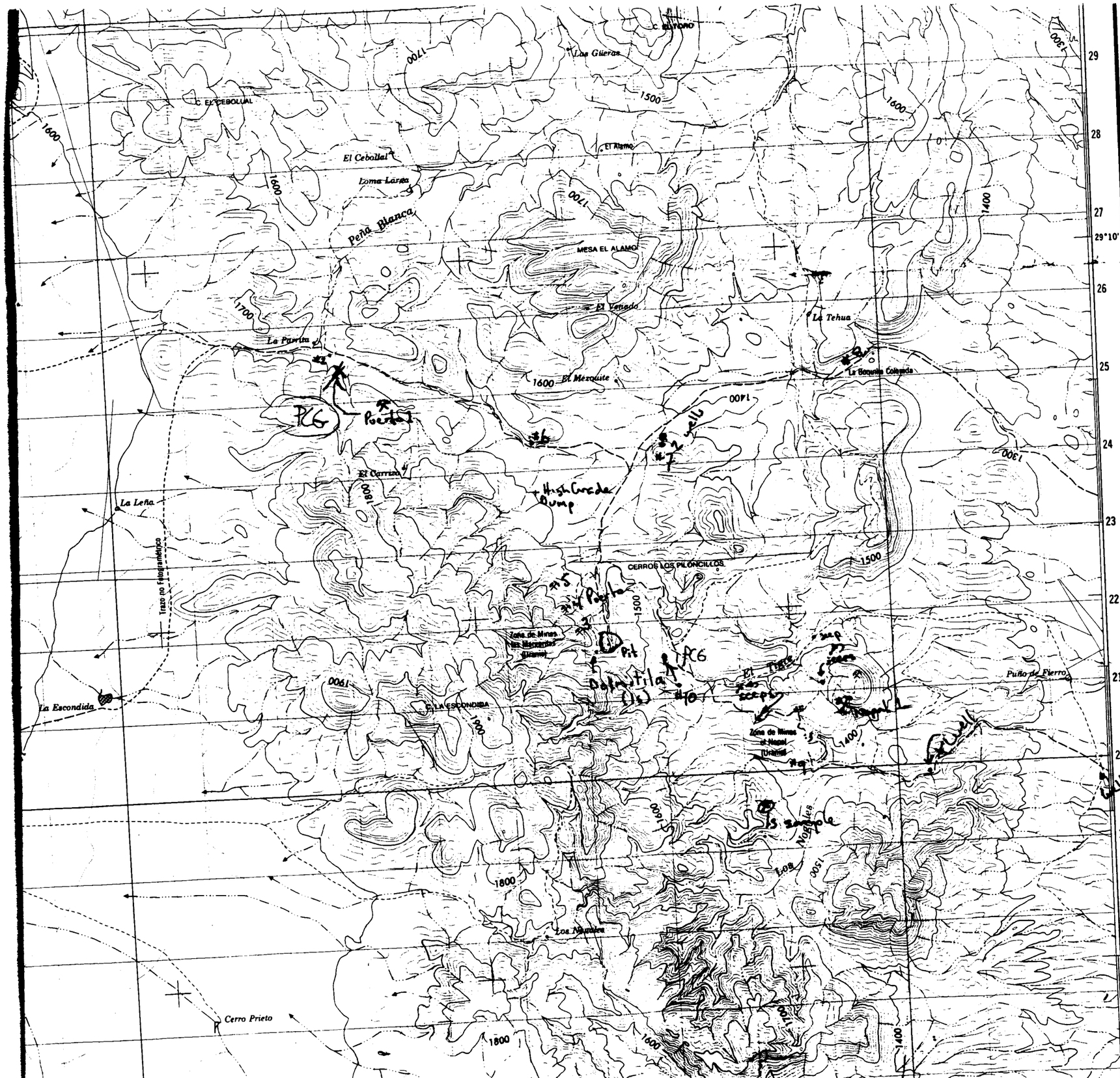
NATURAL ANALOGS WATER CHEMISTRY RESULTS PENA BLANCA

308 --- Q200408300009
Supplemental Material, Technical Activity
Supporting Documentation: Experimental Data
for Natural Analogs Water Chemistry Results
Pena Blanca (11/04/1991 through 01/03/1992)



DEPOSITO DE AGUA, OTROS DEPOSITOS (ROTULADO)
CANAL, PRESA, BORDO
PUENTE, TUNEL, PASO A DESNIVEL
EMBARCADERO, MUELLE, MALECON
FARO (2 DESTELLOS BLANCOS 15 MILLAS NAUTICAS), ROMPEOLAS

LIMITES

ESTATAL
INTERNACIONAL

PUNTOS GEODESICOS

VERTICE DE PRIMER ORDEN, DE SEGUNDO O TERCER ORDEN — △TLALOC
BANCO DE NIVEL DE PRIMER ORDEN, DE SEGUNDO O TERCER ORDEN — BN × GR-11
PUNTO DE NIVELACION ACOTADO (METROS)

REPRESENTACION DEL RELIEVE

CURVA DE NIVEL ACOTADA EN METROS
CURVA DE NIVEL ORDINARIA
CURVA DE NIVEL AUXILIAR
CURVA DE NIVEL APROXIMADA
DEPRESIONES, COTA FOTOGRAMETRICA EN METROS

RASGOS HIDROGRAFICOS

CORRIENTE PERENNE, CORRIENTE INTERMITENTE
MANANTIAL, CORRIENTE QUE DESAPARECE
RAPIDOS, SALTO DE AGUA

ADAS

ENSOS, AGRICULTURA
LAGUNA INTERMITENTE
SUJETO A INUNDACION

ESCALA 1:50,000

1 2 3 4 Kilómetros

ESCALA 1:50,000

UIDISTANCIA ENTRE CURVAS DE NIVEL: 20

CUBRIMIENTO FOTOGRA

LINEAS	
09 (03-10)	+ +
10 (20-12)	+ +
11 (02-09)	+ +

1974 ZONA 56 1:70

VARIACION MAGNETICA ANUAL 3' EN DIRECCION OESTE

LOS VALORES DE CONVERGENCIA Y DECLINACION SEÑALADOS FUERON CALCULADOS PARA EL CENTRO DE LA HOJA

INDICE DE HOJAS ADYACENTES

H13C24	H13C25 Estación el Molino	H13C26 La Esperanza	H13C27 El Refugio
H13C34	H13C35 El Carrizalillo	H13C36 Ojo Laguna	H13C37 Nuevo Porvenir

Correspondence

Center for Nuclear Waste Regulatory Analyses

6220 CULEBRA ROAD • P.O. DRAWER 28510 • SAN ANTONIO, TEXAS, U.S.A. 78228-0510
(210) 522-5160 • FAX (210) 522-5184

January 12, 1993

Melanie Barnes
Department of Geoscience
Texas Tech University
Lubbock, TX 79409-1053

Dear Melanie,

I hope you had a good holiday season and are back in the thick of the academic session. I have already sent a total of 40 rock samples for chemical analysis by ICP for the major elements (Si, Ti, Al, Fe, Mn, Mg, Ca, Na, K, P), and for trace elements (Sr, Zn, Y, Nb, Ba, Sc, Cr, Ni, Cu, Zr; Rb by flame atomic emission), and for FeO by titration. Four of the samples require powdering. Please also determine LOI if enough material is present to complete the analysis. I have enclosed two tables which indicate which analyses are to completed for each sample. Please return remaining sample powders to me. The samples will be paid by two separate requisitions (# 850679, I don't have the second requisition number for the second batch of 15 samples) through our purchasing department. I would like to have these analyses accomplished by mid-February (12th). Please send me the results at your earliest convenience.

I have also included two tables which outline your performance on the water samples you analyzed for me back in May of 1992. For the most part they are okay, accept for the Na analyses which appear to be systematically too low by a factor of 20. It might be advisable to measure Na in water samples by AAS, where the sensitivity and reproducibility is much improved. Anyway, thanks for all your help in these analyses. I hope that somehow we can get together to discuss the ongoing work on both the natural analog work in Mexico and Santorini Greece. If you are interested, we could present our work to your department as a seminar. Best of luck in the New Year!

Sincerely,

Bret Leslie

Bret W. Leslie, Ph.D.
Research Scientist

Washington Office • Crystal Gateway One, Suite 1102 • 1235 Jefferson Davis Hwy. • Arlington, Virginia 22202-3293

Na analyses with concentrations in ppm.

Sample Identification	CNWRA and SwRI	TEXAS TECH
31992-2	16.1 & 14.6	0.8
31992-4	236	12
31992-6	19.8	1.0
31992-10	19.2	1.0
31992-11	0.89	0.0
31992-12	90.7 & 84.2	5.3

Note that 31992-6 and 31992-10 are duplicates and that water sampled from the same location one year previous is sample 31992-2. Sample 31992-11 is QC sample whose true Na concentration is 0.89 ppm.

Major and trace element analyses (ppm) versus QC samples (ICP-19 and ICP-7).

Element	ICP-19	31992-7	31992-9	ICP-7	31992-11
Si		5.0	2.7	0.53	1.3
Ti	1.00	0.9	0.9		
Al		0.1	0.0	1.00	1.0
Fe	1.00	1.0	1.0		
Mn	1.00	1.1	1.0		
Mg	1.00	0.9	1.0		
Ca	1.00	1.0	1.0		
Na		0	0.0	0.89	0.0
K		0	0.0	10.0	9.4
P		0	0.0		
Sc		0.0	0.0		
V	1.00	1.4	1.4		
Cr	1.00	1.2	1.2		
Ni	1.00	0.7	0.7		
Cu	1.00	1.4	1.4		
Zn	1.00	0.9	0.9		
Nb		0.3	0.3		
Y		0.2	0.2		
Zr		0.3	0.3		
Ba		0.0	0.0	1.00	0.9
Sr		0.0	0.0		
Pb	1.00	0.95	0.95		

October 8, 1991

Mary Rebecca Riddle
Supervisor, Trace Metals Laboratory
Department of Environmental Sciences
Chemistry and Chemical Engineering Division
Southwest Research Institute

Dear Becky,

Enclosed are 7 fluid samples for chemical analyses by ICP for the major elements (Si, Ca, K, Mg and Na), and trace elements (Al, Ba, Cd, Cr, Cu, Fe, Mn, Ni, Pb, and Sr). 4 of the samples have been acidified (10 ml nitric acid/liter sample) and filtered (CT-1, CT-2, EM-1-1, BH-12-1). The other three samples were similarly acidified, but were not filtered, and thus require digestion prior to analysis (CT-3, EM-1-2, BH-12-2).

Additionally, I have enclosed 4 fluid samples for chemical analyses by ion chromatography for the following anions: fluoride, chloride, nitrate, phosphate, and sulfate. These samples were not acidified, but were filtered (EM-1-3, BH-12-3, AN-1, AN-2).

I would like to have these analyses accomplished within 2 weeks of your receipt of the samples. These analyses should be charged to account # 20-3704-063. If you have any questions don't hesitate to call me at extension 5077.

Please send me a copy of your current analytical procedures for our QA records, along with your results.

Please return the remaining sample fluids to me.

Sincerely,

Bret W. Leslie, Ph.D.
Research Scientist

FAX

Texas Tech University
Department of Geosciences
Box 41053
Lubbock, TX 79409-1053
Tel: 806-742-3102
Fax: 806-742-0100

—2049

Date: 4 May 92

To: Dr. Bret Leslie

Fax: (512) 522 5155

 # Of Pages (including cover) 2

Dear Bret,

Miracles do occur. Enclosed find analyses for 12 water samples minus lead. There is still a hold up in the other lab. I hope to be successful by Wed. Samples and water procedure and price list to follow via mail. Hope all is well with you and your research.

Melanie.

Melanie Barnes
Texas Tech University

Broadway & University
Science Building
Room 125
Lubbock, Texas 79409

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Melanie

SOUTHWEST RESEARCH INSTITUTE

6220 CULEBRA - SAN ANTONIO, TX 78238-5166

(512) 684-5111

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DATE: 1/11/93

PRIOR TO REPAIR OF ANY ITEM MENTIONED BELOW, PLEASE CONTACT 512/522-3074 WITH ESTIMATE AND FOR P.O. NO.

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TEXAS TECH UNIVERSITY

ATTN: MELANIE BARNES
SCIENCE BLDG.

BROADWAY & UNIVERSITY

ROOM 125

LUBBOCK, TX 79409

VENDOR PHONE NO. 806/742-2049

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Circle specific method of shipment by Air Freight or UPS

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AIR FREIGHT (PRIORITY AIR GENERAL CARGO)	☐	☐
UPS (1 day, 2 days or 7—10 days)	☐	☐
FEDERAL EXPRESS (1 day, 2 days)	☒	☐
OTHER	☐	☐

PPD. ☒ COLL ☐	INSURE FOR $	DECLARED VALUE $	GOVT. PROJ. ☐	DEPT. NO.	PURCHASE ORDER NO. 850679 — 850686

AIR BILL OR W/B NO.	ACCT. OR PROJECT NO.	SWRI REQ. NO.	RETURN INITIATED BY	EXT.

	rock samples	

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NO. OF PACKAGES	TYPE OF PACKAGE ☐ BOX ☐ CTN ☐ DRUM ☐ _____	WEIGHT	DIMENSIONS

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MEMORANDUM

LOG-IN

DATE : 03-26-92

TO: SEE DISTRIBUTION BELOW

FROM: JIM TAYLOR Division 01 Log-in Approved J. Boyd:

RE: NEW LOGIN PROCEDURES FOR SAMPLES BROUGHT INTO LOGIN

Starting April 1, 1992 all samples brought to Log-in for any analysis will have to be accompanied by the **Request For Analysis** form (see attached). When samples are brought to Log-in, the person delivering them or the Project Manager, MUST fill out the form. The form will be available in the Log-in area file on the counter. No workorder will be issued without this form being completed and given to Log-in personnel. The purpose of this is to assure the Project Manager that the proper QC analytical and reporting requirements will be adhered to. If you have any questions, please see me or Jo Ann Boyd.

cc.
Johnson, D.
Hsu
Boyd
Schattenberg
Villalobos
Pan
Saenz
Scheller
Riddle
Brewer
Camann
Harding
Geary
Bunting
Wheeler
Tan
MacNaughton
Merritt
Geno
Cummins
Atiyeh
Shull
Barajas
Kohl, K (08)
Magott, R (57)
Manaktala (20)
Bendele (08)
Leslie (20)
Price (42)
Perez (08)
Marr (02)
Windhorst (08)
Goodrich (08)
Switzer (01)
Miller, R (42)

Scientific
Notebook Pages

02/46

11/4/91 BWL

Received results from Becky Riddle for ion chromatography & IC P analyses of Knowns & Peña Blanca fluids
Results (xerox copies) are below for total Metals & pg 47 for anions

Total Metals Analysis-Table 1
20-3704-063
All Results in PPM

*	BLK	PSPK %R	CT-3	EM-1-2	EM12(DUP)
AL	<0.10	91	1.74	0.12	0.078
BA	<0.058	98	<0.058	<0.058	<0.058
CD	<0.006	97	<0.006	0.013	0.013
CR	<0.011	102	0.18	<0.011	<0.011
CU	<0.020	100	0.098	<0.020	<0.020
FE	<0.022	99	<0.022	0.075	0.069
MN	<0.007	102	<0.007	0.073	0.073
NI	<0.036	116	0.19	<0.036	<0.036
PB	<0.001	116	1.07	<0.001	<0.001
SR	<0.011	105	5.16	0.11	0.092
SI	<0.11	85	<0.11	23.1	23.2
CA	<1.1	91	9.6	25.0	25.6
K	<1.1	90	3.2	10.4	10.9
MG	<1.1	68	<1.1	<1.1	<1.1
NA	<1.1	71	<1.1	83.7	86.4

Total Metals Analysis-Table 2
20-3704-063
All Results in PPM

*	BLK	PSPK %R	BH-12-2	BH-MS%R	MS LEVEL
AL	<0.10	91	4.75	145	2.0
BA	<0.058	98	<0.058	99	1.0
CD	<0.006	97	<0.006	95	0.10
CR	<0.011	102	<0.011	99	0.10
CU	<0.020	100	0.022	96	0.20
FE	<0.022	99	0.78	125	0.10
MN	<0.007	102	0.60	73	0.10
NI	<0.036	116	<0.036	106	0.10
PB	<0.001	116	0.036	111	0.50
SR	<0.011	105	0.22	109	0.50
SI	<0.11	85	22.4	104	5.0
CA	<1.1	91	65.0	56+	10.0
K	<1.1	90	6.1	89	10.0
MG	<1.1	68	<1.1	97	10.0
NA	<1.1	71	13.8	82	10.0

+SAMPLE GREATER THAN 4X SPIKE VALUE

11/4/91 Anion Results
BWL

Anion Analysis Summary
20-3704-063
All Results in PPM

SAMPLE	FLUORIDE	CHLORIDE	PHOSPHATE	NITRATE	SULFATE
EM-1-3	3.31	26.5	<0.10	4.13	330
BH-12-3	1.57	3.00	<0.10	2.48	733
AN-1	<0.05	<0.05	<0.10	<0.50	<0.5
AN-2	<0.05	<0.05	<0.10	<0.50	<0.5
MS %R	81	102	116	97	89
MS LEVEL	0.20	0.20	1.0	0.33	2.0
BLANK	<0.05	<0.05	<0.10	<0.50	<0.50

Dissolved Metals Analysis
20-3704-063
All Results in PPM

*	BLK	CT-1	CT-2	EM-1-1	BH-12-1
AL	<0.094	1.86	1.85	<0.094	0.173
BA	<0.053	<0.053	<0.053	<0.053	<0.053
CD	<0.005	<0.005	<0.005	0.050	<0.005
CR	<0.010	0.232	0.228	<0.010	0.020
CU	<0.018	0.081	0.086	<0.018	0.032
FE	<0.020	<0.020	<0.020	<0.020	<0.020
MN	<0.006	<0.006	<0.006	0.054	0.187
NI	<0.032	0.193	0.194	<0.032	<0.032
PB	<0.10	0.89	0.88	0.12	<0.10
SR	<0.010	5.38	5.08	<0.010	0.207
SI	<0.10	<0.10	<0.10	10.2	6.53
CA	<1.0	9.5	9.8	25.5	57.7
K	<1.0	2.8	2.8	10.2	1.5
MG	<1.0	<1.0	<1.0	<1.0	<1.0
NA	<1.0	<1.0	<1.0	84.2	<14.6

ALL METALS RESULTS OBTAINED BY ICPAES EXCEPT LEAD FOR TOTAL ANALYSIS. TOTAL LEAD WAS ANALYZED BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROPHOTOMETRY.

12/23/91

Division 1 (SwRI) Chemical Analyses

Knowns, accuracy and precision

Cations	Known concentration (ppm)	Dissolved CT-1	Dissolved CT-2	Total CT-3	Accuracy %	Precision %	IDL
~~(micromole/l)~~ BWL 12/23/91							
Na	2	<1	<1	<1.1	>50		1.0
K	4.07	2.8	2.8	3.2	40.00	0	0.8
Ca	10	9.5	9.8	9.6	3.50	21.21	1.3
Mg	6.85	<1	<1	<1.1	>85		1.2
Sr	4.99	5.38	5.08	5.16	4.81	21.21	
Al	2	1.86	1.85	1.74	7.25	0.71	0.94
Si	0	<0.1	<0.1	<0.11			
Ba	1.32	<0.53	<0.53	<0.058	>60		0.053
Cd	0	<0.005	<0.005	<0.005			0.005
Cr	0.2	0.232	0.228	0.18	15.00	0.28	0.010
Cu	0.1	0.081	0.086	0.098	16.50	0.35	0.018
Fe	0.09	<0.02	<0.02	<0.022	>77		0.020
Mn	0.1	<0.006	<0.006	<0.007	>94		0.006
Ni	0.2	0.193	0.194	0.19	3.25	0.07	0.032
Pb	1.02	0.89	0.88	1.07	13.24	0.71	0.20

Accuracy is average of CT-1 and CT-2 divided by known concentration subtracted from one and then multiplied by 100

Precision is the standard deviation of the CT-1 and CT-2 measurements

IDL is instrument detection limit for ICP analysis by EPA methods 200.7 & 3015 in ppm.

BWL/12/23/91

The results of the chemical analyses of fluid samples collected in September 1991 from the Peña Blanca analyzed by Division 1 were presented on pgs 46 & 47. The above table on pg 49 addresses the accuracy and precision of the measurements for cations by Div 1. Unfortunately a similar analysis of the anion results is not possible since the knowns samples submitted to the division were below detection limit. A mistake in the dilution calculation was the cause of this error. To test the accuracy of their anion results sulfate will be measured. Similarly since the known cation samples CT-1 → CT-3 did not have a known Si BWL 12/23/91 concentration Si will be analyzed according to TOP-014. ~~The accuracy of the Na analysis is not constrained as no known concentration of Na was in cation standards (CT-1, CT-2, CT-3) in contradiction to the value of 2.00 ppm Na stated on pg 42.~~ BWL 12/23/91 Spex standard MIXSTD 4 contains 200 ppm Na (200 ug/ml) and was used in making CT-1, CT-2, & CT-3 (see pg 42) so accuracy calculation above ~~are~~ BWL 12/23/91 is okay for Na.

Since the Na concentration is important in the system Na measurements by the electrode measurement currently used in the sorption project will be used. The sample concentrations on pages 46-47 have not been corrected for dilution by acid. A summary of sample bottle numbers, sample identification, filtration used, and acidification scheme, & dilution factors are presented below. Note that CT-3 total standard have been digested by microwave (Method EPA 3015) prior to analysis by ICP (Method EPA 200.7).

Samples for Silica, Anions, alkalinity BWL 12/23/91, and dissolved metals were filtered in the field using a paper filter of qualitative grade. These samples (except alkalinity BWL 12/23/91) were then refiltered at CNWRA through 0.45 μM filter on 9/30/91.

EM = El Mesquite BH = borehole - 12 is borehole #12

Sample Bottle Number	Sample Designation	Type of Sample	Dilution Factor @	Filtered 0.45um	Acidified
#10	EM-10	Alkalinity			
#13	EM-13	Silica		✓	
#22	EM-1-3	Anions		✓	
#27	EM-1-1	Dissolved Metal	1.0106	✓	✓
#31	EM-1-2	Total Metal	1.0095		✓
#19	BH-12-19	Alkalinity			
#18	BH-12-18	Silica		✓	
#7	BH-12-3	Anions		✓	
#26	BH-12-1	Dissolved Metal	1.0154	✓	✓
101.37	BH-12-2	Total Metal	1.0145		✓

@ Dilution Factor should be multiplied to measured results to get actual concentration. This factor corrects for the volume of acid added and is derive from table on pg 38

$$Df = \frac{1}{\frac{\text{Sample Wt}}{\text{Sample wt + acid wt}}} = \text{Dilution factor}$$

Si analysis of Peña Blanca Samples

I will take aliquots of EM-13, EM-1-1, BH-12-18, BH-12-1 and analyze them for silica. I expect Si concentrations to be 5-25 ppm. EM-1-1 & BH-12-1 represent acidified and filtered samples, while EM-13 & BH-12-18 have been filtered but not ~~acidified~~ (BWL 12/23/91) acidified.

These analyses will be performed using the heteropoly blue method outlined in TCP-C14.

This requires that concentrations lie between 50 ppb - 2.5 ppm. I will need to dilute my samples be at least a factor of 10. Similarly standards need to be diluted to the appropriate concentration range.

Standards will be in ppb 0, ~175, ~350, ~877, 1750 which requires 0, 1, 2, 5, 10 ml of 10 ppm Si solution diluted to 57 ml total volume.

Standard solution is 10ppm	GC-03/234
HCl reagent	GC-03/234
Ammonium molybdate	GC-03/234
Oxalic acid	GC-03/234
Reducing agent	GC-03/234

Samples will all be 1 ml to 57 ml total volume diluted to 50 ml with nanopure H_2O.

STD	CONC ppb	ABS	ID#		CONC	ABS
0	0	-.004	1	EM-13 DUP	1040	.352
1	175.44	.057	2	EM-13	1033	.349
2	350.88	.118	3	EM-1-1	1009	.341
3	877.19	.300	4	BH-12-1	689	.232
4	1754.39	.593	5	BH-12-18	665	.224

BWL

12/27/91
BWL

```
815.0NM -164.*C
815.0NM -.008*A
STD #    ABS    CONC

 1     -.004   .0000
 2      .057   175.4
 3      .118   350.9

 4      .300   877.2
 5      .593   1754.

LINEAR FIT
NOT THRU ZERO
SLOPE            2937.
INTERCEPT        7.381

CORR COEF      1.0000
 ---------------- ID# 1      TST24
 815.0NM      1041. C

 ----------------   815.0NM   .352*A
ID# 2      TST24
 815.0NM      1033. C

 ----------------   815.0NM   .349*A
ID# 3      TST24
 815.0NM      1009. C

 ----------------   815.0NM   .341*A
ID# 4      TST24
 815.0NM       689. C

 ----------------   815.0NM   .232*A
ID# 5      TST24
 815.0NM       665. C

 ----------------   815.0NM   .224*A
```

Results of Si analyses
The raw data are presented at the left and the identity of samples is at bottom of pg 51.

Duplicate samples (#1 & #2) are within 1%.
There is no consistent difference between the acidified & filtered samples and the filtered samples. Correction for dilutions appears below with a comparison of the results to that of Div #1 analyses.

Sample ID	Measured Concentration (ppm)	Analysis Dilution	Acid Dilution (pg 50)	Final Concentration (ppm)	Div 1 Final Conc. (ppm)
EM-1-1	1.009	57	1.0106	58.12	10.31 ~~23.40~~ BWL 12/27/91
EM-13	1.033	57		58.88	
EM-13 DUP	1.041	57		59.33	
BH-12-1	0.689	57	1.0154	39.88	6.63 ~~22.4~~ BWL 12/27/91 ~~22.74~~ BWL 12/27/91
BH-12-18	0.665	57		37.91	

The Si analyses of DIV are thus suspect and we will use the following values for EM and BH12 for Si in ppm which represent the average of duplicate samples & the unacidified results
EM = E1 Mesquite = 59.11 ppm Si BH-12 = 37.91 ppm Si

12/27/91 SO_4 analysis

Using the Turbidimetric method (426.C) from the standard methods of chemical analysis of waters and waste waters. It is based on light absorbance due to $BaSO_4$ suspension.

Standards and solutions should be between 0-40 mg/L

Reagents:

1) Buffer A — Dissolve 30 g $MgCl_2 \cdot 6H_2O$ magnesium chloride
5 g $CH_3COONa \cdot 3H_2O$ sodium acetate
1.0 g KNO_3 potassium nitrate
20 ml CH_3COOH (99%) acetic acid

into 500 ml nanopure H_2O dilute to 1000 ml.

2) Standard SO_4 solution

1.00 ml = 100 ug SO_4^{2-} ⇒ 100 ppm SO_4^{2-}

0.1479 g Na_2SO_4

actual wt = 0.1477 g ⇒ 99.86 ppm SO_4^{2-}

Dilution of primary sulfate standard completed using volumetric flasks and pipets (glass).

ID #	Conc	Abs
1	24.97	.230
2	19.97	.208
3	14.98	.170
4	9.99	.114
5	0	.002

BH-12-3 2 ml ⇒ 100 ml .002

BH-12-3 Dup 10 ml ⇒ 100 ml .002

a bust so the samples are either way off or there is a matrix problem so will have to rerun

BW

SO_4 Analysis Redo

12/28/91

ID #	Conc	Abs
1	24.97	.253
2	19.97	.205
3	14.98	.153
4	9.99	.083
5	4.99	.036
6	0	-.001

Using 0.5, 1, 2 pipets diluted standard pg 53 to 10 ml with nanopure H_2O to get ~ 0, 5, 10, 15, 20, 25 ppm SO_4 Then added 2 ml Buffer & ~.2 g $BaCl_2 \cdot 2H_2O$

				Dilution Factor	conc ppm	
Dilution 3→10	EM-1-3	13.68	.134	3	41.04	
"	EM-1-3 DUP	12.68		3	38.04	BWL 12/28/91
"	BH-12-3	12.07	.117	3	36.21	
"	BH-12-3 DUP	11.64	113	3	34.92	
	EM-10 no Ba	1.55	.005	0	1.55	see below
	BH-12-19 no Ba	1.74	.007	0	1.74	
3→10 Dilution	EM-10 w/Ba	11.28	.109	3	33.84	
2→10 Dilution	BH-12-19 w/Ba	7.55	.069	2		

The observation of 12/27/91 suggested that ~~soil~~ 12/28/91 BWL SO_4^{2-} concentrations were probably less than 50 ppm so that samples probably will only have to be diluted by a factor of 2-5.

Samples EM-10 & BH-12-19 were not filtered through 0.45 um filter so that they needed to be corrected for turbidity blank.

This corresponds to a decrease of the absorbance by 0.0015 for sample EM-10 w/Ba and 0.0014 for BH-12-19 w/Ba

Thus absorbance for

			SO_4 ppm
EM-10	.1075	⇒	11.16
BH-12-19	.0676	⇒	7.41

conc = slope (abs) + intercept

conc = 94.13 (abs) + 1.045

Correction for dilution is as follows = $\dfrac{\text{measured conc}}{\left(\dfrac{\text{sample volume}}{\text{total volume}}\right)}$

12/28/91

Sulfate Analysis
12/28/91
BWL

```
Err5  -.7*C
ID# 7

 420.0NM        -.7*C
ID# 1----------
 420.0NM       .000*A
  ----------------
```

Blank Absorbance

1	.253	24.97
2	.205	19.97
3	.153	14.98
4	.083	9.990
5	.036	4.990
6	-.001	.0000

```
LINEAR FIT
NOT THRU ZERO
SLOPE            94.13
INTERCEPT        1.045

CORR COEF        .9968
  ----------------  ID# 1
 420.0NM      13.68*C

  ----------------  ID# 2
 420.0NM       .134*A
  ----------------
ID# 3
 420.0NM      12.68*C
  ----------------    ----------------
ID# 5
 420.0NM      12.07*C
  ----------------  ID# 6

 420.0NM       .117*A
  ----------------  ID# 7
 420.0NM      11.64*C

  ----------------  ID# 8
 420.0NM       .113*A
  ----------------
ID# 9
 420.0NM       1.55*C
  ----------------  ID# 10

 420.0NM       .005*A
  ----------------  ID# 11
 420.0NM       .007*A

  ----------------  ID# 12
 420.0NM       1.74*C
  ----------------
ID# 13
 420.0NM      11.28*C
  ----------------  ID# 14

 420.0NM       .109*A
  ----------------  ID# 15
 420.0NM       .069*A

  ----------------  ID# 16
 420.0NM       7.55*C
  ----------------
```

Sample	Concentration Sulfate (ppm)
EM-13	45.57
EM-13-DUP	42.27
EM-10 w/Ba	37.20
BH-12-3	40.23
BH-12-3-Dup	38.80
BH-12-19 w/Ba	37.05

Sample	Average Conc* Sulfate (ppm)
El Mesquite	44
Borehole 12	39

* average from filtered samples!

BWL

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COPY 024

031/24

3/19/92
BWL

Analysis of Water Samples by Texas Tech (Melanie Barnes)

The ICP lab at Texas Tech in the Geology department has previously analyzed rock samples for the Center and are a qualified supplier for these services. They have not yet analyzed natural waters for us by ICP methods. The SwPI division can not provide timely or precise & accurate results thus we will send these samples to Texas Tech.

Twelve samples are being sent these are as follows:

31992-1 : Reagent Blank
31992-2 : BH-12-1-1 9/27/91 Dissolved Metals Bottle #26
31992-3 : Bottle 39 Distilled H_2O from UACH, Mexico
31992-4 : SSS DP/E-2/R
31992-5 : CT-1 10/4/91
31992-6 : 92-3/BH-12 Bottle 41
31992-7 : ICP-19
31992-8 : Filter Blank
31992-9 : ICP-19
31992-10 : 92-3/BH-12 Bottle 42
31992-11 : ICP-7
31992-12 : EM-1-1 9/25/91

where first five digits (31992) is today's date,

These samples and standards have been prepared as follows:

31992-2 just a split from the Bottle #26 (022/32)
31992-5 just a split from CT-1 bottle (024/42)
31992-6 just a split from 92-3/BH-12 bottle #41 (035/10)
31992-10 just a split from 92-3/BH-12 bottle #42 (035/10)
31992-12 just a split from EM-1-1 Bottle 27 (022/26)
31992-4 a split of Uranium bearing mineral from Salt & Sea
This a test of their ability to measure dissolved ore material.
The mineral is sphene $CaTiSiO_4$ or allanite and represents 0.0064g dissolved into 250ml of acid solution (HCl)
31992-3 a split of Distilled H_2O from Bottle 39 (035/11)
acidified with 25ml HNO_3 (concentrated Lot# 910962) 1% v/v
and into 250ml volumetric flask.
31992-1 Bldg 57 Geochemistry Lab nanopure H_2O with
5% v/v HCl (Lot FL-02-0786) 25ml with TD graduated cylinder
1% v/v HNO_3 (Lot 910962) 5ml with oxford pipet.
to 500ml nanopure in volumetric flask

3/19/92 BWL

3 1992-B Nanopure H_2O thru filtration device used in the field with 0.45 um filter. Acidified with HNO_3 1% v/v ~~Lot# 910962~~ BWL 3/19/92 Lot # 910962 2.5 ml with oxford pipet to 250 ml in volumetric flask

1+1 HNO_3 solution made with 10 ml HNO_3 Lot#910962 + 10 ml H_2O nanopure delivered with pipet oxford.

1+1 HCl solution made with 25 ml HCl Lot FL-02-0786 in TD graduated cylinder to 50 ml in volumetric with nanopure H_2O

3/20/92 BWL

Oxalic acid reagent to reduce and dissolve Fe-oxides from quartz crystals
Based upon oxalic reagent in silica analyses
it was determined to make an acid solution in excess of 0.5M oxalic acid.
Weighed 37.5g oxalic acid (Lot # 905504) on top loading into 450ml nanopure, stirred (magnetic slight heat) poured and rinsed quantitatively to 500ml in volumetric flask

Finishing up the ICP samples for Texas Tech

31992-7: split of ICP-19 standard made from SPEX QC sample ICP-19. This QC sample is made by adding 10ml of 1+1 HCl solution (031/25) and 1ml of 1+1 HNO_3 (031/25) to an acid-washed 100ml volumetric flask and transfering 10.0 ml (volumetric pipet) into flask and diluting to 100ml with nanopure.
31992-9: this a duplicate formulation of 31992-7 i.e. the whole procedure was repeated. The SPEX sample is QCS-ICP and is from Batch 822 & lot 7659 and is a U.S EPA calibrated solution of multielements
31992-11 is ICP-7 made from SPEX QC sample ICP-7 as part of QCS-ICP standard set. It is an EPA calibrated multielement quality control sample. It from lot 6762 and is Batch 839. It is made by 10ml 1+1 HCl solution 2ml 1+1 HNO_3 (lot 031/25) into 100ml volumetric flask and adding 1.0 ml of ICP-7 using calibrated pipet (1.00ml) and diluting to 100ml with nanopure water.

The true values for ICP-19 and ICP-7 solutions are opposite page.

ICP-19 Solution

Analyte		True Value, mg/liter	31992-7 measured value	31992-9 measured value
Arsenic	As	1.00		
Beryllium	Be	1.00		
Calcium	Ca	1.00	1	1
Cadmium	Cd	1.00		
Cobalt	Co	1.00		
Chromium	Cr	1.00	1	1
Copper	Cu	1.00	1	1
Iron	Fe	1.00	1	1
Magnesium	Mg	1.00	1	1
Manganese	Mn	1.00	1	1
Molybdenum	Mo	1.00		
Nickel	Ni	1.00	1	1
Lead	Pb	1.00		.95
Antimony	Sb	1.00		
Selenium	Se	1.00		
Titanium	Ti	1.00	1	1
Thallium	Tl	1.00		
Vanadium	V	1.00	1	1
Zinc	Zn	1.00	1	1

ICP-7 Solution

Analyte		True Value, mg/liter	31992-11 measured value 5/4/92 BWL
Silver	Ag	1.00	+
Aluminum	Al	1.00	1
Boron	B	1.00	
Barium	Ba	1.00	1
Potassium	K	10.0	9
Sodium	Na	0.89	0
Silicon	Si	0.53	1

7/15/92 OCL

THE SODIUM CONCENTRATION IN SIX SAMPLES HAS BEEN DETERMINED USING THE PERKIN ELMER, MODEL 3100, ATOMIC ABSORPTION SPECTROPHOTOMETER. STANDARD CONDITIONS FOR SODIUM ANALYSIS WAS DETERMINED BY LOOKING THROUGH THE TEXT OF "ANALYTICAL METHODS FOR ATOMIC ABSORPTION SPECTROPHOTOMETRY" WHICH STATED THE CONDITIONS FOR WAVELENGTH, FLAME TYPE, AND ETC.. THE OPTIMIZATION AND INSTALLATION OF THE LAMP, FLAME, AND THE PROCEDURES FOR STANDARD CALIBRATION ~~WAS~~ WERE TAKEN FROM THE MANUAL

9/10/92 OCL

RUNNING THE 3100 OPERATING INSTRUCTIONS. (PARTS 5 AND 6)

SOLUTION PREPARATION OF STANDARDS FOR CALIBRATION IS AS FOLLOWS:

- 1 ppm Na^+ SOLUTION - 1 mL OF SODIUM REFERENCE SOLUTION (LOT# 913671-24) WAS ADDED TO A CLEANED TC 1000 mL VOLUMETRIC FUSK AND NANODURE H_2O WAS ADDED TO THE 1 L MARK. .1% KCL (LOT # 885967) WAS FINALLY ADDED.

- 5 ppm Na^+ SOLUTION - 5 mL OF SODIUM REFERENCE SOLUTION (LOT # 913671-24) WAS ADDED TO A CLEANED TC 1000 mL VOLUMETRIC FUSK AND NANOPURE H_2O WAS ADDED TO THE 1L MARK. .1% KCL (LOT # 885967) WAS FINALLY ADDED.

- 10 ppm Na^+ - 1 mL OF SODIUM REFERENCE SOLUTION (LOT # 913671-24) WAS ADDED TO A CLEANED TC 100 mL VOLUMETRIC FUSK AND NANOPURE H_2O WAS ADDED TO THE 100 mL MARK. .1% KCL (LOT # 885967) WAS FINALLY ADDED.

7/15/92 TO EACH SAMPLE SOLUTION, .1% KCL WAS ADDED. THE FOLLOWING TABLE SHOWS THE DILUTION FACTOR NEEDED TO MEASURE EACH SOLUTION ON THE ATOMIC ABSORPTION SPECTROPHOTOMETER, AND THE FIRST READING IS THE READING BY THE ATOMIC ABSORPTION SPECTROPHOTOMETER. THE FINAL COLUMN IS THE ACTUAL SODIUM CONCENTRATION TAKING INTO ACCOUNT THE DILUTION FACTOR ~~BY~~ FOR EACH SAMPLE. 7/15/92

Na^+ concentration of various samples

SAMPLE	SAMPLE DILUTION	CONCENTRATION READOUT	ACTUAL CONCENTRATION
31992 - 2	1:10	1.61	16.1 ppm
31992 - 4	1:100	2.36	236 ppm
31992 - 6	1:10	1.98	19.8 ppm
31992 - 10	1:10	1.92	19.2 ppm
31992 - 11	—	.89	.89 ppm
31992 - 12	1:10	9.07	90.7 ppm

OCL PREPARATION OF CHEMICAL REAGENTS FOR U-SERIES MEASUREMENTS:

ACID PREPARATION AS FOLLOWS:

9M HCL IN labeled 2L glass bottle (cleaned with HNO_3 and rinsed with nanopure H_2O). 512 mL OF Nanopure H_2O is measured out in a 500 mL and 25 mL TD GRADUATED cylinders and poured into the cleaned glass bottle. Next, 1488 ml of HCL (LOT # FL-02-0786) [12.1N] IS ADDED INTO THE

Cations

[redacted]

$BaCl_2 \cdot 2H_2O$ MW = ~~226.236~~ 244.2360

Ba MW = 137.33

g Ba / g $BaCl_2 \cdot 2H_2O$ ~~1000g/g~~ .5623 g/g ⇒ 1.7785 g ⇒ 1 g Ba

= 0.0018 g $BaCl_2 \cdot 2H_2O$ into 1000 ~~ppm~~ DIW ⇒ 1000 ppm Ba

$\overbrace{CaCl_2 \cdot 2H_2O}^{106.906}$ MW = 146.986 g Ca / g $BaCl_2 \cdot 2H_2O$ = .2727 ⇒ 3.6673 g CaCl = 1 g Ca

Ca MW = 40.08

$CuCl_2 \cdot 2H_2O$ MW = 170.452

MW Cu = 63.546 .3728 g Cu / g Cl_2 ⇒ 2.6823 g $CuCl_2 \cdot 2H_2O$ = 1 g Cu

[redacted]

106.359

$FeCl_3 \cdot 6H_2O$ MW = 270.296

MW Fe = 55.847 .2066 g Fe / Cl_3 ⇒ 4.8399 g Cl_3 ⇒ 1 g Fe

$MgCl_2 \cdot 2H_2O$ MW = 131.211

MW Mg = 24.305 .1852 g / Cl_2 5.3985 g Cl_2 ⇒ 1 g Mg

$KMnO_4$ MW 158.032

MW Mn = 54.938 ⇒ 0.3476 g Mn / KO_4 2.8766 g $KMnO_4$ = 1 g Mn

MW K = 39.0983 .2474 g K / KO_4 4.0419 g KO_4 = 1 g K

.8040 = 1000 ppm

KCl MW = 74.551

MW K = 39.098 .5244 g K / KCl 1.9068 g KCl = 1 g K

[redacted]

NaCl MW = 58.443

MW Na = 22.99 .3934 g Na / NaCl 2.5421 g NaCl = 1 g Na

Anions

[redacted]

mw NaF = 41.988

MWF = 18.998 .4525 gF/NaF 2.2101 g NaF = 1 g F

mw NaCl = 58.443

mw Cl = 35.453 .6066g Cl/NaCl 1.6485 g NaCl = 1 g Cl

$NaNO_3$ mw = 84.997

MNNO3 62.007 .7295 g $NaNO_3$/g $NaNO_3$ ⇒ 1.3708 g $NaNO_3$ = 1 g NO_3

Na_2PO_4 mw = 140.95

MW PO_4 = 94.97 0.6738 g PO_4/Na 1.4842 g Na_2PO_4 = 1 g PO_4

[redacted] SO_4 MW = 142

mw SO_4 = 96.02 .6762 g SO_4/Na 1.4789 g Na_2SO_4 = 1 g SO_4

[redacted]

F	.0022 g	1000 ml	0.50 ml
Cl	.0081 g	500 ml	1.03 ml
NO_3	.0071 g	500 ml	0.10 ml
PO_4	.0089 g	500 ml	0.10 ml
SO_4	.0073 g	500 ml	0.50 ml

1) Need to calibrate 1, 5, 25 ml vol pipette 10, ml
obtain 0.1 ml & 0.5 ml pipettes

2) obtain 1000 ml volumetric flask # = 13 cat working Standards

Ba, Fe, Mg, Mn, K, Na cations in HNO_3 work st anions

F, Cl, NO_3, PO_4, SO_4 anions

3) Sample Bottles 2 1 l & 2 500 ml

4) Conc HNO_3

Mixed Standard

10 ml of Spex mixed Std #4 1000ppm Ca
9.998 ml
400ppm K
200 ppm Al, Na
20 ppm Cr, Ni

.1 ml Cu Div 1 Std 1000 ppm Cu
4.9935 ml of 1000 ppm Sr
1.02 ml of 1000 ppm Div #1 Std Pb
0.0237 g $BaCl_2 \cdot 2H_2O$ 13,167 .1 ml
.0029 g $KMnO_4$ .1 ml

.0037 g $MgCl_2 \cdot 2H_2O$ 1370.4 4.995 ml
.0044 g $FeCl_3 \cdot 6H_2O$ .1 ml

Conc Actual	Element	ppm Conc
9.998	Ca	10
3.9992	K	4
1.9996	Al	2
1.996	Na	2
0.19996	Cr	.2
0.19996	Ni	.2
0.10	Cu	.1
4.994	Sr	5
1.02	Pb	1
1.317	Ba	
0.10	Mn	
0.073	K	
6.845	Mg	
0.092	Fe	
4.072	K_{total}	

Element	Reagent	Estimated conc.	(ppm) Limit of Detection	g of reagent in 1000 ml to give 1000 ppm = mg/l (1000)	(10,000)	ml of 1000 ppm to make x ppm in 1000 ml DIW
Al	1000 ppm Std 200 None	1	0.1	~~0~~	—	0
Ba	$BaCl_2 \cdot 2H_2O$	1	0.05	0.0018	0.0178	.1 ml of 10,000
Ca	1000 ppm sol 100 $CaCl_2 \cdot 2H_2O$	5	1.3	~~.0037~~	~~.0367~~	.5 ml of 10,000 or 5 ml of 1000
Cu	1000 ppm sol $CuCl_2 \cdot 2H_2O$	.1	0.02	~~.0027~~	~~.0268~~	.1 ml of 1000
Fe	$FeCl_3 \cdot 6H_2O$	.1	0.02	.0048		.1 ml of 1000
Pb	1000 ppm None	1	0.20	—	—	1 ml of 1000 solution
Mg	$MgCl_2 \cdot 2H_2O$	5	1.2	.0054	.027/500 .0540	.5 ml of 10,000 5 ml of 1000
Mn	$KMnO_4$	.1	0.01	.0029		.1 ml of 1000
K	KCl 400	5	0.8	.0019	.0191	.5 ml of 10,000 5 ml of 1000
Na	NaCl 200	10	1.0	.0025	.0254	1 ml of 10,000
Sr	$SrCl_2 \cdot 2H_2O$	5	ND	—	—	1 ml of 1000 ppm sol
Cr	1000 ppm solution					
Ni						
F	NaF	0.5	0.05	.0022	.0083	.5 ml of 1000
Cl	NaCl	10	0.10	.0016	.0165	1 ml of 10,000
NO_3	$NaNO_3$	1	0.20	.0014	.0137 .0069	.1 ml of 10,000
PO_4	Na_2PO_4	1	0.20	.0015	.0148	.1 ml of 10,000
SO_4	Na_2SO_4	5	0.50	.0015	.0148	.5 ml of 10,000
Br	None		0.50			
Si	1000 ppm Si	25	1 ppm			25 ml of 1000 ppm
Ni	20					
Cr	20					
	pipettes	need	1, 5 ml 25 ml	& .1 ml & .5 ml		

3/11/92
BWL

Since Todd Dietrich is running U today we will try to analyze the fluid collected from BH12 on the March trip. The fluid collection & preparation (filtering & acid) is given in Notebook 035 (B. Leslie's field notes). Dilution factor determination can be arrived at from notes on page 72 notebook 024 Nat. Analogs.

The sample will be measured using 10ml sample + 0.5ml 1.05M Tartaric acid/triethanolamine solution. TD ~~2/19/92~~ BWL 3/11/92 2/19/92

Calibrated pipet is 9.998 ml. 0.5ml pipet used to transfer solution

Sample number 92-3/BH-12/42 where 42 is the prenumbered book number. 2 samples will be taken for the U determination since U concentration maybe lower than 1ppm. 2 standard curves are used 1-5 ppm and ~~150 ppb - 1~~ BWL 3/11/92 100ppb - 1 ppm.

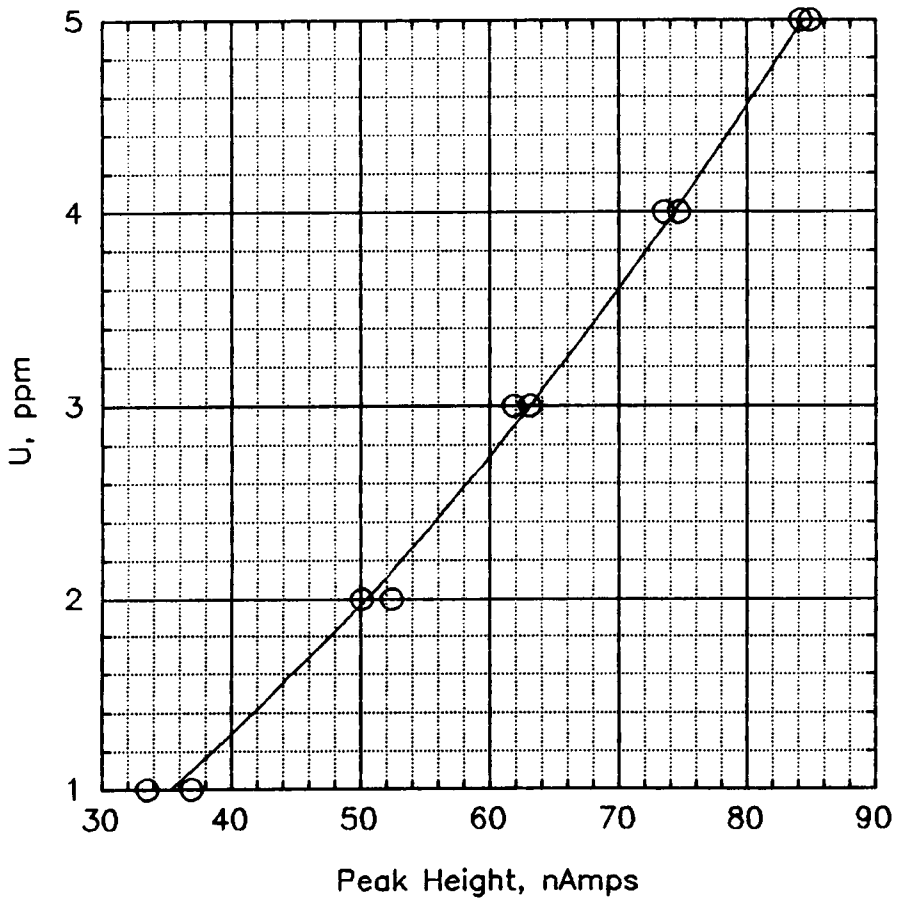
The first sample is 92-3/BH-12/42-1 1-5 ppm
& second 92-3/BH-12/42-2 100ppb - 1 ppm

Each sample is run twice
Results for 92-3/BH-12/42-1 are 1.21 ppm U & 1.53 ppm U
= 1.37 ppm U

Printout of results are stored in Binder #8 of Polarographic analysis of Uranium representing Samples #23 & #24

(Untitled): Wed, 11-Mar-92

	U, ppm 1	Peak Height 2	Regress. 2nd 3
1	1	33.5	-0.53246
2	1	36.9	0.027442
3	2	50.1	0.00045186
4	2	52.4	0
5	3	61.8	0
6	3	63.1	0
7	4	73.5	0
8	4	74.7	0
9	5	84.2	0
10	5	84.9	0
11			0
12			0.99838


5
4
3
2
1
U, ppm
30
40
50
60
70
80
90
Peak Height, nAmps

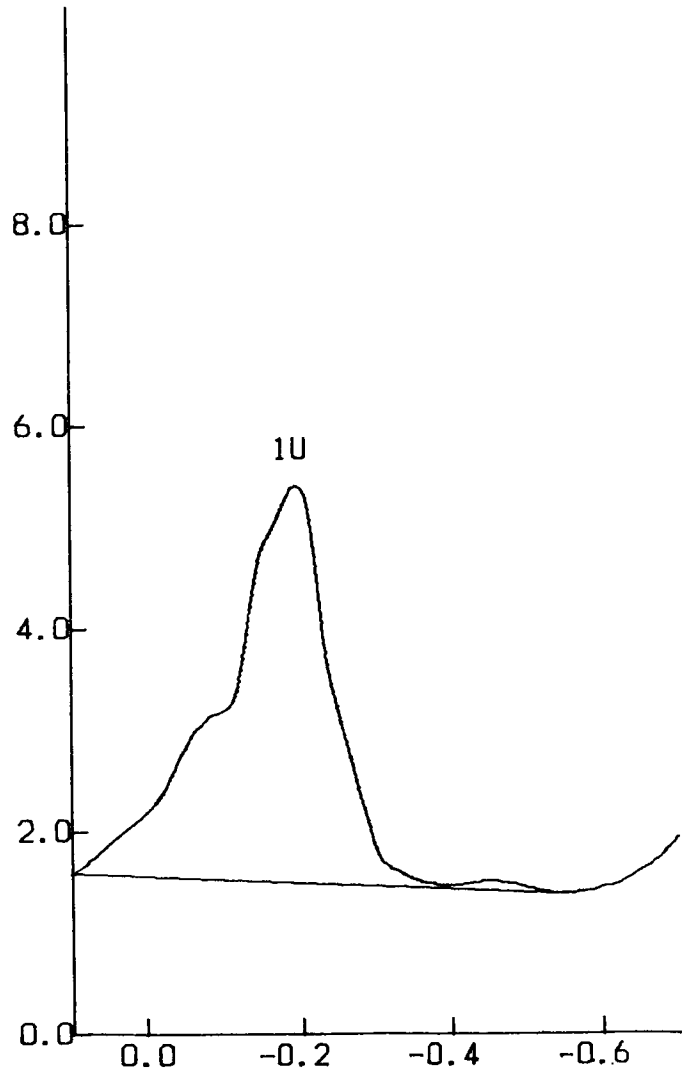
1st try

3/11/92

Sample 92-3/BH-12/42-1

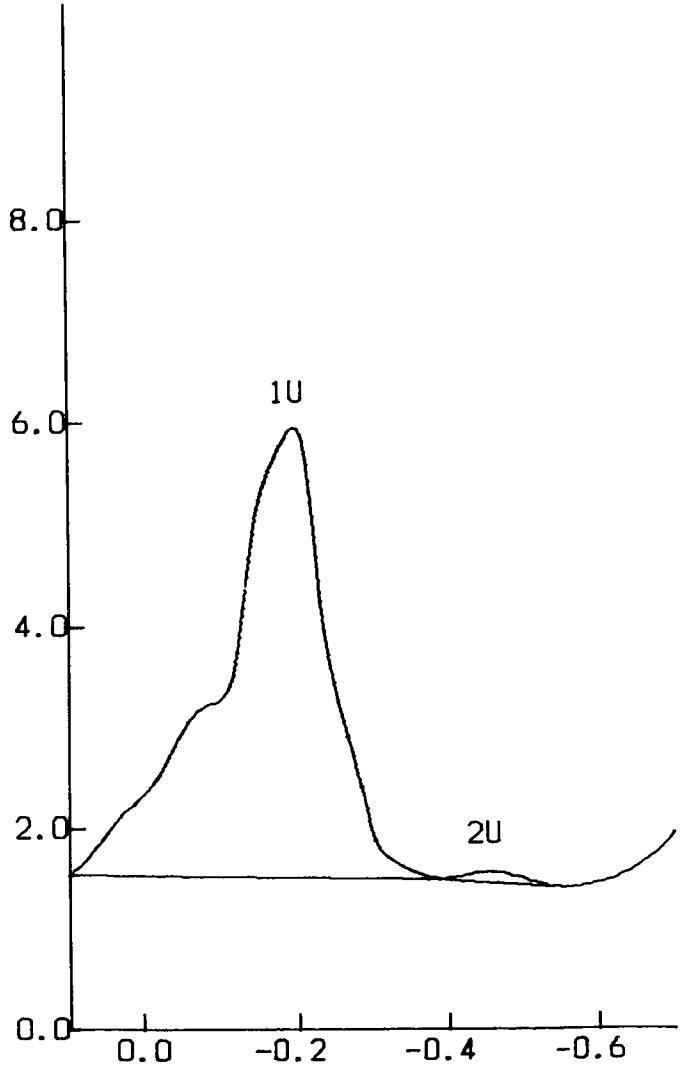
1.205 ppm U

Need to recalculate for dilution



CURRENT X 10^1 NA
11-MAR-92 CELL #1
STANDARD#1 DPS
SAMPLE # 23
INITIAL E 0.100 V
FINAL E -0.700 V

PEAK
1U -0.188V
3.868E1 NA



CURRENT X 10^1 NA
11-MAR-92 CELL #1
STANDARD#1 DPS
SAMPLE # 24
INITIAL E 0.100 V
FINAL E -0.700 V

PEAK
1U -0.188V
4.370E1 NA
2U -0.446V
0.950E0 NA

2nd try
3/11/92
Sample 92-3/BH-12/42-1

1.53 ppm U
need to recalculate
for
dilution

024/56

1/3/92 Bula Mueller reported that the polarographic
BWL analyses for U in the fluid samples from Penta Blanca
are EM1 = 0.225 ppm U & BH-12-1 = 2.21 ppm U
and the raw data & calculations can be found in
Polarographic Analyses of Uranium Binder Vol 6
12/14/91

Geochemistry Research
Laboratory Notebook

VOL. GC-05

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std	pk height nAmps run1	pk height nAmps run2	temp. °F
500 ppb	5.160EO	4.930EO	67.4
750 ppb	9.140EO	8.800EO	67.4
1500 ppb	2.015EI	2.008EI	67.5

Calibration curve: $y = 0.015x - 2.393$

sample	pk height nAmps run1	pk height nAmps run2	concn ppb	temp °F
ID#1a#U1#1	1.644EI	1.591EI	1240	67.7
#2	1.591EI	1.589EI	1220	67.8
ID#1b#U1#1	1.616EI	1.622EI	1240	68.0
#2	1.855EI	1.617EI		68.1
"	pk hgt, run3	1.630EI	1290	
ID#1a#U2#1	1.588EI	1.570EI	1210	68.1
1500 ppb std	2.058EI	2.040EI	1530	68.1
ID#1a#U2#2	1.621EI	1.609EI	1240	68.2
ID#1b#U2#1	1.644EI	1.581EI	1230	68.2
#2	1.685EI	1.657EI	1260	68.3
1500 ppb std	2.066EI	2.054EI	1530	68.2

All plots are stored in Polarographic Analysis of Uranium, Vol 5, 11-Dec-91, 0924 - 1630

12/14/91 BM 0910 Analyzed Pine Blanco water samples EM-1-1 and BH-12-1 for uranium

Uranium is present in these samples probably somewhere between 200 ppb and 2 ppm. Square wave voltammetry might be used to locate the uranium peak, or differential pulse polarography

will be used to determine how much uranium is present.

Equipment used:

EG&G Princeton Applied Research
Model 384B Polarographic Analyzer
EG&G PARC Model 303A SMDE

Initial parameters used for square-wave analysis:

initial potential	0.100 V
final potential	-1.000 V
pulse height	0.020 V
frequency	100 Hz
equilibrium time	10 seconds
purge time	480 seconds
cycles	5
scan increment	2 MV
drop size	medium

[illegible] sample was run of F-1-1. The [illegible] was [illegible] -0.800 V + rerun.

[illegible] spike of 100 [illegible] was added [illegible] sample.

The [illegible] 1 ml of 100 [illegible] $UO_2(NO_3)_2 \cdot 6H_2O$ in water uranium standard (lot #6175) [illegible] to volume in a 10 ml volumetric flask with nanopure water.

The spiked sample was repurged and stirred for [illegible] minutes, then analyzed by SWV. The [illegible] added [illegible] at -0.160 V. The final potential will be changed to -0.450 V,

and a new 10 mL sample of FM-1-1 run using differential pulse polarography

Initial parameters for differential pulse analysis

initial potential	-0.100 V
final potential	-0.450 V
pulse height	0.020 V
purge time	480 seconds
scan increment	2 mV
drop time	1.0 s
drop size	medium

1035 PM Scan increment was changed to 4 mV/s, + sample re-run.
10 µl of 100 ppm U std was added to sample, the sample re-purged for 240 seconds, and DPP analysis done.

The repurge has dropped the baseline again, so won't be used in next trial. Another 10 µl of the 100 ppm U std was added to the sample, the sample stirred for 120 seconds and DPP analysis done.

The U peak is clearly visible, + adding ~ 200 ppb does not shift the [illegible] to the right. Anew 10 mL FM-1-1 sample will be run with final potential at -0.400 V.

A 10 ppm standard was made from the 100 ppm standard used by diluting 1 mL of the 100 ppm standard to 10 mL in a volumetric flask with nanopure water. 50 µl of the 10 ppm U standard was added to the FM-1-1 sample, the sample stirred for 2 minutes and the sample analyzed.

~~1131 PM~~
1155 PM The FM-1-1 sample Upk measured 10.31 nAmps. The FM-1-1 plus 50 µl of the 10 ppm Ustd (~ 50 ppb final concentration) measured 12.27 nAmps. With another 50 µl addition + 2 min restir, the sample's U peak measured 14.34 nAmps.

There is about a 2.02 nAmp increase per ~50 ppb addition.

1210 PM The BH-12-1 sample will now be analyzed. Since the sample matrix is somewhat similar in pH & chemical composition to FM-1-1, DPP will be used to begin analysis on a 10 mL aliquot of BH-12-1.

Initial parameters for DP analysis:

initial potential	0.100 V
final potential	-0.500 V
pulse height	0.020 V
purge time	480 seconds
scan increment	4 mV
drop time	1.0 s
drop size	medium

1232 After looking at the sample plot, the initial potential will begin at 0.150 V and the final potential will be at -0.300 V.
The beginning and ending potential were readjusted after checking a plot. Beginning potential will be at 0.175 V, ending at -0.350 V.

Sample	peak height nAmps run1	peak height nAmps run2	concentration (avg.) ppb	temp. °F
[illegible]	15.81	15.66	1149	71.1
1500ppb U std	22.24	21.84	(1536)	71.1

All plots can be found in Polarographic Analyses of Uranium, Vol 6, 16-Dec-91, 1312-1630

12/18/91 1035 PM Analysis of Peña Blanca water sample BH-12-1 for uranium - continued from p 156

A 10 mL sample of BH-12-1 was run using square-wave voltammetry. Parameters used were:

initial potential	0.100 V
final potential	-0.800 V
pulse height	0.020 V
Frequency	100 Hz
equilib. time	10 seconds
purge time	480 seconds
cycles	5
scan increment	2 mV
drop size	medium

A 10 ppm U standard was made by taking 1 mL of 1000 ppm U standard (lot # G175) by appendorf pipette and diluting to volume in a 100 mL volumetric flask with Nanopure water.

100 µl of the 10 ppm U standard was added to the sample, the sample stirred for 2 minutes, + the sample reanalyzed.

1115 PM Without the 100 µl spike the plot of the SWV analysis shows 3 peaks, with a broad one in the area where the U peak is expected. With the spike, the broad peak increases in height by about 75% and is located at -0.124 V.

The initial and final potentials will be changed to ~~0.5~~ 0.35 V and -0.4 V, and a new 10 ml sample of BH-12-1-1 run using differential pulse polarography.

Initial parameters for differential pulse analysis:

initial potential	~~0.500~~ 0.050 V
final potential	-0.400 V
pulse height	0.020 V
purge time	480 s
scan increment	4 mV
drop time	10 second
drop size	medium

50 µl of the 10 ppm U std was added to the sample, the sample stirred for 2 minutes, + the sample re-analyzed with DPP.

1150 PM Another 50 µl spike was added the sample stirred for 2 minutes, + the sample re-analyzed.

The plots do not show any regular change in the pk heights present, so SWV will be used again.

1034 TM Preparation of 0.1M EDTA solution:

Weigh out 3.7224 g of EDTA (disodium ethylenediamine tetraacetate) - lot # 905518 - and dilute to volume in a 100 mL volumetric flask with Nanopure water. When EDTA is dissolved, add NaOH to bring solution to a pH of 7.00.

Weight of EDTA used: 3.72228 g

pH was adjusted with 6M NaOH (see GC-03/123, 2/13/91) until pH was ~6.85 then 0.3M NaOH was used.
Final pH: 7.00

1330 TM Analysis of Peña Blanca water samples EM-01-1 and BH-12-1 for Uranium.
continued

Earlier analyses of sample BH-12-1 for uranium using DPP + SWV (see 12/18/91) were rather inconclusive. A 10 mL aliquot of BH-12-1-1, 1 mL of the PIPES/NaOH prepared today, 200 µL of the oxine, and 100 µL of the EDTA prepared today were added to a 100 mL volumetric flask and brought to volume using nanopure water.
Final concentration of solutions used:

2×10^{-5} M oxine
1×10^{-4} M EDTA
0.01 M PIPES

The solution was analyzed using differential pulse stripping using the following parameters:

Initial E: 0.000 V
Final E: -0.350 V
drop size: medium
purge: 360 s
step time: 10 s
scan increment: 4.0 mV
equilibration: 10 seconds
deposition time: 60 s
pulse height: 0.020 V

A 10 mL aliquot of the sample spiked with ~ 1 ppm U (from 1000 ppm U standard 6175) showed a U peak located at -0.132 V. An additional spike of about 100 ppb Cu in weak acid confirmed that the peak located immediately to the left of the U peak is due to the Cu already present in the sample.

A 10 mL aliquot of the sample was run using the above parameters. The sample was mechanically stirred during the deposition step. A 100 µl spike of 5 ppm U standard was added to the sample, the solution stirred for 60 seconds, and the sample reanalyzed.

A second spike of the 5 ppm U standard was added to the sample, the solution stirred for 60 seconds, and the sample reanalyzed.

Polarographic plots of the above analyses can be found in Polarographic Analyses of Uranium, Vol. 6, 27-Dec-91, 1538 - 1602.

The U peak for the three analyses was measured using 0.0005 meter increments.

Original sample U peak height : 200
+ first spike : 247.5
+ second spike : 285

total peak height increase : 85.0

Concentration of the sample was found by using the equation

$$C_1 = \frac{i_1 \, v \, C_{std}}{\Delta i \, (V + v) + i_1 \, v}$$

where C_1 = original U concentration of the sample
i_1 = original peak height
v = volume of standard solution added
C_{std} = concentration of standard solution
Δi = increase in peak height
V = original volume of the sample solution

$$C_1 = \frac{200\,(200\,\mu l)(5000\,ppb)}{85.0\,(10000\,\mu l + 200\,\mu l) + 200\,(200\,\mu l)}$$

$$= 220.5\,ppb$$

The sample was diluted 1/10 for this analysis, so the calculated concentration of U in BH-12-1-1 is 10 (220.5 ppb) or 2.21 ppm.

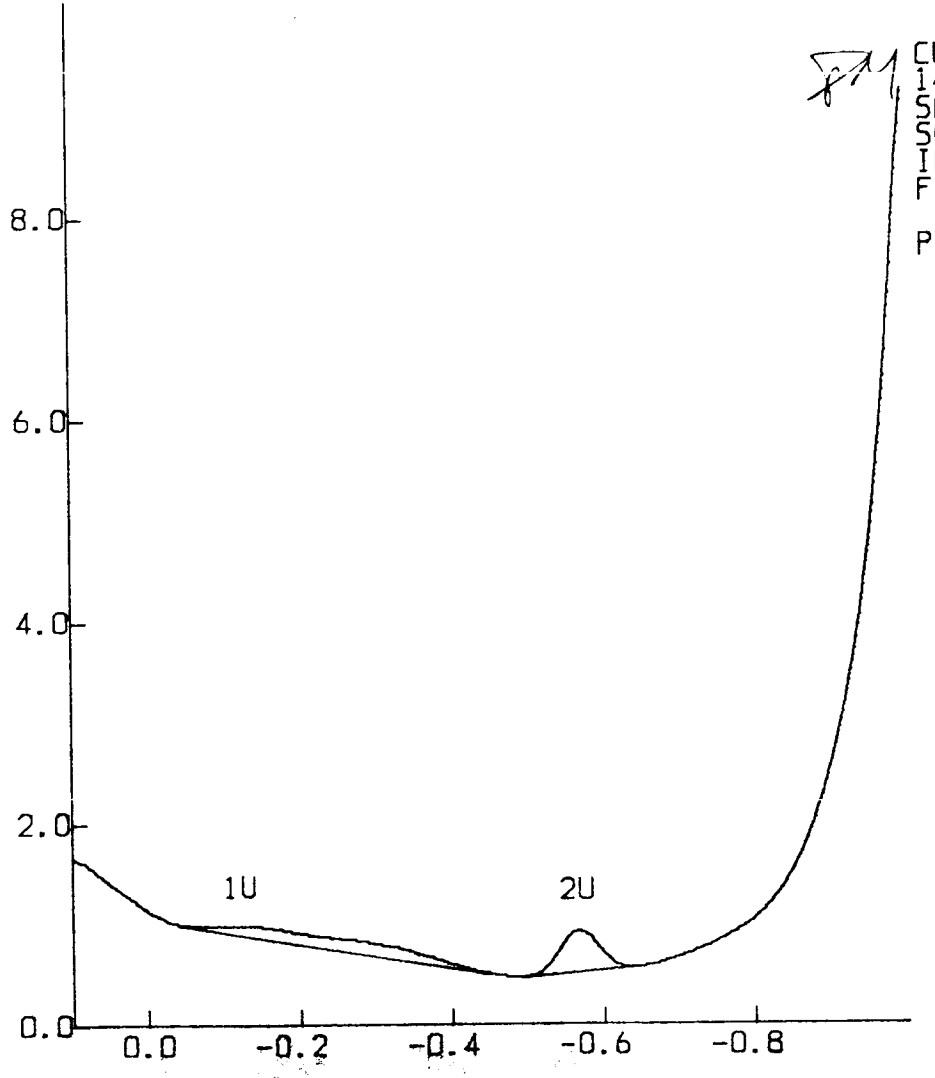
1/3/92 PM 1330 Preparation of 1000 mL of 0.111 M HCl

2.0 M HCl is first made up by diluting 10 16.4 mL of concentrated HCl (lot # 144C-0212) with Nanopure water to volume in a 100 mL volumetric flask. 55.5 mL of the 2.0 M HCl solution is then taken and made up to volume with

T=65.8

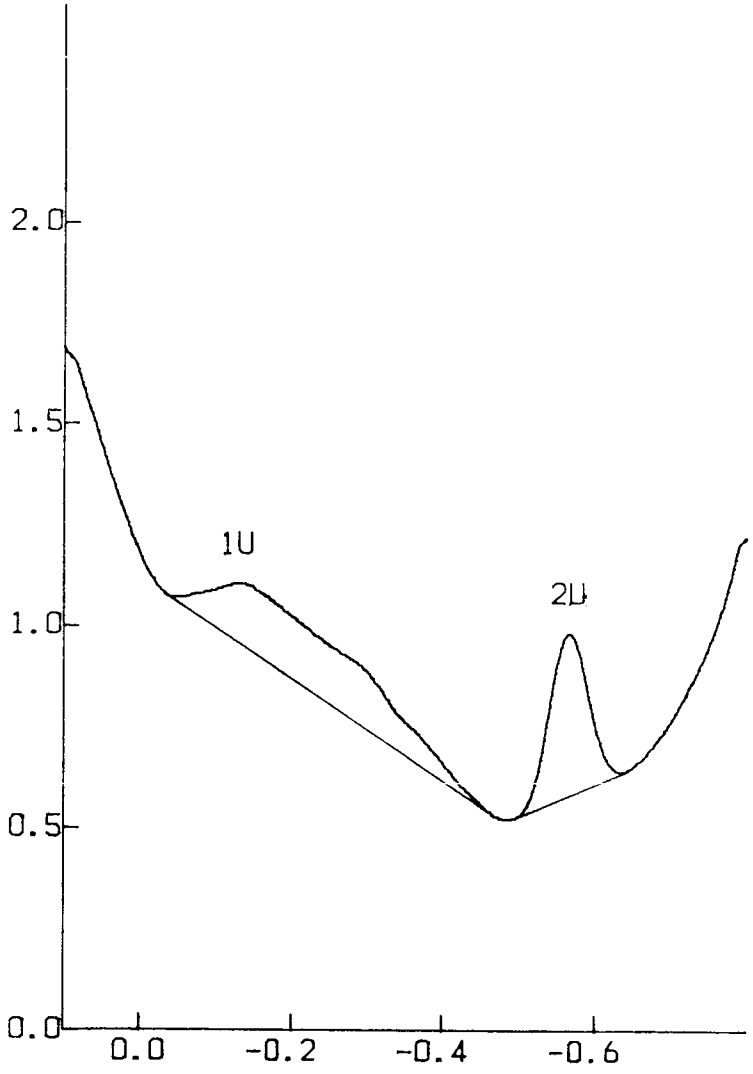
0951

EM-1-1



CURRENT X 10^2NA
14-DEC-91 CELL #1
SAMPLE SWV
SAMPLE # 1
INITIAL E 0.100 V
FINAL E -1.000 V

PEAK
1U -0.122V
8.700E0 NA
2U -0.566V
4.090E1 NA



CURRENT X $1U^2$NA
14-DEC-91 CELL #1
SAMPLE SWV
SAMPLE # 2
INITIAL E 0.100 V
FINAL E -0.800 V

PEAK
1U -0.128V
1.440E1 NA
2U -0.566V
4.000E1 NA

0 959

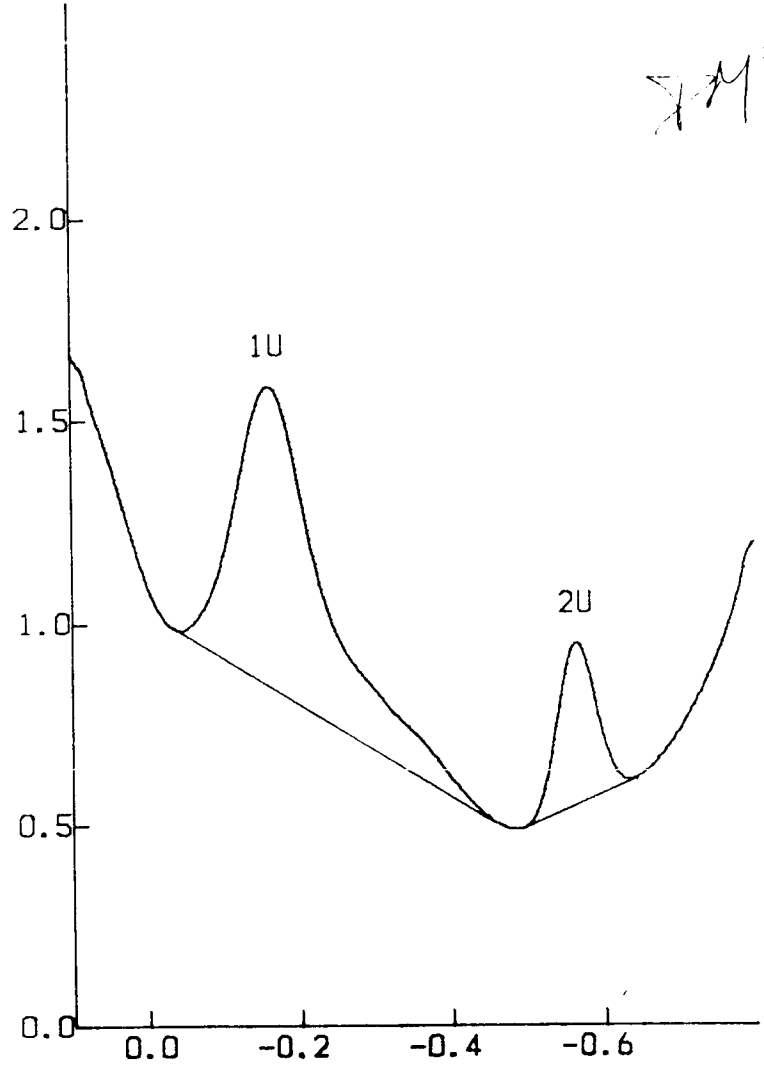
rerun of

EM-1-1

SWV

Final potential

changed to -0.8 V



CURRENT X 10^2 NA
14-DEC-91 CELL #1
SAMPLE SWV
SAMPLE # 3
INITIAL E 0.100 V
FINAL E -0.800 V

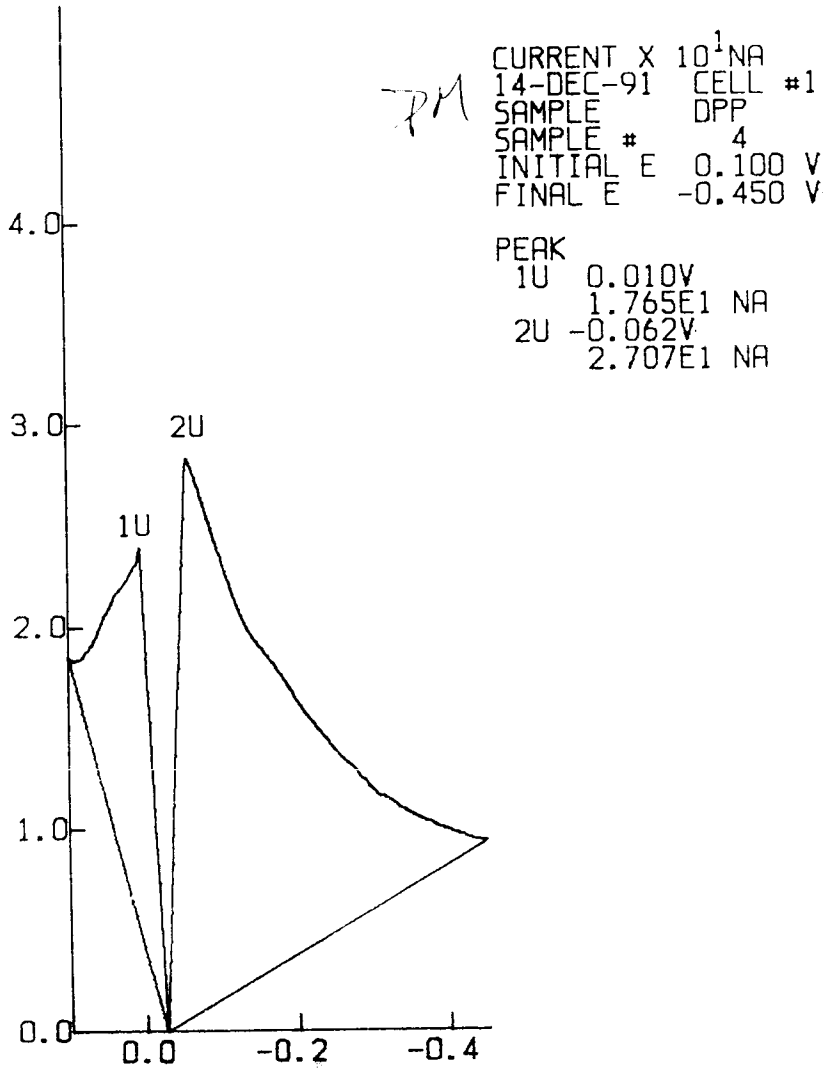
PEAK
1U -0.160V
7.390E1 NA
2U -0.564V
3.990E1 NA

T=66.0°
1014
rerun of
EM-1-1
SWV

+ 50 µl of 100ppm Ustd
(~500ppb)
with 240 sparge

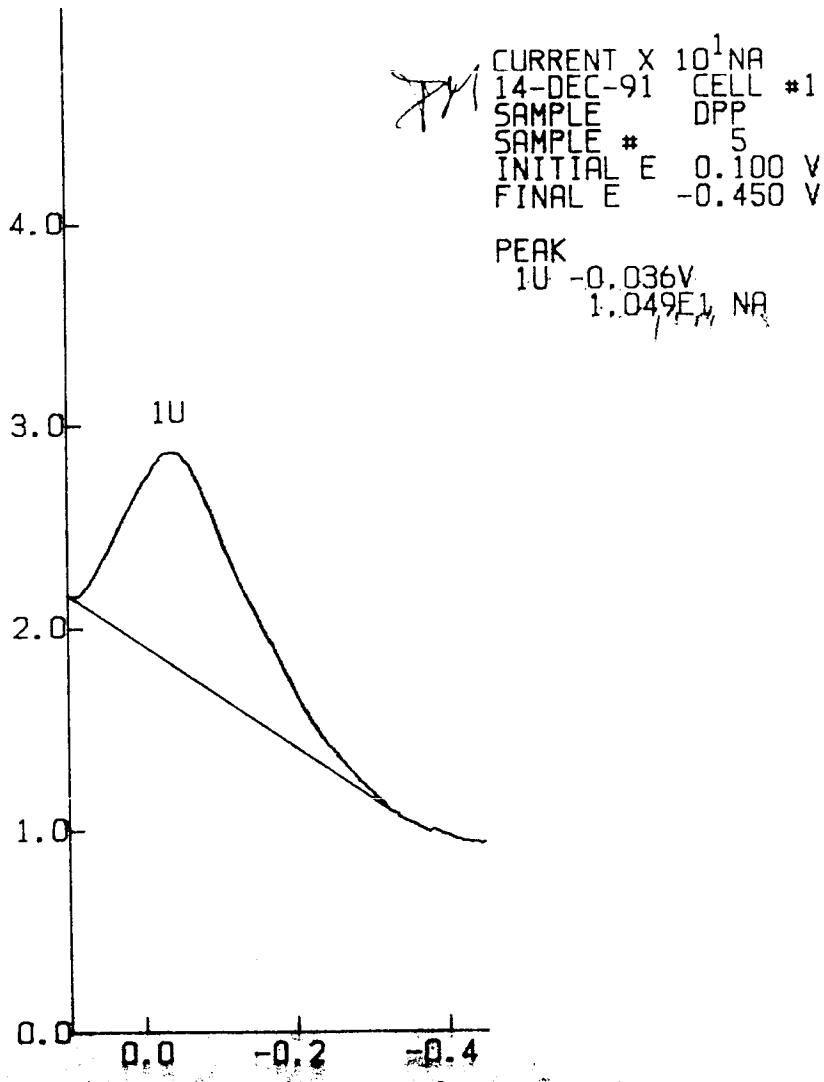
T=66.5°F

1035



new
EM-1-1
DPP
2 mV/s
480 sparge

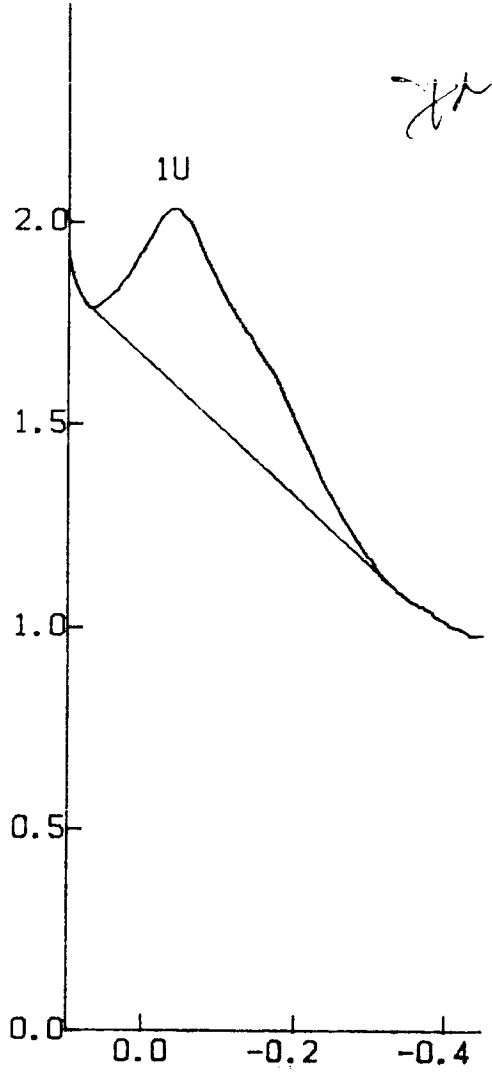
T=66.7



1C39

rerun of
EM-1-1
DPP
4 mV/s

no repurge



CURRENT X 10^1 NA
14-DEC-91 CELL #1
SAMPLE DPP
SAMPLE # 6
INITIAL E. 0.100 V
FINAL E. -0.450 V

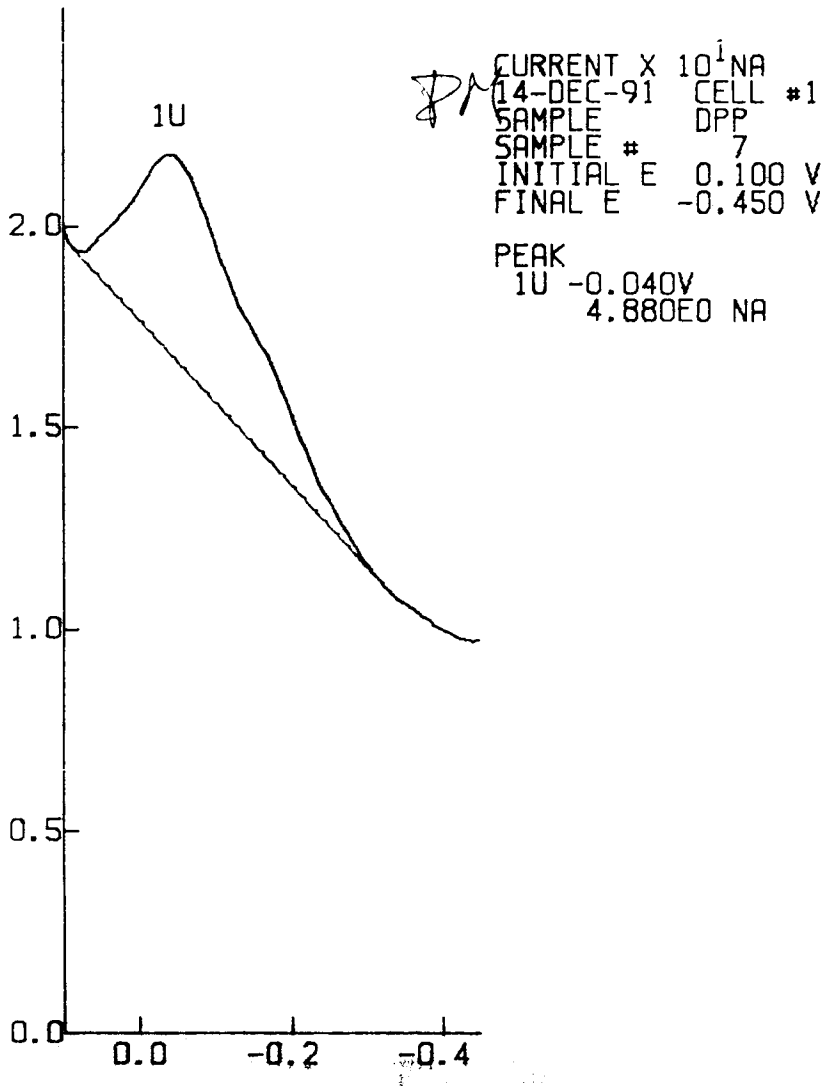
PEAK
1U -0.036V
4.240E0 NA

1050
rerun of
EM-1-1
with
10 µl spike of 100 ppm U
(~ 100 ppb)
+ 240 sec purge

1054

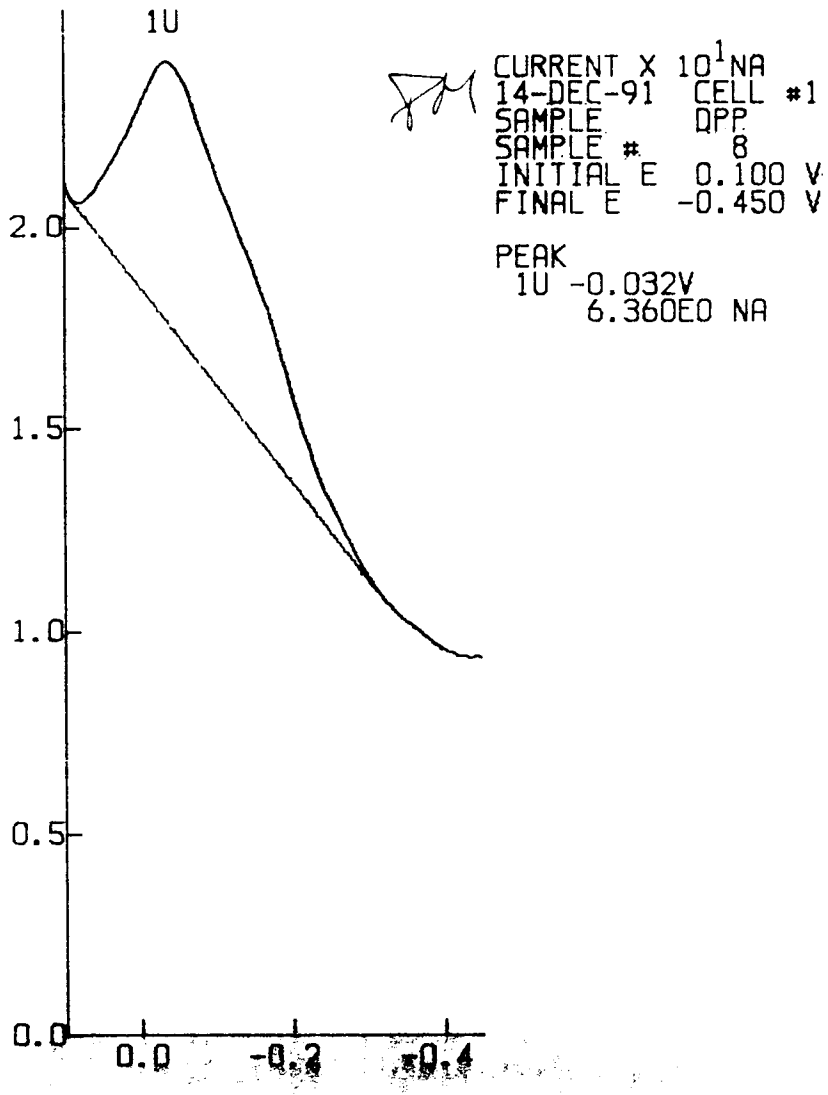
rerun of

EM-1-1



T = 66.9 °F

1101

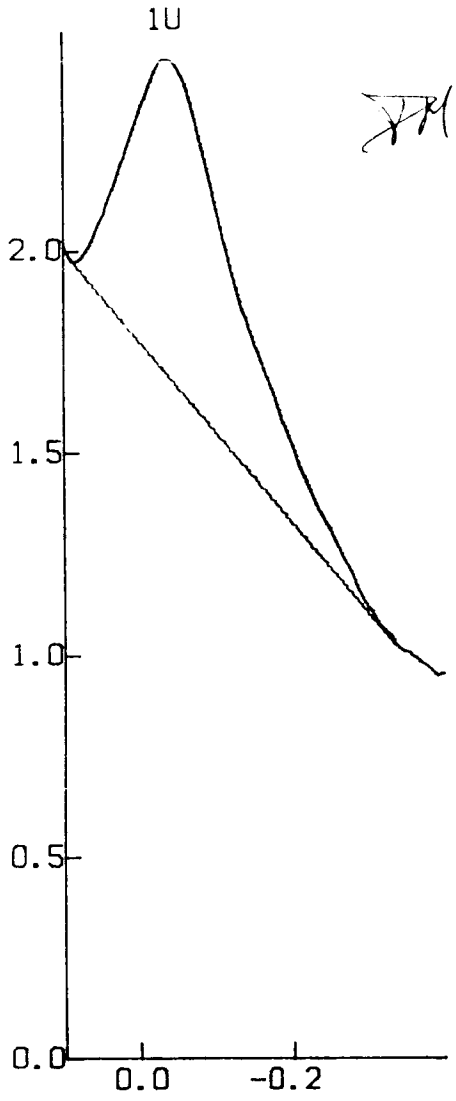


removal
EM-1-1 +
2nd 10 µl spike

no purge
120 s re-stir

T = 67.2°F 1121

new EM-1-1
final potential = -0.40 V



CURRENT X 10^1NA
14-DEC-91 CELL #1
SAMPLE DPP
SAMPLE # 9
INITIAL E 0.100 V
FINAL E -0.400 V

PEAK
1U -0.036V
7.760E0 NA

T = 67.5

1148

new EM-1-1

480 sparge

med drop

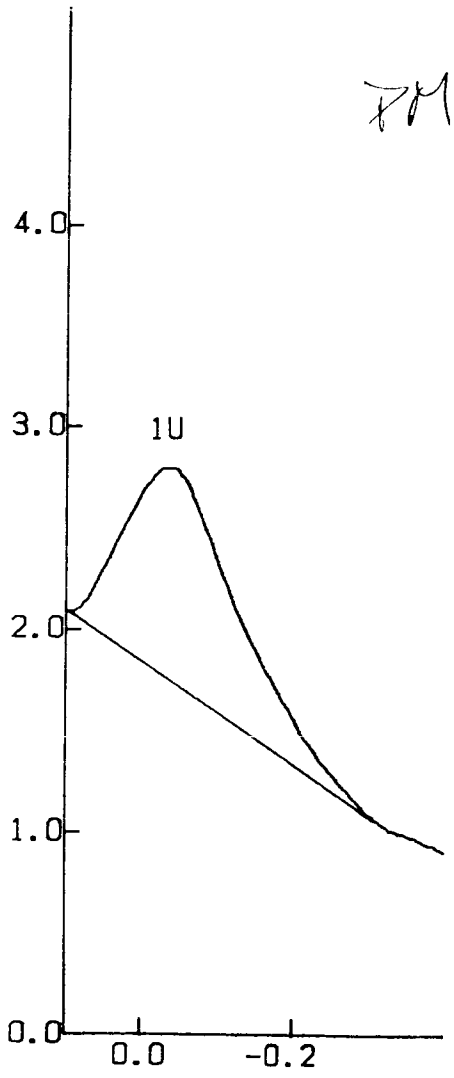
4 mV/s

p. height = 0.02 V

PM

CURRENT X 10^1 NA
14-DEC-91 CELL #1
SAMPLE DPP
SAMPLE # 10
INITIAL E 0.100 V
FINAL E -0.400 V

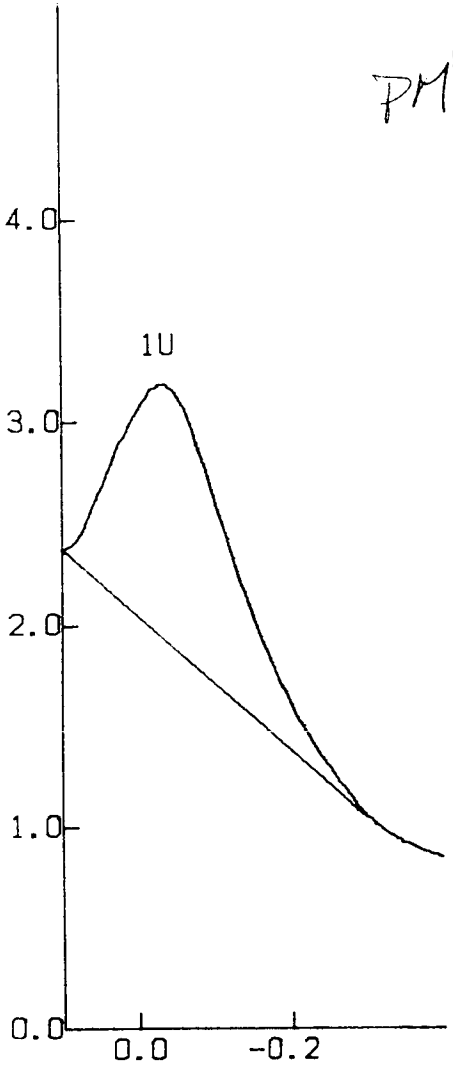
PEAK
1U -0.032V
1.031E1 NA



1155

EM-1-1

+ 50µl of 10ppm U std
(~ 50ppb)
2 min stir no repurge



PM

CURRENT X 10^1 NA
14-DEC-91 CELL #1
SAMPLE DPP
SAMPLE # 11
INITIAL E 0.100 V
FINAL E -0.400 V

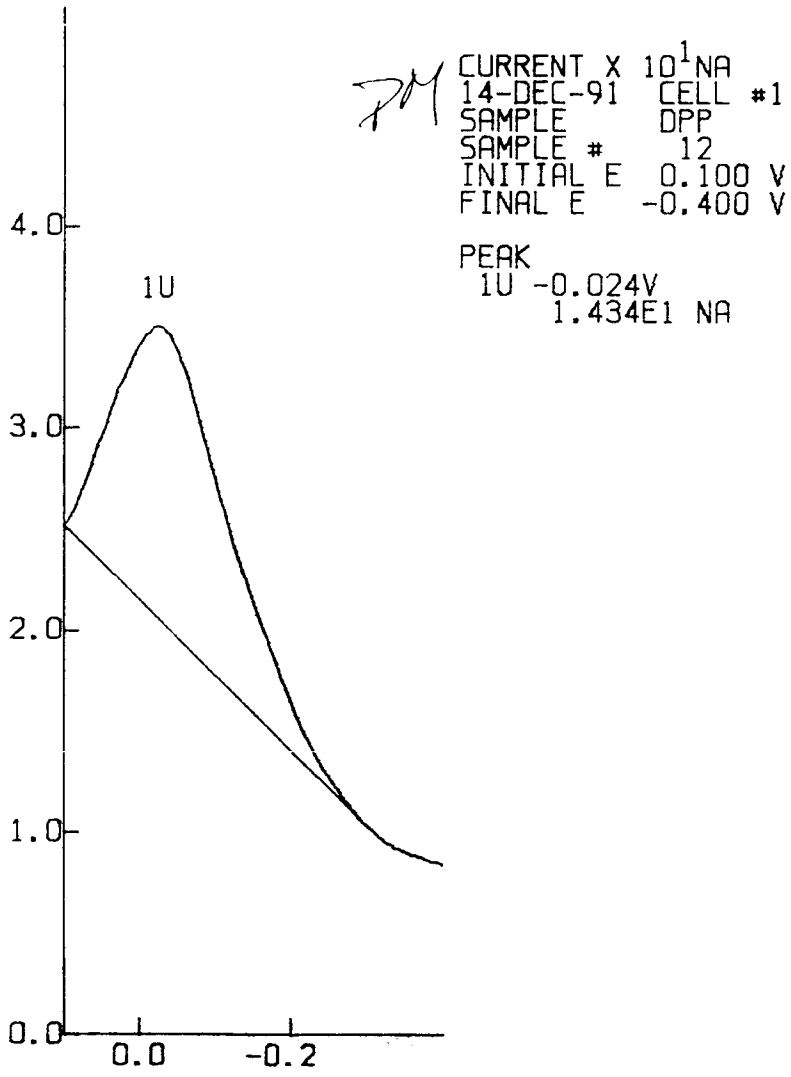
PEAK
1U -0.028V
1.227E1 NA

T = 67.8 °F

1202

EM-1-1

+ 2nd
50 µl of 10 ppm Ustd
(~ 100 ppb)
2 min stir, no repurge



2.07 nAmp increase
1.96 nAmp increase
abt 2.02 increase per 50 ppb

$\frac{10.31 \text{ nAmps}}{2.02} = 5.10$

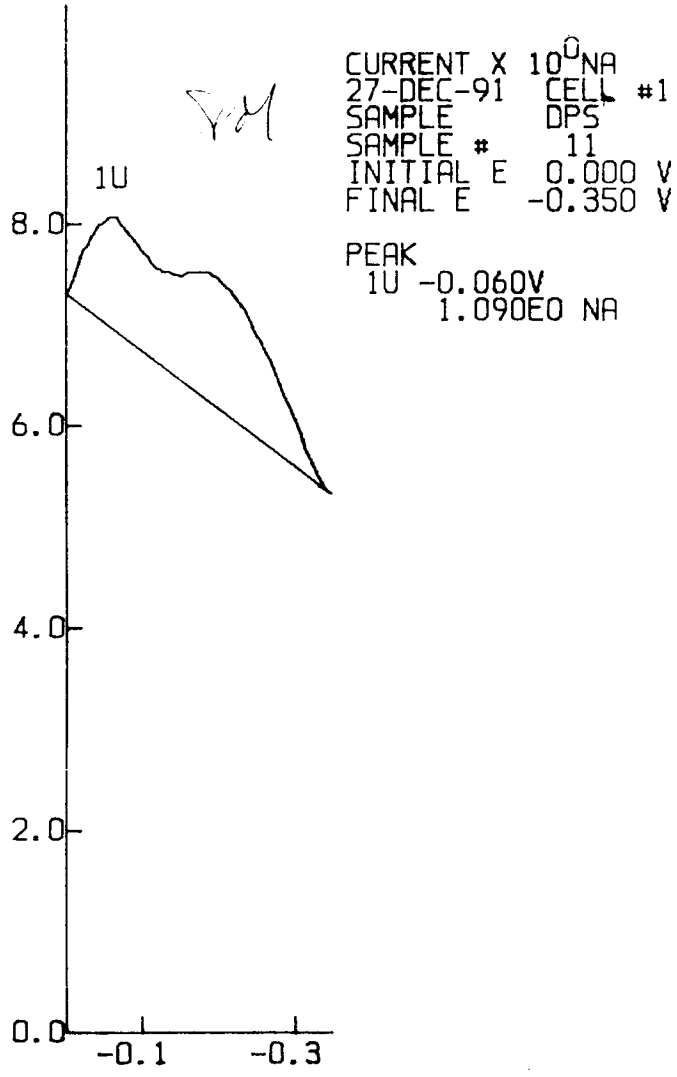
5.10 (50 ppb) = 255 ppb U in sample

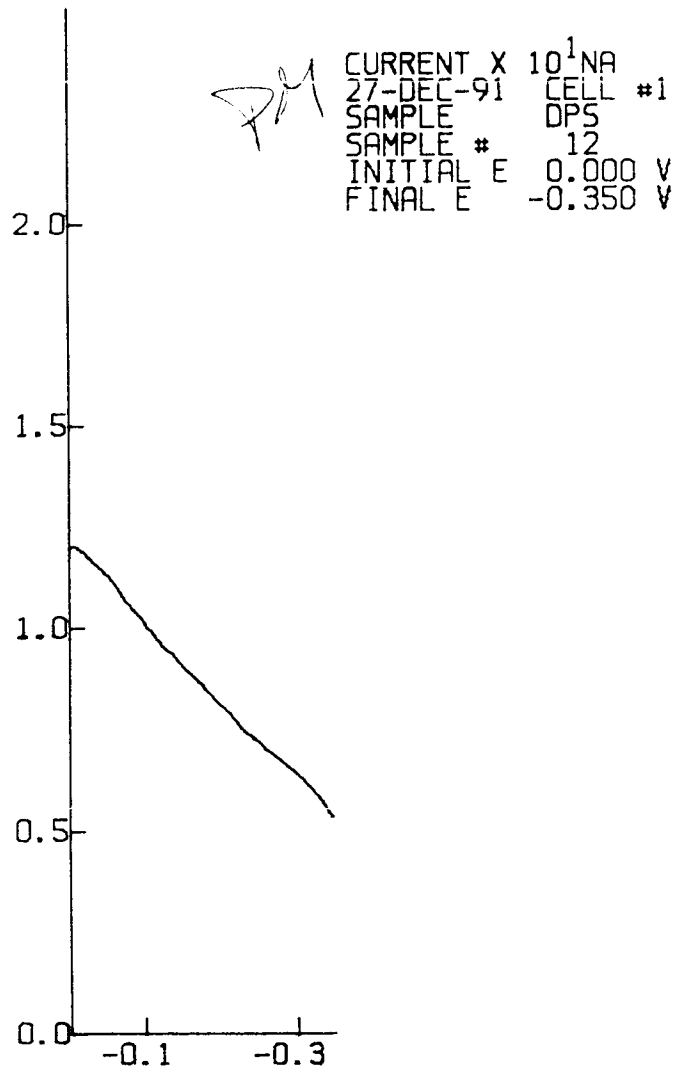
T = 744F

1538

BH-12-1-1

(U pk expected at -.132





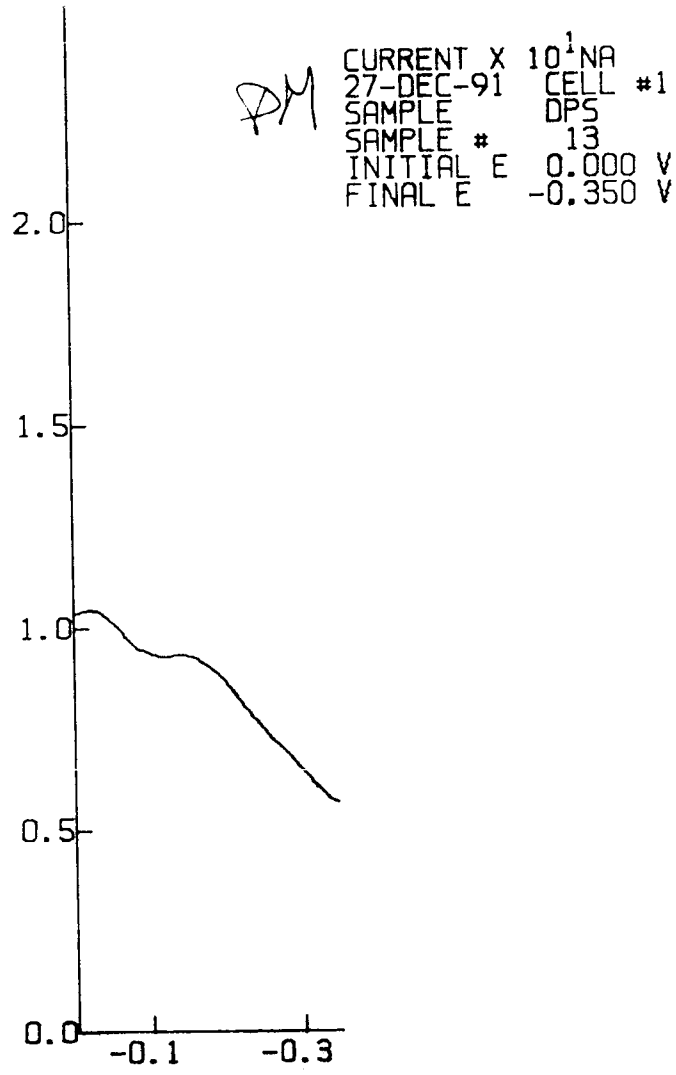
1542

BH-12-1-1

+ 100 µl of 5 ppm Std

~~(~ 25 ppb)~~

no stirring
during deposition



1547

BH-12-1-1

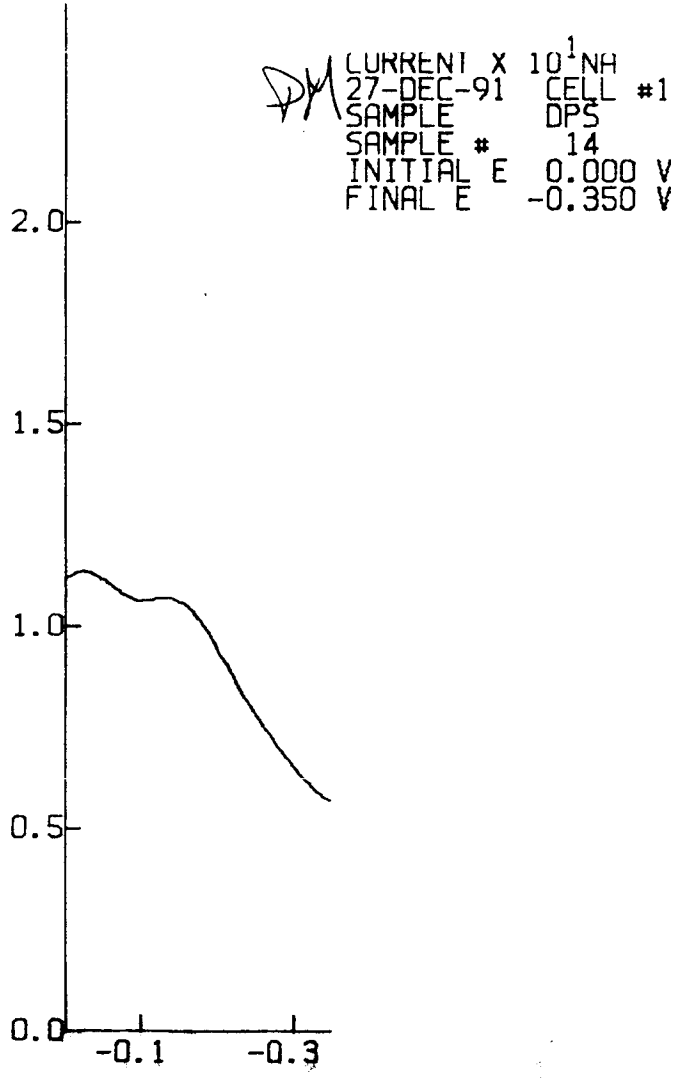
+ 100 µl of 5 ppm U std

~~(~ 25 ppb)~~

0.0493 ppm

or

49.26 ppb



1556

BH-12-1-1

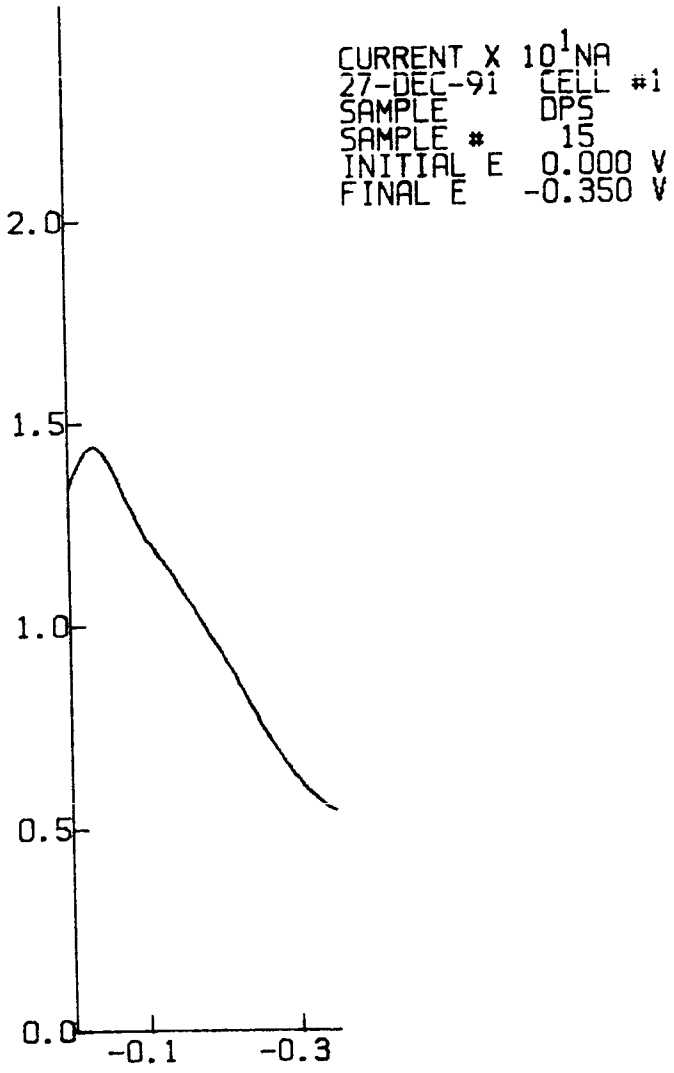
+ 2

100 µl of 5 ppm std

~~(~50 ppb)~~

~ 97.55 ppb

14u increase



1602

BH-R-1-1

+ ~~100 µl of 5 ppm U std (~25 ppb)~~

+ ~~100 µl of 10 ppm Cu std (~50 ppb)~~

+ ~ 97.55 ppb U

+ ~ 99.01 ppb Cu

MODEL 384B POLAROGRAPHIC ANALYZER 1/10

27-DEC-91 CELL NUMBER 1
DPS
INITIAL E 0.000 V
FINAL E -0.350 V
PURGE 360 SECONDS
STEP TIME 1.0 SECONDS
SCAN INCREMENT 4 MV
CONDITION 0 SECONDS
CONDITION 0.000 V
EQUILIBRATE 10 SECONDS
DEPOSITION 60 SECONDS
PULSE HEIGHT 0.020 V
REPLICATIONS 1

STANDARD CURVE
BLANK SUBTRACTION: NO
TANGENT FIT: YES
PEAK LOCATION: YES
DERIVATIVE: NO
FORCE LINEAR FIT: NO

SAMPLE 1/10 BH-12-1
ANALYTE
SUPP. ELEC. 1 ml PIPES, 200 µl oxine, 100 µl EDTA
SAMPLE PREP.

	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
OVERRIDE	N	N	Y	Y	N	Y	Y	N	N	Y	N	Y	N	N	Y	N

PEAK POT STD 1 STD 2 STD 3

Blank: + 50 ppb + 100 ppb

hgt 200 marks 99 marks 114 marks

scale $\frac{5}{2}$

99 (2.5)
247.5 marks

114 (2.5)
285 marks

37.5 increase 47.5 increase

~ 42.5 increase per 50 ppb U increase

~~0.1 cm~~
~~.01 m~~

$\frac{200}{42.5} = 4.71$

~~0.025 cm~~ cm

$4.71\ (50) = 235.5$ ppb U

.025
1:40 => 0.0005 M per increment $\left(\frac{.025}{50}\right)$

$$C_1 = \frac{i_1 v C_{std}}{\Delta i\ (V + v) + i_1 v}$$

i_1 = original pk hgt

v = volume of std solution added

C_{std} = [ ] std solution

Δi = increase in peak height

V = original volume of the unknown solution

$$= \frac{200u(200\mu l)(5{,}000 ppb)}{85.0u\ (10{,}000\mu l + 200\mu l) + 200u\ (200\mu l)}$$

$\frac{u\text{-}\mu l\ ppb}{u\mu l + u\mu l}$

$C_1 = 220.5$ ppb

Analyses

Dissolved Metals Analysis
20-3704-063
All Results in PPM

*	BLK	CT-1	CT-2	EM-1-1	BH-12-1
AL	<0.094	1.86	1.85	<0.094	0.173
BA	<0.053	<0.053	<0.053	<0.053	<0.053
CD	<0.005	<0.005	<0.005	0.050	<0.005
CR	<0.010	0.232	0.228	<0.010	0.020
CU	<0.018	0.081	0.086	<0.018	0.032
FE	<0.020	<0.020	<0.020	<0.020	<0.020
MN	<0.006	<0.006	<0.006	0.054	0.187
NI	<0.032	0.193	0.194	<0.032	<0.032
PB	<0.10	0.89	0.88	0.12	<0.10
SR	<0.010	5.38	5.08	<0.010	0.207
SI	<0.10	<0.10	<0.10	10.2	6.53
CA	<1.0	9.5	9.8	25.5	57.7
K	<1.0	2.8	2.8	10.2	1.5
MG	<1.0	<1.0	<1.0	<1.0	<1.0
NA	<1.0	<1.0	<1.0	84.2	<14.6

ALL METALS RESULTS OBTAINED BY ICPAES EXCEPT LEAD FOR TOTAL ANALYSIS. TOTAL LEAD WAS ANALYZED BY GRAPHITE FURNACE ATOMIC ABSORPTION SPECTROPHOTOMETRY.

Total Metals Analysis-Table 1
20-3704-063
All Results in PPM

*	BLK	PSPK %R	CT-3	EM-1-2	EM12(DUP)
AL	<0.10	91	1.74	0.12	0.078
BA	<0.058	98	<0.058	<0.058	<0.058
CD	<0.006	97	<0.006	0.013	0.013
CR	<0.011	102	0.18	<0.011	<0.011
CU	<0.020	100	0.098	<0.020	<0.020
FE	<0.022	99	<0.022	0.075	0.069
MN	<0.007	102	<0.007	0.073	0.073
NI	<0.036	116	0.19	<0.036	<0.036
PB	<0.001	116	1.07	<0.001	<0.001
SR	<0.011	105	5.16	0.11	0.092
SI	<0.11	85	<0.11	23.1	23.2
CA	<1.1	91	9.6	25.0	25.6
K	<1.1	90	3.2	10.4	10.9
MG	<1.1	68	<1.1	<1.1	<1.1
NA	<1.1	71	<1.1	83.7	86.4

Total Metals Analysis-Table 2
20-3704-063
All Results in PPM

*	BLK	PSPK %R	BH-12-2	BH-MS%R	MS LEVEL
AL	<0.10	91	4.75	145	2.0
BA	<0.058	98	<0.058	99	1.0
CD	<0.006	97	<0.006	95	0.10
CR	<0.011	102	<0.011	99	0.10
CU	<0.020	100	0.022	96	0.20
FE	<0.022	99	0.78	125	0.10
MN	<0.007	102	0.60	73	0.10
NI	<0.036	116	<0.036	106	0.10
PB	<0.001	116	0.036	111	0.50
SR	<0.011	105	0.22	109	0.50
SI	<0.11	85	22.4	104	5.0
CA	<1.1	91	65.0	56+	10.0
K	<1.1	90	6.1	89	10.0
MG	<1.1	68	<1.1	97	10.0
NA	<1.1	71	13.8	82	10.0

+SAMPLE GREATER THAN 4X SPIKE VALUE

Anion Analysis Summary
20-3704-063
All Results in PPM

SAMPLE	FLUORIDE	CHLORIDE	PHOSPHATE	NITRATE	SULFATE
EM-1-3	3.31	26.5	<0.10	4.13	330
BH-12-3	1.57	3.00	<0.10	2.48	733
AN-1	.5 <0.05	10-11 <0.05	1.2 <0.10	1 <0.50	5 <0.5
AN-2	<0.05	<0.05	<0.10	<0.50	<0.5
MS %R	81	102	116	97	89
MS LEVEL	0.20	0.20	1.0	0.33	2.0
BLANK	<0.05	<0.05	<0.10	<0.50	<0.50

12/18/91 BWL Actual concentration are 1000 times less than I had thought

eg. for F

I dissolved $\frac{0.0022\,g\ NaF}{1000\,ml} * \frac{0.5\,ml}{1000\,ml} \Rightarrow 1.1$ ppb F instead of 1.1 ppm F

$\frac{.0022\,g\ NaF}{liter}$ $\frac{42\,g\ NaF}{mole\ NaF}$ $\frac{1\ mole\ F}{mole\ NaF}$

$= 52\ \frac{u\,moles}{liter}$ $\frac{19\,g}{moles}$ $\frac{1\,mg}{L}$

Sulfate Analysis
12/28/91
BWL

```
6rr5  -.7*C
ID# 7

 420.0NM        -.7*C
 ----------------
ID# 1
 420.0NM       .000*A
  ----------------
```

Blank Absorbance

1	.253	24.97
2	.205	19.97
3	.153	14.98
4	.083	9.990
5	.036	4.990
6	-.001	.0000

```
LINEAR FIT
NOT THRU ZERO
SLOPE            94.13
INTERCEPT        1.045

CORR COEF        .9968
  ----------------  ID# 1
 420.0NM      13.68*C

  ----------------  ID# 2
 420.0NM       .134*A
  ----------------
ID# 3
 420.0NM      12.68*C
  ----------------    ----------------
ID# 5
 420.0NM      12.07*C
  ----------------  ID# 6

 420.0NM       .117*A
  ----------------  ID# 7
 420.0NM      11.64*C

  ----------------  ID# 8
 420.0NM       .113*A
  ----------------
ID# 9
 420.0NM       1.55*C
  ----------------  ID# 10

 420.0NM       .005*A
  ----------------  ID# 11
 420.0NM       .007*A

  ----------------  ID# 12
 420.0NM       1.74*C
  ----------------
ID# 13
 420.0NM      11.28*C
  ----------------  ID# 14

 420.0NM       .109*A
  ----------------  ID# 15
 420.0NM       .069*A

  ----------------  ID# 16
 420.0NM       7.55*C
```

815.0NM -164.*C
815.0NM -.008*A

BWL
12/23/91
Si Analysis
Peña Blanca
Samples

STD #	ABS	CONC
1	-.004	.0000
2	.057	175.4
3	.118	350.9
4	.300	877.2
5	.593	1754.

LINEAR FIT
NOT THRU ZERO
SLOPE 2937.
INTERCEPT 7.381

CORR COEF 1.0000

---------- ID# 1 TST24
815.0NM 1041. C

---------- 815.0NM .352*A
ID# 2 TST24
815.0NM 1033. C

---------- 815.0NM .349*A
ID# 3 TST24
815.0NM 1009. C

---------- 815.0NM .341*A
ID# 4 TST24
815.0NM 689. C

---------- 815.0NM .232*A
ID# 5 TST24
815.0NM 665. C

---------- 815.0NM .224*A

Lab Notebook 024
pg 51-52

12/30/91

Bill:

I reanalyzed the Peña Blanca water samples for sulfate and silica and the results do not compare favorably to those of Division 1.

Sample Id	El Mesquite		Borehole -12	
	Div 20	Division 1	Div 20	Division 1
Silica (ppm)	59.1	10.2	37.9	6.63
sulfate (ppm)	44	330	39	733

They used ICP for silica analysis and anion chromatography for sulfate analysis, while I used the standard colorimetric method for silica that has been used in the anaclime dissolution experiments and turbidometric method (EPA standard method) for sulfate. Both my precison and accuracy are better than those of Div 1 for both analyses, so I would probably use these numbers for silica and sulfate in the calculations. Polarographic analysis of the borehole #12 fluid by Paula indicated that U concentration is 2.21 ppm. I plan to run these samples on the alpha spectrometer by Jan 7 so I will have some isotopic data and a check on the U concentration in the fluid.

Bret

Polarographic Analyses of Uranium
vol 6, 12-14-91

Cations (micromole/l)	Known concentration (ppm)	Dissolved CT-1	Dissolved CT-2	Total CT-3	Accuracy %	Precision %
Na	2	<1	<1	<1.1	>50	
K	4.07	2.8	2.8	3.2	40.00	0
Ca	10	9.5	9.8	9.6	3.50	21.21320344
Mg	6.85	<1	<1	<1.1	>85	
Sr	4.99	5.38	5.08	5.16	4.81	21.21320344
Al	2	1.86	1.85	1.74	7.25	0.707106781
Si	0	<0.1	<0.1	<0.11		
Ba	1.32	<0.53	<0.53	<0.058	>60	
Cd	0	<0.005	<0.005	<0.005		
Cr	0.2	0.232	0.228	0.18	15.00	0.282842712
Cu	0.1	0.081	0.086	0.098	16.50	0.353553391
Fe	0.09	<0.02	<0.02	<0.022	>77	
Mn	0.1	<0.006	<0.006	<0.007	>94	
Ni	0.2	0.193	0.194	0.19	3.25	0.070710678
Pb	1.02	0.89	0.88	1.07	13.24	0.707106781

Accuracy is average of CT-1 and CT-2 divided by known concentration subtracted from one and then multiplied by 100

alk workshhet

	bh-12	Em	bh-12	Em	bh-12	Em		
	ppm	ppm	meq/l	meq/l	%meq/l	%meq/l		
F	1.6	3.3	0.08421939	0.17370249	1.16971377	1.6455333	F	
Cl	3	26.5	0.08461907	0.74746848	1.1752649	7.08098218	Cl	
NO3	2.5	4.1	0.04031998	0.06612477	0.55999971	0.62641878	NO3	
SO4	39	44	0.81202632	0.91613226	11.2781433	8.67878227	SO4	
Na	13.8	84.2	0.60026098	3.66246194	8.3369581	34.695547	Na	
K	1.5	10.2	0.03836513	0.26088291	0.53284908	2.47141824	K	
Ca	57.7	25.5	2.87924152	1.27245509	39.9894655	12.0543301	Ca	
Mg	1	1	0.0822876	0.0822876	1.14288327	0.77953387	Mg	
Si	37.9	59.1			35.8190343	31.9691127	carb alk(HCO3)	
Uranium	2.21	0.225	0.0557075	0.00567158	0.77371525			
CO2	20	13						
pH	7.5	7.2	ppm HCO3	ppm HCO3				
HCO3	~~350~~		157.28883	205.817111				
alkalinity								
		sum an	1.02118476	1.903428				
		cat sum	3.60015523	5.27808753				
		carb alk(HCO3)	2.57897047	3.37465954	35.8190343	31.9691127		
		sum eq	7.20031046	10.5561751				

SOUTHWEST RESEARCH INSTITUTE
MEMORANDUM

DATE: March 27, 1992

TO: Brent Leslie

FROM: Lorraine Scheller

SUBJECT: Results of Anion Analysis of Water Samples
Received on March 19, 1992.
SwRI Project 20-3704-063

The above referenece results are as follows:

Sample ID	F (ppm)	Cl (ppm)	No_3N (ppm)	Po_4P (ppm)	So_4 (ppm)
3171	1.16	3.62	U 0.002	1.63	4.48
3172	U 0.01	U 0.02	U 0.002	U 0.003	U 0.02
3173	1.05	3.43	U 0.002	1.69	4.34
3174	U 0.01	U 0.02	U 0.002	U 0.003	U 0.02
3175	1.14	3.72	U 0.002	1.96	3.57

U - Undetected at MDL given.

Samples were analyzed on March 25, 1992

Instrument: Dionex Model 2020i
Column: Dionex AS4A (Separator column)
Dionex AG4 (guard column)
Dionex Anion Micromembrane Suppressor
Detector: Dionex conductivity detector
Method: EPA 300.0
Operator: Joe Tsai
Analyst: Lorraine Scheller

LS:ds

Silica Analyses
of
3/92 BH-12 Samples

ID# 10 TST24

815.0NM 1544. C ———————— 44.0 ppm

ID# 11 TST24

815.0NM 1523. C ———————— 43.4 ppm

Sample Identity			Spex Alkalinity sample 50 ml		
Spex Alkalinity sample 25 ml			ml Acid	pH	
ml Acid	pH		0.000	7.90	
0.000	7.7		0.200	7.28	
0.200	6.86		0.300	7.26	
0.250	6.78		1.400	4.60	
0.300	6.66		1.468	4.30	
0.400	6.42				
0.500	6.27		Date	9-Apr-92	
0.600	5.97				
0.700	5.67				
0.800	5.11	92-3/BH-12 sample 50 ml		92-3/BH-12 sample 50 ml	
0.900	4.22	ml Acid	pH	ml Acid	pH
Date	25-Mar-92	0.000	7.09	6.300	5.27
		0.200	7.05	6.400	5.19
92-3/BH-12 sample 25 ml		0.400	6.95	6.500	5.08
ml Acid	pH	0.600	6.89	6.600	4.96
0.000	7.09	0.800	6.83	6.700	4.84
0.500	6.91	1.000	6.77	6.800	4.67
1.000	6.76	1.200	6.72	6.890	4.50
1.500	6.63	1.400	6.67	6.943	4.37
2.000	6.52	1.600	6.62		
2.500	6.40	1.800	6.58	Date	9-Apr-92
3.000	6.29	2.000	6.54		
3.500	6.18	2.200	6.49		
4.000	6.07	2.400	6.45		
4.500	5.95	2.600	6.40		
5.000	5.82	2.800	6.36		
5.500	5.64	3.000	6.32		
6.000	5.42	3.400	6.23		
6.200	5.32	3.600	6.18		
6.400	5.16	3.800	6.14		
6.500	5.07	4.000	6.10		
6.600	4.96	4.400	6.00		
6.700	4.84	4.800	5.89		
6.750	4.75	5.000	5.83		
6.800	4.66	5.200	5.77		
6.882	4.50	5.400	5.70		
6.946	4.36	5.500	5.67		
		5.700	5.59		
Date	9-Apr-92	6.000	5.45		
		6.100	5.39		
		6.200	5.33		

SRI WATER ANALYSES

STANDARDS

Standards were prepared from single element standard solutions of 1000ppm. The major element standard (Si, Ti, Al, Fe, Mn, Mg, Ca, Na, K, and P) was prepared by pipetting 20ml of each standard solution into a clean Nalgene bottle. The resulting standard (Standard 5) contained 100ppm of each element except Ca which had a concentration of 50ppm. Other standard were diluted from Standard 5. For the trace element standard (Sc, V, Cr, Ni, Cu, Zn, Nb, Y, Ar, Ba, and Sr) the same procedure was followed. Standard 5 for the trace elements had a concentration of 90.0ppm.

SAMPLES

Samples were run as received.

LEAD

Lead analyses were done by Atomic Abosorption. Samples 4, 5, 7 and 9 were done by flame and the rest were done by graphite furnance. The internal standard for flame was .604ppm at the beginning of the run and .643ppm at the end of the run. The high standard for graphite was .025ppm and the low was .005ppm. The internal standard for graphite was .0102ppm and analyzed as .0103ppm. Two samples (1 and 2) had to be diluted (automatically by the autosampler) to be within range for the graphite furnance.

Sample	31992-1	31992-2	31992-3	31992-4	31992-5	31992-6	31992-7	31992-8	31992-9	31992-10	31992-11	31992-12
S[redacted]	0.0	18.4	0.0	2628.0	16.5	25.8	5.0	1.9	2.7	21.0	1.3	27.8
Ti	0.0	0.0	0.0	0.3	0.0	0.0	0.9	0.0	0.9	0.0	0.0	0.0
Al	0.0	0.5	0.0	87.3	2.1	0.0	0.1	0.0	0.0	0.0	1.0	0.0
Fe	0.0	0.2	0.0	3.1	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0
Mn	0.0	0.2	0.0	0.0	0.0	1.9	1.1	0.0	1.0	1.8	0.0	0.0
Mg	0.0	4.1	0.0	1.7	0.0	5.1	0.9	0.0	1.0	5.6	0.0	1.6
Ca	0.0	82.4	0.0	25.0	10.5	97.0	1.0	0.0	1.0	96.0	0.0	28.8
Na	0.0	0.8	0.0	12.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	5.3
K	0.1	2.9	0.0	1.0	3.9	4.8	0.0	0.0	0.0	4.7	9.4	11.3
P	0.0	0.1	0.0	0.3	0.0	3.6	0.0	0.0	0.0	3.7	0.0	0.1

Sample	STD 2	STD 3	STD 5	STD 6	STD 7
Si	9.4	24.1	99.1	53.0	71.0
Ti	9.1	24.7	99.8	53.6	65.5
Al	9.0	24.6	98.9	53.6	66.4
Fe	9.3	25.1	104.0	55.2	66.0
Mn	9.4	25.3	104.0	54.1	65.6
Mg	9.3	25.0	97.2	52.2	65.3
Ca	4.4	12.0	47.2	26.2	32.9
Na	8.8	23.6	92.6	51.7	64.6
K	8.6	23.3	93.3	50.0	65.4
P	0.9	2.4	9.9	5.3	6.3

	(other elements)	Si	Ca
std 2 =	9.1 ppm	8.8	4.6
3 =	25 ppm	24.3	12.5
5 =	100 ppm	97	50
6 =	53 ppm	51.4	26.5
7 =	66.7 ppm	64.7	33.3

[redacted]

Sample	31992-1	31992-2	31992-3	31992-4	31992-5	31992-6	31992-7	31992-8	31992-9	31992-10	31992-11	31992-12
Sc	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
V	0.4	0.4	0.4	0.4	0.4	0.4	1.4	0.4	1.4	0.4	0.4	0.4
Cr	0.1	0.2	0.2	0.2	0.3	0.1	1.2	0.2	1.2	0.2	0.2	0.1
Ni	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.7	0.0	0.0	0.0
Cu	0.4	0.5	0.4	0.5	0.5	0.4	1.4	0.4	1.4	0.4	0.4	0.4
Zn	0.0	0.0	0.0	2.6	0.0	0.0	0.9	0.0	0.9	0.0	0.0	0.0
Nb	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Y	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2
Zr	0.3	0.3	0.3	3.0	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3
Ba	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0
Sr	0.0	0.1	0.0	0.0	5.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Pb	~~0.04~~	.09	.01	.23	.95	.01	.95	.0	.95	.02	.01	0

samples 4, 5, 7, 9 by flame AA for Pb

≠ our blank

Sample	BLANK	STD 2	STD 3	STD 4	STD 5	STD 6
Sc	0.0	8.6	23.7	47.5	90.7	69.5
V	0.4	8.3	21.8	44.3	96.0	68.3
Cr	0.2	8.3	21.6	45.3	91.0	67.8
Ni	0.0	8.4	22.2	45.2	89.5	67.3
Cu	0.5	8.4	22.6	46.3	94.8	72.0
Zn	0.0	8.4	22.9	43.7	89.4	66.4
Nb	0.3	8.5	22.8	45.7	87.0	69.3
Y	0.3	8.5	22.7	45.8	94.2	69.1
Zr	0.4	8.3	22.8	46.1	93.3	69.9
Ba[redacted]	0.0	8.3	21.1	45.9	86.6	62.5
Sr	0.0	8.3	21.4	45.6	87.6	62.7

std 2 = 8.2 ppm
3 = 22.7 ppm
4 = 45.5 ppm
5 = 90.9 ppm
6 = 68.2 ppm

for all elements

Sample	Reagent BLK 31992-1	Dissolved #26 BH-12-1-1 31992-2	H2O Distilled WATCH 31992-3	Ep/SSDP 31992-4	CT-1 31992-5	92-3/BH-12 31992-6	ICP-19 31992-7	Filter BLK 31992-8	ICP-19 31992-9	92-3/BH-12 31992-10	ICP-7 31992-11	EM-11 31992-12
	OK	OK	OK	OK			OK	OK but	OK		Marginal	
Si	0	18	0	2628	17	26	5	2	3	21	1	28
Ti	0	0	0	0	0	0	1	0	1	0	0	0
Al	0	0	0	87	22	0	0	0	0	0	1	0
Fe	0	0	0	3	0	0	1	0	1	0	0	0
Mn	0	0	0	0	0	2	1	0	1	2	0	0
Mg	0	4	0	2	0	5	1	0	1	6	0	2
Ca	0	82	0	25	11	97	1	0	1	96	0	29
Na	0	1	0	12	0	1	0	0	0	1	0	5
K	0	3	0	1	4	5	0	0	0	5	9	11
P	0	0	0	0	0	4	0	0	0	4	0	0

Sample	STD 2	STD 3	STD 5	STD 6	STD 7
Si	9	24	99	53	71
Ti	9	25	100	54	66
Al	9	25	99	54	66
Fe	9	25	104	55	66
Mn	9	25	104	54	66
Mg	9	25	97	52	65
Ca	4	12	47	26	33
Na	9	24	93	52	65
K	9	23	93	50	65
P	1	2	10	5	6

Sample	31992-1	31992-2	31992-3	31992-4	31992-5	31992-6	31992-7	31992-8	31992-9	31992-10	31992-11	31992-12
Sc	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
V	0	0	0	0	0	0	1	0	1	0	0	0
Cr	0	0	0	0	0.2	0	1	0	1	0	0	0
Ni	0	0	0	0	0.2	0	1	0	1	0	0	0
Cu	0	0	0	1	1	0	1	0	1	0	0	0
Zn	0	0	0	3	0	0	1	0	1	0	0	0
Nb	0	0	0	0	0	0	0	0	0	0	0	0
Y	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zr	0	0	0	3	0	0	0	0	0	0	0	0
Ba	0	0	0	0	0	0	0	0	0	0	1	0
Sr	0	0	0	0	5	0	0	0	0	0	0	0

Sample	BLANK	STD 2	STD 3	STD 4	STD 5	STD 6
Sc	0.0	8.6	23.7	47.5	90.7	69.5
V	0	8	22	44	96	68
Cr	0	8	22	45	91	68
Ni	0	8	22	45	90	67
Cu	0	8	23	46	95	72
Zn	0	8	23	44	89	66
Nb	0	8	23	46	87	69
Y	0.3	8.5	22.7	45.8	94.2	69.1
Zr	0	8	23	46	93	70
Ba	0	8	21	46	87	63
Sr	0	8	21	46	88	63

Sample	31992-1	31992-2	31992-3	31992-4	31992-5	31992-6	31992-7	31992-8	31992-9	31992-10	31992-11	31992-12
Si	0	18	0	2628	17	26	5	2	3	21	1	28
Ti	0	0	0	0	0	0	1	0	1	0	0	0
Al	0	0	0	87	2	0	0	0	0	0	1	0
Fe	0	0	0	3	0	0	1	0	1	0	0	0
Mn	0	0	0	0	0	2	1	0	1	2	0	0
Mg	0	4	0	2	0	5	1	0	1	6	0	2
Ca	0	82	0	25	11	97	1	0	1	96	0	29
Na	0	1	0	12	0	1	0	0	0	1	0	5
K	0	3	0	1	4	5	0	0	0	5	9	11
P	0	0	0	0	0	4	0	0	0	4	0	0

Sample	STD 2	STD 3	STD 5	STD 6	STD 7
Si	9	24	99	53	71
Ti	9	25	100	54	66
Al	9	25	99	54	66
Fe	9	25	104	55	66
Mn	9	25	104	54	66
Mg	9	25	97	52	65
Ca	4	12	47	26	33
Na	9	24	93	52	65
K	9	23	93	50	65
P	1	2	10	5	6

Sample	31992-1	31992-2	31992-3	31992-4	31992-5	31992-6	31992-7	31992-8	31992-9	31992-10	31992-11	31992-12
Sc	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
V	0	0	0	0	0	0	1	0	1	0	0	0
Cr	0	0	0	0	0	0	1	0	1	0	0	0
Ni	0	0	0	0	0	0	1	0	1	0	0	0
Cu	0	0	0	1	1	0	1	0	1	0	0	0
Zn	0	0	0	3	0	0	1	0	1	0	0	0
Nb	0	0	0	0	0	0	0	0	0	0	0	0
Y	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zr	0	0	0	3	0	0	0	0	0	0	0	0
Ba	0	0	0	0	0	0	0	0	0	0	1	0
Sr	0	0	0	0	5	0	0	0	0	0	0	0

Sample	BLANK	STD 2	STD 3	STD 4	STD 5	STD 6
Sc	0.0	8.6	23.7	47.5	90.7	69.5
V	0	8	22	44	96	68
Cr	0	8	22	45	91	68
Ni	0	8	22	45	90	67
Cu	0	8	23	46	95	72
Zn	0	8	23	44	89	66
Nb	0	8	23	46	87	69
Y	0.3	8.5	22.7	45.8	94.2	69.1
Zr	0	8	23	46	93	70
Ba	0	8	21	46	87	63
Sr	0	8	21	46	88	63

Sample	31992-1	31992-2	31992-3	31992-4	31992-5	31992-6	31992-7	31992-8	31992-9	31992-10	31992-11	31992-12
Si	0	18	0	2628	17	26	5	2	3	21	1	28
Ti	0	0	0	0	0	0	1	0	1	0	0	0
Al	0	0	0	87	2	0	0	0	0	0	1	0
Fe	0	0	0	3	0	0	1	0	1	0	0	0
Mn	0	0	0	0	0	2	1	0	1	2	0	0
Mg	0	4	0	2	0	5	1	0	1	6	0	2
Ca	0	82	0	25	11	97	1	0	1	96	0	29
Na	0	1	0	12	0	1	0	0	0	1	0	5
K	0	3	0	1	4	5	0	0	0	5	9	11
P	0	0	0	0	0	4	0	0	0	4	0	0

Sample	STD 2	STD 3	STD 5	STD 6	STD 7
Si	9	24	99	53	71
Ti	9	25	100	54	66
Al	9	25	99	54	66
Fe	9	25	104	55	66
Mn	9	25	104	54	66
Mg	9	25	97	52	65
Ca	4	12	47	26	33
Na	9	24	93	52	65
K	9	23	93	50	65
P	1	2	10	5	6

Sample	31992-1	31992-2	31992-3	31992-4	31992-5	31992-6	31992-7	31992-8	31992-9	31992-10	31992-11	31992-12
Sc	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
V	0	0	0	0	0	0	1	0	1	0	0	0
Cr	0	0	0	0	0	0	1	0	1	0	0	0
Ni	0	0	0	0	0	0	1	0	1	0	0	0
Cu	0	0	0	1	1	0	1	0	1	0	0	0
Zn	0	0	0	3	0	0	1	0	1	0	0	0
Nb	0	0	0	0	0	0	0	0	0	0	0	0
Y	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Zr	0	0	0	1	0	0	0	0	0	0	0	0
Ba	0	0	0	0	0	0	0	0	0	0	1	0
Sr	0	0	0	0	5	0	0	0	0	0	0	0

Sample	BLANK	STD 2	STD 3	STD 4	STD 5	STD 6
Sc	0.0	8.6	23.7	47.5	90.7	69.5
V	0	8	22	44	96	68
Cr	0	8	22	45	91	68
Ni	0	8	22	45	90	67
Cu	0	8	23	46	95	72
Zn	0	8	23	44	89	66
Nb	0	8	23	46	87	69
Y	0.3	9.5	22.7	45.8	94.2	69.1
Zr	0	8	23	46	93	70
Ba	0	8	21	46	87	63
Sr	0	8	21	46	88	63

ample	31992-1	31992-2	31992-3	31992-4	31992-5	31992-6	31992-7	31992-8	31992-9	31992-10	31992-11	31992-12
Si	0.0	18.4	0.0	2628.0	16.5	25.8	5.0	1.9	2.7	21.0	1.3	27.8
Ti	0.0	0.0	0.0	0.3	0.0	0.0	0.9	0.0	0.9	0.0	0.0	0.0
Al	0.0	0.5	0.0	87.3	2.1	0.0	0.1	0.0	0.0	0.0	1.0	0.0
Fe	0.0	0.2	0.0	3.1	0.0	0.0	1.0	0.0	1.0	0.0	0.0	0.0
Mn	0.0	0.2	0.0	0.0	0.0	1.9	1.1	0.0	1.0	1.8	0.0	0.0
Mg	0.0	4.1	0.0	1.7	0.0	5.1	0.9	0.0	1.0	5.6	0.0	1.6
Ca	0.0	82.4	0.0	25.0	10.5	97.0	1.0	0.0	1.0	96.0	0.0	28.8
Na	0.0	0.8	0.0	12.0	0.0	1.0	0.0	0.0	0.0	1.0	0.0	5.3
K	0.1	2.9	0.0	1.0	3.9	4.8	0.0	0.0	0.0	4.7	9.4	11.3
P	0.0	0.1	0.0	0.3	0.0	3.6	0.0	0.0	0.0	3.7	0.0	0.1

ample	STD 2	STD 3	STD 5	STD 6	STD 7
Si	9.4	24.1	99.1	53.0	71.0
Ti	9.1	24.7	99.8	53.6	65.5
Al	9.0	24.6	98.9	53.6	66.4
Fe	9.3	25.1	104.0	55.2	66.0
Mn	9.4	25.3	104.0	54.1	65.6
Mg	9.3	25.0	97.2	52.2	65.3
Ca	4.4	12.0	47.2	26.2	32.9
Na	8.8	23.6	92.6	51.7	64.6
K	8.6	23.3	93.3	50.0	65.4
P	0.9	2.4	9.9	5.3	6.3

	(other elements)	Si	Ca
std 2 =	9.1 ppm	8.8	4.6
3 =	25 ppm	24.3	125
5 =	100 ppm	97	50
6 =	53 ppm	51.4	26.5
7 =	66.7 ppm	64.7	33.3

ample	31992-1	31992-2	31992-3	31992-4	31992-5	31992-6	31992-7	31992-8	31992-9	31992-10	31992-11	31992-12
Sc	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
V	0.4	0.4	0.4	0.4	0.4	0.4	1.4	0.4	1.4	0.4	0.4	0.4
Cr	0.1	0.2	0.2	0.2	0.3	0.1	1.2	0.2	1.2	0.2	0.2	0.1
Ni	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0	0.7	0.0	0.0	0.0
Cu	0.4	0.5	0.4	0.5	0.5	0.4	1.4	0.4	1.4	0.4	0.4	0.4
Zn	0.0	0.0	0.0	2.6	0.0	0.0	0.9	0.0	0.9	0.0	0.0	0.0
Nb	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Y	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2	~~0.0~~.2
Zr	0.3	0.3	0.3	3.0	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3
Ba	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0
Sr	0.0	0.1	0.0	0.0	5.4	0.2	0.0	0.0	0.0	0.0	0.0	0.0
Pb	~~0~~.04	.09	.01	.23	.95	.01	.95	.0	.95	.02	.01	0

samples 4, 5, 7, 9 by flame AA for Pb

≠ our blank

ample	BLANK	STD 2	STD 3	STD 4	STD 5	STD 6
Sc	0.0	8.6	23.7	47.5	90.7	69.5
V	0.4	8.3	21.8	44.3	96.0	68.3
Cr	0.2	8.3	21.6	45.3	91.0	67.8
Ni	0.0	8.4	22.2	45.2	89.5	67.3
Cu	0.5	8.4	22.6	46.3	94.8	72.0
Zn	0.0	8.4	22.9	43.7	89.4	66.4
Nb	0.3	8.5	22.8	45.7	87.0	69.3
Y	0.3	8.5	22.7	45.8	94.2	69.1
Zr	0.4	8.3	22.8	46.1	93.3	69.9
Ba	0.0	8.3	21.1	45.9	86.6	62.5
Sr	0.0	8.3	21.4	45.6	87.6	62.7

std 2 = 8.2 ppm
3 = 22.7 ppm
4 = 45.5 ppm
5 = 90.9 ppm
} for all elements

6 = 68.2 ppm

Results

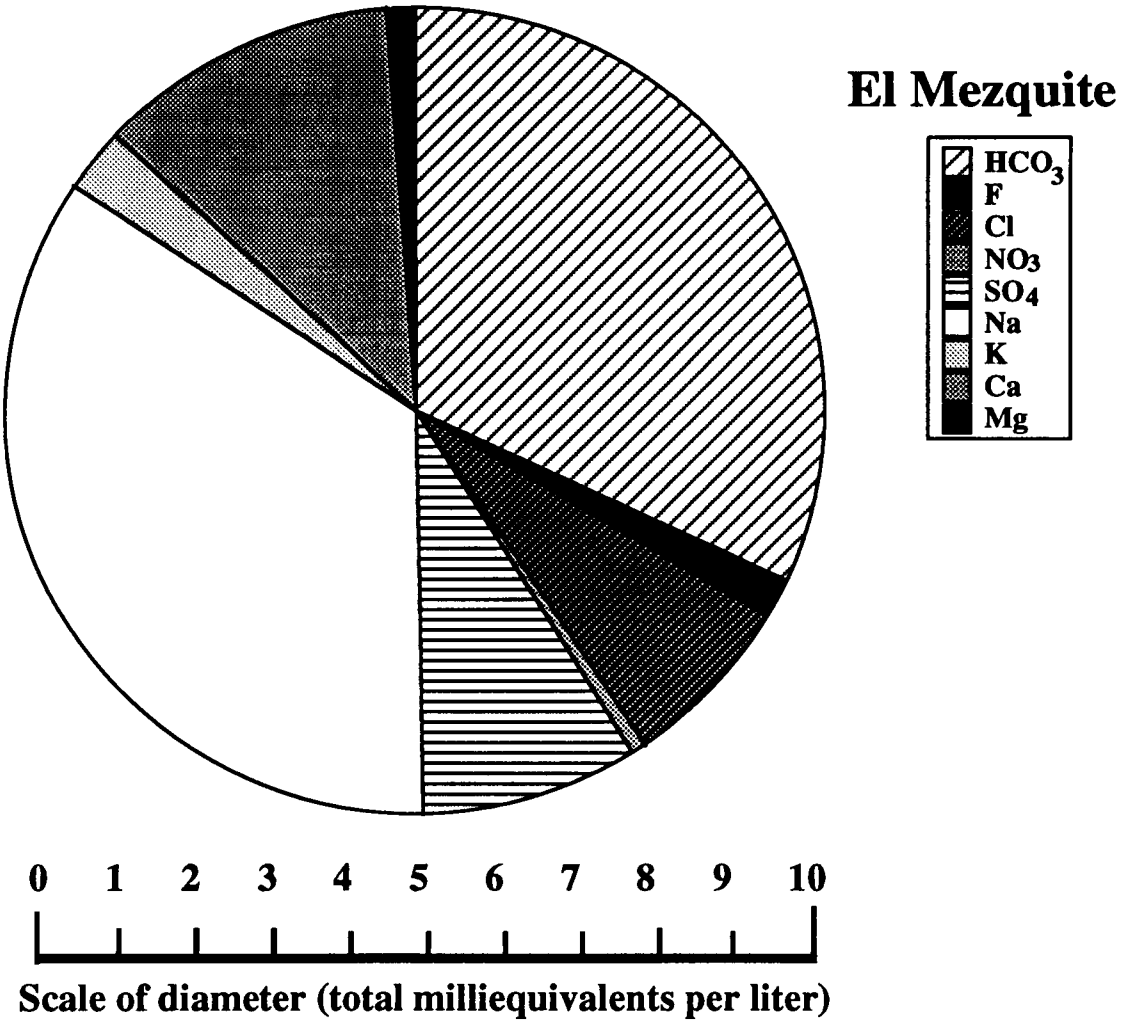
Pena Blanca Fluid Analyses

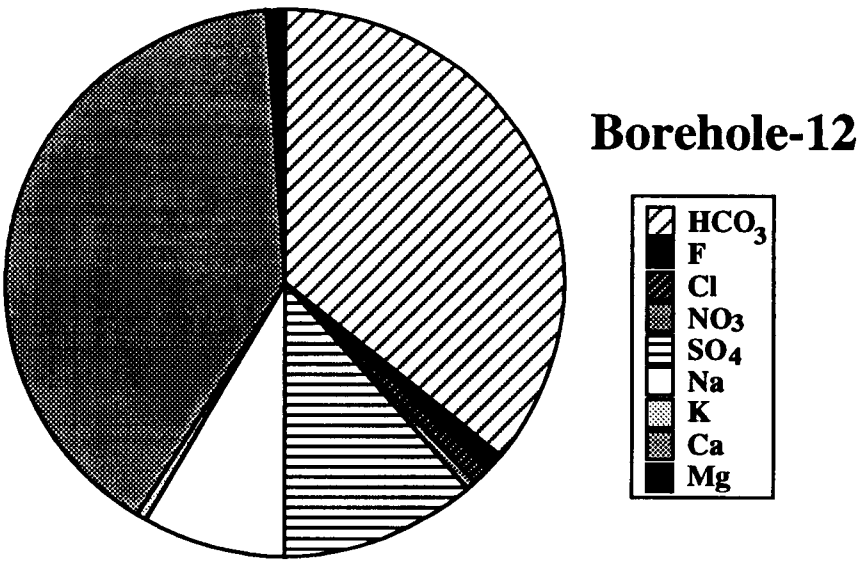
Parameter	BH-12 filtered	BH-12 unfiltered	El Mesquite filtered	El Mesquite unfiltered
Field Measurements				
pH		7.5		7.2
Eh (mV)				138
CO2 (micromole/l)		454		295
Dissolved O2 (micromole/l)		94		63
Silica (micromole/l)		>534		>534
Temperature oC		24		17
Lab Measurements				
Alkalinity (micromole/l)	3545			
Anions (micromole/l)				
F	84.2		174	
Cl	84.6		748	
PO4	<1		<1	
NO3	40.3		66.1	
SO4	7631		3435	
Cations (micromole/l)				
Na	<635	603	261	3655
K	38.4	156	261	266
Ca	1440	1622	636	624
Mg	<41	<45	<41	<45
Sr	2.4	2.50	<0.1	1.25
Al	6.3	176	<3	4.40
Si	233	798	363	823
Ba	<0.39	<0.42	<0.39	<0.42
Cd	<0.04	<0.05	0.44	0.12
Cr	0.38	<0.2	<0.2	<0.2
Cu	0.5	0.35	<0.28	<0.31
Fe	<0.36	14	<0.36	1.34
Mn	3.5	10.90	0.98	1.33
Ni	<0.55	<0.61	<0.54	<0.66
Pb	<0.48	0.17	0.58	<0.005
Uranium			0.95	

Table 7.3
Chemical Composition (mg/l) of Waters Collected Near and at the Nopal I Deposit.

Species	El Mezquite	Borehole-12
Na	84.2	13.8
K	10.2	1.5
Mg	<1.0	<1.0
Ca	25.5	57.7
Sr	<0.01	0.21
Mn	0.05	0.19
U	0.23	2.21
Al	<0.1	0.17
SiO_2	59.1	37.9
F	3.3	1.6
Cl	26.5	3.0
NO_3	4.1	2.5
SO_4	44	39
Alkalinity*	206[a]	156
pH	7.2	7.5

* Alkalinity as HCO_3.
[a] Alkalinity as HCO_3 calculated from charge balance.


El Mezquite
HCO3
F
Cl
NO3
SO4
Na
K
Ca
Mg
0 1 2 3 4 5 6 7 8 9 10
Scale of diameter (total milliequivalents per liter)


Borehole-12
HCO3
F
Cl
NO3
SO4
Na
K
Ca
Mg

Parameter	BH-12 filtered	BH-12 unfiltered	El Mesquite filtered	El Mesquite unfiltered
Field Measurements		µM		µM
pH		7.5		7.2
Eh (mV)				138
CO2 (ppm)	MW 44.011 g CO2/mole CO2	20 454		13 295
Dissolved O2 (ppm)		3 93.75		2 62.5
Silica (ppm)		>15 534		>15 >534
Temperature oC		24		17
Lab Measurements				
Alkalinity (ppm)	156			
Anions (ppm)		µmolar		
F	1.6	84.2	3.3 173.7	
Cl	3.0	84.6	26.5 747.5	
PO4	<.1	<1	<.1 <1	
NO3	2.5	40.3	4.1 66.1	
SO4	733	7631	330 3435	
Cations				
Na	<635 <14.6	603 13.8	3677 84.2	3655 83.7
K	38.4 1.5	156 6.1	261 10.2	266 10.4
Ca	1440 57.7	1622 65	636 25.5	624 25
Mg	<41 <1.0	<45 <1.1	<41 <1.0	<45 <1.1
Sr	2.4 0.21	2.5 0.22	<0.1 <0.01	1.25 0.11
Al	6.3 0.17	176 4.75	<3 <0.094	4.4 0.12
Si	233 6.53	798 22.4	363 10.2	823 23.1
Ba	<.39 <0.053	<.42 <0.058	<.39 <0.053	<.42 <0.058
Cd	<0.04 <0.005	<.05 <0.006	0.44 0.05	0.12 0.013
Cr	0.38 0.02	<.2 <0.011	<.2 <0.01	<.2 <0.011
Cu	0.50 0.032	0.35 0.022	<.28 <0.018	<.31 <0.02
Fe	0.36 <0.02	14 0.78	<.036 <0.02	1.34 0.075
Mn	3.5 0.19	10.9 0.60	0.98 0.054	1.33 0.073
Ni	<0.55 <0.032	<0.61 <0.036	<0.54 <0.032	<.66 <0.036
Pb	<.48 <0.10	0.17 0.036	0.58 0.12	<0.001
Uranium			0.95 0.225	

mole O2 / 32 g O 3 µg O2 / g H2O 32 g O / mole O2

12/17/91

1 g/l × 100 µmole × 100 µmoles Si / liter × 28.085 g Si / moles

Parameter	BH-12 3/93	BH-12 9/91	El Mesquite
Field Measurements			
pH	7.38	7.5	7.2
Eh (V)	-0.213		0.138
CO2 (mg/l)	54	20	13
Dissolved O2 (mg/l)	<1	3	2
Silica (mg/l)		>15	>15
Temperature oC	22.8	24	17
H2S	>1		
Lab Measurements			
Alkalinity as HCO3- (mg/l)	324.79	161.45	230.5
Anions (mg/l)			
F	1.09	1.6	3.3
Cl	3.52	3	26.5
PO4	1.66	<.1	<.1
NO3	<0.002	2.5	4.1
SO4	4.41	39	44
Cations (mg/l)			
Na	1	13.8	84.2
K	5	1.5	10.2
Ca	96.5	57.7	25.5
Mg	5.5	<1	<1
Sr		0.21	<.01
Al	0.16	0.17	<.1
Si	43.4	37.9	59.1
Fe			
Mn	2	0.19	0.05
Uranium	1.37	2.21	0.23
P	4		
HCO3 by charge balance	316.6		

Parameter	BH-12 filtered	BH-12 unfiltered	El Mesquite filtered	El Mesquite unfiltered
Field Measurements				
pH		7.5		7.2
Eh (mV)				138
CO2 (ppm)		20		13
Dissolved O2 (ppm)		3		2
Silica (ppm)		>15		>15
Temperature oC		24		17
Lab Measurements				
Alkalinity (ppm)	156			
Anions (ppm)				
F	1.6		3.3	
Cl	3.0		26.5	
PO4	<.1		<.1	
NO3	2.5		4.1	
SO4	733		330	
Cations				
Na	<14.6	13.8	84.2	83.7
K	1.5	6.1	10.2	10.4
Ca	57.7	65	25.5	25
Mg	<1.0	<1.1	<1.0	<1.1
Sr	0.21	0.22	<0.01	0.11
Al	0.17	4.75	<0.094	0.12
Si	6.53	22.4	10.2	23.1
Ba	<0.053	<0.058	<0.053	<0.058
Cd	<0.005	<0.006	0.05	0.013
Cr	0.02	<0.011	<0.01	<0.011
Cu	0.032	0.022	<0.018	<0.02
Fe	<0.02	0.78	<0.02	0.075
Mn	0.19	0.60	0.054	0.073
Ni	<0.032	<0.036	<0.032	<0.036
Pb	<0.10	0.036	0.12	<0.001
Uranium			0.225	

Parameter	BH-12 3/93	BH-12 9/91	El Mesquite
Field Measurements			
pH	7.38	7.5	7.2
Eh (V)	-0.213		0.138
CO2 (mg/l)	54	20	13
Dissolved O2 (mg/l)	<1	3	2
Silica (mg/l)		>15	>15
Temperature oC	22.8	24	17
H2S	>1		
Lab Measurements			
Alkalinity as HCO3- (mg/l)	324.79	161.45	230.5
Anions (mg/l)			
F	1.09	1.6	3.3
Cl	3.52	3	26.5
PO4	1.66	<.1	<.1
NO3	<0.002	2.5	4.1
SO4	4.41	39	44
Cations (mg/l)			
Na	1	13.8	84.2
K	5	1.5	10.2
Ca	96.5	57.7	25.5
Mg	5.5	<1	<1
Sr		0.21	<.01
Al	0.16	0.17	<.1
Si	43.4	37.9	59.1
Fe			
Mn	2	0.19	0.05
Uranium	1.37	2.21	0.23
P	4		
HCO3 by charge balance	316.6		

Parameter	BH-12 3/93	BH-12 9/91	El Mesquite
Field Measurements			
pH	7.38	7.5	7.2
Eh (V)	-0.213		0.138
CO2 (mg/l)	54	20	13
Dissolved O2 (mg/l)	<1	3	2
Silica (mg/l)		>15	>15
Temperature oC	22.8	24	17
H2S	>1		
Lab Measurements			
Alkalinity as HCO3- (mg/l)	324.79	161.45	230.5
Anions (mg/l)			
F	1.09	1.6	3.3
Cl	3.52	3	26.5
PO4	1.66	<.1	<.1
NO3	<0.002	2.5	4.1
SO4	4.41	39	44
Cations (mg/l)			
Na	1	13.8	84.2
K	5	1.5	10.2
Ca	96.5	57.7	25.5
Mg	5.5	<1	<1
Sr		0.21	<.01
Al	0.16	0.17	<.1
Si	43.4	37.9	59.1
Fe			
Mn	2	0.19	0.05
Uranium	1.37	2.21	0.23
P	4		
HCO3 by charge balance	316.6		