-6.347	-0.23			5
11/16/2005	L-7684	J-283	MW-25-4 A	58.4	-5.954	0.167	0.17	0.00	
11/16/2005	L-7685	J-283	MW-25-4 A	58.4	-5.951	0.170			
11/16/2005	L-7686	J-283	MW-25-4 A	58.4	-5.957	0.164			
11/16/2005	L-7687	J-283	MW-25-4 A	58.4	-5.942	0.179	0.18	0.01	
11/16/2005	L-7688	J-283	MW-25-4 A	58.4	-5.945	0.176			
11/16/2005	L-7689	J-283	MW-25-4 A	58.4	-5.930	0.191			
11/16/2005	L-7690	J-283	MW-25-4 B	49.6	-6.030	0.091	0.09	0.01	
11/16/2005	L-7691	J-283	MW-25-4 B	49.6	-6.026	0.095			
11/16/2005	L-7692	J-283	MW-25-4 B	49.6	-6.039	0.082			
11/16/2005	L-7693	J-283	MW-25-4 B	49.6	-6.042	0.079	0.08	0.00	
11/16/2005	L-7694	J-283	MW-25-4 B	49.6	-6.037	0.084			
11/16/2005	L-7695	J-283	MW-25-4 B	49.6	-6.036	0.085			
11/16/2005	L-7696	J-283	MW-25-4 B	49.6	-6.045	0.076	0.08	0.00	
11/16/2005	L-7697	J-283	MW-25-4 B	49.6	-6.043	0.078			
11/16/2005	L-7698	J-283	MW-25-4 B	49.6	-6.039	0.082			
9/23/2005	L-6270	J-284	MW-25-3	200	-8.595	-2.47	-2.47	0.01	5
9/23/2005	L-6271	J-284	MW-25-3	200	-8.590	-2.47			5
9/23/2005	L-6272	J-284	MW-25-3	200	-8.581	-2.46			5
10/11/2005	L-6343	J-284	MW-25-3 B	65.1	-5.926	0.19	0.20	0.00	5
10/11/2005	L-6344	J-284	MW-25-3 B	65.1	-5.919	0.20			5
10/11/2005	L-6345	J-284	MW-25-3 B	65.1	-5.925	0.20			5
10/11/2005	L-6346	J-284	MW-25-3 A	59.4	-6.108	0.01	0.01	0.00	5
10/11/2005	L-6347	J-284	MW-25-3 A	59.4	-6.107	0.01			5
10/11/2005	L-6348	J-284	MW-25-3 A	59.4	-6.108	0.01			5
10/11/2005	L-6358	J-284	MW-17-3 B		-5.974	0.15	0.15	0.00	5
10/11/2005	L-6359	J-284	MW-17-3 B		-5.972	0.15			5
10/11/2005	L-6360	J-284	MW-17-3 B		-5.971	0.15			5
9/20/2005	L-6236	J-285	MW-25-1	128.1	-6.144	-0.02	-0.02	0.00	5
9/20/2005	L-6237	J-285	MW-25-1	128.1	-6.141	-0.02			5
9/20/2005	L-6238	J-285	MW-25-1	128.1	-6.148	-0.03			5
9/20/2005	L-6224	J-286	MW-19-2	125.7	-5.941	0.18	0.18	0.00	5.5
9/20/2005	L-6225	J-286	MW-19-2	125.7	-5.938	0.18			5.5
9/20/2005	L-6226	J-286	MW-19-2	125.7	-5.941	0.18			5.5

9/20/2005	L-6227	J-286	MW-19-2	125.7	-5.941	0.18	0.18	0.00	5
9/20/2005	L-6228	J-286	MW-19-2	125.7	-5.948	0.17			5
9/20/2005	L-6229	J-286	MW-19-2	125.7	-5.940	0.18			5
10/11/2005	L-6352	J-287	MW-17-3 A	82.6	-5.902	0.22	0.19	0.05	5
10/11/2005	L-6353	J-287	MW-17-3 A	82.6	-5.895	0.23			5
10/11/2005	L-6354	J-287	MW-17-3 A	82.6	-5.989	0.13			5
10/11/2005	L-6349	J-288	MW-25-2 A		-5.974	0.15	0.15	0.00	5
10/11/2005	L-6350	J-288	MW-25-2 A		-5.968	0.15			5
10/11/2005	L-6351	J-288	MW-25-2 A		-5.969	0.15			5
10/11/2005	L-6355	J-288	MW-25-2 B	48.5	-6.041	0.08	0.09	0.01	5
10/11/2005	L-6356	J-288	MW-25-2 B	48.5	-6.032	0.09			5
10/11/2005	L-6357	J-288	MW-25-2 B	48.5	-6.030	0.09			5

Shiao, Tien

From: Neil C Sturchio [sturchio@uic.edu]
Sent: Monday, April 03, 2006 4:36 PM
To: Shiao, Tien
Subject: MW-16 Perchlorate Isotope Data for oxygen
Importance: High

Tien,

Here are the final results for duplicate analysis of oxygen isotope ratios of MW-16. We will report Cl isotope ratios by next week.
Note that the delta 18-O result is lower than any of the other samples we measured, meaning it is consistent with the JPL site perchlorate being an end-member in mixtures of perchlorate as we discussed in Columbus.

-Neil

oxygen isotope results
MW-16 perchlorate

delta 18-O	Delta 17-O
-21.711	0.017
-21.950	0.028

Shiao, Tien

From: Linnea Heraty [lheraty@uic.edu]
Sent: Friday, April 28, 2006 5:56 PM
To: Shiao, Tien; Sass, Bruce M
Cc: Neil Sturchio
Subject: Re: MW-16 for Perchlorate Isotope Analysis

Hot off the press, here is the chlorine isotope data for MW-16

MW-16a d37Cl = 0.47
MW-16b d37Cl = 0.32

The average for a and b splits = 0.39

Linnea

Linnea Heraty
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University of Illinois at Chicago (MC-186)
845 West Taylor Street SES 2438
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fax: 312-413-2279
email: lheraty@uic.edu

Shiao, Tien

From: Sturchio, Neil C. [sturchio@uic.edu]
Sent: Monday, February 20, 2006 8:12 PM
To: Shiao, Tien; filedsk@BATTELLE.ORG; Sass, Bruce M; Ohart, Carolyn J
Subject: QA/QC tests of perchlorate isotope analysis methods

Attachments: QA-QC Perchlorate Isotope Analyses.xls

QA-QC Perchlorate Isotope Anal...

Attached is a spreadsheet showing results of several tests in which we ran multiple perchlorate isotope reference materials through the entire extraction/purification procedure to ensure that the isotopic composition of perchlorate was not changed by the procedure.

Shiao, Tien

From: Cutie, Betsy
Sent: Thursday, January 25, 2007 5:21 PM
To: Shiao, Tien
Subject: FW: Cl isotope ratios for new JPL samples

Tien,

Here is the new isotope data.

Betsy

-----Original Message-----
From: Sturchio, Neil C. [mailto:sturchio@uic.edu]
Sent: Thursday, January 25, 2007 9:21 AM
To: Fields, Keith A
Cc: Cutie, Betsy
Subject: RE: Cl isotope ratios for new JPL samples

Keith,

I'll send the QA/QC data later this morning.

Neil

On Thu, January 25, 2007 8:11 am, Fields, Keith A wrote:
> Neil,
>
> We need QA/QC data package for these new data as soon as possible.
> Please send them to me and Betsy. Thanks.
>
> Keith A. Fields
> Battelle
> Environmental Restoration Department
> phone: (614) 424-7723
> fax: (614) 424-3667
>
> -----Original Message-----
> From: Sturchio, Neil C. [mailto:sturchio@uic.edu]
> Sent: Thursday, January 18, 2007 9:45 PM
> To: Fields, Keith A; Sass, Bruce M
> Subject: Cl isotope ratios for new JPL samples
>
> Keith and Bruce,
>
> Here are the final values for the new JPL samples.
>

	d18O	D17O	d37Cl
OU-1	-19.3	+0.1	+0.3
MW-16	-20.7	-0.2	+0.1

>
> -Neil
>
>

--
Neil C. Sturchio
Professor and Head
Department of Earth and Environmental Sciences University of Illinois at Chicago, MC-186
845 West Taylor Street, Room 2442

UIC Environmental Isotope Geochemistry Laboratory

QA/QC analyses of Perchlorate Isotopic Reference Materials Measured With MW-16 and OU-1

Date	Sample	$\delta^{18}O$	accepted value	$\Delta^{17}O$	accepted value	$\delta^{37}Cl$	accepted value
1/15/2007	RSIL-4	-17.0	-17.0	-0.16	0.00		
1/15/2007	RSIL-5	52.5	52.5	72.50	*		
1/18/2007	RSIL-4					0.77	0.60
1/18/2007	RSIL-5					-87.2	-87.2
1/18/2007	CBN-1					-0.07	0.00

*No final reference value has yet been established for D17O in RSIL-5

Note: RSIL-4 and RSIL-5 are synthetic KClO4 salts; CBN-1 is seawater from Conception Bay, Newfoundland.

QA/QC analyses of Perchlorate Isotopic Reference Materials

Date	Sample	$\delta^{18}O$	accepted value	$\Delta^{17}O$	accepted value	$\delta^{37}Cl$	accepted value
Perchlorate isotope reference materials prepared using initial procedure							
2/6/2005	RSIL-4-A	-16.8	-17.0	-0.01	0.00	0.6	0.6
2/6/2005	RSIL-4-B	-17.3	-17.0	0.03	0.00	0.3	0.6
6/6/2005	RSIL-2-A	-14.9	-14.6	-0.15	0.00	na	na
6/6/2005	RSIL-2-B	-14.9	-14.6	-0.09	0.00	na	na
6/6/2005	RSIL-2-C	-14.7	-14.6	-0.13	0.00	na	na
6/6/2005	RSIL-2-D	-15.1	-14.6	-0.13	0.00	na	na
6/6/2005	RSIL-2-E	-15.0	-14.6	-0.17	0.00	na	na
5/12/2005	UIC-1-A	na		na		1.2	1.2
5/12/2005	UIC-1-B	na		na		0.9	1.2
Perchlorate isotope reference materials prepared using revised procedure							
12/22/2005	UIC-1-A	-16.0	-16.0	-0.12	0.00	na	na
12/22/2005	UIC-1-B	-16.0	-16.0	-0.05	0.00	na	na
12/22/2005	UIC-1-C	-16.0	-16.0	-0.11	0.00	na	na
12/22/2005	UIC-2-A	-24.9	-24.8	0.19	0.00	na	na
12/22/2005	UIC-2-B	-24.1	-24.8	0.05	0.00	na	na

Shiao, Tien

From: Sturchio, Neil C. [sturchio@uic.edu]
Sent: Sunday, February 19, 2006 1:32 AM
To: Shiao, Tien; Fields, Keith A; Ohart, Carolyn J; Sass, Bruce M
Subject: summary of revised perchlorate procedure

Attached is a revised version of the extraction and purification procedure for perchlorate that we used for most of the JPL water samples (because of high sulfate encountered).

I will send some QA/QC data tomorrow morning (results for standard reference materials that we analyzed along with the JPL samples).

-Neil

--
Neil C. Sturchio
Director, Environmental Isotope Geochemistry Laboratory Professor and Head Department of Earth and Environmental Sciences University of Illinois at Chicago, MC-186
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Chicago, IL 60607-7059

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sturchio@uic.edu

i. Resin and sample preparation

The resin from the field columns is transferred to beakers and about 15 to 20 bed volumes D.I. water (enough for resin to move around) is added and sonifed 3 minutes at med/low power. The liquor is then decanted into a poly bottle. The number of times the samples are sonified will depend on how murky the water is after each sonification. All washes are transferred into bottles and stored for IC analysis.

I. Displacement of ClO_4

Resins are transferred to 500-mL bottles (wet-transfer; use as little water as possible) for elution. Add 3.0 bed volumes of $FeCl_3$/HCl and place it on the shaker. Shake it in low setting for 1 hour. Pass the resins through a clean empty column to filter out the resins and save the eluent in a beaker. Properly label all beakers and bottles.

II. Removal of Fe:

The $FeCl_3$/HCl eluent is diluted by 4 (to get 1M HCl) then passed through a Ag-50W 100-200 mesh, H+ form resin column. Sample and water washes are combined and 10mL 6% H_2O_2 is added to oxidize any organics.

III. Sample concentration and precipitation

Sample volume is reduced by evaporation at med-low heat to ~100 mL. 1mL aliquot is removed for IC analysis to determine whether $BaSO_4$ precipitation is necessary for sulfate removal. If needed, add 2.0mL of a 0.1M $BaCl_2$ solution. Solid $BaSO_4$ is removed by centrifugation and the washes saved. Excess Cl^- is removed by passing through Dionex OnGuard Ag cartridges (prepared by flushing with 200mL DiH_2O) at 1.5mL/min. Excess Ba and displaced Ag is removed by passing through a 1mL cation column.

The sample is further evaporated to a volume of <1.0mL low heat and 0.2 mL of 10M CsOH is added. $CsClO_4$ is allowed to precipitate overnight.

IV. Sample purification

CsOH is removed by washing the solids in methanol with centrifugation. If nitrate or phosphate anions were detected by IC analysis, the solid sample is further rinsed with small aliquots of deionized H_2O until the contaminants are rinsed away (monitored by IC analysis of each wash). The remaining solid is transferred into an 8" long 9-mm o.d. pyrex tube with 2 constrictions, at 1" and 2".

V. Combustion and measurement of perchlorate salt isotopes:

The CsClO4 is dried completely and sealed under vacuum using a hand torch. The sealed sample is then combusted at 600°C for 30 minutes.

The combusted sample is attached to vacuum using a tube cracker. The O_2 gas is transferred onto silica beads at liquid nitrogen temperature and saved for later dual inlet $\delta^{18}O$ and $\delta^{17}O$ analysis. The contents (CsCl) of the combustion tube are rinsed into a beaker and chloride is reprecipitated using $AgNO_3$. The AgCl is dried and combined with CH_3I and

sealed under vacuum, then combusted at 300°C for 2 hours. The resulting CH_3Cl gas is cryogenically purified and sealed in individual ampoules for dual inlet $\delta^{37}Cl$ analysis.

Perchlorate parts and materials list

Part	Company	Part #/catalogue #
Field column, 30 mL (Chromatographic pre-column, #11 threads)	Ace glass	5796-34
Field column, 90 mL (Chromatographic column, #11 threads, 21 x 300 mm)	Ace glass	5795-10
Field column, 220 mL (Chromatographic column, #11 threads, 40 x 350 mm)	Ace glass	5795-16
End fittings, 11 mm adapter	Ace glass	5801-14
Plugs		
Elbow joints (L "1/8" NPT x 3/8" ID)	Cole-Parmer	30622-87 or L2-6NN
Field tubing	Cole-Parmer	06408-12
Test pump (Masterflex L/S)		
Coarse glass wool		
Purolite A-530E resin (same as D-3696)		
Teflon barbed pipe adaptors (1/8 x 5/32")	Cole-Parmer	06373-90
Ion exchange columns	Lab Glass	
Cation exchange resin (Biorad AG-50W 100-200 mesh)		
Large teflon beakers with caps		
Small teflon beakers		
8" long, 9-mm o.d. pyrex tubes, constrictions at 1" and 2"		