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Scientific Notebook # 365

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20-1402-871: KTI on Radionuclide Transport

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COPY 365

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Objectives (20-1402-871) - KTI on Radionuclide Transport (08/22/00)

The purpose of the research discussed in this scientific notebook (CNWRA Controlled Copy 365) is to document the results of sorption experiments conducted at CNWRA on behalf of the Radionuclide Transport KTI. These data are to be used to help provide independent constraints on parameters used to simulate radionuclide transport from the proposed repository. Uses of these data may include parameter determination, process-model calibration, and parameter uncertainty estimation. Computer codes that may be used include the geochemical codes such as PHREEQC, MINTEQA2, or EQ3/6 or commercial software such as data acquisition software, Microsoft Excel, SigmaPlot, and WordPerfect. As appropriate, this notebook may include references to previous scientific notebooks for procedures and calibrations.

8/11/99 Continued from 266/303

```
SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 09-Aug-1999 10:29
   C14 Eff (0-156 keV) = 96.44 %
C14 CHI SQUARE IPA DATA PROCESSED - 09-Aug-1999 10:39
   C14 Chi Square = 13.78
H3 IPA DATA PROCESSED - 09-Aug-1999 10:40
   H3 Eff (0-18.6 keV) = 65.40 %
H3 CHI SQUARE IPA DATA PROCESSED - 09-Aug-1999 10:51
   H3 Chi Square = 14.34
BKG IPA DATA PROCESSED - 09-Aug-1999 11:51
   Bkg (0-18.6 keV) = 17.08 cpm
   Bkg (0-156 keV)  = 24.13 cpm
   C14 E^2/B (1-156 keV)   = 501.40
   H3  E^2/B (1-18.6 keV)  = 252.08
10 Aug 1999  04:41          ALPHA/BETA - 1.09
Protocol #:43               TC-99 CPM                User : J

Time: 999.99
Data Mode: CPM                  Nuclide: MANUAL
Background Subtract: 1st Vial

            LL    UL   LCR   2S%    BKG
Region A:   0.0 -  300    0   0.0   19.33
Region B:   2.0 -  300    0   3.0   18.09
Region C:   0.0 - 2000    0   0.0   25.14

Quench Indicator: SIS
BETA CPM TC-99
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal
```

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
1	999.99	19.33	1.44	18.09	1.49	25.14	1.26	128.22	B
2	0.90	5030.67	2.98	4968.58	3.00	5028.19	2.98	174.39	
3	0.86	5226.01	2.99	5156.33	3.01	5221.37	2.99	176.22	
4	0.90	4992.89	2.99	4935.25	3.01	4993.75	2.99	173.90	
5	0.89	5055.95	2.99	5013.37	3.00	5055.75	2.99	173.45	
6	0.87	5165.72	2.99	5112.95	3.00	5171.41	2.99	177.02	
7	0.88	5106.80	2.99	5048.96	3.01	5104.40	2.99	172.68	
8	0.89	5088.53	2.98	5025.73	3.00	5088.34	2.98	170.64	
9	0.86	5202.76	3.00	5151.68	3.01	5200.44	3.00	174.09	
10	0.87	5174.92	2.99	5118.69	3.00	5173.71	2.99	174.63	
11	0.89	5088.53	2.98	5035.85	2.99	5087.22	2.98	175.59	

1 MISSING TUBE(S)

Tc-pH 300 ppb 3 days

13	8.51	510.04	3.09	504.59	3.11	508.82	3.11	180.40	
14	8.35	519.11	3.09	514.25	3.11	520.01	3.11	177.53	
15	8.57	506.34	3.09	500.82	3.11	506.59	3.11	172.81	Tc-P*
16	8.62	503.40	3.09	497.46	3.11	503.51	3.11	176.97	30 PPb
17	8.41	515.15	3.10	510.33	3.11	514.33	3.12	176.09	6days
18	8.72	496.61	3.10	491.78	3.11	496.87	3.12	179.76	
19	8.70	499.17	3.09	493.29	3.11	498.30	3.11	175.52	
20	8.40	517.09	3.09	510.96	3.11	516.28	3.11	176.54	
21	8.65	501.13	3.10	496.13	3.11	500.17	3.12	174.86	
22	8.48	510.62	3.10	506.21	3.11	510.23	3.12	175.22	
14 MISSING TUBE(S)									
37	8.26	525.94	3.09	520.05	3.10	524.13	3.11	173.20	
38	8.28	525.11	3.09	518.75	3.10	523.65	3.11	176.31	
39	8.36	517.99	3.10	513.73	3.11	517.20	3.12	175.05	Tc-K*
40	8.30	523.32	3.09	517.94	3.10	522.81	3.11	175.24	
41	8.43	514.95	3.09	509.31	3.11	515.78	3.11	175.50	
42	8.23	527.81	3.09	521.89	3.10	529.53	3.10	173.12	21days
1 MISSING TUBE(S)									
44	8.67	498.43	3.10	494.48	3.11	497.58	3.12	177.07	
45	8.96	482.90	3.10	478.23	3.11	482.67	3.12	174.97	Tc-KC*
46	8.48	511.09	3.10	506.32	3.11	511.65	3.11	176.15	
47	8.26	526.79	3.09	520.29	3.10	526.19	3.11	175.31	21days
48	8.30	523.92	3.09	517.33	3.11	524.98	3.10	173.30	
49	8.27	524.20	3.09	519.76	3.10	525.28	3.11	173.52	

12 Aug 1999 14:32 ALPHA/BETA - 1.09

Protocol #:43 TC-99 CPM U

C14 Eff (0-156 keV) = 96.61 %
C14 CHI SQUARE IPA DATA PROCESSED - 12-Aug-1999 14:43
C14 Chi Square = 26.18
H3 IPA DATA PROCESSED - 12-Aug-1999 14:44
H3 Eff (0-18.6 keV) = 65.24 %
H3 CHI SQUARE IPA DATA PROCESSED - 12-Aug-1999 14:55
H3 Chi Square = 10.54
BKG IPA DATA PROCESSED - 12-Aug-1999 15:55
Bkg (0-18.6 keV) = 16.85 cpm
Bkg (0-156 keV) = 24.18 cpm
C14 E^2/B (1-156 keV) = 505.61
H3 E^2/B (1-18.6 keV) = 249.63

13 Aug 1999 08:45 ALPHA/BETA - 1.09

Protocol #:43 TC-99 CPM User

Time: 999.99
Data Mode: CPM Nuclide: MANUAL
Background Subtract: 1st Vial

	LL	UL	LCR	2S%	BKG
Region A:	0.0 -	300	0	2.0	19.08
Region B:	2.0 -	300	0	0.0	17.81
Region C:	0.0 -	2000	0	0.0	24.91

Quench Indicator: SIS
BETA CPM TC-99
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG	
1	999.99	19.08	1.45	17.81	1.50	24.91	1.27	127.98	B	
2	1.99	5013.08	2.01	4962.09	2.02	5011.27	2.01	177.12		
3	1.93	5166.41	2.01	5113.28	2.02	5166.80	2.01	172.89		Tc-P*
4	2.00	4991.92	2.01	4936.69	2.02	4989.59	2.01	172.39		300
5	2.01	5102.81	1.98	5054.33	1.99	5099.97	1.98	176.04		PPb
6	2.01	4970.47	2.00	4912.54	2.02	4973.10	2.01	174.23		
7	2.12	4721.02	2.00	4673.23	2.01	4717.07	2.01	174.61		
8	2.01	5062.02	1.99	5007.07	2.00	5062.65	1.99	174.63		
9	1.91	5236.94	2.00	5188.48	2.01	5237.92	2.00	172.85		
10	1.95	5120.41	2.01	5070.40	2.01	5121.24	2.01	176.08		
11	1.92	5193.42	2.01	5146.26	2.02	5193.84	2.01	177.46		
1 MISSING TUBE(S)										
13	19.05	505.86	2.08	500.78	2.08	505.64	2.09	175.38		
14	18.23	529.47	2.07	524.76	2.08	529.62	2.08	176.41		Tc-P*
15	19.08	505.03	2.08	499.54	2.09	505.02	2.09	175.56		30 PPb
16	18.80	512.89	2.07	508.68	2.08	513.28	2.09	177.51		
17	19.10	504.59	2.08	499.10	2.09	504.99	2.09	177.88		
18	18.18	530.98	2.07	525.65	2.08	531.14	2.08	178.07		
19	18.78	513.72	2.07	509.08	2.08	513.64	2.09	176.75		
20	18.24	529.33	2.07	523.37	2.08	530.24	2.08	173.95		
21	18.19	530.78	2.07	524.08	2.08	531.38	2.08	173.88		
22	18.63	517.74	2.07	512.79	2.08	517.49	2.09	176.43		
1 MISSING TUBE(S)										
24	1.08	9257.77	2.00	9147.01	2.01	9255.65	2.00	160.79		
25	1.21	8280.09	2.00	8184.67	2.01	8282.53	2.00	162.92		Filtered
26	1.10	9146.38	2.00	9032.19	2.01	9145.09	2.00	160.95		thru
27	1.24	8072.86	2.00	7991.06	2.01	8072.67	2.00	164.30		0.2 µm
28	1.17	8575.79	2.00	8479.63	2.01	8576.80	2.00	161.95		300
29	1.24	8108.34	2.00	8016.06	2.01	8105.73	2.00	165.05		PPb
										Tc-99

8/16/99 AJ

Preparation of $NaHCO_3$ (1M)
Dilute 84.01 g of $NaHCO_3$ (lot # 936883) with DI H_2O to 1000 ml.

8/19/99 ^{233}U-sorption onto Clinoptilolite at $pCO_2^{-2.0}$

Experimental Procedure for experiment - U sorption onto clinoptilolite at $pCO_2^{-2.0}$

Objective: To investigate the characteristics of U sorption onto clinoptilolite at $pCO_2^{-2.0}$ as a function of pH.

Initial conditions:
- $\sum U$ = 50 ppb (2.14×10^{-7})
- containers in glove box with pCO_2 of -2.0
- pH range 3.0-9.0
- solution volume = 35 ml
- mass of solid clinoptilolite = 0.700 g
- M/V = 20 g/L

Equipment:
Orion 920A pH meter and combination pH electrode
Gyratory shaker
Glove box
Fisher Marathon 21K centrifuge
Mettler PM4600 and AE240 balances
Packard 2500 TR/AB LSC
Eppendorf micropipetters and tips
Oxford pipettes and tips
Repipettor for transfer of scintillation cocktail

Supplies:
100/200 fraction clinoptilolite in Na-form
50 ppb ^{233}U stock solution
polycarbonate centrifuge tubes with caps (40 ml capacity)
polypropylene centrifuge tubes with caps (40 ml capacity)
pH buffer solutions
Ultima-Gold liquid scintillation cocktail
7 ml scintillation vials

reagent grade NaHCO3 (lot 936883)
concentrated HNO_3 (lot 983546)
HNO_3 and NaHCO3 stock solutions at various concentrations
weighing paper/boats
deionized ultrapure water, DH_2O
teflon beaker

Procedure:

A. Prepare separate 50 ppb U solutions for sorption experiments.
- On the Metler balance, weigh 100 g of 500 ppb U stock solution into a tared 1000 ml FEP bottle.
- Dilute to a total of 1000 g using degassed 0.1m $NaNO_3$ stock solution.
- Cap and label bottle accordingly.

B. Transfer (2.14×10^{-7}) 50 ppb ^{233}U stock solution to experimental containers.

- Label 24 polycarbonate centrifuge tubes (40 ml capacity) CU-pCO_2- pHi (where i is the approximate pH of each solution, see Table CU-pCO_2).

- Label 1 polycarbonate centrifuge tube CU- pCO_2-IU.
- Weigh and record the weight of each container.
- About 840 ml of ^{233}U solution will be required for this experiment.
- Add ~35 g of the 50 ppb ^{233}U stock solution to each container.
  Note: the stock solution should be transferred to a teflon beaker for easier dispensing into the sample containers.
- Record weight of each container.

C. Add clinoptilolite to sample containers.

- Add ~0.700 g of clinoptilolite to each sample container. **Do not** add clinoptilolite to the CU-pCO_2- IU container.
- Record weight of each sample container after addition of clinoptilolite.

D. Adjust pH of each solution by adding HNO_3 or NaHCO3.

- Add the volume of HNO_3 or NaHCO3 to each experimental container as listed in Table CU-pCO_2. Take care to add HNO_3 or NaHCO3 in the concentrations specified in Table CU-pCO_2.
- For sample CU-pCO_2-IU add 100 μl of 50/50 V/V HNO_3 to the sample container.
- Weigh and record the weight of each sample container.

E. Sample CU-pCO_2-IU for initial [U].

- Label two 7 ml LSC vials as CU-pCO_2-IUa and CU-pCO_2-IUb.
- Add 0.5 ml of 0.02 M HNO_3 to each vial.
- Record weight of each vial.
- Transfer 0.5 ml of solution from CU-pCO_2-U-IU to each sample vial.
- Record weight of each vial.
- Add 5 ml of Ultima-Gold cocktail to each vial, mix, and set aside for counting.
- Record weight of container CU-pCO_2-IU

F. Wait for equilibrium.

- Place caps on sample containers but do not tighten the caps.
- Place containers inside the glove box maintained at ~ 10,000 ppm CO_2 atmosphere.
- Place containers on gyratory shaker set at about 120 rpm and allow samples to equilibrate for at least 10 days.

G. Sample experimental solutions for [U] and pH.

- For each sample solution label two 7 ml LSC vials (e.g., CU-pCO_2-pH3a and CU-pCO_2-pH3b).
- Add 0.5 ml of 0.02 M HNO_3 to each vial.
- Record weight of each vial.
- Record weight of each sample container.
- From each sample container withdraw two 0.5 ml aliquots of solution and transfer to the appropriately labeled LSC vials.
- Record weight of each vial.
- Add 5 ml of Ultima-Gold cocktail to each vial, mix, and set aside for counting.

8/19/99 AJ Total Clinoptilolite = 35.9 g.
Clinoptilolite total ≈ 20 g (unused portion in container)

Sample Name	Original Container wt., g
AJ	
CU-pH 3.0	22.0207
CU-pH 3.5	22.2107
CU-pH 4.0	22.3910
CU-pH 4.25	22.4051
CU-pH 4.5	22.0088
CU-pH4.75	22.3455
CU-pH 5.0	22.1068
CU-pH 5.25	22.0049
CU-pH 5.5	22.0712
CU-pH 5.75	22.0179
CU-pH 6.0	22.3347
CU-pH 6.25	22.3474
CU-pH 6.5	22.0040
CU-pH 6.75	22.2165
CU-pH 7.0	22.0564
CU-pH 7.25	22.2425
CU-pH 7.5	22.0325
CU-pH 7.75	21.9862
CU-pH 8.0	22.3920
CU-pH 8.25	21.9862
CU-pH 8.5	22.3447
CU-pH 8.75	22.0748
CU-pH 9.0	22.2881
CU-pCO_2 – IU	22.0165 g

8/19/99
AJ

CU - IVa
CU - IVb
CU - IVc
CU - IVa
50 ppb U-Spike

7.3167
7.2940
7.8478
7.8934

7.8235
7.7997
8.3496
8.3952

AJ

	Sample Name	Wt. Of Container + clinoptilolite + U soln., g
C	QU-pH 3.0	57.7298
C	QU-pH 3.5	57.9170
C	QU-pH 4.0	58.0868
C	QU-pH 4.25	58.0977
C	QU-pH 4.5	57.7093
C	QU-pH4.75	58.0516
C	QU-pH 5.0	57.8142
C	QU-pH 5.25	57.7167
C	QU-pH 5.5	57.7767
C	QU-pH 5.75	57.7278
C	QU-pH 6.0	58.0436
C	QU-pH 6.25	58.0546
C	QU-pH 6.5	57.7148
C	QU-pH 6.75	57.9243
C	QU-pH 7.0	57.7583
C	QU-pH 7.25	57.9432
C	QU-pH 7.5	57.7338
C	QU-pH 7.75	57.6925
C	QU-pH 8.0	58.0903
C	QU-pH 8.25	57.6843
C	QU-pH 8.5	58.0423
C	QU-pH 8.75	57.7854
C	QU-pH 9.0	57.9863
C	CU-PCO2 IV	57.0313

8/19/99

CU-PCO2-IVa ~~7.3167~~ 7.8256 ~~7.8235~~ 8.3171
CU-PCO2-IVb ~~7.2940~~ AJ 7.8379 DKW 8/22/00 ~~7.7997~~ AJ 8.3311
CU-PCO2-IVc ~~7.8478~~ AJ 7.8432 8.3468
CU-PCO2-IVd ~~7.8524~~ AJ 7.8524 8.3583

AJ

	Sample Name	Wt. Of container + U-soln, g
C	QU-pH 3.0	57.0299
C	QU-pH 3.5	57.216
C	QU-pH 4.0	57.3865
C	QU-pH 4.25	57.3974
C	QU-pH 4.5	57.0091
C	QU-pH4.75	57.3508
C	QU-pH 5.0	57.1133
DKW 8/22/00 C	QU-pH 5.25	57.0159
C	QU-pH 5.5	57.0760
for all C	QU-pH 5.75	57.0261
C	QU-pH 6.0	57.3434
C	QU-pH 6.25	57.3529
C	QU-pH 6.5	57.0138
C	QU-pH 6.75	57.2228
C	QU-pH 7.0	57.0568
C	QU-pH 7.25	57.2422
C	QU-pH 7.5	57.0335
C	QU-pH 7.75	56.9910
C	QU-pH 8.0	57.3894
C	QU-pH 8.25	56.9834
C	QU-pH 8.5	57.3415
C	QU-pH 8.75	57.0845
C	QU-pH 9.0	57.2852

pH adjustments for a 2.1x10-7 U solution (50 ppb) at a PCO2 of 10-2 atm. Solution volume is 35 ml.

8/20/99

Sample pH	Amount of HNO3 to add	Molarity of HNO3
2.5	0.13 100+20+10	1.0
3	DLW 8/22/00 0.39 ~~200~~ 300 +50+20+20	0.1
3.25	NA DLW 8/22/00 0.21 ~~200+10~~ pc	0.1
3.5	0.1 200+10	0.1
3.75	NA 0.08	0.05
4	0.03 20+10	0.05
	Amount of NaHCO3 to add	**Molarity of NaHCO3**
4.25	0.1 100	0.005
4.5	0.34 300+20+20	0.005
4.75	0.25 250	0.01
5	0.31 300+10	0.01
5.25	0.39 300+50+20+20	0.01
5.5	0.5 500	0.01
5.75	0.14 100+20+20	0.05
6	0.2 200	0.05
6.25	0.32 300+20	0.05
6.5	0.26 200+50+10	0.1
6.75	0.45 200+200+50	0.1
7	0.16 100+50+10	0.5
7.25	0.27 200+50+20	0.5
7.5	0.49 250+200+20+20	0.5
7.75	0.44 200+200+20+20	1.0
8	0.79 500+250+20+20	1.0
8.25	0.73 1000+200+~~200~~ 250 +10 DLW 8/22/00	~~2.0~~ 1.0
8.5	1.39	2.0
8.75	1.85	3.0
9	2.5 No additions	5.0

IV 0.100 50/50 HNO_3

8/20/99

	Sample Name	Container Wt. After additions of HNO3 and NaHCO3., g
A0		
C	QU-pH 3.0	58.1219
C	QU-pH 3.5	58.0167
C	QU-pH 4.0	58.1122
C	QU-pH 4.25	58.1972
C	QU-pH 4.5	58.0487
C	QU-pH4.75	58.3006
C	QU-pH 5.0	58.1171
C	QU-pH 5.25	58.1033
C	QU-pH 5.5	58.2772
C	QU-pH 5.75	57.8659
C	QU-pH 6.0	58.24
C	QU-pH 6.25	58.3722
C	QU-pH 6.5	57.9759
C	QU-pH 6.75	58.4766
C	QU-pH 7.0	57.9206
C	QU-pH 7.25	58.2131
C	QU-pH 7.5	58.2323
C	QU-pH 7.75	58.1471
C	QU-pH 8.0	58.9141
C	QU-pH 8.25	58.938
C	QU-pH 8.5	59.8159
C	QU-pH 8.75	59.8839
C	QU-pH 9.0	59.181

CU-PO_2 IV DLW 8/22/00 ~~AJ~~ 57.1547 g

CU-PO_2 IV after sampling 55.1588 g & after 2nd sampling = 55.1588

8/25/99 AJ

PH adjustments for PH 5.0 & PH 9.0 samples

QU-PH5.0 DLW 8/22/00 ~~0.500~~ 0.200 ml of 1.0 M HNO_3 added

QU-PH 9.0 0.500 ml of 1.0 M HNO_3 added

24 Aug 1999 04:01 ALPHA/BETA - 1.0
Protocol #:23 U-233 3% 2 SIGMA

	LL	UL	LCR	2S%
Region A:	0.0 -	100	0	0.3
Region B:	100 -	350	0	3.0
Region C:	0.0 -	2000	0	0.1

Time: 999.99
Data Mode: CPM Nuclide: MANUAL
Background Subtract: 1st Vial

Alpha CPM U-233

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
P# 1	999.99	16.15	1.57	2.95	3.69	24.45	1.28	148.22	B
23 2	7.80	5.51	60.64	566.93	3.02	574.79	3.05	543.72	spike
23 3	8.07	6.40	52.40	548.23	3.01	557.59	3.05	540.74	spike
23 4	7.92	6.32	54.04	558.29	3.02	569.87	3.04	616.06	spike
23 5	7.95	4.85	67.20	556.80	3.01	566.25	3.05	619.71	spike
23 6	8.50	7.61	44.06	520.47	3.02	531.44	3.04	614.33	CU-PuO$_2$-IV
23 7	8.24	3.63	85.70	536.62	3.02	544.12	3.05	613.58	CU-PuO$_2$-IV
23 8	8.05	1.74	172.5	549.10	3.02	553.57	3.06	614.80	CU-PuO$_2$-IV
23 9	7.85	5.63	60.03	563.55	3.01	572.75	3.05	606.73	CU-PuO$_2$-IV

8/31/99 AJ

Sample Name	Container wt. before sampling & pH measurements, g	Measured pH 9/1/99	Container wt. after sampling & pH measurements, g 9/2/99
QU-pH 3.0	57.6697	3.44	56.6395
QU-pH 3.5	57.3857	4.32	56.3619
QU-pH 4.0	57.6038	4.93	56.5738
QU-pH 4.25	57.8161	5.21	56.7928
QU-pH 4.5	57.6931	5.28	56.6809
QU-pH4.75	58.0218	5.30	57.0006
QU-pH 5.0	57.9242	2.57	56.9018
QU-pH 5.25	57.7801	5.54	56.7627
QU-pH 5.5	57.4417	5.61	56.3912
QU-pH 5.75	57.4072	5.69	56.3747
QU-pH 6.0	57.3519	5.82	56.3209
QU-pH 6.25	57.9938	6.04	56.9715
QU-pH 6.5	57.6326	6.32	56.5926
QU-pH 6.75	58.1275	6.63	57.1070
QU-pH 7.0	57.4453	6.79	56.4279
QU-pH 7.25	57.6008	7.05	56.5730
QU-pH 7.5	57.8420	7.31	56.8153
QU-pH 7.75	57.6342	7.60	56.6440
QU-pH 8.0	58.5238	7.78	57.4798
QU-pH 8.25	58.6242	7.88	57.5840
QU-pH 8.5	59.5782	8.12	58.5558
QU-pH 8.75	59.4773	8.19	58.4301
QU-pH 9.0	59.181	2.13	58.1646

DRJ 8/22/00 for all

DRJ 8/22/00 for all X-outs

Sample Name	wt. of vial	wt. Of vial + sample
CU QC0U -pH 3a	7.8805	8.3741
CU QC0U -pH 3b	7.8812	8.376
CU QC0U--pH 3.5a	7.8632	8.3600
CU QC0U-pH 3.5b	7.8290	8.3271
CU QC0U--pH 4a	7.8015	8.2945
CU QC0U--pH 4b	7.8503	8.3444
CU QC0U--pH 4.25a	7.8218	8.3173
CU QC0U--pH 4.25b	7.8573	8.3530
CU QC0U-pH 4.5a	7.8882	8.3813
CU QC0U-pH 4.5b	7.7624	8.2593
CU QC0U-pH 4.75a	7.8134	8.3043
CU QC0U-pH 4.75b	7.8863	8.3758
CU QC0U-pH 5a	7.8066	8.3064
CU QC0U-pH 5b	7.8545	8.35
CU QC0U-pH 5.25a	7.8358	8.3313
CU QC0U-pH 5.25b	7.8687	8.359
CU QC0U-pH 5.5a	7.8831	8.3786
CU QC0U-pH 5.5b	7.7969	8.2959
CU QC0U-pH 5.75a	7.8547	8.3536
CU QC0U-pH 5.75b	7.8653	8.3642
CU QC0U-pH 6a	7.8170	8.3149
CU QC0U-pH 6b	7.8380	8.3357
CU QC0U-pH 6.25a	7.7845	8.2836
CU QC0U-pH 6.25b	7.8377	8.3311
CU QC0U-pH 6.5a	7.8776	8.3724
CU QC0U-pH 6.5b	7.8331	8.3253
CU QC0U-pH 6.75a	7.8378	8.3363
CU QC0U-pH 6.75b	7.8552	8.3496
CU QC0U-pH 7a	7.8580	8.3524
CU QC0U-pH 7b	7.7722	8.2677
CU QC0U-pH 7.25a	7.7836	8.279
CU QC0U-pH 7.25b	7.8264	8.3215
CU QC0U-pH 7.5a	7.8658	8.3624
CU QC0U-pH 7.5b	7.8345	8.3278
CU QC0U-pH 7.75a	7.8702	8.331
CU QC0U-pH 7.75b	7.7983	8.2923
CU QC0U-pH 8a	7.8974	8.3874
CU QC0U-pH 8b	7.7986	8.2945
CU QC0U-pH 8.25a	7.7832	8.2761
CU QC0U-pH 8.25b	7.8377	8.3336
CU QC0U-pH 8.5a	7.8743	8.3708
CU QC0U-pH 8.5b	7.8541	8.3505
CU QC0U-pH 8.75a	7.8844	8.3791
CU QC0U-pH 8.75b	7.8071	8.3057
QC0U-pH 9a	7.8620	8.3486
CU QC0U-pH 9b	7.7719	8.2336

03 Sep 1999 06:31 ALPHA/BETA - 1.09 P
Protocol #:23 U-233 3% 2 SIGMA User :

Time: 999.99
Data Mode: CPM Nuclide: MANUAL
Background Subtract: 1st Vial

	LL	UL	LCR	2S%	BKG
Region A:	0.0 -	100	0	0.3	16.19
Region B:	100 -	350	0	3.0	2.97
Region C:	0.0 -	2000	0	0.1	24.72

Quench Indicator: SIS
ALPHA CPM U-233
Luminescence Correction On
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal
Count Data Filename: C:\JIMP\SDATA23.DAT

WARNING: USER HAS MODIFIED COUNT CONDITIONS

S#	P#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
	1	999.99	16.19	1.57	2.97	3.67	24.72	1.27	148.14	B
23	2	11.00	2.27	114.7	401.03	3.02	403.64	3.09	611.26	↑
23	3	10.89	2.55	104.5	405.21	3.02	408.89	3.09	608.25	
23	4	16.27	0.84	247.2	270.30	3.03	270.85	3.15	607.67	CU-PlO_2
23	5	16.19	0.00	0.00	271.71	3.03	271.76	3.15	610.19	
23	6	26.06	0.00	0.00	167.56	3.05	167.10	3.25	612.68	
23	7	26.25	0.88	186.8	166.44	3.05	167.28	3.24	608.74	
23	8	29.70	0.14	1048	146.66	3.06	147.26	3.28	611.79	
23	9	29.13	0.00	0.00	149.59	3.06	149.53	3.28	610.94	
23	10	31.30	1.20	127.4	139.01	3.07	140.71	3.28	606.14	
23	11	30.62	0.67	228.4	142.20	3.06	143.17	3.28	607.39	
23	12	30.90	0.68	224.4	140.88	3.06	141.81	3.29	607.16	
23	13	30.45	0.00	0.00	142.98	3.06	144.11	3.28	611.90	
23	14	9.04	0.00	0.00	488.74	3.02	488.00	3.09	608.74	
23	15	9.10	1.07	262.3	485.60	3.02	487.59	3.08	606.60	
23	16	33.30	0.78	187.4	130.52	3.07	131.22	3.31	605.27	
23	17	33.62	0.65	222.8	129.31	3.07	129.77	3.32	608.61	
23	18	31.62	0.00	0.00	137.61	3.07	136.85	3.32	610.25	
23	19	31.68	0.67	222.4	137.31	3.07	138.06	3.29	603.01	
23	20	29.80	0.63	245.0	146.16	3.06	147.53	3.27	603.80	
23	21	30.63	1.02	150.7	142.12	3.06	143.87	3.27	603.74	
23	22	26.78	0.00	0.00	162.98	3.06	162.88	3.26	606.14	
23	23	26.33	1.51	110.4	165.81	3.05	167.99	3.23	602.81	
23	24	25.24	0.18	930.2	173.10	3.05	173.57	3.24	605.65	
23	25	25.46	0.59	282.2	171.66	3.05	172.72	3.23	601.93	
23	26	21.42	0.00	0.00	204.69	3.04	205.86	3.19	605.95	
23	27	21.81	0.50	353.4	201.02	3.04	202.93	3.19	605.70	

23	28	14.85	0.78	276.6	296.56	3.03	298.78	3.13	606.49
23	29	14.70	0.48	449.0	299.41	3.03	300.79	3.13	606.92
23	30	11.62	0.51	477.4	379.99	3.02	380.27	3.11	605.90
23	31	11.39	0.67	364.2	387.55	3.02	388.97	3.10	603.30
23	32	9.46	1.05	259.4	467.01	3.02	469.15	3.08	603.93
23	33	9.33	0.00	0.00	473.88	3.02	474.31	3.08	605.83
23	34	8.51	4.50	70.36	519.71	3.02	523.69	3.07	598.95
23	35	8.55	0.19	1491	517.62	3.02	517.15	3.08	605.97
23	36	9.11	1.82	155.4	485.62	3.02	487.35	3.08	609.97
23	37	8.32	1.00	287.9	531.17	3.02	532.73	3.07	606.44

03 Sep 1999 19:19 ALPHA/BETA - 1.09
Protocol #:23 U-233 3% 2 SIGMA User :

23	38	8.41	0.00	0.00	525.57	3.02	526.88	3.08	613.02
23	39	8.57	2.72	111.0	516.29	3.02	520.67	3.07	606.56
23	40	8.33	1.94	154.5	531.01	3.02	533.62	3.07	612.52
23	41	8.51	0.97	293.6	519.83	3.02	522.28	3.07	613.11
23	42	8.45	3.70	83.28	523.66	3.02	526.99	3.07	613.23
23	43	8.56	1.34	214.7	516.31	3.02	518.27	3.07	615.69
23	44	8.83	0.00	0.00	501.00	3.02	501.55	3.08	624.11
23	45	8.58	2.58	116.5	514.98	3.02	519.80	3.07	618.03
23	46	8.77	1.15	249.4	504.10	3.02	506.18	3.08	606.53
23	47	9.36	3.26	89.76	472.14	3.02	475.92	3.08	602.95
23									

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 03-Sep-1999 20:54
C14 Eff (0-156 keV) = 96.89 %
C14 CHI SQUARE IPA DATA PROCESSED - 03-Sep-1999 21:05
C14 Chi Square = 24.89
H3 IPA DATA PROCESSED - 03-Sep-1999 21:06
H3 Eff (0-18.6 keV) = 65.28 %
H3 CHI SQUARE IPA DATA PROCESSED - 03-Sep-1999 21:17
H3 Chi Square = 17.54
BKG IPA DATA PROCESSED - 03-Sep-1999 22:17
Bkg (0-18.6 keV) = 16.38 cpm
Bkg (0-156 keV) = 23.25 cpm
C14 E^2/B (1-156 keV) = 513.20
H3 E^2/B (1-18.6 keV) = 256.37

08 Sep 1999 05:02 ALPHA/BETA - 1.09

Protocol #:23 U-233 3% 2 SIGMA User

Time: 999.99

Data Mode: CPM Nuclide: MANUAL

Background Subtract: 1st Vial

	LL	UL	LCR	2S%	BKG
Region A:	0.0 -	100	0	0.3	16.23
Region B:	100 -	350	0	3.0	2.88
Region C:	0.0 -	2000	0	0.1	24.58

Quench Indicator: SIS

ALPHA CPM U-233

Luminescence Correction On

Coincidence Time(ns): 18

Delay Before Burst(ns): Normal

Count Data Filename: C:\JIMP\SDATA23.DAT

CU - PtO_2 sorption

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
1	999.99	16.23	1.57	2.88	3.73	24.58	1.28	145.97	B
2	10.73	0.27	941.8	411.48	3.02	412.23	3.10	613.44	
3	10.59	0.00	0.00	416.77	3.02	414.89	3.11	610.46	
4	16.17	0.00	0.00	272.14	3.03	272.76	3.15	611.48	
5	16.80	2.11	100.6	261.71	3.03	263.99	3.14	605.71	
6	26.39	0.00	0.00	165.52	3.05	165.19	3.25	614.22	
7	26.02	0.00	0.00	167.92	3.05	167.27	3.26	611.84	
8	28.31	0.16	965.6	154.10	3.06	154.33	3.27	610.55	
9	29.14	0.55	280.6	149.63	3.06	150.81	3.26	608.45	
10	30.89	0.09	1694	140.99	3.06	141.72	3.28	612.40	
11	30.77	0.15	989.6	141.58	3.06	142.43	3.28	607.38	
12	30.24	0.31	495.8	144.15	3.06	145.46	3.27	609.17	
13	30.25	1.03	150.7	144.10	3.06	145.44	3.27	608.31	
14	9.05	2.22	131.2	488.40	3.02	491.55	3.08	605.79	
15	9.09	3.57	84.27	486.23	3.02	492.25	3.07	605.34	
16	33.28	0.66	222.7	130.66	3.07	131.76	3.30	610.46	
17	33.06	0.68	215.7	131.55	3.07	132.10	3.31	608.73	
18	30.66	0.11	1335	142.07	3.06	142.84	3.28	610.41	
19	31.93	0.00	0.00	136.30	3.06	136.43	3.30	610.51	
20	29.72	1.23	127.3	146.72	3.06	148.90	3.26	607.52	
21	31.17	0.00	0.00	139.70	3.06	138.40	3.32	614.55	
22	26.42	0.92	180.0	165.37	3.05	166.45	3.24	604.55	
23	26.23	0.00	0.00	166.59	3.05	166.54	3.25	611.20	
24	25.57	0.00	0.00	170.92	3.05	169.79	3.26	610.66	
25	25.21	1.58	108.9	173.52	3.05	175.62	3.22	603.74	
26	21.90	4.41	44.78	200.05	3.04	205.33	3.16	595.48	
27	21.80	5.84	35.18	200.98	3.04	207.62	3.15	590.24	
28	15.35	3.71	62.27	286.64	3.03	291.31	3.12	599.73	
29	15.17	4.14	56.67	290.07	3.03	294.73	3.12	600.99	
30	11.08	1.46	175.6	398.57	3.02	400.51	3.10	604.80	
31	11.51	0.89	279.1	383.48	3.02	386.45	3.10	603.85	

32	9.10	2.67	109.5	485.59	3.02	489.70	3.07	603.42
33	9.22	2.75	105.9	479.34	3.02	483.99	3.07	600.78
34	8.58	3.00	101.3	515.07	3.02	518.54	3.07	604.61
35	8.40	3.77	82.10	526.53	3.02	531.37	3.06	601.75
36	8.79	2.54	115.4	502.81	3.02	506.14	3.07	610.65
37	8.42	1.94	153.8	525.27	3.02	527.91	3.07	606.77
38	8.49	2.15	139.3	520.80	3.02	523.12	3.07	610.13
39	8.36	3.39	91.81	529.06	3.02	534.15	3.06	610.06

08 Sep 1999 18:13 ALPHA/BETA - 1.09

Protocol #:23 U-233 3% 2 SIGMA User

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
40	8.46	1.03	282.3	522.89	3.02	524.47	3.07	612.19	
41	8.53	4.17	75.26	518.11	3.02	523.95	3.06	609.82	
42	8.46	4.58	69.54	522.66	3.02	528.14	3.06	612.18	
43	8.71	4.09	75.73	507.46	3.02	512.96	3.06	613.70	
44	8.54	4.50	70.28	518.09	3.02	522.26	3.07	617.55	
45	8.80	4.00	76.94	502.69	3.02	507.46	3.07	618.17	
46	8.71	2.83	106.2	507.92	3.02	512.04	3.07	602.92	
47	9.47	2.46	115.9	466.50	3.02	469.19	3.08	605.53	
2 MISSING TUBE(S)									
50	7.96	6.51	52.64	555.79	3.01	564.49	3.05	596.30	
51	8.09	4.54	70.83	547.06	3.01	553.29	3.06	603.24	

30
8/30/99 AJ

AJ
Heavy liquid treatment of 60/100 mesh size, carbonates removed & iron removed quartz.
Using Procedure from 266/16, prepare heavy liquid with density $\rho = 2.75$ g/cc
$\rho_{qtz} = 2.65$ g/cc
11.56 ml of N-N dimethyl formamide, $\rho = 0.93445$ g/cc
150 ml of bromoform $\rho_{bromo} = 2.8899$ g/cc

Mix N-N dimethyl formamide & bromoform and store in dark bottle.

31
8/31/99 AJ

Heavy liquid treatment of 60/100 * RC * RFe quartz.

9/3/99 AJ

~~Crush~~ AJ quartz Heavy liquid treatment for removal of impurities heavier than quartz completed. Wash quartz with DI H_2O & dry in the oven ~ 90°C.

9/7/99

AJ
Using procedure 266/41
Crush W510 * UC * RC * RFe * HL to ≤325 mesh size
Collect the fraction in Pan (325/pan)

9/8/99

AJ

Crush W510 * UC * RC * RFe * HL to ≤325 mesh size.

9/9/99

Crush quartz to ≤325 mesh size. The quartz used was treated for removal of carbonate & iron impurities & HL removal

9/10/99

Crush 60/100 fraction quartz to ≤325 mesh size

9/13/99

AJ
Crush chemically pretreated quartz for carbonate iron and heavier impurities to 325 mesh size

Total prepared quartz ~ 62 g (200/325 mesh)
~ 40 g (≤ 325 mesh)

Wash quartz with DI H_2O & ultrasonic cleaner 3 times.

Following procedure on 266/42 remove particles < 0.004 mm

Dry W510 * 325 mesh * RC * RFe * HL at 85°C overnight.
Total qtz after complete treatment = 32 g (≤325 mesh)

9/14/99 AJ

&

9/15/99

Objective:- To analyse surface area of 325/200 mesh size fraction of chemically cleaned quartz.

Equipments needed:- Coulter SA3100
W510 * UC * RC * RFe * 325/200 * HL quartz
Liquid N_2
N_2 & He gas tanks
Weighing balance
Weighing boat

Procedure:- As per Coulter 3100 product manual

(1) wt. of tube assembly # 1 = 33.6431 g

wt of quartz added = 1.6718 g
outgass time = 720 min.
outgas temp. = 350°C
wt. of tube assembly after outgas = 35.3130

wt of outgassed sample = 1.6699
SA = 0.136 m^2/g

(2) wt. of tube assembly # 2 = 33.2364
wt. of quartz added = 1.0076 g
wt. of tube assembly with sample after outgas = 34.2424 g
wt. of outgassed sample = 1.0060
SA = 0.118 m^2/g

9/20/99 AJ
9/21/99 objective:- To analyse surface area of ~~200/325~~ 325/pan (≤325) mesh size fraction of chemically ~~pre~~ cleaned quartz using Coulter SA 3100. AJ DRJ 8/22/00 DRJ 8/22/00

(1) W510 * VC * RC * RFe * HL * ≤325 mesh * R ≤ 0.004 mm
wt. of tube assembly # 2 = 33.2420 g
wt. of quartz added = ~~33~~ 1.5035 g AJ DRJ 8/22/00
wt of outgassed sample + tube assembly = 34.7338
wt. of outgassed sample = 1.4918
SA = 0.271 m^2/g

(2) wt. of tube assembly # 9 = 33.2235 g
wt. of quartz added = 1.0922 g
wt. of tube assembly and outgassed sample = 34.3094 g
wt. of outgassed sample = 34.3094
− 33.2235
1.0859 g
SA = 0.275 m^2/g

(3) Crush W510 * VC * RFe * HL to ≤325 mesh size for high PCO_2 sorption experiments

9/22/99 AJ
Crush W510 * VC * RFe * HL * RC to ≤325 mesh size (for high PCO_2 U-sorption experiments) using agate mortar & pestle.

9/23/99 AJ
Crush W510 * VC * RC * RFe * HL to ≤325 mesh size (for high PCO_2 U-sorption experiments) using agate mortar & pestle.

9/24/99 AJ
Crush W510 * VC * RC * RFe * HL to ≤325 mesh size (for high PCO_2 U-sorption experiments) using agate mortar & pestle
Total crushed qtz ≈ 30 g

(1) Wash quartz with DI H_2O using ultrasonic cleaner twice. Decant the supernatant & throw it out.
(2) Wash 3-4 more times with DI water until the supernatant is not milky.
(3) Centrifuge about ~2g of quartz with 30-40 ml of DI water at 1500 rpm for 2 min. Repeat once more to remove particles < 0.004 mm.

9/27/99 AJ

(1) Removal of particles < 0.004 mm from W510 * RC * VC * RFe * ≤325 mesh * HL.

(2) Crush untreated CDV to 100/200 mesh size (for high PCO_2 sorption experiments) using agate mortar & pestle.

9/28/99 AJ

(1) Crush untreated clinoptilolite (CDV) to 100/200 mesh size for high PCO_2 sorption experiments.

9/29/99 AJ (1) Analyze surface area of ≤-325 mesh size fraction of chemically cleaned quartz using Coulter SA 3100.

9/30/99 (a) wt. of tube assembly # 2 = 33.4020 g
wt. of quartz added = 1.0466 g

wt. of outgassed sample + tube assembly = 34.4334 g
wt. of outgassed sample = 34.4334 − 33.4020
= 1.0314 g
10/1/99
surface area = 0.239 m^2/g

9/30/99 AJ (6) wt. of tube assembly #9 = 33.3043 g
wt. of quartz added = 1.2960 g
wt. of outgassed sample + tube assembly = 34.6063 g
wt. of outgassed sample = 34.6063
− 33.3043
1.3020 g
10/1/99
surface area = 0.226 m^2/g

Conditions for outgassing
outgas temp. = 350°C, outgas time = 720 min.

9/29/99 (2) Crush Clinoptilolite to 100/200 mesh size using agate mortar and pestle & 8" diameter sieves for high PCO_2 V-sorption experiments.

9/30/99 AJ
(1) Crush Clinoptilolite to 100/200 mesh size using agate mortar & pestle & 8" diameter sieves for high PCO_2 V-sorption experiments.

10/1/99 AJ (2) Sodium acetate buffer at PH = 5.0, 1N for carbonates removal from CDV.
Na acetate trihydrate (937077) = 136 g.
Acetic acid (971798) = 28 ml

Dissolve 136 g. of sodium acetate trihydrate in

~ 900 ml of ultrapure H_2O. Add acetic acid slowly until PH = 5.0. Dilute it with DI H_2O till 1L mark.

Following procedure for "Removal of Carbonates" from 266/3, carbonates were removed from 100/200 mesh size CDV.
~4 g of CDV was treated with ~40 ml of NaOAc Buffer at PH = 5.0 at ~95°C for 30 min.

10/4/99 AJ

(1) Prepare 0.3M Na-citrate solution for iron-oxide removal (impurities) from CDV * RC * 100/200 mesh
88.0 g of Na-citrate dihydrate lot # 940621 was diluted with ultrapure H_2O up to 1000 ml mark.

(2) Iron-Oxide Removal from CDV * RC * 100/200 mesh.
Following procedure from 266/03 iron-oxide ~~was~~ impurities were removed.
AJ

1M $NaHCO_3$ solution from 8/16/99 was used.

$Na_2S_2O_4$ (sodium dithionite) Lot # 930669 was used.

5g CDV / 20ml Na-citrate & 2.5 ml 1M $NaHCO_3$ soln. and 0.5g of $Na_2S_2O_4$ three times each.

Saturated NaCl 5ml / 5g of CDV.

(3) Surface area measurements on W510 * RC * RFe * HL * ≤325 mesh — 10/5/99 AJ

(a) wt. of tube assembly # 2 = 33.4034 g
wt. of qtz added = 1.0895 g.
10/5/99 wt. of tube assembly + outgassed sample = 33.4921
wt. of outgassed sample = 1.0887 g
SA = 0.272 m²/g

outgassed at 350°C for 900 hrs.
W510 * ≤325 * RC * RFe * HL

(b) wt. of tube assembly # 9 = 33.3051 g
wt. of qtz added = 1.0860 g
10/5/99 wt. of tube assembly + outgassed sample = 34.3513
SA = 0.288 m²/g

10/5/99 AJ.

(1) wt. of tube assembly # 1 = 33.65~~48~~ AJ 71 g
wt. of tube assembly + sample qtz = 34.7406 g
W510 * RC * RFe * HL * ≤325
wt. of qtz added ≈ 1.0835 g
outgas time = 900 hrs, outgas temp. = 350°C

wt. of tube assembly + outgassed quartz = 34.7347 g
wt. of outgassed quartz = 34.7347
− ~~34.7406~~ AJ
33.6571
1.0776 g
SRJ 8/22/00

SA = 0.303 g

Experimental Procedure for experiment uncapped U-233 sorption onto quartz at 25° C.

Objective: To investigate the characteristics of U sorption onto quartz as a function of pH.

Initial conditions:
- $\sum U$ = 50 ppb [2.1×10^{-7} molal]
- equilibrium with above atmospheric $CO_2(g)$; $pCO_2 = 10^{-2.5}$
- pH range 2.5-9.0
- solution volume = 35 ml
- mass of solid = 1.000 g
- M/V = 28.57

Equipment:
Orion 920A pH meter and combination pH electrode
Gyratory shaker
Fisher Marathon 21K centrifuge
Mettler PM4600 and AE240 balances
Packard 2500 TR/AB LSC
Eppendorf micropipetters and tips
Oxford pipettes and tips
Repipettor for transfer of scintillation cocktail

Supplies:
quartz (W510*<325 mesh*UC*RC*RFe*HL)
2.1×10^{-6} m ^{233}U stock solution (spike 28A)
0.1M $NaNO_3$ matrix to dilute spike 28A
polycarbonate centrifuge tubes with caps (40 ml capacity)
polypropylene centrifuge tubes with caps (40 ml capacity)
pH buffer solutions
Ultima-Gold liquid scintillation cocktail
7 ml scintillation vials
reagent grade $NaHCO_3$ (lot 936883)
concentrated HNO_3 (lot 983546)
HNO_3 and $NaHCO_3$ stock solutions at various concentrations
weighing paper/boats
deionized ultrapure water, DH_2O
teflon beaker

Procedure:

A. Prepare separate 50 ppb U solutions for sorption experiments.
4. On the Metler balance, weigh 200g of 500 ppb U stock solution into a tared 2000 ml FEP bottle.
5. Dilute to a total of 2000g using 0.1m $NaNO_3$ stock solution.
6. Cap and label bottle accordingly.

B. Transfer (2.14×10^{-7}) 50 ppb ^{233}U stock solution to experimental containers.
a. Label 24 polycarbonate centrifuge tubes (40 ml capacity) QU-pHi (where i is the approximate pH of each solution, see Table QU).
b. Label 1 polycarbonate centrifuge tube QU-IU.
c. Weigh and record the weight of each container.
d. About 900ml of ^{233}U solution will be required for this experiment.
e. Add ~35 g of the 50 ppb ^{233}U stock solution to each container. *Note: the stock solution should be transferred to a Teflon beaker for easier dispensing into the sample containers.*
f. Record weight of each container.

C. Add quartz to sample containers.
- Add ~1.00 g of quartz to each sample container. **Do not** add quartz to the QU-IU container.
- Record weight of each sample container after addition of quartz .

D. Adjust pH of each solution by adding HNO_3 or NaHCO3.
- Add the volume of HNO_3 or Nah.)3 to each experimental container as listed in Table QU20. Take care to add HNO_3 or NaHCO3 in the concentrations specified in Table QU20.

- For sample QU-IU (as listed in Table QU20) add 100 μl of 50/50 V/V HNO_3 to the sample container.
- Weigh and record the weight of each sample container.

E. Sample QU20-IU for initial [U].

- Label two 7 ml LSC vials as QU-IUa and QU-IUb.
- Add 0.5 ml of 0.02 M HNO_3 to each vial.
- Record weight of each vial.
- Transfer 0.5 ml of solution from QU-IU to each sample vial.
- Record weight of each vial.
- Add 5 ml of Ultima-Gold cocktail to each vial, mix, and set aside for counting.
- Record weight of container QU-IU.

F. Wait for equilibrium.

- Place caps on sample containers but do not tighten. Leave caps loose so that solutions can equilibrate with CO2 rich atmosphere.
- Place containers on gyratory shaker set at about 120 rpm and allow samples to equilibrate with CO2 rich atmosphere for at least 10 days.

G. Sample experimental solutions for [U] and pH.

- For each sample solution label two 7 ml LSC vials (e.g.,QU-pH3a and QU-pH3b).
- Add 0.5 ml of 0.02 M HNO_3 to each vial.
- Record weight of each vial.
- Record weight of each sample container.
- Measure pH of each experimental solution.
- From each sample container withdraw two 0.5 ml aliquots of solution and transfer to the appropriately labeled LSC vials.
- Record weight of each vial.
- Add 5 ml of Ultima-Gold cocktail to each vial, mix, and set aside for counting.
- Record weight of each sample container after pH measurement and sampling for LSC counting.

H. Transfer quartz for desorption.

- Record weight of sample containers. *Note: this step can be skipped if the quartz transfer is done immediately after the last step in section G..*
- For each sample container, label a corresponding polypropylene (PP) test tube (50 ml capacity) (e.g., QUd-pH3 for sample container QUd-pH3).
- Record weight of PP test tubes.
- Using an Eppendorf or Oxford pipette, withdraw clinoptilolite from the polycarbonate sample containers and transfer to the corresponding PP test tubes.
- Record weights of sample containers and PP test tubes.
- Add approximately 3 ml of 0.1 M HNO_3 to both experimental containers and PP test tubes and mix thoroughly.
- Record weights of sample containers and PP test tubes.
- Place sample containers and PP test tubes on gyratory shaker (at about 120 rpm) and allow to desorb for at least 10 days.

I. Sample solutions for [U].

- For each sample container and PP test tube label two 7 ml LSC vials (e.g., QU-pH3a and QU-pH3b).
- Add 0.5 ml of 0.02 M HNO_3 to each vial.
- Record weight of each vial.
- Record weight of each sample container and PP test tube.
- From each sample container and PP test tube withdraw two 0.5 ml aliqouts of solution and transfer to the appropriately labeled LSC vials.
- Record weight of each vial.
- Add 5 ml of Ultima-Gold cocktail to each vial, mix, and set aside for counting.
- Record weight of each sample container and PP test tube.

10/6/99 AJ

Sample name	original wt. of container
PCO_2-QU- PH 2.5	DR 8/22/00 { ~~21.9758~~ AJ 22.2336
PCO_2-QU- PH 3.0	{ ~~21.9884~~ DR 9758
PCO_2-QU- PH 3.5	21.9884
PCO_2-QU- PH 4.0	21.9474
PCO_2-QU- PH 4.25	22.2032
PCO_2-QU- PH 4.5	22.4492
PCO_2-QU- PH 4.75	22.4018
PCO_2-QU- PH 5.0	22.3350
PCO_2-QU- PH 5.25	22.3663
PCO_2-QU- PH 5.5	21.9775
PCO_2-QU- PH 5.75	22.1963
PCO_2-QU- PH 6.0	22.0159
PCO_2- QU- PH 6.25	22.3912
PCO_2-QU- PH 6.5	22.3719
PCO_2- QU- PH 6.75	22.3528
PCO_2-QU- PH 7.0	22.2147
PCO_2-QU- PH 7.25	22.0530
PCO_2-QU- PH 7.5	22.0928
PCO_2-QU- PH 7.75	21.9951
PCO_2-QU- PH 8.0	22.2100
PCO_2- QU- PH 8.25	21.9520
PCO_2- QU- PH 8.5	22.3175
PCO_2-QU- PH 8.75	22.3392
AJ ~~QU- PH 9.0~~ DR 8/22/00	
QU- IU	22.0340

	wt. of vial	wt. of vial + sample of spike	Spike
a	7.9058	8.4082	50 PPb
b	7.8059	8.3080	

Dilute Spike 28A to 50PPb. 50g. of spike #28A was diluted to 500 g with 0.1M $NaNO_3$ matrix.

10/6/99 AJ

Sample name	wt. of container + U-soln.
PCO_2 - QU PH 2.5	57.2486
PCO_2 - QU PH 3.0 DRW 8/22/00	56.9795
PCO_2 - QU PH 3.~~25~~ AJ 5	57.0029
PCO_2 - QU PH 4.0	56.9506
PCO_2 - QU PH 4.25	57.2181
PCO_2 - QU PH 4.5	57.4530
PCO_2 - QU PH 4.75	57.4061
PCO_2 - QU PH 5.0	57.3415
PCO_2 - QU PH 5.25	57.4027
PCO_2 - QU PH 5.5	56.9890
PCO_2 - QU PH 5.75	57.2105
PCO_2 - QU PH 6.0	57.0203
PCO_2 - QU PH 6.25	57.4069
PCO_2 - QU PH 6.5	57.3770
PCO_2 - QU PH 6.75	57.3692
PCO_2 - QU PH 7.0	57.2193
PCO_2 - QU PH 7.25	57.0568
PCO_2 - QU PH 7.5	57.1083
PCO_2 - QU PH 7.75	57.0052
PCO_2 - QU PH 8.0	57.2201
PCO_2 - QU PH 8.25	56.9549
PCO_2 - QU PH 8.5	57.3370
PCO_2 - QU PH 8.75	57.3522
PCO_2 QU ~~PH 9.0~~ AJ IV	57.0602

DRW 8/22/00

10/6/99 AJ ① wt. of tube assembly #2 = 33.3999 g
wt. of qtz. added ≈ 1.0847 g
wt. of tube assembly + qtz added = 34.4724 g
W510 * S325 * RC * RFe * HL
Actual amount of qtz. added ≈ 1.0725 g.
wt. of tube assembly + outgassed sample = 34.4589 g.
10/7/99 AJ wt. of outgassed sample = 34.4589 − 33.3999
= 1.0590 g

SA = 0.263 m^2/g

② wt. of tube assembly #9 = 33.1778 g
wt. of qtz. added = 1.0852 g
wt. of tube assembly + qtz added = 34.2570 g
Actual amount of qtz added ≈ 1.0792 g
wt. of tube assembly + outgassed sample = 34.2525
10/7/99 AJ wt. of outgassed sample = 34.2525
33.1778
1.0747 g

SA = 0.212 m^2/g

10/7/99 AJ

Sample	wt. of container + U-soln + Quartz added, g
QU-PCO_2 PH 2.5	58.2465
QU-PCO_2 PH 3.0	57.9795
QU-PCO_2 PH 3.5	58.002~~2~~ ~~30~~ AJ AJ 30
QU-PCO_2 4.0	57.956~~3~~ AJ 15
QU-PCO_2 4.25	58.227~~8~~ AJ 22
QU-PCO_2 4.5	58.452~~3~~ AJ 33
QU-PCO_2 4.75	58.40~~57~~ AJ 81
QU-PCO_2 5.0	58.344~~4~~ AJ 58
QU-PCO_2 5.25	58.403~~7~~ AJ 50
QU-PCO_2 5.5	57.9938
QU-PCO_2 5.75	58.2102
QU-PCO_2 6.0	58.0186
QU-PCO_2 6.25	58.4111
QU-PCO_2 6.5	58.3773
QU-PCO_2 6.75	58.3704
QU-PCO_2 7.0	58.2209
QU-PCO_2 7.25	58.0570
QU-PCO_2 7.5	58.1108
QU-PCO_2 7.75	58.0061
QU-PCO_2 8.0	58.2216
QU-PCO_2 8.25	57.9547
QU-PCO_2 8.5	58.3377
QU-PCO_2 8.75	58.3555

DRJ 8/22/00 for all x-outs

Acid & base (HNO_3 & $NaHCO_3$) additions were made to adjust PH of experimental solutions using QU Table on page 32.

10/7/99

Sample	wt. of container + U soln + qtz + acid/base additions, g
QU-PCO_2 PH 2.5	58.3986
QU-PCO_2 3.0	58.0282
QU-PCO_2 3.5	58.1113
QU-PCO_2 4.0	58.0193
QU-PCO_2 4.25	58.3062
QU-PCO_2 4.5	58.7455
QU-PCO_2 4.75	58.6092
QU-PCO_2 5.0	58.5824
QU-PCO_2 5.25	58.6599
QU-PCO_2 5.5	58.2652
QU-PCO_2 5.75	58.4935
QU-PCO_2 6.0	58.3183
QU-PCO_2 6.25	58.7340
QU-PCO_2 6.5	58.4467
QU-PCO_2 6.75	58.4601
QU-PCO_2 7.0	58.3238
QU-PCO_2 PH 7.25	58.2013
QU-PCO_2 PH 7.5	58.3217
QU-PCO_2 PH 7.75	58.17~~3~~ 35 42 DRJ 8/22/00
QU-PCO_2 PH 8.0	58.5059
QU-PCO_2 PH 8.25	58.0534
QU-PCO_2 PH 8.5	58.5162
QU-PCO_2 PH 8.75	58.5239
QU-PCO_2 IU	57.1878

10/8/99 AJ

wt. of vial →		wt. of vial + sample
QU-PCO_2 - IVa	7.7050	8.2067
QU-PCO_2 - IVa	7.7644	8.2662

Table QU: Estimated solution pH and volumes of HNO3 or NaHCO3 solutions needed for adjustment of pH in 0.1 m NaNO3 solutions with 50 ppb U in contact with q/clinoz (35 ml)
for $PCO_2^{-3.5}$

Estimated solution pH	Volume of HNO3 added, ml	Molarity of HNO3 to use
2	0.421	1
2.25	0.235	1
2.5	- 0.131	1
2.75	0.072	1
3	DB 8/22/00 - ~~0.394~~ 0.40	DB 8/22/00 1 ~~0.1~~
3.25	0.209	0.1
3.5	- 0.106	0.1
3.75	0.047	0.1
4	- 0.071	0.02
Estimated solution pH	**Volume of NaHCO3 added, ml**	**Molarity of NaHCO3 to use**
4.25	0.084	0.005
4.5	0.292	0.005
4.75	0.205	0.01
5	0.239	0.01
5.25	0.260	0.01
5.5	0.274	0.01
5.75	0.286	0.01
6	0.300	0.01
6.25	0.322	0.01
6.5	- 0.071	0.05
6.75	0.084	0.05
7	0.106	0.05
7.25	0.145	0.05
7.5	0.214	0.05
7.75	0.169	0.1
8	0.282	0.1
8.25	0.097	0.5
8.5	0.174	0.5
8.75	- 0.160	1
9	0.305	1
QU-PCO2-IU	0.100	50% HNO3

Note:- Should have used table on pg. 10 for $PCO_2^{-2.0}$.

10/8/99 AJ

Heavy Liquid density seperation on CDV* 100/200 * RC *RFe following the procedure on 266/7.

Preparation of Heavy liquids of desired $\rho = 2.3$ g/cc

Heavy liquid tetrabromoethane, $\rho = 2.9672$ g/c.c
diluent density of Clinoptilolite = g/cc
N-N dimethyl formamide, $\rho = 0.93445$ g/c.c
V_h, Volume of tetrabromoethane = 150 ml,
V_l Volume of N-N dimethyl formamide = ??

$$V_l = V_h \frac{\rho_h - \rho_x}{\rho_x - \rho_l}$$

$$V_l = \left(\frac{2.9672 - 2.3}{2.3 - 0.93445}\right) \times 150\text{ml}$$

$$V_l = \left(\frac{0.6672}{1.36555}\right) 150$$

= 73.29 ml of N-N dimethyl formamid

(130 ml of N-N dimethyl formamide was mixed with 264 ml of tetrabromomethane).

10/11/99 AJ

Removal of impurities by heavy liquids density separation (CDV* 100/200 * RC * RFe) following the procedure in 266/7

10/12/99
10/13/99
AJ

(1)

Sample		Measured PH
QU-PCO_2 PH	2.5	1.80
QU-PCO_2	3.0	2.34
QU-PCO_2	3.5	3.55
QU-PCO_2	4.0	3.81
QU-PCO_2	4.25	4.35
QU-PCO_2	4.5	4.57
QU-PCO_2	4.75	4.86
QU-PCO_2	5.0	4.94
QU-PCO_2	5.25	5.16 - add 1M $NaHCO_3$ 0.600 ml
QU-PCO_2	5.5	5.10 — 10/13/99
QU-PCO_2	5.75	5.19 — add 1M $NaHCO_3$ 0.800 ml
QU-PCO_2	6.0	5.24
QU-PCO_2	6.25	5.31 -
QU-PCO_2	6.5	5.30 — add 1M $NaHCO_3$ 1.000 ml
QU-PCO_2	6.75	5.54
QU-PCO_2	7.0	5.62
QU-PCO_2	7.25	5.91
QU-PCO_2	7.5	6.12 - ~~add 0.1M $NaHCO_3$ 0~~ AJ 10/13/99
QU-PCO_2	7.75	6.34
QU-PCO_2	8.0	6.59
QU-PCO_2	8.25	6.84
QU-PCO_2	8.5	7.07
QU-PCO_2	8.75	7.32

(2) Heavy liquid density separation of CDV* 100/200 * RC * RFe continued.


```
SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 07-Oct-1999 13:21
   C14 Eff (0-156 keV) = 96.38 %
C14 CHI SQUARE IPA DATA PROCESSED - 07-Oct-1999 13:31
   C14 Chi Square = 18.10
H3 IPA DATA PROCESSED - 07-Oct-1999 13:32
   H3 Eff (0-18.6 keV) = 65.79 %
H3 CHI SQUARE IPA DATA PROCESSED - 07-Oct-1999 13:43
   H3 Chi Square = 13.16
BKG IPA DATA PROCESSED - 07-Oct-1999 14:43
   Bkg (0-18.6 keV) = 18.17 cpm
   Bkg (0-156 keV)  = 26.32 cpm
   C14 E^2/B (1-156 keV)   = 454.21
   H3  E^2/B (1-18.6 keV)  = 238.70

08 Oct 1999  07:33          ALPHA/BETA - 1.09
Protocol #:23               U-233 3% 2 Sigma                User :

Time: 999.99
Data Mode: CPM                 Nuclide: MANUAL
Background Subtract: 1st Vial

              LL    UL   LCR   2S%    BKG
Region A:   0.0 -  100    0   0.3  18.25
Region B:   100 -  350    0   3.0   3.14
Region C:   0.0 - 2000    0   0.1  27.05

Quench Indicator: SIS
Alpha CPM U-233 1st Vial Bkgnd.
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal
Count Data Filename: c:\JimP\SDATA23.DAT

 S#    TIME     CPMA A:2S%    CPMB B:2S%    CPMC C:2S%     SIS FLAG
  1 999.99    18.25  1.48    3.14  3.57   27.05  1.22  143.43    B
  2   7.83    49.18 11.95  564.42  3.02  618.03  2.94  575.13 ] spike for
  3   7.90    48.71 11.97  559.52  3.02  612.06  2.94  574.19 ]  QU high
                                                                 PCO2 expts.
```

DRS 8/22/00

SYSTEM NORMALIZED

```
C14 IPA DATA PROCESSED - 08-Oct-1999 12:37
   C14 Eff (0-156 keV) = 96.93 %
C14 CHI SQUARE IPA DATA PROCESSED - 08-Oct-1999 12:47
   C14 Chi Square = 13.46
H3 IPA DATA PROCESSED - 08-Oct-1999 12:49
   H3 Eff (0-18.6 keV) = 65.39 %
H3 CHI SQUARE IPA DATA PROCESSED - 08-Oct-1999 12:59
   H3 Chi Square = 17.85
BKG IPA DATA PROCESSED - 08-Oct-1999 14:00
   Bkg (0-18.6 keV) = 18.58 cpm
   Bkg (0-156 keV)  = 26.33 cpm
   C14 E^2/B (1-156 keV)   = 479.32
   H3  E^2/B (1-18.6 keV)  = 229.80
```

09 Oct 1999 06:49 ALPHA/BETA - 1.09 Page
Protocol #:23 U-233 3% 2 Sigma User : Alk

Time: 999.99
Data Mode: CPM Nuclide: MANUAL
Background Subtract: 1st Vial

	LL	UL	LCR	2S%	BKG
Region A:	0.0 -	100	0	0.3	18.02
Region B:	100 -	350	0	3.0	3.15
Region C:	0.0 -	2000	0	0.1	26.77

Quench Indicator: SIS
Alpha CPM U-233 1st Vial Bkgnd.
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal
Count Data Filename: c:\JimP\SDATA23.DAT

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG	
1	999.99	18.02	1.49	3.15	3.57	26.77	1.22	144.22	B	
2	7.85	56.37	10.93	563.35	3.02	623.68	2.92	566.54		spike U
3	7.87	51.99	11.49	561.53	3.02	615.92	2.93	569.72		
4	8.08	50.05	11.61	547.35	3.02	600.95	2.93	564.31		QU-PlO2 IUa & IUb.
5	7.87	48.43	12.01	561.66	3.02	613.00	2.94	570.92		

DR 8/22/00

10/14/99 AJ
Preparation of 3M NaCl for changing COV*RC*RFe*HL*100/200 to Na-clinoptilolite.

NaCl (lot # 984321) 175.32 g diluted with ultrapure H_2O & filled upto 1L mark.

Heavy liquid density separation on COV*RC*RFe*100/200.

10/15/99 AJ
① Rinse COV*RC*RFe*HL*100/200 with acetone using ultrasonic cleaner twice and one more time & let it air dry.
② Glove box CO_2 level ~ 10,010 ppm.

10/18/99 AJ Preparation of Na-form Clinoptilolite

Obj: Generate Na-Clinoptilolite

Method: cation exchange sites are filled with Na^+ by reacting the solid with 3M NaCl.

Equipment & Supplies :-
- Fisher waterbath Model 236
- 3M NaCl (lot 984321)
- Blue M drying oven
- 500 ml PP bottles

Procedure :- as 266/9

Started at 4:00 PM.

10/19/99 AJ
Add more water to waterbath Model 236

10/20/99 AJ CO_2 level = 10,030 ppm

Sample	Measured PH
QU-PCO2 PH 2.5	1.79
QU-PCO2 3.0	2.33
QU-PCO2 3.5	3.68
QU-PCO2 4.0	3.92
QU-PCO2 4.25	4.74
QU-PCO2 4.5	4.82
QU-PCO2 4.75	4.94
QU-PCO2 5.0	4.98
QU-PCO2 5.25	7.75
QU-PCO2 5.5	5.09
QU-PCO2 5.75	7.96
QU-PCO2 6.0	5.26
QU-PCO2 6.25	5.35
QU-PCO2 6.5	8.28
QU-PCO2 6.75	5.48
QU-PCO2 7.0	5.57
QU-PCO2 7.25	5.88
QU-PCO2 7.5	6.10
QU-PCO2 7.75	6.30
QU-PCO2 8.0	6.50
QU-PCO2 8.25	6.81
QU-PCO2 8.5	7.03
QU-PCO2 8.75	7.28

~~9.0~~ AJ DRJ 8/22/00

Change 3m NaCl solution for converting COV to Na form

Sample	wt. of container before sampling & PH measurements	wt. of container after sampling & PH measurements 10/21/99 nc
QU-PCO2 PH 2.5	57.9190	56.8921
QU-PCO2 3.0	57.5320	56.5089
QU-PCO2 3.5	57.7323	56.7050
QU-PCO2 4.0	57.6054	56.5838
QU-PCO2 4.25	57.9180	56.8981
QU-PCO2 4.5	58.1621	57.1386
QU-PCO2 4.75	58.3081	57.2952
QU-PCO2 5.0	58.2845	57.2601
QU-PCO2 5.25	58.4646	57.4435
QU-PCO2 5.5	57.8655	56.8537
QU-PCO2 5.75	58.~~8~~ AJ 9004	57.8334
QU-PCO2 6.0	57.9767	56.9547
QU-PCO2 6.25	58.3595	57.3454
QU-PCO2 6.5	59.2031	58.1789
QU-PCO2 6.75	58.1261	57.1017
QU-PCO2 7.0	57.9902	56.9654
QU-PCO2 7.25	57.6700	56.5680
QU-PCO2 7.5	57.9793	56.9600
QU-PCO2 7.75	57.8535	56.9024
QU-PCO2 8.0	57.9503	56.9303
QU-PCO2 8.25	57.7769	56.7559
QU-PCO2 8.5	58.1801	57.0389
QU-PCO2 8.75	58.1291	57.0994

10/21/99 AJ 10/22/99

	wt. of vial	wt. of vial + Sample
QU-PCO2 PH2.5a	7.7362	8.2394
QU-PCO2 2.5b	7.8579	8.3608
QU-PCO2 3a	7.8369	8.3368
QU-PCO2 3b	7.7913	8.2931
QU-PCO2 3.5a	7.7519	8.2572
QU-PCO2 3.5b	7.7286	8.2318
QU-PCO2 4a	7.7486	8.2514
QU-PCO2 4b	7.8356	8.3384
QU-PCO2 4.25a	7.7906	8.2929
QU-PCO2 4.25b	7.8221	8.3219
QU-PCO2 4.5a	7.7696	8.2694
QU-PCO2 4.5b	7.7974	8.3008
QU-PCO2 4.75a	7.8431	8.3345
QU-PCO2 4.75b	7.8625	8.3566 DRJ 8/22/00
QU-PCO2 5a	7.8195	8.30~~50~~ 93 AJ
QU-PCO2 5b	7.7606	8.2660
QU-PCO2 5.25a	7.8533	8.3467
QU-PCO2 5.25b	7.8096	8.3106
QU-PCO2 5.5a	7.7281	8.2266
QU-PCO2 5.5b	7.7510	8.2485
QU-PCO2 5.75a	7.7527	8.2546
QU-PCO2 5.75b	7.8651	8.3635
QU-PCO2 6a	7.8393	8.3414
QU-PCO2 6b	7.8340	8.3358
QU-PCO2 6.25a	7.8145	8.3054
QU-PCO2 6.25b	7.9029	8.3956
QU-PCO2 6.5a	7.7527	8.2525
QU-PCO2 6.5b	7.8630	8.3655
QU-PCO2 6.75a	7.7882	8.2896
QU-PCO2 6.75b	7.7688	8.2718
QU-PCO2 7a	7.7323	8.2368
QU-PCO2 7b	7.7438	8.2445
QU-PCO2 7.25a	7.8002	8.3040
QU-PCO2 7.25b	7.8049	8.3088

	wt. of vial	wt. of vial + sample
QU-PCO2 7.5a	7.8050	8.3067
QU-PCO2 7.5b	7.8718	8.3684
QU-PCO2 7.75a	7.7805	8.2067
QU-PCO2 7.75b	7.8315	8.3320
QU-PCO2 8a	7.8581	8.3570
QU-PCO2 8b	7.8025	8.3025
QU-PCO2 8.25a	7.8563	8.3578
QU-PCO2 8.25b	7.8383	8.3375
QU-PCO2 8.5a	7.8378	8.3388
QU-PCO2 8.5b	7.8436	8.3477
QU-PCO2 8.75a	7.8503	8.3518
QU-PCO2 8.75b	7.8062	8.3117

3 M NaCl (Lot 947723) 175.32 g diluted with ultrapure H_2O upto 1L mark.
87.66 g diluted with ultrapure H_2O upto 500 ml mark. DRJ 8/22/00

Change the 3m NaCl solution for ~~the~~ exchanging CDV to Na form.

Sample		Desorption wt. of PP tubes
dt QU-PCO2 PH 2.5		13.7687
dt QU-PCO2	3	13.4135
dt QU-PCO2	3.5	13.3963
dt QU-PCO2	4.0	13.7318
dt QU-PCO2	4.25	13.3025
dt QU-PCO2	4.5	13.7728
dt QU-PCO2	4.75	13.3277
dt QU-PCO2	5.0	14.1469
dt QU-PCO2	5.25	13.3319
dt QU-PCO2	5.5	13.8642
dt QU-PCO2	5.75	13.8110
dt QU-PCO2	6.0	13.7771
dt QU-PCO2	6.25	13.3965
dt QU-PCO2	6.5	13.7051

	wt. of PP tubes
QU-PCO2 6.75	13.3759
QU-PCO2 7.0	13.7727
QU-PCO2 7.25	13.7560
QU-PCO2 7.5	13.8241
QU-PCO2 7.75	13.8771
QU-PCO2 8.0	13.9188
QU-PCO2 8.25	13.9180
QU-PCO2 8.5	13.8501
QU-PCO2 8.75	13.8739

10/25/99 AJ

Sample	Start of desorp. wt. of Container	wt. of container after transfer of supernatant
QU-PCO2 PH 2.5	56.8256	RC ~~29.3777~~ 25.4445
QU-PCO2 3.0	56.4824	RC ~~31.7497~~ 25.7513
QU-PCO2 3.5	56.6701	25.3434
QU-PCO2 4.0	56.5498	24.7371
QU-PCO2 4.25	56.8674	26.0798
QU-PCO2 4.5	57.0572	25.9606
QU-PCO2 4.75	57.2470	24.8254
QU-PCO2 5.0	57.2166	24.8497
QU-PCO2 5.25	57.3978	RC ~~24.4647~~ 25.4825
QU-PCO2 5.5	56.8280	24.4647
QU-PCO2 5.75	57.7775	24.7578
QU-PCO2 6.0	56.9287	24.5256
QU-PCO2 6.25	57.3089	25.1561
QU-PCO2 6.5	58.1435	24.8589
QU-PCO2 6.75	57.0557	25.3232
QU-PCO2 7.0	56.9255	24.6089
QU-PCO2 7.25	56.5256	24.8999
QU-PCO2 7.5	56.9346	24.4921
QU-PCO2 7.75	56.8732	22.9953
QU-PCO2 8.0	56.9003	24.4608
QU-PCO2 8.25	56.7242	22.9171
QU-PCO2 8.5	56.9811	24.4199
QU-PCO2 8.75	57.0609	24.5223
QU-PCO2		

DEJ 8/22/00

RC

	Wt. of PP tubes after transfer of solid	Wt. of Container after retransfer of supernatant + acid
QU-PCO2 2.5	RC ~~56.5495~~ 16.9464	56.5495
QU-PCO2 3.0	17.1468	53.9893
QU-PCO2 3.5	16.7085	57.9321
QU-PCO2 4.0	16.4498	56.7282
QU-PCO2 4.25	17.1254	55.9651
QU-PCO2 4.50	17.2272	56.5048
QU-PCO2 4.75	15.7058	57.8117
QU-PCO2 5.0	16.6109	57.6779
QU-PCO2 5.25	16.4079	57.2007
QU-PCO2 5.5	16.3136	57.2016
QU-PCO2 5.75	16.3373	58.1329
QU-PCO2 6.0	16.2447	57.3704
QU-PCO2 6.25	16.1106	57.4985
QU-PCO2 6.5	16.1617	58.5628
QU-PCO2 6.75	16.3093	57.~~4811~~ 0509
QU-PCO2 7.0	16.1265	57.4811
QU-PCO2 7.25	16.5579	56.6054
QU-PCO2 7.5	16.1534	57.4690
QU-PCO2 7.75	15.8415	57.6314
QU-PCO2 8.0	16.1317	57.5448
QU-PCO2 8.25	15.8174	57.6534
QU-PCO2 8.5	15.9024	57.7666
QU-PCO2 8.75	16.0166	57.7959

DEJ 8/22/00

10/26/99 AJ

Sample	wt. of PP tubes after acid additions
QU-PCO2 2.5	19.9726
QU-PCO2 3.0	20.2050
QU-PCO2 3.5	19.7614
QU-PCO2 4.0	19.5159
QU-PCO2 4.25	20.1909
QU-PCO2 4.5	20.2927
QU-PCO2 4.75	18.7724
QU-PCO2 5.0	19.6595
QU-PCO2 5.25	19.4756

QU-PCO_2 PH 5.5	19.3786
QU-PCO_2 PH 5.75	19.4050
QU-PCO_2 PH 6.0	19.3131 DBJ 8/22/00
QU-PCO_2 PH 6.25	19.1774
QU-PCO_2 PH 6.5	19.2233
QU-PCO_2 PH 6.75	19.3708
QU-PCO_2 PH 7.0	19.1860
QU-PCO_2 PH 7.25	19.6102
QU-PCO_2 PH 7.5	19.1917
QU-PCO_2 PH 7.75	18.8985
QU-PCO_2 PH 8.0	19.1836
QU-PCO_2 PH 8.25	18.8796
QU-PCO_2 PH 8.5	18.9422
QU-PCO_2 PH 8.75	19.0713

Change 3M NaCl soln. on Clinoptilolite being converted to Na form.

10/28/99 AJ

```
SYSTEM NORMALIZED


C14 IPA DATA PROCESSED - 25-Oct-1999 10:00
   C14 Eff (0-156 keV) = 96.99 %
C14 CHI SQUARE IPA DATA PROCESSED - 25-Oct-1999 10:10
   C14 Chi Square = 15.79
H3 IPA DATA PROCESSED - 25-Oct-1999 10:11
   H3 Eff (0-18.6 keV) = 65.22 %

WARNING: Questionable H3 Chi square value - Please view historic data


BKG IPA DATA PROCESSED - 25-Oct-1999 11:22
   Bkg (0-18.6 keV) = 16.22 cpm
   Bkg (0-156 keV)  = 23.97 cpm
   C14 E^2/B (1-156 keV)   = 500.91
   H3  E^2/B (1-18.6 keV)  = 260.74
```


26 Oct 1999 04:12 ALPHA/BETA - 1.09

Protocol #:23 U-233 3% 2 Sigma User :

Time: 999.99
Data Mode: CPM Nuclide: MANUAL
Background Subtract: 1st Vial

	LL	UL	LCR	2S%	BKG
Region A:	0.0 -	100	0	0.3	17.07
Region B:	100 -	350	0	3.0	3.05
Region C:	0.0 -	2000	0	0.1	25.48

Quench Indicator: SIS
Alpha CPM U-233 1st Vial Bkgnd.
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal
Count Data Filename: c:\JimP\SDATA23.DAT

High PCO_2 = -2.0, QU

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
1	999.99	17.07	1.53	3.05	3.62	25.48	1.25	147.67	B
2	8.07	49.84	11.57	547.75	3.02	599.43	2.94	568.80	
3	7.78	51.31	11.57	569.06	3.01	622.34	2.93	568.61	
4	7.68	43.87	12.86	576.51	3.01	623.35	2.95	577.42	
5	8.01	43.98	12.57	552.00	3.02	598.25	2.95	576.28	
6	8.61	47.27	11.58	513.09	3.02	562.91	2.94	568.38	
7	8.68	45.37	11.84	509.39	3.02	555.63	2.95	570.30	
8	8.86	45.23	11.74	498.75	3.02	546.42	2.94	573.33	
9	9.14	45.07	11.58	483.16	3.02	530.54	2.94	571.09	
10	12.31	43.37	10.24	357.96	3.03	403.12	2.93	558.98	
11	12.56	39.38	10.79	351.09	3.03	392.28	2.94	563.70	
12	12.27	44.46	10.09	359.13	3.03	404.76	2.93	558.34	
13	12.12	43.08	10.36	363.61	3.03	408.60	2.93	560.79	
14	11.54	41.25	10.92	382.22	3.02	425.13	2.94	563.12	
15	11.19	44.32	10.59	394.27	3.02	441.28	2.93	564.14	QU-PCO_2
16	11.76	42.45	10.62	374.92	3.02	420.02	2.93	562.63	
17	11.47	42.39	10.76	384.39	3.02	428.93	2.94	564.46	
18	8.37	45.29	12.07	528.25	3.02	574.29	2.95	575.94	
19	8.10	45.64	12.21	546.21	3.02	592.06	2.95	576.32	
20	14.90	48.03	8.72	295.40	3.03	346.07	2.89	545.04	
21	14.79	43.24	9.36	297.42	3.03	344.50	2.91	551.72	
22	8.34	41.80	12.73	529.92	3.02	572.25	2.96	581.19	
23	8.38	43.55	12.37	527.26	3.02	571.90	2.95	578.84	
24	13.09	45.65	9.61	336.75	3.03	383.69	2.92	552.78	
25	13.52	45.58	9.46	325.72	3.03	373.86	2.91	551.82	
26	16.66	42.77	8.88	263.69	3.04	307.42	2.91	544.69	
27	16.97	50.34	7.94	258.88	3.04	310.65	2.87	533.38	
28	8.76	41.72	12.44	504.25	3.02	547.01	2.96	578.20	
29	8.66	40.90	12.67	510.80	3.02	553.28	2.96	580.74	
30	14.36	48.11	8.87	306.42	3.03	356.28	2.90	544.40	
31	14.32	47.73	8.93	307.35	3.03	357.56	2.89	544.83	
32	15.64	48.34	8.48	281.09	3.03	331.81	2.88	540.73	
33	16.14	47.74	8.41	272.41	3.03	321.80	2.88	540.45	
34	15.39	47.13	8.69	285.84	3.03	335.15	2.89	543.51	
35	15.84	44.54	8.87	277.76	3.03	324.15	2.90	542.10	
36	13.99	46.05	9.24	314.75	3.03	362.73	2.91	550.06	
37	14.42	44.44	9.31	305.34	3.03	352.40	2.91	549.78	

38	16.23	36.53	9.97	270.95	3.03	309.34	2.94	558.81
39	13.15	43.92	9.83	334.97	3.03	380.38	2.92	555.00
40	12.96	51.60	8.94	339.85	3.03	391.65	2.90	538.54

26 Oct 1999 12:25 ALPHA/BETA - 1.09
Protocol #:23 U-233 3% 2 Sigma User :

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
41	12.27	47.64	9.66	359.21	3.03	408.27	2.91	559.15	
42	10.27	45.54	10.86	429.76	3.02	475.89	2.94	564.90	
43	10.48	44.57	10.90	421.28	3.02	468.51	2.93	563.12	QV-P102
44	8.80	45.77	11.69	501.95	3.02	548.73	2.94	568.22	
45	8.86	44.67	11.83	499.09	3.02	544.95	2.95	571.18	
46	8.32	53.48	10.90	531.68	3.02	585.10	2.93	566.30	
47	8.18	44.42	12.36	540.47	3.02	586.38	2.95	569.93	

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 26-Oct-1999 13:30
C14 Eff (0-156 keV) = 96.59 %
C14 CHI SQUARE IPA DATA PROCESSED - 26-Oct-1999 13:41
C14 Chi Square = 28.70
H3 IPA DATA PROCESSED - 26-Oct-1999 13:42
H3 Eff (0-18.6 keV) = 65.05 %
H3 CHI SQUARE IPA DATA PROCESSED - 26-Oct-1999 13:53
H3 Chi Square = 19.92
BKG IPA DATA PROCESSED - 26-Oct-1999 14:53
Bkg (0-18.6 keV) = 18.58 cpm
Bkg (0-156 keV) = 26.28 cpm
C14 E^2/B (1-156 keV) = 470.76
H3 E^2/B (1-18.6 keV) = 228.00

Change 3M NaCl solution for CDV in process of being converted to Na-form.

10/29/99 AJ
Water bath refill.

10/30/99 AJ
Water bath refill. Change 3M NaCl solution on CDV

in process of being converted to Na-form.

11/1/99 AJ

① Prepared 3M NaCl solution
175.32 g of NaCl (lot # 947723) diluted with ultrapure H_2O upto 1L mark.

11/2/99 AJ

① Water bath refill. Change 3M NaCl solution on CDV being converted to Na-form. DRJ 2/22/00 AJ

② Prepared saturated NaCl solution to store ~~NaCl~~ Na-Clinoptilolite in dessicator over saturated NaCl solution.

11/3/99 AJ

① Water bath refill.

11/4/99 CDV * Na-form rinsed several times with ultrapure H_2O & dried.

11/8/99 AJ

Sample	desorption wt. of container before sampling	desorption wt. of PP tubes before sampling
QU-PCO2 PH 2.5	56.4000	19.9646
QU-PCO2 3.0	53.9018	20.1930
QU-PCO2 3.5	57.8146	19.7517
QU-PCO2 4.0	56.5964	19.5045
QU-PCO2 4.25	55.8145	20.1842
QU-PCO2 4.5	56.1514	20.2857
QU-PCO2 4.75	57.7031	18.7656
QU-PCO2 5.0	57.5405	19.6518
QU-PCO2 5.25	57.0941	19.4701
QU-PCO2 5.5	57.1208	19.3705
QU-PCO2 5.75	58.0402	19.3723
QU-PCO2 6.0	57.2863	19.3070
QU-PCO2 6.25	57.3742	19.1723
QU-PCO2 6.5	58.4732	19.2140
QU-PCO2 6.75	56.9578	19.3542
QU-PCO2 7.0	57.3891	19.1811
QU-PCO2 7.25	56.4928	19.5931
QU-PCO2 7.5	57.3925	19.16~~3~~40 AJ
QU-PCO2 7.75	57.4911	18.8657
QU-PCO2 8.0	57.4532	19.1710
QU-PCO2 8.25	57.5675	18.8698
QU-PCO2 8.5	57.6681	18.9271
QU-PCO2 8.75	57.6674	19.0666

Sample	Desorption ~~containers~~ AJ 11/8/99 wt. of vial	Tubes wt. of vial + sample
QU-PCO2 PH 2.5a	7.7620	8.2603
QU-PCO2 PH 2.5b	7.7237	8.2241
QU-PCO2 PH 3.0a	7.7708	8.2659
QU-PCO2 PH 3.0b	7.7753	8.2724
QU-PCO2 PH 3.5a	7.7093	8.2074
QU-PCO2 PH 3.5b	7.7323	8.2331

QU-PCO2 PH 4a	7.8070		8.3067
QU-PCO2 4b	7.7308		8.2318
QU-PCO2 4.25a	7.7638		8.0127
QU-PCO2 4.25b	7.8226		8.0799
QU-PCO2 4.5a	7.8277		8.3266
QU-PCO2 4.5b	7.7955		8.4116
QU-PCO2 4.75a	7.7803		8.2793
QU-PCO2 4.75b	7.6629		8.1646
QU-PCO2 5a	7.7888		8.2890
QU-PCO2 5b	7.7743		8.2769
QU-PCO2 5.25a	7.~~8059~~ 7488	DW 8/22/00	8.2516
QU-PCO2 5.25b	7.7126 AJ		8.2127
QU-PCO2 5.5a	7.~~7488~~ 8059	DW 8/22/00	8.3066
QU-PCO2 5.5b	7.7593 AJ		8.2620
QU-PCO2 5.75a	7.7438		8.2452
QU-PCO2 5.75b	7.6856		8.1959
QU-PCO2 6a	7.8272		8.3281
QU-PCO2 6b	7.8427		8.3440
QU-PCO2 6.25a	7.8183		8.3181
QU-PCO2 6.25b	7.7536		8.2541
QU-PCO2 6.5a	7.8519		8.3510
QU-PCO2 6.5b	7.8259		8.3235
QU-PCO2 6.75a	7.7618		8.2600
QU-PCO2 6.75b	7.8048		8.3118
QU-PCO2 7a	7.8273		8.3269
QU-PCO2 7b	7.8412		8.3428
QU-PCO2 7.25a	7.7893		8.2914
QU-PCO2 7.25b	7.7992		8.3013
QU-PCO2 7.5a	7.7523		8.2516
QU-PCO2 7.5b	7.7648		8.2655
QU-PCO2 7.75a	7.7067		8.2067
QU-PCO2 7.75b	7.6862		8.1923
QU-PCO2 8a	7.8159		8.3190
QU-PCO2 8b	7.8380		8.3424
QU-PCO2 8.25a	7.8049		8.3066
QU-PCO2 8.25b	7.8403		8.3544

QU-PCO2 PH 8.5a	7.7999	8.3074
QU-PCO2 PH 8.5b	7.8618	8.3706
QU-PCO2 PH 8.75a	7.6881	8.1960
QU-PCO2 PH 8.75b	7.7474	8.2567

Desorption ~~Tubes~~ AJ 10/8/99 Containers

Sample	wt. of vial	wt. of vial + sample
QU-PCO2 PH 2.5a	7.7683	8.2707
QU-PCO2 2.5b	7.8775	8.3826
QU-PCO2 3a	7.7823	8.2828
QU-PCO2 3b	7.7943	8.2962
QU-PCO2 3.5a	7.8168	8.3179
QU-PCO2 3.5b	7.8243	8.3281
QU-PCO2 4a	7.7223	8.2228
QU-PCO2 4b	7.7290	8.2304
QU-PCO2 4.25a	7.7408	8.2410
QU-PCO2 4.25b	7.8358	8.3383
QU-PCO2 4.5a	7.8311	8.3301
QU-PCO2 4.5b	7.7139	8.2157
QU-PCO2 4.75a	7.8386	8.3372
QU-PCO2 4.75b	7.8079	8.3097
QU-PCO2 5a	7.8192	8.3179
QU-PCO2 5b	7.7592	8.2584
QU-PCO2 5.25a	7.7836	8.2811
QU-PCO2 5.25b	7.8709	8.3713
QU-PCO2 5.5a	7.8036	8.3011
QU-PCO2 5.5b	7.7682	8.2667
QU-PCO2 5.75a	7.8058	8.3038
QU-PCO2 5.75b	7.8173	8.3177
QU-PCO2 6.0a	7.8025	8.2991
QU-PCO2 6b	7.8031	8.3032
QU-PCO2 6.25a	7.8152	8.3120
QU-PCO2 6.25b	7.8613	8.3600
QU-PCO2 6.5a	7.7758	8.2747
QU-PCO2 6.5b	7.8135	8.3137
QU-PCO2 6.75a	7.6725	8.1725

QU-PCO2 PH 6.75b	7.7575	8.2566
QU-PCO2 7.0a	7.7523	8.2511
QU-PCO2 7.0b	7.7446	8.2426
QU-PCO2 7.25a	7.7824	8.2817
QU-PCO2 7.25b	7.7713	8.2705
QU-PCO2 7.5a	7.7541	8.2533
QU-PCO2 7.5b	7.8370	8.3371
QU-PCO2 7.75a	7.8441	8.3432
QU-PCO2 7.75b	7.7856	8.2853
QU-PCO2 8.0a	7.8243	8.3250
QU-PCO2 8.0b	7.8070	8.3071
QU-PCO2 8.25a	7.8438	8.3444
QU-PCO2 8.25b	7.7336	8.2339
QU-PCO2 8.5a	7.8417	8.3416
QU-PCO2 8.5b	7.8613	8.3611
QU-PCO2 8.75a	7.8088	8.3072
QU-PCO2 8.75b	7.7725	8.2716

11/10/99

AJ Sample	wt. of desorption container after sampling	wt. of desorption tubes after sampling
QU-PCO2 PH 2.5	55.3658	18.9421
QU-PCO2 3.0	52.8835	19.1241
QU-PCO2 3.5	56.7584	18.7223
QU-PCO2 4.0	55.5622	18.4531
QU-PCO2 4.25	54.7809	19.6654
QU-PCO2 4.5	55.0944	19.0917
QU-PCO2 4.75	56.6604	AJ 17.7119
QU-PCO2 5.0	56.5085	18.5576
QU-PCO2 5.25	56.0520	18.4406
QU-PCO2 5.5	56.1018	18.3189
QU-PCO2 5.75	57.0106	18.2373
QU-PCO2 6.0	56.2782	18.2871
QU-PCO2 6.25	56.3602	18.1446
QU-PCO2 6.5	57.4466	18.1586
QU-PCO2 6.75	55.9301	18.3033
QU-PCO2 7.0	56.3729	18.1636

QU-PCO2	PH 7.25	55.4746	18.5809
QU-PCO2	7.5	56.3669	18.1387
QU-PCO2	7.75	56.4634	17.8166
QU-PCO2	8.0	56.4058	18.1277
QU-PCO2	8.25	56.5339	17.8144
QU-PCO2	8.5	56.6430	17.8931
QU-PCO2	8.75	56.6367	18.0269

11/10/99

Experimental Procedure for experiment - U sorption on mixed minerals (clinoptilolite and quartz) at 25° C.

Objective: To investigate the characteristics of U sorption on the mixture of clinoptilolite and quartz as a function of pH at higher than atmospheric CO_2(g).

Initial conditions: - $\sum U$ = 50 ppb (2.14 x 10^{-7})
- equilibrium with atmospheric CO_2(g); $pCO_2 = 10^{-2.0}$
- pH range 4.0-9.5
- solution volume = 35 ml
- mass of solid 1, quartz = 1.000 g
- mass of solid 2, clinoptilolite = 0.700 g
- M/V = 28.57 g/L

Equipment:
Orion 920A pH meter and combination pH electrode
Gyratory shaker
Fisher Marathon 21K centrifuge
Mettler PM4600 and AE240 balances
Packard 2500 TR/AB LSC
Eppendorf micropipetters and tips
Oxford pipettes and tips
Repipettor for transfer of scintillation cocktail
Glove box
CO_2(g) cylinder

Supplies:
CDV*100/200*RC*RFe*HL*Naf
W510*<325*RC*RFe*HL
50 ppb ^{233}U stock solution
polycarbonate centrifuge tubes with caps (50 ml capacity)
polypropylene centrifuge tubes with caps (50 ml capacity)
pH buffer solutions
Ultima-Gold liquid scintillation cocktail
7 ml scintillation vials
reagent grade $NaHCO_3$ (lot 936883)
concentrated HNO_3 (lot 983546)
HNO_3 and $NaHCO_3$ stock solutions at various concentrations
weighing paper/boats
deionized ultrapure water, DH_2O
teflon beaker

Procedure:

A. Prepare separate 50 ppb U solutions for sorption experiments.
- On the Metler balance, weigh 100 g of 500 ppb U stock solution into a tared 1000 ml FEP bottle.
- Dilute to a total of 1000 g using 0.1m $NaNO_3$ stock solution.
- Cap and label bottle accordingly.

B. Transfer (2.14 x 10^{-7}) 50 ppb ^{233}U stock solution to experimental containers.
- Label 24 polycarbonate centrifuge tubes (50 ml capacity) QC20U-HCO2-pHi (where i is the approximate pH of each solution, see Table CQU).
- Label 1 polycarbonate centrifuge tube QC20U-HC02-IU.
- Weigh and record the weight of each container.
- About 1L of ^{233}U solution will be required for this experiment.
- Add ~35 g of the 50 ppb ^{233}U stock solution to each container. *Note: the stock solution should be transferred to a teflon beaker for easier dispensing into the sample containers.*
- Record weight of each container.

C. Add quartz to sample containers.
- Add ~1.000 g of quartz to each sample container. **Do not** add quartz to the QC20U-HCO2-IU container.
- Record weight of each sample container after addition of quartz .

D. Add clinoptilolite to sample containers.
- Add ~0.700 g of clinoptilolite to each sample container. **Do not** add clinoptilolite to the QC20U-HCO2-IU container.
- Record weight of each sample container after addition of clinoptilolite.

E. Adjust pH of each solution by adding HNO_3 or NaHCO3.
- Add the volume of HNO_3 or $NaHCO_3$ to each experimental container as listed in Table QCU. Take care to add HNO_3 or $NaHCO_3$ in the concentrations specified in Table QCU.
- For sample QC20U-HCO2-IU (not listed in Table CQU) add 100 μl of 50/50 V/V HNO_3 to the sample container.
- Weigh and record the weight of each sample container.

F. Sample QC20U-HCO2-IU for initial [U].
- Label two 7 ml LSC vials asQC20U-HCO2-IUa and QC20U-HCO2-IUb.
- Add 0.5 ml of 0.02 M HNO_3 to each vial.
- Record weight of each vial.
- Transfer 0.5 ml of solution from QC20-HCO2-IU to each sample vial.
- Record weight of each vial.
- Add 5 ml of Ultima-Gold cocktail to each vial, mix, and set aside for counting.
- Record weight of container QC20U-HCO2-IU

G. Wait for equilibrium.
- Place caps on sample containers but do not tighten. Leave caps loose so that solutions can equilibrate with CO_2(g).
- Place containers on gyratory shaker set at about 120 rpm and allow samples to equilibrate with CO_2(g) for at least 10 days.

U-solution (e.g., QC20Ud-HCo2-pH3 for sample container QC20Ud-HCO2-pH3).

- Record weight for both set of of PP test tubes.
- Add 3.0 ml of 0.1M HNO3 to 50 ml PP tubes labeled as QC20Ud-HCO2-pH.
- Pour supernatant from PC containers into corressponding PP tubes leaving behind about 5ml in PCcontainer with quartz.
- Vortex the PC containers to suspend all the solid.
- Immediately transfer all the solid and solution to the corressponding PP tubes marked as QC20Ud-HCO2-pH.
- Transfer supernatant from the first PP tubes back to original PC containers.
- Record weights of sample containers and PP test tubes.
- Add approximately 3 ml of 0.1 M HNO_3 to both experimental containers and PP test tubes and mix thoroughly.
- Add 3.0 ml of 0.1M HNO3 to PP tubes containing the solid. *Note: Keep track of the tube weights.*
- Record weights of sample containers and both set of PP test tubes.
- Place sample containers and PP test tubes on gyratory shaker (at about 120 rpm) and allow to desorb for at least 10 days.

I. Sample solutions for [U].

- For each sample container and PP test tube label two 7 ml LSC vials (e.g., QC20Ud-HCo2-pH3a and QC20Ud-HCO2-pH3b).
- Add 0.5 ml of 0.02 M HNO_3 to each vial.
- Record weight of each vial.
- Record weight of each sample container and PP test tube.
- From each sample container and PP test tube withdraw two 0.5 ml aliqouts of solution and transfer to the appropriately labeled LSC vials.
- Record weight of each vial.
- Add 5 ml of Ultima-Gold cocktail to each vial, mix, and set aside for counting.
- Record weight of each sample container and PP test tube.

H. Sample experimental solutions for [U] and pH.

- For each sample solution label two 7 ml LSC vials (e.g., QC20U-HCO2-pH2.5a and QC20U-HCO2-pH2.5b).
- Add 0.5 ml of 0.02 M HNO_3 to each vial.
- Record weight of each vial.
- Record weight of each sample container.
- From each sample container withdraw two 0.5 ml aliquots of solution and transfer to the appropriately labeled LSC vials.
- Record weight of each vial.
- Add 5 ml of Ultima-Gold cocktail to each vial, mix, and set aside for counting.
- Record weight of each sample container.
- Measure pH of each experimental solution.
- Record weight of each sample container after pH measurement.

I. Transfer mixture of quartz and clinoptilolite for desorption.

- Record weight of sample containers. *Note: this step can be skipped if the solid transfer is done immediately after the last step in section H.*
- Centrifuge polycarbonate containers containing experimental solutions at 10,000 rpm for 15 min to remove fine particles from suspension.
- For each sample container, label a corresponding polypropylene (PP) test tube (50 ml capacity) for transfering solid(e.g., QC20Ud-HC)2-pH3 for sample container QC20Ud-HCO2-pH3).
- For each sample container, label a corresponding polypropylene (PP) test tube (50 ml capacity) for

11/10/99	Sample name	wt. of original container	wt. of container + U-soln.
	QC20U-HCO2 PH 2.5	22.3314	57.3439
	QC20U-HCO2 3.0	22.0242	57.0453
	QC20U-HCO2 3.5	22.0501	57.0597
	QC20U-HCO2 4.0	22.1917	57.1946
	QC20U-HCO2 4.25	22.1233	57.1321
	QC20U-HCO2 4.5	22.2216	57.2150
	QC20U-HCO2 4.75	22.2825	57.2925
	QC20U-HCO2 5.0	22.3441	57.3395
	QC20U-HCO2 5.25	22.2742	57.2876
	QC20U-HCO2 5.5	22.0273	57.0209
	QC20U-HCO2 5.75	22.0110 DLW 8/22/00	57.0182
	QC20U-HCO2 6.0	22.325~~8~~7 AT	57.3279
	QC20U-HCO2 6.25	22.2138	57.2021
	QC20U-HCO2 6.5	22.1324 DLW 8/22/00	57.1~~3~~2~~3~~7 AT 11
	QC20U-HCO2 6.75	22.2826	57.2762
	QC20U-HCO2 7.0	22.2019	57.2094
	QC20U-HCO2 7.25	22.~~2~~1597 AT DLW 8/22/00	57.1544
	QC20U-HCO2 7.5	22.5232	57.5229
	QC20U-HCO2 7.75	22.0833	57.0916
	QC20U-HCO2 8.0	21.9635	56.9629
	QC20U-HCO2 8.25	21.9557	56.9630
	QC20U-HCO2 8.5	22.3709	57.3803
	QC20U-HCO2 PH 8.75	22.3657	57.3798
	QC20U-HCO2 – IU	22.1682	57.1970

11/11/99		wt. of vial	wt. vial + sample
	Spike – a	7.7802	8.2823
	Spike – b	7.8915	8.3929
	QC20U-HCO2 IUa	7.7371	8.2392
	QC20U-HCO2 IUb	7.7479	8.~~2586~~ AT 2526
			wt. after sampling
	QC20U-HCO2 – IU		56.1893

EAP 8/24/00

Putting my initials AND TODAY'S DATE Here MAKES THIS Better. EAP 8/24/00

11/11/99 AJ

Sample	wt. of Container + Usoln + Clinop	wt. of Container + U-soln + Quartz + Clinop
QC20U-HCO2 PH2.5	58.0432	59.0415
QC20U-HCO2 3.0	57.7477	58.7461
QC20U-HCO2 3.5	57.7614	58.8879
QC20U-HCO2 4.0	57.8962	58.8962
QC20U-HCO2 4.25	57.8330	58.8327
QC20U-HCO2 4.5	57.9160	58.9134
QC20U-HCO2 4.75	58.6860	59.6854
QC20U-HCO2 5.0	58.0413	59.0376
QC20U-HCO2 5.25	57.9890	58.9761
QC20U-HCO2 5.5	57.7226	58.7199
QC20U-HCO2 5.75	57.7204	58.7144
QC20U-HCO2 6.0	58.0296	59.0158
QC20U-HCO2 6.25	57.8650	58.8651
QC20U-HCO2 6.5	57.8332	58.8307
QC20U-HCO2 6.75	57.9775	58.9703
QC20U-HCO2 7.0	57.9116	58.9083
QC20U-HCO2 7.25	57.8564	58.8500 AJ DRW 8/22/00
QC20U-HCO2 7.5	58.2253	59.2213
QC20U-HCO2 7.75	57.7928	58.7892
QC20U-HCO2 8.0	57.6648	58.6618
QC20U-HCO2 8.25	57.6640	58.6582
QC20U-HCO2 8.5	58.0833	59.0837
QC20U-HCO2 8.75	58.0823	59.0813

CDV1 → CDV * 100/200 * RC * RFe * HL * Na-form

(1) wt. of tube assembly = 33.5926 g.
wt. of tube assembly + outgassed sample = 34.6728 g
wt. of outgassed sample = 34.6728
− 33.5926
1.0802 g.

SE = 11.296 m^2/g

(2) wt. of tube assembly = 33.4552 g
wt. of tube assembly + outgassed sample = 34.5410 g.

wt. of outgassed sample = 34.5410 − 33.4552 = 1.0858 g.
SE of Clinoptilolite = 11.149 m^2/g

(3) wt. of tube assembly = 33.0874 g.
wt. of tube assembly + outgassed sample = 34.1701 g.
wt. of outgassed sample = 34.1701
− 33.0874
1.0827 g.

AJ ~~wt~~ SE of Clinoptilolite = 11.473 m^2/g.

11/15/99 AJ

Sample:	Acid/base additions per as table on Pg. 10	wt. of container after acid/base add
QC20U-HCO2 PH 2.5		59.1407
QC20U-HCO2 3.0		59.0870
QC20U-HCO2 3.5		59.0697 DRW 8/22/00
QC20U-HCO2 4.0		58.94~~2~~30 AJ
QC20U-HCO2 4.25		58.8918
QC20U-HCO2 4.5		59.2092
QC20U-HCO2 4.75		59.8675
QC20U-HCO2 5.0		59.3093
QC20U-HCO2 5.25		59.3669
QC20U-HCO2 5.5		59.1951
QC20U-HCO2 5.75		58.8233
QC20U-HCO2 6.0		59.1708
QC20U-HCO2 6.25		59.1293
QC20U-HCO2 6.5		59.0454
QC20U-HCO2 6.75		59.9460
QC20U-HCO2 7.0		59.0332
QC20U-HCO2 7.25		59.5867
QC20U-HCO2 7.5		60.1060
QC20U-HCO2 7.75		59.9768
QC20U-HCO2 8.0		59.6678
QC20U-HCO2 8.25		60.4127
QC20U-HCO2 8.5	1.5 ml NaHCO3 (1M)	60.6118
QC20U-HCO2 8.75	2.0 ml 1M NaHCO3	61.3149

2M NaHCO3 :- NaHCO3 (Lot # 936883)
42.01 g ~~in 25~~ AJ DRW 8/22/00 of NaHCO3 diluted in 200 ml of ultra-

pure H_2O & up to 250 ml mark. $NaHCO_3$ didn't dissolve so more water was added.
Finally, 1M $NaHCO_3$ was prepared i.e. dilute it to 500 ml mark.

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 10-Nov-1999 10:19
C14 Eff (0-156 keV) = 96.60 %
C14 CHI SQUARE IPA DATA PROCESSED - 10-Nov-1999 10:29
C14 Chi Square = 21.42
H3 IPA DATA PROCESSED - 10-Nov-1999 10:30
H3 Eff (0-18.6 keV) = 65.07 %
H3 CHI SQUARE IPA DATA PROCESSED - 10-Nov-1999 10:41
H3 Chi Square = 14.03
BKG IPA DATA PROCESSED - 10-Nov-1999 11:41
Bkg (0-18.6 keV) = 16.85 cpm
Bkg (0-156 keV) = 24.17 cpm
C14 E^2/B (1-156 keV) = 503.17
H3 E^2/B (1-18.6 keV) = 252.84

11 Nov 1999 04:31 ALPHA/BETA - 1.09
Protocol #:23 U-233 3% 2 Sigma User

Time: 999.99
Data Mode: CPM Nuclide: MANUAL
Background Subtract: 1st Vial

	LL	UL	LCR	2S%	BKG
Region A:	0.0 -	100	0	0.3	17.37
Region B:	100 -	350	0	3.0	3.02
Region C:	0.0 -	2000	0	0.1	25.72

Quench Indicator: SIS
Alpha CPM U-233 1st Vial Bkgnd.
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal
Count Data Filename: c:\JimP\SDATA23.DAT

DRW 8/22/00

Desorption of U-PO_2 10^{-2} tubes

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
1	999.99	17.37	1.52	3.02	3.64	25.72	1.25	143.97	B
2	16.50	24.39	13.09	266.32	3.03	293.01	3.00	566.59	
3	17.27	25.65	12.35	254.48	3.03	282.68	2.99	551.81	
4	14.67	30.96	11.76	300.26	3.03	334.54	2.96	551.42	
5	14.89	35.28	10.69	295.44	3.03	333.25	2.95	547.33	
6	8.81	37.23	13.39	501.64	3.02	540.80	2.97	558.61	
7	8.78	36.05	13.70	503.14	3.02	542.39	2.97	560.35	
8	8.48	44.78	12.11	521.51	3.02	566.97	2.95	551.37	
9	8.07	47.31	11.98	548.16	3.02	597.33	2.94	549.01	

10	8.49	20.44	20.69	520.42	3.02	542.36	3.02	604.22
11	8.39	20.17	21.01	526.78	3.02	548.66	3.02	601.05
12	4.99	39.94	16.98	887.57	3.01	930.20	2.98	576.47
13	4.10	51.41	15.94	1082.84	3.01	1134.53	2.97	553.70
14	4.06	24.50	26.24	1094.03	3.01	1119.60	3.00	577.80
15	4.05	27.57	24.18	1095.01	3.01	1128.11	2.99	577.02
16	3.57	31.65	23.43	1244.04	3.00	1278.21	2.99	574.20
17	3.61	26.67	26.21	1228.84	3.01	1256.28	3.00	575.53
18	16.46	23.15	13.60	267.03	3.03	293.48	3.00	560.82
19	16.49	23.75	13.35	266.54	3.03	292.90	3.00	559.76
20	4.22	23.39	26.60	1052.44	3.01	1075.94	3.00	571.59
21	4.23	22.11	27.66	1048.76	3.01	1076.41	3.00	575.04
22	17.96	26.84	11.73	244.54	3.04	276.01	2.97	545.12
23	17.55	27.53	11.66	250.26	3.04	281.07	2.98	545.17
24	3.67	26.23	26.30	1209.25	3.01	1238.59	3.00	571.73
25	3.64	24.11	28.02	1218.96	3.01	1245.16	3.00	576.64
26	3.69	34.12	21.91	1203.49	3.00	1242.31	2.98	568.03
27	3.64	29.33	24.44	1220.61	3.00	1252.58	2.99	574.87
28	18.14	19.90	14.47	241.97	3.04	264.80	3.02	560.71
29	17.65	22.57	13.38	248.94	3.04	275.47	3.00	552.64
30	2.54	27.91	30.27	1749.74	3.00	1780.19	3.00	573.27
31	2.51	30.04	28.95	1774.28	3.00	1807.35	2.99	577.02
32	2.31	29.82	30.33	1924.69	3.00	1959.57	2.99	577.14
33	2.33	24.26	34.86	1906.86	3.00	1934.80	3.00	579.55
34	2.56	27.94	30.13	1733.31	3.01	1762.57	3.00	575.85
35	2.62	20.42	37.23	1693.55	3.01	1718.18	3.00	584.27
36	2.34	24.51	34.54	1901.69	3.00	1926.42	3.00	579.27
37	2.30	26.54	32.94	1937.42	3.00	1965.15	2.99	574.88
38	2.10	22.15	39.18	2115.08	3.00	2142.38	3.00	580.14
39	2.04	23.32	38.32	2176.40	3.00	2202.23	3.00	573.94
40	2.53	24.13	33.58	1759.04	3.00	1788.51	2.99	572.61

11 Nov 1999 09:40 ALPHA/BETA - 1.09
Protocol #:23 U-233 3% 2 Sigma User

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
41	2.57	35.55	25.54	1731.62	3.00	1773.51	2.98	574.30	
42	3.65	25.10	27.20	1214.52	3.01	1243.33	3.00	575.53	
43	3.68	26.65	25.97	1205.41	3.01	1239.77	2.99	573.80	
44	7.24	27.10	18.31	611.35	3.01	645.42	2.98	572.63	
45	7.25	23.60	20.18	610.50	3.01	638.97	3.00	575.28	
46	15.44	22.27	14.44	284.81	3.03	313.27	2.99	567.69	
47	15.54	19.70	15.74	283.02	3.03	309.36	3.00	572.00	
1 MISSING TUBE(S)									
49	8.52	42.72	12.45	519.05	3.02	562.66	2.95	569.52	
50	8.46	44.80	12.12	522.87	3.02	569.67	2.95	577.08	
51	9.53	42.34	11.84	463.30	3.02	507.55	2.95	573.37	
52	9.45	43.90	11.62	467.36	3.02	511.64	2.95	573.11	
53	8.73	42.88	12.27	506.38	3.02	551.72	2.95	581.04	
54	8.57	44.24	12.14	515.54	3.02	559.93	2.95	576.45	
55	10.07	39.63	12.03	438.59	3.02	480.44	2.95	574.06	
56	9.44	44.07	11.59	468.17	3.02	512.53	2.95	574.55	
57	12.25	39.45	10.94	359.92	3.02	400.65	2.95	569.07	
58	12.41	37.91	11.16	355.16	3.03	394.99	2.95	568.41	

containers DRW 8/22/00

59	10.94	41.68	11.17	403.38	3.02	446.31	2.94	566.24
60	10.84	40.47	11.43	407.13	3.02	448.73	2.95	568.94
61	10.84	38.26	11.86	407.13	3.02	446.98	2.96	572.72
62	11.00	42.54	10.99	401.17	3.02	443.65	2.95	562.35
63	11.90	42.13	10.63	370.68	3.02	415.21	2.93	565.31
64	11.74	38.42	11.37	375.69	3.02	415.43	2.95	568.99
65	8.93	38.96	12.91	495.08	3.02	535.09	2.96	579.09
66	8.67	39.26	13.04	509.90	3.02	550.87	2.96	581.36
67	10.86	40.00	11.51	406.29	3.02	447.40	2.95	568.82
68	10.95	37.33	11.99	403.10	3.02	442.05	2.96	574.27
69	8.92	39.02	12.91	495.42	3.02	534.04	2.97	579.07
70	8.75	38.17	13.22	504.98	3.02	544.34	2.97	581.89
71	11.55	35.88	11.99	382.01	3.02	419.39	2.96	573.12
72	11.39	38.73	11.48	387.59	3.02	428.46	2.95	568.16
73	11.28	40.70	11.17	391.40	3.02	433.15	2.95	572.09
74	11.22	42.34	10.91	393.42	3.02	437.12	2.94	564.84
75	8.71	39.81	12.89	507.20	3.02	548.22	2.96	581.72
76	8.69	42.81	12.31	508.38	3.02	553.57	2.95	577.21
77	14.25	44.31	9.41	308.98	3.03	353.37	2.92	551.51
78	13.93	43.65	9.61	316.15	3.03	362.01	2.92	552.65
79	14.34	41.28	9.82	306.96	3.03	348.90	2.93	555.46
80	13.94	46.12	9.27	315.78	3.03	363.02	2.91	554.41
81	13.80	43.43	9.69	319.09	3.03	363.34	2.92	560.06
82	13.51	42.51	9.92	326.30	3.03	370.21	2.93	557.12
83	13.68	43.38	9.74	321.98	3.03	366.76	2.92	557.15
84	13.68	43.74	9.68	321.84	3.03	367.49	2.92	557.46
85	13.58	43.53	9.75	324.38	3.03	368.10	2.93	555.18
86	14.02	40.76	10.01	313.96	3.03	355.53	2.93	557.88
87	12.66	46.77	9.64	348.17	3.03	396.56	2.91	555.23
88	12.70	41.21	10.44	347.22	3.03	389.95	2.94	561.65
89	10.51	46.57	10.61	419.82	3.02	467.34	2.93	567.32
90	11.03	40.56	11.32	400.43	3.02	442.83	2.94	567.20
91	9.41	44.80	11.49	469.46	3.02	515.09	2.94	568.32
92	9.27	48.76	10.97	476.38	3.02	526.17	2.93	565.68
93	8.73	39.79	12.88	506.26	3.02	546.34	2.96	578.70
94	8.90	42.97	12.14	496.76	3.02	542.15	2.95	575.03
8 MISSING TUBE(S)								
103	7.66	52.60	11.50	577.14	3.02	631.46	2.93	580.14

QC20V HCO2 Spike

DRW 8/22/00

11 Nov 1999 19:36 ALPHA/BETA - 1.09 Pa-
Protocol #:23 U-233 3% 2 Sigma User : A

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
104	7.75	54.63	11.17	570.66	3.02	628.74	2.92	561.78	↓
2 MISSING TUBE(S)									
107	7.94	48.25	11.93	556.68	3.02	607.16	2.94	575.45	↑ QC20V
108	7.81	49.47	11.84	566.00	3.02	616.79	2.94	576.40	↓ HCO2 IVa & IVb

no acid added to sample. Redone.

DRW 8/22/00

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 11-Nov-1999 19:59
C14 Eff (0-156 keV) = 96.51 %
C14 CHI SQUARE IPA DATA PROCESSED - 11-Nov-1999 20:10
C14 Chi Square = 22.44
H3 IPA DATA PROCESSED - 11-Nov-1999 20:11
H3 Eff (0-18.6 keV) = 64.84 %

WARNING: Questionable H3 Efficiency value - Please rerun quench curves & view historic data

H3 CHI SQUARE IPA DATA PROCESSED - 11-Nov-1999 20:21
H3 Chi Square = 21.24
BKG IPA DATA PROCESSED - 11-Nov-1999 21:22
Bkg (0-18.6 keV) = 17.92 cpm
Bkg (0-156 keV) = 26.10 cpm
C14 E^2/B (1-156 keV) = 476.95
H3 E^2/B (1-18.6 keV) = 233.73

11/16/99 AJ

	wt. of vial	wt. of vial + sample
QC20V-HCO2-IVc	7.8004	8.3017
QC20V-HCO2-IVd	7.7602	8.2619

wt. of container QC20V-HCO2-IV 56.1663 g (before acid add)
wt. of container after acid add (100 µl of 50/50 HNO_3)
56.2896 g
wt. of container after sampling 55.2846 g

11/18/99 AJ

Sample name		measured PH	
QC20V-HCO_2 PH	2.5	2.64	
QC20V-HCO_2	3.0	2.63	— 0.1M $NaHCO_3$ 0.030
	3.5	2.96	—
	4.0	3.41	
	4.25	5.04	
	4.5	5.24	
	4.75	5.65	— 1M HNO_3 0.020
	5.0	5.58	
	5.25	5.68	— 1M HNO_3 0.020
	5.5	5.76	
	5.75	5.89	— 0.1M $NaHCO_3$ 0.075
	6.0	6.09	
	6.25	6.38	
	6.5	6.60	
	6.75	7.22	
	7.0	7.18	
	7.25	7.78	
	7.5	7.86	
	7.75	8.22	
	8.0	8.14	
	8.25	8.35	
	8.5	9.18	
	8.75	9.11	

DR 8/22/00

11/19/99 AJ

		Measured PH ~~after additions~~ AJ	
QC20V-HCO_2 PH	3.0	2.71	added 1M $NaHCO_3$ 0.075
QC20V-HCO_2	4.75	3.67	added 1M $NaHCO_3$ 0.010
QC20V-HCO_2	5.25	3.60	added " " 0.010
QC20V-HCO_2	5.75	6.27	Added " 0.010

11/29/99 AJ

Sample Name		wt. of container before PH measurement	11/30/99 Measured PH
QC20V-HCO_2-PH	2.5	58.9030	2.83
QC20V-HCO_2	3.0	58.8952	3.56
QC20V-HCO_2	3.5	58.7637	3.21
QC20V-HCO_2	4.0	58.3511	3.75
QC20V-HCO_2	4.25	58.6553	5.39
QC20V-HCO_2	4.5	58.9732	5.53
QC20V-HCO_2	4.75	59.4559	5.14
QC20V-HCO_2	5.0	59.0810	5.75
QC20V-HCO_2	5.25	58.9958	4.77
QC20V-HCO_2	5.5	58.7773	5.93
QC20V-HCO_2	5.75	58.6549	6.88
QC20V-HCO_2	6.0	58.8937	6.27
QC20V-HCO_2	6.25	58.7752	6.45
QC20V-HCO_2	6.5	58.7948	6.61
QC20V-HCO_2	6.75	59.6705	7.13
QC20V-HCO_2	7.0	58.8042	7.08
QC20V-HCO_2	7.25	59.3575	7.68
QC20V-HCO_2	7.5	59.8705	7.64
QC20V-HCO_2	7.75	59.6884	8.00
QC20V-HCO_2	8.0	59.4189	AJ ~~8.10~~ 7.94
QC20V-HCO_2	8.25	60.1717	AJ ~~8.28~~ 8.14
QC20-HCO_2	8.5	60.3912	AT ~~8.23~~ 8.10
QC20V-HCO_2	8.75	59.9051	8.20

DR 8/22/00 for all x-outs

12/1/99 AJ

Sample name:	wt. of vial	wt. of vial + sample
QC20U-HCO2 PH 2.5a	7.7737	8.2782
QC20U-HCO2 PH 2.5b	7.8379	8.3431
QC20U-HCO2 3.0a	7.8522	8.3489
QC20U-HCO2 3.0b	7.9096	8.3968
QC20U-HCO2 3.5a	7.8118	8.3168
QC20U-HCO2 3.5b	7.9102	8.4150
QC20U-HCO2 4.0a	7.8582	8.3601
QC20U-HCO2 4.0b	7.8639	8.3682
QC20U-HCO2 4.25a	7.7509	8.2552
QC20U-HCO2 4.25b	7.7583	8.2618
QC20U-HCO2 4.5a	7.7737	8.2762
QC20U-HCO2 4.5b	7.7865	8.2886
QC20U-HCO2 4.75a	7.7845	8.2880
QC20U-HCO2 4.75b	7.8292	8.3335
QC20U-HCO2 5a	7.8803	8.3854
QC20U-HCO2 5b	7.8309	8.3395
QC20U-HCO2 5.25a	7.8011	8.3048
QC20U-HCO2 5.25b	7.8466	8.4471
QC20U-HCO2 5.5a	7.7558	8.2665
QC20U-HCO2 5.5b	7.8353	8.3453
QC20U-HCO2 5.75a	7.7871	8.2915
QC20U-HCO2 5.75b	7.7440	8.2455
QC20U-HCO2 6a	7.8402	8.3440
QC20U-HCO2 6b	7.7546	8.2570
QC20U-HCO2 6.25a	7.7956	8.3014
QC20U-HCO2 6.25b	7.7504	8.2547
QC20U-HCO2 6.5a	7.8480	8.3537
QC20U-HCO2 6.5b	7.8491	8.3548
QC20U-HCO2 6.75a	7.8112	8.3149
QC20U-HCO2 6.75b	7.8099	8.3119
QC20U-HCO2 7a	7.7996	8.3028
QC20U-HCO2 7b	7.8251	8.3281
QC20U-HCO2 7.25a	7.8508	8.3537

QC20U-HCO2 PH 7.5b	7.7772	8.2791
QC20U-HCO2 7.5a	.	
QC20U-HCO2 7.5b	.	
QC20U-HCO2 7.75a	7.8138	8.3172
QC20U-HCO2 7.75b	7.8488	8.3526
QC20U-HCO2 8a	7.8206	8.3240
QC20U-HCO2 8b	7.7992	8.3027
QC20U-HCO2 8.25a	7.8760	8.3792
QC20U-HCO2 8.25b	7.8522	8.3561
QC20U-HCO2 8.5a	7.7446	8.2488
QC20U-HCO2 8.5b	7.7636	8.2664
QC20U-HCO2 8.75a	7.7674	8.2704
QC20U-HCO2 8.75b	7.7831	8.2893

Sample Name:-	wt. of container after PH measurement and sampling
QC20U-HCO2 PH 2.5	57.8761
QC20U-HCO2 3.0	57.8954
QC20U-HCO2 3.5	57.7366
QC20U-HCO2 4.0	57.3280
QC20U-HCO2 4.25	57.6283
QC20U-HCO2 4.5	57.9474
QC20U-HCO2 4.75	58.4095
QC20U-HCO2 5.0	57.9611
QC20U-HCO2 5.25	58.9778
QC20U-HCO2 5.5	57.7515
QC20U-HCO2 5.75	57.6303
QC20U-HCO2 6.0	57.6146
QC20U-HCO2 6.25	57.7548
QC20U-HCO2 6.5	57.7643
QC20U-HCO2 6.75	58.6453
QC20U-HCO2 7.0	57.7785
QC20U-HCO2 7.25	58.3382
QC20U-HCO2 7.5	

QC20U-HCO2	PH 7.75	58.6496
QC20U-HCO2	8.0	58.3804
QC20U-HCO2	8.25	59.1175
QC20U-HCO2	8.5	59.3672
QC20U-HCO2	8.75	58.8562

21 Nov 1999 03:24 ALPHA/BETA - 1.09
Protocol #:23 U-233 3% 2 Sigma

Time: 999.99
Data Mode: CPM Nuclide: MANUAL
Background Subtract: 1st Vial

	LL	UL	LCR	2S%	BKG
Region A:	0.0 -	100	0	0.3	17.23
Region B:	100 -	350	0	3.0	3.08
Region C:	0.0 -	2000	0	0.1	25.73

Quench Indicator: SIS
Alpha CPM U-233 1st Vial Bkgnd.
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal
Count Data Filename: c:\JimP\SDATA23.DAT

1 MISSING TUBE(S)

24	7.90	49.61	11.74	560.33	3.01	612.12	2.94	568.83	QC20U-HCO2 IVa & IVb
25	7.88	49.90	11.71	560.88	3.02	612.72	2.94	564.77	

SYSTEM NORMALIZED

DRW 8/22/00

C14 IFA DATA PROCESSED - 21-Nov-1999 03:01
C14 Eff (0-156 keV) = 96.54 %
C14 CHI SQUARE IFA DATA PROCESSED - 21-Nov-1999 03:12
C14 Chi Square = 19.42
H3 IFA DATA PROCESSED - 21-Nov-1999 03:13
H3 Eff (0-18.6 keV) = 65.15 %
H3 CHI SQUARE IFA DATA PROCESSED - 21-Nov-1999 03:23
H3 Chi Square = 23.51
BKG IFA DATA PROCESSED - 21-Nov-1999 04:24
Bkg (0-18.6 keV) = 17.70 cpm
Bkg (0-156 keV) = 25.93 cpm
C14 E^2/B (1-156 keV) = 471.39
H3 E^2/B (1-18.6 keV) = 240.96

07 Dec 1999 05:54 ALPHA/BETA - 1.09 Pa
Protocol #:23 U-233 3% 2 Sigma User : F

Time: 999.99
Data Mode: CPM Nuclide: MANUAL
Background Subtract: 1st Vial

	LL	UL	LCR	2S%	BKG
Region A:	0.0 -	100	0	0.3	17.44
Region B:	100 -	350	0	3.0	3.09
Region C:	0.0 -	2000	0	0.1	26.19

Quench Indicator: SIS
Alpha CPM U-233 1st Vial Bkgnd.
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal
Count Data Filename: c:\JimP\SDATA23.DAT

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
1	999.99	17.44	1.51	3.09	3.60	26.19	1.24	145.44	B
2	8.71	46.96	11.59	507.24	3.02	553.14	2.95	568.67	
3	8.44	50.33	11.27	523.57	3.02	572.86	2.94	569.97	
4	9.50	44.35	11.52	464.91	3.02	510.65	2.94	573.18	
5	9.87	42.74	11.57	447.36	3.02	490.32	2.95	570.10	
6	9.03	43.91	11.89	489.05	3.02	534.27	2.95	577.32	
7	8.97	42.98	12.09	492.45	3.02	535.91	2.95	573.67	
8	10.74	41.68	11.28	410.69	3.02	453.33	2.95	569.77	
9	10.87	43.09	10.97	405.74	3.02	448.42	2.95	566.10	
10	20.09	47.02	7.64	218.11	3.04	266.49	2.87	526.42	
11	19.65	45.71	7.87	223.27	3.04	268.72	2.89	532.05	
12	20.30	43.64	7.97	216.02	3.04	259.08	2.90	534.63	
13	20.03	45.26	7.84	218.88	3.04	264.67	2.88	530.80	
14	20.56	46.81	7.57	213.06	3.04	260.24	2.87	526.69	
15	20.61	44.52	7.81	212.63	3.04	258.09	2.88	530.76	
16	20.49	46.29	7.64	213.79	3.04	260.44	2.87	526.35	
17	19.92	47.42	7.63	220.05	3.04	266.98	2.88	528.14	
18	24.62	46.45	6.96	177.49	3.05	224.54	2.85	510.41	
19	20.73	55.59	6.77	211.33	3.04	266.91	2.82	505.87	
20	25.34	48.58	6.67	172.28	3.05	220.89	2.83	506.60	
21	24.44	48.27	6.82	178.74	3.05	228.11	2.83	510.64	
22	14.36	41.12	9.84	306.59	3.03	347.35	2.94	553.79	
23	14.49	48.67	8.79	303.74	3.03	351.45	2.91	544.13	
24	19.56	45.13	7.95	224.11	3.04	269.62	2.89	529.82	
25	18.63	45.04	8.15	235.45	3.04	280.36	2.90	534.26	
26	17.32	43.81	8.61	253.49	3.04	298.46	2.90	540.54	
27	17.34	46.40	8.29	253.42	3.04	300.22	2.89	540.62	
28	16.83	48.45	8.19	260.96	3.04	309.82	2.89	533.12	
29	16.22	49.14	8.26	270.95	3.03	321.04	2.88	535.08	

30	9.81	48.31	10.73	449.92	3.02	498.27	2.94	561.04
31	10.16	48.80	10.48	434.31	3.02	483.65	2.93	563.00
32	9.94	49.66	10.48	444.29	3.02	495.94	2.92	559.45
33	10.05	51.21	10.22	439.30	3.02	491.22	2.92	555.39
34	8.04	45.37	12.34	549.89	3.02	596.57	2.95	575.70
35	8.17	44.86	12.33	541.34	3.02	586.78	2.95	574.58
2 MISSING TUBE(S)								
38	7.99	45.51	12.35	554.10	3.01	600.22	2.95	580.86
39	7.84	47.61	12.11	564.25	3.02	613.86	2.94	577.92
40	7.92	48.59	11.90	558.40	3.02	606.76	2.95	575.25
41	8.07	52.82	11.18	548.09	3.02	602.19	2.93	572.35

07 Dec 1999 15:34 ALPHA/BETA - 1.09
Protocol #:23 U-233 3% 2 Sigma User : A

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS FLAG
42	8.18	41.60	12.93	540.18	3.02	582.86	2.96	585.82
43	8.24	47.60	11.82	536.35	3.02	584.49	2.95	578.92
44	8.15	44.52	12.40	542.31	3.02	585.96	2.96	580.87
45	8.21	46.62	12.00	538.44	3.02	586.36	2.95	576.95
46	7.82	51.61	11.53	565.32	3.02	618.69	2.94	582.38
47	8.07	47.24	12.00	548.09	3.02	595.62	2.95	582.59

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 07-Dec-1999 16:27
C14 Eff (0-156 keV) = 96.49 %
C14 CHI SQUARE IPA DATA PROCESSED - 07-Dec-1999 16:37
C14 Chi Square = 13.42
H3 IPA DATA PROCESSED - 07-Dec-1999 16:39
H3 Eff (0-18.6 keV) = 64.99 %
H3 CHI SQUARE IPA DATA PROCESSED - 07-Dec-1999 16:49
H3 Chi Square = 13.35
BKG IPA DATA PROCESSED - 07-Dec-1999 17:49
Bkg (0-18.6 keV) = 18.47 cpm
Bkg (0-156 keV) = 25.90 cpm
C14 E^2/B (1-156 keV) = 472.91
H3 E^2/B (1-18.6 keV) = 227.16

12/9/99 AJ
12/10/99

Surface Area analysis on Quartz & Clinoptilolite mixture using Coulter SA 3100 for high PCO_2 sorption experiments.

Qtz = 1.000 g & Clinop = 0.700 g (QC20U-PCO2)

(1) wt. of tube assembly # 1 = 33.7129 gms.
wt. of tube assembly + outgassed Qtz/Clinop mixture = 35.2798 g
wt. of outgassed sample = 35.2798
33.7129
1.5669 g

SA = 4.597 m^2/g DRJ 4/22/00 for all x-outs

(2) wt. of tube assembly # 2 = ~~34.9661 g~~ AJ 33.3828 g
wt. of tube assembly + outgassed Qtz/Clinop mixture = ~~35.2798 g~~ AJ 34.9661 g
wt. of outgassed sample = ~~33.9661~~ AJ 34.9661
− 33.3828
1.5833 g

SA = 4.515 m^2/g

(3) wt. of tube assembly # 9 = 33.0838 g
wt. of tube assembly + outgassed Qtz/Clinop = 34.6511 g
wt. of outgassed sample = 34.6511
33.0838
1.5673 g.

SA = 4.425 m^2/g.

Note:- All the original data sheets are stored in a folder in Geochemistry lab. Folder named as Surface Area Results.

FINAL Entry:

This notebook complies generally w/ QAP-001.

E. C. Pe

8/27/00

FINAL FINAL Entry:

The statement above fully complies with QAP-001 section 3.6.8.

E. C. Pe

8/22/2000

FINAL FINAL FINAL ENTRY!

I HAVE reviewed this notebook A THIRD TIME AND I still find it in compliance with QAP-001. THERE is sufficient information so THAT ANOTHER qualified individual could repeat the activity.

E. C. Pe

8/24/2000