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Scientific Notebook # 494 -- Continued Ion  
Exchange Experiments in Scientific Notebook  
# 558

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CONTROLLED  
COPY 494

Bradley Werling 522-6565

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Initials

Bradley Werling

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BAW

Paul Bertetti

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PB

Alka Jain

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AJ

error and correction review by PI 03/08/02

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Monthly review 01 Apr 02 ~~PB~~, 01 May 02 ~~PB~~, 11 Jun 02 ~~PB~~Periodic review completed 06 Aug 02 ~~PB~~Periodic review completed 04 Nov 02 ~~PB~~Periodic review completed 02 Dec 02 ~~PB~~

BW

1/14/02

BW

Continuation of Ion Exchange Experiments from  
Scientific Notebook 420Stratium AA analysis of  $\text{SrCl}_2$ -KCl stock solns

Perkin Elmer 3100 Atomic Absorption Spectrophotometer

Sr Hollow-Cathode lamp - 12 mA Fisher 14-386-106W

 $\lambda = 460.7$ , slit = 0.7 nm Air-acetylene flame

Blank = 1% Lact (w/w) (420/198)

Integration time = 3 sec

Sample = DF20 (420/199) of (420/161 + 162 soln)  
BW 1/14/02

Absorbance of Stds (420/199)

ID	Conc Sr (ppm)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
Sr1	5	0.211	0.211	0.211	0.212	0.212
Sr2	2.5	0.108	0.106	0.107	0.106	0.107
Sr3	1.5	0.064	0.064	0.064	0.064	0.064
Sr4	1.0	0.043	0.042	0.042	0.042	0.042
Sr5	0.5	0.021	0.021	0.021	0.021	0.021
Sr6	0.25	0.010	0.010	0.010	0.010	0.010

Absorbance of Samples (420/199)

ID	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
DF20	0.099	0.099	0.099	0.099	0.098
Sr2	0.106	0.107	0.107	0.106	0.107

No A/Z corrections made during analysis

1/14/02  
CONT BAW

# Preparation of Calcium and Potassium AA cal curves for Ca-K Ion Exchange Experiment

2 Ca and 2 K cal curves will be prepared.  
Calcium curves will have 3 ppm K and 0.3 ppm matrix  
Potassium curves will have 5 ppm Ca and 0.15 ppm matrix

20 ppm Ca Soln - Labeled CA20

Added 2 mL of 1000 ppm Ca\* to a 100 mL volumetric flask and diluted to mark with nanopure water

50 ppm Ca Soln - Labeled CA50

Added 5 mL (vol pipet) of 1000\* Ca to a 100 mL vol. flask and diluted to mark with nanopure water.

15 ppm Ca Soln - Labeled CA15

CA50 (494/2) - 1/14/02  
Added 15 mL of 1000 ppm Ca\* to a 100 mL vol flask and diluted to mark with nanopure water.

\* Spex Certiprep 1000 ppm Ca in 2% HNO<sub>3</sub> -  
cat# PLCA2-2Y, lot 8-140 CA, rec 1/14/02, open 1/14/02

30 ppm K Soln - Labeled K30

Added 3 mL (vol pipet) of 1000 ppm K\* to a 100 mL vol flask and diluted to mark with nanopure water.

10 ppm K Soln - Labeled K10

Added 1 mL (vol pipet) of 1000 ppm K\* to a 100 mL vol flask and diluted to mark with nanopure water

\* Spex Certiprep 1000 ppm K in 2% HNO<sub>3</sub> - cat# PLK2-2Y  
lot# 8-33K-Y, rec 1/14/02, open 1/14/02.

1/14/02  
CONT BAW

## Calcium calibration curves in Potassium matrix

Volumetric pipets were used to transfer all solutions in the 0.5 mL to 25 mL volume range.  
% LaCl is w/w with a final target concentration of 0.1%

20 ppm Ca was CA20 (494/2)

1% LaCl was 420/198

30 ppm K was K30 (494/2)

## Calcium calibration curve with 3 ppm K

Soln ID	Target Conc of Ca (ppm)	Final Vol (mL)	Vol (mL) of 20 ppm Ca	Vol (mL) of 1% LaCl	Vol (mL) of 30 ppm K
Ca1A	5	100	25	10	10
Ca2A*	4	50	10	5	5
Ca3A	2	50	5	5	5
Ca4A	1.2	50	3	5	5
Ca5A	0.4	50	1	5	5
Ca6A	0.2	100	1	10	10

\* AA sensitivity check

## Calcium calibration curve with 0.3 ppm K

Soln ID	Target Conc of Ca (ppm)	Final Vol (mL)	Vol (mL) of 20 ppm Ca	Vol (mL) of 1% LaCl	Vol (mL) of 30 ppm K
Ca1B	5	100	25	10	1.0
Ca2B*	4	50	10	5	0.5
Ca3B	2	50	5	5	0.5
Ca4B	1.2	50	3	5	0.5
Ca5B	0.4	50	1	5	0.5
Ca6B	0.2	100	1	10	1.0

\* AA sensitivity check

15 Jan 02  
BAW



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CONT BAW

## Potassium calibration curves

All final volumes were 50mL (volumetric flasks)

Volumetric pipets were used to transfer all solutions in the 0.5 mL to 25 mL volume range

% LaCl is w/w 1% LaCl (420/198)

10 ppm K was K10 (420/2)

1% LaCl was 1% LaCl (420/198)

50 ppm Ca was CA50 (494/2)

15 ppm Ca was CA15 (494/2)

## Potassium calibration curve with 5 ppm Ca

Soln ID	Target Conc of k (ppm)	Target Conc of LaCl (%)	Target Conc of Ca (ppm)	Vol (mL) of 10 ppm K	Vol (ml) of (1% LaCl)	Vol (ml) of 50 ppm Ca
K1A*	2	0.1	5	10	5	5
K2A	1	0.1	5	5	5	5
K3A	0.6	0.1	5	3	5	5
K4A	0.4	0.1	5	2	5	5
K5A	0.2	0.1	5	1	5	5
K6A	0.1	0.1	5	0.5	5	5

\* AA sensitivity check

Potassium calibration curve with 0.15 ppm Ca <sup>Ca BW 14 Jan 02</sup>

Soln ID	Target Conc of k (ppm)	Target Conc of LaCl (%)	Target Conc of Ca (ppm)	Vol (mL) of 10 ppm K	Vol (ml) of (1% LaCl)	Vol (ml) of 15 ppm Ca
K1B*	2	0.1	0.15	10	5	0.5
K2B	1	0.1	0.15	5	5	0.5
K3B	0.6	0.1	0.15	3	5	0.5
K4B	0.4	0.1	0.15	2	5	0.5
K5B	0.2	0.1	0.15	1	5	0.5
K6B	0.1	0.1	0.15	0.5	5	0.5

14 Jan 02  
BAW1-14-02  
CONT BAW

## AA analysis for calcium and potassium of Ca/K binary solutions with zeolite

The calcium and potassium concentrations of the calcium/potassium binary solutions with zeolite was to be determined using AA. Dilutions would also be required in order to bring the analyte concentrations into the calibration curve range (0.2 to 5 ppm Ca and 0.1 to 2 ppm K). The solutions analyzed were 14 sample solutions (420/189) and three reference solutions (420/188). All three reference solutions were analyzed for calcium. Two reference solutions were analyzed for potassium. One reference solution contained no initial potassium. Therefore, this solution was not analyzed for potassium.

Matrix effects were a concern since the concentration of both cations varied. The calcium and potassium target concentrations were known for each solution. Samples were diluted in order to bring the analyte concentrations into the calibration curve range. The concentration of the non analyte cation was also calculated in order to determine the appropriate curve matrix. Table 1 contains target concentrations for undiluted and diluted samples.

An initial AA sample prep scheme was based on the information from Table 1. Three different DFs would be used: 20, 50 and 500. Two calcium cal curves would be prepared with various potassium matrix concentrations: 3 ppm and 0.3 ppm. Two potassium cal curves would be prepared with various calcium matrix concentrations: 5 ppm and 0.15 ppm. Table 2 contains the scheme for the calcium analysis. Table 3 contains the scheme for the potassium analysis.

14 Jan 02  
BAW

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CONT BAW

TABLE 1

Sample ID	Target Conc Ca (ppm)	Target Conc K (ppm)	Ca conc DF50	K Conc DF50	Ca conc DF500	K Conc DF500	Cs conc DF20	K Conc DF20
1	19.27	353.38	0.39	7.07	0.04	0.71	0.96	17.67
2	39.38	314.16	0.79	6.28	0.08	0.63	1.97	15.71
3	59.01	275.85	1.18	5.52	0.12	0.55	2.95	13.79
4	77.42	239.94	1.55	4.80	0.15	0.48	3.87	12.00
5	94.22	207.15	1.88	4.14	0.19	0.41	4.71	10.36
6	116.19	164.29	2.32	3.29	0.23	0.33	5.81	8.21
7	134.44	128.69	2.69	2.57	0.27	0.26	6.72	6.43
8	149.36	99.57	2.99	1.99	0.30	0.20	7.47	4.98
9	164.93	69.19	3.30	1.38	0.33	0.14	8.25	3.46
10	176.52	46.59	3.53	0.93	0.35	0.09	8.83	2.33
11	185.00	30.05	3.70	0.60	0.37	0.06	9.25	1.50
12	191.07	18.20	3.82	0.36	0.38	0.04	9.55	0.91
13	195.28	9.98	3.91	0.20	0.39	0.02	9.76	0.50
14	198.05	4.58	3.96	0.09	0.40	0.01	9.90	0.23

Ref Soln Xi, Ca CaCL-KCL	Target Conc Ca (ppm)	Target Conc K (ppm)	Ca conc DF50	K Conc DF50	Ca conc DF500	K Conc DF500
0.3	60.1	273.7	1.20	5.47	0.12	0.55
0.6	120.2	156.4	2.40	3.13	0.24	0.31
1.0	200.4	0	4.01	0.00	0.40	0

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TABLE 2

Calcium Analysis

Sample ID	Dilution Factor DF50	Cal Curve Matrix	
		3 ppm K	0.3 ppm K
1	Yes	Yes	
2	Yes	Yes	
3	Yes	Yes	
4	Yes	Yes	
5	Yes	Yes	
6	Yes	Yes	
7	Yes	Yes	
8	Yes	Yes	
9	Yes	Yes	
10	Yes		Yes
11	Yes		Yes
12	Yes		Yes
13	Yes		Yes
14	Yes		Yes

Reference Soln Xi, Ca (0.005N) CaCL-KCL	Dilution Factor DF50	Cal Curve Matrix	
		3 ppm K	0.3 ppm K
0.3	Yes	Yes	
0.6	Yes	Yes	
1.0	Yes		Yes

TABLE 3

Potassium Analysis

Sample ID	Dilution Factor DF20	Dilution Factor DF50	Dilution Factor DF500	Cal Curve Matrix	
				5 ppm Ca	0.15 ppm Ca
1			Yes		Yes
2			Yes		Yes
3			Yes		Yes
4			Yes		Yes
5			Yes		Yes
6			Yes		Yes
7			Yes		Yes
8			Yes		Yes
9		Yes		Yes	
10		Yes		Yes	
11		Yes		Yes	
12		Yes		Yes	
13		Yes		Yes	
14	Yes			Yes	

Reference Soln Xi, Ca (0.005N) CaCL-KCL	Dilution Factor DF20	Dilution Factor DF50	Dilution Factor DF500	Cal Curve Matrix	
				5 ppm Ca	0.15 ppm Ca
0.3			Yes		Yes
0.6			Yes		Yes
1*					

\* Not analyzed for K since no K present in original solution



1-15-02  
BAW

# Sample Dilutions for Ca and K analysis (AA) of Ca-K binary solutions

Samples from 420/189 and 420/188

All dilutions (except single DF20) were two step dilutions. Final dilutions were DF10 (described later)

See page 494/7 for Sample list with DF5

DF20 (single step) sample

Added 0.5 mL of sample and 1.0 mL (vol pipet) of 1% LaCl<sub>3</sub> (420/198) to a 10 mL vol flask and diluted to mark with nanopure water

DF50 samples

Initial dilution DF5

Added 2 mL of sample to a 10 mL vol flask and diluted to mark with nanopure water.

DF500 samples

Initial dilution DF50

Added 1 mL (vol pipet) of sample to a 50 mL flask and diluted to mark with nanopure water.

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BAW

# Sample dilutions for Ca and K AA analysis of Ca-K binary solutions

Second dilution step - DF10

DF20 (final)

no further dilution

DF50 (final)

Added 1 mL (vol pipet) of DF5 and 1 mL of 1% LaCl<sub>3</sub> (420/198) to a 10 mL vol flask and diluted to mark with nanopure water.

DF500 (final)

Added 1 mL (vol pipet) of DF500 and 1 mL of

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BAW

BW 2/25/02

1% LaCl<sub>3</sub> (420/198) to a 10 mL flask and diluted to mark with nanopure water.

0.1% LaCl<sub>3</sub> Blank = Soln B 463/41

# Calcium AA Analysis of Ca-K Binary Solus

Perkin Elmer 3100 Atomic Absorption Spectrophotometer

Ca-Mg Lamp @ 6 mL,  $\lambda = 422.7 \text{ nm}$ , slit = 0.7, low Air-acetylene flame

Blank = 0.1% LaCl<sub>3</sub> = Soln B (463/41)

Calcium Curve with 3 ppm K

Absorbance of Standards Ca X A series 494/3

ID	Conc (ppm)	Trial				
		1	2	3	4	5
Ca1A	5	0.329	0.330	0.331	0.331	0.332
Ca2A	4	0.268	0.269	0.269	0.271	0.270
Ca3A	2	0.136	0.136	0.137	0.136	0.137
Ca4A	1.2	0.083	0.083	0.083	0.083	0.083
Ca5A	0.4	0.028	0.028	0.028	0.027	0.028
Ca6A	0.2	0.015	0.015	0.015	0.015	0.015

Absorbance of Standards <sup>BW 1/16/02</sup> Samples (494/8)

ID	DF	Trial				
		1	2	3	4	5
1	50	0.030	0.030	0.030	0.030	0.030
2	50	0.059	0.059	0.059	0.059	0.059
3	50	0.097	0.098	0.098	0.098	0.097
4	50	0.116	0.117	0.116	0.116	0.117

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CONT BAW

## Absorbance of Samples (494/8)

ID	DF	Trial				
		1	2	3	4	5
5	50	0.152	0.152	0.152	0.152	0.152
6	50	0.178	0.178	0.177	0.178	0.178
7	50	0.192	0.192	0.191	0.193	0.192
8	50	0.208	0.209	0.208	0.208	0.208
9	50	0.227	0.227	0.226	0.225	0.226
R0.3	50	0.079	0.079	0.078	0.078	0.079
R0.6	50	0.156	0.156	0.156	0.156	0.157
CA3A	-	0.135	0.135	0.135	0.135	0.135

Max AZ Correction = -0.001

Calcium Curve with 0.3 ppm K

## Absorbance of Standards CaXB Series (494/3)

ID	Conc (ppm)	Trial				
		1	2	3	4	5
Ca1B	5	0.332	0.332	0.331	0.330	0.332
Ca2B	4	0.265	0.269	0.266	0.266	0.266
Ca3B	2	0.134	0.135	0.136	0.135	0.135
Ca4B	1.2	0.082	0.082	0.082	0.081	0.081
Ca5B	0.4	0.027	0.027	0.027	0.027	0.027
Ca6B	0.2	0.014	0.014	0.014	0.014	0.015

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BAW

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CONT BAW

## Absorbance of Samples (494/8)

ID	DF	Trial				
		1	2	3	4	5
10	50	0.240	0.239	0.240	0.240	0.240
11	50	0.248	0.248	0.247	0.247	0.247
12	50	0.488	0.489	na	-	-
13	50	0.258	0.260	0.260	0.259	0.259
14	50	0.260	0.260	0.262	0.260	0.259
R1.0	50	0.263	0.263	0.263	0.264	0.264
Ca2B	-	0.267	0.267	0.269	0.269	0.267

Max AZ correction = -0.001

Rinsed AA w/ 0.2N HNO<sub>3</sub> (420/140) for 5 min and then nanopure water for 5 min at end of analysis.

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BAW

## Sample Dilution (Redo) for mixture 12

Dilution of mixture 12 was redone. Calcium AA value (494/11) was outside of calibration curve and much larger than expected. Wanted to eliminate possibility of dilution error.

Two step dilution for DF50 (final)

Initial dilution = DF5

Added 2 mL (vol pipet) of #12 <sup>BAW 1/17/02</sup> to a 10 mL vol. flask and diluted to mark with nanopure water.

Final dilution DF10 for total DF50.

Added 1 mL (vol pipet) of DF5 and 1 mL of 1% Lysol to a 10 mL vol flask and diluted to mark with nanopure water. The new soln will be used for both Ca and K analysis.



1-17-02  
CONT BLWCalcium AA Analysis for #12 (redo)

Perkin Elmer 3100 AA Spectrophotometer

Ca-Mg Lamp @ 6mV

 $\lambda = 422.7 \text{ nm}$ , slit = 0.7, low

Air-acetylene flame

Blank = 0.1% LaCl = Soln B (463/41)

Calcium Curve with 0.3 ppm K

Absorbance of Stds CaXB series 494/3

ID	Conc (ppm)	Trial				
		1	2	3	4	5
Ca1A	5	0.350	0.350	0.350	0.350	0.350
Ca2A	4	0.284	0.282	0.294	0.285	0.284
Ca3A	2	0.148	0.142	0.143	0.148	0.143
Ca4A	1.2	0.087	0.087	0.087	0.087	0.088
Ca5A	0.4	0.029	0.029	0.029	0.029	0.029
Ca6A	0.2	0.014	0.014	0.014	0.014	0.014

Absorbance of #12 (494/11)

ID	DF	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
12	50	0.261	0.261	0.261	0.263	0.262
Ca2A	-	0.280	0.281	0.277	0.278	0.279

Max AZ correction = -0.001

Potassium Analysis (AA) of Ca-K solutions

Perkin Elmer 3100 AA Spectrophotometer

K-hollow cathode lamp 8mA Fisher 14-386-106 H

 $\lambda = 766.5 \text{ nm}$ , slit = 0.7 nm, high, Air-acetylene1-17-02  
CONT BLW

Blank = 0.1% LaCl (w/w) = 463/41

Integration time = 3 sec

Potassium Curve with 5 ppm Calcium

Absorbance of Stds KXA Series (494/4)

ID	Conc (ppm)	Trial				
		1	2	3	4	5
K1A	2	0.211	0.211	0.212	0.212	0.211
K2A	1	0.106	0.107	0.106	0.105	0.106
K3A	0.6	0.064	0.063	0.064	0.063	0.063
K4A	0.4	0.042	0.042	0.042	0.042	0.042
K5A	0.2	0.021	0.020	0.020	0.020	0.020
K6A	0.1	0.009	0.009	0.009	0.009	0.010

Absorbance of Samples (494/8)

ID	DF	Trial				
		1	2	3	4	5
1	500	NOT ANALYZED				
2	500					
3	500					
4	500	ON 5 ppm Ca curve				
5	500					
6	500					
7	500					
8	500					
9	50	0.105	0.103	0.104	0.105	0.103
10	50	0.071	0.072	0.071	0.071	0.071
11	50	0.046	0.045	0.046	0.046	0.045
12	50	0.026	0.026	0.026	0.026	0.025

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CONT BW

Absorbance of Samples (494/8) cont

ID	DF	Trial				
		1	2	3	4	5
13	50	0.010	0.010	0.010	0.010	0.010
14	20	0.018	0.018	0.018	0.018	0.018
R0.6	500	NOT ANALYZED ON 5ppm Curve				
R0.3	500					
K4A	—	0.044	0.044	0.044	0.044	0.044

Potassium Cal Curve with 0.15ppm Ca  
Absorbance of Stds KXB Series (494/4)

ID	conc (ppm)	Trial				
		1	2	3	4	5
2	K1B	0.213	0.212	0.212	0.213	0.214
1	K2B	0.107	0.106	0.109	0.107	0.106
0.6	K3B	0.063	0.063	0.063	0.063	0.062
0.4	K4B	0.041	0.042	0.042	0.042	0.041
0.2	K5B	0.018	0.018	0.018	0.018	0.019
0.1	K6B	0.009	0.008	0.009	0.008	0.009

Absorbance of Samples (494/8)

ID	DF	Trial				
		1	2	3	4	5
1	500	0.067	0.068	0.068	0.066	0.067
2	500	0.058	0.058	0.057	0.057	0.057
3	500	0.042	0.042	0.042	0.042	0.042

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CONT BW

Absorbance of Samples (494/8) cont.

ID	DF	Trial				
		1	2	3	4	5
4	500	0.035	0.035	0.035	0.035	0.035
5	500	0.028	0.028	0.028	0.028	0.028
6	500	0.015	0.015	0.015	0.015	0.015
7	50	0.200	0.200	0.200	0.202	0.203
8	50	0.156	0.154	0.154	0.155	0.154
R0.6	500	0.027	0.027	0.027	0.027	0.027
R0.3	500	0.044	0.044	0.044	0.044	0.044
K4B	—	0.043	0.042	0.043	0.042	0.043

Max A2 correction  $\pm 0.001$

At end of analysis, aspirated with 0.2N HNO<sub>3</sub>  
(420/140) for 5 minutes and then nanopure water  
for 5 minutes

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BAW

AA Results for SrCl<sub>2</sub>-KCl Stock Soln

### Strontium Concentration in Strontium Stock Solution for SrCl<sub>2</sub>-KCl Solns (420/199)

Sr Std Data (1% La w/w)

Solution ID	Sr Std (ppm)	Absorbance					Average Absorbance
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
Sr1	5	0.211	0.211	0.211	0.212	0.212	0.2114
Sr2	2.5	0.108	0.106	0.107	0.106	0.107	0.1068
Sr3	1.5	0.064	0.064	0.064	0.064	0.064	0.0640
Sr4	1	0.043	0.042	0.042	0.042	0.042	0.0422
Sr5	0.5	0.021	0.021	0.021	0.021	0.021	0.021
Sr6	0.25	0.010	0.010	0.010	0.010	0.010	0.01

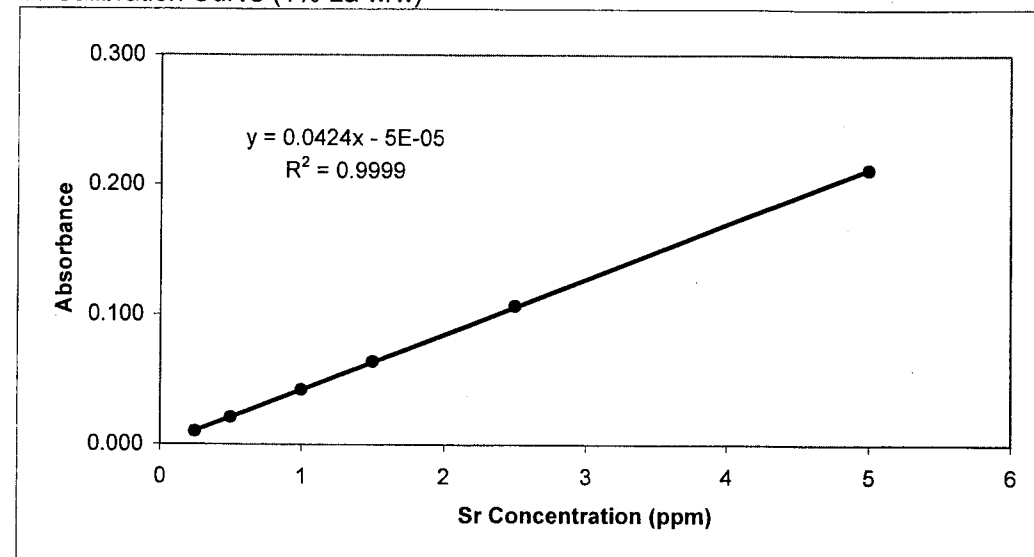
Data from Scientific notebook 494/1



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CONT BW

Sr Calibration Curve (1% La w/w)



Sr Data from Scientific notebook 494/1

Solution ID	Dilution Factor	Absorbance					Average Absorbance
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
Stock*	20	0.099	0.099	0.099	0.099	0.098	0.0988

\*SrCl<sub>2</sub>/KCl\*0.0005N\*1.0Esr sample aliquot (420/161) was taken before the stock solution was spiked with radioactive Sr90 (420/174)

Solution ID	Dilution Factor	Average Absorbance	K Conc (ppm) dilute soln	K Conc (ppm) Orig soln*
Stock	20	0.0988	2.33	47

\*Calculated by multiplying the concentration of dilute solution times the dilution factor

Target conc for soln was 43.8 ppm (420/195)

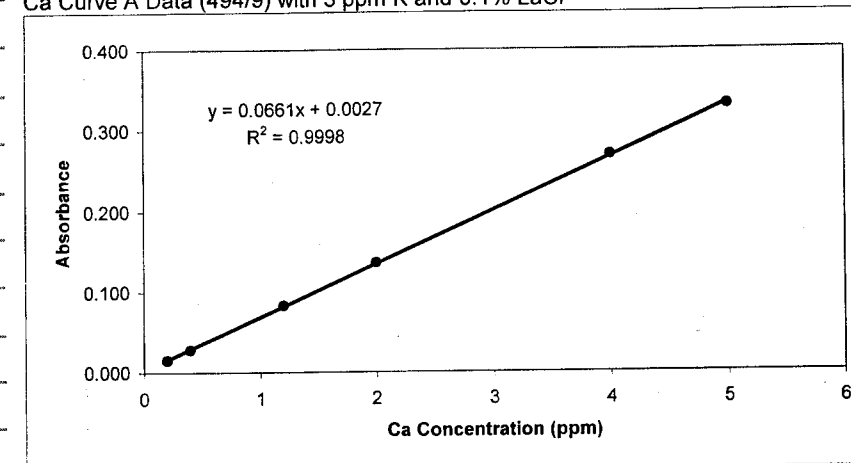
1-18-02  
BW

## Calcium Concentration in Ca-K ion exchange solns (420/188 + 189)

Ca Curve A Data (494/9) with 3 ppm K and 0.1% LaCl

Solution ID	Ca Std (ppm)	Absorbance					Average Absorbance
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
Ca1A	5	0.329	0.330	0.331	0.331	0.332	0.3306
Ca2A	4	0.268	0.269	0.269	0.271	0.270	0.2694
Ca3A	2	0.136	0.136	0.137	0.136	0.137	0.1364
Ca4A	1.2	0.083	0.083	0.083	0.083	0.083	0.083
Ca5A	0.4	0.028	0.028	0.028	0.027	0.028	0.0278
Ca6A	0.2	0.015	0.015	0.015	0.015	0.015	0.015

Ca Curve A Data (494/9) with 3 ppm K and 0.1% LaCl



Calcium cal curve A with 3 ppm K

Ca Data (494/9+10) for samples analyzed on cal curve A (3 ppm K)

Solution ID	Dilution Factor	Absorbance					Average Absorbance
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
1	50	0.030	0.030	0.030	0.030	0.030	0.0300
2	50	0.059	0.059	0.059	0.059	0.059	0.0590
3	50	0.097	0.098	0.098	0.098	0.097	0.0976
4	50	0.116	0.117	0.116	0.116	0.117	0.1164
5	50	0.152	0.152	0.152	0.152	0.152	0.1520
6	50	0.178	0.178	0.177	0.178	0.178	0.1778
7	50	0.192	0.192	0.191	0.193	0.192	0.1920
8	50	0.208	0.209	0.208	0.208	0.208	0.2082
9	50	0.227	0.227	0.226	0.225	0.226	0.2262
R0.3	50	0.079	0.079	0.078	0.078	0.079	0.0786
R0.6	50	0.156	0.156	0.156	0.156	0.157	0.1562

Ca Summary Data for samples (494/9+10)

Solution ID	Dilution Factor	Average Absorbance	Ca Conc (ppm) dilute soln	Ca Conc (ppm) Orig soln*
1	50	0.0300	0.41	20.7
2	50	0.0590	0.85	42.6
3	50	0.0976	1.44	71.8
4	50	0.1164	1.72	86.0
5	50	0.1520	2.26	113
6	50	0.1778	2.65	132
7	50	0.1920	2.86	143
8	50	0.2082	3.11	155
9	50	0.2262	3.38	169
R0.3	50	0.0786	1.15	57.4
R0.6	50	0.1562	2.32	116

\*Calculated by multiplying the concentration of dilute solution times the dilution factor

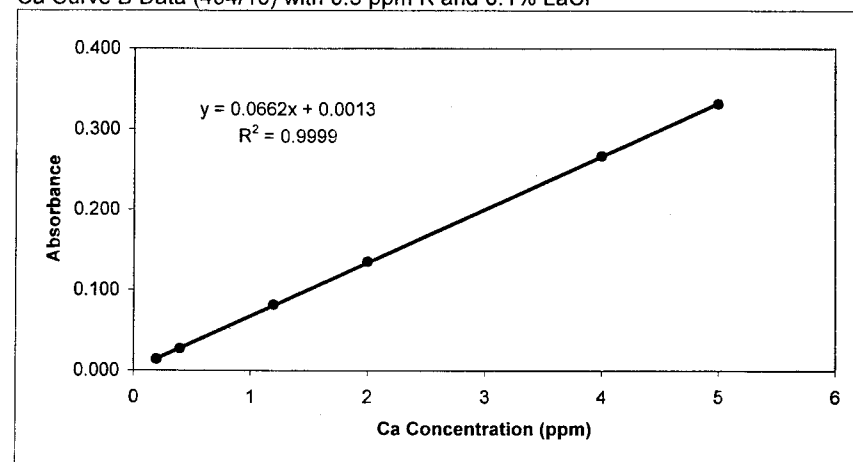
1-18-02  
CONT BW

### Calcium Concentration in Ca-K ion exchange solns (420/188 + 189)

Ca Curve B Data (494/10) with 0.3 ppm K and 0.1% LaCl

Solution ID	Ca Std (ppm)	Absorbance					Average Absorbance
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
Ca1B	5	0.332	0.332	0.331	0.330	0.332	0.3314
Ca2B	4	0.265	0.269	0.266	0.266	0.266	0.2664
Ca3B	2	0.134	0.135	0.136	0.135	0.135	0.1350
Ca4B	1.2	0.082	0.082	0.082	0.081	0.081	0.0816
Ca5B	0.4	0.027	0.027	0.027	0.027	0.027	0.027
Ca6B	0.2	0.014	0.014	0.014	0.014	0.013	0.0138

Ca Curve B Data (494/10) with 0.3 ppm K and 0.1% LaCl



### Calcium cal curve B with 0.3 ppm K

Ca Data (494/11) for samples analyzed on cal curve B (0.3 ppm K)

Solution ID	Dilution Factor	Absorbance					Average Absorbance
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
10	50	0.240	0.239	0.240	0.240	0.240	0.2398
11	50	0.248	0.248	0.247	0.247	0.247	0.2474
12	50	0.488*	0.489	na	na	na	na
13	50	0.258	0.26	0.26	0.259	0.259	0.2592
14	50	0.26	0.26	0.262	0.260	0.259	0.2602
R1.0	50	0.263	0.263	0.263	0.264	0.264	0.2634

\*Absorbance outside calibration range. Suspect problem with dilution. Redo dilution and analyze.

Ca Summary Data for samples (494/11)

Solution ID	Dilution Factor	Average Absorbance	Ca Conc (ppm) dilute soln	Ca Conc (ppm) Orig soln*
10	50	0.2398	3.60	180
11	50	0.2474	3.72	186
12	50	na	na	na
13	50	0.2592	3.90	195
14	50	0.2602	3.91	196
R1.0	50	0.2634	3.96	198

\*Calculated by multiplying the concentration of dilute solution times the dilution factor

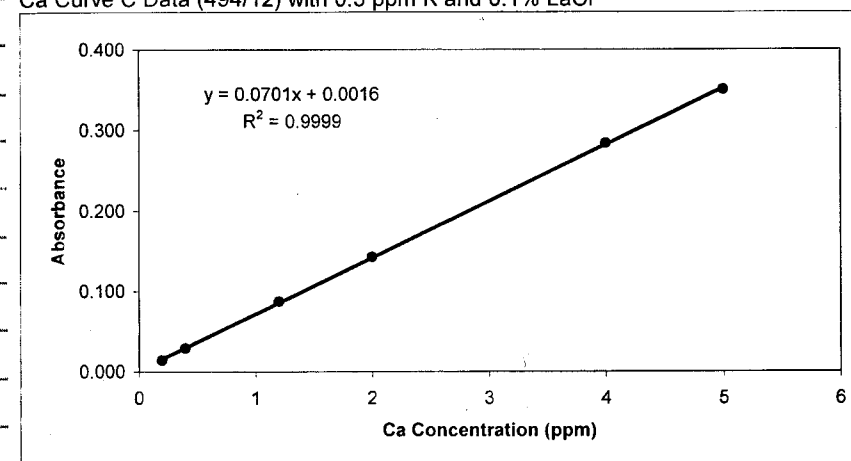
1-18-02  
CONT BW

### Calcium Concentration in Ca-K ion exchange solns (420/188 + 189)

Ca Curve C Data (494/12) with 0.3 ppm K and 0.1% LaCl

Solution ID	Ca Std (ppm)	Absorbance					Average Absorbance
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
Ca1B	5	0.350	0.350	0.350	0.350	0.350	0.3500
Ca2B	4	0.284	0.282	0.284	0.285	0.284	0.2838
Ca3B	2	0.143	0.142	0.143	0.143	0.143	0.1428
Ca4B	1.2	0.087	0.087	0.087	0.087	0.088	0.0872
Ca5B	0.4	0.029	0.029	0.029	0.029	0.029	0.029
Ca6B	0.2	0.014	0.014	0.014	0.014	0.014	0.014

Ca Curve C Data (494/12) with 0.3 ppm K and 0.1% LaCl



### Calcium cal curve C with 0.3 ppm K

Ca Data (494/12) for sample analyzed on cal curve C (0.3 ppm K)

Solution ID	Dilution Factor	Absorbance					Average Absorbance
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
12	50	0.261	0.261	0.261	0.263	0.262	0.262

\*Absorbance of initial dilution outside calibration range. Suspected problem with dilution.

Ran new dilution on new curve.

Ca Summary Data for samples (494/12)

Solution ID	Dilution Factor	Average Absorbance	Ca Conc (ppm) dilute soln	Ca Conc (ppm) Orig soln*
12	50	0.262	3.71	186

\*Calculated by multiplying the concentration of dilute solution times the dilution factor

1-18-02  
CONT BAW

Summary data for Calcium AA analysis of Ca-K solns

Solution ID	Measured Calcium Conc (ppm)	Initial Estimates of Ca Conc (ppm) before running experiment
1	21	19.27
2	43	39.38
3	72	59.01
4	86	77.42
5	113	94.22
6	132	116.19
7	143	134.44
8	155	149.36
9	169	164.93
10	180	176.52
11	186	185
12	186	191.07
13	195	195.28
14	196	198.05
R0.3	57	60.1
R0.6	116	120.2
R1.0	198	200.4

Ca-K solutions from 420/188 and 189  
Measured values from 494/9 to 12  
Initial estimates provided by Bobby Pabalan

Ca-K solns  
ion exchange solns  
(0.01N)

Summary results  
From 420/188  
494/17 to 19

1/18/02  
AJ Reanalyze final K<sup>+</sup> conc. for 0.0005N CaCl<sub>2</sub>/KCl ion exchange experiments to test the reproducibility of the measured values.

0.01M K<sup>+</sup> std. solution:- 100 ml of 0.01M K<sup>+</sup> std. solution was prepared and all other dilutions were made using 0.01M K<sup>+</sup> std. solution.

391 ppm or 0.01M K<sup>+</sup> std. :  $\frac{0.01M \times 10ml}{100ml}$

1.96 ppm or 0.00005M :  $\frac{0.01M \times 0.5ml}{100ml}$

3.91 ppm or 0.0001M :  $\frac{0.01M \times 1ml}{100ml}$

7.82 ppm or 0.0002M :  $\frac{0.01M \times 2ml}{100ml}$

15.64 ppm or 0.0004M :  $\frac{0.01M \times 4ml}{100ml}$

23.46 ppm or 0.0006M :  $\frac{0.01M \times 6ml}{100ml}$

39.1 ppm or 0.001M :  $\frac{0.01M \times 10ml}{100ml}$

Note: mixture # 1, 2 & 3 were diluted to 10 ml. 1 ml of experimental solution was used & diluted to 10 ml due to small sample size.

Mixture # CaK-0005*	ECa,i	Weight K- zeol. to use (gm)	Volume soln. to use (ml)	Calc. K ppm,i	Calc. K ppm,f	Meas. K ppm, f
1	1	0.1507	25	0	19.23	56.5
2	1	0.1473	50	0	18.8	48.0
3	1	0.1162	50	0	18.53	43.5
4	1	0.1602	100	0	17.89	39.1
5	1	0.10428	100	0	16.64	31.1
6	1	0.2039	250	0	15.61	26.7
7	1	0.1447	250	0	13.85	21.9
8	1	0.1158	250	0	12.56	18.7
9	1	0.166	500	0	10.59	14.3
10	1	0.1325	500	0	9.3	12.1
11	1	0.1874	1000	0	7.47	9.5
12	1	0.1478	1000	0	6.37	7.82
13	1	0.1024	1000	0	4.9	5.98
14	1	0.1591	2000	0	4.06	4.93
15	1	0.1075	2000	0	3	3.47
16	1	0.0819	2000	0	2.42	2.70

1/18/02

↑ dilution factor  
of  $\frac{1}{10}$  was  
used to  
analyze

1/22/02  
AT

Analyze initial  $\text{Ca}^{+2}$  ion conc. for 0.01N  
 $\text{CaCl}_2/\text{KCl}$  ion exchange experiments

Required  $\text{Ca}^{+2}$  std. solns.:

200 ppm or 0.005M :  $\frac{0.1\text{M} \times 10\text{ml}}{200\text{ml}}$

All other dilutions were made from 200 ppm.

100 ppm :  $\frac{200\text{PPM} \times 50\text{ml}}{100\text{ml}}$

50 ppm :  $\frac{200\text{PPM} \times 25\text{ml}}{100\text{ml}}$

Mixture # CaK-01*	ECa,i to use	Weight K- zeol. to use (gm)	Volume soln. to use (ml)	Calc. Ca ppm,i	1st trial Measured Ca ppm,i	2nd trial Measured Ca ppm,i	3rd trial Measured Ca ppm,i
1	0.3	0.2498	10	60.1	58.2	56.4	54.1
2	0.3	0.1586	25	60.1			
3	0.6	0.1248	10	120.2			
4	0.6	0.1637	25	120.2	117	116	118
5	1	0.1299	10	200.4			
6	1	0.1981	25	200.4			
7	1	0.1261	25	200.4	196	194	198
8	1	0.1643	50	200.4			
9	1	0.0943	50	200.4			
10	1	0.1082	100	200.4			
11	1	0.1519	250	200.4			



1-22-02  
CONT BW

AA analysis for potassium of Sr/K binary solutions with zeolite

The potassium concentration of the strontium/potassium binary solutions with zeolite was to be determined using AA. Dilutions would also be required in order to bring the potassium concentration into the calibration curve range (0.1 to 2 ppm K). The solutions analyzed were 17 sample solutions (420/175) and no reference solutions (420/174). The one reference solution (420/174) contained no initial potassium. Therefore, this solution was not analyzed for potassium.

Matrix effects were a concern since the concentration of both cations varied. The potassium and strontium target concentrations were known for each solution. I used the potassium concentration to determine what dilution factor would be required to result in a potassium concentration that would fall within the cal curve. I also wanted to know what the strontium concentration of the diluted samples would be in order to determine if potassium cal curves with different strontium concentrations would be required. Table 1 contains the target concentrations in the undiluted samples. Tables 2 contains the target concentrations of the fifty fold diluted samples (DF50) based on Table 1.

An initial AA sample prep scheme was based on the information from these tables. Two potassium cal curves would be prepared. The first curve will contain a 0.5 ppm strontium matrix concentrations. The second curve will contain no strontium. Table 3 shows which potassium calibration curve (0.5 ppm Sr or 0 ppm Sr) will be used for each sample.

1-22/02  
BAW1-22-02  
CONT BWTable 1 Experiment  $\text{SrCl}_2/\text{KCl} - 0.0005\text{N}$ 

Mixture # SrK-001*	$E_{\text{Sr},i}$ to use	Weight K-zeol. to use (gm)	Volume soln. to use (ml)	Calc. Sr ppm, <sub>i</sub>	Calc. Sr ppm, <sub>f</sub>	Calc. K ppm, <sub>i</sub>	Calc. K ppm, <sub>f</sub>
1	1.0	0.1527	25	43.8	0.13	0.0	38.98
2	1.0	0.1521	50	43.8	0.31	0.0	38.82
3	1.0	0.1214	50	43.8	0.42	0.0	38.72
4	1.0	0.1723	100	43.8	0.70	0.0	38.47
5	1.0	0.1188	100	43.8	1.33	0.0	37.91
6	1.0	0.0976	100	43.8	1.92	0.0	37.38
7	1.0	0.1894	250	43.8	3.19	0.0	36.25
8	1.0	0.1624	250	43.8	4.34	0.0	35.22
9	1.0	0.1299	250	43.8	6.65	0.0	33.16
10	1.0	0.1119	250	43.8	8.61	0.0	31.41
11	1.0	0.1769	500	43.8	12.18	0.0	28.22
12	1.0	0.1496	500	43.8	14.93	0.0	25.78
13	1.0	0.1138	500	43.8	19.39	0.0	21.79
14	1.0	0.1866	1000	43.8	22.47	0.0	19.05
15	1.0	0.1344	1000	43.8	26.99	0.0	15.01
16	1.0	0.1057	1000	43.8	29.84	0.0	12.47
17	1.0	0.0706	1000	43.8	33.72	0.0	9.00

Numbers in Table 1 (420/164) are wrong. This Table 1 is the correct update. Calculation of strontium concentration on 420/195

1-22-02  
BAW

1-22-02 Table 2 DF50 Target Concentrations  
CONT BUS

Sample ID	Target Conc K (ppm)	Target Conc Sr (ppm)	K conc DF50	Sr Conc DF50
1	38.98	0.13	0.78	0.00
2	38.82	0.31	0.78	0.01
3	38.72	0.42	0.77	0.01
4	38.47	0.70	0.77	0.01
5	37.91	1.33	0.76	0.03
6	37.38	1.92	0.75	0.04
7	36.25	3.19	0.73	0.06
8	35.22	4.34	0.70	0.09
9	33.16	6.65	0.66	0.13
10	31.41	8.61	0.63	0.17
11	28.22	12.18	0.56	0.24
12	25.78	14.93	0.52	0.30
13	21.8	19.39	0.44	0.39
14	19.1	22.47	0.38	0.45
15	15.0	26.99	0.30	0.54
16	12.5	29.84	0.25	0.60
17	9.0	33.72	0.18	0.67

Starting stock solution SrCl2/KCl\*0.0005N\*1ESr contained no K, so no K analysis was performed

Potassium AA cal curve = 0.1 to 2 ppm

Table 3: ID of Sr matrix for K cal curve

Sample ID	DF	Sr (ppm) matrix for cal curve
1	50	0
2	50	0
3	50	0
4	50	0
5	50	0
6	50	0
7	50	0
8	50	0.5
9	50	0.5
10	50	0.5
11	50	0.5
12	50	0.5
13	50	0.5
14	50	0.5
15	50	0.5
16	50	0.5
17	50	0.5

1-22-02 Potassium calibration curves  
CONT BUS

All final volumes were 50mL (volumetric flasks)  
Volumetric pipets were used to transfer all solutions in the 0.5 mL to 25 mL volume range  
% LaCl is w/w 10 ppm K is 10K (494/27)  
BW 2/25/02 1% LaCl is 420/198  
25 ppm Sr 25 ppm Sr is Sr stock (420/198)  
Potassium calibration curve with 0.5 ppm Sr

Soln ID	Target Conc of k (ppm)	Target Conc of LaCl (%)	Target Conc of Sr (ppm)	Vol (mL) of 10 ppm K	Vol (ml) of (1% LaCl)	Vol (ml) of 25 ppm Sr
K1A*	2	0.1	0.5	10	5	1
K2A	1	0.1	0.5	5	5	1
K3A	0.6	0.1	0.5	3	5	1
K4A	0.4	0.1	0.5	2	5	1
K5A	0.2	0.1	0.5	1	5	1
K6A	0.1	0.1	0.5	0.5	5	1

\* AA sensitivity check

Potassium calibration curve with no Sr

Soln ID	Target Conc of k (ppm)	Target Conc of LaCl (%)	Target Conc of Sr (ppm)	Vol (mL) of 10 ppm K	Vol (ml) of (1% LaCl)	Vol (ml) of 25 ppm Sr
K1B*	2	0.1	0	10	5	0
K2B	1	0.1	0	5	5	0
K3B	0.6	0.1	0	3	5	0
K4B	0.4	0.1	0	2	5	0
K5B	0.2	0.1	0	1	5	0
K6B	0.1	0.1	0	0.5	5	0

\* AA sensitivity check

10ppm K Soln labeled 10K

Added 1mL (vol pipet) of 1000ppm K (Spec Certiprep, 2% HNO3, cat # PLK 2-24, lot # 8-33 K-Y rec 1/4/02, open 1/14/02) to a 100mL vol flask and diluted to mark with nanopure water.

1-23-02  
BAWLSA Cherenkov Analysis Sample Prep  
For Strontium AnalysisSamples from  $\text{SrCl}_2\text{-KCl}$  solns

Second analysis for stock soln (see 420/177)

Initial analysis for 17 experimental solutions (420/175)

Samples in duplicate (9/6)

Ten mL (vol pipet) aliquots of sample were  
transferred to a 20 mL plastic LSA vial

Labeled	Esrl	Esrl
	SrKL792	SrKL762

and	0.0005N	0.0005N
	SrK	SrK
	141	1761

- Not enough  $\text{SrCl}_2/\text{KCl} * 0.0005\text{N} * 1.0\text{N} * \text{Esrl}$  soln  
(420/161) was present to sample for LSA so  
old samples (420/177) could be reused.

## SAMPLE PREP OF Sr-K solns for AA analysis K

17 samples (494/24) will be diluted to DF50  
in two steps: DF5, then DF10. This is the  
DF5 step.

2 mL (vol pipet) of sample added to a 10 mL vol  
flask and diluted to mark w/ nanopure water

## Analysis

1-24-02  
BAWAA Analysis for K in K-Sr experimental solns  
Rus 2/25/02

Final dilution step - Total DF50, Initial DF5  
Final step DF10

Samples: 17 solns of DF5 from 494/28

Added 1 mL (vol pipet) of DF5 and 1 mL (2100 fixed  
volume eppendorf pipette) of 1% LaCl (420/198) to  
a 10 mL vol. flask and diluted to mark with  
nanopure water.

Perkin Elmer 3100 AA Spectrophotometer

K - hollow cathode lamp SMA Fisher 14-386-106H

 $\lambda = 766.5\text{ nm}$ , slit = 0.7 nm, high, air-acetylene

Blank = 0.1% LaCl (420/198) = soln B 463/41

Integration time = 3 sec

Potassium Curve with No strontium  
Series KXB (494/27)

ID	conc (ppm)	Trial				
		1	2	3	4	5
K1B	2	0.227 <del>0.208</del> 1-24-02	0.227	0.228	0.228	0.227
K2B	1	0.114	0.116	0.114	0.114	0.115
K3B	0.6	0.069	0.069	0.069	0.069	0.069
K4B	0.4	0.045	0.045	0.045	0.045	0.045
K5B	0.2	0.021	0.021	0.020	0.020	0.020
K6B	0.1	0.009	0.009	0.009	0.009	0.009

1-24-02 Absorbance of Samples 494/28 on 0 ppm Sr Curve

CONT BW

ID	DF	Trial				
		1	2	3	4	5
1	50	0.075	0.074	0.074	0.074	0.074
2	50	0.072	0.071	0.071	0.071	0.071
3	50	0.073	0.072	0.073	0.073	0.072
4	50	0.069	0.070	0.069	0.069	0.069
5	50	0.061	0.060	0.061	0.060	0.061
6	50	0.052	0.052	0.052	0.052	0.052
7	50	0.038	0.038	0.038	0.038	0.038
K3B	—	0.067	0.066	0.067	0.067	0.066

Potassium Curve with 0.5 ppm Sr  
Series KXA 494/27

ID	Conc (ppm)	Trial				
		1	2	3	4	5
K1A	2	0.226	0.224	0.228	0.228	0.228
K2A	1	0.114	0.113	0.113	0.112	0.113
K3A	0.6	0.068	0.067	0.067	0.068	0.067
K4A	0.4	0.044	0.044	0.044	0.044	0.044
K5A	0.2	0.020	0.020	0.020	0.020	0.019
K6A	0.1	0.009	0.009	0.009	0.009	0.009

Absorbance of Samples 494/28 on  
0.5 ppm Sr Curve

Ⓢ Solns 14 to 17 were DF5, Soln K3A was DF1  
BW 3/8/02

1-24-02

CONT BW

ID	DF	Trial				
		1	2	3	4	5
8	50	0.040	0.040	0.040	0.040	0.040
9	50	0.033	0.034	0.033	0.033	0.033
10	50	0.034	0.034	0.034	0.034	0.034
11	50	0.028	0.028	0.027	0.027	0.027
12	50	0.024	0.024	0.024	0.024	0.024
13	50	0.019	0.018	0.018	0.018	0.018
14 BW	500	0.202	0.203	0.204	0.204	0.203
15 1-24-02	500	0.160	0.161	0.160	0.159	0.159
16	500	0.111	0.111	0.111	0.111	0.111
17	500	0.089	0.089	0.089	0.089	0.089
K3A	DF5	0.067	0.068	0.068	0.067	0.067

Ⓢ see top of page BW 3/8/02

May 02 correction = 50.001

BW 1-24-02 DF5

DF500 via 0.100 mL 10% LaCl (420/197) into  
DF5 (minus -1 mL) from 494/28

BW 1-24-02 DF500 for ID # 8-17.  
DF5

1-28-02

BAW

Zeolite Samples to Washington State Univ  
for analysis

9 samples were sent  
5 gm sample size (1 exception), 26 (sample size  
in 4 gm due to lack of original material)  
1 sample was weighed out. others just matched  
volume, samples placed in 15 mL pp bottles

Tared bottle = 4.91g (Mettler PM4600)  
WT w/ sample = 9.91  
Sample WT = 5.00g



1-28-02

CONT BW

Legend for 9 samples

Delivery ID SWRI ID

Z1

CDV\*200/325\*UC\*RC\*HL\*  
RFe\*CaF 10/31/01 AJ

Z2

CDV\*200/325\*UC\*WA\*RC\*HL  
RFe\*KF 420/54-67  
5/2/01 AJ

Z3

CDV\*200/325\*UC\*WA\*RC\*HL\*  
RFe\*NaF 420/54-67  
5/2/01 AJ

Z4

CDV\*200/325\*UC\*WA\*RC\*HL\*  
RFe 420/63  
4/17/01 AJ

Z5

CDV\*100/200\*HL\*CP\*KF  
1/25/01 AJ

Z6

CDV\*(100/200 meth)\*HL\*RC\*  
RFe 420/5-15  
12/7/00 AJ

Z7

Obsidian Rock NBS standard  
ref. material 278 Apr 7, 1982

Z8

Potassium  
BW 2-25-02 Potassium Feldspar NBS standard  
ref material 70g Aug 16, 1983

Z9

Sodium Feldspar NBS standard  
ref material 99g 781310

1-30-02

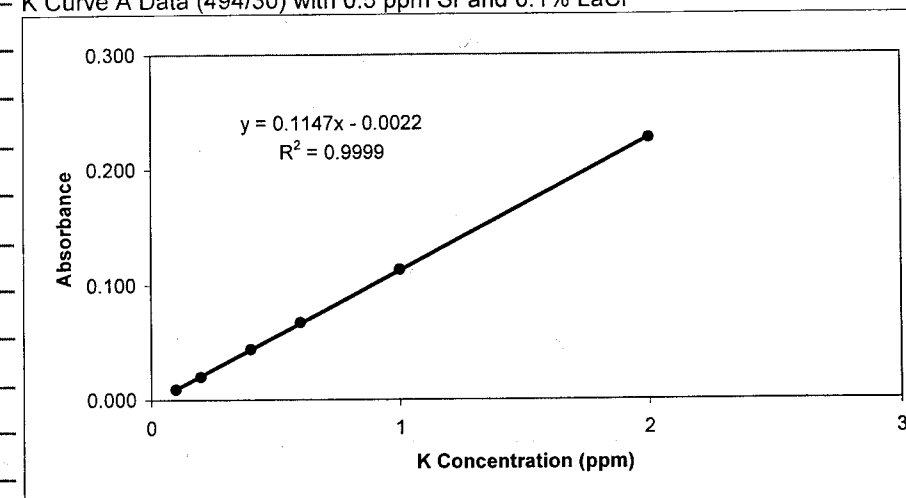
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Potassium Concentration in  
Sr-K ion exchange solns (494/25 + 28)

K Curve A Data (494/30) with 0.5 ppm Sr and 0.1% LaCl

Solution ID	K Std (ppm)	Absorbance					Average Absorbance
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
K1A	2	0.226	0.224	0.228	0.228	0.228	0.2268
K2A	1	0.114	0.113	0.113	0.112	0.113	0.1130
K3A	0.6	0.068	0.067	0.067	0.068	0.067	0.0674
K4A	0.4	0.044	0.044	0.044	0.044	0.044	0.044
K5A	0.2	0.020	0.020	0.020	0.020	0.019	0.0198
K6A	0.1	0.009	0.009	0.009	0.009	0.009	0.009

K Curve A Data (494/30) with 0.5 ppm Sr and 0.1% LaCl



Potassium cal curve A with 0.5 ppm Sr

K Data (494/31) for samples analyzed on cal curve A (0.5 ppm Sr)

Solution ID	Dilution Factor	Absorbance					Average Absorbance
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
8	50	0.040	0.040	0.040	0.040	0.040	0.0400
9	50	0.033	0.034	0.033	0.033	0.033	0.0332
10	50	0.034	0.034	0.034	0.034	0.034	0.0340
11	50	0.028	0.028	0.027	0.027	0.027	0.0274
12	50	0.024	0.024	0.024	0.024	0.024	0.0240
13	50	0.019	0.018	0.018	0.018	0.018	0.0182
14	5	0.202	0.203	0.204	0.204	0.203	0.2032
15	5	0.160	0.161	0.16	0.159	0.159	0.1598
16	5	0.111	0.111	0.111	0.111	0.111	0.1110
17	5	0.089	0.089	0.089	0.089	0.089	0.0890

K Summary Data for samples (494/31)

Solution ID	Dilution Factor	Average Absorbance	K Conc (ppm) dilute soln	K Conc (ppm) Orig soln*
8	50	0.0400	0.3612	18
9	50	0.0332	0.3020	15
10	50	0.0340	0.3090	15
11	50	0.0274	0.2515	13
12	50	0.0240	0.2219	11
13	50	0.0182	0.1715	8.6
14	5	0.2032	1.7815	8.9
15	5	0.1598	1.4038	7.0
16	5	0.1110	0.9791	4.9
17	5	0.0890	0.7876	3.9

\*Calculated by multiplying the concentration of dilute solution times the dilution factor

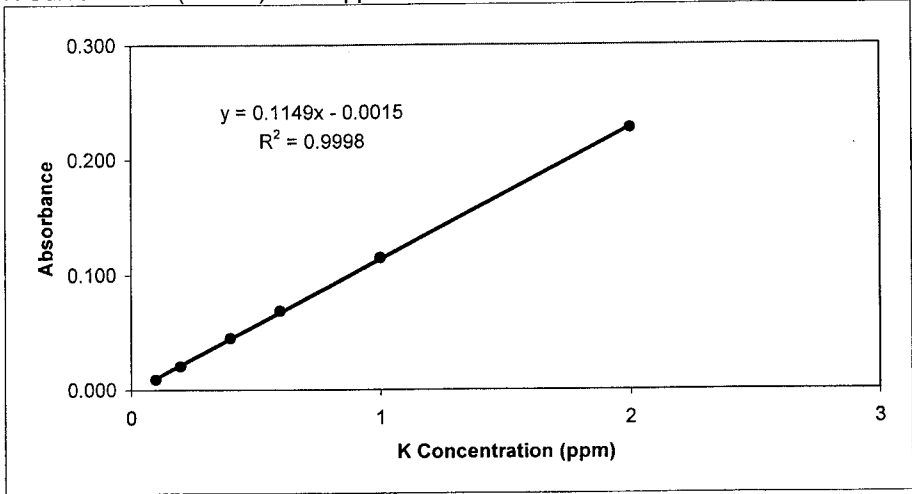
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CONT BW

Potassium Concentration in  
Sr-K ion exchange solns (494/25 + 28)

K Curve B Data (494/29) with 0 ppm Sr and 0.1% LaCl

Solution ID	K Std (ppm)	Absorbance					Average Absorbance
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
K1B	2	0.227	0.227	0.228	0.228	0.227	0.2274
K2B	1	0.114	0.116	0.114	0.114	0.115	0.1146
K3B	0.6	0.069	0.069	0.068	0.069	0.069	0.0688
K4B	0.4	0.045	0.045	0.045	0.045	0.045	0.045
K5B	0.2	0.021	0.021	0.020	0.020	0.020	0.0204
K6B	0.1	0.009	0.009	0.009	0.009	0.009	0.009

K Curve B Data (494/29) with 0 ppm Sr and 0.1% LaCl



Potassium cal curve B with 0 ppm Sr

K Data (494/30) for samples analyzed on cal curve A (0 ppm Sr)

Solution ID	Dilution Factor	Absorbance					Average Absorbance
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
1	50	0.075	0.074	0.074	0.074	0.074	0.0742
2	50	0.072	0.071	0.071	0.071	0.071	0.0712
3	50	0.073	0.072	0.073	0.073	0.072	0.0726
4	50	0.069	0.07	0.068	0.069	0.069	0.0690
5	50	0.061	0.06	0.061	0.060	0.061	0.0606
6	50	0.052	0.052	0.052	0.052	0.052	0.0520
7	50	0.038	0.038	0.038	0.038	0.038	0.0380

K Summary Data for samples (494/30)

Solution ID	Dilution Factor	Average Absorbance	K Conc (ppm) dilute soln	K Conc (ppm) Orig soln*
1	50	0.0742	0.6661	33
2	50	0.0712	0.6399	32
3	50	0.0726	0.6521	33
4	50	0.0690	0.6207	31
5	50	0.0606	0.5475	27
6	50	0.0520	0.4725	24
7	50	0.0380	0.3505	18

\*Calculated by multiplying the concentration of dilute solution times the dilution factor

1-30-02  
CONT BW

Summary data for PotassiumAA analysis of Sr-K 0.0005N solns

Solution ID	Measured Potassium Conc (ppm)	Estimates of K final Conc (ppm) before running experiment
1	33.3	38.98
2	32.0	38.82
3	32.6	38.72
4	31.0	38.47
5	27.4	37.91
6	23.6	37.38
7	17.5	36.25
8	18.1	35.22
9	15.1	33.16
10	15.4	31.41
11	12.6	28.22
12	11.1	25.78
13	8.57	21.79
14	8.91	19.05
15	7.02	15.01
16	4.90	12.47
17	3.94	9

Sr-K solutions - originally prepared in 420/175  
AA measurements in 494/24-31  
Initial estimates provided by Bobby Pabalan  
NOTE most potassium conc should be reported with only two significant figures

BW  
01/30/02

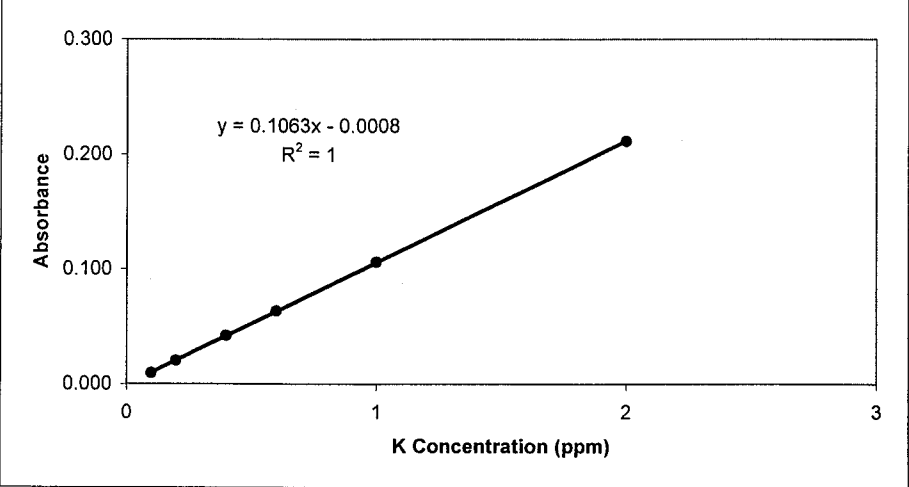
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Potassium Concentration in  
Ca-K ion exchange solns (494/5-8)

K Curve A Data (494/13) with 5 ppm Ca and 0.1% LaCl

Solution ID	K Std (ppm)	Absorbance					Average Absorbance
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
K1A	2	0.211	0.211	0.212	0.212	0.211	0.2114
K2A	1	0.106	0.107	0.106	0.105	0.106	0.1060
K3A	0.6	0.064	0.063	0.064	0.063	0.063	0.0634
K4A	0.4	0.042	0.042	0.042	0.042	0.042	0.042
K5A	0.2	0.021	0.020	0.020	0.020	0.020	0.0202
K6A	0.1	0.009	0.009	0.009	0.010	0.010	0.0094

K Curve A Data (494/13) with 5 ppm Ca and 0.1% LaCl



Potassium cal curve A with 5 ppm Ca

K Data (494/13+14) for samples analyzed on cal curve A (5 ppm Ca)

Solution ID	Dilution Factor	Absorbance					Average Absorbance
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
9	50	0.105	0.103	0.104	0.105	0.103	0.1040
10	50	0.071	0.072	0.071	0.071	0.071	0.0712
11	50	0.046	0.045	0.046	0.046	0.045	0.0456
12	50	0.026	0.026	0.026	0.026	0.025	0.0258
13	50	0.010	0.010	0.010	0.010	0.010	0.0100
14	20	0.018	0.018	0.018	0.018	0.018	0.0180

K Summary Data for samples (494/13+14)

Solution ID	Dilution Factor	Average Absorbance	K Conc (ppm) dilute soln	K Conc (ppm) Orig soln*
9	50	0.1040	0.9859	49.3
10	50	0.0712	0.6773	33.9
11	50	0.0456	0.4365	21.8
12	50	0.0258	0.2502	12.5
13	50	0.0100	0.1016	5.08
14	20	0.0180	0.1769	3.54

\*Calculated by multiplying the concentration of dilute solution times the dilution factor  
Note - some concs should be reported with only two significant figures

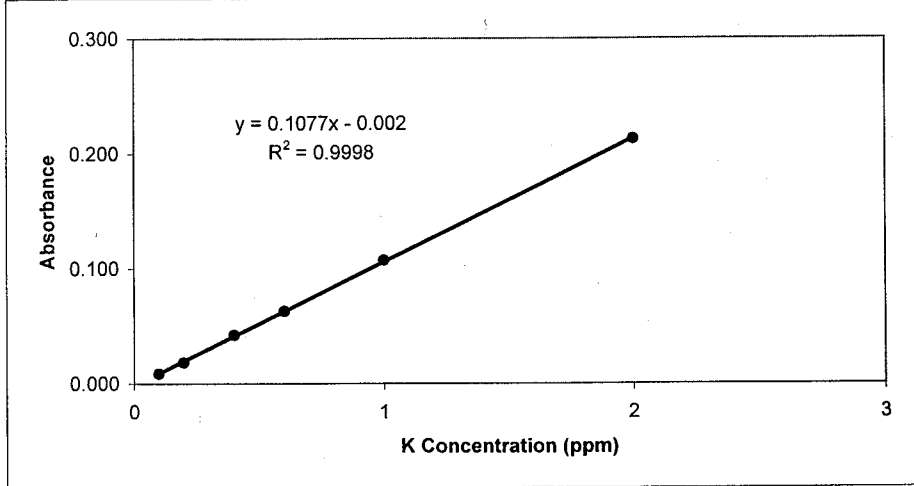
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Potassium Concentration in  
Ca-K ion exchange solns (494/5-8)

K Curve B Data (494/14) with 0.15 ppm Ca and 0.1% LaCl

Solution ID	K Std (ppm)	Absorbance					Average Absorbance
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
K1B	2	0.213	0.212	0.212	0.213	0.214	0.2128
K2B	1	0.107	0.106	0.109	0.107	0.106	0.1070
K3B	0.6	0.063	0.063	0.063	0.063	0.062	0.0628
K4B	0.4	0.041	0.042	0.042	0.042	0.043	0.042
K5B	0.2	0.018	0.018	0.018	0.018	0.019	0.0182
K6B	0.1	0.009	0.008	0.009	0.008	0.009	0.0086

K Curve B Data (494/14) with 0.15 ppm Ca and 0.1% LaCl



Potassium cal curve B with 0.15 ppm Ca

K Data (494/14+15) for samples analyzed on cal curve B (0.15 ppm Ca)

Solution ID	Dilution Factor	Absorbance					Average Absorbance
		Trial 1	Trial 2	Trial 3	Trial 4	Trial 5	
1	500	0.067	0.068	0.068	0.066	0.067	0.0672
2	500	0.058	0.058	0.057	0.057	0.057	0.0574
3	500	0.042	0.042	0.042	0.042	0.042	0.0420
4	500	0.035	0.035	0.035	0.035	0.035	0.0350
5	500	0.028	0.028	0.028	0.028	0.028	0.0280
6	500	0.015	0.015	0.015	0.015	0.015	0.0150
7	50	0.200	0.200	0.200	0.202	0.203	0.2010
8	50	0.156	0.154	0.154	0.155	0.154	0.1546
R0.6	500	0.027	0.027	0.027	0.027	0.027	0.0270
R0.3	500	0.044	0.044	0.044	0.044	0.044	0.0440

K Summary Data for samples (494/14+15)

Solution ID	Dilution Factor	Average Absorbance	K Conc (ppm) dilute soln	K Conc (ppm) Orig soln*
1	500	0.0672	0.6425	321
2	500	0.0574	0.5515	276
3	500	0.0420	0.4085	204
4	500	0.0350	0.3435	172
5	500	0.0280	0.2786	139
6	500	0.0150	0.1578	78.9
7	50	0.2010	1.8849	94.2
8	50	0.1546	1.4540	72.7
R0.6	500	0.0270	0.2693	135
R0.3	500	0.0440	0.4271	214

\*Calculated by multiplying the concentration of dilute solution times the dilution factor

1-30-02  
LONT BAW

Summary data for Potassium AA analysis of Ca-K solns

Solution ID	Measured Potassium Conc (ppm)	Estimates of K final Conc (ppm) before running experiment
1	321	353
2	276	314
3	204	276
4	172	240
5	139	207
6	78.9	164
7	94.2	129
8	72.7	99.6
9	49.3	69.2
10	33.9	46.6
11	21.8	30.1
12	12.5	18.2
13	5.08	9.98
14	3.54	4.58
R0.6	135	156
R0.3	214	274

Ca-K solutions - originally prepared in 420/188+189  
AA measurements in 494/12-15  
Initial estimates provided by Bobbly Pabalan  
NOTE some potassium conc should be reported with only two significant figures

Ternary (Cs- Na- K) Ion Exchange Results from Div 01 ICP and ICP/MS Analysis

Transfer of Custody Paperwork 420/192-4

Sample Preparation on 420/190 NOTE- Some samples were diluted at CNWRA prior to delivery to Div 01

Table 1 shows summary of Div 01 results and calculated concentrations of the original solns

Table 2 shows a comparison of duplicate analysis. Some dups were prepared at Div 20 while others were prepared at Div 01

1-30-02  
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Table 1. Concs for experimental and stock solns for Cs-Na-K 0.05N ternary ion exchange solns

Solution ID	Dilution Factor	Concentration of Div 01 sample			Actual Sample conc for original solution*		
		Cs ppm f	Na ppm f	K ppm f	Cs ppm f	Na ppm f	K ppm f
R1.0	1	6141	0	0	6141	0	0
R0.7	1	4207	331	0	4207	331	0
R0.3	1	1823	747	0	1823	747	0
R0.1	1	602	956	0	602	956	0
R0.1 dup	1	575	939	0	575	939	0
R0.05	1	306	1018	0	306	1018	0
R0.2A	1	1195	444	752	1195	444	752
R0.2B	1	1218	436	738	1218	436	738
M1	20	181	0	37.4	3620	0	748
M2	20	148	0	46.0	2960	0	920
M3	20	249	0	16.0	4980	0	320
M4A	20	233	0	20.8	4660	0	416
M4B	20	245	0	21.4	4900	0	428
M5	20	95.0	16.0	36.3	1900	320	726
M6	20	67.0	16.0	46.5	1340	320	930
M7	20	42.0	15.0	52.8	840	300	1056
M8	20	16.8	35.4	25.7	336	708	514
M9	20	7.06	33.0	33.3	141	660	666
M10	20	3.62	43.8	13.6	72.4	876	272
M11	20	1.81	41.7	19.4	36.2	834	388
M12	20	1.20	39.3	23.5	24.0	786	470
M13	20	1.23	45.8	11.9	24.6	916	238
M13 dup	20	1.26	45.7	11.7	25.2	914	234
M14	20	0.681	42.7	17.3	13.6	854	346
M15	20	0.468	40.2	21.4	9.36	804	428
M16	20	20.4	20.8	48.8	408	416	976
M17	20	9.18	19.9	53.7	184	398	1074
M18	20	5.54	19.1	56.4	111	382	1128

\*Calculated by multiplying the DF by the Conc of Div 01 sample  
Values reported as zero are below the reporting limit.  
DF = samples were diluted at CNWRA before transferring to Div 01 for analysis  
Note - most concs should be reported with 3 significant figures

Element	Reporting Limit in ppm	
	DF1	DF20
Cesium	0.0005	0.01
Potassium	0.2	4
Sodium	0.2	4

Table 2. Duplicate Analysis Comparison

Solution ID	Cesium			Sodium			Potassium		
	original	dup	% diff	original	dup	% diff	original	dup	% diff
CsCl-NaCl-KCl*0.05N*0.1ECs	602	575	4.49	956	939	1.78	0	0	na
CsCl-NaCl-KCl*0.05N*0.2ECs	1195	1218	-1.92	444	436	1.80	752	738	1.86
Mixture # 4	4660	4900	-5.15	0	0	na	416	428	-2.88
Mixture # 13	24.6	25.2	-2.44	916	914	0.22	238	234	1.68



***SOUTHWEST RESEARCH INSTITUTE***  
SAMPLE ANALYSIS DATA SHEET

Sample ID  
M1

Lab Name: Southwest Research Institute      Client: Division 20  
Lab Code: SwRI      Date Received: 01/09/02  
Matrix: Water      Project No.: 20.R4211.01.001  
Lab System ID: 180030      Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	181	0.0005
Potassium	37.4	0.2
Sodium	<0.2	0.2

Sample ID  
M2

Lab Name: Southwest Research Institute      Client: Division 20  
Lab Code: SwRI      Date Received: 01/09/02  
Matrix: Water      Project No.: 20.R4211.01.001  
Lab System ID: 180040      Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	148	0.0005
Potassium	46.0	0.2
Sodium	<0.2	0.2

Sample ID  
M3

Lab Name: Southwest Research Institute      Client: Division 20  
Lab Code: SwRI      Date Received: 01/09/02  
Matrix: Water      Project No.: 20.R4211.01.001  
Lab System ID: 180041      Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	249	0.0005
Potassium	16.0	0.2
Sodium	<0.2	0.2

***SOUTHWEST RESEARCH INSTITUTE***  
SAMPLE ANALYSIS DATA SHEET

Sample ID  
M4A

Lab Name: Southwest Research Institute      Client: Division 20  
Lab Code: SwRI      Date Received: 01/09/02  
Matrix: Water      Project No.: 20.R4211.01.001  
Lab System ID: 180042      Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	233	0.0005
Potassium	20.8	0.2
Sodium	<0.2	0.2

Sample ID  
M4B

Lab Name: Southwest Research Institute      Client: Division 20  
Lab Code: SwRI      Date Received: 01/09/02  
Matrix: Water      Project No.: 20.R4211.01.001  
Lab System ID: 180043      Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	245	0.0005
Potassium	21.4	0.2
Sodium	<0.2	0.2

Sample ID  
M5

Lab Name: Southwest Research Institute      Client: Division 20  
Lab Code: SwRI      Date Received: 01/09/02  
Matrix: Water      Project No.: 20.R4211.01.001  
Lab System ID: 180044      Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	95.0	0.0005
Potassium	36.3	0.2
Sodium	16.0	0.2

1-30-02  
CONT BW

SOUTHWEST RESEARCH INSTITUTE  
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute

Lab Code: SwRI

Matrix: Water

Lab System ID: 180045

Client: Division 20

Date Received: 01/09/02

Project No.: 20.R4211.01.001

Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	67.0	0.0005
Potassium	46.5	0.2
Sodium	16.0	0.2

Lab Name: Southwest Research Institute

Lab Code: SwRI

Matrix: Water

Lab System ID: 180046

Client: Division 20

Date Received: 01/09/02

Project No.: 20.R4211.01.001

Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	42.0	0.0005
Potassium	52.8	0.2
Sodium	15.0	0.2

Lab Name: Southwest Research Institute

Lab Code: SwRI

Matrix: Water

Lab System ID: 180047

Client: Division 20

Date Received: 01/09/02

Project No.: 20.R4211.01.001

Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	16.8	0.0005
Potassium	25.7	0.2
Sodium	35.4	0.2

1-30-02  
CONT BW

SOUTHWEST RESEARCH INSTITUTE  
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute

Lab Code: SwRI

Matrix: Water

Lab System ID: 180048

Client: Division 20

Date Received: 01/09/02

Project No.: 20.R4211.01.001

Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	7.06	0.0005
Potassium	33.3	0.1
Sodium	33.0	0.05

Lab Name: Southwest Research Institute

Lab Code: SwRI

Matrix: Water

Lab System ID: 180049

Client: Division 20

Date Received: 01/09/02

Project No.: 20.R4211.01.001

Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	306	0.0005
Potassium	<0.2	0.2
Sodium	1018	0.2

Lab Name: Southwest Research Institute

Lab Code: SwRI

Matrix: Water

Lab System ID: 180050

Client: Division 20

Date Received: 01/09/02

Project No.: 20.R4211.01.001

Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	602	0.0005
Potassium	<0.2	0.2
Sodium	956	0.2

1-30-02  
CONT BW

SOUTHWEST RESEARCH INSTITUTE  
DUPLICATE SUMMARY

Lab Name: Southwest Research Institute

Lab Code: SwRI

Matrix: Water

Lab System ID: 180050

Client: Division 20

Date Received: 01/09/02

Project No.: 20.R4211.01.001

Work Order: 21572

Analysis	Sample Result (mg/L)	Duplicate Result (mg/L)	RPD
Cesium	602	575	4.43%
Potassium	<0.2	<0.2	0.00%
Sodium	956	939	1.82%

Lab Name: Southwest Research Institute

Lab Code: SwRI

Matrix: Water

Lab System ID: 180051

Client: Division 20

Date Received: 01/09/02

Project No.: 20.R4211.01.001

Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	1195	0.0005
Potassium	752	0.2
Sodium	444	0.2

Lab Name: Southwest Research Institute

Lab Code: SwRI

Matrix: Water

Lab System ID: 180052

Client: Division 20

Date Received: 01/09/02

Project No.: 20.R4211.01.001

Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	1218	0.0005
Potassium	738	0.2
Sodium	436	0.2

1-30-02  
CONT BW

SOUTHWEST RESEARCH INSTITUTE  
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute

Lab Code: SwRI

Matrix: Water

Lab System ID: 180053

Client: Division 20

Date Received: 01/09/02

Project No.: 20.R4211.01.001

Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	1823	0.0005
Potassium	<0.2	0.2
Sodium	747	0.2

Lab Name: Southwest Research Institute

Lab Code: SwRI

Matrix: Water

Lab System ID: 180054

Client: Division 20

Date Received: 01/09/02

Project No.: 20.R4211.01.001

Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	4207	0.0005
Potassium	<0.2	0.2
Sodium	331	0.2

Lab Name: Southwest Research Institute

Lab Code: SwRI

Matrix: Water

Lab System ID: 180055

Client: Division 20

Date Received: 01/09/02

Project No.: 20.R4211.01.001

Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	6141	0.0005
Potassium	<0.2	0.2
Sodium	<0.2	0.2

1-30-02  
CONT BW

**SOUTHWEST RESEARCH INSTITUTE**  
SAMPLE ANALYSIS DATA SHEET

Sample ID  
M10

Lab Name: Southwest Research Institute  
Lab Code: SwRI  
Matrix: Water  
Lab System ID: 180031

Client: Division 20  
Date Received: 01/09/02  
Project No.: 20.R4211.01.001  
Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	3.62	0.0005
Potassium	13.6	0.2
Sodium	43.8	0.2

Sample ID  
M11

Lab Name: Southwest Research Institute  
Lab Code: SwRI  
Matrix: Water  
Lab System ID: 180032

Client: Division 20  
Date Received: 01/09/02  
Project No.: 20.R4211.01.001  
Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	1.81	0.0005
Potassium	19.4	0.2
Sodium	41.7	0.2

Sample ID  
M12

Lab Name: Southwest Research Institute  
Lab Code: SwRI  
Matrix: Water  
Lab System ID: 180033

Client: Division 20  
Date Received: 01/09/02  
Project No.: 20.R4211.01.001  
Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	1.20	0.0005
Potassium	23.5	0.2
Sodium	39.3	0.2

1-30-02  
CONT BW

**SOUTHWEST RESEARCH INSTITUTE**  
SAMPLE ANALYSIS DATA SHEET

Sample ID  
M13

Lab Name: Southwest Research Institute  
Lab Code: SwRI  
Matrix: Water  
Lab System ID: 180034

Client: Division 20  
Date Received: 01/09/02  
Project No.: 20.R4211.01.001  
Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	1.23	0.0005
Potassium	11.9	0.2
Sodium	45.8	0.2

Sample ID  
M13

Lab Name: Southwest Research Institute  
Lab Code: SwRI  
Matrix: Water  
Lab System ID: 180034

Client: Division 20  
Date Received: 01/09/02  
Project No.: 20.R4211.01.001  
Work Order: 21572

Analysis	Sample Result (mg/L)	Duplicate Result (mg/L)	RPD
Cesium	1.23	1.26	1.92%
Potassium	11.9	11.7	1.88%
Sodium	45.8	45.7	0.08%

Sample ID  
M14

Lab Name: Southwest Research Institute  
Lab Code: SwRI  
Matrix: Water  
Lab System ID: 180035

Client: Division 20  
Date Received: 01/09/02  
Project No.: 20.R4211.01.001  
Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	0.681	0.0005
Potassium	17.3	0.2
Sodium	42.7	0.2



1-30-02  
CONT BW

SOUTHWEST RESEARCH INSTITUTE  
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute  
Lab Code: SwRI  
Matrix: Water  
Lab System ID: 180036

Client: Division 20  
Date Received: 01/09/02  
Project No.: 20.R4211.01.001  
Work Order: 21572

Sample ID  
M15

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	0.468	0.0005
Potassium	21.4	0.2
Sodium	40.2	0.2

Lab Name: Southwest Research Institute  
Lab Code: SwRI  
Matrix: Water  
Lab System ID: 180037

Client: Division 20  
Date Received: 01/09/02  
Project No.: 20.R4211.01.001  
Work Order: 21572

Sample ID  
M16

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	20.4	0.0005
Potassium	48.8	0.2
Sodium	20.8	0.2

Lab Name: Southwest Research Institute  
Lab Code: SwRI  
Matrix: Water  
Lab System ID: 180038

Client: Division 20  
Date Received: 01/09/02  
Project No.: 20.R4211.01.001  
Work Order: 21572

Sample ID  
M17

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	9.18	0.0005
Potassium	53.7	0.2
Sodium	19.9	0.2

1-30-02  
CONT BW

SOUTHWEST RESEARCH INSTITUTE  
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute  
Lab Code: SwRI  
Matrix: Water  
Lab System ID: 180039

Sample ID  
M18  
Client: Division 20  
Date Received: 01/09/02  
Project No.: 20.R4211.01.001  
Work Order: 21572

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	5.54	0.0005
Potassium	56.4	0.2
Sodium	19.1	0.2

SOUTHWEST RESEARCH INSTITUTE  
LABORATORY CONTROL SAMPLE

Lab Name: Southwest Research Institute  
Lab Code: SwRI  
Matrix: Water  
Lab System ID: NA

Sample ID  
LCSW-A16P2  
Client: Division 20  
Date Received: NA  
Project No.: 20.R4211.01.001  
Work Order: 21572

Analysis	Sample Result (mg/L)	True Value (mg/L)	Recovery
Cesium	0.010	0.01	99.0%
Potassium	18.8	20.0	93.9%
Sodium	19.1	20.0	95.5%

NA- Not Applicable.

Lab Name: Southwest Research Institute  
Lab Code: SwRI  
Matrix: Water  
Lab System ID: NA

Sample ID  
LCSW-A16P1  
Client: Division 20  
Date Received: NA  
Project No.: 20.R4211.01.001  
Work Order: 21572

Analysis	Sample Result (mg/L)	True Value (mg/L)	Recovery
Cesium	0.010	0.01	100.5%
Potassium	18.9	20.0	94.3%
Sodium	19.0	20.0	94.9%

NA- Not Applicable.

1-30-02  
CONT BW

**SOUTHWEST RESEARCH INSTITUTE**  
BLANK SUMMARY

Lab Name: Southwest Research Institute

Lab Code: SwRI

Matrix: Water

Lab System ID: NA

Client: Division 20

Date Received: NA

Project No.: 20.R4211.01.001

Work Order: 21572

Sample ID  
PBW-A16P1

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	<0.0005	0.0005
Potassium	<0.2	0.2
Sodium	<0.2	0.2

NA- Not Applicable.

**SOUTHWEST RESEARCH INSTITUTE**  
BLANK SUMMARY

Lab Name: Southwest Research Institute

Lab Code: SwRI

Matrix: Water

Lab System ID: NA

Client: Division 20

Date Received: NA

Project No.: 20.R4211.01.001

Work Order: 21572

Sample ID  
PBW-A16P2

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Cesium	<0.0005	0.0005
Potassium	<0.2	0.2
Sodium	<0.2	0.2

NA- Not Applicable.

1-30-02  
CONT BW

**SOUTHWEST RESEARCH INSTITUTE**  
MATRIX SPIKE SUMMARY

Lab Name: Southwest Research Institute

Lab Code: SwRI

Matrix: Water

Lab System ID: 180051

Client: Division 20

Date Received: 01/09/02

Project No.: 20.R4211.01.001

Work Order: 21572

Sample ID  
R0.2A

Analysis	Sample Result (mg/L)	Spike Result (mg/L)	Spike Added (mg/L)	Recovery
Cesium	1195	2166	1000	97.1%
Potassium	752	980	200	114.3%
Sodium	444	662	200	109.3%

**SOUTHWEST RESEARCH INSTITUTE**  
MATRIX SPIKE SUMMARY

Lab Name: Southwest Research Institute

Lab Code: SwRI

Matrix: Water

Lab System ID: 180035

Client: Division 20

Date Received: 01/09/02

Project No.: 20.R4211.01.001

Work Order: 21572

Sample ID  
M14

Analysis	Sample Result (mg/L)	Spike Result (mg/L)	Spike Added (mg/L)	Recovery
Cesium	0.681	1.63	1.00	94.7%
Potassium	17.3	37.7	20.0	101.9%
Sodium	42.7	63.1	20.0	101.8%

1/29/02  
AJ  
K<sup>+</sup> final conc. for 0.01N CaCl<sub>2</sub>/KCl ion exchange experiments.

2/1/02  
AJ  
K<sup>+</sup> std. solutions required:

0.01M or 391 ppm :  $\frac{0.01M \times 10\text{ ml}}{100\text{ ml}}$

200 ml of 0.01M or 391 ppm solution was prepared from 0.1M std.

All other dilutions ~~were~~ made using 0.01M.  
were by 03/08/02

0.0001M or 3.91 ppm :  $\frac{0.01M \times 1\text{ ml}}{100\text{ ml}}$

0.0002M or 7.82 ppm :  $\frac{0.01M \times 2\text{ ml}}{100\text{ ml}}$

15.64 ppm or 0.0004M :  $\frac{0.01M \times 4\text{ ml}}{100\text{ ml}}$

0.0006M or 23.46 ppm :  $\frac{0.01M \times 6\text{ ml}}{100\text{ ml}}$

0.001M or 39.1 ppm :  $\frac{0.01M \times 10\text{ ml}}{100\text{ ml}}$

0.0015M or 58.65 ppm :  $\frac{0.01M \times 15\text{ ml}}{100\text{ ml}}$

0.002M or 78.2 ppm :  $\frac{0.01M \times 20\text{ ml}}{100\text{ ml}}$

0.003M or 117.3 ppm :  $\frac{0.01M \times 30\text{ ml}}{100\text{ ml}}$

0.004M or 156.4 ppm :  $\frac{0.01M \times 40\text{ ml}}{100\text{ ml}}$

Mixture # CaK-01*	ECa, l to use	Weight K-zeol. to use (gm)	Volume soln. to use (ml)	Calc. K ppm, f	1/29/02 & 2/1/02 Measured K ppm, f
1	0.3	0.2498	10	353.38	341, 354
2	0.3	0.1586	25	314.16	302, 303
3	0.6	0.1248	10	275.85	270, 275
4	0.6	0.1637	25	239.94	220, 222
5	1	0.1299	10	207.15	182, 191
6	1	0.1981	25	164.29	130, 134
7	1	0.1261	25	128.69	108, 105
8	1	0.1643	50	99.57	82.9, 81.6
9	1	0.0943	50	69.19	57.5, 61.3
10	1	0.1082	100	46.59	38.8, 39.6
11	1	0.1519	250	30.05	26.2, 25.8
12	1	0.163	500	18.2	16.6, 16.8
13	1	0.1604	1000	9.98	9.39, 9.42
14	1	0.1001	1500	4.58	4.57, 4.62

dil.  
1/10

Note: # 1 mixture was diluted to 1 due to lack of experimental solution<sup>10</sup>

Solution 03/08/02  
# 3 & 5 were diluted to 3.  
10

20 FEB 02  
BAW

## LSA Analysis of Various Solutions

Method: Cerenkov ~~not~~ <sup>BAW 2/20/02</sup> counting for strontium  
3 sample "categories" analyzed plus blank

Category 1 = SrCl<sub>2</sub>-KCl 0.0005N 17 experimental solns  
analyzed in duplicate (Source 494/28)

Results on initial analysis here

Category 2 = strontium stock solution used in SrCl<sub>2</sub>-KCl  
0.0005N experiment (Source 420/176)

Results of second analysis here

Results of initial analysis 420/177-180

Category 3 = strontium stock solution #51A (369/40)

Results of second analysis here

Results of initial analysis 420/177-180

Blank = cycle 1

Category 1 = cycles 2-34

Category 2 = cycles 37-38

Category 3 = cycles 40-44

Cycle	ID	Cycle	ID	Cycle	ID
1	Blank	15	8a1	29	15a1
2	1a1	16	8b1	30	15b1
3	2a1	17	9a1	31	16a1
4	2b1	18	9b1	32	16b1
5	3a1	19	10a1	33	17a1
6	3b1	20	10b1	34	17b1
7	4a1	21	11a1	37	Esrl.0 SrKL7a
8	4b1	22	11b1	38	Esrl.0 SrKL7b
9	5a1	23	12a1	40	#51A 1
10	5b1	24	12b1	41	#51A 2
11	6a1	25	13a1	42	#51A 3
12	6b1	26	13b1	43	#51A 4
13	7a1	27	14a1	44	#51A 5
14	7b1	28	14b1		

20 Feb 02  
CONT BAW

2/20/02 6:36:45 AM QuantaSmart (TM) - 1.10  
Protocol# 17 - Sr90Cerenkov.lsa Serial# 405314

Page # 1  
User: Bertetti

## Assay Definition-

Assay Description:  
Cerenkov counting of Sr90/Y90

Assay Type: CPM  
Report Name: Sr90 Cerenkov  
Output Data Path: C:\Packard\Tricarb\Results\Bertetti\Sr90Cerenkov  
Raw Results Path: C:\Packard\Tricarb\Results\Bertetti\Sr90Cerenkov  
Comma-Delimited File Name: C:\Packard\Tricarb\Results\Bertetti\Sr90Cerenkov\Sr90Cerenkov.002

## Count Conditions-

Nuclide: Sr90 Cerenkov  
Quench Indicator: SIS  
External Std Terminator (sec): n/a  
Pre-Count Delay (min): 0.00  
Quench Set: n/a  
Count Time (min): 180.00  
Count Mode: Normal  
Assay Count Cycles: 1 Repeat Sample Count: 1  
#Vials/Sample: 1 Calculate % Reference: Off

Background Subtract: On - 1st Vial  
Low CPM Threshold: Off  
2 Sigma % Terminator: On - Any Region

Regions	LL	UL	Bkg Subtract	2Sigma % Terminator
A	0.0	30.0	1st Vial	2.00
B	0.0	100.0	1st Vial	0.00
C	0.0	2000.0	1st Vial	0.00

## Count Corrections-

Static Controller: On Luminescence Correction: Off  
Colored Samples: n/a Heterogeneity Monitor: n/a  
Coincidence Time (nsec): 18 Delay Before Burst (nsec): 75

## Half Life-

Regions	Half Life	Units	Reference Date	Reference Time
A				
B				
C				

IPA Block Data  
Software Version IC: 2.09  
Software Version EC: 1.10  
Instrument Model: Tri-Carb 3100TR  
Instrument Serial Number: 405314  
3H Chi Square: 13.68 Date Processed: 2/19/02 11:52:41 AM  
14C Chi Square: 17.65 Date Processed: 2/19/02 11:52:41 AM  
3H E<sup>2</sup>/B (0-18.6 keV and 1-18.6 keV): 269.78 Date Processed: 2/19/02 11:52:41 AM  
14C E<sup>2</sup>/B (0-156 keV and 1-156 keV): 538.77 Date Processed: 2/19/02 11:52:41 AM  
3H Efficiency (0-18.6 keV): 65.74 Date Processed: 2/19/02 11:52:41 AM  
14C Efficiency (0-156 keV): 96.75 Date Processed: 2/19/02 11:52:41 AM  
IPA Background Date Processed: 2/19/02 11:52:41 AM  
3H Background CPM (0-18.6 keV): 16.05 Date Processed: 2/19/02 11:52:41 AM  
14C Background CPM (0-156 keV): 22.80 Date Processed: 2/19/02 11:52:41 AM  
3H Calibration DPM: 285000  
3H Reference Date: 10/29/99  
14C Calibration DPM: 134100  
===== Errors and Warnings =====  
===== End of Errors and Warnings =====



20 FEB 02  
CONT. BW

Cycle-Sample ID legend on 494/54

2/20/02 6:36:45 AM QuantaSmart (TM) - 1.10  
Protocol# 17 - Sr90Cerenkov.lsa Serial# 405314Page # 2  
User: Bertetti

## Cycle 1 Results

S#	Count Time	CPMA	MESSAGES	A:2S%	CPMB	B:2S%	CPMC	SIS
1	180.00	14	B	4.0	23	3.1	23	91.5
2	180.00	28		3.9	29	4.5	29	28.9
3	97.34	89		2.4	89	2.5	88	27.1
4	95.53	91		2.4	91	2.5	91	28.0
5	67.42	134		2.2	135	2.3	135	29.1
6	67.16	135		2.2	135	2.3	135	27.6
7	40.82	231		2.1	232	2.2	231	27.9
8	41.37	228		2.1	228	2.2	228	28.4
9	24.76	390		2.1	390	2.1	390	28.9
10	25.23	383		2.1	383	2.1	383	28.7
11	19.84	490		2.1	491	2.1	491	28.5
12	19.93	488		2.1	490	2.1	489	28.2
13	15.81	619		2.0	620	2.1	620	28.2
14	15.64	626		2.0	628	2.1	628	29.0
15	11.59	850		2.0	852	2.0	852	25.9
16	13.85	708		2.0	711	2.0	711	29.0
17	12.11	812		2.0	815	2.0	815	29.0
18	12.11	812		2.0	813	2.0	813	29.2
19	11.08	889		2.0	891	2.0	891	28.2
20	11.40	863		2.0	866	2.0	866	28.6
21	9.95	992		2.0	994	2.0	994	29.0
22	10.11	976		2.0	979	2.0	979	28.5
23	9.38	1052		2.0	1055	2.0	1054	28.1
24	9.45	1045		2.0	1049	2.0	1050	28.8
25	8.51	1163		2.0	1165	2.0	1165	29.0
26	8.67	1141		2.0	1144	2.0	1144	28.4
27	8.08	1224		2.0	1229	2.0	1229	28.5
28	8.08	1225		2.0	1227	2.0	1227	28.8
29	7.59	1304		2.0	1310	2.0	1310	29.1
30	7.55	1312		2.0	1316	2.0	1316	28.9
31	7.24	1368		2.0	1373	2.0	1373	29.3
32	7.20	1376		2.0	1380	2.0	1380	28.6
33	6.82	1454		2.0	1458	2.0	1458	28.4
34	6.94	1427		2.0	1432	2.0	1432	28.5
Missing vial 35.								
Missing vial 36.								
37	6.29	1577		2.0	1581	2.0	1580	26.6
38	5.94	1670		2.0	1673	2.0	1673	28.3
Missing vial 39.								
40	0.13	79947		2.0	80139	2.0	80138	28.9
41	0.26	39155		2.0	39289	2.0	39292	28.7
42	0.64	15708		2.0	15749	2.0	15750	28.6
43	1.41	7115		2.0	7130	2.0	7129	28.5
44	6.92	1432		2.0	1434	2.0	1434	27.9

Blank  
T  
17  
Sr<sup>90</sup>-KEL  
0.0005N  
exp solns

Esr 1.0 SrKLTx

#51A X

Note: cycles 15 and 16 were aliquots from experimental soln #8. The CPM values (experimental) were not similar (850 vs 708 for CMA BW 2/20/02 CPM). Suspected geometry problem (different volumes). Cycles 15 and 16 had the same sample volumes upon visual inspection.

Note: for variation in cycles 37 and 38 see 420/180 (geometry problem - sample volumes different.)

25 Feb 02  
BAW

## LSA Analysis of Various Solutions

Reanalysis (same vials) of samples analyzed 20 Feb 02 (494/54-56)

Samples analyzed in same sequence for legend see 494/54

The results enter on 25 Feb 02 represent the second analysis for category 1+2 <sup>BW</sup> 2/25/02 samples and the third analysis for category 3 samples. For previous results see info on 494/54.

NOTE: Soln 8 (cycles 15+16)

Initial analysis yielded CMA results of 850 and 708 for aliquots of soln 8. Verified geometry (volume) same. Analysis entered 25 Feb 02 (494/59) yielded similar CMA results of 700 and 708.

NOTE: Esr 1.0 SrKLTx (cycles 37+38)

Previous two analysis yielded results that vials had different values for same solution. Verified geometry (volume) was different. Analysis entered 25 Feb 02 (494/59) yielded dif <sup>BW</sup> 2/25/02 similar values. Geometry verified as different.

BW  
2/25/02

25 Feb 02

CONT

BAW

2/23/02 12:29:17 PM QuantaSmart (TM) - 1.10  
Protocol# 17 - Sr90Cerenkov.lsa Serial# 405314

Page # 1  
User: Bertetti

## Assay Definition-

## Assay Description:

Cerenkov counting of Sr90/Y90

## Assay Type: CPM

Report Name: Sr90 Cerenkov

Output Data Path: C:\Packard\Tricarb\Results\Bertetti\Sr90Cerenkov

Raw Results Path: C:\Packard\Tricarb\Results\Bertetti\Sr90Cerenkov

Comma-Delimited File Name: C:\Packard\Tricarb\Results\Bertetti\Sr90Cerenkov\Sr90Cerenkov.003

## Count Conditions-

Nuclide: Sr90 Cerenkov

Quench Indicator: SIS

External Std Terminator (sec): n/a

Pre-Count Delay (min): 0.00

Quench Set: n/a

Count Time (min): 180.00

Count Mode: Normal

Assay Count Cycles: 1

Repeat Sample Count: 1

#Vials/Sample: 1

Calculate % Reference: Off

Background Subtract: On - 1st Vial

Low CPM Threshold: Off

2 Sigma % Terminator: On - Any Region

Regions	LL	UL	Bkg Subtract	2Sigma % Terminator
A	0.0	30.0	1st Vial	2.00
B	0.0	100.0	1st Vial	0.00
C	0.0	2000.0	1st Vial	0.00

## Count Corrections-

Static Controller: On

Luminescence Correction: Off

Colored Samples: n/a

Heterogeneity Monitor: n/a

Coincidence Time (nsec): 18

Delay Before Burst (nsec): 75

## Half Life-

Half Life Correction: Off

Regions	Half Life	Units	Reference Date	Reference Time
A				
B				
C				

## IPA Block Data

Software Version IC: 2.09

Software Version EC: 1.10

Instrument Model: Tri-Carb 3100TR

Instrument Serial Number: 405314

3H Chi Square: 18.10 Date Processed: 2/22/02 5:41:29 PM

14C Chi Square: 33.48 Date Processed: 2/22/02 5:41:29 PM

3H E<sup>2</sup>/B (0-18.6 keV and 1-18.6 keV): 274.19 Date Processed: 2/22/02 5:41:29 PM14C E<sup>2</sup>/B (0-156 keV and 1-156 keV): 546.30 Date Processed: 2/22/02 5:41:29 PM

3H Efficiency (0-18.6 keV): 65.78 Date Processed: 2/22/02 5:41:29 PM

14C Efficiency (0-156 keV): 96.31 Date Processed: 2/22/02 5:41:29 PM

IPA Background Date Processed: 2/22/02 5:41:29 PM

3H Background CPM (0-18.6 keV): 15.67 Date Processed: 2/22/02 5:41:29 PM

14C Background CPM (0-156 keV): 22.33 Date Processed: 2/22/02 5:41:29 PM

3H Calibration DPM: 285000

3H Reference Date: 10/29/99

14C Calibration DPM: 134100

===== Errors and Warnings =====

===== End of Errors and Warnings =====

25 Feb 02

CONT

BAW

2/23/02 12:29:17 PM QuantaSmart (TM) - 1.10  
Protocol# 17 - Sr90Cerenkov.lsa Serial# 405314

Page # 2  
User: Bertetti

## Cycle 1 Results

S#	Count	Time	CPMA	MESSAGES	A:2S%	CPMB	B:2S%	CPMC	SIS
1	180.00		14	B	4.0	21	3.2	22	90.5
2	180.00		28		3.9	29	4.4	29	30.9
3	97.18		89		2.4	90	2.5	90	28.4
4	96.18		90		2.4	91	2.5	91	28.6
5	68.11		133		2.2	134	2.3	134	28.7
6	66.16		138		2.2	139	2.3	139	29.5
7	41.77		226		2.1	227	2.2	227	28.4
8	41.99		225		2.1	226	2.2	225	28.4
9	24.76		390		2.1	393	2.1	393	29.6
10	24.89		388		2.1	391	2.1	391	29.1
11	19.85		490		2.1	493	2.1	493	28.7
12	19.62		496		2.1	497	2.1	497	28.0
13	15.55		630		2.0	632	2.1	632	28.6
14	15.80		620		2.0	622	2.1	622	28.8
15	14.02		700		2.0	703	2.0	702	28.4
16	13.86		708		2.0	710	2.0	710	28.8
17	12.16		810		2.0	813	2.0	813	28.8
18	12.11		813		2.0	815	2.0	815	29.0
19	11.03		894		2.0	897	2.0	896	28.9
20	11.28		874		2.0	878	2.0	879	28.7
21	10.09		978		2.0	982	2.0	982	28.9
22	9.91		996		2.0	1000	2.0	999	28.6
23	9.30		1063		2.0	1064	2.0	1064	28.1
24	9.43		1048		2.0	1052	2.0	1052	29.0
25	8.59		1152		2.0	1157	2.0	1158	28.9
26	8.77		1128		2.0	1132	2.0	1132	28.8
27	8.12		1219		2.0	1221	2.0	1221	28.8
28	8.07		1226		2.0	1230	2.0	1231	29.1
29	7.64		1297		2.0	1303	2.0	1303	29.2
30	7.64		1297		2.0	1302	2.0	1303	28.9
31	7.39		1340		2.0	1345	2.0	1345	28.7
32	7.20		1377		2.0	1379	2.0	1380	28.6
33	6.90		1437		2.0	1442	2.0	1441	28.7
34	6.96		1425		2.0	1432	2.0	1432	28.9
Missing vial 35.									
Missing vial 36.									
37	6.02		1650		2.0	1651	2.0	1651	26.2
38	6.04		1644		2.0	1648	2.0	1648	28.7
Missing vial 39.									
40	0.13		79302		2.0	79548	2.0	79547	29.2
41	0.26		39648		2.0	39767	2.0	39770	28.7
42	0.64		15841		2.0	15911	2.0	15912	28.9
43	1.36		7396		2.0	7414	2.0	7414	29.0
44	6.98		1421		2.0	1423	2.0	1424	28.2

BLANK

17

SREL-KEE

0.0005N

exp selns

Est 1.05eKLT7X

#51AX

BAW

3-4-02

4 Mar 02  
BW

Determination of Mass of 50 mL of 0.05 N  
and 0.005 N solutions.

Reference =  $\text{CsCl} - \text{NaCl} - \text{KCl} * 0.05 \text{ N} * 0.05 \text{ E}_{\text{CS}}$   
420/182 12-14-01 BW

0.05 N 50 mL mass 1 Mettler PM4600)

Added Ref Soln to mark of a tared 50 mL  
Vol. flask (class A). Mass = 49.76 g

0.005 N 50 mL mass. BW

Tared a 50 mL vol. pipet 3-4-02 flask, added  
5 mL (vol pipet) of Ref. soln and diluted to  
mark with nanopure water.  
Mass = 49.65 g

Mass of 50 mL of nanopure water

Tared an empty 50 mL vol flask. Filled to  
mark with nanopure water. Mass = 49.69 g

Note class A 50 mL vol flask specs are  
50 mL  $\pm$  0.05 mL (Fisher Sci 2002/03 catalog  
page 545)

3-6-02

BW

3/6/02  
AJ

Preparation of  $\text{SrCl}_2 - \text{CaCl}_2$  (0.05 N) solutions  
for Binary Ion Exchange Experiments

1. Prepare  $\text{SrCl}_2 - \text{CaCl}_2$  aqueous mixtures with a total normality of 0.05 N and a fixed Sr/Ca ratio by taring reagent grade  $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$  and  $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$  in the amounts given in Table 1. In preparing the solutions, make sure that 10-mL samples will be available for analysis of initial  $\text{Sr}^{2+}$  and  $\text{Ca}^{2+}$  concentration.

Transfer the solution into clean polypropylene bottles of the appropriate size. Label the bottle (e.g.,  $\text{SrCl}_2/\text{CaCl}_2 * 0.05 \text{ N} * 0.1 \text{ E}_{\text{Sr}}$ , plus Date and Initial, and lab notebook volume & page#).

Table 1.

$\text{E}_{\text{Sr}}$ (0.05 N) ( $\text{SrCl}_2/\text{CaCl}_2$ soln.)	Wt. $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ needed	Wt. $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ needed	Wt. $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ used	Wt. $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ used
0.1 (100 mL)	0.0667	0.3308	0.0670	0.3310
0.2 (100 mL)	0.1333	0.2940	0.1335	0.2943
0.4 (100 mL)	0.2666	0.2205	0.2669	0.2208
0.6 (250 mL)	0.9998	0.3676	1.0001	0.3679
1 (1 L)	6.6654	0.0000	6.6658	0.0000

3-6-02  
CONT  
BW

Repeat of Determination of Mass of 50 mL of  
0.05 N and 0.005 N solutions.

Repeat of procedure of 4 Mar 02 with one exception -  
flasks oven dried, then cooled.

	water	0.05 N	0.005 N
mass (g)	49.86	49.94	49.90

03 Mar 02  
PP

Addition of Sr-90 spike to 0.05N  $\text{SrCl}_2 - \text{CaCl}_2$  reference solutions (494/16).

As in previous experiments, an aliquot of Sr-90 will be added to Sr-bearing reference solutions and used as a tracer (analog for the Sr concentration change during the ion exchange expts. Spike # 51A (369/3A) will be used. Approximately 1 g (mL) per liter will be added to each ref. soln.

ref soln.	Vol (mL)	Vol 51A added (mL)
ESr 0.1	100	0.1
ESr 0.2	100	0.1
ESr 0.4	100	0.1
ESr 0.6	250	0.25
ESr 1.0	1000	1.0

Spike #51A has an activity of  $2.236 \times 10^5$  dpm/g so the activity of each reference soln is now approximately

ESr 1.0  
example

$$\frac{2.236 \times 10^5 \text{ dpm}}{\text{g}} \cdot \frac{1 \text{ g added}}{1000 \text{ g soln}} = 2.236 \times 10^2 \text{ dpm/g}$$

Collected samples for reference counting of solutions by withdrawing 10 mL of solution (duplicates - 20 mL total) from each reference solution. Vials were labeled as follows:

	Volume		Volume
ESr 0.1 Sr/Ca 05 ref A	10 mL	ESr 0.6 Sr/Ca 05 ref A	10 mL
ESr 0.1 Sr/Ca 05 ref B	10 mL	ESr 0.6 Sr/Ca 05 ref B	10 mL
ESr 0.2 Sr/Ca 05 ref A	10 mL	ESr 1.0 Sr/Ca 05 ref A	10 mL
ESr 0.2 Sr/Ca 05 ref B	10 mL	ESr 1.0 Sr/Ca 05 ref B	10 mL
ESr 0.4 Sr/Ca 05 ref A	10 mL		
ESr 0.4 Sr/Ca 05 ref B	10 mL		

06 Mar 02  
PB

reference solution samples placed in plastic ~~30~~ 300/12 20-mL LSA vials and set aside for later counting.

08 Mar 02  
PB

error and entry review by principal investigator.

3/11/02  
AJ

$\text{SrCl}_2 - \text{CaCl}_2$  0.05N experiments continued

Mixture # SrCa-05*	ESr <sub>i</sub> to use	Weight Ca-zeol. to use (gm)	Volume soln. to use (ml)	Weight Ca-zeol. to used (gm)	
1	0.1	0.2811	10	0.2814	
2	0.1	0.2099	10	0.2105	
3	0.1	0.1137	10	0.1142	
4	0.2	0.1298	10	0.1301	
5	0.2	0.1163	25	0.1166	
6	0.4	0.1490	10	0.1494	
7	0.4	0.1620	25	0.1622	
8	0.6	0.1326	10	0.1331	
9	0.6	0.1628	25	0.1630	
10	0.6	0.1333	100	0.1337	
11	1	0.1554	10	0.1558	
12	1	0.1171	10	0.1176	
13	1	0.1902	25	0.1905	
14	1	0.1421	25	0.1426	
15	1	0.1813	50	0.1815	
16	1	0.1604	100	0.1606	
17	1	0.1386	250	0.1388	
18	1	0.09044	500	0.0907	

3-14-2002  
BAW

SrCl<sub>2</sub>-NaCl-KCl Ternary Ion Exchange Experiments (0.05N and 0.005N)

Thirty 200mL reference solutions with a total normality of 0.05N will be prepared. Two experimental sets will be generated from these reference solutions: thirty 0.05N solutions and thirty 0.005N solutions. All experimental sets will have a fixed solution volume (50mL) and a fixed amount of zeolite (0.1g). The composition of the 30 reference solution will vary (see table). The 0.05N experimental set will consist of 50 mL aliquots of the reference solutions. A 0.005N experimental set will be prepared from a ten-fold dilution of the 0.05N reference solutions. The ternary ion exchange solutions will be prepared in the following manner.

Preparation of the 0.05N reference solutions

For convenience, the 0.05N reference solutions can be prepared in groups of 10. Label ten 250mL beakers with a sharpie. Tare an appropriately sized weighing boat on the AE240 balance. Add the appropriate amount of NaCl (see table) and record the mass. Transfer the compound to a 250mL beaker. Carefully rinse the weighing boat with nanopure water from a squirt bottle and transfer the washings into the beaker. Repeat this rinsing step several times. Throw away the used weighing boat. After the NaCl additions to the ten solutions has been completed, then the KCl additions can begin. Tare an appropriately sized weighing boat on the AE240 balance. Add the appropriate amount of KCl (see table) and record the mass. Transfer the compound to the appropriate 250mL beaker (beaker already contain a NaCL solution). Carefully rinse the weighing boat with nanopure water from a squirt bottle and transfer the washing into the beaker. Repeat this rinsing step several times. Throw away the used weighing boat. After all ten KCl additions have been completed, then begin with the SrCl<sub>2</sub>\*6H<sub>2</sub>O additions. Add some water to an appropriately sized weighing boat on the AE240 balance and tare. Add the appropriate amount of SrCl<sub>2</sub>\*6H<sub>2</sub>O (see table) and record the mass. Transfer the compound to the appropriate 250mL beaker (beaker already contains NaCl/KCl solution). Carefully rinse the weighing boat with nanopure water from a squirt bottle several times and transfer the washings into the beaker.

3-14-02  
CONT  
BAW

Throw away the used weighing boat. Ensure that all solids are dissolved in the 250mL beaker. Swirl and/or add water if necessary. Ensure that total solution volume in beaker does not exceed much beyond 100mL. Let the solution stand for at least one minute before transferring into the volumetric flask. Label ten 200mL volumetric flasks with a sharpie. Decant the contents of the 250mL beaker into the appropriate 200mL volumetric flask. Carefully rinse the beaker with nanopure water from a squirt bottle and transfer the washing into the beaker. Repeat this rinsing step several times. Fill the volumetric flask to about 2-3 inches below the mark with nanopure water and swirl for mixing. Then add nanopure water dropwise up to the mark and remix. Transfer each solution to an appropriately labeled polypropylene bottle. Label the bottles SrCl<sub>2</sub>-NaCl-KCl\*0.05N\*Ref1 to 30. Clean the ten beakers and ten volumetric flasks by rinsing three times with DI water and then three times with nanopure water (no acid wash). Reuse this glassware and repeat this procedure for the next ten reference solutions. For convenient preparation, it is suggested that the 0.005N solutions (0.05N dilutions) be prepared before making the next set of ten 0.05N solutions.

Preparation of the 0.005N reference solutions

Add 10mL (volumetric pipet) of the 0.05N reference solution to a 100mL volumetric flask and dilute to mark with nanopure water. Mix thoroughly. Clean the pipets by thoroughly rinsing with DI water, then with nanopure water (no acid wash). Place pipets in oven for drying. Transfer each solution to an appropriately labeled polypropylene bottle. Label the bottles SrCl<sub>2</sub>-NaCl-KCl\*0.005N\*Ref1 to 30. Clean the flasks by thoroughly rinsing with DI water, then with nanopure water (do not acid wash). For convenience, it is suggested that all 60 reference solutions be finished before starting to prepare the experimental solutions. All 60 reference solutions (thirty 0.05N and thirty 0.005N) will be spiked with radioactive strontium (#51A 369/39). The spiking ratio is 1mL of radioactive strontium solution for each 1000mL of reference solution per Paul Bertetti. For the thirty 0.05N reference solutions (each at



3-14-2002  
CONT  
BAW

190mL solution volume), add 200uL (200-300-500uL eppendorf pipet) of strontium stock solution to each of the reference solutions. For the thirty 0.005N reference solutions (each at 100mL solution volume), add 100uL (100uL eppendorf pipet) of strontium stock solution to each of the reference solutions.

Preparation of 0.05N Experimental Solutions – Addition of zeolite

All experimental sets will have a fixed solution volume (50mL) and a fixed amount of zeolite (0.1g). The sodium form of the zeolite (Na-zeo) will be used. Record the zeolite label information in the notebook. For convenience, the experimental solutions can be prepared in groups of 10. Transfer and record the mass (target = 0.1g) of Na-zeo into a 60mL polypropylene bottle. The bottles should be labeled SrCl<sub>2</sub>-NaCl-KCl\*0.05N\*Exp1 to 30. Add 50.00g (Metler PM4600 balance) of the appropriate reference solution to the bottle containing the zeolite. (It is suggested that an oxford pipet with a 10mL disposal tip be used to transfer the bulk of the solution. Then a disposable 5mL pipet can be used to add the final amount of reference solution dropwise to obtain the 50.00g mark.) Record the mass of solution. Repeat this procedure for making each experimental solution.

Preparation of 0.005N Experimental Solutions – Addition of zeolite

All experimental sets will have a fixed solution volume (50mL) and a fixed amount of zeolite (0.1g). The sodium form of the zeolite (Na-zeo) will be used. For convenience, the experimental solutions can be prepared in groups of 10. Transfer and record the mass (target = 0.1g) of Na-zeo into a 60mL polypropylene bottle. The bottles should be labeled SrCl<sub>2</sub>-NaCl-KCl\*0.005N\*Exp1 to 30. Add 50.00g (Metler PM4600 balance) of the appropriate reference solution to the bottle containing the zeolite. (It is suggested that an oxford pipet with a 10mL disposal tip be used to transfer the bulk of the solution. Then a disposable 5mL pipet can be used to add the final amount of reference solution dropwise to obtain the 50.00g mark.) Record the mass of solution. Repeat this procedure for making each experimental solution

3-14-02  
CONT  
BAW

NA-K-SR total normality at 0.05 N													
TN	Solution ID	ENa	EK	ESr	NaCl	KCl	target mass for 200mL						
0.05	SrCl2-NaCl-KCl*0.05N*Ref 1	0.10	0.45	0.45	0.0584	0.3355	SrCl2.6H2O			0.5999			
	SrCl2-NaCl-KCl*0.05N*Ref 2	0.20	0.40	0.40	0.1169	0.2982				0.5332			
	SrCl2-NaCl-KCl*0.05N*Ref 3	0.30	0.35	0.35	0.1753	0.2609				0.4666			
0.1 g zeol. 50 ml. Soln. (prepare 1000 mL total)	SrCl2-NaCl-KCl*0.05N*Ref 4	0.40	0.30	0.30	0.2338	0.2237				0.3999			
	SrCl2-NaCl-KCl*0.05N*Ref 5	0.50	0.25	0.25	0.2922	0.1864				0.3333			
	SrCl2-NaCl-KCl*0.05N*Ref 6	0.60	0.20	0.20	0.3507	0.1491				0.2666			
	SrCl2-NaCl-KCl*0.05N*Ref 7	0.70	0.15	0.15	0.4091	0.1118				0.2000			
	SrCl2-NaCl-KCl*0.05N*Ref 8	0.80	0.10	0.10	0.4675	0.0746				0.1333			
	SrCl2-NaCl-KCl*0.05N*Ref 9	0.90	0.05	0.05	0.5260	0.0373				0.0667			
	SrCl2-NaCl-KCl*0.05N*Ref 10	1.00	0.00	0.00	0.5844	0.0000				0.0000			
	SrCl2-NaCl-KCl*0.05N*Ref 11	0.45	0.10	0.45	0.2630	0.0746				0.5999			
	SrCl2-NaCl-KCl*0.05N*Ref 12	0.40	0.20	0.40	0.2338	0.1491				0.5332			
	SrCl2-NaCl-KCl*0.05N*Ref 13	0.35	0.30	0.35	0.2046	0.2237				0.4666			
	SrCl2-NaCl-KCl*0.05N*Ref 14	0.30	0.40	0.30	0.1753	0.2982				0.3999			
	SrCl2-NaCl-KCl*0.05N*Ref 15	0.25	0.50	0.25	0.1461	0.3728				0.3333			
	SrCl2-NaCl-KCl*0.05N*Ref 16	0.20	0.60	0.20	0.1169	0.4473				0.2666			
	SrCl2-NaCl-KCl*0.05N*Ref 17	0.15	0.70	0.15	0.0877	0.5219				0.2000			
	SrCl2-NaCl-KCl*0.05N*Ref 18	0.10	0.80	0.10	0.0584	0.5964				0.1333			
	SrCl2-NaCl-KCl*0.05N*Ref 19	0.05	0.90	0.05	0.0292	0.6710				0.0667			
	SrCl2-NaCl-KCl*0.05N*Ref 20	0.00	1.00	0.00	0.0000	0.7455				0.0000			
	SrCl2-NaCl-KCl*0.05N*Ref 21	0.45	0.45	0.10	0.2630	0.3355				0.1333			
	SrCl2-NaCl-KCl*0.05N*Ref 22	0.40	0.40	0.20	0.2338	0.2982				0.2666			
	SrCl2-NaCl-KCl*0.05N*Ref 23	0.35	0.35	0.30	0.2046	0.2609				0.3999			
	SrCl2-NaCl-KCl*0.05N*Ref 24	0.30	0.30	0.40	0.1753	0.2237				0.5332			
	SrCl2-NaCl-KCl*0.05N*Ref 25	0.25	0.25	0.50	0.1461	0.1864				0.6665			
	SrCl2-NaCl-KCl*0.05N*Ref 26	0.20	0.20	0.60	0.1169	0.1491				0.7998			
	SrCl2-NaCl-KCl*0.05N*Ref 27	0.15	0.15	0.70	0.0877	0.1118				0.9332			
	SrCl2-NaCl-KCl*0.05N*Ref 28	0.10	0.10	0.80	0.0584	0.0746				1.0665			
	SrCl2-NaCl-KCl*0.05N*Ref 29	0.05	0.05	0.90	0.0292	0.0373				1.1998			
	SrCl2-NaCl-KCl*0.05N*Ref 30	0.00	0.00	1.00	0.0000	0.0000				1.3331			

BAW 3-14-02

3-14-02  
CONT  
BAW

### Prep of 0.05N reference solns

Followed procedure listed in 494/64-67

$\text{NaCl}$  = Fisher S271-3, lot # 984321

$\text{KCl}$  = Fisher P217-500, lot # 006242

$\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$  = Fisher S541-500, lot # 000052  
nanopure water

\* Complete label for solution IDs for 0.05N reference solutions was  $\text{SrCl}_2\text{-NaCl-KCl} \cdot 0.05\text{N} \cdot \text{Ref X}$

Soln ID (*)	$\text{NaCl}$ mass(g)	$\text{KCl}$ mass(g)	$\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ mass(g)
Ref1	0.0584	0.3354	0.5999
Ref2	0.1170	0.2981	0.5334
Ref3	0.1753	0.2610	0.4667
Ref4	0.2338	0.2239	0.3996
Ref5	0.2922	0.1865	0.3331
Ref6	0.3506	0.1490	0.2663
Ref7	0.4091	0.1120	0.2002
Ref8	0.4673	0.0748	0.1333
Ref9	0.5259	0.0372	0.0666
Ref10	skipped*	—	—

\* Sodium only with sodium form zeolite skipped

3-14-02  
CONT  
BAW

$\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$  modification - water not added to weighing dish before taring. Weight was "dry".

3-15-02  
BAW

Prep of  $\text{SrCl}_2\text{-NaCl-KCl}$  0.05N + 0.005N solutions for ternary ion exchange continued

Prep of 0.005N reference solutions 1 to 10

Ref solns 1 to 10 for 0.005N were prepared following the procedure found in 494/64-67

3-18-02  
BAW

### Prep of 0.05N reference solns

Followed procedure listed in 494/64-67 with modification listed 494/69

Reagents: see 46 BW 3/18/02 494/68

\* Complete label for soln IDs for 0.05N reference solns was  $\text{SrCl}_2\text{-NaCl-KCl} \cdot 0.05\text{N} \cdot \text{Ref X}$

Soln ID (*)	$\text{NaCl}$ mass(g)	$\text{KCl}$ mass(g)	$\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ mass(g)
Ref11	0.2631	0.0744	0.5998
Ref12	0.2340	0.1491	0.5332
Ref13	0.2044	0.2238	0.4667
Ref14	0.1752	0.2980	0.3997
Ref15	0.1459	0.3727	0.3334
Ref16	0.1167	0.4471	0.2664
Ref17	0.0876	0.5218	0.1999
Ref18	0.0584	0.5963	0.1332
Ref19	0.0294	0.6710	0.0665
Ref1020	0	0.7457	0

BW 3-18-02

3-19-02  
BAW

Prep of 0.005N ternary (Sr-K-Na) reference solutions # 11 to 20

0.05N reference solns # 11 to 20 from 494/69

Procedure from 494/64-67 followed.

Prep of 0.05N ternary (Sr-K-Na) reference solutions # 21 to 30

Followed procedure listed in 494/64-67 with modification listed 494/69

Reagents: see 494/68

\* Complete label for soln IDs for 0.05N reference solns was  $\text{SrCl}_2\text{-NaCl-KCl} * 0.05N * \text{Ref X}$   
 BAW 3/19/02

Soln ID *	NaCl mass (g)	KCl mass (g)	$\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ mass (g)
Ref 21	0.2630	0.3355	0.1334
Ref 22	0.2338	0.2982	0.2664
Ref 23	0.2046	0.2608	0.3999
Ref 24	0.1755	0.2235	0.5332
Ref 25	0.1462	0.1863	0.6667
Ref 26	0.1167	0.1491	0.7998
Ref 27	0.0876	0.1116	0.9331
Ref 28	0.0582	0.0744	1.0664
Ref 29	0.0290	0.0372	1.1995
Ref 30	0	0	1.3331

3-20-02  
BAW

Prep of ternary (Sr-K-Na) 0.005N reference solutions # 21 to 30

0.05N reference solns # 21 to 30 from 494/70

Procedure from 494/64-67 followed

3-21-02  
BAW

Rad spiking of ternary (Sr-K-Na) 0.05N + 0.005N reference solutions.

30 0.05N Ref solns and 30 0.005N Ref solns from 494/68-71

Followed procedure from 494/64-67

Radioactive spike = #51A 369/39

Eppendorf (100µL) used for 0.005N Ref spike

200µL Eppendorf (200-300-500µL) used for 0.05N ref spike.

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3-22-02  
BAW

Preparation of 0.05N and 0.005N Experimental Solutions - Zeolite Addition

Sodium form of zeolite used: CDV \* 200/325 \* 4C \*  
 WA \* RE \* HL \* RE \* R BAW 3-22-02 NaF  
 420/54-67 AJ 5/2/01

Followed procedure from 494/64-67 with one modification - zeolite not added directly to 60mL bottle. Zeolite weighed on tared wt paper. Then

3-22-02  
CONT  
BAW transferred to a 60mL bottle with a wt paper funnel inserted in bottle.

Mass of 20.0001g wt at start of analysis / 19.9998g

⊗ Complete label for bottle IDs for 0.05N experimental solns was  $\text{SrCl}_2\text{-NaCl-KCl} \times 0.05\text{N} \times \text{EXPX}$   
For 0.005N solns, ...  $\times 0.005\text{N} \times \text{EXPX}$

FOR 0.05N Experimental Solns

ID	Mass(g)	ID	Mass(g)	ID	Mass(g)
Exp1	0.1005	Exp11	0.0999	Exp21	0.1003
Exp2	0.1001	Exp12	0.1007	Exp22	0.1006
Exp3	0.0996	Exp13	0.1008	Exp23	0.1004
Exp4	0.1001	Exp14	0.1004	Exp24	0.1007
Exp5	0.1002	Exp15	0.1002	Exp25	0.1005
Exp6	0.1002	Exp16	0.1001	Exp26	0.1002
Exp7	0.1002	Exp17	0.1001	Exp27	0.1000
Exp8	0.1000	Exp18	0.1004	Exp28	0.1002
Exp9	0.1001	Exp19	0.1002	Exp29	0.1001
Exp10	0.1007	Exp20	0.1000	Exp30	0.1000

3-22-02

CONT

BAW

FOR 0.005N Experimental Solns

ID	Mass(g)	ID	Mass(g)	ID	Mass(g)
EXP1	0.1001	EXP11	0.1002	EXP21	0.1003
EXP2	0.1007	EXP12	0.1000	EXP22	0.1008
EXP3	0.1003	EXP13	0.1003	EXP23	0.1006
EXP4	0.1005	EXP14	0.1008	EXP24	0.1006
EXP5	0.1001	EXP15	0.1005	EXP25	0.1002
EXP6	0.1002	EXP16	0.1001	EXP26	0.1009
EXP7	0.1002	EXP17	0.1004	EXP27	0.1006
EXP8	0.1004	EXP18	0.1002	EXP28	0.1005
EXP9	0.1008	EXP19	0.1003	EXP29	0.1002
EXP10	0.1002	EXP20	0.1000	EXP30	0.1007

Mass of 20.0001g wt at end of analysis = 20.0001

Preparation of 0.05N and 0.005N (Sr-Na-K) experimental solns - solution addition

Added 50.00g of spiked reference soln - 494/71 via procedure in 494/64-67.

22 Mar 02  
PB

Addition of 0.05 and 0.005 solutions to experimental containers (continued from previous page). Individual experimental solution bottles are tared using the Mettler PM 4600 balance prior to addition of solution. Solutions are then added using a combination of 10 mL Oxford pipet tips and disposable transfer pipets to make up to 50.00 g (target, actual weight recorded in table below).

0.05N EXPERIMENTAL SOLUTIONS (see p. 444/72 for label details)

Container ID	soln. mass added	Container ID	soln. mass added
EXP 1	50.01	EXP 16	50.00
EXP 2	50.00	EXP 17	50.01 3/22/02
EXP 3	50.00	EXP 18	<del>50.01</del> 50.00
EXP 4	50.00	EXP 19	50.01
ref 6 → EXP 5	50.02	EXP 20	50.01
ref 5 → EXP 6	50.01	EXP 21	50.01
EXP 7	50.00	EXP 22	50.00
EXP 8	50.00	EXP 23	50.00
EXP 9	50.00	EXP 24	50.00
ref 11 → EXP 10	50.01	EXP 25	50.01
<del>EXP 11</del> 3/22/02		EXP 26	50.00
EXP 12	50.01	EXP 27	50.00
EXP 13	50.00	EXP 28	50.01
EXP 14	50.01	EXP 29	50.00
EXP 15	50.00	EXP 30	50.00

Note: appropriate reference soln. used for each EXP soln.

B

3/22/02

not done on 22 Mar 02  
PB

0.005N EXPERIMENTAL SOLUTIONS

Container ID	soln. mass added	Container ID	soln. mass added
EXP 1	50.02	EXP 16	50.01
EXP 2	50.04	EXP 17	50.00
EXP 3	50.02	EXP 18	50.03
EXP 4	50.00	EXP 19	50.00
EXP 5	50.00	EXP 20	50.00
EXP 6	50.01	EXP 21	50.00
EXP 7	50.01	EXP 22	49.99
EXP 8	50.03	EXP 23	50.00
EXP 9	50.01	EXP 24	50.01
EXP 10	skipped - Na only	EXP 25	49.99
EXP 11	50.01	EXP 26	50.01
EXP 12	50.01	EXP 27	50.01
EXP 13	50.01	EXP 28	50.02
EXP 14	50.00	EXP 29	50.02
EXP 15	50.01	EXP 30	50.01

01 Apr 02 PB monthly review and error check.

02 Apr 02  
BW Prepared 0.0005N (Sr-K-Na) Ternary Exp Solns listed above as BW 4/2/02 using the procedure listed on the top of page 494/74

Mass of 400.00g at start = 400.00g

Mass of 400.00g at end of analysis = 400.00g

4-2-02

BW



02 Apr 02

BAW

CONT

CaCl<sub>2</sub>-NaCl-KCl Ternary Ion Exchange Experiments (0.05N and 0.005N)

Thirty 200mL reference solutions with a total normality of 0.05N will be prepared. Two experimental sets will be generated from these reference solutions: thirty 0.05N solutions and thirty 0.005N solutions. All experimental sets will have a fixed solution volume (50mL) and a fixed amount of zeolite (0.1g). The composition of the 30 reference solution will vary (see table). The 0.05N experimental set will consist of 50 mL aliquots of the reference solutions. A 0.005N experimental set will be prepared from a ten-fold dilution of the 0.05N reference solutions. The ternary ion exchange solutions will be prepared in the following manner.

## Preparation of the 0.05N reference solutions

For convenience, the 0.05N reference solutions can be prepared in groups of 10. Label ten 250mL beakers with a sharpie. Tare an appropriately sized weighing boat on the AE240 balance. Add the appropriate amount of NaCl (see table) and record the mass. Transfer the compound to a 250mL beaker. Carefully rinse the weighing boat with nanopure water from a squirt bottle and transfer the washings into the beaker. Repeat this rinsing step several times. Throw away the used weighing boat. After the NaCl additions to the ten solutions has been completed, then the KCl additions can begin. Tare an appropriately sized weighing boat on the AE240 balance. Add the appropriate amount of KCl (see table) and record the mass. Transfer the compound to the appropriate 250mL beaker (beaker already contain a NaCl solution). Carefully rinse the weighing boat with nanopure water from a squirt bottle and transfer the washing into the beaker. Repeat this rinsing step several times. Throw away the used weighing boat. After all ten KCl additions have been completed, then begin with the CaCl<sub>2</sub>\*2H<sub>2</sub>O additions. Keep the CaCl<sub>2</sub>\*2H<sub>2</sub>O container covered as much as possible in order to minimize adsorption of water from the atmosphere. Tare an appropriately sized weighing boat on the AE240 balance. Add the appropriate amount of CaCl<sub>2</sub>\*2H<sub>2</sub>O (see table) and record the mass. Transfer the compound to

02 Apr 02

CONT

BAW

the appropriate 250mL beaker (beaker already contains NaCl/KCl solution). Carefully rinse the weighing boat with nanopure water from a squirt bottle several times and transfer the washings into the beaker. Throw away the used weighing boat. Ensure that all solids are dissolved in the 250mL beaker. Swirl and/or add water if necessary. Ensure that total solution volume in beaker does not exceed much beyond 100mL. Let the solution stand for at least one minute before transferring into the volumetric flask. Label ten 200mL volumetric flasks with a sharpie. Decant the contents of the 250mL beaker into the appropriate 200mL volumetric flask. Carefully rinse the beaker with nanopure water from a squirt bottle and transfer the washing into the beaker. Repeat this rinsing step several times. Fill the volumetric flask to about 2-3 inches below the mark with nanopure water and swirl for mixing. Then add nanopure water dropwise up to the mark and remix. Transfer each solution to an appropriately labeled polypropylene bottle. Label the bottles CaCl<sub>2</sub>-NaCl-KCl\*0.05N\*Ref1 to 30. Clean the ten beakers and ten volumetric flasks by rinsing three times with DI water and then three times with nanopure water (no acid wash). Reuse this glassware and repeat this procedure for the next ten reference solutions. For convenient preparation, it is suggested that the 0.005N solutions (0.05N dilutions) be prepared before making the next set of ten 0.05N solutions.

## Preparation of the 0.005N reference solutions

Add 10mL (volumetric pipet) of the 0.05N reference solution to a 100mL volumetric flask and dilute to mark with nanopure water. Mix thoroughly. Clean the pipets by thoroughly rinsing with DI water, then with nanopure water (do not acid wash). Place glassware in oven for drying. Transfer each solution to an appropriately labeled polypropylene bottle. Label the bottles CaCl<sub>2</sub>-NaCl-KCl\*0.005N\*Ref1 to 30. Clean the flasks by thoroughly rinsing with DI water, then with nanopure water (no acid wash). Place pipets in oven for drying. For convenience, it is suggested that all 60 reference solutions be finished before starting to prepare the experimental solutions.

02 Apr 02  
CONT  
BAW

Preparation of 0.05N Experimental Solutions – Addition of zeolite

All experimental sets will have a fixed solution volume (50mL) and a fixed amount of zeolite (0.1g). The XXX form of the zeolite (XXX-zeo) will be used. Record the zeolite label information in the notebook. For convenience, the experimental solutions can be prepared in groups of 10. Transfer and record the mass (target = 0.1g) of XXX-zeo into a 60mL polypropylene bottle. The bottles should be labeled CaCl<sub>2</sub>-NaCl-KCl\*0.05N\*Exp1 to 30. Add 50.00g (Metler PM4600 balance) of the appropriate reference solution to the bottle containing the zeolite. (It is suggested that an oxford pipet with a 10mL disposal tip be used to transfer the bulk of the solution. Then a disposable 5mL pipet can be used to add the final amount of reference solution dropwise to obtain the 50.00g mark.) Record the mass of solution. Repeat this procedure for making each experimental solution.

Preparation of 0.005N Experimental Solutions – Addition of zeolite

All experimental sets will have a fixed solution volume (50mL) and a fixed amount of zeolite (0.1g). The XXX form of the zeolite (XXX-zeo) will be used. For convenience, the experimental solutions can be prepared in groups of 10. Transfer and record the mass (target = 0.1g) of XXX-zeo into a 60mL polypropylene bottle. The bottles should be labeled CaCl<sub>2</sub>-NaCl-KCl\*0.005N\*Exp1 to 30. Add 50.00g (Metler PM4600 balance) of the appropriate reference solution to the bottle containing the zeolite. (It is suggested that an oxford pipet with a 10mL disposal tip be used to transfer the bulk of the solution. Then a disposable 5mL pipet can be used to add the final amount of reference solution dropwise to obtain the 50.00g mark.) Record the mass of solution. Repeat this procedure for making each experimental solution.

02 Apr 02  
CONT  
BAW

NA-K-CA total normality at 0.05 N		target mass for 200mL				
TN	Solution ID	ENa	EK	ECa	NaCl	CaCl <sub>2</sub> .2H <sub>2</sub> O
0.05	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 1	0.10	0.45	0.45	0.0584	0.3308
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 2	0.20	0.40	0.40	0.1169	0.2940
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 3	0.30	0.35	0.35	0.1753	0.2573
0.1 g zeol. 50 ml. Soln.	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 4	0.40	0.30	0.30	0.2338	0.2205
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 5	0.50	0.25	0.25	0.2922	0.1864
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 6	0.60	0.20	0.20	0.3507	0.1491
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 7	0.70	0.15	0.15	0.4091	0.1103
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 8	0.80	0.10	0.10	0.4675	0.0746
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 9	0.90	0.05	0.05	0.5260	0.0373
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 10	1.00	0.00	0.00	0.5844	0.0000
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 11	0.45	0.10	0.45	0.2630	0.0746
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 12	0.40	0.20	0.40	0.2338	0.1491
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 13	0.35	0.30	0.35	0.2046	0.2237
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 14	0.30	0.40	0.30	0.1753	0.2982
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 15	0.25	0.50	0.25	0.1461	0.3728
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 16	0.20	0.60	0.20	0.1169	0.4473
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 17	0.15	0.70	0.15	0.0877	0.5219
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 18	0.10	0.80	0.10	0.0584	0.5964
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 19	0.05	0.90	0.05	0.0292	0.6710
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 20	0.00	1.00	0.00	0.0000	0.7455
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 21	0.45	0.45	0.10	0.2630	0.3355
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 22	0.40	0.40	0.20	0.2338	0.2982
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 23	0.35	0.35	0.30	0.2046	0.2609
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 24	0.30	0.30	0.40	0.1753	0.2237
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 25	0.25	0.25	0.50	0.1461	0.1864
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 26	0.20	0.20	0.60	0.1169	0.1491
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 27	0.15	0.15	0.70	0.0877	0.1118
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 28	0.10	0.10	0.80	0.0584	0.0746
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 29	0.05	0.05	0.90	0.0292	0.0373
	CaCl <sub>2</sub> -NaCl-KCl*0.05N*Ref 30	0.00	0.00	1.00	0.0000	0.0000
						0.7351

02 Apr 02  
CONT  
BAW

Prep of 0.05N Ternary Ca-Na-K Ref. Solns

Followed procedure listed in 494/76-79

Will use sodium form of zeolite therefore Ref soln 10 will be skipped. Ref soln 10 has only sodium in soln, so sodium soln w/ sodium zeolite skipped.

03 Apr 02  
BAW

$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$  = Fisher C79-500, lot # 016231  
rec 10/15/01

$\text{NaCl}$  = Fisher S271-3, lot # 984321

$\text{KCl}$  = Fisher P217-500, lot # 006242  
nanopure water

\* Complete label for solution IDs for 0.05N ref solns was  $\text{CaCl}_2\text{-NaCl-KCl} \times 0.05\text{N} \times \text{Ref X}$

Soln ID (*)	$\text{NaCl}$ mass(g)	$\text{KCl}$ mass(g)	$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ mass(g)
Ref 1	0.0585	0.3354	0.3311
Ref 2	0.1170	0.2979	0.2938
Ref 3	0.1751	0.2608	0.2574
Ref 4	0.2338	0.2235	0.2204
Ref 5	0.2922	0.1864	0.1841
Ref 6	0.3505	0.1492	0.1471
Ref 7	0.4091	0.1116	0.1104
Ref 8	0.4673	0.0748	0.0732
Ref 9	0.5258	0.0375	0.0366
Ref 10	Skipped*	—	—

\* Sodium only soln with sodium form zeolite skipped

Mass before analysis (target = 20.0001g) was 20.0002g

03 Apr 02  
CONT  
BAW

Mass after analysis (target = 20.0001g) = 20.0002g

$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$  modification to procedure (494/76-79) <sup>BW 4/13/02</sup>  
Water not added BW 4/13/02

0.05N (Ca-Na-K) Ref Solns 1 to 10 completed

Preparation of 0.005N (Ca-Na-K) Ref Solns 1 to 10

Prepared by following procedure on 494/76-79

04 Apr 02  
BAW

Preparation of 0.05N (Ca-Na-K) Ref Solns 11-20

Prepared by following procedure on 494/76-79

Reagents: see 494/80

\* Complete label for soln IDs for 0.05N ref solns was  $\text{CaCl}_2\text{-NaCl-KCl} \times 0.05\text{N} \times \text{Ref X}$

Soln ID (*)	$\text{NaCl}$ mass(g)	$\text{KCl}$ mass(g)	$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ mass(g)
Ref 11	0.2632	0.0746	0.3306
Ref 12	0.2337	0.1491	0.2938
Ref 13	0.2046	0.2235	0.2572
Ref 14	0.1753	0.2981	0.2207
Ref 15	0.1461	0.3730	0.1836
Ref 16	0.1167	0.4471	0.1470
Ref 17	0.0875	0.5220	0.1101
Ref 18	0.0581	0.5966	0.0733
Ref 19	0.0291	0.6707	0.0367
Ref 20	0	0.7452	0

Mass at start of analysis (target 20.0001g) = 20.0001g

04 Apr 02  
CONT  
BAW

Mass at end of analysis (target = 20.0001g) = 20.0001g

Preparation of 0.005N (Ca-Na-K) Ref Solns 11-20

Prepared by following procedure on 494/76-79

05 Apr 02  
BAW

Preparation of 0.05N (Ca-Na-K) Ref Solns 21-30

Followed by BAW 4/5/02 procedure listed in 494/76-79

Reagents: see 494/80

\* Complete label for solutions for 0.05N ref solns was  $\text{CaCl}_2\text{-NaCl-KCl} \times 0.05\text{N} \times \text{Ref X}$ .

Soln ID (*)	NaCl mass(g)	KCl mass(g)	$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ mass(g)
----------------	-----------------	----------------	--

Ref 21	0.2628	0.3355	0.0735
Ref 22	0.2338	0.2983	0.1471
Ref 23	0.2047	0.2607	0.2208
Ref 24	0.1755	0.2235	0.2939
Ref 25	0.1461	0.1867	0.3676
Ref 26	0.1169	0.1493	0.4410
Ref 27	0.0875	0.1117	0.5146
Ref 28	0.0583	0.0748	0.5883
Ref 29	0.0291	0.0374	0.6617
Ref 30	0	0	0.7353

Mass before analysis (target = 20.0001g) = 20.0001g

Mass after analysis (target = 20.0001g) = 20.0002g

4/10/02  
AT

Sampling of Initial and Final Experimental solutions for  $\text{SrCl}_2\text{-CaCl}_2$  (0.05N) Ion exchange experiments.

Objective:- To prepare diluted samples for final ion concentration analysis in experimental solutions of  $\text{SrCl}_2\text{-CaCl}_2$ , 0.05N ion exchange experiments.

Supplies:- ① 30 ml Nalgene PP bottles

② 2, 5 & 10 ml glass pipets

③ 23, 25 ml capacity volumetric flasks

④ Radioactive material labels

Procedure:- All experimental and initial reference solutions were diluted to 25 ml. 1, 2, 5 and 10 ml aliquots were added to 25 ml volumetric flasks & diluted to 25 ml with nano pure water. The samples were transferred to PP bottles and labeled.

Initial Solutions

$E_{i,\text{Sr}}$ (0.05 N) ( $\text{SrCl}_2/\text{CaCl}_2$ soln.)	Volume of soln. used (ml)	Diluted volume of soln. (ml.)
0.1 (100 mL)	5	25
0.2 (100 mL)	5	25
0.4 (100 mL)	5	25
0.6 (250 mL)	5	25
1 (1 L)	2	25

4/10/2002  
CONT  
BAW

Preparation of 0.005N (Ca-Na-K) Ref Solns 21-30

Prepared by following procedure on 494/76-79

4/11/2002  
BAW

Preparation of 0.05N + 0.005N Ca-Na-K Experimental Solns - Zeolite Addition

Sodium form of zeolite used: CDV\*200/325\*4CX  
WA\*RL\*HL\*RF\*NaF 420/54-67  
AS 5/2/01

Followed procedure from 494/76-79 with one modification - zeolite not added directly to 60mL bottle, zeolite weighed on tared wt paper, then transferred to a 60mL bottle with a weighing paper funnel inserted in bottle.

⊗ Complete table for bottle IDs for 0.05N experimental solns was  $\text{CaCl}_2\text{-NaCl-KCl} \times 0.05\text{N} \times \text{ExpX}$ .

For 0.005N solns, ...  $\times 0.005\text{N} \times \text{ExpX}$

Mass <sup>BAW 4/11/02</sup> of at start of analysis (target = <sup>BAW 4/11/02</sup> 20.0001g)  
was 20.0001g

Mass at end of analysis (target = 20.0001g)  
was 20.0001g

BAW  
4-11-02

4/11/02  
CONT  
BAW

FOR 0.05N Experimental Solns

ID	Mass(g)	ID	Mass(g)
Exp1	0.0999	Exp16	0.1005
Exp2	0.0997	Exp17	0.1003
Exp3	0.0996	Exp18	0.1005
Exp4	0.1003	Exp19	0.1006
Exp5	0.1008	Exp20	0.1007
Exp6	0.1002	Exp21	0.1006
Exp7	0.1006	Exp22	0.1001
Exp8	0.1004	Exp23	0.1002
Exp9	0.0997	Exp24	0.1007
Exp10	0.1006	Exp25	0.1000
<sup>11</sup> <del>Exp11</del> <sup>BAW 4-11-02</sup>	0.1009	Exp26	0.1002
Exp12	0.1009	Exp27	0.1008
Exp13	0.1007	Exp28	0.1004
Exp14	0.1003	Exp29	0.1007
Exp15	0.1008	Exp30	0.1005



4/11/02  
CONT  
BAW

For 0.005N Experimental Solns

ID	Mass(g)	ID	Mass(g)
Exp1	0.1004	Exp16	0.1004
Exp2	0.1007	Exp17	0.1000
Exp3	0.1006	Exp18	<del>0.1007</del> 0.1003 BW 4-11-02
Exp4	0.1004	Exp19	0.1003
Exp5	0.1003	Exp20	0.1002
Exp6	0.1009	Exp21	0.1007
Exp7	0.1001	Exp22	0.1000
Exp8	0.1005	Exp23	0.1006
Exp9	0.1000	Exp24	0.1000
Exp10	skipped	Exp25	0.1008
Exp11	0.0999	Exp26	0.1004
Exp12	0.1008	Exp27	0.1005
Exp13	0.1006	Exp28	0.1004
Exp14	0.1004	Exp29	0.1008
Exp15	0.1007	Exp30	0.1002

4/12/02  
BAW

Preparation of 0.05N and 0.005N Ca-Na-K  
Experimental Solutions - Solution Addition

Added 50.00g of appropriate reference soln  
by procedure in 494/76-79

0.05N Experimental Solns (see p 494/84  
for label details) see table below

Soln ID	Soln Mass(g)	Soln ID	Soln Mass(g)
Exp1	50.00	Exp16	50.02
Exp2	50.00	Exp17	50.03
Exp3	50.00	Exp18	50.02
Exp4	50.01	Exp19	50.01
Exp5	50.02	Exp20	49.99
Exp6	50.03	Exp21	50.01
Exp7	50.01	Exp22	50.00
Exp8	50.00	Exp23	50.00
Exp9	50.02	Exp24	49.99
Exp10	NA	Exp25	50.01
Exp11	50.02	Exp26	49.99
Exp12	50.03	Exp27	49.98
Exp13	50.00	Exp28	50.00
Exp14	50.02	Exp29	49.98
Exp15	50.00	Exp30	49.99

Ref solns from 494/80-82, 84)

BW  
4/12/02

4/12/02  
CONT  
BAW

0.005N Experimental Solutions (see p 494/84  
for label details) see table below

Soln ID	Soln Mass (g)	Soln ID	Soln Mass (g)
EXP1	50.00	EXP16	49.99
EXP2	50.00	EXP17	50.01
EXP3	50.00	EXP18	50.01
EXP4	50.01	EXP19	50.01
EXP5	50.00	EXP20	50.01
EXP6	50.00	EXP21	50.00
EXP7	50.01	EXP22	50.00
EXP8	50.02	EXP23	50.00
EXP9	50.02	EXP24	50.01
EXP10	nq	EXP25	50.00
EXP11	50.00	EXP26	50.00
EXP12	49.99	EXP27	50.01
EXP13	50.01	EXP28	50.01
EXP14	50.00	EXP29	50.00
EXP15	50.02	EXP30	50.00

Mass at start of analysis (target = 400.00g) was 400.00g

Mass at end of analysis (target = 400.00g) was 400.00g

The 60 ~~expts~~ <sup>gus</sup> 4-12-02 experimental solns were  
placed in a gyratory shaker

4-12-02

BAW

4/15/02  
BAW

Sampling of 0.05N (Sr-Na-K) Experimental  
Solns for LSA analysis

Samples were <sup>29 4/14/02 BAW</sup> 30 experimental  $\text{SrCl}_2\text{-NaCl-KCl}$   
0.05N solutions from 494/74  
~~sampled in duplicate (9/b notation) gus 4/15/02~~  
Labeled 0.05N SrNaK EX91 and 0.05N SrNaK EX61  
where X = soln # 1 to 30 and suffix 1 is initial sampling

Ten mL (oxford pipet w/ 10mL plastic tip) aliquots  
of sample were transferred to an appropriately  
labeled 20mL plastic LSA vial

Sampling of 0.05N (SrNaK) Experimental  
Solns for Div 01 ICP Analysis

Samples were <sup>29 4/19/02 BAW 4/16/02 BAW 4/19/02</sup> 30 experimental  $\text{SrCl}_2\text{-NaCl-KCl}$   
0.05N solutions from 494/74  
Labeled EXSNK05 where E = experimental  
(not reference), X = soln # 1 to 30, SNK =  
SrNaK, and 05 = 0.05N.

Approximately 20mL (oxford pipet w/ 10mL plastic  
tip) aliquots of sample were transferred to  
an appropriately labeled 30mL polypropylene  
bottle

4/16/02  
BAW

Sampling of 0.05N (Sr-Na-K) Reference  
Soln for Div 01 ICP Analysis

One reference soln ( $\text{SrCl}_2\text{-NaCl-KCl}$ ) 0.05N REF4)  
was used as a "known spiked" sample to be  
included in the Div 01 analysis of the  
0.05N Experimental Solns.

Ref soln source 494/71 target 494/67 target 494/67  
BAW 4/16/02

4/16/02  
CONT  
BAW

Approximately 20mL (Oxford pipet with 10mL plastic tip) aliquot of sample was transferred to an appropriately labeled 30mL pp bottle - R45NK05 - where R = reference, 4 = soln #4, SNK = SrNaK, and 05 = 0.05N

4/16/02  
AJ

Sampling of Initial and final experimental solutions for  $\text{SrCl}_2\text{-CaCl}_2$  0.05N ion exchange experiments continued.

Mixture # SrCa-05*	ES <sub>r,i</sub> to use	Volume of soln. used (ml)	Diluted volume of soln. (ml.)
1	0.1	1.0	25
2	0.1	1.0	25
3	0.1	1.0	25
4	0.2	1.0	25
5	0.2	1.0	25
6	0.4	1.0	25
7	0.4	2	25
8	0.6	1.0	25
9	0.6	2	25
10	0.6	10	25
11	1	1.0	25
12	1	1.0	25
13	1	2	25
14	1	2	25
15	1	5	25
16	1	10	25
17	1	10	25
18	1	10 <sup>5/1/02</sup>	25

Mixture # 1 to 18 (Sr/Ca 0.05N) were sampled for LSA analysis. All vials contain 5ml of experimental solution and 5 ml of DI H<sub>2</sub>O.

4/16/02  
CONT  
BAW

Transfer of Custody Paperwork for DIV 01 - ICP Analysis of 0.05N Sr-Ng-K Ion Exchange Experimental Solns

SAMPLE LIST/CHAIN OF CUSTODY				Requested Turnaround:		REMARKS
Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166				<input type="checkbox"/> 1 Week <input type="checkbox"/> 2 Weeks (Normal) <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4 Weeks	SWRI Contact: Mike Damman	
Client Name/Address	Bradley Werling CNW EA - DIV 20 BLD 57	Site/Zone ID		Analyses Requested		NO preservation - analysis preservation 45 is a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Other (Specify)
Client Purchase Order/Other ID						
Sample ID	E15NK05	Sample Collection Date (mm/dd/yy)	4/15/02	Sample Type	W DN	
	E25NK05					
	E35NK05					
	E45NK05					
	E55NK05					
	E65NK05					
	E75NK05					
	E85NK05					
	E95NK05					
	E105NK05					
Matrix Types: A - Air; P - Product; S - Soil; T - Tissue; W - Water						Project is nuclear safety related - use appropriate QA procedures POC for questions is Bradley Werling phone 6565 fax 5184
Sample Types: DM - Dissolved Metals; ER - Equipment Rinseate; FB - Field Blank; MSD - Matrix Spike Duplicate; MS - Matrix Spike; TB - Trip Blank; TM - Total Metals; ES - Environmental Samples; FD - Field Duplicate						
Relinquished by (Signature): Bradley Werling						
Relinquished by (Signature):						Radioactivity - Early Bottle contains a Sr activity of $\pm 0.1$ nCi or 3.7 Bq/g
Relinquished by (Signature):						
Relinquished by (Signature):						
Comments:	4/14/89 SrCl <sub>2</sub> -NaCl-0.05N					

4-16-02  
CONT  
BW

Client Name/Address Bradley Werling CNWRA - DIV 20 BLD 57		SAMPLE LIST/CHAIN OF CUSTODY Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166		Requested Turnaround: <input type="checkbox"/> 1 Week <input type="checkbox"/> 2 Weeks (Normal) <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4 Weeks	
Client Purchase Order/Other ID		Site/Zone ID		Analyses Requested	
Sample ID		Sample Collection Date (mm/dd/yy)	Sample Collection Time (mm/dd/yy)	Matrix Type	Sample Type
					# of Containers
					ICP analysis for 3 cations
					Sr, Na, K
E12SNK05		4-15-02		W	DM
E13SNK05					
E14SNK05					
E15SNK05					
E16SNK05					
E17SNK05					
E18SNK05					
E19SNK05					
E20SNK05					
E21SNK05					
Matrix Types: A - Air; P - Product; S - Soil; T - Tissue; W - Water		Relinquished by (Signature):		SwRI Project No.	
Sample Types: DM - Dissolved Metals; ER - Equipment Rinsate; FB - Field Blank; MSD - Matrix Spike Duplicate; MS - Matrix Spike; TB - Trip Blank; TM - Total Metals; ES - Environmental Samples; FD - Field Duplicate		Received by (Signature):		Received by SwRI Lab (Signature):	
Relinquished by Sampler (Signature):		Relinquished by (Signature):		Samples Disposed by:	
Received by (Signature):		Comments:		Date/Time:	

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BW  
4-16-02

4-16-02  
CONT  
BW

Client Name/Address Bradley Werling CNWRA - DIV 20 BLD 57		SAMPLE LIST/CHAIN OF CUSTODY Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166		Requested Turnaround: <input type="checkbox"/> 1 Week <input type="checkbox"/> 2 Weeks (Normal) <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4 weeks	
Client Purchase Order/Other ID		Site/Zone ID		Analyses Requested	
Sample ID		Sample Collection Date (mm/dd/yy)	Sample Collection Time (mm/dd/yy)	Matrix Type	Sample Type
					# of Containers
					ICP analysis for 3 cations
					Sr, Na, K
E22SNK05		4-15-02		W	DM
E23SNK05					
E24SNK05					
E25SNK05					
E26SNK05					
E27SNK05					
E29SNK05					
E30SNK05					
R4SNK05					
Matrix Types: A - Air; P - Product; S - Soil; T - Tissue; W - Water		Relinquished by (Signature):		SwRI Project No.	
Sample Types: DM - Dissolved Metals; ER - Equipment Rinsate; FB - Field Blank; MSD - Matrix Spike Duplicate; MS - Matrix Spike; TB - Trip Blank; TM - Total Metals; ES - Environmental Samples; FD - Field Duplicate		Received by (Signature):		Received by SwRI Lab (Signature):	
Relinquished by Sampler (Signature):		Relinquished by (Signature):		Samples Disposed by:	
Received by (Signature):		Comments:		Date/Time:	

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BW  
4-16-02

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BW  
4-16-02

4-19-02

B4U

Delivery of SrCl<sub>2</sub>-CaCl<sub>2</sub> samples to Div 1 for ICP analysis.

A-BU 4-19-02

5 Reference samples from 494/61  
18 Experimental samples from 494/90  
NOTE: Ref samples not diluted - Exp samples diluted  
I labeled Exp. samples E1 to E18 and  
Ref samples R01, R02, R04, R06, R10

Client Name/Address Bradley Werling CNWRA - DIV 20 BLD 57		SAMPLE LIST/CHAIN OF CUSTODY Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166					Requested Turnaround: <input type="checkbox"/> 1 Week <input type="checkbox"/> 2 Weeks (Normal) <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4 weeks				
Client Purchase Order/Other ID		Site/Zone ID		Analyses Requested					SwRI Contact: Mike Dammann		
Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time (mm/dd/yy)	Matrix Type	Sample Type	# of Containers	by ICP	REMARKS no preservation analysis as is a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Other (Specify)				
E1	4-16-02		W	DM	1	✓	Nuclear Safety Related - use appropriate QA procedures				
E2						✓					
E3						✓					
E4						✓					
E5						✓	POC - Bradley Werling phone 6565 fax 5184				
E6						✓					
E7						✓					
E8						✓					
E9						✓					
E10						✓					
Matrix Types: A - Air; P - Product; S - Soil; T - Tissue; W - Water						Relinquished by (Signature):		SwRI Project No.			
Sample Types: DM - Dissolved Metals; ER - Equipment Rinse; FB - Field Blank; MSD - Matrix Spike Duplicate; MS - Matrix Spike; TB - Trip Blank; TM - Total Metals; ES - Environmental Samples; FD - Field Duplicate						Received by (Signature):		20.R9211.01.001			
Relinquished by Sampler (Signature): Bradley Werling						Relinquished by (Signature):		Received by SwRI Lab (Signature):			
Received by (Signature):						Comments: 494/94 SrCl <sub>2</sub> -CaCl <sub>2</sub> -0.05N		Samples Disposed by:			
								Date/Time: 10-22-4/16/02			

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4-19-02

CONT

B4U

Client Name/Address Bradley Werling CNWRA - DIV 20 BLD 57		SAMPLE LIST/CHAIN OF CUSTODY Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166					Requested Turnaround: <input type="checkbox"/> 1 Week <input type="checkbox"/> 2 Weeks (Normal) <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4 weeks				
Client Purchase Order/Other ID		Site/Zone ID		Analyses Requested					SwRI Contact: Mike Dammann		
Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time (mm/dd/yy)	Matrix Type	Sample Type	# of Containers	by ICP	REMARKS No preservation analyze Preservation 315 a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Other (Specify)				
E11	4-16-02		W	DM	1	✓	Nuclear Safety Related - use appropriate QA procedures				
E12						✓					
E13						✓					
E14						✓					
E15						✓					
E16						✓	POC - Brad Werling phone 6565 fax 5184				
E17						✓					
E18						✓					
R01						✓					
R02						✓					
Matrix Types: A - Air; P - Product; S - Soil; T - Tissue; W - Water						Relinquished by (Signature):		SwRI Project No.			
Sample Types: DM - Dissolved Metals; ER - Equipment Rinse; FB - Field Blank; MSD - Matrix Spike Duplicate; MS - Matrix Spike; TB - Trip Blank; TM - Total Metals; ES - Environmental Samples; FD - Field Duplicate						Received by (Signature):		20.R9211.01.001			
Relinquished by Sampler (Signature): Bradley Werling						Relinquished by (Signature):		Received by SwRI Lab (Signature):			
Received by (Signature):						Comments: 494/94 SrCl <sub>2</sub> -CaCl <sub>2</sub> -0.05N		Samples Disposed by:			
								Date/Time: 10-22-4/16/02			

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[illegible]

4-19-02  
CONT  
BAW

Sampling of 0.005N (Sr-Na-K) Experimental Solns for LSA Analysis

29 experimental solns were 0.005N Sr-Mg-K from 494/75  
Ten mL (Covord pipet) aliquots of sample were transferred into an appropriately labelled 20 mL plastic LSA vial  
Labelling - 0.005N SrMgK EX91 where  
E = experimental soln, X = soln # 1 to 30,  
9 = 1 sample (not duplicated - a/b), and  
1 = initial sampling.

Sampling of 0.005N (Sr-Mg-K) Experimental Solns  
for DVC ICP Analysis

29 experimental solns were 0.005N sr-Ng-K from  
494/75

Approximately 20 mL (Oxford pipet with 10 mL tip) aliquots of sample were transferred to an appropriately labelled 30 mL pp bottle.

Labeling - 005SNKEX where  
005 = 0.005 N soln, SNK = Sr-Na-K,  
E = experimental soln, and X = soln # 1 to 30

4/22/02  
BAW

### Sampling of 0.005N (Sr-Ng-K) Reference Solution for TCP D101 Analysis

one reference soln - 0.005N Sr-Mg-K ref soln  
( $\text{SrCl}_2$ -NaCl-KCl 0.005N\* Ref 14 from 494/71 via  
494/67 1/10 dilution), was used as a "known  
spiked" sample to be included in the DVO  
analysis of the 0.005N Experimental solutions  
Approximately 20 mL (oxford pipet with 10 mL plastic  
tip) aliquot of sample was transferred to an  
appropriately labeled 30 mL pp bottle;

4/22/02  
CENT  
BAW  
005SNKE14  
RTHSNKE05 where  
R = reference but 4/22/02 reference  
SNKE = Sr-Na-K and  
005 = 0.005N

Transfer of Custody Paperwork for DIVE1-ICP Analysis  
of 0.005N Sr-Na-K Ion Exchange experimental salms.

Client Name/Address Bradley Werling CNWRA - DIV 20 BLD 57		SAMPLE LIST/CHAIN OF CUSTODY Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166		Requested Turnaround: <input type="checkbox"/> 1 Week <input type="checkbox"/> 2 Weeks (Normal) <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4 weeks	
Client Purchase Order/Other ID		Site/Zone ID		Analyses Requested	
Sample ID		Sample Collection Date (mm/dd/yy)		Sample Collection Time (mm/dd/yy)	
Matrix Type		Sample Type		# of Containers	
Sr, Na, K by ICP					
005SNKE1		4-19-02		W DM 1	
005SNKE2					
005SNKE3					
005SNKE4					
005SNKE5					
005SNKE6					
005SNKE7					
005SNKE8					
005SNKE9					
005SNKE11					
Matrix Types: A - Air; P - Product; S - Soil; T - Tissue; W - Water		Relinquished by (Signature):		SwRI Project No.	
Sample Types: DM - Dissolved Metals; ER - Equipment Rinsate; FB - Field Blank; MSD - Matrix Spike Duplicate; MS - Matrix Spike; TB - Trip Blank; TM - Total Metals; ES - Environmental Samples; FD - Field Duplicate		Received by (Signature):		20.R9211.01.001	
Relinquished by Sampler (Signature):		Relinquished by (Signature):		Received by SwRI Lab (Signature):	
Bradley Werling		RADIO ACTIVITY - Each bottle contains a Sr 90 activity of $\leq 0.1 \text{ nCi/g}$ or $3.7 \text{ Bq/g}$		Samples Disposed by:	
Received by (Signature):		Comments:		Date/Time:	
		4/94/97 SrCl <sub>2</sub> -NaCl-KCl - 0.005N		4/22/02 10:35	

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4-22-02  
CENT  
BAW

Client Name/Address Bradley Werling CNWRA - DIV 20 BLD 57		SAMPLE LIST/CHAIN OF CUSTODY Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166		Requested Turnaround: <input type="checkbox"/> 1 Week <input type="checkbox"/> 2 Weeks (Normal) <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4 weeks	
Client Purchase Order/Other ID		Site/Zone ID		Analyses Requested	
Sample ID		Sample Collection Date (mm/dd/yy)		Sample Collection Time (mm/dd/yy)	
Matrix Type		Sample Type		# of Containers	
Sr, Na, K by ICP					
005SNKE12		4-19-02		W DM 1	
005SNKE13					
005SNKE14					
005SNKE15					
005SNKE16					
005SNKE17					
005SNKE18					
005SNKE19					
005SNKE20					
005SNKE21					
Matrix Types: A - Air; P - Product; S - Soil; T - Tissue; W - Water		Relinquished by (Signature):		SwRI Project No.	
Sample Types: DM - Dissolved Metals; ER - Equipment Rinsate; FB - Field Blank; MSD - Matrix Spike Duplicate; MS - Matrix Spike; TB - Trip Blank; TM - Total Metals; ES - Environmental Samples; FD - Field Duplicate		Received by (Signature):		20.R9211.01.001	
Relinquished by Sampler (Signature):		Relinquished by (Signature):		Received by SwRI Lab (Signature):	
Bradley Werling		RADIO ACTIVITY - Each bottle contains a Sr 90 activity of $\leq 0.1 \text{ nCi/g}$ or $3.7 \text{ Bq/g}$		Samples Disposed by:	
Received by (Signature):		Comments:		Date/Time:	
		4/94/97 SrCl <sub>2</sub> -NaCl-KCl - 0.005N		4/22/02 10:35	

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4-22-02  
CONT  
BAW

SAMPLE LIST/CHAIN OF CUSTODY				Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166			
Requested Turnaround:				Analyses Requested			
<input type="checkbox"/> 1 Week <input type="checkbox"/> 2 Weeks (Normal) <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4 wks				SWRI Contact: Mike DeMunnyn			
Client Name/Address				Site/Zone ID			
BRADLEY WERLING CNWRA-DIV20 BLD 57							
Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time (mm/dd/yy)	Matrix Type	Sample Type	# of Containers	REMARKS	
005SNKE22	4/19/02		WDM		1	No preservation - analyze	
005SNKE23						Preservation 15.5	
005SNKE24						a = HCl to pH <2	
005SNKE25						b = HNO <sub>3</sub> to pH <2	
005SNKE26						c = H <sub>2</sub> SO <sub>4</sub> to pH <2	
005SNKE27						d = NaOH to pH >12	
005SNKE28						e = Other (Specify)	
005SNKE29						Nuclear Safety Related	
005SNKE30						use appropriate QA procedures	
005SNKE31						POC - Bradley Werling	
005SNKE32						phone 6565	
005SNKE33						Fax 5784	
005SNKE34							
005SNKE35							
005SNKE36							
005SNKE37							
005SNKE38							
005SNKE39							
005SNKE40							
005SNKE41							
005SNKE42							
005SNKE43							
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005SNKE45							
005SNKE46							
005SNKE47							
005SNKE48							
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005SNKE87							
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005SNKE89							
005SNKE90							
005SNKE91							
005SNKE92							
005SNKE93							
005SNKE94							
005SNKE95							
005SNKE96							
005SNKE97							
005SNKE98							
005SNKE99							
005SNKE00							

DN 01 COC Form 01-01-001, Rev 1/97

4-22-02  
CONT  
BAWSampling of 0.05N and 0.005N Sr-Na-K  
Reference Solutions for LSA AnalysisSource 29 0.05N and 29 0.005N Sr-Na-K  
reference solutions from 494/68-71 - spiked  
on 494/71Ten mL (oxford pipet) aliquots of soln were  
transferred to an appropriately labeled 20mL  
plastic LSA vial

Labeling 0.05N SrNaKRXaI where

0.05N = 0.05N soln

R = reference (not experimental)

X = soln # 1 to 30

a = 1 sample (not a/b duplicates) and  
I = initial sampling.

For 0.005N solns, replace 0.05N with 0.005N

4-30-02  
BAWSampling of 0.05N (Ca-Na-K) Experimental Solns  
for ICP Analysis by Div 0129 experimental solns were 0.05N (Ca-Na-K) from 494/87  
Approximately 20mL (oxford pipet with 10mL tip)aliquots of sample were transferred to an  
approx 8mL 4-30-02 appropriately labeled 30mL pp bottleLabeling - EXCNK05 where E = experimental soln,  
X = soln number, CNK = Ca-Na-K, and  
05 = 0.05N soln.Sampling of 0.05N (Ca-Na-K) Reference Soln  
for ICP Analysis by Div 01One reference soln was used as a "known spiked"  
sample to be included in the Div 01 analysis of  
the experimental solns

4-30-02  
CONT  
BW

REF 3  
Ref soln =  $\text{CaCl}_2$ -NaCl-KCl  $\times 0.05\text{N}$  ~~EXP REF 4~~ BW 4/3/02  
from 494/80  
approximately 20 mL (oxford pipet with 10 mL tip)  
aliquot of soln was transferred to an approximately  
appropriately labeled 30 mL pp bottle. BW 4/30/02  
R3CNK05 where R = reference soln, 3 = ref.  
soln # 3, CNK = Ca-Na-K, and 05 = 0.05N soln.

Sampling of 0.005N Ca-Na-K Experimental Solns  
for MCP Analysis by DVOI

29 experimental solns were 0.005N  $\text{Ca-Na-K}$  from 4/9/88  
Approximately 20 mL (Oxford pipet with 10 mL tip)  
aliquots of sample were transferred to an appropriately  
labeled 30 mL pp bottle.  
Labeling - 005CNKEX where 005 = 0.005N Soln,  
CNK =  $\text{Ca-Na-K}$ , E = experimental soln, and  
X = exp soln # 1 to 30.

Sampling of 0.005N Ca-Ng-K Reference Soln  
for ICP Analysis by Div 01

One reference soln was used as a "Known spiked" sample to be included in the DVOI analysis of the experimental solns.

Ref soln =  $\text{CaCl}_2 - \text{NaCl} - \text{KCl} \times 0.005 \text{N} \times \text{REF 3}$   
from 494/81

Approximately 20mL (oxford pipet with 10mL tip) aliquot of soln was transferred to an appropriately labeled 30mL pp bottle

RZ BW 4/30/02 0.05 CNKR3 where  
0.05 = 0.005 N soln, CNKR = Ca-Na-K, RZ =  
reference soln } (1/10 dilution of 0.05 N soln)

5/1/2002  
BAW

Transfer of Custody Paperwork for D101 ICP Analysis of 0.05N Ca-Na-K Ion Exchange Experimental solns

Client Name/Address	SAMPLE LIST/CHAIN OF CUSTODY				Requested Turnaround:	
BRADLEY WERLING CNWRA - DIV 20 BLD 57	Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166				<input type="checkbox"/> 1 Week <input type="checkbox"/> 2 Weeks (Normal) <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4 weeks	
Client Purchase Order/Other ID	Site/Zone ID	Analyses Requested				SWRI Contact:
Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time (mm/dd/yy)	Matrix Type	Sample Type	# of Containers	REMARKS
E1CNK05	4-30-02		W	DN1	1	No Presumptive Analysis 8/5/15 Preservation
E2CNK05						a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Other (Specify)
E3CNK05						Nuclear Safety Related - Use appropriate QA procedures
E4CNK05						
E5CNK05						PAC - Bradley Werling
E6CNK05						Phone - 6565
E7CNK05						Fax - 5184
E8CNK05						
E9CNK05						Ambient Temp. #026
E11CNK05						
Matrix Types: A - Air; P - Product; S - Soil; T - Tissue; W - Water						SWRI Project No.
Sample Types: DM - Dissolved Metals; ER - Equipment Rinseate; FB - Field Blank; MSD - Matrix Spike Duplicate; MS - Matrix Spike; TB - Trip Blank; TM - Total Metals; ES - Environmental Samples; FD - Field Duplicate						R207211, 01.001
Relinquished by Sampler (Signature): Bradley Werling						Received by SWRI Lab (Signature): K. Lee
Relinquished by (Signature):						Samples Disposed by:
Received by (Signature):						Date/Time: 5/1/02 0909



1 May 02  
CONT  
BWL

Client Name/Address BRADLEY WERLING CNWRA-DIV 20 BLD-57		<b>SAMPLE LIST/CHAIN OF CUSTODY</b>  Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166				Requested Turnaround: <input type="checkbox"/> 1 Week <input type="checkbox"/> 2 Weeks (Normal) <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4 wks		
Client Purchase Order/Other ID		Site/Zone ID		Analyses Requested				SwRI Contact: Mike Damman
Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time (mm/dd/yy)	Matrix Type	Sample Type	# of Containers	C, Na, K by ICP	REMARKS No Preservation analyze Preservation 4515 a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Other (Specify)	
E12CNK05	4.30.02		W	DM	1	✓	Nuclear Safety Related	
E13CNK05						✓	Use appropriate QA	
E14CNK05						✓	procedures	
E15CNK05						✓		
E16CNK05						✓	POC - Bradley Werling	
E17CNK05						✓	phone 6565	
E18CNK05						✓	Fax 5184	
E19CNK05						✓		
E20CNK05						✓	Ambient Temp #026	
E21CNK05						✓		
Matrix Types: A - Air; P - Product; S - Soil; T - Tissue; W - Water						Relinquished by (Signature):		SwRI Project No. 20.R9211.01.001
Sample Types: DM - Dissolved Metals; ER - Equipment Rinsate; FB - Field Blank; MSD - Matrix Spike Duplicate; MS - Matrix Spike; TB - Trip Blank; TM - Total Metals; ES - Environmental Samples; FD - Field Duplicate						Received by (Signature)		Received by SwRI Lab (Signature): Khalid
Relinquished by Sampler (Signature): Bradley Werling						Relinquished by (Signature)		Samples Disposed by:
Received by (Signature):						Comments: 494/101		Date/Time: 0909 5/1/02

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1 May 02  
CONT  
BWL

Client Name/Address BRADLEY WERLING CNWRA-DIV 20 BLD 57		<b>SAMPLE LIST/CHAIN OF CUSTODY</b>  Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166				Requested Turnaround: <input type="checkbox"/> 1 Week <input type="checkbox"/> 2 Weeks (Normal) <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4 wks		
Client Purchase Order/Other ID		Site/Zone ID		Analyses Requested				SwRI Contact: Mike Damman
Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time (mm/dd/yy)	Matrix Type	Sample Type	# of Containers	C, Na, K by ICP	REMARKS No preservation - analyze 4515 Preservation a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Other (Specify)	
E22CNK05	4.30.02		W	DM	1	✓	Nuclear Safety Related	
E23CNK05						✓	Use appropriate QA	
E24CNK05						✓	procedures	
E25CNK05						✓		
E26CNK05						✓	POC - Bradley Werling	
E27CNK05						✓	phone 6565	
E28CNK05						✓	Fax 5184	
E29CNK05						✓		
E30CNK05						✓	Ambient Temp #026	
R3CNK05						✓		
Matrix Types: A - Air; P - Product; S - Soil; T - Tissue; W - Water						Relinquished by (Signature):		SwRI Project No. 20.R9211.01.001
Sample Types: DM - Dissolved Metals; ER - Equipment Rinsate; FB - Field Blank; MSD - Matrix Spike Duplicate; MS - Matrix Spike; TB - Trip Blank; TM - Total Metals; ES - Environmental Samples; FD - Field Duplicate						Received by (Signature)		Received by SwRI Lab (Signature): Khalid
Relinquished by Sampler (Signature): Bradley Werling						Relinquished by (Signature)		Samples Disposed by:
Received by (Signature):						Comments: 494/87-101 C, Na, K by ICP 0.05N		Date/Time: 0909 5/1/02

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1 MAY 02  
CONT  
BRW  
Transfer of Custody Paperwork for DIV 01 ICP Analysis  
of 0.005N Ca-Ng-K Ion Exchange Experimental Solns

Client Name/Address BRADLEY WERLING CNWRA DIV 20 BLD 57		SAMPLE LIST/CHAIN OF CUSTODY  Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166				Requested Turnaround: <input type="checkbox"/> 1 Week <input type="checkbox"/> 2 Weeks (Normal) <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4 wks			
Client Purchase Order/Other ID		Site/Zone ID		Analyses Requested				SwRI Contact: Mike Dammann	
Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time (mm/dd/yy)	Matrix Type	Sample Type	# of Containers	Ca, Na, K by ICP			REMARKS No Preservation analyze Preservation 95 IS a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Other (Specify)
005CNKE1	4-30-02		W	DM	1	✓			Nuclear Safety Related
005CNKE2						✓			Use appropriate QA
005CNKE3						✓			procedures
005CNKE4						✓			
005CNKE5						✓			POC - Bradley Werling
005CNKE6						✓			phone 6585
005CNKE7						✓			Fax 5184
005CNKE8						✓			
005CNKE9						✓			Ambient Temp #026
005CNKE11						✓			
Matrix Types: A - Air; P - Product; S - Soil; T - Tissue; W - Water						Relinquished by (Signature):		SwRI Project No. 20R9211.01.001	
Sample Types: DM - Dissolved Metals; ER - Equipment Rinse; FB - Field Blank; MSD - Matrix Spike Duplicate; MS - Matrix Spike; TB - Trip Blank; TM - Total Metals; ES - Environmental Samples; FD - Field Duplicate						Received by (Signature):		Received by SwRI Lab (Signature): Kane	
Relinquished by Sampler (Signature): Bradley Werling						Relinquished by (Signature):		Samples Disposed by:	
Received by (Signature):						Comments: 494/102 Ca-Ng-K 0.005N		Date/Time: 5/1/02 0909	

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1 MAY 02  
CONT  
BRW

Client Name/Address BRADLEY WERLING CNWRA DIV 20 BLD 57		SAMPLE LIST/CHAIN OF CUSTODY  Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166				Requested Turnaround: <input type="checkbox"/> 1 Week <input type="checkbox"/> 2 Weeks (Normal) <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 1 wks			
Client Purchase Order/Other ID		Site/Zone ID		Analyses Requested				SwRI Contact: Mike Dammann	
Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time (mm/dd/yy)	Matrix Type	Sample Type	# of Containers	Ca, Na, K by ICP			REMARKS No Preservation analyze Preservation 95 IS a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Other (Specify)
005CNKE12	4-30-02		W	DM	1	✓			Nuclear Safety Related
005CNKE13						✓			Use appropriate QA
005CNKE14						✓			procedures
005CNKE15						✓			
005CNKE16						✓			POC - Bradley Werling
005CNKE17						✓			phone 6585
005CNKE18						✓			Fax 5184
005CNKE19						✓			
005CNKE20						✓			Ambient Temp. #026
005CNKE21						✓			
Matrix Types: A - Air; P - Product; S - Soil; T - Tissue; W - Water						Relinquished by (Signature):		SwRI Project No. 20R9211.01.001	
Sample Types: DM - Dissolved Metals; ER - Equipment Rinse; FB - Field Blank; MSD - Matrix Spike Duplicate; MS - Matrix Spike; TB - Trip Blank; TM - Total Metals; ES - Environmental Samples; FD - Field Duplicate						Received by (Signature):		Received by SwRI Lab (Signature): Kane	
Relinquished by Sampler (Signature): Bradley Werling						Relinquished by (Signature):		Samples Disposed by:	
Received by (Signature):						Comments: 494/102		Date/Time: 5/1/02 0909	

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1 MAY 02  
CONT  
BAW

Client Name/Address		Client Purchase Order/Other ID		Site/Zone ID		SAMPLE LIST/CHAIN OF CUSTODY										Requested Turnaround:
BRADLEY WERLING CNWRA-DIVZO BLD 57						Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166										<input type="checkbox"/> 1 Week <input type="checkbox"/> 2 Weeks (Normal) <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4 weeks
Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time (mm/dd/yy)	Matrix Type	Sample Type	# of Containers	Analyses Requested										SWRI Contact: Mike Dammann
005CNKE22	11/30/02		W DM		1											<b>REMARKS</b> No preservation analyze Preservation as follows: a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Other (Specify)
005CNKE23															Nuclear Safety Related	
005CNKE24															Use appropriate QA procedures	
005CNKE25																
005CNKE26															POC - Bradley Werling	
005CNKE27															phone 6585	
005CNKE28															fax 5184	
005CNKE29															Khald E29	
005CNKE30															Ambient Temp. #026	
005CNKE31															SWRI Project No.	
						Relinquished by (Signature):										20R9211.01.001
						Received by (Signature)										Received by SWRI Lab (Signature): K.A. E28
						Relinquished by (Signature)										Samples Disposed by:
						Comments: 11/21/02										Date/Time: 5/1/02

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BAW

### CaCl<sub>2</sub>-SrCl<sub>2</sub>-NaCl-KCl Quaternary Ion Exchange Experiments (0.05N)

Forty 500mL reference solutions with a total normality of 0.05N will be prepared. Forty 0.05N experimental solutions will be prepared from these reference solutions. All experimental solutions will have a fixed solution volume (50mL) and a fixed amount of zeolite (0.1g). The composition of the 40 reference solutions will vary (see table). The quaternary ion exchange solutions will be prepared in the following manner.

### Preparation of the 0.05N reference solutions

For convenience, the 0.05N reference solutions can be prepared in groups of 10. Label ten 600mL beakers with a sharpie. Tare an appropriately sized weighing boat on the AE240 balance. Add the appropriate amount of NaCl (see table) and record the mass. Transfer the compound to a 600mL beaker. Carefully rinse the weighing boat with nanopure water from a squirt bottle and transfer the washings into the beaker. Repeat this rinsing step several times. Throw away the used weighing boat. After the NaCl additions to the ten solutions has been completed, then the KCl additions can begin. Tare an appropriately sized weighing boat on the AE240 balance. Add the appropriate amount of KCl (see table) and record the mass. Transfer the compound to the appropriate 600mL beaker (beaker already contain a NaCl solution). Carefully rinse the weighing boat with nanopure water from a squirt bottle and transfer the washing into the beaker. Repeat this rinsing step several times. Throw away the used weighing boat. After all ten KCl additions have been completed, then begin with the  $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$  additions. Tare an appropriately sized weighing boat on the AE240 balance. Add the appropriate amount of  $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$  (see table) and record the mass. Transfer the compound to the appropriate 600mL beaker (beaker already contains NaCl/KCl solution). Carefully rinse the weighing boat with nanopure water from a squirt bottle several times and transfer the washings into the beaker. Throw away the used weighing boat. After all ten  $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$  additions have been completed, then begin with the  $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$  additions. Tare an appropriately sized weighing boat on the AE240 balance. Add the appropriate amount of  $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$  (see table) and record the mass. Transfer the compound

7 MAY 02  
CONT  
BAW

to the appropriate 600mL beaker (beaker already contains NaCl/KCl/ SrCl<sub>2</sub>\*6H<sub>2</sub>O solution).  
Carefully rinse the weighing boat with nanopure water from a squirt bottle several times and transfer the washings into the beaker. Throw away the used weighing boat. Ensure that all solids are dissolved in the 600mL beaker. Swirl and/or add water if necessary. Ensure that total solution volume in beaker does not exceed much beyond 300mL. Let the solution stand for at least one minute before transferring into the volumetric flask. Label ten 500mL volumetric flasks with a sharpie. Decant the contents of the 600mL beaker into the appropriate 500mL volumetric flask. Carefully rinse the beaker with nanopure water from a squirt bottle and transfer the washing into the beaker. Repeat this rinsing step several times. Fill the volumetric flask to about 2-3 inches below the mark with nanopure water and swirl for mixing. Then add nanopure water dropwise up to the mark and remix. Transfer each solution to an appropriately labeled polypropylene bottle. Label the bottles QRef1 to 40 (Q for quaternary and Ref for reference solution). Clean the ten beakers and ten volumetric flasks by rinsing three times with DI water and then three times with nanopure water (no acid wash). Reuse this glassware and repeat this procedure for the next ten reference solutions.

Preparation of Experimental Solution

All experimental sets will have a fixed solution volume (50mL) and a fixed amount of zeolite (0.1g). The sodium form of the zeolite (Na-zeo) will be used. Record the zeolite label information in the notebook. Transfer and record the mass (target = 0.1g) of Na-zeo into a 60mL polypropylene bottle. The bottles should be labeled QExp1 to 40. Add 50.00g (Metler PM4600 balance) of the appropriate reference solution to the bottle containing the zeolite. (It is suggested that an oxford pipet with a 10mL disposal tip be used to transfer the bulk of the solution. Then a disposable 5mL pipet can be used to add the final amount of reference solution dropwise to obtain the 50.00g mark.) Record the mass of solution. Repeat this procedure for making each experimental solution.

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CONT  
BAW

Experiment Na-K-Ca-SR @ 0.05 N

Solution ID	ENa	EK	ECa	ESr	For 500mL solutions			
					NaCL mass (g)	KCL mass (g)	CaCl2*2H2O mass (g)	SrCl2*6H2O mass (g)
QREF1	0.1000	0.3000	0.3000	0.3000	0.1461	0.5591	0.5513	0.9998
QREF2	0.2000	0.2667	0.2667	0.2667	0.2922	0.4970	0.4901	0.8887
QREF3	0.3000	0.2333	0.2333	0.2333	0.4383	0.4349	0.4288	0.7776
QREF4	0.4000	0.2000	0.2000	0.2000	0.5844	0.3728	0.3675	0.6665
QREF5	0.5000	0.1667	0.1667	0.1667	0.7305	0.3106	0.3063	0.5555
QREF6	0.6000	0.1333	0.1333	0.1333	0.8766	0.2485	0.2450	0.4444
QREF7	0.7000	0.1000	0.1000	0.1000	1.0228	0.1864	0.1838	0.3333
QREF8	0.8000	0.0667	0.0667	0.0667	1.1689	0.1243	0.1225	0.2222
QREF9	0.9000	0.0333	0.0333	0.0333	1.3150	0.0621	0.0613	0.1111
QREF10	1.0000	0.0000	0.0000	0.0000	1.4611	0.0000	0.0000	0.0000
QREF11	0.3000	0.1000	0.3000	0.3000	0.4383	0.1864	0.5513	0.9998
QREF12	0.2667	0.2000	0.2667	0.2667	0.3896	0.3728	0.4901	0.8887
QREF13	0.2333	0.3000	0.2333	0.2333	0.3409	0.5591	0.4288	0.7776
QREF14	0.2000	0.4000	0.2000	0.2000	0.2922	0.7455	0.3675	0.6665
QREF15	0.1667	0.5000	0.1667	0.1667	0.2435	0.9319	0.3063	0.5555
QREF16	0.1333	0.6000	0.1333	0.1333	0.1948	1.1183	0.2450	0.4444
QREF17	0.1000	0.7000	0.1000	0.1000	0.1461	1.3046	0.1838	0.3333
QREF18	0.0667	0.8000	0.0667	0.0667	0.0974	1.4910	0.1225	0.2222
QREF19	0.0333	0.9000	0.0333	0.0333	0.0487	1.6774	0.0613	0.1111
QREF20	0.0000	1.0000	0.0000	0.0000	0.0000	1.8638	0.0000	0.0000
QREF21	0.3000	0.3000	0.1000	0.3000	0.4383	0.5591	0.1838	0.3333
QREF22	0.2667	0.2667	0.2000	0.2667	0.3896	0.4970	0.3675	0.6665
QREF23	0.2333	0.2333	0.3000	0.2333	0.3409	0.4349	0.5513	0.9998
QREF24	0.2000	0.2000	0.4000	0.2000	0.2922	0.3728	0.7351	1.3331
QREF25	0.1667	0.1667	0.5000	0.1667	0.2435	0.3106	0.9189	1.6664
QREF26	0.1333	0.1333	0.6000	0.1333	0.1948	0.2485	1.1026	1.9996
QREF27	0.1000	0.1000	0.7000	0.1000	0.1461	0.1864	1.2864	2.3329
QREF28	0.0667	0.0667	0.8000	0.0667	0.0974	0.1243	1.4702	2.6662
QREF29	0.0333	0.0333	0.9000	0.0333	0.0487	0.0621	1.6539	2.9994
QREF30	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	1.8377	3.3327
QREF31	0.3000	0.3000	0.3000	0.1000	0.4383	0.5591	0.5513	0.0000
QREF32	0.2667	0.2667	0.2667	0.2000	0.3896	0.4970	0.4901	0.0000
QREF33	0.2333	0.2333	0.2333	0.3000	0.3409	0.4349	0.4288	0.0000
QREF34	0.2000	0.2000	0.2000	0.4000	0.2922	0.3728	0.3675	0.0000
QREF35	0.1667	0.1667	0.1667	0.5000	0.2435	0.3106	0.3063	0.0000
QREF36	0.1333	0.1333	0.1333	0.6000	0.1948	0.2485	0.2450	0.0000
QREF37	0.1000	0.1000	0.1000	0.7000	0.1461	0.1864	0.1838	0.0000
QREF38	0.0667	0.0667	0.0667	0.8000	0.0974	0.1243	0.1225	0.0000
QREF39	0.0333	0.0333	0.0333	0.9000	0.0487	0.0621	0.0613	0.0000
QREF40	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000

Reference solns were 500mL  
Experimental solns were 0.1g zeolite in 50mL  
Legend for Solution ID: Q = quaternary experiment, Ref = reference solution

Preparation of Quaternary Reference Solns

Followed procedure listed in 494/109-111

Sodium form of zeolite used, so sodium only reference soln (QREF10) was skipped

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CONT  
BAW

Reagents

super Q water

NaCl = Fisher S271-3, lot # 984321

KCl = Fisher P217-500, lot # 006242

$\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$  = Fisher S541-500, lot # 000052

rec 2/9/2001, opened 2/21/2001

$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$  = Fisher C79-3, lot # 015282 rec 3-21-02

Reference Solns 1 to 10 (10 skipped, so 1 to 9)

SOLN ID	NaCl mass(g)	KCl mass(g)	$\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ mass(g)	$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ mass(g)
QREF1	0.1458	0.5589	1.0002	0.5518
QREF2	0.2922	0.4972	0.8885	0.4902
QREF3	0.4389 <sup>5-7-02</sup> BUS	0.4352	0.7773	0.4288
QREF4	0.5843	0.3727	0.6665	0.3674
QREF5	0.7308	0.3105	0.5559	0.3066
QREF6	0.8770	0.2488	0.4443	0.2452
QREF7	1.0232	0.1865	0.3332	0.1840
QREF8	1.1693	0.1243	0.2219	0.1227
QREF9	1.3153	0.0622	0.1111	0.0618

5-8-02  
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BAW

Preparation of Quaternary Ref Solns 11 to 20

Followed procedure from 494/109-111

Reagents: see 494/112

SOLN ID	NaCl mass(g)	KCl mass(g)	$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ mass(g)	$\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ mass(g)
QREF11	0.4383	0.1862	0.5518	0.9990
QREF12	0.3894	0.3727	0.4901	0.8890
QREF13	0.3411	0.5591	0.4286	0.7770
QREF14	0.2924	0.7454	0.3676	0.6663
QREF15	0.2434	0.9317	0.3061	0.5558
QREF16	0.1953	1.1181	0.2452	0.4441
QREF17	0.1457	1.3046	0.1843	0.3335
QREF18	0.0977	1.4915	0.1227	0.2225
QREF19	0.0487	1.6775	0.0613	0.1112
QREF20	0	1.8637	0	0

09 May 02  
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Preparation of Quaternary Ref Solns 21 to 30

Followed procedure from 494/109-111. Reagents: see 494/112

SOLN ID	NaCl mass(g)	KCl mass(g)	$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ mass(g)	$\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ mass(g)
QREF21	0.4382	0.5590	0.1839	0.3339
QREF22	0.3892	0.4968	0.3672	0.6666
QREF23	0.3409	0.4350	0.5512	0.9994
QREF24	0.2923	0.3730	0.7352	1.3336
QREF25	0.2436	0.3105	0.9192	1.6660
QREF26	0.1945	0.2483	1.1026	1.9991
QREF27	0.1457	0.1865	1.2865	2.3331
QREF28	0.0973	0.1246	1.4707	2.6662
QREF29	0.0490	0.0622	1.6542	2.9998
QREF30	0	0	1.8378	3.3324

DO NOT  
USE DATA

SEE  
494/114 to  
116

BAW  
5-21-02

10 MAY 02  
BAWPreparation of Quaternary Ref Solns 31 to 40Followed procedure from 494/109-111 + 115  
Reagents: see 494/112

SOLN ID	NaCl mass (g)	KCl mass (g)	$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ mass (g)	$\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ mass (g)
QREF31	0.4384	0.5592	0.5516	0.3336
QREF32	0.3897	0.4973	0.4900	0.6668
QREF33	0.3408	0.4350	0.4290	0.9994
QREF34	0.2920	0.3725	0.3675	1.3333
QREF35	0.2435	0.3003	0.3064	1.6660
QREF36	0.1947	0.2485	0.2453	2.0000
QREF37	0.1458	0.1868	0.1840	2.3332
QREF38	0.0979	0.1241	0.1224	2.6664
QREF39	0.0492	0.0622	0.0613	2.9989
QREF40	0	0	0	3.3331

Notes: An error was found in the table (494/111) concerning the  $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$  mass for QREF21 to QREF40. A new, corrected table was generated (494/115). These numbers were used for Ref Solns 31 to 40 above. QREF21 to 30 will need to be remade.

5-13-02  
BAW18 MAY 02  
CMT  
BAW

Experiment Na-K-Ca-SR @ 0.05 N

Solution ID	ENa	EK	ECa	ESr	For 500mL solutions			
					NaCl mass (g)	KCL mass (g)	$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ mass (g)	$\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ mass (g)
QREF1	0.1000	0.3000	0.3000	0.3000	0.1461	0.5591	0.5513	0.9998
QREF2	0.2000	0.2667	0.2667	0.2667	0.2922	0.4970	0.4901	0.8887
QREF3	0.3000	0.2333	0.2333	0.2333	0.4383	0.4349	0.4288	0.7776
QREF4	0.4000	0.2000	0.2000	0.2000	0.5844	0.3728	0.3675	0.6665
QREF5	0.5000	0.1667	0.1667	0.1667	0.7305	0.3106	0.3063	0.5555
QREF6	0.6000	0.1333	0.1333	0.1333	0.8766	0.2485	0.2450	0.4444
QREF7	0.7000	0.1000	0.1000	0.1000	1.0228	0.1864	0.1838	0.3333
QREF8	0.8000	0.0667	0.0667	0.0667	1.1689	0.1243	0.1225	0.2222
QREF9	0.9000	0.0333	0.0333	0.0333	1.3150	0.0621	0.0613	0.1111
QREF10	1.0000	0.0000	0.0000	0.0000	1.4611	0.0000	0.0000	0.0000
QREF11	0.3000	0.1000	0.3000	0.3000	0.4383	0.1864	0.5513	0.9998
QREF12	0.2667	0.2000	0.2667	0.2667	0.3896	0.3728	0.4901	0.8887
QREF13	0.2333	0.3000	0.2333	0.2333	0.3409	0.5591	0.4288	0.7776
QREF14	0.2000	0.4000	0.2000	0.2000	0.2922	0.7455	0.3675	0.6665
QREF15	0.1667	0.5000	0.1667	0.1667	0.2435	0.9319	0.3063	0.5555
QREF16	0.1333	0.6000	0.1333	0.1333	0.1948	1.1183	0.2450	0.4444
QREF17	0.1000	0.7000	0.1000	0.1000	0.1461	1.3046	0.1838	0.3333
QREF18	0.0667	0.8000	0.0667	0.0667	0.0974	1.4910	0.1225	0.2222
QREF19	0.0333	0.9000	0.0333	0.0333	0.0487	1.6774	0.0613	0.1111
QREF20	0.0000	1.0000	0.0000	0.0000	0.0000	1.8638	0.0000	0.0000
QREF21	0.3000	0.3000	0.1000	0.3000	0.4383	0.5591	0.1838	0.9998
QREF22	0.2667	0.2667	0.2000	0.2667	0.3896	0.4970	0.3675	0.8887
QREF23	0.2333	0.2333	0.3000	0.2333	0.3409	0.4349	0.5513	0.7776
QREF24	0.2000	0.2000	0.4000	0.2000	0.2922	0.3728	0.7351	0.6665
QREF25	0.1667	0.1667	0.5000	0.1667	0.2435	0.3106	0.9189	0.5555
QREF26	0.1333	0.1333	0.6000	0.1333	0.1948	0.2485	1.1026	0.4444
QREF27	0.1000	0.1000	0.7000	0.1000	0.1461	0.1864	1.2864	0.3333
QREF28	0.0667	0.0667	0.8000	0.0667	0.0974	0.1243	1.4702	0.2222
QREF29	0.0333	0.0333	0.9000	0.0333	0.0487	0.0621	1.6539	0.1111
QREF30	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	1.8377	0.0000
QREF31	0.3000	0.3000	0.3000	0.1000	0.4383	0.5591	0.5513	0.3333
QREF32	0.2667	0.2667	0.2667	0.2000	0.3896	0.4970	0.4901	0.6665
QREF33	0.2333	0.2333	0.2333	0.3000	0.3409	0.4349	0.4288	0.9998
QREF34	0.2000	0.2000	0.2000	0.4000	0.2922	0.3728	0.3675	1.3331
QREF35	0.1667	0.1667	0.1667	0.5000	0.2435	0.3106	0.3063	1.6664
QREF36	0.1333	0.1333	0.1333	0.6000	0.1948	0.2485	0.2450	1.9996
QREF37	0.1000	0.1000	0.1000	0.7000	0.1461	0.1864	0.1838	2.3329
QREF38	0.0667	0.0667	0.0667	0.8000	0.0974	0.1243	0.1225	2.6662
QREF39	0.0333	0.0333	0.0333	0.9000	0.0487	0.0621	0.0613	2.9994
QREF40	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	3.3327

Reference solns were 500mL

Experimental solns were 0.1g zeolite in 50mL

Legend for Solution ID: Q = quaternary experiment, Ref = reference solution

5-13-02  
BAW



13 May 02  
BLWRemake of Quaternary Ref Solns 21-30

Followed procedure from 494/109-111 + 115  
Reagents: see 494/112

SOLN ID	NaCl mass(g)	KCl mass(g)	$\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ mass(g)	$\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ mass(g)
QREF21	0.4385	0.5591	0.1840	1.0001
QREF22	0.3896	0.4971	0.3675	0.8887
QREF23	0.3406	0.4351	0.5518	0.7772
QREF24	0.2924	0.3730	0.7354	0.6667
QREF25	0.2438	0.3105	0.9189	0.5555
QREF26	0.1946	0.2487	1.1029	0.4442
QREF27	0.1465	0.1864	1.2862	0.3331
QREF28	0.0977	0.1243	1.4707	0.2223
QREF29	0.0487	0.0625	1.6546	0.1113
QREF30	0	0	1.8382	0

Preparation of Quaternary Experimental Solutions - Zeolite Addition

Sodium form of zeolite used:

CDV\*200/325\*UC\*WAX\*RC\*HL\*RF<sub>2</sub>\*NaF  
420/54-67 AJ 5/2/01

Followed procedure from 494/109-111, Zeolite weighed on tared wt paper, then transferred to 60 mL pp bottle with a weighing paper funnel inserted in bottle

Labeled QEXPX where Q = quaternary,  
EXP = experimental soln  
X = soln # 1 to 40

13 May 02  
CONT  
BLW

ID	Zeolite Mass(g)	ID	Zeolite Mass(g)	ID	Zeolite mass(g)
QEXP1	0.0997	QEXP16	0.1001	QEXP31	0.1003
QEXP2	0.1002	QEXP17	0.1001	QEXP32	0.1002
QEXP3	0.1001	QEXP18	0.1002	QEXP33	0.1007
QEXP4	0.1008	<del>QEXP19</del> <sup>QEXP19</sup> 0.1004		QEXP34	0.1006
QEXP5	0.1006	QEXP20	0.1004	QEXP35	0.1000
QEXP6	0.1000	QEXP21	0.1004	QEXP36	0.1005
QEXP7	0.1004	QEXP22	0.1007	QEXP37	0.1009
QEXP8	0.1006	QEXP23	0.1007	QEXP38	0.1007
QEXP9	0.1004	QEXP24	0.1000	QEXP39	0.1007
QEXP10	na	QEXP25	0.1006	QEXP40	0.1003
QEXP11	0.1006	QEXP26	0.1007		
QEXP12	0.1002	QEXP27	0.1003		
QEXP13	0.1001	QEXP28	0.1000		
QEXP14	0.1003	QEXP29	0.1006		
QEXP15	0.1002	QEXP30	0.1005		

Exp solns will have reference soln added after this zeolite step.

14 May 02  
BAWPreparation of Ferr BW 5/14/02 Quaternary Exp  
Solutions - Solution AdditionAdded 50.00g of appropriate reference soln  
by procedure in 494/109-111 + 115

Bottles with zeolite from 494/117

SOLN ID	Soln Mass(g)	SOLN ID	Soln Mass(g)
QEXP 1	50.00	QEXP 21	49.99
QEXP 2	50.00	QEXP 22	50.01
QEXP 3	50.10	QEXP 23	50.00
QEXP 4	50.01	QEXP 24	50.00
QEXP 5	50.01	QEXP 25	50.01
QEXP 6	50.01	QEXP 26	50.00
QEXP 7	50.00	QEXP 27	50.01
QEXP 8	50.01	QEXP 28	50.01
QEXP 9	50.00	QEXP 29	50.01
QEXP 10	19	QEXP 30	50.02
QEXP 11	50.00	QEXP 31	50.00
QEXP 12	50.02	QEXP 32	50.02
QEXP 13	50.01	QEXP 33	50.00
QEXP 14	50.01	QEXP 34	50.01
QEXP 15	50.01	QEXP 35	50.02
QEXP 16	50.02	QEXP 36	50.00
QEXP 17	50.02	QEXP 37	50.01
QEXP 18	50.03	QEXP 38	50.01
QEXP 19	50.00	QEXP 39	50.00
QEXP 20	50.00	QEXP 40	50.00

29 May 02  
BAWSampling of 0.05N Quaternary Experimental  
Solutions for ICP Analysis by Div 0139 experimental solutions from 494/118  
Approximately 20 mL (oxford pipet with 10 mL tip)  
aliquots of sample were transferred to an  
appropriately labelled 30 mL pp bottle.Labeling - 05QEX where  
05 = 0.05 N solution

Q = Quaternary (Sr, Na, K, Ca)

E = Experimental soln

X = exp soln # 1 to 40

Sampling of 0.05N Quaternary Reference  
Solution for ICP Analysis by Div 01One reference soln was used as a "known spiked"  
sample to be included in the Div 01 analysis of the experimental solns.  
analysis of the experimental solns.

Ref soln = QREF13 from 494/113

Approximately 20 mL (oxford pipet with 10 mL tip)  
aliquot of soln was transferred to an  
appropriately labeled 30 mL pp bottle.  
Labeled 05QRI3Transfer of Custody Paperwork for Div 01  
ICP Analysis of 0.05N Quaternary  
Ion Exchange solns

5-29-02 BAW



29 May 02  
CONF  
BAW

Shipper Name/Address		SAMPLE LIST/CHAIN OF CUSTODY				Requested Turnaround:	
BRADLEY WERLING CNWRA - DIV 20 BLD 57		Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166				<input type="checkbox"/> 2 Weeks <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4wk	
Client		Client Purchase Order/Other ID		Site/Zone ID		SwRI Contact	
						Mike Dammann	
		Analyses Requested				REMARKS	
Sample ID	Sample Collection Date (mm/dd/yyyy)	Sample Collection Time	Matrix Type	Sample Type	# of Containers		
05QE22	5/29/02		W		1	X	
05QE23						X	
05QE24						X	
05QE25						X	
05QE26						X	
05QE27						X	
05QE28						X	
05QE29						X	
05QE30						X	
05QE31						X	
Matrix Types: A - Air B - Biota D - Dust E - Emission/Stack P - Product S - Soil SED - Sediment T - Tissue W - Water WP - Wipe		Sample Types: D - Duplicate ER - Equipment Rinsate FB - Field Blank FD - Field Duplicate MS - Matrix Spike MSD - Matrix Spike Dup TB - Trip Blank		Relinquished by (Print/Signature) Brad Werling / Brad Werling Received by (Print/Signature) Brad Werling / PB Relinquished by (Print/Signature) Received by (Print/Signature) Relinquished by (Print/Signature)		Date Time Date Time Date Time Date Time Date Time	
Temp: 22°C		Therm #: 026				SwRI Project: Received by SwRI Lab: (Signature) Date Time Date Time Date Time Date Time	
Comments: INTACT						Nuclear Safety Related-use appropriate QA procedures POC - Brad Werling PHONE 6565 FAX 5184 20.R9211.01.001 5/29/02 1408 Samples Disposed: Date Time Samples Disposed by: Date Time	

Div 01 COC Form 01-01-001, Rev 4/02

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29 May 02  
CONF  
BAW

Shipper Name/Address		SAMPLE LIST/CHAIN OF CUSTODY				Requested Turnaround:	
BRADLEY WERLING CNWRA - DIV 20 BLD 57		Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166				<input type="checkbox"/> 2 Weeks <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4wk	
Client		Client Purchase Order/Other ID		Site/Zone ID		SwRI Contact	
						Mike Dammann	
		Analyses Requested				REMARKS	
Sample ID	Sample Collection Date (mm/dd/yyyy)	Sample Collection Time	Matrix Type	Sample Type	# of Containers		
05QE32	5/29/02		W		1	X	
05QE33						X	
05QE34						X	
05QE35						X	
05QE36						X	
05QE37						X	
05QE38						X	
05QE39						X	
05QE40						X	
05QR13						X	
Matrix Types: A - Air B - Biota D - Dust E - Emission/Stack P - Product S - Soil SED - Sediment T - Tissue W - Water WP - Wipe		Sample Types: D - Duplicate ER - Equipment Rinsate FB - Field Blank FD - Field Duplicate MS - Matrix Spike MSD - Matrix Spike Dup TB - Trip Blank		Relinquished by (Print/Signature) Brad Werling / Brad Werling Received by (Print/Signature) Brad Werling / PB Relinquished by (Print/Signature) Received by (Print/Signature) Relinquished by (Print/Signature)		Date Time Date Time Date Time Date Time Date Time	
Temp: 22°C		Therm #: 026				SwRI Project: Received by SwRI Lab: (Signature) Date Time Date Time Date Time Date Time	
Comments:						Nuclear Safety Related-use appropriate QA procedures POC - Brad Werling PHONE 6565 FAX 5184 BAW 5/29/02 20.R9211.01.001 5/29/02 1408 Samples Disposed: Date Time Samples Disposed by: Date Time	

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11 Jan 02  
Monthly notebook review completed

18 JUNE 02  
BAW  
Div 01 Results for ICP Analysis of Various  
ACR Ion Exchange Experiments

Work order 22379 on page 494/125  
CaCl<sub>2</sub>-NaCl-KCl 0.005N experiment  
Samples on page 494/102  
Chain of Custody on page 494/106-108

Work order 22295 on page 494/126  
SrCl<sub>2</sub>-CaCl<sub>2</sub> 0.05N experiment  
Samples on page 494/90 (exp) + 494/61 (ref)  
Chain of Custody on page 494/94-96  
Exp solns diluted, Ref solns not diluted.  
6-19-02

Work order 22380 on page 494/127  
CaCl<sub>2</sub>-NaCl-KCl 0.05N experiment  
Samples on page 494/101+102  
Chain of Custody on page 494/103-105

Work order 22264 on page 494/128  
SrCl<sub>2</sub>-NaCl-KCl 0.05N experiment  
Samples on page 494/89-90  
Chain of Custody on page 494/91-93

Work order 22306 on page 494/129  
SrCl<sub>2</sub>-NaCl-KCl 0.005N experiment  
Samples on page 494/97+98  
Chain of Custody on page 494/98-100

18 JUNE 02  
CONT  
BAW

SOUTHWEST RESEARCH INSTITUTE  
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute  
Lab Code: SwRI  
Matrix: Liquid  
Work Order: 22379  
Client: Division 20  
Date Received: 05/01/02  
Project No.: 20.R9211.01.001

Sample ID	Lab System ID	Calcium Results (mg/L)	Potassium Results (mg/L)	Sodium Results (mg/L)
Prep Blank	----	<0.05	<0.2	<0.2
Lab Control	----	20.2	18.9	19.6
True Value	----	20.0	20.0	20.00
Recovery	----	101%	94.7%	98.2%
005CNKE1	204942	18.7	14.2	80.3
Duplicate result	204942	18.8	14.1	80.7
RPD	204942	0.53%	0.71%	0.50%
005CNKE11	204943	7.51	1.32	99.6
Spike result	204943	27.9	21.7	120
Spike added	204943	20.0	20.0	20.0
Recovery	204943	101.9%	102.1%	103.6%
005CNKE12	204944	7.89	3.09	98.3
005CNKE13	204945	7.94	5.80	96.9
005CNKE14	204946	7.75	9.70	95.2
005CNKE15	204947	6.97	14.9	92.5
005CNKE16	204948	6.16	21.9	89.6
005CNKE17	204949	4.74	30.0	86.2
005CNKE18	204950	3.05	38.6	82.2
005CNKE19	204951	1.34	48.3	78.6
005CNKE2	204952	13.6	10.5	87.2
005CNKE20	204953	0.057	58.9	74.1
005CNKE21	204954	0.822	8.42	102
005CNKE22	204955	3.00	8.18	99.8
005CNKE23	204956	6.36	7.29	96.5
005CNKE24	204957	10.7	6.23	92.2
005CNKE25	204958	15.1	4.85	88.3
005CNKE26	204959	19.8	3.73	83.4
005CNKE27	204960	24.7	2.64	77.7
005CNKE28	204961	30.4	1.78	72.4
005CNKE29	204962	35.1	0.958	67.5
Duplicate result	204962	34.7	1.00	67.1
RPD	204962	1.15%	4.29%	0.59%
005CNKE3	204963	9.17	7.68	92.2
Spike result	204963	28.8	28.0	114
Spike added	204963	20.0	20.0	20.0
Recovery	204963	98.2%	101.6%	109.0%
005CNKE30	204964	40.1	0.470	63.1
005CNKE4	204965	5.41	5.19	99.0
005CNKE5	204966	2.68	3.34	104
005CNKE6	204967	1.06	1.94	106
005CNKE7	204968	0.375	0.984	107
005CNKE8	204969	0.116	0.548	108
005CNKE9	204970	<0.05	0.331	107
005CNR3E	204971	33.3	63.3	32.6

Reporting Limit: 0.05 mg/L 0.2 mg/L 0.2 mg/L  
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18 June 02  
CONT  
BAW

SOUTHWEST RESEARCH INSTITUTE  
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute      Client: Division 20  
Lab Code: SwRI      Date Received: 04/19/02  
Matrix: Liquid      Project No.: 20.R9211.01.001  
Work Order: 22295

Sample ID	Lab System ID	Calcium Results (mg/L)	Strontium Results (mg/L)
Prep Blank - 05/31/02	----	<0.05	<0.03
Lab Control - 05/31/02	----	20.2	2.92
True Value	----	20.0	3.00
Recovery	----	101%	97.3%
Prep Blank - 06/05/02	----	<0.05	<0.03
Lab Control - 06/05/02	----	20.9	9.65
True Value	----	20.0	10.0
Recovery	----	105%	96.5%
E1	204078	38.9	2.21
Duplicate result	204078	38.8	2.17
RPD	204078	0.26%	1.83%
E10	204079	160	522
Spike result	204079	366	991
Spike added	204079	200	500
Recovery	204079	103.0%	93.8%
E11	204080	6.45	75.1
E12	204081	4.74	77.9
E13	204082	5.96	159
E14	204083	4.45	163
E15	204084	7.00	421
E16	204085	6.25	853
E17	204086	2.44	860
E18	204087	0.785	860
E2	204088	37.7	3.52
E3	204089	36.9	5.38
E4	204090	33.8	12.3
E5	204091	32.4	15.6
E6	204092	27.6	27.9
E7	204093	50.6	63.3
E8	204094	20.1	44.4
E9	204095	35.6	95.7
R0.1	204096	178	44.0
R0.2	204097	157	86.3
Duplicate result	204097	157	86.4
RPD	204097	0.00%	0.12%
R0.4	204098	117	172
Spike result	204098	316	199
Spike added	204098	200	30.0
Recovery	204098	99.5%	90.0%
R0.6	204099	78.0	256
R1.0	204100	0.090	208

Reporting Limit:                      0.05 mg/L      0.03 mg/L

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18 June 02  
CONT  
BAW

SOUTHWEST RESEARCH INSTITUTE  
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute      Client: Division 20  
Lab Code: SwRI      Date Received: 05/01/02  
Matrix: Liquid      Project No.: 20.R9211.01.001  
Work Order: 22380

Sample ID	Lab System ID	Calcium Results (mg/L)	Potassium Results (mg/L)	Sodium Results (mg/L)
Prep Blank - 06/11/02	----	<0.1	<0.2	<0.2
Lab Control - 06/11/02	----	20.4	18.6	19.4
True Value	----	20.0	20.0	20.0
Recovery	----	102%	93.0%	97.0%
Prep Blank - 06/12/02	----	<0.1	<0.2	<0.2
Lab Control - 06/12/02	----	20.7	19.4	20.2
True Value	----	20.0	20.0	20.0
Recovery	----	104%	97.0%	101.0%
E11CNK05	204972	411	101	552
Duplicate result	204972	410	102	550
RPD	204972	0.24%	0.99%	0.36%
E12CNK05	204973	372	256	508
Spike result	204973	572	459	715
Spike added	204973	200	200	200
Recovery	204973	100.0%	101.5%	103.5%
E13CNK05	204974	325	421	455
E14CNK05	204975	279	591	403
E15CNK05	204976	232	764	352
E16CNK05	204977	186	946	301
E17CNK05	204978	137	1110	245
E18CNK05	204979	92.2	1300	193
E19CNK05	204980	45.9	1460	138
E1CNK05	204981	418	683	191
E20CNK05	204982	0.418	1650	85.6
E21CNK05	204983	91.5	687	568
E22CNK05	204984	182	595	512
E23CNK05	204985	276	513	462
E24CNK05	204986	365	423	404
E25CNK05	204987	457	341	350
E26CNK05	204988	547	255	297
E27CNK05	204989	635	174	242
E28CNK05	204990	734	101	189
E29CNK05	204991	814	36.4	134
E2CNK05	204992	370	601	305
Duplicate result	204992	367	600	302
RPD	204992	0.81%	0.17%	0.99%
E30CNK05	204993	878	2.15	73.0
Spike result	204993	1070	23.1	283
Spike added	204993	200	20.0	200
Recovery	204993	96.0%	104.8%	105.0%
E3CNK05	204994	319	510	407
E4CNK05	204995	272	426	517
E5CNK05	204996	223	340	619
E6CNK05	204997	177	258	719
E7CNK05	204998	130	176	825
E8CNK05	204999	83.5	101	925
E9CNK05	205000	36.9	36.6	1020
R3CNK05	205001	323	638	334

Reporting Limit:                      0.1 mg/L      0.2 mg/L      0.2 mg/L

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18 JUNE 02  
CONT  
BAW

***SOUTHWEST RESEARCH INSTITUTE***  
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SwRI

Date Received: 04/16/02

Matrix: Liquid

Project No.: 20.R9211.01.001

Work Order: 22264

Sample ID	Lab System ID	Potassium Results (mg/L)	Sodium Results (mg/L)	Strontium Results (mg/L)
Prep Blank - 05/30/02	----	<0.2	<0.2	<0.025
Lab Control - 05/30/02	----	18.8	19.1	2.91
True Value	----	20.0	20.0	3.00
Recovery	----	94.0%	95.5%	97.0%
Prep Blank - 06/05/02	----	<0.05	<0.2	<0.2
Lab Control - 06/05/02	----	19.5	19.9	9.61
True Value	----	20.0	20.0	10.0
Recovery	----	97.5%	99.5%	96.1%
E10SNK05	203829	114	558	919
Duplicate result	203829	114	556	922
RPD	203829	0.00%	0.36%	0.33%
E12SNK05	203830	271	514	832
Spike result	203830	473	716	1778
Spike added	203830	200	200	1000
Recovery	203830	101.0%	101.0%	94.6%
E13SNK05	203831	436	457	738
E14SNK05	203832	599	399	635
E15SNK05	203833	781	353	528
E16SNK05	203834	958	303	421
E17SNK05	203835	1120	243	305
E18SNK05	203836	1270	188	202
E19SNK05	203837	1460	138	104
E1SNK05	203838	687	187	956
E20SNK05	203839	1610	83.9	<0.025
E21SNK05	203840	677	552	201
E22SNK05	203841	595	501	418
E23SNK05	203842	504	440	627
E24SNK05	203843	423	390	839
E25SNK05	203844	340	337	1040
E26SNK05	203845	273	301	1250
E27SNK05	203846	191	244	1450
E28SNK05	203847	115	188	1650
E29SNK05	203848	48.0	133	1850
E2SNK05	203849	612	303	842
Duplicate result	203849	597	296	848
RPD	203849	2.48%	2.34%	0.71%
E30SNK05	203850	1.32	75.7	2060
Spike result	203850	197	277	4312
Spike added	203850	200	200	2000
Recovery	203850	97.8%	100.7%	112.6%
E3SNK05	203851	526	407	737
E4SNK05	203852	443	515	617
E5SNK05	203853	268	710	399
E6SNK05	203854	356	619	503
E7SNK05	203855	190	817	286
E8SNK05	203856	111	920	181
E9SNK05	203857	39.5	1020	74.4
R4SNK05	203858	532	425	636

Reporting Limit:	0.2 mg/L	0.2 mg/L	0.025 mg/L
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18 JUN 02  
CONT  
BAW

***SOUTHWEST RESEARCH INSTITUTE***  
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SwRI

Date Received: 04/22/02

Matrix: Liquid

Project No.: 20.R9211.01.001

Work Order: 22306

Sample ID	Lab System ID	Potassium Results (mg/L)	Sodium Results (mg/L)	Strontium Results (mg/L)
Prep Blank - 05/31/02	----	<0.2	<0.2	<0.01
Lab Control - 05/31/02	----	19.2	19.8	2.92
True Value	----	20.0	20.0	3.00
Recovery	----	95.9%	99.1%	97.4%
Prep Blank - 06/05/02	----	<0.2	<0.2	<0.01
Lab Control - 06/05/02	----	40.0	41.1	9.94
True Value	----	40.0	40.0	10.0
Recovery	----	100.0%	102.7%	99.4%
005SNKE1	204172	19.1	77.9	31.4
Duplicate result	204172	19.1	79.0	31.5
RPD	204172	0.00%	1.40%	0.32%
005SNKE11	204173	1.54	99.0	9.07
Spike result	204173	43.1	302	38.0
Spike added	204173	40.0	200	30.0
Recovery	204173	103.9%	101.5%	96.5%
005SNKE12	204174	3.61	97.8	9.25
005SNKE13	204175	7.23	95.5	9.94
005SNKE14	204176	11.7	92.7	9.35
005SNKE15	204177	17.9	89.8	8.47
005SNKE16	204178	24.5	87.0	6.61
005SNKE17	204179	33.1	83.0	4.89
005SNKE18	204180	41.2	78.6	2.73
005SNKE19	204181	49.2	76.1	1.06
005SNKE2	204182	13.7	85.8	20.9
005SNKE20	204183	58.2	71.4	<0.01
005SNKE21	204184	8.56	98.3	0.443
005SNKE22	204185	8.60	97.7	2.47
005SNKE23	204186	8.60	95.3	7.81
005SNKE24	204187	7.81	91.9	15.1
005SNKE25	204188	6.77	86.5	25.4
005SNKE26	204189	5.29	82.5	37.2
005SNKE27	204190	3.69	78.3	46.2
005SNKE28	204191	2.42	72.5	59.3
005SNKE29	204192	1.12	67.1	72.6
Duplicate result	204192	1.15	67.7	73.0
RPD	204192	2.64%	0.89%	0.55%
005SNKE3	204193	10.7	90.2	14.5
Spike result	204193	50.8	289	43.3
Spike added	204193	40.0	200	40.0
Recovery	204193	100.3%	99.4%	72.0%
005SNKE30	204194	0.405	62.2	85.0
005SNKE4	204195	5.94	96.1	5.97
005SNKE5	204196	3.47	99.5	2.34
005SNKE6	204197	1.73	101	0.652
005SNKE7	204198	0.935	102	0.200
005SNKE8	204199	0.369	101	0.053
005SNKE9	204200	<0.2	102	0.010
005SNKR14	204201	73.7	30.6	63.3

Reporting Limit:	0.2 mg/L	0.2 mg/L	0.01 mg/L
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28 JUNE 02  
BAW

Pilot Results for ICP Analysis of Various  
ACE Ion Exchange Experiments

Work order 22552  
Ca<sup>2+</sup> K<sup>+</sup> Na<sup>+</sup> Sr<sup>2+</sup> 0.05N experiment  
Samples on page 494/119  
Preliminary results received by email on 6-28-02  
Chain of Custody on 494/119 to 123

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**SOUTHWEST RESEARCH INSTITUTE**  
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute      Client: Division 20  
Lab Code: SwRI      Date Received: 05/29/02  
Matrix: Liquid      Project No.: 20.R9211.01.001  
Work Order: 22552

Sample ID	Lab System ID	Calcium Results (mg/L)	Potassium Results (mg/L)	Sodium Results (mg/L)	Strontium Results (mg/L)
05QE31	206937	293	420	395	196
05QE32	206938	256	362	354	432
05QE33	206939	223	307	320	653
05QE34	206940	193	257	285	871
05QE35	206941	160	205	251	1080
05QE36	206942	130	160	220	1300
05QE37	206943	95.3	108	181	1500
05QE38	206944	63.5	62.7	146	1700
05QE39	206945	32.0	25.5	112	1900
05QE4	206946	192	257	488	429
05QE40	206947	0.246	1.10	70.8	2080
05QE5	206948	158	203	585	307
05QE6	206949	127	154	686	242
05QE7	206950	93.7	105	783	175
05QE8	206951	60.9	58.9	880	108
05QE9	206952	27.8	20.5	971	41.4
05QR13	206953	226	510	242	524

Reporting Limit:                      0.1 mg/L      0.1 mg/L      0.2 mg/L      0.01 mg/L

28 JUNE 02  
CONT  
BAW

**SOUTHWEST RESEARCH INSTITUTE**  
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute      Client: Division 20  
Lab Code: SwRI      Date Received: 05/29/02  
Matrix: Liquid      Project No.: 20.R9211.01.001  
Work Order: 22552

Sample ID	Lab System ID	Calcium Results (mg/L)	Potassium Results (mg/L)	Sodium Results (mg/L)	Strontium Results (mg/L)
Prep Blank - 06/17/02	----	<0.1	<0.1	<0.2	<0.01
Lab Control - 06/17/02	----	20.5	18.7	19.4	2.81
True Value	----	20.0	20.0	20.0	3.00
Recovery	----	102.5%	93.5%	97.0%	93.7%
05QE1	206914	287	426	188	657
Duplicate result	206914	287	426	188	646
RPD	206914	0.00%	0.00%	0.00%	1.69%
05QE11	206915	285	110	391	621
Spike result	206915	488	307	596	909
Spike added	206915	200	200	200	300
Recovery	206915	101.5%	98.5%	102.5%	96.0%
05QE12	206916	255	264	361	571
05QE13	206917	222	424	328	510
05QE14	206918	191	593	294	442
05QE15	206919	158	759	258	330
05QE16	206920	127	926	224	266
05QE17	206921	95.8	1100	189	202
05QE18	206922	64.1	1270	155	135
05QE19	206923	30.8	1430	118	67.8
05QE2	206924	256	367	288	575
05QE20	206925	<0.1	1600	84.0	0.011
05QE21	206926	95.3	423	393	650
05QE22	206927	191	366	358	570
05QE23	206928	286	310	324	498
05QE24	206929	385	258	288	428
05QE25	206930	481	202	253	319
05QE26	206931	580	152	220	254
05QE27	206932	679	103	185	186
05QE28	206933	767	57.0	147	116
05QE29	206934	857	20.4	110	49.8
Duplicate result	206934	858	19.9	110	49.7
RPD	206934	0.12%	2.48%	0.00%	0.20%
05QE3	206935	227	314	392	495
Spike result	206935	435	516	599	790
Spike added	206935	200	200	200	300
Recovery	206935	104.0%	101.0%	103.5%	98.3%
05QE30	206936	939	1.17	70.5	0.298

Reporting Limit:                      0.1 mg/L      0.1 mg/L      0.2 mg/L      0.01 mg/L

4 July 02  
BAW

CsCl-NaCl-KCl Ternary Ion Exchange Experiment (0.005N)

Twenty-nine reference solutions with a total normality of 0.005N will be prepared. These reference solutions will be either 500mL or 1000mL in volume. All experimental solutions will have a fixed solution volume (50mL) and a fixed amount of sodium form zeolite (0.1g). The composition of the 29 reference solution will vary (see table). The ternary ion exchange solutions will be prepared in the following manner.

Preparation of the 0.005N reference solutions

For convenience, the 0.005N reference solutions can be prepared in groups of 10. Label ten 250mL beakers with a sharpie. Tare an appropriately sized weighing boat on the AE240 balance. Add the appropriate amount of NaCl (see table) and record the mass. Transfer the compound to a 250mL beaker. Carefully rinse the weighing boat with nanopure water from a squirt bottle and transfer the washings into the beaker. Repeat this rinsing step several times. Throw away the used weighing boat. After the NaCl additions to the ten solutions has been completed, then the KCl additions can begin. Tare an appropriately sized weighing boat on the AE240 balance. Add the appropriate amount of KCl (see table) and record the mass. Transfer the compound to the appropriate 250mL beaker (beaker already contain a NaCL solution). Carefully rinse the weighing boat with nanopure water from a squirt bottle and transfer the washing into the beaker. Repeat this rinsing step several times. Throw away the used weighing boat. After all ten KCl additions have been completed, then begin with the CsCl additions. Tare an appropriately sized weighing boat on the AE240 balance. Add the appropriate amount of CsCl (see table) and record the mass. Transfer the compound to the appropriate 250mL beaker (beaker already contains NaCl/KCl solution). Carefully rinse the weighing boat with nanopure water from a squirt bottle several times and transfer the washings into the beaker. Throw away the used weighing boat.

Ensure that all solids are dissolved in the 250mL beaker. Swirl and/or add water if necessary. Ensure that total solution volume in beaker does not exceed much beyond 100mL. Let

4 JUL 02  
CONT  
BAW

the solution stand for at least one minute before transferring into the volumetric flask. Label ten volumetric flasks (500mL and/or 1000mL) with a sharpie. Decant the contents of the 250mL beaker into the appropriately sized volumetric flask. Carefully rinse the beaker with nanopure water from a squirt bottle and transfer the washing into the beaker. Repeat this rinsing step several times. Fill the volumetric flask to about 2-3 inches below the mark with nanopure water and swirl for mixing. Then add nanopure water dropwise up to the mark and remix. Transfer each solution to an appropriately labeled polypropylene bottle (500mL or 1000mL). Label the bottles CsCl-NaCl-KCl\*0.005N\*Ref1 to 30. Clean the ten beakers and ten volumetric flasks with DI water and then with nanopure water (no acid wash). Reuse this glassware and repeat this procedure for the next ten reference solutions.

Preparation of 0.005N Experimental Solutions – Addition of zeolite

All experimental sets will have a fixed solution volume (50mL) and a fixed amount of sodium form zeolite (0.1g). Record the zeolite label information in the notebook. For convenience, the experimental solutions can be prepared in groups of 10. Fold and tare a piece of weighing paper on the AE240 balance. Add the zeolite (target = 0.1g) on top of the paper and record the mass. Place a funnel made from weighing paper into a 60mL polypropylene bottle. Carefully transfer the zeolite into the appropriately labeled bottle. The bottles should be labeled CsCl-NaCl-KCl\*0.005N\*Exp1 to 30. Gently tap the paper funnel to ensure complete transfer of zeolite into the bottle.

Place the bottle containing the zeolite on the PM4600 balance and tare. Add 50.00g (Mettler PM4600 balance) of the appropriate reference solution to the bottle containing the zeolite. (It is suggested that an oxford pipet with a 10mL disposal tip be used to transfer the bulk of the solution. Then a disposable 5mL pipet can be used to add the final amount of reference solution dropwise to obtain the 50.00g mark.) Record the mass of solution. Repeat this procedure for making each experimental solution.

4 JUL 02  
CONT  
BAW

EXPT. NA-K-CS 0.005 N

TN = 0.005

0.1 g zeol.  
50 ml. Soln.

SKIP 10

Soln ID	E <sub>Na</sub>	E <sub>K</sub>	E <sub>CS</sub>	For 1000 mL			For 500mL		
				wt. NaCl(g)	wt. KCl(g)	wt. CsCl(g)	wt. NaCl(g)	wt. KCl(g)	wt. CsCl(g)
CsCl-KCl-NaCl*0.005N*Ref 1	0.1	0.45	0.45	0.0292	0.1677	0.3788	0.0292	0.0746	0.1684
CsCl-KCl-NaCl*0.005N*Ref 2	0.2	0.4	0.4				0.0438	0.0652	0.1473
CsCl-KCl-NaCl*0.005N*Ref 3	0.3	0.35	0.35				0.0584	0.0559	0.1263
CsCl-KCl-NaCl*0.005N*Ref 4	0.4	0.3	0.3				0.0731	0.0466	0.1052
CsCl-KCl-NaCl*0.005N*Ref 5	0.5	0.25	0.25				0.0877	0.0373	0.0842
CsCl-KCl-NaCl*0.005N*Ref 6	0.6	0.2	0.2				0.1023	0.0280	0.0631
CsCl-KCl-NaCl*0.005N*Ref 7	0.7	0.15	0.15						
CsCl-KCl-NaCl*0.005N*Ref 8	0.8	0.1	0.1	0.2338	0.0373	0.0842			
CsCl-KCl-NaCl*0.005N*Ref 9	0.9	0.05	0.05	0.2630	0.0186	0.0421			
CsCl-KCl-NaCl*0.005N*Ref 10	1	0	0	na	na	na	na	na	na
CsCl-KCl-NaCl*0.005N*Ref 11	0.45	0.1	0.45	0.1315	0.0373	0.3788	0.0584	0.0373	0.1684
CsCl-KCl-NaCl*0.005N*Ref 12	0.4	0.2	0.4				0.0511	0.0559	0.1473
CsCl-KCl-NaCl*0.005N*Ref 13	0.35	0.3	0.35				0.0438	0.0746	0.1263
CsCl-KCl-NaCl*0.005N*Ref 14	0.3	0.4	0.3				0.0365	0.0932	0.1052
CsCl-KCl-NaCl*0.005N*Ref 15	0.25	0.5	0.25				0.0292	0.1118	0.0842
CsCl-KCl-NaCl*0.005N*Ref 16	0.2	0.6	0.2				0.0219	0.1305	0.0631
CsCl-KCl-NaCl*0.005N*Ref 17	0.15	0.7	0.15						
CsCl-KCl-NaCl*0.005N*Ref 18	0.1	0.8	0.1	0.0292	0.2982	0.0842	0.0000	0.1864	0.0000
CsCl-KCl-NaCl*0.005N*Ref 19	0.05	0.9	0.05	0.0146	0.3355	0.0421	0.0657	0.0839	0.0421
CsCl-KCl-NaCl*0.005N*Ref 20	0	1	0				0.0584	0.0746	0.0842
CsCl-KCl-NaCl*0.005N*Ref 21	0.45	0.45	0.1				0.0511	0.0652	0.1263
CsCl-KCl-NaCl*0.005N*Ref 22	0.4	0.4	0.2				0.0438	0.0559	0.1684
CsCl-KCl-NaCl*0.005N*Ref 23	0.35	0.35	0.3				0.0365	0.0466	0.2104
CsCl-KCl-NaCl*0.005N*Ref 24	0.3	0.3	0.4				0.0292	0.0373	0.2525
CsCl-KCl-NaCl*0.005N*Ref 25	0.25	0.25	0.5				0.0219	0.0280	0.2946
CsCl-KCl-NaCl*0.005N*Ref 26	0.2	0.2	0.6						
CsCl-KCl-NaCl*0.005N*Ref 27	0.15	0.15	0.7						
CsCl-KCl-NaCl*0.005N*Ref 28	0.1	0.1	0.8	0.0292	0.0373	0.6734			
CsCl-KCl-NaCl*0.005N*Ref 29	0.05	0.05	0.9	0.0146	0.0186	0.7576			
CsCl-KCl-NaCl*0.005N*Ref 30	0	0	1				0.0000	0.0000	0.4209

Source for 1000mL masses: Paul's ternary design.xls

\* Solution number 10 was skipped: Sodium form zeolite in a "sodium only" reference solution was not needed.  
Reference solutions were either 1000mL or 500mL

4 JUL 02  
CONT  
BAW

Preparation of Cs-Na-K 0.005N Reference Solns

Followed procedure listed in 494/132-134  
Sodium form zeolite used - so sodium only  
reference soln (soln#10) was skipped

Reagents supplied BW 7-4-02

nanopure type1 water

NaCl = Fisher S271-3, lot# 984321

KCl = Fisher P217-500, lot# 006242

CsCl = Fisher BP210-500, lot# 010406

1000mL Ref Solns: 1, 8, 9, 11, 18, 19, 28, 29

SOLN ID	NaCl mass(g)	KCl mass(g)	CsCl mass(g)
REF 1	0.0290	0.1680	0.3794
REF 8	0.2338	0.0375	0.0842
REF 9	0.2635	0.0188	0.0422
REF 11	0.1318	0.0371	0.3801
REF 18	0.0292	0.2986	0.0842
REF 19	0.0146	0.3355	0.0420
REF 28	0.0293	0.0373	0.6735
REF 29	0.0145	0.0185	0.7570

Challenge mass (20.0001g) at start of analysis = 20.0002g  
" " " " end " " = 20.0004g

Preparation of Cs-Na-K 0.005N Experimental Solutions - Zeolite Addition

Sodium form of zeolite used:

CDV\*200/325\*4E\*WA\*RC\*HL\*RF\*NaF  
420/54-67 AS 5/2/01



4 Jul 02 <sup>714-02</sup>  
 Fotte BAW Followed procedure in 494/132-134  
 Labeled CsCl-NaCl-KCl \* 0.005N \* EXP 1 to 30  
 CONT  
 BAW

ID	Zeolite mass (g)	ID	Zeolite mass (g)
EXP 1	0.1005	EXP 17	0.1012
EXP 2	0.1005	EXP 18	0.1006
EXP 3	0.1005	EXP 19	0.1009
EXP 4	0.1008	EXP 20	0.1010
EXP 5	0.1004	EXP 21	0.1006
EXP 6	0.1009	EXP 22	0.1011
EXP 7	0.1000	EXP 23	0.1010
EXP 8	0.1009	EXP 24	0.1008
EXP 9	0.1004	EXP 25	0.1005
EXP 11	0.1000	EXP 26	0.1008
EXP 12	0.1002	EXP 27	0.1001
EXP 13	0.1011	EXP 28	0.1006
EXP 14	0.1015	EXP 29	0.1008
EXP 15	0.1009	EXP 30	0.1007
EXP 16	0.1015		

Challenge mass at start (20.0003) - at end (20.0003)

5 Jul 02  
 BAW

Preparation of Cs-Na-K Reference Solutions  
 2-7 and 12-16 (500 mL solns)

Followed procedure listed in 494/132-134  
 Reagents - see 494/135

SOLN ID	NaCl mass (g)	KCl mass (g)	CsCl mass (g)
REF 2	0.0295	0.0745	0.1696
REF 3	0.0440	0.0658	0.1486
REF 4	0.0585	0.0564	0.1272
REF 5	0.0735	0.0469	0.1054
REF 6	0.0878	0.0374	0.0844
REF 7	0.1024	0.0279	0.0632
<del>REF 8</del> BAW 7-5-02	—	—	—
REF 12	0.0587	0.0375	0.1690
REF 13	0.0510	0.0565	0.1477
REF 14	0.0441	0.0748	0.1272
REF 15	0.0371	0.0937	0.1050
REF 16	0.0296	0.1120	0.0848

Challenge mass at start (20.0002)  
 " " " end (20.0003)

6 Jul 02  
 BAW

Preparation of Cs-Na-K Reference Solns  
 17, 20-27, 30 (500 mL)

Followed procedure listed in 494/132-134  
 Reagents - see 494/135

Challenge mass at start = 20.0003g  
 " " " end = 20.0003g

6JUL02 CONT BAW	SOLN ID	NaCl mass(g)	KCl mass(g)	CsCl mass(g)
	REF 17	0.0218	0.1308	0.0639
	REF 20	0	0.1865	0
	REF 21	0.0662	0.0842	0.0420
	REF 22	0.0584	0.0751	0.0838
	REF 23	0.0512	0.0654	0.1269
	REF 24	0.0440	0.0562	0.1684
	REF 25	0.0369	0.0470	0.2108
	REF 26	0.0292	0.0375	0.2527
	REF 27	0.0224	0.0280	0.2945
	REF 30	0	0	0.4208

### Preparation of Cs-Na-K Exp solns - Ref soln Addition

Added 50.00g (PM4600) of appropriate ref. soln (494/135-138) to bottles w/ zeolite (494/136) by procedure in (494/132-134)

SOLN ID	SOLN MASS(g)	SOLN ID	SOLN MASS(g)
EXP1	50.00	EXP17	50.00
EXP2	50.02	EXP18	50.01
EXP3	50.01	EXP19	50.02
EXP4	50.01	EXP20	50.01
EXP5	50.04	EXP21	50.02
EXP6	50.01	EXP22	50.00
EXP7	50.01	EXP23	50.03
EXP8	50.02	EXP24	50.00
EXP9	50.02	EXP25	50.01
EXP11	50.03	EXP26	50.00
EXP12	50.00	EXP27	50.01
EXP13	50.03	EXP28	50.75
EXP14	50.02	EXP29	50.02
EXP15	50.00	EXP30	50.01
EXP16	50.00		

6JUL02  
CONT  
BAW  
Challenge mass at start = 400.00  
" " " end = 400.00

Set exp solns on gyratory shaker at set rpm ~ 150.

15JUL02  
BAW  
Preparation of 0.005N Cs-Na-K QA Sample

Target value 20ppm BW 15-Jul-02  
40ppm Na, 80ppm K, and 0 ppm Cs

Reference solns: nanopure type I  
Potassium 1000ppm soln - Spex Certiprep cat# PLK2-2Y, lot# 8-33K-Y, rec 1/14/02  
spenned 1/14/02  
Sodium 1000ppm sol - Spex Certiprep cat# PLNA2-2Y, lot# 8-66NA, rec 1/14/02

Added 1mL Na 1000ppm (volumetric pipet) and 2mL 1000ppm K (volumetric pipet) into a 25mL vol flask and diluted to mark with nanopure type I. Transferred into 30mL pp bottle labeled 005CSNKQ

Sampling of ~~0.005~~<sup>BW</sup> 7-15-02 0.005N Cs-Na-K Exp solns for ICP + ICPMS Analysis by Div 01

29 exp solns (0.005N Cs-Na-K from 494/138) approximately 20mL (orford pipet with 10mL tip) aliquots of sample were transferred to an appropriately labeled 30mL pp bottle.

Labeling 005CSNKX where X = 1 to 30

16 Jul 02  
RATU  
of 0.005N CS-Na-K solutions 494/139

Shipper Name/Address		SAMPLE LIST/CHAIN OF CUSTODY										Requested Turnaround:		
Client		Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166										<input type="checkbox"/> 2 Weeks <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: <u>4 wks</u>		
		Client Purchase Order/Other ID					Site/Zone ID					SwRI Contact		
		Analyses Requested										Mike Dammann		
Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time	Matrix Type	Sample Type	# of Containers	Na, K by ICP	Cs by ICP-MS							REMARKS
005C5NK1	7-15-02		W		1	✓	✓							Preservation a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Cool (4°C±2°C) f = Other (specify) none
005C5NK2						✓	✓							Nuclear Safety
005C5NK3						✓	✓							Relative use
005C5NK4						✓	✓							appropriate QA
005C5NK5						✓	✓							procedures
005C5NK6						✓	✓							POC - Brad Werling
005C5NK7						✓	✓							phone 6565
005C5NK8						✓	✓							Fax 5184
005C5NK9						✓	✓							
005C5NKQ						✓	✓							20,01402.871
Matrix Types:		Sample Types:		Relinquished by (Print/Signature)		Date		Time		SwRI Project#:				
A - Air		D - Duplicate		Bradley Werling / Bradley Werling		7/16/02		1355		Received by SwRI Lab:				
B - Biota		ER - Equipment Rinsate		Received by (Print/Signature)		Date		Time		(Signature)				
D - Dust		FB - Field Blank		Relinquished by (Print/Signature)		Date		Time		Date		Time		
E - Emission/Stack		FD - Field Duplicate		Received by (Print/Signature)		Date		Time		7/16/02		1355		
P - Product		MS - Matrix Spike				Date		Time		Date		Time		
S - Soil		MSD - Matrix Spike Dup				Date		Time		Date		Time		
SED - Sediment		TB - Trip Blank				Date		Time		Date		Time		
T - Tissue						Date		Time		Date		Time		
W - Water						Date		Time		Date		Time		
WP - Wipe						Date		Time		Date		Time		
Temp: 22.6°C		Therm #: 026		Relinquished by (Print/Signature)		Date		Time		Date		Time		
Comments: Received intact						Date		Time		Date		Time		
494/139 C5-N-K 0.005N						Date		Time		Date		Time		

BRADLEY WERLING CNWRA- DIV 20 BLD 57						SAMPLE LIST/CHAIN OF CUSTODY Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166								Requested Turnaround: <input type="checkbox"/> 2 Weeks <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4 wks													
Client						Client Purchase Order/Other ID				Site/Zone ID				SwRI Contact Mike Dammann													
														Analyses Requested													
Sample ID						Sample Collection Date (mm/dd/yyyy)		Sample Collection Time		Matrix Type		Sample Type		# of Containers		N <sub>9</sub> , K by ICP		CS by ICP-MS		REMARKS Preservation a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Cool (4°C±2°C) f = Other (specify) none							
005C5NK11						7-15-02				U				1		✓		✓		Nuclear Safety Related - use appropriate QA procedures							
005C5NK12														1		✓		✓									
005C5NK13														1		✓		✓									
005C5NK14														1		✓		✓									
005C5NK15														1		✓		✓									
005C5NK16														1		✓		✓		Per Brad Werling phone 6565 fax 5184							
005C5NK17														1		✓		✓									
005C5NK18														1		✓		✓									
005C5NK19														1		✓		✓									
005C5NK20														1		✓		✓		20.01402.871							
Matrix Types:						Sample Types:						Relinquished by (Print/Signature)						Date		Time		SwRI Project#					
A - Air						D - Duplicate						Bradley Werling / Bradley Werling						7/18/02		1355		Received by SwRI Lab: (Signature)					
B - Biota						ER - Equipment Rinsate						Received by (Print/Signature)						Date		Time		Name A Palomo					
D - Dust						FB - Field Blank						Relinquished by (Print/Signature)						Date		Time		7/16/02 13.55					
E - Emission/Stack						FD - Field Duplicate						Received by (Print/Signature)						Date		Time		Samples Disposed:					
P - Product						MS - Matrix Spike												Date		Time		Date					
S - Soil						MSD - Matrix Spike Dup																Time					
SED - Sediment						TB - Trip Blank																					
T - Tissue																											
W - Water																											
WP - Wipe																											
Temp: 22.0C						Therm #: 026																					
Comments: Received Intact																											
494/139 CS-N-K 01005N																											

16 July 02  
cost  
RAW

Div 01 COC Form 01-01-001, Rev 4/02

Periodic notebook review completed by principal investigator.

27 Sep 02  
BAW

## DVOI ICP Results for 0.005N CSCI-NGL-KCL ACR Ion Exchange Experimental Solutions

Work order 22830

CSCl-NaCl-KCl 0.005N experiment

Samples from 494/139

preliminary results received by email on 9-25-02

Chain of Custody on 494/140-142

QA sample from 494/139

QA recovers % Difference = -0.1 K and ~~0.15~~ Nq

-0.5

BW 9-27-02

~~Pro 9-27-02~~

## SOUTHWEST RESEARCH INSTITUTE

## SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute

Client: Division 20

Lab Code: SwRI

Date Received: 07/16/02

Matrix: Liquid

Project No.: 20.01402.871

Work Order: 22830

Sample ID	Lab System ID	Cesium Results (mg/L)	Potassium Results (mg/L)	Sodium Results (mg/L)
Prep Blank - j18w1	----	----	<0.2	<0.2
Lab Control - j18w1	----	----	20.5	20.4
True Value	----	----	20.0	20.0
Recovery	----	----	103%	102%
Prep Blank - j18w2	----	----	<0.2	<0.2
Lab Control - j18w2	----	----	19.9	19.9
True Value	----	----	20.0	20.0
Recovery	----	----	99.5%	99.5%
Prep Blank - j18w3	----	<0.001	----	----
Lab Control - j18w3	----	0.101	----	----
True Value	----	0.100	----	----
Recovery	----	101%	----	----
Prep Blank - j18w4	----	<0.001	----	----
Lab Control - j18w4	----	0.090	----	----
True Value	----	0.100	----	----
Recovery	----	90.0%	----	----
005CSNK1	209368	40.5	28.9	94.8
Duplicate result	209368	38.8	28.9	95.0
RPD	209368	4.29%	0.00%	0.21%
005CSNK11	209369	12.2	1.54	113
Spike result	209369	21.7	22.9	134
Spike added	209369	10.0	20.0	20.0
Recovery	209369	95.0%	107%	105%
005CSNK12	209370	11.3	3.85	112
005CSNK13	209371	10.7	7.76	109
005CSNK14	209372	9.82	13.0	106
005CSNK15	209373	8.70	20.0	102
005CSNK16	209374	6.88	27.5	98.2
005CSNK17	209375	5.31	36.4	94.4
005CSNK18	209376	3.34	45.7	88.4
005CSNK19	209377	1.56	53.7	83.5
005CSNK2	209378	22.8	18.9	100
005CSNK20	209379	0.003	62.7	77.4
005CSNK21	209380	1.69	9.37	110
005CSNK22	209381	4.34	9.46	111
005CSNK23	209382	8.35	9.28	109
005CSNK24	209383	16.0	9.29	108
005CSNK25	209384	29.2	8.94	105
005CSNK26	209385	56.3	7.21	102
005CSNK27	209386	93.1	5.45	96.3
005CSNK28	209387	131	3.56	91.7
005CSNK29	209388	179	2.06	85.9
Duplicate result	209388	173	2.16	85.5
RPD	209388	3.41%	4.74%	0.47%
005CSNK3	209389	12.3	11.7	107
Spike result	209389	20.8	32.8	128
Spike added	209389	10.0	20.0	20.0
Recovery	209389	85.0%	106%	105%
005CSNK30	209390	212	1.04	79.4
005CSNK4	209391	7.20	6.49	109
005CSNK5	209392	4.12	3.58	113
005CSNK6	209393	2.41	1.95	113
005CSNK7	209394	1.20	1.05	113
005CSNK8	209395	0.600	0.584	116
005CSNK9	209396	0.245	0.284	115
005CSNKQ	209397	<0.001	79.9	39.8

Reporting Limit: 0.001 mg/L 0.2 mg/L 0.2 mg/L

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30102  
BAW

## Analysis of Quaternary Ref Solns

The 39 Quaternary Ref Solns 0.05N (494/115) were sent to Div 01 for analysis by ICP

Aliquots of the Ref solns were poured into 60ml pp bottles. Labels were dated 10-8-02. The QREFX was also used on the label where X = 1 to 40 (no #10).

Analysis of 0.05N SRX<sub>2</sub>-NaCl-KCl Ref Solns

The 29 Sr-Na-K Ref Solns (494/67) were sent to Div 01 for ICP analysis.

Aliquots of the Ref solns were poured into 60 ml pp bottles. Labels were dated 10-9-02. Labeled SNKRX where X = 1 to 30 (no #10)

## QA Sample for Quaternary + Sr-Na-K Ref Solns

One QA sample was made (100mL). This sample was split into two aliquots and used for the Quaternary and SRNK QA samples.

Target 100ppm K, 100ppm Na, 100 ppm Sr

Added 10mL 1000ppm K (Spex Certiprep cat# PLK2-2Y, lot# 8-33K-Y) and 10mL 1000ppm Na (Spex Certiprep cat# PLNA2-2Y, lot# 8-66NA) and 10mL of 1000ppm Sr (Spex Certiprep cat# PLSR2-2Y, lot# 8-1345R) to a 100 mL vol flask and diluted to mark with nanopure type I water. (10mL vol via vol pipet). Split sample evenly into two 60mL pp bottles. Labeled QREFQA for Quat samples and SNKQA for Sr-Na-K samples.



9 OCT 02  
BAW

Shipper Name/Address <b>BRADLEY WERLING</b> <b>CNWRA-DIV 20</b> <b>BLD 57</b>			<b>SAMPLE LIST/CHAIN OF CUSTODY</b> <b>Southwest Research Institute</b> Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166										Requested Turnaround: <input type="checkbox"/> 2 Weeks <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: <b>4 wks</b>								
													SwRI Contact <b>Mike Dammann</b>								
Client			Client Purchase Order/Other ID					Site/Zone ID					Analyses Requested		REMARKS Preservation a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Cool (4°C±2°C) <input checked="" type="checkbox"/> f = Other (specify) <b>none</b>						
Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time	Matrix Type	Sample Type	# of Containers																
SNKR 1	10-9-02		W		1	X											Nuclear Safety Related - use appropriate QA procedures				
SNKR 2						X															
SNKR 3						X															
SNKR 4						X															
SNKR 5						X															
SNKR 6						X											POC: Brad Werling phone 6565 fax 5184				
SNKR 7						X															
SNKR 8						X															
SNKR 9						X															
SNKR 11						X															
<b>Matrix Types:</b> A - Air B - Biota D - Dust E - Emission/Stack P - Product S - Soil SED - Sediment T - Tissue W - Water WP - Wipe						<b>Sample Types:</b> D - Duplicate ER - Equipment Rinse FB - Field Blank FD - Field Duplicate MS - Matrix Spike MSD - Matrix Spike Dup TB - Trip Blank						Relinquished by (Print/Signature) <b>Brad Werling / Brad Werling</b>				Date <b>10-9-02</b>		Time <b>13:53</b>		SwRI Project#: Received by SwRI Lab: (Signature) <b>Monica L. Palomo</b>	
						Received by (Print/Signature)				Date		Time									
						Relinquished by (Print/Signature)				Date		Time		Date <b>10/9/02</b>		Time <b>1353</b>					
						Received by (Print/Signature)				Date		Time		Samples Disposed: Date Time							
Temp: <b>42°C</b> Comments: <b>Radioactivity - Each bottle contains a Sr-90 activity of 494/145 ≤ 0.1 nCi/g or 3.7 Bq/g</b>						Relinquished by (Print/Signature)				Date		Time		Samples Disposed by:							

Div 01 COC Form 01-01-001, Rev 4/02

Page 1 of 3

Shipper Name/ Address  <b>BRADLEY WERLING</b> <b>CNWRA- DIV 20</b> <b>BLD 57</b>		<b>SAMPLE LIST/CHAIN OF CUSTODY</b> <b>Southwest Research Institute</b> Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166				Requested Turnaround: <input type="checkbox"/> 2 Weeks <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: <b>4 WKS</b>	
Client		Client Purchase Order/Other ID		Site/Zone ID		SwRI Contact	
Sample ID		Sample Collection Date (mm/dd/yyyy)	Sample Collection Time	Matrix Type	Sample Type	# of Containers	Analyses Requested
SNK R12	10902			W		1	X
SNK R13							X
SNK R14							X
SNK R15							X
SNK R16							X
SNK R17							X
SNK R18							X
SNK R19							X
SNK R20							X
SNK R21							X
							REMARKS Preservation a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Cool (4°C±2°C) f = Other (specify) none
							Nuclear Safety Related - use appropriate QA procedures
							POC - Brad Werling phone - 6565 fax - 5184
							20.R9211.01.001
<b>Matrix Types:</b> A – Air B – Biota D – Dust E – Emission/Stack P – Product S – Soil SED – Sediment T – Tissue W – Water WP – Wipe		<b>Sample Types:</b> D – Duplicate ER – Equipment Rinseate FB – Field Blank FD – Field Duplicate MS – Matrix Spike MSD – Matrix Spike Dup TB – Trip Blank		Relinquished by (Print/Signature) <i>Brad Werling / Brad Werling</i>		Date	Time
Temp: 22.0 °C Therm #: 0157				Received by (Print/Signature)		Date	Time
Comments: RADIOACTIVITY: Each bottle contains a Sr90 activity of ≤ 1494/145 c.p.m./g as 3.7 Bq/g				Relinquished by (Print/Signature)		Date	Time
				Received by (Print/Signature)		Date	Time
				Relinquished by (Print/Signature)		Date	Time

9oct02

CONT

BLW

Shipper Name/Address		SAMPLE LIST/CHAIN OF CUSTODY										Requested Turnaround:	
Client		Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166										<input type="checkbox"/> 2 Weeks <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4 wks	
		Client Purchase Order/Other ID					Site/Zone ID					SwRI Contact	
		Analyses Requested										SwRI Project#	
Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time	Matrix Type	Sample Type	# of Containers								REMARKS
SNK R22	10-9-02		W		1	X							Preservation a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Cool (4°C±2°C) f = Other (specify) none
SNK R23						X							Nuclear Safety
SNK R24						X							Related- use
SNK R25						X							appropriate QA
SNK R26						X							procedures
SNK R27						X							POC- Brad Werling
SNK R28						X							phone- 6565
SNK R29						X							fax- 5184
SNK R30						X							
SNKQA*						X							
Matrix Types: A - Air B - Biota D - Dust E - Emission/Stack P - Product S - Soil SED - Sediment T - Tissue W - Water WP - Wipe		Sample Types: D - Duplicate ER - Equipment Rinsate FB - Field Blank FD - Field Duplicate MS - Matrix Spike MSD - Matrix Spike Dup TB - Trip Blank		Relinquished by (Print/Signature) Brad Werling / Brad Werling		Date 10-9-02		Time 13:53		SwRI Project#		Received by SwRI Lab: (Signature) Mike Dammann	
Temp: 22.0°C		Therm #: 027		Received by (Print/Signature)		Date		Time		Date		Time	
Comments: Radioactivity: each bottle contains a 5-10 activity of 494/145 ≤ 0.1 nCi/g or 3.7 Bq/g				Relinquished by (Print/Signature)		Date		Time		Date		Time	
				Received by (Print/Signature)		Date		Time		Date		Time	
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				Relinquished by (Print/Signature)		Date		Time		Date		Time	
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				Relinquished by (Print/Signature)		Date		Time		Date		Time	
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				Relinquished by (Print/Signature)		Date		Time		Date		Time	
				Received by (Print/Signature)		Date		Time		Date		Time	
				Relinquished by (Print/Signature)		Date		Time		Date		Time	
				Received by (Print/Signature)		Date		Time		Date		Time	
				Relinquished by (Print/Signature)		Date		Time		Date		Time	
				Received by (Print/Signature)		Date		Time					



9 OCT 02

CONT  
BAW

SAMPLE LIST/CHAIN OF CUSTODY									
Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166									
Requested Turnaround:		SWRI Contact		Analyses Requested		Remarks			
<input type="checkbox"/> 2 Weeks	<input type="checkbox"/> 3 Weeks	<input checked="" type="checkbox"/> Other: 4 wks	Mike Dammann			Preservation a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Cool (4°C±2°C) f = Other (specify) none			
Client Purchase Order/Other ID		Site/Zone ID				Nuclear Safety Related-use appropriate QA procedures			
Bradley Werling CNWRA - Div 20 Bld 57						POC - Bradley Werling phone - 6565 fax - 5184			
Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time	Matrix Type	Sample Type	# of Containers	Relinquished by (Print/Signature)	Received by (Print/Signature)	Date	Time
QREF32	10-8-02		W			Brad Werling	Brad Werling	10-9-02	1353
QREF33									
QREF34									
QREF35									
QREF36									
QREF37									
QREF38									
QREF39									
QREF40									
QREF41									
QREF42									
QREF43									
QREF44									
QREF45									
QREF46									
QREF47									
QREF48									
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QREF93									
QREF94									
QREF95									
QREF96									
QREF97									
QREF98									
QREF99									
QREF100									

494/145 Out Ref

Div 01 CQC Form 01-01-001, Rev 4/02

04 Nov 02  
PB

Completed periodic review of notebook.

22  
11 NOV 02  
BAW  
BWSampling of 0.05N Ca-Na-K Reference Solns  
for ICP analysis by DIV 01

11-22-02

29 Reference solutions (494/78-82) were  
agitated/swirled and roughly 50ml of each  
soln was decanted into an appropriately labelled  
60ml pp bottle. Labeled 05NKCgRX where  
X = 1 to 30. 05 = 0.05N  
NKCg = Sodium-Potassium-Calcium  
R = Reference  
X = soln id number

Preparation of 0.05N Ca-Na-K QA Sample

Target Values: 100ppm Na, 180ppm K, 50ppm Ca

Ref Solns: nanopure type I

1000ppm K: Spex-Certiprep cat# PLK2-2Y, lot#  
8-33K-Y, open 1-14-02, Exp 12-30-021000ppm Na: Spex-Certiprep cat# PLNA2-2Y, lot#  
8-66NA, open ?, Exp 12-30-021000ppm Ca: Spex-Certiprep cat# PLCA2-2Y, lot#  
8-140CA, open 1-14-02, Exp 12-30-02

Added 10mL (vol pipet) of 1000ppm K, 10mL (vol  
pipet) of 1000ppm Na, and 5mL of 1000ppm Ca (vol  
pipet) into a 100mL vol. flask and diluted  
to mark with nanopure type I water. Transferred part  
into 60mL pp bottle labeled 05NKCgR31.  
See above for labeling legend.



SAMPLING OF  $\text{SrCl}_2$ -KCl - 0.0005N Reference Soln for ICP Analysis by Divol

① REF soln:  $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$   $1.0 \text{E}_{\text{Sr}}$   
Not RADIO ACTIVE

This ref was diluted 40 fold before being sent to div 01.

Added 3 mL (vol pipet) of sample into a 25 mL vol. flask and diluted to mark with nanopure type I water. The soln was transferred to a 50 mL pp pwr 11-22-02 bottle labeled SRK REF1. This resulted in a 8.33 fold dilution.

⑦ REF soln:  $\text{SrCl}_2 \cdot 6\text{H}_2\text{O} * 0.0005 \text{N} * 1.0 \text{E}_{\text{Sr}}$   
Radioactive  
420/16/ 10-23-01 BW

The ref soln was diluted exactly 10-fold before being sent to Divol

Added 5 mL (vol pipet) of sample into a 50 mL vol flask and diluted to mark with nanopure Type I water. The solution was transferred to a 60 mL pp bottle labeled SRK REF 2.

25 Nov 02  
BAW

Delivery of Sr-K 0.0005N Ref and Ca-Na-K 0.05N Ref Samples to Divol for ICP analysis

Two SDGs delivered  
29 Cr-Na-K samples and 1 QA sample (494/153)  
and 2 Sr-K samples (494/154)  
Note: Sr-K samples were diluted prior to  
delivery to Divol.

25 Nov 02  
CONT  
BW

SAMPLE LIST/CHAIN OF CUSTODY				Requested Turnaround:			
Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5166				<input type="checkbox"/> 2 Weeks <input type="checkbox"/> 3 Weeks <input checked="" type="checkbox"/> Other: 4 weeks			
Client Purchase Order/Other ID				Site/Zone ID			
Analyses Requested				REMARKS			
Sample ID	Sample Collection Date (mm/dd/yyyy)	Sample Collection Time	Matrix Type	Sample Type	# of Containers	Preservation a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Cool (4°C±2°C) f = Other (specify) none	
SRKREF1			W	I	1	Nuclear Safety	
SRKREF2			I	I	1	Related-use appropriate QA procedures	
						POC-Brad Werling phone-6565 fax-5184	
						20R9211.01.001	
Matrix Types:	Sample Types:	Relinquished by (Print/Signature)	Date	Time	SwRI Project:		
A - Air	D - Duplicate	Brad Werling / Brad Werling			Received by SwRI Lab:		
B - Biota	ER - Equipment Rinseate	Received by (Print/Signature)	Date	Time	(Signature)		
D - Dust	FB - Field Blank				Date		
E - Emission/Stack	FD - Field Duplicate				Time		
P - Product	MS - Matrix Spike				Date		
S - Soil	MSD - Matrix Spike Dup				Time		
SED - Sediment	TB - Trip Blank				Date		
T - Tissue					Time		
W - Water					Date		
WP - Wipe					Time		
Temp: 20.2°C	Therm #: 027				Date		
Comments: * Radioactive - 11/10/19						Samples Disposed by:	
494/153						Date	





25 Nov 02  
CONT  
BW

BRADLEY WERLING CNUWA - DIV 20 BL057		SAMPLE LIST/CHAIN OF CUSTODY Southwest Research Institute Chemistry and Chemical Engineering Division 6220 Culebra Road San Antonio, Texas 78238-5168		Requested Turnaround: <input type="checkbox"/> 2 Weeks <input checked="" type="checkbox"/> 3 Weeks Other: 4 weeks	
Shipper Name/Address		Client Purchase Order/Other ID		Site/Zone ID	
Client		Analyses Requested		SwRI Contact Mike Dammann	
Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time	Matrix Type	Sample Type	# of Containers
05NKG9R1			W		1
05NKG9R2					
05NKG9R3					
05NKG9R4					
05NKG9R5					
05NKG9R6					
05NKG9R7					
05NKG9R8					
05NKG9R9					
05NKG9R11					
Matrix Types: A - Air B - Biota D - Dust E - Emission/Stack P - Product S - Soil SED - Sediment T - Tissue W - Water WP - Wipe		Sample Types: D - Duplicate ER - Equipment Rinse FB - Field Blank FD - Field Duplicate MS - Matrix Spike MSD - Matrix Spike Dup TB - Trip Blank		Relinquished by (Print/Signature) Brad Werling / Brad Werling	
Temp: 20.7°C		Therm #: 027		Received by (Print/Signature) Mike Dammann	
Comments: 494/156-158				Date 11/25/02	
				Time 09:36	
				Samples Disposed by: Date	
				Time	
				Samples Disposed by: Date	
				Time	
				Remarks: Preservation a = HCl to pH <2 b = HNO <sub>3</sub> to pH <2 c = H <sub>2</sub> SO <sub>4</sub> to pH <2 d = NaOH to pH >12 e = Cool (4°C/20°C) f = Other (specify) none	
				Nuclear Safety	
				Related - use	
				appropriate QA	
				procedures	
				PC - Brad Werling	
				phone - 6565	
				fax - 5184	
				20.R9211.01.001	

4 DEC 02  
BAW

END OF NOTE BOOK

CONTINUED Ion Exchange (ACE)  
Experiments in Scientific Note book  
558

No Further Entries  
4 Dec 02 BAW

02 Dec 02  
BW

Periodic notebook review completed by principal investigator.

4 Dec 02  
CONT  
BAW

No Further Entries  
4 Dec 02  
BAW

I have reviewed this scientific notebook and find it in agreement with QAP-001. There is sufficient information regarding methods used for conducting tests, acquiring and analyzing data so that another qualified individual could repeat the activity.

E.C. Dem  
12/20/2002