Drift Scale Heater Test
TH Coupled

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12/21/99 This scientific notebook documents work performed on the Thermal Hydrology KTI Project (TEF). Specifically, this notebook documents work performed on the Drift Scale Heater Test investigating reflux/dripping/corrosion using the Topopah Spring Tuff.

Initial Entry on 12/21/99 by M. Hill

12/21/99

YMP-101-R3
06/06/94

YUCCA MOUNTAIN SITE CHARACTERIZATION PROJECT
SAMPLE COLLECTION REPORT

Page 1 of 1

Date Collected: 12-7-99

Collector Name: DICK KOVACH

Organization: LANL Phone: (702) 295-6180

Address: ESF PAD
M/S 735

Recipient Name: RON GREEN

Organization: SOUTHWEST RESEARCH Phone: (210) 522-5305

Address: SOUTHWEST RESEARCH Study Plan No.: NA
BUILDING 51
6220 CULEBRA ROAD
SAN ANTONIO, TX 78238 Title: NA

Type of Sample: (circle one) rock soil alluvium caliche (muck) liquid gas other _____

Number of Samples Collected: 6 BARRELS/DRUMS

Site Type: (circle one) Trench Outcrop Surface Spring (Tunnel) Borehole
Other _____

Describe Sample: ☐ Q ☒ Non-Q

MUCK TRANSPORTED FROM NICHE #5, ECRB TO MUCK PILE VIA CONVEYOR BELT. TPGOLL (Topopah Spring lower lithophysal zone) TSw2

Describe Site:

MUCK PILE AT END OF CONVEYOR BELT, ESF PAD.

Other Documentation (Field photos, maps, reports, etc.):

SIX (6), 55 GALLON DRUMS/BARRELS

Remarks:

SPC 00552582

SPC *00552582*

For SMF Use Only
Record Verified By: Chris J. Hermes SMF TS Date: 12-7-99

Exhibit YAP-SII.4Q.1

12/21/99

01/17/00 gp

Prepartion of rock powders

Objective - prepare rock powders from samples of the Topopah Spring welded ~~tuff~~ (lower lithophysal unit) recieved from Yucca Mountain. (TSw2)

Method - utilize mixer/mill to powder TSw2 samples.

Equipment/Materials
- Spex mixer/mill Model 8000
- tungsten carbide vial
- plastic containers + bags
- rock hammer.

Procedure
1. Selected several hand sized specimens of TSw2 from the 55 gallon drums recieved from YM.
2. Several ~~a~~ centimeter sized pieces of rock were broken off from the hand sized specimens. Three pieces were powdered using the Spex mixer/mill and tungsten carbine vial. less than 1.0

③ The resultant powder was placed in a snap cap plastic vial and labeled.

④ The remainder of the hand sized specimen was placed in a plastic bag and labeled.

Hand sized specimen were labeld as follows:

TSW2-101
TSW2-102
TSW2-103
TSW2-104
TSW2-105
TSW2-106
TSW2-107

Powders in plastic container were labeled as follows:

TSW2-101P
TSW2-102P
TSW2-103P
TSW2-104P
TSW2-105P
TSW2-106P
TSW2-107P

01/17/00 gp

Thin section preparation

Objective - have thin sections of TSW2 made for mineralogic examination

Method - prepare thin section blocks and send to Mineral Optics Laboratory.

Equipment/Materials
- trim saw
- sample bags.

Procedure
① Hand sized specimens TSW2 thru TSW7 were cut to a size (27x46 mm) appropriate for standard thin section manufacture using a rock trim saw in Bldg 51.

② The blocks were placed in sample bags and sent to Mineral Optics lab in Wilder VT.

(3) The bags containing the blocks were labeled as follows:

TSW2-101TS
TSW2-102TS
TSW2-103TS
TSW2-104TS
TSW2-105TS
TSW2-106TS
TSW2-107TS

(4) Samples sent to

Mineral Optics Laboratory
29 "A" Street
P.O. Box 828
Wilder, VT 05088

01/18/00 gp

XRD Analysis of TSW2 rock powders.

Portions of TSW2 rock powders prepared on p 3-4 were placed in plastic vials. Samples were labeled and sent to Div for XRD analysis.

Standard procedures for XRD analysis were followed by Div to conduct the analyses. Analyses were performed w/ a Siemens D500 diffractometer. Data reduction and analysis was conducted using JADE XRD software.

01/27/00

Bulk Chemical Analysis of TSw2 powders

Portions of the TSw2 powders prepared on p 3-4 were placed in plastic vials. The vials were labeled as shown below and sent to Texas Tech University, Geoscience Department for bulk rock chemical analysis by digestion + ICP analysis

Sample	vial label
TSW2-101P	TS-101
TSW2-102P	TS-102
TSW2-103P	TS-103
TSW2-104P	TS-104
TSW2-105P	TS-105
TSW2-106P	TS-106
TSW2-107P	TS-107

To check quality of results 3 USGS rock standards were sent with the TSw2 powders. Portions of the USGS rock standards were placed in plastic vials and labeled as follows

USGS std	Vial Label
QLO-1 Quartz latite	TS-108
RGM-1 Glass Mnt Rhyolite	TS-109
STM-1 Nepheline Syenite	TS-110

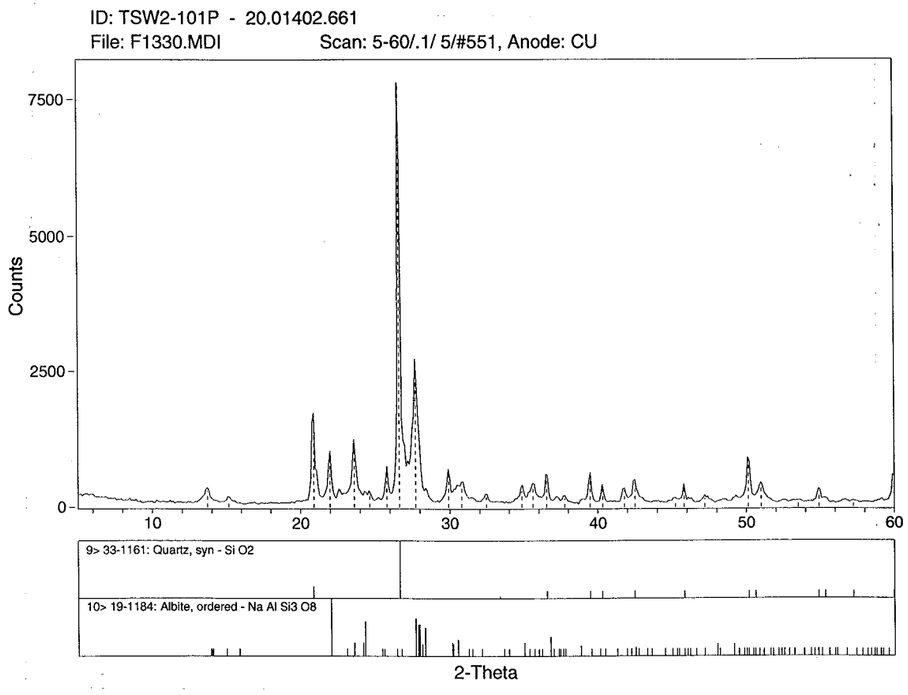
The rock standards were chosen based on their reported chemistry which should be similar to the TSw2 powders, especially for major elements such as Si, Al, Ca, Na, K, Fe, and Mg.

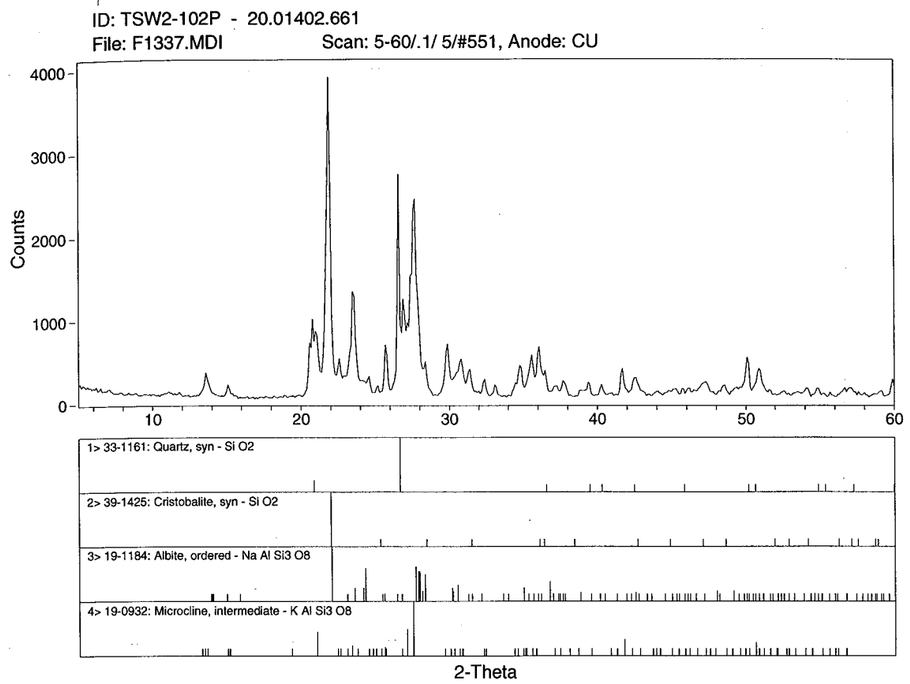
Samples were sent to the following address

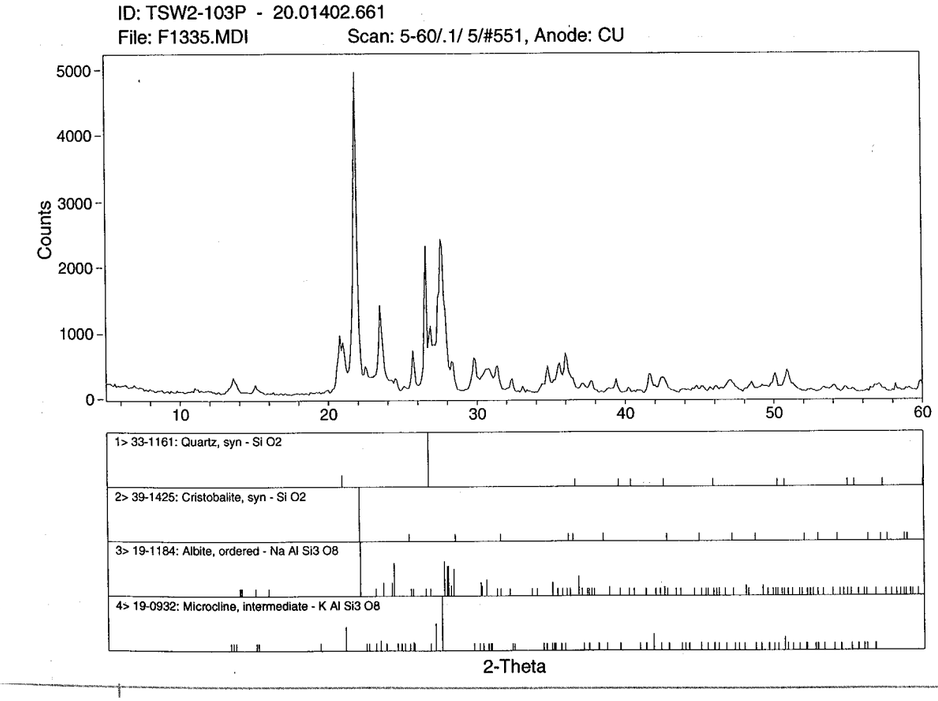
Melanie Barnes
Texas Tech University
Geosciences
Broadway and University
Science Bldg, Rm 125
Lubbock, TX 79409-1053

2/3/00 gp Results of XRD analysis of TSW2 powders.

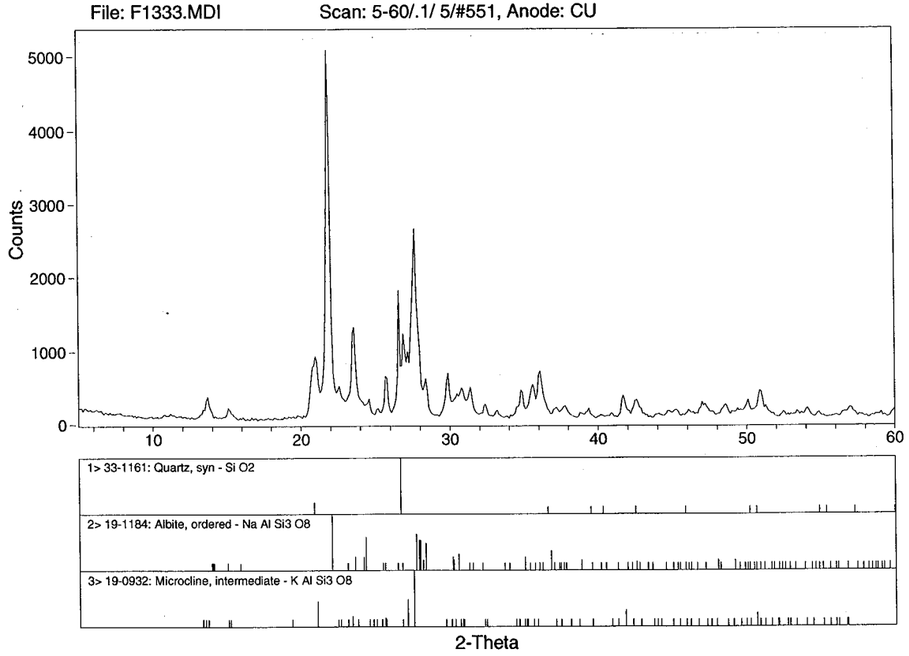
XRD patterns for the TSW2 rock powders are shown below and on the following pages. Patterns indicate that quartz, cristobalite, and feldspars are the major mineral phases of TSW2.







ID: TSW2-104P - 20.01402.661
File: F1333.MDI Scan: 5-60/.1/ 5/#551, Anode: CU



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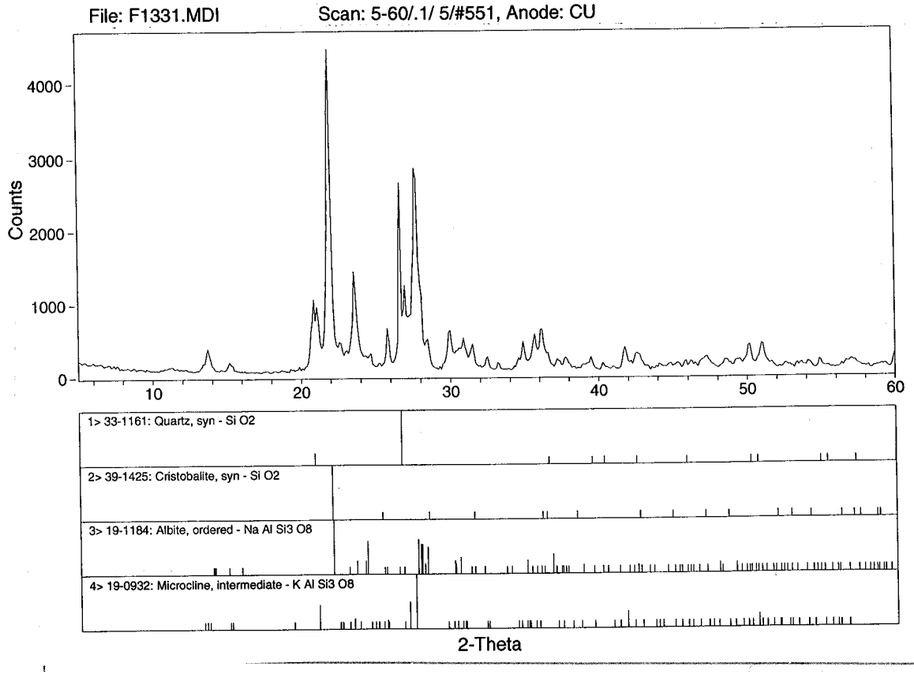

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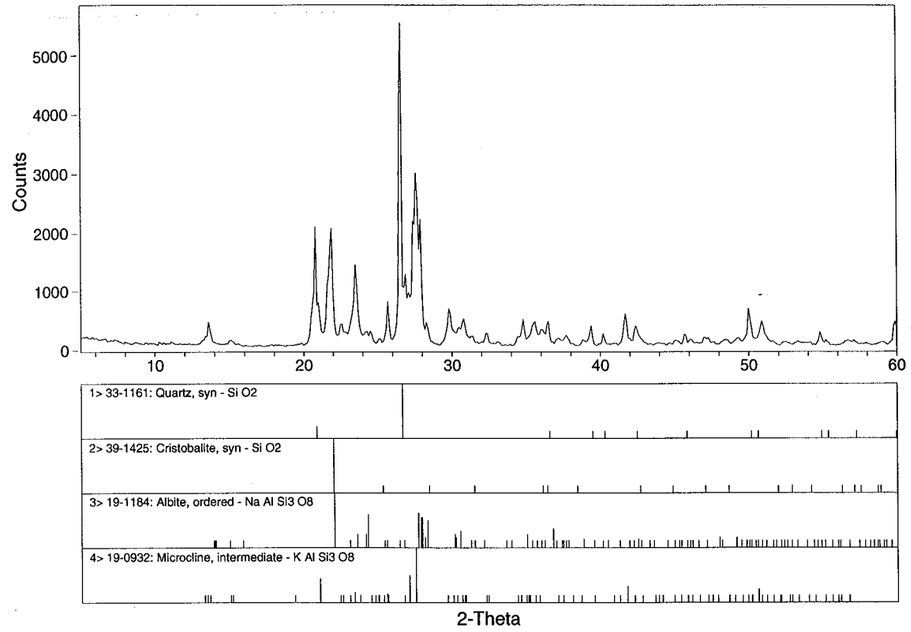

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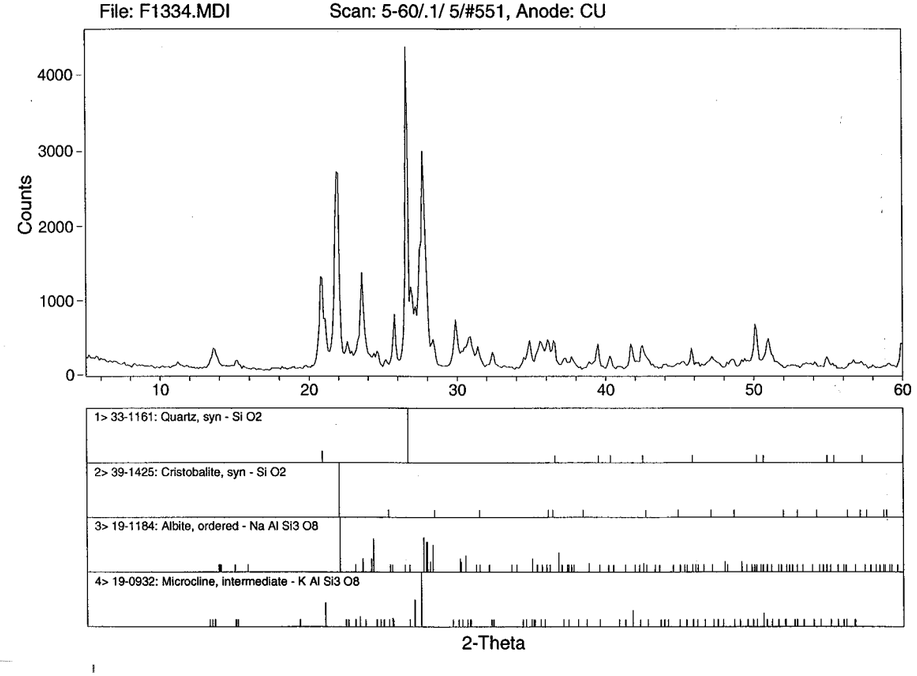
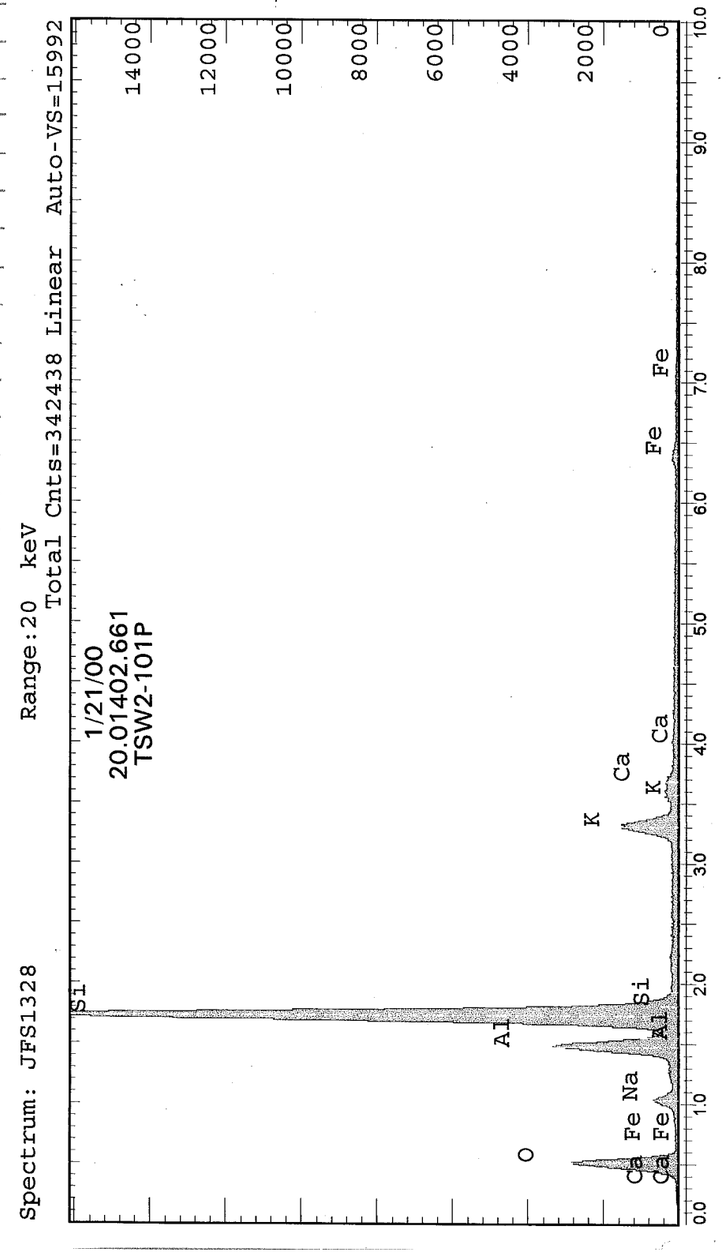


2/3/00 gp An EDS analysis of TSW2-101P showing elemental composition is shown below.



2-28-00 gp

Separate TSW2 rock into size fractions

Obj - separate TSW2 into various size fractions for use in lab scale heater test #3.

Method - sieving and hand separation

Materials + Equipment
- brass sieves (1 in, 5/8", and 5/16")
- 30 gal polyethylene containers
- 50 gal steel drums.

Procedure
1) Use sieves and hand separation to separate TSW2 rock into 4 size fractions:

   > 1 inch (25 mm)
   < 1 inch (25 mm) to 5/8 inch (16 mm)
   < 5/8 inch (16 mm) to 5/16 inch (8 mm)
   < 5/16 inch (8 mm).

2) Place size fractions into separate containers; either 30 gal PE containers or 50 gal steel drums.

3/2/00 JP

Equilibrate water with TSw2 rock

Obj - Equilibrate water with TSw2 rock for use in lab scale heater test

Method - place TSw2 rock in contact with D.I. water in 30 gal plastic containers and allow rock to react with water for ~2 months.

Materials and Supplies
- > 1 inch TSw2 size fraction
- < 5/16 inch TSw2 size fraction
- 30 gal plastic containers
- D.I. water
- plastic bottles and containers as needed
- scale (Santorius, 30 kg max)
- drying oven (Blue M)

Procedure
① Wash < 5/16 inch and > 1 inch TSw2 size fractions several times with D.I. water to remove Li tag.

② After washing dry rock overnight in Blue M oven at ~85°C.

gp 4/2/00

(3) Into two 30 gal plastic containers the following quantities of rock were placed:

30,000 gp 3/2/00
>1" TSW2 - ~~11,800~~ g
<5/16" TSW2 - 11,800 g

(4) Transfer 75 L of DI water to each of the two 30 gal plastic containers.

(5) Lids were placed on containers to reduce evaporation.

(6) Lids will be removed periodically to renew air in headspace of containers.

(7) Allow water and rock to react for at least 2 months.

4/2/00 gp

4/2/00 gp

Thin sections of the Topopah Spring lower lithophysal unit were recieved from Mineral Optics laboratory (see p 5-6).

4/17/00 JP

Results of chemical analyses of bulk rock powders of the Topapah Spring lower lithophysal unit are shown on the next page.

Analyses were performed by ICP at Texas Tech University.

Chemical Analyses of Topapah Spring rock Powders.

	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	LOI	Total	Sr	Ba	Zr	Y	Sc	V	Cr	Ni	Cu	Zn	Nb	Be
TS-101	75.15	0.09	12.67	0.91	0.06	0.18	0.56	3.75	4.76	0.01	0.87	99.01	24	49	126	32.0	2.5	0	1	1	-1	54	19	3.0
TS-102	76.07	0.09	12.70	1.10	0.08	0.15	0.51	3.51	5.02	0.01	0.59	99.82	21	52	122	22.0	2.6	4	1	0	0	62	18	3.1
TS-103	76.84	0.09	12.56	0.91	0.06	0.15	0.52	3.79	4.76	0.01	0.71	100.40	22	46	126	28.8	2.5	2	1	7	0	41	18	2.8
TS-104	75.61	0.09	12.78	0.86	0.07	0.14	0.47	3.76	4.98	0.01	0.64	99.42	21	77	129	17.5	2.5	0	1	6	-3	34	18	2.7
TS-105	76.58	0.09	12.47	0.85	0.06	0.15	0.50	3.64	4.83	0.01	0.60	99.78	23	50	123	21.4	2.5	0	-1	3	-4	38	17	2.7
TS-106	75.85	0.09	12.51	0.84	0.06	0.16	0.48	3.78	4.88	0.01	0.58	99.24	21	50	122	30.2	2.5	1	3	2	-2	42	17	2.9
TS-107	76.23	0.09	12.61	0.89	0.06	0.17	0.50	3.56	4.99	0.01	1.60	100.70	23	47	123	25.1	2.6	-1	1	0	-2	46	17	2.8
TS-108	65.76	0.63	16.71	4.20	0.09	1.07	3.35	4.52	3.57	0.27	0.63	100.80	360	1365	190	22.1	8.6	45	1	2	29	66	11	1.6
TS-109	72.22	0.27	14.13	1.84	0.03	0.32	1.19	4.12	4.36	0.05	1.11	99.64	105	800	231	21.9	4.4	13	7	3	10	35	9	1.9
TS-110	59.13	0.13	18.65	5.12	0.21	0.15	1.15	8.96	4.31	0.16	1.55	99.52	705	570	1347	42.4	0.7	0	2	4	3	246	246	9.7

*Oxides are in weight percent.

8/2/00

Remove Fines From Topopah Spring welded (TSw2) tuff.

Obj - Remove Fines from TSw2 which is to be used in lab scale heater test #3.

Method - wash and rinse with DI water.

Materials + Supplies
- sieved TSw2 rock
  - > 1 inch
  - < 1 inch to 5/8 inch
  - < 5/8 inch to 5/16 inch
- DI water
- plastic trays
- rubber containers

Procedure

(1) Plastic 30 gal containers and steel drums containing the TSw2 size fraction were filled with DI water.

(2) The rock was initially washed and rinsed inside the containers. Fines were allowed to settle to the container bottom.

(3) After initial rinsing + washing the rock was transferred to rubber containers filled with DI water. The rock was given a second rinsing.

(4) The rock was then placed in plastic trays for drying and storage.

Note - the < 1 inch to 5/8 inch and < 5/8 inch to 5/16 inch size fraction were mixed together during the washing + rinsing procedure to create one size fraction consisting of < 1 inch to 5/16 inch rock pieces.

8/15/00 gf

Lab Scale Heater Test using welded tuff from the Topopah Spring lower lithophysal unit

Obj - measure and monitor thermo-chemical parameters in a heated drift with water infiltrate from above.

Method - construct and instrument a simulated adit surrounded by Topopah Spring welded tuff

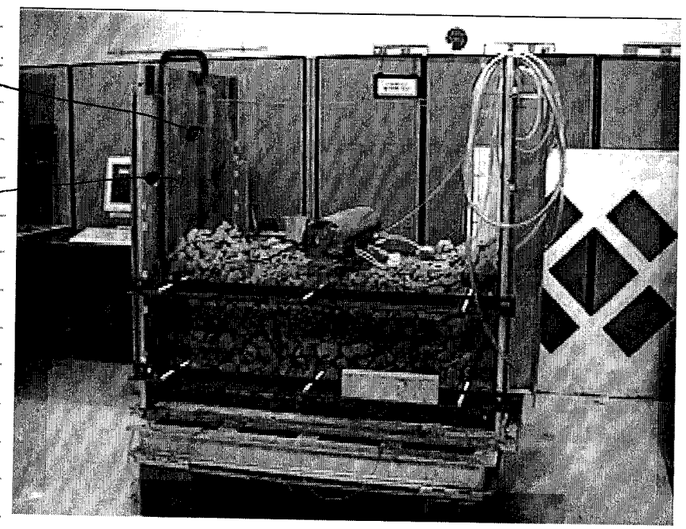
Materials and Equipment

- aluminum frame that will accomodate a 4' x 4' x 2' sample volume
- hexan plastic sheets, 1/2" thick
- angle iron supports (8) - 2" angle 1/4" wide x 52" long
- Fiberglass insulation
- 12" Cartridge heater, 3/4" diameter, Omega brand
- Manostat cassette pump
- Hewlett Packard 34970A Data acquisition unit
- Datalogger HP BenchLink Software Version 1.1
- Staco Variable transformer, Type 3PN1510
- Vaisalla HMP235 Temperature/Humidity probe
- Omega Type K fiberglass thin wire thermocouple with 6' leads
- plastic tubing - various sizes as needed
- Teflon beakers - 600 ml, 250 ml, 100 ml

- Topopah Spring tuff lower lithophysal unit with fines removed.
  - > 1 inch size fraction
  - < 1 inch to 5/16 inch size fraction
- Plexiglass - 1/2" x 2' x 4' sheets (2)
- Spectra Mesh Nylon Filter (210 µm mesh openings)
- 2' long x 16" diameter steel mesh
- Omega Type T thermocouple probe (12 inch long)
- porous ceramic tube (11 inch long)
- Soly Tuve® plus temperature controller, Love Control Corp.

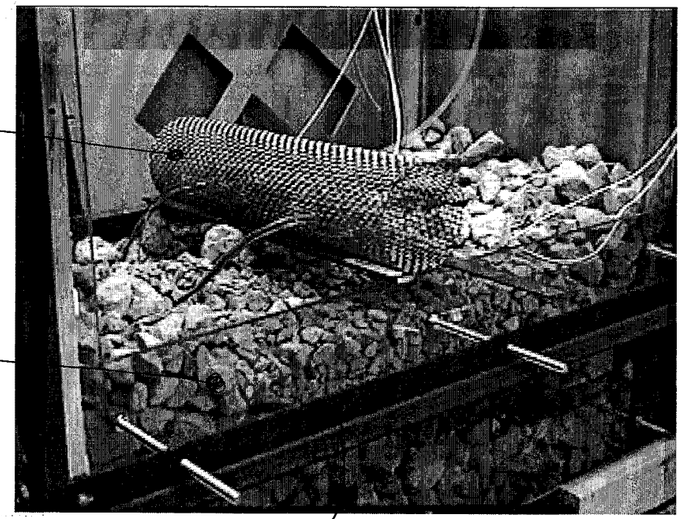
8/15/00 JP Assembly

(1) A 4' high by 4' wide by ~3' deep aluminum frame shown in the photo below was used to construct the lab scale heater test. The front and back of ~~the~~ aluminum frame are open.



8/16/00 JP (2) 4' x 2' x 1/2" plexiglass sheets were secured to the inner right and left side of the alumn frame to provide a 2' wide spacing for emplacement of the Tuff and simulated cuttings. Location of plexiglass sheets are shown in above photo.

8/17/00 JP (3) 4' x 21" x 1/2" sheets of lexan plates were secured to the front and back of the aluminum frame using the angle iron supports. These sheets and the angle iron supports are shown in the photo below.

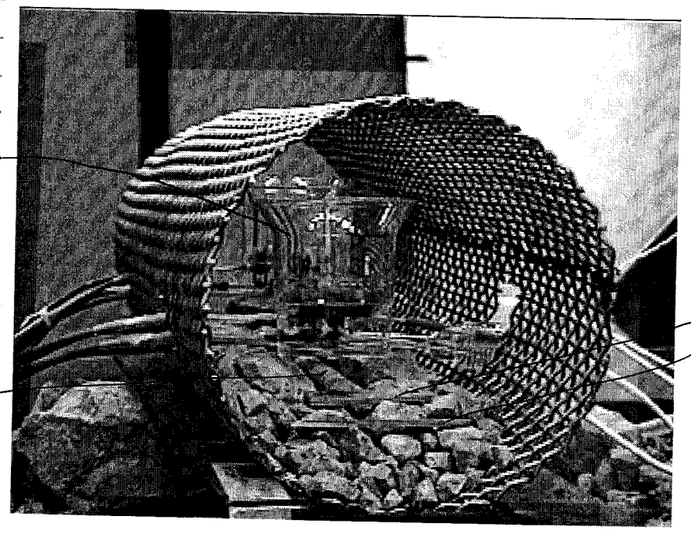


8/17/00 JP (4) The enclosure was filled with the >1 inch Topopah Spring tuff up to a level of about 16 inches. Above the level the enclosed area was filled progressively with >1 inch Tuff at the right and left corners and with <1 inch to 5/16" Tuff in the middle.

8/18/00 JP

(5) The 2' long by 6" diameter steel enclosure (simulated adit) was placed at the center of the open sided alumin frame. See photo on previous page.

(6) The floor of the steel enclose was filled with <1 inch to >5/16" tuff. See photo below. A 12" cartridge heater with a 3/4" diameter was placed to top of the floor.



Lead wires for the cartridge heater were run under the steel enclosure and thru two holes drilled in the front lexan cover. The heater was connected to a Staco variable transformer.

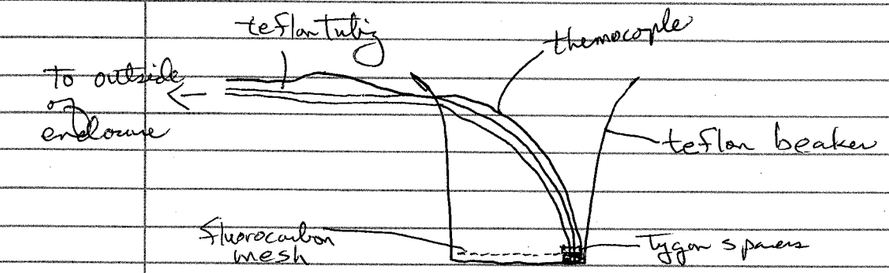
8/21/00 JP

(7) Instruments and metal samples were placed inside the adit to measure parameter related to corrosion. Two glass cups for measing conductivity, Cl, corrosion potential, etc and metal coupons made of various materials were placed in the adit (see photo on previous page). The glass cups were designed to capture infiltrating water.

See scientific notebook # for a more detailed description of these instruments and samples.

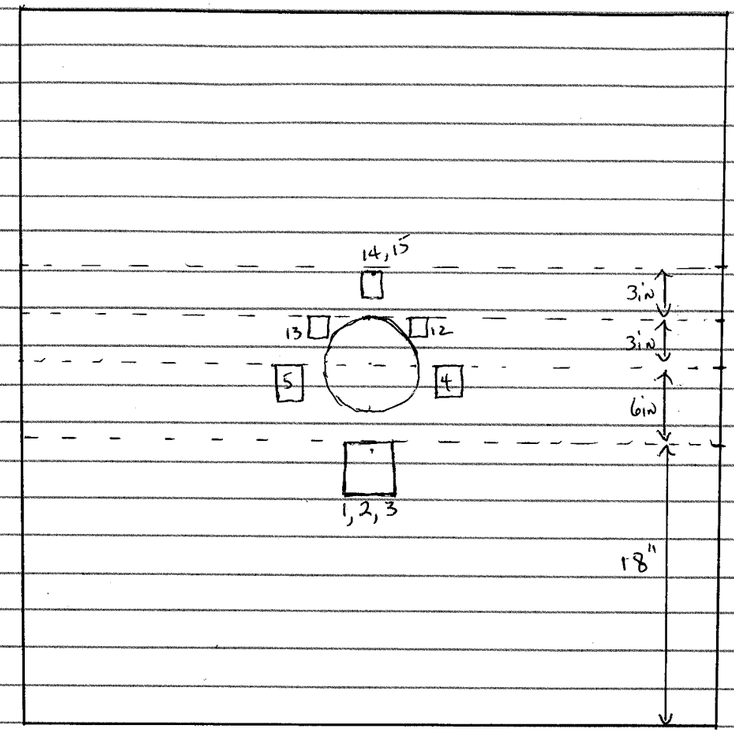
Lead wires for the sample cups were run out the side of the steel enclosure and thru holes drilled in the back lexan cover.

(8) Teflon sample cups were placed at various location around the simulated adit as tuff was added to the enclosure. The purpose of the cups was to collect water as it infiltrates downward thru the tuff. The diagram below shows how each sampling cup was constructed.



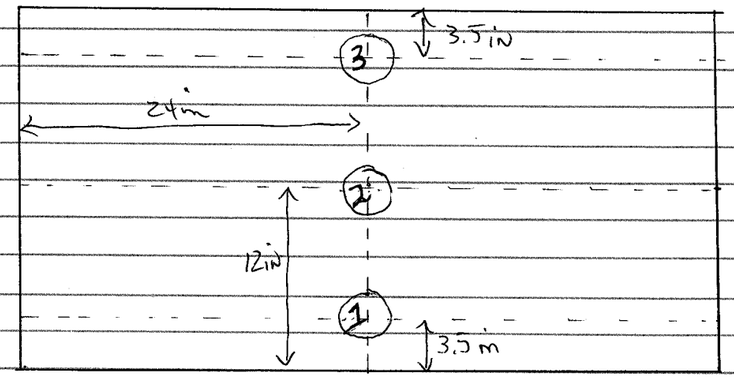
Teflon tubing ran from the bottom of the sampling cup to outside of the enclosure. A syringe can be attached to the tubing outside the enclosure to draw out any water that collects in the bottom of the beaker.

The location of each sampling cup are shown in the diagrams on the next pages

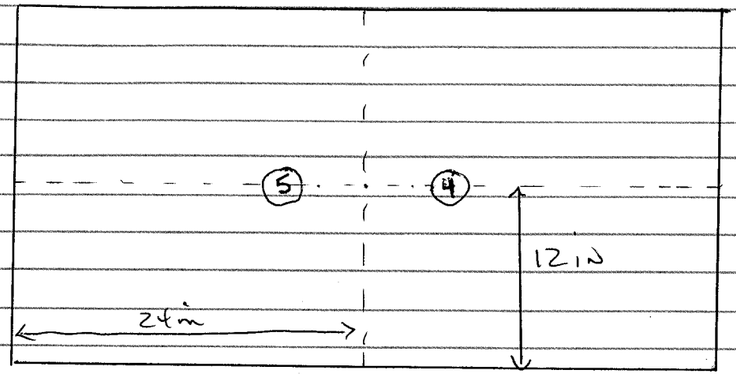


Front view

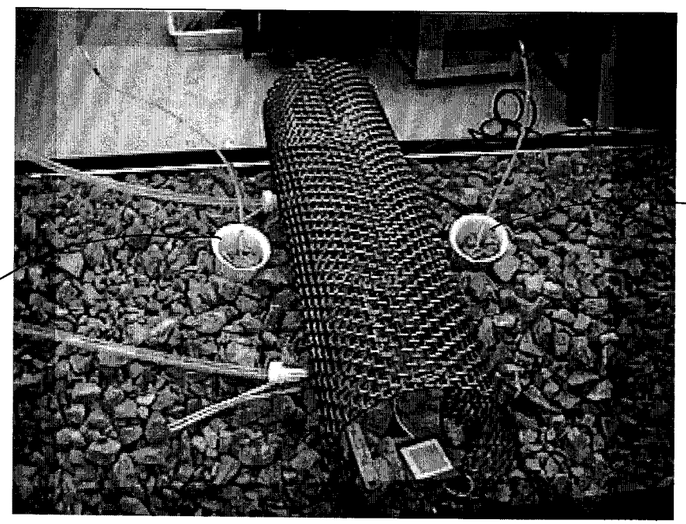
Plan views
Sample cups 1, 2, + 3



Simple cups 4 and 5



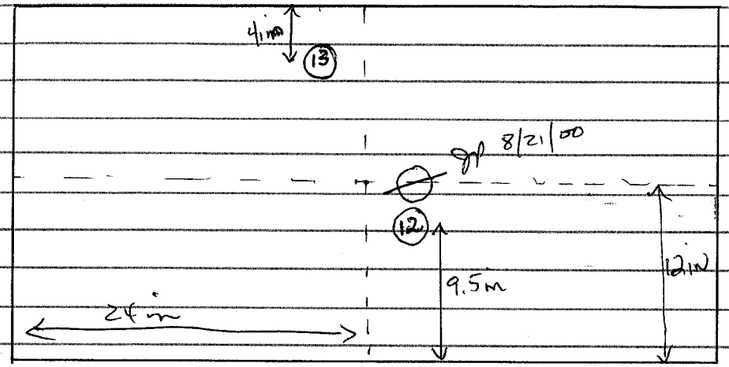
Front



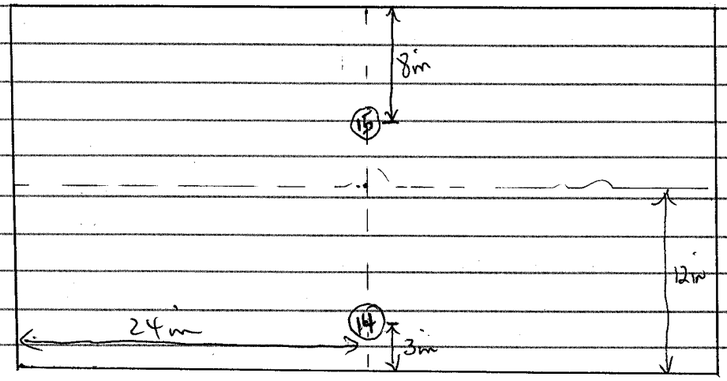
Back

Photo showing location of simple cups 4 and 5 in enclosure.

Simple cups 12+13



Simple cups 14+15



(9.) Thermocouples were placed in each supply cup and at other selected locations inside and outside the simulated adit. A total of 31 thermocouples (30 possible thin wire type K thermocouples and 1 type J thermocouple).

Before placement the thermocouples were calibrated using the procedure below.

Thermocouple calibrate

Equipment & materials
- curing hot plate
- ice
- 1L glass beaker
- calibrated thermometer (S/N C96-833)
- HP3497OA data acquisition unit
- Omega Precision fine wire thermocouples with 72 inch leads Type K. (30)
- Omega 12" thermocouple probe Type J. (1)

Procedure

(10) Thermocouples were placed in a beaker filled with ice along with the calibrated thermometer. The 30 Type K thin wire thermocouples were labeled T1 - T30 and the Type J 12 inch thermocouple probe was labeled T34

Temperatures are recorded below

Calibrated thermometer -0.7°C

T1 - 1.1	T16 - 0.7
T2 - 0.9	T17 - 0.7
T3 - 0.7	T18 - 0.9
T4 - 1.2	T19 - 0.5
T5 - 0.6	T20 - 0.4
T6 - 0.5	T21 - 0.9
T7 - 0.8	T22 - 0.8
T8 - 0.7	T23 - 1.1
T9 - 0.9	T24 - 1.1
T10 - 1.1	T25 - 0.7
T11 - 1.0	T26 - 0.8
T12 - 1.0	T27 - 0.6
T13 - 0.9	T28 - 0.5
T14 - 1.2	T29 - 0.6
T15 - 0.6	T30 - 0.6
	T34 - 0.9

(9a) Thermocouples were placed in a beaker of hot water (~95°C) with the calibrated thermometer.

Temperatures are recorded below.

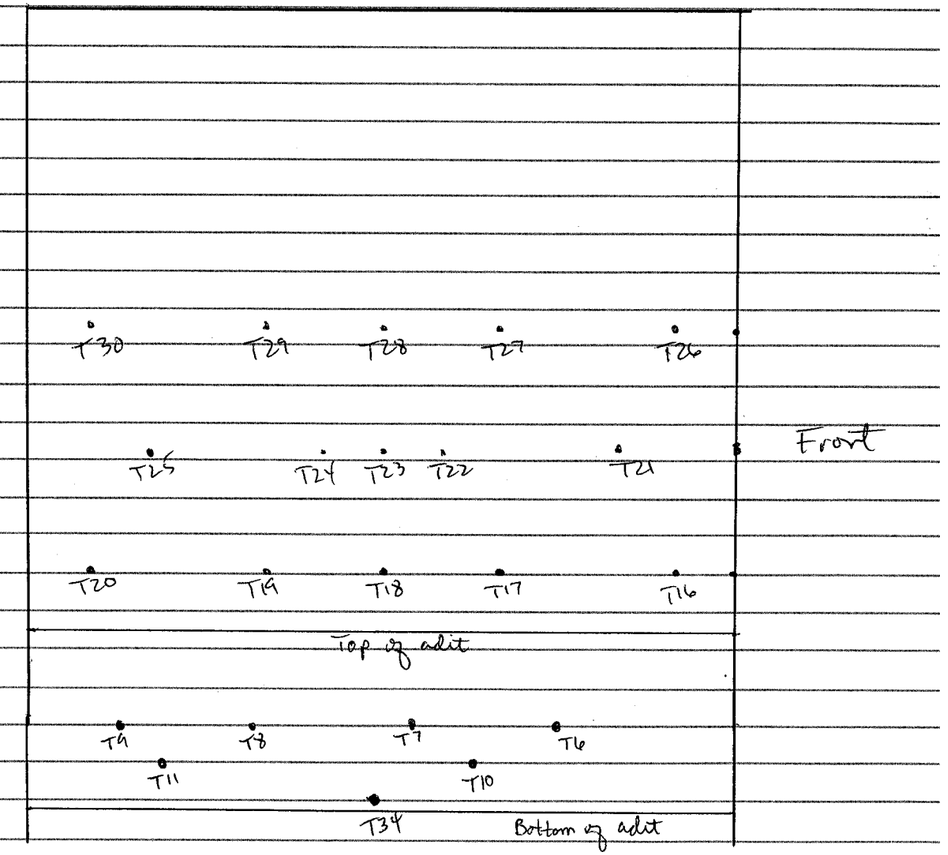
Calibrated thermometer - 95°C

T1 - 95.3	T16 - 95.1
T2 - 94.7	T17 - 95.6
T3 - 94.7	T18 - 95.0
T4 - 95.0	T19 - 95.2
T5 - 95.3	T20 - 94.6
T6 - 95.6	T21 - 94.6
T7 - 94.7	T22 - 94.7
T8 - 94.8	T23 - 94.6
T9 - 94.8	T24 - 94.5
T10 - 94.7	T25 - 94.8
T11 - 95.1	T26 - 95.0
T12 - 95.1	T27 - 95.0
T13 - 95.0	T28 - 94.9
T14 - 94.9	T29 - 94.8
T15 - 94.8	T30 - 94.7
	T34 - 95.3

(10) 8/22/00 gp

Diagram below shows the location of thermocouples inside the enclosure.

Thermocouples 1, 2, 3, 4, 5, 12, 13, 14, & 15 were placed inside the teflon sample cups. Their approximate locations are shown in the diagram on pp 31-33.



Side View

Thermocouples 6, 7, 8, + 9 are inside the Tunnel at the approximate middle.

Thermocouples 10 and 11 were placed inside the glass sample cups.

Thermocouples T16 - T30 are above the adit at the midpoint.

Thermocouple T34 is touching the heater inside the adit.

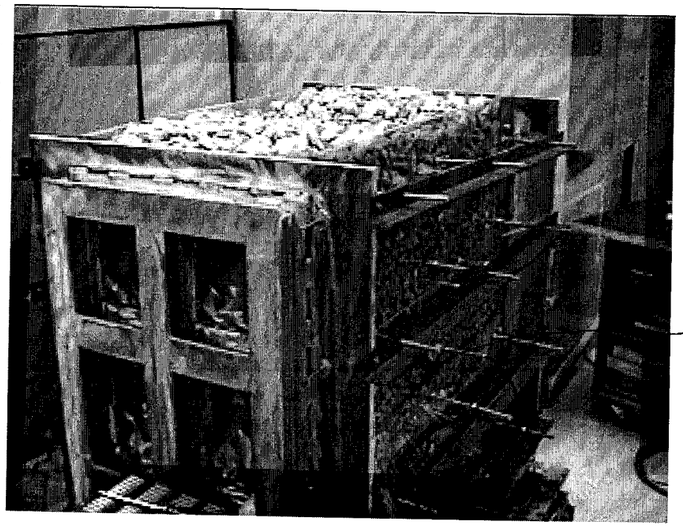
Thermocouple leads for type K thermocouples were run outside from the left front corner of the enclosure. The leads were attached to the HP34970A data acquisition system.

The Type J probe was run thru a hole drilled in the front lexan cover.

(11) 4' x 27" x 1/2" sheets of lexan plastic were placed on the front + back of the alumin frame to complete the enclosure as tuff was added. These lexan sheets are also held in place by angle iron supports. The cavity between the two lexan sheets on the front and back of the assembly was sealed with RTV compound.

8/23/00

(12) The enclosure was filled to the top with Tuff. The >1 inch tuff material was used along the right and left sides of the enclosure while the <1 inch to 5/16 inch Tuff material was used around the simulated adit and the top middle of the enclosure. A photo of the filled enclosure is shown on the next page.



Temperature/humidity probe

(13) A hole was drilled in the front lexan sheet into the adit to accomodate a Vaisala temperature/humidity probe. The probe can be seen in the photo above.

(14) A porous ceramic tube was placed on the top of the tuff along the middle of the frame. The photo on the next page shows the ceramic tube after placement. The ceramic tube was connected to a Manostate cassette pump via plastic tubing.

(15) The Manostat cassette pump was calibrated to determine the flow rate of water delivered from the porous ceramic tube at various Manostat settings.

The Manostat calibration is described on the following page.

porous ceramic tube

Manostat calibrate

Equipment/materials
- Manostat cassette pump
- 11 inch porous drain tube
- DI water
- volumetric flask.

(1) Plastic tubing was used to connect the cassette pump to a reservoir of DI water and the porous drain tube.

(2) The drain tube was placed in a volumetric flask.

(3) The cassette pump was run at different settings (10 to 3) for timed intervals and the water delivered by the drain tube was collected in the volumetric flask.

A table shows the value of water collected at each setting and the time elapsed is shown on the following page.

Setting	Time Elapsed (min)	Volume Collected (ml)
10	15	16.5
9	15	16
8	15	15
7	15	13
6	15	10
5	15	8
4	15	7
3	36	14

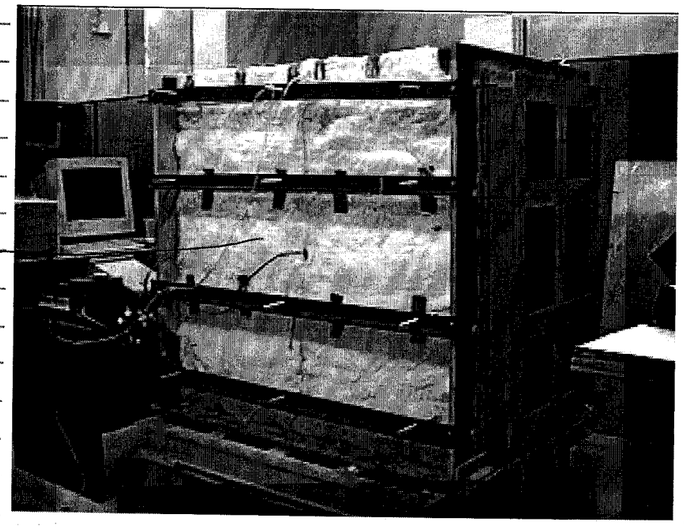
The volume collected and time elapsed for each setting was used to calculate the volume of water that would be delivered by the tube in one day for the various settings. The formula is:

$$\frac{\text{Vol collected (ml)}}{\text{Time elapsed (min)}} \times \frac{1440 \text{ min}}{\text{Day}} = \frac{\text{Vol (ml)}}{\text{Day}}$$

Setting	Delivery Rate
10	1.58 L/Day
9	1.54 L/Day
8	1.44 L/Day
7	1.25 L/Day
6	.96 L/Day
5	.76 L/Day
4	.67 L/Day
3	.56 L/Day

8/24/00 gf

(16) The front and back of the enclosure was covered with a layer of fiberglass insulation.



Fiberglass insulation

The top of the assembly was covered with a layer of 1/8" neoprene followed by a layer of fiberglass insulation followed by a layer of 1/2" lexan plastic.

(17) The poron cream tube at the top of the assembly was connected to the Masterflex cassette pump via plastic tubing. The Masterflex was also connected to a 20L reservoir of water that was equilibrated with the tuff. (see p 17+18)

(18) The 20L reservoir of water was spiked with NaCl to increase the Cl content of the water by 10 ppm.

(19) Thermocouple #7 was attached to a temperature controller (Self Tune® plus, Love Controls Corp) to control temperature in the dirt. The Staco variable transformer which controls the voltage supply to the controller heater was connected to the controller.

8/28/00 JP

Start of lab scale heater test 3

① Voltage was applied to the cartridge heater by the Variable Transformer to heat up the system. The purpose is to raise the temperature of air in the adit to ~100°C before adding water to the system.

② Power to the heater was controlled via a temperature controller with attachment to thermocouple #7 and the Variable Transformer. The Variable Transformer was adjusted until cycling was minimal. Minimal cycling of the heater allowed temperature inside the adit to remain relatively constant. Minimal cycling was achieved at a variable transformer setting of 60.

③ Thermocouple temperature were monitored using HP Benchlink Datalogger software.

9/11/00 JP

④ Temperature were monitored for about 2 weeks to insure that system had reached a steady state before adding water. The temperature of thermocouples after attaing steady state are shown below.

Data Grid

	Channel	Reading	Time
1	<101>T1	26.07400 C	08:57:47.791 AM
2	<102>T2	26.68800 C	08:57:47.832 AM
3	<103>T3	26.12500 C	08:57:47.870 AM
4	<104>T4	50.56600 C	08:57:47.909 AM
5	<105>T5	48.10400 C	08:57:47.948 AM
6	<106>T6	71.26500 C	08:57:47.987 AM
7	<107>T7	96.34600 C	08:57:48.026 AM
8	<108>T8	101.4120 C	08:57:48.065 AM
9	<109>T9	70.47900 C	08:57:48.103 AM
10	<110>T10	109.9660 C	08:57:48.142 AM
11	<111>T11	74.57800 C	08:57:48.181 AM
12	<112>T12	94.18700 C	08:57:48.221 AM
13	<113>T13	71.90400 C	08:57:48.260 AM
14	<114>T14	85.00500 C	08:57:48.299 AM
15	<115>T15	105.4590 C	08:57:48.338 AM
16	<116>T16	76.15900 C	08:57:48.377 AM
17	<117>T17	101.9290 C	08:57:48.416 AM
18	<118>T18	111.4350 C	08:57:48.455 AM
19	<119>T19	104.1850 C	08:57:48.493 AM
20	<120>T20	79.58700 C	08:57:48.532 AM

Data Grid

	Channel	Reading	Time
1	<121>T21	81.61800 C	08:59:48.559 AM
2	<122>T22	101.2280 C	08:59:48.598 AM
3	<123>T23	87.77900 C	08:59:48.637 AM
4	<124>T24	103.3190 C	08:59:48.676 AM
5	<125>T25	86.60800 C	08:59:48.715 AM
6	<126>T26	73.37600 C	08:59:48.754 AM
7	<127>T27	90.00600 C	08:59:48.793 AM
8	<128>T28	93.90100 C	08:59:48.832 AM
9	<129>T29	91.90200 C	08:59:48.870 AM
10	<130>T30	75.69300 C	08:59:48.909 AM
11	<134>T34	282.7360 C	08:59:48.948 AM

9/12/00 gf

⑤ At 08:25 on 9/12/00 water addition at a rate of ~1L/day was started.

Temperature of thermocouples was acquired at 2 minute intervals.

Temperature data is stored in the following files

test_3_1.csv (9/12/00)
test_3_2.csv (9/13/00)
test_3_3.csv (9/13-9/14)
test_3_4.csv (9/14-9/15)

9/15/00 gf Temperature aquisition settings were changed to a 5 min interval.

test_3_5.csv (9/15)
test_3_6.csv (9/15)
test_3_7.csv (9/15-9/18)
test_3_8.csv (9/18-9/19)
test_3_9.csv (9/19-9/20)
test_3_10.csv (9/20-9/21)
test_3_11.csv (9/21-9/22)
test_3_12.csv (9/22-9/25)
test_3_13.csv (9/25-9/28)
test_3_14.csv (9/28-9/29)
test_3_15.csv (9/29-10/2)
test_3_16.csv (10/2-10/4)
test_3_17.csv (10/4-10/5)
test_3_18.csv (10/5-10/6)
test_3_19.csv (10/6-10/9)
test_3_20.csv (10/9-10/10)
test_3_21.csv (10/10-10/11)
test_3_22.csv (10/11-10/13)
test_3_23.csv (10/13-10/16)
test_3_24.csv (10/16-10/17)
test_3_25.csv (10/17-10/18)
test_3_26.csv (10/18-10/19)
test_3_27.csv (10/19-10/20)
test_3_28.csv (10/20-10/23)
test_3_29.csv (10/23-10/24)
test_3_30.csv (10/24-10/25)
test_3_31.csv (10/25-10/26)
test_3_32.csv (10/26-10/26)
test_3_33.csv (10/26-10/30)
test_3_34.csv (10/30-10/31)
test_3_35.csv (10/31-11/1)
test_3_36.csv (11/1-11/2)
test_3_37.csv (11/2-11/3)

Cont on page 53

Readings in mA from the temperature/humidity probe (Vaisala HMP235) were taken daily and converted to temperature and humidity using the formulas below.

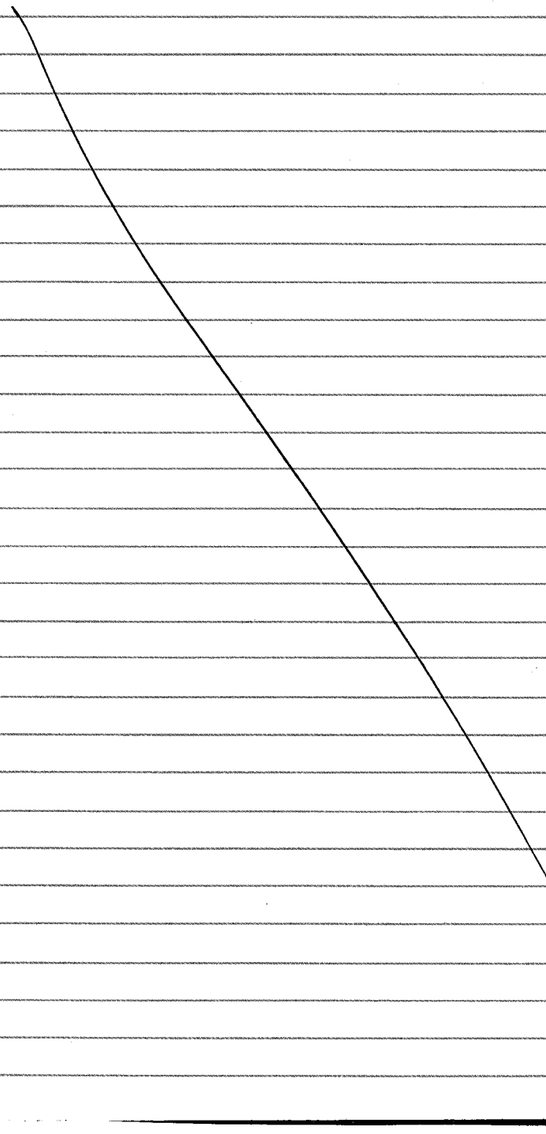
$$\text{Relative Humidity} = \left(\frac{(\text{mA reading} - 4)}{16}\right) * 100$$

$$\text{Temperature} = \left(\left(\frac{(\text{mA reading} - 4)}{16}\right) * 200\right) - 20$$

		mA readings			
		RH	Temp	RH	Temperature
9/12/00	1525	5.58	13.69	9.87%	101.1°C
9/13/00	1325	6.10	13.64	13.12%	100.5°C
9/14/00	0820	6.18	13.85	13.62%	103.1°C
9/15/00	0750	~~6.31~~ gf 9/15/00 6.25	13.91	14.06%	103.9°C
9/18/00	0835	6.55	13.55	15.94%	99.4°C
9/19/00	0740	6.45	13.73	15.31%	101.6°C
9/20/00	0750	6.44	13.69	15.25%	101.1°C
9/21/00	0750	6.07	14.28	12.94%	108.5°C
9/22/00	0750	5.87	14.54	11.69%	111.7°C
9/25/00	0820	5.79	14.67	11.19%	113.4°C
9/28/00	0740	6.14	14.22	13.37%	107.7°C
9/29/00	0910	5.96	14.41	12.25%	110.1°C
10/2/00	0805	6.21	13.95	13.81%	104.4°C
10/4/00	0730	6.54	14.00	15.87%	105.0°C
10/5/00	0845	7.19	13.43	19.94%	97.8°C
10/6/00	0755	7.12	13.30	19.50%	96.2°C
10/6/00	1550	7.31	13.08	20.69%	93.5°C
10/9/00	0840	7.45	13.10	21.56%	93.7°C
10/10/00	0750	7.35	13.20	20.94%	95.0°C
10/11/00	0740	7.50	13.19	21.87%	94.9°C
10/11/00	1415	7.57	13.00	22.31%	92.5°C
10/13/00	0755	7.23	13.17	20.19%	94.6°C

9/29/00 JF

1430 hrs
Ceramic tube used to deliver water at top of apparatus was replaced. Then original tube appeared to be clogged.



10/13/00 JF

Temperature + Realative Humidity readings
(continued from p 49)

		mA RH	Temp		RH	Temp
10/13/00	1555	7.15	13.23		19.68%	95.4°C
10/16/00	0840	6.76	13.74		17.25%	101.7°C
10/17/00	0840	6.79	13.69		17.44%	101.1°C
10/18/00	0730	6.74	13.72		17.12%	101.5°C
10/19/00	0755	6.86	13.60		17.87%	100.0°C
10/20/00	1100	6.84	13.60		17.75%	100.0°C
10/23/00	0800	6.94	13.63		18.37%	100.4°C
10/24/00	0900	6.86	13.69		17.87%	101.1°C
10/25/00	0745	6.53	14.01		15.81%	105.1°C
10/26/00	0900	6.50	14.05		15.62%	105.6°C
10/26/00	1335	6.91	13.61		18.19%	100.1°C
10/27/00	0845	6.86	13.53	MH	17.87%	99.1°C
10/30/00	0745	6.97	13.35		18.56%	96.9°C
10/31/00	0800	7.02	13.50		18.87%	98.1°C
11/1/00	0815	7.02	13.61		18.87%	100.1°C
11/1/00	1030	7.27	13.38		20.43%	97.25°C
11/2/00	0730	7.29	12.88		20.56%	91.0°C
11/3/00	1035	7.23	12.93		20.19%	91.6°C
11/3/00	1340	7.41	12.80		21.31%	90.0°C
11/6/00	0750	7.36	12.80		21.0%	90.0°C
11/7/00	0800	7.75	12.46		23.44%	85.1°C
11/7/00	1615	8.34	12.08		27.12%	81.0°C
11/8/00	0745	8.46	12.03		27.87%	80.4°C
11/9/00	0755	7.76	12.32		23.50%	84.0°C
11/10/00	0730	7.71	12.33		23.19%	84.1°C
11/10/00	1600	7.75	12.32		23.44%	84.0°C
11/13/00	0725	8.16	12.12		26.07%	81.5°C
11/13/00	1340	8.58	11.84		28.62%	78°C
11/14/00	1015	8.27	12.10		26.69%	81.2°C
11/15/00	0800	8.70	12.19		29.37%	82.4°C

(cont on p 56)

10/24/00 JP

1400 hrs The flowrate of water introduced to the system thru the ceramic tube was changed from ~1L/day to 2L/day

10/26/00 JP
0920hr
Controller that provides power to transformer was set from 106° (100°C) to 99°C. This will allow temperature in the adit to decrease by about 5°C

11/1/00 JP
0815hr
Controller that provide pwr to transformer was set to 99°C.
* Disregard above two lines, controller was not changed.
Instead the transformer setting was reduced from 56 to 52.

11/3/00 JP
1240hr
Transformer setting reduced from 52 to 50

11/6/00 JP
Cont from p48
Temperature data is stored in following files

test_3_38.csv (11/3-11/6)
test_3_39.csv (11/6-11/7)
test_3_40.csv (11/7-11/8)
test_3_41.csv (11/8-11/9)
test_3_42.csv (11/9-11/10)
test_3_43.csv (11/10-11/13)
test_3_44.csv (11/13-11/14)
test_3_45.csv (11/14-11/15)
test_3_46.csv (11/15-11/16)
test_3_47.csv (11/16-11/19)
test_3_48.csv (11-19-11/22)
test_3_49.csv (11/22-11/27)
test_3_50.csv (11/27-11/28)
test_3_51.csv (11/28-11/29)
test_3_52.csv (11/29-11/30)
test_3_53.csv (11/30-12/1)
test_3_54.csv (12/1-12/4)
test_3_55.csv (12/4-12/5)
test_3_56.csv (12/5-12/6)
test_3_57.csv (12/6-12/7)
test_3_58.csv (12/7-12/8)
test_3_59.csv (12/8-12/11)
test_3_60.csv (12/11-12/12)
test_3_61.csv (12/12-12/13)
test_3_62.csv (12/13-12/14)
test_3_63.csv (12/14-12/18)
test_3_64.csv (12/18-12/19)
test_3_65.csv (12/19-12/20)
test_3_66.csv (12/20-12/21)
test_3_67.csv (12/21-12/22)
test_3_68.csv (12/22-12/28)
test_3_69.csv (12/28-01/02)
test_3_70.csv (01/02-01/03)
test_3_71.csv (01/3-10/4)
test_3_72.csv (10/4-10/5)
test_3_73.csv (10/5-10/8)
test_3_74.csv (10/8-10/9)
test_3_75.csv (10/9-01/10)
test_3_76.csv (01/10-01/11)
test_3_77.csv (01/11-01/12)
test_3_78.csv (01/12-01/15)
test_3_79.csv (01/15-01/16)
test_3_80.csv (01/16-01/17)
test_3_81.csv (01/17-01/18)
test_3_82.csv (01/18-01/19)
test_3_83.csv (01/19-01/22)
test_3_84.csv (01/22-01/23)
test_3_85.csv (01/23-01/24)
test_3_86.csv (01/24-01/25)
test_3_87.csv (01/25-01/26)
test_3_88.csv (01/26-01/29)
test_3_89.csv (01/29-01/30)
test_3_90.csv (01/30-01/31)
test_3_91.csv (01/31-02/01)
test_3_92.csv (02/01-02/02)
test_3_93.csv (02/02-02/05)
test_3_94.csv (02/05-02/06)
test_3_95.csv (02/06-02/07)
test_3_96.csv (02/07-02/08)
test_3_97.csv (02/08-02/09)
test_3_98.csv (02/09-02/12)
test_3_99.csv (02/12-02/13)
test_3_100.csv (02/13-02/13)
test_3_101.csv (02/14-02/15)
test_3_102.csv (02/15-02/16)

(cont on p 114)

11/6/00 JP
0850 hr
Transformer setting reduced from 50 to 48.

11/7/00 JP
1100 hr
To reduce water vapor loss from the top of the test cell a layer of sponge neoprene was placed over the rock and covered with a layer of 1/2" plexiglass. This created a better seal at the top boundary of the test cell. Fiberglass insulation followed by a layer of 1/2" lexan plastic was then placed on top of the plexiglass layer.

11/8/00 JP
1430 hr
The flowrate of water introduced at the top of the test cell was decreased from 2L/Day to 1L/Day.

11/13 1300 hr JP
An additional layer of sponge neoprene was placed along the top margin of the apparatus to reduce heat and moisture loss. An additional 50 lb sacks of lead beads were placed on top of the cell to create a better seal between the neoprene and top cell margins.

11/15/00 gp

Temperature + Relative Humidity Readings
(continued from p 51)

			mA RH	mA Temp	RH	Temp
	11/16/00	0935	8.80	12.31	30.0%	83.9°C
	11/16/00	1605	8.89	12.27	30.5%	83.4°C gp 11/27/00
MH	11/17/00	0900	8.94	12.19	30.87%	82.4°C
	11/17/00	1705	8.93	12.21	30.81%	82.6°C
	11/19/00	1030	9.01	12.16	31.31%	82.0°C
MH	11/20/00	0900	9.53	12.03	34.86%	80.4°C
	11/20/00	1705	9.43	12.04	33.94%	80.5°C
	11/22/00	0900	10.06	12.01	37.87%	80.1°C
MH 11/22/00	11/22/00	Ø 1705	9.45	12.11	34.06%	81.4°C
	11/27/00	0750	9.94	12.02	37.12%	80.2°C
	11/27/00	1500	10.46	11.79	40.4%	77.4°C
	11/28/00	0745	10.46	11.70	40.4%	76.2°C
	11/29/00	0715	11.44	11.37	46.5%	72.1°C
	11/30/00	0735	11.53	11.28	47.06%	71.0°C
	12/1/00	0805	12.42	11.06	52.6%	68.2°C
	12/4/00	0915	13.02	10.39	56.37%	59.9°C
	12/5/00	0755	12.75	10.98	54.69%	67.2°C
	12/6/00	0800	12.80	11.16	55.00%	69.5°C
	12/7/00	1000	11.46	11.33	46.62%	71.6°C
	12/8/00	0815	11.34	11.18	45.87%	69.7°C
	12/11/00	0830	10.40	11.41	40.00%	71.6°C
	12/12/01	0820	10.75	11.25	42.19%	70.6°C
	12/13/00	0935	10.52	11.35	40.75%	71.9°C
	12/14/00	0745	11.58	11.01	47.37%	67.6°C
	12/18/00	0801	15.50	10.04	71.87%	55.5°C
	12/19/00	0825	17.01	9.72	81.31%	51.5°C
	12/20/00	0800	17.73	9.69	85.81%	51.1°C
	12/21/00	0750	19.40	9.52	96.25%	49.0°C

			mA RH	mA TEMP	RH	Temp
	12/22/00	0800	19.40	9.53	96.25%	49.1°C 01/02/01
MH	12/27/00	0945	18.54	9.50	90.87%	~~49.1°C~~ 43.75°C
MH	12/28/00	0920	17.13	9.96	82.06%	54.5°C
MH	12/29/00	0940	17.76	10.09	82.81%	56.1°C
	01/02/01	0830	15.71	10.21	73.19%	57.6°C
	01/03/01	0745	16.06	10.31	75.37%	58.9°C
	01/04/01	0820	17.95	10.10	87.19%	56.2°C
	01/05/01	0805	18.14	9.82	88.37%	52.7°C
	01/08/01	0735	18.46	9.74	90.37%	51.7°C
	01/09/01	0950	18.56	9.76	91.00%	52°C
	01/10/01	0835	18.40	9.71	90.00%	51.3°C
	01/11/01	1000	17.99	9.80	87.44%	52.5°C
	01/12/01	0830	18.41	9.77	90.06%	52.12°C
	01/15/01	0735	15.31	10.01	70.69%	55.12°C
	01/16/01	0945	17.01	9.93	81.31%	54.12°C
	01/17/01	0945	15.55	9.97	72.19%	54.62°C
	01/18/01	0815	18.55	9.74	90.94%	51.75°C
	01/19/01	0955	19.10	9.68	94.37%	51.0°C
	01/22/01	0725	18.76	9.75	92.25%	51.81°C
	01/23/01	0940	18.77	9.78	92.31%	52.25°C
	01/24/01	0940	18.87	9.73	92.94%	51.62°C
	01/25/01	0720	18.38	9.95	89.88%	54.37°C
	01/26/01	0940	17.98	10.17	87.74%	57.1°C
	01/29/01	0720	18.18	10.13	88.62%	56.62°C
	01/30/01	0945	18.07	10.23	87.94%	57.87°C
	01/31/01	0935	17.76	10.25	86.0%	58.12°C
	02/01/01	0730	18.50	10.16	90.62%	57.0°C
	02/02/01	0730	18.04	10.19	87.75%	57.37°C
	02/05/01	0715	18.11	10.17	88.19%	57.12°C
	02/06/01	0930	16.90	10.49	80.62%	61.12°C
	02/07/01	0935	17.38	10.62	83.62%	62.75°C
	02/08/01	0900	16.54	10.96	78.37%	67.0°C
	02/09/01	0945	15.95	11.10	74.69%	68.75°C
	02/12/01	0715	16.90	11.02	80.62%	67.75°C

(Temp + RH Readings continued on p 112)

12/5/00 JP
1300 hrs

Collection of water equilibrated with the Topapah Spring lower lithophysal rock and water equilibrated with Topapah Spring lower lithophysal rock and spiked with 10 ppm Cl. These water were collected for chemical analyses.

Approximately 125 ml of equilibrated Topapah Spring lower lithophysal water was placed in a 125 ml plastic container and labeled TSEQ.

Approximately 125 ml of equilibrated Topapah Spring lower lithophysal rock water spiked with 10 ppm Cl⁻ was placed in a 125 ml plastic container and labeled TSEQCL.

12/5/00 JP
1330 hrs.

pH of water collected on previous page - TSEQ & TSEQCL

Obj - measure pH of water samples

Equipment & Supplies
- Orion pH electrode
- ATC probe
- Orion pH/mV/ISE meter Model 920A
- plastic sample cups
- Fisher buffer solution
  pH4 (lot 994523-24)
  pH10 (lot 987055-24)
- Corning stirrer
- Mini teflon stir bar.

Procedure
1. Calibrate pH electrode using Orion pH/mV/ISE meter and buffer solutions.
2. Place ~10 ml of sample (TSEQ or TSEQCL) in sample cups with mini stir bar.
3. Measure pH with calibrated pH electrode.
4. Discard pH sample.

Results

Sample	pH
TSEQ	6.88
TSEQCL	6.83

12/5/00 JP
1340 hrs.

Alkalinity of water collected on p58-
TSEQ & TSEQCL

Obj - determine alkalinity of water samples.

Method - titration with standard acid

Equipment + Supplies
- Mettler DZ1 Titrator
- Mettler Toledo DG111-SC pH electrode
- Plastic sample cups
- 0.1 N HCl standard s/w
  Prepared by adding 8.2 ml concentrated HCl to 1L DI water in a 1L Volumetric flask.
- Fisher buffer solution
  pH4 lot (994523-24)
  pH10 lot (987055-24)

Procedure -
① Calibrate pH electrode w/ Fisher buffer solution.

② Transfer 40 ml of water sample (TSEQ or TSEQCL) to plastic sample cups.

(3) Set up Mettler DL21 titrator to perform a p- and/or m- value end point titration using 0.1 N HCl standard acid.

(4) Attach sample cup to automatic titrator and perform titration.

(5) Results of the titration to determine alkalinity are shown on the following pages.

Sample TSEQ

```
=============== METTLER DL21  Titrator  date 05-12 00 ================

TITRATION              1      operator

METHOD              4011        2  04-12 0
WEIGHT g               1
IDENT                  0      remarks

conc mol/L         .10000
const              25.000
START pH            8.125

pH0 pH              7.298
SLOPE mV/pH         -57.4

M-POINT pH          4.300
P-POINT pH          8.200

RESULT mL          .43739

M-VALUE mmol/L
                   1.0935
```

$$\text{Alkalinity} = \frac{\text{ml std acid used} \times \text{normality std acid} \times 50000}{\text{ml sample}} =$$

$$= \frac{.43739 \times 0.1 \times 50000}{40} = 54.67 \text{ mg } CaCO_3/L$$

Sample TSEQCL

========== METTLER DL21 Titrator date 05-12 00 ==========

TITRATION	2	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	6.847	
pH0 pH	7.298	
SLOPE mV/pH	-57.4	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.41404	
M-VALUE mmol/L	1.0351	

Alkalinity = $\frac{.41404 \times .1 \times 50000}{40}$ = 51.75 mg $CaCO_3$/L

12/5/00 JJP
1400 hr.

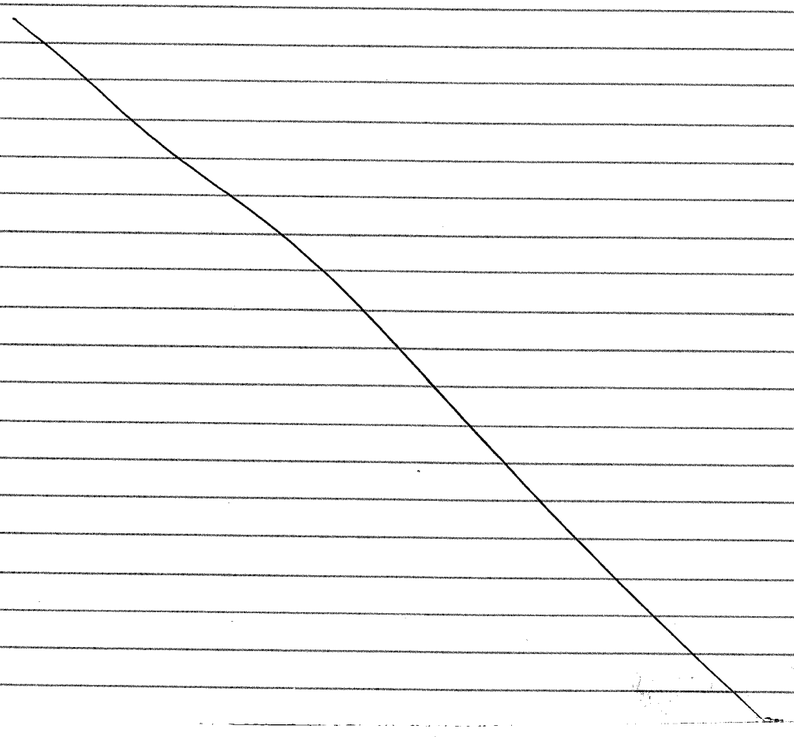
Sample TSEQ and TSEQCL remaining after pH and alkalinity analysis were split into two equal aliquots and placed in 60 ml PP containers. One of the aliquots of each sample was acidified to pH < 2 with conc HNO_3. These acidified samples were labeled TSEQ-A and TSEQCL-A. The unacidified samples kept their original labels of TSEQ and TSEQCL. These samples were refrigerated for later analysis.

12/6/00 JP
1100 hrs.

The ceramic tube that delivers water to the system was repositioned. The tube was lowered about 2 inches into the crushed Tuff.

12/14/00 JP
0830 hrs.

Transformer was set to 30. This will reduce temperature of cartridge heaters and then the temperature in the adit. This was done to try to induce higher humidity and dripping in the adit.



12/19/00 JP 0900hrs

Collection of water from sampling cups.
See p 30-34 to see location of each cup.

Sample cup NO	Approximate amount of water collected	Temp of water collected
1	—	
2	—	
3	—	
4	40 ml	30.7°C
5	40 ml	30.4°C
12	—	
13	—	
14	15 ml	37.2°C
15	20 ml	40.5°C

Water collected were placed in 60 ml PP bottles and labeled as follows.

Sample cup NO	Label
4	S4
5	S5
14	S14
15	S15

12/19/00 gp 0930 hr

The pH of samples collected on previous page were measured using procedure on p 59.

Results

Sample		pH
S4	gp 12/19/00	~~10.75~~ 7.96
S5	gp 12/19/00	~~6.80~~ 8.01
S14	gp 12/19/00	~~7.61~~ 7.80
S15	gp 12/19/00	~~7.53~~ 7.78

12/19/00 gp 1000 hr

The alkalinity of sample S5 was determined using procedure on p 61

Results are shown below

========== METTLER DL21 Titrator date 19-12 00 ====

TITRATION	2	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	Sample S5
const	25.000	
START pH	7.856	
pH0 pH	7.281	
SLOPE mV/pH	-57.4	40 ml sample volume
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.85573	
M-VALUE mmol/L	2.1393	

Alkalinity = $\frac{.85573 \times .1 \times 50000}{40}$ = 106.97 mg $CaCO_3$/L

12/19/00 JP 1100 hrs.

After pH and alkalinity measurements samples S4, S5, S14, and S15 were split into two equal aliquots and placed in 30 ml PP bottles. One aliquot of each sample was acidified to pH < 2 with HNO_3. These acidified samples were labeled as follows:

S4-A
S5-A
S14-A
S15-A

The unacidified samples kept their original labels. All samples were refrigerated for later analysis.

12/19/00 gp 0330 hr

The following set of pictures show the progress of the wetty front in the lab scale Leach test. Digital images were taken of the front of the apparatus with the insulation removed to show the boundary of the wetty front with respect to the side. Pictures were taken on 12/5/00, 12/13/00, & 12/19/00.

Picture taken on 12/5/00 at 0900 hr

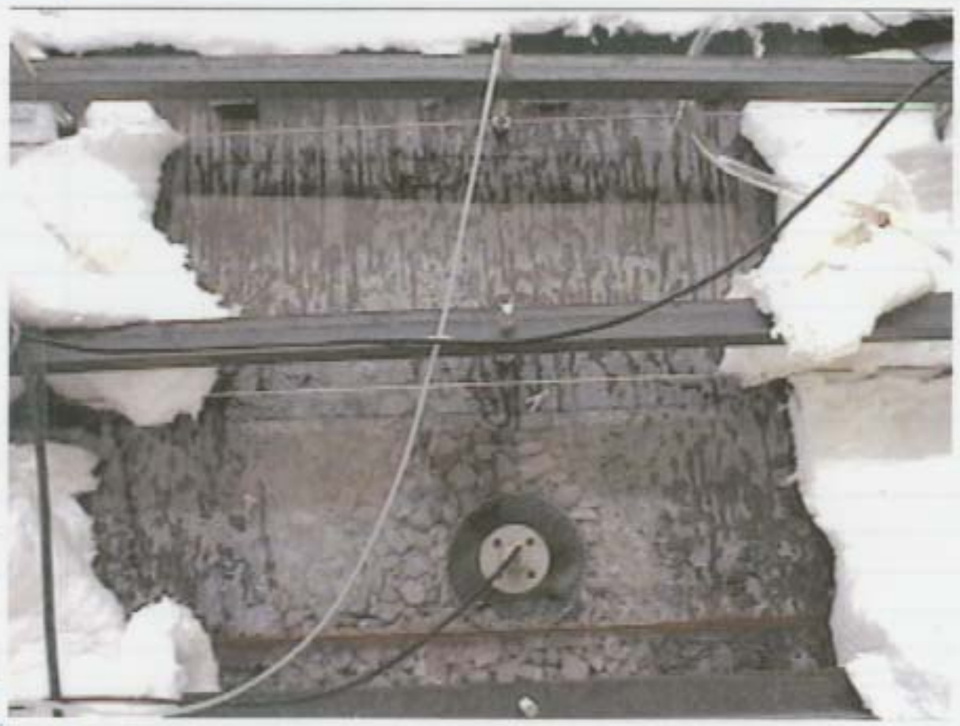
Picture taken on 12/5/00 at 0900 hr.

Picture taken on 12/13/00 at 1115 hrs

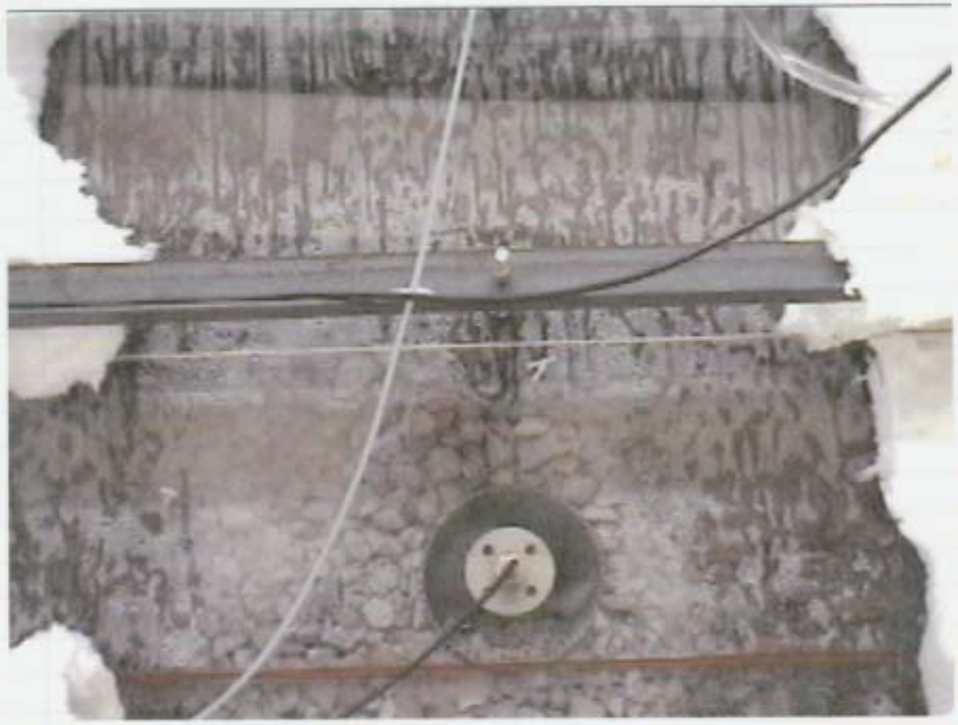
Picture taken on 12/13/00 at 1115 hrs.

~~@~~ 12/19/00 1515 hr

Picture taken on 12/19/00 at ~~0300~~ 1500 hr.



Picture taken on 12/19/00 at 1500 hr.



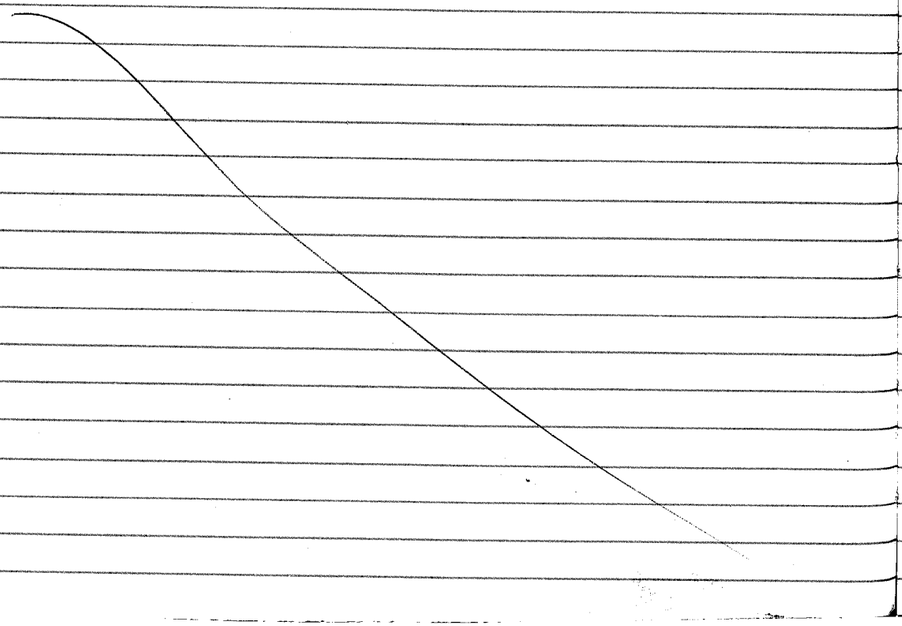
12/21/00 JP 0835hr.

Collection of water samples for alkalinity analyses

Sample Cup No	Approximate amount collected	Temp
4	40 ml	30.7°C
5	40 ml	30.3°C
14	15 ml	34.63°C
15	10 ml	40.36°C

Waters were placed in 60ml PP bottles and labeled as follows.

S4A Sample cup 4
S5A " 5
S14A " 14
S15A " 15



12/21/00 JP 0845hr

Alkalinity of samples collected on previous page were determined using procedure on p61.

Results are shown below

```
================ METTLER DL21  Titrator  date 21-12 00 ====

TITRATION                1     operator

METHOD                4011        2  04-12 0
WEIGHT g                 1
IDENT                    0     remarks

conc mol/L          .10000
const               26.700
START pH            8.110

pH0 pH              7.252
SLOPE mV/pH         -57.5

M-POINT pH          4.300
P-POINT pH          8.200

RESULT mL           .85649

M-VALUE mmol/L
                    2.2868
```

Sample S4

37.5 ml sample volume

Alkalinity = $\frac{.85649 \times .1 \times 50000}{37.5}$ = 114.20 mg $CaCO_3$/L

========== METTLER DL21 Titrator date 21-12 00 ======

TITRATION	2	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	7.810	Sample S5
pH0 pH	7.252	
SLOPE mV/pH	-57.5	40ml sample volume
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.80847	
M-VALUE mmol/L	2.0212	

Alkalinity = $\frac{.80847 \times .1 \times 50000}{40}$ = 101.06 mg $CaCO_3$/L

========== METTLER DL21 Titrator date 21-12 00 ==

TITRATION	3	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	66.700	Sample S14
START pH	7.607	
pH0 pH	7.252	
SLOPE mV/pH	-57.5	15ml sample volume
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.20949	
M-VALUE mmol/L	1.3973	

Alkalinity = $\frac{.20949 \times .1 \times 50000}{15}$ = 69.83 mg $CaCO_3$/L

1/8/01 JP 0905hr

Collection of water samples for pH and alkalinity analyses. And chemical analysis

Sample Cup No. at label	Approximate amount	Temp °C
S2B	60 ml	24.83°C
S4B	50 ml	31.13°C
S5B	50 ml	30.86°C
S12B	3 ml	39.85°C
S14B	25ml	37.5°C
S15B	10ml	44.9°C

1/8/01 JP 0930hr

The pH of samples collected on previous page were measured via procedure on p59.

Results.

Sample	pH
S2B	7.60
S4B	8.06
S5B	8.08
S14B	8.16
S15B	8.17

1/8/01 JP 1000hr.

Alkalinity of samples on previous page were measured by procedure on p 61.

Results:

========== METTLER DL21 Titrator date 08-01-01 ===

TITRATION	1	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	S2B
const	25.000	
START pH	6.922	
pH0 pH	7.259	40 ml sample volume
SLOPE mV/pH	-57.6	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.86801	
M-VALUE mmol/L	2.1700	

Alkalinity = $\frac{.86801 \times .1 \times 50000}{40}$ = 108.5 mg $CaCO_3$/L

========== METTLER DL21 Titrator date 08-01-01 ===

TITRATION	2	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	S4B
const	33.300	
START pH	7.463	
pH0 pH	7.259	30 ml sample volume
SLOPE mV/pH	-57.6	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.46869	
M-VALUE mmol/L	1.5607	

Alkalinity = $\frac{.46869 \times .1 \times 50000}{30}$ = 78.115 mg $CaCO_3$/L

========== METTLER DL21 Titrator date 08-01-01 =======

TITRATION	3	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	50.000	
START pH	7.038	
pHØ pH	7.259	
SLOPE mV/pH	-57.6	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.33804	
M-VALUE mmol/L	1.6902	

SBS

20ml Sample Volume

Alkalinity = $\frac{.33804 \times .1 \times 50000}{20}$ = 84.51 mg $CaCO_3/L$

========== METTLER DL21 Titrator date 08-01-01 =======

TITRATION	4	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	50.000	
START pH	7.694	
pHØ pH	7.259	
SLOPE mV/pH	-57.6	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.30800	
M-VALUE mmol/L	1.5400	

514B

20ml Sample Volume

Alkalinity = $\frac{.30800 \times .1 \times 50000}{20}$ = 77.0 mg $CaCO_3/L$

1/8/01 gp 1115hr.

After pH and alkalinity measurements samples S2B, S4B, S5B, and S14B were split into two equal aliquots and placed in 30 ml PP bottles. One aliquot of each sample was acidified to pH<2 with HNO_3. These acidified samples were labeled as follows.

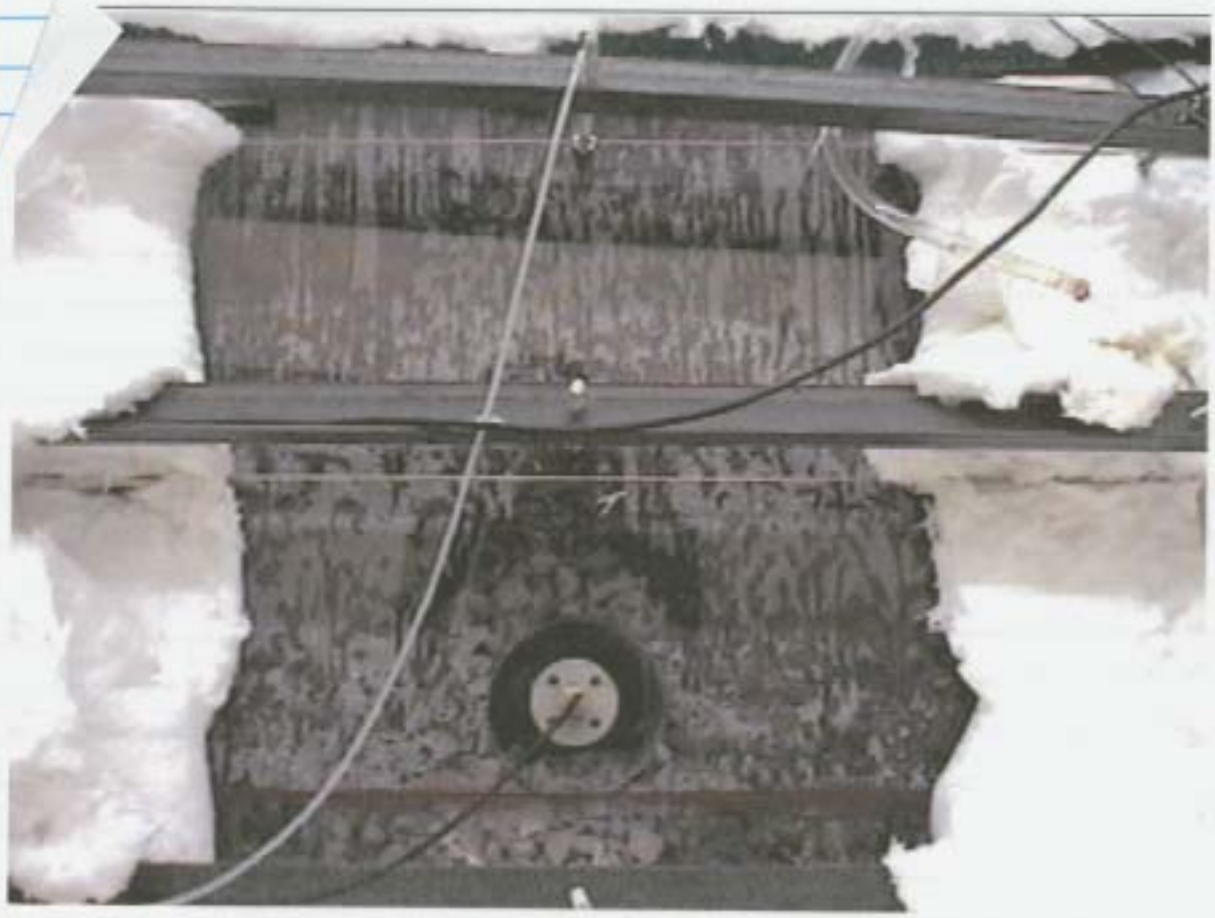
S2B-A
S4B-A
S5B-A
gp 1/8/01 S14B-A ~~S15B-A~~

The acidified samples kept their sample labels. Samples were then refrigerated for later analysis.

1/8/01 gp 1130hr.

Additional picture showing progression of wetting front in the 1-D scale Infiltrometer test.

Picture taken at 3:00pm on 1/5/01



Picture taken at 3:00pm on 1/5/01

1/24/01 JP 1000 hr.

Collection of water samples for chemical analysis.

Sample Cup No or label	Approximate amount	Temp °C
S2C	40 ml	25.2°C
S4C	50 ml	31.1°C
S5C	50 ml	31.1°C
S12C	15 ml	39.0°C
S14C	25 ml	37.3°C
S15C	15 ml	43.6°C

1/24/01 @ 1030hr.

The pH of solution collected in previous page was measured using procedure on p 59.

Results

Sample	pH
S2C	8.02
S4C	8.23
S5C	8.38
S12C	8.52
S14C	8.47
S15C	8.50

1/24/01 @ 1045hr.

Alkalinity of samples on previous page were determined using procedure on p 61.

Results

========== METTLER DL21 Titrator date 24-01-01 ====

TITRATION	1	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	7.781	S2C
pH0 pH	7.310	40ml sample volume
SLOPE mV/pH	-57.3	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.89897	
M-VALUE mmol/L	2.2474	

Alkalinity = $\frac{.89897 \times .1 \times 50000}{40}$ = 112.37 mg $CaCO_3$ /L

========== METTLER DL21 Titrator date 24-01-01 ========

TITRATION	2	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	7.445	
pHØ pH	7.310	
SLOPE mV/pH	-57.3	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.51222	
M-VALUE mmol/L	1.2806	

S4C

40 ml Sample Volume

$$\text{Alkalinity} = \frac{.51222 \times .1 \times 50000}{40} = 64.03 \text{ mg } CaCO_3/L$$

========== METTLER DL21 Titrator date 24-01-01 ===

TITRATION	3	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	50.000	
START pH	7.567	
pHØ pH	7.310	
SLOPE mV/pH	-57.3	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.34466	
M-VALUE mmol/L	1.7233	

S5C

20 ml Sample Volume

$$\text{Alkalinity} = \frac{.34466 \times .1 \times 50000}{20} = 86.16 \text{ mg } CaCO_3/L$$

========== METTLER DL21 Titrator date 24-01-01 =====

TITRATION	4	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	50.000	S14C
START pH	7.669	
pH0 pH	7.310	20 ml sample volume
SLOPE mV/pH	-57.3	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.30302	
M-VALUE mmol/L	1.5151	

Alkalty = $\frac{.30302 \times .1 \times 50000}{20}$ = 75.75 mg $CaCO_3$/L

01/24/01 JP 1130h.

After pH & alkalinity measurements samples were split into two equal aliquots & placed in 30 ml PP bottles. One aliquot of each sample was acidified to pH < 2 with conc HNO_3 (10 µl). These acidified samples were labeled as follows.

S2C-A
S4C-A
S5C-A
S12C-A
S14C-A
S15C-A

The unacidified samples kept the original sample label. Samples were then refrigerated for later analysis

01/24/01 gp 1300 hrs.

Variable transformer was changed from a setty of 33 to a setty of 38. Flowrate of Dated introduced to the top of the apparatus was also increased to 3L/day.

01/25/01 gp 0730 hrs

Variable transformer was changed from a setty of 38 to a setty of 40.

01/25/01 gp

Water samples of equilibrated Topapah Spring tuff were split into several aliquots. These samples were labeled TSEQ, TSEQ-A, TSEQCL and TSEQCL-A (see p 65). Each sample was split into 3 approximate equal aliquots and relabeled as shown below.

Original label	New labels
TSEQ	EQ1
	EQ2
	EQ3
TSEQ-A	EQ1-A
	EQ2-A
	EQ3-A
TSEQCL	EQ4
	EQ5
	EQ6
TSEQCL-A	EQ4-A
	EQ5-A
	EQ6-A

01/26/01 [initials] 1000 hr.

Water samples were sent to Div 01 for chemical analysis. Analysis of major and minor cations will be done by ICP and anion analysis will be done by ion chromatography.

The sample list/chain of custody for the samples are shown on the following pages.

SAMPLE LIST/CHAIN OF CUSTODY

Southwest Research Institute
Chemistry and Chemical Engineering Division
6220 Culebra Road
San Antonio, Texas 78238-5166

Client Name/Address: Jim Prikryl, CNWRA / Div 20, Bldg 57

Requested Turnaround:
- ☐ 1 Week
- ☒ 2 Weeks (Normal)
- ☐ 3 Weeks
- ☐ Other:

Client Purchase Order/Other ID:
Site/Zone ID:
SwRI Contact:

Analyses Requested

Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time (mm/dd/yy)	Matrix Type	Sample Type	# of Containers	ICP of major and minor elements - include Si + Pb
S4B-A	1/8/01		W	DM	1	X
S5B-A	1/8/01				1	X
S14B-A	1/8/01				1	X
S2B-A	1/8/01				1	X
S4-A	12/19/00				1	X
S5-A	12/19/00				1	X
S14-A	12/19/00				1	X
S15-A	12/19/00				1	X
S2C-A	1/24/01				1	X
S4C-A	1/24/01				1	X

REMARKS

Preservation
- a = HCl to pH <2
- b = HNO_3 to pH <2 (circled)
- c = H_2SO_4 to pH <2
- d = NaOH to pH >12
- e = Other (Specify)

Project is nuclear safety related
10 CFR 50 Part 21
Appendix B

Questions contact
Jim Prikryl x5667

Matrix Types: **A** - Air; **P** - Product; **S** - Soil; **T** - Tissue; **W** - Water

Sample Types: **DM** - Dissolved Metals; **ER** - Equipment Rinsate; **FB** - Field Blank; **MSD** - Matrix Spike Duplicate; **MS** - Matrix Spike; **TB** - Trip Blank; **TM** - Total Metals; **ES** - Environmental Samples; **FD** - Field Duplicate

Relinquished by Sampler (Signature): James D. Prikryl [signature]
Received by (Signature): Bradley Werling [signature]

Relinquished by (Signature):
Received by (Signature):
Relinquished by (Signature):
Comments:

SwRI Project No.: 20.01402.861
Received by SwRI Lab (Signature): [signature]
Samples Disposed by:
Date/Time: 01/26/01 08:50

Page ____ of ____

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

SAMPLE LIST/CHAIN OF CUSTODY

Southwest Research Institute
Chemistry and Chemical Engineering Division
6220 Culebra Road
San Antonio, Texas 78238-5166

Client Name/Address: Jim Prikryl, CNWRA / Div 20, Bldg 57

Requested Turnaround: ☐ 1 Week ☒ 2 Weeks (Normal) ☐ 3 Weeks ☐ Other: ____

Client Purchase Order/Other ID: | Site/Zone ID: | SwRI Contact:

Analyses Requested

Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time (mm/dd/yy)	Matrix Type	Sample Type	# of Containers	Analysis of major + minor elements by ICP (include Si + Al)
S5C-A	1/24/01		W	DM	1	X
S12C-A	1/24/01		W	DM	1	X
S14C-A	1/24/01		W	DM	1	X
S15C-A	1/24/01		W	DM	1	X
EQ1-A	12/5/00		W	DM	1	X
EQ2-A	12/5/00		W	DM	1	X
EQ3-A	12/5/00		W	DM	1	X
EQ4-A	12/5/00		W	DM	1	X
EQ5-A	12/5/00		W	DM	1	X
EQ6-A	12/5/00		W	DM	1	X

REMARKS

Preservation
~~a = HCl to pH <2~~
(b = HNO_3 to pH <2) (circled)
c = H_2SO_4 to pH <2
d = NaOH to pH >12
e = Other (Specify)

Project is nuclear safety related 10 CFR 50 Part 21 Appendix B

Questions contact Jim Prikryl x5667

Matrix Types: A - Air; P - Product; S - Soil; T - Tissue; W - Water

Sample Types: DM - Dissolved Metals; ER - Equipment Rinsate; FB - Field Blank; MSD - Matrix Spike Duplicate; MS - Matrix Spike; TB - Trip Blank; TM - Total Metals; ES - Environmental Samples; FD - Field Duplicate

Relinquished by Sampler (Signature): James D. Prikryl
Received by (Signature): Bradley Werling
Relinquished by (Signature):
Received by (Signature):
Relinquished by (Signature):
Comments:

SwRI Project No. 20-01402-361
Received by SwRI Lab (Signature): [signature]
Samples Disposed by:
Date/Time: 01/24/01 08:52

Page ____ of ____

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

SAMPLE LIST/CHAIN OF CUSTODY

Southwest Research Institute
Chemistry and Chemical Engineering Division
6220 Culebra Road
San Antonio, Texas 78238-5166

Client Name/Address: Jim Prikryl, CNWRA / Div 20, Bldg 57

Requested Turnaround: ☐ 1 Week ☒ 2 Weeks (Normal) ☐ 3 Weeks ☐ Other: ____

Client Purchase Order/Other ID: | Site/Zone ID: | SwRI Contact:

Analyses Requested

Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time (mm/dd/yy)	Matrix Type	Sample Type	# of Containers	Analysis of anions by ion chromatography (Cl, Br, SO4, NO3, etc.)
~~S4B~~	1/8/01		W	DM	1	X
~~S5B~~	1/8/01		W	DM	1	X
~~S14B~~	1/8/01		W	DM	1	X
~~S2B~~	1/8/01		W	DM	1	X
S4	12/19/00		W	DM	1	X
S5	12/19/00		W	DM	1	X
S14	12/19/00		W	DM	1	X
S15	12/19/00		W	DM	1	X
S2C	1/24/01		W	DM	1	X
S4C	1/24/01		W	DM	1	X

REMARKS

Preservation
a = HCl to pH <2
b = HNO_3 to pH <2
c = H_2SO_4 to pH <2
d = NaOH to pH >12
e = Other (Specify)

Project is nuclear safety related 10 CFR 50 Part 21 Appendix B

Questions POC Jim Prikryl x5667

Matrix Types: A - Air; P - Product; S - Soil; T - Tissue; W - Water

Sample Types: DM - Dissolved Metals; ER - Equipment Rinsate; FB - Field Blank; MSD - Matrix Spike Duplicate; MS - Matrix Spike; TB - Trip Blank; TM - Total Metals; ES - Environmental Samples; FD - Field Duplicate

Relinquished by Sampler (Signature): James D. Prikryl
Received by (Signature): Bradley Werling
Relinquished by (Signature):
Received by (Signature):
Relinquished by (Signature):
Comments:

SwRI Project No. 20-01402-361
Received by SwRI Lab (Signature): [signature]
Samples Disposed by:
Date/Time: 01/24/01 08:50

Page ____ of ____

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

SAMPLE LIST/CHAIN OF CUSTODY

Client Name/Address: Jim Pinkerton / CNWRA / Div 20 / Bldg 57

Client Purchase Order/Other ID:

Site/Zone ID:

Analyses Requested

Requested Turnaround: ☐ 1 Week ☒ 2 Weeks (Normal) ☐ 3 Weeks ☐ Other:

SwRI Contact:

Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time (mm/dd/yy)	Matrix Type	Sample Type	# of Containers	Analysis of anions by ion chromatography	REMARKS Preservation a = HCl to pH <2 b = HNO_3 to pH <2 c = H_2SO_4 to pH <2 d = NaOH to pH >12 e = Other (Specify)
S5C	12/4/01		W	DM	1	X	Purged + pumped sampled collected
S12C	12/4/01		W		1	X	
S14C	12/4/01				1	X	
S15C	12/4/01				1	X	
EQ1	12/4/01				1	X	
EQ2	12/4/01				1	X	
EQ3	12/4/01				1	X	
EQ4	12/4/01				1	X	
EQ5	12/4/01				1	X	
EQ6	12/5/01				1	X	

Matrix Types: **A** - Air; **P** - Product; **S** - Soil; **T** - Tissue; **W** - Water

Sample Types: **DM** - Dissolved Metals; **ER** - Equipment Rinsate; **FB** - Field Blank; **MSD** - Matrix Spike Duplicate; **MS** - Matrix Spike; **TB** - Trip Blank; **TM** - Total Metals; **ES** - Environmental Samples; **FD** - Field Duplicate

Relinquished by (Signature): [signature] — Received by (Signature): [signature]

Relinquished by (Signature): [signature] — Received by (Signature): [signature]

Comments: Page ___ of ___

Div 01 COC Form 01-07-001, Rev 1/97

2/5/01 JP 0815hr

Collected another set of water samples for chemical analysis

Sample Cup No Label	Appropriate amount	Temp °C
S2D	60	25.5°C
S4D	50	33.7°C
S5D	45	32.7°C
S12D	20	42.3°C
S14D	25	40.2°C
S15D	15	46.5°C

2/5/01 JP 0830hr

The pH of solutions collected above were measured using procedure on p 59.

Results

Sample	pH
S2D	8.22
S4D	8.26
S5D	8.41
S12D	8.60
S14D	8.36
S15D	8.58

2/5/01 JP 0900hr.

Alkalinity of samples collected on previous page were measured using procedure on p 61.

Results -

========== METTLER DL21 Titrator date 05-02-01 ==========

TITRATION	1	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	52D
START pH	8.039	
pH0 pH	7.023	40ml sample volume
SLOPE mV/pH	-57.6	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.77568	
M-VALUE mmol/L	1.9392	

Alkalinity = $\frac{.77568 \times .1 \times 50000}{40}$ = 96.96 mg $CaCO_3$/L

========== METTLER DL21 Titrator date 05-02-01 ==========

TITRATION	2	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	50.000	54D
START pH	7.567	
pH0 pH	7.023	
SLOPE mV/pH	-57.6	20 ml sample volume
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.22100	
M-VALUE mmol/L	1.1050	

Alkalinity = $\frac{.22100 \times .1 \times 50000}{20}$ = 55.25 mg $CaCO_3$/L

========== METTLER DL21 Titrator date 05-02-01 ==========

TITRATION	3	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	40.000	SSD
START pH	7.902	
pH0 pH	7.023	25 ml
SLOPE mV/pH	-57.6	Syple Volume
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.41396	
M-VALUE mmol/L	1.6559	

$\text{Alkalinity} = \frac{.41396 \times .1 \times 50000}{25} = 82.74 \text{ mg } CaCO_3/L$

========== METTLER DL21 Titrator date 05-02-01 ==========

TITRATION	4	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	40.000	SIHD
START pH	8.082	
pH0 pH	7.023	20 ml
SLOPE mV/pH	-57.6	Syple Volume
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.27774	
M-VALUE mmol/L	1.1110	

$\text{Alkalinity} = \frac{.27774 \times .1 \times 50000}{20} = 69.435 \text{ mg } CaCO_3/L$

2/5/01 JP 0930hr.

After pH & alkalinity measurements samples were split into 2 aliquots & placed in 30 ml PP bottles. One aliquot were acidified with HNO_3 (10 ml) These acidified samples were labeled as follows.

S2D-A
S4D-A
S5D-A
S12D-A
S14D-A
S15D-A

The unacidified samples kept their original labels. Samples were refrigerated for later analysis.

2/5/01 JP 1000hr.

Variable transformer was changed from a setting to 40 to a setting of 44.

2/6/01 JP 0930 hr.

Variable Transformer was changed from a setting of 44 to a setting of 48.

2/7/01 JP 0930hr.

Variable transformer was changed from setting of 48 to 50.

Temperature and Relative Humidity Readings

(cont. from p 57)

Date/Time		mA RH	Temp	RH	Temp
02/13	0730	17.83	10.92	86.44%	66.5°C
02/14	1350	17.86	10.94	86.62%	66.7°C
02/15	0940	18.31	10.83	89.44%	65.4°C
02/16	0945	18.16	10.81	88.5%	65.1°C
02/20	0855	16.09	11.11	75.6%	68.9°C
02/21	0940	14.75	11.28	67.2%	71.0°C
02/22	0715	14.14	11.45	63.4%	73.1°C
02/23	1010	14.03	11.45	62.7%	73.1°C
02/24	0740	13.04	11.79	56.5%	77.3°C
02/27	0730	14.22	11.65	63.9%	75.6°C
02/28	0940	14.94	11.58	68.4%	74.75°C
03/01	0820	15.99	11.21	74.94%	70.1°C
03/02	0920	16.06	11.27	75.4%	70.9°C
03/05	0725	13.77	11.78	61.06%	77.2°C
03/06	0940	17.98	11.00	81.4%	67.5°C
03/07	0950	17.45	11.27	84.1%	70.9°C
03/08	0750	18.22	11.24	88.9%	70.5°C
03/09	1000	18.56	11.11	91.0%	68.9°C
03/12	0740	18.41	11.12	90.1%	69.0°C
03/13	0740	18.32	11.10	89.5%	68.7°C
03/14	0740	17.15	11.24	82.2%	70.5°C
03/15	0745	18.63	11.03	91.4%	67.9°C
3/16	0745	17.05	11.29	81.6%	71.1°C
3/19	0750	15.80	11.37	73.7%	72.1°C
3/20	1020	16.30	11.22	80.0%	70.2°C
3/21	1010	17.40	11.20	83.7%	70.0°C
3/22	0940	14.25	11.73	76.6%	74.0°C
3/23	0935	14.08	11.88	75.5%	78.5°C
3/26	0715	17.72	11.70	85.7%	76.2°C
3/27	0745	17.90	11.78	86.9%	77.2°C
3/28	0940	18.24	11.82	89.0%	77.7°C
3/29	0735	18.27	11.96	89.7%	78.2°C

Date/Time		mA RH	Temp	RH	Temp
3/30		18.54	11.89	90.9%	78.6°C
4/2		15.19	12.38	69.9%	84.7°C
4/3	0955	~~14.16~~ 9/443	12.57	63.5%	87.1°C
4/4	0945	13.82	12.60	61.4%	87.5°C
4/5	0720	13.05	12.81	56.6%	90.1°C
4/6	0945	13.46	12.42	59.1%	85.2°C
4/9	0705	14.02	12.38	62.6%	84.7°C
4/10	0940	13.92	12.49	62.0%	86.1°C
4/11	0945	13.75	12.46	60.9%	85.7°C
4/12	0725	13.54	12.56	59.6%	87.0°C
4/13	0745	12.29	13.06	51.8%	93.2°C
4/16	1740	7.84	14.63	24.0%	112.8°C
4/17	1415	7.87	14.57	24.2%	112.1°C
4/18	1815	10.36	13.56	39.7%	99.5°C
4/19	1340	10.16	13.72	38.5%	101.5°C
4/20	1435	7.62	14.64	22.6%	113.0°C
4/23	1700	6.87	15.13	17.9%	119.1°C
4/24	0730	8.95	13.00	30.9%	92.5°C
4/25	1400	10.47	11.57	40.4%	74.6°C
4/26	1140	11.06	11.10	44.1%	68.7°C
4/27	0745	10.95	10.87	43.4%	65.8°C
4/27	1545	15.76	10.25	73.5%	58.1°C
4/30	1645	18.33	10.15	89.6%	56.9°C
5/1	1640	18.97	10.12	93.4%	56.5°C
5/2	1620	18.80	10.68	92.5%	63.5°C
5/3	0740	17.68	11.09	85.5%	68.6°C
5/4	1515	17.28	11.26	83.0%	70.7°C
5/7	1005	15.70	12.00	70.0%	80.0°C
5/8	0655	14.61	12.28	66.3%	83.5°C
5/9	1400	11.61	12.83	47.5%	90.4°C
5/10	1500	13.40	12.56	61.9%	87.0°C
5/11	1500	14.33	12.51	64.6%	86.4°C
5/14	0715	10.74	13.58	42.1%	99.8°C
5/15	0725	9.40	13.88	5/14 3433.8%	103.5°C
5/16	0715	7.96	14.79	24.7%	114.9°C
5/17	0750	8.68	13.79	29.2%	102.4°C

Readings cont on p 138

2/19/01 JP
Cont. from p 53
Temperature data is stored in following files.

test_3_103.csv (2/16-2/19)
test_3_104.csv (02/19-02/20)
test_3_105.csv (02/20-02/21)
test_3_106.csv (02/21-02/22)
test_3_107.csv (2/22-02/23)
test_3_108.csv (02/23-02/26)
test_3_109.csv (02/26-02/27)
test_3_110.csv (02/27-02/28)
test_3_111.csv (02/28-03/01)
test_3_112.csv (03/01-03/02)
test_3_113.csv (03/02-03/05)
test_3_114.csv (03/05-03/06)
test_3_115.csv (03/06-03/07)
test_3_116.csv (03/07-03/08)
test_3_117.csv (03/08-03/09)
test_3_118.csv (03/09-03/12)
test_3_119.csv (03/12-03/13)
test_3_120.csv (03/14-03/15) ~~(03/13-03/14)~~ JP 3/15/01
test_3_121.csv (03/15-03/16)
test_3_122.csv (03/16-03/19)
test_3_123.csv (03/19-03/20)
test_3_124.csv (03/20-03/21)
test_3_125.csv (03/21-03/22)
test_3_126.csv (03/22-03/23)
test_3_127.csv (03/23-03/26)
test_3_128.csv (03/26-03/27)
test_3_129.csv (03/27-03/28)
test_3_130.csv (03/28-03/29)
test_3_131.csv (03/29-03/30)
test_3_132.csv (03/30-4/2)
test_3_133.csv (4/2-4/3)
test_3_134.csv (4/3-4/4)
test_3_135.csv (4/4-4/5)
test_3_136.csv (4/5-4/6)
test_3_137.csv (4/6-4/9)
test_3_138.csv (4/9-4/10)
test_3_139.csv (4/10-4/11)
test_3_140.csv (4/11-4/12)
test_3_141.csv (4/12-4/13)
test_3_142.csv (4/13-4/16)
test_3_143.csv (4/16-4/17)
test_3_144.csv (4/17-4/18)
test_3_145.csv (4/18-4/19)
test_3_146.csv (4/19-4/20)
test_3_147.csv (4/20-4/23)
test_3_148.csv (4/23-4/24)
test_3_149.csv (4/24-4/25)
test_3_150.csv (4/25-4/26)
test_3_151.csv (4/26-4/27)
test_3_152.csv (4/27-4/30)
test_3_153.csv (4/30-5/1)
test_3_154.csv (5/1-5/2)
test_3_155.csv (5/2-5/3)
test_3_156.csv (5/3-5/4)
test_3_157.csv (5/4-5/7)
test_3_158.csv (5/7-5/8)
test_3_159.csv (5/8-5/9)
test_3_160.csv (5/9-5/10)
test_3_161.csv (5/10-5/11)
test_3_162.csv (5/11-5/14)
test_3_163.csv (5/14-5/15)
test_3_164.csv (5/15-5/16)
test_3_165.csv (5/16-5/17)
test_3_166.csv (5/17-5/18)
test_3_167.csv (5/18-5/21)
Temp data cont on p

3/1/01 JP 0930 hr.

Collected another set of water samples for chemical analysis.

Sample Cup No Label	Appropriate Amount	Temp °C
S1E	60	25.6
S2E	60	25.2
S4E	10	37.4
S5E	25	35.2
S14E	20	45.1

3/1/01 JP 0950 hr.

The pH of solution collected above were measured using procedure on p59

Sample	pH
S1E	8.41
S2E	8.24
S4E	7.98
S5E	8.25
S14E	8.54

3/1/01 JP 1015hr.

Alkalinity of samples collected on previous page were analyzed using procedure on p 61.

Results:

========== METTLER DL21 Titrator date 01-03-01 ========

TITRATION	1	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	8.481	S1E
pH0 pH	6.980	
SLOPE mV/pH	-57.0	40ml sample volume
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.05857	
P-VALUE mmol/L	.14642	
RESULT mL	1.1080	
M-VALUE mmol/L	2.7701	

Carbonate Alkalinity $= 2\left(\frac{.05857 \times .1 \times 50000}{40}\right) = 14.64$ mg $CaCO_3/L$

Bicarbonate conc $= \left(\frac{1.16457 \times .1 \times 50000}{40}\right) - 14.64 = 131.18$ mg $CaCO_3/L$

========== METTLER DL21 Titrator date 01-03-01 ========

TITRATION	2	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	7.714	S2E
pH0 pH	6.980	40ml sample volume
SLOPE mV/pH	-57.0	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.65936	
M-VALUE mmol/L	1.6484	

Alkalinity $= \frac{.65936 \times .1 \times 50000}{2540} = 82.42 \times 1.59 = 131.07$ mg $CaCO_3/L$

JP 3/1/01

JP 3/1/01

========== METTLER DL21 Titrator date 01-03-01 ==========

TITRATION 3 operator

METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	50.000	
START pH	7.852	SSE
pHØ pH	6.980	20ml
SLOPE mV/pH	-57.0	Sample
M-POINT pH	4.300	Vol
P-POINT pH	8.200	
RESULT mL	.22501	
M-VALUE mmol/L	1.1250	

Alkalinity = $\frac{.22501 \times .1 \times 50000}{20}$ = 56.25 mg $CaCO_3$/L

========== METTLER DL21 Titrator date 01-03-01 ==========

TITRATION 4 operator

METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	66.670	
START pH	8.092	S14E
pHØ pH	6.980	15ml
SLOPE mV/pH	-57.0	Sample
M-POINT pH	4.300	Volume
P-POINT pH	8.200	
RESULT mL	.25970	
M-VALUE mmol/L	1.7314	

Alkalinity = $\frac{.25970 \times .1 \times 50000}{15}$ = 86.57 mg $CaCO_3$/L

3/1/01 JP 1100 hr.

After pH & alkalinity parameter sample were split into 2 aliquots and placed in 30 ml PP bottles. One aliquot was acidified with HNO_3 (10 µl). These acidified samples were labeled as follows.

S1E-A
S2E-A
S4E-A
S5E-A
S14E-A

The unacidified samples kept their original labels. Samples were refrigerated for later analysis.

03/01/01 JP 1135 hr.

Variable Transformer was changed from 50 to 52.

03/02/01 JP 0930 hr

Variable Transformer was changed from 52 to 55

03/09/01 JP 1400hr.
Results of DIV 01 Chemical analyses

Results of chemical analyses of water samples sent to Div 01 (see p 100-104)

ICP analyses of major and minor cations

All sample results are in mg/L

Sample label	Description or Location	Date collected	Solution temp C	Aluminum	Antimony	Arsenic	Barium	Beryllium	Bismuth	Boron	Cadmium	Calcium
EQ1-A	Equilibrated with Topapah Spring lower	12/5/2000		<0.05	<0.015	<0.01	0.005	<0.005	<0.01	<0.05	<0.005	8.96
EQ2-A	lithophysal unit	12/5/2000		<0.05	<0.015	<0.01	<0.005	<0.005	<0.01	<0.05	<0.005	8.96
EQ3-A		12/5/2000		<0.05	<0.015	<0.01	0.005	<0.005	<0.01	<0.05	<0.005	8.96
EQ4-A	Equilibrated with Topapah Spring lower	12/5/2000		<0.05	<0.015	<0.01	0.042	<0.005	<0.01	<0.05	<0.005	7.92
EQ4-A	lithophysal unit and spiked with 10 ppm Cl	12/5/2000		<0.05	<0.015	<0.01	0.042	<0.005	<0.01	<0.05	<0.005	7.90
EQ5-A		12/5/2000		<0.05	<0.015	<0.01	0.043	<0.005	<0.01	<0.05	<0.005	8.04
EQ6-A		12/5/2000		<0.05	<0.015	<0.01	0.043	<0.005	<0.01	<0.05	<0.005	8.00
S2B -A	Below center of drift	1/8/2001	24.8	<0.1	<0.03	<0.02	0.036	<0.01	<0.02	0.295	<0.01	31.9
S2C -A		1/24/2001	25.2	<0.1	<0.03	<0.02	0.027	<0.01	<0.02	0.141	<0.01	21.9
S4 -A	Adjacent to center of drift	12/19/2000	30.7	<0.1	<0.03	<0.02	0.029	<0.01	<0.02	0.317	<0.01	36.4
S4B -A		1/8/2001	31.1	<0.1	<0.03	<0.02	<0.01	<0.01	<0.02	0.145	<0.01	10.6
S4C -A		1/24/2001	31.1	<0.1	<0.03	<0.02	<0.01	<0.01	<0.02	0.114	<0.01	9.93
S5 -A	Adjacent to center of drift	12/19/2000	30.4	<0.1	<0.03	<0.02	0.023	<0.01	<0.02	0.182	<0.01	25.5
S5B -A		1/8/2001	30.9	<0.1	<0.03	<0.02	0.016	<0.01	<0.02	<0.1	<0.01	14.0
S5C -A		1/24/2001	31.1	<0.1	<0.03	<0.02	0.012	<0.01	<0.02	<0.1	<0.01	17.6
S12C -A	Just off center and above drift	1/24/2001	39	<0.1	<0.03	<0.02	0.041	<0.01	<0.02	0.571	<0.01	47.7
S14 -A	Above and toward front of drift	12/19/2000	37.2	0.055	<0.015	<0.01	0.053	<0.005	<0.01	0.840	<0.005	85.8
S14B -A		1/8/2001	37.5	<0.1	<0.03	<0.02	0.015	<0.01	<0.02	0.327	<0.01	19.3
S14C -A		1/24/2001	37.3	<0.1	<0.03	<0.02	<0.01	<0.01	<0.02	0.149	<0.01	13.0
S15 -A	Above and slightly off center of drift	12/19/2000	40.5	0.191	<0.015	<0.01	0.072	<0.005	<0.01	0.385	<0.005	75.2
S15C -A		1/24/2001	43.6	<0.1	<0.03	<0.02	<0.01	<0.01	<0.02	<0.1	<0.01	13.9

Sample label	Chromium	Cobalt	Copper	Iron	Lanthanum	Lead	Lithium	Magnesium
EQ1-A	<0.005	<0.005	<0.005	<0.025	<0.005	<0.005	0.038	0.575
EQ2-A	<0.005	<0.005	<0.005	<0.025	<0.005	<0.005	0.038	0.577
EQ3-A	<0.005	<0.005	<0.005	<0.025	<0.005	<0.005	0.038	0.572
EQ4-A	<0.005	<0.005	<0.005	<0.025	0.008	<0.005	0.039	0.508
EQ4-A	<0.005	<0.005	<0.005	<0.025	0.009	<0.005	0.038	0.507
EQ5-A	<0.005	<0.005	<0.005	<0.025	0.009	<0.005	0.039	0.521
EQ6-A	<0.005	<0.005	<0.005	<0.025	0.009	<0.005	0.038	0.518
S2B -A	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.250	2.14
S2C -A	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.121	1.53
S4 -A	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.172	2.46
S4B -A	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.070	0.716
S4C -A	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.059	0.681
S5 -A	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.100	1.76
S5B -A	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.045	1.00
S5C -A	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.031	1.41
S12C -A	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.267	2.19
S14 -A	<0.005	<0.005	0.009	<0.025	<0.005	<0.005	0.167	5.82
S14B -A	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.125	1.22
S14C -A	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.048	0.863
S15 -A	<0.005	<0.005	0.007	0.062	0.008	<0.005	0.276	5.08
S15C -A	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	0.066	1.05

Cation analyses are cont on following page

IC analyses of anions

All sample results are in mg/L

Sample label	Description or Location	Date collected	Solution temp C	Bromide	Chloride	Fluoride	Nitrate-N	Nitrite-N	Phosphate-P	Sulfate	pH	Alkalinity in mg CaCO3/L
EQ1	Equilibrated with Topapah Spring lower	12/5/2000		0.441	0.669	0.238	0.140	<0.1	<0.1	0.814	6.88	54.67
EQ1	lithophysal unit	12/5/2000		0.445	0.668	0.231	0.155	<0.1	<0.1	0.831	6.88	54.67
EQ2		12/5/2000		0.468	0.676	0.243	0.140	<0.1	<0.1	0.833	6.88	54.67
EQ3		12/5/2000		0.445	0.687	0.231	0.131	<0.1	<0.1	0.759	6.88	54.67
EQ4	Equilibrated with Topapah Spring lower	12/5/2000		0.510	11.3	0.248	0.161	<0.1	<0.1	0.832	6.83	51.75
EQ5	lithophysal unit and spiked with 10 ppm Cl	12/5/2000		0.462	11.3	0.270	0.535	<0.1	<0.1	0.860	6.83	51.75
EQ6		12/5/2000		0.488	11.3	0.254	0.590	<0.1	<0.1	0.803	6.83	51.75
S2B	Below center of drift	1/8/2001	24.8	4.87	49.1	3.89	1.68	<0.1	<0.1	12.6	7.6	108.5
S2C		1/24/2001	25.2	1.55	38.9	0.743	1.26	<0.1	<0.1	4.33	8.02	112.4
S4	Adjacent to center of drift	12/19/2000	30.7	6.57	89.7	2.01	2.57	<0.1	<0.1	13.9	7.96	114.2
S4B		1/8/2001	31.1	1.10	27.3	1.18	0.948	<0.1	<0.1	4.13	8.06	78.1
S4C		1/24/2001	31.1	0.591	28.9	0.801	2.00	<0.1	<0.1	2.81	8.23	64
S5	Adjacent to center of drift	12/19/2000	30.4	2.25	53.3	1.42	1.18	<0.1	<0.1	6.00	8.01	107
S5B		1/8/2001	30.9	0.391	20.2	0.604	0.847	<0.1	<0.1	1.61	8.08	84.5
S5C		1/24/2001	31.1	0.235	19.3	0.314	1.06	<0.1	<0.1	1.12	8.38	86.2
S12C	Just off center and above drift	1/24/2001	39	9.35	249	1.06	6.59	<0.1	<0.1	12.5	8.52	
S14	Above and toward front of drift	12/19/2000	37.2	11.3	304	0.285	3.75	<0.1	<0.1	22.6	7.8	69.8
S14B		1/8/2001	37.5	4.20	92.7	1.97	2.75	<0.1	<0.1	9.61	8.16	77
S14C		1/24/2001	37.3	0.567	22.6	0.748	1.94	<0.1	<0.1	3.56	8.47	75.7
S15	Above and slightly off center of drift	12/19/2000	40.5	9.84	209	1.57	2.54	<0.1	<0.1	15.0	7.78	
S15C		1/24/2001	43.6	0.980	39.3	0.463	3.132	<0.1	<0.1	2.52	8.5	

Continuation of cation analyses

Sample label	Manganese	Molybdenum	Nickel	Palladium	Phosphorus	Potassium	Selenium	Silicon	Silver	Sodium	Strontium	Sulfur
EQ1-A	<0.005	<0.005	<0.005	<0.01	<0.25	0.619	<0.01	11.6	<0.005	5.38	0.079	0.300
EQ2-A	<0.005	<0.005	<0.005	<0.01	<0.25	0.632	<0.01	11.6	<0.005	5.28	0.079	0.296
EQ3-A	<0.005	<0.005	<0.005	<0.01	<0.25	0.627	<0.01	11.6	<0.005	5.25	0.079	0.296
EQ4-A	<0.005	<0.005	<0.005	<0.01	<0.25	1.41	<0.01	11.2	<0.005	10.6	0.070	0.290
EQ4-A	<0.005	<0.005	<0.005	<0.01	<0.25	1.38	<0.01	11.1	<0.005	10.6	0.070	0.309
EQ5-A	<0.005	<0.005	<0.005	<0.01	<0.25	1.40	<0.01	11.3	<0.005	10.9	0.071	0.301
EQ6-A	<0.005	<0.005	<0.005	<0.01	<0.25	1.39	<0.01	11.3	<0.005	10.5	0.071	0.306
S2B -A	0.014	<0.01	<0.01	<0.02	<0.5	2.54	<0.02	23.1	<0.01	34.2	0.293	4.45
S2C -A	<0.01	<0.01	<0.01	<0.02	<0.5	8.29	<0.02	20.5	<0.01	26.1	0.202	1.56
S4 -A	<0.01	0.013	<0.01	<0.02	<0.5	9.07	<0.02	25.6	<0.01	44.0	0.336	5.24
S4B -A	<0.01	<0.01	<0.01	<0.02	<0.5	2.13	<0.02	23.7	<0.01	28.7	0.098	1.52
S4C -A	<0.01	<0.01	<0.01	<0.02	<0.5	5.73	<0.02	22.0	<0.01	25.0	0.093	1.06
S5 -A	<0.01	<0.01	<0.01	<0.02	<0.5	9.08	<0.02	23.8	<0.01	31.4	0.226	2.35
S5B -A	<0.01	<0.01	<0.01	<0.02	<0.5	2.72	<0.02	20.9	<0.01	20.1	0.126	0.610
S5C -A	<0.01	<0.01	<0.01	<0.02	<0.5	2.49	<0.02	16.8	<0.01	15.5	0.158	0.459
S12C -A	<0.01	0.025	<0.01	<0.02	<0.5	13.7	<0.02	35.8	<0.01	145	0.444	4.82
S14 -A	0.026	0.018	<0.005	<0.01	<0.25	107	<0.01	36.2	<0.005	73.4	0.731	8.71
S14B -A	0.015	0.015	<0.01	<0.02	<0.5	4.73	<0.02	30.7	<0.01	62.8	0.173	3.58
S14C -A	<0.01	<0.01	<0.01	<0.02	<0.5	3.82	<0.02	25.5	<0.01	22.7	0.116	1.39
S15 -A	1.02	0.015	0.034	<0.01	<0.25	41.7	<0.01	34.9	<0.005	129	0.635	5.76
S15C -A	<0.01	<0.01	<0.01	<0.02	<0.5	3.52	<0.02	19.0	<0.01	39.3	0.133	0.934

Sample label	Thallium	Thorium	Tin	Titanium	Tungsten	Uranium	Vanadium	Yttrium	Zinc	Zirconium
EQ1-A	<0.005	<0.01	<0.005	<0.005	<0.02	<0.1	<0.005	<0.005	<0.005	<0.005
EQ2-A	<0.01	<0.01	<0.005	<0.005	<0.02	<0.1	<0.005	<0.005	<0.005	<0.005
EQ3-A	<0.01	<0.01	<0.005	<0.005	<0.02	<0.1	<0.005	<0.005	<0.005	<0.005
EQ4-A	<0.01	<0.01	<0.005	<0.005	<0.02	<0.1	<0.005	<0.005	0.035	<0.005
EQ4-A	<0.01	<0.01	<0.005	<0.005	<0.02	<0.1	<0.005	<0.005	0.034	<0.005
EQ5-A	<0.01	<0.01	<0.005	<0.005	<0.02	<0.1	<0.005	<0.005	0.017	<0.005
EQ6-A	<0.01	<0.01	<0.005	<0.005	<0.02	<0.1	<0.005	<0.005	0.018	<0.005
S2B -A	<0.02	<0.02	<0.01	<0.01	<0.04	<0.2	<0.01	<0.01	0.011	<0.01
S2C -A	<0.02	<0.02	<0.01	<0.01	<0.04	<0.2	<0.01	<0.01	0.015	<0.01
S4 -A	<0.02	<0.02	<0.01	<0.01	<0.04	<0.2	<0.01	<0.01	0.018	<0.01
S4B -A	<0.02	<0.02	<0.01	<0.01	<0.04	<0.2	<0.01	<0.01	<0.01	<0.01
S4C -A	<0.02	<0.02	<0.01	<0.01	<0.04	<0.2	<0.01	<0.01	<0.01	<0.01
S5 -A	<0.02	<0.02	<0.01	<0.01	<0.04	<0.2	<0.01	<0.01	0.010	<0.01
S5B -A	<0.02	<0.02	<0.01	<0.01	<0.04	<0.2	<0.01	<0.01	<0.01	<0.01
S5C -A	<0.02	<0.02	<0.01	<0.01	<0.04	<0.2	<0.01	<0.01	<0.01	<0.01
S12C -A	<0.02	<0.02	<0.01	<0.01	<0.04	<0.2	0.012	<0.01	<0.01	<0.01
S14 -A	<0.01	<0.01	<0.005	<0.005	<0.02	<0.1	<0.005	<0.005	0.068	<0.005
S14B -A	<0.02	<0.02	<0.01	<0.01	<0.04	<0.2	<0.01	<0.01	0.013	<0.01
S14C -A	<0.02	<0.02	<0.01	<0.01	<0.04	<0.2	<0.01	<0.01	<0.01	<0.01
S15 -A	<0.01	<0.01	<0.005	<0.005	<0.02	<0.1	<0.005	<0.005	0.032	<0.005
S15C -A	<0.02	<0.02	<0.01	<0.01	<0.04	<0.2	<0.01	<0.01	<0.01	<0.01

3/21/01 @ 1305hr.

Collected new set of water samples for chemical analysis.

Sample Cup No Label	Appropriate Amount	Temp°C
S1F	60ml	25.37°C
S2F	60ml	25.14°C
S4F	50ml	36.56°C
S5F	50ml	35.85°C
S14F	20ml	46.80°C
S15F	15ml	60.53°C

3/21/01 @ 1330 hr

pH of solutions collected above. See p 59 for procedure.

Sample	pH
S1F	8.33
S2F	8.22
S4F	8.28
S5F	8.22
S14F	8.52
S15F	8.75

3/21/01 1400hr @

Alkalinity of samples on previous page were determined using procedure on p61.

Results

========== METTLER DL21 Titrator date 21-03-01 ==

TITRATION	1	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	8.223	S1F
pH0 pH	7.043	
SLOPE mV/pH	-57.5	40ml sample volume
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.05226	
P-VALUE mmol/L	.13065	
RESULT mL	1.3223	
M-VALUE mmol/L	3.3057	

Carbonate Alkalinity $= 2\left(\frac{.05226 \times .1 \times 50000}{40}\right) = 13.065$ mg $CaCO_3/L$

Bicarbonate Alk. $= \left(\frac{1.3756 \times .1 \times 50000}{40}\right) - 13.065 = 158.75$ mg $CaCO_3/L$.

========== METTLER DL21 Titrator date 21-03-01 ======

TITRATION	2	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	7.873	
pH0 pH	7.043	
SLOPE mV/pH	-57.5	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.76014	
M-VALUE mmol/L	1.9004	

S2F

40 ml Sample Volume

$$\text{Alkalig} = \frac{.76014 \times .1 \times 50000}{40} = 95.02 \text{ mg } CaCO_3/L$$

========== METTLER DL21 Titrator date 21-03-01 ======

TITRATION	3	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	50.000	
START pH	7.539	
pH0 pH	7.043	
SLOPE mV/pH	-57.5	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.24306	
M-VALUE mmol/L	1.2153	

S4F

20 ml Sample Volume

$$\text{Alkalig} = \frac{.24306 \times .1 \times 50000}{20} = 60.765 \text{ mg } CaCO_3/L$$

========== METTLER DL21 Titrator date 21-03-01 =====

TITRATION	4	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	50.000	
START pH	7.423	55F
pH0 pH	7.043	
SLOPE mV/pH	-57.5	20ml Sample Volume
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.19745	
M-VALUE mmol/L	.98724	

$$\text{Alkalinity} = \frac{.19745 \times .1 \times 50000}{20} = 49.36 \text{ mg } CaCO_3/L$$

========== METTLER DL21 Titrator date 21-03-01 =====

TITRATION	5	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	66.670	
START pH	8.068	514F
pH0 pH	7.043	
SLOPE mV/pH	-57.5	15ml Sample Volume
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.25390	
M-VALUE mmol/L	1.6928	

$$\text{Alkalinity} = \frac{.25390 \times .1 \times 50000}{15} = 84.63 \text{ mg } CaCO_3/L$$

3/21/01 gp 1500hr.

After pH & alkalinity measurments samples were split into 2 aliquots & placed in 30 ml PP bottles. One aliquot was acidified by adding 10µ HNO_3. These samples were labeled as follows.

S1F-A
S2F-A
S4F-A
S5F-A
S14F-A
S15F-A.

The acidified samples returned their original labels. Samples were separated for later analysis.

3/21/01 gp 1530 hr.

Variable transfomer was changed from 55 To ~~57.~~ 60, gp 3/21/01

4/5/01 gp 0830hrs

Relative humidity readings over the past 4 or 5 days indicated problems with flow to the system (probably problems with ceramic tube delivering water to system). The top of the apparatus was disassembled, the ceramic tube was cleaned with acid to remove residues and the tubing was repositioned. The top of the apparatus was then reassembled.

4/12/01 gp 0910hr.

Collected water samples for chemical analysis

Sample Cup No labeled	Approximate Amount	Temp °C
S1G	60 ml	27.3°C
S2G	60 ml	27.8°C
S3G	8 ml	27.2°C
S4G	50 ml	41.7°C
S5G	50 ml	39.0°C
S12G	20 ml	53.3°C
S14G	20 ml	50.1°C
S15G	15ml	58.8°C

4/12/01 gp 0945hr.

pH of solutions above were measured using procedure on p 59.

Sample	pH
S1G	8.25
S2G	8.34
S3G	7.81
S4G	8.35
S5G	8.38
S12G	8.68
S14G	8.56
S15G	8.70

4/12/01 1030hr.
Alkalinity of sample on previous page were determined using procedure on p 61

Results

========== METTLER DL21 Titrator date 12-04-01 ======

TITRATION	1	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	8.212	
pH0 pH	6.950	
SLOPE mV/pH	-55.6	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.02668	
P-VALUE mmol/L	.06669	
RESULT mL	.82190	
M-VALUE mmol/L	2.0548	

S1G
40ml sample volume

Alkalinity = $\frac{(.02668 + .82190) * .1 * 50000}{40}$ = 106.07 mg $CaCO_3$/L

========== METTLER DL21 Titrator date 12-04

TITRATION	3	operator
METHOD	4011	2 04-12
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	8.259	
pH0 pH	6.950	
SLOPE mV/pH	-55.6	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.01885	
P-VALUE mmol/L	.04712	
RESULT mL	.82314	
M-VALUE mmol/L	2.0579	

S2G
40ml sample volume

========== METTLER DL21 Titrator date 12-0

TITRATION	4	operator
METHOD	4011	2 04-1
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	40.000	
START pH	7.669	
pH0 pH	6.950	
SLOPE mV/pH	-55.6	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.27928	
M-VALUE mmol/L	1.1171	

S4G
25ml sample volume

Alkalinity = $\frac{.27928 \times .1 \times 50000}{25}$ =

55.86 mg $CaCO_3$/L

Alkalinity = $\frac{(.01885 + .82314) * .1 * 50000}{40}$ =

105.25 mg $CaCO_3$/L

========== METTLER DL21 Titrator date 1?

TITRATION 6 operator

METHOD	4011	2 04
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	40.000	
START pH	8.157	
pHØ pH	6.950	
SLOPE mV/pH	-55.6	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.28423	

M-VALUE mmol/L
1.1369

556
25ml
Sample Volume

Alkalj = $\frac{.28423 \times .1 \times 50000}{25}$ =

56.85 mg $CaCO_3$/L

========== METTLER DL21 Titrator date 1?

TITRATION 9 operator

METHOD	4011	2 04
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	50.000	
START pH	8.441	
pHØ pH	6.950	
SLOPE mV/pH	-55.6	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.02204	

P-VALUE mmol/L
.11020

RESULT mL .30884

M-VALUE mmol/L
1.5442

5126
20ml
Sample Volume

Alkalj = $\frac{(.02204 + .30884) * .1 * 50000}{20}$ =

82.72 mg $CaCO_3$/L

========== METTLER DL21 Titrator date 12-04-(

TITRATION 8 operator

METHOD	4011	2 04-12
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	66.700	
START pH	8.176	
pHØ pH	6.950	
SLOPE mV/pH	-55.6	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.17601	

M-VALUE mmol/L
1.1740

5146
15ml
Sample Volume

Alkalj = $\frac{.17601 \times .1 \times 50000}{15}$ = 58.67 mg $CaCO_3$/L

4/12/01 JP 1130 hr

Variable Temp timer changed from setting of 60 to 65.

4/19/01 JP 1000 hr.

Problems with the cassette pump caused delivery of water to the apparatus to be severely decreased over a several day period. This caused temperature around the adit to increase and relative humidity to decrease. Increase in temperature caused drying out of the rock surrounding the adit.

4/20/01 JP The cassette pump was repaired and delivery of water at an increased rate was resumed. The variable temp timer was set to 40 to allow rewetting of the rock surrounding the adit.

5/1/01 1645 hr.
JP The variable temp timer was set to 50.

5/2/01 1625
JP The variable temp timer was set to 55

5/4/01 1540
JP The variable temp timer was set to 60

5/10/01 1500 JP
Variable temp timer set to 63

5/11/01 1500 hr JP
Variable temp timer set to 65

5/15 JP 1020 hr
Variable temp timer set to 60.

5/17 JP 1245 hr
Variable temp timer set to 55.

6/14 JP 0730 hr.
Variable temp timer set to 48

6/20 JP 0900 hr.
A new ceramic tube was placed in the apparatus to deliver water. The old ceramic tube was clogged.

Temperature and RH Readings

(cont from p 113)

Date/Time	mA RH	mA Temp	RH	Temp
5/18 0745	16.46	11.75	77.9%	76.8°C
5/21 1000	14.99	11.85	68.7%	78.1°C
5/26 0840	15.77	11.76	73.6%	77.0°C
5/29 0735	15.68	11.83	73.0%	77.9°C
5/30 0735	15.41	11.87	71.3%	78.4°C
5/31 0745	16.07	11.92	75.4%	79.0°C
6/1 0755	15.32	11.87	70.7%	78.4°C
6/4 0750	15.38	12.14	71.1%	81.7°C
6/5 0745	15.69	11.83	73.1%	77.9°C
6/6 0715	15.30	11.81	70.6%	77.6°C
6/7 0735	14.89	11.85	68.1%	78.1°C
6/8 0730	14.69	11.87	66.8%	78.4°C
6/11 0730	14.59	11.60	66.2%	75.0°C
6/12 0725	14.55	11.65	65.9%	75.6°C
6/13 0715	1439	11.65	64.9%	75.6°C
6/14 0720	14.70	11.46	66.9%	73.2°C
6/15 0740	14.35	11.36	64.7%	72.0°C
6/18 0740	14.10	11.28	63.1%	71.8°C
6/19 0735	14.38	11.24	64.9%	70.7°C
6/20 1040	12.22	11.65	51.4%	75.6°C
6/21 0715	16.81	11.03	80.1%	67.9°C
6/22 0800	17.10	11.02	81.9%	67.7°C
6/25 0800	16.97	11.21	81.1%	70.1°C
6/26 0820	17.93	10.92	87.1%	66.5°C
6/27 1200	17.46	10.97	84.1%	67.1°C
6/28 0720	17.13	11.02	82.1%	67.7°C
6/29 0710	17.49	10.99	84.3%	67.4°C
7/2 0745	17.11	10.82	81.9%	65.2°C
7/3 0735	16.88	10.72	80.5%	64.0°C
7/5 0745	16.72	10.75	79.5%	64.4°C
7/6 0730	16.61	10.77	78.8%	64.6°C
7/9 0715	16.16	10.87	76.0%	65.8°C

Date/Time	mA RH	mA Temp	RH	Temp
7/10 0710	17.06	10.69	81.6%	63.6°C
7/11 10:15	16.48	10.72	78.0%	64.0°C
7/12 0705	17.44	10.63	84.0%	62.9°C
7/13 0730	17.68	10.63	85.5%	62.9°C
7/16 0740	17.38	~~0740~~ 10.72	83.6%	64.0°C
7/17 0730	18.79	10.63	92.4%	62.9°C
7/18 0725	18.80	10.61	92.5%	62.6°C
7/19 0740	19.16	10.56	94.7%	62.0°C
7/20 0720	18.87	10.59	92.9%	62.4°C
7/23 0710	16.41	10.86	77.6%	65.7°C
7/24 0710	19.22	10.70	95.1%	63.7°C
7/25 0945	17.86	10.69	86.6%	63.6°C
7/26 0705	17.70	10.68	85.6%	63.5°C
7/27 0720	17.75	10.71	85.9%	63.8°C
7/30 0730	17.37	10.77	83.6%	64.6°C
7/31 0710	17.33	10.75	83.3%	64.4°C
8/1 0710	17.48	10.74	84.2%	64.2°C
8/2 0735	17.78	10.68	86.1%	63.5°C
8/3 0750	17.63	10.67	85.2%	63.4°C
8/6 ~~0710~~ 0720	17.08	10.81	81.7%	65.1°C
8/7 0720	17.30	10.80	83.1%	65.0°C
8/8 0740	16.99	10.77	81.2%	64.6°C
8/9 0725	16.72	10.84	79.5%	65.5°C
8/10 0725	16.68	10.86	79.2%	65.7°C
8/13 0715	19.72	10.56	98.2%	62.0°C
8/14 0655	20.02	10.59	100.1%	62.4°C
8/15 0730	4.01	10.75		64.4°C
8/16 0745	4.01	10.74		64.9°C
8/17 0745	18.37	10.77	89.8%	64.6°C
8/20 0910	17.23	10.70	82.7%	63.7°C
8/21 0905	17.38	9.02	83.6%	42.7°C
8/22 0935	17.36	9.01	83.5%	42.6°C
8/23 0925	17.49	9.02	84.3%	42.7°C
8/24 0920	17.52	8.99	84.5%	42.4°C

(cont on p 142)

5/29/01 JF

Cont. from p 114

Temperature data is stored in following files

test_3_168.csv (5/21-5/29)
test_3_169.csv (5/29-5/30)
test_3_170.csv (5/30-5/31)
test_3_171.csv (5/31-6/1)
test_3_172.csv (6/1/6/4)
test_3_173.csv (6/4-6/5)
test_3_174.csv (6/5-6/6)
test_3_175.csv (6/6-6/7)
test_3_176.csv (6/7-6/8)
test_3_177.csv (6/8-6/11)
test_3_178.csv (6/11-6/12)
test_3_179.csv (6/12-6/13)
test_3_180.csv (6/13-6/14)
test_3_181.csv (6/14-6/15)
test_3_182.csv (6/15-6/18)
test_3_183.csv (6/18-6/19)
test_3_184.csv (6/19-6/20)
test_3_185.csv (6/20-6/21)
test_3_186.csv (6/21-6/22)
test_3_187.csv (6/22-6/25)
test_3_188.csv (6/25-6/26)
test_3_189.csv (6/26-6/27)
test_3_190.csv (6/27-6/28)
test_3_191.csv (6/28-6/29)
test_3_192.csv (6/29-7/2)
test_3_193.csv (7/2-7/3)
test_3_194.csv (7/3-7/5)
test_3_195.csv (7/5-7/6)
test_3_196.csv (7/6-7/9)
test_3_197.csv (7/9-7/12)
test_3_198.csv (7/12-7/13)
test_3_199.csv (7/13-7/16)
test_3_200.csv (7/16-7/19)
test_3_201.csv (7/19-7/20)
test_3_202.csv (7/20-7/23)
test_3_203.csv (7/23-7/27)
test_3_204.csv (7/27-7/30)
test_3_205.csv (7/30-8/3)
test_3_206.csv (8/3-8/6)
test_3_207.csv (8/6-8/10)
test_3_208.csv (8/10-8/13)
test_3_209.csv (8/13-8/17)
test_3_210.csv (8/17-8/20)
test_3_211.csv (8/20-8/24)
test_3_212.csv (8/24-8/27)
test_3_213.csv (8/27-8/31)
test_3_214.csv (8/31-9/4)
test_3_215.csv (9/4-9/7)
test_3_216.csv (9/7-9/10)
test_3_217.csv (9/10-9/14)
test_3_218.csv (9/14-9/17)
test_3_219.csv (9/17-9/21)
test_3_220.csv (9/21-9/24)
test_3_221.csv (9/24-9/28)
test_3_222.csv (9/28-10/1)
test_3_223.csv (10/1-10/5)
test_3_224.csv (10/5-10/8)
test_3_225.csv (10/8-10/12)
test_3_226.csv (10/12-10/15)
test_3_227.csv (10/15-10/19)
test_3_228.csv (10/19-10/23)
test_3_229.csv (10/23-10/26)
test_3_230.csv (10/26-10/29)
test_3_231.csv (10/29-11/2)

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test_3_232.csv (11/2-11/5)
test_3_~~224~~ 233.csv (11/5-11/9)
test_3_234.csv (11/9-11/12)
test_3_235.csv (11/12-11/15)
test_3_236.csv (11/15-11/21)
test_3_237.csv (11/21-11/26)
test_3_238.csv (11/26-11/30)
test_3_239.csv (11/30-12/3)
test_3_240.csv (12/3-12/7)
test_3_241.csv (12/7-12/10)
test_3_242.csv (12/10-12/14)
test_3_243.csv (12/14-12/17)
test_3_244.csv (12/17-12/21)
test_3_245.csv (12/21-12/27)
test_3_246.csv (12/27-12/31)
test_3_247.csv (12/31-1/4)
test_3_248.csv (1/4-1/7)
test_3_249.csv (1/7-1/11)
test_3_250.csv (1/11-1/14)
test_3_251.csv (1/14-1/18)
test_3_252.csv (1/18-1/21)
test_3_253.csv (1/21-1/24)
test_3_254.csv (1/24-1/28)
test_3_255.csv (1/28-2/1)
test_3_256.csv (2/1-2/4)
test_3_257.csv (2/4-2/8)
test_3_258.csv (2/8-2/11)
test_3_259.csv (2/11-2/15)
test_3_260.csv (2/15-2/18)
test_3_261.csv (2/18-2/22)
test_3_262.csv (2/22-2/25)
test_3_263.csv (2/25-3/1)
test_3_264.csv (3/1-3/4)
test_3_265.csv (3/4-3/8)
test_3_266.csv (3/8-3/11)
test_3_267.csv (3/11-3/13) *
test_3_268.csv (3/13-3/18)
test_3_269.csv (3/18-3/20) *
test_3_270.csv (3/20-3/22)
test_3_271.csv (3/22-3/25)
test_3_272.csv (3/25-3/26)
test_3_273.csv (4/1-4/1)
test_3_274.csv (4/5-4/5)
test_3_275.csv (4/10-4/10)
test_3_276.csv (4/15-4/17)
test_3_277.csv (4/19-4/22)
test_3_278.csv (4/22-4/26)
test_3_279.csv (4/26-4/29)
test_3_280.csv (5/3-5/3)
test_3_281.csv (5/10-5/10)
test_3_282.csv (5/15-5/15)
test_3_283.csv (5/29-5/29)
test_3_284.csv (6/3-6/3)
test_3_285.csv (6/3-6/4)
test_3_286.csv (6/6-6/10)
test_3_287.csv (6/10-6/17)
test_3_288.csv (7/29-7/29)
test_3_289.csv (7/30-8/2)
test_3_290.csv (8/2-8/5)
test_3_291.csv (8/8-8/12)
test_3_292.csv (10/1-10/4)
test_3_293.csv (10/4-10/7)
test_3_294.csv (10/7-10/8)
test_3_295.csv (10/10-10/14)
test_3_296.csv (10/14-10/18)
test_3_297.csv (10/18-10/21)
test_3_298.csv (10/21-10/25)
test_3_299.csv (10/25-10/28)
test_3_300.csv (10/28-10/25)
test_3_301.csv (11/1-11/7)
test_3_302.csv (11/7-11/12)
test_3_303.csv (11/12-11/18)

cont on p. 159

Temperature + RH Readings
(cont from p 139)

Date/Time		RH	Temp	RH	Temp
		mA			
8/27	0700	17.23	8.99	82.7%	42.4°C
8/28	0920	17.37	8.96	83.6%	42.0°C
8/29	0955	17.45	8.97	84.1%	42.1°C
8/30	1530	17.57	9.04	84.8%	43.0°C
8/31	0910	17.64	9.08	85.2%	43.5°C
9/4	0920	18.05	9.07	87.8%	43.4°C
9/5	0740	18.48	9.16	90.5%	44.5°C
9/6	0915	18.04	9.17	87.7%	44.6°C
9/7	0850	18.22	9.17	88.9%	44.6°C
9/10	0850	16.58	9.26	78.6%	45.7°C
9/11	0920	17.67	9.23	85.4%	45.4°C
9/12	0850	19.05	9.17	93.7%	44.6°C
9/13	0910	19.08	9.14	94.2%	44.2°C
9/14	0810	18.97	9.16	93.6%	44.5°C
9/17	0805	19.04	9.10	94.0%	43.7°C
9/18	0905	20.00	9.11	100.0%	43.9°C
9/19	0700	20.00	9.10	100.0%	43.7°C
9/20	0925	20.00	9.12	100.0%	44.0°C
9/21	0820	20.00	9.13	100.0%	44.1°C
9/24	0755	17.85	9.08	86.6%	43.5°C
9/25	0905	17.55	9.09	84.7%	43.6°C
9/26	0800	17.43	9.11	83.9%	43.9°C
9/27	0820	17.03	9.11	81.4%	43.9°C
9/28	0840	17.56	9.12	84.7%	44.0°C
10/1	0735	17.47	9.10	84.2%	43.7°C
10/2	0945	17.54	9.09	84.6%	43.6°C
10/3	0835	17.66	9.10	85.4%	43.7°C
10/4	0930	17.42	9.09	83.9%	43.6°C
10/5	0810	17.63	9.10	85.2%	43.7°C
10/8	0750	17.20	9.09	82.5%	43.6°C
10/9	0915	17.57	9.03	84.8%	42.9°C
10/10	0745	18.32	9.00	89.5%	42.5°C

Date/Time		RH	Temp	RH	Temp
		mA			
10/11	0925	18.62	8.93	91.4%	41.6°C
10/12	0920	19.05	8.99	94.1%	42.4°C
10/15	0800	18.36	8.95	89.7%	41.9°C
10/16	0730	18.65	10.66	91.6%	63.2°C
10/17	0815	18.86	10.62	92.9%	62.7°C
10/18	0845	18.90	10.63	93.1%	62.9°C
10/19	0800	18.94	10.66	93.4%	63.2°C
10/22	0940	18.75	10.91	92.2%	66.4°C
10/23	0800	18.63	10.93	91.4%	66.6°C
10/24	0805	19.50	10.67	96.9%	63.4°C
10/25	1030	18.87	10.69	92.9%	63.6°C
10/26	0840	20.02	10.70	100.0%	63.7°C
10/29	0730	18.93	10.59	93.3%	62.4°C
10/30	0930	19.05	10.61	94.1%	62.6°C
10/31	0800	19.00	10.61	93.7%	62.6°C
11/1	0800	19.00	10.65	93.7%	63.1°C
11/2	0825	19.02	10.69	93.9%	63.6°C
11/5	0815	18.36	10.80	89.7%	65.0°C
11/6	0740	18.19	10.71	94.9%	63.9°C
11/7	0750	19.53	10.73	97.1%	64.1°C
11/8	0755	19.43	10.74	96.4%	64.2°C
11/9	0800	19.41	10.75	96.3%	64.4°C
11/12	0800	18.95	10.83	93.4%	65.4°C
11/13	0920	19.20	10.64	95.0%	63.0°C
11/14	0845	19.15	10.65	94.7%	63.1°C
11/15	0810	19.12	10.66	94.5%	63.2°C
11/16	0720	19.07	10.67	94.2%	63.4°C
MA 11/19	0855	18.90	10.64	93.1%	63.0°C
MA 11/20	1605	18.73	10.60	92.1%	62.5°C
11/21	1005	18.71	10.58	91.9%	62.2°C
11/26	0935	17.09	10.69	81.8%	63.6°C
11/27	0740	19.46	10.61	96.6%	63.1°C
11/28	0955	19.44	10.71	96.6%	63.9°C
11/29	0840	19.62	10.77	97.6%	64.6°C
11/30	0930	1998	10.72	99.9%	64.0°C

cont on next page

Date/Time	mA RH	Temp	RH	Temp
12/3 0920	20.02	10.63	100%	62.9°C
12/4 0730	20.00	10.71	100%	63.9°C
12/5 0930	20.00	10.73	100%	64.1°C
12/6 0725	20.00	10.60	100%	62.5°C
12/7 1000	20.00	10.68	100%	63.5°C
12/10 0920	20.00	10.86	100%	65.7°C
12/11 0920	20.00	10.84	100%	65.5°C
12/12 0750	20.00	10.88	100%	66.0°C
12/13 0930	20.00	10.87	100%	65.9°C
12/14 0930	20.00	10.90	100%	66.2°C
12/17 0800	20.00	10.86	100%	65.7°C
12/18 0745	20.00	16.90	100%	66.2°C
12/19 0800	20.00	10.93	100%	66.6°C
12/20 0810	20.00	10.91	100%	66.4°C
12/21 0815	20.00	10.97	100%	67.1°C
12/27 0805	17.86	11.10	86.6%	68.7°C
12/28 0800	19.19	11.09	94.9%	68.6°C
12/31 0820	18.86	11.08	92.8%	68.5°C
1/2 0820	19.11	11.06	94.4%	68.3°C
1/3 0825	19.73	11.10	98.3%	68.7°C
1/4 0825	19.49	11.12	96.8%	68.9°C
1/7 0930	19.22	11.11	95.1%	68.8°C
1/8 0805	18.99	11.16	93.7%	69.5°C
1/9 0925	18.04	11.31	87.7%	71.4°C
1/10 0755	18.26	11.25	89.1%	70.6°C
1/11 0935	18.39	11.26	89.9%	70.7°C
1/14 0745	17.74	11.30	85.9%	71.2°C
1/15 0805	17.91	11.28	86.9%	71.0°C
1/16 0920	19.55	11.05	97.2%	68.1°C
1/17 0930	19.71	11.09	98.2%	68.6°C
1/18 0935	19.71	11.06	98.2%	68.2°C
1/21 0755	18.27	11.24	89.2%	70.5°C
1/23 0935	19.24	11.11	95.2%	68.9°C
1/24 0930	19.36	11.11	96.0%	68.9°C
1/28 0740	17.74	11.27	86.0%	70.9°C

Date/Time	mA RH	TEMP	RH	Temp
1/29 0745	19.41	11.09	96.3%	68.6°C
1/30 0935	18.72	11.10	92.0%	68.7°C
1/31 0930	19.53	10.91	97.1%	66.4°C
2/1 0930	18.33	11.06	89.6%	68.3°C
2/4 0720	17.62	11.06	85.1%	68.3°C
2/5 0740	19.08	10.86	94.2%	65.7°C
2/6 0930	19.20	10.92	95.0%	66.4°C
2/7 0925	18.26	11.04	89.1%	68.1°C
2/8 0925	18.10	11.05	88.1%	68.2°C
2/11 0730	17.69	11.02	85.5%	67.7°C
2/12 0755	18.06	11.05	87.9%	68.2°C
2/13 0935	17.80	11.05	86.2%	68.2°C
2/14 0925	18.49	10.84	90.5%	65.5°C
2/15 0935	17.78	10.89	86.1%	66.1°C
2/18 0750	17.06	10.91	81.6%	66.4°C
2/19 0755	17.06	10.97	81.6%	67.1°C
2/20 0930	17.24	10.98	82.7%	67.2°C
2/21 0800	17.24	11.04	82.7%	68.1°C
2/22 0940	18.23	11.05	88.9%	68.2°C
2/25 0715	18.02	11.08	87.6%	68.5°C
2/26 1315	18.28	11.00	89.2%	67.5°C
2/27 0930	18.11	11.08	88.2%	68.5°C
2/28 0925	18.20	11.06	88.7%	68.3°C
3/1 0925	18.28	11.06	89.2%	68.3°C
3/4 0735	17.71	11.06	85.7%	68.3°C
3/5 0810	18.24	10.95	89.0%	66.9°C
3/6 0930	18.19	10.97	88.7%	67.1°C
3/8 0915	18.21	10.99	88.8%	67.3°C
3/11 1345	17.80	11.01	86.2%	67.6°C
3/12 0750	18.20	10.99	88.7%	67.3°C
3/13 0755	17.98	11.02	87.4%	67.7°C
3/14 0740	18.01	11.00	87.4%	67.5°C
3/15 0815	18.06	11.01	87.9%	67.6°C
3/18 0745	17.96	10.89	87.2%	66.1°C
3/19 0725	18.00	11.03	87.7%	67.8°C
3/20 0915	18.08	10.96	88.0%	66.2°C

Cont on p. 149

1/8/02 JP 0925hr.

Collected water samples for chemical analysis; pH was determined using procedure on p 59

Sample Cup No Label	~Amount	Temp °C	pH
S1H	60ml	28.0°C	7.29
S2H	60ml	27.7°C	6.97
S3H	60ml	26.9°C	7.96
S4H	50ml	38.5°C	7.73 ~~7.58~~ JP 1/8/02
S5H	50ml	31.4°C	7.58
S12H	—	—	
S13H	20ml	45.0°C	7.96
S14H	20ml	44.4°C	8.01
S15H	10ml	52.5°C	8.12

1/8/02 1030hr JP

Alkalinity of samples were determined using procedure on p61.

Results.

========== METTLER DL21 Titrator date 08-01-02 ==

TITRATION	2	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	8.540	S1H
pH0 pH	7.067	
SLOPE mV/pH	-57.3	40ml Sample volume
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.04920	
P-VALUE mmol/L	.12300	
RESULT mL	.66645	
M-VALUE mmol/L	1.6661	

Alkalinity =

$$\frac{(.04920 + .66645) * .1 * 50000}{40} =$$

89.46 mg $CaCO_3/L$

========== METTLER DL21 Titrator date 08-01-02 ==

TITRATION	3	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	7.341	S2H
pH0 pH	7.067	
SLOPE mV/pH	-57.3	40ml Sample volume
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.75827	
M-VALUE mmol/L	1.8957	

========== METTLER DL21 Titrator date 08-01-02 ==

TITRATION	4	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	7.369	S3H
pH0 pH	7.067	
SLOPE mV/pH	-57.3	40ml Sample volume
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.66187	
M-VALUE mmol/L	1.6547	

→ Alkalinity = $\frac{.75827 * .1 * 50000}{40} =$

94.78 mg $CaCO_3/L$

========== METTLER DL21 Titrator date 08-01-0

TITRATION	6	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	8.414	
pH0 pH	7.067	S4H
SLOPE mV/pH	-57.3	
M-POINT pH	4.300	40ml Sample volume
P-POINT pH	8.200	
RESULT mL	.04554	
P-VALUE mmol/L	.11386	
RESULT mL	.67585	
M-VALUE mmol/L	1.6896	

Alkalinity = $\frac{(.04554 + .67585) * .1 * 50000}{40} =$

90.17 mg $CaCO_3/L$

→ Alkalinity = $\frac{.66187 * .1 * 50000}{40} =$

82.73 mg $CaCO_3/L$

========== METTLER DL21 Titrator date 08-01-02

TITRATION	7	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	7.315	
pH0 pH	7.067	
SLOPE mV/pH	-57.3	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.49726	
M-VALUE mmol/L	1.2431	

55H
40ml
Sample
Volume

Alkalty = $\frac{.49726 * .1 * 50000}{40}$ =

62.16 mg $CaCO_3$/L

11/8/02
1200h ggp

After pH & alkalinity measurment samples were split into 2 aliquots & placed in 30 ml PP bottles. One aliquot was acidified by addg 10 µl HNO_3 and labeled as follows.

S1H-A, S2H-A, S3H-A, S4H-A, S5H-A, S13H-A, S14H-A, S15H-A.

The acidified samples retained their original labels.
Samples were refrigerated for later analysis.

Temperature & RH readings (cont from p145)

Date	Time	mA RH	mA Temp	RH	Temp
3/21	0935	18.16	10.84	88.5%	65.5°C
3/22	0940	18.22	10.79	88.9%	64.9°C
3/25	0725	17.87	11.06	86.7%	68.2°C
3/26	0745	17.97	11.09	87.3%	68.6°C
3/27	0920	18.05	11.10	87.8%	68.7°C
3/28	0925	17.94	11.12	87.1%	68.9°C
3/29	0845	18.30	11.04	89.4%	68.0°C
4/1	0725	17.59	11.02	84.9%	67.7°C
4/2	0735	17.97	11.05	87.3%	68.1°C
4/3	0925	18.14	11.03	88.4%	67.9°C
4/4	0915	18.31	11.00	89.5%	67.5°C
4/5	0935	18.30	10.98	89.4%	67.2°C
4/8	0755	17.80	11.00	86.2%	67.5°C
4/9	0740	18.26	11.00	89.1%	67.5°C
4/10	0905	18.17	11.01	88.6%	67.6°C
4/11	0925	18.24	11.00	89.0%	67.5°C
4/12	0925	18.18	11.01	88.6%	67.6°C
4/15	0740	18.06	11.00	87.9%	67.5°C
4/16	0750	13.67	11.65	60.4%	75.6°C
4/17	1000	19.22	10.88	95.1%	66.0°C
4/18	0925	20.00	11.00	100.0%	67.5°C
4/19	0920	20.00	11.03	100.0%	67.9°C
4/22	0735	19.32	11.12	95.7%	69.0°C
4/23	0750	20.02	11.09	100%	68.6°C
4/24	0930	20.00	10.97	100%	67.1°C
4/26	0730	20.00	10.91	100%	66.4°C
4/29	0720	20.00	10.90	100%	66.2°C
4/30	0800	19.58	10.91	97.4%	66.4°C
5/1	0925	18.95	10.94	93.4%	66.7°C
5/2	0940	18.97	10.95	93.6%	66.8°C
5/3	0925	19.40	10.90	96.2%	66.2°C
5/6	0930	18.89	10.90	93.1%	66.2°C
5/7	0740	19.03	10.92	93.9%	66.5°C
5/8	0800	18.73	11.00	92.1%	67.5°C

cont on page 150

Date/Time		mA RH	Temp	RH	Temp
5/9	0925	18.08	11.05	88.0%	68.1°C
5/10	0925	18.66	11.03	91.6%	67.9°C
5/13	0735	17.68	11.12	85.5%	69.0°C
5/14	0725	17.15	11.14	82.2%	69.2°C
5/15	0740	19.98	10.98	99.9%	67.2°C
5/16	0940	19.43	10.98	96.4%	67.2°C
5/17	1800	19.11	11.06	94.4%	68.2°C
5/20	0945	19.35	11.11	95.9%	68.9°C
5/21	1325	19.58	11.18	97.4%	69.7°C
5/23	1310	19.47	11.08	96.7%	68.5°C
5/28	0805	18.41	11.09	90.1%	68.6°C
5/29	0755	19.47	11.13	96.7%	69.1°C
5/30	0745	19.78	11.11	98.6%	68.9°C
6/3	0745	14.57	11.54	66.1%	74.2°C
6/4	0750	16.90	11.33	80.6%	71.6°C
6/5	0805	16.92	11.33	80.7%	71.6°C
6/6	0750	17.54	11.22	84.6%	70.2°C
6/7	0815	16.99	11.27	81.2%	70.9°C
6/10	0725	17.02	11.30	81.4%	71.2°C
6/11	0920	17.52	11.19	84.5%	69.9°C
6/12	0730	17.44	11.21	84.0%	70.1°C
6/13	0735	17.55	11.23	84.7%	70.3°C
6/14	0745	17.64	11.21	85.2%	70.1°C
6/17	0725	15.80	11.36	73.7%	72.0°C
6/18	0755	16.01	11.32	75.0%	71.5°C
6/19	0705	16.08	11.45	75.5%	73.1°C
6/20	0725	16.04	11.35	75.2%	71.9°C
6/21	0735	16.70	11.23	79.4%	70.4°C
6/24	0725	16.44	11.38	77.7%	72.2°C
6/25	0720	17.14	11.32	82.1%	71.5°C
6/26	0720	17.40	11.39	83.7%	71.1°C
6/27	0715	17.42	11.30	83.9%	71.2°C
6/28	0730	17.48	11.31	84.2%	71.3°C
7/1	0725	16.52	11.38	78.2%	72.2°C

Date/Time		mA RH	Temp	RH	Temp
7/2	0730	16.69	11.40	79.3%	72.5°C
7/3	0740	17.53	11.32	84.5%	71.5°C
7/5	0750	17.42	11.27	83.9%	70.9°C
7/8	0735	17.00	11.24	81.2%	70.5°C
7/9	0730	17.40	11.25	83.7%	70.6°C
7/10	0730	17.35	11.26	83.4%	70.8°C
7/11	0730	17.26	11.25	82.9%	70.6°C
7/12	0735	17.30	11.28	83.1%	80.0°C

* Switched Vaisala Temp/Humidity probe S/N J1240028 with S/N U1840037.

7/12	0800	19.64	8.78		
7/15	0815	17.19	9.27	87.4%	45.8°C
7/16	0825	17.38	9.27	83.6%	45.8°C
7/17	0755	17.38	9.20	83.6%	45.0°C
7/18	0735	16.73	9.26	79.6%	45.7°C
7/19	0755	15.32	9.35	70.7%	46.9°C
7/22	0810	16.38	9.29	77.4%	46.0°C
7/23	0725	16.67	9.26	79.2%	45.7°C
7/24	0730	16.59	9.31	80.6%	46.4°C
7/25	0745	16.59	9.34	80.6%	~~64.7°C~~ 46.7°C 9/24/02
7/26	0740	16.62	9.33	78.9%	46.6°C
7/29	0740	16.26	9.34	76.6%	~~64.7°C~~ 44.7°C 9/24/02
7/30	0725	16.48	9.32	78.0%	46.5°C
7/31	0700	16.54	9.31	78.4%	46.4°C
8/1	0830	16.80	9.24	80.0%	45.5°C
8/2	0745	16.68	9.24	79.2%	45.5°C
8/5	0725	16.39	9.23	77.4%	45.4°C
8/6	0725	16.82	9.21	80.1%	45.1°C
8/7	0725	11.65	9.71	47.8%	51.4°C
8/8	0745	16.54	9.33	78.4%	46.6°C
8/12	0755	15.88	9.34	74.2%	46.7°C
8/13	0750	16.75	9.32	79.7%	46.5°C
8/14	0800	16.60	9.31	78.7%	46.4°C

Cont on Next page

Date/Time		mA RH	Temp	RH	Temp
8/15	0745	16.46	9.31	77.9%	46.4°C
8/16	0750	16.69	9.30	79.3%	46.3°C
8/19	0755	16.55	9.32	78.4%	46.5°C
8/20	0750	17.18	9.30	82.4%	46.3°C
8/21	0800	17.29	9.29	83.1%	46.2°C
8/22	0805	17.17	9.28	82.3%	46.1°C
8/23	0805	17.48	9.26	84.2%	45.9°C
8/26	0720	16.93	9.30	80.8%	46.3°C
8/27	0820	16.49	9.32	78.1%	46.5°C
8/28	0815	16.12	9.28	75.7%	46.1°C
8/29	0810	16.36	9.23	77.2%	45.4°C
9/5	0940	16.72	9.24	79.5%	45.5°C
9/6	0910	16.49	9.26	78.1%	45.9°C
9/9	0822	17.35	9.22	83.4%	45.2°C
9/10	0905	17.16	9.22	82.2%	45.2°C
9/11	0907	17.14	9.23	82.1%	45.4°C
9/12	0905	16.92	9.25	80.7%	45.0°C
9/13	0925	17.01	9.23	81.3%	45.4°C
9/14	0936	16.76	9.23	79.7%	45.4°C
9/17	1030	17.11	9.24	81.9%	45.5°C
9/18	0905	16.75	9.26	79.7%	45.7°C
9/19	0925	16.84	9.27	80.2%	45.8°C
9/20	0905	16.70	9.27	79.4%	45.8°C
9/23	0725	16.82	9.20	80.1%	45.0°C
9/24	0905	16.77	9.22	79.8%	45.2°C
9/25	0910	16.72	9.21	79.5%	45.1°C
9/26	0905	16.70	9.22	79.4%	45.2°C
9/27	0920	16.78	9.21	79.9%	45.1°C
9/30	0920	16.82	9.22	80.1%	45.2°C
10/1	0920	16.83	9.25	80.2%	45.6°C
10/4	0920	16.61	9.29	78.8%	46.1°C
10/7	0925	16.71	9.23	79.4%	45.4°C
10/8	0940	16.76	9.25	79.7%	45.6°C
10/9	0925	16.81	9.28	80.1%	46.0°C
10/10	0905	16.86	9.27	80.4%	45.9°C
10/11	0915	16.91	9.25	80.7%	45.6°C

		mA RH	Temp	RH	Temp
10/14	0740	RH 16.70	Temp 9.19	79.4%	44.9°C
10/15	0740	16.66	9.20	79.1%	45.0°C
10/16	0915	16.65	9.22	79.1%	45.2°C
10/17	0900	16.54	9.24	78.4%	45.5°C
10/18	0915	16.46	9.27	77.9%	45.8°C
10/21	0910	16.80	9.24	80.0%	45.5°C
10/22	0830	16.68	9.26	79.2%	45.7°C
10/23	0915	16.69	9.28	79.3%	46.0°C
10/24	1620	16.58	9.29	78.6%	46.1°C
10/25	0915	16.73	9.29	79.6%	46.1°C
10/28	0915	16.48	9.31	78.0%	46.4°C
10/29	0745	16.50	9.31	78.1%	46.4°C
10/30	0915	16.59	9.28	78.7%	46.0°C
10/31	1210	16.47	9.28	77.9%	46.0°C
11/1	0935	17.09	9.17	81.8%	44.6°C
11/4	0930	16.95	9.12	80.9%	44.0°C
11/5	0955	16.57	9.19	79.4%	44.9°C
11/6	0915	16.62	9.20	78.9%	45.0°C
11/7	1315	16.34	9.24	77.1%	45.5°C
11/8	1020	16.24	9.26	76.5%	45.7°C
11/12	0745	15.61	9.32	72.6%	46.5°C
11/13	1005	15.40	9.30	71.2%	46.3°C
11/14	0905	12.84	9.49	55.2%	48.6°C
11/15	1000	12.90	9.50	55.6%	48.7°C
11/18	0905	16.19	9.30	76.2%	46.3°C
11/19	0740	16.25	9.31	76.6%	46.4°C
11/20	0916	16.53	9.30	78.3%	46.3°C
11/21	0900	16.54	9.28	78.4%	46.0°C
11/22	0910	16.27	9.32	76.7%	46.5°C
12/2	0930	15.00	9.47	68.7%	48.4°C
12/3	0805	15.39	9.46	71.2%	48.3°C
12/4	0910	15.94	9.34	74.6%	46.7°C
12/5	0915	15.99	9.31	74.9%	46.4°C
12/6	0915	15.54	9.35	72.1%	46.8°C
12/9	0915	13.91	9.47	61.9%	48.4°C

(cont on p2 of scientific notebook 559).

11/22/02 gp 1335hr.

Collected water samples for chemical analyses, pH were determined using procedure on p 59

Sple cup label	~Amount	Temp °C	pH
S1I	80ml	29.2°C	8.41
S2I	80ml	30.38°C	8.34
S3I	70ml	26.7°C	8.38
S4I	10ml	40.52°	7.93
S5I	30ml	39.5°C	8.40
S12I	—	—	—
S13I	—	—	—
S14I	20ml	43.3°C	8.51
S15I	—	—	—

11/22/02 gp 1505hr

Alkalinity of samples S1I, S2I, & S3I were determined using procedure on p61. Results are shown on Solley pages.

---------- METTLER DL21 Titrator date 22-11-02 ----

TITRATION	1	operator
METHOD	4011	2 04-12 0
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	9.317	
pH0 pH	7.000	
SLOPE mV/pH	-57.1	
M-POINT pH	4.300	
P-POINT pH	8.200	
RESULT mL	.03381	
P-VALUE mmol/L	.08453	
RESULT mL	.64710	
M-VALUE mmol/L	1.6178	

S1I

40ml sample

$$\text{Alkalinity} = \frac{(0.03381 + .64710) * .1 * 50000}{40} = 85.11 \text{ mg } CaCO_3/L$$

========== METTLER DL21 Titrator date 22-11-02 ==

TITRATION	4	operator
METHOD	4011	2 04-12 9
WEIGHT g	1	
IDENT	2	remarks
conc mol/L	.10000	
const	25.000	
START pH	7.161	
pHØ pH	7.060	
SLOPE mV/pH	-57.1	
M-POINT pH	4.200	
P-POINT pH	9.200	
RESULT mL	.60217	
M-VALUE mmol/L	1.5054	

S2I

40ml Sample

Alkalinity = $\frac{.60217 * .1 * 50000}{40}$ = 75.27 mg $CaCO_3$/L

========== METTLER DL21 Titrator date 22-11-02 ==

TITRATION	5	operator
METHOD	4011	2 04-12 9
WEIGHT g	1	
IDENT	0	remarks
conc mol/L	.10000	
const	25.000	
START pH	7.367	
pHØ pH	7.060	
SLOPE mV/pH	-57.1	
M-POINT pH	4.200	
P-POINT pH	9.200	
RESULT mL	.73146	
M-VALUE mmol/L	1.8286	

S3I

40ml Sample

Alkalinity = $\frac{.73146 * .1 * 50000}{40}$ = 91.43 mg $CaCO_3$/L

11/22/02 JP 1620hr.

After pH & alkalinity measurements samples were split into two aliquots & placed in 30 ml PP bottles. One aliquot was acidified by adding 10 µl conc HNO_3 & labled as follows.

S1I-A
S2I-A
S3I-A
S4I-A
S5I-A
S14I-A

The unacidified aliquots retained their original labels.
Samples were refrigerated for later analysis.

12/2/02 JP
Cont from p 141.
Temperature data is stored in following files

test_3_304.csv (11/22-12/02)
test_3_305.csv (12/2-12/6)
test_3_306.csv (12/6-12/9)
test_3_307.csv (12/20-12/30)
test_3_308.csv (12/30-1/2)
test_3_309.csv (1/2-1/6)
test_3_310.csv (1/6-1/10)
test_3_311.csv (1/10-1/14)
test_3_312.csv (1/14-1/20)
test_3_313.csv (1/20-1/24)
test_3_314.csv (1/24-1/27)

12/10/02 JP

Entries for the lab scale heater test are continued in scientific notebook 559.

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

E. C. Piscitelli

3/13/2003