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Scientific Notebook No. 098: Thermohydrology Research Project--Coupled-Process Experiment Designed to Create a Gas-Gradient in the Container (11/22/1993-09/21/1995)

X-Y Densitometer

21
300

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COPY ~~097~~ 098 Ronald T Green 12/2/93 per comment by Alice Cortinas

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Ronald T Green = RTG
Kristi Yager = KM
Steve Swedeman = SS

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11/22/93 This notebook is for documenting a cylindrical experiment to be conducted on the x-y densitometer. The experiment is a coupled-process experiment designed to create a gas-gradient in the container.

Earlier scoping experiments were conducted using alumina powder (w/ a k_{sat} of ~ $5 \times 10^{-14} m^2$). A gas gradient was not achieved. This was attributed to the fact that the k_{sat} was too high (based on past numerical simulations). A phone discussion w/ Jack Dreamer (U-Nevada-Reno) revealed that media with $k_{sat} < 10^{-16} m^2$ can be attained if a concrete mixture is used as the medium.

A 1-part portland cement / 2 parts silica sand mixture was prepared and put into a 15 cm diameter, 12 cm high cylinder. The cylinder has an aluminum side wall with plexi-glass end plates. There is an internal heater w/ temperature probe and small diameter tube to allow measurement of gas pressure. There are two side wall access ports for measuring gas pressure at the side walls.

The concrete was mixed on 11/22/93 and requires 2-3 weeks to cure before heat can be applied.

Two additional samples of concrete were collected to permit testing of media properties

RH

12/20/93 Heat was applied to test container. A water manometer was attached to both the inside and exterior of the cylinder to measure gas pressure.

9:40 heater turned on and raised manually until interior temp was at 190 at 11:30 with a gas pressure differential of ~~0.8~~ 0.6 inches of water (0.8 on interior, ~~0.0~~ 12/20/93 0.2 on exterior). ⇒ 150 Pa

The interior tube was opened & air was surged into interior pipe to purge any condensed water, if possible. Tube was reattached to interior manometer, gas pressure was back to about 0.1 inch

Temp set down a little (maped out at 190°C) to 55 on variable autotransformer (from 60).

12/21/93 Gas pressure on exterior was about 0.1 inch of water and on interior was about 0.2 inch of water at 3 PM. Interior temperature was about 189°C & exterior temperature was 28.7°C.

Condensation noticed near center at top had dried out, but there was noticable condensation further out

Turned off heat source at 3:45 PM for a total of 30 hours of heating.

12/22/93 Stabel heater again, turned on to 55 on ~~RK~~ 12/22/94 autotransformer (should give temp of about ~~15~~ 190°C) at 8:40 AM to see if there is any instantaneous jump in pressure

3/15/94 Prepared new concrete test container. Concrete from previous container was inadequate. Per discussion w/ J. Daemen (UNR), we will prepared a cement paste with 1 part water / 2 parts cement (by volume) ⇒ 0.5 water/cement ratio.

C3

A square container previously filled for a Test 7 series test will be filled and a ~12" diameter cylinder for the x-y gas-gradient test will be filled. Silicon gel will be applied to the entire interior wall of the two end plates to reduce the potential for a short circuit gas path to form. Cylinder is 4½" tall. An extra sample was poured into a styrofoam cast for use in media characterization

3/18/94 Staff from Div 04 prepared a slurry for a second cylinder. Mixture is same as the used by Asad Chowdhury in his seismic motion experiments. Following is recipe as given by Allen Pickens/04

17# 10z	WATER
2.45 gms	VYNSOL RESIN AIR ENTRAINMENT
77 gms	DARACEM 100
14.7 gms	WHITE IVORY LIQUID SOAP (OLD STYLE)
17# 10z	TYPE I PORTLAND CEMENT
2.65 oz	BENTONITE
31# 10z	BARITE

This sample named C3, sample from 4½" tall cylinder is C4
~~Another~~ RK 3/18/94

The 7" tall cylinder was filled with the mixture and allowed to cure. These ~6" tall 2" cylinders were poured into plexiglass cylinders to be used for media characterization

4/18/94 RJ — Moved the 4½" (C4) and the 7" (C3) tall cylinders to the thermo lab & prepared them for testing. It is assumed that they both have had sufficient time to cure.

The cement slurry level of the 4½" (C3) cylinder shrunk down to about ¼ inch below the level of the cylinder lid. The 7" cylinder shrunk less than ⅛". Both were filled to the top with silicon sealant. The 4½" (C3) cylinder was completely filled. While ~90% of the void space above the cement level in the 7" (C4) was filled.

4/19/94 RJ — The 4½" (C4) cylinder was plumbed and instrumented to conduct a preliminary scoping experiment to test for the presence of a gas gradient. Heat was applied to source at center of cell & slowly incremented up over 1 hr 18 min. Gas pressure at center went up to 7.3" H_2O and was climbing rapidly at the time the test was discontinued. It appears that flashing or boiling was occurring in the cement after the heater element had attained > 150–170°C. Test was shut down to stop significant redistribution of moisture prior to conduct of actual test.

Note: At 9:05:30 and 9:22:00 the parallel drops in pressure is attributed to barometer change caused possibly by air conditioner turning on.

	(inches H_2O) reading inside	outside	Barom Temp	core Temp	Setting
8:15	0.1"	1.8	21.7	21.0	20
8:20	0.0	"	"	30.0	"
8:22:30	0.0	1.8	"	31.5	30
8:24:30	-0.05	"	21.8	37.0	30
8:27	-0.05	"	21.8	40.4	40
8:30	+0.05	1.8	21.7	50.2	40
8:30:25	"	"	"	51.6	50
8:33:30	-0.25	1.8	21.7	68.0	50
8:36	-0.35	1.8	21.7	74.6	50
8:37	-0.45	1.8	21.7	76.7	60
8:39:30	-0.65	1.8	21.7	92.0	60
8:41	-0.75	1.8	21.7	97.3	60
8:43	-0.85	1.8	21.7	101.5	60
8:44:30	-0.90	1.8	21.7	104.8	60
8:46:30	-0.90	1.8	21.7	108.2	60
8:48:0	-1.00	1.8	21.7	110.6	60
8:50:30	-1.25	1.8	21.7	114.0	60
8:53:00	-1.40	1.8	21.7	116.8	60
8:55:00	-1.50	1.8	21.7	118.8	60
8:59:30	-1.60	1.8	21.7	122.6	60
9:00:30	-1.65	1.8	21.7	123.5	70
9:02:00	-1.70	1.8	21.7	132.0	70
9:03:30	-1.70	1.8	21.7	137.4	70
9:05:30	-1.65	1.7	21.7	149.7	70
9:08:00	-1.85	1.8	21.7	148.4	70
9:10:00	-2.05	1.8	21.7	150.3	70
9:13:00	-2.10	1.8	21.8	153.8	70
9:15:00	-2.15	1.8	21.8	156.1	70
9:18:00	-2.20	1.8	21.8	158.9	70
9:20:00	-2.15	1.8	21.8	160.6	70
9:22:00	-2.10	1.7	21.8	162.4	80
9:23:30	-2.15	1.8	21.8	172.6	80
9:26:00	-2.35	1.8	21.9	182.3	80
9:28:00	-2.80	1.8	21.9	186.7	80
9:30:00	-3.30	1.8	21.9	189.9	80
Shut down 9:33:30	-3.60 (7.3" H_2O total pressure)	1.8	21.9	193.5	80

actual pressure is double from reading of 0.1

3.7
3.6
7.3

This shows a vacuum forming

(← this is a pressure of 3.90" H_2O)

even again

barometric effects ?

suction forced again

Hey could heat be bouncing in water level?

not > 100°C

RJ 4/19/94

Tests are ready to run, waiting for final approval on Cs^{137} source.

KM 5/25/94 Preparation of C5 cement samples. –
Ingredients: 20 # 6 oz water (tapewater)
92 gms Daracem 100
3.10 gms Air Entrainment Liquid
17.0 gms Ivory Liquid Soap
20 # 6 oz Type I Portland
37 # 2 oz Barite
2 # 13 oz Bentonite.

Used large "Hubart Mixer." The first 4 items above were weighed out and put in mixer bowl and STIRRED. Dry Ingredients (REMAING 3) were mixed together in another bowl (bucket) and added incrementally to create a slurry. Cement was allowed to mix, while scraping sides of bowl for about 3 min. Mixture was poured into:
1) 12 in cylinder labeled C5 * D1
2) 3 B size plexi. sleves labeled C5 * B1 ... B3
and 3) Remaining was poured into white 5 gallon bucket for later coring.

KM 5/31/94 Covered samples with plastic WRAP.

RH 12/8/94

6/1/94 RH X-Y Densitometer is set up to conduct a test on a cylindrical test cell containing a cement slurry as the medium. The container was prepared on 3/15/94 w/ slurry named C4. Hydraulic properties of C4 are being assessed in Hydraulic Properties lab by K. Reyes.

Data Aquisition system is still not operating properly. Tests are underway to test system. Steve Bird / Dem 04 is trouble shooting DAS. He has changed system software and restarted. DAS system has been started and allowed to run.

6/3/94 RH Count time on Canberra was set to 120 seconds and DAS restarted. DAS appears to be running.

6/7/94 RH S. Sudeman pulled files from DAS and restarted system. He will check files to see if system is operating.

6/8/94 10:30AM RH DAS not running, restarted DAS

6/17/94 RH DAS is now operating w/ Cs^{137} source installed and γ-ray measurements being made to see how the system will operate. 120 second count at each location has been specified. No other measurements are being made (i.e. via fluke) at this time.

6/22/94 11:15 AM DAS Down, restarted DAS
RH

6/23/94 1:45 PM DAS working fine
RH

6/24/94 4:30 PM DAS working fine
RH

6/27/94 12:49 AM looks like DAS hung up at 5:25 PM
RH on 6/29/94

1:15 PM restarted DAS w/ fluke ~~[illegible]~~ RH 6/27/94 connected to see if fluke is operational.
put in configuration file to get baseline readings of cylinder, configuration file is in cement.cfg

3:30 PM restarted DAS with fluke reading two pressures and two temperatures, to see if system is operational

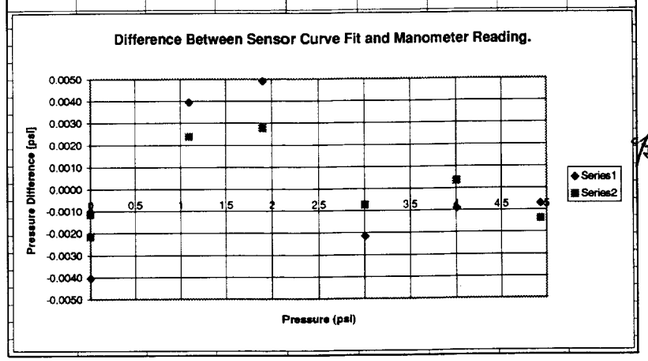
6/20/94 Calibrated pressure transducers and thermocouples
RH w/ S Sveden. See next page for calibration results

RH 12/8/94

CNWRA, 20-5704.023 Thermohydrology
Pressure Sensor Calibration for Cement Test. 6/28/94.

----Manometer----- Pressure [in Hg]	[psi]	Pressure Sensor 3 [VDC]	Pressure Sensor 4 [VDC]	Difference P3	Difference P4
0	0	0.999	0.999	-0.0010	-0.0012
2.24	1.096189	2.087	2.085	0.0039	0.0024
3.9	1.908543	2.896	2.892	0.0049	0.0028
6.14	3.004732	3.996	3.985	-0.0022	-0.0008
8.19	4.00794	4.995	4.981	-0.0009	0.0003
10.08	4.93285	5.917	5.902	-0.0007	-0.0014
0	0	1.002	1	-0.0040	-0.0022
Curve Fit:	Slope	1.002955	1.00614		
	Inters.	-1.00092	-1.00398		

P3 [psi]= 1.00295*VDC - 1.00092
P4 [psi]= 1.00614*VDC - 1.00398



RH 6/28/94

Thermocouples were calibrated by S. Svedeman using an ice water bath

RH 12/8/94

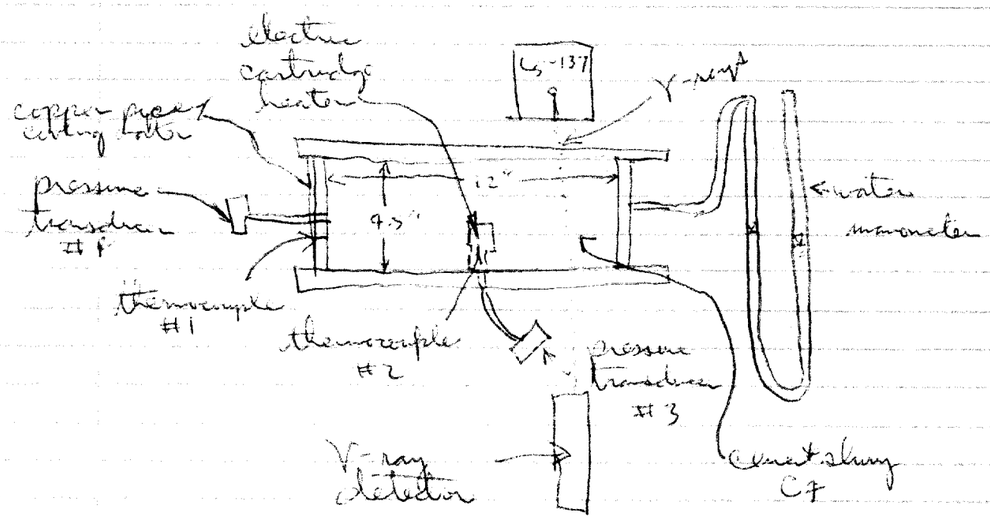
On Friday the following channels were set:

#1) thermocouple for side wall of container
#2) thermocouple for heater element
#3) pressure transducer at heater
#4) pressure transducer at sidewall of container

Pressure transducers are set to measure positive air pressures.

Also, a water manometer was attached to cylinder container side wall opposite the pressure transducer. This was connected as a safety precaution to provide an pressure outlet if pressures become too great.

The experimental set looks like the following



Power supply to heater is routed through transducer (variac) to allow measurement of heat load (Watts), indicated on X-2 densitometer DAS

The objective of this experiment is to provide a heat source to the cell at the center of the container and record any pressure gradient in the gas phase using the two pressure transducers and the change in moisture content using the X-Y densitometer using a Cs-137 source.

All measurements will be taken using the DAS. Measurements will running essentially continuously since the maximum pressure gradient in the gas is predicted to occur in the first 24 hrs.

The external side walls of the container are cooled to approximated 20°C using water circulated through a chiller. The top & bottom of the cell are plexiglass w/ no insulation.

Experimental set up is now configured & installed DAS running fine

6-28-94 SS

DAS Configuration

PC IBM PS/2 Model 70 386 USED FOR RUNNING TRAVERSING SYSTEM AND LOGGING PRESSURE, TEMPERATURE SENSORS AND DENSITOMETER

DATA LOGGER - FLUKE HYDRA S/N 5777560

GAMMA DETECTOR - CANBERRA SERIES 35 Plus Pulse Height Analyzer Ser. # 03937555

RA 12/8/94

RH 6/29/94

6/28/94 9:43 AM restarted DAS to record data taken on aluminum block standards. Heater was turned on to 40.6 Watts, heater warm quickly to 68°C & reached ~80°C within 2 min and to ~93°C w/in 6 min.
RFF

10:22 AM heater T = 108°C P_{water} ~ 0.35 psi

10:27 AM heater power set to 66.5 Watts ("70" on variac)

10:37 AM heater T = 152°C P_{int} ~ 0.3 psi
extend (auto) P_{int} ~ 0 psi

10:38 AM set heat power to 65 → 55.1 Watts

RH 6/29/94 3:14 PM heater power = 55 Watts, heater T = 199°C
P_{int} ~ 2.6 psi

6:50 PM heater power decreased to 47.7 Watts
(temp was 215.5°C which was too high)
P_{int} ~ 2.77 psi

6/30/94 1:25 PM heat load at 47.4 Watts temp = 191.4°C
RFF P_{int} = 1.436 psi

RH 12/8/94

7/1/94 9:45 AM heater temp = 193°C, heater power = −0.07 psi
RFF

There is water in the pressure sensing lines. Pulled the pressure line for the outside pressure line off, it was P ≈ 1 − 0.039 ~ −0.9 psi gage read 0.0 psi when was off so it is working OK.
Reconnected to container and P_{int} went back to −0.4 psi since a little air was allowed into line during procedure.
Manometer on other side of cylinder was reading ~ −0.4 inches H_2O, also indicating a vacuum on the container.

Disconnected heater pressure line & blew out water with pressurized Nitrogen. Reconnected, pressure P_{int} went back to ~0.1 psi

10:09 AM restarted DAS after above work
heater power = 48 watts

7/5/94 DAS "hung up" lost data recorded data on 6/29/94, but it looked OK on 7/1/94, will need to inspect data files more closely
RFF

renamed files JCRRUN.XXX → CEMENTA.XXX
JCNKRUN.YYY → CEMENT.YYY

heater power 48 Watts, heater temp 193°C, pressure in manometer = +19.6" H_2O
P_{int} ≅ +0.07 psi, P_{out} ≅ −0.1 psi

Densitometer Region of interest lost - reset to channels 3169 to 3754

Restarted DAS

7/5/94 5:20 PM DAS "hung up" again, but it looks like it went through 1 full time cycle
RH

7/6/94 9:30AM
RH DAS hung up again - it looks like it went through the matrix file one time & hung up again

Restarted DAS
heater power = 48 watts, temp = 192°C
P_{int} ~ 0.05 psi
Case pressure ~ 0.03 psi, manometer reading ≈ 29.6" H_2O

5:49PM DAS operating fine

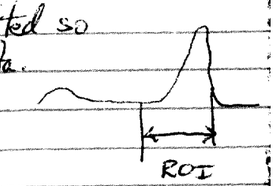
7/7/94 8:25AM Manometer is at 29.6" H_2O
RH heater power = 46.9 watts
DAS operating OK

5:35PM DAS operating fine

7/8/94 7:55AM DAS operating OK
manometer at 33" H_2O
heater temp at 192.8°C

7-8-94 SS
8:35AM TURNED OFF HEATER TO LET CEMENT COOL DOWN - LEFT DAS ON TO RECORD MOISTURE MOVEMENT.

7-12-94 SS
2:35PM DAS working O.K.
Canberra region of interest has shifted so peak is on edge of recorded data.
Reduced gain slightly



Temp heater = 20°C
Both Pressure sensor read 0.001 VDC
∴ press < -1.0 psi
Manometer shows 0 psig
There is water in the heater pressure line.

7-14-94 SS
10:00AM DAS "Hung-up" - Restarted DAS

7-18-94 SS 1:15PM DAS "Hung-up" -
Last time data file was written to was 7-14-94 @ 12:49PM
Restarted DAS
Manometer Pressure on container = 0 SS 7-18-94
Heater Press ~ ~~1.0~~ 0.0 psi SS 7-18-94 Well Press ~ ~~1.0~~ 0.0 psi SS 7-18-94

✳ The connection to the ~~multi~~ 8.0 vdc power supply had been pulled out. I do not know when this happened.

7-19-94 2:00PM SS DAS "Hung-up" - Restarted it again.
7-20-94 9:37AM SS " " " " " "
7-22-94 8:40AM SS DAS Running O.K.

7/14/94
KM

Put the following in the HOBART mixer and blended well:

9,242 g Portland Type I cement
~~16,83~~ KM 7/14/94 16 840 g Barite Powder
1,276 g Bentonite Powder

After mixing removed from bowl and put into 5 gal bucket.
Mixed liquid ingredients in bowl. They were: 9,242 g Water (TAP Water)
92 g Daracen 100
3.90 g air entrainment
17 g ivory liquid soap
Added dry ingredients a little at a time so it would mix well. Lost aprox 10 g due to spillage.
Mixed in HOBART for about 10 min.

Filled: cylinder "C6"
5 B size tubes
poured rest into 5 gal bucket.
Attached ~~B~~ KM 7/14/94 cement vibrator to 2nd step of lab foot ladder, and vibrated cylinder to remove air. This was done during pouring to remove bubbles. Water came to the top creating a film where cement was originally "overtopped." This water ran down the sides of the cylinder. After about 15 minutes mixture began to "boil" (CO_2 gas?) around the edges. Let cylinder set.

KM 7/19/94 covered all specimens with plastic wrap.

Test 10

10/4/94
RW

Initiated second cylinder test. This test has same set up as described on pgs 10-11 used for first cylinder test. The difference is that a new data acquisition system (by Steve Bird, DNV Ø4) is being used. There is a 2 min count time for each densitometer and pressure and temperature are measured every 2 minutes by the fluke.

Again, the objective of this test is to observe the transient gas pressure resulting from heat source.

Initiated test at 9:21 AM after recording background for several days. Container temperature set at 20°C. Cranked heater power up to 50 Watts. Based on first test, this should give heater temperature of about 200°C. Barometric pres = 14.54 psia

Following are early values, prior to turning on DAS

time	heater power (watts)	heater T (°C)	manometer container P (mH$_2$O)	P heater (psia)	P case (psia)
9:19	0	20.6	0.0	0.0	−0.029
9:21	50	28.0	−1.0	+.008	
9:25	50	~~65~~ 55		0.162	−0.037
9:27	50	63		0.239	
9:30	50	72	−0.1	0.336	−0.011
9:33	50	81		0.418	
Heard crack from container, possible concrete crack since no indication of container crack & cracks are visible on top side of concrete cylinder					
9:37	50	87	+1.0	0.368	+0.058
9:42	50	93.3	+2.3	0.350	+0.088
9:47	49	99.2		0.4070	+0.141
turned on DAS					
10:06	50		+7.0		
10:22	50		+7.5		

Time	T_{Heater} (c)	$T_{coolant}$ (c)	P_{case} (in H_2O) / $P_{manometer}$ (psi)	P_{Heater} (psia)	P_{case} (psia)
10:46			+11.8		
11:15			+12.8		
11:44			+20.2		
1:13 PM	168.1	20.8	+16.1	0.112	0.563
2:12 PM			+11.0		
2:39			+10.4		
7:46	202.1	21.3	+5.1	0.055	0.176
7:52	216.8	21.3	+2.8	0.026	−0.122

Since pressure in case is also going up, the integrity of the container, but probably the concrete, has been compromised.

System crashed, restarted at 7:45 Tuesday night: data file → RONSTART 10/4/94

System crashed again after 10PM, set sample interval to 4:00:00 & restarted → RON2

10-5-94 12:50PM SS – DAS DOWN AGAIN. Changed Fluke Scan interval to 5 minutes & turned off "monitored channel".
Heater Temp = 215 °C, Heater P = −0.011 psig,
Case P = −0.13 psig, Manometer on Case = −3.1
Heater Power = 49.0 Watts

10-7-94 11:10 AM Heater Power = 48.7 watts, Manometer reading of case pressure = +8 in H_2O.
Heater T = 223.9 °C, Heater P = +0.267 psig,
Case P = 0.288 psig

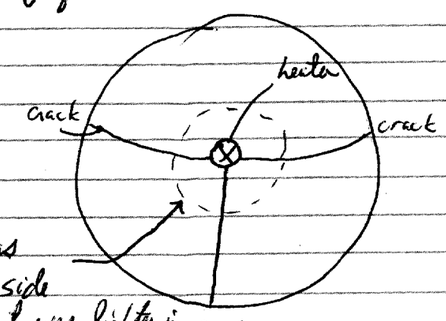
10-12-94 10:15 AM SS
T HEATER = 240 °C, Heater Power = 48.7 watts,
Heater P = 0.019 psig, Case P = 0.000 psig
Manometer Reading of case pressure = 0.0" H_2O

10/12/94 Turned off heater RH
3:02 PM, temperature was at 235.4 °C

10-19-94 12:35 PM SS
Densitometer positioning looks like it is "off".
Restarted DAS.

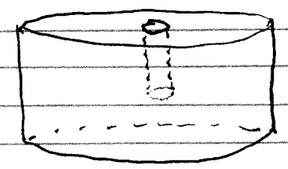
10-25-94 10:00 AM SS
TEST STOPPED

THE Cement cylinder was removed from the test stand. The bottom plate was removed and it showed 3 large cracks in the cement that run radially from the heater.



a discolored area ~4" in diameter was clearly visible. Inside the circle the cement was lighter in color.

10/31/94 RH Have prepared cylinder test with a piece of tuff rock. This test will be used to assess the formation of gas gradients in low permeable media. The cylinder media was prepared from 18" diameter core collected ~1970 from Apache Leap Site by the Sandia Rock Mechanics group. The core was cut to 12" diameter and ~4½" thick. The two ends were ground down to an even surface. The aluminum casing was cut and shrunk to provide a close fit to the rock cylinder. A ~1" diameter heater hole was drilled into the center of the cylinder



A coil of copper with circulating water is used to cool the outer edge. Plexiglass smeared with silicon prohibits gas movement along the ends. The plexiglass cracked on the edges but the silicon remained intact. There are pressure transducers attached to the center heater and the edge. Have with thermistors. The dessicantes will measure along one radius every 1 hr 45 min.

Test is called ROCK.
Configuration file is ROCK.CFG with 32 pts spaced evenly at 0.2"
DAS set at 1 hr 50 minutes. One full scan takes about 1 hr 40 minutes, 10 minutes dead time between scans

Will raise temp to ~190°C to keep plexiglass from degrading. A manometer will allow manual observation of edge pressure during test.

I restarted DAS, can monitor fluids at all times except when up-loading info

Turned Heater on at 9:02, set at 35.2 Watts

Time	T_{core} (°C)	T_{center} (°C)	$P_{manometer}$ (inch H_2O)	P_{Heater} (psi)	P_{case} (psi)
9:07 AM	20.1	50.9	0	0.307	0.004
9:14		64.1	0.3	0.492	0.013
9:22		72.6	0.3	0.641	0.006
9:23	raised heater to 41.8 Watts				
9:28		81.6	0.5	0.810	0.017
9:36		88.6	0.3	0.958	0.012
9:44	20.2	92.0	0.4	1.058	0.016
9:50	Heater at 41.2 Watts				
9:55	20.3	95.7	0.8	1.212	0.035
9:58	Heater raised to 45.3 Watts				
10:03	20.4	101.0	0.5	1.263	0.018
10:04	Heater at 45.2 Watts				RH 10/31/94 0.023
10:15	20.5	104.9	0.8	1.395	0.029
10:17	Set Heater up to 46.5 Watts				
10:20	20.6	106.5	1.1	1.472	0.040
10:27	20.7	109.8	0.7	1.561	0.042
10:28	Heater at 47.1 Watts				
10:37	20.8	112.3	1.5	1.686	0.059
10:38	Heater at 47.2 Watts				
11:13	21.1	117.5	1.7	1.836	0.063
11:14	Heater at 47.1 Watts				
11:37	21.3	119.4	2.6	1.973	0.098
11:38	Heater at 47.1 Watts				

Time	T_{case} °C	T_{center} °C	$P_{manometer}$ inch H_2O	P_{Heater} PSI	P_{case} PSI
11:55AM	21.3	120.7	2.6	~~2~~ 1.971 RH 10/31/94	0.095
11:56	Heater at 46.8 Watts				
11:58	Set heater to 52.8 Watts				
12:23	21.5	130.4	2.7	2.235	0.116
12:24	Heater at 52.5 Watts				
12:42	21.5	132.6	3.0	2 RH 10/31/94 ~~3~~.307	0.126
12:43	Heater at 52.5 Watts				
12:44	Set heater to 59.1 Watts				
1:01 PM	21.7	142.5	4.2	2.614	0.157
1:03	Heater at 59.2 Watts				
1:22	21.7	144.5	4.2	2.631	0.153
1:23	heater at 58.7 Watts				
1:24	Set heater to 66.1 Watts				
1:40	21.8	155.3	4.5	2.235	0.159
1:41	Heater at 66.2 Watts				
2:03	22.0	159.0	5.2	1.513	0.190
2:24	22.0	160.1	5.3	1.323	0.191
2:25	Heater at 65.0 Watts				
2:42	22.1	161.1	5.4	1.191	0.195
2:43	Heater at 65.2 Watts				
3:00	22.2	161.7	5.5	1.084	0.197
3:01	Heater at 65.3 Watts				
3:18	22.2	162.1		1.000	0.203
3:19	Heater at 65.9 Watts				
3:58	22.3	163.0	6.3	1.041	0.229
3:59	Heater at 66.6 Watts				
4:38	22.4	161.3	6.3	1.078	0.229
4:39	Heater at 65.9 Watts				
11/1/94					
RH 7:48 AM	22.5	159.8	4.4	1.246	0.162
7:49	Heater at 66.5 Watts				
11:06 AM	22.5	157.4	4.2	1.092	0.149
11:07	Heater at 65.2 Watts				
3:58	22.5	156.9	4.1	1.042	0.149
3:59	Heater at 64.9 Watts				

Time	T_{case} °C	T_{center} °C	$P_{manometer}$ inches H_2O	P_{Heater} PSI	P_{case} PSI
11/2/94 RH					
10:18	22.5	156.3	1.6	0.075	0.038
	Heater at 63.7 Watts				

11/7/94 9:30 AM SS
Heater Power @ 65.0 Watts
TURNED OFF HEATER

11/17/94 4:15 PM Power Failure – Traversing System is "OFF" (Power Failed at ~ 2:00PM Today)
Restarted DAS. Manometer +0.2" H_2O

12/5/94 10:00 AM SS
Date on computer was set to 11-23-94, changed to 12/5/95.
DAS did not record since 11/22/94. Restarted DAS

12/22/94 11:40AM SS
DAS Traversing system "off" – power failure 1 or 2 days ago is probable cause – Restarted DAS.

1/10/95 8:40 AM SS
Shut down Test.

1/10/95 SS

11/1/95
RH

11/1/94
KM

Cut core of Apache Leap tuff from same bulk sample that the densitometer experiment on page 20 of this notebook. Drilling fluid was tap-water. Dimensions of core are 12.93 cm long by 5.01 cm in diameter.

Vol of sample $= \pi r^2 h$
$= 254.90 cm^3$

Left core to dry at ambient laboratory temps on RH T ~ 24°C RH ~ 53%

11/2/94
KM

wt of core sample before putting in oven = 618.7 g.

Placed core in oven at 105°C.

11/7/94
KM

Wt of core = 613.7 g.
Used Sartorius Scale; got 3 consecutive weights of 613.7 g. Core was weighed hot.

11/18/94
KM

Wt. of hot core = 613.4 g
placed core in jar of dessicant to cool

11/21/94
KM

Wt. of "cooled" dry core = 613.4 g

Placed core in permeameter, pulled a vacuum for 30 min. Filled permeameter with DA-DI water put under 75 psi of water pressure.

KM 12/16/94

Removed core from permeameter. Patted with Kimwipe so no "free" water coated the surface
Wt of saturated core 631.1 g.

$$n_{eff} = \frac{(631.1 - 613.4)}{254.9} \times 100 = 6.94\%$$

Pages 1 through 25 of this Scientific Notebook were reviewed for compliance with QAP-001 in response to Corrective Action Request 94-02. Corrections and clarifications were made as appropriate. In some cases, the date of a change will reflect the date of this review rather than the date of the original Scientific Notebook entry.

Randy Folch
SWRI QA
12/12/94

KM 12/16/94 Moisture content on 11/2/94

$$MC_{11/2/94} = \frac{618.7 - 613.4}{631.1 - 613.4} \times 100 = 29.94\% \text{ saturated}$$

KM 12/27/94 ALcup sample used in previous experiments given sample id = AL * 1.5 * 4. This sample was cut for a piece to be used on the permeameter. EJ James is running the K_{sat} test.

9/21/95 Notebook closed out
RKF

Note that there are 4 3-ring binders with laboratory experiment photos and data disks as supplemental information

ADDITIONAL INFORMATION FOR SCIENTIFIC NOTEBOOK #: 098

Document Date:	11/22/1993
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Data Sensitivity:	■"Non-Sensitive" □ Sensitive □"Non-Sensitive - Copyright" □ Sensitive - Copyright
Date Generated:	1990 through 1999
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File Types: (.exe, .bat, .zip, etc.)	Various
Remarks: (computer runs, etc.)	Media contains: Thermohydrology tests data; and separate effects tests data. Photographs and slides of the separate effects tests.