Battelle
Columbus Laboratories

CHAIN OF CUSTODY RECORD

Form No. _____

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

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

PO# 191723

DATE	TIME	SAMPLE I.D.	SAMPLE TYPE (√) Sr (87Sr/86Sr)	Container No.	Number of Containers	Remarks
02 JUN 05	1340	GARFIELD	X		1	
02 JUN 05	1052	SUNSET	X		1	
02 JUN 05	1530	~~BINGHAM~~ BANGHAM	X		1	
03 JUN 05	0930	LF WC-2	X		1	
03 JUN 05	1330	LA WC-3	X		1	
05 JUN 05	1130	MW-1	X		1	

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 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: MIT	

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CHAIN OF CUSTODY RECORD

Form No. _____

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

SAMPLERS: (Signature) D. Conner

PO# 191723

DATE	TIME	SAMPLE I.D.	SAMPLE TYPE (√) SP (87SC/86SC)	Container No.	Number of Containers	Remarks
7/19/2005	12:30	MW-25-5	X			
7/19/2005	14:00	MW-25-4	X			
7/19/2005	15:10	MW-25-3	X			
7/19/2005	16:15	MW-25-2	X			
7/19/2005	17:30	MW-25-1	X			
7/20/2005	09:00	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				
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Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks	
				To: MIT	

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Battelle
Columbus Laboratories

Form No. _____

CHAIN OF CUSTODY RECORD

Proj. No.	Project Title
64861111 -T3	Source Determination Study

SAMPLERS: (Signature)

PO# 191723

DATE	TIME	SAMPLE I.D.	SAMPLE TYPE (√) Sr (84Sr/86Sr)	Container No.	Number of Containers	Remarks
7/25/2005	09:00	MW-24-4	X			
7/25/2005	10:30	MW-24-3	X			
7/25/2005	12:00	MW-24-2	X			
7/25/2005	13:15	MW-24-1	X			
7/25/2005	15:30	MW-24-5	X			
7/26/2005	08:30	MW-21-5	X			
7/26/2005	10:30	MW-21-4	X			
7/26/2005	12:15	MW-21-3	X			
7/26/2005	14:45	MW-21-2	X			
7/26/2005	16:00	MW-21-1	X			
1-Aug-05	0857	MW-20-5	X			
1-Aug-05	1050	MW-20-4	X			
1-Aug-05	1230	MW-20-3	X			
1-Aug-05	1407	MW-20-2	X			
1-Aug-05	1608	MW-20-1	X			

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
Mike Woolf	8/3/05 1700				

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Relinquished by: (Signature)	Date/Time	Received for Laboratory by: (Signature)	Date/Time	Remarks
		M. O. Dale	8/4/05 09:45	To: MIT

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Battelle
The Business of Innovation

CHAIN OF CUSTODY RECORD

Form No. _____

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

SAMPLERS: (Signature)

PO # 191723

DATE	TIME	SAMPLE I.D.	SAMPLE TYPE (√) Sr (89/Sr/86Sr)	Container No.	Number of Containers	Remarks
8/15/05	09:30	MW-17-5	X			Sample lost bottle was not sealed!
8/15/05	10:45	MW-17-4	X			
8/15/05	12:45	MW-17-3	X			
8/15/05	13:45	MW-17-2	X			
8/15/05	15:30	MW-17-1	X			

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
[signature]	8-16-05 16:00	[signature]		8/17/05 9:30AM	
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: MIT	

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Battelle
The Business of Innovation

CHAIN OF CUSTODY RECORD

Form No. _____

Proj. No.	Project Title
G4861111-T3	Source Determination Study

SAMPLERS: (Signature) M. Woolfe

PO # 191723

DATE	TIME	SAMPLE I.D.	SAMPLE TYPE (√) Sr (87Sr/86Sr)	Container No.	Number of Containers	Remarks
8/23/2005	10:35	MW-17-5	X			

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
M. Woolfe	8/23/05 1419	[illegible]			

Relinquished by: (Signature)	Date/Time	Received by: (Signature)	Relinquished by: (Signature)	Date/Time	Received by: (Signature)
		8-24-05 3:20 pm			

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

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Results of Isotopic Analysis

MIT TIMS Lab

Date: 6/29/05

MIT #	Client #	87Sr/86Sr (1)	% S.E. (2)	2-sigma s.e.	Sr, ppm (3)
T-359	**Garfield**	0.711182	0.0008	0.000011	0.292
T-360	**Sunset**	0.711227	0.0007	0.000010	0.748
T-361	**Bangham**	0.710709	0.0005	0.000007	0.493
T-362	**LF WC-2**	0.711467	0.0006	0.000009	0.483
T-363	**LA WC-3**	0.711392	0.0006	0.000009	0.399
T-364	**MW-1**	0.711281	0.0006	0.000009	0.438

(1) Long term reproducibility of NBS-987 at MIT: 0.710240 ± 0.000014 (2-sigma s.d.).
(2) Within-run internal precision of measured ratio.
(3) Determined by isotope dilution using an 84Sr spike.

Results of Isotopic Analysis
MIT TIMS Lab

Date: 8/23/05; corrected 8/29/05

MIT #	Client #	87Sr/86Sr (1)	% S.E. (2)	2-sigma s.e.	Sr, ppm (3)
T-388	MW-18-1	0.711352	0.0005	0.000007	0.3116
T-389	MW-18-2	0.711256	0.0009	0.000013	0.4044
T-390	MW-18-3	0.711604	0.0006	0.000009	0.4563
T-391	MW-18-4	0.712158	0.0013	0.000019	0.4017
T-392	MW-18-5	0.710518	0.0006	0.000009	0.1661
T-393	MW-19-1	0.711065	0.0006	0.000009	0.3832
T-394	MW-19-2	0.710640	0.0005	0.000007	0.8825
T-395	MW-19-3	0.710658	0.0007	0.000010	0.5283
T-396	MW-19-4	0.710927	0.0005	0.000007	0.6719
T-397	MW-19-5	0.710953	0.0006	0.000009	0.7753
T-398	MW-25-1	0.711020	0.0006	0.000009	0.6963
T-399	MW-25-2	0.711214	0.0008	0.000011	0.2645
T-400	MW-25-3	0.711333	0.0007	0.000010	0.5392
T-401	MW-25-4	0.711233	0.0009	0.000013	0.5186
T-402	MW-25-5	0.710950	0.0007	0.000010	0.1892

(1) Long term reproducibility of NBS-987 at MIT: 0.710240 ± 0.000014 (2-sigma s.d.).
(2) Within-run internal precision of measured ratio.
(3) Determined by isotope dilution using an 84Sr spike.

Results of Isotopic Analysis

MIT TIMS Lab

Date: 8/23/05; corrected 8/29/05

MIT #	Client #	87Sr/86Sr (1)	% S.E. (2)	2-sigma s.e.	Sr, ppm (3)
T-391	MW-18-4	0.712158	0.0013	0.000019	0.4017
T-396	MW-19-4	0.710927	0.0005	0.000007	0.6719
T-400	MW-25-3	0.711333	0.0007	0.000010	0.5392
T-391R	MW-18-4	0.712170	0.0009	0.000013	0.4028
T-396R	MW-19-4	0.710916	0.0005	0.000007	0.6723
T-400R	MW-25-3	0.711345	0.0006	0.000009	0.5400
Blank*					30 pg

(1) Long term reproducibility of NBS-987 at MIT: 0.710240 ± 0.000014 (2-sigma s.d.).
(2) Within-run internal precision of measured ratio.
(3) Determined by isotope dilution using an 84Sr spike.

* The blank was near the detection limit; the analysis was within uncertainty of our spike value.

Results of Isotopic Analysis
MIT TIMS Lab

Date: 9/2/05

MIT #	Other #	87Sr/86Sr (1)	% S.E. (2)	2-sigma s.e.	Sr, ppm (3)
T 403 IC	**MW-20-1**	0.711068	0.0010	0.000014	0.5093
T 404 IC	**MW-20-2**	0.710817	0.0009	0.000013	0.3725
T 405 IC	**MW-20-3**	0.711339	0.0007	0.000010	0.4900
T 406 IC	**MW-20-4**	0.711024	0.0010	0.000014	0.1102
T 407 IC	**MW-20-5**	0.710147	0.0007	0.000010	0.0922
T 408 IC	**MW-21-1**	0.710318	0.0006	0.000009	1.209
T 409 IC	**MW-21-2**	0.710631	0.0007	0.000010	1.290
T 410 IC	**MW-21-3**	0.710885	0.0006	0.000009	0.9985
T 411 IC	**MW-21-4**	0.710945	0.0008	0.000011	0.6032
T 412 IC	**MW-21-5**	0.710997	0.0009	0.000013	0.7226
T 413 IC	**MW-24-1**	0.711387	0.0009	0.000013	0.3870
T 414 IC	**MW-24-2**	0.712020	0.0010	0.000014	0.3696
T 415 IC	**MW-24-3**	0.712963	0.0010	0.000014	0.2969
T 416 IC	**MW-24-4**	0.710896	0.0008	0.000011	0.2420
T 417 IC	**MW-24-5**	0.711249	0.0006	0.000009	0.3453
T 409R IC	**MW-21-2**	0.710639	0.0006	0.000009	1.278
T 415R IC	**MW-24-3**	0.712967	0.0008	0.000011	0.2958

(1) Long term reproducibility of NBS-987 at MIT: 0.710240 ± 0.000014 (2-sigma s.d.).
(2) Within-run internal precision of measured ratio.
(3) Determined by isotope dilution using an 84Sr spike.

Results of Isotopic Analysis
MIT TIMS Lab

Date: 9/8/05

MIT #	Other #	87Sr/86Sr (1)	% S.E. (2)	2-sigma s.e.	Sr, ppm
T 469 IC	MW-17-1	0.711363	0.0006	0.000009	0.2513
T 470 IC	MW-17-2	0.711189	0.0006	0.000009	0.8619
T 471 IC	MW-17-3	0.711635	0.0006	0.000009	0.6489
T 472 IC	MW-17-4	0.710836	0.0007	0.000010	0.1851
T 473 IC	MW-17-5	0.711013	0.0008	0.000011	0.1494
T 469R IC	MW-17-1	0.711375	0.0007	0.000010	0.2508

Replicates are done on Sr isotopic compositions and Sr concentration determinations. The replicates are total procedure replicates meaning new aliquots of the same samples were processed completely independently of the original analysis. Replicates are done on 10% of the total number of samples.

Shiao, Hsin T

From: Frank Dudas [fdudas@MIT.EDU]
Sent: Monday, December 13, 2004 5:07 PM
To: Shiao, Hsin T
Subject: RE: Sr isotopic analyses in groundwater

Hi Tien,

We typically do not do duplicates of our Sr isotopic composition measurements because we use our Sr isotopic standard as a measure of analytical precision. The two-sigma, external reproducibility (i.e., precision of analyses done on separate samples, at separate times) of our standard is about 20 ppm over a period of about 10 years.

When we have had to do replicates because of what we have regarded as irregularities in our analyses, we have replicated the 87Sr/86Sr of samples - these are complete replicates, starting from raw sample material - to within 0.00003 (roughly 40 ppm), keeping in mind that the first of these analyses was "questionable," for whatever reason.

When I have done large batches of samples (> 20 samples) for a single project, I have usually done one or two replicates, just out of curiosity, and at no charge to the client. I've never collated the data from these replicates, but my recollection is that the data replicate to within 0.00003. If a client specifically requests us to do replicates, there is no problem in doing them; for small sets of samples (<10), we would have to charge the client for the replicate.
For larger sample sets, we would be happy to do one replicate per 20 samples at no additional charge if the client requests it.

For determinations involving Sr concentration, we would have to do more replicates to assess both the precision and the accuracy of the concentration determinations. Relatively little of our work involves isotope dilution determinations of Sr concentration, so I can't give you good estimates of the precision and accuracy of these. I am confident that we can reproduce our concentration determinations to within 0.5%; again, if a client asks us to do replicates to assess the precision of concentration determinations, we would be happy to do so.

Our standard charge for Sr isotope composition determinations is $200 per sample. If a concentration determination is also requested, that is an additional $50. There is no separate sample preparation charge for water samples, but there is a $50 sample preparation charge for rock or soil samples, and for water samples in which a separate hydrocarbon phase is present.

Our standard turn-around time is 30 days from receipt of the samples.
We can provide two-week turn-around at a 50% premium over the standard charges. Assuming the groundwater samples behave as other groundwater samples we have analyzed in the past, we would have no trouble in providing data within 30 days of receipt of samples for a batch of 25 analyses.

Regards,
Frank

>Hi Frank,
>
>Thanks for the information below. It has been a while since I emailed
>you. We have been working on a report and incorporating the information
>you have provided us. I just wanted find out a few additional
>information if you don't mind.
>
>(1) I'd like to know whether duplicates are taken during the Sr
>isotopic analyses to determine precision of measurements.
>