

The order of this data package is as follows:

1. Chain-of-Custody/Lab Request
2. Copies of field COCs
3. Validation Report
4. Laboratory analysis

Comments:

Validation report not required for University of Illinois samples.

A revised report begins on page 21.

[illegible]

SAMPLE COLLECTION LOG/FIELD CHAIN OF CUSTODY

EVENT ID: 11015

EVENT NAME: Mort/Sandia_Sand MY2017 Q1

SAMPLE ID: CASA-17-127268

WORK ORDER:

	AS PLANNED	AS COLLECTED		AS PLANNED	AS COLLECTED
Date Collected (MM/DD/YYYY):	11/10/16	OK	FIELD MATRIX:	WG	OK
TIME COLLECTED (HH:MM):	1240		MEDIA:	UA	↓
PRS ID:	OK		SAMPLE TECH CODE:	UA	GSP
LOCATION ID:	R-36		FIELD PREP:	F	OK
LOCATION TYPE:	OK		FIELD QC TYPE:	FD	↓
TOP DEPTH:	↓		SAMPLE USAGE:	QC	↓
BOTTOM DEPTH:	↓	↓	EXCAVATED:		YES / NO / NA

PRIORITY	ORDER	CONTAINER	#	PRESERVATIVE	COLLECTED Y/N	SPECIAL INSTRUCTIONS
NA	WSP-All Metals	1 LITER POLY	1	HNO3 ICE	Y	NA
↓	WSP-CR52/53	1 LITER POLY	1	ICE	↓	↓
↓	WSP- GENINORG+PerChlorat e	1 LITER POLY	1	ICE	↓	↓
↓	WSP-N15/O18- NO3	40 ML SEPTUM AMBER GLASS	2	ICE	↓	↓
↓	WSP- NH3+NO3/NO2	500 ML AMBER GLASS	1	H2SO4	↓	↓

SAMPLE COMMENTS:

LOCATION COMMENTS:

FIELD PARAMETERS:

Dissolved Oxygen _____ mg/L Flow (in gpm) AS 11/10/16 GPM Oxidation-Reduction Potential _____ mV
 pH _____ SU Specific Conductance _____ uS/cm Temperature _____ deg C
 Turbidity _____ NTU

COLLECTED BY (PRINT): D. Andersen, S. Kosler

RELINQUISHED BY (Printed Name) <u>Allyson Starfield</u> (Signature) <u>[Signature]</u>	Date/Time <u>11/10/16</u> <u>1345</u>	RECEIVED BY (Printed Name) <u>K. Greene</u> (Signature) <u>[Signature]</u>	Date/Time <u>11/10/16</u> <u>1:45</u>
RELINQUISHED BY (Printed Name) (Signature)	Date/Time	RECEIVED BY (Printed Name) (Signature)	Date/Time

SAMPLE COLLECTION LOG/FIELD CHAIN OF CUSTODY

EVENT ID: 11015

EVENT NAME: Mort/Sandia_Sand MY2017 Q1

SAMPLE ID: CASA-17-127290

WORK ORDER: NA

	AS PLANNED	AS COLLECTED		AS PLANNED	AS COLLECTED
Date Collected (MM/DD/YYYY):	11/16/16	OK	FIELD MATRIX:	WG	OK
TIME COLLECTED (HH:MM):			MEDIA:	UA	↓
PRS ID:			SAMPLE TECH CODE:	UA	GSP
LOCATION ID:	R-11		FIELD PREP:	F	OK
LOCATION TYPE:	MON		FIELD QC TYPE:	REG	↓
TOP DEPTH:	OK		SAMPLE USAGE:	INV	↓
BOTTOM DEPTH:	↓	↓	EXCAVATED:		YES / NO / NA

PRIORITY	ORDER	CONTAINER	#	PRESERVATIVE	COLLECTED Y/N	SPECIAL INSTRUCTIONS
NA	WSP-All Metals	1 LITER POLY	1	HNO3 ICE	Y	NA
↓	WSP-CR52/53	1 LITER POLY	1	ICE	↓	↓
↓	WSP- GENINORG+PerChlorat e	1 LITER POLY	1	ICE	↓	↓
↓	WSP-N15/O18- NO3	40 ML SEPTUM AMBER GLASS	2	ICE	↓	↓
↓	WSP- NH3+NO3/NO2	500 ML AMBER GLASS	1	H2SO4	↓	↓

SAMPLE COMMENTS:

LOCATION COMMENTS:

FIELD PARAMETERS:

Dissolved Oxygen	_____	mg/L	Flow (in gpm)	_____	GPM	Oxidation-Reduction Potential	_____	mV
pH	_____	SU	Specific Conductance	_____	uS/cm	Temperature	_____	deg C
Turbidity	_____	NTU						

COLLECTED BY (PRINT): S. Kusler / D. Yaranillo

RELINQUISHED BY (Printed Name) <i>Wagon Sanchez</i> (Signature) <i>Wagon Sanchez</i>	Date/Time 11/16/16 1555	RECEIVED BY <i>S. Shearwood</i> (Printed Name) (Signature) <i>S. Shearwood</i>	Date/Time 11/16/16 1555
RELINQUISHED BY (Printed Name) (Signature)	Date/Time	RECEIVED BY (Printed Name) (Signature)	Date/Time

SAMPLE COLLECTION LOG/FIELD CHAIN OF CUSTODY

EVENT ID: 11015

EVENT NAME: Mort/Sandia_Sand MY2017 Q1

SAMPLE ID: CASA-17-127291

WORK ORDER: NA

	AS PLANNED	AS COLLECTED		AS PLANNED	AS COLLECTED
Date Collected (MM/DD/YYYY):	11/09/2016	OK	FIELD MATRIX:	WG	OK
TIME COLLECTED (HH:MM):	12:29	OK	MEDIA:	UA	↓
PRS ID:	NA	↓	SAMPLE TECH CODE:	UA	GSP
LOCATION ID:	R-35a	↓	FIELD PREP:	F	OK
LOCATION TYPE:	MON	↓	FIELD QC TYPE:	REG	↓
TOP DEPTH:	NA	↓	SAMPLE USAGE:	INV	↓
BOTTOM DEPTH:	↓	↓	EXCAVATED:		YES / NO / NA

PRIORITY	ORDER	CONTAINER	#	PRESERVATIVE	COLLECTED Y/N	SPECIAL INSTRUCTIONS
NA	WSP-All Metals	1 LITER POLY	1	HNO3 ICE	Y	NA
↓	WSP-CR52/53	1 LITER POLY	1	ICE	↓	↓
↓	WSP- GENINORG+PerChlorat e	1 LITER POLY	1	ICE	↓	↓
↓	WSP-N15/O18- NO3	40 ML SEPTUM AMBER GLASS	2	ICE	↓	↓
↓	WSP- NH3+NO3/NO2	500 ML AMBER GLASS	1	H2SO4	↓	↓

SAMPLE COMMENTS:

LOCATION COMMENTS:

FIELD PARAMETERS:

Dissolved Oxygen _____ mg/L Flow (in gpm) _____ GPM Oxidation-Reduction Potential _____ mV
 pH _____ SU Specific Conductance _____ uS/cm Temperature _____ deg C
 Turbidity _____ NTU

COLLECTED BY (PRINT): A. Starfield

RELINQUISHED BY (Printed Name) Daniel Starfield (Signature) [Signature]	Date/Time 11/9/16 1315	RECEIVED BY (Printed Name) K. Greene (Signature) [Signature]	Date/Time 11/9/16 1115
RELINQUISHED BY (Printed Name) (Signature)	Date/Time	RECEIVED BY (Printed Name) (Signature)	Date/Time

SAMPLE COLLECTION LOG/FIELD CHAIN OF CUSTODY

EVENT ID: 11015

EVENT NAME: Mort/Sandia_Sand MY2017 Q1

SAMPLE ID: CASA-17-127292

WORK ORDER: NA

	AS PLANNED	AS COLLECTED		AS PLANNED	AS COLLECTED
Date Collected (MM/DD/YYYY):	11/09/2016	OK	FIELD MATRIX:	WG	OK
TIME COLLECTED (HH:MM):	1227		MEDIA:	UA	I
PRS ID:	NA		SAMPLE TECH CODE:	UA	GSP
LOCATION ID:	R-35b		FIELD PREP:	F	OK
LOCATION TYPE:	MON		FIELD QC TYPE:	REG	I
TOP DEPTH:	NA		SAMPLE USAGE:	INV	I
BOTTOM DEPTH:			EXCAVATED:		YES / NO / (NA)

PRIORITY	ORDER	CONTAINER	#	PRESERVATIVE	COLLECTED Y/N	SPECIAL INSTRUCTIONS
NA	WSP-All Metals	1 LITER POLY	1	HNO3 ICE	Y	NA
	WSP-CR52/53	1 LITER POLY	1	ICE		
	WSP- GENINORG+PerChlorat e	1 LITER POLY	1	ICE		
	WSP-N15/O18- NO3	40 ML SEPTUM AMBER GLASS	2	ICE		
	WSP- NH3+NO3/NO2	500 ML AMBER GLASS	1	H2SO4		

SAMPLE COMMENTS:

LOCATION COMMENTS:

FIELD PARAMETERS:

Dissolved Oxygen	_____	mg/L	Flow (in gpm)	_____	GPM	Oxidation-Reduction Potential	_____	mV
pH	_____	SU	Specific Conductance	_____	uS/cm	Temperature	_____	deg C
Turbidity	_____	NTU						

COLLECTED BY (PRINT): W. SANCHEZ

RELINQUISHED BY (Printed Name) (Signature)	DAVE ANDERSON <i>[Signature]</i>	Date/Time 11-9-16 1310	RECEIVED BY (Printed Name) (Signature)	K. Greer <i>[Signature]</i>	Date/Time 11/9/16 1110
RELINQUISHED BY (Printed Name) (Signature)		Date/Time	RECEIVED BY (Printed Name) (Signature)		Date/Time

SAMPLE COLLECTION LOG/FIELD CHAIN OF CUSTODY

EVENT ID: 11015

EVENT NAME: Mort/Sandia_Sand MY2017 Q1

SAMPLE ID: CASA-17-127293

WORK ORDER: NA

	AS PLANNED	AS COLLECTED		AS PLANNED	AS COLLECTED
Date Collected (MM/DD/YYYY):	11/10/16	OK	FIELD MATRIX:	WG	OK
TIME COLLECTED (HH:MM):	1240		MEDIA:	UA	↓
PRS ID:	OK		SAMPLE TECH CODE:	UA	GSP
LOCATION ID:	R-36		FIELD PREP:	F	OK
LOCATION TYPE:	MON		FIELD QC TYPE:	REG	↓
TOP DEPTH:	OK		SAMPLE USAGE:	INV	↓
BOTTOM DEPTH:	↓	✓	EXCAVATED:		YES / NO / (NA)

PRIORITY	ORDER	CONTAINER	#	PRESERVATIVE	COLLECTED Y/N	SPECIAL INSTRUCTIONS
NA	WSP-All Metals	1 LITER POLY	1	HNO3 ICE	Y	NA
	WSP-CR52/53	1 LITER POLY	1	ICE	↓	
	WSP- GENINORG+PerChlorat e	1 LITER POLY	1	ICE	↓	
	WSP-N15/O18- NO3	40 ML SEPTUM AMBER GLASS	2	ICE	↓	
✓	WSP- NH3+NO3/NO2	500 ML AMBER GLASS	1	H2SO4	↓	↓

SAMPLE COMMENTS:

LOCATION COMMENTS:

FIELD PARAMETERS:

Dissolved Oxygen _____ mg/L Flow (in gpm) _____ GPM Oxidation-Reduction Potential _____ mV
 pH _____ SU Specific Conductance _____ uS/cm Temperature _____ deg C
 Turbidity _____ NTU

COLLECTED BY (PRINT): D. Andersen, S. Kosler

RELINQUISHED BY (Printed Name) (Signature)	Date/Time	RECEIVED BY (Printed Name) (Signature)	Date/Time
Allyn Stanford	11/10/16 1345	K. Green	11/10/16 1145
RELINQUISHED BY (Printed Name) (Signature)	Date/Time	RECEIVED BY (Printed Name) (Signature)	Date/Time

SAMPLE COLLECTION LOG/FIELD CHAIN OF CUSTODY

EVENT ID: 11015

EVENT NAME: Mort/Sandia_Sand MY2017 Q1

SAMPLE ID: CASA-17-127294

WORK ORDER: NA

	AS PLANNED	AS COLLECTED		AS PLANNED	AS COLLECTED
Date Collected (MM/DD/YYYY):	11/14/2016	DA 11-14-16 OK	FIELD MATRIX:	WG	OK
TIME COLLECTED (HH:MM):	1251		MEDIA:	UA	L
PRS ID:	NA		SAMPLE TECH CODE:	UA	GSP
LOCATION ID:	R-43 S1		FIELD PREP:	F	OK
LOCATION TYPE:	MON		FIELD QC TYPE:	REG	L
TOP DEPTH:	NA		SAMPLE USAGE:	INV	L
BOTTOM DEPTH:	L		EXCAVATED:		YES / NO / (NA)

PRIORITY	ORDER	CONTAINER	#	PRESERVATIVE	COLLECTED Y/N	SPECIAL INSTRUCTIONS
NA	WSP-All Metals	1 LITER POLY	1	HNO3 ICE	Y	NA
L	WSP-CR52/53	1 LITER POLY	1	ICE	L	L
L	WSP- GENINORG+PerChlorat e	1 LITER POLY	1	ICE	L	L
L	WSP-N15/O18- NO3	40 ML SEPTUM AMBER GLASS	2	ICE	L	L
L	WSP- NH3+NO3/NO2	500 ML AMBER GLASS	1	H2SO4	L	L

SAMPLE COMMENTS:

LOCATION COMMENTS:

FIELD PARAMETERS:

Dissolved Oxygen _____ mg/L Flow (in gpm) _____ GPM Oxidation-Reduction Potential _____ mV
pH _____ SU Specific Conductance _____ uS/cm Temperature _____ deg C
Turbidity _____ NTU

COLLECTED BY (PRINT): A STANFIELD

RELINQUISHED BY (Printed Name) (Signature)	Date/Time 11-14-16 1520	RECEIVED BY (Printed Name) (Signature)	Date/Time 11/14/16 1520
RELINQUISHED BY (Printed Name) (Signature)	Date/Time	RECEIVED BY (Printed Name) (Signature)	Date/Time

Report Date: 11/02/2016

SAMPLE COLLECTION LOG/FIELD CHAIN OF CUSTODY

EVENT ID: 11015

EVENT NAME: Mort/Sandia_Sand MY2017 Q1

SAMPLE ID: CASA-17-127295

WORK ORDER: NA

	AS PLANNED	AS COLLECTED		AS PLANNED	AS COLLECTED
Date Collected (MM/DD/YYYY):	11/14/2016	OK	FIELD MATRIX:	WG	OK
TIME COLLECTED (HH:MM):	1426		MEDIA:	UA	↓
PRS ID:	NA		SAMPLE TECH CODE:	UA	GSP
LOCATION ID:	R-43 S2		FIELD PREP:	F	OK
LOCATION TYPE:	MON		FIELD QC TYPE:	REG	↓
TOP DEPTH:	NA		SAMPLE USAGE:	INV	↓
BOTTOM DEPTH:	↓	↓	EXCAVATED:		YES / NO / (NA)

PRIORITY	ORDER	CONTAINER	#	PRESERVATIVE	COLLECTED Y/N	SPECIAL INSTRUCTIONS
NA	WSP-All Metals	1 LITER POLY	1	HNO3 ICE	Y	NA
↓	WSP-CR52/53	1 LITER POLY	1	ICE	↓	↓
	WSP- GENINORG+PerChlorat e	1 LITER POLY	1	ICE		
	WSP-N15/O18- NO3	40 ML SEPTUM AMBER GLASS	2	ICE		
↓	WSP- NH3+NO3/NO2	500 ML AMBER GLASS	1	H2SO4	↓	↓

SAMPLE COMMENTS:

None

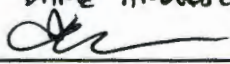
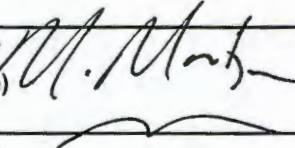
LOCATION COMMENTS:

SAMPLES COLLECTED 40' FROM RUNNING DIESEL GENERATOR

FIELD PARAMETERS:

Dissolved Oxygen	3.36	mg/L	Flow (in gpm)	1.61	GPM	Oxidation-Reduction Potential	179.9	mV
pH	8.68	SU	Specific Conductance	197.4	uS/cm	Temperature	19.2	deg C
Turbidity	0.52	NTU						

COLLECTED BY (PRINT): D HUGHES

RELINQUISHED BY (Printed Name) (Signature)	DATE ANDERSEN 	Date/Time 11-14-16 1520	RECEIVED BY (Printed Name) (Signature)	M. Mark 	Date/Time 11/14/16 1520
RELINQUISHED BY (Printed Name) (Signature)		Date/Time	RECEIVED BY (Printed Name) (Signature)		Date/Time

SAMPLE COLLECTION LOG/FIELD CHAIN OF CUSTODY

EVENT ID: 11015

EVENT NAME: Mort/Sandia_Sand MY2017 Q1

SAMPLE ID: CASA-17-127296

WORK ORDER: NA

	AS PLANNED	AS COLLECTED		AS PLANNED	AS COLLECTED
Date Collected (MM/DD/YYYY):	11/16/2016	OK	FIELD MATRIX:	WG	OK
TIME COLLECTED (HH:MM):	0938		MEDIA:	UA	↓
PRS ID:	NA		SAMPLE TECH CODE:	UA	GSP
LOCATION ID:	R-67		FIELD PREP:	F	OK
LOCATION TYPE:	MON		FIELD QC TYPE:	REG	↓
TOP DEPTH:	NA		SAMPLE USAGE:	INV	↓
BOTTOM DEPTH:	↓	↓	EXCAVATED:		YES / NO (NA)

PRIORITY	ORDER	CONTAINER	#	PRESERVATIVE	COLLECTED Y/N	SPECIAL INSTRUCTIONS
NA	WSP-All Metals	1 LITER POLY	1	HNO3 ICE	Y	NA
↓	WSP-CR52/53	1 LITER POLY	1	ICE	↓	↓
	WSP- GENINORG+PerChlorat e	1 LITER POLY	1	ICE	↓	↓
↓	WSP-N15/O18- NO3	40 ML SEPTUM AMBER GLASS	2	ICE	↓	↓
↓	WSP- NH3+NO3/NO2	500 ML AMBER GLASS	1	H2SO4	↓	↓

SAMPLE COMMENTS:

LOCATION COMMENTS:

FIELD PARAMETERS:

Dissolved Oxygen _____ mg/L Flow (in gpm) _____ GPM Oxidation-Reduction Potential _____ mV
pH _____ SU Specific Conductance _____ uS/cm Temperature _____ deg C
Turbidity _____ NTU

COLLECTED BY (PRINT): A UGIL

RELINQUISHED BY (Printed Name) (Signature)	Date/Time 11-16-16 1300	RECEIVED BY (Printed Name) (Signature)	Date/Time 11/16/16 1300
RELINQUISHED BY (Printed Name) (Signature)	Date/Time	RECEIVED BY (Printed Name) (Signature)	Date/Time

SAMPLE COLLECTION LOG/FIELD CHAIN OF CUSTODY

EVENT ID: 11015

EVENT NAME: Mort/Sandia_Sand MY2017 Q1

SAMPLE ID: CASA-17-127296

WORK ORDER: NA

SAMPLE COLLECTION LOG/FIELD CHAIN OF CUSTODY

EVENT ID: 11015

EVENT NAME: Mort/Sandia_Sand MY2017 Q1

SAMPLE ID: CASA-17-127307

WORK ORDER: NA

	AS PLANNED	AS COLLECTED		AS PLANNED	AS COLLECTED
Date Collected (MM/DD/YYYY):	11/15/2016	OK	FIELD MATRIX:	WG	OK
TIME COLLECTED (HH:MM):	1035		MEDIA:	UA	↓
PRS ID:	NA		SAMPLE TECH CODE:	UA	RSP
LOCATION ID:	SCI-1		FIELD PREP:	F	OK
LOCATION TYPE:	MON		FIELD QC TYPE:	REG	↓
TOP DEPTH:	NA		SAMPLE USAGE:	INV	↓
BOTTOM DEPTH:	↓	↓	EXCAVATED:		YES / NO / NA

PRIORITY	ORDER	CONTAINER	#	PRESERVATIVE	COLLECTED Y/N	SPECIAL INSTRUCTIONS
NA	WSP-All Metals	1 LITER POLY	1	HNO3 ICE	Y	NA
	WSP-CR52/53	1 LITER POLY	1	ICE		
	WSP- GENINORG+PerChlorat e	1 LITER POLY	1	ICE		
	WSP-N15/O18- NO3	40 ML SEPTUM AMBER GLASS	2	ICE		
	WSP- NH3+NO3/NO2	500 ML AMBER GLASS	1	H2SO4		

SAMPLE COMMENTS:

LOCATION COMMENTS:

FIELD PARAMETERS:

Dissolved Oxygen _____ mg/L Flow (in gpm) _____ GPM Oxidation-Reduction Potential _____ mV
pH _____ SU Specific Conductance _____ uS/cm Temperature _____ deg C
Turbidity _____ NTU

COLLECTED BY (PRINT): A VIGIL

RELINQUISHED BY (Printed Name) (Signature)	DAVE ANDERSON <i>[Signature]</i>	Date/Time 11-15-16 1155	RECEIVED BY (Printed Name) (Signature)	Stephri Sherwood <i>[Signature]</i>	Date/Time 11/15/16 1155
RELINQUISHED BY (Printed Name) (Signature)		Date/Time	RECEIVED BY (Printed Name) (Signature)		Date/Time

SAMPLE COLLECTION LOG/FIELD CHAIN OF CUSTODY

EVENT ID: 11015

EVENT NAME: Mort/Sandia_Sand MY2017 Q1

SAMPLE ID: CASA-17-127308

WORK ORDER: NA

	AS PLANNED	AS COLLECTED		AS PLANNED	AS COLLECTED
Date Collected (MM/DD/YYYY):	11-18-2016	OK	FIELD MATRIX:	WG	OK
TIME COLLECTED (HH:MM):	11:50		MEDIA:	UA	L
PRS ID:	NA		SAMPLE TECH CODE:	UA	RSP
LOCATION ID:	SCI-2		FIELD PREP:	F	OK
LOCATION TYPE:	MON		FIELD QC TYPE:	REG	L
TOP DEPTH:	NA		SAMPLE USAGE:	INV	L
BOTTOM DEPTH:	L	✓	EXCAVATED:		YES / NO / NA

PRIORITY	ORDER	CONTAINER	#	PRESERVATIVE	COLLECTED Y/N	SPECIAL INSTRUCTIONS
NA	WSP-All Metals	1 LITER POLY	1	HNO3 ICE	Y	NA
	WSP-CR52/53	1 LITER POLY	1	ICE		
	WSP- GENINORG+PerChlorat e	1 LITER POLY	1	ICE		
	WSP-N15/O18- NO3	40 ML SEPTUM AMBER GLASS	2	ICE		
	WSP- NH3+NO3/NO2	500 ML AMBER GLASS	1	H2SO4		

SAMPLE COMMENTS:

LOCATION COMMENTS:

FIELD PARAMETERS:

Dissolved Oxygen _____ mg/L Flow (in gpm) _____ GPM Oxidation-Reduction Potential _____ mV
pH _____ SU Specific Conductance _____ uS/cm Temperature _____ deg C
Turbidity _____ NTU

COLLECTED BY (PRINT): M. Shendo

RELINQUISHED BY (Printed Name) (Signature)	Date/Time 11-18-2016 13:05	RECEIVED BY (Printed Name) (Signature)	Date/Time 11/18/16 1305
RELINQUISHED BY (Printed Name) (Signature)	Date/Time	RECEIVED BY (Printed Name) (Signature)	Date/Time

Report Date: 11/02/2016

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

Department of Geology

School of Earth, Society, & Environment
156 Computing Applications Building
605 E. Springfield Avenue
Champaign, IL 61820



14 April, 2017

Ms. Susan Leese
ARS International, LLC
2609 North River Road
Port Allen, LA 70767-3469
225.381.2991 sleese@amrad.com

Subject: Cr stable isotope results

Dear Susan:

Please find below tabulated results from Cr stable isotope analysis of water samples from Los Alamos National Laboratory (LANL). The samples were analyzed on April 13th and 14th, 2017 and results were reported via EDD, on April 14th.

COC #	Sample ID	$\delta^{53}\text{Cr}^1$ (per mil)	Duplicate $\delta^{53}\text{Cr}^1$ (per mil)
2017-650-1	CAMO-17-127242	1.64	
2017-650-1	CAMO-17-127214	1.59	
2017-650-1	CAMO-17-127243	1.14	
2017-650-1	CAMO-17-127244	1.15	
2017-650-1	CAMO-17-127215	1.04	
2017-650-1	CAMO-17-127245	1.03	
2017-650-1	CAMO-17-127247	0.84	
2017-650-1	CAMO-17-127249	1.43	
2017-650-1	CAMO-17-127250	1.24	
2017-650-1	CAMO-17-127252	Reprep ³	
2017-650-1	CAMO-17-127253	1.13	
2017-650-1	CAMO-17-127254	0.98	
2017-650-1	CAMO-17-127255	1.23	1.25
2017-650-1	CAMO-17-127257	0.93	
2017-650-1	CAMO-17-127258	0.92	
2017-650-1	CAMO-17-127260	0.90	
2017-650-1	CAMO-17-127261	0.97	
2017-649	CASA-17-127290	1.20	
2017-649	CASA-17-127291	1.80	
2017-649	CASA-17-127292	Reprep ³	
2017-649	CASA-17-127293	0.93	
2017-649	CASA-17-127268	0.94	
2017-649	CASA-17-127294	0.91	0.87
2017-649	CASA-17-127295	1.28	
2017-649	CASA-17-127296	1.84	
2017-649	CASA-17-127307	0.12	
2017-649	CASA-17-127308	1.12	

¹Parts per thousand deviation of the measured $^{53}\text{Cr}/^{52}\text{Cr}$ ratio from that of the NIST SRM-979 standard.

²Not analyzed; insufficient Cr(VI) was present in the sample to allow accurate isotope ratio analysis.

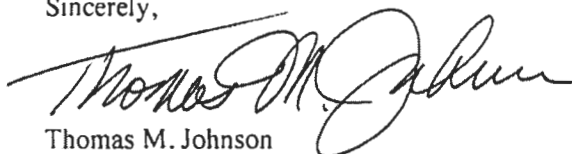
³Reanalysis in progress; sample must be prepared again.

The analytical methods used for these samples are identical to those used for LANL water analyses for the past several years, and are described in the article: Reinhard, C.T., et al., 2014. The isotopic composition of authigenic chromium in anoxic marine sediments: A case study from the Cariaco Basin. *Earth and Planetary Science Letters* vol. 407, pp. 9-18. Nominal precision is ± 0.2 per mil, though actual reproducibility is generally better than that.

A raw data table is attached. Analyses identified as "979" are NIST SRM-979. Analyses identified as "3112a" are NIST SRM-3112a, which has a published value of -0.07 per mil. The SRM-3112a standard solutions were processed through the sample preparation procedure with the reported samples. Sample results are normalized to the mean value of SRM-979 for the analytical session.

Chain of Custody (COC) forms are also attached. Some samples, as indicated above, were not analyzed. Where indicated, very little Cr was recovered by our sample preparation method. We assume this is because actual concentrations were much lower than expected. Other possible causes are: 1) The samples were acidified or 2) Other dissolved components in the sample (e.g., organic compounds) interfered with our anion exchange process. In some cases, sufficient Cr is present but samples must be prepared a second time to attain an acceptable ratio of double spike to sample Cr.

Sincerely,

A handwritten signature in black ink, appearing to read "Thomas M. Johnson". The signature is fluid and cursive, with the first name "Thomas" being the most prominent part.

Thomas M. Johnson
Professor of Geology

Smpl ID	S2 Int (V)	std err	Raw 50/52	std err	Raw 53/52	std err	Raw 54/52	std err	Raw 56/54	std err	Raw 51/52
'979_125ppb' run	1.98E+00	{ 1.16E-03 }	6.05E-01	{ 2.88E-05 }	1.18E-01	{ 2.49E-06 }	5.13E-01	{ 3.31E-05 }	4.44E-03	{ 0.00E+00 }	1.53E-05
'979_125ppb' run	1.94E+00	{ 8.47E-03 }	6.05E-01	{ 4.87E-05 }	1.18E-01	{ 2.23E-06 }	5.13E-01	{ 4.46E-05 }	4.40E-03	{ 2.91E-11 }	9.71E-06
'979_125ppb' run	1.96E+00	{ 7.16E-03 }	6.05E-01	{ 5.36E-05 }	1.18E-01	{ 2.32E-06 }	5.13E-01	{ 4.68E-05 }	4.29E-03	{ 0.00E+00 }	1.29E-05
'979_125ppb' run	1.97E+00	{ 6.85E-03 }	6.05E-01	{ 4.13E-05 }	1.18E-01	{ 2.54E-06 }	5.13E-01	{ 3.35E-05 }	4.43E-03	{ 0.00E+00 }	1.12E-05
'3112a_125ppb' ri	2.68E+00	{ 1.26E-03 }	6.57E-01	{ 8.36E-06 }	1.18E-01	{ 1.57E-06 }	5.59E-01	{ 6.88E-06 }	1.46E-02	{ 5.89E-11 }	6.48E-04
'3112a_125ppb' ri	2.64E+00	{ 7.68E-03 }	6.57E-01	{ 1.87E-05 }	1.18E-01	{ 2.21E-06 }	5.59E-01	{ 1.49E-05 }	1.46E-02	{ 5.59E-11 }	6.49E-04
'979_75ppb' run a	8.89E-01	{ 3.24E-03 }	5.98E-01	{ 7.48E-05 }	1.18E-01	{ 2.71E-06 }	5.08E-01	{ 5.92E-05 }	1.29E-02	{ 0.00E+00 }	1.82E-05
'979_75ppb' run c	9.03E-01	{ 7.72E-04 }	5.98E-01	{ 2.45E-05 }	1.18E-01	{ 4.04E-06 }	5.07E-01	{ 1.86E-05 }	1.36E-02	{ 6.90E-11 }	1.12E-05
'979_125ppb' run	1.96E+00	{ 6.99E-03 }	6.04E-01	{ 2.24E-05 }	1.18E-01	{ 2.47E-06 }	5.13E-01	{ 5.41E-05 }	4.43E-03	{ 0.00E+00 }	1.23E-05
'979_125ppb' run	1.96E+00	{ 3.95E-03 }	6.04E-01	{ 1.77E-05 }	1.18E-01	{ 2.60E-06 }	5.13E-01	{ 1.42E-05 }	4.38E-03	{ 1.17E-11 }	1.14E-05
'979_125ppb' run	1.96E+00	{ 1.38E-03 }	6.04E-01	{ 3.47E-05 }	1.18E-01	{ 3.18E-06 }	5.13E-01	{ 3.18E-05 }	4.50E-03	{ 0.00E+00 }	1.45E-05
979_125ppb'	1.97E+00	{ 2.99E-03 }	6.04E-01	{ 2.82E-05 }	1.18E-01	{ 1.84E-06 }	5.13E-01	{ 2.59E-05 }	4.35E-03	{ 0.00E+00 }	9.62E-06
Proc_3112a_1'	1.15E+00	{ 1.75E-03 }	6.02E-01	{ 1.03E-05 }	1.18E-01	{ 3.28E-06 }	5.11E-01	{ 9.17E-06 }	3.31E-02	{ 1.92E-10 }	6.66E-05
979_125ppb'	1.97E+00	{ 3.95E-03 }	6.05E-01	{ 4.60E-05 }	1.18E-01	{ 1.99E-06 }	5.14E-01	{ 3.76E-05 }	5.24E-03	{ 0.00E+00 }	1.17E-05
Proc_3112a_1'	1.16E+00	{ 5.51E-04 }	6.02E-01	{ 1.30E-05 }	1.18E-01	{ 2.78E-06 }	5.11E-01	{ 8.31E-06 }	3.25E-02	{ 0.00E+00 }	6.80E-05
Proc_3112a_2'	1.73E+00	{ 6.89E-04 }	5.90E-01	{ 7.24E-06 }	1.18E-01	{ 2.50E-06 }	5.01E-01	{ 5.52E-06 }	4.75E-02	{ 0.00E+00 }	5.95E-05
979_underspiked'	2.14E+00	{ 1.36E-03 }	2.89E-01	{ 8.17E-06 }	1.17E-01	{ 2.28E-06 }	2.40E-01	{ 6.29E-06 }	3.37E-02	{ 2.10E-10 }	1.82E-05
979_125ppb'	1.99E+00	{ 5.34E-03 }	6.05E-01	{ 1.49E-05 }	1.18E-01	{ 2.15E-06 }	5.14E-01	{ 2.55E-05 }	4.22E-03	{ 2.67E-11 }	1.24E-05
127242'	1.15E+00	{ 2.55E-03 }	5.53E-01	{ 8.64E-06 }	1.18E-01	{ 3.33E-06 }	4.70E-01	{ 7.64E-06 }	1.22E-02	{ 5.14E-12 }	9.84E-04
127214'	1.34E+00	{ 3.68E-03 }	5.71E-01	{ 1.08E-05 }	1.18E-01	{ 3.30E-06 }	4.86E-01	{ 1.02E-05 }	1.95E-02	{ 1.07E-10 }	5.11E-03
127243'	2.15E+00	{ 1.43E-03 }	5.93E-01	{ 8.24E-06 }	1.18E-01	{ 2.09E-06 }	5.05E-01	{ 5.84E-06 }	4.05E-02	{ 9.44E-11 }	7.40E-04
127244'	1.51E+00	{ 9.37E-04 }	5.82E-01	{ 1.04E-05 }	1.18E-01	{ 2.97E-06 }	4.95E-01	{ 1.07E-05 }	1.67E-02	{ 0.00E+00 }	1.95E-02
127215'	1.56E+00	{ 1.20E-03 }	5.51E-01	{ 7.49E-06 }	1.18E-01	{ 2.51E-06 }	4.70E-01	{ 6.97E-06 }	9.98E-02	{ 0.00E+00 }	1.86E-02
979_125ppb'	2.06E+00	{ 1.25E-03 }	5.96E-01	{ 8.30E-05 }	1.18E-01	{ 2.22E-06 }	5.06E-01	{ 7.94E-05 }	4.62E-03	{ 0.00E+00 }	1.11E-05
127245'	1.12E+00	{ 6.95E-04 }	3.03E-01	{ 7.71E-06 }	1.17E-01	{ 3.18E-06 }	2.54E-01	{ 8.35E-06 }	1.50E-01	{ 7.84E-10 }	2.98E-02
127247'	1.46E+00	{ 4.47E-03 }	5.67E-01	{ 1.06E-05 }	1.18E-01	{ 3.36E-06 }	4.83E-01	{ 1.23E-05 }	2.18E-02	{ 8.28E-11 }	4.14E-03
127249'	1.52E+00	{ 3.35E-03 }	3.03E-01	{ 9.21E-06 }	1.17E-01	{ 2.42E-06 }	2.52E-01	{ 5.06E-06 }	4.16E-02	{ 2.73E-10 }	2.40E-03
127250'	1.33E+00	{ 7.03E-04 }	2.78E-01	{ 7.41E-06 }	1.17E-01	{ 2.77E-06 }	2.30E-01	{ 1.20E-05 }	8.90E-02	{ 0.00E+00 }	2.25E-02
127252'	6.56E-01	{ 9.37E-04 }	5.71E-01	{ 1.83E-05 }	1.18E-01	{ 5.26E-06 }	4.92E-01	{ 1.01E-05 }	1.87E-02	{ 6.46E-11 }	6.49E-03
125ppb_979'	2.11E+00	{ 4.53E-03 }	5.96E-01	{ 1.03E-04 }	1.18E-01	{ 1.92E-06 }	5.06E-01	{ 1.01E-04 }	4.66E-03	{ 1.19E-11 }	1.58E-05
127253'	1.51E+00	{ 3.14E-03 }	5.37E-01	{ 1.42E-05 }	1.18E-01	{ 3.63E-06 }	4.55E-01	{ 8.33E-06 }	1.26E-02	{ 0.00E+00 }	1.37E-02
127254'	1.97E+00	{ 9.57E-04 }	6.04E-01	{ 8.98E-06 }	1.18E-01	{ 2.05E-06 }	5.13E-01	{ 8.81E-06 }	5.34E-02	{ 0.00E+00 }	5.21E-03
127255'	1.54E+00	{ 1.01E-03 }	5.54E-01	{ 8.92E-06 }	1.18E-01	{ 2.97E-06 }	4.70E-01	{ 8.92E-06 }	2.23E-02	{ 0.00E+00 }	6.15E-03
127257'	2.30E+00	{ 5.17E-03 }	5.86E-01	{ 8.86E-06 }	1.18E-01	{ 1.89E-06 }	4.97E-01	{ 6.07E-06 }	2.80E-02	{ 1.23E-10 }	1.93E-03
127258'	1.15E+00	{ 1.48E-03 }	3.11E-01	{ 1.12E-05 }	1.17E-01	{ 3.38E-06 }	2.61E-01	{ 1.08E-05 }	1.24E-01	{ 0.00E+00 }	3.32E-02
979_125ppb'	2.10E+00	{ 3.79E-03 }	5.98E-01	{ 1.23E-04 }	1.18E-01	{ 2.00E-06 }	5.07E-01	{ 1.14E-04 }	4.60E-03	{ 3.39E-11 }	1.43E-05
127260'	2.15E+00	{ 9.63E-04 }	5.91E-01	{ 7.13E-06 }	1.18E-01	{ 2.02E-06 }	5.01E-01	{ 4.89E-06 }	2.92E-02	{ 1.93E-10 }	4.83E-04
127261'	1.23E+00	{ 2.19E-03 }	3.19E-01	{ 8.02E-06 }	1.17E-01	{ 2.71E-06 }	2.65E-01	{ 7.84E-06 }	3.10E-02	{ 0.00E+00 }	7.40E-03
127290'	1.76E+00	{ 1.04E-03 }	5.58E-01	{ 6.29E-06 }	1.18E-01	{ 2.37E-06 }	4.73E-01	{ 6.75E-06 }	1.25E-02	{ 0.00E+00 }	3.99E-03
127291'	8.73E-01	{ 5.75E-04 }	3.08E-01	{ 1.07E-05 }	1.18E-01	{ 4.06E-06 }	2.57E-01	{ 9.55E-06 }	2.22E-02	{ 7.26E-11 }	6.75E-02
127292'	9.69E-01	{ 1.80E-03 }	3.15E-01	{ 7.82E-06 }	1.17E-01	{ 3.24E-06 }	2.72E-01	{ 5.09E-06 }	6.33E-01	{ 1.57E-09 }	4.62E-02
979_125ppb'	2.10E+00	{ 2.95E-03 }	5.91E-01	{ 2.69E-04 }	1.18E-01	{ 2.65E-06 }	5.01E-01	{ 2.39E-04 }	4.88E-03	{ 3.56E-11 }	1.91E-05
127293'	1.32E+00	{ 3.20E-03 }	3.05E-01	{ 7.84E-06 }	1.17E-01	{ 2.85E-06 }	2.53E-01	{ 6.63E-06 }	3.73E-02	{ 0.00E+00 }	3.05E-02
127268'	1.42E+00	{ 2.16E-03 }	3.04E-01	{ 5.48E-06 }	1.17E-01	{ 3.13E-06 }	2.53E-01	{ 4.76E-06 }	1.07E-01	{ 0.00E+00 }	4.23E-03
127294'	2.18E+00	{ 1.28E-03 }	6.17E-01	{ 7.58E-06 }	1.18E-01	{ 2.40E-06 }	5.25E-01	{ 6.63E-06 }	4.96E-02	{ 0.00E+00 }	7.52E-04
127295'	1.73E+00	{ 9.83E-04 }	5.66E-01	{ 7.08E-06 }	1.18E-01	{ 2.60E-06 }	4.81E-01	{ 4.85E-06 }	3.51E-02	{ 1.52E-10 }	3.11E-03
127296'	1.18E+00	{ 1.11E-03 }	5.77E-01	{ 7.40E-06 }	1.18E-01	{ 3.07E-06 }	4.90E-01	{ 6.61E-06 }	2.94E-02	{ 0.00E+00 }	2.04E-03
979_125ppb'	2.11E+00	{ 1.26E-03 }	5.88E-01	{ 1.84E-04 }	1.18E-01	{ 2.28E-06 }	4.98E-01	{ 1.69E-04 }	5.02E-03	{ 0.00E+00 }	1.57E-05
127307'	9.32E-01	{ 5.46E-04 }	6.19E-01	{ 1.10E-05 }	1.18E-01	{ 3.49E-06 }	5.29E-01	{ 9.06E-06 }	3.37E-02	{ 0.00E+00 }	8.98E-03
127308'	2.37E+00	{ 1.11E-03 }	5.51E-01	{ 5.40E-06 }	1.18E-01	{ 1.55E-06 }	4.67E-01	{ 4.83E-06 }	4.95E-02	{ 2.83E-10 }	1.03E-04
127255-2'	1.21E+00	{ 6.50E-04 }	6.12E-01	{ 9.87E-06 }	1.18E-01	{ 2.82E-06 }	5.20E-01	{ 8.25E-06 }	1.25E-02	{ 6.67E-11 }	6.50E-04
127294-2'	2.23E+00	{ 1.29E-03 }	5.99E-01	{ 7.54E-06 }	1.18E-01	{ 2.18E-06 }	5.09E-01	{ 3.84E-06 }	2.75E-02	{ 0.00E+00 }	6.79E-04
110538'	2.15E+00	{ 1.10E-03 }	5.61E-01	{ 7.21E-06 }	1.18E-01	{ 1.86E-06 }	4.77E-01	{ 4.57E-06 }	9.08E-02	{ 0.00E+00 }	5.70E-04
979_125ppb'	2.12E+00	{ 1.56E-03 }	5.87E-01	{ 1.08E-04 }	1.18E-01	{ 2.26E-06 }	4.97E-01	{ 9.91E-05 }	5.05E-03	{ 0.00E+00 }	1.23E-05
Proc_3112a_1'	1.32E+00	{ 1.02E-03 }	6.02E-01	{ 1.12E-05 }	1.18E-01	{ 2.80E-06 }	5.11E-01	{ 6.40E-06 }	3.07E-02	{ 1.59E-10 }	6.45E-05
Proc_3112a_2'	1.83E+00	{ 1.24E-03 }	5.91E-01	{ 7.74E-06 }	1.17E-01	{ 2.33E-06 }	5.00E-01	{ 5.21E-06 }	4.53E-02	{ 0.00E+00 }	5.59E-05
979_125ppb'	2.11E+00	{ 1.25E-03 }	5.93E-01	{ 1.16E-04 }	1.18E-01	{ 2.13E-06 }	5.02E-01	{ 1.05E-04 }	5.01E-03	{ 0.00E+00 }	1.49E-05
979_125ppb'	2.11E+00	{ 1.07E-03 }	5.95E-01	{ 7.35E-05 }	1.18E-01	{ 2.27E-06 }	5.04E-01	{ 6.72E-05 }	4.91E-03	{ 3.25E-11 }	1.34E-05

std err	Raw 49/50	std err	Conv Err	std err	FeCorrEst	std err	VCorrEst	std err	TiCorrEst	std err	Mass Bias
{ 1.06E-06 }	8.82E-06	{ 5.84E-14 }	-5.61E-05	{ 6.86E-06 }	8.88E-02	{ 2.33E-06 }	1.44E-05	{ 9.96E-07 }	2.18E-03	{ 3.18E-08 }	3.16E+01
{ 8.63E-07 }	8.82E-06	{ 0.00E+00 }	-4.09E-05	{ 6.89E-06 }	8.81E-02	{ 8.91E-07 }	9.12E-06	{ 8.11E-07 }	2.18E-03	{ 1.23E-08 }	3.17E+01
{ 9.62E-07 }	5.75E-06	{ 1.46E-14 }	-2.12E-05	{ 6.39E-06 }	8.58E-02	{ 1.13E-06 }	1.22E-05	{ 9.04E-07 }	1.42E-03	{ 1.04E-08 }	3.17E+01
{ 9.29E-07 }	5.93E-06	{ 2.65E-14 }	-4.52E-05	{ 7.60E-06 }	8.86E-02	{ 8.22E-07 }	1.05E-05	{ 8.73E-07 }	1.47E-03	{ 7.56E-09 }	3.18E+01
{ 1.04E-06 }	4.86E-05	{ 1.17E-14 }	-3.24E-05	{ 3.78E-06 }	2.92E-01	{ 2.22E-06 }	5.60E-04	{ 9.00E-07 }	1.20E-02	{ 5.09E-08 }	3.15E+01
{ 8.38E-07 }	4.63E-05	{ 1.16E-13 }	-3.68E-05	{ 4.08E-06 }	2.92E-01	{ 7.21E-06 }	5.61E-04	{ 7.24E-07 }	1.15E-02	{ 1.57E-07 }	3.17E+01
{ 2.38E-06 }	1.52E-05	{ 0.00E+00 }	-3.59E-05	{ 6.54E-06 }	2.57E-01	{ 4.23E-06 }	1.73E-05	{ 2.26E-06 }	3.77E-03	{ 3.44E-08 }	3.17E+01
{ 2.64E-06 }	1.41E-05	{ 0.00E+00 }	-3.93E-05	{ 1.22E-05 }	2.71E-01	{ 3.10E-06 }	1.06E-05	{ 2.51E-06 }	3.50E-03	{ 2.22E-08 }	3.17E+01
{ 1.41E-06 }	5.34E-06	{ 3.26E-14 }	-2.83E-05	{ 7.01E-06 }	8.86E-02	{ 2.90E-06 }	1.16E-05	{ 1.33E-06 }	1.32E-03	{ 2.40E-08 }	3.20E+01
{ 1.10E-06 }	5.24E-06	{ 1.85E-14 }	-4.05E-05	{ 7.49E-06 }	8.76E-02	{ 7.57E-07 }	1.07E-05	{ 1.04E-06 }	1.30E-03	{ 6.23E-09 }	3.20E+01
{ 1.15E-06 }	6.25E-06	{ 0.00E+00 }	-3.33E-05	{ 6.62E-06 }	9.00E-02	{ 7.68E-07 }	1.36E-05	{ 1.08E-06 }	1.55E-03	{ 1.08E-09 }	3.22E+01
{ 1.14E-06 }	5.60E-06	{ 9.83E-15 }	-3.78E-05	{ 5.46E-06 }	8.70E-02	{ 1.06E-06 }	9.04E-06	{ 1.07E-06 }	1.39E-03	{ 9.37E-09 }	3.21E+01
{ 1.68E-06 }	1.18E-04	{ 6.61E-13 }	-1.16E-05	{ 1.03E-05 }	6.63E-01	{ 7.37E-05 }	6.29E-05	{ 1.59E-06 }	2.92E-02	{ 1.80E-07 }	3.15E+01
{ 1.19E-06 }	5.34E-06	{ 1.27E-14 }	1.01E-06	{ 6.10E-06 }	1.05E-01	{ 1.32E-05 }	1.10E-05	{ 1.11E-06 }	1.32E-03	{ 9.29E-09 }	3.20E+01
{ 2.07E-06 }	1.12E-04	{ 3.86E-13 }	-2.81E-05	{ 8.31E-06 }	6.51E-01	{ 9.53E-05 }	6.43E-05	{ 1.96E-06 }	2.78E-02	{ 2.26E-07 }	3.15E+01
{ 1.45E-06 }	7.66E-05	{ 0.00E+00 }	-3.24E-05	{ 8.88E-06 }	9.50E-01	{ 8.89E-05 }	5.73E-05	{ 1.40E-06 }	1.90E-02	{ 9.85E-08 }	3.14E+01
{ 8.72E-07 }	1.87E-05	{ 0.00E+00 }	-3.06E-04	{ 6.42E-05 }	6.74E-01	{ 1.22E-05 }	3.50E-05	{ 1.72E-06 }	4.63E-03	{ 4.60E-08 }	3.18E+01
{ 1.17E-06 }	6.95E-06	{ 0.00E+00 }	-2.88E-05	{ 6.71E-06 }	8.45E-02	{ 8.86E-07 }	1.17E-05	{ 1.09E-06 }	1.72E-03	{ 1.00E-08 }	3.19E+01
{ 2.20E-06 }	2.53E-04	{ 1.29E-12 }	6.64E-04	{ 1.30E-05 }	2.44E-01	{ 2.09E-06 }	1.01E-03	{ 2.26E-06 }	6.27E-02	{ 2.97E-07 }	3.25E+01
{ 2.14E-06 }	2.09E-04	{ 0.00E+00 }	5.92E-04	{ 1.10E-05 }	3.89E-01	{ 6.00E-06 }	5.08E-03	{ 2.10E-06 }	5.18E-02	{ 4.43E-07 }	3.22E+01
{ 1.00E-06 }	8.58E-05	{ 3.26E-13 }	3.91E-04	{ 7.06E-06 }	8.10E-01	{ 8.64E-06 }	7.09E-04	{ 9.60E-07 }	2.13E-02	{ 1.26E-07 }	3.19E+01
{ 4.42E-06 }	3.10E-04	{ 1.96E-12 }	4.00E-04	{ 9.35E-06 }	3.34E-01	{ 5.55E-06 }	1.90E-02	{ 4.26E-06 }	7.69E-02	{ 7.09E-07 }	3.22E+01
{ 2.42E-06 }	2.76E-04	{ 0.00E+00 }	4.81E-04	{ 1.01E-05 }	1.99E+00	{ 1.72E-05 }	1.91E-02	{ 2.53E-06 }	6.85E-02	{ 3.27E-07 }	3.23E+01
{ 1.05E-06 }	6.94E-06	{ 0.00E+00 }	-2.61E-05	{ 7.21E-06 }	9.25E-02	{ 1.07E-06 }	1.06E-05	{ 9.98E-07 }	1.72E-03	{ 1.11E-08 }	3.19E+01
{ 3.18E-06 }	4.01E-04	{ 4.69E-13 }	2.65E-03	{ 8.21E-05 }	2.99E+00	{ 6.23E-05 }	5.59E-02	{ 7.65E-06 }	9.94E-02	{ 1.15E-06 }	3.23E+01
{ 1.70E-06 }	1.75E-04	{ 0.00E+00 }	3.07E-04	{ 1.18E-05 }	4.35E-01	{ 5.97E-06 }	4.14E-03	{ 1.72E-06 }	4.35E-02	{ 3.31E-07 }	3.29E+01
{ 2.19E-06 }	5.47E-04	{ 7.38E-13 }	3.41E-03	{ 6.57E-05 }	8.32E-01	{ 1.45E-05 }	4.49E-03	{ 4.11E-06 }	1.35E-01	{ 1.31E-06 }	3.19E+01
{ 4.36E-06 }	6.95E-04	{ 0.00E+00 }	3.93E-03	{ 1.01E-04 }	1.78E+00	{ 2.77E-05 }	4.62E-02	{ 9.43E-06 }	1.72E-01	{ 1.49E-06 }	3.18E+01
{ 4.65E-06 }	6.88E-04	{ 0.00E+00 }	2.10E-04	{ 1.86E-05 }	3.72E-01	{ 5.53E-06 }	6.38E-03	{ 4.56E-06 }	1.71E-01	{ 1.41E-06 }	3.55E+01
{ 1.14E-06 }	6.82E-06	{ 4.65E-14 }	-2.54E-05	{ 6.94E-06 }	9.32E-02	{ 1.08E-06 }	1.50E-05	{ 1.08E-06 }	1.69E-03	{ 1.09E-08 }	3.17E+01
{ 1.22E-05 }	1.68E-04	{ 0.00E+00 }	4.95E-04	{ 1.13E-05 }	2.53E-01	{ 4.63E-06 }	1.45E-02	{ 1.29E-05 }	4.16E-02	{ 4.23E-07 }	3.20E+01
{ 1.12E-06 }	1.16E-04	{ 0.00E+00 }	3.32E-04	{ 6.09E-06 }	1.07E+00	{ 1.03E-05 }	4.91E-03	{ 9.33E-07 }	2.86E-02	{ 1.53E-07 }	3.14E+01
{ 2.38E-06 }	4.38E-04	{ 2.73E-12 }	5.01E-04	{ 1.11E-05 }	4.46E-01	{ 7.50E-06 }	6.31E-03	{ 2.48E-06 }	1.08E-01	{ 1.01E-06 }	3.20E+01
{ 8.66E-07 }	2.33E-04	{ 5.51E-13 }	3.23E-04	{ 6.42E-06 }	5.61E-01	{ 5.67E-06 }	1.87E-03	{ 8.39E-07 }	5.77E-02	{ 3.24E-07 }	3.16E+01
{ 4.94E-06 }	4.86E-04	{ 2.11E-12 }	2.15E-03	{ 7.65E-05 }	2.48E+00	{ 3.75E-05 }	6.06E-02	{ 1.31E-05 }	1.20E-01	{ 1.01E-06 }	3.22E+01
{ 9.13E-07 }	7.02E-06	{ 0.00E+00 }	-1.59E-05	{ 6.21E-06 }	9.21E-02	{ 1.16E-06 }	1.36E-05	{ 8.69E-07 }	1.74E-03	{ 1.21E-08 }	3.17E+01
{ 9.49E-07 }	5.98E-05	{ 4.30E-13 }	3.07E-04	{ 6.72E-06 }	5.84E-01	{ 4.52E-06 }	4.65E-04	{ 9.13E-07 }	1.48E-02	{ 6.37E-08 }	3.13E+01
{ 3.49E-06 }	5.12E-04	{ 0.00E+00 }	1.98E-03	{ 6.24E-05 }	6.21E-01	{ 9.30E-06 }	1.32E-02	{ 6.62E-06 }	1.27E-01	{ 1.05E-06 }	3.14E+01
{ 1.40E-06 }	4.72E-04	{ 0.00E+00 }	4.72E-04	{ 9.88E-06 }	2.50E-01	{ 2.20E-06 }	4.07E-03	{ 1.41E-06 }	1.17E-01	{ 5.72E-07 }	3.17E+01
{ 7.59E-06 }	5.62E-04	{ 3.48E-12 }	4.02E-03	{ 9.52E-05 }	4.44E-01	{ 7.58E-06 }	1.24E-01	{ 1.71E-05 }	1.40E-01	{ 1.32E-06 }	3.35E+01
{ 4.61E-06 }	6.40E-04	{ 2.37E-12 }	3.02E-03	{ 8.48E-05 }	1.27E+01	{ 1.86E-04 }	8.31E-02	{ 8.60E-06 }	1.59E-01	{ 1.29E-06 }	3.26E+01
{ 1.42E-06 }	8.36E-06	{ 3.28E-14 }	-3.17E-05	{ 8.04E-06 }	9.76E-02	{ 9.64E-07 }	1.84E-05	{ 1.37E-06 }	2.07E-03	{ 1.14E-08 }	3.16E+01
{ 5.99E-06 }	4.64E-04	{ 1.72E-12 }	2.15E-03	{ 6.84E-05 }	7.47E-01	{ 1.03E-05 }	5.69E-02	{ 1.11E-05 }	1.15E-01	{ 8.78E-07 }	3.16E+01
{ 1.78E-06 }	3.19E-04	{ 0.00E+00 }	2.36E-03	{ 8.04E-05 }	2.14E+00	{ 3.23E-05 }	7.92E-03	{ 3.31E-06 }	7.91E-02	{ 6.62E-07 }	3.13E+01
{ 1.07E-06 }	7.00E-05	{ 8.93E-14 }	2.87E-04	{ 7.18E-06 }	9.93E-01	{ 8.87E-06 }	6.94E-04	{ 9.89E-07 }	1.73E-02	{ 8.59E-08 }	3.14E+01
{ 1.36E-06 }	2.57E-04	{ 0.00E+00 }	5.02E-04	{ 9.57E-06 }	7.03E-01	{ 5.01E-06 }	3.12E-03	{ 1.36E-06 }	6.38E-02	{ 2.52E-07 }	3.18E+01
{ 1.70E-06 }	2.00E-04	{ 0.00E+00 }	6.78E-04	{ 1.10E-05 }	5.88E-01	{ 5.54E-06 }	2.01E-03	{ 1.68E-06 }	4.95E-02	{ 2.59E-07 }	3.18E+01
{ 1.01E-06 }	8.23E-06	{ 5.32E-14 }	-1.34E-05	{ 6.82E-06 }	1.00E-01	{ 9.74E-07 }	1.52E-05	{ 9.79E-07 }	2.04E-03	{ 1.10E-08 }	3.16E+01
{ 3.00E-06 }	3.26E-04	{ 7.20E-13 }	2.36E-05	{ 9.83E-06 }	6.72E-01	{ 6.36E-06 }	8.22E-03	{ 2.77E-06 }	8.09E-02	{ 4.25E-07 }	3.31E+01
{ 9.21E-07 }	7.63E-05	{ 3.78E-13 }	4.90E-04	{ 6.77E-06 }	9.91E-01	{ 7.57E-06 }	1.06E-04	{ 9.52E-07 }	1.89E-02	{ 8.01E-08 }	3.12E+01
{ 1.42E-06 }	1.56E-04	{ 8.14E-13 }	3.76E-04	{ 8.48E-06 }	2.50E-01	{ 2.35E-05 }	8.03E-04	{ 1.37E-06 }	3.85E-02	{ 2.01E-07 }	3.18E+01
{ 1.02E-06 }	5.53E-05	{ 2.88E-14 }	2.83E-04	{ 6.57E-06 }	5.50E-01	{ 4.67E-06 }	6.45E-04	{ 9.66E-07 }	1.37E-02	{ 6.46E-08 }	3.15E+01
{ 7.29E-07 }	1.11E-04	{ 0.00E+00 }	4.31E-04	{ 7.12E-06 }	1.82E+00	{ 1.10E-05 }	5.78E-04	{ 7.40E-07 }	2.75E-02	{ 9.27E-08 }	3.12E+01
{ 1.14E-06 }	1.01E-05	{ 0.00E+00 }	-6.78E-06	{ 6.60E-06 }	1.01E-01	{ 8.07E-07 }	1.20E-05	{ 1.10E-06 }	2.49E-03	{ 1.10E-08 }	3.14E+01
{ 2.21E-06 }	1.14E-04	{ 5.47E-13 }	-1.23E-05	{ 8.49E-06 }	6.16E-01	{ 8.62E-06 }	6.10E-05	{ 2.09E-06 }	2.83E-02	{ 2.20E-07 }	3.12E+01
{ 1.18E-06 }	7.68E-05	{ 0.00E+00 }	-1.20E-05	{ 7.50E-06 }	9.08E-01	{ 7.01E-06 }	5.40E-05	{ 1.13E-06 }	1.90E-02	{ 8.14E-08 }	3.07E+01
{ 1.07E-06 }	8.43E-06	{ 0.00E+00 }	-2.07E-05	{ 6.93E-06 }	1.00E-01	{ 1.10E-06 }	1.43E-05	{ 1.03E-06 }	2.09E-03	{ 1.27E-08 }	3.16E+01
{ 1.21E-06 }	6.92E-06	{ 0.00E+00 }	-1.22E-05	{ 6.88E-06 }	9.82E-02	{ 7.23E-07 }	1.28E-05	{ 1.16E-06 }	1.72E-03	{ 7.01E-09 }	3.16E+01

std err	S4Spk/52Nat	Delta 53Cr	std err	Smpl ID	Date	Time	979 std mean	53Cr	Final Delta	Diff vs. Orig.	Comment
{ 1.42E-02 }	4.54E-01 { 2.89E-05 }	-0.18 { 2.13E-02 }	'979_125ppb'	13-Apr	14:51	-1.23E-01	-0.06				
{ 5.48E-03 }	4.55E-01 { 4.05E-05 }	-0.13 { 2.14E-02 }	'979_125ppb'	13-Apr	15:01	-1.23E-01	-0.01				
{ 7.14E-03 }	4.55E-01 { 4.34E-05 }	-0.07 { 1.99E-02 }	'979_125ppb'	13-Apr	15:11	-1.23E-01	0.05				
{ 5.03E-03 }	4.55E-01 { 3.23E-05 }	-0.15 { 2.36E-02 }	'979_125ppb'	13-Apr	15:21	-1.23E-01	-0.02				
{ 4.12E-03 }	4.97E-01 { 5.63E-06 }	-0.15 { 1.49E-02 }	'3112a_125pp	13-Apr	15:36	-1.23E-01	-0.03				
{ 1.34E-02 }	4.97E-01 { 4.05E-06 }	-0.16 { 1.61E-02 }	'3112a_125pp	13-Apr	15:46	-1.23E-01	-0.04				
{ 8.92E-03 }	4.49E-01 { 5.76E-05 }	-0.12 { 1.96E-02 }	'979_75ppb' r	13-Apr	16:01	-1.23E-01	0.00				
{ 6.19E-03 }	4.49E-01 { 1.79E-05 }	-0.13 { 3.64E-02 }	'979_75ppb' r	13-Apr	16:11	-1.23E-01	-0.01				
{ 1.77E-02 }	4.54E-01 { 3.33E-05 }	-0.09 { 2.18E-02 }	'979_125ppb'	13-Apr	16:26	-1.23E-01	0.03				
{ 4.69E-03 }	4.55E-01 { 1.40E-05 }	-0.13 { 2.33E-02 }	'979_125ppb'	13-Apr	16:35	-1.23E-01	0.01				
{ 4.63E-03 }	4.54E-01 { 3.00E-05 }	-0.11 { 2.06E-02 }	'979_125ppb'	13-Apr	16:57	-1.23E-01	0.02				
{ 6.60E-03 }	4.55E-01 { 2.34E-05 }	-0.12 { 1.70E-02 }	979_125ppb'	13-Apr	17:59	-6.44E-02	-0.06				
{ 6.03E-03 }	4.52E-01 { 6.33E-06 }	-0.08 { 3.09E-02 }	Proc_3112a_1	13-Apr	18:14	-6.44E-02	-0.01				
{ 6.85E-03 }	4.55E-01 { 3.70E-05 }	0.00 { 1.90E-02 }	979_125ppb'	13-Apr	18:29	-6.44E-02	0.06				
{ 7.93E-03 }	4.52E-01 { 4.60E-06 }	-0.13 { 2.49E-02 }	Proc_3112a_1	13-Apr	18:44	-6.44E-02	-0.06				
{ 6.07E-03 }	4.49E-01 { 1.54E-06 }	-0.15 { 2.48E-02 }	Proc_3112a_1	13-Apr	18:59	-6.44E-02	-0.09				
{ 9.88E-03 }	1.97E-01 { 5.57E-06 }	-0.13 { 2.31E-02 }	979_Underspi	13-Apr	19:14	-6.44E-02	-0.06				
{ 5.58E-03 }	4.55E-01 { 1.92E-05 }	-0.09 { 2.10E-02 }	979_125ppb'	13-Apr	19:29	-6.44E-02	-0.03				
{ 4.64E-03 }	4.13E-01 { 6.01E-06 }	1.58 { 3.12E-02 }	127242'	13-Apr	19:44	-6.44E-02	1.64				
{ 8.37E-03 }	4.28E-01 { 5.48E-06 }	1.53 { 2.88E-02 }	127214'	13-Apr	19:59	-6.44E-02	1.59				
{ 5.79E-03 }	4.46E-01 { 3.97E-06 }	1.08 { 2.03E-02 }	127243'	13-Apr	20:15	-6.44E-02	1.14				
{ 9.00E-03 }	4.37E-01 { 5.94E-06 }	1.09 { 2.59E-02 }	127244'	13-Apr	20:30	-6.44E-02	1.15				
{ 4.67E-03 }	4.11E-01 { 4.59E-06 }	0.97 { 2.32E-02 }	127215'	13-Apr	20:45	-6.44E-02	1.04				
{ 6.29E-03 }	4.48E-01 { 7.13E-05 }	-0.08 { 2.15E-02 }	979_125ppb'	13-Apr	21:00	-6.44E-02	-0.02				
{ 1.14E-02 }	2.08E-01 { 6.00E-06 }	0.97 { 3.20E-02 }	127245'	13-Apr	21:15	-6.44E-02	1.03				
{ 7.45E-03 }	4.24E-01 { 5.26E-06 }	0.78 { 2.93E-02 }	127247'	13-Apr	21:30	-6.44E-02	0.84				
{ 9.47E-03 }	2.08E-01 { 5.32E-06 }	1.37 { 2.68E-02 }	127249'	13-Apr	21:45	-6.44E-02	1.43				
{ 8.50E-03 }	1.87E-01 { 5.55E-06 }	1.18 { 3.14E-02 }	127250'	13-Apr	22:00	-6.44E-02	1.24				
0.09E-02											
{ 6.28E-03 }	4.48E-01 { 8.68E-05 }	-0.08 { 2.08E-02 }	125ppb_979	13-Apr	22:30	-6.44E-02	-0.02				
{ 9.92E-03 }	3.99E-01 { 4.50E-06 }	1.07 { 2.47E-02 }	127253'	13-Apr	22:45	-6.44E-02	1.13				
{ 5.20E-03 }	4.54E-01 { 4.36E-06 }	0.92 { 1.81E-02 }	127254'	13-Apr	23:00	-6.44E-02	0.98				
{ 9.21E-03 }	4.13E-01 { 3.21E-06 }	1.16 { 2.62E-02 }	127255'	13-Apr	23:15	-6.44E-02	1.23				
{ 5.48E-03 }	4.39E-01 { 4.21E-06 }	0.86 { 1.78E-02 }	127257'	13-Apr	23:30	-6.44E-02	0.93				
{ 8.25E-03 }	2.15E-01 { 8.56E-06 }	0.86 { 3.27E-02 }	127258'	13-Apr	23:45	-6.44E-02	0.92				
{ 6.81E-03 }	4.49E-01 { 1.04E-04 }	-0.05 { 1.87E-02 }	979_125ppb'	14-Apr	0:00	-6.44E-02	0.01				
{ 4.20E-03 }	4.43E-01 { 3.90E-06 }	0.84 { 1.92E-02 }	127260'	14-Apr	0:15	-6.44E-02	0.90				
{ 8.15E-03 }	2.20E-01 { 6.19E-06 }	0.91 { 2.94E-02 }	127261'	14-Apr	0:30	-6.44E-02	0.97				
{ 4.78E-03 }	4.16E-01 { 4.48E-06 }	1.13 { 2.41E-02 }	127290'	14-Apr	0:45	-6.44E-02	1.20				
{ 9.35E-03 }	2.13E-01 { 8.30E-06 }	1.74 { 4.15E-02 }	127291'	14-Apr	1:00	-6.44E-02	1.80				
0.01E-02											
{ 5.35E-03 }	4.43E-01 { 2.23E-04 }	-0.10 { 2.34E-02 }	979_125ppb'	14-Apr	1:30	-6.44E-02	-0.03				
{ 7.50E-03 }	2.09E-01 { 4.55E-06 }	0.87 { 2.83E-02 }	127293'	14-Apr	1:45	-6.44E-02	0.93				
{ 8.23E-03 }	2.09E-01 { 3.33E-06 }	0.88 { 3.23E-02 }	127268'	14-Apr	2:00	-6.44E-02	0.94				
{ 4.84E-03 }	4.64E-01 { 4.81E-06 }	0.85 { 2.28E-02 }	127294'	14-Apr	2:15	-6.44E-02	0.91				
{ 3.87E-03 }	4.23E-01 { 4.23E-06 }	1.22 { 2.41E-02 }	127295'	14-Apr	2:30	-6.44E-02	1.28				
{ 5.11E-03 }	4.32E-01 { 4.66E-06 }	1.77 { 2.95E-02 }	127296'	14-Apr	2:46	-6.44E-02	1.84				
{ 5.25E-03 }	4.41E-01 { 1.55E-04 }	-0.04 { 2.00E-02 }	979_125ppb'	14-Apr	3:01	-6.44E-02	0.03				
{ 5.14E-03 }	4.68E-01 { 7.20E-06 }	0.05 { 3.22E-02 }	127307'	14-Apr	3:16	-6.44E-02	0.12				
{ 4.14E-03 }	4.10E-01 { 2.77E-06 }	1.06 { 1.55E-02 }	127308'	14-Apr	3:31	-6.44E-02	1.12				
{ 5.10E-03 }	4.61E-01 { 4.88E-06 }	1.19 { 2.72E-02 }	127255-2'	14-Apr	3:46	-6.44E-02	1.25			0.03	
{ 4.60E-03 }	4.50E-01 { 3.50E-06 }	0.81 { 1.96E-02 }	127294-2'	14-Apr	4:01	-6.44E-02	0.87			-0.04	
{ 3.29E-03 }	4.19E-01 { 4.31E-06 }	0.89 { 1.67E-02 }	110538'	14-Apr	4:16	-6.44E-02	0.96			-0.02	
{ 4.32E-03 }	4.40E-01 { 9.09E-05 }	-0.03 { 1.88E-02 }	979_125ppb'	14-Apr	4:31	-6.44E-02	0.04				
{ 7.58E-03 }	4.52E-01 { 4.26E-06 }	-0.08 { 2.54E-02 }	Proc_3112_1	14-Apr	4:50	-6.44E-02	-0.02				
{ 4.18E-03 }	4.42E-01 { 4.48E-06 }	-0.11 { 2.10E-02 }	Proc_3112_2	14-Apr	5:05	-6.44E-02	-0.04				
{ 5.94E-03 }	4.45E-01 { 9.70E-05 }	-0.07 { 2.03E-02 }	979_125ppb'	14-Apr	5:20	-6.44E-02	0.00				
{ 3.99E-03 }	4.46E-01 { 6.25E-05 }	-0.04 { 2.04E-02 }	979_125ppb'	14-Apr	5:35	-6.44E-02	0.02				

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[illegible]

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21 July, 2017

Ms. Susan Leese
ARS International, LLC
2609 North River Road
Port Allen, LA 70767-3469
225.381.2991 sleese@amrad.com

Subject: Cr stable isotope results

Dear Susan:

Please find below tabulated results from Cr stable isotope analysis of water samples from Los Alamos National Laboratory (LANL). The samples were analyzed on July 19th and 20th, 2017 and results were reported via EDD, on July 21st.

COC #	Sample ID	$\delta^{53}\text{Cr}^1$ (per mil)	Duplicate $\delta^{53}\text{Cr}^1$ (per mil)
2017-1391	CrCH1-17-129984	0.80	
2017-1391	CrCH1-17-129981	0.88	
2017-1391	CrCH1-17-129732	0.90	
2017-1391	CrCH1-17-129980	0.83	
2017-1391	CrCH1-17-129735	0.86	
2017-1392	CASA-17-129340	0.75	0.92
2017-1392	CASA-17-129341	1.84	
2017-1392	CAMO-17-129411	1.01	
2017-1392	CAMO-17-129290	1.25	
2017-1392	CAMO-17-129413	0.85	
2017-1392	CAMO-17-129412	1.20	
2017-1393	CrEX3-17-127067	0.89	
2017-1393	CrEX3-17-126943	1.33	
2017-1393	Cr-EX3-16-123292	1.03	
2017-1393	CrCH2-16-123335	1.34	
2017-1393	CrCH2-16-123328+123329	1.80	
2017-1393	CrCH2-16-123324-123326	2.84	
2017-1393	CrCH2-16-123342	1.25	1.25
2017-1393	CrCH2-16-123510	1.69	
2017-1393	CrCH2-16-123557	1.31	
2017-1393	CrCH2-16-123560	0.99	
2017-1393	CrCH2-16-123566	1.04	
2017-1393	CrCH2-17-129559	1.17	
2017-1393	CrCH2-17-129562	1.25	
2017-1396	TRR-42-16-123764	0.88	
2017-1396	TRR-42-16-123769	0.79	
2017-1396	TRR-28-16-123657	1.07	
2017-1396	TRR-42-16-123759	0.90	
2017-1396	TRR-28-16-123688	1.23	
2017-1396	TRR-28-16-123667	1.23	
2017-1396	TRR-28-16-123651	1.11	

2017-1396	TRR-42-16-123756	0.97	
2017-1396	TRR-28-16-123677	1.26	
2017-1396	TRR-42-17-126877	0.95	
2017-1396	TRR-42-17-126884	0.89	
2017-1396	TRR-28-17-127645	1.13	
2017-1396	TRR-28-17-129043	1.19	
2017-1396	TRR-42-17-126870	0.86	
2017-1396	TRR-28-17-127650	1.03	0.95
2017-1396	TRR-28-17-127668	0.97	
2017-1398	CrCH2-16-123532	1.05	
2017-1398	CrCH2-16-123582	1.28	
2017-1398	CrCH2-16-123578	1.25	
2017-1398	CrCH2-17-128860	1.20	1.22
2017-1398	CrCH2-17-128857	1.19	
2017-1398	CrCH2-17-128859	1.18	
2017-1398	CrCH2-17-128856	1.35	
2017-1398	CrCH2-17-128862	1.14	
2017-650-1	CAMO-17-127252	1.05	
2017-649	CASA-17-127292	1.13	

¹Parts per thousand deviation of the measured ⁵³Cr/⁵²Cr ratio from that of the NIST SRM-979 standard.

²Not analyzed; insufficient Cr(VI) was present in the sample to allow accurate isotope ratio analysis.

³Reanalysis in progress; sample must be prepared again.

The analytical methods used for these samples are identical to those used for LANL water analyses for the past several years, and are described in the article: Reinhard, C.T., et al., 2014. The isotopic composition of authigenic chromium in anoxic marine sediments: A case study from the Cariaco Basin. *Earth and Planetary Science Letters* vol. **407**, pp. 9-18. Nominal precision is ±0.2 per mil, though actual reproducibility is generally better than that.

A raw data table is attached. Analyses identified as “979” are NIST SRM-979. Analyses identified as “3112a” are NIST SRM-3112a, which has a published value of -0.07 per mil. The SRM-3112a standard solutions were processed through the sample preparation procedure with the reported samples. Sample results are normalized to the mean value of SRM-979 for the analytical session.

Chain of Custody (COC) forms are also attached. Some samples may not have been analyzed, as indicated above. Where indicated, very little Cr was recovered by our sample preparation method. Other possible causes are: 1) The samples were acidified or 2) Other dissolved components in the sample (e.g., organic compounds) interfered with our anion exchange process. In some cases, sufficient Cr is present but samples must be prepared a second time to attain an acceptable ratio of double spike to sample Cr.

Sincerely,



Thomas M. Johnson
Professor of Geology