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4/21/98
AJ

Uranium Sorption on Clinoptilolite
Sorption (C20) Experiments

Written By: Alka Jain
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Date Written: April 21, 1998
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CONDITIONS:

1. U = 500 ppb
2. 0.1 M $NaNO_3$ matrix, equilibrium with atmosphere CO_2 (g). pCO_2 = 10 -3.5
3. pH range 2-9
4. Initial solutions volume = 40 ml, initial clinoptilolite mass = 0.1 g

OBJECTIVES:

- To investigate the characteristics of U absorption on clinoptilolite as a function of solution pH.
- To investigate the reproducibility and reversibility of U sorption reactions.
- To investigate the effects of using polycarbonate experimental containers in U sorption experiments.

EQUIPMENT:

Gyratory Shaker
Packard liquid scintillation counter
Orion pH/mV/ISE/ C meter
Combination pH electrode
ATC probe
Analytical balances (Mettler 4600 and 240 AE)
survey instruments

SUPPLIES:

29	2 oz polycarbonate bottles (acid washed and dried)
1	Repipettor for transfer of scintillation cocktail
Several	Eppendorf micropippetors for solution transfer
	Eppendorf pippet disposable tips
	pH buffer solutions
	Ultima-Gold liquid scintillation cocktail

PROCEDURE:

Special considerations:

- Experimental solutions and sample containers/vials should be weighed at each step. Do not add or subtract contents without weighing before and after each process. Always record weight of solutions.
- When measuring pH, minimize the amount of time the glass electrode is in contact with the U bearing solution. Make sure to rinse the electrode thoroughly before measuring other solution. Take care to introduce lint particles or other foreign objects into the experimental or sample containers.
- Liquid scintillation analysis (LSA) should be performed within two days of each sampling interval so that results can be reviewed during the experiment. Sample vials should "rest" in the absence of light for at least 24 hours prior to initial analysis to allow for decay of incident radiation pulses.
- Following each sampling period, swipes and frisks of the work area should be performed. If contamination is found, follow the radiological procedures for clean-up, and inform the division radiation safety point of contact (RSPOC). Radioactive solutions may not be disposed of without following all radiation safety guidelines. Do not dispose of any solutions without prior approval of the division RSPOC.

1. a) Add 500 ppb U solutions to each experiment container.
   b) Label twenty-nine 2 oz. Polycarbonate containers C20- pH_i (where i is the approximate pH of each solution) and pre-weigh. Record weight.
   c) Add 40 g of the 500 ppb U solution to each container. Record weight.
   d) Label ten 2 oz. Polycarbonate containers C20-C* pH_i (where i is the approximate pH of each solution) and pre-weigh. Record weight.
   e) Add 40 g of the 500 ppb U solution to each container. Record weight.
   f) Transfer the remaining (~ 40 g) 500 ppb U solution into a pre-weighed 2 oz. Polycarbonate container labled C20-IU. Add 100 micro liters of 50% HNO_3 solution to the bottle and mix throughly. Record weight.

Note: If pH adjustment is to be made at a later time (i.e. few hours later), cap the bottles tightly.

2. For C20-pH_i C20-C*pHi solutions, add HNO_3 and $NaHCO_3$ to adjust pH to desired value.

   a) Adjust pH by adding HNO_3 and $NaHCO_3$ using an Eppendorf micropipet. Record the amount and concentration added to each container. Mix well by swirling the solutions.
   b) Re-weigh each container. Record weight.
   c) Replace screw caps, but do not tighten! Solutions must be open to atmosphere.
   d) Place bottles on a gyratory shaker at 120 rpm. Allow at least 10 days for pH equilibration.

3. Sample C20-IU to determine initial U concentration for experimental solutions.

   a) Using an eppendorf pippet withdraw two 0.5 ml samples from C20-IU and transfer to liquid scintillation vials. Re-weigh vials and record weight.
   b) Add 5 ml of Ultima-Gold cocktail to each vial. Homogenize sample and set aside for LSA.

April 22, 98 AJ

Preparation of Clinoptilolite for U-sorption Experiments

Materials & Equipments

1. Clinoptilolite [Death Valley Junction, California]
2. 8-inch diameter stainless steel sieves [35, 100, 200 mesh]
3. Ro-Tap Sieve Shaker
4. Ultrasonic Cleaner FS-28
5. Water Bath
6. 1N NaOAc Buffer at PH = 5.0 [136 gms of $CH_3COONa \cdot 3H_2O$ (Lt No. 940621) per liter of nano pure water] PH adjusted to 5.0 using Glacial acetic acid (Lot # 956018)
7. 0.3 M Sodium citrate dihydrate solution [88 g of $Na_3C_6H_5O_7 \cdot 2H_2O$ (Lot # 940621) Fischer Scientific Per liter of NH_2O]
8. Sodium Dithionite, $Na_2S_2O_4$ [Lot # FS 916643]
9. Saturated Solution of NaCl [FS Lot # 912763] in NH_2O.
10. ~~Acetone~~ AJ. 4/22/98 1N $NaHCO_3$ solution [84 g of $NaHCO_3$ (Lot # FS 936883) in 1L of NH_2O].
11. Nano pure H_2O.
12. Several glass graduated beakers
13. Magnetic Stirrers.
14. Stir Plate, Corning Stirrer/Hot Plate
15. Plastic bottles to store solutions.
16. Several centrifuge tubes (50 ml)
17. Glass and rubber tip glass stirrer.
18. Filter Paper (19cm diameter, medium Porosity, glass fiber by FS)
19. Glass Funnels
20. Separator funnels for density seperation.
21. Spatulas
22. Weighing balance Mettler PM 4600 Delta Range
23. Acetone [FS Lot # 966257]
24. Microscope
25. Table top centrifuge by Fischer Scientific marathon 21K
26. Bromoform [FS Lot # 916133]
27. NN-dimethyl formamide [~~Lot # 4929 KE99~~ AJ. 4/22/98]

NN-dimethy formamide by ~~Mallinckrodt, Analytical Reagent~~ AJ. 4/22/98 Fisher Scientific Lot # 893658

28. Drying oven (Stabil-Therm) C-4850-Q)
29. Eppendorf Micropippetor to transfer solutions.
30. Eppendorf Pippetor Tips
31. PH electrode. Orion 920A

PROCEDURE :-

1. Crush Clinoptilolite using mortar & pestle. Seive thru 8" diameter stainless steel 100-200 mesh seives using Sieve shaker.
2. Wash Clinoptilolite with Nano-pure water several times till supernatant is clear. Use ultrasonic cleaner.
3. Removal of Carbonates :-
   a) Transfer 5.0 g of clinoptilolite in several 100ml centrifuge tubes.
   b) Add 50 ml of NaOAc buffer (at PH = 5) to each tube.
   c) The suspension is digested in a ≈ 95°C water bath for 30 minutes. The suspension is stirred with a rubber tipped rod before putting in water bath.
   d) The suspension is then centrifuged at 6000 rpm for 5 min. The supernatant is decanted.
   e) The suspension is then washed with Nanopure water and centrifuged at 6000 rpm for 5 min two times.
4. Removal of Iron-Oxides :-
   a) Transfer 10.0 g of clinoptilolite in several 100 ml centrifuge tubes.
   b) Add 40 ml of 0.3 M Na-citrate solution and 5 ml of 1 M $NaHCO_3$ solution (these solutions can be added ahead of time).
   c) The temperature is brought to 75°-80°C (not >80°C) in a water bath. The suspension is transferred to the water bath and 1 gm of solid $Na_2S_2O_4$ is added to each tube. The

mixture is stirred for 1 minute and digested for 5 min.

d) A second 1 gm portion of $Na_2S_2O_4$ (sodium dithionite) is added with stirring and digested for 5 min.

e) A third 1 gm portion of $Na_2S_2O_4$ is added with stirring & digested for another 5 min.

f) The suspension is then centrifuged at 6000 rpm for 5 min. The supernatent is decanted.

g) The suspension is then mixed with 10 ml of saturated NaCl solution and warmed in water bath for 5 min. The suspension is then centrifuged at 6000 rpm for 5 min. The supernatent is decanted.

h) The suspension is then washed with nanopure water and centrifuged at 6000 rpm for 5 min two times.

i) The suspension is filtered & dried in oven.

⑤ Heavy Liquid Mineral Separation :-

a) A mixture of heavy liquid, Bromoform ($\rho_{20^\circ C} = 2.8899$ g/cc) and diluent, NN-dimethyl formamide ($\rho_{20^\circ C} = 0.9445$ g/cc) is prepared using the following formula for volume ratio.

$$V_\ell = V_h \frac{G_h - G_x}{G_x - G_\ell}$$

where G_x = density of the mixture desired.

G_h = density of heavy liquid, bromoform 2.8899 g/cc

G_ℓ = density of diluent

V_h = volume of heavy liquid

V_ℓ = volume of diluent.

b) Transfer heavy liquid mixture to seperatory funnel clamped on metal stand. Add some clinoptilolite, cover with cork & shake it to mix well. Wait for about 30 minutes for complete density separation. Seperation is done under exhaust hood.

c) Open the stopper of separating funnel & trap the settled heavy impurities in a flask covered with filter & funnel. Pass most of the liquid thru it.

d) Change the flask and trap clean clinoptilolite in filter & funnel. Rinse the seperatory funnel with acetone

e) Repeat the whole procedure several times till all the clinoptilolite is cleaned.

f) Remove the filter & let it dry under exhaust.

⑥ Rinse the clean clinoptilolite several times with DI H_2O & dry it in oven.

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Following procedure ①, clinoptilolite was grounded, sieved into 100-200 mesh size fraction (150-75 μm)

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① Clinoptilolite grounded & sieved to 100-200 mesh size using procedure ① step.

② NaOAc Reagent Prepared for Carbonates removal

Sodium acetate Trihydrate = 136 g mixed with (Lot # 94062, FS) 950 ml of nanopure water on stir plate. Adjust PH = 5 with glacial CH_3COOH acid ≈ 29 ml. Bring to mark of 1000 ml after PH adjust by adding H_2O.

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① Clinoptilolite ~ 7100 gms, size 100-200 mesh was cleaned with DI H_2O several times (15 times) till supernatant was no more milky. Used ultrasonic cleaner first few times.

② 0.3 M Na-citrate Reagent prepared for iron-oxide removal. 0.3 M Na-citrate stock solution.

88 g of Na-citrate dihydrate was mixed with 950 ml of nanopure H_2O on stir plate. Bring it to 1000 ml mark after complete mixing by adding H_2O.

③ 1 N $NaHCO_3$ stock solution was prepared by adding 84 g of $NaHCO_3$ (lot # 936883, FS) to 950 ml of nanopure H_2O. Mix it on stir plate & raise the level to 1000 ml after complete mixing.

④ Using Procedure step ③, carbonate impurities were removed (a) Clinoptilolite was transferred upto 5ml mark in 19 falcon tubes (50ml).
(b) 50 ml of NaOAc was added to each tube.
(c) Soaked at ~ boiling water, 95°C water bath for 30 min.
(d) Centrifuged at 6000 rpm for 5 min. The supernatant decanted.
(e) Repeat centrifuge with nanopure H_2O 2 times.

4/29/98 AJ

Using procedure step ④, free iron oxides were removed from Clinoptilolite already treated for carbonate removal. Add Clinoptilolite upto 5 ml level in Falcon tubes (50 ml), 20 ml Na-citrate solution (0.3 M), 2.5 ml of 1N $NaHCO_3$ using micropipettor. The suspension is mixed with Na dithionite in water bath at 75°C. Add 3 times at the interval of 5 min & quatity of Na dithionite add each time is 0.5 g. Centrifuge at 6000 rpm for 5 min. Finally, saturated NaCl is added & digested in water bath for 5 min. The suspension is then washed with H_2O, centrifuged, filtered & dried in oven.

5/1/98 AJ

Following Procedure step ⑤ heavy liquid separation was done to remove impurities.
N,N-dimethyl formamide (diluent) density = 0.93445 g/cc
Bromoform (heavy liquid) = 150 ml
$\rho_{Bromoform} = 2.8899$ g/cc, $\rho_{desired} = 2.3$ g/cc

$$V_d = 150 \frac{2.8899 - 2.3}{2.3 - 0.93445}$$

$$= 150 \frac{0.5899}{1.36555}$$

$= 64.8$ ml (volume of diluent N,N-dimethyl formamide)

Mix 150 ml of Bromoform with 64.8 ml of N,N-dimethyl formamide using graduated cylinders under the exhaust hood.

5/4/98 AJ

① Wash cleaned (pretreated) Clinoptilolite for carbonate, iron oxide & heavy liquids removal with DI H_2O & dry it in oven. Total wt ≈ 85 g

② Prepare another batch of clinoptilolite to 100-200 mesh size fraction by crushing & sieving (step 1 of procedure on page 3).

5/5/98 Prepared Clinoptilolite to 100-200 mesh size fraction. Total wt. ≈ 88 g

5/6/98 ① Prepare Clinoptilolite to 100-200 mesh size fraction. Total wt ≈ 127 g

② Washed Clinoptilolite using procedure 8 step 2.

③ 1N NaOAc buffer at PH = 5
Na acetate trihydrate = 136 g (937077)
Nano pure water ≈ 1 L
Acetic acid ≈ 29 ml to adjust PH = 5

(4) Na citrate (0.3M) solution
88 g of Na citrate dihydrate / 1L of nanopure water. Stirred on magnetic stirrer.

(5) Saturated NaCl solution prepared for iron-oxide removal step.
Nanopure water ≈ 550 ml
NaCl crystals = 146 g

(6) Using procedure step #(3), carbonates were removed from clinoptilolite.
(7) Using procedure step #(4), iron oxide impurities were removed from clinoptilolite.
5/8/98 JP (8) Using procedures step #(5) other mineral impurities were removed from clinoptilolite by heavy liquid separation

5/11/98 JP 0800 hrs

Approximately 155 g of purified clinoptilolite was prepared using the above procedures. The solid was placed in a beaker labeled CDV*100/200*UC*WA*~~CC*CE~~ CPT*HL 4/15/98 JP

5/11/98 JP 0820 hrs. Preparation of Na-Form clinoptilolite

Obj - generate Na-clinoptilolite

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

Equipment + Materials
- Fisher Versabath Model 236
- 3 m NaCl (lot 914193)
- 500ml PP bottles
- Blue M drying oven

Procedure

JP 0900 hrs (1) Approximately 40 g of purified clinoptilolite was placed in a 500 ml PP bottle. 3 bottles were prepared.

(2) 400 ml of 3M NaCl was added to the bottles

(3) The bottles were placed in water bath set at 90°C and continuously agitated for about 2 weeks. The 3M NaCl solution was replaced every 2 days.

(4) In addition a 20 g bath of clinoptilolite was prepared using 200 ml of solution.

JP 5/29/98 0830 hrs (5) Bottles were removed from waterbath.

(6) The clinoptilolite was washed several times with deionized water at 90°C and dried in an oven at 65°C.

(7) After drying the clinoptilolite was transferred to a glass jar and labeled CDV * 100/200 * UC * WA * ~~CC * CFC~~ CPT * HL * NaF. 7/15/98

(8) The jar was placed in a desiccator over saturated NaCl.

7/10/98 AJ
40 Polycarbonate centrifuge tubes (~50 ml capacity) are acid washed in 10% HNO_3 acid bath.

7/13/98 AJ
40 Polycarbonate centrifuge tubes were rinsed with nanopure water several times, air dried for few hrs. & then dried in the oven (~65°C) overnight.

Preparation of Stock Solutions of HNO_3 and $NaHCO_3$ of various concentrations.

objective :- Prepare Stock solutions

200 ml 1 M HNO_3 50 ml 50% HNO_3
200 ml 0.1 M HNO_3
200 ml 0.02 M HNO_3
250 ml 1 M $NaHCO_3$
250 ml 0.5 M $NaHCO_3$
250 ml 0.1 M $NaHCO_3$
250 ml 0.05 M $NaHCO_3$
250 ml 0.01 M $NaHCO_3$

Equipment & Materials :-
500 ml Glass Beakers
Magnetic Stirer & stirer bars.
Conc. HNO_3 (lot 983546 FS)
$NaHCO_3$ (lot # 936883) FS

Nanopure water

method :- The $NaHCO_3$ solution should be prepared with degassed ultrapure water (deionized water is degassed by boiling it in flasks & cooling it while the mouth was covered with rubber stopper), and stored in tightly capped glass reagent bottles.

Procedure :-

(1) Boil 2L of nanopure water in 2 1000 ml capacity flasks & cool it with rubber stopper.

7/14/98 AJ

(2) 21.02 g of $NaHCO_3$ & 250 ml of degassed nanopure water. (1M $NaHCO_3$)

(3) 10.51 g of $NaHCO_3$ dissolved in 250 ml of degassed nanopure water (0.5M $NaHCO_3$)

(4) 2.10 g of $NaHCO_3$ dissolved in 250 ml of degassed nanopure water (0.1M $NaHCO_3$)

(5) 1.05 g of $NaHCO_3$ dissolved in 250 ml of degassed nanopure water (0.05 M $NaHCO_3$)

(6) 0.21 g of $NaHCO_3$ dissolved in 250 ml of degassed nanopure water (0.01M $NaHCO_3$)

(7) 12.6 ml of conc. HNO_3 (~16M) & dilute it to 200 ml of nanopure water. [1M HNO_3]

(8) 20 ml of 1M HNO_3 & dilute it to 200 ml of nanapure H_2O. [0.1M HNO_3]

(9) 4 ml of 1M HNO_3 & dilute it to 200 ml of nanopure H_2O. [0.02M HNO_3]

7/16/98 AJ

(10) Dilute 25 ml of conc. HNO_3 with 25ml of nanopure H_2O. (50% HNO_3).

7/17/98 AJ

C20-U- absorption experiments were started using the following procedure.

Experimental Procedure for experiment C20 - U sorption on clinoptilolite at 25° C.

Objective: To investigate the characteristics of U sorption on clinoptilolite as a function of pH.

Initial conditions:
- $\sum U$ = 500 ppb [2.1×10^{-6} molal]
- equilibrium with atmospheric $CO_2(g)$; $pCO_2 = 10^{-3.5}$
- pH range 2.5-9.5
- solution volume = 32.5 ml
- mass of solid = 0.065 g
- M/V = 2

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:
Na-clinoptilolite (CDV*100/200*UC*WA*CPT*HL*Naf)
2.1×10^{-6} m ^{233}U stock solution (spike 28A)
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. Transfer 2.1×10^{-6} m (500 ppb) ^{233}U stock solution to experimental containers.

- Label 29 polycarbonate centrifuge tubes (~40 ml capacity) C20-U-pHi (where i is the approximate pH of each solution, see Table C20).
- Label 1 polycarbonate centrifuge tube C20-U-IU.
- Weigh and record the weight of each container.
- The concentration of spike 28A is 2.1×10^{-6} m ^{235}U and therefore this stock solution does not require dilution. About 1.2L of spike 28A will be required for this experiment.
- Add ~32.5 g of the 2.1×10^{-6} m ^{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.

B. Add clinoptilolite to sample containers.

- Add ~0.065 g of Na-clinoptilolite to each sample container. **Do not** add clinoptilolite to the C20-U-IU container.
- Record weight of each sample container after addition of clinoptilolite.

- Adjust pH of each solution by adding HNO_3 or $NaHCO_3$.

  - Add the volume of HNO_3 or $NaHCO_3$ to each experimental container as listed in Table C20. Take care to add HNO_3 or $NaHCO_3$ in the concentrations specified in Table C20.
  - For sample C20-U-IU (not listed in Table C20) add 100 μl of 50/50 V/V HNO_3 to the sample container.
  - Weigh and record the weight of each sample container.

- Sample C20-U-IU for initial [U].

  - Label two 7 ml LSC vials as C20-U-IUa and C20-U-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 C20-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 C20-U-IU

- Wait for equilibrium.

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

SAMPLE NAME	WT.OF BOTTLE, g	WT. OF BOTTLE & U SOLN., g	WT. OF U SOLN., g	WT. OF Soln + BOTTLE & CLINOPTILOLITE, g	WT. OF CLINOPTILOLITE, g	WT. AFTER pH ADJUST, g
C20-pH 2.5	22.5195	55.0516	32.5321	55.1132	0.0616	55.2373
C20-pH 2.75	22.3431	54.8453	32.5022	54.9092	0.0639	54.9644
C20-pH 3	22.5595	55.0681	32.5086	55.1335	0.0654	55.2945
C20-pH 3.25	22.2296	54.7357	32.5061	54.8006	0.0649	54.8941
C20-pH 3.5	22.2594	54.7593	32.4999	54.8244	0.0651	54.9868
C20-pH 3.75	22.3111	54.8262	32.5151	54.8912	0.0650	55.1245
C20-pH 4	22.2753	54.7818	32.5065	54.8467	0.0649	55.1156
C20-pH 4.25	22.5336	55.0265	32.4929	55.0869	0.0604	55.3758
C20-pH 4.5	22.2878	54.7932	32.5054	54.8579	0.0647	55.1568
C20-pH 4.75	22.1848	54.6757	32.4909	54.7267	0.0510	55.0252
C20-pH 5	22.2032	54.7048	32.5016	54.7625	0.0577	55.0733
C20-pH 5.25	22.4202	54.9158	32.4956	54.9785	0.0627	55.2724
C20-pH 5.5	22.3656	54.8626	32.4970	54.9277	0.0651	55.2472
C20-pH 5.75	22.2489	54.7646	32.5157	54.8281	0.0635	55.1464
C20-pH 6	22.2732	54.7803	32.5071	54.8466	0.0663	55.1653
C20-pH 6.25	22.1768	54.6716	32.4948	54.7298	0.0582	55.0488
C20-pH 6.5	22.5974	55.0662	32.4688	55.1115	0.0453	55.4298
C20-pH 6.75	22.2156	54.7078	32.4922	54.7683	0.0605	55.1043
C20-pH 7	22.3069	54.7923	32.4854	54.8421	0.0498	55.1866
C20-pH 7.25	22.3863	54.9186	32.5323	54.9815	0.0629	55.3523
C20-pH 7.5	22.2582	54.7574	32.4992	54.8013	0.0439	55.1985
C20-pH 7.75	22.5778	55.0877	32.5099	55.1495	0.0618	55.2541
C20-pH 8	22.2590	54.7631	32.5041	54.8268	0.0637	54.9477
C20-pH 8.25	22.2553	54.7384	32.4831	54.8008	0.0624	54.9737
C20-pH 8.5	22.2548	54.7545	32.4997	54.8129	0.0584	55.0733
C20-pH 8.75	22.2338	54.7222	32.4884	54.7876	0.0648	55.0111
C20-pH 9	22.1519	54.6393	32.4874	54.7055	0.0662	55.1060
C20-pH 9.25	22.2052	54.7131	32.5079	54.7789	0.0658	55.7405
C20-pH 9.5	22.3118	54.8376	32.5258	54.9024	0.0648	56.6113
C20-U-IU	22.3322	54.8251	32.4929			55.9446

		wt. Of vial +				
	wt. Of vial	sample	wt. Of sample			
C20-U-Iua	7.5781	8.0791	0.5010			
C20-U-Iub	7.6644	8.1647	0.5003			

7/20/98

C20-U-IU (left) 53.8890 g.

Table 20C. Estimated solution pH and volumes of HNO_3 or $NaHCO_3$ solutions needed for adjustment of pH in 0.1 m $NaNO_3$ solutions with 500 ppb U in contact with clinoptilolite. ~~(50 ml)~~ (40 ml)

Estimated solution pH	Volume of HNO_3 added, ml	Molarity of HNO_3 to use
2.5	0.12	1
2.75	0.055	1
3	0.165	0.1
Estimated solution pH	**Volume of $NaHCO_3$ added, ml**	**Molarity of $NaHCO_3$ to use**
3.25	0.095	0.05
3.5	0.165	0.1
3.75	0.235	0.1
4	0.270	0.1
4.25	0.290	0.1
4.5	0.300	0.1
4.75	0.310	0.1
5	0.315	0.1
5.25	0.315	0.1
5.5	0.320	0.1
5.75	0.320	0.1
6	0.320	0.1
6.25	0.325	0.1
6.5	0.330	0.1
6.75	0.335	0.1
7	0.350	0.1
7.25	0.370	0.1
7.5	0.410	0.1
7.75	0.100	0.5
8	0.120	0.5
8.25	0.170	0.5
8.5	0.255	0.5
8.75	0.210	1
9	0.380	1
9.25	0.920	1
9.5	1.630	1

C20-V-IU 0.100 50% HNO_3

7/20/98 AJ

Prepare sample solutions to measure initial U-conc. following the "Step B" sample C-20-V-IU for initial [U]" from "procedure on page 13.

	wt. of vial + 0.5 ml of 0.02M HNO_3	wt. of vial + 0.02M HNO_3 + sample
C20-V-Iua	7.5781	8.0A1
C20 V-Iub	7.6644	8.1647

Add 5ml of Ultima Gold Cocktail (AB) & set aside for counting. (Data on Page 18) 19). AJ

7/22/98 AJ

Preparation of Heavy liquid of $\rho = 2.75$ g/cc for removal of impurities from quartz.

$\rho_{quartz} = 2.65$ g/cc

Following Step # 5 on page 4 of this book, HL of $\rho = 2.75$ g/cc was prepared

150 ml of Bromoform, $\rho_{bromoform} = 2.8899$ g/cc
? of N,N-dimethyl Formamide, $\rho_{formamide} = 0.93445$ g/cc

$$V_{N,N\text{-dimethylformamide}} = 150 \frac{2.8899 - 02.75}{2.75 - 0.93445}$$
$$= 150 \times 0.07706$$
$$= 11.56 \text{ ml}$$

Mix 150 ml of bromoform with 11.56 ml of N-N dimethyl formamide.

on page 4

7/23/98 AJ Using Procedure step # 5, other mineral impurities were removed from quartz by heavy liquid separation.

Preparation of Reagents for Al determination

② Preparation of 0.02N H_2SO_4

Add 0.28 ml of Conc. H_2SO_4 (Lot # 913495) to 350 ml of DI H_2O. Dilute it to 500 ml with H_2O & store in plastic bottle.

③ Preparation of Buffer Reagent

136 g of Na acetate trihydrate (Lot # 937077) is added to 800 ml of nanopure H_2O. Dilute 2.9ml of CH_3COOH (Lot # 971798) in 50 ml of H_2O. Add 40 ml of acetic acid soln. to the sodium acetate soln & dilute to 1L with H_2O. Store in Plastic bottle. AJ

④ Preparation of Stock Dye Soln.

Add 0.150 g (150 mg) [Eriochrome Cyanine R (Lot # 249482 588)] to 50 ml of nanopure H_2O. Dilute 5ml of glacial CH_3COOH (Lot # 971798) to 10ml with H_2O. Adjust PH to 2.9 with acetic acid soln. added dropwise. (≈ 3.5 ml is required). Dilute the solution with H_2O to 100 ml. Store soln. in plastic bottle.

⑤ Working Dye Soln.

Add 10 ml of Stock Dye Soln. & dilute it to 100 ml with H_2O. Store in plastic bottle.

⑥ Preparation of 0.01M EDTA (lot # 905518)

Add 3.7 g of disodium ethylenediamine tetra acetate, EDTA in about 500 ml of H_2O. Dilute it to 1L with H_2O. Store in plastic bottle.

7/24/98 AJ

Preparation of stock solutions (Reagents) for Silica determination by spectrophotometry.

① Preparation of 1N H_2SO_4

Dilute 14ml of conc. H_2SO_4 (Lot # 913495) with H_2O to 500 ml. Store in plastic bottle.

② Preparation of 1+1 HCl soln.

Mix 250 ml of HCl (Lot # 956110) with 250 ml of H_2O. Store in plastic bottle.

③ Preparation of 6M NaOH

Dissolve 240 g of NaOH (Lot # 980698) with H_2O & make it upto 1000 ml in a plastic beaker. Plastic beaker is used to avoid any silica impurities in soln. from glass. Store in plastic bottle.

④ Preparation of Ammonium Molybdate Reagent

Place 10g of ammonium molybdate (Lot # 901533) in water in 100 ml volumetric beaker. Dissolve by stirring & gentle warming. Dilute it to 100 ml. Filter if necessary. ~~Not requ~~ AJ Adjust solution PH 7 to 8 with 6M NaOH added dropwise. Store soln. in plastic bottle.

⑤ Preparation of Oxalic Acid Solution

Dissolve 7.5 g oxalic acid (Lot # 906135B) in water & dilute it to 100 ml. Store soln in plastic bottle.

⑥ Preparation of Reducing Agent

Dissolve 0.500 g (500 mg) of 1-amino-2-napthol-4-sulfonic acid (Lot # 1807KEKS) and 1 g of sodium sulfite (Na_2SO_3, Lot # 904672) in 50 ml of H_2O with gentle warming (if necessary). Dissolve 30 g of sodium bisulfite ($NaHSO_3$, Lot # 915268) in 150 ml of H_2O. Mix the two solutions & filter (fast filter) into a plastic bottle. Cover the bottle with foil & referigerate the soln. Avoid exposure to light.

Protocol # 24 7/23/98

```
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    20.17
Region B:    100 -  350      0    5.0     3.26
Region C:    0.0 - 2000      0    0.1    28.94

Quench Indicator: SIS
alpha cpm U-233  1st vial bkgnd
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    20.17  1.41     3.264  3.50    28.94  1.18 137.60     B
1 MISSING TUBE(S)
   3    0.30    53.17 58.82 5460.069  4.94 5524.39  4.93 613.81
   4    0.30    16.50 134.0 5456.736  4.94 5487.73  4.94 612.53

SYSTEM NORMALIZED


C14 IPA DATA PROCESSED - 23-Jul-98 03:50
   C14 Eff (0-156 keV) = 96.89 %
C14 CHI SQUARE IPA DATA PROCESSED - 23-Jul-98 04:01
   C14 Chi Square = 29.94
H3 IPA DATA PROCESSED - 23-Jul-98 04:02
   H3 Eff (0-18.6 keV) = 65.08 %
H3 CHI SQUARE IPA DATA PROCESSED - 23-Jul-98 04:12
   H3 Chi Square = 18.60
BKG IPA DATA PROCESSED - 23-Jul-98 05:13
   Bkg (0-18.6 keV) = 23.15 cpm
   Bkg (0-156 keV)  = 33.03 cpm
```

7/27/98 AJ

① Quartz cleaned with heavy liquid density separation was cleaned with nanopure H_2O & kept in oven for drying.

② Following step "Sample Experimental Solutions for [U] & PH" ; samples for LSA were ~~prepared~~ AJ 7/27/98 labeled.

- Sample experimental solutions for [U] and pH.
  - For each sample solution label two 7 ml LSC vials (e.g., C20-U-pH3a and C20-U-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.
  - Record weight of each sample container.
  - Measure pH of each experimental solution.
  - Record weight of each sample container after pH measurement.

7/28/98
7/29/98 AJ

① Containers were weighed before sampling and PH measurements.

② PH was measured and samples were weighed after sampling. The results are noted in the following table:-

Sample Name	7/28/98 Container wt. before sampling & pH measurements	7/29/98 Measured pH	7/29/98 Container wt. after sampling & pH measurements	7/29/98 Container wt. after addition of 0.1 HNO_3 to lower PH.
C20-pH 2.5	55.0272	2.45	53.9883	
C20-pH 2.75	54.7595	2.68	53.7366	
C20-pH 3	55.1107	2.98	54.0844	
C20-pH 3.25	54.6535	3.34	53.6248	
C20-pH 3.5	54.7475	3.80	53.7109	
C20-pH 3.75	54.9398	4.96	53.9103	
C20-pH 4	54.8912	7.0	53.8633	
C20-pH 4.25	55.1465	7.20	54.1214	54.2207
C20-pH 4.5	54.9650	7.28	53.9551	54.0238
C20-pH 4.75	54.7908	7.36	53.7618	53.84732
C20-pH 5	54.8651	7.40	53.8357	53.9109
C20-pH 5.25	55.0966	7.24	54.0754	
C20-pH 5.5	55.0833	7.43	54.0566	54.1333
C20-pH 5.75	54.9241	7.43	53.8497	53.9190
C20-pH 6	54.9705	7.45	53.9451	
C20-pH 6.25	54.7334	7.45	53.7060	53.7929
C20-pH 6.5	55.2456	7.68	54.2247	54.2600
C20-pH 6.75	54.9220	7.52	53.9042	
C20-pH 7	54.9124	7.68	53.8964	53.9555
C20-pH 7.25	55.1867	7.76	54.1533	
C20-pH 7.5	54.9313	7.74	53.8739	53.9349
C20-pH 7.75	54.9647	7.96	53.9239	
C20-pH 8	54.7073	8.15	53.6828	
C20-pH 8.25	54.7334	8.31	53.7038	
C20-pH 8.5	54.8550	8.62	53.8345	
C20-pH 8.75	54.8033	8.80	53.7592	
C20-pH 9	54.9228	9.01	53.8785	
C20-pH 9.25	55.5470	9.21	53.4645	
C20-pH 9.5	56.4335	9.17	55.4004	
C20-U-IU	53.8586			

[redacted] The measured PH in the above table showed error. This error was attributed to the volumes of HNO_3 & $NaHCO_3$ added to adjust PH for 40 ml [U] solution. Actual U solution used in expt. is 32.5 ml. The

corrected table for PH adjustment is as follows :-

Table 20C. Estimated solution pH and volumes of HNO3 or NaHCO3 solutions needed for adjustment of pH in 0.1 m NaNO3 solutions with 500 ppb U in contact with clinoptilolite (32.5 ml)

Estimated solution pH	Volume of HNO3 needed, ml	Molarity of HNO3 to use
2.5	0.097	1
2.75	0.043	1
3	0.131	0.1
Estimated solution pH	**Volume of NaHCO3 needed, ml**	**Molarity of NaHCO3 to use**
3.25	0.075	0.05
3.5	0.133	0.1
3.75	0.186	0.1
4	0.216	0.1
4.25	0.233	0.1
4.5	0.242	0.1
4.75	0.248	0.1
5	0.251	0.1
5.25	0.254	0.1
5.5	0.254	0.1
5.75	0.256	0.1
6	0.258	0.1
6.25	0.260	0.1
6.5	0.263	0.1
6.75	0.269	0.1
7	0.279	0.1
7.25	0.297	0.1
7.5	0.329	0.1
7.75	0.078	0.5
8	0.098	0.5
8.25	0.136	0.5
8.5	0.205	0.5
8.75	0.169	1
9	0.302	1
9.25	0.736	1
9.5	1.306	1

more acid was required to lower the PH of the samples. Those samples were reweighed after addition of acid & wlight was recorded in table on page 21. These samples were repeated for equilibrium step for 10 days.
~~The other samples~~
AJ 7/28/98

(3) The following table shows the weights of samples for LSA

Sample Name	wt. Of vial	wt. Of vial + sample
C20-pH 2.5at	7.6402	8.1425
C20-pH 2.5bt	7.6463	8.1466
C20-pH 2.75at	7.5871	8.0849
C20-pH 2.75bt	7.5827	8.0830
C20-pH 3at	7.6228	8.1198
C20-pH 3bt	7.5644	8.0638
C20-pH 3.25at	7.6048	8.1036
C20-pH 3.25bt	7.6658	8.1653
C20-pH 3.5at	7.5986	8.0983
C20-pH 3.5bt	7.6680	8.1671
C20-pH 3.75at	7.6194	8.1170
C20-pH 3.75bt	7.5444	8.0441
C20-pH 4at	7.6569	8.1565
C20-pH 4bt	7.6485	8.1476
C20-pH 4.25at	7.5999	8.0969
C20-pH 4.25bt	7.646	8.1429
C20-pH 4.5at	7.5688	8.0660
C20-pH 4.5bt	7.6286	8.1284
C20-pH 4.75at	7.6324	8.1356
C20-pH 4.75bt	7.6556	8.1547
C20-pH 5at	7.6193	8.1202
C20-pH 5bt	7.5929	8.0974
C20-pH 5.25at	7.6525	8.1516
C20-pH 5.25bt	7.5878	8.0868
C20-pH 5.5at	7.6069	8.1076
C20-pH 5.5bt	7.6433	8.1419
C20-pH 5.75at	7.5761	8.0759
C20-pH 5.75bt	7.6290	8.1285
C20-pH 6at	7.6597	8.1574
C20-pH 6bt	7.5879	8.0869
C20-pH 6.25at	7.6078	8.1070
C20-pH 6.25bt	7.6090	8.1073
C20-pH 6.5at	7.6559	8.1540
C20-pH 6.5bt	7.5580	8.0560
C20-pH 6.75at	7.6157	8.1136
C20-pH 6.75bt	7.6097	8.1072
C20-pH 7at	7.6552	8.1483
C20-pH 7bt	7.7028	8.1997
C20-pH 7.25at	7.6577	8.1556
C20-pH 7.25bt	7.5581	8.0565
C20-pH 7.5at	7.6105	8.1047
C20-pH 7.5bt	7.6711	8.1659
C20-pH 7.75at	7.6374	8.1354
C20-pH 7.75bt	7.582	8.0746
C20-pH 8at	7.6600	8.1587
C20-pH 8bt	7.6323	8.1297
C20-pH 8.25at	7.6404	8.1387
C20-pH 8.25bt	7.6943	8.1915
C20-pH 8.5at	7.6385	8.1336
C20-pH 8.5bt	7.6603	8.1550
C20-pH 8.75at	7.5757	8.0724
C20-pH 8.75bt	7.6216	8.1181
C20-pH 9at	7.5950	8.0884
C20-pH 9bt	7.5731	8.0678
C20-pH 9.25at	7.5965	8.0949
C20-pH 9.25bt	7.6326	8.1298
C20-pH 9.5at	7.6257	8.1234
C20-pH 9.5bt	7.5642	8.0634

These samples were left under the glass cover (away from light) for 24 hrs before LSA counting.

AJ
7/30/98 ① LSA results are as follows: The samples were removed & kept aside.

② Using the procedure on page 26. these samples were desorbed.

30 Jul 98 05:12 ALPHA/BETA - 1.02
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	20.41
Region B:	100 -	350	0	3.0	3.72
Region C:	0.0 -	2000	0	0.1	29.98

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLA
1	999.99	20.41	1.40	3.720	3.28	29.98	1.16	148.22	
2	0.82	10.07	121.1	5452.377	2.99	5470.02	2.99	629.72	
3	0.84	21.25	66.29	5314.137	2.99	5334.30	3.00	622.99	
4	0.84	18.87	72.49	5318.899	2.99	5340.26	2.99	624.08	
5	0.81	10.45	118.2	5550.601	2.98	5567.55	2.99	623.01	
6	0.85	14.88	86.63	5242.162	3.00	5261.78	3.00	626.52	
7	0.83	28.98	53.24	5377.003	2.99	5408.57	2.99	623.29	
8	0.86	17.96	74.41	5218.373	2.99	5244.44	2.99	627.03	
9	0.84	21.25	66.29	5310.565	3.00	5331.92	3.00	626.51	
10	0.85	20.76	67.06	5268.044	2.99	5294.72	2.99	626.61	
11	0.84	28.40	53.70	5299.852	3.00	5333.11	3.00	626.72	
12	1.03	19.39	64.13	4317.639	3.00	4338.95	3.00	624.49	
13	1.03	7.74	135.1	4317.639	3.00	4324.39	3.01	628.89	
14	1.57	7.61	111.1	2828.764	3.00	2833.71	3.01	625.80	
15	1.59	15.44	61.55	2808.859	2.99	2822.22	3.00	624.54	
16	1.39	21.31	51.43	3205.633	3.00	3225.41	3.00	626.04	
17	1.35	9.22	101.7	3290.354	3.00	3295.94	3.01	629.45	
18	1.35	15.14	67.81	3308.873	2.99	3326.31	3.00	627.34	
19	1.34	20.63	53.67	3322.399	3.00	3344.65	3.00	629.20	
20	1.25	14.79	71.80	3564.280	3.00	3578.82	3.00	627.67	

[illegible]	[illegible]	13.81	67.59	3498.642	3.00	3513.33	3.01	627.55
22	1.26	10.54	94.09	3526.439	3.00	3542.24	3.01	628.63
23	1.25	23.59	50.32	3563.480	3.00	3594.02	3.00	626.61
24	1.34	12.42	79.73	3313.444	3.00	3328.23	3.01	626.95
25	1.38	7.12	125.5	3222.367	3.00	3231.61	3.01	627.75
26	1.26	14.51	72.60	3546.280	2.99	3562.08	3.00	626.84
27	1.28	13.18	77.77	3479.093	3.00	3489.55	3.01	628.86
28	1.27	3.21	269.0	3515.965	2.99	3525.92	3.00	625.59
29	1.27	13.45	76.84	3521.477	2.99	3536.16	3.00	625.90
30	1.25	20.39	56.07	3574.680	2.99	3594.82	3.00	627.29
31	1.24	20.72	55.62	3591.441	3.00	3618.41	3.00	627.38
32	1.22	5.82	159.5	3647.100	3.00	3655.26	3.01	624.98
33	1.20	17.92	63.10	3718.780	3.00	3737.52	3.00	624.20
34	1.27	22.11	52.36	3503.367	3.00	3525.14	3.00	626.85
35	1.24	36.04	37.45	3586.603	3.00	3626.47	2.99	621.02
36	1.19	6.48	146.8	3742.498	3.00	3748.17	3.01	629.92
37	1.21	15.95	68.76	3670.660	3.00	3687.37	3.01	626.19
38	1.18	12.64	83.79	3797.128	2.99	3813.24	2.99	630.11
39	1.17	22.32	54.17	3800.554	3.00	3823.86	3.00	627.24
40	1.07	20.71	59.89	4157.027	3.00	4176.56	3.00	626.14
41	1.09	15.37	74.59	4096.280	2.99	4111.30	3.00	625.63

30 Jul 98 06:12 ALPHA/BETA - 1.02
Protocol #:23 U-233 3% 2 sigma User

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLA
42	1.01	19.19	65.28	4403.210	3.00	4426.45	3.00	627.87	
43	1.04	17.09	70.31	4293.396	2.99	4311.36	3.00	625.75	
44	0.94	18.95	68.32	4734.578	3.00	4756.19	3.00	623.32	
45	0.91	27.94	52.19	4896.280	3.00	4928.26	3.00	624.17	
46	0.88	6.86	162.4	5083.780	2.99	5092.75	3.00	630.53	
47	0.87	32.46	48.04	5115.820	3.00	5144.73	3.00	625.84	
48	0.87	27.86	53.48	5161.797	2.99	5190.71	2.98	627.76	
49	0.83	19.35	71.57	5401.099	2.99	5425.44	2.99	626.58	
50	0.83	21.76	65.54	5379.413	2.99	5407.37	2.99	627.60	
51	0.84	35.54	45.94	5353.423	2.98	5386.69	2.98	626.25	
52	0.81	31.44	50.91	5508.625	3.00	5545.33	2.99	630.78	
53	0.82	14.95	87.86	5415.792	3.00	5434.65	3.00	631.54	
54	0.84	11.73	105.5	5346.280	2.99	5361.69	2.99	634.31	
55	0.85	20.76	67.06	5265.691	2.99	5292.37	2.99	632.16	
56	0.85	7.82	147.4	5262.162	2.99	5271.19	3.00	637.88	
57	0.85	17.23	77.25	5226.868	3.00	5241.78	3.00	636.34	
58	0.85	30.18	51.14	5237.456	3.00	5267.67	3.00	639.34	
59	0.90	28.48	51.78	4982.947	2.99	5011.13	2.99	641.17	
1 MISSING TUBE(S)									
61	0.82	44.22	40.16	5441.402	3.00	5494.41	2.99	616.79	
62	0.81	20.33	69.79	5512.329	2.99	5544.09	2.99	621.98	
1 MISSING TUBE(S)									
64	0.83	26.57	56.64	5363.750	3.00	5395.32	3.00	621.44	
65	0.85	31.35	49.79	5233.927	3.00	5273.55	3.00	618.85	

- Transfer clinoptilolite for desorption.
  - Record weight of sample containers. *Note: this step can be skipped if the clinoptilolite transfer is done immediately after the last step in section F.*
  - Centrifuge polycarbonate tubes containing experimental solutions at about 5,000 rpm for 5 min to remove fine particles from suspension.
  - For each sample container, label a corresponding polypropylene (PP) test tube (50 ml capacity) (e.g., C20d-U-pH3 for sample container C20-U-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.

Desorption

Sample Name	wt. Of PP tubes	wt. Of PP tubes after trans clinop	wt. Of PP tubes after acid add	Container wt. after trans clinop	Container wt. After acid add
C20d-pH 2.5	13.3937	17.6665	20.6793	49.6952	52.7176
C20d-pH 2.75	14.0943	20.2947	23.3421	47.4918	50.5159
C20d-pH 3	13.7952	17.5577	20.5892	50.2928	53.3098
C20d-pH 3.25	13.3364	17.0436	20.0856	49.8889	52.9205
C20d-pH 3.5	13.2573	17.8181	20.8562	49.1200	52.1377
C20d-pH 3.75	13.4046	18.1220	21.1696	49.1489	52.1775
C20d-pH 4	13.8878	18.0771	21.1250	49.6406	52.6649
C20d-pH 4.25	13.3635				
C20d-pH 4.5	13.3306				
C20d-pH 4.75	13.3341				
C20d-pH 5	13.4177				
C20d-pH 5.25	13.3634	18.0681	21.0969	49.3445	52.3776
C20d-pH 5.5	13.3830				
C20d-pH 5.75	13.4074				
C20d-pH 6	13.8372	17.9078	20.9474	48.8495	52.8736
C20d-pH 6.25	13.3690				
C20d-pH 6.5	13.4433				
C20d-pH 6.75	13.8150	17.5241	20.4861	50.1771	53.1982
C20d-pH 7	13.8525				
C20d-pH 7.25	13.3341	16.3240	19.3594	51.1363	54.1618
C20d-pH 7.5	13.3010				
C20d-pH 7.75	13.7052	16.3613	19.4126	51.2558	54.2770
C20d-pH 8	13.8881	16.9394	19.9824	50.5512	53.5756
C20d-pH 8.25	13.8926	17.8423	20.9159	49.7234	52.7523
C20d-pH 8.5	13.7589	16.5960	19.6555	50.9623	53.9836
C20d-pH 8.75	13.2605	16.7361	19.7689	50.2061	53.2208
C20d-pH 9	13.3703	17.7788	20.8279	49.4130	52.4272
C20d-pH 9.25	13.3234	17.1455	20.2016	50.3998	53.6230
C20d-pH 9.5	13.3687	17.6889	20.7286	51.0341	54.0515

These samples were placed on gyratory shaker at 125 rpm for 10 days.

8/5/98 AJ

(1) BET surface (area) analysis was performed on cleaned quartz, using Coulter 3100. Quartz used was 60/100 fraction.

wt. of tube assembly = 33.5688 g.

wt. of quartz added = 8.0014 g

wt. of tube assembly + outgassed sample = 41.5407 g

wt. of outgassed quartz = 41.5407 − 33.5688 = 7.9731 g.

BET surface area results are compiled in binder marked as "Coulter 3100 Surface Analysis"

8/6/98 AJ

Objective:- BET surface area analysis on standard NIST 8005.

Equipments needed:- (1) Coulter 3100
(2) NIST 8005 powder
(3) He & N gas tanks
(4) Liquid nitrogen
(5) tube & assembly.

Procedure 1-

wt. of tube assembly = 33.4238 g

wt. of NIST 8005 added = 1.7080 g
to tube assembly

wt. of outgassed sample = 35.1160 g
+ assembly

Actual wt. of outgassed sample = 35.1160
− 33.4238
1.6922 g

Results :-
The results of BET surface area are compiled in binder marked as "Coulter 3100 Surface Analysis".

8/11/98
8/12/98
13
8/19/98 AJ
8/14/98

Following procedure was used for desorption samples. The weights were recorded in a table before LSA counting.

C. Sample solutions for [U].

- For each sample container and PP test tube label two 7 ml LSC vials (e.g., C20-U-pH3a and C20-U-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.

Polycarbonate containers (Desorption)

Sample Name	wt. Of vial	wt. Of vial + sample
C20-pH 2.5aC	7.6318	8.1340
C20-pH 2.5bC	7.6516	8.1515
C20-pH 2.75aC	7.6136	8.1146
C20-pH 2.75bC	7.6954	8.1958
C20-pH 3aC	7.7015	8.2010
C20-pH 3bC	7.5857	8.0863
C20-pH 3.25aC	7.6895	8.1905
C20-pH 3.25bC	7.6006	8.1039
C20-pH 3.5aC	7.6248	8.1260
C20-pH 3.5bC	7.59341	8.0976
C20-pH 3.75aC	7.5948	8.0968
C20-pH 3.75bC	7.7134	8.2152
C20-pH 4aC	7.6463	8.1461
C20-pH 4bC	7.6161	8.1167
C20-pH 4.25aC	7.	
C20-pH 4.25bC		
C20-pH 4.5aC		
C20-pH 4.5bC		
C20-pH 4.75aC		
C20-pH 4.75bC		
C20-pH 5aC		
C20-pH 5bC		
C20-pH 5.25aC	7.6178	8.1208
C20-pH 5.25bC	7.6621	8.1635
C20-pH 5.5aC		
C20-pH 5.5bC		
C20-pH 5.75aC		
C20-pH 5.75bC		
C20-pH 6aC	7.5618	8.0617
C20-pH 6bC	7.6323	8.1341
C20-pH 6.25aC		
C20-pH 6.25bC		
C20-pH 6.5aC		
C20-pH 6.5bC		
C20-pH 6.75aC	7.6292	8.1308
C20-pH 6.75bC	7.6503	8.1514
C20-pH 7aC		
C20-pH 7bC		
C20-pH 7.25aC	7.6207	8.1234
C20-pH 7.25bC	7.6229	8.1255
C20-pH 7.5aC		
C20-pH 7.5bC		
C20-pH 7.75aC	7.6080	8.1092
C20-pH 7.75bC	7.6134	8.1142
C20-pH 8aC	7.6326	8.1345
C20-pH 8bC	7.6755	8.1776
C20-pH 8.25aC	7.5850	8.0869
C20-pH 8.25bC	7.5934	8.0967
C20-pH 8.5aC	7.5904	8.0935
C20-pH 8.5bC	7.6187	8.1215
C20-pH 8.75aC	7.6396	8.1415
C20-pH 8.75bC	7.6368	8.1396
C20-pH 9aC	7.6741	8.1749
C20-pH 9bC	7.6232	8.1256
C20-pH 9.25aC	7.6377	8.1379
C20-pH 9.25bC	7.5486	8.0515
C20-pH 9.5aC	7.6134	8.1163
C20-pH 9.5bC	7.6156	8.1195

8/11/98 -
Sorption for samples

Sample Name	Container wt. before sampling & pH measurements	Measured pH	Container wt. after sampling & pH measurements
C20-pH 2.5			
C20-pH 2.75			
C20-pH 3			
C20-pH 3.25			
C20-pH 3.5			
C20-pH 3.75			
C20-pH 4			
C20-pH 4.25	53.9150	4.47	52.3013
C20-pH 4.5	53.4987	4.56	51.9716
C20-pH 4.75	53.6112	4.54	52.5912
C20-pH 5	53.6443	5.73	52.6177
C20-pH 5.25	0.0000		0.0000
C20-pH 5.5	53.8103	5.17	52.7739
C20-pH 5.75	53.6238	6.3	52.5906
C20-pH 6	0.0000		0.0000
C20-pH 6.25	53.5048	6.55	52.4807
C20-pH 6.5	53.9512	6.88	52.9234
C20-pH 6.75	0.0000		0.0000
C20-pH 7	53.6693	7.1	52.6516
C20-pH 7.25	0.0000		0.0000
C20-pH 7.5	53.6446	7.48	52.6225

PP Test tubes [Desorption]

Sample Name	wt. Of vial	wt. Of vial + sample
C20-pH 2.5at	7.6287	8.1294
C20-pH 2.5bt	7.6282	8.1260
C20-pH 2.75at	7.6257	8.1251
C20-pH 2.75bt	7.6440	8.1409
C20-pH 3at	7.6264	8.1210
C20-pH 3bt	7.6506	8.1454
C20-pH 3.25at	7.6271	8.1250
C20-pH 3.25bt	7.6598	8.1565
C20-pH 3.5at	7.7362	8.2317
C20-pH 3.5bt	7.6348	8.1316
C20-pH 3.75at	7.6901	8.1865
C20-pH 3.75bt	7.6495	8.1442
C20-pH 4at	7.6567	8.1556
C20-pH 4bt	7.6438	8.1410
C20-pH 4.25at		
C20-pH 4.25bt		
C20-pH 4.5at		
C20-pH 4.5bt		
C20-pH 4.75at		
C20-pH 4.75bt		
C20-pH 5at		
C20-pH 5bt		
C20-pH 5.25at	7.5929	8.0867
C20-pH 5.25bt	7.6278	8.1264
C20-pH 5.5at		
C20-pH 5.5bt		
C20-pH 5.75at		
C20-pH 5.75bt		
C20-pH 6at	7.6433	8.1408
C20-pH 6bt	7.6186	8.1164
C20-pH 6.25at		
C20-pH 6.25bt		
C20-pH 6.5at		
C20-pH 6.5bt		
C20-pH 6.75at	7.6372	8.1364
C20-pH 6.75bt	7.6153	8.1174
C20-pH 7at		
C20-pH 7bt		
C20-pH 7.25at	7.6345	8.1344
C20-pH 7.25bt	7.5776	8.0789
C20-pH 7.5at		
C20-pH 7.5bt		
C20-pH 7.75at	7.6467	8.1569
C20-pH 7.75bt	7.6119	8.1139

C20-pH 8at	7.6342	8.1303
C20-pH 8bt	7.5945	8.0923
C20-pH 8.25at	7.6363	8.1335
C20-pH 8.25bt	7.6486	8.1471
C20-pH 8.5at	7.5842	8.0795
C20-pH 8.5bt	7.6601	8.1594
C20-pH 8.75at	7.6412	8.1473
C20-pH 8.75bt	7.6612	8.1582
C20-pH 9at	7.6133	8.1111
C20-pH 9bt	7.6120	8.1115
C20-pH 9.25at	7.6659	8.1837
C20-pH 9.25bt	7.6631	8.1613
C20-pH 9.5at	7.6455	8.1442
C20-pH 9.5bt	7.6652	8.1647

Sorption samples

8/11/98

Sample Name	wt. Of vial	wt. Of vial + sample
C20-pH 4.25a	7.5460	8.0753
C20-pH 4.25b	7.6452	8.1503
C20-pH 4.5a	7.6118	8.1119
C20-pH 4.5b	7.5922	8.0926
C20-pH 4.75a	7.6712	8.1707
C20-pH 4.75b	7.5805	8.0786
C20-pH 5a	7.6656	8.1659
C20-pH 5b	7.5172	8.0173
C20-pH 5.25a	0.0000	0.0000
C20-pH 5.25b	0.0000	0.0000
C20-pH 5.5a	7.6624	8.1630
C20-pH 5.5b	7.6423	8.1430
C20-pH 5.75a	7.6882	8.1875
C20-pH 5.75b	7.6221	8.1243
C20-pH 6a	0.0000	0.0000
C20-pH 6b	0.0000	0.0000
C20-pH 6.25a	7.6310	8.1323
C20-pH 6.25b	7.6888	8.1897
C20-pH 6.5a	7.5834	8.0858
C20-pH 6.5b	7.6521	8.1536
C20-pH 6.75a	0.0000	0.0000
C20-pH 6.75b	0.0000	0.0000
C20-pH 7a	7.5889	8.0894
C20-pH 7b	7.6313	8.1314
C20-pH 7.25a	0.0000	0.0000
C20-pH 7.25b	0.0000	0.0000
C20-pH 7.5a	7.6134	8.1137
C20-pH 7.5b	7.5638	8.0650

Sample Name	Container wt. before sampling	wt. Of PP tubes before sampling	Container wt. after sampling	wt. Of PP tubes after sampling
C20d-pH 2.5	52.6282	20.6676	51.6179	19.6623
C20d-pH 2.75	50.4222	23.3043	49.4148	22.3028
C20d-pH 3	53.2363	20.5342	52.2300	19.5332
C20d-pH 3.25	52.8689	20.0664	51.7831	19.0651
C20d-pH 3.5	52.0348	20.8321	51.0243	19.8304
C20d-pH 3.75	52.0518	21.1280	51.0433	20.1276
C20d-pH 4	52.5956	21.0889	51.5908	20.0902
C20d-pH 4.25				
C20d-pH 4.5				
C20d-pH 4.75				
C20d-pH 5				
C20d-pH 5.25	52.3222	21.0698	51.3124	20.0695
C20d-pH 5.5	~~49.8450~~ AJ			
C20d-pH 5.75				
C20d-pH 6	52.8024	20.8991	51.7944	19.8895
C20d-pH 6.25				
C20d-pH 6.5				
C20d-pH 6.75	53.1398	20.4318	52.1336	19.4274
C20d-pH 7				
C20d-pH 7.25	54.0721	19.3719	53.0620	18.3173
C20d-pH 7.5				
C20d-pH 7.75	54.1754	19.3550	53.1684	18.3545
C20d-pH 8	53.4990	19.9702	52.4896	18.9692
C20d-pH 8.25	52.6016	20.7850	51.5926	19.7862
C20d-pH 8.5	53.8669	19.6029	52.8574	18.6023
C20d-pH 8.75	53.1460	19.6676	52.1362	18.6656
C20d-pH 9	52.3440	20.8067	51.3349	19.8061
C20d-pH 9.25	53.5005	20.1074	52.4921	19.1060
C20d-pH 9.5	53.9872	20.7079	52.9765	19.7075

The samples were kept under glass cover away from light for 24 hrs before counting.

8/17/98 AJ

8/18/98

① LSA counting started. The results are posted on page 32.

② Cleaned agate mortar & pestle, 325 mesh for quartz crushing to 325 mesh.

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

	LL	UL	LCR	2S%	BKG
Region A:	0.0 -	100	0	0.3	20.20
Region B:	100 -	350	0	3.0	3.71
Region C:	0.0 -	2000	0	0.1	29.61

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	F
1	999.99	20.20	1.41	3.705	3.29	29.61	1.16	149.56	
2	0.89	15.76	80.70	5036.745	2.99	5051.29	2.99	628.05	
3	0.91	50.13	35.08	4921.569	2.99	4978.08	2.98	620.07	
4	0.94	26.61	53.05	4748.422	2.99	4781.03	2.99	625.53	
5	0.95	22.96	58.73	4691.032	3.00	4717.76	3.00	624.42	
6	0.97	44.75	36.58	4799.388	2.93	4844.62	2.93	623.35	
7	0.93	18.51	69.72	4793.069	3.00	4813.40	3.00	626.02	
8	1.68	11.94	73.28	2654.033	3.00	2668.01	3.00	625.45	
9	1.70	16.86	55.41	2621.589	3.00	2638.63	3.00	623.14	
10	1.21	13.69	77.37	3693.815	2.99	3710.06	3.00	626.11	
11	1.21	7.07	134.3	3671.501	3.00	3677.00	3.01	626.69	
12	2.08	5.76	122.7	2137.160	3.00	2144.43	3.02	623.27	
13	2.03	1.48	443.3	2191.862	3.00	2191.58	3.02	625.47	
14	2.06	8.44	88.41	2154.062	3.00	2161.17	3.02	624.71	
15	2.01	14.63	56.95	2215.698	3.00	2231.59	3.01	622.15	
16	1.87	10.28	78.58	2375.439	3.00	2389.64	3.01	624.28	
17	1.88	15.97	54.96	2360.657	3.00	2379.44	3.01	625.49	
18	1.64	6.02	132.9	2724.953	2.99	2734.42	3.00	626.20	
19	1.60	27.30	39.93	2775.670	3.00	2803.52	3.00	619.79	
20	1.26	28.21	43.95	3547.089	2.99	3577.54	2.99	623.03	
21	1.27	8.93	107.3	3504.956	3.00	3516.85	3.01	624.13	
15 MISSING TUBE(S)									
37	1.31	21.02	53.38	3394.768	3.00	3422.30	3.00	611.66	
38	1.33	9.88	96.34	3339.904	3.00	3356.11	3.01	612.77	
39	1.14	25.41	49.79	3903.313	3.00	3932.67	3.00	610.35	
40	1.13	18.74	62.67	3951.162	2.99	3971.28	3.00	615.25	
41	1.28	12.61	80.31	3491.607	2.99	3511.02	3.00	612.04	
42	1.32	8.59	108.8	3375.840	3.00	3389.33	3.00	616.05	
43	1.27	14.45	72.34	3501.807	3.00	3519.21	3.00	611.00	
44	1.28	19.64	56.82	3491.607	2.99	3515.71	2.99	610.48	
45	1.13	16.08	70.48	3935.233	3.00	3953.58	3.00	619.08	
46	1.09	14.66	77.16	4078.864	3.00	4094.25	3.00	614.90	
47	0.61	25.70	67.51	7338.917	2.99	7368.75	2.99	613.31	
48	0.63	38.53	50.12	7159.787	2.98	7205.31	2.97	612.05	
49	0.33	64.65	49.61	13875.08	2.96	13949.2	2.95	612.03	
50	0.33	31.32	79.80	13726.60	2.97	13770.4	2.97	614.46	
51	0.41	11.51	152.9	10993.86	2.98	11009.4	2.98	616.13	
52	0.39	13.13	140.8	11611.68	2.97	11642.2	2.97	615.50	
53	0.42	51.23	50.92	10634.39	2.99	10689.4	2.99	612.60	
54	0.42	15.52	118.9	10848.68	2.96	10868.0	2.96	614.02	
55	0.44	22.98	86.22	10334.93	2.97	10372.7	2.96	616.31	
56	0.44	25.26	80.50	10107.66	3.00	10129.5	3.00	612.62	
57	0.48	27.72	72.10	9312.962	2.99	9349.56	2.99	613.74	
58	0.48	58.97	43.56	9385.879	2.98	9451.64	2.97	612.40	
59	0.84	40.52	41.97	5322.485	2.99	5373.96	2.98	608.69	
60	0.89	14.63	85.53	5018.767	2.99	5047.92	2.99	612.06	
61	1.05	14.09	81.16	4242.962	3.00	4265.63	3.00	612.67	
62	1.05	6.47	155.9	4257.248	2.99	4268.49	3.00	612.36	
63	1.26	4.40	200.8	3542.327	3.00	3548.96	3.00	616.44	
64	1.23	12.32	83.50	3632.067	2.99	3641.94	3.00	614.23	
65	1.53	9.21	95.23	2911.328	3.00	2927.26	3.00	613.42	
66	1.51	24.83	44.00	2951.262	3.00	2984.96	2.99	611.47	
67	1.42	13.60	71.76	3132.210	3.00	3149.27	3.00	614.04	
68	1.52	15.33	63.11	2941.032	2.99	2959.87	3.00	613.75	
69	1.38	13.13	74.87	3231.802	3.00	3247.20	3.00	617.51	
70	1.36	19.51	55.42	3278.648	3.00	3304.95	3.00	616.82	
71	1.43	17.56	58.54	3118.673	3.00	3137.53	3.00	618.02	
72	1.46	7.88	111.3	3050.405	3.00	3060.12	3.01	621.99	
73	1.40	22.66	48.85	3170.581	3.00	3192.54	3.01	624.07	
74	1.42	19.94	53.34	3131.506	3.00	3158.42	3.00	617.59	
16 MISSING TUBE(S)									
91	0.88	25.26	56.93	5058.795	3.00	5085.17	3.00	615.89	
92	0.92	22.19	61.19	4864.773	2.99	4891.04	2.99	616.70	
93	0.93	20.66	64.18	4797.370	3.00	4820.93	3.00	616.43	
94	0.94	25.55	54.63	4745.231	3.00	4770.39	3.00	618.82	
95	0.91	21.56	62.86	4902.888	3.00	4927.54	3.00	618.15	
96	0.94	22.35	60.21	4759.061	2.99	4783.16	2.99	617.58	
97	0.93	18.51	69.72	4804.897	2.99	4823.08	3.00	619.47	
98	0.95	24.01	56.83	4688.927	3.00	4713.55	3.00	617.65	
99	0.93	13.13	91.19	4812.424	2.99	4831.68	2.99	619.38	
100	0.96	15.22	79.85	4662.962	2.99	4679.77	2.99	619.30	
101	1.11	5.93	163.8	4000.799	3.00	4008.23	3.01	621.07	
102	1.12	3.91	237.5	3973.973	3.00	3982.89	3.01	625.86	
103	1.83	19.69	47.44	2426.350	3.00	2447.44	3.01	618.37	
104	1.78	9.01	89.94	2500.789	3.00	2514.77	3.01	622.16	
105	1.51	3.64	218.4	2948.613	3.00	2959.13	3.01	621.52	
106	1.58	15.24	62.17	2996.928	2.91	3015.33	2.91	623.90	
107	1.35	12.39	79.33	3296.295	3.00	3313.36	3.00	621.51	
108	1.37	9.00	102.7	3257.609	3.00	3266.74	3.00	622.32	
109	1.30	8.26	113.3	3430.910	3.00	3441.93	3.00	619.34	
110	1.29	13.13	77.44	3462.187	2.99	3477.37	3.00	621.75	
111	1.20	4.80	190.2	3707.128	3.00	3713.73	3.01	619.85	
112	1.19	7.53	128.2	3761.001	2.99	3772.07	3.00	621.71	
113	0.98	20.62	62.62	4559.560	2.99	4582.64	2.99	619.10	
114	1.00	19.80	63.90	4441.295	3.00	4464.39	3.00	618.09	
115	0.94	10.65	107.6	4751.614	2.99	4760.82	3.00	620.59	
116	0.98	15.52	77.84	4571.805	2.99	4587.74	2.99	620.06	
117	0.93	12.06	97.71	4790.918	3.00	4800.50	3.00	623.64	
118	0.93	32.49	46.34	4791.994	3.00	4830.61	2.99	620.97	
119	0.93	24.96	55.84	4804.897	2.99	4828.46	2.99	622.55	
120	0.92	24.37	57.14	4849.556	3.00	4875.83	3.00	625.27	
121	0.91	36.94	42.91	4919.372	2.99	4960.50	2.99	611.70	
122	0.91	23.76	58.52	4908.383	2.99	4940.72	2.99	622.20	
123	0.94	7.46	145.5	4777.146	2.99	4785.29	2.99	632.37	
124	0.94	11.72	99.50	4747.359	3.00	4760.82	3.00	629.13	
125	0.93	29.26	49.85	4822.102	2.99	4851.04	2.99	629.20	
126	0.93	31.41	47.44	4796.295	3.00	4827.38	2.99	629.02	

18 Aug 98 06:32 ALPHA/BETA - 1.02
Protocol #:23 U-233 3% 2 sigma User

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLA
127	1.00	12.80	89.78	4797.295	2.89	4810.39	2.89	643.92	
128	0.94	39.38	40.44	4753.742	2.99	4792.73	2.99	633.26	

8/19/98 AJ

(1) Following procedure on page (4). other mineral impurities were removed from quartz by heavy liquid separation

(2) Prepare containers (50 ml) & teflon 2lt. bottles for mixed mineral sorption experiments.

8/21/98 AJ

(1) Crush quartz (60/100 fraction) to 325 mesh.

(2) Continue heavy liquid seperation to remove impurities from quartz.

(3) Preparation of 0.1M $NaNO_3$ matrix

16.9968 gms of $NaNO_3$ (lot # 930601) in 2000 gms of nanopure H_2O.

(4) Preparation of 50 PPb U-233 solution

Dilute 200.0 g of 500 PPb soln. (Spike # 28A) to 2000.0 g ~~of~~ with 0.1M $NaNO_3$ matrix.

8/24/98 AJ

(1) Crush quartz (60/100 fraction) to 325 mesh.

(2) BET surface analysis started on clinoptilolite using Coulter 3100 SA.

wt. of tube assembly = 33.6212 g
wt. of clinoptilolite added = 1.9905 g

The sample was outgassed for minutes.

8/25/98 AJ

(1) wt. of outgassed clinoptilolite & assembly = 35.3158

wt. of outgassed clinoptilolite = 35.3158
− 33.6212
1.6946 g

The results are stored in binder marked as "Coulter 3100 SA".

(2) Sampling for desorption step on samples which were adjusted for PH. The samples were kept under glass cover for 24 hrs before counting.

8/26/98 AJ

(1) BET surface analysis started on clinoptilolite using Coulter 3100 SA.

wt. of tube assembly = 33.6328 g
wt. of Clinop. added = 2.5052 g.

The sample was outgassed for minutes.

(2) LSA run started.

8/27/98 AJ

(1) wt. of outgassed clinop. + assembly = 35.7470 g
wt. of outgassed clinop. = 35.7470
− 33.6328
2.1142 g

The run was completed & results are stored in binder marked as "Coulter 3/100 SA surface analysis results".

(2) LSA results are recorded in following table.

27 Aug 98 05:41 ALPHA/BETA - 1.02
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	20.18
Region B:	100 -	350	0	3.0	3.80
Region C:	0.0 -	2000	0	0.1	29.79

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

PP Tubes

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS F
1	999.99	20.18	1.41	3.798	3.25	29.79	1.16	150.93
2	0.86	32.15	48.54	5192.714	2.99	5228.35	2.99	610.77
3	0.86	20.52	67.07	5204.342	2.99	5224.86	2.99	611.70
4	0.73	19.55	75.49	6153.736	2.98	6175.69	2.99	608.42
5	0.73	12.70	105.7	6153.736	2.98	6170.21	2.99	610.57
6	0.73	27.77	58.38	6085.243	3.00	6120.89	3.00	607.24
7	0.73	15.44	90.51	6126.339	2.99	6141.44	2.99	608.45
8	0.33	46.49	61.15	13756.81	2.97	13815.7	2.97	608.59
9	0.34	50.41	57.17	13313.85	2.97	13379.0	2.97	613.16
10	0.54	16.86	98.27	8266.572	2.99	8283.17	3.00	611.59
11	0.54	53.89	43.47	8294.350	2.99	8347.99	2.98	610.32
12	0.31	24.98	96.63	14425.23	2.99	14463.8	2.99	611.33
13	0.32	54.82	55.85	14064.95	2.98	14132.7	2.98	611.57
14	0.35	36.96	69.14	12827.63	2.99	12867.4	2.98	609.85
15	0.36	35.38	70.24	12515.65	2.98	12548.0	2.98	611.97
16	0.28	54.82	59.71	16039.06	2.98	16098.8	2.98	606.19
17	0.29	38.44	73.97	15765.17	2.96	15821.9	2.96	609.21
18	0.42	36.96	63.12	10786.68	2.97	10825.0	2.97	606.82
19	0.42	22.68	89.10	10593.82	3.00	10622.6	3.00	610.08
20	0.47	28.76	70.97	9570.670	2.98	9595.74	2.98	609.40
21	0.47	30.88	67.50	9466.415	3.00	9497.87	3.00	610.49

15 MISSING TUBE(S) containers

37	1.03	15.74	75.05	4321.445	3.00	4345.94	3.00	620.46
38	1.03	10.89	100.9	4321.445	3.00	4333.31	3.00	617.95
39	1.06	11.90	92.51	4195.259	3.00	4206.06	3.01	618.33
40	1.02	10.21	106.9	4365.810	3.00	4377.07	3.00	616.72
41	1.04	14.44	79.95	4277.933	3.00	4295.21	3.00	621.05
42	1.04	12.51	89.64	4274.087	3.00	4285.59	3.01	614.86
43	1.80	10.93	76.10	2473.980	3.00	2489.10	3.01	619.73
44	1.77	13.72	63.83	2517.106	3.00	2532.35	3.00	614.95
45	1.28	5.60	160.3	3489.952	2.99	3498.33	3.00	617.30
46	1.30	9.05	104.8	3441.587	2.99	3456.36	3.00	616.70
47	2.40	190.65	9.83	1853.702	3.00	2047.29	2.87	546.08
48	2.06	14.77	55.80	2153.483	3.01	2172.64	3.01	615.65
49	2.09	0.87	727.5	2122.518	3.01	2124.27	3.02	617.25
50	2.16	10.38	72.55	2062.406	3.00	2071.60	3.01	614.66
51	1.86	5.63	132.5	2387.062	3.00	2394.94	3.02	615.85
52	1.89	5.22	140.6	2354.932	3.00	2359.10	3.01	616.95
53	1.74	9.71	85.45	2563.443	3.00	2575.95	3.00	617.18
54	1.69	12.37	71.02	2626.971	3.00	2640.62	3.01	617.11
55	1.33	13.66	73.90	3363.119	2.99	3378.48	3.00	615.91

27 Aug 98 06:34 ALPHA/BETA - 1.02
Protocol #:23 U-233 3% 2 sigma

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS FL
56	1.39	9.32	98.93	3304.116	2.95	3316.97	2.96	617.37

8/31/98 AJ

(1) Crush quartz 60/100 fraction to ≤325 mesh.
(2) containers dried in oven at 75°C.

9/1/98 AJ

① Preparation of heavy liquid for removing impurities from quartz.

$\rho_{tetrabromoethane}$ = 2.9672 g/c.c.

ρ_{quartz} = 2.65 g/c.c.

$\rho_{N\text{-}N\ dimethyl\ formamide}$ = 0.93445 g/c.c.

liquid to be prepared with ρ_{liquid} = 2.75 g/c.c. Using procedure for heavy liquid separation on page ④, for 150 ml of tetrabromoethane. ?? of N-N dimethyl formamide is required

$$V_1 = \frac{(2.9672 - 2.75)}{2.75 - 0.93445}\ 150\ ml$$

$$= \frac{0.217200}{1.81555} \times 150\ ml$$

$$= 0.11963317 \times 150\ ml$$

$$= 17.945\ ml \text{ of N-N dimethyl.}$$

mix 150 ml of tetrabromoethane to 17.95 ml of N-N dimethyl formamide & store in dark color bottle.
A batch of 200 ml was prepared by mixing 200 ml of tetrabromoethane to 23.9 ml of N-N dimethyl formamide.

② Crush quartz 60/100 fraction to ≤325 mesh.

9/2/98 AJ

① Crush quartz 60/100 fraction to ≤325 mesh

② with agate mortar & pestle & Ro-Tap sieve shaker.

② Treat quartz with heavy liquid for removal of another mineral impurities. Use procedure on page ⑤.

9/3/98 AJ

① Crush 60/100 fraction of quartz to ≤325 mesh using mortal & pestle & Ro-Tap sieve shaker.

② Treat quartz with heavy liquid for removal of mineral impurities. Followed procedure on page ⑤

③ Clean ≤325 mesh quartz ultrasonically with nanopure water. Centrifuge at 1500 rpm for 1 min to remove particles < 0.044 mm.

9/4/98 AJ

① Continue heavy liquid treatment of quartz. Refer to page ⑤.

② Crush quartz to ≤325 mesh with agate mortar & pestle.

③ 45 g of quartz ≤325 mesh dried in oven at 80°C.

9/8/98 AJ

① Crush quartz to 325 mesh with agate mortar & pestle & Ro-Tap sieve shaker.

② Rinse 60/100 Quartz after HL treatment with nanopure H_2O several times & also in ultrasonic cleaner. Kept in oven for drying at ~80°C.

9/9/98 AJ

① Crush quartz to 325 mesh using agate mortar & pestle & RO-Tap sieve shaker.

② Detection of Al & SiO_2 in solution of C20-U experiments. The procedure is mentioned in TOP-013 & TOP-014 & followed to obtain the following results :-

SiO2 and Al solution concentrations
Measurement of solutions from desorption containers.

exp soln	equilib. pH	SiO2 ppm	Al ppb	
pH-2.5	2.45	5.83	2739	
pH-2.75	2.68			
pH-3	2.98	2.3	1028	
pH-3.25	3.34			
pH-3.5	3.80	1.09	259	
pH-3.75	4.96			
pH-4	7.00	1.17	171	
pH-4.25	4.47			
pH-4.5	4.56	1.61	117	
pH-4.75	4.54			
pH-5	5.73	1.4	67	
pH-5.25	7.24			
pH-5.5	5.17	1.48	72	
pH-5.75	6.30			
pH-6	7.45	1.16	126	
pH-6.25	6.55			
pH-6.5	6.88	1.32	58	
pH-6.75	7.52			
pH-7	7.10	1.44	80	
pH-7.25	7.76			
pH-7.5	7.48	1.56	60	
pH-7.75	7.96			
pH-8	8.15	1.93	154	
pH-8.25	8.31			
pH-8.5	8.62	2.37	102	
pH-8.75	8.80			
pH-9	9.01	2.74	41	
pH-9.25	9.21			
pH-9.5	9.17	3.24	0	

Al std. soln. Lot # 981033-18

SiO_2 std. soln. Lot # 8037-5

9/10/98 AJ

① Crush quartz to ≤325 mesh using agate mortar & pestle & RO-Tap sieve shaker.

9/11/98 AJ

① Crush 60/100 fraction of quartz to ≤325 mesh using agate mortar & pestle & RO-Tap sieve shaker.

9/14/98 AJ

① Crush quartz to ≤325 mesh size using agate mortar & pestle & RO-Tap sieve shaker.

9/16/98 AJ

① Crush quartz to ≤325 mesh size using agate mortar & pestle & RO-Tap sieve shaker.

② Rinse 60/100 quartz with acetone & then water. kept in oven to dry at ~80°C.

9/17/98

① Crush quartz to ≤325 mesh size using agate mortar & pestle & RO-Tap sieve shaker.

9/18/98 Crush 60/100 fraction pretreated quartz to ≤325 mesh size using agate mortar & pestle and RO-Tap sieve shaker.

9/21/98

① Crush 60/100 fraction pretreated quartz to 325 mesh size using agate mortar & pestle and RO-Tap sieve shaker. Total quartz to ≈ 170 g.

② Divide 170 g of cleaned 325 mesh quartz into two beakers & clean ultrasonically with DI water 2 times.

9/22/98 AJ

Objective :- To remove particles < 0.004 mm from 325 mesh fraction of quartz.

Procedure :- Aliquot ~2 g of quartz in 50 ml PP tubes. Add 30-40 ml of H_2O & centrifuge at 1500 rpm for 1 min. Decant the supernatant liquid & discard till it is clear.

Equipments needed :- PP tubes
Table top centrifuge (Marathon 21K)
Nanopure water
glasswares.
Oven

Using the above procedure quartz was treated for removal of particles <0.004 mm centrifuged 2 times. Quartz was kept in oven at ~ 82°C for overnight to dry.

9/23/98 AJ
9/24/98

① Weighs quartz which was dried overnight ≈ 140 g.

Total = 45 g (previous batch) + 140 g
= 185 g.

② Objective :- To analyse surface area of 325 mesh fraction of quartz prepared.

Equipments needed :- ① Coulter SA3100
② Quartz
③ Liquid N_2
④ N_2 & He gas tanks
⑤ Weighing balance
⑥ weighing boat

Procedure :- Followed per Coulter SA3100 product manual.

Results :- The results are filed in a ring binder marked as "Results of Surface Analysis" in the lab.

① wt. of tube + assembly = 33.5656 g
wt. of qz added ≈ 4.2540 g
outgas time = 120 min . outgas temp. = 350°C
wt. of outgassed qz + tube assembly = 37.7861 g

wt. of outgassed qz = 37.7861
− 33.5656
4.2205 g

AJ ② Sample didn't outgass for 120 min & so test was repeated.

② Preparation of 0.005 m $NaHCO_3$ soln.

Dilute 0.084 g of $NaHCO_3$ (Lot # 936883) with nanopure H_2O up to 200 ml mark.

③ wt. of tube + assembly = 33.2573 g.
wt. of sample added ≈ 2.0125 g
outgas time = 720 min

max^m. temp = 350°C

wt. of outgassed qz + tube assembly = 35.2541 g

wt. of outgassed qz = 35.2541
− 33.2573
1.9968 g.

Results filed in binder marked as "Surface Area Analysis" in Geochemistry Lab.

(4) wt. of tube assembly = 33.5656
outgas time = 120 min, temp. = 350°C

wt. of tube assembly + outgassed qz = 37.7864 g

wt. of outgassed qz = 37.7864
− 33.5656
4.2208 g

Results filed in binder marked as "Surface Area Analysis" in Geochem. lab.

AT
9/25/98 AJ

BET Surface Area Analysis

(1) wt. of tube assembly = 33.6672 g
outgas time = 720 min, temp. = 350°C
wt. of outgassed 325 mesh qz + tube assembly
= 35.6149 g

wt. of outgassed 325 mesh qz = 35.6149
− 33.6672
1.9477 g

Results filed in ring binder

(2) wt. of tube assembly = 33.5713 g

outgas time = 720 min, max. temp. = 350°C

wt. of outgassed qz < 325 mesh + tube assembly
= 35.5612 g

wt. of outgassed qz < 325 mesh = 35.5612
− 33.5713
1.9899 g

Results filed in binder named as "Surface Area Analysis" in Geochemistry Lab.

(3) wt. of tube assembly = 33.3789 g

Outgas time = 720 min, max^m. temp. = 350°C

wt. of outgassed qz (old batch) + tube assembly
= 35.3897 g

wt. of outgassed qz (old batch) = 35.3897
− 33.3789
2.0108 g

Results filed in binder named as "Results of Surface Area Analysis" in Geochem. Lab.

9/28/98 AJ

Crush 60/100 fraction quartz to ≤325 mesh size using mortar & pestle & Ro-Tap sieve shaker.
≈ 26 g.

9/29/98 AJ

Crush 60/100 fraction quartz to ≤325 mesh size using agate mortar & pestle & Ro-Tap sieve shaker.

≈ 55g.
Clean with nanopure water in ultrasonic cleaner.

9/30/98 AJ

① Centrifuge ~ 2g of ≤ 325 mesh quartz with 35-40 ml of nanopure H_2O in PP tubes at 1500 rpm for 1 min. This process is necessary to remove any fine particles < 0.004 mm.

② Prepare sample holder for surface area measurements. Wash the sample holder with nanopure water using disposable plastic pippet & dry in oven overnight.

10/1/98 AJ

① Wlight of total quartz (crushed to 325 mesh & particles ~~for~~ < 0.004 mm removed)
= 225.09 g.

② BET surface area analysis of quartz 325 mesh size. The procedure is in reference to Coulter SA3100 product manual in the Geochemistry lab.

wt. of tube assembly = 33.6892 g

Outgas temperature = 350°C
Outgas time = 120 min.

wt. of tube assembly + outgassed quartz
= 37.7102 g

wt. of outgassed quartz = 37.7102
− 33.6892
4.0210 g.

The results are filed in binder marked as "Results of Surface Area Analysis".
BET surface area = 0.145 sq.m/g

③ Objective :- BET surface area analysis on prepared Quartz (325 mesh) and on mixture of Clinoptilolite and quartz in the following ratio:

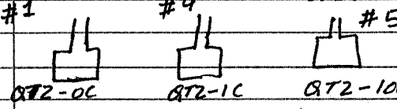
ⓐ No Clinoptilolite i.e. 0.0 mg

ⓑ Qz = 1000 mg & Clino = 3.5 mg

ⓒ Qz = 1000 mg & Clino = 35 mg

Equipments :- ① Sample holders & tube assembly
② N_2 liquid
③ He gas tank & N_2 gas tank
④ Weighing scale & weighing boats.
⑤ Coulter SA 3100 surface area analyzer

Procedure :- As per coulter SA3100 product manual.



Ⓐ wt. of # 1 tube assembly = 33.6664 g
amount of qz added ≈ 2.0191 g
amount of Clino added = 0.0 g

Ⓑ wt. of # 4 tube assembly = 33.6328 g
wt. of qz added = 1.00g x 3 ≈ 3.0016 g
wt. of Clino added = 0.0035 (3.5 mg) x 3
= 0.0105 g

total wt. of mixture sample = 3.0016 g
+0.0105
3.0121 g.

(c) wt. of #5 tube assembly = 33.6677 g

wt. of qz added = 1.0g x 2 = 2.000g
wt. of clino added = 0.035g x 2 = 0.070g

Outgas time for #1, #4 & #5 tubes
= 720 min ≈ 12 hrs.

outgas temp. for #1, #4 & #5 tubes
= 350°C

10/2/98 AJ

(1) #1 & #4 samples had leak & therefore could not be outgassed. This is to be repeated.

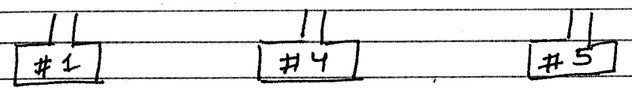
(2) wt. of tube assembly #5 + outgassed sample
= 35.4056 g.

wt. of outgassed sample = 35.4056
- 33.6677
1.7379 g

The results of #5 tube sample showed surface area = 0.794 sq.m/g on screen but couldn't complete the run as other samples were kept to outgas. Both the runs were stopped & has to be repeated.

10/5/98 AJ
10/6/98

(1) Objective :- To redo the surface area analysis of the samples on page 47.



(a) wt. of tube assembly #1 = 33.6664 g.

(b) wt. of tube assembly #4 = 33.6328 g

(c) wt. of tube assembly #5 = 3.6677 g.

Procedure :- As per Coulter SA3100 product manual.

Equipments :- As on page 47.

The samples were outgassed for 720 min at 350°C.

(a) wt. of outgassed sample & tube assembly #1
= 35.6904 g.

wt. of outgassed qz = 35.6904
- 33.6664
2.0240 g

BET surface area = 0.304 sq.m/g

The complete results are stored in binder marked "Results of Surface Area Analysis".

(b) wt. of outgassed sample & tube assembly #4
= 36.6155 g.

wt. of outgassed qz & clino mixture = 36.6155
(0.1 g/L) - 33.6328

= 2.9827 g.

BET surface area = 0.314 sq.m/g

The complete results are stored in binder marked as "Surface Area Analysis Results".

(c) wt. of outgassed sample & tube assembly #5
= 35.4041 g

wt. of outgassed mixture of quartz & clino. (1.0 g/L)
= 35.4041
−33.6677
1.7364 g.

BET surface area analysis = 0.698 sq.m/g

The complete results are stored in binder "Results of surface Area Analysis".

(d) Objective :- Surface Area Analysis for the mixture of quartz & Clinoptilolite with ratio 10g/L.

(i) Qz = 1g . Clino = 350 mg
= 0.35 g

Procedure & Equipments are same as on page 47.

wt. of tube assembly #9 = 33.1748 g

wt. of Qz added ≈ 2.008 g [1g x 2]
wt. of clino added ≈ 0.703 g [0.35 x 2]

wt. of total mixture sample = 2.008 + 0.703
= 2.711 g.

(e) BET surface area analysis for quartz (325 mesh) repeated.

wt. of tube assembly #7 = 33.6892 g
wt of Qz added ≈ 2 g

(f) BET surface area analysis repeated for 0.1g/L mixture of quartz & clino.

wt. of tube assembly #1 = 33.6328 g.

10/7/98 AJ

① wt. of tube assembly #9 + mixture sample outgassed
= 35.7579 g

wt. of outgassed mixture sample (10g/L)
= 35.7579
−33.1748
2.5831 g.

BET surface area = 2.943 sq.m/g

The results are filed in a binder marked as "Results of Surface Analysis".

② wt. of tube assembly #7 and quartz outgassed = 35.6912 g
wt. of outgassed quartz = 35.6912
33.6892
2.0020 g.

BET surface area = 0.306 sq.m/g

The results are filed in binder marked as "Results of surface Area Analysis".

③ wt. of tube assembly # + mixture of outgassed q2/Clino (0.1 g/L) = g.

wt. of outgassed mixture = 36.6142
− 33.6328
2.9814 g

BET surface area = 0.311 sq.m/g

The results are filed in binder marked as "Results of surface area analysis".

10/8/98 AJ

objective!-

AJ ① BET surface area analysis for quartz (325 mesh size) and mixtures of quartz and Clinoptilolite.

Procedure and equipments required are same as on page 47.

① wt. of tube assembly # 1 = 33.6665 g
wt. of quartz added = 2.0132 g

outgas temp. = 350°C & outgas time = 720 min.

② wt. of tube assembly #4 = 33.5702 g
wt. of quartz added = 3.0030 g
wt. of Clinoptilolite added = ~~0.07~~ AJ 0.0117 g

outgas temp. = 350°C
outgas time = 720 min

③ wt. of tube assembly #5 = 33.3636 g
wt. of quartz added = 2.0016 g
wt. of Clinoptilolite added = 0.0789 g

outgas temp. = 350°C , outgas time = 720 min.

All three samples were loaded for outgassing.

10/9/98 AJ

① wt. of tube assembly # 1 + outgassed quartz = 35.6628 g

wt. of outgassed quartz = 35.6628
− 33.6665
1.9963 g

The samples were analyzed using procedure as per BET Coulter SA 3100 product manual.
BET surface area = 0.308 m^2/g

② wt. of tube assembly #4 + outgassed mixture of quartz & Clinoptilolite (0.1 g/L) = 36.5651 g

wt. of outgassed mixture of q2/Clino = 36.5651
− 33.5702
2.9949 g

BET surface area = 0.329 m^2/g

③ wt. of tube assembly # 5 + outgassed mixture of quartz and Clinoptilolite (AJ ~~0.0~~ 1.0 g/L) = 35.4110 g

wt. of outgassed mixture of q2/Clino
= 35.4110
− 33.3636
2.0474 g

BET surface area = 0.597 m^2/g

10/12/98 AJ

Objective :- BET surface area analysis of Clinoptilolite and quartz & Clinoptilolite mixtures.

Procedure and equipments needed are same as on page 47.

① wt. of tube assembly #4 = 33.5719 g
wt. of Clinoptilolite added = 1.9510 g

outgas time = 720 min, outgas temp. = 350°C

② wt. of tube assembly #5 = 33.2866 g
wt. of quartz added = 2.0000 g
wt. of Clinoptilolite added = 0.0718 g

outgas time = 720 min, outgas temp. = 350°C

③ wt. of tube assembly #9 = 33.2354 g.
wt. of quartz added = 2.0036 g
wt. of Clinop added = 0.7066 g

outgas time = 720 min, outgas temp. = 350°C

10/13/98 AJ

① wt. of tube assembly #4 + outgassed Clinoptilolite = 35.2374 g

wt. of outgassed Clinoptilolite = 35.2374
− 33.5719
1.6655 g

BET surface area = 11.818 m^2/g

② wt. of tube assembly #5 + outgassed Qz/Clinop mixture = 35.3287 g (1g/L)

wt. of outgassed mixture Qz/Clinop = 35.3287
− 33.2866
2.0421 g

BET surface area = 0.588 m^2/g

③ wt. of tube assembly #9 + outgassed Clinop & Qz. mixture = 35.8269 g (10 g/L)

wt. of outgassed Qz/Clinop mixture = 35.8269
− 33.2354
2.5915 g

BET surface area = 2.970 m^2/g

④ Mixed mineral sorption experiments started (Refer Pg. 57)

10/14/98 AJ

Objective :- BET surface area analysis on Clinoptilolite (PCDV), surfactant added Clinoptilolite (CHDTMA-PCDV) and mixture of quartz & Clinoptilolite in ratio, Qz = 1 g & Clinoptilolite = 350 mg (0.350 g)

Procedure & equipments needed are same as on page 47.

① wt. of tube assembly #5 = 33.3624 g.
wt. of PCDV added = 2.0045 g.
outgas temp. = 350°C & outgas time = 720 min.

② wt. of tube assembly #7 = 33.6844 g
wt. of HDTMA-PCDV added = 1.6974 g
outgas temp. = 350°C & outgas time = 720 min.

③ wt. of tube assembly #9 = 33.1803 g
wt. of clinoptilolite added = ~~2.0003~~ AJ 0.7020 g
wt. of quartz added = 2.0003 g

outgas time = 720 min., outgas temp. = 350°C

10/15/98 AJ

① wt. of tube assembly #5 + outgassed PCDV = 35.0995 g
wt. of outgassed PCDV = 35.0995 − 33.3624 = 1.7371 g.

BET SA = 18.827 m^2/g

② wt. of tube assembly #7 + outgassed HDTMA-PCDV = 35.1506 g
wt. of outgassed PCDV (HDTMA) = 35.1506 − 33.6844 = 1.4662 g

BET SA = 76.692 m^2/g

③ wt. of tube assembly #9 + outgassed mixture of quartz and clinoptilolite = 35.7646 g
wt. of outgassed qz/clinop = 35.7646 − 33.1803 = 2.5843 g

BET SA = 2. m^2/g

④ wt. of tube assembly #1 = 33.5880 g
wt. of PCDV added from different container = 1.7506 g

outgas temp. = 350°c & outgas time = 720 min.

⑤ wt. of tube assembly #4 = 33.5722 g
wt. of qz added = 2.1553 g
wt. of clinop added = 0.0756 g

Quartz only, unwapped

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

Objective: To investigate the characteristics of U sorption on mixture of clinoptilolite and quartz as a function of pH.

Initial conditions:
- $\sum U$ = 50 ppb (2.14 x 10^{-7})
- equilibrium with atmospheric $CO_2(g)$; $pCO_2 = 10^{-3.5}$
- pH range 4.0-9.5
- solution volume = 35 ml
- mass of solid 1, quartz = 1.000 g
- mass of solid 2, clinoptilolite = 0.000 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

Supplies:
≤325 mesh Qtz AJ
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 ~~NaOH (lot)~~ $NaHCO_3$ (lot 936883) AJ
concentrated HNO_3 (lot 983546)
HNO_3 and NaHCO3 or NaOHstock 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 200 g of 500 ppb U stock solution into a tared 2000 ml FEP bottle.
- Dilute to a total of 2000 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 26 polycarbonate centrifuge tubes (50 ml capacity) CQU-pHi (where i is the approximate pH of each solution, see Table CQU).
- Label 1 polycarbonate centrifuge tube CQ0U-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.

B. Add quartz to sample containers.

- Add ~1.000 g of quartz to each sample container. **Do not** add quartz to the CQ20-U-IU container.
- Record weight of each sample container after addition of quartz .

- Adjust pH of each solution by adding HNO_3 or NaHCO3.
  - Add the volume of HNO_3 or NaOHto each experimental container as listed in Table CQU. Take care to add HNO_3 or NaOH in the concentrations specified in Table CQU.
  - For sample CQ0U-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.

- Sample CQ0U-IU for initial [U].
  - Label two 7 ml LSC vials as CQ0U-IUa and CQ0U-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 CQ20-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 CQ0U-IU

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

- Sample experimental solutions for [U] and pH.
  - For each sample solution label two 7 ml LSC vials (e.g., CQ0U-pH3a and CQ0U-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.
  - Record weight of each sample container.
  - Measure pH of each experimental solution.
  - Record weight of each sample container after pH measurement.

- Transfer quartz for desorption.

- Record weight of sample containers. *Note: this step can be skipped if the clinoptilolite transfer is done immediately after the last step in section F.*
- Centrifuge polycarbonate tubes containing experimental solutions at about 5,000 rpm for 5 min to remove fine particles from suspension.
- For each sample container, label a corresponding polypropylene (PP) test tube (50 ml capacity) (e.g., CQ0dU-pH3 for sample container CQ0U-pH3).
- Record weight of PP test tubes.
- Using an Eppendorf or Oxford pipette, withdraw quartz 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.

C. Sample solutions for [U].

- For each sample container and PP test tube label two 7 ml LSC vials (e.g., CQ0U-pH3a and CQ02U-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.

Table CQU: 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)

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	0.394	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

Table CQU: Estimated solution pH and volumes of HNO3 or NaOH solutions needed for adjustment of pH in 0.1 m NaNO3 solutions with 50 ppb U in contact with qz/clino (35 m

ONLY FOR CAPPED VIALS

Estimated solution pH	Volume of HNO3 added, ml	Molarity of HNO3 to use
2.5	0.143	1
2.75	0.080	1
3	0.045	1
3.25	0.025	1
3.5	0.143	0.1
3.75	0.080	0.1
4	0.452	0.01
4.25	0.254	0.01
4.5	0.143	0.01
4.75	0.081	0.01
5	0.045	0.01
5.25	0.025	0.01
5.5	0.014	0.01
5.75	0.073	0.001
6	0.035	0.001
6.25	0.014	0.001
6.5	0.001	0.001
Estimated solution pH	**Volume of NaOH added, ml**	**Molarity of NaOH to use**
6.75	0.007	0.001
7	0.012	0.001
7.25	0.018	0.001
7.5	0.026	0.001
7.75	0.038	0.001
8	0.059	0.001
8.25	0.095	0.001
8.5	0.016	0.01
8.75	0.027	0.01
9	0.047	0.01
9.25	0.082	0.01
9.5	0.145	0.01
9.75	0.256	0.01
10	0.454	0.01

UNCAPPED (Sorption)

10/12/98 10/12/98 10/13/98 10/13/98

SAMPLE NAME	Wt.Of PC container, g	Wt. Of PC container+ quartz, g	Wt.Of PC container + quartz + U soln., g	Wt. After additions of HNO3 and NaHCO3, g
QC0U-pH 3.0	22.3469	23.3499	58.3571	58.7462
QC0U-pH 3.5	22.416	23.4155	58.4135	58.5186
QC0U-pH 4.0	22.2385	23.2388	58.2338	58.3053
QC0U-pH 4.5	22.3547	23.3532	58.3683	58.6576
QC0U-pH4.75	22.3396	23.3365	58.3354	58.5395
QC0U-pH 5.0	22.2663	23.2671	58.2635	58.5022
QC0U-pH 5.25	22.6252	23.6239	58.6204	58.8786
QC0U-pH 5.5	22.2349	23.2324	58.2501	58.5219
QC0U-pH 5.75	22.4509	23.4505	58.4722	58.7543
QC0U-pH 6.0	22.3244	23.3236	58.3101	58.6068
QC0U-pH 6.25	22.3204	23.3194	58.3872	58.7054
QC0U-pH 6.5	22.3304	23.3310	58.3419	58.4160
QC0U-pH 6.75	22.3333	23.3316	58.3524	58.4454
QC0U-pH 7.0	22.4125	23.4109	58.4124	58.5223
QC0U-pH 7.25	22.2155	23.2110	58.2007	58.3426
QC0U-pH 7.5	22.2492	23.2485	58.2375	58.4487
QC0U-pH 7.75	22.5698	23.5697	58.5892	58.7660
QC0U-pH 8.0	22.3028	23.~~3385~~ 3009 AJ	58.2892	58.5690
QC0U-pH 8.25	22.3435	23.~~3385~~ 3009 AJ	58.3543	58.4692
QC0U-pH 8.5	22.3688	23.3651	58.3678	58.5478
QC0U-pH 8.75	22.2773 AJ	23.2757	58.2786	58.4603
QC0U-pH 9.0	22.2210	23.2190	58.2303	AJ 59 ~~58~~.5797
QC0U-pH 9.25	22.5929	23.5918	58.5891	59 ~~58~~.5023
QC0U-pH 9.5	22.3097	23.3096	58.3125	AJ 59 ~~58~~.6169
QC0U-IU	22.3186		57.3182	57.4426

	wt. Of vial (g)	wt. of vial + sample (g)
QCOU-IVa	7.5825	8.0873
QCOU-IVb	7.6374	8.1734

10/13/98

Table CQ20: 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)

Estimated solution pH	Volume of HNO3 added, ml	Molarity of HNO3 to use
2	0.421 0.250+0.150+0.020	1
2.25	0.235 0.150+0.075+0.010	1
2.5	0.131 0.100+0.020+0.010	1
2.75	0.072 0.050+0.020	1
3	0.394 0.250+0.020+0.075+0.050	0.1
3.25	0.209 0.100+0.100+0.010	0.1
3.5	0.106 0.075+0.020+0.010	0.1
3.75	0.047 0.025+0.020	0.1
4	0.071 0.050+0.020	0.02
Estimated solution pH	**Volume of NaHCO3 added, ml**	**Molarity of NaHCO3 to use**
4.25	0.084 0.075+0.010	0.005
4.5	0.292 0.250+0.020+0.020	0.005
4.75	0.205 0.100+0.075+0.020+0.010	0.01
5	0.239 0.100+0.100+0.020+0.020	0.01
5.25	0.260 0.250+0.010	0.01
5.5	0.274 0.250+0.025	0.01
5.75	0.286 0.250+0.025+0.010	0.01
6	0.300 0.250+0.050	0.01
6.25	0.322 0.250+0.050+0.020	0.01
6.5	0.071 0.050+0.020	0.05
6.75	0.084 0.050+0.025+0.010	0.05
7	0.106 0.075+0.020+0.010	0.05
7.25	0.145 0.100+0.025+0.020	0.05
7.5	0.214 0.100+0.050+0.025+0.040	0.05
7.75	0.169 0.150+0.020	0.1
8	0.282 0.250+0.020+0.010	0.1
8.25	0.097 0.075+0.020	0.5
8.5	0.174 0.100+0.075	0.5
8.75	0.160 0.150+0.010	1
9	0.305 0.200+0.075+0.020+0.010	1
CQOU-IV		
9.25	0.825	1
9.5	1.200	1

Quartz only, clinop = 0 g

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

CAPPED EXPTS.

10/15/

Objective: To investigate the characteristics of U sorption on mixture of clinoptilolite and quartz as a function of pH.

Initial conditions:
- $\sum U$ = 50 ppb (2.14×10^{-7})
- Capped containers
- pH range 3.0-9.5
- solution volume = 35 ml
- mass of solid 1, quartz = 1.000 g
- mass of solid 2, clinoptilolite = 0.000 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

Supplies: WS10 * RC * RFe * HL * ≤ 325 mesh AJ
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 NaOH (lot 976631)
concentrated HNO_3 (lot 983546)
HNO_3 and NaHCO3 or NaOHstock 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 200 g of 500 ppb U stock solution into a tared 2000 ml FEP bottle.
- Dilute to a total of 2000 g using 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 26 polycarbonate centrifuge tubes (50 ml capacity) CQU-pHi (where i is the approximate pH of each solution, see Table CQ0U).
- Label 1 polycarbonate centrifuge tube CQ0U-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.

B. Add quartz to sample containers.

- Add ~1.000 g of quartz to each sample container. **Do not** add quartz to the CQ20-U-IU container.
- Record weight of each sample container after addition of quartz .

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

- Add the volume of HNO_3 or NaOHto each experimental container as listed in Table CQU. Take care to add HNO_3 or NaOH in the concentrations specified in Table CQU.
- For sample CQ0U-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.

- Sample CQ0U-IU for initial [U].

- Label two 7 ml LSC vials as CQ0U-IUa and CQ0U-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 CQ20-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 CQ0U-IU

- Wait for equilibrium.

- Place caps on sample containers but tighten the caps.
- Place containers on gyratory shaker set at about 120 rpm and allow samples to equilibrate for at least 10 days.

- Sample experimental solutions for [U] and pH.

- For each sample solution label two 7 ml LSC vials (e.g., CQ0U-pH3a and CQ0U-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.
- Record weight of each sample container.
- Measure pH of each experimental solution.
- Record weight of each sample container after pH measurement.

- Transfer quartz for desorption.

- Record weight of sample containers. *Note: this step can be skipped if the clinoptilolite transfer is done immediately after the last step in section F.*
- Centrifuge polycarbonate tubes containing experimental solutions at about 5,000 rpm for 5 min to remove fine particles from suspension.
- For each sample container, label a corresponding polypropylene (PP) test tube (50 ml capacity) (e.g., CQ0dU-pH3 for sample container CQ0U-pH3).
- Record weight of PP test tubes.
- Using an Eppendorf or Oxford pipette, withdraw quartz 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.

G. Sample solutions for [U].

- For each sample container and PP test tube label two 7 ml LSC vials (e.g., CQ0U-pH3a and CQ02U-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.

Table CQ0U: Estimated solution pH and volumes of HNO3 or NaOH solutions needed for adjustment of pH in 0.1 m NaNO3 solutions with 50 ppb U in contact with qz/clino (35 ml and capped)

Estimated solution pH	Volume of HNO3 added, ml	Molarity of HNO3 to use
3	0.045	1
3.25	0.254	1
3.5	0.143	0.1
3.75	0.080	0.1
4	0.452	0.01
4.25	0.254	0.01
4.5	0.143	0.01
4.75	0.081	0.01
5	0.045	0.01
5.25	0.025	0.01
5.5	0.140	0.001
5.75	0.073	0.001
6	0.035	0.001
6.25	0.140	0.001
6.5	0.010	0.001
Estimated solution pH	**Volume of NaOH added, ml**	**Molarity of NaOH to use**
6.75	0.007	0.001
7	0.012	0.001
7.25	0.018	0.001
7.5	0.026	0.001
7.75	0.038	0.001
8	0.059	0.001
8.25	0.095	0.001
8.5	0.160	0.001
8.75	0.027	0.01
9	0.047	0.01
9.25	0.082	0.01
9.5	0.145	0.01

CAPPED 10/15/98

Sample Name	Original Container wt., g
QC0U-pH 3.0	22.2814
QC0U-pH 3.5	22.3164
QC0U-pH 4.0	22.2015
QC0U-pH 4.25	22.4189
QC0U-pH 4.5	22.2534
QC0U-pH4.75	22.3343
QC0U-pH 5.0	22.2908
QC0U-pH 5.25	22.3581
QC0U-pH 5.5	22.2616
QC0U-pH 5.75	22.2747
QC0U-pH 6.0	22.3086
QC0U-pH 6.25	22.5789
QC0U-pH 6.5	22.2996
QC0U-pH 6.75	22.5477
QC0U-pH 7.0	22.2264
QC0U-pH 7.25	22.4240
QC0U-pH 7.5	22.5538
QC0U-pH 7.75	22.3680
QC0U-pH 8.0	22.2458
QC0U-pH 8.25	22.5762
QC0U-pH 8.5	22.2989
QC0U-pH 8.75	22.2349
QC0U-pH 9.0	22.3123
QC0U-pH 9.25	22.3063
QC0U-pH 9.5	22.2314

10/16/98 AJ

① wt. of tube assembly + outgassed PCDV = 35.0195 g.
wt. of outgassed PCDV = 35.0195
− 33.5880
1.4314 g.

BET SA = 27.673 m^2/g.

Data stored in binder marked as "Results of Surface Area Analysis".

② wt. of tube assembly + outgassed Clinop & Qz mixture = 35.7772 g.

wt. of outgassed Qz/Clinop mixture = 35.7772
− 33.5722
2.2056 g

BET SA = 0.643 m^2/g

Data stored in binder marked as "Results of Surface Area Analysis".

③ 1g of quartz was added to each container & weighed. Data on next page (Capped Containers expt.).

CAPPED 10/16/98

Sample Name	Wt. Of container + quartz, g
QC0U-pH 3.0	23.298
QC0U-pH 3.5	23.3365
QC0U-pH 4.0	23.2202
QC0U-pH 4.25	23.4397
QC0U-pH 4.5	23.2727
QC0U-pH4.75	23.3554
QC0U-pH 5.0	23.3106
QC0U-pH 5.25	23.3782
QC0U-pH 5.5	23.2786
QC0U-pH 5.75	23.2969
QC0U-pH 6.0	23.3256
QC0U-pH 6.25	23.5966
QC0U-pH 6.5	23.3003
QC0U-pH 6.75	23.5496
QC0U-pH 7.0	23.2273
QC0U-pH 7.25	23.4238
QC0U-pH 7.5	23.5566
QC0U-pH 7.75	23.3674
QC0U-pH 8.0	23.2473
QC0U-pH 8.25	23.5771
QC0U-pH 8.5	23.3002
QC0U-pH 8.75	23.2324
QC0U-pH 9.0	23.3139
QC0U-pH 9.25	23.3056
QC0U-pH 9.5	23.2314

10/20/98 AJ

① Add U-soln (50 PPb stock soln.) to each container
② Weigh ~35g of solution & add to each container
③ Record weight of each container.
Data on next page & this page

CAPPED 10/20/98

Sample Name	Wt. Of Container + quartz + U soln., g
QC0U-pH 3.0	58.3299
QC0U-pH 3.5	58.4445
QC0U-pH 4.0	58.2426
QC0U-pH 4.25	58.4646
QC0U-pH 4.5	58.2996
QC0U-pH4.75	58.3833
QC0U-pH 5.0	58.3403
QC0U-pH 5.25	58.4168
QC0U-pH 5.5	58.2984
QC0U-pH 5.75	58.3111
QC0U-pH 6.0	58.3649
QC0U-pH 6.25	58.6248
QC0U-pH 6.5	58.3332
QC0U-pH 6.75	58.5738
QC0U-pH 7.0	58.2730
QC0U-pH 7.25	58.4423
QC0U-pH 7.5	58.5764
QC0U-pH 7.75	58.3712
QC0U-pH 8.0	58.2573

QC0U-pH 8.25	58.6098
QC0U-pH 8.5	58.3618
QC0U-pH 8.75	58.2537
QC0U-pH 9.0	58.3124
QC0U-pH 9.25	58.3212
QC0U-pH 9.5	58.2468

10/20/98 AJ

① Preparation of solutions of different conc. of NaOH & HNO_3.

ⓐ Starting Stock Soln. 6M NaOH.
ⓑ Starting Stock Soln. 1M HNO_3.

ⓐ 100 ml of 1M NaOH

$6M \times Volume = 1M \times 100\ ml$

$Volume\ of\ NaOH = \frac{100}{6} = 16.7\ ml$

Add 16.7 ml of 6M NaOH solution to DI H_2O & fill it up to 100 ml mark in 100 ml volumetric flask.

ⓑ 0.1M NaOH (100 ml) from 1M NaOH.

$1M \times V = 0.1 \times 100$

$V = \frac{0.1 \times 100}{1}\ ml = 10\ ml$

Add 10 ml of 1M NaOH to H_2O & dilute it up to 100 ml mark on volumetric flask.

ⓒ 100 ml of 0.01M NaOH from 1M NaOH

$1M \times V = 0.01M \times 100\ ml$

$V = 1\ ml$

Add 1 ml of 1M NaOH to H_2O & dilute it to 100 ml

ⓒ 100 ml of 0.01M NaOH from 1M NaOH Soln
Dilute 0.1 ml of 1M NaOH with H_2O to 100 ml mark.

10/21/98 AJ

CAPPED 10/21/98

Sample Name	Container Wt. After additions of HNO3 and NaOH., g
QC0U-pH 3.0	58.3719
QC0U-pH 3.5	58.5872
QC0U-pH 4.0	58.6910
QC0U-pH 4.25	58.7128
QC0U-pH 4.5	58.4385
QC0U-pH4.75	58.4590
QC0U-pH 5.0	58.#3814
QC0U-pH 5.25	58.4371
QC0U-pH 5.5	58.4334
QC0U-pH 5.75	58.3788
QC0U-pH 6.0	58.3938
QC0U-pH 6.25	58.7599
QC0U-pH 6.5	58.3382
QC0U-pH 6.75	58.5789
QC0U-pH 7.0	58.2826
QC0U-pH 7.25	58.4563
QC0U-pH 7.5	58.6001
QC0U-pH 7.75	58.4047
QC0U-pH 8.0	58.2994
QC0U-pH 8.25	58.7000
QC0U-pH 8.5	58.4715
QC0U-pH 8.75	58.2768
QC0U-pH 9.0	58.3530
QC0U-pH 9.25	58.3978
QC0U-pH 9.5	58.3850

The amounts of HNO_3 & NaOH additions are on next page.

10/21/98 CAPPED

Table CQU: Estimated solution pH and volumes of HNO3 or NaOH solutions needed for adjustment of pH in 0.1 m NaNO3 solutions with 50 ppb U in contact with qz/clino (35 ml

Estimated solution pH	Volume of HNO3 added, ml	Molarity of HNO3 to use
2.5	0.143	1
2.75	0.080	1
3	0.045	1
3.25	0.025	1
3.5	0.143	0.1
3.75	0.080	0.1
4	0.452	0.01
4.25	0.254	0.01
4.5	0.143	0.01
4.75	0.081	0.01
5	0.045	0.01
5.25	0.025	0.01
5.5	~~0.014~~ 0.140	~~0.01~~ 0.001
5.75	0.073	0.001
6	0.035	0.001
6.25	~~0.014~~ 0.140	~~0.001~~ 0.0001
6.5	~~0.001~~ 0.010	~~0.001~~ 0.0001
Estimated solution pH	**Volume of NaOH added, ml**	**Molarity of NaOH to use**
6.75	0.007	0.001
7	0.012	0.001
7.25	0.018	0.001
7.5	0.026	0.001
7.75	0.038	0.001
8	0.059	0.001
8.25	0.095	0.001
8.5	~~0.016~~ 0.160	~~0.01~~ 0.001
8.75	0.027	0.01
9	0.047	0.01
9.25	0.082	0.01
9.5	0.145	0.01
9.75	0.256	0.01
10	0.454	0.01

Keep the containers on gyratory shaker at 125 rpm tightly capped for 10 days.

10/22/98 AJ

(1) Preparation of 0.1M $NaNO_3$ matrix.
Refer to page 34, #3 on 8/21/98.

(2) Preparation of 50 ppb U-233 solution.
Refer to step #4 on page 34 dated 8/21/98.

(3) Label and weigh LSA vials for uncapped sorption.

10/23/98 Data on page 107 — 117 ⟶

10/26/98
10/27/98
AJ

UNCAPPED

	10/26/98	10/26/98	10/27/98
Sample Name	Container wt. before sampling & pH measurements, g	Measured pH	Container wt. after sampling & pH measurements, g
QC0U-pH 3.0	58.4620	2.89	57.4363
QC0U-pH 3.5	58.3103	3.42	57.2708
QC0U-pH 4.0	58.0361	4.02	57.0022
QC0U-pH 4.5	58.4261	4.60	57.3723
QC0U-pH4.75	58.2380	5.40	57.1786
QC0U-pH 5.0	58.1550	5.90	57.0944
QC0U-pH 5.25	58.6790	6.16	57.6144
QC0U-pH 5.5	58.2458	6.28	57.1855
QC0U-pH 5.75	58.5302	6.36	57.4821
QC0U-pH 6.0	58.3222	6.47	57.2920
QC0U-pH 6.25	58.4866	6.56	57.4593
QC0U-pH 6.5	58.1347	6.67	57.1036
QC0U-pH 6.75	58.1654	6.86	57.1318
QC0U-pH 7.0	58.3242	7.02	57.2782
QC0U-pH 7.25	58.0054	7.25	56.9681
QC0U-pH 7.5	58.1339	7.43	57.0996
QC0U-pH 7.75	58.5229	7.69	57.4212
QC0U-pH 8.0	58.3107	7.93	57.2810
QC0U-pH 8.25	58.2595	8.22	57.2184
QC0U-pH 8.5	58.3156	8.4	57.2743
QC0U-pH 8.75	58.1642	8.7	57.1146
QC0U-pH 9.0	58.3253	8.94	57.2979
QC0U-pH 9.25	58.9514	9.17	57.8931
QC0U-pH 9.5	59.3251	9.23	AJ 58.2753
QC0U-IU	57.3725		56.331

Sorption 10/26/98 UNCAPPED 10/27/98

Sample Name	wt. Of vial, g	wt. Of vial + sample, g
QC0U-pH 2a	7.5995	8.0965
QC0U-pH 2b	7.6098	8.1107
QC0U-pH 2.5a	7.5969	8.1056
QC0U-pH 2.5b	7.6040	8.1141
QC0U-pH 3a	7.6250	8.1328
QC0U-pH 3b	7.6885	8.1973
QC0U--pH 3.5a	7.6420	8.1486
QC0U-pH 3.5b	7.5713	8.0808
QC0U--pH 4a	7.5936	8.1006
QC0U--pH 4b	7.5756	8.0847
QC0U-pH 4.5a	7.6521	8.1594
QC0U-pH 4.5b	7.6181	8.1281
QC0U-pH 4.75a	7.6215	8.1274
QC0U-pH 4.75b	7.6168	8.1238
QC0U-pH 5a	7.6467	8.1508
QC0U-pH 5b	7.5074	8.0146
QC0U-pH 5.25a	7.6550	8.1570
QC0U-pH 5.25b	7.6484	8.1536
QC0U-pH 5.5a	7.5945	8.1015
QC0U-pH 5.5b	7.6517	8.1608
QC0U-pH 5.75a	7.7248	8.2296
QC0U-pH 5.75b	7.6767	8.1829
QC0U-pH 6a	7.6155	8.1229
QC0U-pH 6b	7.6447	8.1512
QC0U-pH 6.25a	7.6753	8.1803
QC0U-pH 6.25b	7.6098	8.1157
QC0U-pH 6.5a	7.5903	8.0909
QC0U-pH 6.5b	7.6146	8.1176
QC0U-pH 6.75a	7.6478	8.1506
QC0U-pH 6.75b	7.6146	8.1177
QC0U-pH 7a	7.6030	8.1080
QC0U-pH 7b	7.6006	8.1073
QC0U-pH 7.25a	7.6286	8.1331
QC0U-pH 7.25b	7.6595	8.1631
QC0U-pH 7.5a	7.5742	8.0766
QC0U-pH 7.5b	7.6378	8.1418
QC0U-pH 7.75a	7.6207	8.1248
QC0U-pH 7.75b	7.6675	8.1718
QC0U-pH 8a	7.6814	8.1859
QC0U-pH 8b	7.6313	8.1361

QC0U-pH 8.25a	7.6963	8.1998
QC0U-pH 8.25b	7.6333	8.1396
QC0U-pH 8.5a	7.7209	8.2267
QC0U-pH 8.5b	7.6821	8.1878
QC0U-pH 8.75a	7.6408	8.1508
QC0U-pH 8.75b	7.5509	8.0570
QC0U-pH 9a	7.6371	8.1398
QC0U-pH 9b	7.6053	8.1075
QC0U-pH 9.25a	7.5855	8.0874
QC0U-pH 9.25b	7.5239	8.0281
QC0U-pH 9.5a	7.6024	8.1060
QC0U-pH 9.5b	7.6570	8.1629

		wt. of vial	wt of vial + sample
From Page 63	QC0V-IV4	7.5825 g	8.0873 g
	QC0V-IV6	7.6374 g	8.1734 g

UNCAPPED (Description)

	10/27/98	11/2/98	11/2/98	11/2/98	11/2/98
Sample Name	wt. Of PP tubes, g	wt. Of PP tubes after trans quartz, g	wt. Of PP tubes after acid add, g	Container wt. after transfer of supernatant, g	Container wt. After acid add & supernatant retransfer, g
QC0dU-pH 3.0	13.9370	19.7021	22.6931	28.1662	54.5584
QC0dU-pH 3.5	13.3977	18.4884	21.4646	27.5504	55.0728
QC0dU-pH 4	13.6386	19.6744	22.6495	28.3190	53.8556
QC0dU-pH 4.5	13.3731	19.5322	22.5070	28.5747	54.0888
QC0dU-pH 4.75	13.4440	18.9486	21.9173	28.9500	54.5690
QC0dU-pH 5	13.3082	18.9112	21.8803	28.8525	54.3923
QC0dU-pH 5.25	13.3002	19.4492	22.4172	28.3850	54.3492
QC0dU-pH 5.5	13.3362	19.4266	22.3925	28.8661	53.9627
QC0dU-pH 5.75	13.4615	19.8219	22.8020	AJ 7 28.7298	53.9961
QC0dU-pH 6	13.3058	18.6368	21.6075	28.9765	54.8188
QC0dU-pH 6.25	13.8832	20.3925	23.3546	28.4339	53.8392
QC0dU-pH 6.5	13.3545	19.3664	22.3296	28.4738	53.9934
QC0dU-pH 6.75	13.3763	19.4420	22.4016	29.3177	53.9672
QC0dU-pH 7	13.3160	20.1758	23.1398	27.3177	53.2533
QC0dU-pH 7.25	13.9328	19.2558	22.2121	28.6095	54.5424
QC0dU-pH 7.5	13.8498	20.0710	23.0286	28.5504	53.7594
QC0dU-pH 7.75	13.8157	20.1472	23.1164	28.9607	53.9406
QC0dU-pH 8	13.8956	20.9892	23.9604	28.4487	53.0075
QC0dU-pH 8.25	13.9114	20.1958	23.1594	28.7827	53.6849
QC0dU-pH 8.5	13.3848	19.8462	22.8040	28.8835	53.6768
QC0dU-pH 8.75	13.2552	19.3537	22.3091	28.4279	53.8206
QC0dU-pH 9	13.3564	19.2908	22.2547	28.2387	54.2202
QC0dU-pH 9.25	13.8177	19.9246	22.8843	28.7752	54.6056
QC0dU-pH 9.5	13.8417	21.1124	24.071	AJ 9 28.6548	53.7028

UNCAPPED

Sample Name	Container wt. before sampling (11/12/98)	Container wt. after sampling (11/12/98)	wt. Of PP tubes before sampling (11/13/98)	wt. Of PP tubes after sampling (11/16/98)
QC0U-pH 3.0	54.3694	53.3672	22.6079	21.6196
QC0U-pH 3.5	54.9548	53.9503	21.4538	20.4400
QC0U-pH 4.0	53.7894	52.7797	22.6406	21.6576
QC0U-pH 4.5	54.0169	52.9890	22.4985	21.4221
QC0U-pH4.75	54.4816	53.4762	21.8850	20.7662
QC0U-pH 5.0	54.3155	52.2754	21.8184	20.7876
QC0U-pH 5.25	54.2364	53.2243	22.3602	21.3089
QC0U-pH 5.5	53.8962	52.8860	22.3789	21.3067
QC0U-pH 5.75	53.9273	52.9224	22.7762	21.7630
QC0U-pH 6.0	54.6987	53.6962	21.5463	20.5227
QC0U-pH 6.25	53.7313	52.7239	23.3190	22.2796
QC0U-pH 6.5	53.9292	52.9048	23.3019	21.2711
QC0U-pH 6.75	53.8602	52.8569	22.2793	21.2264
QC0U-pH 7.0	53.1704	52.1560	22.0535 (AJ 3)	22.0162
QC0U-pH 7.25	54.4493	53.4394	22.1217	21.0784
QC0U-pH 7.5	53.6893	52.6831	22.8737	21.8218
QC0U-pH 7.75	53.8378	52.8331	23.1049	22.0889
QC0U-pH 8.0	52.9416	51.9409	23.9330	22.8944
QC0U-pH 8.25	53.5846	52.5743	23.1445	22.1288
QC0U-pH 8.5	53.5601	52.5517	22.7589	21.7285
QC0U-pH 8.75	53.7539	52.7544	22.2900	21.2573
QC0U-pH 9.0	54.1434	53.1365	22.2288	21.2246
QC0U-pH 9.25	54.5034	53.4947	22.8775	21.8621
QC0U-pH 9.5	53.615	52.5718	24.0616	23.0454

DESORPTION (UNCAPPED)

Sample Name	PP tubes wt. of vial,g (11/13/98)	Desorption wt. Of vial + sample,g (11/12/98)		PC containers wt. of vial,g	Desorption wt. Of vial + sample,g (11/12/98)
QC0U-pH 3a	7.6128	8.1109		7.6319	8.1479
QC0U-pH 3b	7.6332	8.1248		7.6100	8.1215
QC0U--pH 3.5a	7.6077	8.1081		7.6195	8.1336
QC0U-pH 3.5b	7.7021	8.1942		7.6862	8.1952
QC0U--pH 4a	7.7182	8.2098		7.6374	8.1428
QC0U--pH 4b	7.7623	8.2503		7.6217	8.1277
QC0U-pH 4.5a	7.7152	8.2247		7.5812	8.0908
QC0U-pH 4.5b	7.6936	8.1991		7.5669	8.0803
QC0U-pH 4.75a	7.7347	8.2376		7.6325	8.1338
QC0U-pH 4.75b	7.7445	8.2481		7.6093	8.1139
QC0U-pH 5a	7.7220	8.2255		7.6474,7.5967	8.1498, 8.1003
QC0U-pH 5b	7.7301	8.2311		7.6042,7.5967	8.1082,8.1001
QC0U-pH 5.25a	7.6881	8.1949		7.6092	8.1158
QC0U-pH 5.25b	7.7201	8.2301 (AJ 10)		7.6496	8.1544
QC0U-pH 5.5a	7.7081	8.2110		7.6185	8.1246
QC0U-pH 5.5b	7.7282	8.2295		7.5961	8.1017
QC0U-pH 5.75a	7.7550	8.2598		7.6102	8.1122
QC0U-pH 5.75b	7.7103	8.2133		7.5853	8.0888
QC0U-pH 6a	7.7196	8.2239		7.6630 (AJ 63)	8.1670
QC0U-pH 6b	7.7192	8.2249		7.6372	8.1382
QC0U-pH 6.25a	7.7198	8.2176		7.5556	8.0589
QC0U-pH 6.25b	7.7370	8.2347		7.5969	8.0996
QC0U-pH 6.5a	7.7546	8.2550		7.6082	8.1184
QC0U-pH 6.5b	7.6972	8.1996		7.6099	8.1242
QC0U-pH 6.75a	7.7638	8.2691		7.5658	8.0670
QC0U-pH 6.75b	7.7634	8.2700		7.5742	8.0763
QC0U-pH 7a	7.7436	8.2574		7.6015	8.1018
QC0U-pH 7b	7.7259	8.2294		7.5727	8.0857
QC0U-pH 7.25a	7.7279	8.2382		7.5122	8.0171
QC0U-pH 7.25b	7.7228	8.2264		7.6356	8.1397
QC0U-pH 7.5a	7.7202	8.2259		7.5886	8.0924
QC0U-pH 7.5b	7.7196	8.2228		7.5977	8.0992
QC0U-pH 7.75a	7.7337	8.2401		7.6060	8.1068
QC0U-pH 7.75b	7.7906	8.2929		7.5951	8.0950
QC0U-pH 8a	7.7802	8.2847		7.6011	8.1023
QC0U-pH 8b	7.7126	8.2280		7.5984	8.0978

QC0U-pH 8.25a	7.8764	8.3804		7.6224	8.1230
QC0U-pH 8.25b	7.7479	8.2513		7.6088	8.1091
QC0U-pH 8.5a	7.7592	8.2658		7.6060	8.1085
QC0U-pH 8.5b	7.7712	8.2796		7.6368	8.1387
QC0U-pH 8.75a	7.7016	8.2096		7.6100	8.1095
QC0U-pH 8.75b	7.7295	8.2435		7.5646	8.0656
QC0U-pH 9a	7.7049	8.2060		7.6408	8.1424
QC0U-pH 9b	7.7095	8.0790		7.5786	8.0826
QC0U-pH 9.25a	7.7422	8.2471		7.5980	8.0995
QC0U-pH 9.25b	7.6484	8.1503		7.6812	8.1821
QC0U-pH 9.5a	7.7131	8.2173		7.6382	8.1400
QC0U-pH 9.5b	7.7528	8.2611		7.5338	8.0754

Data Recounted for initial counts (~~from page~~ AJ on 2/10/99)

	(CPM)
QC0U-IVa	513.334
QC0U-IVb	521.267

231 MISSING TUBE(S) 2/10/99 Std.

	31	8.60	2.80	116.9	513.334	3.02	515.93	3.09	631.76
23	32	8.47	1.15	277.5	521.267	3.02	523.01	3.09	633.89
23									

Initial conc. recounted on 2/20/99

231 MISSING TUBE(S) Std. 2/20/99

	103	8.55	0.10	3173	516.770	3.02	517.42	3.09	637.04
23	104	8.43	1.09	289.9	524.057	3.02	525.20	3.09	638.39

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	20.11
Region B:	100 -	350	0	3.0	3.78
Region C:	0.0 -	2000	0	0.1	29.81

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

29 Oct., 1998 AJ
Protocol # 23
QC0U - Sorption Data
UNCAPPED

S#	TIME	CPMA A:2S%		CPMB B:2S%		CPMC C:2S%		SIS FLAG	
P# 1	999.99	20.11	1.41	3.783	3.25	29.81	1.16	151.00	B
23 2	8.63	1.09	288.3	511.512	3.02	511.56	3.10	617.35	] Std.
23 3	8.35	0.37	859.7	528.432	3.02	530.19	3.09	612.42	
231 MISSING TUBE(S)									
5	9.14	2.53	124.7	482.431	3.02	486.60	3.09	618.59	29
23 6	8.74	0.94	331.8	505.141	3.02	506.00	3.10	613.68	26 QC0
23 7	8.68	3.73	89.09	509.005	3.02	514.20	3.08	617.77	2.59 Sorp
23 8	8.41	4.26	80.16	525.111	3.02	530.36	3.08	617.75	2.5b
23 9	8.61	0.00	0.00	513.058	3.02	510.37	3.10	628.59	39
23 10	8.81	3.27	100.0	500.871	3.02	504.47	3.09	623.48	3b
23 11	8.75	2.17	147.5	504.217	3.02	506.42	3.09	619.82	3.59
23 12	8.78	2.78	116.6	502.367	3.02	505.27	3.09	625.51	
23 13	9.14	1.77	175.7	482.431	3.02	483.54	3.10	621.91	
23 14	8.81	0.00	0.00	501.552	3.02	502.99	3.09	625.67	
23 15	9.98	0.00	0.00	441.808	3.02	441.03	3.12	629.38	
23 16	9.68	1.68	179.0	455.514	3.02	456.55	3.11	620.04	
23 17	19.54	0.00	0.00	223.648	3.05	222.44	3.23	626.49	
23 18	19.65	1.46	144.4	222.426	3.05	224.08	3.21	621.51	
23 19	32.72	0.00	0.00	132.067	3.09	131.89	3.38	632.04	
23 20	31.31	0.23	706.4	138.184	3.08	139.27	3.35	623.68	
23 21	42.68	0.11	1313	100.341	3.12	100.39	3.50	627.77	
23									
22	41.63	0.28	508.7	102.991	3.11	103.94	3.46	625.22	
23 23	45.85	0.34	396.1	93.142	3.12	93.59	3.53	624.90	
23 24	45.29	0.00	0.00	94.340	3.12	94.08	3.54	626.88	
23 25	42.99	1.54	93.82	99.590	3.12	102.03	3.45	620.27	
23 26	42.83	1.02	140.9	99.976	3.12	101.24	3.47	619.87	
23 27	42.76	1.38	104.9	100.146	3.12	101.92	3.46	619.18	
23 28	42.49	1.07	134.8	100.830	3.11	101.80	3.47	619.97	
23 29	42.49	0.53	270.0	100.853	3.11	101.70	3.48	622.63	
23 30	43.27	0.18	785.8	98.944	3.12	99.54	3.49	621.19	
23 31	43.46	0.00	0.00	98.472	3.12	97.96	3.52	628.09	
23 32	42.63	0.65	220.2	100.486	3.12	101.39	3.48	623.25	
23 33	33.99	0.60	265.0	126.961	3.09	128.26	3.37	625.84	
23 34	34.16	0.17	902.3	126.340	3.09	126.72	3.39	626.07	
23 35	33.55	0.39	403.8	128.706	3.09	129.44	3.38	622.10	
23 36	33.46	0.99	163.5	129.032	3.09	130.56	3.36	623.62	
23 37	29.70	1.03	165.9	145.948	3.08	148.30	3.31	619.79	
23 38	29.78	0.00	0.00	145.445	3.08	144.74	3.35	632.98	
23 39	24.11	0.00	0.00	180.539	3.06	180.43	3.28	623.27	
23 40	24.36	2.22	87.26	178.647	3.06	180.86	3.26	616.25	
23 41	17.47	0.00	0.00	250.596	3.05	249.24	3.21	627.38	

23	42	16.86	0.17	1290	259.799	3.04	260.88	3.19	623.35
23	43	13.93	2.07	122.7	315.384	3.04	318.86	3.14	620.54
23	44	13.90	0.82	300.6	316.073	3.04	316.66	3.16	621.64
23	45	9.79	0.93	317.2	450.967	3.02	453.85	3.10	622.77
23	46	9.66	0.49	602.3	456.879	3.02	457.77	3.10	622.29
23	47	9.04	0.00	0.00	487.810	3.02	488.44	3.10	621.62
23	48	9.07	2.27	139.1	486.404	3.02	490.59	3.09	621.72
23	49	8.67	3.07	106.9	508.904	3.02	513.44	3.08	621.66
23	50	8.49	2.50	131.0	519.656	3.02	521.90	3.09	620.95
23	51	8.77	0.75	411.2	503.058	3.02	504.62	3.09	628.43
23	52	8.59	0.61	512.6	513.563	3.02	514.54	3.09	625.70
23	53	9.18	1.89	164.4	481.184	3.02	483.81	3.09	620.60
23	54	8.70	3.56	92.89	507.137	3.02	511.22	3.09	620.87
23	55	9.14	3.30	97.37	482.541	3.02	485.94	3.09	632.96
23	56	9.01	2.86	112.1	489.447	3.02	494.27	3.09	632.50
23									

17 Nov 98 10:07 ALPHA/BETA - 1.02 Pa
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	20.10
Region B:	100 -	350	0	3.0	3.81
Region C:	0.0 -	2000	0	0.1	29.75

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

QCOUd
PC containers desorptions
UNCAPPED

S#		TIME	CPMA A:2S%		CPMB B:2S%		CPMC C:2S%		SIS	FLAG
P#	1	999.99	20.10	1.41	3.807	3.24	29.75	1.16	152.02	B
23	2	9.43	3.02	104.1	467.879	3.02	470.36	3.10	617.78	
23	3	9.28	2.86	110.6	475.072	3.02	478.44	3.09	621.27	
23	4	9.62	1.32	227.7	458.355	3.02	460.28	3.10	621.89	
23	5	9.27	8.06	43.40	476.020	3.02	486.00	3.07	619.03	
23	6	9.82	4.14	76.22	449.146	3.02	454.06	3.09	626.72	
23	7	9.96	1.49	198.6	442.578	3.03	445.05	3.10	627.39	
23	8	10.51	0.74	382.4	419.124	3.03	420.68	3.11	624.63	
23	9	10.75	2.23	130.0	409.588	3.03	412.12	3.11	623.88	
23	10	17.58	1.46	152.8	249.037	3.05	251.65	3.18	627.13	
23	11	17.41	2.36	96.95	251.449	3.05	254.86	3.18	621.23	
23	12	25.65	0.18	1025	169.487	3.07	169.79	3.29	629.40	
23	13	25.58	1.91	98.15	169.922	3.07	171.86	3.27	619.02	
23	14	25.12	1.44	130.2	173.223	3.07	175.35	3.26	623.04	

Cor

23	15	25.11	2.24	85.00	173.174	3.07	176.03	3.26	622.87
23	16	34.82	2.99	55.23	123.849	3.09	127.58	3.34	614.34
23	17	34.37	2.45	67.08	125.492	3.09	128.79	3.35	618.93
23	18	33.76	0.49	324.4	127.828	3.09	128.52	3.38	621.52
23	19	33.65	1.54	105.9	128.258	3.09	130.55	3.35	618.04
23	20	36.94	1.80	86.84	116.523	3.10	118.96	3.39	619.15
23	21	35.34	1.07	147.3	121.943	3.10	123.96	3.38	619.70
23	22	35.57	1.16	135.9	121.130	3.10	122.26	3.39	617.48
23	23	36.95	1.47	105.5	116.464	3.10	118.27	3.40	620.03
23	24	33.29	1.02	158.6	129.687	3.09	131.71	3.35	620.96
23	25	32.47	2.39	70.78	133.119	3.09	136.41	3.33	616.03
23	26	32.58	0.04	4221	132.626	3.09	133.48	3.36	623.38
23	27	32.94	1.09	149.1	131.135	3.09	132.64	3.36	619.45
23	28	32.04	0.85	194.2	134.957	3.09	137.17	3.34	622.85
23	29	32.96	2.99	56.75	131.023	3.09	135.21	3.32	615.00
23	30	33.92	2.37	69.79	127.237	3.09	129.54	3.36	620.67
23	31	34.02	1.24	129.4	126.881	3.09	128.72	3.36	622.59
23	32	29.03	0.88	195.6	149.345	3.08	151.03	3.31	623.78
23	33	29.06	1.20	144.2	149.118	3.08	151.05	3.31	627.93
23	34	25.68	1.40	132.4	169.324	3.07	171.35	3.27	622.30
23	35	24.91	0.00	0.00	174.595	3.07	175.51	3.28	633.02
23	36	18.66	0.91	235.2	234.349	3.05	235.80	3.20	626.17
23	37	19.01	1.37	157.0	230.017	3.05	231.06	3.21	624.65
23	38	14.76	2.40	103.7	297.277	3.04	299.66	3.16	619.12
23	39	14.91	0.56	423.4	294.248	3.04	295.61	3.16	629.02
23	40	10.29	2.74	109.2	428.554	3.03	431.48	3.10	623.72
23	41	10.42	3.90	78.25	422.680	3.03	426.30	3.10	620.87

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Protocol #:23 U-233 3% 2 sigma Us

23	42	9.51	3.14	99.93	463.806	3.02	466.68	3.10	625.45
23	43	9.80	2.45	124.2	449.764	3.03	453.32	3.10	624.41
23	44	9.55	2.52	122.6	461.952	3.02	465.02	3.10	625.18
23	45	9.36	0.00	0.00	471.193	3.02	471.11	3.11	626.94
23	46	9.63	4.62	69.66	457.771	3.02	462.78	3.09	626.02
23	47	9.54	5.06	64.43	462.021	3.02	466.90	3.09	622.40
23	48	9.53	4.14	77.31	462.720	3.02	467.74	3.09	629.62
23	49	9.46	3.90	82.03	466.172	3.02	470.04	3.09	634.55
23	50	10.13	4.29	72.70	434.890	3.03	440.84	3.09	621.81
23	51	9.23	7.21	47.90	477.883	3.02	485.42	3.08	622.61
233	MISSING TUBE(S) QCOUd, PP tubes desorption								
55		13.97	1.95	129.7	314.303	3.04	318.14	3.14	615.93
23	56	14.21	1.01	241.9	308.930	3.04	310.72	3.15	618.86
23	57	12.82	2.76	97.38	342.839	3.03	346.62	3.13	609.40
23	58	13.67	2.95	88.67	321.504	3.03	325.78	3.13	609.51
23	59	10.85	0.00	0.00	406.239	3.03	406.66	3.12	617.43
23	60	10.84	2.87	101.8	406.525	3.03	411.58	3.10	620.80
23	61	7.94	3.20	107.3	556.646	3.02	559.17	3.08	612.34
23	62	8.21	2.56	130.3	537.849	3.02	540.90	3.08	612.37
23	63	3.41	10.40	57.57	1300.005	3.01	1308.08	3.03	612.78
23	64	3.42	5.63	97.50	1297.363	3.01	1304.17	3.03	615.17

QCOV, desorption for PP tubes

23	66	2.69	5.93	105.1	1651.955	3.00	1657.62	3.02	616.29
23	67	2.49	9.62	71.87	1787.759	3.00	1796.36	3.02	609.79
23	68	2.56	8.03	82.65	1732.521	3.01	1741.35	3.02	612.85
23	69	2.55	12.06	58.94	1742.468	3.00	1754.96	3.01	610.11
23	70	2.61	9.02	74.11	1702.323	3.00	1708.57	3.02	612.95
23	71	2.57	7.14	91.27	1729.656	3.00	1734.85	3.02	613.11
23	72	2.60	1.83	318.4	1711.962	3.00	1715.25	3.02	616.37
23	73	2.25	2.13	296.1	1977.971	3.00	1983.59	3.02	612.65
23	74	2.23	2.77	231.2	1997.538	3.00	1998.95	3.02	611.58
23	75	2.77	10.23	64.76	1604.857	3.00	1617.19	3.02	611.56
23	76	2.71	7.21	88.15	1638.628	3.00	1644.42	3.02	617.85
23	77	2.51	6.60	98.97	1771.890	3.00	1779.02	3.02	621.68
23	78	2.50	12.30	58.57	1777.793	3.00	1791.85	3.01	612.59
23	79	2.53	7.18	91.60	1758.248	3.00	1763.93	3.02	611.88
23	80	2.47	7.03	94.39	1796.598	3.01	1805.48	3.02	620.46
23	81	2.67	3.87	154.9	1660.612	3.01	1665.76	3.03	607.18
23	82	2.69	8.90	73.86	1650.840	3.00	1661.33	3.02	610.56
23	83	2.56	5.68	111.8	1738.380	3.00	1747.60	3.02	605.69
23	84	2.50	10.70	65.64	1775.793	3.00	1786.65	3.02	609.06
23	85	3.13	8.66	70.10	1418.877	3.01	1426.48	3.02	610.84
23	86	3.14	8.88	68.47	1413.709	3.01	1422.48	3.02	612.40
23	87	3.43	6.43	86.57	1293.277	3.01	1299.70	3.03	611.87
23	88	3.58	9.23	62.08	1238.930	3.01	1250.98	3.02	609.20
23	89	4.75	3.90	115.4	932.193	3.01	937.83	3.04	614.53
23	90	4.49	4.85	97.43	985.948	3.01	990.52	3.04	612.85
23	91	8.35	4.09	83.43	529.127	3.02	536.00	3.07	598.37
23	92	8.60	4.90	69.79	513.286	3.02	518.86	3.08	608.71
23	93	10.36	4.90	63.63	425.633	3.03	431.64	3.09	612.12
23	94	10.46	2.46	119.7	421.050	3.03	423.60	3.11	612.73
23	95	12.50	4.54	62.13	351.873	3.03	356.65	3.12	611.87
23	96	13.05	0.00	0.00	336.883	3.03	338.15	3.14	621.04
23	97	12.35	2.57	105.8	356.031	3.03	359.00	3.13	616.52
23	98	12.92	1.88	139.3	340.311	3.03	341.77	3.14	615.71
23	99	12.84	4.20	65.83	342.377	3.03	347.28	3.12	612.90
23	100	13.16	1.33	192.9	333.883	3.03	335.98	3.14	621.33

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Protocol #:23 U-233 3% 2 sigma Us

23	101	12.68	0.57	454.4	346.824	3.03	347.86	3.14	624.32
23	102	12.49	3.60	76.89	352.078	3.03	356.80	3.12	618.61

UNCAPPED, Qtz = 1.0g, Clinop = 0.035g

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

Objective: To investigate the characteristics of U sorption on mixture of clinoptilolite and quartz as a function of pH.

Initial conditions:
- $\sum U$ = 50 ppb (2.14×10^{-7})
- equilibrium with atmospheric $CO_2(g)$; $pCO_2 = 10^{-3.5}$
- pH range 4.0-9.5
- solution volume = 35 ml
- mass of solid 1, quartz = 1.000 g
- mass of solid 2, clinoptilolite = 35mg (0.035 g)
- M/V = 28.57 g/L M/V for clinop = 1.0 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

Supplies:
WS10 * UR * RC * RFe * HL * ≤325 mesh AJ
≤325 mesh Qtz / 100/200 mesh clinoptilolite & NaCl AJ
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 ~~NaOH (lot)~~ $NaHCO_3$ (lot 936883) AJ
concentrated HNO_3 (lot 983546)
HNO_3 and NaHCO3 or NaOHstock 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 200 g of 500 ppb U stock solution into a tared 2000 ml FEP bottle.
- Dilute to a total of 2000 g using 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 26 polycarbonate centrifuge tubes (50 ml capacity) QCU-pHi (where i is the approximate pH of each solution, see Table QCU).
- Label 1 polycarbonate centrifuge tube QC1.0U-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.

B. Add quartz to sample containers.

- Add ~1.000 g of quartz to each sample container. **Do not** add quartz to the QC1.0-U-IU container.
- Record weight of each sample container after addition of quartz .

- Adjust pH of each solution by adding HNO_3 or NaHCO3.
  - Add the volume of HNO_3 or NaHC)3 to each experimental container as listed in Table QC1.0U. Take care to add HNO_3 or NaHCO3 in the concentrations specified in Table CQ0U.
  - For sample QC1.0U-IU (not listed in Table QC1.0U) add 100 μl of 50/50 V/V HNO_3 to the sample container.
  - Weigh and record the weight of each sample container.

- SampleQC10.0U-IU for initial [U].
  - Label two 7 ml LSC vials as QC1.0U-IUa and QC1.0U-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 QC1.0U-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 QC1.0U-IU.

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

- Sample experimental solutions for [U] and pH.
  - For each sample solution label two 7 ml LSC vials (e.g.,QC1.0U-pH3a and QC1.0U-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.
  - Record weight of each sample container.
  - Measure pH of each experimental solution.
  - Record weight of each sample container after pH measurement.

- Transfer mixture of quartz and clinoptilolite for desorption.

- Record weight of PC sample containers. *Note: this step can be skipped if the mixture transfer is done immediately after the last step in section F.*
- Centrifuge polycarbonate containers containing experimental solutions at 10,000 rpm for 15 min to remove fine particles from suspension.
- For each PC sample container, label two corresponding polypropylene (PP) test tubes A and B(50 ml capacity).
- Record weight for both set of PP tubes A and B.
- Add 3.0 ml of 0.1M HNO3 to 50 ml PP tubes labeled as **B**-QC1.0Ud-pH.
- Pour supernatant from PC containers into PP tubes with acid and labeled as **B**-QC1.0Ud-pH leaving behind about 7 to 8ml of solution in PC container with the solid mixture.
- Record the weight of PC containers containing the solid mixture and some solution.
- Stir the solid mixture in solution vigorously and immediately transfer all the solid and solution to the corresponding PP tubes marked as **A**-QC1.0Ud-pH.
- Record the weight of PP tubes **A**-QC1.0Ud-pH.
- Transfer supernatant with HNO3 acid from the PP tubes **B**-QC1.0Ud-pH back to original PC containers.
- Record weights of PC sample containers.
- Add approximately 3 ml of 0.1 M HNO_3 to PP tubes containing solid mixture, **A**-QC1.0Ud-pH.
- Record weights of PP tubes **A**-QC1.0Ud-pH and PC sample containers.
- Place sample containers and PP test tubes on gyratory shaker (at about 120 rpm) and allow to desorb for at least 10 days.

L. Sample solutions for [U].

- For each sample container and PP test tube label two 7 ml LSC vials (e.g., QC1.0Ud-pH3a and QC1.0Ud-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 aliquot 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.

Table QC1.0U: 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 qtz/clinop (35 ml)

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	0.394	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

UNCAPPED 10/29/98

Sample Name	Original Container wt., g
QC1.0U-pH 3.0	22.3323
QC1.0U-pH 3.5	22.5936
QC1.0U-pH 4.0	22.2613
QC1.0U-pH 4.25	22.3276
QQC1.0U-pH 4.5	22.5725
QC1.0U-pH4.75	22.3045
QC1.0U-pH 5.0	22.3232
QC1.0U-pH 5.25	22.2925
QC1.0U-pH 5.5	22.3033
QC1.0U-pH 5.75	22.2452
QC1.0U-pH 6.0	22.4783
QC1.0U-pH 6.25	22.6249
QC1.0U-pH 6.5	22.3593
QC1.0U-pH 6.75	22.3052
QC1.0U-pH 7.0	22.3182
QC1.0U-pH 7.25	22.2863
QC1.0U-pH 7.5	22.2375
QC1.0U-pH 7.75	22.3816
QC1.0U-pH 8.0	22.4682
QC1.0U-pH 8.25	22.2326
QC1.0U-pH 8.5	22.3215
QC1.0U-pH 8.75	22.3988
QC1.0U-pH 9.0	22.5997
QC1.0U-pH 9.25	22.3002
QC1.0U-pH 9.5	22.3950
QC1.0U-IV	22.3530

UNCAPPED 10/29/98

Sample Name	Container wt. + U soln., g
QC1.0U-pH 3.0	57.3498
QC1.0U-pH 3.5	57.6082
QC1.0U-pH 4.0	57.2715
QC1.0U-pH 4.25	57.3226
QQC1.0U-pH 4.5	57.5683
QC1.0U-pH4.75	57.3194
QC1.0U-pH 5.0	57.3303
QC1.0U-pH 5.25	57.3048
QC1.0U-pH 5.5	57.3172
QC1.0U-pH 5.75	57.2456
QC1.0U-pH 6.0	57.4883
QC1.0U-pH 6.25	57.6329
QC1.0U-pH 6.5	57.3567
QC1.0U-pH 6.75	57.3074
QC1.0U-pH 7.0	57.3292
QC1.0U-pH 7.25	57.2989
QC1.0U-pH 7.5	57.2472
QC1.0U-pH 7.75	57.3776
QC1.0U-pH 8.0	57.4807
QC1.0U-pH 8.25	57.2246
QC1.0U-pH 8.5	57.3261
QC1.0U-pH 8.75	57.3937
QC1.0U-pH 9.0	57.6052
QC1.0U-pH 9.25	57.3033
QC1.0U-pH 9.5	57.3746
QC1.0U-IU	57.3519

UNCAPPED, 82/Clinop, 1g/L, 10/29/98

Sample Name	Container wt. + U soln. + quartz, g
QC1.0U-pH 3.0	58.3501
QC1.0U-pH 3.5	58.6074
QC1.0U-pH 4.0	58.2584
QC1.0U-pH 4.25	58.3088
QQC1.0U-pH 4.5	58.5582
QC1.0U-pH4.75	58.3055
QC1.0U-pH 5.0	58.3179
QC1.0U-pH 5.25	58.2924
QC1.0U-pH 5.5	58.3058
QC1.0U-pH 5.75	58.2311
QC1.0U-pH 6.0	58.4688
QC1.0U-pH 6.25	58.6205
QC1.0U-pH 6.5	58.3415
QC1.0U-pH 6.75	58.2986
QC1.0U-pH 7.0	58.3151
QC1.0U-pH 7.25	58.2867
QC1.0U-pH 7.5	58.2346
QC1.0U-pH 7.75	58.3625
QC1.0U-pH 8.0	58.4670
QC1.0U-pH 8.25	58.2119
QC1.0U-pH 8.5	58.3095
QC1.0U-pH 8.75	58.3805
QC1.0U-pH 9.0	58.5926
QC1.0U-pH 9.25	58.2903
QC1.0U-pH 9.5	58.3620

UNCAPPED 11/3/98

Sample Name	Container wt. + U soln. + quartz + clinop, g
QC1.0U-pH 3.0	58.3604
QC1.0U-pH 3.5	58.6108
QC1.0U-pH 4.0	58.2833
QC1.0U-pH 4.25	58.3387
QQC1.0U-pH 4.5	58.5839
QC1.0U-pH4.75	58.3355
QC1.0U-pH 5.0	58.3483
QC1.0U-pH 5.25	58.3204
QC1.0U-pH 5.5	58.3346
QC1.0U-pH 5.75	58.2551
QC1.0U-pH 6.0	58.4936
QC1.0U-pH 6.25	58.6491
QC1.0U-pH 6.5	58.3673
QC1.0U-pH 6.75	58.3270
QC1.0U-pH 7.0	58.3454
QC1.0U-pH 7.25	58.3157
QC1.0U-pH 7.5	58.2646
QC1.0U-pH 7.75	58.3900
QC1.0U-pH 8.0	58.4969
QC1.0U-pH 8.25	58.2402
QC1.0U-pH 8.5	58.3385
QC1.0U-pH 8.75	58.4080
QC1.0U-pH 9.0	58.6189
QC1.0U-pH 9.25	58.3206
QC1.0U-pH 9.5	58.3997

UNCAPPED 11/4/98

Sample Name	Container Wt. After additions of HNO3 and NaHCO3, g
QC1.0U-pH 3.0	58.7452
QC1.0U-pH 3.5	58.7067
QC1.0U-pH 4.0	58.3416
QC1.0U-pH 4.25	58.4154
QQC1.0U-pH 4.5	58.8661
QC1.0U-pH4.75	58.5315
QC1.0U-pH 5.0	58.5808
QC1.0U-pH 5.25	58.5730
QC1.0U-pH 5.5	58.6044
QC1.0U-pH 5.75	58.5340
QC1.0U-pH 6.0	58.7796
QC1.0U-pH 6.25	58.9588
QC1.0U-pH 6.5	58.4221
QC1.0U-pH 6.75	58.3991
QC1.0U-pH 7.0	58.4373
QC1.0U-pH 7.25	58.4479
QC1.0U-pH 7.5	58.4668
QC1.0U-pH 7.75	58.5466
QC1.0U-pH 8.0	58.7709
QC1.0U-pH 8.25	58.3415
QC1.0U-pH 8.5	~~58.5696~~ 58.5036
QC1.0U-pH 8.75	~~58.9232~~ 58.5696
QC1.0U-pH 9.0	~~58.1999~~ 9232
QC1.0U-pH 9.25	59.1999
QC1.0U-pH 9.5	59.6589
QC1.0V-IV	57.4526

UNCAPPED 11/16/98 11/17/98 11/18/98

Sample Name	Container wt. before sampling & pH measurements, g	Measured pH	Container wt. after sampling & pH measurements, g
QC1.0U-pH 3.0	58.4578	2.96	57.4506
QC1.0U-pH 3.5	58.4542	3.51	57.4467
QC1.0U-pH 4.0	58.0686	4.16	57.0160
QC1.0U-pH 4.25	58.1245	4.49	57.1252
QQC1.0U-pH 4.5	58.6345	4.84	57.6217
QC1.0U-pH4.75	58.2099	5-64	57.1951
QC1.0U-pH 5.0	58.2613	6.09	57.2473
QC1.0U-pH 5.25	58.3060	6.21	57.3009
QC1.0U-pH 5.5	58.3167	6.34	57.2888
QC1.0U-pH 5.75	58.1578	6.36	57.1462
QC1.0U-pH 6.0	58.3896	6.47	57.3805
QC1.0U-pH 6.25	58.7341	6.57	57.7327
QC1.0U-pH 6.5	58.1691	6.58	57.1520
QC1.0U-pH 6.75	58.0652	6.77	57.0488
QC1.0U-pH 7.0	58.0944	7.05	57.0639
QC1.0U-pH 7.25	58.1822	7.21	57.1822
QC1.0U-pH 7.5	58.1020	7.39	57.1077
QC1.0U-pH 7.75	58.1832	7.63	57.1763
QC1.0U-pH 8.0	58.5972	7.85	57.5905
QC1.0U-pH 8.25	58.0773	8.16	57.0687
QC1.0U-pH 8.5	58.2145	8.36	57.1937
QC1.0U-pH 8.75	58.3393	8.65	57.3441
QC1.0U-pH 9.0	58.6522	8.86	57.6730
QC1.0U-pH 9.25	58.9036	9.17	57.9134
QC1.0U-pH 9.5	58.4413	9.09	58.4278
QC0U-IU	57.4063		56.4068

UNCAPPED SORPTION

11/16/98 11/17/98 & 11/18/98

Sample Name	wt. of vial,g	wt. Of vial + sample
QC1.0U-pH 3a	7.6749	8.1638
QC1.0U-pH 3b	7.7212	8.2071
QC1.0U-pH 3.5a	7.412	8.2302
QC1.0U-pH 3.5b	7.7404	8.2300
QC1.0U-pH 4a	7.6736	8.1759
QC1.0U-pH 4b	7.7338	8.2493
QC1.0U-pH 4.25a	7.7604	8.2475
QC1.0U-pH 4.25b	7.6533	8.1390
QC1.0U-pH 4.5a	7.7470	8.2336
QC1.0U-pH 4.5b	7.6947	8.1852
QC1.0U-pH 4.75a	7.7123	8.2037
QC1.0U-pH4.75b	7.6622	8.1556
QC1.0U-pH 5a	7.6953	8.1865
QC1.0U-pH 5b	7.7235	8.1848
QC1.0U-pH 5.25a	7.6947	8.2141
QC1.0U-pH 5.25b	7.7330	8.1847
QC1.0U-pH 5.5a	7.7005	8.2229
QC1.0U-pH 5.5b	7.6860	8.1916
QC1.0U-pH 5.75a	7.6626	8.1735
QC1.0U-pH 5.75b	7.7334	8.1509
QC1.0U-pH 6a	7.6933	8.2257
QC1.0U-pH 6b	7.7031	8.1840
QC1.0U-pH 6.25a	7.6848	8.1915
QC1.0U-pH 6.25a	7.7130	8.1704
QC1.0U-pH 6.5a	7.7672	8.2046
QC1.0U-pH 6.5b	7.7036	8.2546
QC1.0U-pH 6.75a	7.7234	8.1956
QC1.0U-pH 6.75b	7.7098	8.2136
QC1.0U-pH 7a	7.7537	8.1982
QC1.0U-pH 7b	7.7095	8.2454
QC1.0U-pH 7.25a	7.7085	8.1990
QC1.0U-pH 7.25b	7.7117	8.1956
QC1.0U-pH 7.5a	7.6967	8.1992
QC1.0U-pH 7.5b	7.7081	8.1835
QC1.0U-pH 7.75a	7.7035	8.1959
QC1.0U-pH 7.75b	7.6715	8.1942
QC1.0U-pH 8a	7.7261	8.1614
QC1.0U-pH 8b	7.6760	8.2172
QC1.0U-pH 8.25a	7.7275	8.1641
QC1.0U-pH 8.25b	7.7877	8.2159
QC1.0U-pH 8.5a	7.6621	8.2765
QC1.0U-pH 8.5b	7.7261	8.1468
QC1.0U-pH 8.75a	7.7254	8.2183
QC1.0U-pH 8.75b	7.7376	8.2108
QC1.0U-pH 9a	7.6924	8.2165
QC1.0U-pH 9b	7.7247	8.1661
QC1.0U-pH 9.25a	7.7199	8.2075
QC1.0U-pH 9.25	7.7199	8.2010
QC1.0U-pH 9.5a	7.7199	8.2041
QC1.0U-pH 9.5b	7.6947	8.1816
QC1.0U-Iua	7.7230	8.2215
QC1.0U-IUb	7.6991	8.1970
QC1.0U-IUc	7.7227	8.2266

19 Nov 98 08:46 ALPHA/BETA - 1.02 Pac
Protocol #:23 U-233 3% 2 sigma User :

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

QC1.0 U Sorption
Qtz & Clinoptilolite (0.035g) M/V = 1 g/L
UNCAPPED

	LL	UL	LCR	2S%	BKG
Region A:	0.0 -	100	0	0.3	20.34
Region B:	100 -	350	0	3.0	3.77
Region C:	0.0 -	2000	0	0.1	30.19

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

S#	TIME	CPMA A:2S%		CPMB B:2S%		CPMC C:2S%		SIS FLAG	
P# 1	999.99	20.34	1.40	3.770	3.26	30.19	1.15	149.31	B
23 2	8.56	0.80	392.7	515.973	3.02	519.11	3.09	637.70	std.
23 3	8.28	2.61	128.2	532.945	3.02	536.96	3.08	617.88	
23 4	8.37	1.28	251.4	527.532	3.02	529.91	3.09	632.39	
23 5	8.75	2.06	156.0	504.573	3.02	506.73	3.09	630.49	
23 6	9.27	0.00	0.00	476.273	3.02	475.10	3.11	635.98	
23 7	8.86	0.43	721.4	498.262	3.02	500.51	3.09	635.72	
23 8	8.85	4.40	76.20	498.377	3.02	502.58	3.09	629.81	
23 9	9.24	0.87	349.5	477.182	3.02	478.79	3.10	632.55	
23 10	9.02	0.83	369.0	489.135	3.02	490.77	3.10	631.39	
23 11	10.62	0.19	1502	414.686	3.03	415.76	3.12	640.85	
23 12	10.56	2.76	107.5	417.442	3.03	419.43	3.11	634.91	
23 13	12.96	0.00	0.00	339.208	3.03	338.64	3.15	639.96	
23 14	12.87	1.88	140.5	341.762	3.03	343.01	3.14	635.67	
23 15	28.74	1.61	109.7	150.858	3.08	153.25	3.30	635.91	
23 16	27.66	0.00	0.00	157.004	3.07	156.87	3.32	636.22	
23 17	39.72	0.00	0.00	108.113	3.11	109.41	3.44	637.46	
23 18	39.70	0.26	557.8	108.170	3.11	108.73	3.46	636.24	
23 19	42.37	0.00	0.00	101.116	3.11	101.01	3.50	636.27	
23 20	41.46	1.20	122.7	103.442	3.11	105.10	3.45	627.89	
23 21	41.82	0.18	815.5	102.519	3.11	102.93	3.48	633.92	
23 22	41.34	1.16	126.4	103.753	3.11	105.66	3.45	630.95	
23 23	42.17	0.19	731.6	101.613	3.11	101.71	3.49	633.29	
23 24	42.31	0.01	16476	101.335	3.11	101.93	3.48	633.84	
23 25	40.54	1.14	129.7	105.850	3.11	107.85	3.44	631.05	
23 26	38.76	0.76	197.0	110.884	3.10	112.02	3.43	628.76	
23 27	44.66	0.66	211.6	95.760	3.12	96.75	3.50	630.71	
23 28	43.12	0.69	205.7	99.291	3.12	100.75	3.48	633.04	
23 29	37.44	0.00	0.00	114.927	3.10	115.22	3.43	636.91	
23 30	37.86	0.84	180.9	113.715	3.10	114.50	3.43	635.43	
23 31	34.81	2.70	61.22	123.894	3.09	127.41	3.35	626.28	
23 32	35.49	1.69	94.59	121.448	3.09	123.04	3.39	628.70	

23	33	33.21	0.95	171.7	130.075	3.09	130.22	3.39	633.25
23	34	31.97	0.87	190.9	135.298	3.08	136.16	3.36	634.74
23	35	28.01	0.00	0.00	154.959	3.07	155.17	3.32	637.80
23	36	27.64	1.37	131.4	157.011	3.07	158.89	3.30	632.12
23	37	22.95	0.00	0.00	189.912	3.06	190.16	3.26	642.67
23	38	22.61	2.22	91.09	192.780	3.06	195.29	3.24	634.01
23	39	18.49	1.08	201.8	236.738	3.05	238.55	3.20	637.57
23	40	18.83	0.42	500.4	232.236	3.05	232.42	3.22	636.52
23	41	13.72	1.89	135.6	320.210	3.04	322.22	3.15	634.54

20 Nov 98 02:31 ALPHA/BETA - 1.02
Protocol #:23 U-233 3% 2 sigma User

23	42	13.45	0.92	274.3	326.862	3.03	328.55	3.15	636.14
23	43	10.09	0.27	1051	436.963	3.03	436.91	3.12	630.48
23	44	10.58	0.83	342.3	416.268	3.03	417.92	3.12	636.81
23	45	9.30	2.45	128.1	474.510	3.02	476.26	3.10	635.52
23	46	9.18	0.79	385.0	480.653	3.02	481.25	3.10	636.69
23	47	8.86	4.38	76.60	497.923	3.02	502.54	3.09	623.47
23	48	8.90	0.00	0.00	495.781	3.02	495.77	3.10	638.60
23	49	9.03	4.35	76.24	488.367	3.02	492.29	3.09	636.93
23	50	9.08	2.79	115.0	486.208	3.02	488.97	3.09	638.73
23	51	9.30	0.52	579.7	474.725	3.02	475.40	3.10	638.70
23	52	9.12	1.81	173.1	483.620	3.02	485.27	3.10	636.86
23	53	9.11	1.61	193.3	484.814	3.02	487.16	3.09	645.97
23	54	9.19	0.22	1338	480.234	3.02	480.37	3.10	644.18

231 MISSING TUBE(S) 2/10/99 Std.

24		8.39	4.33	79.12	526.271	3.02	530.54	3.08	625.90
23	25	8.58	4.72	72.33	514.656	3.02	519.30	3.08	610.53
23	26	8.58	1.22	258.8	514.889	3.02	516.74	3.09	603.02
23	27	8.31	2.64	125.9	531.492	3.02	535.81	3.08	595.86
23	28	8.23	0.00	0.00	536.814	3.02	537.18	3.09	603.81
23	29	8.26	0.00	0.00	534.852	3.02	534.39	3.09	606.93

QC1.0U Uncapped Recounted on 2/10/99

↓ The samples were resampled from QC1.0U-IV container & counted. The wts. are written below.

231 MISSING TUBE(S) 2/20/99 Std.

96		8.87	1.74	180.0	497.663a	3.02	500.74	3.09	632.72
23	97	8.49	0.47	656.8	520.329b	3.02	520.46	3.09	615.99
23	98	8.32	1.01	315.1	531.512c	3.02	534.22	3.08	607.12
23	99	8.20	1.44	225.2	538.487d	3.02	540.39	3.09	601.79
23	100	8.43	1.45	220.5	524.175e	3.02	526.03	3.09	604.74
23	101	8.41	0.55	570.8	524.955f	3.02	524.62	3.09	609.96

ATTN: These samples were recounted on 2/20/99. No resampling was done

2/8/99	wt. of vial	wt. of vial + sample
QC1.0V-IVc	7.8733	8.3816
QC1.0V-IVd	7.8780	8.3842
QC1.0V-IVe	7.8377	8.3458
QC1.0V-IVf	7.9457	8.4528

DESORPTION, UNCAPPED

Sample Name	11/18/98 wt. Of PP tubes, g	11/18/98 wt. Of PP tubes after transfer of qtz/clino, g	11/18/98 wt. Of PP tubes after acid add, g	11/18/98 Container wt. after transfer of supernatant, g	11/18/98 Container wt. After acid add & supernatant retransfer,g
QC1.0U-pH 3.0	13.6074	18.1869	21.2190	26.9476	55.8491
QC1.0U-pH 3.5	13.2172	18.4885	21.5188	27.8934	55.1699
QC1.0U-pH 4.0	13.6698	18.0004	21.0235	26.6494	55.6086
QC1.0U-pH 4.25	13.2340	18.2879	21.3129	27.4393	54.9294
QC1.0U-pH 4.5	13.2506	19.6177	22.6376	29.0415	54.1688
QC1.0U-pH4.75	13.6424	19.4899	22.5126	28.1950	54.2535
QC1.0U-pH 5.0	13.6963	20.4197	23.4410	29.0820	53.4536
QC1.0U-pH 5.25	13.9760	20.8086	23.8266	29.1618	53.3485
QC1.0U-pH 5.5	13.2502	19.6975	22.7103	28.7897	53.7715
QC1.0U-pH 5.75	13.8666	20.0620	23.0834	28.5026	53.8624
QC1.0U-pH 6.0	13.6487	19.3171	22.3251	28.2655	54.5177
QC1.0U-pH 6.25	13.7516	21.2215	24.2522	30.1779	53.2249
QC1.0U-pH 6.5	13.6656	21.2442	24.2692	30.0263	52.5027
QC1.0U-pH 6.75	13.7502	20.8399	23.8688	29.4774	52.9202
QC1.0U-pH 7.0	13.2876	18.4619	21.4851	27.5609	54.8337
QC1.0U-pH 7.25	13.7078	20.3383	23.3622	29.0057	53.5182
QC1.0U-pH 7.5	13.1775	19.0609	22.0825	28.2165	54.2846
QC1.0U-pH 7.75	13.1655	18.6224	21.6501	27.9263	54.6694
QC1.0U-pH 8.0	13.1787	19.7807	22.8098	29.1449	53.9198
QC1.0U-pH 8.25	13.2808	18.5994	21.6295	27.6297	54.7335
QC1.0U-pH 8.5	13.6522	18.9538	21.9886	27.7047	54.8375
QC1.0U-pH 8.75	13.1900	21.1200	24.1608	30.4509	52.3354
QC1.0U-pH 9.0	13.2779	20.2215	23.2595	29.6807	53.6661
QC1.0U-pH 9.25	13.7046	19.7087	22.7398	28.4268	54.7739
QC1.0U-pH 9.5	13.1839	19.7935	22.8205	29.1532	54.7573
QC0U-pH 9.25					
QC0U-pH 9.5					

DESORPTION (UNCAPPED)

Sample Name	11/30/98 Container wt. before sampling	12/2/98 Container wt. after sampling	11/30/98 wt. Of PP tubes before sampling	12/1/98 wt. Of PP tubes after sampling
QC1.0U-pH 3.0	55.7510	54.742	21.2156	20.2399
QC1.0U-pH 3.5	55.0891	54.0717	21.5070	20.5207
QC1.0U-pH 4.0	55.5337	54.5242	21.0149	20.0290
QC1.0U-pH 4.25	54.8747	54.8745	21.3076	20.3271
QQC1.0U-pH 4.5	54.0585	53.0461	22.6329	21.6454
QC1.0U-pH4.75	54.2045	53.2062	22.5054	20.5900
QC1.0U-pH 5.0	53.4009	52.4016	22.4356	21.5124
QC1.0U-pH 5.25	53.2642	52.4016	23.8220	22.8589
QC1.0U-pH 5.5	53.7242	52.2617	23.7041	22.6934
QC1.0U-pH 5.75	53.7459	52.7232	23.0758	22.0827
QC1.0U-pH 6.0	54.4303	52.7499	22.2782	21.2710
QC1.0U-pH 6.25	53.1504	53.4269	24.2281	23.2315
QC1.0U-pH 6.5	52.4356	52.1440	24.2515	23.2518
QC1.0U-pH 6.75	52.8512	51.4308	23.8650	22.8771
QC1.0U-pH 7.0	54.7518	51.8475	21.4627	20.4793
QC1.0U-pH 7.25	53.4725	53.7529	23.3532	22.3478
QC1.0U-pH 7.5	54.2304	52.4725	22.0626	21.0621
QC1.0U-pH 7.75	54.5932	53.2245	21.6423	20.6539
QC1.0U-pH 8.0	53.8649	53.5711	22.7748	21.8359
QC1.0U-pH 8.25	54.5927	52.8671	21.6241	20.6558
QC1.0U-pH 8.5	54.7684	53.7621	21.7243	20.7702
QC1.0U-pH 8.75	52.2589	51.2555	24.1296	23.1666
QC1.0U-pH 9.0	53.5708	52.5604	23.2536	22.3062
QC1.0U-pH 9.25	54.6178	53.6050	22.7312	21.7886
QC1.0U-pH 9.5	54.6490	53.6358	22.8073	21.8445

	PP tubes	Desorption UNCAPPED
Sample Name	wt. of vial,g	wt. Of vial + sample
QC1.0U-pH 3a	7.7046	8.1811
QC1.0U-pH 3b	7.7372	8.2138
QC1.0U-pH 3.5a	7.7297	8.2072
QC1.0U-pH 3.5b	7.7122	8.1947
QC1.0U-pH 4a	7.7444	8.2231
QC1.0U-pH 4b	7.7337	8.2166
QC1.0U-pH 4.25a	7.7075	8.1853
QC1.0U-pH 4.25b	7.7284	8.2090
QC1.0U-pH 4.5a	7.7223	8.2015
QC1.0U-pH 4.5b	7.6644	8.1447
QC1.0U-pH 4.75a	7.6758	8.1657
QC1.0U-pH4.75b	7.6701	8.1334
QC1.0U-pH 5a	7.5932	8.0894
QC1.0U-pH 5b	7.6435	8.1416
QC1.0U-pH 5.25a	7.6899	8.1723
QC1.0U-pH 5.25b	7.6973	8.2135
QC1.0U-pH 5.5a	7.7089	8.1710
QC1.0U-pH 5.5b	7.6996	8.1290
QC1.0U-pH 5.75a	7.7021	8.1944
QC1.0U-pH 5.75b	7.7203	8.2179
QC1.0U-pH 6a	7.7457	8.1925
QC1.0U-pH 6b	7.7070	8.2362
QC1.0U-pH 6.25a	7.7137	8.1984
QC1.0U-pH 6.25a	7.7205	8.2040
QC1.0U-pH 6.5a	7.7623	8.2107
QC1.0U-pH 6.5b	7.6984	8.2548
QC1.0U-pH 6.75a	7.7437	8.1852
QC1.0U-pH 6.75b	7.8052	8.2326
QC1.0U-pH 7a	7.7063	8.2814
QC1.0U-pH 7b	7.7099	8.1846
QC1.0U-pH 7.25a	7.6696	8.1892
QC1.0U-pH 7.25b	7.6625	8.1452
QC1.0U-pH 7.5a	7.7073	8.1401
QC1.0U-pH 7.5b	7.7083	8.0547
QC1.0U-pH 7.75a	7.7478	8.2171
QC1.0U-pH 7.75b	7.6505	8.1810
QC1.0U-pH 8a	7.6858	8.1058
QC1.0U-pH 8b	7.7029	8.1376
QC1.0U-pH 8.25a	7.6918	8.1613
QC1.0U-pH 8.25b	7.7605	8.1495
QC1.0U-pH 8.5a	7.7299	8.2286
QC1.0U-pH 8.5b	7.7308	8.1984
QC1.0U-pH 8.75a	7.7623	8.1962
QC1.0U-pH 8.75b	7.6470	8.2268
QC1.0U-pH 9a	7.7381	8.1108
QC1.0U-pH 9b	7.6981	8.2077
QC1.0U-pH 9.25a	7.6767	8.1598
QC1.0U-pH 9.25	7.6248	8.1358
QC1.0U-pH 9.5a	7.7487	8.0988
QC1.0U-pH 9.5b	7.7360	8.2194

PC containers	Desorption
wt. of vial,g	wt. Of vial + sample
7.7172	8.2103
7.6990	8.1941
7.6884	8.1844
7.6954	8.1926
7.7039	8.2062
7.6942	8.1892
7.6565	8.1509
7.7308	8.2262
7.7135	8.2090
7.6628	8.1601
7.7014	8.1960
7.6758	8.1703
7.6814	8.1761
7.6976	8.1925
7.6402	8.1334
7.6953	8.1889
7.6876	8.1821
7.6655	8.1593
7.6527	8.1476
7.6447	8.1406
7.6297	8.1260
7.5936	8.0901
7.6925	8.1903
7.7158	8.2139
7.8063	8.3008
7.7380	8.2330
7.6514	8.1507
7.6745	8.1715
7.7152	8.2122
7.6836	8.1779
7.7102	8.2072
7.6961	8.1932
7.7460	8.2473
7.7422	8.2381
7.7584	8.2574
7.6751	8.1720
7.7643	8.2608
7.6958	8.1905
7.6945	8.1916
7.7017	8.1944
7.7541	8.2542
7.7564	8.2562
7.6823	8.1801
7.6862	8.1836
7.7553	8.2530
7.6511	8.1455
7.6330	8.1322
7.5915	8.0908
7.6618	8.1608
7.6809	8.1767

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SYSTEM NORMALIZED


C14 IPA DATA PROCESSED - 02-Dec-98 11:39
   C14 Eff (0-156 keV) = 96.58 %
C14 CHI SQUARE IPA DATA PROCESSED - 02-Dec-98 11:50
   C14 Chi Square = 23.43
H3 IPA DATA PROCESSED - 02-Dec-98 11:51
   H3 Eff (0-18.6 keV) = 65.31 %
H3 CHI SQUARE IPA DATA PROCESSED - 02-Dec-98 12:01
   H3 Chi Square = 13.88
BKG IPA DATA PROCESSED - 02-Dec-98 13:02
   Bkg (0-18.6 keV) = 22.60 cpm
   Bkg (0-156 keV)  = 32.35 cpm

WARNING: Questionable C14 Background value - Please view historic data


WARNING: Questionable C14 Figure of Merit value - Please view historic


   C14 E^2/B (1-156 keV)    = 374.01
   H3  E^2/B (1-18.6 keV)   = 187.68
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03 Dec 98  05:51          ALPHA/BETA - 1.02                    Page
Protocol #:23             U-233 3% 2 sigma                     User : A

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   20.18
Region B:    100 -   350      0    3.0    3.57
Region C:    0.0 - 2000       0    0.1   29.59

Quench Indicator: SIS
alpha cpm U-233  1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal
```

QC1.0U uncapped desorption

QC1.0V, desorption tubes uncapped

S#	TIME	CPMA A:2S%		CPMB B:2S%		CPMC C:2S%		SIS	FLAG
P#	1 999.99	20.18	1.41	3.574	3.35	29.59	1.16	145.04	B
23	2 14.42	1.25	195.8	304.609	3.04	306.88	3.15	623.80	
23	3 14.26	2.76	92.60	308.137	3.03	312.41	3.14	625.08	
23	4 11.49	0.45	596.9	383.632	3.03	385.29	3.12	625.49	
23	5 11.91	2.58	107.8	369.810	3.03	373.85	3.11	621.24	
23	6 8.46	2.40	136.6	521.958	3.02	526.32	3.08	621.71	
23	7 8.60	3.20	103.5	513.868	3.02	517.85	3.08	618.54	
23	8 6.85	2.45	148.7	645.769	3.02	649.39	3.07	624.99	
23	9 6.75	4.42	86.66	655.685	3.01	660.48	3.06	619.95	
23	10 5.45	2.39	170.4	812.022	3.01	814.44	3.06	621.99	
23	11 5.32	2.57	161.3	831.764	3.01	834.51	3.05	619.05	
23	12 3.05	7.04	84.98	1455.115	3.01	1466.15	3.02	619.91	
23	13 3.13	4.43	126.9	1416.234	3.01	1419.93	3.03	621.95	
23	14 2.96	0.10	5513	1499.129	3.01	1503.18	3.03	623.18	
23	15 3.01	10.39	61.40	1475.828	3.00	1486.35	3.02	618.96	
23	16 2.78	6.08	101.1	1594.987	3.01	1602.06	3.02	620.27	
23	17 2.77	5.10	118.7	1601.841	3.01	1609.76	3.02	616.95	
23	18 3.00	6.49	91.96	1482.426	3.00	1489.07	3.02	623.53	
23	19 2.89	6.12	98.65	1537.256	3.00	1548.95	3.02	624.11	
23	20 2.93	8.15	76.36	1513.832	3.01	1522.97	3.02	623.20	
23	21 2.98	3.65	155.1	1489.043	3.01	1493.23	3.03	625.26	
23	22 2.56	4.43	140.0	1740.176	3.00	1750.88	3.01	619.41	
23	23 2.59	7.24	89.98	1718.048	3.00	1727.16	3.02	620.71	
23	24 2.44	8.51	80.62	1825.934	3.00	1832.70	3.01	619.59	
23	25 2.50	6.62	98.94	1776.826	3.00	1785.21	3.02	623.15	
23	26 2.94	5.34	110.6	1511.392	3.00	1520.41	3.02	624.30	
23	27 2.95	4.57	126.9	1507.612	3.00	1512.78	3.02	620.78	
23	28 3.06	4.33	130.7	1450.021	3.01	1456.68	3.03	623.23	
23	29 3.01	9.73	64.88	1474.167	3.01	1483.36	3.02	620.59	
23	30 2.88	4.82	122.3	1539.481	3.01	1544.71	3.03	620.36	
23	31 2.89	3.70	155.5	1537.602	3.00	1541.00	3.03	621.32	
23	32 2.42	10.40	68.39	1838.161	3.00	1850.57	3.01	610.39	
23	33 2.35	8.76	80.17	1891.745	3.00	1899.77	3.02	621.18	
23	34 2.91	5.25	112.7	1526.323	3.00	1534.67	3.02	622.52	
23	35 2.99	0.00	0.00	1487.396	3.00	1490.14	3.03	622.43	
23	36 2.97	12.15	54.36	1494.742	3.01	1509.13	3.02	618.00	
23	37 4.09	3.30	145.6	1083.712	3.01	1089.48	3.04	639.97	
23	38 3.09	9.27	66.64	1437.526	3.00	1449.37	3.02	621.34	
23	39 3.11	4.26	131.7	1426.329	3.01	1431.50	3.03	621.03	
23	40 4.73	6.46	73.57	937.018	3.01	944.19	3.04	620.14	
23	41 4.65	3.91	116.6	954.706	3.01	960.95	3.04	632.37	

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

23	42	7.02	0.05	6462	630.044	3.02	632.23	3.07	631.34
23	43	7.03	6.00	64.51	629.427	3.02	637.55	3.06	624.07
23	44	10.46	4.11	74.51	421.378	3.03	427.48	3.09	623.48
23	45	10.46	1.62	178.8	421.569	3.02	425.09	3.10	623.12
23	46	11.73	0.88	305.5	375.284	3.03	377.06	3.12	627.06
23	47	11.73	2.67	105.0	375.454	3.03	379.44	3.11	619.97
23	48	12.44	1.69	157.8	353.902	3.03	355.62	3.13	628.20
23	49	12.58	2.80	97.13	349.765	3.03	353.48	3.12	626.89
23	50	13.37	0.17	1471	328.887	3.03	329.27	3.15	635.60
23	51	13.54	2.28	113.8	324.639	3.03	327.79	3.14	636.95
23	52	13.33	2.41	108.9	329.809	3.03	333.12	3.13	634.02
23	53	13.20	3.31	81.06	333.168	3.03	338.82	3.12	636.03
231	MISSING TUBE(S) containers								
55		9.43	4.11	78.41	468.218	3.02	474.23	3.08	627.94
23	56	9.50	0.04	8297	464.215	3.02	465.67	3.10	628.55
23	57	9.39	0.38	785.2	469.802	3.02	471.05	3.10	631.38
23	58	9.49	2.59	120.3	465.235	3.02	469.56	3.09	627.45
23	59	10.07	2.57	117.7	438.233	3.02	440.02	3.10	626.38
23	60	10.19	1.02	283.6	432.540	3.03	434.29	3.11	628.38
23	61	11.03	3.76	78.73	399.418	3.03	402.41	3.11	626.22
23	62	10.92	0.43	643.5	403.660	3.03	403.56	3.12	632.47
23	63	12.97	1.26	205.5	339.140	3.03	340.42	3.14	631.44
23	64	12.77	3.00	90.19	344.507	3.03	347.70	3.13	626.27
23	65	23.79	0.72	264.8	183.269	3.06	183.82	3.26	632.27
23	66	23.52	0.00	0.00	185.414	3.06	185.67	3.26	628.79
23	67	34.14	1.09	147.1	126.625	3.09	128.08	3.37	625.07
23	68	32.83	0.00	0.00	131.820	3.08	131.85	3.37	635.02
23	69	33.77	0.32	500.6	128.111	3.08	128.68	3.38	627.13
23	70	35.03	1.61	99.77	123.317	3.09	125.25	3.37	628.27
23	71	31.93	1.43	116.4	135.668	3.08	137.71	3.33	628.46
23	72	31.86	0.45	366.1	135.911	3.08	137.14	3.35	634.97
23	73	31.07	1.42	119.0	139.458	3.08	141.41	3.33	628.52
23	74	30.80	2.00	86.03	140.712	3.08	142.84	3.32	623.92
23	75	33.03	1.41	116.3	130.970	3.08	133.08	3.35	627.29
23	76	32.98	0.59	271.0	131.174	3.08	132.75	3.35	631.08
23	77	32.03	0.00	0.00	135.233	3.08	135.66	3.36	635.92
23	78	31.86	0.23	717.5	135.974	3.08	137.17	3.35	634.76
23	79	29.94	2.90	61.25	144.856	3.08	148.03	3.30	612.96
23	80	30.00	0.56	302.2	144.593	3.08	145.87	3.32	633.75
23	81	30.94	0.61	274.1	140.091	3.08	140.93	3.34	630.48
23	82	30.60	0.58	289.9	141.655	3.08	142.56	3.34	630.91
23	83	31.29	2.10	81.48	138.452	3.08	140.65	3.33	630.75
23	84	30.75	1.26	134.9	140.946	3.08	142.28	3.33	625.59
23	85	27.68	0.63	277.1	157.047	3.07	158.09	3.30	629.61
23	86	26.92	1.82	100.8	161.619	3.07	164.32	3.27	629.70
23	87	22.58	1.30	151.2	193.237	3.06	195.52	3.23	630.89
23	88	23.22	1.70	115.2	187.899	3.06	189.79	3.24	624.97

Uncapped QC1.0U, desorption containers

23	89	19.54	1.68	127.2	224.010	3.05	224.91	3.21	626.62
23	90	19.87	0.00	0.00	220.080	3.05	220.43	3.22	635.31
23	91	14.38	1.80	138.3	305.605	3.03	308.24	3.15	636.44
23	92	14.59	0.94	259.0	301.155	3.04	301.73	3.16	634.52
23	93	11.32	1.20	229.7	389.094	3.03	390.46	3.12	631.22
23	94	10.97	1.70	166.7	401.713	3.03	404.23	3.11	635.08
23	95	9.50	2.56	121.3	464.321	3.02	466.41	3.10	627.52
23	96	9.78	3.96	79.74	451.232	3.02	456.09	3.09	630.05
23	97	9.33	1.15	263.2	472.739	3.02	474.69	3.10	636.26
23	98	9.65	1.59	190.2	457.151	3.02	458.80	3.10	632.52

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Protocol #:23 U-233 3% 2 sigma User : A

23	99	9.56	1.48	204.6	461.384	3.02	464.55	3.10	634.02
23	100	9.49	0.00	0.00	464.919	3.02	466.61	3.10	639.19
23	101	9.69	0.67	439.2	455.353	3.02	456.48	3.10	640.60
23	102	9.87	5.86	55.61	446.781	3.02	453.08	3.09	636.16
23	103	10.05	3.80	81.54	438.814	3.02	443.54	3.09	625.69
23	104	10.10	3.49	88.14	436.723	3.02	440.11	3.10	632.28

23

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 04-Dec-98 04:57
C14 Eff (0-156 keV) = 96.43 %
C14 CHI SQUARE IPA DATA PROCESSED - 04-Dec-98 05:07
C14 Chi Square = 20.94
H3 IPA DATA PROCESSED - 04-Dec-98 05:09
H3 Eff (0-18.6 keV) = 65.63 %
H3 CHI SQUARE IPA DATA PROCESSED - 04-Dec-98 05:19
H3 Chi Square = 34.64
BKG IPA DATA PROCESSED - 04-Dec-98 06:20
Bkg (0-18.6 keV) = 21.32 cpm
Bkg (0-156 keV) = 30.27 cpm

WARNING: Questionable C14 Background value - Please view historic data

C14 E^2/B (1-156 keV) = 408.94
H3 E^2/B (1-18.6 keV) = 201.63

[Data continued from page 75]

M/V (Qtz/U-233 son = 2 g/L), M/V (Clinop/U-233 = 0]
No clinoptilolite was added, only qtz is used as substrate. The vials were kept capped during expts.

CAPPED (SORPTION)

12/15/98 NO Clinop (Qtz only) 12/15/98

Sample Name	Container wt. before sampling & pH measurements, g	Measured pH	Container wt. after sampling & pH measurements, g
QC0U-pH 3.0	58.751	2.76	57.7308
QC0U-pH 3.5	58.2928	3.33	57.2753
QC0U-pH 4.0	58.387	3.81	57.3728
QC0U-pH 4.25	58.7951	4.02	57.776
QC0U-pH 4.5	58.6863	4.17	57.6716
QC0U-pH4.75	58.8825	4.18	57.8639
QC0U-pH 5.0	58.4776	6.42	57.4513
QC0U-pH 5.25	58.3792	5.24	57.3691
QC0U-pH 5.5	58.3364	5.63	57.3213
QC0U-pH 5.75	58.4606	5.88	57.4401
QC0U-pH 6.0	60.8091	4.17	59.7894
QC0U-pH 6.25	58.9162	6.36	57.8957
QC0U-pH 6.5	58.5745	6.49	57.5569
QC0U-pH 6.75	58.8107	6.67	57.7926
QC0U-pH 7.0	58.4751	6.76	57.4443
QC0U-pH 7.25	59.4786	8.96	58.4402
QC0U-pH 7.5	58.6428	6.46	57.6221
QC0U-pH 7.75	58.4439	6.66	57.4205
QC0U-pH 8.0	58.7237	7.11	57.7038
QC0U-pH 8.25	58.761	6.89	57.7335
QC0U-pH 8.5	58.8678	8.38	57.8484
QC0U-pH 8.75	58.3256	7.64	57.3118
QC0U-pH 9.0	58.3678	7.41	57.3518
QC0U-pH 9.25	58.4654	7.6	57.4356
QC0U-pH 9.5	58.6553	9.3	57.6418

No Clino (Quartz only) **CAPPED** Sorption

Sample Name	wt. of vial	wt. Of vial + sample
QC0U -pH 3a	7.6277	8.1289
QC0U -pH 3b	7.6124	8.114
QC0U--pH 3.5a	7.6103	8.1094
QC0U-pH 3.5b	7.6141	8.1136
QC0U--pH 4a	7.6293	8.128
QC0U--pH 4b	7.5996	8.0969
QC0U--pH 4.25a	7.6643	8.1623
QC0U--pH 4.25b	7.6206	8.1212
QC0U-pH 4.5a	7.6567	8.1552
QC0U-pH 4.5b	7.5669	8.0655
QC0U-pH 4.75a	7.6373	8.1353
QC0U-pH 4.75b	7.5542	8.0542
QC0U-pH 5a	7.5661	8.0644
QC0U-pH 5b	7.6265	8.1254
QC0U-pH 5.25a	7.6174	8.1166
QC0U-pH 5.25b	7.6613	8.1612
QC0U-pH 5.5a	7.6273	8.1263
QC0U-pH 5.5b	7.626	8.1254
QC0U-pH 5.75a	7.6426	8.1399
QC0U-pH 5.75b	7.6356	8.1348
QC0U-pH 6a	7.613	8.1132
QC0U-pH 6b	7.6196	8.1242
QC0U-pH 6.25a	7.6704	8.1706
QC0U-pH 6.25b	7.5978	8.1022
QC0U-pH 6.5a	7.6094	8.1075
QC0U-pH 6.5b	7.6363	8.1339
QC0U-pH 6.75a	7.5789	8.0758
QC0U-pH 6.75b	7.6454	8.1433
QC0U-pH 7a	7.5346	8.036
QC0U-pH 7b	7.6585	8.1577
QC0U-pH 7.25a	7.6329	8.1337
QC0U-pH 7.25b	7.609	8.108
QC0U-pH 7.5a	7.5549	8.0539
QC0U-pH 7.5b	7.6114	8.1115
QC0U-pH 7.75a	7.5558	8.0558
QC0U-pH 7.75b	7.5858	8.0865
QC0U-pH 8a	7.5091	8.0092
QC0U-pH 8b	7.631	8.1305
QC0U-pH 8.25a	7.6081	8.1084
QC0U-pH 8.25b	7.6294	8.131
QC0U-pH 8.5a	7.6407	8.141
QC0U-pH 8.5b	7.5817	8.0808

QC0U-pH 8.75a	7.6708	8.17
QC0U-pH 8.75b	7.6469	8.1481
QC0U-pH 9a	7.6431	8.1399
QC0U-pH 9b	7.5868	8.0852
QC0U-pH 9.25a	7.6081	8.1062
QC0U-pH 9.25b	7.6449	8.1425
QC0U-pH 9.5a	7.6848	8.183
QC0U-pH 9.5b	7.632	8.1298

CAPPED 12/16/98 Desorption, No Clino (Quartz only)

Sample Name	wt. Of PP tubes, g	wt. Of PP tubes after transfer of qtz/clino, g	wt. Of PP tubes after acid add, g	Container wt. after transfer of supernatant, g	Container wt. after supernatant retransfer & acid add ,g
QC0U-pH 3.0	13.3781	19.929	22.9547	28.9298	54.1225
QC0U-pH 3.5	13.7006	18.228	21.2486	26.9279	55.6617
QC0U-pH 4.0	13.3093	19.6383	22.6548	28.6026	53.9925
QC0U-pH 4.25	13.2509	19.7356	22.754	28.9859	54.1984
QC0U-pH 4.5	13.4218	19.9782	22.9821	28.8807	54.012
QC0U-pH4.75	13.2197	20.1703	23.1964	28.3522	53.8527
QC0U-pH 5.0	13.6255	20.1656	23.1766	28.9143	53.8014
QC0U-pH 5.25	13.1447	20.6611	23.671	29.9456	52.7603
QC0U-pH 5.5	13.3152	20.1629	23.1875	29.2199	53.3854
QC0U-pH 5.75	13.7556	19.427	22.4403	28.0543	54.6243
QC0U-pH 6.0	13.2029	20.7294	23.7356	29.917	55.1739
QC0U-pH 6.25	13.2228	17.3315	20.3424	26.7841	56.479
QC0U-pH 6.5	13.248	18.8222	21.8292	27.9732	54.8127
QC0U-pH 6.75	13.6727	19.658	22.657	28.645	54.7056
QC0U-pH 7.0	13.2973	19.1927	22.1966	28.2086	54.4132
QC0U-pH 7.25	13.4084	19.7785	22.7829	28.9287	54.8841
QC0U-pH 7.5	13.708	18.8564	21.8698	27.7738	55.3327
QC0U-pH 7.75	13.6143	20.2859	23.2962	29.3197	53.6148
QC0U-pH 8.0	13.2137	19.2373	22.2371	28.3196	54.4824
QC0U-pH 8.25	13.8855	19.0705	22.0806	27.8605	55.3817
QC0U-pH 8.5	13.6274	20.2118	23.2062	29.033	54.1125
QC0U-pH 8.75	13.6811	19.6402	22.6486	28.2915	54.1677
QC0U-pH 9.0	13.773	18.0081	21.6223	26.7945	55.9653
QC0U-pH 9.25	13.7498	19.6771	22.672	28.552	54.18
QC0U-pH 9.5	13.352	18.303	24.3285	27.4536	55.6034

CAPPED DESORPTION (No Clinoptilolite (Quartz only) 12/28/98

Sample Name	Container wt. before sampling	wt. Of PP tubes before sampling	Container wt. after sampling	wt. Of PP tubes after sampling
QC0U-pH 3.0	54.0384	22.9487	53.0251	21.9376
QC0U-pH 3.5	55.5330	21.1106	54.5260	20.1039
QC0U-pH 4.0	53.9046	22.649	52.8944	21.6428
QC0U-pH 4.25	54.0948	22.7458	53.0834	21.7419
QC0U-pH 4.5	53.9312	22.9754	52.9205	21.9671
QC0U-pH4.75	53.7206	22.1894	52.7096	22.186
QC0U-pH 5.0	53.6984	23.1557	52.6850	22.1512
QC0U-pH 5.25	52.6334	23.6626	51.6527	22.6565
QC0U-pH 5.5	53.2628	23.1642	52.2509	22.1635
QC0U-pH 5.75	54.4061	22.3553	53.3938	21.3517
QC0U-pH 6.0	55.0814	23.7064	54.0738	22.7052
QC0U-pH 6.25	56.3376	20.3066	55.3291	19.305
QC0U-pH 6.5	54.6909	21.7216	53.6846	20.7188
QC0U-pH 6.75	54.5430	22.5339	53.5372	21.5314
QC0U-pH 7.0	54.3314	22.1708	53.3239	21.158
QC0U-pH 7.25	54.7348	22.7064	53.7248	21.7023
QC0U-pH 7.5	55.1963	21.6659	54.1906	20.6688
QC0U-pH 7.75	53.4834	23.2497	52.4740	22.2489
QC0U-pH 8.0	54.4052	22.1968	53.3958	21.1946
QC0U-pH 8.25	55.2194	22.0334	54.2088	21.0269
QC0U-pH 8.5	53.9198	22.9139	52.9025	21.9049
QC0U-pH 8.75	54.0234	22.55	53.0146	21.5409
QC0U-pH 9.0	55.8171	20.967	54.8041	19.9622
QC0U-pH 9.25	53.9557	22.6504	52.9465	21.6442
QC0U-pH 9.5	55.3931	24.247	54.3624	23.2438

(No Clino (Quartz only)) DESORPTION (CAPPED) Tubes & Containers

	PP tubes Desorption 12/28/98		PC containers Desorption	
Sample Name	wt. of vial,g	wt. of vial+sample,g	wt. of vial,g	wt. of vial+sample,g
QC0U -pH 3a	7.8796	8.3799	7.5608	8.0641
QC0U -pH 3b	7.8703	8.3719	7.5461	8.0529
QC0U--pH 3.5a	7.8011	8.2999	7.5379	8.0383
QC0U-pH 3.5b	7.9514	8.4509	7.6211	8.1238
QC0U--pH 4a	7.8647	8.3641	7.6590	8.1615
QC0U--pH 4b	7.8686	8.3674	7.5590	8.0648
QC0U--pH 4.25a	7.8776	8.3753	7.5976	8.1003
QC0U--pH 4.25b	7.9322	8.4329	7.5803	8.0865
QC0U-pH 4.5a	7.9120	8.4099	7.5867	8.0891
QC0U-pH 4.5b	7.8640	8.3640	7.6206	8.1273
QC0U-pH 4.75a	7.8751	8.3722	7.6248	8.1276
QC0U-pH 4.75b	8.0188	8.5184	7.6409	8.1459
QC0U-pH 5a	7.9450	8.4418	7.5390	8.0414
QC0U-pH 5b	8.0148	8.5142	7.6086	8.1142
QC0U-pH 5.25a	7.8462	8.3436	7.6007	8.1037
QC0U-pH 5.25b	7.9621	8.4611	7.6342	8.1393
QC0U-pH 5.5a	7.8215	8.3162	7.6163	8.1193
QC0U-pH 5.5b	7.8515	8.3484	7.6021	8.1082
QC0U-pH 5.75a	7.8564	8.3536	7.6514	8.1535
QC0U-pH 5.75b	7.8576	8.3552	7.5688	8.0743
QC0U-pH 6a	7.8782	8.3731	7.6376	8.1403
QC0U-pH 6b	7.9346	8.4306	7.6388	8.1422
QC0U-pH 6.25a	7.8529	8.3473	7.6447	8.1468
QC0U-pH 6.25b	7.8775	8.3744	7.5836	8.0883
QC0U-pH 6.5a	7.9092	8.4044	7.5871	8.0873
QC0U-pH 6.5b	7.9127	8.4107	7.6106	8.1146
QC0U-pH 6.75a	7.8209	8.3165	7.5998	8.1007
QC0U-pH 6.75b	7.8918	8.3877	7.5100	8.0131
QC0U-pH 7a	7.7809	8.2782	7.5898	8.0928
QC0U-pH 7b	7.8261	8.3243	7.6497	8.1533
QC0U-pH 7.25a	7.8293	8.3277	7.6066	8.1095
QC0U-pH 7.25b	7.9167	8.4135	7.5833	8.0884
QC0U-pH 7.5a	7.8635	8.3586	7.5728	8.0737
QC0U-pH 7.5b	7.8083	8.3051	7.5628	8.066
QC0U-pH 7.75a	7.9811	8.4761	7.6565	8.1587
QC0U-pH 7.75b	7.8928	8.3882	7.6288	8.1339
QC0U-pH 8a	7.8571	8.3532	7.5831	8.086
QC0U-pH 8b	7.8961	8.3941	7.7187	8.2244
QC0U-pH 8.25a	7.8661	8.3642	7.7471	8.2508
QC0U-pH 8.25b	7.9240	8.4236	7.7682	8.2729
QC0U-pH 8.5a	7.9126	8.4098	7.8132	8.3152

CAPPED DESORPTION (Quartz only), NO Clinop

QC0U-pH 8.5b	7.8829	8.3837	7.8377	8.3449
QC0U-pH 8.75a	7.8157	8.3148	7.8688	8.3697
QC0U-pH 8.75b	7.8674	8.3685	7.8539	8.3561
QC0U-pH 9a	7.915	8.4114	7.8306	8.3305
QC0U-pH 9b	7.9266	8.4267	7.9264	8.4297
QC0U-pH 9.25a	7.8263	8.3249	7.8912	8.3922
QC0U-pH 9.25b	7.8200	8.3192	7.9250	8.4263
QC0U-pH 9.5a	7.9508	8.4466	7.9677	8.4768
QC0U-pH 9.5b	7.8765	8.3755	7.8930	8.4039

SYSTEM NORMALIZED

CAPPED SORPTION LSA, Qtz only

QC0U

C14 IPA DATA PROCESSED - 17-Dec-98 12:14
C14 Eff (0-156 keV) = 96.28 %
C14 CHI SQUARE IPA DATA PROCESSED - 17-Dec-98 12:24
C14 Chi Square = 20.85
H3 IPA DATA PROCESSED - 17-Dec-98 12:26
H3 Eff (0-18.6 keV) = 64.94 %

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

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

BKG IPA DATA PROCESSED - 17-Dec-98 13:37
Bkg (0-18.6 keV) = 22.42 cpm
Bkg (0-156 keV) = 32.50 cpm

WARNING: Questionable C14 Background value - Please view historic data

WARNING: Questionable C14 Figure of Merit value - Please view historic data

C14 E^2/B (1-156 keV) = 372.47
H3 E^2/B (1-18.6 keV) = 188.22

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	19.96
Region B:	100 -	350	0	3.0	3.54
Region C:	0.0 -	2000	0	0.1	29.42

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

Capped Sorption
QC0U

S#	TIME	CPMA A:2S%		CPMB B:2S%		CPMC C:2S%		SIS FLAG
P# 1	999.99	19.96	1.42	3.544	3.36	29.42	1.17	145.20 B
23 2	8.83	5.18	65.36	499.967	3.02	506.02	3.08	630.04
23 3	8.96	1.25	248.1	492.885	3.02	494.57	3.09	632.52
23 4	8.85	2.30	138.5	498.716	3.02	501.31	3.09	628.26
23 5	8.73	3.52	93.48	506.078	3.02	511.01	3.08	629.71
23 6	9.00	3.26	98.87	490.567	3.02	495.91	3.08	629.19
23 7	9.19	2.78	113.6	480.134	3.02	482.66	3.09	629.69
23 8	9.43	1.25	241.3	468.354	3.02	471.43	3.09	632.28
23 9	9.45	2.90	107.8	467.144	3.02	471.53	3.09	627.54
23 10	9.20	4.17	77.97	479.499	3.02	484.05	3.09	626.47
23 11	9.02	1.33	232.7	489.250	3.02	490.53	3.10	627.94
23 12	9.38	3.49	90.88	470.443	3.02	474.63	3.09	625.60
23 13	9.09	6.22	54.74	485.565	3.02	491.81	3.08	621.35
23 14	50.38	1.85	72.60	84.666	3.13	86.69	3.52	622.85
23 15	52.27	2.37	56.52	81.514	3.13	84.33	3.52	617.17
23 16	16.84	3.02	77.91	260.351	3.04	264.10	3.16	624.49
23 17	16.17	1.50	154.8	271.348	3.04	272.74	3.17	630.84
23 18	32.65	3.32	51.62	132.566	3.08	136.33	3.31	619.85
23 19	32.77	1.86	89.11	132.159	3.08	135.33	3.32	627.61
23 20	47.01	1.27	108.2	90.989	3.12	92.93	3.49	624.98
23 21	46.47	1.52	91.60	92.088	3.12	93.71	3.49	623.09
23 22	10.44	0.44	635.6	422.222	3.03	424.03	3.11	631.96
23 23	9.82	2.24	134.9	449.104	3.02	451.94	3.10	629.00
23 24	50.99	0.59	219.4	83.630	3.13	84.56	3.56	631.18
23 25	51.98	0.80	162.3	81.950	3.13	83.72	3.55	627.46
23 26	54.78	1.62	79.57	77.617	3.14	79.78	3.57	621.79
23 27	54.72	0.65	192.7	77.669	3.14	78.69	3.60	628.03
23 28	52.86	1.64	79.65	80.527	3.14	82.21	3.56	620.65
23 29	51.79	0.62	207.4	82.264	3.13	83.80	3.55	632.54
23 30	44.26	1.30	108.8	96.863	3.11	98.48	3.47	624.16
23 31	45.05	0.37	368.3	95.102	3.11	95.93	3.50	632.36
23 32	31.49	3.13	55.51	137.802	3.08	141.68	3.30	620.53
23 33	31.59	3.05	56.67	137.165	3.08	140.44	3.31	620.38
23 34	42.09	2.37	62.54	102.158	3.10	104.84	3.42	619.71

23	35	40.39	1.88	79.79	106.483	3.10	108.88	3.41	624.26
23	36	40.71	1.53	96.55	105.643	3.10	107.57	3.43	622.11
23	37	41.53	2.00	74.08	103.487	3.10	105.80	3.43	621.87
23	38	36.56	0.53	289.3	118.010	3.09	118.99	3.40	628.80
23	39	37.10	1.79	86.91	116.267	3.09	117.94	3.39	627.14
23	40	36.67	0.93	165.3	117.645	3.09	119.06	3.39	625.54
23	41	36.13	1.55	101.5	119.456	3.09	121.48	3.38	630.53

Capped Sorption QCOU

19 Dec 98 02:54 ALPHA/BETA - 1.02 Pa

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

23	42	31.43	0.31	531.1	137.881	3.08	138.51	3.35	634.36
23	43	30.70	0.72	230.1	141.244	3.08	144.19	3.31	628.92
23	44	38.13	0.34	438.7	113.005	3.10	113.51	3.42	636.87
23	45	36.86	1.80	86.90	117.020	3.09	118.98	3.39	623.71
23	46	30.54	1.59	107.5	141.970	3.08	144.32	3.31	630.74
23	47	30.33	2.49	69.95	142.978	3.08	145.52	3.31	624.91
23	48	22.56	0.00	0.00	193.442	3.06	193.67	3.25	633.06
23	49	22.83	1.68	117.3	191.112	3.06	193.31	3.24	627.50
23	50	34.44	2.77	59.44	125.492	3.09	129.00	3.34	622.55
23	51	34.84	0.22	710.9	124.010	3.09	125.48	3.37	636.32
231	MISSING TUBE(S)								
53		8.40	3.25	102.5	525.504	3.02	529.39	3.08	629.31
23	54	8.40	0.99	319.6	526.099	3.02	527.24	3.09	634.08
23									

] Std.

~~Standards Recounted on 2/10/99~~ AJ

~~Standards Recounted on 2/12/99~~ AJ

30 Dec 98 04:03 ALPHA/BETA - 1.02 Page

Protocol #:23 U-233 3% 2 sigma User : A

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	20.39
Region B:	100 -	350	0	3.0	3.68
Region C:	0.0 -	2000	0	0.1	30.01

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

capped
QCOU Desorption Containers
Qtz only, No Clinop.

S#	TIME	CPMA A:2S%		CPMB B:2S%		CPMC C:2S%		SIS FLAG	
P# 1	999.99	20.39	1.40	3.675	3.30	30.01	1.15	147.05	B
23 2	9.62	2.47	125.1	458.695	3.02	461.57	3.10	623.00	
23 3	9.67	3.39	92.89	456.304	3.02	459.96	3.10	621.59	
2 4	9.54	0.00	0.00	462.467	3.02	463.39	3.10	629.96	
2 5	9.63	5.25	62.35	457.799	3.02	462.93	3.09	623.99	
23 6	9.79	2.59	118.9	450.462	3.02	453.14	3.10	625.48	
23 7	9.92	1.58	189.1	444.410	3.02	446.10	3.11	627.16	
23 8	9.70	2.80	110.9	454.779	3.02	458.86	3.10	624.14	
23 9	9.65	1.06	283.5	456.843	3.02	458.70	3.10	627.50	
23 10	10.16	2.15	139.5	434.120	3.02	436.82	3.10	628.65	
23 11	9.85	3.46	90.24	447.594	3.02	450.50	3.10	625.14	
23 12	9.85	0.82	357.9	448.305	3.02	449.48	3.11	629.71	
23 13	9.71	4.63	69.60	454.203	3.02	458.56	3.09	622.83	
23 14	25.54	0.79	233.9	170.327	3.07	170.85	3.29	625.42	
23 15	26.37	0.00	0.00	165.001	3.07	164.87	3.30	630.26	
23 16	16.01	0.00	0.00	273.964	3.04	274.24	3.18	630.09	
23 17	15.94	0.94	249.1	275.309	3.04	276.89	3.17	626.11	
23 18	21.27	2.74	76.91	205.305	3.05	208.21	3.22	621.50	
23 19	22.00	1.15	173.7	198.416	3.06	199.81	3.24	625.65	
23 20	24.09	0.00	0.00	180.841	3.06	180.45	3.28	633.92	
23 21	23.88	1.67	116.1	182.590	3.06	185.28	3.25	626.38	
23 22	10.63	2.65	111.5	414.575	3.03	417.59	3.11	627.74	
23 23	10.82	3.45	86.44	407.046	3.03	411.21	3.11	623.88	
23 24	25.59	1.06	174.9	169.987	3.07	171.24	3.28	628.39	
23 25	25.77	1.88	100.1	168.812	3.07	171.54	3.27	627.02	
23 26	24.72	2.79	70.28	176.179	3.06	179.13	3.25	625.39	
23 27	24.63	2.26	85.77	176.796	3.06	180.26	3.25	623.50	
23 28	23.70	1.72	113.8	183.836	3.06	185.86	3.25	625.52	
23 29	23.22	1.35	144.5	187.712	3.06	190.15	3.24	623.38	
23 30	28.55	1.78	100.5	152.017	3.07	154.23	3.30	619.88	
23 31	27.57	0.86	206.7	157.623	3.07	159.44	3.30	627.82	
23 32	28.69	1.63	108.6	151.222	3.07	152.49	3.32	624.29	
23 33	29.30	1.18	148.0	147.997	3.08	149.17	3.32	623.29	
23 34	25.45	0.00	0.00	170.981	3.07	171.37	3.29	627.68	
23 35	24.96	1.12	167.7	174.410	3.06	175.80	3.27	624.26	
23 36	22.33	2.04	99.17	195.385	3.06	198.12	3.23	625.68	
23 37	22.48	0.82	238.2	194.012	3.06	195.44	3.25	627.07	
23 38	29.04	1.78	99.37	149.355	3.08	152.26	3.30	622.53	
23 39	28.52	0.00	0.00	152.251	3.07	152.60	3.32	624.21	
23 40	25.58	1.38	135.2	170.094	3.07	171.09	3.28	620.17	
23 41	25.39	1.94	97.93	171.355	3.07	173.02	3.27	617.64	

QCOU cap

Desorp Cntrs

Qtz No Cl

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Protocol #:23 U-233 3% 2 sigma User : A

23	42	28.49	1.40	126.3	152.345	3.07	154.62	3.30	618.87	
23	43	28.58	2.94	62.16	151.923	3.07	155.30	3.29	608.33	
23	44	28.28	3.72	50.21	153.468	3.07	157.58	3.28	611.69	
23	45	29.05	2.02	88.30	149.303	3.08	152.19	3.30	615.12	
23	46	22.44	4.92	43.58	194.409	3.06	199.58	3.21	609.50	
23	47	22.40	4.65	45.89	194.852	3.06	199.10	3.22	611.78	
23	48	20.06	4.73	47.70	217.910	3.05	222.58	3.19	609.57	
23	49	20.87	3.47	62.22	209.310	3.05	213.74	3.20	616.85	
23	50	29.04	4.57	41.04	149.390	3.07	153.46	3.28	611.72	
23	51	28.48	3.31	55.85	152.364	3.07	155.07	3.30	610.57	

233 MISSING TUBE(S) Desorption tubes capped. No Clinop. Qtz only

55	13.20		6.20	46.04	333.598	3.03	340.29	3.11	603.46	
23	56	12.84	10.91	28.73	342.898	3.03	354.03	3.09	597.94	
23	57	14.43	9.34	30.90	304.364	3.04	314.07	3.11	593.67	
23	58	14.96	3.47	73.27	293.451	3.04	297.20	3.15	609.14	
23	59	11.99	3.46	81.97	366.967	3.03	369.99	3.12	608.22	
23	60	11.86	7.01	43.57	371.114	3.03	378.93	3.10	601.94	
23	61	11.65	5.36	55.76	377.956	3.03	384.41	3.10	606.47	
23	62	11.27	4.01	73.79	391.179	3.03	395.55	3.11	607.58	
23	63	11.12	4.79	63.17	396.055	3.03	402.19	3.10	611.89	
23	64	11.07	5.71	54.00	398.222	3.03	403.42	3.10	609.04	
23	65	10.76	4.70	65.28	409.708	3.03	414.42	3.10	606.84	
23	66	10.64	6.20	51.18	414.370	3.03	421.12	3.09	611.65	
23	67	3.76	7.00	77.23	1182.229	3.00	1188.61	3.03	611.62	
23	68	3.75	16.67	37.75	1184.592	3.01	1201.99	3.02	605.83	
23	69	4.61	12.14	43.82	962.268	3.01	974.98	3.03	607.88	
23	70	4.62	4.93	95.15	959.745	3.01	964.15	3.04	613.82	
23	71	4.48	15.99	35.69	991.414	3.01	1008.61	3.02	602.51	
23	72	4.50	9.61	53.84	985.880	3.01	996.88	3.03	608.55	
23	73	4.31	10.93	49.41	1027.880	3.01	1039.60	3.03	606.04	
23	74	4.28	13.25	42.37	1035.344	3.01	1048.73	3.03	604.80	
23	75	11.26	5.54	55.05	391.085	3.03	396.63	3.11	608.74	
23	76	10.97	4.13	72.78	401.430	3.03	406.55	3.10	615.16	
23	77	2.28	20.40	41.50	1949.395	3.00	1968.68	3.01	604.93	
23	78	2.24	21.12	40.78	1989.629	3.00	2007.49	3.00	603.37	
23	79	2.85	15.40	46.07	1558.079	3.00	1575.25	3.01	605.67	
23	80	2.86	15.97	44.69	1550.870	3.01	1565.80	3.02	605.48	
23	81	2.93	24.66	31.83	1514.755	3.01	1540.30	3.01	599.05	
23	82	2.94	18.72	39.00	1511.631	3.00	1532.24	3.01	604.96	
23	83	2.72	15.64	46.59	1636.766	3.00	1654.92	3.01	605.76	
23	84	2.75	9.79	67.76	1612.689	3.01	1622.72	3.02	607.25	
23	85	2.86	15.97	44.69	1551.220	3.01	1568.94	3.01	605.41	
23	86	2.89	23.55	33.14	1535.079	3.01	1558.23	3.01	604.00	
23	87	2.66	13.06	54.34	1672.641	3.00	1685.78	3.01	606.42	
23	88	2.76	12.94	53.76	1609.731	3.00	1625.06	3.01	604.66	
23	89	3.24	11.40	55.03	1369.164	3.01	1380.79	3.02	612.25	
23	90	3.46	15.15	42.34	1282.741	3.01	1299.18	3.02	611.23	

Qcou capp (Deso tub Qtz wo

23	91	2.85	18.90	39.32	1561.939	3.00	1582.27	3.01	605.95	
23	92	2.83	24.84	32.21	1572.297	3.00	1597.55	3.00	604.42	
23	93	2.46	9.69	72.26	1805.675	3.00	1816.33	3.02	609.72	
23	94	2.50	19.21	41.47	1775.925	3.00	1798.39	3.01	607.49	
23	95	2.96	13.73	49.51	1499.703	3.01	1513.91	3.02	610.13	
23	96	2.98	23.23	32.96	1491.291	3.00	1513.95	3.01	606.04	
23	97	2.67	23.80	34.21	1662.992	3.00	1686.47	3.01	604.06	
23	98	2.70	13.31	53.13	1645.955	3.00	1658.14	3.02	610.01	
23	99	2.50	29.61	30.23	1776.725	3.00	1808.79	3.00	604.00	
23	100	2.39	23.96	35.98	1855.739	3.01	1880.87	3.01	604.23	

QCOU capped desorption tubes

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

23	101	3.34	15.83	41.64	1328.062	3.01	1344.24	3.02	609.27
23	102	3.30	12.03	52.17	1346.931	3.00	1359.69	3.02	609.49
23	103	3.50	15.89	40.56	1266.611	3.01	1282.28	3.02	602.69
23	104	3.56	16.12	39.77	1248.010	3.00	1264.94	3.02	603.43
23									

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 31-Dec-98 02:52
C14 Eff (0-156 keV) = 96.83 %
C14 CHI SQUARE IPA DATA PROCESSED - 31-Dec-98 03:03
C14 Chi Square = 32.02
H3 IPA DATA PROCESSED - 31-Dec-98 03:04
H3 Eff (0-18.6 keV) = 65.16 %
H3 CHI SQUARE IPA DATA PROCESSED - 31-Dec-98 03:15
H3 Chi Square = 21.04
BKG IPA DATA PROCESSED - 31-Dec-98 04:15
Bkg (0-18.6 keV) = 22.02 cpm
Bkg (0-156 keV) = 32.15 cpm

WARNING: Questionable C14 Background value - Please view historic data

12/22/98 AJ

① Preparations of 0.1 M $NaNO_3$ matrix to dilute the V-233 stock solutions.

Refer to page 34 for procedure

16.9968 g of $NaNO_3$ (lot # 930601) in 2000 g of nanopure water.

② Preparation of 50 PPb V stock soln.
Refer to page (34) for procedure.

③ For CAPPED VIAL EXPERIMENT, prepare all the reagents in degassed water.

Note 1- Degassed water was prepared by boiling 1000 ml of water in flasks and cooling it with mouth covered with rubber stopper. 3 batches of 1000 ml were prepared.

Prepare 1M, 0.1M, 0.001 M, 0.01M HNO_3 stock solutions

④ 1M HNO_3 :-
AJ 15.75 ml of Conc. HNO_3 diluted it to ~~with~~ AJ 250 ml of degassed H_2O.

⑤ 0.1M HNO_3

20 ml of 1M HNO_3 & dilute it to 200 ml with degassed H_2O

⑥ 0.01M HNO_3

2ml of 1M HNO_3 & dilute it to 200 ml with degassed H_2O

⑦ 0.001M HNO_3

Dilute 20 ml of 0.01 M HNO_3 to 200 ml with degassed H_2O.

⑧ Degassed $NaNO_3$ soln.

Dilute 16.9968 g of $NaNO_3$ (lot # 930601) with 2000 g of nanopure water.

⑨ Boil 2 lts of nanopure H_2O for NaOH & HNO_3 stocks solution for capped vials.

12/30/98
AJ ① Degassed 50 PPb V-233 stock solution

Dilute 200g of 5000 PPb soln (28A Spike) to 20000 g with nanopure water. PH of starting V-233 solution = 4.28

② 1 M NaOH (degassed)

Dilute 40g of NaOH pellets (lot #) to 2000 g with degassed H_2O.

③ 0.1 M NaOH

Dilute 10 ml of 1M NaOH soln to 100 ml with degassed H_2O.

④ 0.05 NaOH
Dilute 10 ml of 1M NaOH to 200 ml with degassed H_2O.

⑤ 0.02 m HNO_3
Dilute 2 ml of 1M HNO_3 to 100 ml AJ with degassed H_2O.

Qtz=1g, Clinop=0.35g, QC10U, UNCAPPED EXPTS.

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

Objective: To investigate the characteristics of U sorption on mixture of clinoptilolite and quartz as a function of pH.

Initial conditions:- $\sum U$ = 50 ppb (2.14×10^{-7})
- equilibrium with atmospheric $CO_2(g)$; $pCO_2 = 10^{-3.5}$
- pH range 4.0-9.5
- solution volume = 35 ml
- mass of solid 1, quartz = 1.000 g
- mass of solid 2, clinoptilolite = 350mg (0.35 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

Supplies:
WS10 * UC * RC * RFe * HL * ≤ 325 mesh AJ
CDV * UC * RC * RFe * HL * Naf * 100/200 mesh AT
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 ~~NaOH (lot)~~ $NaHCO_3$ (lot 936883) AJ
concentrated HNO_3 (lot 983546)
HNO_3 and NaHCO3 or NaOHstock 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 200 g of 500 ppb U stock solution into a tared 2000 ml FEP bottle.
- Dilute to a total of 2000 g using 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 26 polycarbonate centrifuge tubes (50 ml capacity) QCU-pHi (where i is the approximate pH of each solution, see Table QCU).
- Label 1 polycarbonate centrifuge tube QC10.0U-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 QC10.0-U-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 NaHC)3 to each experimental container as listed in Table QC10.0U. Take care to add HNO_3 or NaHCO3 in the concentrations specified in Table CQ0U.
- For sample QC10.0U-IU (not listed in Table QC10.0U) add 100 μl of 50/50 V/V HNO_3 to the sample container.
- Weigh and record the weight of each sample container.

E SampleQC10.0U-IU for initial [U].

- Label two 7 ml LSC vials as QC10.0U-IUa and QC10.0U-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 QC10.0U-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 QC10.0U-IU.

F Wait for equilibrium.

- Place caps on sample containers but do not tighten. Leave caps loose so that solutions can equilibrate with air.
- Place containers on gyratory shaker set at about 120 rpm and allow samples to equilibrate with air 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.,QC10.0U-pH3a and QC10.0U-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.
- Record weight of each sample container.
- Measure pH of each experimental solution.
- Record weight of each sample container after pH measurement.

H Transfer mixture of quartz and clinoptilolite for desorption.

- Record weight of PC sample containers. *Note: this step can be skipped if the mixture transfer is done immediately after the last step in section* FG. AS
- Centrifuge polycarbonate containers containing experimental solutions at 10,000 rpm for 15 min to remove fine particles from suspension.
- For each PC sample container, label two corresponding polypropylene (PP) test tubes A and B(50 ml capacity).
- Record weight for both set of PP tubes A ~~and B~~ AS
- Add 3.0 ml of 0.1M HNO3 to 50 ml PP tubes labeled as **B**-QC10.0Ud-pH.
- Pour supernatant from PC containers into PP tubes with acid and labeled as **B**-QC10.0Ud-pH leaving behind about 7 to 8ml of solution in PC container with the solid mixture.
- Record the weight of PC containers containing the solid mixture and some solution.
- Stir the solid mixture in solution vigorously and immediately transfer all the solid and solution to the corresponding PP tubes marked as **A**-QC10.0Ud-pH.
- Record the weight of PP tubes **A**-QC10.0Ud-pH.
- Transfer supernatant with HNO3 acid from the PP tubes **B**-QC10.0Ud-pH back to original PC containers.
- Record weights of PC sample containers.
- Add approximately 3 ml of 0.1 M HNO_3 to PP tubes containing solid mixture, **A**-QC10.0Ud-pH.
- Record weights of PP tubes **A**-QC10.0Ud-pH and PC sample containers.
- Place sample containers and PP test tubes on gyratory shaker (at about 120 rpm) and allow to desorb for at least 10 days.

C. Sample solutions for [U].

- For each sample container and PP test tube label two 7 ml LSC vials (e.g., QC10.0Ud-pH3a and QC10.0Ud-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 aliquot 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.

Table QC10.0U: 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 qtz/clinop (35 ml)

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	0.394	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

QC10.0 - 1U

UNCAPPED 12/18/98

Sample Name	Original Container wt., g
QC10U-pH 3.0	22.2461
QC10U-pH 3.5	22.2512
QC10U-pH 4.0	22.2562
QQC10U-pH 4.25	22.128
QQC10U-pH 4.5	22.2214
QC1.0U-pH4.75	22.2285
QC10U-pH 5.0	22.2894
QC10U-pH 5.25	22.2356
QC10U-pH 5.5	22.1926
QC10U-pH 5.75	22.2095
QC10U-pH 6.0	22.2183
QC10U-pH 6.25	22.1481
QC10U-pH 6.5	22.2123
QC10U-pH 6.75	22.1355
QC10U-pH 7.0	22.1952
QC10U-pH 7.25	22.3005
QC10U-pH 7.5	22.5150
QC10U-pH 7.75	22.1720
QC10U-pH 8.0	22.2748
QC10U-pH 8.25	22.1974
QC10U-pH 8.5	22.2697
QC10U-pH 8.75	22.1780
QC10U-pH 9.0	22.2977
QC10U-pH 9.25	22.2218
QC10U-pH 9.5	22.4932
QC10U-IU	

UNCAPPED 12/18/98

Sample Name	Container wt. + U soln., g
QC10U-pH 3.0	57.2563
QC10U-pH 3.5	57.2677
QC10U-pH 4.0	57.2494
QQC10U-pH 4.25	57.1432
QQC10U-pH 4.5	57.2285
QC1.0U-pH4.75	57.2555
QC10U-pH 5.0	57.311
QC10U-pH 5.25	57.2587
QC10U-pH 5.5	57.2103
QC10U-pH 5.75	57.2282
QC10U-pH 6.0	57.24
QC10U-pH 6.25	57.1674
QC10U-pH 6.5	57.2249
QC10U-pH 6.75	57.1419
QC10U-pH 7.0	57.2183
QC10U-pH 7.25	57.335
QC10U-pH 7.5	57.536
QC10U-pH 7.75	57.2002
QC10U-pH 8.0	57.2982
QC10U-pH 8.25	57.2287
QC10U-pH 8.5	57.2952
QC10U-pH 8.75	57.1998
QC10U-pH 9.0	57.3223
QC10U-pH 9.25	57.2453
QC10U-pH 9.5	57.5162

UNCAPPED

12/18/98

Sample Name	Container wt. + U soln. + quartz, g
QC10U-pH 3.0	58.2531
QC10U-pH 3.5	58.2708
QC10U-pH 4.0	58.2519
QQC10U-pH 4.25	58.1417
QQC10U-pH 4.5	58.2303
QC1.0U-pH4.75	58.2553
QC10U-pH 5.0	58.3094
QC10U-pH 5.25	58.2609
QC10U-pH 5.5	58.2129
QC10U-pH 5.75	58.2294
QC10U-pH 6.0	58.2412
QC10U-pH 6.25	58.1696
QC10U-pH 6.5	58.2251
QC10U-pH 6.75	58.1451
QC10U-pH 7.0	58.2198
QC10U-pH 7.25	58.3348
QC10U-pH 7.5	58.5383
QC10U-pH 7.75	58.1976
QC10U-pH 8.0	58.296
QC10U-pH 8.25	58.2291
QC10U-pH 8.5	58.2974
QC10U-pH 8.75	58.2014
QC10U-pH 9.0	58.3217
QC10U-pH 9.25	58.2444
QC10U-pH 9.5	58.5163

UNCAPPED

12/21/98

Sample Name	Container wt. + U soln. + quartz + clinop, g
QC10U-pH 3.0	58.6105
QC10U-pH 3.5	58.6291
QC10U-pH 4.0	58.6044
QQC10U-pH 4.25	58.5003
QQC10U-pH 4.5	58.5894
QC1.0U-pH4.75	58.6145
QC10U-pH 5.0	58.6693
QC10U-pH 5.25	58.6174
QC10U-pH 5.5	58.5734
QC10U-pH 5.75	58.5902
QC10U-pH 6.0	58.6021
QC10U-pH 6.25	58.5295
QC10U-pH 6.5	58.5851
QC10U-pH 6.75	58.5002
QC10U-pH 7.0	58.5742
QC10U-pH 7.25	58.6932
QC10U-pH 7.5	58.8912
QC10U-pH 7.75	58.5542
QC10U-pH 8.0	58.6541
QC10U-pH 8.25	58.586
QC10U-pH 8.5	58.6555
QC10U-pH 8.75	58.5556
QC10U-pH 9.0	58.6783
QC10U-pH 9.25	58.5961
QC10U-pH 9.5	58.8698

UNCAPPED

12/21/98

Sample Name	Container Wt. After additions of HNO3 and NaHCO3, g
QC10U-pH 3.0	59.0062
QC10U-pH 3.5	58.7378
QC10U-pH 4.0	58.6758
QQC10U-pH 4.25	58.5837
QQC10U-pH 4.5	58.8808
QC1.0U-pH4.75	58.8179
QC10U-pH 5.0	58.9078
QC10U-pH 5.25	58.8745
QC10U-pH 5.5	58.8952
QC10U-pH 5.75	58.9236
QC10U-pH 6.0	58.9002
QC10U-pH 6.25	58.8498
QC10U-pH 6.5	58.6586
QC10U-pH 6.75	58.5691
QC10U-pH 7.0	58.6838
QC10U-pH 7.25	58.8369
QC10U-pH 7.5	59.1058
QC10U-pH 7.75	58.723
QC10U-pH 8.0	58.9372
QC10U-pH 8.25	58.6958
QC10U-pH 8.5	58.8348
QC10U-pH 8.75	58.7331
QC10U-pH 9.0	59.0121
QC10U-pH 9.25	59.4747
QC10U-pH 9.5	60.1318

UNCAPPED

1/5/99 1/6/99 1/6/99

Sample Name	Container wt. before sampling & pH measurements, g	Measured pH	Container wt. after sampling & pH measurements, g
QC10U-pH 3.0	58.2581	3.33	57.2281
QC10U-pH 3.5	58.192	4.09	57.1605
QC10U-pH 4.0	57.7203	4.95	56.6878
QQC10U-pH 4.25	57.6966	5.37	56.6606
QQC10U-pH 4.5	58.0359	5.94	56.9892
QC1.0U-pH4.75	58.0791	6.17	57.0511
QC10U-pH 5.0	58.1816	6.38	57.1589
QC10U-pH 5.25	58.0076	6.4	56.9783
QC10U-pH 5.5	58.2206	6.66	57.1848
QC10U-pH 5.75	57.913	6.76	56.8819
QC10U-pH 6.0	58.1497	6.58	57.1353
QC10U-pH 6.25	57.8511	6.72	56.823
QC10U-pH 6.5	57.945	6.67	56.9217
QC10U-pH 6.75	57.6963	6.68	56.6692
QC10U-pH 7.0	57.5858	7.07	56.5626
QC10U-pH 7.25	57.7721	7.29	56.7502
QC10U-pH 7.5	58.1379	7.46	57.1065
QC10U-pH 7.75	57.9802	7.7	56.9411
QC10U-pH 8.0	58.2211	7.94	57.1919
QC10U-pH 8.25	57.7166	8.22	56.6868
QC10U-pH 8.5	58.1778	8.42	57.1551
QC10U-pH 8.75	58.2655	8.72	57.2298
QC10U-pH 9.0	58.3952	8.96	57.3774
QC10U-pH 9.25	58.8248	9.23	57.8061
QC10U-pH 9.5	59.7944	9.16	58.7531

UNCAPPED SORPTION 1/5/99 1/6/99

Sample Name	wt. of vial , g	wt. Of vial + sample , g
QC10U-pH 3a	7.9815	8.4772
QC10U-pH 3b	7.8747	8.3721
QC10U-pH 3.5a	7.862	8.3645
QC10U-pH 3.5b	7.8448	8.3459
QC10U-pH 4a	7.8717	8.3662
QC10U-pH 4b	7.8578	8.3557
QC10U-pH 4.25a	7.9213	8.4163
QC10U-pH 4.25b	7.8476	8.3466
QC10U-pH 4.5a	7.9402	8.4421
QC10U-pH 4.5b	7.8646	8.3636
QC10U-pH 4.75a	7.8611	8.3636
QC10U-pH4.75b	7.9154	8.4158
QC10U-pH 5a	7.8724	8.3696
QC10U-pH 5b	7.8623	8.3592
QC10U-pH 5.25a	7.8578	8.3546
QC10U-pH 5.25b	7.9878	8.4829
QC10U-pH 5.5a	7.8973	8.401
QC10U-pH 5.5b	7.9184	8.4192
QC10U-pH 5.75a	7.8837	8.3813
QC10U-pH 5.75b	7.8296	8.3298
QC10U-pH 6a	7.939	8.4383
QC10U-pH 6b	7.928	8.4257
QC10U-pH 6.25a	7.8332	8.337
QC10U-pH 6.25a	7.9121	8.4093
QC10U-pH 6.5a	7.8774	8.3756
QC10U-pH 6.5b	7.928	8.4329
QC10U-pH 6.75a	7.837	8.4106
QC10U-pH 6.75b	7.8992	8.3235
QC10U-pH 7a	7.8211	8.3272
QC10U-pH 7b	7.8738	8.375
QC10U-pH 7.25a	7.926	8.4248
QC10U-pH 7.25b	7.9572	8.4626
QC10U-pH 7.5a	7.829	8.3343
QC10U-pH 7.5b	7.8752	8.3774
QC10U-pH 7.75a	7.909	8.4157
QC10U-pH 7.75b	7.7619	8.2686
QC10U-pH 8a	7.8921	8.3935
QC10U-pH 8b	7.9024	8.4034
QC10U-pH 8.25a	7.8461	8.3511
QC10U-pH 8.25b	7.8497	8.3451
QC10U-pH 8.5a	7.8705	8.373
QC10U-pH 8.5b	7.9854	8.4913
QC10U-pH 8.75a	7.9283	8.4294
QC10U-pH 8.75b	7.9191	8.4126
QC10U-pH 9a	7.7834	8.2791
QC10U-pH 9b	7.8361	8.3322
QC10U-pH 9.25a	7.859	8.3568
QC10U-pH 9.25	7.9304	8.4264
QC10U-pH 9.5a	7.8259	8.3311
QC10U-pH 9.5b	7.8628	8.3653


```
SYSTEM NORMALIZED


C14 IPA DATA PROCESSED - 07-Jan-99 15:11
   C14 Eff (0-156 keV) = 96.88 %
C14 CHI SQUARE IPA DATA PROCESSED - 07-Jan-99 15:21
   C14 Chi Square = 22.67
H3 IPA DATA PROCESSED - 07-Jan-99 15:22
   H3 Eff (0-18.6 keV) = 65.00 %
H3 CHI SQUARE IPA DATA PROCESSED - 07-Jan-99 15:33
   H3 Chi Square = 28.23
BKG IPA DATA PROCESSED - 07-Jan-99 16:33
   Bkg (0-18.6 keV) = 22.07 cpm
   Bkg (0-156 keV)  = 30.93 cpm

WARNING: Questionable C14 Background value - Please view historic data


   C14 E^2/B (1-156 keV)   .= 391.15
   H3  E^2/B (1-18.6 keV)  = 190.00
```

08 Jan 99 09:23 ALPHA/BETA - 1.02 Page

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

QC10U Sorption Uncapped

```
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   20.35
Region B:    100 -  350     0   3.0    3.56
Region C:    0.0 - 2000     0   0.1   29.91

Quench Indicator: SIS
alpha cpm U-233  1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal
```

S#	TIME	CPMA A:2S%		CPMB B:2S%		CPMC C:2S%		SIS FLAG	
P#	1 999.99	20.35	1.40	3.557	3.35	29.91	1.16	145.52	B
23	2 9.59	1.96	156.1	460.051	3.02	461.85	3.10	627.36	
23	3 9.45	0.28	1050	467.237	3.02	467.44	3.10	625.73	
23	4 12.45	0.00	0.00	353.551	3.03	353.86	3.14	622.93	
23	5 12.28	0.58	455.9	358.658	3.03	360.48	3.13	627.70	
23	6 29.32	1.37	127.0	148.012	3.07	149.62	3.32	622.26	
23	7 28.23	0.00	0.00	153.900	3.07	153.01	3.33	630.77	
23	8 50.82	1.27	104.9	83.889	3.13	85.53	3.55	621.26	
23	9 51.32	0.21	632.7	83.037	3.13	82.83	3.60	624.81	
23	10 80.43	0.81	131.6	51.721	3.21	52.65	3.90	617.03	

23	11	78.84	0.25	430.6	52.823	3.21	53.58	3.90	625.68
23	12	88.56	0.00	0.00	46.624	3.24	45.85	4.10	636.69
23	13	88.25	0.79	128.7	46.811	3.24	47.55	4.01	617.42
23	14	97.34	0.30	324.6	42.097	3.27	42.38	4.15	624.45
23	15	96.17	0.83	118.3	42.653	3.26	43.41	4.10	617.18
23	16	90.23	0.00	0.00	45.695	3.24	45.99	4.06	628.36
23	17	88.77	0.90	112.6	46.516	3.24	47.52	4.00	620.11
23	18	87.23	0.00	0.00	47.389	3.24	47.15	4.05	632.17
23	19	86.28	0.00	0.00	47.973	3.23	47.94	4.03	630.03
23	20	77.84	0.78	138.4	53.547	3.21	54.14	3.89	617.65
23	21	77.08	0.00	0.00	54.123	3.20	54.58	3.89	624.82
23	22	86.08	0.80	128.6	48.093	3.23	49.15	3.96	619.81
23	23	87.17	1.27	81.45	47.424	3.23	48.71	3.96	613.83
23	24	83.28	0.96	109.3	49.841	3.22	51.26	3.91	615.49
23	25	84.82	1.80	58.94	48.836	3.23	50.97	3.89	608.41
23	26	83.23	0.00	0.00	49.849	3.22	50.13	3.97	632.85
23	27	82.21	0.00	0.00	50.500	3.22	49.98	4.01	636.45
23	28	78.88	0.40	265.6	52.794	3.21	52.98	3.92	625.37
23	29	78.77	0.52	206.0	52.860	3.21	53.47	3.90	625.35
23	30	54.33	0.00	0.00	78.258	3.14	77.80	3.65	625.95
23	31	56.01	0.16	767.7	75.786	3.14	76.37	3.64	627.09
23	32	47.19	1.28	107.8	90.637	3.12	91.85	3.52	619.55
23	33	47.24	0.35	386.3	90.516	3.12	90.53	3.55	626.45
23	34	37.32	0.12	1263	115.521	3.09	115.40	3.43	624.65
23	35	37.95	2.39	65.92	113.544	3.10	115.99	3.39	613.43
23	36	28.90	0.51	336.0	150.249	3.07	150.33	3.33	624.07
23	37	28.25	0.53	327.2	153.753	3.07	153.80	3.32	620.56
23	38	19.95	1.80	118.0	219.400	3.05	221.21	3.21	624.91
23	39	20.01	0.00	0.00	218.582	3.05	218.11	3.23	630.17
23	40	11.94	0.00	0.00	368.972	3.03	367.66	3.14	625.80
23	41	12.59	1.17	224.3	349.580	3.03	350.94	3.14	624.75

10 Jan 99 00:24 ALPHA/BETA = 1.02 Us
Protocol #:23 U-233 3% 2 sigma

23	42	10.33	0.46	619.0	426.840	3.02	428.17	3.11	625.59
23	43	10.42	0.95	301.6	422.930	3.03	424.98	3.11	622.95
23	44	9.55	4.88	66.83	461.888	3.02	466.53	3.09	624.61
23	45	10.01	3.12	98.46	440.599	3.02	444.21	3.10	626.18
23	46	9.30	2.01	154.7	474.723	3.02	477.18	3.10	624.46
23	47	9.26	1.14	268.9	476.357	3.02	478.19	3.10	626.47
23	48	9.10	2.18	145.3	484.904	3.02	487.23	3.10	627.28
23	49	9.41	5.47	60.78	468.813	3.02	474.23	3.09	625.63
23	50	9.20	0.00	0.00	479.486	3.02	478.24	3.11	630.38
23	51	9.52	0.97	309.6	463.670	3.02	464.10	3.11	633.32

23

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 10-Jan-99 02:08
C14 Eff (0-156 keV) = 96.57 %
C14 CHI SQUARE IPA DATA PROCESSED - 10-Jan-99 02:19
C14 Chi Square = 22.48
H3 IPA DATA PROCESSED - 10-Jan-99 02:20
H3 Eff (0-18.6 keV) = 65.12 %

UNCAPPED

Sample Name	wt. Of PP tubes, g (1/6/99)	wt. Of PP tubes after transfer of qtz/clino, g (1/6/99)	wt. Of PP tubes after acid add, g (1/6/99)	Container wt. after transfer of supernatant, g (1/6/99)	Container wt. after supernatant retransfer+acid added ,g (1/6/99)
QC10U-pH 3.0	13.3882	20.0566	23.0702	29.1569	53.509
QC10U-pH 3.5	14.2561	22.7533	25.7666	30.911	51.6603
QC10U-pH 4.0	13.4387	21.2664	24.2717	30.253	51.7673
QQC10U-pH 4.25	13.5213	21.8909	24.9018	30.7126	51.1656
QQC10U-pH 4.5	13.8959	22.4032	25.4113	30.9227	51.3899
QC1.0U-pH4.75	13.4965	20.7492	23.7661	29.8166	52.609
QC10U-pH 5.0	13.84	20.8944	23.9058	29.5268	52.9498
QC10U-pH 5.25	13.5259	22.5365	25.5492	31.3836	50.7881
QC10U-pH 5.5	13.3544	21.4084	24.4173	30.3688	52.1227
QC10U-pH 5.75	13.4256	20.2156	23.2238	29.185	53.0853
QC10U-pH 6.0	13.3795	21.0142	24.0287	30.2244	52.3024
QC10U-pH 6.25	13.8493	19.9505	22.9663	28.4309	53.5624
QC10U-pH 6.5	14.0001	20.0864	23.091	28.5433	53.631
QC10U-pH 6.75	13.4094	18.7669	21.7789	27.672	54.173
QC10U-pH 7.0	13.4493	19.728	22.751	28.6904	53.062
QC10U-pH 7.25	13.3919	20.901	23.9151	30.0244	52.0258
QC10U-pH 7.5	13.8809	20.7569	23.7706	29.629	53.2148
QC10U-pH 7.75	13.3392	21.0146	24.0246	30.157	52.2518
QC10U-pH 8.0	13.4757	21.2954	24.3075	30.4301	52.166
QC10U-pH 8.25	13.4952	20.7627	23.7792	29.6842	52.2201
QC10U-pH 8.5	13.5342	18.6819	21.6887	27.7038	54.8316
QC10U-pH 8.75	13.4621	20.9606	23.9696	29.9143	52.4546
QC10U-pH 9.0	13.825	21.9107	24.9219	30.5274	52.0722
QC10U-pH 9.25	13.8604	21.2474	24.2566	29.7688	53.2118
QC10U-pH 9.5	13.3972	24.4548	27.467	33.6803	50.4637

	PP Tubes 1/8/99	Desorption UNCAPPED
Sample Name	wt. of vial,g	wt. Of vial + sample
QC10U-pH 3a	7.8441	8.3431
QC10U-pH 3b	7.8162	8.3165
QC10U-pH 3.5a	7.8097	8.3084
QC10U-pH 3.5b	7.7645	8.264
QC10U-pH 4a	7.8354	8.3334
QC10U-pH 4b	7.7852	8.2843
QC10U-pH 4.25a	7.7902	8.288
QC10U-pH 4.25b	7.7897	8.2889
QC10U-pH 4.5a	7.8273	8.3257
QC10U-pH 4.5b	7.8853	8.3846
QC10U-pH 4.75a	7.7454	8.2435
QC10U-pH4.75b	7.7721	8.2716
QC10U-pH 5a	7.7646	8.2625
QC10U-pH 5b	7.7331	8.2324
QC10U-pH 5.25a	7.8044	8.3029
QC10U-pH 5.25b	7.8475	8.3484
QC10U-pH 5.5a	7.8739	8.3722
QC10U-pH 5.5b	7.7586	8.2586
QC10U-pH 5.75a	7.7142	8.2128
QC10U-pH 5.75b	7.7548	8.2545
QC10U-pH 6a	7.8036	8.3034
QC10U-pH 6b	7.8217	8.3222
QC10U-pH 6.25a	7.8287	8.3285
QC10U-pH 6.25a	7.838	8.339
QC10U-pH 6.5a	7.8437	8.3413
QC10U-pH 6.5b	7.7685	8.2681
QC10U-pH 6.75a	7.7051	8.203
QC10U-pH 6.75b	7.7788	8.2784
QC10U-pH 7a	7.8408	8.3386
QC10U-pH 7b	7.769	8.268
QC10U-pH 7.25a	7.8008	8.2986
QC10U-pH 7.25b	7.8011	8.3011
QC10U-pH 7.5a	7.8291	8.3281
QC10U-pH 7.5b	7.7744	8.2732
QC10U-pH 7.75a	7.8215	8.3191
QC10U-pH 7.75b	7.7816	8.2803
QC10U-pH 8a	7.8056	8.3029
QC10U-pH 8b	7.7656	8.2641
QC10U-pH 8.25a	7.7695	8.2664
QC10U-pH 8.25b	7.8101	8.3093
QC10U-pH 8.5a	7.8167	8.3138
QC10U-pH 8.5b	7.7944	8.2941
QC10U-pH 8.75a	7.7785	8.275
QC10U-pH 8.75b	7.7312	8.2301
QC10U-pH 9a	7.8504	8.3035
QC10U-pH 9b	7.7502	8.2515
QC10U-pH 9.25a	7.7603	8.258
QC10U-pH 9.25	7.7748	8.2726
QC10U-pH 9.5a	7.8392	8.3385
QC10U-pH 9.5b	7.7281	8.2282

1/8/99	PC containers	UNCAPPED Desorption
Sample Name	wt. of vial,g	wt. Of vial + sample
QC10U-pH 3a	7.7803	8.2853
QC10U-pH 3b	7.8482	8.3511
QC10U-pH 3.5a	7.8068	8.3038
QC10U-pH 3.5b	7.8119	8.3129
QC10U-pH 4a	7.745	8.2461
QC10U-pH 4b	7.7708	8.2719
QC10U-pH 4.25a	7.7823	8.281
QC10U-pH 4.25b	7.7472	8.2466
QC10U-pH 4.5a	7.8096	8.3097
QC10U-pH 4.5b	7.7568	8.2602
QC10U-pH 4.75a	7.8262	8.3256
QC10U-pH4.75b	7.798	8.2992
QC10U-pH 5a	7.8346	8.334
QC10U-pH 5b	7.7508	8.2513
QC10U-pH 5.25a	7.7753	8.2763
QC10U-pH 5.25b	7.8278	8.3288
QC10U-pH 5.5a	7.8407	8.3402
QC10U-pH 5.5b	7.7697	8.27
QC10U-pH 5.75a	7.8084	8.3085
QC10U-pH 5.75b	7.7865	8.2891
QC10U-pH 6a	7.7326	8.2319
QC10U-pH 6b	7.7951	8.3032
QC10U-pH 6.25a	7.8627	8.3621
QC10U-pH 6.25a	7.8206	8.3224
QC10U-pH 6.5a	7.7389	8.2381
QC10U-pH 6.5b	7.8328	8.3345
QC10U-pH 6.75a	7.804	8.3052
QC10U-pH 6.75b	7.7915	8.293
QC10U-pH 7a	7.8314	8.3298
QC10U-pH 7b	7.8115	8.3182
QC10U-pH 7.25a	7.7523	8.2504
QC10U-pH 7.25b	7.8341	8.3348
QC10U-pH 7.5a	7.7532	8.253
QC10U-pH 7.5b	7.8058	8.3063
QC10U-pH 7.75a	7.7938	8.293
QC10U-pH 7.75b	7.8053	8.3061
QC10U-pH 8a	7.829	8.3282
QC10U-pH 8b	7.7638	8.2634
QC10U-pH 8.25a	7.7746	8.2723
QC10U-pH 8.25b	7.8279	8.3281
QC10U-pH 8.5a	7.8466	8.346
QC10U-pH 8.5b	7.8052	8.3081
QC10U-pH 8.75a	7.7873	8.2857
QC10U-pH 8.75b	7.8115	8.3135
QC10U-pH 9a	7.7743	8.2731
QC10U-pH 9b	7.828	8.3278
QC10U-pH 9.25a	7.7108	8.2086
QC10U-pH 9.25	7.7956	8.297
QC10U-pH 9.5a	7.84	8.3379
QC10U-pH 9.5b	7.8142	8.315

UNCAPPED DESORPTION

Sample Name	1/18/99 Container wt. before sampling	1/18/99 Container wt. after sampling	1/18/99 wt. Of PP tubes before sampling	1/18/99 wt. Of PP tubes after sampling
QC10U-pH 3.0	53.4050	52.3936	23.0291	22.0220
QC10U-pH 3.5	51.5187	50.5175	25.7543	24.7494
QC10U-pH 4.0	51.6495	50.6443	24.2478	23.2431
QQC10U-pH 4.25	51.0448	50.0442	24.8573	23.8511
QQC10U-pH 4.5	51.2532	50.2461	25.3549	24.3498
QC1.0U-pH4.75	52.4787	51.4757	23.7543	22.7514
QC10U-pH 5.0	52.8509	51.8476	23.8942	22.8872
QC10U-pH 5.25	50.6711	49.6676	25.539	24.5332
QC10U-pH 5.5	51.9925	50.9905	24.4097	23.3976
QC10U-pH 5.75	52.9976	51.9918	23.2182	22.2142
QC10U-pH 6.0	52.1927	51.1798	24.0186	23.0127
QC10U-pH 6.25	53.4618	52.4555	22.9576	21.9498
QC10U-pH 6.5	53.5266	52.521	23.0822	22.0796
QC10U-pH 6.75	54.0993	53.0933	21.7703	20.7683
QC10U-pH 7.0	52.9162	51.9075	22.7343	21.7325
QC10U-pH 7.25	51.866	50.8649	23.9042	22.9016
QC10U-pH 7.5	53.0183	52.0161	23.746	22.7434
QC10U-pH 7.75	52.1199	51.1178	24.0128	23.0127
QC10U-pH 8.0	52.0464	51.045	24.2992	23.2972
QC10U-pH 8.25	52.0512	51.051	23.7733	22.7712
QC10U-pH 8.5	54.696	53.6903	21.6696	20.6664
QC10U-pH 8.75	52.295	51.291	23.9604	22.9546
QC10U-pH 9.0	51.9474	50.9437	24.898	23.8962
QC10U-pH 9.25	53.0564	52.0546	24.2437	23.2422
QC10U-pH 9.5	50.3413	49.3402	24.4555	23.4468


```
SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 19-Jan-99 10:52
   C14 Eff (0-156 keV) = 96.71 %
C14 CHI SQUARE IPA DATA PROCESSED - 19-Jan-99 11:03
   C14 Chi Square = 13.26
H3 IPA DATA PROCESSED - 19-Jan-99 11:04
   H3 Eff (0-18.6 keV) = 65.23 %
H3 CHI SQUARE IPA DATA PROCESSED - 19-Jan-99 11:15
   H3 Chi Square = 19.48
BKG IPA DATA PROCESSED - 19-Jan-99 12:15
   Bkg (0-18.6 keV) = 21.17 cpm
   Bkg (0-156 keV)  = 30.75 cpm

WARNING: Questionable C14 Background value - Please view historic data

   C14 E^2/B (1-156 keV)   = 380.09
   H3  E^2/B (1-18.6 keV)  = 198.70
20 Jan 99  05:05          ALPHA/BETA - 1.02                          Page #:
Protocol #:23              U-233 3% 2 sigma                          User : Alka

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    20.20
Region B:     100 -   350       0      3.0     3.39
Region C:     0.0 -  2000       0      0.1    29.57

Quench Indicator: SIS
alpha cpm U-233  1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

 S#    TIME      CPMA A:2S%      CPMB B:2S%      CPMC C:2S%      SIS FLAG
P#    1 999.99   20.20  1.41     3.386  3.44     29.57  1.16  141.21
23    2  10.45    4.01 76.16   422.260  3.02    425.26  3.10  616.93
23    3  10.22    2.02 147.0   431.448  3.02    434.32  3.10  618.29
23    4  13.58    1.60 159.3   323.860  3.03    324.85  3.15  624.42
23    5  13.70    3.45 76.53   321.066  3.03    324.37  3.14  618.04
23    6  29.31    0.89 193.5   148.269  3.07    149.51  3.31  610.13
23    7  28.66    0.00  0.00   151.673  3.07    151.03  3.33  622.55
23    8  48.15    0.12  1153    88.909  3.12     88.73  3.55  618.27
23    9  47.01    1.22 112.6    91.168  3.11     92.53  3.50  616.23
23   10  67.85    0.76 150.6    62.126  3.17     62.69  3.76  621.91
23   11  65.47    0.45 254.9    64.492  3.16     65.13  3.73  614.85
23   12  60.80    0.66 182.9    69.739  3.15     69.87  3.69  621.34
23   13  60.26    0.65 187.1    70.361  3.15     71.16  3.67  618.92
23   14  78.39    0.00  0.00    53.305  3.20     53.09  3.92  627.20
23   15  76.19    0.29 368.2    54.955  3.19     55.44  3.86  622.84
```

QC10U UNCAPPED Desorption Containers

B

QC10 unc De Co

23	16	81.38	0.55	192.1	51.222	3.21	51.70	3.92	616.02
23	17	81.62	0.90	117.1	51.098	3.21	51.79	3.91	617.73
23	18	81.64	0.00	0.00	51.048	3.21	51.39	3.93	627.43
23	19	80.17	1.01	105.8	52.084	3.20	53.73	3.85	613.42
23	20	71.47	0.86	130.2	58.836	3.18	59.95	3.78	626.45
23	21	68.24	0.07	1598	61.737	3.17	62.22	3.77	619.71
23	22	74.03	0.44	246.3	56.644	3.19	57.45	3.82	621.79
23	23	73.42	1.21	91.93	57.142	3.18	58.67	3.78	612.15
23	24	70.42	0.00	0.00	59.735	3.18	60.05	3.80	625.10
23	25	69.10	0.00	0.00	60.956	3.17	60.72	3.81	634.52
23	26	67.30	0.56	204.2	62.647	3.17	63.77	3.73	621.12
23	27	65.97	0.00	0.00	63.978	3.16	63.21	3.79	626.63
23	28	66.44	0.06	1819	63.516	3.17	63.64	3.76	616.25
23	29	63.19	1.69	71.64	66.957	3.16	69.27	3.64	610.97
23	30	53.15	0.69	186.8	80.226	3.13	81.34	3.58	619.38
23	31	47.70	0.00	0.00	89.780	3.12	90.05	3.54	619.65
23	32	54.65	1.10	116.1	77.931	3.13	79.49	3.58	616.13
23	33	46.41	1.87	75.37	92.412	3.11	94.84	3.47	617.28
23	34	38.88	1.00	150.8	110.914	3.09	112.74	3.41	621.61
23	35	38.42	0.50	301.3	112.283	3.09	113.04	3.42	627.76
23	36	29.24	3.16	57.24	148.666	3.07	151.38	3.29	611.81
23	37	30.80	0.13	1284	140.932	3.07	141.37	3.34	624.54
23	38	21.78	2.71	76.28	200.700	3.05	204.40	3.21	616.85
23	39	21.39	2.62	79.63	204.515	3.05	205.91	3.23	611.05
23	40	13.52	0.59	424.6	325.534	3.03	327.23	3.14	620.20
23	41	13.88	1.49	168.9	316.787	3.03	318.27	3.15	618.41

79
7.25a
76
7.25b

Containers

21 Jan 99 15:31 ALPHA/BETA - 1.02 User : A

Protocol #:23 U-233 3% 2 sigma

23	42	11.30	3.34	86.75	389.888	3.03	393.26	3.11	626.10
23	43	11.62	3.81	75.74	379.058	3.03	383.42	3.11	612.70
23	44	10.50	1.23	233.0	420.233	3.02	422.52	3.11	617.18
23	45	10.53	3.55	85.08	418.741	3.02	423.61	3.10	622.01
23	46	10.58	3.91	77.63	417.030	3.02	420.24	3.10	620.27
23	47	10.56	3.95	76.87	417.447	3.02	423.17	3.10	618.14
23	48	10.58	1.73	167.1	416.935	3.02	419.29	3.11	627.80
23	49	10.26	3.68	83.20	430.045	3.02	434.27	3.10	626.58
23	50	10.32	0.73	390.0	427.234	3.02	428.67	3.11	631.44
23	51	10.29	0.41	700.0	428.781	3.02	428.93	3.11	628.18

233 MISSING TUBE(S)

55		9.06	2.65	120.3	487.232	3.02	490.63	3.09	621.00
23	56	8.84	2.32	138.4	499.781	3.02	504.03	3.08	613.54
23	57	5.93	4.76	86.38	746.867	3.01	750.36	3.06	618.11
23	58	5.70	4.01	102.9	776.439	3.01	781.13	3.05	615.75
23	59	3.21	8.15	72.99	1383.218	3.01	1392.24	3.02	613.51
23	60	3.17	5.67	100.9	1399.453	3.01	1404.18	3.03	615.49
23	61	2.97	4.05	141.4	1494.594	3.01	1501.07	3.02	615.42
23	62	3.02	9.94	63.64	1471.448	3.00	1482.02	3.02	616.16
23	63	2.87	8.38	75.42	1546.091	3.01	1554.40	3.02	608.12
23	64	2.87	5.59	107.4	1547.485	3.00	1554.75	3.02	616.00
23	65	2.53	14.19	52.00	1754.322	3.00	1769.64	3.01	611.09
23	66	2.56	13.01	55.42	1735.677	3.00	1750.51	3.01	613.37
23	67	2.47	15.03	50.30	1798.233	3.00	1814.96	3.01	604.80
23	68	2.38	9.64	73.54	1866.362	3.00	1876.73	3.02	608.80
23	69	2.90	16.70	42.75	1533.855	3.00	1551.46	3.01	608.49
23	70	2.98	12.35	53.55	1488.225	3.01	1500.63	3.02	614.25
23	71	2.71	5.27	116.6	1643.108	3.00	1649.76	3.02	614.42
23	72	2.81	8.99	71.80	1583.091	3.00	1594.63	3.02	606.27
23	73	2.33	10.28	70.44	1904.339	3.01	1915.06	3.02	609.11
23	74	2.37	7.65	89.67	1879.315	3.00	1888.15	3.01	604.66
23	75	2.57	9.76	69.99	1733.190	3.00	1742.80	3.01	612.72
23	76	2.22	10.43	71.25	2000.218	3.00	2007.82	3.02	612.69
23	77	2.65	12.26	57.15	1674.350	3.01	1687.79	3.02	610.68
23	78	2.08	10.09	75.67	2134.114	3.00	2143.99	3.02	616.27
23	79	2.14	10.18	74.09	2076.988	3.00	2088.19	3.01	614.20
23	80	2.23	15.68	51.20	1995.269	3.00	2011.24	3.01	610.57
23	81	1.96	8.89	86.76	2271.614	3.00	2280.12	3.01	609.42
23	82	1.92	14.70	58.04	2311.198	3.00	2327.72	3.01	607.37
23	83	2.31	6.21	109.0	1923.887	3.00	1931.47	3.02	609.23
23	84	2.37	17.78	45.06	1873.407	3.00	1894.90	3.01	603.86
23	85	2.74	6.45	96.85	1621.797	3.00	1627.36	3.02	612.51
23	86	2.73	16.07	45.40	1626.651	3.00	1644.79	3.01	610.87
23	87	2.67	13.89	51.50	1666.277	3.00	1682.79	3.01	610.28
23	88	2.62	8.81	75.59	1695.851	3.00	1706.69	3.02	613.40
23	89	3.13	8.56	70.91	1420.576	3.00	1429.21	3.02	610.01
23	90	3.10	8.84	69.34	1433.388	3.00	1442.04	3.02	607.46
23	91	4.28	1.77	257.0	1035.866	3.01	1035.38	3.05	617.28
23	92	4.23	9.59	55.42	1048.387	3.01	1059.79	3.03	611.60
23	93	6.93	48.35	13.02	639.038	3.01	688.75	2.96	487.19
23	94	6.31	6.75	61.41	701.527	3.01	710.21	3.05	611.43
23	95	8.99	3.83	85.68	491.497	3.02	496.01	3.08	611.01
23	96	9.14	4.42	74.52	483.047	3.02	487.39	3.09	611.92
23	97	12.39	3.77	74.08	355.290	3.03	358.97	3.12	613.85
23	98	12.65	0.99	263.1	348.235	3.03	350.74	3.13	611.61
23	99	14.89	26.95	13.25	295.069	3.03	321.60	3.02	468.22
23	100	12.77	2.04	129.9	344.617	3.03	347.09	3.13	615.49

QC/C desorption unc

desorption PP Tubes

QC/OU unc capped

21 Jan 99 21:03 ALPHA/BETA - 1.02 User :

Protocol #:23 U-233 3% 2 sigma

23	101	14.11	3.19	81.17	311.568	3.03	315.86	3.13	613.22
23	102	13.86	1.74	145.7	317.537	3.03	318.77	3.15	603.72
23	103	17.81	2.49	91.45	246.361	3.04	249.88	3.17	617.68
23	104	17.97	2.01	111.6	243.971	3.04	246.56	3.18	616.99

```
23
SYSTEM NORMALIZED


C14 IPA DATA PROCESSED - 21-Jan-99 22:20
   C14 Eff (0-156 keV) = 96.78 %
C14 CHI SQUARE IPA DATA PROCESSED - 21-Jan-99 22:30
   C14 Chi Square = 17.40
H3 IPA DATA PROCESSED - 21-Jan-99 22:31
   H3 Eff (0-18.6 keV) = 64.86 %

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


H3 CHI SQUARE IPA DATA PROCESSED - 21-Jan-99 22:42
   H3 Chi Square = 15.87
BKG IPA DATA PROCESSED - 21-Jan-99 23:42
   Bkg (0-18.6 keV) = 22.17 cpm
   Bkg (0-156 keV)  = 32.03 cpm

WARNING: Questionable C14 Background value - Please view historic data


   C14 E^2/B (1-156 keV)    = 382.47
   H3  E^2/B (1-18.6 keV)   = 189.46
```


CAPPED , Qtz = 1.00 g , Clinop = 0.35g , V = 35ml

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

Objective: To investigate the characteristics of U sorption on mixture of clinoptilolite and quartz as a function of pH.

Initial conditions:- $\sum U$ = 50 ppb (2.14×10^{-7})
- Capped containers
- pH range 4.0-9.5
- solution volume = 35 ml
- mass of solid 1, quartz = 1.000 g
- mass of solid 2, clinoptilolite = 350mg (0.35 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

Supplies:
WS10 * UC * RC * RFe * HL * ≤325 AJ
CDV * UC * RC * RFe * HL * 800/200 * NaO AJ
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 NaOH (lot 976631) AJ
concentrated HNO_3 (lot 983546)
HNO_3 and NaOHstock solutions at various concentrations prepared in degassed water.
0.1m $NaNO_3$ matrix prepared with degassed water.
weighing paper/boats
deionized ultrapure water, DH_2O
Teflon beaker

Note: Ultrapure water was degassed by boiling it in a flask and cooled with mouth covered with rubber stopper.

Procedure:

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

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

- Label 26 polycarbonate centrifuge tubes (50 ml capacity) QCU-pHi (where i is the approximate pH of each solution, see Table QCU).
- Label 1 polycarbonate centrifuge tube QC10.0U-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 QC10.0-U-IU container.
- Record weight of each sample container after addition of quartz.

D. Add clinoptilolite to sample containers.

- Add 0.35 g of clinoptilolite to each sample container. **Do not** add clinoptilolite to the QC10.0-U-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 NaOH to each experimental container as listed in Table QC10.0U. Take care to add HNO_3 or NaOH in the concentrations specified in Table CQ10U.
- For sample QC10.0U-IU (not listed in Table QC10.0U) add 100 μl of 50/50 V/V HNO_3 to the sample container.
- Weigh and record the weight of each sample container.

F. SampleQC10.0U-IU for initial [U].

- Label two 7 ml LSC vials as QC10.0U-IUa and QC10.0U-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 QC10.0U-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 QC10.0U-IU.

G. Wait for equilibrium.

- Place caps on sample containers and tighten the caps.
- Place containers on gyratory shaker set at about 120 rpm and allow samples to equilibrate for at least 10 days.

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

- For each sample solution label two 7 ml LSC vials (e.g.,QC10.0U-pH3a and QC10.0U-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.
- 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 PC sample containers. *Note: this step can be skipped if the mixture transfer is done immediately after the last step in section F.*
- Centrifuge polycarbonate containers containing experimental solutions at 10,000 rpm for 15 min to remove fine particles from suspension.
- For each PC sample container, label two corresponding polypropylene (PP) test tubes A and B(50 ml capacity).
- Record weight for both set of PP tubes A and B.
- Add 3.0 ml of 0.1M HNO3 to 50 ml PP tubes labeled as **B**-QC10.0Ud-pH.
- Pour supernatant from PC containers into PP tubes with acid and labeled as **B**-QC10.0Ud-pH leaving behind about 7 to 8ml of solution in PC container with the solid mixture.
- Record the weight of PC containers containing the solid mixture and some solution.
- Stir the solid mixture in solution vigorously and immediately transfer all the solid and solution to the corresponding PP tubes marked as **A**-QC10.0Ud-pH.
- Record the weight of PP tubes **A**-QC10.0Ud-pH.
- Transfer supernatant with HNO3 acid from the PP tubes **B**-QC10.0Ud-pH back to original PC containers.
- Record weights of PC sample containers.
- Add approximately 3 ml of 0.1 M HNO_3 to PP tubes containing solid mixture, **A**-QC10.0Ud-pH.
- Record weights of PP tubes **A**-QC10.0Ud-pH and PC sample containers.
- Place sample containers and PP test tubes on gyratory shaker (at about 120 rpm) and allow to desorb for at least 10 days.

J. Sample solutions for [U].

- For each sample container and PP test tube label two 7 ml LSC vials (e.g., QC10.0Ud-pH3a and QC10.0Ud-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 aliquot 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.

Table CQ10U: Estimated solution pH and volumes of HNO3 or NaOH solutions needed for adjustment of pH in 0.1 m NaNO3 solutions with 50 ppb U in contact with quartz and clinoptilolite (35ml).

Estimated solution pH	Volume of HNO3 added, ml	Molarity of HNO3 to use
3	0.060	1
3.5	0.205	0.1
4	0.385	0.01
4.25	0.190	0.01
Estimated solution pH	**Volume of NaOH added, ml**	**Molarity of NaOH to use**
4.50	0.09	0.01
4.75	0.150	0.01
5	0.200	0.01
5.25	0.225	0.01
5.5	0.250	0.01
5.75	0.275	0.01
6	0.300	0.01
6.25	0.325	0.01
6.5	0.350	0.01
6.75	0.375	0.01
7	0.400	0.01
7.25	0.050	0.05
7.5	0.115	0.05
7.75	0.130	0.05
8	0.175	0.05
8.25	0.150	0.05
8.5	0.160	0.1
8.75	0.100	0.1
9	0.125	0.1
9.25	0.150	0.1
9.5	0.175	0.1
QC10U-IU	0.100	50% HNO3

CAPPED
12/21/98

Sample Name	Original Container wt., g
QC10U-pH 3.0	22.1594
QC10U-pH 3.5	22.2558
QC10U-pH 4.0	22.1769
QQC10U-pH 4.25	22.2406
QQC10U-pH 4.5	22.1356
QC10U-pH4.75	22.1431
QC10U-pH 5.0	22.2298
QC10U-pH 5.25	22.4727
QC10U-pH 5.5	22.5386
QC10U-pH 5.75	22.2069
QC10U-pH 6.0	22.253
QC10U-pH 6.25	22.133
QC10U-pH 6.5	22.1541
QC10U-pH 6.75	22.2216
QC10U-pH 7.0	22.2538
QC10U-pH 7.25	22.1982
QC10U-pH 7.5	22.1939
QC10U-pH 7.75	22.1712
QC10U-pH 8.0	22.4646
QC10U-pH 8.25	22.9947
QC10U-pH 8.5	22.1262
QC10U-pH 8.75	22.2643
QC10U-pH 9.0	22.2225
QC10U-pH 9.25	22.236
QC10U-pH 9.5	22.303
QC10U-IU	22.2969

CAPPED
12/29/98

Sample Name	Container wt. + U soln., g
QC10U-pH 3.0	57.1645
QC10U-pH 3.5	57.2676
QC10U-pH 4.0	57.2032
QQC10U-pH 4.25	57.2618
QQC10U-pH 4.5	57.1745
QC10U-pH4.75	57.168
QC10U-pH 5.0	57.2242
QC10U-pH 5.25	57.4896
QC10U-pH 5.5	57.5372
QC10U-pH 5.75	57.2339
QC10U-pH 6.0	57.2495
QC10U-pH 6.25	57.1492
QC10U-pH 6.5	57.148
QC10U-pH 6.75	57.2192
QC10U-pH 7.0	57.2629
QC10U-pH 7.25	57.2304
QC10U-pH 7.5	57.203
QC10U-pH 7.75	57.1932
QC10U-pH 8.0	57.479
QC10U-pH 8.25	57.985
QC10U-pH 8.5	57.1556
QC10U-pH 8.75	57.2708
QC10U-pH 9.0	57.2416
QC10U-pH 9.25	57.2037
QC10U-pH 9.5	57.3100
QC10U-IU	57.2885

CAPPED
12/29/98

Sample Name	Container wt. + U soln. + quartz, g
QC10U-pH 3.0	58.1574
QC10U-pH 3.5	58.2719
QC10U-pH 4.0	58.205
QQC10U-pH 4.25	58.2596
QQC10U-pH 4.5	58.177
QC10U-pH4.75	58.1669
QC10U-pH 5.0	58.2202
QC10U-pH 5.25	58.4916
QC10U-pH 5.5	58.539
QC10U-pH 5.75	58.2328
QC10U-pH 6.0	58.247
QC10U-pH 6.25	58.1453
QC10U-pH 6.5	58.1284
QC10U-pH 6.75	58.2171
QC10U-pH 7.0	58.2672
QC10U-pH 7.25	58.227
QC10U-pH 7.5	58.2011
QC10U-pH 7.75	58.1912
QC10U-pH 8.0	58.4745
QC10U-pH 8.25	58.9797
QC10U-pH 8.5	58.1518
QC10U-pH 8.75	58.2675
QC10U-pH 9.0	58.2408
QC10U-pH 9.25	58.2
QC10U-pH 9.5	58.3137

CAPPED

12/29/98

Sample Name	Container wt. + U soln. + quartz + clinop, g
QC10U-pH 3.0	58.5081
QC10U-pH 3.5	58.6227
QC10U-pH 4.0	58.5577
QQC10U-pH 4.25	58.6089
QQC10U-pH 4.5	58.4393
QC10U-pH4.75	58.5199
QC10U-pH 5.0	58.5719
QC10U-pH 5.25	58.8402
QC10U-pH 5.5	58.8874
QC10U-pH 5.75	58.5831
QC10U-pH 6.0	58.597
QC10U-pH 6.25	58.4971
QC10U-pH 6.5	58.4713
QC10U-pH 6.75	58.5676
QC10U-pH 7.0	58.6107
QC10U-pH 7.25	58.5771
QC10U-pH 7.5	58.5495
QC10U-pH 7.75	58.5429
QC10U-pH 8.0	58.8267
QC10U-pH 8.25	58.3288
QC10U-pH 8.5	58.5033
QC10U-pH 8.75	58.6146
QC10U-pH 9.0	58.5941
QC10U-pH 9.25	58.5508
QC10U-pH 9.5	58.6664

CAPPED

12/30/98

Sample Name	Container Wt. After additions of HNO3 and NaHCO3, g
QC10U-pH 3.0	58.5608
QC10U-pH 3.5	58.7677
QC10U-pH 4.0	58.6958
QQC10U-pH 4.25	58.622
QQC10U-pH 4.5	58.5266
QC10U-pH4.75	58.6689
QC10U-pH 5.0	58.771
QC10U-pH 5.25	58.0645
QC10U-pH 5.5	58.1359
QC10U-pH 5.75	58.8564
QC10U-pH 6.0	58.2195
QC10U-pH 6.25	58.8439
QC10U-pH 6.5	58.7953
QC10U-pH 6.75	58.9417
QC10U-pH 7.0	59.0095
QC10U-pH 7.25	58.6277
QC10U-pH 7.5	58.6227
QC10U-pH 7.75	58.6404
QC10U-pH 8.0	58.9507
QC10U-pH 8.25	58.4763
QC10U-pH 8.5	58.5767
QC10U-pH 8.75	58.713
QC10U-pH 9.0	58.719
QC10U-pH 9.25	58.6997
QC10U-pH 9.5	58.8413
QC10U-IU	57.4141

CAPPED

Sample Name	Container wt. before sampling & pH measurements, g (1/11/99)	Measured pH (1/11/99)	Container wt. after sampling & pH measurements, g (1/11/99)
QC10U-pH 3.0	58.4978	3.17	57.4708
QC10U-pH 3.5	58.7498	3.8	57.7109
QC10U-pH 4.0	58.7433	4.59	57.7105
QQC10U-pH 4.25	58.7132	4.84	57.6836
QQC10U-pH 4.5	58.6085	5.01	57.5768
QC10U-pH4.75	58.6975	5.35	57.6448
QC10U-pH 5.0	58.7558	5.62	57.7464
QC10U-pH 5.25	58.0156	5.75	57.9918
QC10U-pH 5.5	58.1269	5.92	58.1054
QC10U-pH 5.75	58.8535	6.01	57.8303
QC10U-pH 6.0	58.3461	6.78	58.3204
QC10U-pH 6.25	58.8238	6.47	57.8059
QC10U-pH 6.5	58.7246	6.41	57.6867
QC10U-pH 6.75	58.8426	6.64	57.7232
QC10U-pH 7.0	58.9809	6.7	57.9601
QC10U-pH 7.25	58.729	6.93	57.6996
QC10U-pH 7.5	58.6124	7.04	57.5763
QC10U-pH 7.75	58.7626	7.16	57.7164
QC10U-pH 8.0	58.8764	7.27	57.8487
QC10U-pH 8.25	58.4862	7.5	57.4569
QC10U-pH 8.5	58.5491	7.6	57.5213
QC10U-pH 8.75	58.6516	8.6	57.6339
QC10U-pH 9.0	58.7752	8.85	57.7366
QC10U-pH 9.25	58.6744	9.24	57.6430
QC10U-pH 9.5	58.8578	9.26	57.8170
QC10U-IU	57.2861		56.2850

actual amounts added

Table CQ10U: Estimated solution pH and volumes of HNO3 or NaOH solutions needed for adjustment of pH in 0.1 m NaNO3 solutions with 50 ppb U in contact with qz/clino (35 ml (12/30/98) (1/5/99)

Estimated solution pH	Volume of HNO3 added, ml	Molarity of HNO3 to use	
3	0.060	1	
3.5	0.205	0.1	
4	0.385	0.01	
4.25	0.190	0.01	
Estimated solution pH	**Volume of NaOH added, ml**	**Molarity of NaOH to use**	**Volume of 0.01M HNO3 added, ml**
4.50	0.09	0.01	0.125
4.75	0.150	0.01	0.075
5	0.200	0.01	0.050
5.25	0.225	0.01	0.045
5.5	0.250	0.01	0.050
5.75	0.275	0.01	0.040
6	0.300	0.01	0.200
6.25	0.325	0.01	0.380
6.5	0.350	0.01	0.335
6.75	0.375	0.01	
7	0.400	0.01	
7.25	0.050	0.05	
7.5	0.115	0.05	
7.75	0.130	0.05	
8	0.175	0.05	
8.25	0.150	0.05	
8.5	0.160	0.1	
8.75	0.100	0.1	
9	0.125	0.1	
9.25	0.150	0.1	0.020
9.5	0.175	0.1	
QC10U-IU	0.100	50% HNO3	

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Protocol #:23 U-233 3% 2 sigma User : A

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	19.71
Region B:	100 -	350	0	3.0	3.44
Region C:	0.0 -	2000	0	0.1	28.97

QC10U, Capped SORPTION

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

S#	TIME	CPMA A:2S%		CPMB B:2S%		CPMC C:2S%		SIS	FLAG
P#	1 999.99	19.71	1.42	3.443	3.41	28.97	1.18	145.55	B
23	2 8.74	0.77	399.1	505.024	3.02	506.50	3.09	630.16	
23	3 8.75	2.80	114.8	504.786	3.02	507.26	3.09	625.77	
23	4 9.91	2.59	116.3	444.993	3.02	448.83	3.10	623.79	
23	5 9.69	6.09	53.79	455.277	3.02	462.57	3.08	621.24	
23	6 15.99	0.99	231.5	274.543	3.04	277.35	3.16	624.14	
23	7 15.57	3.86	64.15	282.106	3.04	286.38	3.15	621.72	
23	8 19.08	0.99	211.9	229.471	3.05	230.67	3.20	624.63	
23	9 18.59	2.34	93.68	235.718	3.04	238.92	3.18	622.39	
23	10 29.03	1.41	123.0	149.674	3.07	151.15	3.30	620.49	
23	11 29.47	1.36	125.9	147.490	3.07	149.11	3.31	624.19	
23	12 39.80	0.31	459.2	108.240	3.10	108.64	3.44	619.02	
23	13 40.27	1.20	122.5	106.962	3.10	109.05	3.41	619.05	
23	14 53.80	0.85	149.6	79.159	3.13	80.60	3.57	621.27	
23	15 54.04	1.51	84.79	78.792	3.13	80.19	3.57	616.62	
23	16 62.13	0.44	266.0	68.101	3.16	69.18	3.67	625.40	
23	17 64.40	1.35	87.51	65.563	3.16	67.89	3.65	618.19	
23	18 63.74	0.89	131.7	66.435	3.16	68.21	3.65	627.09	
23	19 64.11	1.07	109.9	65.875	3.16	67.71	3.66	620.21	
23	20 68.45	0.45	248.9	61.480	3.17	62.09	3.76	621.86	
23	21 69.21	0.20	553.8	60.767	3.18	61.78	3.75	626.69	
23	22 42.03	1.66	87.79	102.362	3.10	104.65	3.42	621.18	
23	23 41.35	1.64	89.07	104.054	3.10	106.58	3.41	620.99	
23	24 67.54	0.94	120.8	62.355	3.17	63.67	3.72	619.12	
23	25 64.68	1.38	85.33	65.295	3.16	66.64	3.68	616.24	
23	26 67.50	0.99	115.9	62.394	3.17	64.11	3.70	617.24	
23	27 67.12	0.97	118.1	62.767	3.17	64.68	3.69	617.31	
23	28 66.04	0.88	130.4	63.865	3.17	65.29	3.70	625.39	
23	29 67.83	0.00	0.00	62.103	3.17	62.23	3.77	628.69	
23	30 62.29	1.99	60.84	67.901	3.16	70.66	3.61	611.24	
23	31 62.96	0.00	0.00	67.173	3.16	67.43	3.70	632.67	
23	32 76.83	0.33	317.1	54.399	3.20	54.67	3.87	623.59	

QC1... Ca... Sorp...

23	33	74.13	0.00	0.00	56.506	3.19	56.92	3.83	630.32
23	34	59.22	1.25	98.14	71.599	3.15	73.43	3.61	614.10
23	35	62.78	2.18	55.79	67.344	3.16	69.71	3.63	612.25
23	36	46.88	1.49	92.04	91.352	3.12	93.64	3.47	618.96
23	37	45.33	1.56	89.86	94.594	3.11	97.35	3.45	618.09
23	38	38.50	0.00	0.00	111.986	3.09	112.33	3.42	629.04
23	39	39.37	2.13	71.04	109.435	3.10	112.23	3.39	618.22
23	40	52.73	0.52	242.0	80.854	3.13	82.50	3.55	627.56
23	41	52.49	2.05	64.40	81.221	3.13	83.72	3.52	614.99

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Protocol #:23 U-233 3% 2 sigma User : A

23	42	47.26	1.26	108.1	90.590	3.12	92.42	3.49	619.25
23	43	48.80	0.74	178.9	87.623	3.12	88.59	3.52	619.65
23	44	94.02	0.62	157.9	43.898	3.24	45.59	3.98	624.93
23	45	90.18	0.85	117.3	45.836	3.24	46.88	3.98	615.50
23	46	108.30	1.46	63.44	37.591	3.29	40.24	4.06	604.93
23	47	109.78	0.71	127.3	37.038	3.29	38.13	4.20	614.07
23	48	126.08	1.97	44.52	31.812	3.34	34.73	4.21	601.19
23	49	131.70	0.11	767.0	30.300	3.36	31.40	4.45	632.82
23	50	53.87	1.23	104.0	79.070	3.13	81.17	3.55	617.50
23	51	53.99	1.16	109.5	78.887	3.13	80.20	3.57	620.13

23
SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 17-Jan-99 05:46
C14 Eff (0-156 keV) = 96.57 %
C14 CHI SQUARE IPA DATA PROCESSED - 17-Jan-99 05:56
C14 Chi Square = 14.26
H3 IPA DATA PROCESSED - 17-Jan-99 05:58
H3 Eff (0-18.6 keV) = 65.55 %
H3 CHI SQUARE IPA DATA PROCESSED - 17-Jan-99 06:08
H3 Chi Square = 15.41
BKG IPA DATA PROCESSED - 17-Jan-99 07:08
Bkg (0-18.6 keV) = 22.27 cpm
Bkg (0-156 keV) = 31.42 cpm

WARNING: Questionable C14 Background value - Please view historic data

C14 E^2/B (1-156 keV) = 397.03
H3 E^2/B (1-18.6 keV) = 192.95

CAPPED SORPTION

Sample Name	wt. of vial 1/11/99	wt. Of vial + sample 1/11/99
QC10U-pH 3a	7.7837	8.2866
QC10U-pH 3b	7.9141	8.4181
QC10U-pH 3.5a	7.862	8.369
QC10U-pH 3.5b	7.8844	8.3959
QC10U-pH 4a	7.8321	8.3379
QC10U-pH 4b	7.8863	8.3949
QC10U-pH 4.25a	7.9267	8.431
QC10U-pH 4.25b	7.861	8.3662
QC10U-pH 4.5a	7.8618	8.3649
QC10U-pH 4.5b	7.8541	8.3606
QC10U-pH 4.75a	7.7981	8.3004
QC10U-pH4.75b	7.8422	8.3447
QC10U-pH 5a	7.8548	8.3612
QC10U-pH 5b	7.824	8.3269
QC10U-pH 5.25a	7.9179	8.4209
QC10U-pH 5.25b	7.8766	8.3788
QC10U-pH 5.5a	7.8783	8.3807
QC10U-pH 5.5b	7.8646	8.3674
QC10U-pH 5.75a	7.9006	8.4029
QC10U-pH 5.75b	7.8196	8.3217
QC10U-pH 6a	7.8938	8.3956
QC10U-pH 6b	7.9612	8.4638
QC10U-pH 6.25a	8.7933	8.2939
QC10U-pH 6.25a	7.9327	8.436
QC10U-pH 6.5a	7.8427	8.3467
QC10U-pH 6.5b	7.9057	8.4109
QC10U-pH 6.75a	7.9143	8.4169
QC10U-pH 6.75b	7.8638	8.3675
QC10U-pH 7a	7.804	8.3006
QC10U-pH 7b	7.9084	8.4108
QC10U-pH 7.25a	7.8469	8.3526
QC10U-pH 7.25b	7.9181	8.4214
QC10U-pH 7.5a	7.8658	8.3669
QC10U-pH 7.5b	7.8466	8.3502
QC10U-pH 7.75a	7.8454	8.3459
QC10U-pH 7.75b	7.8453	8.3489
QC10U-pH 8a	7.9125	8.4159
QC10U-pH 8b	7.8734	8.3764
QC10U-pH 8.25a	7.9482	8.4523
QC10U-pH 8.25b	7.8902	8.3954
QC10U-pH 8.5a	7.8631	8.3641
QC10U-pH 8.5b	7.887	8.3889
QC10U-pH 8.75a	7.86	8.3605
QC10U-pH 8.75b	7.886	8.3876

QC10U-pH 9a	7.9279	8.4303
QC10U-pH 9b	7.8859	8.3885
QC10U-pH 9.25a	7.9296	8.4316
QC10U-pH 9.25	7.867	8.3685
QC10U-pH 9.5a	7.8299	8.3361
QC10U-pH 9.5b	7.8822	8.3873
QC10U-lua	7.9449	8.4445
QC10U-lub	7.9161	8.4172

CAPPED

Sample Name	wt. Of PP tubes, g 1/13/99	wt. Of PP tubes after transfer of qtz/clino, g 1/13/99	wt. Of PP tubes after acid add, g 1/13/99	Container wt. after transfer of supernatant, g 1/13/99	Container wt. after supernatant retransfer+acid added ,g
QC10U-pH 3.0	13.6813	19.8772	22.8917	28.5038	54.2301
QC10U-pH 3.5	13.7468	22.2644	25.29	30.8796	52.1295
QC10U-pH 4.0	13.8652	22.5024	25.5145	30.9919	52.0106
QQC10U-pH 4.25	13.6692	23.2113	26.2413	31.9711	51.0112
QQC10U-pH 4.5	13.6636	22.3014	25.3463	30.9296	51.7904
QC1.0U-pH4.75	13.84	21.3549	24.3978	30.1765	52.6843
QC10U-pH 5.0	13.8628	23.5048	26.5293	32.0717	51.0529
QC10U-pH 5.25	13.673	20.4494	23.4915	29.4862	54.0945
QC10U-pH 5.5	13.6769	20.7575	23.7842	29.8424	53.949
QC10U-pH 5.75	13.1407	20.7956	23.8268	29.991	53.1365
QC10U-pH 6.0	13.6871	21.29	24.3137	30.0156	53.6434
QC10U-pH 6.25	13.7045	20.9043	23.9591	29.5488	53.584
QC10U-pH 6.5	13.6684	22.1018	25.1402	30.747	52.1253
QC10U-pH 6.75	13.3205	19.6056	22.6429	28.6153	54.3981
QC10U-pH 7.0	13.6804	21.2994	24.3347	30.0281	53.3042
QC10U-pH 7.25	13.6975	20.8965	23.9304	29.6246	53.4606
QC10U-pH 7.5	13.6759	22.5802	25.668	31.2918	51.5506
QC10U-pH 7.75	13.3118	20.2618	23.3082	29.2881	53.7104
QC10U-pH 8.0	13.6778	20.1252	23.176	29.1026	54.3482
QC10U-pH 8.25	13.2921	22.2529	25.2987	31.1902	51.3317
QC10U-pH 8.5	13.29	20.2786	23.3274	29.2569	53.4716
QC10U-pH 8.75	13.7101	21.8255	24.8739	30.7748	52.2201
QC10U-pH 9.0	13.8633	19.9431	22.9744	28.41	54.5586
QC10U-pH 9.25	13.7524	20.312	23.3641	28.9155	54.0762
QC10U-pH 9.5	13.6349	21.4969	24.534	30.3054	52.8766

CAPPED DESORPTION

1/25/99

Sample Name	Container wt. before sampling	Container wt. after sampling	wt. Of PP tubes before sampling	wt. Of PP tubes after sampling
QC10U-pH 3.0	54.1277	53.1124	22.8862	21.8761
QC10U-pH 3.5	52.0317	51.022	25.2837	24.2751
QC10U-pH 4.0	51.8994	50.3873	25.5088	24.5033
QQC10U-pH 4.25	50.9058	49.8977	26.2329	25.2196
QQC10U-pH 4.5	51.704	50.6947	25.3348	24.312
QC1.0U-pH4.75	52.5667	51.5566	24.3904	23.3772
QC10U-pH 5.0	50.958	49.9483	26.5232	25.5193
QC10U-pH 5.25	53.9638	52.9517	23.4841	22.4716
QC10U-pH 5.5	53.8371	52.8188	23.7769	22.7664
QC10U-pH 5.75	53.05	52.0445	23.8195	22.8145
QC10U-pH 6.0	53.5398	52.5345	24.306	23.299
QC10U-pH 6.25	53.491	52.4855	23.9528	22.9134
QC10U-pH 6.5	52.0235	51.0201	25.1324	24.1279
QC10U-pH 6.75	54.301	53.293	22.6291	21.6237
QC10U-pH 7.0	53.2056	52.1962	24.3282	23.3231
QC10U-pH 7.25	53.3751	52.3681	23.9245	22.9153
QC10U-pH 7.5	51.4424	50.4379	25.6517	24.6146
QC10U-pH 7.75	53.617	52.6087	23.3017	22.283
QC10U-pH 8.0	54.201	53.1851	23.17	22.1531
QC10U-pH 8.25	51.1777	50.1671	25.2923	24.2534
QC10U-pH 8.5	53.3624	52.358	23.3005	22.2846
QC10U-pH 8.75	52.1256	51.1172	24.8666	23.8545
QC10U-pH 9.0	54.4779	53.4757	22.9668	21.9467
QC10U-pH 9.25	53.9985	52.9899	23.3586	22.3241
QC10U-pH 9.5	52.7837	51.7782	24.5277	23.5172

QC10U-JV 57.3295 56.3212

	PP Tubes 1/25/99	Desorption
Sample Name	wt. of vial,g	wt. Of vial + sample
QC10U-pH 3a	7.8669	8.3696
QC10U-pH 3b	7.8743	8.371
QC10U-pH 3.5a	7.8493	8.3473
QC10U-pH 3.5b	7.8779	8.3798
QC10U-pH 4a	7.7634	8.2647
QC10U-pH 4b	7.765	8.2666
QC10U-pH 4.25a	7.7082	8.2086
QC10U-pH 4.25b	7.7512	8.2538
QC10U-pH 4.5a	7.7637	8.2703
QC10U-pH 4.5b	7.8494	8.3455
QC10U-pH 4.75a	7.8378	8.3333
QC10U-pH4.75b	7.7837	8.2837
QC10U-pH 5a	7.7893	8.2862
QC10U-pH 5b	7.7769	8.2748
QC10U-pH 5.25a	7.7933	8.2929
QC10U-pH 5.25b	7.8065	8.3034
QC10U-pH 5.5a	7.8096	8.3022
QC10U-pH 5.5b	7.7594	8.254
QC10U-pH 5.75a	7.7142	8.2152
QC10U-pH 5.75b	7.8307	8.326
QC10U-pH 6a	7.83	8.3312
QC10U-pH 6b	7.8017	8.3006
QC10U-pH 6.25a	7.7968	8.3116
QC10U-pH 6.25a	7.7939	8.3094
QC10U-pH 6.5a	7.7628	8.259
QC10U-pH 6.5b	7.7576	8.2555
QC10U-pH 6.75a	7.7682	8.2633
QC10U-pH 6.75b	7.8103	8.312
QC10U-pH 7a	7.804	8.2995
QC10U-pH 7b	7.8072	8.3071
QC10U-pH 7.25a	7.794	8.2928
QC10U-pH 7.25b	7.7759	8.2723
QC10U-pH 7.5a	7.768	8.2776
QC10U-pH 7.5b	7.876	8.3806
QC10U-pH 7.75a	7.8258	8.3285
QC10U-pH 7.75b	7.8331	8.3309
QC10U-pH 8a	7.7667	8.27
QC10U-pH 8b	7.7781	8.2829
QC10U-pH 8.25a	7.7507	8.2659
QC10U-pH 8.25b	7.7777	8.2902
QC10U-pH 8.5a	7.7274	8.2317
QC10U-pH 8.5b	7.7499	8.2513
QC10U-pH 8.75a	7.7999	8.2971
QC10U-pH 8.75b	7.7392	8.2399
QC10U-pH 9a	7.7908	8.292
QC10U-pH 9b	7.8239	8.3333
QC10U-pH 9.25a	7.7544	8.2563
QC10U-pH 9.25	7.7732	8.2908
QC10U-pH 9.5a	7.7401	8.2366
QC10U-pH 9.5b	7.8062	8.3087
QC10U-lUa	7.8134	8.3196
QC10U-lUb	7.8680	8.3742

1

1/25/99	Capped Desorption	PC containers
Sample Name	wt. of vial,g	wt. Of vial + sample
QC10U-pH 3a	7.7383	8.2441
QC10U-pH 3b	7.7099	8.215
QC10U-pH 3.5a	7.8322	8.3353
QC10U-pH 3.5b	7.7501	8.254
QC10U-pH 4a	7.7782	8.7836
QC10U-pH 4b	7.841	8.345
QC10U-pH 4.25a	7.8387	8.3414
QC10U-pH 4.25b	7.7984	8.3015
QC10U-pH 4.5a	7.727	8.2306
QC10U-pH 4.5b	7.8187	8.3226
QC10U-pH 4.75a	7.7813	8.2839
QC10U-pH4.75b	7.7808	8.2853
QC10U-pH 5a	7.9263	8.4279
QC10U-pH 5b	7.8005	8.3061
QC10U-pH 5.25a	7.8504	8.3524
QC10U-pH 5.25b	7.8584	8.3224
QC10U-pH 5.5a	7.7677	8.2803
QC10U-pH 5.5b	7.81	8.3126
QC10U-pH 5.75a	7.7868	8.2892
QC10U-pH 5.75b	7.8639	8.364
QC10U-pH 6a	7.6968	8.1983
QC10U-pH 6b	7.7414	8.2431
QC10U-pH 6.25a	7.8165	8.3172
QC10U-pH 6.25a	7.796	8.2974
QC10U-pH 6.5a	7.7706	8.2722
QC10U-pH 6.5b	7.7554	8.2554
QC10U-pH 6.75a	7.8287	8.3346
QC10U-pH 6.75b	7.7785	8.2792
QC10U-pH 7a	7.761	8.2643
QC10U-pH 7b	7.7912	8.2931
QC10U-pH 7.25a	7.8094	8.3141
QC10U-pH 7.25b	7.8738	8.3753
QC10U-pH 7.5a	7.8439	8.3458
QC10U-pH 7.5b	7.8019	8.3058
QC10U-pH 7.75a	7.7764	8.2788
QC10U-pH 7.75b	7.7612	8.2634
QC10U-pH 8a	7.8035	8.3107
QC10U-pH 8b	7.8393	8.3437
QC10U-pH 8.25a	7.7642	8.2666
QC10U-pH 8.25b	7.7892	8.2913
QC10U-pH 8.5a	7.7893	8.2912
QC10U-pH 8.5b	7.7983	8.2995
QC10U-pH 8.75a	7.8469	8.3507
QC10U-pH 8.75b	7.7606	8.2628
QC10U-pH 9a	7.7772	8.2784
QC10U-pH 9b	7.7918	8.2907
QC10U-pH 9.25a	7.8441	8.3455
QC10U-pH 9.25	7.7647	8.2696
QC10U-pH 9.5a	7.8145	8.3157
QC10U-pH 9.5b	7.8219	8.3205


```
BKG IPA DATA PROCESSED - 27-Jan-99 10:42
   Bkg (0-18.6 keV) = 22.30 cpm
   Bkg (0-156 keV)  = 31.62 cpm

WARNING: Questionable C14 Background value - Please view historic data


   C14 E^2/B (1-156 keV)    = 384.06
   H3  E^2/B (1-18.6 keV)   = 187.83
```

QC10U
Capped
Desorption

```
SYSTEM NORMALIZED


C14 IPA DATA PROCESSED - 28-Jan-99 13:23
   C14 Eff (0-156 keV) = 96.25 %
C14 CHI SQUARE IPA DATA PROCESSED - 28-Jan-99 13:34
   C14 Chi Square = 14.31
H3 IPA DATA PROCESSED - 28-Jan-99 13:35
   H3 Eff (0-18.6 keV) = 65.04 %
H3 CHI SQUARE IPA DATA PROCESSED - 28-Jan-99 13:45
   H3 Chi Square = 16.29
BKG IPA DATA PROCESSED - 28-Jan-99 14:46
   Bkg (0-18.6 keV) = 21.95 cpm
   Bkg (0-156 keV)  = 31.55 cpm

WARNING: Questionable C14 Background value - Please view historic data


   C14 E^2/B (1-156 keV)    = 387.54
   H3  E^2/B (1-18.6 keV)   = 191.79
```

```
                                                                    Page
29 Jan 99  07:35          ALPHA/BETA - 1.02                         User : A
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    20.02
Region B:      100 -   350       0     3.0     3.52
Region C:      0.0 -  2000       0     0.1    29.48

Quench Indicator: SIS
alpha cpm U-233  1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal
```

Container desorption, Capped QC10U

S#		TIME	CPMA A:2S%		CPMB B:2S%		CPMC C:2S%		SIS FLAG
P#	1	999.99	20.02	1.41	3.524	3.37	29.48	1.16	144.10
23	2	7.80	11.77	34.38	566.732	3.02	579.62	3.05	597.62
23	3	7.75	3.08	112.6	570.799	3.02	575.94	3.07	608.19
23	4	9.63	3.03	102.5	458.158	3.02	462.52	3.09	599.84
23	5	9.45	0.00	0.00	467.693	3.02	467.87	3.10	608.40
23	6	11.16	5.25	57.59	394.953	3.03	399.64	3.10	605.39
23	7	11.39	3.77	76.99	386.731	3.03	391.06	3.11	599.31
23	8	8.75	1.12	278.1	505.047	3.02	507.09	3.09	573.75
23	9	17.72	0.52	416.4	247.322	3.04	248.28	3.19	608.17
23	10	21.62	2.18	93.81	202.119	3.05	205.07	3.22	603.10
23	11	20.92	0.44	455.4	208.952	3.05	209.67	3.23	613.53
23	12	31.43	0.69	238.0	137.901	3.08	139.27	3.34	604.11
23	13	30.73	1.13	148.7	141.090	3.08	142.53	3.33	608.31
23	14	41.59	0.66	218.6	103.329	3.10	104.52	3.45	610.39
23	15	41.94	1.56	93.84	102.461	3.11	104.31	3.44	602.02
23	16	48.66	1.83	75.04	87.865	3.12	89.90	3.51	604.25
23	17	48.26	0.00	0.00	88.561	3.12	88.61	3.55	612.30
23	18	55.27	0.91	138.3	76.899	3.14	78.33	3.59	603.61
23	19	62.05	2.17	56.60	68.112	3.16	70.16	3.65	586.48
23	20	50.78	1.84	73.00	84.010	3.13	85.72	3.54	599.28
23	21	51.67	0.26	489.6	82.483	3.13	83.12	3.58	608.95
23	22	62.29	0.69	172.2	67.820	3.16	68.77	3.69	608.61
23	23	63.92	0.18	655.3	66.016	3.17	66.75	3.71	613.12
23	24	40.99	0.00	0.00	104.893	3.10	103.67	3.49	619.30
23	25	41.36	0.00	0.00	103.923	3.10	103.30	3.48	612.58
23	26	57.92	0.00	0.00	73.220	3.15	73.38	3.66	621.21
23	27	60.66	0.00	0.00	69.737	3.16	69.41	3.71	619.58
23	28	56.52	0.45	274.5	75.103	3.14	76.20	3.62	608.13
23	29	57.44	0.85	145.1	73.844	3.15	74.82	3.63	608.61
23	30	60.64	0.12	1032	69.777	3.16	70.19	3.69	615.64
23	31	61.84	0.03	3720	68.339	3.16	68.90	3.69	614.18
23	32	58.53	0.79	155.2	72.420	3.15	73.06	3.65	611.50
23	33	58.63	0.00	0.00	72.273	3.15	72.14	3.68	621.03
23	34	64.89	0.14	839.5	64.961	3.17	65.31	3.74	614.11
23	35	64.99	0.28	418.9	64.871	3.17	64.93	3.75	618.86
23	36	58.63	0.17	693.0	72.273	3.15	73.06	3.65	618.47
23	37	60.16	0.00	0.00	70.396	3.15	69.69	3.72	626.01
23	38	46.75	0.00	0.00	91.578	3.12	90.75	3.55	629.23
23	39	46.96	0.55	245.9	91.110	3.12	92.90	3.50	612.61
23	40	39.88	0.00	0.00	107.935	3.10	107.43	3.46	624.56
23	41	40.07	0.84	174.4	107.382	3.10	108.13	3.44	611.39

B Std. S

QC10 Capp Conta deso

30 Jan 99 12:16 ALPHA/BETA - 1.02 Page 2 F
Protocol #:23 U-233 3% 2 sigma User

23	42	49.66	0.00	0.00	85.964	3.13	85.92	3.57	620.91
23	43	49.54	1.03	129.1	86.181	3.13	87.47	3.53	612.31
23	44	47.20	0.00	0.00	90.629	3.12	90.98	3.53	611.86
23	45	46.60	0.00	0.00	91.862	3.12	92.41	3.52	610.54
23	46	91.04	0.21	462.9	45.290	3.24	46.27	4.01	605.02
23	47	89.98	0.75	133.4	45.865	3.24	46.91	4.00	605.11
23	48	112.33	0.00	0.00	36.038	3.31	36.03	4.34	612.36
23	49	115.94	0.34	263.9	34.806	3.32	35.43	4.33	604.74
23	50	131.10	0.02	4636	30.404	3.37	30.76	4.55	609.58
23	51	128.79	0.00	0.00	30.990	3.36	31.12	4.54	611.82
23	52	59.25	0.62	195.4	71.497	3.15	72.36	3.65	601.31
23	53	59.09	0.63	194.1	71.700	3.15	72.31	3.66	606.59
231	MISSING TUBE(S) PP tubes desorption, QC10U, Capped Vials								
55		9.44	1.80	169.5	467.768	3.02	469.57	3.10	607.07
23	56	9.41	2.19	140.9	469.165	3.02	473.07	3.09	606.39
23	57	7.32	2.66	132.9	604.126	3.02	606.17	3.08	607.85
23	58	6.87	4.43	85.34	643.492	3.02	649.12	3.06	603.81
23	59	4.25	2.57	179.9	1042.594	3.01	1046.99	3.04	599.52
23	60	4.31	4.34	109.7	1028.727	3.01	1033.86	3.04	602.45
23	61	4.03	2.56	185.2	1102.431	3.01	1105.26	3.04	618.62
23	62	3.98	3.10	156.0	1113.059	3.01	1116.00	3.04	605.54
23	63	3.21	4.28	128.8	1384.015	3.00	1389.52	3.03	601.38
23	64	3.32	9.50	62.86	1335.030	3.01	1346.12	3.02	604.51
23	65	2.64	0.06	9940	1685.491	3.00	1685.67	3.02	603.04
23	66	2.64	8.01	81.44	1680.946	3.01	1690.59	3.02	604.54
23	67	3.22	6.38	89.90	1378.774	3.01	1385.11	3.03	603.54
23	68	3.22	4.51	122.5	1379.706	3.00	1385.11	3.03	605.40
23	69	2.41	8.61	80.13	1845.024	3.00	1855.17	3.01	598.50
23	70	2.38	3.51	179.4	1864.543	3.01	1868.00	3.02	606.11
23	71	2.54	9.11	74.39	1751.988	3.00	1762.25	3.01	605.26
23	72	2.53	5.28	120.0	1760.112	3.00	1767.75	3.02	602.52
23	73	2.55	5.86	108.8	1741.574	3.00	1748.95	3.02	600.78
23	74	2.54	15.81	47.55	1746.082	3.01	1765.01	3.01	601.48
23	75	2.82	7.64	82.08	1576.263	3.00	1588.25	3.02	599.11
23	76	2.59	2.76	215.2	1716.939	3.00	1725.34	3.02	608.29
23	77	2.48	2.56	236.0	1789.218	3.01	1792.70	3.02	604.62
23	78	2.47	2.65	228.7	1804.978	3.00	1810.60	3.01	599.52
23	79	2.66	0.28	1972	1669.032	3.00	1671.27	3.03	606.68
23	80	2.75	3.98	148.6	1614.294	3.01	1617.06	3.03	598.44
23	81	2.14	8.02	90.37	2079.654	3.00	2089.68	3.01	606.30
23	82	2.12	6.39	110.5	2094.589	3.00	2103.07	3.02	602.00
23	83	2.51	4.68	134.2	1766.994	3.01	1772.91	3.02	605.76
23	84	2.50	0.78	740.7	1777.676	3.00	1778.52	3.02	609.95
23	85	2.44	7.03	94.82	1820.246	3.00	1827.90	3.02	606.03
23	86	2.44	10.72	66.29	1818.607	3.01	1828.72	3.02	606.33
23	87	3.02	3.82	147.3	1469.986	3.01	1475.15	3.03	610.89

QC Cap PP des

23	88	2.96	2.95	188.9	1502.557	3.00	1507.01	3.02	602.23
23	89	2.50	7.58	87.75	1777.276	3.00	1789.32	3.01	603.95
23	90	2.47	5.89	110.1	1800.929	3.00	1808.98	3.02	603.21
23	91	2.43	1.38	430.9	1825.282	3.01	1826.90	3.03	601.28
23	92	2.49	6.08	106.5	1785.633	3.00	1791.80	3.02	604.83
23	93	2.94	7.19	84.71	1511.442	3.00	1517.12	3.02	600.04
23	94	3.00	5.31	109.5	1481.476	3.00	1486.19	3.02	603.69
23	95	2.47	7.92	85.05	1802.144	3.00	1813.03	3.01	608.29 b
23	96	2.45	2.02	297.2	1817.700	3.00	1820.72	3.02	599.25 a
23	97	2.61	4.12	147.9	1702.223	3.00	1707.68	3.02	606.26
23	98	2.53	5.28	120.0	1757.346	3.00	1762.61	3.02	600.52

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Protocol #:23 U-233 3% 2 sigma User : Al

23	99	2.03	8.06	92.37	2196.969	3.00	2208.45	3.01	595.81
23	100	1.89	9.61	82.46	2349.386	3.00	2358.88	3.01	598.66
23	101	2.06	4.74	146.5	2157.641	3.00	2161.30	3.02	602.86
23	102	2.07	20.56	43.09	2148.167	3.00	2170.52	3.00	604.58
23	103	2.59	3.53	170.9	1717.712	3.00	1721.48	3.02	606.75
23	104	2.56	0.00	0.00	1734.367	3.00	1730.28	3.03	605.72
23	105	8.16	acidU 0.08	4049	541.206	3.02	540.74	3.09	604.35
23	106	8.47	std 1.35	236.4	521.151	3.02	522.94	3.09	600.35
23	107	8.57	acidU 3.55	93.76	515.379	3.02	521.74	3.08	597.04
23	108	8.61	std 2.28	141.7	512.620	3.02	516.63	3.08	596.31
23									

a QC1
b QC10 std

uncapped

1/26/99 AJ

stock U-soln recounted for QC10U uncapped expts.

wt. of original Container	wt. of container +U soln.	wt. of container + U-soln + Acid
19.6480	54.6673	57.3693

PH of starting solution = 4.16

	wt of vials	wt of vials + sample
QC10U - Ia	7.7576	8.2599
QC10U - Ib	7.7941	8.2949

UNCAPPED, Qtz = 1.0g, Clinop = 0.700g.

1/28/99 AJ

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

Objective: To investigate the characteristics of U sorption on mixture of clinoptilolite and quartz as a function of pH.

Initial conditions:
- $\sum U$ = 50 ppb (2.14×10^{-7})
- equilibrium with atmospheric $CO_2(g)$; $pCO_2 = 10^{-3.5}$
- pH range 4.0-9.5
- solution volume = 35 ml
- mass of solid 1, quartz = 1.000 g
- mass of solid 2, clinoptilolite = 700mg (0.70 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

Supplies:
≤325 mesh prepared Qtz & 100/200 mesh Clinoptilolite in NaCl AJ
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 ~~NaOH (lot)~~ $NaHCO_3$ (lot 936883) AJ
concentrated HNO_3 (lot 983546)
HNO_3 and NaOHstock solutions at various concentrations prepared in degassed water.
0.1m $NaNO_3$ matrix prepared with degassed water.
weighing paper/boats
deionized ultrapure water, DH_2O
Teflon beaker

Note: Ultrapure water was degassed by boiling it in a flask and cooled with mouth covered with rubber stopper.

Procedure:

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

B. Transfer (2.14×10^{-7}) 50 ppb ^{233}U stock solution to experimental containers.
- Label 26 polycarbonate centrifuge tubes (50 ml capacity) QCU-pHi (where i is the approximate pH of each solution, see Table QCU).
- Label 1 polycarbonate centrifuge tube QC20.0U-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 QC20.0-U-IU container.
- Record weight of each sample container after addition of quartz.

D. Add clinoptilolite to sample containers.

- Add 0.70 g of clinoptilolite to each sample container. **Do not** add clinoptilolite to the QC20.0-U-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 NaOH to each experimental container as listed in Table QC20.0U. Take care to add HNO_3 or NaOH in the concentrations specified in Table CQ20U.
- For sample QC20.0U-IU (as listed in Table QC20.0U) add 100 μl of 50/50 V/V HNO_3 to the sample container.
- Weigh and record the weight of each sample container.

F. SampleQC20.0U-IU for initial [U].

- Label two 7 ml LSC vials as QC20.0U-IUa and QC20.0U-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 QC20.0U-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 QC20.0U-IU.

G. Wait for equilibrium.

- Place caps on sample containers and tighten the caps.
- Place containers on gyratory shaker set at about 120 rpm and allow samples to equilibrate for at least 10 days.

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

- For each sample solution label two 7 ml LSC vials (e.g.,QC20.0U-pH3a and QC20.0U-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.
- 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 PC sample containers. *Note: this step can be skipped if the mixture 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 PC sample container, label two corresponding polypropylene (PP) test tubes A and B(50 ml capacity).
- Record weight for the set of PP tubes A .
- Add 3.0 ml of 0.1M HNO3 to 50 ml PP tubes labeled as **B**-QC20.0Ud-pH.
- Pour supernatant from PC containers into PP tubes with acid and labeled as **B**-QC20.0Ud-pH leaving behind about 7 to 8ml of solution in PC container with the solid mixture.
- Record the weight of PC containers containing the solid mixture and some solution.
- Stir the solid mixture in solution vigorously and immediately transfer all the solid and solution to the corresponding PP tubes marked as **A**-QC20.0Ud-pH.
- Record the weight of PP tubes **A**-QC20.0Ud-pH.
- Transfer supernatant with HNO3 acid from the PP tubes **B**-QC20.0Ud-pH back to original PC containers.
- Record weights of PC sample containers.
- Add approximately 3 ml of 0.1 M HNO_3 to PP tubes containing solid mixture, **A**-QC20.0Ud-pH.
- Record weights of PP tubes **A**-QC20.0Ud-pH and PC sample containers.
- Place sample containers and PP test tubes on gyratory shaker (at about 120 rpm) and allow to desorb for at least 10 days.

J. Sample solutions for [U].

- For each sample container and PP test tube label two 7 ml LSC vials (e.g., QC20.0Ud-pH3a and QC20.0Ud-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 aliquot 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.

Table QC20.0U: 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 qtz/clinop (35 ml)

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	0.394	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
QC20U-IU	0.100	50% HNO3

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Sample Name	Original Container wt., g
QC20U-pH 3.0	22.1799
QC20U-pH 3.5	22.2045
QC20U-pH 4.0	22.3451
QC20U-pH 4.25	22.2656
QC20U-pH 4.5	22.1422
QC20U-pH4.75	22.3608
QC20U-pH 5.0	22.2403
QC20U-pH 5.25	22.1384
QC20U-pH 5.5	22.2506
QC20U-pH 5.75	22.5185
QC20U-pH 6.0	22.3267
QC20U-pH 6.25	22.5600
QC20U-pH 6.5	22.2974
QC20U-pH 6.75	22.2558
QC20U-pH 7.0	22.1861
QC20U-pH 7.25	22.1911
QC20U-pH 7.5	22.1452
QC20U-pH 7.75	22.2309
QC20U-pH 8.0	22.3018
QC20U-pH 8.25	22.2579
QC20U-pH 8.5	22.5666
QC20U-pH 8.75	22.5728
QC20U-pH 9.0	22.3169
QC20U-pH 9.25	22.1572
QC20U-pH 9.5	22.6105
	-
QC20U-IU	22.2603

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Sample Name	Container wt. + U soln., g
QC20U-pH 3.0	57.1809
QC20U-pH 3.5	57.2135
QC20U-pH 4.0	57.3418
QC20U-pH 4.25	57.2782
QC20U-pH 4.5	57.1402
QC20U-pH4.75	57.3554
QC20U-pH 5.0	57.2654
QC20U-pH 5.25	57.1329
QC20U-pH 5.5	57.2592
QC20U-pH 5.75	57.5194
QC20U-pH 6.0	57.3422
QC20U-pH 6.25	57.5858
QC20U-pH 6.5	57.3012
QC20U-pH 6.75	57.2558
QC20U-pH 7.0	57.1861
QC20U-pH 7.25	57.1969
QC20U-pH 7.5	57.1483
QC20U-pH 7.75	57.2423
QC20U-pH 8.0	57.3022
QC20U-pH 8.25	57.2586
QC20U-pH 8.5	57.5659
QC20U-pH 8.75	57.5686
QC20U-pH 9.0	57.3288
QC20U-pH 9.25	57.1686
QC20U-pH 9.5	57.6046
QC20U-IU	57.2523

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Sample Name	Container wt. + U soln. + quartz, g
QC20U-pH 3.0	58.1781
QC20U-pH 3.5	58.2146
QC20U-pH 4.0	58.3428
QC20U-pH 4.25	58.2783
QC20U-pH 4.5	58.1415
QC20U-pH4.75	58.3553
QC20U-pH 5.0	58.2660
QC20U-pH 5.25	58.1315
QC20U-pH 5.5	58.2451
QC20U-pH 5.75	58.5171
QC20U-pH 6.0	58.3420
QC20U-pH 6.25	58.5857
QC20U-pH 6.5	58.3014
QC20U-pH 6.75	58.2581
QC20U-pH 7.0	58.1850
QC20U-pH 7.25	58.1973
QC20U-pH 7.5	58.1483
QC20U-pH 7.75	58.2407
QC20U-pH 8.0	58.3019
QC20U-pH 8.25	58.2580
QC20U-pH 8.5	58.5674
QC20U-pH 8.75	58.5691
QC20U-pH 9.0	58.3288
QC20U-pH 9.25	58.1717
QC20U-pH 9.5	58.6042

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2/2/99

Sample Name	Container wt. + U soln. + quartz + clinop, g
QC20U-pH 3.0	58.8489
QC20U-pH 3.5	58.8669
QC20U-pH 4.0	59.0073
QC20U-pH 4.25	58.9372
QC20U-pH 4.5	58.8042
QC20U-pH4.75	59.0169
QC20U-pH 5.0	58.9379
QC20U-pH 5.25	58.8068
QC20U-pH 5.5	58.9199
QC20U-pH 5.75	59.1655
QC20U-pH 6.0	59.0138
QC20U-pH 6.25	59.2514
QC20U-pH 6.5	58.9760
QC20U-pH 6.75	58.9317
QC20U-pH 7.0	58.8596
QC20U-pH 7.25	58.8734
QC20U-pH 7.5	58.8136
QC20U-pH 7.75	58.9047
QC20U-pH 8.0	58.9649
QC20U-pH 8.25	58.9291
QC20U-pH 8.5	59.2289
QC20U-pH 8.75	59.2438
QC20U-pH 9.0	58.9978
QC20U-pH 9.25	58.8387
QC20U-pH 9.5	59.2655

Actual volumes added for PH adjust

Table QC20U: 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 quartz and clinoptilolite (35ml).

Estimated solution pH	Volume of HNO3 added, ml	Molarity of HNO3 to use
3	0.394 0.300+0.075+0.020	0.1
3.25	0.209 0.200+0.010	0.1
3.5	0.106	0.1
3.75	0.047	0.1
4	0.071 0.050+0.020	0.02
Estimated solution pH	**Volume of NaHCO3 added, ml**	**Molarity of NaHCO3 to use**
4.25	0.084 0.075	0.005
4.5	0.292 0.250	0.005
4.75	0.205 0.150	0.01
5	0.239 0.200	0.01
5.25	0.260 0.200+0.025	0.01
5.5	0.274 0.200+0.040	0.01
5.75	0.286 0.250	0.01
6	0.300 0.275	0.01
6.25	0.322 0.300	0.01
6.5	0.071 0.065	0.05
6.75	0.084 0.095	0.05
7	0.106 0.105	0.05
7.25	0.145 0.100+0.020+0.025	0.05
7.5	0.214 0.100+0.075+0.020+0.020	0.05
7.75	0.169 0.175	0.1
8	0.282 0.285	0.1
8.25	0.097 0.100	0.5
8.5	0.174 0.175	0.5
8.75	0.160 0.100+0.050+0.010	1
9	0.305 0.310	1
9.25	0.825	1
9.5	1.220	1
QC20U-IU	**0.100**	**50% HNO_3**

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2/2/99

Sample Name	Container Wt. After additions of HNO3 and NaHCO3, g
QC20U-pH 3.0	59.2335
QC20U-pH 3.5	59.0733
QC20U-pH 4.0	59.1498
QC20U-pH 4.25	59.0076
QC20U-pH 4.5	59.0504
QC20U-pH4.75	59.1630
QC20U-pH 5.0	59.1349
QC20U-pH 5.25	59.0293
QC20U-pH 5.5	59.1552
QC20U-pH 5.75	59.4115
QC20U-pH 6.0	59.2865
QC20U-pH 6.25	59.5492
QC20U-pH 6.5	59.0380
QC20U-pH 6.75	59.0245
QC20U-pH 7.0	59.9627
QC20U-pH 7.25	59.0159
QC20U-pH 7.5	59.0255
QC20U-pH 7.75	59.0783
QC20U-pH 8.0	59.2482
QC20U-pH 8.25	59.0290
QC20U-pH 8.5	59.4061
QC20U-pH 8.75	59.4121
QC20U-pH 9.0	59.3223
QC20U-pH 9.25	59.7157
QC20U-pH 9.5	60.5643
QC20U-IU	57.3522

18 Feb 99 11:38 ALPHA/BETA - 1.02 Pag
Protocol #:23 U-233 3% 2 sigma User : A

H3 Eff (0-18.6 keV) = 65.10 %
H3 CHI SQUARE IPA DATA PROCESSED - 18-Feb-99 11:48
H3 Chi Square = 31.04
BKG IPA DATA PROCESSED - 18-Feb-99 12:49
Bkg (0-18.6 keV) = 21.12 cpm
Bkg (0-156 keV) = 30.72 cpm

WARNING: Questionable C14 Background value - Please view historic data

C14 E^2/B (1-156 keV) = 394.48
H3 E^2/B (1-18.6 keV) = 200.12

19 Feb 99 05:38 ALPHA/BETA - 1.02 Pag
Protocol #:23 U-233 3% 2 sigma User : T

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	19.90
Region B:	100 -	350	0	3.0	3.46
Region C:	0.0 -	2000	0	0.1	29.24

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

QC20U uncapped Sorption

S#	TIME	CPMA A:2S%		CPMB B:2S%		CPMC C:2S%		SIS	FLAG
P# 1	999.99	19.90	1.42	3.464	3.40	29.24	1.17	143.08	B
23 2	8.06	1.56	209.9	548.645	3.02	550.41	3.08	608.96	
23 3	8.10	1.58	207.1	545.919	3.02	548.04	3.08	599.18	
23 4	8.05	0.00	0.00	548.834	3.02	548.89	3.09	607.15	
23 5	8.18	2.59	128.5	539.934	3.02	542.03	3.08	606.26	
23 6	8.13	1.38	236.0	544.014	3.02	546.16	3.08	609.82	
23 7	8.42	0.05	6272	524.921	3.02	527.17	3.08	608.16	
23 8	10.94	2.49	115.4	402.752	3.03	405.31	3.11	612.84	
23 9	11.14	0.00	0.00	395.459	3.03	396.34	3.12	609.13	
23 10	13.99	0.00	0.00	314.191	3.03	313.93	3.16	618.59	
23 11	14.21	0.29	817.1	309.273	3.03	310.16	3.15	618.99	
23 12	53.55	0.73	174.0	79.524	3.13	80.02	3.60	610.89	
23 13	53.52	1.66	78.39	79.570	3.13	81.44	3.56	603.56	
23 14	74.98	1.09	100.6	55.805	3.19	56.97	3.81	602.60	
23 15	74.92	0.00	0.00	55.853	3.19	55.34	3.89	619.16	
23 16	87.30	1.19	86.30	47.441	3.23	49.26	3.91	603.11	
23 17	84.93	0.20	517.6	48.861	3.22	49.55	3.95	611.44	
23 18	88.26	0.70	144.8	46.910	3.23	48.21	3.95	606.86	
23 19	86.99	0.00	0.00	47.622	3.23	47.68	4.01	613.99	
23 20	61.82	0.79	151.5	68.422	3.16	69.51	3.67	609.77	

QC20U IU

QC20U Sorption

23	21	61.80	0.86	139.2	68.445	3.16	69.72	3.66	606.65
23	22	69.06	0.00	0.00	60.886	3.18	60.78	3.80	615.76
23	23	68.77	0.19	579.6	61.201	3.17	61.30	3.78	604.08
23	24	81.67	0.51	204.4	50.950	3.21	51.87	3.90	606.21
23	25	81.15	0.01	9774	51.299	3.21	52.12	3.90	614.67
23	26	84.94	0.59	172.2	48.867	3.22	49.66	3.94	604.68
23	27	83.71	0.17	613.6	49.624	3.22	50.20	3.94	610.31
23	28	74.30	0.45	242.7	56.388	3.19	57.34	3.81	609.01
23	29	72.24	0.18	597.8	58.053	3.19	57.95	3.84	610.02
23	30	77.22	0.00	0.00	54.086	3.20	53.75	3.91	623.91
23	31	77.47	0.41	256.4	53.913	3.20	54.41	3.87	612.67
23	32	75.13	0.34	314.8	55.687	3.19	56.42	3.83	605.72
23	33	76.20	0.50	213.0	54.856	3.20	55.41	3.85	608.18
23	34	107.41	10.29	10.66	37.910	3.29	47.88	3.61	453.42
23	35	81.94	0.01	7426	50.771	3.21	50.56	3.96	612.98
23	36	74.02	0.02	4509	56.574	3.19	57.00	3.83	613.15
23	37	72.58	0.94	117.6	57.779	3.19	59.17	3.78	603.83
23	38	59.99	0.18	649.2	70.632	3.15	71.07	3.67	611.52
23	39	59.44	0.64	189.4	71.300	3.15	71.40	3.68	606.77
23	40	40.44	0.40	362.6	106.452	3.10	107.18	3.44	604.64
23	41	39.71	0.27	542.1	108.473	3.10	109.34	3.43	610.98

50% uncapped

23	42	29.56	1.38	125.1	146.908	3.07	148.56	3.31	607.01
23	43	28.76	0.00	0.00	151.160	3.07	150.90	3.32	614.68
23	44	20.61	0.91	222.6	212.208	3.05	213.07	3.22	609.34
23	45	19.79	0.31	660.4	221.195	3.05	221.39	3.22	616.20
23	46	13.37	1.86	137.9	328.997	3.03	331.04	3.14	600.69
23	47	13.34	0.86	291.5	330.119	3.03	331.48	3.14	610.83
23	48	10.11	1.26	230.0	436.398	3.02	439.00	3.10	613.86
23	49	9.78	0.00	0.00	451.035	3.02	452.86	3.10	614.67
23	50	8.55	2.79	117.3	516.419	3.02	519.18	3.09	611.27
23	51	8.69	0.93	336.0	508.389	3.02	509.08	3.09	613.09
23	52	8.51	2.89	113.5	519.333	3.02	522.34	3.08	610.20
23	53	8.45	3.41	97.76	522.927	3.02	526.97	3.08	610.12
23	54	8.65	2.99	109.3	510.293	3.02	514.57	3.08	615.98
23	55	8.42	1.83	176.2	525.039	3.02	526.81	3.09	618.02
23	56	8.66	0.00	0.00	510.277	3.02	510.02	3.10	628.65
23	57	8.69	0.23	1302	508.274	3.02	508.27	3.10	625.53

QC20U uncapped sorption

C14 IPA DATA PROCESSED - 21-Feb-99 04:59
C14 Eff (0-156 keV) = 96.61 %
C14 CHI SQUARE IPA DATA PROCESSED - 21-Feb-99 05:09
C14 Chi Square = 18.56
H3 IPA DATA PROCESSED - 21-Feb-99 05:11
H3 Eff (0-18.6 keV) = 65.56 %
H3 CHI SQUARE IPA DATA PROCESSED - 21-Feb-99 05:21
H3 Chi Square = 14.62
BKG IPA DATA PROCESSED - 21-Feb-99 06:21
Bkg (0-18.6 keV) = 21.43 cpm
Bkg (0-156 keV) = 30.90 cpm

WARNING: Questionable C14 Background value - Please view historic data

C14 E^2/B (1-156 keV) = 397.20
H3 E^2/B (1-18.6 keV) = 198.97

uncapped sorption 2/11/99

Sample Name	wt. of vial,g	wt. Of vial + sample
QC20U-pH 3a	7.7628	8.2582
QC20U-pH 3b	7.8019	8.3004
QC20U-pH 3.5a	7.8327	8.3303
QC20U-pH 3.5b	7.8903	8.3846
QC20U-pH 4a	7.837	8.3300
QC20U-pH 4b	7.8545	8.3384
QC20U-pH 4.25a	7.8277	8.3212
QC20U-pH 4.25b	7.8298	8.3186
QC20U-pH 4.5a	7.8404	8.3167
QC20U-pH 4.5b	7.8539	8.3492
QC20U-pH 4.75a	7.8177	8.3105
QC20U-pH4.75b	7.863	8.3538
QC20U-pH 5a	7.8199	8.319
QC20U-pH 5b	7.807	8.2979
QC20U-pH 5.25a	7.7695	8.2598
QC20U-pH 5.25b	7.8102	8.2961
QC20U-pH 5.5a	7.8573	8.3489
QC20U-pH 5.5b	7.8911	8.3833
QC20U-pH 5.75a	7.84	8.3127
QC20U-pH 5.75b	7.8248	8.3161
QC20U-pH 6a	7.7909	8.2829
QC20U-pH 6b	7.8295	8.3215
QC20U-pH 6.25a	7.77	8.2515
QC20U-pH 6.25a	7.8376	8.3073
QC20U-pH 6.5a	7.8545	8.3472
QC20U-pH 6.5b	7.8158	8.2971
QC20U-pH 6.75a	7.839	8.3235
QC20-pH 6.75b	7.8111	8.3048
QC20U-pH 7a	7.869	8.3505
QC20U-pH 7b	7.8024	8.2948
QC20U-pH 7.25a	7.8416	8.3164
QC20U-pH 7.25b	7.7714	8.2626
QC20U-pH 7.5a	7.8579	8.3318
QC20U-pH 7.5b	7.8721	8.3478
QC20U-pH 7.75a	7.7799	8.2722
QC20U-pH 7.75b	7.8305	8.3227
QC20U-pH 8a	7.8593	8.3521
QC20U-pH 8b	7.9129	8.3987
QC20U-pH 8.25a	7.7583	8.2487
QC20U-pH 8.25b	7.8536	8.3457
QC20U-pH 8.5a	7.8247	8.3166
QC20U-pH 8.5b	7.8294	8.3064
QC20U-pH 8.75a	7.8038	8.2795
QC20U-pH 8.75b	7.8108	8.3021
QC20U-pH 9a	7.8252	8.2989
QC20U-pH 9b	7.8408	8.3306
QC20U-pH 9.25a	7.8819	8.3703
QC20U-pH 9.25	7.888	8.3789
QC20U-pH 9.5a	7.8466	8.3219
QC20U-pH 9.5b	7.823	8.2963
QC1.0U-Iua	7.7876	8.2933
QC1.0U-IUb	7.812	8.3168
QC1.0U-IUc	7.812	8.3168
QC1.0U-Iud	7.7876	8.2933
QC1.0U-IUe	7.8399	8.3457
QC1.0U-Iuf	7.8136	8.3189
QC1.0U-Iug	7.7792	8.2779
QC1.0U-Iuh	7.7917	8.2897

UNCAPPED

2/15/99 2/15/99 2/15/99

Sample Name	Container wt. before sampling & pH measurements, g	Measured pH	Container wt. after sampling & pH measurements, g
QC20U-pH 3.0	58.9597	3.64	57.9176
QC20U-pH 3.5	58.8334	4.06	57.7767
QC20U-pH 4.0	58.9038	5.3	57.8241
QC20U-pH 4.25	58.6626	5.73	57.6393
QC20U-pH 4.5	58.8128	6.02	57.7857
QC20U-pH4.75	58.6372	6.15	57.6121
QC20U-pH 5.0	58.8768	5.47	57.8448
QC20U-pH 5.25	58.7585	5.61	57.6945
QC20U-pH 5.5	58.8617	6.55	57.7117
QC20U-pH 5.75	59.0804	6.62	58.0551
QC20U-pH 6.0	59.0198	5.69	57.999
QC20U-pH 6.25	59.2660	6.74	58.2475
QC20U-pH 6.5	58.7645	5.87	57.7414
QC20U-pH 6.75	58.7672	6.53	57.7409
QC20U-pH 7.0	58.6867	6.76	57.6635
QC20U-pH 7.25	58.8011	7.03	57.7688
QC20U-pH 7.5	58.7660	6.99	57.6467
QC20U-pH 7.75	58.4453	7.49	57.4263
QC20U-pH 8.0	58.9034	7.84	57.8862
QC20U-pH 8.25	58.7673	8.01	57.7546
QC20U-pH 8.5	59.1525	8.23	58.1378
QC20U-pH 8.75	58.7750	8.48	57.7567
QC20U-pH 9.0	59.0218	8.98	58.0056
QC20U-pH 9.25	59.4197	9.26	58.4030
QC20U-pH 9.5	60.1435	9.31	59.1210
QC20U-IU	57.2936		56.2695

UNCAPPED

2/17/99

Sample Name	wt. Of PP tubes, g	wt. Of PP tubes after transfer of qtz/clino, g	wt. Of PP tubes after acid add, g	Container wt. after transfer of supernatant, g	Container wt. after supernatant retransfer+acid added ,g
QC20U-pH 3.0	13.7634	24.6253	24.6253	30.3292	52.7852
QC20U-pH 3.5	13.6737	24.7739	24.7739	30.3774	52.5684
QC20U-pH 4.0	13.7602	24.1501	24.1501	29.826	53.4697
QC20U-pH 4.25	13.6685	22.92	22.92	28.5918	54.4274
QC20U-pH 4.5	13.7018	24.7779	24.7779	30.3254	52.7219
QC20U-pH4.75	13.3834	24.8742	24.8742	30.9297	52.1173
QC20U-pH 5.0	13.3304	24.6146	24.6146	30.5893	52.5634
QC20U-pH 5.25	13.6852	25.4074	25.4074	30.9526	51.9997
QC20U-pH 5.5	13.7934	27.8423	27.8423	33.4752	49.5728
QC20U-pH 5.75	13.7957	27.0688	27.0688	32.8825	50.791
QC20U-pH 6.0	13.3367	26.6817	26.6817	32.7158	50.6795
QC20U-pH 6.25	13.6752	26.4121	26.4121	32.3821	51.5223
QC20U-pH 6.5	13.4156	26.2204	26.2204	32.1623	50.9328
QC20U-pH 6.75	13.6612	26.6875	26.6875	32.3207	50.6824
QC20U-pH 7.0	13.6323	25.2362	25.2362	30.8409	52.0375
QC20U-pH 7.25	13.4033	25.3688	25.3688	31.2114	51.8139
QC20U-pH 7.5	13.6837	25.0925	25.0925	30.5772	52.2125
QC20U-pH 7.75	13.6385	27.9584	27.9584	33.5829	49.1298
QC20U-pH 8.0	13.6407	25.3139	25.3139	30.9843	52.1904
QC20U-pH 8.25	13.7752	24.6581	24.6581	30.193	52.8849
QC20U-pH 8.5	13.6962	23.7839	23.7839	29.6694	54.0111
QC20U-pH 8.75	13.7015	24.8768	24.8768	30.7691	52.5476
QC20U-pH 9.0	13.6762	25.8989	25.8989	31.5849	51.7199
QC20U-pH 9.25	13.6963	24.7391	24.7391	30.239	53.3325
QC20U-pH 9.5	13.6968	25.1003	25.1003	31.1298	53.4168

UNCAPPED

Sample Name	Container wt. before sampling 3/1/99	Container wt. after sampling 3/2/99	wt. Of PP tubes before sampling 3/1/99	wt. Of PP tubes after sampling 3/2/99
QC20U-pH 3.0	52.6937	51.6748	24.6192	23.5883
QC20U-pH 3.5	52.4735	51.4579	24.767	23.729
QC20U-pH 4.0	53.3806	52.3639	23.5572	22.5403
QC20U-pH 4.25	54.3468	53.329	22.4796	21.4619
QC20U-pH 4.5	52.6166	51.5984	24.7347	23.7122
QC20U-pH4.75	52.0065	50.9839	24.861	23.841
QC20U-pH 5.0	52.4835	51.4599	24.5923	23.5753
QC20U-pH 5.25	51.9148	50.8976	25.3983	24.3877
QC20U-pH 5.5	49.4637	48.4433	27.8243	26.8049
QC20U-pH 5.75	50.651	49.6286	27.0189	25.9981
QC20U-pH 6.0	50.6022	49.5885	26.668	25.6252
QC20U-pH 6.25	51.4435	50.4228	26.4013	25.3835
QC20U-pH 6.5	50.8578	49.8398	26.1983	25.1729
QC20U-pH 6.75	50.6035	49.5885	26.6839	25.6683
QC20U-pH 7.0	51.9616	50.9438	25.2311	24.2155
QC20U-pH 7.25	51.7397	50.7207	25.3534	24.3371
QC20U-pH 7.5	52.1368	51.1128	25.0892	24.0746
QC20U-pH 7.75	49.0291	47.9932	27.9496	26.9241
QC20U-pH 8.0	52.1071	51.0871	25.3062	24.2834
QC20U-pH 8.25	52.8048	51.7858	24.6455	23.6007
QC20U-pH 8.5	53.9287	52.8905	23.7768	22.7532
QC20U-pH 8.75	52.4636	51.4398	24.8715	23.8482
QC20U-pH 9.0	51.6338	50.5203	25.8916	24.8839
QC20U-pH 9.25	53.2293	52.1133	24.7205	23.6903
QC20U-pH 9.5	53.2205	52.2033	25.076	24.029

Sample Name	PP tubes 3/1/99 wt. of vial,g	Desorption 3/2/99 wt. Of vial + sample	PC containers 3/1/99 wt. of vial,g	Desorption 3/2/99 wt. Of vial + sample
QC20U-pH 3a	7.8931	8.3943	7.7653	8.2698
QC20U-pH 3b	7.8979	8.4044	7.7628	8.2634
QC20U-pH 3.5a	7.9974	8.4999	7.895	8.3932
QC20U-pH 3.5b	7.8513	8.3483	7.7658	8.2686
QC20U-pH 4a	7.8731	8.3816	7.8499	8.3556
QC20U-pH 4b	7.8696	8.3733	7.8351	8.339
QC20U-pH 4.25a	7.8566	8.3583	7.8783	8.3767
QC20U-pH 4.25b	7.8793	8.3822	7.8517	8.3562
QC20U-pH 4.5a	7.8156	8.3197	7.7482	8.2518
QC20U-pH 4.5b	7.823	8.3234	7.7813	8.2846
QC20U-pH 4.75a	7.892	8.398	7.858	8.3613
QC20U-pH4.75b	7.884	8.389	7.8378	8.342
QC20U-pH 5a	7.9411	8.4397	7.7436	8.2526
QC20U-pH 5b	7.8524	8.3438	7.7219	8.226
QC20U-pH 5.25a	7.7969	8.2953	7.8992	8.4042
QC20U-pH 5.25b	7.8562	8.3515	7.8721	8.3762
QC20U-pH 5.5a	7.7862	8.2893	7.8055	8.3127
QC20U-pH 5.5b	7.8785	8.3785	7.7832	8.2849
QC20U-pH 5.75a	7.8626	8.3654	7.7715	8.2745
QC20U-pH 5.75b	7.838	8.3381	7.7638	8.2681
QC20U-pH 6a	7.7652	8.2696	7.8296	8.3246
QC20U-pH 6b	7.8274	8.3278	7.8362	8.3367
QC20U-pH 6.25a	7.8353	8.3382	7.7156	8.216
QC20U-pH 6.25a	7.8454	8.3475	7.9053	8.4029
QC20U-pH 6.5a	7.8312	8.3306	7.847	8.3478
QC20U-pH 6.5b	7.9057	8.4006	7.7847	8.2907
QC20U-pH 6.75a	7.8367	8.3397	7.7978	8.3014
QC20-pH 6.75b	7.8533	8.354	7.8476	8.3512
QC20U-pH 7a	7.8728	8.3672	7.7699	8.2751
QC20U-pH 7b	7.8529	8.3536	7.8688	8.3749
QC20U-pH 7.25a	7.8147	8.3183	7.8746	8.3791
QC20U-pH 7.25b	7.9224	8.419	7.8619	8.3596
QC20U-pH 7.5a	7.849	8.3455	7.8293	8.3272
QC20U-pH 7.5b	7.871	8.3701	7.8379	8.3385
QC20U-pH 7.75a	7.7969	8.3011	7.8131	8.3225
QC20U-pH 7.75b	7.8938	8.3927	7.7209	8.2257
QC20U-pH 8a	7.9349	8.4335	7.7961	8.3001
QC20U-pH 8b	7.8895	8.3911	7.7789	8.2825
QC20U-pH 8.25a	7.9818	8.4876	7.7965	8.2996
QC20U-pH 8.25b	7.8163	8.3228	7.7387	8.2415
QC20U-pH 8.5a	7.8994	8.3966	7.8354	8.3361
QC20U-pH 8.5b	7.8785	8.3749	7.8373	8.3375
QC20U-pH 8.75a	7.8588	8.3614	7.8123	8.3184
QC20U-pH 8.75b	7.861	8.3558	7.8237	8.3236
QC20U-pH 9a	7.8927	8.3894	7.844	8.4395
QC20U-pH 9b	7.8332	8.3327	7.7624	8.267
QC20U-pH 9.25a	7.8825	8.3821	7.7761	8.2811
QC20U-pH 9.25	7.8498	8.3537	7.7973	8.394
QC20U-pH 9.5a	7.8533	8.3589	7.8094	8.3084
QC20U-pH 9.5b	7.8277	8.3328	7.7978	8.302

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 03-Mar-99 11:15
C14 Eff (0-156 keV) = 96.50 %
C14 CHI SQUARE IPA DATA PROCESSED - 03-Mar-99 11:25
C14 Chi Square = 31.30
H3 IPA DATA PROCESSED - 03-Mar-99 11:26
H3 Eff (0-18.6 keV) = 65.30 %
H3 CHI SQUARE IPA DATA PROCESSED - 03-Mar-99 11:37
H3 Chi Square = 23.72
BKG IPA DATA PROCESSED - 03-Mar-99 12:37
Bkg (0-18.6 keV) = 21.78 cpm
Bkg (0-156 keV) = 31.80 cpm

WARNING: Questionable C14 Background value - Please view historic data

C14 E^2/B (1-156 keV) = 389.38
H3 E^2/B (1-18.6 keV) = 194.25

04 Mar 99 05:27 ALPHA/BETA - 1.02 Page
Protocol #:23 U-233 3% 2 sigma User : A

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	20.13
Region B:	100 -	350	0	3.0	3.50
Region C:	0.0 -	2000	0	0.1	29.52

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

S#	TIME	CPMA A:2S%		CPMB B:2S%		CPMC C:2S%		SIS FLAG
P# 1	999.99	20.13	1.41	3.502	3.38	29.52	1.16	143.15 B
23 2	8.14	5.30	66.93	542.567	3.02	549.10	3.07	609.79
23 3	8.41	1.03	308.0	525.273	3.02	528.15	3.08	600.03
23 4	8.08	2.52	133.5	546.993	3.02	551.17	3.08	606.06
23 5	8.38	0.75	421.6	526.928	3.02	527.64	3.09	611.08
23 6	8.28	4.02	85.20	533.455	3.02	537.26	3.08	607.07
23 7	8.14	2.60	129.2	543.058	3.02	546.15	3.08	605.29
23 8	12.19	3.49	80.09	361.059	3.03	365.39	3.12	602.76
23 9	11.85	0.29	908.3	371.688	3.03	372.67	3.13	604.02
23 10	15.65	0.00	0.00	280.524	3.04	280.00	3.18	614.17
23 11	15.19	1.99	122.2	289.059	3.04	292.46	3.15	603.39
23 12	41.54	0.00	0.00	103.479	3.10	102.54	3.49	615.51
23 13	43.27	0.44	321.9	99.202	3.11	100.20	3.47	607.71
23 14	47.81	0.53	251.9	89.533	3.12	90.54	3.52	606.85
23 15	50.39	0.19	683.9	84.690	3.13	86.37	3.53	605.03
23 16	50.89	0.00	0.00	83.843	3.13	83.76	3.59	607.05
23 17	50.85	0.14	898.1	83.932	3.13	84.58	3.57	607.83
23 18	48.71	0.48	277.1	87.876	3.12	88.52	3.54	604.87
23 19	49.13	0.06	2184	86.952	3.12	86.64	3.57	608.04
23 20	49.62	0.73	182.5	86.079	3.12	87.12	3.54	599.27
23 21	49.95	0.49	268.9	85.467	3.13	85.89	3.56	599.21
23 22	54.70	0.00	0.00	77.741	3.14	77.75	3.63	610.08
23 23	55.51	0.32	395.0	76.556	3.14	77.47	3.61	601.29
23 24	57.71	0.13	972.8	73.504	3.15	74.25	3.64	602.64
23 25	58.79	0.72	169.4	72.106	3.15	73.32	3.64	592.57
23 26	63.11	0.85	140.0	66.915	3.16	67.56	3.71	595.60
23 27	61.38	0.62	191.6	68.899	3.16	70.18	3.66	591.16
23 28	34.08	0.09	1823	126.926	3.08	126.70	3.39	598.49
23 29	32.55	0.24	676.9	133.119	3.08	133.36	3.36	603.98
23 30	56.60	0.00	0.00	75.014	3.14	74.82	3.66	600.62
23 31	57.14	0.06	1886	74.289	3.15	74.43	3.65	609.33
23 32	51.22	0.41	318.4	83.261	3.13	83.85	3.57	600.38
23 33	52.41	2.77	48.89	81.291	3.13	83.89	3.53	590.00
23 34	35.38	1.12	140.2	122.106	3.09	123.98	3.37	600.93
23 35	34.77	0.00	0.00	124.309	3.09	124.78	3.39	606.55
23 36	51.89	0.00	0.00	82.160	3.13	82.50	3.59	608.68
23 37	50.79	0.19	690.5	84.015	3.13	85.05	3.56	604.27
23 38	38.88	1.14	132.2	110.798	3.10	112.76	3.41	600.55
23 39	40.10	1.12	132.9	107.321	3.10	109.30	3.42	603.68
23 40	38.05	0.95	160.1	113.292	3.09	114.29	3.42	602.30
23 41	37.70	1.46	105.5	114.376	3.09	116.68	3.39	602.75

std. initial

container desorption & CC20 uncapped

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Protocol #:23 U-233 3% 2 sigma User : Al

23	42	29.51	0.00	0.00	147.159	3.07	147.03	3.34	609.22	
23	43	30.72	0.00	0.00	141.159	3.08	142.77	3.33	608.67	
23	44	21.16	1.32	153.6	206.564	3.05	209.47	3.21	603.33	
23	45	22.04	2.24	90.95	198.222	3.05	200.83	3.22	600.27	
23	46	14.75	0.00	0.00	297.922	3.03	299.15	3.16	606.96	QC20U
23	47	14.01	2.35	108.4	313.700	3.03	317.09	3.14	604.15	uncapped
23	48	10.77	1.32	215.3	409.404	3.02	411.05	3.11	604.53	desorption
23	49	10.92	3.40	86.67	403.458	3.03	406.37	3.11	604.10	containers
23	50	9.57	4.32	74.29	461.388	3.02	467.03	3.09	601.07	
23	51	9.52	2.35	131.5	463.725	3.02	465.33	3.10	606.07	
23	52	7.73	1.86	181.9	571.401	3.02	573.32	3.08	595.91	
23	53	9.43	3.30	95.79	467.972	3.02	472.60	3.09	605.18	
23	54	9.33	0.00	0.00	472.918	3.02	473.69	3.10	613.01	
23	55	7.87	0.00	0.00	561.555	3.02	561.20	3.09	602.12	
23	56	9.86	1.57	189.5	447.208	3.02	449.28	3.10	612.04	
23	57	9.95	2.78	109.5	443.634	3.02	446.05	3.10	612.35	
231	MISSING TUBE(S)									
59		5.62	5.85	73.70	787.957	3.01	795.92	3.05	600.01	
23	60	5.65	3.41	120.1	784.109	3.01	788.53	3.05	597.64	
23	61	4.34	8.67	59.51	1020.922	3.01	1031.31	3.03	598.76	
23	62	4.11	2.25	207.5	1078.736	3.01	1081.91	3.04	601.61	
23	63	2.39	2.46	249.9	1855.912	3.01	1856.25	3.03	596.91	
23	64	2.37	2.23	275.6	1880.464	3.00	1885.24	3.02	602.91	
23	65	1.94	5.13	140.9	2293.921	3.00	2298.83	3.01	601.61	
23	66	2.00	11.87	67.45	2224.498	3.00	2237.98	3.01	597.64	
23	67	2.63	11.05	62.39	1691.555	3.00	1703.94	3.01	597.37	
23	68	2.52	5.66	113.1	1760.784	3.01	1770.08	3.02	600.71	
23	69	2.64	6.76	94.48	1680.968	3.01	1687.90	3.02	600.89	
23	70	2.66	1.67	342.6	1669.054	3.00	1668.22	3.03	603.83	
23	71	2.61	2.09	279.4	1703.395	3.00	1708.41	3.02	602.69	
23	72	2.57	6.33	101.5	1730.739	3.00	1737.01	3.02	602.28	
23	73	2.74	11.62	58.64	1618.761	3.01	1633.25	3.02	598.47	
23	74	2.72	11.49	59.42	1630.321	3.01	1642.54	3.02	602.40	QC20U
23	75	3.34	6.52	86.81	1327.336	3.01	1336.34	3.03	601.09	uncapped
23	76	3.32	0.95	529.6	1336.257	3.01	1337.04	3.03	602.22	desorption
23	77	3.03	7.26	82.91	1465.145	3.01	1476.42	3.02	604.28	pp Tubes
23	78	3.10	8.90	68.84	1433.595	3.00	1444.03	3.02	601.20	
23	79	3.33	7.80	74.38	1332.834	3.01	1339.25	3.03	596.21	
23	80	3.35	2.56	204.0	1324.856	3.01	1325.40	3.03	600.79	
23	81	2.92	8.98	70.40	1523.553	3.00	1532.12	3.02	602.71	
23	82	2.97	4.45	129.5	1497.171	3.00	1504.15	3.02	597.21	
23	83	2.92	4.18	138.1	1525.950	3.00	1530.75	3.02	601.71	
23	84	2.94	4.70	123.8	1510.103	3.01	1516.05	3.02	604.20	
23	85	3.28	6.09	92.99	1352.595	3.01	1360.42	3.03	599.44	
23	86	3.30	8.05	72.68	1345.286	3.01	1353.51	3.03	601.54	
23	87	2.65	5.91	106.2	1677.630	3.00	1681.80	3.02	599.66	
23	88	2.63	1.16	490.5	1688.133	3.00	1689.49	3.03	604.02	
23	89	2.90	3.32	171.7	1528.912	3.01	1532.20	3.03	600.36	
23	90	3.00	1.20	444.3	1485.165	3.00	1486.14	3.02	605.94	

23	91	2.74	7.61	83.75	1620.950	3.00	1629.24	3.02	603.07	pp
23	92	2.84	6.28	97.26	1565.160	3.00	1571.18	3.02	600.68	tubes
23	93	3.71	1.70	285.6	1196.228	3.01	1198.78	3.04	604.32	
23	94	3.66	1.45	334.7	1212.072	3.01	1213.92	3.04	604.45	
23	95	3.34	3.52	151.4	1328.534	3.01	1331.55	3.03	606.93	
23	96	3.44	0.00	0.00	1290.975	3.01	1292.28	3.03	602.60	
23	97	4.28	6.50	76.83	1036.685	3.01	1043.84	3.03	601.42	
98		4.42	4.76	99.97	1003.285	3.01	1010.07	3.04	598.13	

QC20U - uncapped Desorption

05 Mar 99 13:57 ALPHA/BETA - 1.02
Protocol #:23 U-233 3% 2 sigma Use

23	99	6.56	1.82	201.6	674.547	3.01	675.51	3.07	602.87
23	100	6.48	1.78	207.0	682.609	3.01	685.91	3.06	601.34
23	101	9.54	4.08	78.35	462.431	3.02	466.07	3.09	596.39
23	102	9.45	2.94	106.8	466.763	3.02	471.64	3.09	599.54
23	103	10.60	4.30	70.88	415.838	3.03	419.34	3.10	601.60
23	104	10.80	4.22	71.47	407.979	3.03	412.98	3.10	597.46
23	105	11.82	4.49	64.62	372.471	3.03	376.31	3.12	599.25
23	106	11.62	2.07	134.1	378.942	3.03	382.27	3.12	598.52
23	107	12.23	0.72	365.3	360.112	3.03	360.66	3.13	602.51
23	108	11.87	3.63	78.42	371.140	3.03	375.19	3.11	596.16
23									

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 05-Mar-99 15:47
C14 Eff (0-156 keV) = 97.32 %
C14 CHI SQUARE IPA DATA PROCESSED - 05-Mar-99 15:58
C14 Chi Square = 14.94
H3 IPA DATA PROCESSED - 05-Mar-99 15:59
H3 Eff (0-18.6 keV) = 65.11 %
H3 CHI SQUARE IPA DATA PROCESSED - 05-Mar-99 16:10
H3 Chi Square = 20.41
BKG IPA DATA PROCESSED - 05-Mar-99 17:10
Bkg (0-18.6 keV) = 21.60 cpm
Bkg (0-156 keV) = 31.37 cpm

WARNING: Questionable C14 Background value - Please view historic c

C14 E^2/B (1-156 keV) = 396.11
H3 E^2/B (1-18.6 keV) = 194.52

QC20U CAPPED EXPERIMENTS

2/18/99

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

Objective: To investigate the characteristics of U sorption on mixture of clinoptilolite and quartz as a function of pH.

Initial conditions:- $\sum U$ = 50 ppb (2.14 x 10^{-7})
- capped polycarbonate containers
- pH range 3.5-9.5
- solution volume = 35 ml
- mass of solid 1, quartz = 1.000 g
- mass of solid 2, clinoptilolite = 700mg (0.70 g)
- M/V = 28.57 g/L

Equipment:
Orion 920A pH meter and combination pH electrode
Glove box
CO_2 gas
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: ≤325 mesh Qtz & 100/200 mesh Clinoptilolite in Naf AJ
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 NaOH (lot 976631)
concentrated HNO_3 (lot 983546)
HNO_3 and NaOHstock solutions at various concentrations prepared in degassed water.
0.1m $NaNO_3$ matrix prepared with degassed water.
weighing paper/boats
deionized ultrapure water, DH_2O
Teflon beaker

Note: Ultrapure water was degassed by boiling it in a flask and cooled with mouth covered with rubber stopper.

Procedure:

A. Prepare separate 50 ppb U solutions for sorption experiments.
- On the Metler balance, weigh 200 g of 500 ppb U stock solution into a tared 2000 ml FEP bottle.
- Dilute to a total of 2000 g using 0.1m degassed $NaNO_3$ 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) QCU-pHi (where i is the approximate pH of each solution, see Table QCU).

- Label 1 polycarbonate centrifuge tube QC20U-IU(capped).
- 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-IU(capped) 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-IU(capped) container.
- Record weight of each sample container after addition of clinoptilolite.

E. Adjust pH of each solution by adding HNO_3 or NaOH.
- Add the volume of HNO_3 or NaOH to each experimental container as listed in Table QC20U. Take care to add HNO_3 or NaOH in the concentrations specified in Table CQ20U.
- For sample QC20U-IU(capped) (as listed in Table QC20U) add 100 μl of 50/50 V/V HNO_3 to the sample container.
- Weigh and record the weight of each sample container.

F. SampleQC20U-IU(capped) for initial [U].
- Label two 7 ml LSC vials as QC20U-IUa(capped) and QC20U-IUb(capped).
- 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 QC20U-IU(capped) 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-IU(capped).

G. Wait for equilibrium.
- Place caps on sample containers and do not tighten the caps.
- Place the containers on gyratory shaker (~120 rpm) placed in carbon controlled atmosphere glove box for 2-3 days.
- Tighten the containers and equilibrate the samples for at least 10 days.

H. Sample experimental solutions for [U] and pH.
- For each sample solution label two 7 ml LSC vials (e.g.,QC20U-pH3a and QC20U-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 inside the glove box.
- From each sample container withdraw two 0.5 ml aliquots of solution and transfer to the

appropriately labeled LSC vials inside the glove box.
- 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.

I. Transfer mixture of quartz and clinoptilolite for desorption.

- Record weight of PC sample containers. *Note: this step can be skipped if the mixture transfer is done immediately after the last step in section H.*
- For each PC sample container, label two corresponding polypropylene (PP) test tubes A and B(50 ml capacity).
- Record weight for the set of PP tubes A .
- Add 3.0 ml of 0.1M HNO3 to 50 ml PP tubes labeled as **B**-QC20Ud-pH(capped).
- Pour supernatant from PC containers into PP tubes with acid and labeled as **B**-QC20Ud-pH(capped) leaving behind about 7 to 8ml of solution in PC container with the solid mixture.
- Record the weight of PC containers containing the solid mixture and some solution.
- Stir the solid mixture in solution vigorously and immediately transfer all the solid and solution to the corresponding PP tubes marked as **A**-QC20Ud-pH(capped).
- Record the weight of PP tubes **A**-QC20Ud-pH(capped).
- Transfer supernatant with HNO3 acid from the PP tubes **B**-QC20Ud-pH(capped) back to original PC containers.
- Record weights of PC sample containers.
- Add approximately 3 ml of 0.1 M HNO_3 to PP tubes containing solid mixture, **A**-QC20Ud-pH(capped).
- Record weights of PP tubes **A**-QC20Ud-pH(capped) and PC sample containers.
- Place sample containers and PP test tubes on gyratory shaker (at about 120 rpm) and allow to desorb for at least 10 days.

J. Sample solutions for [U].

- For each sample container and PP test tube label two 7 ml LSC vials (e.g., QC20Ud-pH3a(capped) and QC20Ud-pH3b(capped)).
- 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 aliquot 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.

CAPPED

2/18/99

Sample Name	Original Container wt., g
QC20U-pH 3.0	22.1645
QC20U-pH 3.5	22.1693
QC20U-pH 4.0	22.348
QC20U-pH 4.25	22.2912
QC20U-pH 4.5	22.3223
QC20U-pH4.75	22.0611
QC20U-pH 5.0	22.2156
QC20U-pH 5.25	22.5646
QC20U-pH 5.5	22.2628
QC20U-pH 5.75	22.3321
QC20U-pH 6.0	22.295
QC20U-pH 6.25	22.2479
QC20U-pH 6.5	22.2783
QC20U-pH 6.75	22.3205
QC20U-pH 7.0	22.5938
QC20U-pH 7.25	22.2407
QC20U-pH 7.5	22.3038
QC20U-pH 7.75	22.324
QC20U-pH 8.0	22.2959
QC20U-pH 8.25	22.0777
QC20U-pH 8.5	22.2543
QC20U-pH 8.75	22.2717
QC20U-pH 9.0	22.5278
QC20U-pH 9.25	22.1685
QC20U-IU	22.6264

CAPPED

2/18/99

Sample Name	Container wt. + quartz, g
QC20U-pH 3.0	23.1662
QC20U-pH 3.5	23.1719
QC20U-pH 4.0	23.3516
QC20U-pH 4.25	23.2952
QC20U-pH 4.5	23.3256
QC20U-pH4.75	23.0628
QC20U-pH 5.0	23.2178
QC20U-pH 5.25	23.5637
QC20U-pH 5.5	23.2676
QC20U-pH 5.75	23.3345
QC20U-pH 6.0	23.2958
QC20U-pH 6.25	23.2487
QC20U-pH 6.5	23.2807
QC20U-pH 6.75	23.3225
QC20U-pH 7.0	23.5946
QC20U-pH 7.25	23.2451
QC20U-pH 7.5	23.3053
QC20U-pH 7.75	23.3253
QC20U-pH 8.0	23.2988
QC20U-pH 8.25	23.0809
QC20U-pH 8.5	23.2574
QC20U-pH 8.75	23.2762
QC20U-pH 9.0	23.5265
QC20U-pH 9.25	23.1691

CAPPED

2/18/99

Sample Name	Container wt. + clinop + quartz, g
QC20U-pH 3.0	23.867
QC20U-pH 3.5	23.872
QC20U-pH 4.0	24.0518
QC20U-pH 4.25	23.9967
QC20U-pH 4.5	24.0259
QC20U-pH4.75	23.7629
QC20U-pH 5.0	23.9181
QC20U-pH 5.25	24.2636
QC20U-pH 5.5	23.9682
QC20U-pH 5.75	24.0348
QC20U-pH 6.0	23.9967
QC20U-pH 6.25	23.9495
QC20U-pH 6.5	23.9807
QC20U-pH 6.75	24.0229
QC20U-pH 7.0	24.2954
QC20U-pH 7.25	23.9456
QC20U-pH 7.5	24.0054
QC20U-pH 7.75	24.0258
QC20U-pH 8.0	23.9988
QC20U-pH 8.25	23.7808
QC20U-pH 8.5	23.9578
QC20U-pH 8.75	23.9759
QC20U-pH 9.0	24.2278
QC20U-pH 9.25	23.8703

CAPPED

2/19/99 2/19/99

Sample Name	Container wt. + U soln. + quartz + clinop, g	Container Wt. After additions of HNO3 and NaOH, g
QC20U-pH 3.0	58.8723	58.9335
QC20U-pH 3.5	58.944	59.1436
QC20U-pH 4.0	59.1211	59.4955
QC20U-pH 4.25	58.9962	59.1891
QC20U-pH 4.5	59.0256	59.0521
QC20U-pH4.75	58.7745	58.8245
QC20U-pH 5.0	58.9222	58.9974
QC20U-pH 5.25	59.2142	59.3136
QC20U-pH 5.5	58.9623	59.0885
QC20U-pH 5.75	59.0616	59.211
QC20U-pH 6.0	59.0648	59.2393
QC20U-pH 6.25	58.9734	59.1716
QC20U-pH 6.5	58.9595	59.1806
QC20U-pH 6.75	59.058	59.431
QC20U-pH 7.0	59.2916	59.6948
QC20U-pH 7.25	58.9948	59.0436
QC20U-pH 7.5	59.0042	59.1128
QC20U-pH 7.75	58.9948	59.1186
QC20U-pH 8.0	59.024	59.1725
QC20U-pH 8.25	58.7936	58.968
QC20U-pH 8.5	58.9327	58.9988
QC20U-pH 8.75	58.9559	59.0479
QC20U-pH 9.0	59.2495	59.3745
QC20U-pH 9.25	58.8202	58.9698
QC20U-IU	57.6826	57.8071

CAPPED

3/16/99

Sample Name	Container wt. before sampling & pH measurements, g	Measured pH	Container wt. after sampling & pH measurements, g
QC20U-pH 3.0	58.2421	3.39	57.2146
QC20U-pH 3.5	58.7987	4.26	57.643
QC20U-pH 4.0	59.2202	3.95	58.1919
QC20U-pH 4.25	58.709	5.15	57.653
QC20U-pH 4.5	58.6449	5.47	57.5839
QC20U-pH4.75	58.2196	5.36	56.8192
QC20U-pH 5.0	58.1086	5.81	56.9773
QC20U-pH 5.25	58.5654	5.96	57.5087
QC20U-pH 5.5	58.3292	5.68	57.1823
QC20U-pH 5.75	58.6344	6.05	57.5887
QC20U-pH 6.0	58.4954	5.92	57.2897
QC20U-pH 6.25	58.3248	6.67	57.1786
QC20U-pH 6.5	58.5232	6.71	57.3612
QC20U-pH 6.75	58.8635	6.82	57.7661
QC20U-pH 7.0	59.1571	6.98	57.7568
QC20U-pH 7.25	58.2569	7.24	57.0805
QC20U-pH 7.5	58.6548	7.52	57.4606
QC20U-pH 7.75	58.5561	8.17	57.2374
QC20U-pH 8.0	58.5422	8.09	57.2802
QC20U-pH 8.25	58.5276	8.49	57.3146
QC20U-pH 8.5	58.1073	8.35	57.0688
QC20U-pH 8.75	58.2252	8.82	57.176
QC20U-pH 9.0	58.7419	9.06	57.7077
QC20U-pH 9.25	57.9519	9.24	56.8521

19
3/20/99
AJ

CAPPED SORPTION

Sample Name	wt. of vial,g	wt. Of vial + sample
QC20U-pH 3a	7.8899	8.3877
QC20U-pH 3b	7.8982	8.4014
QC20U-pH 3.5a	7.8704	8.366
QC20U-pH 3.5b	7.906	8.4029
QC20U-pH 4a	7.818	8.3172
QC20U-pH 4b	7.919	8.4258
QC20U-pH 4.25a	7.904	8.4009
QC20U-pH 4.25b	7.9179	8.4147
QC20U-pH 4.5a	7.859	8.3497
QC20U-pH 4.5b	7.8824	8.3823
QC20U-pH 4.75a	7.8325	8.3328
QC20U-pH4.75b	7.8233	8.3288
QC20U-pH 5a	7.8197	8.3149
QC20U-pH 5b	7.8969	8.4009
QC20U-pH 5.25a	7.8788	8.3759
QC20U-pH 5.25b	7.9875	8.4821
QC20U-pH 5.5a	7.8879	8.3818
QC20U-pH 5.5b	7.8361	8.3391
QC20U-pH 5.75a	7.8536	8.3444
QC20U-pH 5.75b	7.8405	8.3441
QC20U-pH 6a	7.9153	8.4062
QC20U-pH 6b	7.8395	8.3373
QC20U-pH 6.25a	7.8539	8.3487
QC20U-pH 6.25a	7.8961	8.3791
QC20U-pH 6.5a	7.904	8.3978
QC20U-pH 6.5b	7.9156	8.4124
QC20U-pH 6.75a	7.8607	8.3604
QC20-pH 6.75b	7.8669	8.3656
QC20U-pH 7a	7.8234	8.3188
QC20U-pH 7b	7.8597	8.3662
QC20U-pH 7.25a	7.8595	8.3625
QC20U-pH 7.25b	7.9953	8.4939
QC20U-pH 7.5a	7.8041	8.2973
QC20U-pH 7.5b	7.8532	8.3457
QC20U-pH 7.75a	7.8752	8.371
QC20U-pH 7.75b	7.8656	8.3708
QC20U-pH 8a	7.8655	8.3594
QC20U-pH 8b	7.8354	8.3394
QC20U-pH 8.25a	7.7891	8.2851
QC20U-pH 8.25b	7.8859	8.3855
QC20U-pH 8.5a	7.8922	8.3888
QC20U-pH 8.5b	7.8665	8.3654
QC20U-pH 8.75a	7.9086	8.4128
QC20U-pH 8.75b	7.8747	8.3758
QC20U-pH 9a	7.8579	8.3585
QC20U-pH 9b	7.8228	8.328
QC20U-pH 9.25a	7.9481	8.4543
QC20U-pH 9.25	7.8739	8.3764
QC20U-pH 9.5a	7.8466	8.3219
QC20U-pH 9.5b	7.823	8.2963
QC1.0U-Iua	7.7876	8.2933
QC1.0U-IUb	7.812	8.3168
QC1.0U-IUc	7.812	8.3168
QC1.0U-Iud	7.7876	8.2933
QC1.0U-IUe	7.8399	8.3457
QC1.0U-Iuf	7.8136	8.3189
QC1.0U-Iug	7.7792	8.2779
QC1.0U-Iuh	7.7917	8.2897


```
234 MISSING TUBE(S) 2/21/99
109    8.31     5.49 63.91   531.313  3.02   539.23   3.07 608.72
23 110    8.29     5.31 65.92   532.604  3.02   542.41   3.06 609.32
23 111    8.13     3.84 89.39   543.891  3.02   551.32   3.07 606.17
23 112    8.34     5.88 60.03   529.510  3.02   538.74   3.06 609.57
23 113    8.04     3.85 89.53   549.894  3.02   558.32   3.06 607.46
23 114    8.11     4.88 71.86   544.501  3.02   553.00   3.07 603.82
23
YSTEM NORMALIZED

23 Mar 99  03:10          ALPHA/BETA - 1.02                    Page
Protocol #:23              U-233 3% 2 sigma                     User : A

C14 IPA DATA PROCESSED - 23-Mar-99 03:10
   C14 Eff (0-156 keV) = 95.99 %
C14 CHI SQUARE IPA DATA PROCESSED - 23-Mar-99 03:21
   C14 Chi Square = 21.35
H3 IPA DATA PROCESSED - 23-Mar-99 03:22
   H3 Eff (0-18.6 keV) = 64.59 %

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


H3 CHI SQUARE IPA DATA PROCESSED - 23-Mar-99 03:32
   H3 Chi Square = 10.60
BKG IPA DATA PROCESSED - 23-Mar-99 04:33
   Bkg (0-18.6 keV) = 20.23 cpm
   Bkg (0-156 keV)  = 29.92 cpm

WARNING: Questionable C14 Background value - Please view historic data


   C14 E^2/B (1-156 keV)    = 395.58
   H3  E^2/B (1-18.6 keV)   = 203.86
```

QC20U-IU capped

		wt. of vial	wt. of vial + sample
2/19/99	QC20U-IUa	7.7884	8.2908
	QC20U-IUb	7.8063	8.3083
	QC20U-IUc	7.7888	8.2910
	QC20U-IUd	7.8525	8.3558
	QC20U-IUe	7.7662	8.2694
	QC20U-IUf	7.7820	8.2859

3/21/99

AJ

QC20U (Exhl. 2 2nd set) Capped QC20U

	55		9.78	0.00	0.00	451.020	3.02	449.90	3.11	616.11
	23	56	9.69	1.34	222.3	455.756	3.02	457.03	3.10	614.52
	23	57	15.95	0.61	377.7	275.369	3.04	275.69	3.17	617.74
	23	58	15.77	0.33	683.7	278.424	3.04	279.23	3.17	617.12
	23	59	13.05	1.28	200.5	337.159	3.03	338.22	3.14	608.75
	23	60	12.72	1.76	149.8	345.994	3.03	347.91	3.13	612.85
	23	61	29.10	0.50	343.8	149.372	3.07	150.28	3.31	614.67
	23	62	30.10	1.04	162.7	144.297	3.07	145.28	3.32	617.02
	23	63	54.15	1.09	117.7	78.691	3.13	80.30	3.57	613.64
	23	64	49.98	0.75	176.4	85.539	3.12	86.95	3.53	615.45
	23	65	33.28	0.56	284.0	130.187	3.08	131.41	3.35	612.24
	23	66	32.34	0.48	336.4	134.038	3.08	135.39	3.34	611.49
	23	67	73.00	0.25	430.0	57.513	3.18	58.45	3.79	615.02
	23	68	71.95	0.44	251.7	58.402	3.18	58.87	3.80	613.72
	23	69	57.83	0.00	0.00	73.607	3.14	73.71	3.65	619.54
	23	70	58.01	0.84	147.0	73.248	3.14	74.84	3.61	617.02
	23	71	44.37	0.60	231.4	96.781	3.11	97.57	3.48	612.81
	23	72	42.07	0.92	156.2	102.280	3.10	104.21	3.43	608.28
	23	73	54.45	1.52	84.69	78.239	3.13	80.58	3.55	610.22
	23	74	51.07	0.54	240.9	83.641	3.12	84.31	3.56	613.30
	23	75	56.46	0.00	0.00	75.334	3.14	75.52	3.63	619.68
	23	76	56.55	0.00	0.00	75.208	3.14	74.91	3.65	619.58
	23	77	82.19	1.47	72.35	50.693	3.21	52.29	3.86	602.88
	23	78	83.43	1.35	77.80	49.901	3.21	51.92	3.85	610.95
	23	79	84.12	0.00	0.00	49.464	3.21	49.23	3.98	624.07
	23	80	85.32	0.00	0.00	48.709	3.22	49.08	3.96	621.14
	23	81	77.63	0.62	173.5	53.908	3.19	55.08	3.83	613.25
	23	82	77.45	0.08	1273	54.002	3.20	54.92	3.84	614.83
	23	83	61.07	1.18	102.3	69.425	3.15	71.11	3.64	609.41
	23	84	63.08	1.10	108.7	67.073	3.16	68.37	3.67	606.05
	23	85	97.80	0.35	274.7	42.063	3.25	43.04	4.07	613.10
	23	86	97.60	0.54	176.8	42.156	3.25	43.02	4.08	618.09
	23	87	65.18	0.61	188.7	64.803	3.16	65.89	3.70	612.00
	23	88	64.53	0.30	391.1	65.506	3.16	65.96	3.72	615.98
	23	89	66.35	0.00	0.00	63.631	3.16	64.38	3.73	624.66
	23	90	65.22	0.68	171.1	64.792	3.16	65.79	3.70	608.45
	23	91	65.09	0.00	0.00	64.898	3.16	65.21	3.73	618.83
	23	92	63.31	0.00	0.00	66.865	3.16	67.53	3.69	617.52
	23	93	70.22	0.17	639.4	59.910	3.18	60.51	3.78	613.63
	23	94	67.39	0.18	643.7	62.567	3.17	63.65	3.73	618.83
	23	95	86.47	0.31	325.3	48.017	3.22	48.77	3.95	613.10
	23	96	84.45	0.54	191.4	49.246	3.21	50.52	3.90	610.97
	23	97	69.37	0.16	690.8	60.700	3.17	61.17	3.77	618.56
	23	98	67.58	0.34	332.6	62.382	3.17	63.48	3.73	615.15
	23	99	76.67	0.31	340.5	54.586	3.19	55.21	3.85	617.91
	23	100	74.62	0.00	0.00	56.178	3.19	56.21	3.85	622.06
	23	101	69.41	0.00	0.00	60.648	3.17	60.47	3.80	623.70
	23	102	69.16	0.57	197.9	60.880	3.17	62.06	3.74	618.91
	23									

SYSTEM NORMALIZED

CAPPED

3/28/99

Sample Name	wt. Of PP tubes, g	wt. Of PP tubes after transfer of qtz/clino, g	wt. Of PP tubes after acid add, g	Container wt. after transfer of supernatant, g	Container wt. after supernatant retransfer+acid added ,g
QC20U-pH 3.0	13.6579	21.1117	24.1493	29.9928	52.4711
QC20U-pH 3.5	13.6836	23.5961	26.6179	32.2587	50.4958
QC20U-pH 4.0	13.5571	23.4823	26.4956	32.4115	51.0262
QC20U-pH 4.25	13.7629	23.2469	26.2554	31.9782	51.0244
QC20U-pH 4.5	13.6793	23.8224	26.8193	32.6648	50.2929
QC20U-pH4.75	13.6855	21.9358	24.9351	30.5193	51.3388
QC20U-pH 5.0	13.3224	22.034	25.0324	31.2063	50.9743
QC20U-pH 5.25	13.6969	21.8724	24.868	30.9211	52.052
QC20U-pH 5.5	13.6947	21.5299	24.5445	30.3507	52.024
QC20U-pH 5.75	13.687	21.535	24.5322	30.3727	52.5638
QC20U-pH 6.0	13.8746	23.8253	26.8229	32.4456	50.106
QC20U-pH 6.25	13.589	24.0352	27.0399	32.8927	49.54
QC20U-pH 6.5	13.7067	23.2027	26.1964	32.0138	50.5919
QC20U-pH 6.75	13.6713	21.5748	24.5746	30.4269	52.6944
QC20U-pH 7.0	13.6627	19.5214	22.5173	28.8202	54.64
QC20U-pH 7.25	13.686	22.1571	25.1508	30.9484	51.2734
QC20U-pH 7.5	13.7966	22.2487	25.2563	31.158	51.7667
QC20U-pH 7.75	13.411	22.0282	25.0163	31.1785	51.3523
QC20U-pH 8.0	13.6952	22.9669	25.9564	31.8205	50.7663
QC20U-pH 8.25	13.7994	22.406	25.3898	31.0422	51.5076
QC20U-pH 8.5	13.6714	21.9039	24.8946	30.7565	51.612
QC20U-pH 8.75	13.3873	20.2339	23.2236	29.5296	53.0928
QC20U-pH 9.0	13.6398	20.9319	23.9196	30.2069	53.1431
QC20U-pH 9.25	13.6404	23.3224	26.2996	32.2381	49.9017
QC20U-pH 9.5	13.6968	25.1003	25.1003	31.1298	53.4168

3/30/99	PP tubes	Desorption	PC containers	Desorption
Sample Name	wt. of vial,g	wt. Of vial + sample	wt. of vial,g	wt. Of vial + sample
QC20U-pH 3a	7.9776	8.4774	7.9153	8.4181
QC20U-pH 3b	7.9754	8.4764	7.8851	8.3886
QC20U-pH 3.5a	7.8732	8.3705	7.8636	8.3639
QC20U-pH 3.5b	7.8578	8.3582	7.8532	8.3528
QC20U-pH 4a	7.9206	8.4213	7.8877	8.3893
QC20U-pH 4b	7.8551	8.3584	7.8693	8.3727
QC20U-pH 4.25a	7.8029	8.3027	7.8835	8.3841
QC20U-pH 4.25b	7.8888	8.3905	7.868	8.3665
QC20U-pH 4.5a	7.8256	8.3256	7.8843	8.3812
QC20U-pH 4.5b	7.8675	8.3697	7.8443	8.341
QC20U-pH 4.75a	7.9036	8.4043	7.8888	8.3919
QC20U-pH4.75b	7.978	8.4808	7.809	8.3113
QC20U-pH 5a	7.9166	8.4183	7.7824	8.2841
QC20U-pH 5b	7.8648	8.3665	7.8018	8.3045
QC20U-pH 5.25a	7.9196	8.4189	7.8645	8.366
QC20U-pH 5.25b	7.8859	8.3875	7.8339	8.335
QC20U-pH 5.5a	7.95	8.4452	7.9096	8.4123
QC20U-pH 5.5b	7.89	8.3917	7.8415	8.3437
QC20U-pH 5.75a	7.8895	8.3893	7.8817	8.385
QC20U-pH 5.75b	7.879	8.3784	7.8903	8.3931
QC20U-pH 6a	7.8322	8.3288	7.8689	8.3712
QC20U-pH 6b	7.8904	8.3878	7.8639	8.3658
QC20U-pH 6.25a	7.8364	8.3327	7.8378	8.3403
QC20U-pH 6.25a	7.8422	8.3402	7.7491	8.2533
QC20U-pH 6.5a	7.8737	8.3672	7.8525	8.3555
QC20U-pH 6.5b	7.814	8.3087	7.8601	8.3612
QC20U-pH 6.75a	7.9318	8.4219	7.8387	8.3414
QC20-pH 6.75b	7.9091	8.4015	7.8851	8.3867
QC20U-pH 7a	7.9006	8.397	7.9229	8.422
QC20U-pH 7b	7.859	8.3559	7.8487	8.35
QC20U-pH 7.25a	7.8189	8.3141	7.8491	8.3485
QC20U-pH 7.25b	7.8674	8.3631	7.8975	8.3986
QC20U-pH 7.5a	7.8524	8.3449	7.8796	8.3787
QC20U-pH 7.5b	7.8618	8.3557	7.8869	8.3886
QC20U-pH 7.75a	7.8679	8.3637	7.8694	8.3702
QC20U-pH 7.75b	7.9125	8.4077	7.8326	8.3343
QC20U-pH 8a	7.9028	8.3987	7.8867	8.3866
QC20U-pH 8b	7.8179	8.3148	7.8311	8.3325
QC20U-pH 8.25a	7.8378	8.3317	7.8895	8.3887
QC20U-pH 8.25b	7.8274	8.3232	7.9532	8.4535
QC20U-pH 8.5a	7.8546	8.3485	7.8664	8.3656
QC20U-pH 8.5b	7.91	8.4068	7.8601	8.3603
QC20U-pH 8.75a	7.8967	8.3904	7.886	8.3862
QC20U-pH 8.75b	7.8873	8.3837	7.887	8.3861
QC20U-pH 9a	7.9069	8.404	7.9045	8.4025
QC20U-pH 9b	7.8947	8.3929	7.8399	8.339
QC20U-pH 9.25a	7.8643	8.3599	7.8425	8.3407
QC20U-pH 9.25	7.8827	8.3786	7.8147	8.3155

CAPPED

	3/29/99	3/30/99	3/29/99	3/29/99
Sample Name	Container wt. before sampling	Container wt. after sampling	wt. Of PP tubes before sampling	wt. Of PP tubes after sampling
QC20U-pH 3.0	52.3794	51.3561	23.9478	22.9421
QC20U-pH 3.5	50.4439	49.4305	26.5012	25.4813
QC20U-pH 4.0	50.9666	49.9518	26.3068	25.298
QC20U-pH 4.25	50.9113	49.8988	26.0634	25.0531
QC20U-pH 4.5	50.2167	49.2038	26.1856	25.1816
QC20U-pH4.75	51.2173	50.2003	24.8772	23.8645
QC20U-pH 5.0	50.6345	49.6016	24.8633	23.8492
QC20U-pH 5.25	51.9581	50.9442	24.7697	23.7637
QC20U-pH 5.5	51.9588	50.9462	24.1737	23.1718
QC20U-pH 5.75	52.4837	51.4675	24.3296	23.3242
QC20U-pH 6.0	50.0028	48.9883	26.615	25.6064
QC20U-pH 6.25	49.4183	48.4002	26.9494	25.9439
QC20U-pH 6.5	50.4808	49.4655	26.0436	25.0448
QC20U-pH 6.75	52.5911	51.5758	24.4334	23.4442
QC20U-pH 7.0	54.505	53.4909	22.3806	21.3785
QC20U-pH 7.25	51.1524	50.1426	25.0402	24.0417
QC20U-pH 7.5	51.6927	50.6829	25.0706	24.0744
QC20U-pH 7.75	51.1989	50.1828	24.8501	23.8518
QC20U-pH 8.0	50.6826	49.6729	25.7261	24.7265
QC20U-pH 8.25	51.4065	50.3965	25.0435	24.0478
QC20U-pH 8.5	51.515	50.5058	24.6534	23.6563
QC20U-pH 8.75	52.9851	51.9742	22.8822	21.8864
QC20U-pH 9.0	53.0569	52.0497	23.8875	22.8878
QC20U-pH 9.25	49.8185	48.809	26.1015	25.1059

01 Apr 99 13:32 ALPHA/BETA - 1.02 Pag
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	19.92
Region B:	100 -	350	0	3.0	3.47
Region C:	0.0 -	2000	0	0.1	29.41

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

S#	TIME	CPMA A:2S%		CPMB B:2S%		CPMC C:2S%		SIS FLAG	
P#	1 999.99	19.92	1.42	3.465	3.40	29.41	1.17	145.25	B
23	2 8.00	3.33	102.7	552.035	3.02	556.84	3.08	607.54	Std.
23	3 8.11	2.52	132.4	544.747	3.02	551.60	3.07	608.99	
23	4 8.18	3.92	87.43	539.933	3.02	548.22	3.07	607.30	QC20V
23	5 7.91	3.85	90.41	558.735	3.02	564.77	3.07	600.36	uncapped 50 PPB
2314 MISSING TUBE(S)									
20	6.70	1.42	251.6	660.863	3.01	661.63	3.07	596.53	
23	21 6.72	4.19	90.72	657.845	3.02	664.63	3.06	595.64	
23	22 4.68	26.02	24.11	946.321	3.01	973.15	3.01	563.96	
23	23 4.50	6.75	72.29	984.535	3.01	991.03	3.04	581.98	
23	24 5.29	5.41	81.06	838.123	3.01	843.74	3.05	580.53	
23	25 5.41	3.19	130.1	819.456	3.01	823.27	3.05	586.04	
23	26 3.30	4.63	118.1	1343.202	3.01	1348.47	3.03	586.00	
23	27 3.23	1.13	451.6	1373.315	3.01	1374.92	3.03	592.15	
23	28 3.13	3.72	147.9	1417.621	3.01	1421.70	3.03	586.05	
23	29 3.07	3.86	144.4	1444.743	3.01	1449.41	3.03	588.64	
23	30 2.89	4.65	125.6	1538.749	3.00	1543.25	3.02	588.21	QC20V Capped Tubes desorption
23	31 2.83	8.70	73.17	1566.853	3.01	1579.42	3.02	589.92	
23	32 2.70	8.97	73.01	1645.794	3.00	1655.03	3.02	589.55	
23	33 2.63	7.08	90.64	1686.649	3.01	1693.40	3.02	589.29	
23	34 2.59	1.32	435.9	1713.910	3.00	1717.69	3.02	592.58	
23	35 2.67	7.05	90.30	1661.703	3.01	1669.84	3.02	589.67	
23	36 2.65	8.38	78.05	1674.648	3.01	1681.91	3.02	592.16	
23	37 2.69	8.70	75.02	1648.579	3.01	1657.95	3.02	588.48	
23	38 2.57	10.82	63.99	1728.052	3.00	1737.90	3.02	590.12	
23	39 2.59	10.58	64.92	1712.751	3.01	1728.12	3.01	548.54	
23	40 3.13	0.00	0.00	1419.538	3.00	1421.39	3.03	591.21	
23	41 3.09	10.50	59.82	1440.548	3.00	1455.05	3.01	588.01	
23	42 3.13	3.08	176.1	1423.052	3.00	1427.14	3.02	594.96	
23	43 3.17	7.52	78.30	1399.689	3.01	1408.44	3.02	590.21	
23	44 2.85	9.55	67.39	1559.693	3.00	1571.64	3.02	590.48	
23	45 2.80	4.01	146.0	1583.678	3.01	1588.09	3.03	589.37	
23	46 2.44	2.21	272.7	1820.305	3.00	1823.46	3.02	594.13	

23	47	2.43	5.59	116.0	1828.634	3.00	1835.20	3.02	591.60
23	48	1.95	11.36	70.55	2286.279	3.00	2299.82	3.01	588.10
23	49	2.02	3.35	203.0	2202.970	3.00	2205.24	3.02	590.75
23	50	2.54	4.10	150.3	1750.866	3.00	1755.63	3.02	592.18
23	51	2.60	3.54	169.8	1711.535	3.00	1713.66	3.02	590.98
23	52	2.68	9.18	71.83	1658.102	3.00	1667.23	3.02	589.18
23	53	2.66	4.14	145.5	1673.979	3.00	1679.23	3.02	595.08
23	54	2.63	8.98	73.92	1686.269	3.01	1697.96	3.02	590.20

01 Apr 99 16:11 ALPHA/BETA - 1.02 Pa
Protocol #:23 U-233 3% 2 sigma User :

23	55	2.61	8.82	75.35	1705.347	3.00	1714.65	3.02	591.60
23	56	2.73	10.85	61.94	1628.769	3.00	1637.25	3.02	590.45
23	57	2.82	8.09	77.96	1574.195	3.01	1584.77	3.02	590.27
23	58	2.68	10.68	63.35	1659.968	3.00	1671.71	3.01	590.23
23	59	2.56	8.20	80.87	1736.769	3.00	1746.37	3.02	590.63
23	60	2.41	10.79	66.24	1845.083	3.00	1860.21	3.01	590.11
23	61	2.44	8.77	78.28	1821.125	3.00	1832.47	3.01	591.26
23	62	2.39	14.39	52.70	1860.970	3.00	1877.28	3.01	590.07
23	63	2.35	7.74	88.73	1896.961	3.00	1902.93	3.01	590.53
23	64	2.27	11.36	65.41	1966.579	3.00	1981.60	3.00	589.27
23	65	2.21	4.51	147.5	2008.300	3.00	2013.57	3.02	589.26
23	66	3.06	4.92	116.0	1448.823	3.01	1454.90	3.03	590.72
23	67	2.99	3.16	176.2	1486.501	3.00	1488.98	3.03	591.58
235 MISSING TUBE(S)									
73	10.89	0.19	1438	404.799	3.03	407.68	3.11	597.79	
23	74	10.57	3.07	96.54	417.349	3.02	420.63	3.10	590.37
23	75	17.37	1.73	130.4	252.378	3.04	254.35	3.18	593.60
23	76	17.42	0.00	0.00	251.644	3.04	249.00	3.21	600.63
23	77	14.64	1.05	229.6	300.223	3.03	301.39	3.16	594.20
23	78	14.39	1.97	126.0	305.639	3.03	308.88	3.14	590.33
23	79	32.69	0.24	668.0	132.509	3.08	133.39	3.36	595.78
23	80	33.60	0.94	169.8	128.827	3.08	130.44	3.35	590.31
23	81	54.77	0.73	172.7	77.729	3.14	78.86	3.59	591.79
23	82	53.34	1.10	117.4	79.906	3.13	81.57	3.56	589.08
23	83	35.78	0.51	301.3	120.766	3.09	121.54	3.39	595.17
23	84	36.43	1.98	79.42	118.550	3.09	120.90	3.37	586.38
23	85	66.40	1.15	101.1	63.493	3.17	65.09	3.70	584.94
23	86	65.60	0.96	120.7	64.309	3.17	65.16	3.72	587.25
23	87	57.38	1.29	96.82	74.018	3.14	75.97	3.60	585.40
23	88	55.90	0.94	133.6	76.034	3.14	77.21	3.61	592.75
23	89	45.23	1.46	96.18	94.788	3.11	96.48	3.48	590.48
23	90	46.60	0.00	0.00	91.943	3.12	91.21	3.55	603.06
23	91	46.81	0.29	464.8	91.472	3.12	91.50	3.53	597.16
23	92	48.32	0.57	234.5	88.526	3.12	89.36	3.53	593.72
23	93	52.10	0.00	0.00	81.852	3.13	81.87	3.59	594.98
23	94	49.68	0.15	878.4	86.008	3.12	87.23	3.54	591.34
23	95	66.31	0.00	0.00	63.554	3.17	63.02	3.79	598.89
23	96	64.56	0.56	208.5	65.370	3.16	66.61	3.70	590.84
23	97	74.59	0.00	0.00	56.127	3.19	55.79	3.88	602.65
23	98	74.11	0.00	0.00	56.500	3.19	56.46	3.86	599.29
23	99	83.37	0.72	143.1	49.840	3.22	50.45	3.94	587.77

QC20V Capped Tubes desorption

QC20V Capped Containers desorption

23	100	83.86	0.14	742.9	49.528	3.22	50.28	3.94	594.72
23	101	62.01	0.00	0.00	68.201	3.16	68.25	3.71	605.07
23	102	62.26	0.85	140.3	67.945	3.16	68.77	3.69	591.63
23	103	86.32	0.53	192.3	48.018	3.23	49.04	3.95	591.47
23	104	84.13	0.60	172.4	49.358	3.22	50.27	3.93	591.96
23	105	68.42	0.56	203.1	61.545	3.17	62.27	3.76	590.41
23	106	70.63	0.00	0.00	59.454	3.18	58.20	3.87	606.22
23	107	71.89	0.00	0.00	58.366	3.18	58.21	3.84	598.71
23	108	70.11	0.00	0.00	59.921	3.18	59.62	3.82	605.45
23	109	70.87	0.16	693.5	59.241	3.18	59.72	3.80	598.10
23	110	72.64	0.10	1129	57.713	3.19	57.85	3.84	599.95
23	111	74.17	0.74	148.6	56.451	3.19	58.41	3.77	591.34
23	112	73.93	0.29	375.9	56.646	3.19	57.07	3.84	598.85
23	113	92.62	0.59	165.5	44.538	3.24	45.72	4.01	593.29
23	114	91.99	0.10	939.9	44.845	3.24	45.76	4.02	597.58
23	115	41.88	1.26	115.1	102.648	3.10	104.28	3.44	591.62

3/31/99

23 Apr 99 09:32 ALPHA/BETA - 1.02 Pag
Protocol #:23 U-233 3% 2 sigma User :

23	116	42.04	0.00	0.00	102.315	3.10	101.60	3.49	606.49
23	117	88.34	0.66	152.5	46.841	3.23	48.28	3.95	590.59
23	118	86.32	0.27	370.3	48.064	3.22	48.87	3.96	600.34
23	119	53.30	1.11	115.8	79.912	3.13	81.64	3.56	593.97
23	120	53.79	0.98	131.0	79.153	3.14	80.29	3.58	592.55

QC20U capped containers desorp.

Table CQ20U: Estimated solution pH and volumes of HNO3 or NaOH solution needed for adjustment of pH in 0.1 m NaNO3 solutions with 50 ppb U in contact with quartz and clinoptilolite (35ml).

Estimated solution pH	Volume of HNO3 added, ml	Molarity of HNO3 to use
3	0.060	1
3.5	0.205	0.1
4	0.385	0.01
4.25	0.190	0.01

Estimated solution pH	Volume of NaOH added, ml	Molarity of NaOH to use
4.50	0.09	0.01
4.75	0.150	0.01
5	0.200	0.01
5.25	0.225	0.01
5.5	0.250	0.01
5.75	0.275	0.01
6	0.300	0.01
6.25	0.325	0.01
6.5	0.350	0.01
6.75	0.375	0.01
7	0.400	0.01
7.25	0.050	0.05
7.5	0.115	0.05
7.75	0.130	0.05
8	0.175	0.05
8.25	0.160	0.05
8.5	0.100	0.1
8.75	0.100	0.1
9	0.125	0.1
9.25	0.150	0.1
9.5	0.176	0.1
QC10U-HJ	0.100	50% HNO3

Experimental Procedure for experiment - U 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 (2.14 x 10^{-7})
- Capped containers
- pH range 3.0-9.5
- solution volume = 35 ml
- mass of solid 1, quartz = 1.000 g
- mass of solid 2, clinoptilolite = 0.000 g
- M/V = 28.57 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: W510 * VC * RC * Fe * HL * ≤325 mesh AJ
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 NaOH (lot 976631)
concentrated HNO_3 (lot 983546)
HNO_3 and NaHCO3 or NaOHdegassed 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 200 g of 500 ppb U stock solution into a tared 2000 ml FEP bottle.
- Dilute to a total of 2000 g using degassed 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 26 polycarbonate centrifuge tubes (50 ml capacity) CQU-pHi (where i is the approximate pH of each solution, see Table CQ0U).
- Label 1 polycarbonate centrifuge tube CQ0U-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.

B. Add quartz to sample containers.

- Add ~1.000 g of quartz to each sample container. **Do not** add quartz to the CQ20-U-IU container.
- Record weight of each sample container after addition of quartz .

- Adjust pH of each solution by adding HNO_3 or NaHCO3.
  - Add the volume of HNO_3 or NaOHto each experimental container as listed in Table CQ0U. Take care to add HNO_3 or NaOH in the concentrations specified in Table CQ0U.
  - For sample CQ0U-IU (not listed in Table CQ0U) add 100 μl of 50/50 V/V HNO_3 to the sample container.
  - Weigh and record the weight of each sample container.

- Sample CQ0U-IU for initial [U].
  - Label two 7 ml LSC vials as CQ0U-IUa and CQ0U-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 CQ20-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 CQ0U-IU

- Wait for equilibrium.
  - Place caps on sample containers but do not tighten the caps.
  - Place containers inside the glove box. Tighten the caps after 2 days.
  - Place containers on gyratory shaker set at about 120 rpm and allow samples to equilibrate for at least 10 days.

- Sample experimental solutions for [U] and pH.
  - For each sample solution label two 7 ml LSC vials (e.g., CQ0U-pH3a and CQ0U-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.
  - Record weight of each sample container.
  - Measure pH of each experimental solution.
  - Record weight of each sample container after pH measurement.

- Transfer quartz for desorption.

  - Record weight of sample containers. *Note: this step can be skipped if the clinoptilolite transfer is done immediately after the last step in section F.*
  - Centrifuge polycarbonate tubes containing experimental solutions at about 5,000 rpm for 5 min to remove fine particles from suspension.
  - For each sample container, label a corresponding polypropylene (PP) test tube (50 ml capacity) (e.g., CQ0dU-pH3 for sample container CQ0U-pH3).
  - Record weight of PP test tubes.
  - Using an Eppendorf or Oxford pipette, withdraw quartz 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.

C. Sample solutions for [U].

  - For each sample container and PP test tube label two 7 ml LSC vials (e.g., CQ0U-pH3a and CQ02U-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.

Table CQ0U: Estimated solution pH and volumes of HNO3 or NaOH solutions need for adjustment of pH in 0.1 m NaNO3 solutions with 50 ppb U in contact with qz/clino

2/19/99 2/25/99

Estimated solution pH	Volume of HNO3 added, ml	Actual Vol. of HNO_3 added, ml		Molarity of HNO3 to use
3	0.045	0.060		1
3.5	0.143	0.205	0.020 1M NaOH	0.1
4	0.140	0.0375		0.01
4.25	0.014	0.190		0.01
Estimated solution pH	**Volume of NaOH added, ml**	**Actual Volume of NaOH added**		**Molarity of NaOH to use**
4.5	0.09	0.025		0.01
4.75	0.150	0.050	0.050 [0.01M NaOH]	0.01
5	0.200	0.075	0.075 [0.01M NaOH]	0.01
5.25	0.225	0.100	0.100 [0.01M NaOH]	0.01
5.5	0.250	0.125		0.01
5.75	0.275	0.150	0.075 [0.01M NaOH]	0.01
6	0.300	0.175		0.01
6.25	0.325	0.200		0.01
6.5	0.350	0.225		0.01
6.75	0.375		0.050 0.01M HNO_3	0.01
7	0.400		0.055 0.01M HNO_3	0.01
7.25	0.050			0.05
7.5	0.075	0.110	0.015 0.05M HNO_3	0.05
7.75	0.100	0.125	0.020 0.05M HNO_3	0.05
8	0.125	0.150	0.025 0.05M HNO_3	0.05
8.25	0.150	0.175	0.030 0.05M HNO_3	0.05
8.5	0.065	0.090	0.005 0.1M HNO_3	0.1
8.75	0.100	0.100	0.015 0.1M HNO_3	0.1
9	0.125	0.125	0.010 0.1M HNO_3	0.1
9.25	0.150	0.150	0.010 0.1M HNO_3	0.1
9.5	0.175			0.1
QCOU-IU	0.100			50% HNO3

CAPPED

2/18/99

Sample Name	Wt. Of container [redacted] g
QC0U-pH 3.5	22.2395
QC0U-pH 4.0	22.1946
QC0U-pH 4.25	22.1712
QC0U-pH 4.5	22.2782
QC0U-pH4.75	22.1919
QC0U-pH 5.0	22.3295
QC0U-pH 5.25	22.1618
QC0U-pH 5.5	22.4789
QC0U-pH 5.75	22.0817
QC0U-pH 6.0	22.1875
QC0U-pH 6.25	22.09
QC0U-pH 6.5	22.2926
QC0U-pH 6.75	22.533
QC0U-pH 7.0	22.1867
QC0U-pH 7.25	22.4386
QC0U-pH 7.5	22.1048
QC0U-pH 7.75	22.2593
QC0U-pH 8.0	22.2038
QC0U-pH 8.25	22.1826
QC0U-pH 8.5	22.2489
QC0U-pH 8.75	22.934
QC0U-pH 9.0	22.1506
QC0U-pH 9.25	22.1944

CAPPED

2/18/99

Sample Name	Wt. Of container + quartz, g
QC0U-pH 3.5	23.2398
QC0U-pH 4.0	23.1983
QC0U-pH 4.25	23.1723
QC0U-pH 4.5	23.2777
QC0U-pH4.75	23.1931
QC0U-pH 5.0	23.3331
QC0U-pH 5.25	23.1644
QC0U-pH 5.5	23.4796
QC0U-pH 5.75	23.086
QC0U-pH 6.0	23.1898
QC0U-pH 6.25	23.0912
QC0U-pH 6.5	23.2951
QC0U-pH 6.75	23.5336
QC0U-pH 7.0	23.1874
QC0U-pH 7.25	23.4433
QC0U-pH 7.5	23.1056
QC0U-pH 7.75	23.2598
QC0U-pH 8.0	23.2072
QC0U-pH 8.25	23.1852
QC0U-pH 8.5	23.2487
QC0U-pH 8.75	22.8458
QC0U-pH 9.0	23.1523
QC0U-pH 9.25	23.1905

CAPPED

2/18/99

Sample Name	Wt. Of Container + quartz + U soln., g
QC0U-pH 3.5	58.3034
QC0U-pH 4.0	58.2847
QC0U-pH 4.25	58.1612
QC0U-pH 4.5	58.295
QC0U-pH4.75	58.2108
QC0U-pH 5.0	58.3318
QC0U-pH 5.25	58.1736
QC0U-pH 5.5	58.5121
QC0U-pH 5.75	58.0944
QC0U-pH 6.0	58.2034
QC0U-pH 6.25	58.1017
QC0U-pH 6.5	58.2972
QC0U-pH 6.75	58.544
QC0U-pH 7.0	58.1963
QC0U-pH 7.25	58.4628
QC0U-pH 7.5	58.1138
QC0U-pH 7.75	58.2504
QC0U-pH 8.0	58.192
QC0U-pH 8.25	58.1774
QC0U-pH 8.5	58.2643
QC0U-pH 8.75	57.8952
QC0U-pH 9.0	58.1948
QC0U-pH 9.25	58.2333

CAPPED

Sample Name	Container Wt. After additions of HNO3 and NaOH., g
QC0U-pH 3.5	58.5032
QC0U-pH 4.0	58.659
QC0U-pH 4.25	58.3499
QC0U-pH 4.5	58.3207
QC0U-pH4.75	58.26
QC0U-pH 5.0	58.4176
QC0U-pH 5.25	58.2213
QC0U-pH 5.5	58.6339
QC0U-pH 5.75	58.2427
QC0U-pH 6.0	58.3768
QC0U-pH 6.25	58.3002
QC0U-pH 6.5	58.5203
QC0U-pH 6.75	58.9164
QC0U-pH 7.0	58.5266
QC0U-pH 7.25	58.5354
QC0U-pH 7.5	58.2231
QC0U-pH 7.75	58.3732
QC0U-pH 8.0	58.3396
QC0U-pH 8.25	58.3507
QC0U-pH 8.5	58.3289
QC0U-pH 8.75	57.9908
QC0U-pH 9.0	58.317
QC0U-pH 9.25	58.2781

CAPPED

Sample Name	Container wt. before sampling & pH measurements, g	Measured pH	Container wt. after sampling & pH measurements, g
QC0U-pH 3.5	58.075	3.51	57.0306
QC0U-pH 4.0	57.9595	3.15	56.9457
QC0U-pH 4.25	57.9326	4.26	56.914
QC0U-pH 4.5	57.7767	4.6	56.7784
QC0U-pH4.75	57.8441	4.82	56.8248
QC0U-pH 5.0	58.0761	5	57.048
QC0U-pH 5.25	57.6051	4.68	56.6044
QC0U-pH 5.5	58.1816	5.27	57.1639
QC0U-pH 5.75	57.5609	5.46	56.4805
QC0U-pH 6.0	56.6297	5.2	55.613
QC0U-pH 6.25	57.6768	5.52	56.5839
QC0U-pH 6.5	57.8916	5.84	56.8859
QC0U-pH 6.75	58.4256	6.33	57.2239
QC0U-pH 7.0	57.9073	6.29	56.7659
QC0U-pH 7.25	57.8202	6.12	56.7209
QC0U-pH 7.5	57.5984	6.88	56.5986
QC0U-pH 7.75	57.9279	7.25	56.9169
QC0U-pH 8.0	57.9922	7.66	57.0234
QC0U-pH 8.25	57.8801	8.22	56.815
QC0U-pH 8.5	57.6919	8.51	56.5514
QC0U-pH 8.75	57.3205	8.75	56.2408
QC0U-pH 9.0	57.5496	9.22	56.5143
QC0U-pH 9.25	57.3943	9.47	56.3132

CAPPED

Sample Name	wt. of vial	wt. Of vial + sample
QC0U--pH 3.5a	7.9047	8.3989
QC0U-pH 3.5b	7.8337	8.336
QC0U--pH 4a	7.8894	8.3894
QC0U--pH 4b	7.8698	8.3662
QC0U--pH 4.25a	7.9284	8.4209
QC0U--pH 4.25b	7.8604	8.3583
QC0U-pH 4.5a	7.8708	8.3678
QC0U-pH 4.5b	7.9443	8.4427
QC0U-pH 4.75a	7.8766	8.371
QC0U-pH 4.75b	7.9473	8.4489
QC0U-pH 5a	7.912	8.4069
QC0U-pH 5b	7.8722	8.3741
QC0U-pH 5.25a	7.8141	8.315
QC0U-pH 5.25b	7.908	8.4064
QC0U-pH 5.5a	7.839	8.3318
QC0U-pH 5.5b	7.8296	8.325
QC0U-pH 5.75a	7.7992	8.2945
QC0U-pH 5.75b	7.8397	8.3364
QC0U-pH 6a	7.8633	8.3582
QC0U-pH 6b	7.8851	8.3826
QC0U-pH 6.25a	7.8305	8.3308
QC0U-pH 6.25b	7.8993	8.4024
QC0U-pH 6.5a	7.855	8.3502
QC0U-pH 6.5b	7.9245	8.4146
QC0U-pH 6.75a	7.9003	8.3971
QC0U-pH 6.75b	7.9272	8.4299
QC0U-pH 7a	7.8597	8.3607
QC0U-pH 7b	7.8539	8.35
QC0U-pH 7.25a	7.8517	8.3483
QC0U-pH 7.25b	7.8686	8.3681
QC0U-pH 7.5a	7.8704	8.3703
QC0U-pH 7.5b	7.8491	8.3452
QC0U-pH 7.75a	7.842	8.3385
QC0U-pH 7.75b	7.8632	8.3572
QC0U-pH 8a	7.9015	8.3968
QC0U-pH 8b	7.8655	8.3627
QC0U-pH 8.25a	7.7939	8.2877
QC0U-pH 8.25b	7.9249	8.4192
QC0U-pH 8.5a	7.8491	8.3438
QC0U-pH 8.5b	7.9127	8.4092
QC0U-pH 8.75a	7.8663	8.3659
QC0U-pH 8.75b	7.8519	8.3482
QC0U-pH 9a	7.8034	8.2975
QC0U-pH 9b	7.8583	8.3592
QC0U-pH 9.25a	7.8371	8.3342
QC0U-pH 9.25b	7.8983	8.3943

QC0U-lua		
QC0U-lub		
QC0U-luc		
QC0U-lud		
QC0U-lue		
QC0U-luf		

20 Mar 99 09:28 ALPHA/BETA - 1.02
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	20.02
Region B:	100 -	350	0	3.0	3.38
Region C:	0.0 -	2000	0	0.1	29.14

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

capped QC0U Sorption Exp. 2nd set

S#		TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
P#	1	999.99	20.02	1.41	3.377	3.44	29.14	1.17	141.17	B
23	2	8.33	2.19	149.8	530.236	3.02	534.61	3.08	614.57	
23	3	8.29	3.26	103.1	532.691	3.02	537.69	3.08	611.92	
23	4	8.52	5.21	66.23	518.454	3.02	526.03	3.07	610.42	
23	5	8.37	5.55	63.22	527.806	3.02	534.30	3.07	607.91	
23	6	8.56	2.41	134.9	516.132	3.02	518.76	3.09	617.34	
23	7	8.47	3.12	106.3	522.007	3.02	525.05	3.08	613.55	
23	8	9.30	1.59	192.3	475.440	3.02	477.96	3.09	615.63	
23	9	9.11	0.00	0.00	484.548	3.02	485.35	3.10	622.40	
23	10	9.85	2.92	104.8	447.790	3.02	452.38	3.09	612.53	
23	11	10.07	2.22	134.3	438.430	3.02	440.67	3.10	617.49	
23	12	11.34	2.38	118.8	388.598	3.03	393.26	3.11	617.22	
23	13	11.43	1.15	237.5	385.424	3.03	387.83	3.12	615.72	
23	14	10.45	1.42	203.4	421.886	3.02	424.07	3.11	611.96	
23	15	10.45	1.32	217.7	422.078	3.02	424.64	3.10	617.09	
23	16	16.50	2.65	89.22	265.956	3.04	270.38	3.15	611.24	
23	17	15.68	2.30	104.4	280.105	3.04	285.47	3.14	614.63	
23	18	18.19	0.76	283.6	241.098	3.04	243.10	3.19	613.81	
23	19	17.76	2.78	82.04	247.017	3.04	251.66	3.16	612.91	
23	20	16.56	1.66	139.0	265.101	3.04	268.39	3.16	615.16	
23	21	15.99	2.74	87.57	274.609	3.04	279.43	3.15	612.11	
23	22	22.03	2.18	93.14	198.348	3.05	202.18	3.21	612.55	

23	23	21.73	2.25	90.74	201.133	3.05	205.47	3.20	612.41
23	24	30.89	1.12	150.0	140.521	3.07	142.96	3.31	612.91
23	25	29.34	2.03	86.48	148.123	3.07	152.76	3.27	617.41
23	26	27.27	1.87	96.91	159.586	3.06	162.65	3.27	613.84
23	27	26.91	1.31	137.6	161.803	3.06	164.43	3.27	613.36
23	28	29.85	0.75	225.5	145.568	3.07	148.35	3.30	611.59
23	29	29.40	2.84	62.96	147.779	3.07	151.95	3.27	607.02
23	30	37.76	0.98	154.8	114.314	3.09	116.78	3.38	614.90
23	31	38.11	0.26	564.7	113.233	3.09	114.81	3.40	624.79
23	32	37.25	1.30	118.8	115.979	3.09	118.54	3.37	612.69
23	33	38.01	1.42	107.5	113.566	3.09	116.03	3.38	612.57
23	34	39.25	0.97	153.0	109.846	3.09	111.70	3.41	610.94
23	35	40.09	1.16	128.0	107.548	3.10	109.60	3.41	615.05
23	36	38.47	1.50	101.3	112.168	3.09	115.08	3.38	612.39
23	37	39.16	0.61	241.2	110.106	3.09	112.15	3.40	618.06
23	38	36.09	0.21	736.1	119.760	3.09	120.46	3.39	616.61
23	39	36.02	0.55	278.7	120.054	3.09	121.86	3.37	619.24
23	40	38.53	0.46	324.8	111.988	3.09	113.30	3.41	614.28
23	41	38.20	1.24	122.8	112.984	3.09	115.31	3.39	615.99

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

23	42	31.51	1.37	122.1	137.721	3.07	140.62	3.31	608.12
23	43	31.18	1.21	138.2	139.182	3.07	140.62	3.33	613.46
23	44	22.57	0.00	0.00	193.566	3.05	193.37	3.25	616.36
23	45	22.56	1.61	122.8	193.742	3.05	196.13	3.23	612.47
23	46	21.75	0.00	0.00	201.083	3.05	202.08	3.23	617.00
23	47	21.70	0.81	244.6	201.462	3.05	203.40	3.22	616.85

237 MISSING TUBE(S)

CAPPED

Sample Name	wt. Of PP tubes, g	wt. Of PP tubes after transfer of qtz/clino, g	wt. Of PP tubes after acid add, g	Container wt. after transfer of supernatant, g	Container wt. after supernatant retransfer & acid add ,g
QC0U-pH 3.5	13.4138	21.2852	24.3348	30.4239	51.9445
QC0U-pH 4.0	13.7808	22.656	25.6893	31.1719	50.9359
QC0U-pH 4.25	13.3195	22.6802	25.715	31.5926	50.322
QC0U-pH 4.5	13.6938	21.3457	24.378	30.0287	51.8978
QC0U-pH4.75	13.3174	21.713	24.7398	30.6473	51.2238
QC0U-pH 5.0	13.8651	20.9052	23.9341	29.4276	52.8144
QC0U-pH 5.25	13.7675	21.6206	24.6424	30.3035	51.5289
QC0U-pH 5.5	13.6808	22.0589	25.0837	31.1244	51.5901
QC0U-pH 5.75	13.6518	21.7224	24.7443	30.2698	51.2088
QC0U-pH 6.0	13.7025	17.5002	20.5134	26.271	54.6003
QC0U-pH 6.25	13.6753	21.9654	24.9816	30.5427	51.0169
QC0U-pH 6.5	13.6601	21.3192	24.3389	30.0568	51.9747
QC0U-pH 6.75	13.8008	20.9656	23.9796	30.0457	52.7965
QC0U-pH 7.0	13.5995	20.8474	23.868	29.7701	52.266
QC0U-pH 7.25	13.6988	21.8706	24.8945	30.9759	51.2961
QC0U-pH 7.5	13.6369	21.3865	24.3995	30.2397	51.5801
QC0U-pH 7.75	13.6932	23.3674	26.3822	32.279	49.9724
QC0U-pH 8.0	13.7811	20.9377	23.9496	29.714	52.5862
QC0U-pH 8.25	13.3388	23.016	26.0293	32.2348	49.8691
QC0U-pH 8.5	13.7773	19.4989	22.5165	28.2794	53.4822
QC0U-pH 8.75	13.6982	21.4451	24.4567	30.0947	51.2555
QC0U-pH 9.0	13.8022	20.9199	23.9228	29.678	52.1024
QC0U-pH 9.25	13.6409	21.3531	24.3618	30.2734	51.3205

DESORPTION (CAPPED)

	PP tubes	Desorption		PC containers	Desorption
Sample Name	wt. of vial,g	wt. of vial+sample,g		wt. of vial,g	wt. of vial+sample,g
QC0U--pH 3.5a	7.8489	8.3512		7.8145	8.3179
QC0U-pH 3.5b	7.8143	8.3181		7.8666	8.3681
QC0U--pH 4a	7.8293	8.3304		7.9019	8.4052
QC0U--pH 4b	7.8433	8.3431		7.9447	8.4499
QC0U--pH 4.25a	7.8672	8.3645		7.9291	8.4309
QC0U--pH 4.25b	7.8477	8.3492		7.84	8.3423
QC0U-pH 4.5a	7.9254	8.4273		7.8093	8.3115
QC0U-pH 4.5b	7.9131	8.4128		7.8852	8.3908
QC0U-pH 4.75a	7.9206	8.4233		7.8253	8.327
QC0U-pH 4.75b	7.8484	8.3478		7.8276	8.3304
QC0U-pH 5a	7.8789	8.3806		7.9049	8.4061
QC0U-pH 5b	7.9097	8.4095		7.8919	8.3952
QC0U-pH 5.25a	7.8056	8.3049		7.9	8.4011
QC0U-pH 5.25b	7.8152	8.3157		7.8769	8.3791
QC0U-pH 5.5a	7.904	8.4031		7.8585	8.3594
QC0U-pH 5.5b	7.8536	8.3556		7.855	8.3571
QC0U-pH 5.5c	7.8471	8.3451		7.8799	8.381
QC0U-pH 5.5d	7.8623	8.3626		7.8899	8.3939
QC0U-pH 5.75a	7.8411	8.3453		7.8531	8.3548
QC0U-pH 5.75b	7.8434	8.3479		7.9195	8.4208
QC0U-pH 6a	7.9098	8.4062		7.8617	8.3636
QC0U-pH 6b	7.914	8.411		7.8763	8.379
QC0U-pH 6.25a	7.8479	8.345		7.8865	8.3855
QC0U-pH 6.25b	7.9226	8.4256		7.9084	8.4089
QC0U-pH 6.5a	7.8539	8.3554		7.7932	8.293
QC0U-pH 6.5b	7.898	8.3973		7.7966	8.2989
QC0U-pH 6.75a	7.8724	8.3724		7.9319	8.4314
QC0U-pH 6.75b	7.8562	8.3562		7.8704	8.371
QC0U-pH 7a	7.8955	8.3968		7.8648	8.3679
QC0U-pH 7b	7.9111	8.4083		7.9293	8.4355
QC0U-pH 7.25a	7.8905	8.3887		7.8801	8.3849
QC0U-pH 7.25b	7.8733	8.3715		7.8104	8.3157
QC0U-pH 7.5a	7.9554	8.4548		7.8845	8.3858
QC0U-pH 7.5b	7.9265	8.4235		7.8443	8.3469
QC0U-pH 7.75a	7.8335	8.3314		7.8201	8.3218
QC0U-pH 7.75b	7.8745	8.3737		7.8104	8.314
QC0U-pH 8a	7.86	8.3602		7.9448	8.4453
QC0U-pH 8b	7.8988	8.3999		7.8302	8.3312
QC0U-pH 8.25a	7.9614	8.3358		7.9176	8.4173

QC0U-pH 8.25b	7.9016	8.3975		7.8782	8.3796
QC0U-pH 8.5a	7.8782	8.3783		7.8562	8.3565
QC0U-pH 8.5b	7.879	8.377		7.8822	8.3845
QC0U-pH 8.75a	7.8181	8.3121		7.8084	8.3084
QC0U-pH 8.75b	7.8655	8.3641		7.8821	8.3839
QC0U-pH 9a	7.8633	8.866		7.8614	8.361
QC0U-pH 9b	7.8499	8.3499		7.8717	8.3724
QC0U-pH 9.25a	7.8788	8.3781			
QC0U-pH 9.25b	7.8676	8.3685			

```
SYSTEM NORMALIZED


C14 IPA DATA PROCESSED - 31-Mar-99 19:20
   C14 Eff (0-156 keV) = 96.49 %
C14 CHI SQUARE IPA DATA PROCESSED - 31-Mar-99 19:30
   C14 Chi Square = 28.11
H3 IPA DATA PROCESSED - 31-Mar-99 19:32
   H3 Eff (0-18.6 keV) = 64.95 %

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


H3 CHI SQUARE IPA DATA PROCESSED - 31-Mar-99 19:42
   H3 Chi Square = 23.96
BKG IPA DATA PROCESSED - 31-Mar-99 20:43
   Bkg (0-18.6 keV) = 20.82 cpm
   Bkg (0-156 keV)  = 30.25 cpm

WARNING: Questionable C14 Background value - Please view historic data


   C14 E^2/B (1-156 keV)    = 401.20
   H3  E^2/B (1-18.6 keV)   = 201.72
236 MISSING TUBE(S)
127    9.34    2.24 138.0  472.552  3.02  475.30  3.09 593.55
23 128   9.38    1.61 188.5  470.309  3.02  471.76  3.10 587.91
23 129   9.28    0.00  0.00  475.738  3.02  477.81  3.10 596.80
23 130   9.12    3.76 85.95  483.925  3.02  491.53  3.08 597.52
23 131   9.88    2.55 118.8  446.737  3.02  450.24  3.10 596.53
23 132   9.36    0.00  0.00  471.321  3.02  472.62  3.10 599.24
23 133  10.42    3.88 78.24  423.310  3.02  429.32  3.09 592.57
23 134  10.06    3.44 88.98  438.781  3.02  443.25  3.09 594.63
23 135  10.83    2.52 114.9  407.061  3.03  410.29  3.11 591.71
23 136  10.49    2.58 114.2  420.272  3.02  423.97  3.10 597.96
23 137  12.07    0.38 690.1  364.886  3.03  365.78  3.13 601.04
```

capped QC0U containers desorption

23	138	11.84	3.64	77.82	371.957	3.03	374.30	3.12	595.96
23	139	10.30	1.73	168.4	428.380	3.02	431.27	3.10	595.96
23	140	10.42	1.67	172.9	423.598	3.02	426.06	3.10	597.32
23	141	13.07	2.96	90.00	336.856	3.03	341.21	3.12	596.55
23	142	13.18	1.02	248.5	333.788	3.03	335.23	3.14	598.35
23	143	17.10	1.95	116.8	256.418	3.04	259.59	3.17	596.15
23	144	16.97	0.70	315.6	258.409	3.04	260.33	3.18	597.97
23	145	13.97	2.56	99.84	314.788	3.03	318.19	3.14	596.55
23	146	14.50	2.01	123.1	303.087	3.03	306.86	3.14	597.15
23	147	19.55	1.87	113.9	224.003	3.05	227.11	3.19	594.15
23	148	19.98	2.40	88.79	218.957	3.05	222.49	3.20	597.07
23	149	28.82	1.45	120.1	150.733	3.07	153.13	3.29	597.00
23	150	27.98	2.10	85.73	155.363	3.07	158.18	3.28	591.87
23	151	28.11	0.00	0.00	154.735	3.07	155.50	3.31	601.08
23	152	27.86	0.93	187.7	156.119	3.07	157.84	3.29	594.15
23	153	30.36	1.09	154.2	142.912	3.07	145.92	3.30	602.42
23	154	31.28	2.17	78.52	138.607	3.08	140.82	3.32	596.46
23	155	21.45	1.94	104.8	203.761	3.05	205.55	3.22	597.70
23	156	21.57	0.80	246.6	202.655	3.05	203.13	3.24	599.45
23	157	26.78	0.99	180.6	162.480	3.06	163.68	3.29	595.45
23	158	26.60	0.91	197.6	163.640	3.06	165.44	3.28	594.95
23	159	31.14	0.76	217.5	139.245	3.08	140.14	3.34	597.41
23	160	30.63	1.20	140.1	141.719	3.07	143.95	3.31	599.20
23	161	31.49	0.50	327.7	137.691	3.08	138.26	3.35	596.69
23	162	33.82	1.28	125.6	127.937	3.08	129.13	3.36	596.65
23	163	35.48	1.87	85.31	121.817	3.09	124.19	3.36	596.56
23	164	34.86	0.33	466.6	124.045	3.09	124.75	3.38	599.87
23	165	40.77	0.61	237.4	105.586	3.10	106.64	3.44	606.57
23	166	40.77	0.14	996.8	105.586	3.10	106.74	3.44	604.53
23	167	19.68	0.00	0.00	222.500	3.05	223.58	3.21	601.60
23	168	20.60	1.39	147.7	212.312	3.05	214.62	3.21	598.25
23	169	24.10	0.87	216.4	180.933	3.06	183.41	3.25	600.92
23	170	24.47	0.88	211.8	178.145	3.06	180.31	3.25	601.79
23	171	23.49	1.32	145.3	185.722	3.06	186.68	3.25	596.76
23	172	22.59	2.17	92.10	193.348	3.05	196.35	3.22	596.49

238 MISSING TUBE(S)

181		11.04	4.17	71.11	399.343	3.03	404.92	3.10	592.65
23	182	10.94	3.57	82.44	403.391	3.02	408.16	3.10	590.79
23	183	10.87	4.64	65.04	405.827	3.02	412.17	3.09	588.62
23	184	10.53	2.11	137.6	418.757	3.02	424.43	3.09	593.91

04 Apr 99 08:05 ALPHA/BETA - 1.02 Pa

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

23	185	9.71	1.50	198.8	454.413	3.02	458.13	3.09	596.05
23	186	9.76	5.08	63.26	452.068	3.02	457.88	3.09	587.40
23	187	8.27	4.38	78.46	534.141	3.02	541.20	3.07	593.66
23	188	8.19	5.97	59.80	539.514	3.02	546.90	3.07	588.80
23	189	7.02	8.28	48.51	629.868	3.02	640.24	3.05	586.92
23	190	7.25	7.39	52.66	609.500	3.02	620.52	3.05	584.64
23	191	7.98	4.01	86.56	553.678	3.02	559.31	3.07	588.40
23	192	8.10	1.81	181.8	545.300	3.02	549.48	3.08	589.73
23	193	5.31	2.11	193.2	835.895	3.01	839.89	3.05	590.46
23	194	5.29	5.22	83.68	836.800	3.01	845.26	3.04	587.61

23	195	5.35	2.70	152.9	829.245	3.01	834.51	3.05	589.15
23	196	5.34	1.99	204.1	828.932	3.01	833.88	3.05	586.99
23	197	5.38	5.73	76.37	824.974	3.01	833.78	3.04	585.64
23	198	5.50	5.53	77.91	805.262	3.01	813.68	3.04	588.69
23	199	4.10	4.47	109.3	1082.389	3.01	1088.88	3.03	585.96
23	200	4.08	2.87	164.8	1088.447	3.01	1091.17	3.04	585.45
23	201	3.26	5.23	106.3	1364.633	3.00	1372.73	3.02	578.07
23	202	3.34	6.13	91.26	1327.373	3.01	1337.95	3.02	577.78
23	203	3.89	5.27	96.68	1140.494	3.01	1147.96	3.03	589.74
23	204	3.82	6.26	83.79	1161.980	3.01	1172.68	3.03	584.51
23	205	3.11	0.34	1517	1425.795	3.01	1425.89	3.03	585.23
23	206	3.10	5.56	103.2	1431.051	3.01	1436.39	3.03	585.21
23	207	2.97	6.01	98.50	1492.831	3.01	1500.89	3.02	583.66
23	208	2.93	6.02	98.99	1513.600	3.01	1522.46	3.02	582.45
23	209	2.94	9.33	67.67	1511.501	3.00	1521.27	3.02	582.24
23	210	2.92	9.53	66.70	1519.823	3.01	1531.89	3.02	585.00
23	211	3.76	5.88	89.26	1178.716	3.01	1184.42	3.03	584.52
23	212	3.73	6.09	86.91	1189.296	3.01	1198.74	3.03	584.18
23	213	3.38	9.37	62.91	1313.990	3.01	1324.14	3.02	586.04
23	214	3.29	4.70	116.6	1350.942	3.00	1357.82	3.02	586.64
23	215	3.63	5.98	89.53	1221.604	3.01	1231.19	3.03	584.33
23	216	3.65	5.56	95.19	1215.987	3.01	1223.19	3.03	589.16
23	217	2.85	3.59	160.3	1555.833	3.01	1563.57	3.02	581.99
23	218	2.85	4.64	126.6	1556.886	3.01	1564.97	3.02	585.01
23	219	4.74	4.55	100.0	934.721	3.01	938.52	3.05	601.82
23	220	3.57	4.17	124.8	1243.594	3.01	1250.14	3.03	591.53
23	221	2.17	0.00	0.00	2046.304	3.00	2049.39	3.02	584.65
23	222	2.16	8.32	86.98	2055.794	3.00	2065.96	3.02	583.39
23	223	3.82	2.07	232.3	1160.409	3.01	1163.52	3.04	585.14
23	224	3.84	3.52	140.7	1155.910	3.01	1159.39	3.04	586.91
23	225	1.61	14.86	62.58	2757.405	3.00	2777.42	3.01	545.85
23	226	3.20	3.52	154.1	1385.597	3.01	1389.96	3.03	585.30
23	227	3.61	6.12	87.91	1229.776	3.01	1239.28	3.03	586.40
23	228	3.52	6.22	87.79	1261.876	3.01	1268.88	3.03	585.28

23

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 04-Apr-99 11:50
C14 Eff (0-156 keV) = 96.35 %
C14 CHI SQUARE IPA DATA PROCESSED - 04-Apr-99 12:01
C14 Chi Square = 23.02
H3 IPA DATA PROCESSED - 04-Apr-99 12:02
H3 Eff (0-18.6 keV) = 64.86 %

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

3/2/99
AJ

Experimental Procedure for experiment C20 - U sorption on clinoptilolite at 25° C. UNCAPPED (2nd Set)

Objective: To investigate the characteristics of U sorption on clinoptilolite as a function of pH.

Initial conditions: - $\sum U$ = 50 ppb [2.1×10^{-7} molal]
- equilibrium with atmospheric $CO_2(g)$; $pCO_2 = 10^{-3.5}$
- pH range 3.0 - 9.5
- solution volume = 35 ml
- mass of solid = 0.700 g
- M/V = 20 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

Supplies:
Na-clinoptilolite (CDV*100/200*UC*WA*CPT*HL*Naf)
2.1×10^{-7}m ^{233}U stock solution (spike 28A)
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. Transfer 2.1×10^{-7} m (50 ppb) ^{233}U stock solution to experimental containers.

- Label 29 polycarbonate centrifuge tubes (~40 ml capacity) C20U-pHi (where i is the approximate pH of each solution, see Table C20).
- Label 1 polycarbonate centrifuge tube C20U-IU.
- Weigh and record the weight of each container.
- The concentration of spike 28A is 2.1×10^{-7} m ^{233}U and therefore this stock solution does not require dilution. About 1.2L of spike 28A will be required for this experiment.
- Add ~35 g of the 2.1×10^{-7} m ^{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.

B. Add clinoptilolite to sample containers.

- Add ~0.700 g of Na-clinoptilolite to each sample container. **Do not** add clinoptilolite to the C20U-IU container.
- Record weight of each sample container after addition of clinoptilolite.

- Adjust pH of each solution by adding HNO_3 or $NaHCO_3$.
  - Add the volume of HNO_3 or $NaHCO_3$ to each experimental container as listed in Table C20. Take care to add HNO_3 or $NaHCO_3$ in the concentrations specified in Table C20.
  - For sample C20-U-IU (not listed in Table C20) add 100 μl of 50/50 V/V HNO_3 to the sample container.
  - Weigh and record the weight of each sample container.
- Sample C20-U-IU for initial [U].
  - Label two 7 ml LSC vials as C20-U-IUa and C20-U-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 C20-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 C20-U-IU
- Wait for equilibrium.
  - Place caps on sample containers but do not tighten. Leave caps loose so that solutions can equilibrate with air.
  - Place containers on gyratory shaker set at about 120 rpm and allow samples to equilibrate with air for at least 10 days.
- Sample experimental solutions for [U] and pH.
  - For each sample solution label two 7 ml LSC vials (e.g., C20-U-pH3a and C20-U-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.
  - Record weight of each sample container.
  - Measure pH of each experimental solution.
  - Record weight of each sample container after pH measurement.
- Transfer clinoptilolite for desorption.
  - Record weight of sample containers. *Note: this step can be skipped if the clinoptilolite transfer is done immediately after the last step in section F.*
  - Centrifuge polycarbonate tubes containing experimental solutions at about 5,000 rpm for 5 min to remove fine particles from suspension.
  - For each sample container, label a corresponding polypropylene (PP) test tube (50 ml capacity)

(e.g., C20d-U-pH3 for sample container C20-U-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.

C. Sample solutions for [U].

- For each sample container and PP test tube label two 7 ml LSC vials (e.g., C20-U-pH3a and C20-U-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.

Table CQ0U: 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)

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	0.394	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

UNCAPPED

4/2/99

SAMPLE NAME	Wt. of container, g
C20U-pH 3	22.2698
AJ C20U-pH ~~3.25~~ 3.5	22.1503
C20U-pH ~~3.5~~ 4.0	22.4523
C20U-pH ~~3.75~~ 4.25	22.4432
C20U-pH ~~4~~ AJ ~~4.25~~ 4.5	22.3428
C20U-pH ~~4.25~~ 4.75	22.4005
C20U-pH ~~4.5~~ 5.0	22.3805
C20U-pH ~~4.75~~ 5.25	22.5997
C20U-pH ~~5~~ 5.5	22.2312
C20U-pH ~~5.25~~ 5.75	22.5663
C20U-pH ~~5.5~~ 6.0	22.1761
C20U-pH ~~5.75~~ 6.25	22.0155
C20U-pH ~~6~~ 6.5	22.1343
C20U-pH ~~6.25~~ 6.75	22.5258
C20U-pH ~~6.5~~ 7.0	22.0197
C20U-pH ~~6.75~~ 7.25	22.2984
C20U-pH ~~7~~ 7.5	22.4808
C20U-pH ~~7.25~~ 7.75	22.2353
C20U-pH ~~7.5~~ 8.0	22.2532
C20U-pH ~~7.75~~ 8.25	22.2597
C20U-pH ~~8~~ 8.5	22.2468
C20U-pH ~~8.25~~ 8.75	22.3424
C20U-pH ~~8.5~~ 9.0	22.2858
C20U-pH ~~8.75~~ 9.25	22.3918
C20U-pH 9 9.5	22.0813
~~C20U-pH 9.25~~	
~~C20U-pH 9.5~~	
C20U-IU	22.5791

UNCAPPED

4/2/99

SAMPLE NAME	WT. OF CONTAINER + U SOLN., g
C20U-pH 3	57.2817
C20U-pH 3.5	57.1511
C20U-pH 4	57.448
C20U-pH 4.25	57.4492
C20U-pH 4.5	57.3326
C20U-pH 4.75	57.4015
C20U-pH 5	57.3268
C20U-pH 5.25	57.6058
C20U-pH 5.5	57.2473
C20U-pH 5.75	57.569
C20U-pH 6	57.1929
C20U-pH 6.25	57.0167
C20U-pH 6.5	57.1464
C20U-pH 6.75	57.5232
C20U-pH 7	57.0089
C20U-pH 7.25	57.296
C20U-pH 7.5	57.4894
C20U-pH 7.75	57.2464
C20U-pH 8	57.2541
C20U-pH 8.25	57.2613
C20U-pH 8.5	57.2537
C20U-pH 8.75	57.3512
C20U-pH 9	57.282
C20U-pH 9.25	57.4005
C20U-pH 9.5	57.0837
C20U-IU	57.5866

UNCAPPED
4/2/99

SAMPLE NAME	WT. OF CONTAINER + U SOLN +CLINOP , g
C20U-pH 3	57.9897
C20U-pH 3.5	57.8596
C20U-pH 4	58.1559
C20U-pH 4.25	58.1570
C20U-pH 4.5	58.0338
C20U-pH 4.75	58.1086
C20U-pH 5	58.0341
C20U-pH 5.25	58.3144
C20U-pH 5.5	57.9559
C20U-pH 5.75	58.2768
C20U-pH 6	57.9008
C20U-pH 6.25	57.7269
C20U-pH 6.5	57.8559
C20U-pH 6.75	58.2321
C20U-pH 7	57.7187
C20U-pH 7.25	58.0053
C20U-pH 7.5	58.1991
C20U-pH 7.75	57.9567
C20U-pH 8	57.9644
C20U-pH 8.25	57.9705
C20U-pH 8.5	57.9631
C20U-pH 8.75	58.0609
C20U-pH 9	57.9918
C20U-pH 9.25	58.1111
C20U-pH 9.5	57.7916
C20U-IU	

UNCAPPED
4/2/99

SAMPLE NAME	WT. OF CONTAINER AFTER ADDITIONS OF HNO3 /NAHCO3, g
C20U-pH 3	58.3909
C20U-pH 3.5	57.9706
C20U-pH 4	58.3007
C20U-pH 4.25	58.2422
C20U-pH 4.5	58.3258
C20U-pH 4.75	58.3185
C20U-pH 5	58.2716
C20U-pH 5.25	58.5717
C20U-pH 5.5	58.2329
C20U-pH 5.75	58.5671
C20U-pH 6	58.2025
C20U-pH 6.25	58.0461
C20U-pH 6.5	58.9266
C20U-pH 6.75	58.3172
C20U-pH 7	57.8285
C20U-pH 7.25	58.1439
C20U-pH 7.5	58.4117
C20U-pH 7.75	58.1270
C20U-pH 8	58.2432
C20U-pH 8.25	58.0685
C20U-pH 8.5	58.1411
C20U-pH 8.75	58.2293
C20U-pH 9	58.3142
C20U-pH 9.25	58.9848
C20U-pH 9.5	59.1764
C20U-IU	57.6882

Table C20U: Estimated solution pH and volumes of HNO3 or NaHCO3 solutions needed for adjustment of pH in 0.1 m NaNO3 solutions with 50 ppb in contact with quartz (35 ml)

4/2/99

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	0.394	0.1
3.25	0.209	0.1
3.5	0.106 (0.110)	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 +0.300 +0.225	0.01
5.25	0.260	0.01
5.5	0.274 +0.300?	0.01
5.75	0.286 +0.350	0.01
6	0.300 + 0.160	0.01
6.25	0.322 + 0.180	0.01
6.5	0.071 + 0.375	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
9.25	0.825	1
9.5	1.300	1
Q20U-IU	**0.100**	**50% HNO_3**

1M HNO_3 added on 4/16/99

UNCAPPED

Sample Name	wt. Of vial 4/15/99	wt. Of vial + sample 4/16/99
C20-pH 3a	7.7871	8.2838
C20-pH 3b	7.7956	8.2923
C20-pH 4a	7.7227	8.2176
C20-pH 4b	7.7522	8.2476
C20-pH 4.25a	7.8441	8.3390

UNCAPPED

C20-pH 4.25b	7.7868 4/15/99	8.2824 4/16/99
C20-pH 4.5a	7.7846	8.2779
C20-pH 4.5b	7.8248	8.3204
C20-pH 4.75a	7.7426	8.2368
C20-pH 4.75b	7.7524	8.2490
C20-pH 5a	7.6984	8.1931
C20-pH 5b	7.7258	8.2226
C20-pH 5.25a	7.~~7989~~ 8224 AS 4/14/99	8.3297
C20-pH 5.25b	7.~~8747~~ 8463	8.3505
C20-pH 5.5a	7.8190	8.3134
C20-pH 5.5b	7.8046	8.3002
C20-pH 5.75a	7.~~8747~~ 7852	8.2858
C20-pH 5.75b	7.~~8967~~ 8273	8.3281
C20-pH 6a	7.~~9066~~ 8506	8.3493
C20-pH 6b	7.~~8936~~ 8626	8.3626
C20-pH 6.25a	7.~~9104~~ 8406	8.3384
C20-pH 6.25b	7.~~8706~~ 7936	8.2933
C20-pH 6.5a	7.~~8609~~ 7722	8.2706
C20-pH 6.5b	7.~~8645~~ 8303	8.3302
C20-pH 6.75a	7.9058	8.4008
C20-pH 6.75b	7.8939	8.3895
C20-pH 7a	7.~~9098~~ 8532	8.3506
C20-pH 7b	7.~~7850~~ 8090	8.3081
C20-pH 7.25a	7.8645	8.3602
C20-pH 7.25b	7.8594	8.3557
C20-pH 7.5a	7.7829	8.2763
C20-pH 7.5b	7.8392	8.3362
C20-pH 7.75a	7.8116	8.3066
C20-pH 7.75b	7.8558	8.3503
C20-pH 8a	7.8524	8.3463
C20-pH 8b	7.8752	8.3723
C20-pH 8.25a	7.8402	8.3353
C20-pH 8.25b	7.8287	8.4212
C20-pH 8.5a	7.8582	8.3515
C20-pH 8.5b	7.8189	8.3155
C20-pH 8.75a	7.8943	8.3884
C20-pH 8.75b	7.8799	8.3763
C20-pH 9a	7.7472	8.2429
C20-pH 9b	7.7325	8.2308
C20-pH 9.25a	7.7826	8.2910
C20-pH 9.25b	7.8173	8.3017
C20-pH 9.5a	7.8426	8.3341
C20-pH 9.5b	7.8862	8.3828
C20U-lua	7.8374	8.3418
C20U-lub 3/29/99	7.8725	8.3765
C20U-luc	7.8771	8.3809
C20U-lud	7.7977	8.302

unCAPPED

4/15/99 — 4/16/99

Sample Name	Container wt. before sampling & pH measurements	Measured pH	Container wt. after sampling & pH measurements
C20U-pH 3	58.0562	3	57.0276
C20U-pH 3.5	57.6506	3.78	56.6621
C20U-pH 4	57.9927	5.05	57.0092
C20U-pH 4.25	57.9568	5.55	56.9271
C20U-pH 4.5	57.9999	6.02	57
C20U-pH 4.75	57.9555	6.31	56.9436
C20U-pH 5	5/4/99 57.7029	5.07	56.687
C20U-pH 5.25	58.2159	6.53	57.1841
C20U-pH 5.5	-57.7268	5.38	56.7231
C20U-pH 5.75	-58.0483	4.43	57.0468
C20U-pH 6	-57.1332	4.49	56.1333
C20U-pH 6.25	-57.3743	4.78	56.3744
C20U-pH 6.5	57.6382	6.71	56.6114
C20U-pH 6.75	- 57.598	5.89	56.5989
C20U-pH 7	57.4906	7.08	56.4537
C20U-pH 7.25	57.8134	7.1	56.7812
C20U-pH 7.5	58.1286	7.39	57.0621
C20U-pH 7.75	57.7801	7.55	56.7208
C20U-pH 8	57.9075	7.74	56.7861
C20U-pH 8.25	57.6564	8.03	56.6126
C20U-pH 8.5	57.8568	8.29	56.8258
C20U-pH 8.75	57.8957	8.66	56.8664
C20U-pH 9	57.9185	8.89	56.8754
C20U-pH 9.25	58.6502	9.15	57.6164
C20U-pH 9.5	58.7672	9.1	57.7288

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Protocol #:23 — U-233 3% 2 sigma — User : 6

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	19.49
Region B:	100 -	350	0	3.0	3.39
Region C:	0.0 -	2000	0	0.1	28.64

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
P#	1 999.99	19.49	1.43	3.388	3.44	28.64	1.18	143.82	B
23	2 8.77	3.09	104.2	503.339	3.02	506.71	3.08	606.97	
23	3 8.86	3.88	84.07	498.644	3.02	504.55	3.08	599.34	
23	4 8.53	1.50	210.2	518.066	3.02	520.37	3.08	610.08	
23	5 9.08	2.10	147.5	486.149	3.02	489.87	3.09	608.49	
231	MISSING TUBE(S)								
7	9.14	0.65	462.1	482.826	3.02	484.17	3.09	616.12	
23	8 9.05	1.18	257.9	487.662	3.02	489.38	3.09	618.49	
23	9 12.16	0.00	0.00	362.155	3.03	361.09	3.14	631.01	
23	10 12.40	1.00	259.2	355.080	3.03	356.45	3.13	613.53	
23	11 51.63	1.70	77.00	82.686	3.13	85.04	3.51	604.68	
23	12 52.32	0.00	0.00	81.570	3.13	81.36	3.59	615.88	
23	13 72.93	1.45	76.28	57.547	3.18	59.22	3.75	609.04	
23	14 73.26	2.00	55.95	57.273	3.18	59.86	3.72	600.64	
23	15 85.66	0.31	319.9	48.491	3.22	48.78	3.96	614.45	
23	16 83.91	1.01	101.5	49.573	3.21	50.82	3.89	607.24	
23	17 95.81	1.61	60.90	42.995	3.25	44.83	3.98	602.65	
23	18 95.11	0.96	100.5	43.337	3.25	45.33	3.96	607.21	
232	MISSING TUBE(S)								
21	93.66	0.69	139.9	44.060	3.24	45.39	3.99	598.78	
23	22 88.76	1.49	67.81	46.691	3.23	48.76	3.89	594.99	
238	MISSING TUBE(S)								
31	66.96	0.99	115.4	62.995	3.17	64.24	3.70	593.40	
23	32 68.80	1.21	93.43	61.220	3.17	63.07	3.70	592.46	

QFe2O3 std.

5.25 5.25 5.25 5.25 6.75 6.75 6.75 6.75

C20U 50ppb sorption uncapped

232 MISSING TUBE(S)

	35	65.45	0.47	243.4	64.526	3.16	65.16	3.71	603.47
23	36	66.11	0.72	157.8	63.848	3.16	65.00	3.70	600.18
23	37	74.07	1.45	75.64	56.636	3.19	58.63	3.75	602.08
23	38	72.73	1.10	100.3	57.770	3.18	59.35	3.75	600.73
23	39	37.98	1.47	102.7	113.621	3.09	115.81	3.38	601.82
23	40	35.98	1.30	118.6	120.125	3.09	121.39	3.38	606.69
23	41	27.99	0.91	189.3	155.383	3.07	156.75	3.29	607.56
23	42	27.15	1.40	127.1	160.369	3.06	163.15	3.26	605.96
23	43	17.13	2.35	96.94	256.040	3.04	259.34	3.16	605.54
23	44	14.61	0.71	335.6	300.856	3.03	303.33	3.14	602.30
23	45	11.16	4.08	71.56	394.909	3.03	399.05	3.10	605.63
23	46	10.82	1.77	159.1	407.333	3.03	409.26	3.11	607.33
23	47	9.01	1.71	179.9	489.842	3.02	493.12	3.09	610.84
23	48	9.12	0.91	330.6	484.002	3.02	484.96	3.10	610.15
23	49	8.24	2.97	111.7	535.932	3.02	539.45	3.08	606.95
23	50	8.56	0.00	0.00	516.121	3.02	517.16	3.09	607.31

C20V Sorption uncapped

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

23	51	8.20	2.59	127.3	538.685	3.02	540.27	3.08	607.92
23	52	8.28	4.31	79.00	533.327	3.02	537.31	3.08	607.26
23	53	8.26	0.37	844.8	535.474	3.02	537.71	3.08	608.29
23	54	8.45	0.87	358.7	522.529	3.02	522.25	3.09	610.74
23	55	8.58	0.00	0.00	514.794	3.02	515.07	3.09	620.04
23	56	8.66	3.03	106.8	510.238	3.02	513.28	3.08	617.69
23									

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 21-Apr-99 07:43
C14 Eff (0-156 keV) = 96.65 %
C14 CHI SQUARE IPA DATA PROCESSED - 21-Apr-99 07:54
C14 Chi Square = 21.22
H3 IPA DATA PROCESSED - 21-Apr-99 07:55
H3 Eff (0-18.6 keV) = 64.97 %

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

H3 CHI SQUARE IPA DATA PROCESSED - 21-Apr-99 08:05
H3 Chi Square = 10.68
BKG IPA DATA PROCESSED - 21-Apr-99 09:06
Bkg (0-18.6 keV) = 21.40 cpm
Bkg (0-156 keV) = 30.82 cpm

WARNING: Questionable C14 Background value - Please view historic data

C14 E^2/B (1-156 keV) = 396.26
H3 E^2/B (1-18.6 keV) = 196.35

15 May 99 09:24 ALPHA/BETA - 1.02 Page
Protocol #:23 U-233 3% 2 sigma User : A

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	19.86
Region B:	100 -	350	0	3.0	3.39
Region C:	0.0 -	2000	0	0.1	29.12

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
P# 1	999.99	19.86	1.42	3.385	3.44	29.12	1.17	144.08	B
23 2	53.56	0.49	256.6	79.625	3.13	80.24	3.59	615.85	
23 3	56.08	0.36	339.9	75.877	3.14	77.18	3.60	617.97	
23 4	75.58	0.68	159.7	55.414	3.19	56.49	3.82	614.81	
23 5	76.79	0.13	805.8	54.487	3.19	55.20	3.85	615.69	
23 6	20.80	1.58	129.4	210.269	3.05	211.31	3.22	616.59	
23 7	20.75	1.64	125.6	210.832	3.05	213.58	3.21	616.35	
23 8	22.33	1.01	193.3	195.719	3.05	196.90	3.24	619.13	
23 9	22.96	1.48	131.4	190.213	3.05	192.14	3.24	614.81	
23 10	31.50	1.00	165.3	137.694	3.08	138.85	3.34	616.12	
23 11	32.17	1.19	138.4	134.787	3.08	136.53	3.33	613.60	
23 12	137.07	0.74	110.8	29.036	3.37	30.35	4.48	608.76	
23 13	133.20	0.54	154.1	29.978	3.36	30.94	4.48	608.83	
23									

C20V Sorption uncapped

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 15-May-99 21:08
C14 Eff (0-156 keV) = 96.75 %
C14 CHI SQUARE IPA DATA PROCESSED - 15-May-99 21:19
C14 Chi Square = 26.99
H3 IPA DATA PROCESSED - 15-May-99 21:20
H3 Eff (0-18.6 keV) = 65.04 %
H3 CHI SQUARE IPA DATA PROCESSED - 15-May-99 21:31
H3 Chi Square = 22.88
BKG IPA DATA PROCESSED - 15-May-99 22:31
Bkg (0-18.6 keV) = 20.67 cpm
Bkg (0-156 keV) = 29.08 cpm

WARNING: Questionable C14 Background value - Please view historic data

C14 E^2/B (1-156 keV) = 428.94
H3 E^2/B (1-18.6 keV) = 204.25

4/14/99 AJ

Experimental Procedure for experiment uncapped QFe20U sorption on clinoptilolite 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 atmospheric $CO_2(g)$; $pCO_2 = 10^{-3.5}$
- pH range 3.0-9.5
- solution volume = 35 ml
- mass of solid = 0.700 g
- M/V = 20

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*60/100*UC*WA*RC*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 (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.

15. On the Metler balance, weigh 200g of 500 ppb U stock solution into a tared 2000 ml FEP bottle.
16. Dilute to a total of 2000g using 0.1m $NaNO_3$ stock solution.
17. 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 (50 ml capacity) QFe20U-pHi (where i is the approximate pH of each solution, see Table QFe20U).
b. Label 1 polycarbonate centrifuge tube QFe20U-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 ~0.700 g of quartz to each sample container. **Do not** add quartz to the QFe20U-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 NaHCO3 to each experimental container as listed in Table QFe20U. Take care to add HNO_3 or NaHCO3 in the concentrations specified in Table QFe20U.
- For sample QFe20U-IU (as listed in Table QFe20U) 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 QFe20U-IU for initial [U].

- Label two 7 ml LSC vials as QFe20U-IUa and QFe20U-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 QFe20U-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 QFe20U-IU.

F. Wait for equilibrium.

- Place caps on sample containers but do not tighten. Leave caps loose so that solutions can equilibrate with air.
- Place containers on gyratory shaker set at about 120 rpm and allow samples to equilibrate with air 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.,QFe20U- pH3a and

QFe20U-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., QFe20Ud-pH3 for sample container QFe20Ud-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., QFe20U-pH3a and QFe20U-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.

Table QFe20U: 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 quartz (35 ml)

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	0.394	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
9.25	0.825	1
9.5	1.300	1
QFe20U-IU	0.100	50/50 HNO3

UNCAPPED

4/15/99

SAMPLE NAME	Wt. of container, g
QFe20U-pH 3	22.3254
QFe20U-pH 3.5	22.2556
QFe20U-pH 4	22.2226
QFe20U-pH 4.25	22.2616
QFe20U-pH 4.5	22.224
QFe20U-pH 4.75	22.1186
QFe20U-pH 5	22.1164
QFe20U-pH 5.25	22.1562
QFe20U-pH 5.5	22.5396
QFe20U-pH 5.75	22.2485
QFe20U-pH 6	22.2868
QFe20U-pH 6.25	22.2538
QFe20U-pH 6.5	22.5423
QFe20U-pH 6.75	22.2956
QFe20U-pH 7	22.3039
QFe20U-pH 7.25	22.2768
QFe20U-pH 7.5	22.1931
QFe20U-pH 7.75	22.2731
QFe20U-pH 8	22.2255
QFe20U-pH 8.25	22.2586
QFe20U-pH 8.5	22.3135
QFe20U-pH 8.75	22.2828
QFe20U-pH 9	22.2818
QFe20U-pH 9.25	22.3788
QFe20U-pH 9.5	22.5644
QFe20U-lU	

UNCAPPED

4/16/99

SAMPLE NAME	WT. OF CONTAINER + qtz, g
QFe20U-pH 3	23.0303
QFe20U-pH 3.5	22.9600
QFe20U-pH 4	22.926
QFe20U-pH 4.25	22.9663
QFe20U-pH 4.5	22.9286
QFe20U-pH 4.75	22.8165
QFe20U-pH 5	22.8134
QFe20U-pH 5.25	22.8529
QFe20U-pH 5.5	23.2373
QFe20U-pH 5.75	22.9476
QFe20U-pH 6	22.9831
QFe20U-pH 6.25	22.9573
QFe20U-pH 6.5	23.2444
QFe20U-pH 6.75	22.9982
QFe20U-pH 7	23.0062
QFe20U-pH 7.25	22.9794
QFe20U-pH 7.5	22.8949
QFe20U-pH 7.75	22.9758
QFe20U-pH 8	22.9282
QFe20U-pH 8.25	22.9630
QFe20U-pH 8.5	23.0180
QFe20U-pH 8.75	22.9856
QFe20U-pH 9	22.9851
QFe20U-pH 9.25	23.0829
QFe20U-pH 9.5	23.2688

UNCAPPED

4/15/99

SAMPLE NAME	WT. OF CONTAINER + U SOLN +qtz , g
QFe20U-pH 3	58.0234
QFe20U-pH 3.5	57.9872
QFe20U-pH 4	57.9255
QFe20U-pH 4.25	58.0246
QFe20U-pH 4.5	57.9297
QFe20U-pH 4.75	57.8153
QFe20U-pH 5	57.8102
QFe20U-pH 5.25	57.9115
QFe20U-pH 5.5	58.2304
QFe20U-pH 5.75	57.9693
QFe20U-pH 6	57.9927
QFe20U-pH 6.25	57.9697
QFe20U-pH 6.5	58.2763
QFe20U-pH 6.75	57.9882
QFe20U-pH 7	58.0289
QFe20U-pH 7.25	57.9963
QFe20U-pH 7.5	57.8870
QFe20U-pH 7.75	57.9685
QFe20U-pH 8	57.9398
QFe20U-pH 8.25	57.9678
QFe20U-pH 8.5	58.0327
QFe20U-pH 8.75	58.0052
QFe20U-pH 9	57.9934
QFe20U-pH 9.25	58.0986
QFe20U-pH 9.5	58.2761
QFe20U-IU	

UNCAPPED

4/19/99

SAMPLE NAME	WT. OF CONTAINER AFTER ADDITIONS OF HNO3 /NAHCO3, g
QFe20U-pH 3	58.4180
QFe20U-pH 3.5	58.0713
QFe20U-pH 4	57.9936
QFe20U-pH 4.25	58.1058
QFe20U-pH 4.5	58.2223
QFe20U-pH 4.75	58.0142
QFe20U-pH 5	58.0472
QFe20U-pH 5.25	58.1707
QFe20U-pH 5.5	58.5005
QFe20U-pH 5.75	58.2549
QFe20U-pH 6	58.2943
QFe20U-pH 6.25	58.296
QFe20U-pH 6.5	58.3465
QFe20U-pH 6.75	58.0669
QFe20U-pH 7	58.1339
QFe20U-pH 7.25	58.1407
QFe20U-pH 7.5	58.1000
QFe20U-pH 7.75	58.1363
QFe20U-pH 8	58.2109
QFe20U-pH 8.25	58.0696
QFe20U-pH 8.5	58.2112
QFe20U-pH 8.75	58.3317
QFe20U-pH 9	58.3160
QFe20U-pH 9.25	58.9711
QFe20U-pH 9.5	59.6555
QFe20U-IU	

UNCAPPED

Sample Name	Container wt. before sampling & pH measurements (4/30/99)	Measured pH (4/30/99)	Container wt. after sampling & pH measurements (4/30/99)
QFe20U-pH 3	57.9916	2.58	56.9802
QFe20U-pH 3.5	57.7242	3.11	55.7131
QFe20U-pH 4	57.4795	3.69	55.5008
QFe20U-pH 4.25	57.5301	4.38	56.5315
QFe20U-pH 4.5	57.9788	4.82	56.9742
QFe20U-pH 4.75	57.6635	5.64	56.6899
QFe20U-pH 5	57.794	6.1	56.796
QFe20U-pH 5.25	57.9526 5/17/99 AJ	6.28	56.9184
QFe20U-pH 5.5	~~58.2297~~ 57.8253	4.49	56.8414
QFe20U-pH 5.75	58.0249	6.59	57.024
QFe20U-pH 6	57.9746	6.55	56.9547
QFe20U-pH 6.25	57.895	6.62	56.8851
QFe20U-pH 6.5	57.9848	6.69	56.9055
QFe20U-pH 6.75	57.6138	6.95	56.6086
QFe20U-pH 7	57.7188	7.1	56.7067
QFe20U-pH 7.25	57.8859	7.23	56.8789
QFe20U-pH 7.5	57.8066	7.26	56.7999
QFe20U-pH 7.75	57.8525	7.62	56.8401
QFe20U-pH 8	57.8136	7.87	56.7956
QFe20U-pH 8.25	57.7349	8.14	56.7363
QFe20U-pH 8.5	57.8668	8.39	56.8548
QFe20U-pH 8.75	57.9782	8.63	56.9803
QFe20U-pH 9	57.978	8.94	56.9724
QFe20U-pH 9.25	58.7498	9.25	57.763
QFe20U-pH 9.5	59.4224	9.26	58.4292

Sample Name	wt. Of vial (4/30/99)	wt. Of vial + sample (4/30/99)
QFe20U-pH 3a	7.8516	8.3465
QFe20U-pH 3b	7.746	8.2362
QFe20U-pH 3.5a	7.8336	8.3227
QFe20-pH 3.5b	7.7932	8.3356
QFe20-pH 3.5c	7.8416	8.3471
QFe20-pH 3.5d	7.8946	8.3986
QFe20-pH 4a	7.7937	8.2512
QFe20-pH 4b	7.9327	8.455
QFe20-pH 4c	7.8543	8.3384
QFe20-pH 4.25a	7.9017	8.4006
QFe20-pH 4.25b	7.8532	8.3427
QFe20-pH 4.5a	7.9066	8.4016
QFe20-pH 4.5b	7.8441	8.3474
QFe20-pH 4.75a	7.802	8.2869
QFe20-pH 4.75b	7.8684	8.3678
QFe20-pH 5a	7.8399	8.3268
QFe20-pH 5b	7.8436	8.3402
QFe20-pH 5.25a	7.8486	8.3459
QFe20-pH 5.25b	7.7905	8.2883
QFe20-pH 5.5a	~~7.8669~~ 7.8240	8.3254 AJ 5/18
QFe20-pH 5.5b	~~7.8383~~ 7.7303	8.2638 AJ 5/18
QFe20-pH 5.75a	7.8236	8.3158
QFe20-pH 5.75b	7.8332	8.3225
QFe20-pH 6a	7.8522	8.3506
QFe20-pH 6b	7.9023	8.4022
QFe20-pH 6.25a	7.8251	8.3176
QFe20-pH 6.25b	7.8274	8.3198
Fe C20-pH 6.5a	7.8462	8.3448
Fe C20-pH 6.5b	7.8273	8.3307
Fe C20-pH 6.75a	7.8483	8.3388
Fe C20-pH 6.75b	7.8798	8.3697
Fe C20-pH 7a	7.7554	8.25
Fe C20-pH 7b	7.7872	8.277
Fe C20-pH 7.25a	7.8246	8.3126
Fe C20-pH 7.25b	7.8354	8.3261
Fe C20-pH 7.5a	7.8146	8.304
Fe C20-pH 7.5b	7.8402	8.3311

Fe	C20-pH 7.75a	7.7768	8.2674
Fe	C20-pH 7.75b	7.8629	8.3545
Fe	C20-pH 8a	7.8354	8.3239
Fe	C20-pH 8b	7.7451	8.242
Fe	C20-pH 8.25a	7.8527	8.31
Fe	C20-pH 8.25b	7.7654	8.2847
Fe	C20-pH 8.5a	7.8165	8.3
Fe	C20-pH 8.5b	7.835	8.334
Fe	C20-pH 8.75a	7.824	8.3147
Fe	C20-pH 8.75b	7.7836	8.2719
Fe	C20-pH 9a	7.8037	8.2915
Fe	QFe20U-pH 9b	7.7793	8.2776
Fe	C20-pH 9.25a	7.8792	8.369
Fe	QFe20U-pH 9.25b	7.8302	8.3221
Fe	C20-pH 9.5a	7.908	8.3976
Fe	QFe20U-pH 9.5b	7.8939	8.3815

04 May 99 14:29 ALPHA/BETA - 1.02 Page #
Protocol #:23 U-233 3% 2 sigma User : Alk

C14 IPA DATA PROCESSED - 04-May-99 14:29
C14 Eff (0-156 keV) = 96.87 %
C14 CHI SQUARE IPA DATA PROCESSED - 04-May-99 14:39
C14 Chi Square = 21.07
H3 IPA DATA PROCESSED - 04-May-99 14:41
H3 Eff (0-18.6 keV) = 65.06 %
H3 CHI SQUARE IPA DATA PROCESSED - 04-May-99 14:51
H3 Chi Square = 15.94
BKG IPA DATA PROCESSED - 04-May-99 15:52
Bkg (0-18.6 keV) = 20.82 cpm
Bkg (0-156 keV) = 30.47 cpm

WARNING: Questionable C14 Background value - Please view historic data

C14 E^2/B (1-156 keV) = 408.86
H3 E^2/B (1-18.6 keV) = 202.48

05 May 99 08:41 ALPHA/BETA - 1.02 Pag
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	20.30
Region B:	100 -	350	0	3.0	3.40
Region C:	0.0 -	2000	0	0.1	29.52

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

5/4/99

S#		TIME	CPMA A:2S%		CPMB B:2S%		CPMC C:2S%		SIS FLAG	
P#	1	999.99	20.30	1.40	3.404	3.43	29.52	1.16	141.54	B
23	2	8.68	1.48	215.0	508.808	3.02	510.81	3.09	618.74	
23	3	9.01	0.00	0.00	490.048	3.02	491.57	3.09	617.79	
23	4	9.23	2.46	128.3	478.069	3.02	481.86	3.09	622.72	
23	5	8.49	2.20	148.4	520.271	3.02	523.02	3.09	611.99	
23	6	9.32	3.10	102.8	474.386	3.02	477.46	3.09	617.91	
23	7	9.11	2.98	107.8	484.631	3.02	488.27	3.09	612.78	
23	8	10.48	2.99	100.2	420.833	3.02	423.73	3.11	616.55	
23	9	10.38	0.03	8696	425.112	3.02	425.40	3.11	621.82	
23	10	12.69	1.77	149.9	346.793	3.03	350.07	3.13	614.44	
23	11	12.68	2.42	111.3	347.306	3.03	350.21	3.13	617.47	
23	12	19.43	0.34	606.7	225.314	3.05	226.94	3.21	618.95	
23	13	18.78	1.06	203.5	233.284	3.04	234.38	3.20	615.26	
23	14	22.15	0.00	0.00	197.318	3.05	197.71	3.24	620.88	
23	15	21.03	1.39	147.7	207.913	3.05	209.90	3.22	616.62	
23	16	23.57	0.49	384.6	185.141	3.06	186.27	3.25	617.84	
23	17	22.23	0.49	400.9	196.596	3.05	197.74	3.24	617.74	5.25
232	MISSING TUBE(S)									
20		21.44	1.35	150.7	203.919	3.05	205.93	3.22	618.39	5.75
23	21	21.53	2.05	100.6	203.238	3.05	204.90	3.23	613.85	
23	22	20.79	0.77	263.2	210.449	3.05	212.04	3.22	620.52	
23	23	20.27	0.00	0.00	215.984	3.05	215.72	3.23	616.82	
23	24	20.74	2.41	87.48	210.916	3.05	214.50	3.20	613.20	
23	25	20.28	1.01	205.6	215.728	3.05	217.33	3.21	617.45	
23	26	20.79	0.87	234.6	210.353	3.05	212.23	3.22	614.82	
23	27	21.00	1.61	128.1	208.215	3.05	210.63	3.22	613.67	
23	28	20.66	2.50	84.72	211.698	3.05	215.06	3.20	615.43	
23	29	20.61	0.47	430.1	212.219	3.05	213.08	3.22	617.07	
23	30	17.43	0.00	0.00	251.616	3.04	252.70	3.19	617.25	
23	31	18.45	1.11	195.1	237.517	3.04	239.10	3.19	617.28	
23	32	16.27	2.08	113.7	269.737	3.04	271.71	3.17	616.48	
23	33	16.25	1.12	206.5	270.196	3.04	272.08	3.17	616.64	
23	34	16.36	0.55	415.0	268.356	3.04	269.14	3.18	615.44	
23	35	16.78	2.83	83.64	261.435	3.04	264.17	3.17	613.04	
23	36	12.21	0.10	2656	360.724	3.03	361.15	3.13	615.78	
23	37	12.18	1.30	206.4	361.456	3.03	363.67	3.13	615.07	
23	38	10.51	3.87	78.67	420.097	3.02	425.29	3.09	611.36	
23	39	10.50	3.32	90.65	419.929	3.02	423.91	3.10	610.59	
23	40	9.77	2.02	150.4	451.560	3.02	454.21	3.10	614.46	
23	41	9.31	2.69	117.3	473.932	3.02	477.25	3.09	609.41	
23	42	8.98	2.42	131.9	491.474	3.02	493.31	3.09	615.75	

8 Fe20U solution

05 May 99 19:09 ALPHA/BETA - 1.02 Page
Protocol #:23 U-233 3% 2 sigma User : Alk

23	43	8.89	0.85	363.5	496.708	3.02	498.38	3.09	613.62	
23	44	9.08	1.51	206.0	486.244	3.02	488.21	3.09	614.04	
23	45	8.78	2.60	124.8	502.974	3.02	504.65	3.09	613.93	
23	46	8.77	0.00	0.00	503.780	3.02	504.35	3.09	620.90	
23	47	8.53	0.81	391.5	517.698	3.02	517.73	3.09	615.96	
23	48	8.89	0.00	0.00	496.483	3.02	498.60	3.09	622.39	
23	49	8.79	0.00	0.00	502.626	3.02	502.68	3.10	623.62	
23	50	9.22	4.54	72.54	478.809	3.02	483.61	3.09	624.22	
23	51	9.23	2.02	154.4	478.286	3.02	481.43	3.09	626.22	
233	MISSING TUBE(S)									

8 Fe20U solution

09 May 99 06:57 ALPHA/BETA - 1.02 Page #:
Protocol #:23 U-233 3% 2 sigma User : Alk

```
 109   8.87    2.14 149.2  498.062  3.02  502.16  3.08 620.70
 23 110   8.70    2.12 152.1  507.860  3.02  511.86  3.08 620.96
 23 111   8.86    1.15 271.8  498.176  3.02  501.86  3.09 619.73
 23
SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 09-May-99 07:23
   C14 Eff (0-156 keV) = 96.67 %
C14 CHI SQUARE IPA DATA PROCESSED - 09-May-99 07:34
   C14 Chi Square = 10.20
H3 IPA DATA PROCESSED - 09-May-99 07:35
   H3 Eff (0-18.6 keV) = 64.82 %

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


H3 CHI SQUARE IPA DATA PROCESSED - 09-May-99 07:45
   H3 Chi Square = 23.03
BKG IPA DATA PROCESSED - 09-May-99 08:46
   Bkg (0-18.6 keV) = 19.87 cpm
   Bkg (0-156 keV)  = 29.45 cpm

WARNING: Questionable C14 Background value - Please view historic data


   C14 E^2/B (1-156 keV)   = 408.88
   H3  E^2/B (1-18.6 keV)  = 209.96
```

21 May 99 01:09 ALPHA/BETA - 1.02 Page
Protocol #:23 U-233 3% 2 sigma User : Al

```
 23 103  10.19    5.01 62.26  433.038  3.02  440.54  3.08 608.35
 23 104   9.98    0.00  0.00  442.123  3.02  442.90  3.11 614.75
 234 MISSING TUBE(S)
 109   8.86    1.60 194.0  498.451  3.02  499.95  3.09 609.35
 23 110   8.85    2.76 115.8  498.792  3.02  501.00  3.09 604.57
 23 111   8.78    1.80 174.7  503.252  3.02  506.71  3.08 613.05
 23 112   9.04    4.50 72.89  488.125  3.02  493.30  3.08 609.26
 23 113   8.36    1.79 179.1  528.111  3.02  530.39  3.09 607.11
 23 114   8.46    1.30 242.0  522.064  3.02  524.25  3.09 610.47
 23 115   8.51    0.36 856.4  519.329  3.02  520.30  3.09 608.63
 23 116   8.47    4.82 70.69  521.798  3.02  529.03  3.07 607.26
 232 MISSING TUBE(S)
 119  10.88    1.34 208.4  405.264  3.02  407.37  3.11 614.95
 23 120  10.82    2.01 141.4  407.438  3.03  410.25  3.11 611.45
 23
SYSTEM NORMALIZED
```


UNCAPPED

PP TUBES 5/17 & 5/18

Sample Name	wt. Of vial	wt. Of vial + sample
QFe20U-pH 3a	7.8840	8.3768
QFe20U-pH 3b	7.8741	8.3810
QFe20U-pH 3.5a	7.8445	8.3441
QFe20-pH 3.5b	7.8878	8.3889
QFe20-pH 4a	7.8344	8.3343
QFe20-pH 4b	7.8358	8.3362
QFe20-pH 4.25a	7.8322	8.3343
QFe20-pH 4.25b	7.7940	8.2979
QFe20-pH 4.5a	7.8256	8.3277
QFe20-pH 4.5b	7.8836	8.3881
QFe20-pH 4.75a	7.8490	8.3563
QFe20-pH 4.75b	7.8160	8.3286
QFe20-pH 5a	7.8408	8.3428
QFe20-pH 5b	7.9355	8.4432
QFe20-pH 5.25a	7.8340	8.3358
QFe20-pH 5.25b	7.8108	8.3132
QFe20-pH 5.5a	7.8325	8.3330
QFe20-pH 5.5b	7.8834	8.3840
QFe20-pH 5.75a	7.8843	8.3863
QFe20-pH 5.75b	7.8361	8.3391
QFe20-pH 6a	7.8700	8.3731
QFe20-pH 6b	7.8680	8.3743
QFe20-pH 6.25a	7.8083	8.3084
QFe20-pH 6.25b	7.8901	8.3932
QFe20-pH 6.5a	7.8152	8.3162
QFe20-pH 6.5b	7.7396	8.2439
QFe20-pH 6.75a	7.8918	8.3929
QFe20-pH 6.75b	7.8256	8.3278
QFe20-pH 7a	7.8045	8.3061
QFe20-pH 7b	7.8360	8.3377
QFe20-pH 7.25a	7.8266	8.3299
QFe20-pH 7.25b	7.7907	8.2935
QFe20-pH 7.5a	7.8125	8.3147
QFe20-pH 7.5b	7.8504	8.3538
QFe20-pH 7.75a	7.7803	8.2831
QFe20-pH 7.75b	7.7849	8.2861
QFe20-pH 8a	7.8702	8.3727
QFe20-pH 8b	7.7938	8.2975
QFe20-pH 8.25a	7.8703	8.3775
QFe20-pH 8.25b	7.8508	8.3543
QFe20-pH 8.5a	7.8492	8.3518
QFe20-pH 8.5b	7.8275	8.3320
QFe20-pH 8.75a	7.8469	8.3530
QFe20-pH 8.75b	7.8641	8.3678

CONTAINERS

Sample Name	wt. Of vial	wt. Of vial + sample
QFe20U-pH 3a	7.8179	8.3166
QFe20U-pH 3b	7.8032	8.3036
QFe20U-pH 3.5a	7.8458	8.3502
QFe20-pH 3.5b	7.8437	8.3439
QFe20-pH 4a	7.8782	8.3801
QFe20-pH 4b	7.813	8.3141
QFe20-pH 4.25a	7.8258	8.3278
QFe20-pH 4.25b	7.8858	8.3869
QFe20-pH 4.5a	7.8432	8.3465
QFe20-pH 4.5b	7.8166	8.3193
QFe20-pH 4.75a	7.8034	8.3031
QFe20-pH 4.75b	7.8543	8.3549
QFe20-pH 5a	7.7526	8.2535
QFe20-pH 5b	7.8231	8.3242
QFe20-pH 5.25a	7.7415	8.2429
QFe20-pH 5.25b	7.7546	8.253
QFe20-pH 5.5a	7.6555	8.1562
QFe20-pH 5.5b	7.7444	8.2534
QFe20-pH 5.75a	7.7802	8.2803
QFe20-pH 5.75b	7.782	8.2817
QFe20-pH 6a	7.8632	8.3615
QFe20-pH 6b	7.8223	8.3208
QFe20-pH 6.25a	7.7507	8.2499
QFe20-pH 6.25b	7.7828	8.2814
QFe20-pH 6.5a	7.7704	8.2708
QFe20-pH 6.5b	7.7984	8.2982
QFe20-pH 6.75a	7.7992	8.2981
QFe20-pH 6.75b	7.8559	8.3552
QFe20-pH 7a	7.7856	8.2858
QFe20-pH 7b	7.8133	8.313
QFe20-pH 7.25a	7.8213	8.3215
QFe20-pH 7.25b	7.8088	8.3077
QFe20-pH 7.5a	7.8167	8.3133
QFe20-pH 7.5b	7.7663	8.2658
QFe20-pH 7.75a	7.7547	8.2548
QFe20-pH 7.75b	7.8218	8.3214
QFe20-pH 8a	7.7723	8.2729
QFe20-pH 8b	7.7661	8.2664
QFe20-pH 8.25a	7.8193	8.3202
QFe20-pH 8.25b	7.7473	8.2474
QFe20-pH 8.5a	7.7888	8.2888
QFe20-pH 8.5b	7.7384	8.2383
QFe20-pH 8.75a	7.8013	8.3012
QFe20-pH 8.75b	7.8061	8.3055

4/19/99
4/20/99

AJ

BET surface area analysis on Quartz crushed to 60/100 mesh size & with iron impurities (QFeV)

Equipment used :- SA 3100 COUTLER analyzer
tube assembly.
Mettler AE240 balance
Liquid N_2.

① wt of tube assembly # 1 = 33.6475 g
amount of qtz added = 1.6510 g
wt. of tube assembly + outgassed sample = 35.2956 g
wt. of outgassed sample (QFeV) = 35.2956
− 33.6475
1.6481 g

BET surface area = 0.072 m^2/g

② wt. of tube assembly #4 = 33.4884 g
wt. of qtz added = 2.2533 g
wt. of tube assembly + outgassed QFeV = 35.7407 g
wt. of outgassed QFeV = 35.7407
33.4884
2.2523 g

BET surface area = 0.052 m^2/g

③ wt. of tube assembly #5 = 33.3359 g
wt. of qtz added = 2.8946
wt. of tube assembly + outgassed QFeV = 36.2295 g
wt. of outgassed sample = 36.2295
− 33.3359
2.8936 g

BET surface area = 0.048 m^2/g

4/20/99
4/21/99

AJ
BET surface area analysis on QFeV similarly as above.

④ wt. of tube assembly # 7 = 33.6457 g
wt. of qtz added = 2.4969 g
wt. of outgassed sample + assembly = 36.1409 g.
wt. of outgassed QFeV sample = 36.1409
− 33.6457
2.4952 g

BET surface area = 0.074 m^2/g

⑤ wt. of tube assembly # 9 = 33.2214 g
wt. of qtz added = 3.5060 g
wt. of outgassed sample + assembly = 36.7252 g
wt of outgassed QFeV sample = 36.7252
− 33.2214
3.5038 g

BET surface area = 0.056 m^2/g

5/3/99

Prepare 0.1 M HNO_3 stock solution using method as on Page 10-11.
(conc. HNO_3 (lot # 983546)

5/4/99

Preparation of reducing agent using same method as on page (19) for SiO_2 detection by Milton Roy Spectronic 1201 spectrophotometer.

QFe20-pH 9a	7.8326	8.3395
QFe20U-pH 9b	7.8170	8.3203
QFe20-pH 9.25a	7.8018	8.3090
QFe20U-pH 9.25b	7.8281	8.3309
QFe20-pH 9.5a	7.7857	8.2897
QFe20U-pH 9.5b	7.8686	8.3733

QFe20-pH 9a	7.7181	8.2181
QFe20U-pH 9b	7.8173	8.3173
QFe20-pH 9.25a	7.8439	8.3432
QFe20U-pH 9.25b	7.8254	8.3237
QFe20-pH 9.5a	7.8108	8.3083
QFe20U-pH 9.5b	7.7186	8.217

UNCAPPED

Sample Name	5/3/99 wt. Of PP tubes, g	5/4/99 wt. Of PP tubes after transfer of qtz/clino, g	5/4/99 wt. Of PP tubes after acid add, g	5/4/99 Container wt. after transfer of supernatant, g	Container wt. after supernatant retransfer & acid add ,g 5/4/99
QFe20U-pH 3	13.7806	19.0495	22.0107	27.5662	55.0600
QFe20U-pH 3.5	13.7510	18.5800	21.6008	27.1504	53.2416
QFe20U-pH 4	13.6555	18.3568	21.3674	26.9168	53.7496
QFe20U-pH 4.25	13.7143	17.4115	20.4142	25.9421	55.8206
QFe20U-pH 4.5	13.8564	15.5912	18.5647	23.9747	58.2397
QFe20U-pH 4.75	13.6599	15.5193	18.5320	23.9502	57.8269
QFe20U-pH 5	13.8047	15.4623	18.4745	23.8525	55.1063
QFe20U-pH 5.25	13.6033	15.2454	18.2637	23.8850	58.2803
QFe20U-pH 5.5	13.7340	17.0582	20.0862	25.8752	56.5647
QFe20U-pH 5.75	13.8019	15.4662	18.4836	23.9298	58.3461
QFe20U-pH 6	13.4095	15.8362	18.8277	24.8650	57.4439
QFe20U-pH 6.25	13.4005	16.2767	19.2772	25.1433	56.9914
QFe20U-pH 6.5	13.6896	16.6880	19.6848	25.4738	56.9145
QFe20U-pH 6.75	13.7788	16.4953	19.4938	25.0007	56.8861
QFe20U-pH 7	13.7034	15.9592	18.9580	24.5177	57.4336
QFe20U-pH 7.25	13.7748	15.9509	18.9509	24.3095	56.8102
QFe20U-pH 7.5	13.7912	16.5443	19.5722	24.8504	57.0431
QFe20U-pH 7.75	13.7911	16.2636	19.2834	24.7337	57.3800
QFe20U-pH 8	13.6345	16.0852	19.0963	24.5487	57.2900
QFe20U-pH 8.25	13.6861	16.7580	19.7796	25.2827	56.6660
QFe20U-pH 8.5	13.7871	16.7388	19.7715	25.1835	56.9078
QFe20U-pH 8.75	13.0848	15.8161	18.8481	24.9479	57.2540
QFe20U-pH 9	13.5024	16.9376	19.9639	25.6387	56.5258
QFe20U-pH 9.25	13.3253	17.1912	20.2221	26.2375	56.8720
QFe20U-pH 9.5	13.6433	16.1082	19.1361	24.9548	58.9642

UNCAPPED DESORPTION

Sample Name	5/17/99 Container wt. before sampling	5/17 Container wt.after sampling	5/18/99 wt.of PP tubes before sampling	5/18 wt. Of PP tubes after sampling
QFe20U-pH 3	54.8728	53.8627	22.0074	20.9947
QFe20U-pH 3.5	53.1438	52.1263	21.5963	20.5867
QFe20U-pH 4	53.6912	52.6767	21.3632	20.3536
QFe20U-pH 4.25	55.7619	54.7551	20.4099	19.4092
QFe20U-pH 4.5	58.1779	57.1685	18.5605	17.5509
QFe20U-pH 4.75	57.7680	56.7624	18.5281	17.4462
QFe20U-pH 5	55.0478	54.0434	18.4707	17.4542
QFe20U-pH 5.25	58.2219	57.2176	18.2604	17.2191
QFe20U-pH 5.5	57.6044	56.5234	18.3564	17.3112
QFe20U-pH 5.75	58.2625	57.2557	18.4794	17.4494
QFe20U-pH 6	57.3828	56.3788	18.8184	17.7977
QFe20U-pH 6.25	56.9319	55.9243	19.2481	18.2391
QFe20U-pH 6.5	56.8522	55.8469	19.6797	18.6709
QFe20U-pH 6.75	56.8259	55.8212	19.4884	18.4468
QFe20U-pH 7	57.3760	56.3716	18.9476	17.9272
QFe20U-pH 7.25	56.6801	55.6756	18.9442	17.8862
QFe20U-pH 7.5	56.9786	55.9672	19.5628	18.5519
QFe20U-pH 7.75	57.3169	56.3104	19.2696	18.2683
QFe20U-pH 8	57.1849	56.1738	19.0856	18.0669
QFe20U-pH 8.25	56.6110	55.6046	19.7701	18.7125
QFe20U-pH 8.5	56.8464	55.8401	19.7637	18.7353
QFe20U-pH 8.75	57.1758	56.1659	18.8392	17.7488
QFe20U-pH 9	56.4513	55.4398	19.9563	18.9410
QFe20U-pH 9.25	56.7327	55.724	20.2170	19.1905
QFe20U-pH 9.5	58.8962	57.8922	19.1286	18.1142

Background Subtract: 1st Vial

5/19/99

	LL	UL	LCR	2S%	BKG
Region A:	0.0 -	100	0	0.3	19.62
Region B:	100 -	350	0	3.0	3.47
Region C:	0.0 -	2000	0	0.1	28.94

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

S#	TIME	CPMA A:2S%		CPMB B:2S%		CPMC C:2S%		SIS	FLAG
P# 1	999.99	19.62	1.43	3.468	3.40	28.94	1.18	147.55	B
23 2	13.27	0.43	578.0	331.875	3.03	332.63	3.14	605.40	
23 3	13.46	1.56	162.1	326.844	3.03	328.42	3.14	602.90	
23 4	13.08	1.33	191.3	336.364	3.03	337.65	3.14	598.91	
23 5	13.61	3.23	80.61	323.057	3.03	327.71	3.13	600.97	
23 6	10.89	0.49	554.2	405.164	3.02	406.41	3.11	601.57	
23 7	10.97	3.72	78.79	401.910	3.03	406.89	3.10	594.02	
23 8	6.01	5.34	76.49	736.798	3.01	743.11	3.05	583.84	
23 9	6.00	5.55	73.98	737.199	3.01	745.56	3.05	584.59	
23 10	6.22	0.64	565.6	711.001	3.01	714.63	3.06	587.24	
23 11	6.17	2.42	156.3	718.088	3.01	721.14	3.06	583.71	
23 12	3.14	2.36	224.8	1414.366	3.00	1418.51	3.03	584.74	
23 13	3.09	0.00	0.00	1438.603	3.00	1437.08	3.03	586.33	
23 14	2.12	2.55	253.6	2099.362	3.00	2108.80	3.01	582.36	
23 15	2.17	14.48	54.77	2052.753	3.00	2066.91	3.01	580.25	
23 16	2.27	2.85	221.0	1963.052	3.00	1969.74	3.01	580.69	
23 17	2.24	9.40	76.63	1989.836	3.00	2002.76	3.01	580.65	
232 MISSING TUBE(S)									
20	2.10	6.10	114.9	2112.723	3.01	2118.20	3.02	582.66	
23 21	2.10	7.53	95.62	2124.151	3.00	2131.54	3.01	585.34	
23 22	2.35	7.19	94.02	1895.255	3.00	1905.10	3.01	587.82	
23 23	2.34	3.46	181.7	1897.387	3.00	1901.40	3.02	583.62	
23 24	2.58	6.74	94.94	1719.013	3.01	1727.26	3.02	585.55	
23 25	2.50	5.18	121.7	1775.732	3.00	1783.06	3.02	587.68	
23 26	2.67	5.48	112.1	1666.195	3.00	1674.06	3.02	587.16	
23 27	2.56	8.12	81.17	1734.032	3.00	1742.15	3.02	583.73	
23 28	2.58	9.45	71.08	1719.788	3.01	1729.98	3.02	586.70	
23 29	2.53	1.33	432.8	1755.821	3.00	1762.36	3.02	587.38	
23 30	2.29	14.44	53.44	1941.510	3.00	1954.90	3.01	581.92	
23 31	2.25	7.94	88.24	1972.976	3.00	1984.39	3.01	582.01	
23 32	2.37	6.54	101.6	1879.654	3.00	1887.09	3.01	585.03	
23 33	2.50	10.38	66.78	1778.132	3.00	1788.66	3.02	583.22	
23 34	3.33	8.91	65.77	1333.469	3.01	1343.43	3.02	580.91	
23 35	3.27	6.99	81.73	1360.141	3.00	1365.56	3.02	579.44	
23 36	2.08	12.11	64.53	2145.571	3.00	2159.52	3.00	581.88	
23 37	2.09	13.40	59.37	2126.676	3.00	2139.00	3.01	582.19	
23 38	5.73	2.55	154.8	772.274	3.01	777.52	3.05	581.24	
23 39	5.47	0.13	3003	809.878	3.01	811.28	3.06	582.21	
23 40	9.68	0.63	460.7	455.623	3.02	457.11	3.10	586.85	
23 41	9.90	5.43	58.78	445.623	3.02	453.59	3.08	580.04	
23 42	14.26	0.23	1040	308.173	3.03	310.96	3.14	589.10	

5.25b
5.75a
&Fe2O3 tubes desorption
&Fe2O3 tubes desorption

20 May 99 12:16 ALPHA/BETA - 1.02 Page
Protocol #:23 U-233 3% 2 sigma User : A

23	43	14.48	0.13	1753	303.438	3.03	304.07	3.16	589.33
23	44	16.83	3.50	67.51	260.584	3.04	265.12	3.16	580.97
23	45	16.85	1.39	161.7	260.330	3.04	262.75	3.17	584.70
23	46	15.48	3.12	78.16	283.612	3.04	288.11	3.14	580.38
23	47	15.59	1.04	223.6	281.586	3.04	284.53	3.15	586.17
23	48	15.62	3.43	71.29	281.295	3.04	285.15	3.15	583.60
23	49	15.33	1.45	162.6	286.812	3.03	289.59	3.15	588.15
23	50	21.99	1.85	108.0	198.624	3.05	202.76	3.21	585.24
23	51	22.03	2.85	71.50	198.257	3.05	201.79	3.21	580.43
233 MISSING TUBE(S)									
55		9.58	1.16	256.1	460.833	3.02	463.02	3.10	609.75
23	56	9.70	1.72	172.9	454.676	3.02	456.83	3.10	611.23
23	57	9.58	2.93	105.2	460.624	3.02	464.07	3.09	607.09
23	58	9.68	1.46	203.4	455.933	3.02	456.39	3.10	603.29
23	59	9.88	2.85	106.2	446.330	3.02	449.40	3.10	609.08
23	60	9.62	3.46	89.90	458.694	3.02	463.47	3.09	604.55
23	61	10.02	0.44	642.4	440.045	3.02	441.02	3.11	608.80
23	62	9.93	0.02	13948	444.568	3.02	445.68	3.10	613.10
23	63	10.76	1.57	179.4	409.636	3.03	412.23	3.11	610.10
23	64	10.80	0.11	2587	408.106	3.03	408.38	3.12	609.13
23	65	12.66	0.60	421.1	347.559	3.03	348.55	3.13	612.50
23	66	12.77	0.66	381.5	344.535	3.03	346.47	3.13	607.44
23	67	26.33	1.92	95.47	165.313	3.06	167.07	3.27	607.84
23	68	26.38	1.54	118.1	165.069	3.06	167.54	3.26	609.69
23	69	15.23	3.23	76.28	288.324	3.04	293.71	3.14	601.86
23	70	15.13	2.66	91.96	290.319	3.04	293.47	3.15	605.67
232 MISSING TUBE(S)									
73		15.64	0.59	389.9	280.739	3.04	283.21	3.16	608.75
23	74	16.40	0.00	0.00	267.569	3.04	268.32	3.18	608.65
23	75	16.15	1.81	128.4	271.764	3.04	274.09	3.16	605.45
23	76	16.11	2.42	97.40	272.385	3.04	275.03	3.16	601.90
23	77	15.87	3.89	63.04	276.557	3.04	281.39	3.15	601.11
23	78	15.93	2.54	93.44	275.628	3.04	278.59	3.16	606.15
23	79	14.89	1.34	178.8	295.054	3.04	297.05	3.15	6Q5.29
23	80	15.47	0.74	310.4	284.056	3.04	286.57	3.15	608.72
23	81	15.51	0.24	946.4	283.186	3.04	284.54	3.16	608.07
23	82	15.28	0.08	2799	287.435	3.04	287.81	3.17	608.58
23	83	15.85	2.91	82.59	276.910	3.04	280.27	3.15	603.16
23	84	15.84	0.65	351.8	277.151	3.04	278.13	3.17	608.58
23	85	14.64	1.97	124.2	300.220	3.03	302.48	3.15	606.06
23	86	14.71	2.88	86.30	298.775	3.03	302.54	3.14	601.99
23	87	13.72	3.49	74.85	320.512	3.03	325.43	3.13	600.40
23	88	13.79	1.12	219.9	318.794	3.03	320.95	3.14	605.03
23	89	12.56	1.80	145.9	350.433	3.03	352.51	3.13	604.78
23	90	12.48	4.50	62.08	353.022	3.03	357.84	3.11	606.74
23	91	11.10	2.27	124.1	397.343	3.02	399.62	3.11	603.65
23	92	10.64	2.19	131.5	414.577	3.02	417.68	3.10	607.18

5.25b
5.75a
&Fe2O3 Containers desorption
&Fe2O3 containers desorption

3/31/99

23	93	9.90	0.89	325.7	445.724	3.02	446.41	3.11	604.94	
23	94	9.63	0.42	683.1	458.318	3.02	459.33	3.10	605.75	
23	95	9.64	0.00	0.00	457.735	3.02	457.89	3.10	606.10	
23	96	9.83	2.36	127.5	448.923	3.02	452.55	3.09	604.09	
23	97	9.29	1.59	191.0	474.896	3.02	478.06	3.09	605.75	
23	98	9.41	2.91	106.7	468.796	3.02	473.40	3.09	606.52	
23	99	9.45	1.02	291.7	467.114	3.02	467.36	3.10	604.90	
23	100	9.55	0.70	420.5	462.396	3.02	463.31	3.10	608.66	
23	101	9.54	0.30	971.2	462.465	3.02	462.36	3.11	614.56	
23	102	9.48	0.85	348.5	465.308	3.02	467.26	3.10	610.56	

231 MISSING TUBE(S)

9		10.03	1.75	166.9	439.804	3.02	441.98	3.10	608.00	
23	10	10.31	3.02	98.18	428.060	3.02	431.44	3.10	608.01	
23	11	26.30	1.94	93.87	165.607	3.06	168.32	3.26	607.83	
23	12	25.55	2.37	78.69	170.607	3.06	173.75	3.25	608.78	
23	13	12.53	1.20	214.7	351.383	3.03	352.72	3.13	603.28	
23	14	12.76	2.32	113.1	345.067	3.03	348.43	3.12	605.88	
23	15	10.00	1.11	259.0	441.634	3.02	441.30	3.11	611.93	
23	16	9.93	4.28	72.49	444.368	3.02	449.44	3.09	605.99	

232 MISSING TUBE(S)

19		6.12	2.34	161.3	722.778	3.01	725.32	3.06	585.24	
23	20	6.03	0.00	0.00	733.616	3.01	733.59	3.07	586.31	
23	21	2.20	0.61	988.3	2026.179	3.00	2027.76	3.02	579.57	
23	22	2.10	6.80	103.9	2118.539	3.00	2125.68	3.01	578.91	
23	23	2.07	11.05	69.47	2151.223	3.00	2161.73	3.01	578.39	
23	24	2.09	6.93	102.5	2128.213	3.00	2138.38	3.01	581.27	
23	25	21.55	2.88	71.15	202.898	3.05	206.90	3.20	580.61	
23	26	21.90	1.80	110.5	199.602	3.05	202.08	3.22	582.94	

23

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 26-May-99 19:02
C14 Eff (0-156 keV) = 96.45 %
C14 CHI SQUARE IPA DATA PROCESSED - 26-May-99 19:13
C14 Chi Square = 15.65
H3 IPA DATA PROCESSED - 26-May-99 19:14
H3 Eff (0-18.6 keV) = 64.74 %

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

Experimental Procedure for experiment - U sorption onto clinoptilolite at 25° C.

CAPPED C20U

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

Initial conditions:
- $\sum U$ = 50 ppb (2.14 x 10^{-7})
- Capped containers
  - pH range 3.0-9.5
- solution volume = 35 ml
- mass of solid 1, quartz = 1.000 g
- mass of solid 2, clinoptilolite = 0.000 g
- M/V = 28.57 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:
W510 * UC * RFe * RC * HL * ≤ 325 mesh AJ
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 NaOH (lot 980698)
concentrated HNO_3 (lot 983546)
HNO_3 and NaOHdegassed stock solutions at various concentrations
weighing paper/boats
deionized ultrapure water, DH_2O
teflon beaker

Note: Ultrapure water was degassed by boiling it in a flask and cooled with mouth coverd with rubber stopper.

Procedure:

A. Prepare separate 50 ppb U solutions for sorption experiments.
- On the Metler balance, weigh 200 g of 500 ppb U stock solution into a tared 2000 ml FEP bottle.
- Dilute to a total of 2000 g using degassed 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 26 polycarbonate centrifuge tubes (50 ml capacity) C20U-pHi (where i is the approximate pH of each solution, see Table C20U).
- Label 1 polycarbonate centrifuge tube C20U-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 C20-U-IU container.
- Record weight of each sample container after addition of quartz .

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

- Add the volume of HNO_3 or NaOHto each experimental container as listed in Table C20U. Take care to add HNO_3 or NaOH in the concentrations specified in Table C20U.
- For sample C20U-IU (not listed in Table C20U) 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 CQ0U-IU for initial [U].

- Label two 7 ml LSC vials as C20U-IUa and C20U-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 C20-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 C20U-IU

F. Wait for equilibrium.

- Place caps on sample containers but do not tighten the caps.
- Place containers inside the glove box. Tighten the caps after 2 days.
- 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., C20U-pH3a and C20U-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.
- Record weight of each sample container.
- Measure pH of each experimental solution.
- Record weight of each sample container after pH measurement.

H. Transfer quartz for desorption.

- Record weight of sample containers. *Note: this step can be skipped if the clinoptilolite transfer is done immediately after the last step in section F.*
- Centrifuge polycarbonate tubes containing experimental solutions at about 5,000 rpm for 5 min to remove fine particles from suspension.
- For each sample container, label a corresponding polypropylene (PP) test tube (50 ml capacity) (e.g., C20dU-pH3 for sample container C20U-pH3).
- Record weight of PP test tubes.
- Using an Eppendorf or Oxford pipette, withdraw quartz 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., C20U-pH3a and C202U-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.

Table CQ0U: Estimated solution pH and volumes of HNO3 or NaOH solutions needed for adjustment of pH in 0.1 m NaNO3 solutions with 50 ppb U in contact with qz/clino (35 ml and capped)

Estimated solution pH	Volume of HNO3 added, ml	Molarity of HNO3 to use
3	0.045	1
3.25	0.254	1
3.5	0.143	0.1
3.75	0.080	0.1
4	0.452	0.01
4.25	0.254	0.01
4.5	0.143	0.01
4.75	0.081	0.01
5	0.045	0.01
5.25	0.025	0.01
5.5	0.140	0.001
5.75	0.073	0.001
6	0.035	0.001
6.25	0.140	0.001
6.5	0.010	0.001
Estimated solution pH	**Volume of NaOH added, ml**	**Molarity of NaOH to use**
6.75	0.007	0.001
7	0.012	0.001
7.25	0.018	0.001
7.5	0.026	0.001
7.75	0.038	0.001
8	0.059	0.001
8.25	0.095	0.001
8.5	0.160	0.001
8.75	0.027	0.01
9	0.047	0.01
9.25	0.082	0.01
9.5	0.145	0.01

CAPPED

3/31/99

SAMPLE NAME	Wt. of container, g
C20U-pH 3	22.1267
C20U-pH 3.5	21.9274
C20U-pH 4	22.1862
C20U-pH 4.25	22.5285
C20U-pH 4.5	22.212
C20U-pH 4.75	22.1244
C20U-pH 5	22.2846
C20U-pH 5.25	22.3162
C20U-pH 5.5	22.5059
C20U-pH 5.75	21.9452
C20U-pH 6	22.2562
C20U-pH 6.25	22.2638
C20U-pH 6.5	22.4589
C20U-pH 6.75	22.1417
C20U-pH 7	22.3031
C20U-pH 7.25	22.1862
C20U-pH 7.5	22.0453
C20U-pH 7.75	22.1308
C20U-pH 8	22.1459
C20U-pH 8.25	22.0033
C20U-pH 8.5	22.2792
C20U-pH 8.75	22.1029
C20U-pH 9	22.3603
C20U-pH 9.25	21.9743
C20U-pH 9.5	22.3189
C20U-IU	22.4011

CAPPED

4/5/99

SAMPLE NAME	WT. OF CONTAINER +CLINOP , g
C20U-pH 3	22.8383
C20U-pH 3.5	22.6617
C20U-pH 4	22.8951
C20U-pH 4.25	23.2367
C20U-pH 4.5	22.9218
C20U-pH 4.75	22.8343
C20U-pH 5	23.0304
C20U-pH 5.25	23.0262
C20U-pH 5.5	23.2803
C20U-pH 5.75	22.8420
C20U-pH 6	22.9668
C20U-pH 6.25	22.7041
C20U-pH 6.5	23.1895
C20U-pH 6.75	22.8522
C20U-pH 7	23.0145
C20U-pH 7.25	22.8969
C20U-pH 7.5	22.9751
C20U-pH 7.75	22.7293
C20U-pH 8	22.7536
C20U-pH 8.25	22.8192
C20U-pH 8.5	22.9898
C20U-pH 8.75	22.8148
C20U-pH 9	22.8562
C20U-pH 9.25	22.7913
C20U-pH 9.5	23.0304
C20U-IU	48.5970

CAPPED

4/5/99

SAMPLE NAME	WT. OF CONTAINER + U SOLN., g
C20U-pH 3	57.8638
C20U-pH 3.5	57.6675
C20U-pH 4	57.9024
C20U-pH 4.25	58.2645
C20U-pH 4.5	57.9079
C20U-pH 4.75	57.7982
C20U-pH 5	57.9889
C20U-pH 5.25	58.0234
C20U-pH 5.5	58.3124
C20U-pH 5.75	57.9029
C20U-pH 6	57.9604
C20U-pH 6.25	57.7163
C20U-pH 6.5	58.2092
C20U-pH 6.75	57.8425
C20U-pH 7	57.8228
C20U-pH 7.25	57.9521
C20U-pH 7.5	57.9877
C20U-pH 7.75	57.7654
C20U-pH 8	57.7739
C20U-pH 8.25	57.8679
C20U-pH 8.5	58.0319
C20U-pH 8.75	57.9461
C20U-pH 9	57.8662
C20U-pH 9.25	58.1328
C20U-pH 9.5	58.0208

UNCAPPED

AJ 4/5/99

SAMPLE NAME	WT. OF CONTAINER AFTER ADDITIONS OF HNO3 /NAHCO3, g
C20U-pH 3	57.9315
C20U-pH 3.5	57.8690
C20U-pH 4	58.3035
C20U-pH 4.25	58.4661
C20U-pH 4.5	57.9672
C20U-pH 4.75	57.8727
C20U-pH 5	58.0872
C20U-pH 5.25	58.1712
C20U-pH 5.5	58.4853
C20U-pH 5.75	58.0993
C20U-pH 6	58.2080
C20U-pH 6.25	57.9882
C20U-pH 6.5	58.5058
C20U-pH 6.75	58.1879
C20U-pH 7	58.2167
C20U-pH 7.25	58.0504
C20U-pH 7.5	58.1105
C20U-pH 7.75	57.9119
C20U-pH 8	57.9454
C20U-pH 8.25	58.0904
C20U-pH 8.5	58.1055
C20U-pH 8.75	58.0436
C20U-pH 9	58.0155
C20U-pH 9.25	58.3291
C20U-pH 9.5	58.3033

CAPPED

4/29, 4/30, 5/10/99, 5/24/99

Sample Name	Container wt. before sampling & pH measurements	Measured pH (5/12/99)	Container wt. after sampling & pH measurements
C20U-pH 3	57.4055	2.45	56.3848
C20U-pH 3.5	57.3785	3.37	56.3686
C20U-pH 4	57.5555	2.92	56.5303
C20U-pH 4.25	58.0125	4.66	57.9991
C20U-pH 4.5	57.5241	5.10	56.5088
C20U-pH 4.75	57.2056	5.24	56.1803
C20U-pH 5	57.4179	5.40	56.4122
C20U-pH 5.25	57.7551	4.08	56.7656
C20U-pH 5.5	57.9162	4.19	56.9019
C20U-pH 5.75	57.6004	5.68	56.5901
C20U-pH 6	57.5813	5.82	56.5510
C20U-pH 6.25	57.4328	6.75	56.3976
C20U-pH 6.5	58.0057	4.6 5/24 AJ	56.8038
C20U-pH 6.75	57.7474	4.42	55.9628
C20U-pH 7	57.6769	6.39	56.7289
C20U-pH 7.25	57.6765	4.66	56.6336
C20U-pH 7.5	57.3905	7.46	56.6638
C20U-pH 7.75	57.3888	7.23	56.3688
C20U-pH 8	57.3055	6.92	56.3769
C20U-pH 8.25	57.6680	7.62	56.2698
C20U-pH 8.5	57.4445	7.91	56.6303
C20U-pH 8.75	57.4760	8.21	56.4082
C20U-pH 9	57.8340	8.84	56.4487
C20U-pH 9.25	57.5060	9.04	56.6275
C20U-pH 9.5	58.6553	9.53	56.5122

Sample Name	wt. Of vial (CAPPED) 4/26/99	wt. Of vial + sample 4/30/99
C20-pH 3a	7.8064	8.2961
C20-pH 3b	7.8985	8.3429
C20-pH 4a	7.9167	8.3995
C20-pH 4b	7.9096	8.4004
C20-pH 4.25a	7.8719	8.3517
C20-pH 4.25b	7.8038	8.2748
C20-pH 4.5a	7.9112	8.3965
C20-pH 4.5b	7.9250	8.4091
C20-pH 4.75a	7.8973	8.3789
C20-pH 4.75b	7.9356	8.4094
C20-pH 5a	7.8141	8.2858
C20-pH 5b	7.8917	8.3782
C20-pH 5.25a	7.7967	8.2556
C20-pH 5.25b	7.9470	8.4249
C20-pH 5.5a	7.8722	8.3534
C20-pH 5.5b	7.9220	8.4088
C20-pH 5.75a	7.8930	8.3767
C20-pH 5.75b	7.8440	8.3305
C20-pH 6a	7.8118	8.3070
C20-pH 6b	7.8936	8.3787
C20-pH 6.25a	7.8408	8.3243
C20-pH 6.25b	7.8418	8.3293
C20-pH 6.5a	AT 5/24 7.7532	8.2284
C20-pH 6.5b	7.8576	8.3538
C20-pH 6.75a	7.8507	8.3378
C20-pH 6.75b	7.8356	8.3291
C20-pH 7a	7.8289	8.3130
C20-pH 7b	7.8475	8.3356
C20-pH 7.25a	7.7343	8.2200
C20-pH 7.25b	7.9190	8.4074
C20-pH 7.5a	7.8098	8.2923
C20-pH 7.5b	7.8210	8.3078
C20-pH 7.75a	7.8465	8.3284
C20-pH 7.75b	7.8347	8.3195
C20-pH 8a	7.8639	8.3511
C20-pH 8b	7.7894	8.2725
C20-pH 8.25a	7.8828	8.3644
C20-pH 8.25b	7.8332	8.3193
C20-pH 8.5a	7.8903	8.3771
C20-pH 8.5b	7.8167	8.2995

C20-pH 8.75a	7.8593	8.3267
C20-pH 8.75b	7.8264	8.3145
C20-pH 9a	7.8342	8.3191
C20-pH 9b	7.8046	8.3088
C20-pH 9.25a	7.8351	8.3173
C20-pH 9.25b	7.8792	8.3674
C20-pH 9.5a	7.8232	8.3082
C20-pH 9.5b	7.7822	8.2673

```
 55   8.65     0.00  0.00  510.584  3.02  511.06  3.09 614.26
23  56   8.50     2.76 119.6  519.655  3.02  522.60  3.09 612.57   5/5/99
23  57  10.43     0.51 556.5  422.675  3.02  422.93  3.12 614.15
23  58  10.89     0.00  0.00  404.860  3.02  405.10  3.12 621.23
23  59   9.15     0.00  0.00  482.498  3.02  482.61  3.10 614.85
23  60   8.95     1.27 245.7  493.691  3.02  494.62  3.10 611.34
23  61  36.02     0.00  0.00  119.972  3.09  119.29  3.42 616.05
23  62  36.11     1.28 123.0  119.747  3.09  121.49  3.38 610.88 CV20
23  63  69.56     0.00  0.00   60.483  3.17   60.84  3.79 621.65 Capped
23  64  70.26     0.00  0.00   59.847  3.18   60.14  3.80 614.38 6option
23  65  70.25     0.00  0.00   59.856  3.18   59.74  3.82 616.02
23  66  69.22     0.00  0.00   60.797  3.17   60.92  3.79 619.81
23  67 109.18     0.00  0.00   37.309  3.29   37.27  4.30 635.80
23  68 105.88     0.26 361.2   38.568  3.28   39.48  4.18 613.59
23  69  51.54     0.00  0.00   82.840  3.13   83.42  3.57 621.30
23  70  49.48     0.00  0.00   86.410  3.12   85.92  3.58 620.96
23  71  57.04     0.90 139.0   74.506  3.14   75.53  3.62 609.05
23  72  58.06     0.00  0.00   73.137  3.14   73.29  3.66 617.24
23  73 106.67     0.00  0.00   38.257  3.28   38.25  4.26 623.71
23  74 109.03     0.03  3085   37.355  3.29   38.06  4.23 619.62
23  75 118.18     1.14 78.91   34.200  3.32   35.81  4.26 602.74
23  76 127.38     1.15 75.38   31.499  3.34   33.33  4.34 603.38
23  77 154.58     0.22 358.1   25.351  3.43   25.92  4.81 609.39
23  78 156.80     0.00  0.00   24.951  3.44   25.48  4.84 620.51 6.25b
234 MISSING TUBE(S)
 83 127.08     0.22 388.5   31.566  3.34   32.33  4.44 618.78 79
23  84 125.75     0.08  1087   31.936  3.34   32.27  4.47 619.15 76
232 MISSING TUBE(S)
```

	87	112.54	0.00	0.00	36.084	3.30	36.09	4.34	623.86	7.59
23	88	108.33	0.00	0.00	37.628	3.29	37.58	4.29	627.32	
23	89	120.38	0.36	246.0	33.512	3.32	34.15	4.38	616.91	
23	90	121.36	0.00	0.00	33.214	3.33	33.21	4.45	636.29	
23	91	111.21	0.12	774.2	36.556	3.30	37.14	4.27	616.43	
23	92	115.42	0.20	455.8	35.099	3.31	35.64	4.33	616.41	
23	93	93.34	0.00	0.00	44.218	3.24	44.57	4.07	625.71	
23	94	91.64	0.00	0.00	45.101	3.24	45.78	4.03	623.63	
23	95	106.94	0.41	226.7	38.152	3.28	39.11	4.19	614.93	
23	96	110.01	0.00	0.00	37.010	3.29	37.43	4.27	618.02	
23	97	142.51	0.00	0.00	27.794	3.39	28.37	4.65	622.71	
23	98	142.82	0.00	0.00	27.740	3.39	28.01	4.69	619.80	
23	99	243.52	0.11	611.1	14.845	3.77	15.46	5.99	618.10	
23	100	244.98	0.00	0.00	14.740	3.78	15.01	6.12	635.18	
23	101	329.73	0.16	356.6	10.074	4.18	10.75	7.25	627.70	
23	102	316.57	0.37	158.1	10.634	4.11	11.56	6.90	615.37	
23	103	245.27	0.17	374.4	14.715	3.78	15.32	6.01	630.78	
23	104	254.62	0.06	1117	14.049	3.82	14.65	6.15	638.16	

234 MISSING TUBE(S)

CaOV capped 6.5 6.75 7.25

26 May 99 10:40 ALPHA/BETA - 1.02 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	19.39
Region B:	100 -	350	0	3.0	3.37
Region C:	0.0 -	2000	0	0.1	28.60

Quench Indicator: SIS
alpha cpm U-233 1st vial bkgnd
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

S#		TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
P#	1	999.99	19.39	1.44	3.366	3.45	28.60	1.18	144.39	B
23	2	55.30	0.70	176.4	77.014	3.13	77.78	3.59	613.08	
23	3	53.56	1.58	81.24	79.606	3.13	81.80	3.53	606.82	
23	4	38.45	2.72	56.74	112.239	3.09	115.19	3.37	604.91	
23	5	37.61	0.53	281.9	114.821	3.09	115.72	3.40	613.08	
23	6	58.82	0.66	183.2	72.187	3.14	73.49	3.61	616.10	
23	7	56.31	0.94	130.6	75.554	3.14	76.78	3.59	613.13	

CU2O capped

5/26/99
5/28/99

Experimental Procedure for SiO_2 analysis using Spectrophotometry

Objective: To determine the concentrations of SiO_2 in experimental solutions of U-sorption experiments.

Initial Conditions: Operating wavelength = 815 nm

Equipment and Supplies:

Milton Roy Spectronic 1201
1 cm cubettes (FS)
Analytical balance (mettler PM4600)
Hot Plate and magnetic stirrer (Corning model PC220)
Orion 920A PH meter
Nessler tubes matched, 50 ml, EXAX
Glass beakers, flasks, magnetic stirrers
Polyethylene bottles
Pippetors and tips
Weighing paper/boats
deionized ultrapure water, DH_2O
HCl (lot# 956110)
NaOH (lot# 980698)
Ammonium molybdate (lot # 901533)
Oxalic acid (lot# 906135B
1-amino-2-napthol-4-sulfonic acid (lot# 1807KEKS)
Sodium sulfite (lot# 904672)
Sodium bisulfite (lot# 915268)
Filter paper
SiO_2 reference solution (lot# 9944097-24)

Reagents:

SiO_2 reference solution diluted to 10 ppm (prepared on 3/22/99 by JP)
6M NaOH soln.(prepared on 7/24/98 by AJ)
Ammonium molybdate solution (prepared 0n 5/3/99 by RC)
Oxalic Acid solution (prepared 0n 3/22/99 by JP)
Reducing Agent (prepared on 5/4/99 by AJ)
1+1 HCl solution (prepared 0n 7/24/98 by AJ)

Procedure:

Heteropoly Blue method as described in TOP-014

Experimental Procedure for Al analysis using Spectrophotometry

Objective: To determine the concentrations of Al in experimental solutions of U-sorption experiments.

Initial Conditions: Operating wavelength = 535 nm

Equipment and Supplies:

Milton Roy Spectronic 1201
1 cm cubettes (FS)
Analytical balance (mettler PM4600)
Hot Plate and magnetic stirrer (Corning model PC220)
Orion 920A PH meter
Nessler tubes matched, 50 ml, EXAX
Glass beakers, flasks, magnetic stirrers
Polyethylene bottles
Pipettors and tips
Weighing paper/boats
deionized ultrapure water, DH_2O
H_2SO_4 (lot# 913495)
Na acetate trihydrate(lot# 937077)
Acetic acid (lot # 971798)
Disodium ethylenediamine tetra acetate,EDTA (lot# 905518)
Eriochrome cyanine R (lot# 249482 588, Fluka Chemie AG)
Al refernce solution (lot# 981033-18)

Reagents:

Al reference solution diluted to 5 ppm
0.01M EDTA (prepared on 7/22/98 by AJ)
0.02N H_2SO_4 (prepared on 7/22/98 by AJ)
Stock dye solution (prepared on 7/22/98 by AJ)
Working dye solution (prepared on 7/22/98 by AJ)
Buffer reagent (prepared 0n 7/22/98 by AJ)

Procedure: As described in TOP-013

For Al+ calibration: Set wavelength = 535 n m.

Standard solutions were prepared by additions of different volumes of 5 PPM Al std. solution per [50 ml] sample as follows :-

(Al Conc.)	H_2O	Al. Std.	0.02N H_2SO_4	Ascorbic Acid	Buffer Reagent	Dye Soln.
Blank 0 PPb	33 ml	0 ml	1 ml	1 ml	10 ml	5 ml
10 PPb	32.9 ml	0.1	1	1	10	5
50 PPb	32.5 ml	0.5	1	1	10	5
100 PPb	32 ml	1.0	1	1	10	5
250 PPb	30.5	2.5	1	1	10	5

Note :- Samples
Samples were prepared by the additions of 5ml experimental solution from desired PH as follows:

Expt.	Soln.	H_2O	0.02N H_2SO_4	Ascorbic Acid	Buffer Reagent	Dye soln.
	5 ml	28 ml	1 ml	1 ml	10 ml	5 ml

Results :-

PH	CQ0V	QC10V	QC20V
3.5	AJ ~~48.8~~ 6.9	49.9	48.8
4.5	~~44.3~~ 4.3	46.9	44.3
5.0	~~16.0~~ 4.7	21.4	16.0
6.0	~~0~~ 4.5	29.4	0.8
6.5	4.6	60.4	46.9
7.0	4.38	34.3	2.3
8.0	4.39	33.4	0.6
9.0	3.7	7.2	19.5

For SiO_2 Calibration Spectrophotometer wavelength set to 815 nm.

Standard ~~#~~ AJ solutions were prepared by additions of different volumes of 10 ppm SiO_2 solution per [57 ml] sample as follows:-

SiO_2 Conc.	H_2O	SiO_2 Std.	1+1 HCl	Ammo. Molybdate	Oxalic Acid	Reducing Agent
0 ppb	50 ml	0 ml	1ml	2 ml	2 ml	2 ml
88 ppb	49.5	0.5	1	2	2	2
351 ppb	48	2	1	2	2	2
877 ppb	45	5	1	2	2	2
1754 ppb	40	10	1	2	2	2

* Results :-

PH	(QC0U) Conc.	(QC10U) Conc.	(QC20U) Conc.
3.5	45	1094	1416
4.5	75	1063	1333
5.0	358	942	892
6.0	508	1088	716
6.5	622	1645	1400
7.0	766	1362	962
8.0	1149	1687	1231
9.0	1516	1718	1934

* Note :- Samples were prepared by the addition of 5 ml aliquots from each PH & therefore additions are as follows :-

samples :-

Expt. Soln	H_2O	1+1 HCl	Ammon. molybdate	Oxalic Acid	Reducing Agent
5ml	45 ml	1ml	2 ml	2ml	2 ml

SiO2 and Al solution concentrations
Measurement of solutions from desorption containers of mixed mineral (qtz/clinop) experiments

	QC0U			QC10U			QC20U		
Exp soln.	equilib	SiO2	Al	equilib	SiO2	Al	equilib	SiO2	Al
	pH	ppm	ppb	pH	ppm	ppb	pH	ppm	ppb
3.5	3.42	0.42	69	4.09	12.38	499	4.06	16.05	488
4.5	4.6	0.76	43	5.94	12.03	469	6.02	15.11	443
5.0	5.9	3.99	47	6.38	10.65	214	5.47	10.08	160
6.0	6.47	5.70	45	6.58	12.31	294	5.69	8.07	8
6.5	6.67	7.00	46	6.67	18.66	604	5.87	15.87	469
7.0	7.02	8.64	43.8	7.07	15.44	343	6.76	10.88	23
8.0	7.93	13.01	43.9	7.94	19.14	334	7.84	13.94	6
9.0	8.94	17.19	37	8.96	19.49	72	8.98	21.96	195

6/22/99 AT

6/23/99 objective :- BET surface area analysis on γ-Alumina using COULTER SA 3100.

Equipment & Supplies :-
COULTER SA 3100
γ-Alumina { lot # 39812 / C16F19 }
Sample holders (tube assembly)
liquid nitrogen
He & N_2 gas tanks
Mettler AE240 weighing balance
Weighing boats

Procedure :- Followed as per COULTER SA 3100 manual

① wt. of tube assembly #5 = 33.3692 g
wt. of γ-alumina added = 0.4130 g
wt. of tube assembly + outgassed sample = 33.7551 g

wt. of outgassed sample = 33.7551
− 33.3692
0.3859 g

BET SA = 93.062 m^2/g

② wt. of tube assembly #7 = 33.6226 g
0.6788
−0.1732
wt. of sample added = 0.5056 g

wt. of tube assembly + outgassed sample = 34.0935 g

wt of outgassed sample = 34.0935
−33.6226
0.4709 g

BET SA = 92.560 m^2/g

③ wt. of tube assembly # 1 = 33.6262 g
wt. of γ-Al_2O_3 added = 0.3064 g.
wt. of tube assembly + outgassed sample = 33.9120 g

wt. of outgassed sample = 33.9120
− 33.6262
0.2858 g

BET SA = 91.407 m^2/g

④ Preparation of 0.1M NaCl stock solution for Tc-99 spike. NaCl (lot # 914193)

5.9 g NaCl diluted to 1L with DI H_2O.

2 batches were prepared, total of 2L of 0.1M NaCl.

⑤ Calculations for dilution of Tc-99 spike.
Volume = 5 ml.
Activity = 10 μCi , Specific activity = 17.08 mCi/g
Conc. = 2 μCi/ml

Total
Activity = 10 μCi
= 10 μCi × 2.220×10^6 dpm/μCi
= 2.220×10^7 dpm

ⓐ Dilution to 2L

Activity = $\frac{2.220 \times 10^7 \text{ dpm}}{2 \text{ L}}$

= $\frac{2.220 \times 10^7 \text{ dpm}}{2000 \text{ ml}}$

= 11,100 dpm/ml

The sample spike was diluted to 2L using 0.1 M NaCl.

6/24/99 AJ

Sample Name	wt. of vial	wt. Of vial + sample	sample wt.
Tc-1	7.2862		~ 0.5000
Tc-2	7.2829		~ 0.5000
Tc-3	7.2404	7.3400	0.0996
Tc-4	7.3122	7.5124	0.2002
Tc-5	7.2734	7.5737	0.3003
Tc-6	7.3186	7.7194	0.4008
Tc-7	7.268	7.7687	0.5007
Tc-8	7.3149	7.9148	0.5999
Tc-9	7.2322	7.9339	0.7017
Tc-10	7.2501	8.0511	0.8010
Tc-11	7.3007	8.2036	0.9029
Tc-12	7.2654	8.2661	1.0007
			0.0000
Tc-1P AB	3.5106	3.7105	0.1999
Tc-2P AB	3.5223	3.9233	0.4010
Tc-3P AB	3.4698	4.1718	0.7020
Tc-4P AB	3.538	4.5387	1.0007

6/25

Tc-1P G	3.4791	3.6789	0.1998
Tc-2P G	3.4971	3.8979	0.4008
Tc-3P G	3.4926	4.1944	0.7018
Tc-4P G	3.5395	4.5403	1.0008
Tc-4 G	7.2542	7.4536	0.1994
Tc-6 G	7.2821	7.6834	0.4013
Tc-9 G	7.2336	7.9348	0.7012
Tc- 12 G	7.3103	8.3105	1.0002

6/25

24 Jun 99 15:40 ALPHA/BETA - 1.02 Pag
Protocol #:43 TC-99 CPM User : Ji

Time: 10.00
Data Mode: CPM Nuclide: MANUAL
Background Subtract: None

	LL	UL	LCR	2S%	BKG
Region A:	0.0 -	300	0	0.0	0.00
Region B:	2.0 -	300	0	0.0	0.00
Region C:	0.0 -	2000	0	0.0	0.00

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	10.00	1047.50	1.95	1039.80	1.96	1051.90	1.95	210.58	Tc-3
2	10.00	2067.00	1.39	2047.00	1.40	2072.30	1.39	198.72	
3	10.00	3081.00	1.14	3052.00	1.14	3086.40	1.14	187.98	
4	10.00	4096.50	0.99	4054.80	0.99	4101.40	0.99	181.48	
5	10.00	5097.70	0.89	5049.40	0.89	5103.40	0.89	177.42	
6	10.00	6098.70	0.81	6036.40	0.81	6105.40	0.81	173.59	
7	10.00	7166.30	0.75	7090.10	0.75	7172.50	0.75	171.34	
8	10.00	8162.40	0.70	8073.70	0.70	8169.00	0.70	167.81	
9	10.00	9171.20	0.66	9070.70	0.66	9178.10	0.66	164.28	
10	10.00	10167.2	0.63	10053.0	0.63	10173.9	0.63	161.12	Tc-12

24 Jun 99 12:46 ALPHA/BETA - 1.02 Tc-1
Protocol #:12 C-14 CPM

Time: 4.00
Data Mode: CPM Nuclide: MANUAL
Background Subtract: None

	LL		UL	LCR	2S%	BKG
Region A:	0.0	-	156	0	0.0	0.00
Region B:	4.0	-	156	0	0.0	0.00
Region C:	0.0	-	350	0	0.0	0.00

Quench Indicator: tSIE/AEC
Ext Std Terminator: Count
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

S#	TIME	CPMA	CPMB	CPMC	SIS	FLAG	tSIE
1	4.00	3894.25	3836.50	5143.50	122.58		486.78

24 Jun 99 13:06 ALPHA/BETA - 1.02
Protocol #:14 C-14 DPM Tc1 & Tc-2

Time: 5.00
Data Mode: DPM Nuclide: 14C
Background Subtract: None

	LL		UL	LCR	2S%	BKG
Region A:	0.0	-	156	0	0.5	0.00
Region B:	4.0	-	156	0	0.0	0.00
Region C:	0.0	-	0.0	0	0.0	0.00

Quench Indicator: tSIE/AEC
Ext Std Terminator: Count

S#	TIME	CPMA	DPM1	SIS	tSIE	FLAG
1	5.00	3911.20	4118.41	122.92	486.79	
2	5.00	3897.60	4104.13	123.51	486.48	

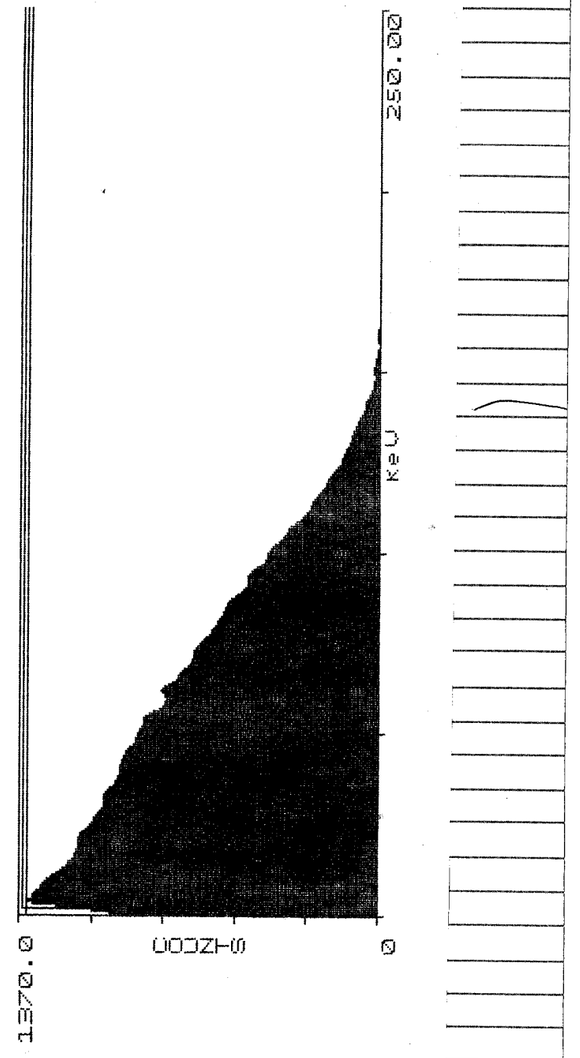
PH of starting spike #43 = 5.4

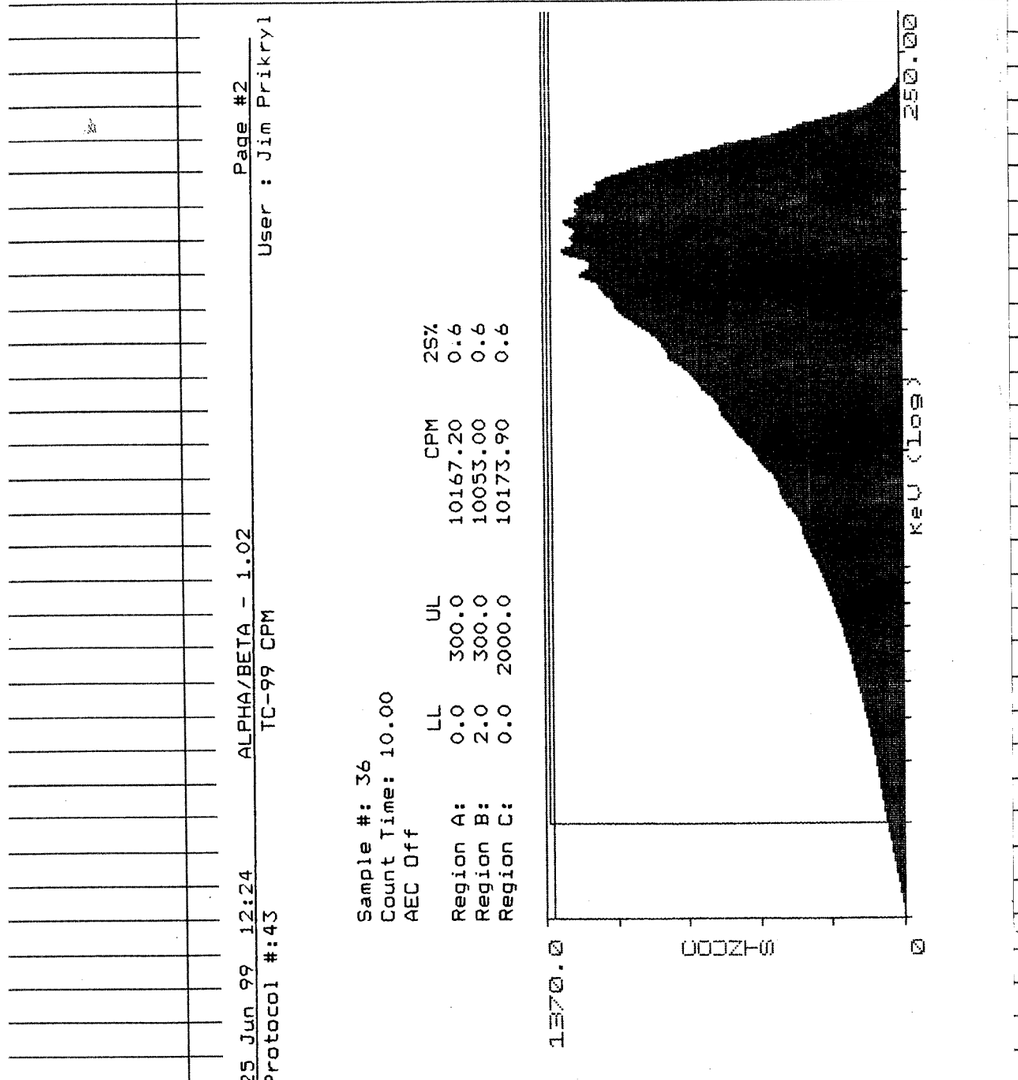
Page #3
User : Jim Prikryl

25 Jun 99 12:25 ALPHA/BETA - 1.02
Protocol #:43 TC-99 CPM

Sample #: 36
Count Time: 10.00
AEC Off

	LL	UL	CPM	2S%
Region A:	0.0	300.0	10167.20	0.6
Region B:	2.0	300.0	10053.00	0.6
Region C:	0.0	2000.0	10173.90	0.6





25 Jun 99 15:07 ALPHA/BETA - 1.02 Page #
Protocol #:43 TC-99 CPM User : Jim P

Time: 10.00
Data Mode: CPM Nuclide: MANUAL
Background Subtract: None

	LL	UL	LCR	2S%	BKG
Region A:	0.0 -	300	0	0.0	0.00
Region B:	2.0 -	300	0	0.0	0.00
Region C:	0.0 -	2000	0	0.0	0.00

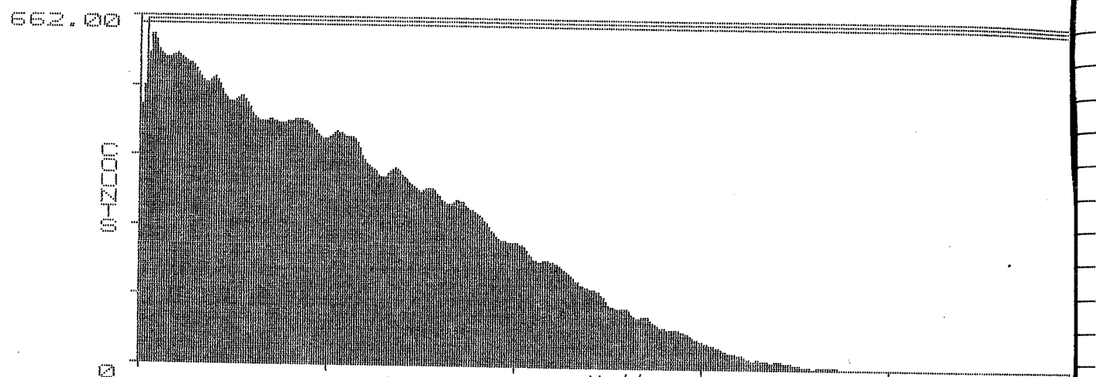
Quench Indicator: SIS
Beta cpm TC-99
Coincidence Time(ns): 18
Delay Before Burst(ns): Normal

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
1	10.00	1028.60	1.97	1019.60	1.98	1034.70	1.97	209.63	Tc-3 0.1000 ml 0.2000 glass AB cocktail
2	10.00	2057.30	1.39	2036.20	1.40	2062.80	1.39	195.03	
3	10.00	3056.10	1.14	3027.40	1.15	3063.00	1.14	186.76	
4	10.00	4091.80	0.99	4046.60	0.99	4098.90	0.99	181.01	
5	10.00	5088.00	0.89	5036.30	0.89	5093.90	0.89	176.41	
6	10.00	6100.50	0.81	6032.80	0.81	6106.70	0.81	172.58	
7	10.00	7175.00	0.75	7099.20	0.75	7180.90	0.75	169.69	
8	10.00	8117.50	0.70	8031.20	0.71	8122.80	0.70	165.82	
9	10.00	9189.70	0.66	9083.10	0.66	9196.10	0.66	163.58	1.00000 ml
10	10.00	10174.5	0.63	10066.3	0.63	10180.0	0.63	160.92	Tc-12
8 MISSING TUBE(S)									
19	10.00	2038.60	1.40	2018.30	1.41	2043.90	1.40	183.59	Tc-4 g glass vials Gold cocktail
20	10.00	4090.10	0.99	4044.50	0.99	4096.90	0.99	172.54	Tc-6 g
21	10.00	7141.70	0.75	7058.60	0.75	7148.10	0.75	166.97	Tc-9 g
22	10.00	10190.3	0.63	10077.5	0.63	10197.8	0.63	165.41	Tc-12 g
1 MISSING TUBE(S)									
24	10.00	2040.00	1.40	2022.10	1.41	2043.80	1.40	215.83	Tc-1P Adhesatic
25	10.00	4108.30	0.99	4072.40	0.99	4114.00	0.99	199.93	Tc-2PAB Vials AB cocktail

5 Jun 99 15:24 ALPHA/BETA - 1.02 Page #2
rotocol #:43 TC-99 CPM User : Jim Prikry

Sample #: 26
Count Time: 7.30
AEC Off

	LL	UL	CPM	2S%
Region A:	0.0	300.0	7161.37	0.9
Region B:	2.0	300.0	7089.04	0.9
Region C:	0.0	2000.0	7166.99	0.9



26	10.00	7153.10	0.75	7081.00	0.75	7159.20	0.75	182.37
27	10.00	10195.2	0.63	10091.5	0.63	10200.7	0.63	171.13
MISSING TUBE(S)								
29	10.00	2050.50	1.40	2029.10	1.40	2057.50	1.39	199.29
30	10.00	4110.20	0.99	4069.90	0.99	4115.90	0.99	190.70
31	10.00	7191.70	0.75	7121.10	0.75	7198.10	0.75	188.76
32	10.00	10189.2	0.63	10085.0	0.63	10196.2	0.63	177.05

Tc - 3P AB Elastic vials
Tc - 4P AB AB cocktail
Tc - 1P ♀
Tc - 2P ♀
Tc - 3P ♀
Gold cocktail Elastic vials
Tc - 4P ♀

25 Jun 99 17:04 ALPHA/BETA - 1.02 Page #
Protocol #:43 TC-99 CPM User : Jim P

Time: 100.00
Data Mode: CPM Nuclide: MANUAL
Sigma Coincidence On
Background Subtract: None

	LL	UL	LCR	2S%	BKG
Region A:	0.0 -	300	0	0.0	0.00
Region B:	2.0 -	300	0	1.0	0.00
Region C:	0.0 -	2000	0	0.0	0.00

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	38.90	1038.05	1.00	1028.46	1.00	1043.60	0.99	209.10	TC-3 ↑
2	19.66	2053.36	1.00	2034.74	1.00	2059.26	0.99	195.74	
3	13.04	3096.40	1.00	3068.64	1.00	3102.53	0.99	187.10	
4	9.97	4057.47	0.99	4013.54	1.00	4064.69	0.99	182.18	
5	7.98	5068.42	0.99	5013.53	1.00	5075.44	0.99	176.48	
6	6.60	6130.30	0.99	6066.97	1.00	6137.12	0.99	172.32	
7	5.59	7232.92	0.99	7155.99	1.00	7239.71	0.99	168.74	
8	5.00	8094.20	0.99	8011.00	1.00	8103.00	0.99	165.58	
9	4.38	9235.39	0.99	9134.70	1.00	9241.78	0.99	163.11	
10	3.97	10192.7	0.99	10085.1	1.00	10196.0	0.99	160.38	↓ Tc - 12
8 MISSING TUBE(S)									
19	19.73	2050.63	0.99	2027.57	1.00	2057.12	0.99	181.53	↑ Tc - 4♀
20	9.82	4120.67	0.99	4073.93	1.00	4127.50	0.99	173.31	-6♀
21	5.66	7151.94	0.99	7070.50	1.00	7158.83	0.99	166.00	-9♀
22	3.95	10247.6	0.99	10139.2	1.00	10254.7	0.99	166.17	↓ Tc-12♀
1 MISSING TUBE(S)									
24	19.67	2051.35	1.00	2034.62	1.00	2056.43	0.99	214.85	↑ Tc - 1P AB
25	9.95	4060.90	0.99	4023.52	1.00	4067.54	0.99	199.04	
26	5.64	7168.97	0.99	7104.26	1.00	7175.18	0.99	183.12	
27	3.98	10165.1	0.99	10057.8	1.00	10172.6	0.99	172.04	↓ Tc-4P AB
1 MISSING TUBE(S)									
29	19.55	2066.55	1.00	2046.45	1.00	2072.79	0.99	201.35	↑ Tc - 1P ♀
30	9.88	4094.33	0.99	4052.33	1.00	4100.71	0.99	191.05	
31	5.62	7194.48	0.99	7130.78	1.00	7200.18	0.99	188.81	
32	3.97	10198.0	0.99	10093.7	1.00	10204.0	0.99	177.49	↓ Tc - 4P ♀

6/28/99 AJ

① (Sample) (wt. of vial) (wt. of vial + 0.1M NaCl + sample) (wt. of vial + 0.1 NaCl ~~+ Sample~~ AJ

T_c-13	7.2946	7.7944	7.6944
T_c-14	7.2147	7.7143	7.5145
T_c-15	7.2862	7.7865	7.4857
T_c-16	7.3508	7.8520	7.4505
T_c-17	7.3169	7.8193	7.3169

	wt. of 0.1 NaCl	wt. of sample added
T_c-13	0.3998 ml	0.1000 ml
T_c-14	0.2998	0.1998
T_c-15	0.1995	0.3008
T_c-16	0.0997	0.4015
T_c-17	0.0000	0.5024

Note:- 0.1M NaCl was added to have same amounts of Na in all samples for counting.
~~d/b~~ cocktail was used.

Result:- Consistent values of SIS obtained.

② PH of spike #43 adjusted to 7.0 using 1.4 ml of 0.1M NaOH.

③ NaCl solution prepared of 0.1M. F.W. NaCl = 59 g
2.950 g of NaCl (lot # 91419 93) was dissolved in DI water and more H_2O was added to mark 500 ml.

28 Jun 99 12:58 ALPHA/BETA - 1.02 Page
Protocol #:43 TC-99 CPM User : Jim

Time: 100.00
Data Mode: CPM Nuclide: MANUAL
Sigma Coincidence On
Background Subtract: None

	LL	UL	LCR	2S%	BKG
Region A:	0.0 -	300	0	0.0	0.00
Region B:	2.0 -	300	0	1.0	0.00
Region C:	0.0 -	2000	0	0.0	0.00

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	38.72	1044.06	0.99	1033.16	1.00	1050.54	0.99	180.68	↑ T_c-13
2	19.67	2054.75	0.99	2035.03	1.00	2061.01	0.99	178.57	
3	13.09	3088.39	0.99	3057.37	1.00	3094.42	0.99	179.25	
4	9.80	4123.37	0.99	4083.57	1.00	4130.71	0.99	178.72	
5	7.93	5101.14	0.99	5046.66	1.00	5105.93	0.99	179.44	↓ T_c-17

6/29/99 AJ
PH checked on Spike #43 (1.30 PM)
PH = 9.22

6/30/99 AJ
PH checked on Spike #43
PH = 7.09
Spike is being stirred constantly for a few hours.

Sample	wt. of vial	wt. of vial + 0.1M NaCl	wt. of vial + sample + NaCl
T_c-18	7.~~2946~~ AJ 2658	7.~~6699~~ 6599	7.7691
T_c-19	7.3071	7.~~5145~~ AJ 6086	7.8097
T_c-20	7.3467	7.~~4857~~ AJ 5480	7.8497
T_c-21	7.2510	7.3506	7.7529
T_c-22	7.2956	7.2956	7.7963

01 Jul 1999 08:20 ALPHA/BETA - 1.09 P
Protocol #:43 TC-99 CPM User : JI

Time: 100.00
Data Mode: CPM Nuclide: MANUAL
Background Subtract: None

#	LL	UL	LCR	2S%	BKG
Region A:	0.0 -	300	0	0.0	0.00
Region B:	2.0 -	300	0	1.0	0.00
Region C:	0.0 -	2000	0	0.0	0.00

Quench Indicator: SIS
BETA CPM TC-99

AB cocktail, glass vials. PH = 7.09

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
1	38.85	1041.85	0.99	1029.76	1.00	1046.80	0.99	174.56	
2	19.58	2066.45	0.99	2043.87	1.00	2071.96	0.99	174.32	
3	13.16	3076.52	0.99	3042.10	1.00	3081.76	0.99	174.66	
4	9.81	4123.14	0.99	4079.31	1.00	4129.66	0.99	173.36	
5	7.91	5112.90	0.99	5058.41	1.00	5117.70	0.99	174.49	

The counts are same as for PH = 5.4 (for Spike # 43).

7/1/99 AJ

Tc-99 KINETICS EXPERIMENT

OBJECTIVE: to determine the time it takes to reach sorption equilibrium between Tc-99 solutions and gamma-alumina powder.

- Initial ΣTc = 29.4 ppb
- Initial solution mass = 35 g
- 0.105 g of gamma alumina
- Equilibrium with atomspheric $CO_2(g)$ ($pCO_2 = 10^{-3.5}$ bar)
- M/V = 30

EQUIPMENT: Liquid Scintillation Analyzer (Packard 2500TR/AB)
ORION ph/mV/ISE/ C meter
Combination ph electrode
Automatic termperature compensator probe
Analytical balances (Mettler 4600 and 240AE)
Gyratory shaker

SUPPLIES: pH buffers (pH= 2,4,7,10)
50 ml polycarbonate centrifuge tubes (43 ml capacity)
LSA vials 7ml
Repipettor for transfer of scintillation cocktail
Packard A/B cocktail
Eppendorf pipet and tips (various volumes)
gamma-alumina (lot C16F19)
1 L FEP teflon bottle
Tc-99 stock solution (**spike #43A**)
HCl (lot 956110) various concentrations; e.g., 1.0 M, 0.1 M, etc...
NaOH (lot 976631) various concentrations; e.g., 1.0 M, 0.1 M, etc...

PROCEDURE:

1. In a precleaned 1L FEP bottle, prepare 280 g of 2.95x10-7 m (29.4 ppm) Tc-99 solution by diluting 28 g of a 2.95×10^{-6} m (294 ppm) ^{99}Tc stock solution (**spike #43A;** in 0.1 m NaCl matrix; prepared from a commercial ^{99}Tc spike) to a total of 280 g by taring 0.1 m NaCl solution into the FEP bottle on a Mettler 4600 balance.

2. Label 3 50 ml polycarbonate centrifuge tubes Tc-K*pHi (where i is the approximate pH of each solution, see Table) and pre-weigh. Record weight.

3. Add 35 g of the 29.4 ppb Tc solution to each tube and record weight.

4. Label 3 50 ml polycarbonate centrifuge tubes Tc-KC*pHi (where i is the approximate pH of each solution, see Table) and pre-weigh. Record weight.

5. Add 40 g of the 29.4 ppb Tc solution to each tube and record weight.

6. Transfer the remaining 29.4 ppb Tc solution (about 35 g) into a pre-weighed 50 ml centrifug tube labeled Tc-K*ITc. Measure the pH of the solution and record weight.

7. Sample Tc-K*ITc to determine initial Tc concentration. Label (e.g. Tc-K*ITca and Tc-K*ITcb) and preweigh two LSA vials. Withdraw two 0.5 ml samples from Tc-K*IU and transfer to the LSA vials. Reweigh vials and record weight. Add 5 ml of scintillation cocktail to each vial. Homogenize sample and set aside for LSA.

8. For the Tc-K*pHi and Tc-KC*pHi solutions adjust pH by adding HCl or NaOH using an Eppendorf pipetter. The amount to be added to each solution is given in the Table. After pH adjustment record weight of containers. Cap loosely and place on gyratory shaker. Wait about 10 days for solutions to reach pH equilibrium.

9. Add 0.105 g of gamma-alumina to Tc-K*pHi solutions. Tare aliqouts of gamma-alumina weighing 0.105 ± 0.001 g onto weighing paper. Transfer to each Tc-K*pHi solution (not Tc-KC*pHi solutions). Reweigh and record. Replace cap loosely. Place samples on gyratory shaker.

10. Sample kinetic and kinetic control solutions for Tc concentration and pH over various time intervals. At intervals of 2 hours, 4 hours, 1 day, 2 days, 4 days, 8 days, 12 days, 16 days, and 21days, sample the solutions (Tc-K*pHi and Tc-KC*pHi) for pH and Tc concentration by:
    - weighing and recording weight of tube
    - withdrawing two 0.5 ml aliqouts and transferring into preweighed and labeled LSA vials and setting aside for LSA.
    - measuring pH of each solution, reweighing tubes, and replacing on gyratory shaker.

11. Determine Tc concentration of solutions by analyzing using LSA.

Sample label	Estimated solution pH	Volume of HCl needed, ml	Molarity of HCl to use
Tc-K*pH4	4	0.075	0.1
		Volume of NaOH needed, ml	**Molarity of NaOH to use**
Tc-K*pH7	7	---	---
Tc-K*pH9.5	9.5	1.5	1.0
		Volume of HCl needed, ml	**Molarity of HCl to use**
Tc-KC*pH4	4	0.075	0.1
		Volume of NaOH needed, ml	**Molarity of NaOH to use**
Tc-KC*pH7	7	---	---
Tc-KC*pH9.5	9.5	1.5	1.0

7/2/99 AJ

(1) PH of spike #43A = 6.75

(2) Prepare 0.1M NaCl to dilute the spike. Following the procedure, step # 1 on page 283, spike 43A was diluted to a conc. of 2.95×10^{-7} m (29.5 PPB).

Sample Name	Original Container wt., g	Container wt. after Tc soln. Add	Container wt. after pH adjust	Container wt. after sampling	Container wt. after alumina add
Tc-K*pH 4	22.4493	57.4518	57.5270		
Tc-K*pH 7	22.4422	57.4436			
Tc-K*pH 9.5	22.4107	57.4157	59.0008		
Tc-K*ITc	22.4349	57.4364		56.4305	
Tc-KC*pH 4	22.593	57.5932	57.6690		
Tc-KC*pH 7	22.3248	57.3239			
Tc-KC*pH 9.5	22.2925	57.2995	57.8913		
	wt. Of vial	wt. Of vial + sample			
Tc-K*ITca	7.2913	7.7947			
Tc-K*ITcb	7.3336	7.8361			

07 Jul 1999 03:58 ALPHA/BETA - 1.09
Protocol #:43 TC-99 CPM User : J

$Tc\text{-}K^*ITc$

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

	LL	UL	LCR	25%	BKG
Region A:	0.0 -	300	0	0.0	18.89
Region B:	2.0 -	300	0	1.0	17.74
Region C:	0.0 -	2000	0	0.0	24.80

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	18.89	1.46	17.74	1.50	24.80	1.27	126.12	B
2	75.98	514.24	1.03	508.72	1.04	514.82	1.04	177.62	
3	76.09	513.48	1.03	507.98	1.04	513.97	1.04	178.20	

7/9/99 AJ

PH measurements on $Tc\text{-}K^*$ & $Tc\text{-}KC^*$ experiments

	wt. before PH		Measured PH	wt. after PH
$Tc\text{-}K^*$ 4.0	57.4020		3.79	57.3929
$Tc\text{-}K^*$ 7.0	57.3776	5.73	~~5.73~~ AJ ~~12.37~~ AJ 5.73 AJ	57.3666
$Tc\text{-}K^*$ 9.5	58.8862		12.37	58.8776
$Tc\text{-}K^*ITc$	56.3510		5.73	56.3382
$Tc\text{-}KC^*$ 4.0	57.5734		3.76	57.5573
$Tc\text{-}KC^*$ 7.0	57.2240		5.76	57.2086
$Tc\text{-}KC^*$ 9.5	58.7818		12.43	58.7757

PH of spike #43A (29.4PPb) = 6.80

The PH of $Tc\text{-}K^*$ & $Tc\text{-}KC^*$ samples (at desired PH of 9.5) was measured ~12.5 which is very high. So, these samples were kept on shaker with caps removed and covered with kimwipe to be equilibrated with atmospheric CO_2.

	wt. without cap
$Tc\text{-}K^*$ 9.5a	56.1516
$Tc\text{-}KC^*$ 9.5b	56.1170

7/12/99 AJ

PH measurements on $Tc\text{-}K^*$ 9.5 = 11.67
Still high & again kept on shaker to equilibrate with atmospheric CO_2.

7/19/99 AJ

PH measurements on $Tc\text{-}K^*$ 9.5 samples.

	wt. of container	PH measured	wt. of container after PH
Tc-K* 9.5a	54.1611	9.91	54.1459
Tc-K* 9.5b	53.8785	9.88	53.8611

Tc-K* 9.5a	56.8527	wt. of containers with lid after PH measurements.
Tc-K* 9.5b	56.5041	

Following step # 9 from Tc-kinetics experiment procedure on page 284, γ-Al_2O_3 was added to Tc-K*(PHi) samples. (0.105 g)

Sample name	wt. of container g.	wt. of container + γ-Al_2O_3 g
Tc-K* 4.0	57.1702	57.2767
Tc-K* 7.0	57.2345	57.3414
Tc-K* 9.5	56.8527	56.9590

7/19/99

Sample Name	wt. of vial	wt. of vial + sample	sample wt.	Container wt. before sampling & pH measurements, g	Measured pH	Container wt. after sampling & pH measurements, g
	1 hour					
Tc-K* pH 4a	7.2184	7.7190	0.5006	57.2744	4.14	56.2539
Tc-K* pH 4b	7.2784	7.7808	0.5024			
Tc-K* pH 7a	7.2625	7.7644	0.5019	57.3392	6.5	56.3217
Tc-K* pH 7b	7.2987	7.8011	0.5024			
Tc-K* pH 9.5a	7.2496	7.752	0.5024	56.9573	9.89	55.9351
Tc-K* pH 9.5b	7.2870	7.7908	0.5038			
Tc-KC* pH 4a	7.3096	7.8078	0.4982	57.3862	3.77	56.3735
Tc-KC* pH 4b	7.2851	7.7866	0.5015			
Tc-KC* pH 7a	7.2475	7.7484	0.5009	57.0216	5.27	56.0013
Tc-KC* pH 7b	7.3353	7.8575	0.5222			
Tc-KC* pH 9.5a	7.3013	7.8039	0.5026	56.5021	9.89	55.4830
Tc-KC* pH 9.5b	7.3388	7.843	0.5042			

	3 hours					
Tc-K* pH 4a	7.2590	7.7578	0.4988	56.2516	4.34	55.2304
Tc-K* pH 4b	7.2328	7.7325	0.4997			
Tc-K* pH 7a	7.2206	7.7178	0.4972	56.3190	6.57	55.3115
Tc-K* pH 7b	7.2799	7.78	0.5001			
Tc-K* pH 9.5a	7.3778	7.8782	0.5004	55.9325	9.91	54.9176
Tc-K* pH 9.5b	7.2648	7.7674	0.5026			
Tc-KC* pH 4a	7.2979	7.7974	0.4995	56.3708	3.77	55.3535
Tc-KC* pH 4b	7.2289	7.7322	0.5033			
Tc-KC* pH 7a	7.2794	7.7788	0.4994	55.9986	5.25	54.9835
Tc-KC* pH 7b	7.2757	7.7768	0.5011			
Tc-KC* pH 9.5a	7.2380	7.7391	0.5011	55.4811	9.91	54.4643
Tc-KC* pH 9.5b	7.2543	7.7576	0.5033			

7/19/99

Sample Name	wt. of vial	wt. of vial + sample	sample wt.	Container wt. before sampling & pH	Measured pH	Container wt. after sampling & pH
	4 hours					
Tc-K* pH 4a	7.2949	7.7924	0.4975	55.1933	5.98	54.1612
Tc-K* pH 4b	7.3078	7.8065	0.4987			
Tc-K* pH 7a	7.2748	7.7723	0.4975	55.3091	6.69	54.2878
Tc-K* pH 7b	7.2169	7.7187	0.5018			
Tc-K* pH 9.5a	7.2972	7.7967	0.4995	54.9154	9.90	53.8998
Tc-K* pH 9.5b	7.2287	7.7307	0.5020			
Tc-KC* pH 4a	7.3155	7.8136	0.4981	55.3517	3.78	54.3296
Tc-KC* pH 4b	7.2727	7.7735	0.5008			
Tc-KC* pH 7a	7.2996	7.7985	0.4989	54.9818	5.28	53.9597
Tc-KC* pH 7b	7.2764	7.7776	0.5012			
Tc-KC* pH 9.5a	7.255	7.7561	0.5011	54.4631	9.89	53.4309
Tc-KC* pH 9.5b	7.2627	7.7658	0.5031			

7/20/99 AJ

	1 day					
Tc-K* pH 4a	7.3038	7.8047	0.5009	54.1225	6.24	53.1071
Tc-K* pH 4b	7.2953	7.7979	0.5026			
Tc-K* pH 7a	7.3574	7.8608	0.5034	54.2764	6.87	53.2641
Tc-K* pH 7b	7.2704	7.7703	0.4999			
Tc-K* pH 9.5a	7.3494	7.8553	0.5059	53.8830	9.84	52.8785
Tc-K* pH 9.5b	7.2473	7.7486	0.5013			
Tc-KC* pH 4a	7.2372	7.7373	0.5001	54.3139	3.78	53.2975
Tc-KC* pH 4b	7.3241	7.8262	0.5021			
Tc-KC* pH 7a	7.3254	7.8256	0.5002	53.9454	5.25	52.9249
Tc-KC* pH 7b	7.2660	7.7699	0.5039			
Tc-KC* pH 9.5a	7.3420	7.8448	0.5028	53.4172	9.85	52.3868
Tc-KC* pH 9.5b	7.2270	7.7325	0.5055			

Sample Name	wt. of vial	wt. of vial + sample	sample wt.	Container wt. before sampling & pH measurements	Measured pH	Container wt. after sampling & pH measurements
7/21/99	2 days					
Tc-K* pH 4a	7.2337	7.7373	0.5036	53.076	6.39	52.0574
Tc-K* pH 4b	7.2378	7.7403	0.5025			
Tc-K* pH 7a	7.2528	7.7524	0.4996	53.2466	7.02	52.2485
Tc-K* pH 7b	7.3386	7.8394	0.5008			
Tc-K* pH 9.5a	7.2498	7.7493	0.4995	52.8597	9.81	51.8592
Tc-K* pH 9.5b	7.2825	7.7838	0.5013			
Tc-KC* pH 4a	7.2594	7.7558	0.4964	53.281	3.77	52.2864
Tc-KC* pH 4b	7.3282	7.8269	0.4987			
Tc-KC* pH 7a	7.2661	7.7647	0.4986	52.408	5.25	51.9406
Tc-KC* pH 7b	7.3528	7.8526	0.4998			
Tc-KC* pH 9.5a	7.3674	7.8666	0.4992	52.3688	9.85	51.3803
Tc-KC* pH 9.5b	7.2719	7.7724	0.5005			


```
   C14 Eff (0-156 keV) = 96.63 %
C14 CHI SQUARE IPA DATA PROCESSED - 20-Jul-1999 09:42
   C14 Chi Square = 17.93
H3 IPA DATA PROCESSED - 20-Jul-1999 09:43
   H3 Eff (0-18.6 keV) = 65.71 %
H3 CHI SQUARE IPA DATA PROCESSED - 20-Jul-1999 09:54
   H3 Chi Square = 24.39
BKG IPA DATA PROCESSED - 20-Jul-1999 10:54
   Bkg (0-18.6 keV) = 15.60 cpm
   Bkg (0-156 keV)  = 22.08 cpm
   C14 E^2/B (1-156 keV)    = 557.32
   H3  E^2/B (1-18.6 keV)   = 275.45
```

21 Jul 1999 03:44 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	0.0	19.08
Region B:	2.0 -	300	0	1.0	17.75
Region C:	0.0 -	2000	0	0.0	24.97

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

1%

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
1	999.99	19.08	1.45	17.75	1.50	24.97	1.27	123.57	B
2	76.39	511.35	1.03	505.91	1.04	511.44	1.04	174.23	
3	76.24	512.34	1.03	506.94	1.04	512.68	1.04	175.03	
4	75.94	514.70	1.03	509.02	1.04	514.68	1.04	172.23	
5	76.42	511.14	1.03	505.69	1.04	511.10	1.04	174.49	
6	75.40	517.67	1.03	512.78	1.04	517.45	1.04	174.59	
7	75.33	518.65	1.03	513.25	1.04	518.45	1.04	173.64	
1 MISSING TUBE(S)									
9	76.65	509.38	1.03	504.12	1.04	509.81	1.04	171.63	
10	75.64	516.08	1.03	511.08	1.04	516.09	1.04	172.52	
11	76.06	513.36	1.03	508.20	1.04	513.30	1.04	173.27	
12	75.81	515.00	1.03	509.89	1.04	515.01	1.04	172.92	
13	74.59	523.87	1.03	518.52	1.04	523.47	1.04	174.06	
14	74.02	528.24	1.03	522.69	1.04	528.26	1.04	173.89	
1 MISSING TUBE(S)									
16	76.74	508.94	1.03	503.49	1.04	509.02	1.04	173.98	
17	77.06	506.53	1.03	501.42	1.04	506.83	1.04	172.36	
18	76.37	511.42	1.03	506.10	1.04	510.79	1.04	173.50	
19	76.24	512.38	1.03	506.94	1.04	512.43	1.04	172.65	
20	75.79	515.36	1.03	510.02	1.04	515.21	1.04	174.16	
21	75.35	518.75	1.03	513.13	1.04	519.19	1.04	175.40	

Tc-K* 1 hr.
Tc-KC* 1 hr.
Tc-K* 3 hrs

1 MISSING TUBE(S)

23	76.00	514.29	1.03	508.57	1.04	513.95	1.04	173.63
24	76.40	511.79	1.03	505.86	1.04	511.77	1.04	172.52
25	76.57	509.69	1.03	504.65	1.04	509.86	1.04	173.13
26	76.52	510.52	1.03	505.03	1.04	510.66	1.04	172.31
27	74.70	523.20	1.03	517.75	1.04	523.28	1.04	172.80
28	74.65	523.50	1.03	518.12	1.04	523.39	1.04	172.09

Tc-KC* 3hr.

WARNING: USER HAS MODIFIED COUNT CONDITIONS

1 MISSING TUBE(S)

30	8.66	501.36	3.09	495.88	3.11	500.55	3.11	171.29
31	8.41	514.93	3.10	510.79	3.10	514.03	3.12	176.84
32	8.33	520.90	3.09	516.22	3.10	521.25	3.11	173.93
33	8.45	512.99	3.09	508.52	3.10	512.31	3.11	173.02
34	8.33	522.58	3.09	515.74	3.10	521.01	3.11	169.99
35	8.32	522.51	3.09	516.51	3.10	522.15	3.11	171.97

Tc-K* 4hr

1 MISSING TUBE(S)

37	8.40	518.30	3.09	511.77	3.10	518.48	3.10	173.67
38	8.42	517.38	3.09	510.64	3.10	517.31	3.10	172.33
39	8.49	510.13	3.10	505.81	3.11	510.01	3.11	173.80

Tc-KC*

22 Jul 1999 11:57 ALPHA/BETA - 1.09

Protocol #:43 TC-99 CPM

User

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
40	8.56	506.04	3.10	501.41	3.11	505.76	3.11	171.04	
41	8.54	508.56	3.09	503.09	3.11	507.94	3.11	174.13	
42	8.36	519.56	3.09	514.55	3.10	519.77	3.11	174.96	

4hr

12 MISSING TUBE(S)

55	8.34	518.69	3.10	515.10	3.10	517.96	3.12	176.66
56	8.18	529.82	3.09	525.77	3.10	528.82	3.11	174.36
57	8.50	511.39	3.09	505.90	3.10	513.38	3.10	174.10
58	8.30	523.33	3.09	518.15	3.10	523.47	3.11	174.11
59	8.42	515.13	3.09	510.16	3.10	515.65	3.11	177.26
60	8.60	505.57	3.09	499.34	3.11	505.38	3.11	171.30

Tc-K* 1day

1 MISSING TUBE(S)

62	8.77	494.15	3.10	489.21	3.11	493.28	3.12	171.24
63	8.20	529.46	3.09	524.93	3.10	529.06	3.11	174.51
64	8.76	495.54	3.09	490.13	3.11	494.44	3.12	172.80
65	8.31	524.00	3.09	517.15	3.10	524.61	3.10	170.18
66	8.21	529.16	3.09	523.66	3.10	527.65	3.11	171.70
67	8.22	529.71	3.09	523.25	3.10	530.75	3.10	173.59

Tc-KC* 1day

5 MISSING TUBE(S)

73	8.79	492.30	3.10	487.83	3.11	492.32	3.12	171.20
74	8.47	511.15	3.10	507.04	3.11	510.69	3.12	175.92
75	8.34	520.85	3.09	515.10	3.10	520.36	3.11	171.90
76	8.43	515.80	3.09	509.65	3.10	514.41	3.11	172.98
77	8.45	513.82	3.09	508.40	3.10	514.91	3.11	171.85
78	8.13	534.43	3.09	529.61	3.10	532.97	3.11	169.76

Tc-K* 2days

1 MISSING TUBE(S)

80	8.60	503.48	3.10	499.23	3.11	505.26	3.11	172.10
81	8.46	513.19	3.09	507.90	3.10	512.38	3.11	170.35
82	8.51	510.30	3.09	504.46	3.11	511.34	3.11	172.79
83	8.46	513.55	3.09	508.37	3.10	513.33	3.11	171.71
84	8.41	516.24	3.09	511.03	3.10	517.01	3.11	174.39
85	8.45	513.94	3.09	508.29	3.11	513.73	3.11	174.47

Tc-KC* 2 days

7/23/99 AJ

7/23/99	4 days					
Tc-K* pH 4a	7.2923	7.7957	0.5034	52.0098	6.52	50.9927
Tc-K* pH 4b	7.2568	7.7588	0.5389			
Tc-K* pH 7a	7.3053	7.8073	0.4535	52.2226	6.92	51.1344
Tc-K* pH 7b	7.2453	7.7454	0.562			
Tc-K* pH 9.5a	7.2807	7.7847	0.4647	51.8228	9.81	50.7633
Tc-K* pH 9.5b	7.2641	7.7653	0.5206			
Tc-KC* pH 4a	7.3293	7.8321	0.5028	52.2532	3.75	51.2223
Tc-KC* pH 4b	7.2513	7.7554	0.5041			
Tc-KC* pH 7a	7.3309	7.8333	0.5024	51.908	5.29	50.8846
Tc-KC* pH 7b	7.276	7.7806	0.5046			
Tc-KC* pH 9.5a	7.3037	7.808	0.5043	51.3452		50.3463
Tc-KC* pH 9.5b	7.2147	7.7189	0.5042		9.85	

24 Jul 1999 05:49 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	25%	BKG
Region A:	0.0 -	300	0	0.0	18.97
Region B:	2.0 -	300	0	3.0	17.74
Region C:	0.0 -	2000	0	0.0	24.73

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

3%

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
1	999.99	18.97	1.45	17.74	1.50	24.73	1.27	124.89	B
2	8.70	498.27	3.10	493.41	3.11	498.95	3.11	176.08	
3	8.44	515.51	3.09	509.04	3.10	514.49	3.11	173.63	Tc-K* 1 hr.
4	8.56	506.96	3.09	501.42	3.11	505.76	3.11	177.92	
5	8.27	526.25	3.09	519.75	3.10	526.30	3.10	171.83	
6	8.21	528.29	3.09	523.80	3.10	528.74	3.11	173.48	
7	8.39	517.74	3.09	512.65	3.10	518.06	3.11	176.21	
1 MISSING TUBE(S)									
9	8.54	509.25	3.09	502.64	3.11	509.93	3.10	173.88	
10	8.46	512.12	3.09	507.67	3.11	511.56	3.11	178.27	Tc-KC*
11	8.62	504.23	3.09	498.04	3.11	503.93	3.11	171.03	
12	8.42	516.90	3.09	510.41	3.10	516.96	3.10	174.11	1 hr.
13	8.25	526.24	3.09	521.29	3.10	527.15	3.10	175.04	
14	8.32	522.86	3.09	516.88	3.10	521.91	3.11	178.49	
1 MISSING TUBE(S)									
16	8.31	523.87	3.09	517.52	3.10	524.13	3.10	174.61	
17	8.28	524.87	3.09	519.34	3.10	523.58	3.11	175.50	Tc-K*
18	8.56	507.20	3.09	501.42	3.11	506.35	3.11	171.73	
19	8.90	488.33	3.09	481.81	3.11	487.41	3.11	174.34	3hr.
20	8.29	523.49	3.09	518.93	3.10	524.00	3.11	174.93	
21	8.58	506.55	3.09	500.68	3.11	507.90	3.10	176.20	
1 MISSING TUBE(S)									
23	8.70	500.00	3.09	493.41	3.11	499.64	3.11	172.28	
24	8.32	521.53	3.09	516.76	3.10	520.46	3.11	174.13	
25	8.66	501.47	3.09	495.77	3.11	500.33	3.11	176.24	Tc-KC*
26	8.51	511.58	3.09	504.94	3.10	511.46	3.10	176.26	3hr.
27	8.35	520.55	3.09	514.60	3.10	518.74	3.11	173.08	
28	8.29	523.85	3.09	518.57	3.10	524.37	3.10	175.92	
8 MISSING TUBE(S)									

37	8.34	521.20	3.09	515.35	3.10	521.31	3.10	178.52	
38	8.50	510.32	3.09	505.44	3.10	510.80	3.11	176.98	Tc-K* 4days
39	8.46	513.54	3.09	507.91	3.10	515.11	3.10	179.66	
40	8.47	513.03	3.09	507.05	3.11	511.52	3.11	176.67	
41	8.43	514.24	3.09	509.54	3.10	514.89	3.11	175.26	
42	8.50	510.32	3.09	505.08	3.11	512.09	3.10	174.41	
1 MISSING TUBE(S)									
44	8.28	523.66	3.09	519.34	3.10	523.82	3.11	175.31	
45	8.45	512.39	3.10	508.53	3.10	513.02	3.11	177.33	Tc-KC* 4days
46	8.53	507.52	3.10	503.48	3.11	506.34	3.12	177.79	
47	8.12	536.20	3.08	529.80	3.10	535.25	3.10	174.62	
48	8.17	531.58	3.09	526.45	3.10	532.43	3.10	173.09	

24 Jul 1999 11:06 ALPHA/BETA - 1.09
Protocol #:43 TC-99 CPM User :

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG
49	8.20	529.93	3.09	524.58	3.10	529.30	3.11	171.27	

7/27/99

Sample Name	wt. of vial	wt. of vial + sample	Container wt. before sampling & pH	Measured pH	Container wt. after sampling & pH
	8 days				
Tc-K* pH 4a	7.3479	7.8512	50.8921	6.52	49.8349
Tc-K* pH 4b	7.2764	7.7818			
Tc-K* pH 7a	7.2221	7.727	51.0435	7.08	50.0197
Tc-K* pH 7b	7.2583	7.7636			
Tc-K* pH 9.5a	7.3426	7.8492	50.6729	9.83	49.6367
Tc-K* pH 9.5b	7.2481	7.7559			
Tc-KC* pH 4a	7.3645	7.8685	51.1447	3.78	50.1166
Tc-KC* pH 4b	7.2812	7.7868			
Tc-KC* pH 7a	7.3286	7.8329	50.8103	5.77	49.7732
Tc-KC* pH 7b	7.1917	7.697			
Tc-KC* pH 9.5a	7.323	7.8276	50.2721	9.8	49.2361
Tc-KC* pH 9.5b	7.2655	7.7723			

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 27-Jul-1999 11:11
C14 Eff (0-156 keV) = 96.32 %
C14 CHI SQUARE IPA DATA PROCESSED - 27-Jul-1999 11:22
C14 Chi Square = 11.34
H3 IPA DATA PROCESSED - 27-Jul-1999 11:23
H3 Eff (0-18.6 keV) = 65.45 %
H3 CHI SQUARE IPA DATA PROCESSED - 27-Jul-1999 11:34
H3 Chi Square = 23.27
BKG IPA DATA PROCESSED - 27-Jul-1999 12:34
Bkg (0-18.6 keV) = 16.93 cpm
Bkg (0-156 keV) = 23.80 cpm
C14 E^2/B (1-156 keV) = 510.59
H3 E^2/B (1-18.6 keV) = 251.21

28 Jul 1999 05:23 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	0.0	18.71
Region B:	2.0 -	300	0	3.0	17.40
Region C:	0.0 -	2000	0	0.0	24.45

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	18.71	1.46	17.40	1.52	24.45	1.28	123.36	B	
2	8.49	510.97	3.09	506.63	3.10	509.82	3.11	179.20		
3	8.55	506.79	3.09	502.37	3.10	507.36	3.11	173.89		Tc-K* 8 days
4	8.34	520.74	3.09	515.69	3.10	520.15	3.11	173.33		
5	8.37	519.64	3.09	514.38	3.10	518.92	3.11	173.62		
6	8.15	532.95	3.09	528.25	3.10	532.36	3.11	180.85		
7	8.24	528.98	3.08	522.65	3.10	530.52	3.09	173.45		
1 MISSING TUBE(S)										
9	8.45	514.07	3.09	509.11	3.10	512.47	3.11	176.94		
10	8.35	520.21	3.09	515.18	3.10	520.70	3.10	175.29		Tc-Kl* 8 days
11	8.48	511.12	3.09	506.78	3.10	511.87	3.11	178.78		
12	8.28	524.53	3.09	519.80	3.10	524.22	3.11	174.49		
13	8.26	528.51	3.08	521.34	3.10	529.30	3.09	173.56		
14	8.21	529.16	3.09	524.38	3.10	528.41	3.11	177.72		
2 MISSING TUBE(S)										
17	8.52	508.64	3.09	504.55	3.10	508.29	3.11	175.92		
18	8.48	512.54	3.09	506.89	3.10	511.16	3.11	175.71		

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 29-Jul-1999 14:38
C14 Eff (0-156 keV) = 96.59 %
C14 CHI SQUARE IPA DATA PROCESSED - 29-Jul-1999 14:48
C14 Chi Square = 13.08
H3 IPA DATA PROCESSED - 29-Jul-1999 14:50
H3 Eff (0-18.6 keV) = 65.53 %
H3 CHI SQUARE IPA DATA PROCESSED - 29-Jul-1999 15:00
H3 Chi Square = 12.18
BKG IPA DATA PROCESSED - 29-Jul-1999 16:01
Bkg (0-18.6 keV) = 15.80 cpm
Bkg (0-156 keV) = 22.55 cpm
C14 E^2/B (1-156 keV) = 537.25
H3 E^2/B (1-18.6 keV) = 268.29

30 Jul 1999 08:50 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	0.0	19.09
Region B:	2.0 -	300	0	3.0	17.85
Region C:	0.0 -	2000	0	0.0	24.81

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

Tc-p*

S#	TIME	CPMA	A:2S%	CPMB	B:2S%	CPMC	C:2S%	SIS	FLAG	
1	999.99	19.09	1.45	17.85	1.50	24.81	1.27	127.49	B	
2	0.90	5019.79	2.98	4965.49	3.00	5022.97	2.98	177.45		300 ppb Tc-99 p*
3	0.89	5073.04	2.98	5014.74	3.00	5071.82	2.98	174.86		
4	8.47	511.60	3.09	506.83	3.11	510.02	3.12	176.65		30 ppb Tc-99 p*
5	8.65	502.06	3.09	496.02	3.11	501.78	3.11	176.41		

Sample Name	wt. of vial	wt. of vial + sample	Container wt. before sampling & pH	Measured pH	Container wt. after sampling & pH
7/30/99	11 days				
Tc-K* pH 4a	7.3493	7.8512	49.7435	6.58	48.707
Tc-K* pH 4b	7.4338	7.9356			
Tc-K* pH 7a	7.3036	7.8088	49.9463	7.15	48.8969
Tc-K* pH 7b	7.2929	7.7958			
Tc-K* pH 9.5a	7.2909	7.7941	49.5636	9.78	48.5287
Tc-K* pH 9.5b	7.3159	7.8218			
Tc-KC* pH 4a	7.3778	7.8833	50.0607	3.83	49.0282
Tc-KC* pH 4b	7.2791	7.7826			
Tc-KC* pH 7a	7.3528	7.8565	49.7171	5.75	48.6835
Tc-KC* pH 7b	7.3274	7.8323			
Tc-KC* pH 9.5a	7.3447	7.8552	49.1749	9.77	48.1343
Tc-KC* pH 9.5b	7.2646	7.7721			
8/5/99	17 days				
Tc-K* pH 4a	7.3316	7.8358	48.5187	6.62	47.4876
Tc-K* pH 4b	7.2551	7.7581			
Tc-K* pH 7a	7.3093	7.7902	48.7494	7.09	47.7151
Tc-K* pH 7b	7.3544	7.8597			
Tc-K* pH 9.5a	7.3807	7.8859	48.3938	9.64	47.3442
Tc-K* pH 9.5b	7.371	7.8779			
Tc-KC* pH 4a	7.3428	7.8471	48.887	3.82	47.8603
Tc-KC* pH 4b	7.2226	7.7266			
Tc-KC* pH 7a	7.3282	7.8309	48.5358	5.77	47.5123
Tc-KC* pH 7b	7.2619	7.7668			
Tc-KC* pH 9.5a	7.3226	7.8244	48.0179	9.65	46.9898
Tc-KC* pH 9.5b	7.3712	7.8774			

31 Jul 1999 08:49 ALPHA/BETA - 1.09
Protocol #:43 TC-99 CPM User 9

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	19.12
Region B:	2.0 -	300	0	3.0	17.91
Region C:	0.0 -	2000	0	0.0	24.93

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	19.12	1.45	17.91	1.49	24.93	1.27	124.40	B	
2	8.34	519.49	3.09	515.31	3.10	519.67	3.11	177.00		
3	8.28	525.08	3.09	519.29	3.10	523.98	3.11	173.92		Tc-K* 11 days
4	8.43	513.86	3.10	509.85	3.10	514.21	3.11	172.94		
5	8.45	511.88	3.10	508.25	3.11	511.52	3.12	175.29		
6	8.45	514.49	3.09	508.13	3.11	514.83	3.11	172.65		
7	8.37	520.19	3.09	513.52	3.10	522.02	3.10	175.11		
1 MISSING TUBE(S)										
9	8.42	516.39	3.09	510.48	3.10	516.40	3.11	175.18		
10	8.22	527.35	3.09	522.85	3.10	527.02	3.11	174.49		
11	8.20	529.66	3.09	524.41	3.10	529.46	3.11	174.72		Tc-KC* 11 days
12	8.46	513.74	3.09	507.98	3.10	514.55	3.10	175.41		
13	8.22	530.51	3.08	523.82	3.10	531.88	3.10	176.80		
14	8.09	536.13	3.09	531.54	3.10	536.01	3.11	177.37		
1 MISSING TUBE(S)										
16	8.45	515.32	3.09	508.25	3.11	514.48	3.11	176.50		
17	8.49	512.09	3.09	505.53	3.11	512.41	3.11	179.70		
1 MISSING TUBE(S)										
19	8.54	508.75	3.09	502.94	3.11	507.39	3.11	173.38		
20	8.32	522.35	3.09	516.47	3.10	522.18	3.11	176.46		
21	8.54	510.04	3.09	502.59	3.11	509.61	3.11	176.62		
22	8.58	506.99	3.09	500.63	3.11	506.42	3.11	173.79		
23	8.42	517.22	3.09	510.95	3.10	517.59	3.10	172.70		Tc-P* 30PPb 0 day
24	8.57	507.02	3.09	501.35	3.11	507.86	3.11	174.36		
25	8.32	522.47	3.09	516.83	3.10	522.42	3.11	172.77		
26	8.20	530.39	3.09	524.78	3.10	530.80	3.10	177.76		
27	8.44	513.34	3.10	508.75	3.11	513.10	3.11	174.90		
28	8.45	514.72	3.09	508.01	3.11	515.42	3.10	172.49		
8 MISSING TUBE(S)										
37	0.88	5122.92	2.98	5065.05	3.00	5122.80	2.99	173.46		
38	0.90	4991.99	2.99	4947.65	3.00	4991.74	2.99	172.66		
39	0.90	4988.66	2.99	4935.43	3.01	4987.29	2.99	176.36		
40	0.92	4922.18	2.98	4869.05	2.99	4920.72	2.98	173.36		
41	0.90	5026.43	2.98	4967.65	3.00	5027.29	2.98	175.53		Tc-P* 300 PPb 0 day
42	0.90	5033.10	2.98	4986.54	2.99	5033.96	2.98	175.04		
43	1.00	5057.88	2.82	5005.09	2.83	5057.07	2.82	175.15		
44	0.88	5117.24	2.99	5066.19	3.00	5115.98	2.99	173.90		
45	0.91	4919.34	3.00	4882.09	3.01	4921.22	3.00	174.06		
46	0.86	5232.04	2.99	5176.28	3.00	5229.72	2.99	175.07		

7/30/99 AJ

Objective:- To investigate the precipitation of technetium in 300 ppb & 30 ppb Tc-99 spike solution at pH range 3-7.

EQUIPMENT: Liquid Scintillation Analyzer (Packard 2500TR/AB)
ORION ph/mV/ISE/ C meter
Combination ph electrode
Automatic termperature compensator probe
Analytical balances (Mettler 4600 and 240AE)
Gyratory shaker

SUPPLIES: pH buffers (pH= 4,7,10)
50 ml polycarbonate centrifuge tubes (43 ml capacity)
LSA vials 7ml
Repipettor for transfer of scintillation cocktail
Packard A/B cocktail
Eppendorf pipet and tips (various volumes)
gamma-alumina (lot C16F19)
1 L FEP teflon bottle
Tc-99 stock solution (**spike #43A**)
HCl (lot 956110) various concentrations; e.g., 1.0 M, 0.1 M, etc...
NaOH (lot 976631) various concentrations; e.g., 1.0 M, 0.1 M, etc...

PROCEDURE:

1. In a precleaned 1L FEP bottle, prepare 280 g of 2.95x10-7 m (29.4 ppb) Tc-99 solution by diluting 28 g of a 2.95×10^{-6} m (294 ppb) ^{99}Tc stock solution (**spike #43A;** in 0.1 m NaCl matrix; prepared from a commercial ^{99}Tc spike) to a total of 280 g by taring 0.1 m NaCl solution into the FEP bottle on a Mettler 4600 balance.

2. Label 3 50 ml polycarbonate centrifuge tubes Tc-P*pHi (where i is the approximate pH of each solution, see Table) and pre-weigh. Record weight.

3. Add 35 g of the 29.4 ppb Tc solution to each tube and record weight.

4. Label 3 50 ml polycarbonate centrifuge tubes Tc-P*pHi (where i is the approximate pH of each solution, see Table) and pre-weigh. Record weight.

5. Add 40 g of the 294 ppb Tc solution to each tube and record weight.

6. Sample Tc-P* to determine initial Tc concentration of both spikes, 294 ppb and 29.4 ppb. Label (e.g. Tc-P*a 30 ppb and Tc-P*b 30 ppb) and preweigh two LSA vials. Withdraw two 0.5 ml samples and transfer to the LSA vials. Reweigh vials and record weight. Add 5 ml of scintillation cocktail to each vial. Homogenize sample and set aside for LSA.

7. Adjust pH by adding HCl or NaOH using an Eppendorf pipetter. The amount to be added to each solution is given in the Table. After pH adjustment record weight of containers.

exp soln	7/29/99 container orig wt	container wt + Tc soln	7/30/99 wt of Tc solution added	7/30/99 measured pH	7/30/99 container wt after pH adjust	7/30/99 amount of acid & base add
300 ppb						
Tc-P* pH 3.0	22.1778	42.1807	20.0029	3.01	42.1807	0.230 (0.1M HCl)
Tc-P* pH 4.0	22.2749	42.2848	20.0099	4.01	42.2848	0.370 (0.01M HCl)
Tc-P* pH 5.0	22.2996	42.3175	20.0179	4.96	42.3175	0.150 (0.01M HCl)
Tc-P* pH 6.0	22.0208	42.0232	20.0024	6.02	42.0232	0.050 (0.01M HCl)
Tc-P* pH 7.0	21.9401	41.954	20.0139	6.82	41.9540	----------
30 ppb						
Tc-P* pH 3.0	22.03	42.0368	20.0068	3.01	42.0368	0.230 (0.1M HCl)
Tc-P* pH 4.0	22.0235	42.0300	20.0065	4.01	42.0300	0.250 (0.01M HCl)
Tc-P* pH 5.0	22.3276	42.3318	20.0042	4.82	42.3318	0.050 (0.01M HCl)
Tc-P* pH 6.0	22.1521	42.1604	20.0083	5.92	42.1604	----------
Tc-P* pH 7.0	21.9991	42.0158	20.0167	7.00	42.0158	0.115 (0.01M NaOH)

sample	wt of vial	wt vial + sample		sample	wt of vial	wt vial + sample
300 ppb				**30 ppb**		
Tc-P*ITca	7.3090	7.8111		Tc-P*ITca	7.3493	7.8515
Tc-P*ITcb	7.3131	7.8153		Tc-P*ITcb	7.3284	7.8316

AJ

sample name	weight vial	wt vial + sample
300 ppb	8/30/99	
Tc-P* pH 3a	7.3634	7.8628
Tc-P* pH 3b	7.3613	7.8613
Tc-P* pH 4a	7.3348	7.8336
Tc-P* pH 4b	7.2885	7.7887
Tc-P* pH 5a	7.3109	7.8106
Tc-P* pH 5b	7.3222	7.8220
Tc-P* pH 6a	7.2578	7.7572
Tc-P* pH 6b	7.3258	7.8253
Tc-P* pH 7a	7.2268	7.7249
Tc-P* pH 7b	7.2809	7.7803
30 ppb		
Tc-P* pH 3a	7.2367	7.7364
Tc-P* pH 3b	7.3231	7.825
Tc-P* pH 4a	7.2644	7.765
Tc-P* pH 4b	7.2824	7.7845
Tc-P* pH 5a	7.3096	7.8088
Tc-P* pH 5b	7.2725	7.7731
Tc-P* pH 6a	7.2841	7.7832
Tc-P* pH 6b	7.2649	7.7656
Tc-P* pH 7a	7.2855	7.7828
Tc-P* pH 7b	7.3405	7.8403

sample name	weight vial	wt vial + sample
3 days 8/11/99 **300 ppb**		
Tc-P* pH 3a	7.2726	7.7714
Tc-P* pH 3b	7.2269	7.7282
Tc-P* pH 4a	7.3548	7.8537
Tc-P* pH 4b	7.2624	7.761
Tc-P* pH 5a	7.3229	7.820
Tc-P* pH 5b	7.2319	7.7287
Tc-P* pH 6a	7.3448	7.8430
Tc-P* pH 6b	7.2607	7.7592
Tc-P* pH 7a	7.3058	7.8043
Tc-P* pH 7b	7.3170	7.8167
30 ppb		
Tc-P* pH 3a	7.3447	7.8459
Tc-P* pH 3b	7.3540	7.8555
Tc-P* pH 4a	7.2945	7.7949
Tc-P* pH 4b	7.3361	7.8371
Tc-P* pH 5a	7.3175	7.8187
Tc-P* pH 5b	7.3004	7.8005
Tc-P* pH 6a	7.3756	7.8752
Tc-P* pH 6b	7.3220	7.824
Tc-P* pH 7a	7.2981	7.7978
Tc-P* pH 7b	7.3053	7.8060

8 d centrifuge at 12,000 for 15 minutes

sample name	weight vial	wt vial + sample
300 ppb 8/6/99		
Tc-P* pH 3a	7.2705	7.7698
Tc-P* pH 3b	7.3269	7.8327
Tc-P* pH 4a	7.2901	7.7897
Tc-P* pH 4b	7.2605	7.7668
Tc-P* pH 5a	7.3234	7.8236
Tc-P* pH 5b	7.2914	7.7988
Tc-P* pH 6a	7.3633	7.8711
Tc-P* pH 6b	7.3546	7.8626
Tc-P* pH 7a	7.3262	7.8236
Tc-P* pH 7b	7.3788	7.8695
30 ppb		
Tc-P* pH 3a	7.3464	7.8431
Tc-P* pH 3b	7.3129	7.8168
Tc-P* pH 4a	7.3518	7.8552
Tc-P* pH 4b	7.4015	7.9033
Tc-P* pH 5a	7.2912	7.7881
Tc-P* pH 5b	7.2954	7.7929
Tc-P* pH 6a	7.3371	7.8314
Tc-P* pH 6b	7.2973	7.7962
Tc-P* pH 7a	7.3405	7.8363
Tc-P* pH 7b	7.2835	7.7909

14 d centrifuge at 12,000 for 30 minutes

sample name	weight vial	wt vial + sample
300 ppb 8/12/99		
Tc-P* pH 3a	7.3104	7.8195
Tc-P* pH 3b	7.3563	7.8657
Tc-P* pH 4a	7.2925	7.7915
Tc-P* pH 4b	7.2851	7.7935
Tc-P* pH 5a	7.3028	7.7944
Tc-P* pH 5b	7.2814	7.7499
Tc-P* pH 6a	7.3518	7.8519
Tc-P* pH 6b	7.3490	7.8566
Tc-P* pH 7a	7.2905	7.7890
Tc-P* pH 7b	7.3217	7.8289
30 ppb		
Tc-P* pH 3a	7.3195	7.8131
Tc-P* pH 3b	7.3686	7.8793
Tc-P* pH 4a	7.3426	7.8366
Tc-P* pH 4b	7.2892	7.8025
Tc-P* pH 5a	7.2834	7.7795
Tc-P* pH 5b	7.4070	7.9204
Tc-P* pH 6a	7.3814	7.878
Tc-P* pH 6b	7.3036	7.8156
Tc-P* pH 7a	7.3146	7.8213
Tc-P* pH 7b	7.3489	7.8474

03 Aug 1999 12:52 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	0.0	19.06
Region B:	2.0 -	300	0	3.0	17.83
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	19.06	1.45	17.83	1.50	24.91	1.27	129.31	B
2	0.89	5071.96	2.98	5018.12	3.00	5070.60	2.98	175.07	
3	0.87	5151.06	2.99	5090.21	3.01	5149.81	3.00	173.96	
4	0.89	5071.96	2.98	5002.39	3.00	5071.72	2.98	174.07	
5	0.97	4933.52	2.90	4880.10	2.91	4932.83	2.90	168.91	
6	0.89	5032.63	2.99	4991.16	3.01	5031.27	3.00	173.16	
7	0.91	4982.04	2.98	4912.94	3.00	4978.39	2.98	174.20	
8	0.87	5168.30	2.99	5104.01	3.01	5168.20	2.99	176.06	
9	0.87	5172.90	2.99	5113.20	3.00	5175.09	2.99	173.10	
10	0.89	5046.11	2.99	5000.14	3.00	5048.13	2.99	171.53	
11	0.88	5105.94	2.99	5041.26	3.01	5110.32	2.99	175.80	
1	MISSING TUBE(S)								
13	8.72	496.54	3.10	492.14	3.11	496.43	3.12	175.83	
14	8.48	511.96	3.09	506.46	3.11	511.65	3.11	177.23	
15	8.53	508.73	3.09	503.15	3.11	508.86	3.11	176.12	
16	8.58	505.42	3.09	500.12	3.11	505.40	3.11	173.56	
17	8.45	514.08	3.09	508.32	3.11	512.85	3.11	172.88	
18	8.14	533.40	3.09	528.24	3.10	533.08	3.11	176.00	
19	8.43	512.85	3.10	509.45	3.11	513.05	3.11	171.96	
20	8.61	503.94	3.09	498.54	3.11	503.78	3.11	169.62	
21	8.31	522.82	3.09	517.67	3.10	522.39	3.11	173.83	
22	8.63	503.42	3.09	497.23	3.11	502.67	3.11	170.25	

Tc-P* 300 PB 3 day

Tc-P* 30 PPb 3 day

8/12/99

14 days filtered through 0.2 micron

300 ppb		
Tc-P* pH 3a	7.3236	8.2438
Tc-P* pH 3b	7.4016	8.2187
Tc-P* pH 4a	7.3618	8.2800
Tc-P* pH 4b	7.2741	8.0824
Tc-P* pH 5a	7.2962	8.1477
Tc-P* pH 5b	7.2941	8.1044

SYSTEM NORMALIZED

C14 IPA DATA PROCESSED - 05-Aug-1999 11:44
C14 Eff (0-156 keV) = 96.72 %
C14 CHI SQUARE IPA DATA PROCESSED - 05-Aug-1999 11:55
C14 Chi Square = 19.32
H3 IPA DATA PROCESSED - 05-Aug-1999 11:56
H3 Eff (0-18.6 keV) = 65.26 %
H3 CHI SQUARE IPA DATA PROCESSED - 05-Aug-1999 12:07
H3 Chi Square = 25.37
BKG IPA DATA PROCESSED - 05-Aug-1999 13:07
Bkg (0-18.6 keV) = 15.83 cpm
Bkg (0-156 keV) = 22.58 cpm
C14 E^2/B (1-156 keV) = 542.93
H3 E^2/B (1-18.6 keV) = 267.42

06 Aug 1999 05:57 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	0.0	19.10
Region B:	2.0 -	300	0	3.0	17.86
Region C:	0.0 -	2000	0	0.0	24.92

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	19.10	1.45	17.86	1.50	24.92	1.27	126.56	B
2	8.42	515.58	3.09	510.52	3.10	516.64	3.11	177.72	
3	8.38	518.73	3.09	512.93	3.10	519.11	3.10	174.80	Tc-K*
4	8.86	490.04	3.09	484.40	3.11	489.41	3.11	174.29	17 days
5	8.48	512.62	3.09	506.43	3.11	512.22	3.11	173.69	
6	8.14	534.34	3.09	528.94	3.10	534.90	3.10	175.29	
7	8.07	539.51	3.08	532.94	3.10	538.77	3.10	172.26	
1 MISSING TUBE(S)									
9	8.12	535.33	3.09	529.55	3.10	535.30	3.10	177.82	
10	8.36	518.22	3.09	513.84	3.10	518.02	3.11	175.40	Tc-K*
11	8.03	540.68	3.09	535.69	3.10	540.58	3.11	172.89	17 days
12	8.05	541.02	3.08	534.44	3.10	541.91	3.10	174.98	
13	8.24	527.87	3.09	521.94	3.10	526.77	3.11	176.02	
14	8.17	532.92	3.09	526.08	3.10	531.75	3.11	174.44	

This Notebook appears to comply with QAP-001.
E. C. Perry
1/13/2000