21
300

R

Ronald T Green Riff

## The Boorum & Pease® Quality Guarantee

The materials and craftsmanship that went into this product are of the finest quality. The pages are thread sewn, meaning they're bound to stay bound. The inks are moisture resistant and will not smear. And the uniform quality of the paper assures consistent rulings, excellent writing surface and erasability. If, at any time during normal use, this product does not perform to your expectations, we will replace it free of charge. Simply write to us:

Boorum & Pease Company
71 Clinton Road, Garden City, NY 11530
Attn: Marketing Services

Any correspondence should include the code number printed at the bottom of this page as well as the book title stamped at the bottom of the spine.

RULED

209

4/21/97 RG

This scientific notebook will be used to record analyses performed for the Thermal Effects on Flow KTI. All entries will be by Ronald Green unless otherwise noted.

4/21/97 RH

Thermal Conductivity experiments.

Following is information on analyses conducted to determine thermal conductivity. The lab experiments were conducted on an apparatus built in Bldg 51. A description of the apparatus is in Notebook # 173. Results of the experiments are in Notebooks # 173 & 212.

The purpose of the experiment was to measure bulk thermal conductivity through bulk geologic media.

The mass of the rock included in the cell was 166.55 kg. The dimensions of the cell are $0.151 \times 0.882 \times 0.885 = 0.11787\ m^3$

$$\frac{166.55\ kg}{0.11787\ m^3} = 1.413e3\ kg/m^3 \quad \text{bulk density}$$

The ALTS tuff used in this experiment has a matrix density of 2440 kg/m³ (Green et al ~~1996~~ 1997 NUREG/CR-6348) RH 4/21/97

$$(1-\theta)\ 2440 = 1413$$
$$1-\theta = 0.57912$$
$$\theta = 0.42088$$

test media had interstitial (secondary) porosity of 0.42



Time required to come to ~ steady state after a change in boundary conditions.

Assume both plates (upper & lower) in cell are raised by 20°C

$C_p$ for tuff = 840 J/kg-K

mass of rock = 166.55 kg

$$(20\ K)(166.55\ kg)(840\ J/kg-K) = 2.798e6\ \cancel{sec}\ J$$

RH 4/21/97

for a flux rate of 200W/m² into a cell by cross-sectional area of

$0.882 \times 0.885 = 0.78057\ m^2$

W into cell is 15.611e1 (J/s

to get time required to get 2.798e6 J into cell @ 15.611 J/s

$$\frac{2.798e6\ J}{15.611e1\ J/s} = 1.7923e\cancel{8}4\ sec$$

RH 4/21/96

≈ 5 hrs.

4/21/97 RH

Ten samples of tuff were collected from the cell at the conclusion of media testing. Results from saturation measurements performed on these samples is as follows

| Sample ID | Mass at time of removal from $K_t$ appar. (g) | Mass dry (g) | Mass sat. (g) | Volume ($cm^3$) | Poros. | Sat. | Bulk density $\rho_b$ $g/cm^3$ |
|---|---|---|---|---|---|---|---|
| 1 | 22.187 | 21.471 | 22.274 | 8.7 | 0.092 | 0.89 | 2.5 |
| 2 | 17.039 | 16.499 | 17.097 | 9.5 | 0.063 | 0.90 | 1.7 |
| 3 | 23.528 | 22.865 | 23.592 | 10.9 | 0.067 | 0.91 | 2.1 |
| 4 | 19.878 | 19.314 | nd* | 9.3 | 0.056 | 100% | 2.1 |
| 5 | 22.962 | 22.266 | nd* | 8.5 | 0.055 | 100% | 2.6 |
| 6 | 26.244 | 26.198 | 27.145 | 11.0 | 0.086 | 0.049 | 2.4 |
| 7 | 25.224 | 25.149 | 25.973 | 10.6 | 0.078 | 0.091 | 2.4 |
| 8 | 19.513 | 19.394 | 20.028 | 8.5 | 0.075 | 0.19 | 2.3 |
| 9 | 20.870 | 20.798 | nd* | 9.3 | 0.052 | 0.15 | 2.2 |
| 10 | 26.092 | 25.865 | nd* | 11.3 | 0.060 | 0.33 | 2.3 |

* no data collected

4/21/97 RH changed from 100 to 1.0

Melissa Hall conducted the analyses and performed the analyses as described in NUREG/CR-6356 Green et al 1995

4/22/97 RH

Plots for the five series of test are on page 5-7
The five series (~~totally~~ total 66 tests) are as follows
RH 4/22/97

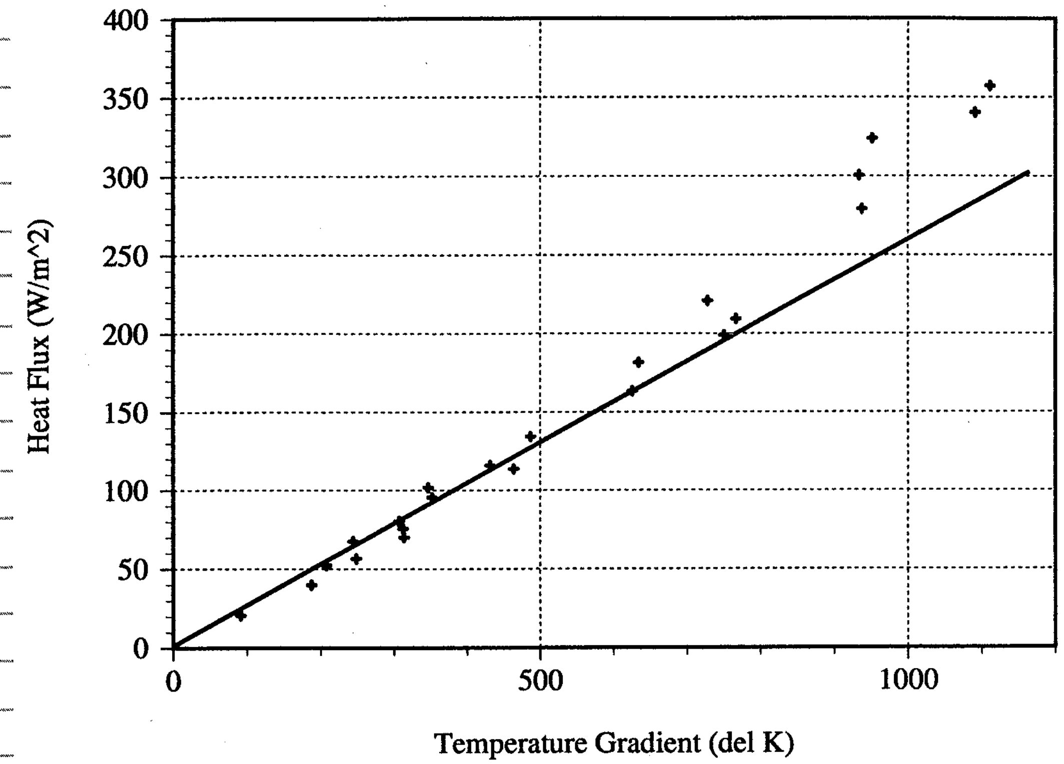
| | test # | |
|---|---|---|
| Series A | 1-23 | fully unsat |
| Series B | 24-34 | fully sat |
| Series C | 35-49 | matrix-only saturated |
| Series D | 50-57 | air only |
| Series E | 58-66 | water only |

RH 9/16/97

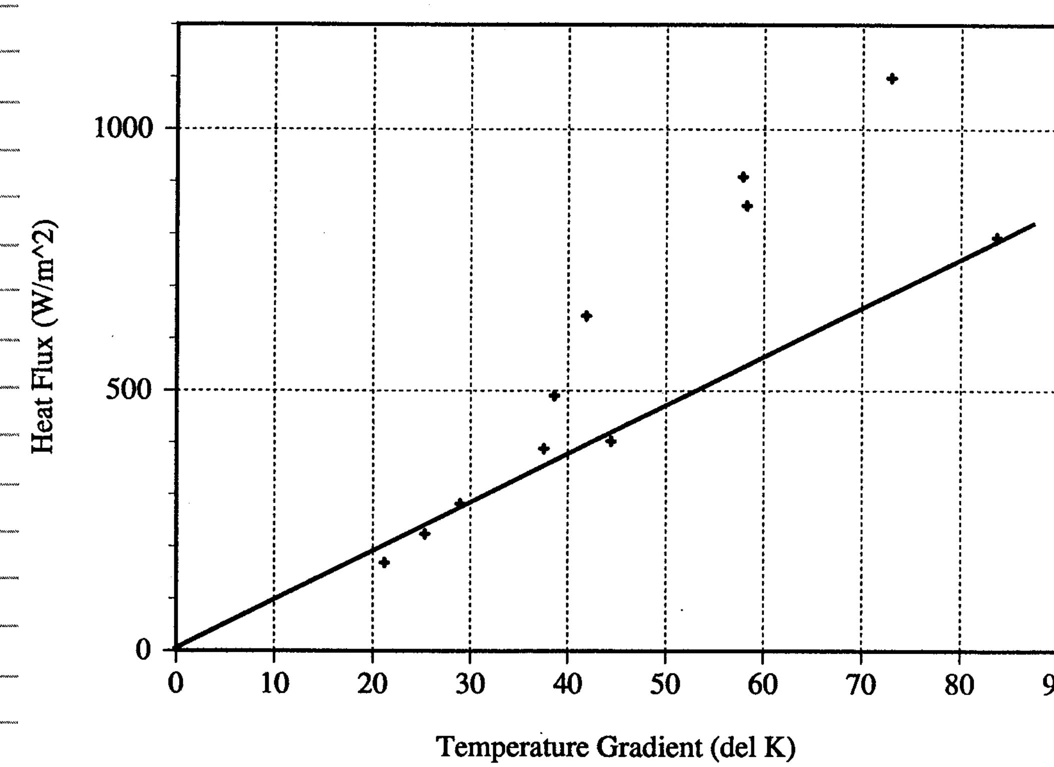
these data are located on /home/sneezy/rgreen/th-cond in th-*i.cnv, raw data in th-new_tab



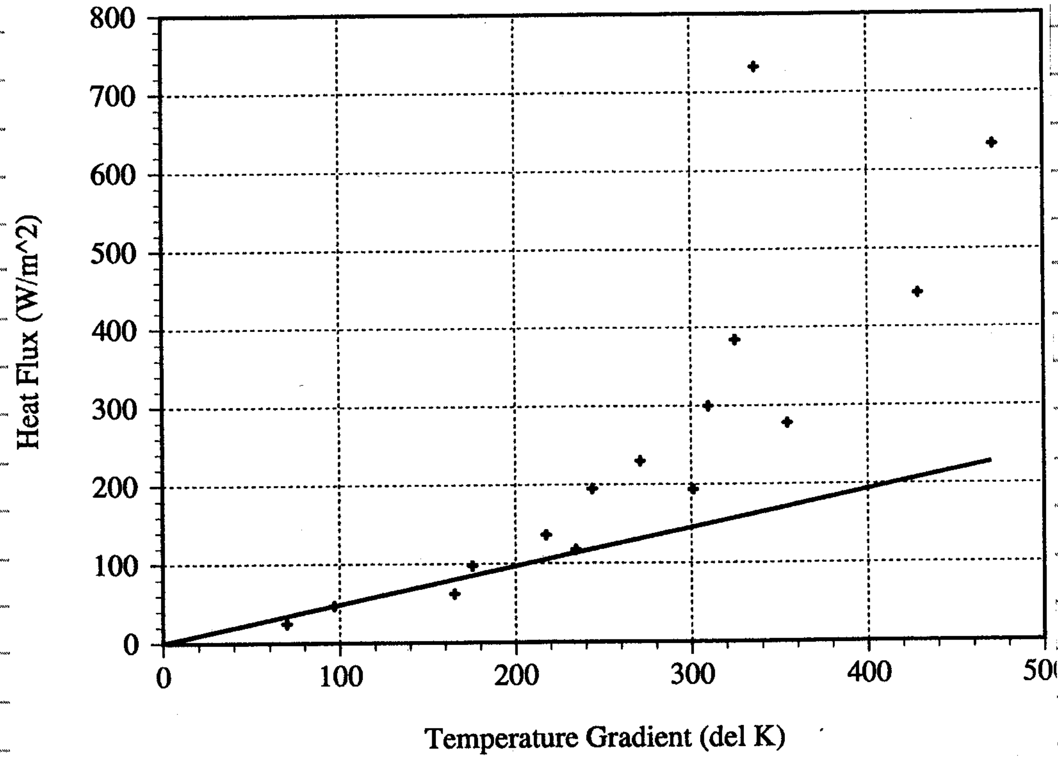
## Series A



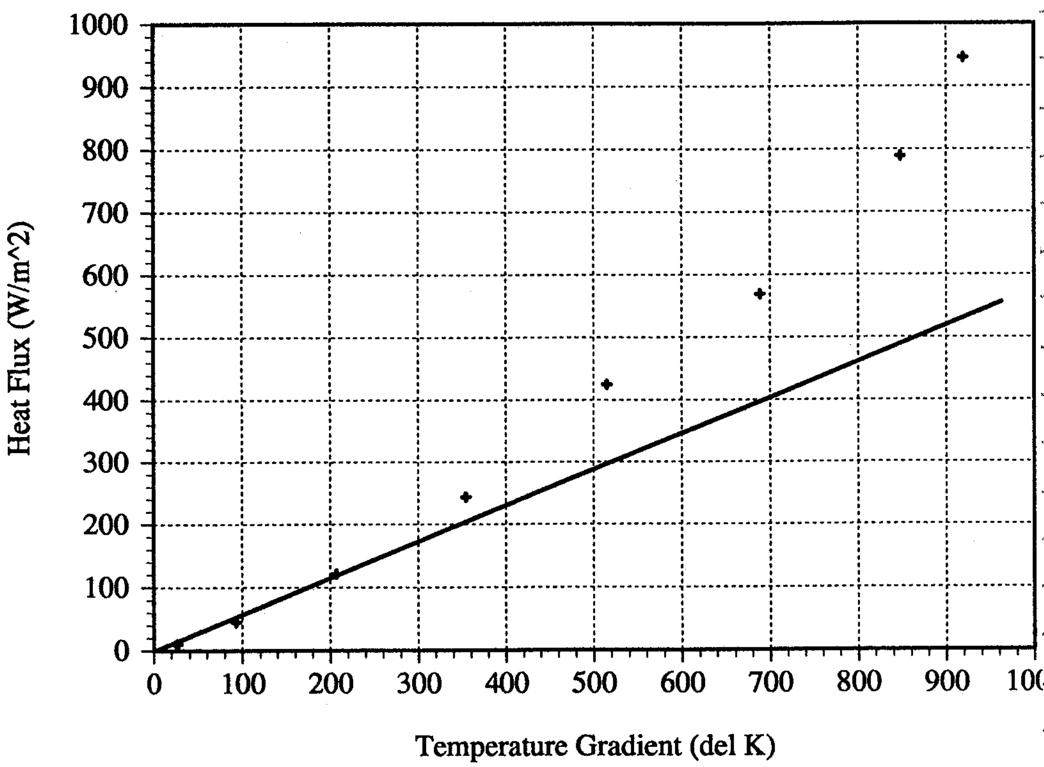

## Series B



Series C

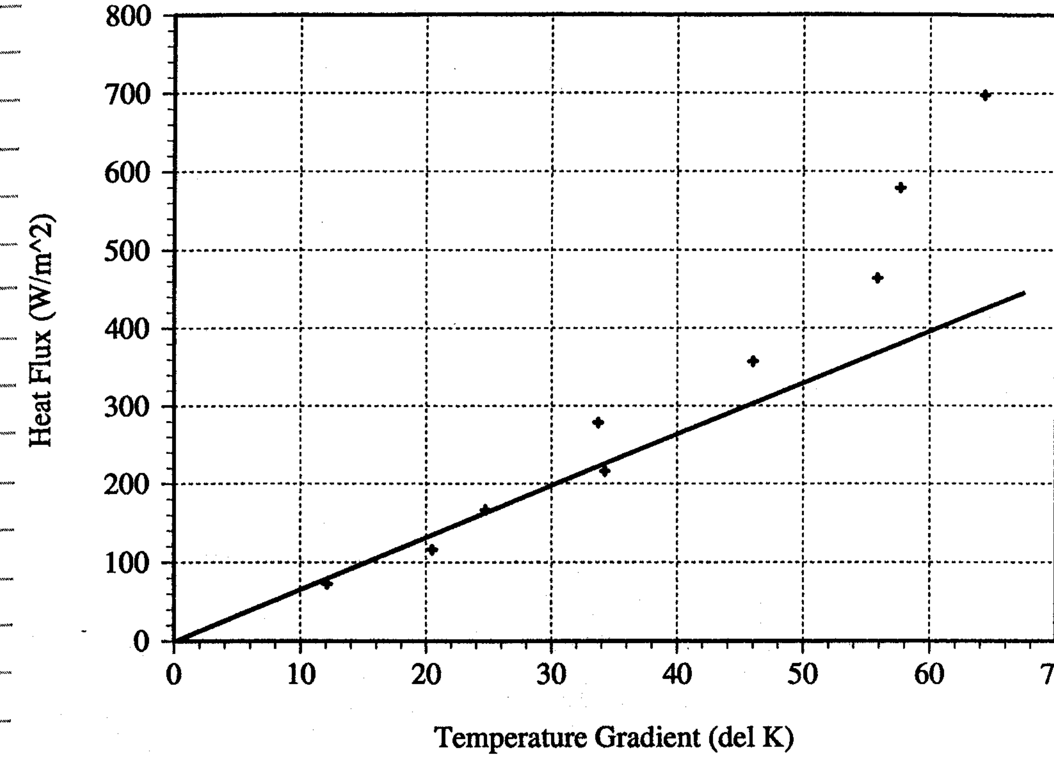



Series D






Series E




Reduced data (taken from notebooks #173 & 212) are presented as tables as follows:

Sample calculations are included in Notebook #173
Note that $\nabla T$ was determined using $\frac{\Delta T}{0.15\,m}$.
0.15 m was used to approximate the distance between the lower & upper plates
i.e. test 1 $\frac{\Delta T}{0.15} = \frac{46.86}{0.15} = 312.40 \frac{K}{m} = \nabla T$

$K_{eff}$ were calculated using $\frac{\Delta T}{l}$ for $\nabla T$ where
$l = 0.1524$ for tests ~~16~~ 1-6 RH 5/7/97, 25-66 and
$l = 0.15873984$ for tests 7-24. These tests had a larger $l$ due to a gasket
i.e. $K_{eff} = \frac{Q}{\nabla T} = \frac{Q\,l}{\Delta T}$

for test 1 $K_{eff} = \frac{(75.52)(0.1524)}{46.86} = 0.246$

RH
4/22/97

Table 6-1. Experimental results for the unsaturated Series A (1-23), saturated Series B (24-34), matrix-only saturated Series C (35-49), air-filled Series D (50-57), and water-filled Series E (58-66) experiments

| Test No. | $T_{lower}$(C) | $T_{top}$ (C) | $T_{avg}$ (C) | ΔT (K) | ∇T (K/m) | Q (W/m$^2$) | $\kappa_{eff}$ (W/m-K) |
|---|---|---|---|---|---|---|---|
| 1 | 70.00 | 23.14 | 46.57 | 46.86 | 312.40 | 75.52 | 0.246 |
| 2 | 69.40 | 23.35 | 46.375 | 46.05 | 307.00 | 80.36 | 0.266 |
| 3 | 76.60 | 39.94 | 58.27 | 36.66 | 244.40 | 67.59 | 0.281 |
| 4 | 92.44 | 40.43 | 66.43 | 52.01 | 346.73 | 101.75 | 0.298 |
| 5 | 85.66 | 20.98 | 53.32 | 64.68 | 431.20 | 115.80 | 0.273 |
| 6 | 33.28 | 19.53 | 26.40 | 13.75 | 91.67 | 20.74 | 0.230 |
| 7 | 165.35 | 25.30 | 95.32 | 140.05 | 933.67 | 300.47 | 0.341 |
| 8 | 192.96 | 26.29 | 109.62 | 166.67 | 1111.13 | 357.20 | 0.34 |
| 9 | 166.18 | 25.56 | 95.87 | 140.62 | 937.47 | 279.26 | 0.315 |
| 10 | 139.73 | 24.75 | 82.24 | 114.98 | 766.53 | 209.13 | 0.289 |
| 11 | 118.32 | 24.49 | 71.40 | 93.83 | 625.53 | 163.40 | 0.276 |
| 12 | 93.05 | 23.53 | 58.29 | 69.52 | 463.47 | 113.56 | 0.259 |
| 13 | 69.90 | 22.85 | 46.37 | 47.05 | 313.67 | 70.06 | 0.236 |
| 14 | 50.62 | 22.44 | 36.53 | 28.18 | 187.87 | 39.97 | 0.225 |
| 15 | 190.19 | 26.57 | 108.38 | 163.62 | 1090.80 | 340.32 | 0.33 |
| 16 | 203.74 | 61.00 | 132.37 | 142.74 | 951.60 | 323.85 | 0.36 |
| 17 | 144.84 | 32.29 | 88.56 | 112.55 | 750.33 | 198.87 | 0.28 |
| 18 | 153.00 | 57.86 | 105.43 | 95.14 | 634.27 | 181.66 | 0.303 |
| 19 | 130.17 | 57.20 | 93.68 | 72.97 | 486.47 | 134.24 | 0.292 |
| 20 | 107.77 | 54.95 | 81.36 | 52.82 | 352.13 | 95.49 | 0.287 |
| 21 | 85.24 | 54.06 | 69.65 | 31.18 | 207.87 | 52.45 | 0.267 |
| 22 | 76.13 | 38.84 | 57.48 | 37.29 | 248.60 | 56.51 | 0.241 |
| 23 | 164.92 | 55.74 | 110.33 | 109.18 | 727.87 | 220.71 | 0.321 |
| 24 | 52.35 | 39.80 | 46.07 | 12.55 | 83.67 | 794.13 | 10.04 |
| 25 | 36.59 | 30.80 | 33.69 | 5.79 | 38.60 | 490.52 | 12.92 |
| 26 | 47.10 | 36.17 | 41.63 | 10.93 | 72.87 | 1098.72 | 15.33 |
| 27 | 38.65 | 29.92 | 34.28 | 8.73 | 58.20 | 854.39 | 14.92 |




RH
4/22/97

Table 6-1. Experimental results for the unsaturated Series A (1-23), saturated Series B (24-34), matrix-only saturated Series C (35-49), air-filled Series D (50-57), and water-filled Series E (58-66) experiments (cont'd)

| Test No. | $T_{lower}$(C) | $T_{top}$ (C) | $T_{avg}$ (C) | ΔT (K) | ∇T (K/m) | Q (W/m$^2$) | $\kappa_{eff}$ (W/m-K) |
|---|---|---|---|---|---|---|---|
| 28 | 22.13 | 15.47 | 18.80 | 6.66 | 44.40 | 402.49 | 9.21 |
| 29 | 31.01 | 25.38 | 28.19 | 5.63 | 37.53 | 388.10 | 10.50 |
| 30 | 28.26 | 23.92 | 26.09 | 4.34 | 28.93 | 282.42 | 9.92 |
| 31 | 26.78 | 22.98 | 24.88 | 3.80 | 25.33 | 224.20 | 9.00 |
| 32 | 25.38 | 22.20 | 23.79 | 3.18 | 21.20 | 169.11 | 8.12 |
| 33 | 36.75 | 30.47 | 33.61 | 6.28 | 41.87 | 643.18 | 15.61 |
| 34 | 47.91 | 39.24 | 43.57 | 8.67 | 57.80 | 909.36 | 15.98 |
| 35 | 33.99 | 19.45 | 26.72 | 14.54 | 96.93 | 47.25 | 0.495 |
| 36 | 47.07 | 20.75 | 33.91 | 26.32 | 175.47 | 97.32 | 0.563 |
| 37 | 60.55 | 23.97 | 42.26 | 36.58 | 243.87 | 194.70 | 0.811 |
| 38 | 54.71 | 22.07 | 38.39 | 32.64 | 217.60 | 136.22 | 0.636 |
| 39 | 65.85 | 25.19 | 45.52 | 40.66 | 271.07 | 229.70 | 0.861 |
| 40 | 70.4 | 23.95 | 47.17 | 46.45 | 309.67 | 299.85 | 0.984 |
| 41 | 74.88 | 26.13 | 50.50 | 48.75 | 325.00 | 384.16 | 1.201 |
| 42 | 80.36 | 29.87 | 55.115 | 50.49 | 336.60 | 732.44 | 2.211 |
| 43 | 90.77 | 20.07 | 55.42 | 70.70 | 471.33 | 632.98 | 1.364 |
| 44 | 29.63 | 19.14 | 24.38 | 10.49 | 69.93 | 24.64 | 0.358 |
| 45 | 44.60 | 19.81 | 32.20 | 24.79 | 165.27 | 61.98 | 0.381 |
| 46 | 55.69 | 20.51 | 38.10 | 35.18 | 234.53 | 117.43 | 0.509 |
| 47 | 66.83 | 21.66 | 44.24 | 45.17 | 301.13 | 193.59 | 0.653 |
| 48 | 76.08 | 22.91 | 49.49 | 53.17 | 354.47 | 277.94 | 0.797 |
| 49 | 89.29 | 24.96 | 57.12 | 64.33 | 428.87 | 442.93 | 1.049 |
| 50 | 23.19 | 19.24 | 21.21 | 3.95 | 26.33 | 10.09 | 0.389 |
| 51 | 33.60 | 19.66 | 26.63 | 13.94 | 92.93 | 45.07 | 0.492 |
| 52 | 51.38 | 20.36 | 35.87 | 31.02 | 206.80 | 121.18 | 0.595 |
| 53 | 74.75 | 21.61 | 48.18 | 53.14 | 354.27 | 243.44 | 0.698 |
| 54 | 100.21 | 22.91 | 61.56 | 77.30 | 515.33 | 424.97 | 0.838 |
| 55 | 128.14 | 24.83 | 76.48 | 103.31 | 688.73 | 568.91 | 0.839 |
| 56 | 158.20 | 30.98 | 94.59 | 127.21 | 848.07 | 789.10 | 0.945 |

Table 6-1. Experimental results for the unsaturated Series A (1-23), saturated Series B (24-34), matrix-only saturated Series C (35-49), air-filled Series D (50-57), and water-filled Series E (58-66) experiments (cont'd)

| Test No. | $T_{lower}$(C) | $T_{top}$ (C) | $T_{avg}$ (C) | ΔT (K) | ∇T (K/m) | Q (W/m$^2$) | $\kappa_{eff}$ (W/m-K) |
|---|---|---|---|---|---|---|---|
| 57 | 172.07 | 34.18 | 103.12 | 137.89 | 919.27 | 945.43 | 1.045 |
| 58 | 22.57 | 20.75 | 21.66 | 1.82 | 12.13 | 72.86 | 6.101 |
| 59 | 24.96 | 21.89 | 23.42 | 3.07 | 20.47 | 116.03 | 5.764 |
| 60 | 29.04 | 23.89 | 26.46 | 5.14 | 34.27 | 215.73 | 6.391 |
| 61 | 41.62 | 34.71 | 38.16 | 6.90 | 46.00 | 357.27 | 7.888 |
| 62 | 49.70 | 41.31 | 45.50 | 8.38 | 55.87 | 463.93 | 8.432 |
| 63 | 64.42 | 54.77 | 59.59 | 9.65 | 64.33 | 697.42 | 11.012 |
| 64 | 57.21 | 48.55 | 52.88 | 8.65 | 57.67 | 579.04 | 10.197 |
| 65 | 33.94 | 28.88 | 31.41 | 5.06 | 33.73 | 278.39 | 8.391 |
| 66 | 21.58 | 17.87 | 19.72 | 3.71 | 24.73 | 166.43 | 6.838 |

5/13/97 RH

Tables of the convection fitting coefficient are presented below. The first step is to determine the heat flux attributable to convection, subtract radiative & conductive contributions from total. In those cases where the predicted component by conduction is excessive, the predicted $Q_{conv}$ is negative. In these cases $Q_{conv}$ is set to zero (i.e. test 1, 6, 12 etc)

Table 9-2. Heat flux attributed to radiation, conduction, and convection. * denotes calculated values and ‡ denotes measured values.

| Test No. | $T_{avg}$ (C) | $\nabla T$ (K/m) | $Q_{rad}$* (W/m²) | $Q_{cond}$* (W/m²) | $Q_{conv}$* (W/m²) | $Q_{Total}$‡ (W/m²) |
|---|---|---|---|---|---|---|
| 1 | 46.57 | 312.40 | 0.16 | 80.78 | 0.0 | 75.52 |
| 2 | 46.37 | 307.00 | 0.15 | 79.39 | 0.81 | 80.36 |
| 3 | 58.27 | 244.40 | 0.24 | 63.20 | 4.14 | 67.59 |
| 4 | 66.43 | 346.73 | 0.51 | 89.66 | 11.56 | 101.75 |
| 5 | 53.32 | 431.20 | 0.33 | 111.50 | 3.95 | 115.80 |
| 6 | 26.40 | 91.67 | 0.01 | 23.70 | 0.0 | 20.74 |
| 7 | 95.32 | 33.67 | 4.10 | 241.44 | 54.91 | 300.47 |
| 8 | 109.62 | 1111.13 | 7.43 | 287.33 | 62.42 | 357.20 |
| 9 | 95.87 | 937.47 | 4.19 | 242.42 | 32.63 | 279.26 |
| 10 | 82.24 | 766.53 | 2.16 | 198.22 | 8.73 | 209.13 |
| 11 | 71.40 | 625.53 | 1.15 | 161.76 | 0.48 | 163.40 |
| 12 | 58.29 | 463.47 | 0.46 | 119.85 | 0.0 | 113.56 |
| 13 | 46.37 | 313.67 | 0.15 | 81.11 | 0.0 | 70.06 |
| 14 | 36.53 | 187.87 | 0.04 | 48.58 | 0.0 | 39.97 |
| 15 | 108.38 | 1090.80 | 7.05 | 282.08 | 51.18 | 340.32 |
| 16 | 132.37 | 951.60 | 11.21 | 246.08 | 66.55 | 323.85 |
| 17 | 88.56 | 750.33 | 2.64 | 194.03 | 2.18 | 198.87 |
| 18 | 105.43 | 634.27 | 3.77 | 164.02 | 13.86 | 181.66 |
| 19 | 93.68 | 486.47 | 2.03 | 125.80 | 6.40 | 134.24 |
| 20 | 81.36 | 352.13 | 0.96 | 91.06 | 3.46 | 95.49 |
| 21 | 69.65 | 207.87 | 0.35 | 53.75 | 0.0 | 52.45 |
| 22 | 57.48 | 248.60 | 0.23 | 64.28 | 0.0 | 56.51 |
| 23 | 110.33 | 727.87 | 0.0 | 188.22 | 27.51 | 220.71 |
| 24 | 46.07 | 83.67 | 0.0 | 97.05 | 697.03 | 794.13 |
| 25 | 3.69 | 38.60 | 0.0 | 44.77 | 445.73 | 490.52 |
| 26 | 41.63 | 72.87 | 0.0 | 84.52 | 1014.16 | 1098.72 |
| 27 | 34.28 | 58.20 | 0.0 | 67.51 | 786.86 | 854.39 |
| 28 | 18.80 | 44.40 | 0.0 | 51.50 | 350.98 | 402.49 |
| 29 | 28.19 | 37.53 | 0.0 | 43.53 | 344.55 | 388.10 |
| 30 | 26.09 | 28.93 | 0.0 | 33.56 | 248.85 | 382.42 |
| 31 | 24.88 | 25.33 | 0.0 | 9.38 | 194.81 | 224.20 |
| 32 | 23.79 | 21.20 | 0.0 | 24.59 | 144.51 | 169.11 |
| 33 | 33.61 | 41.87 | 0.0 | 48.56 | 594.60 | 643.18 |
| 34 | 43.57 | 57.80 | 0.0 | 67.04 | 842.28 | 909.36 |
| 35 | 26.72 | 96.93 | 0.01 | 43.66 | 3.57 | 47.25 |
| 36 | 33.91 | 175.47 | 0.34 | 79.04 | 18.23 | 97.32 |
| 37 | 42.26 | 243.87 | 0.09 | 109.86 | 84.74 | 194.70 |
| 38 | 38.39 | 217.60 | 0.06 | 98.02 | 38.12 | 136.20 |
| 39 | 45.52 | 271.07 | 0.12 | 122.11 | 107.45 | 229.70 |
| 40 | 47.17 | 309.67 | 0.16 | 139.50 | 160.18 | 299.85 |



RH 5/13/97

| Test No. | $T_{avg}$ (C) | $\nabla T$ (K/m) | $Q_{rad}$* (W/m²) | $Q_{cond}$* (W/m²) | $Q_{conv}$* (W/m²) | $Q_{Total}$‡ (W/m²) |
|---|---|---|---|---|---|---|
| 41 | 40.50 | 325.00 | 0.21 | 146.41 | 237.53 | 384.16 |
| 42 | 55.11 | 336.60 | 0.28 | 151.63 | 580.51 | 732.44 |
| 43 | 55.42 | 471.33 | 0.40 | 212.33 | 420.23 | 632.98 |
| 44 | 24.38 | 69.93 | 0.01 | 31.50 | 0.0. | 24.64 |
| 45 | 44.60 | 165.27 | 0.02 | 74.45 | 0.0 | 61.98 |
| 46 | 38.10 | 234.53 | 0.06 | 105.65 | 11.70 | 117.43 |
| 47 | 44.24 | 301.13 | 0.13 | 135.66 | 57.79 | 193.50 |
| 48 | 49.49 | 354.47 | 0.21 | 159.68 | 118.03 | 277.94 |
| 49 | 57.12 | 428.87 | 0.04 | 193.20 | 249.31 | 442.93 |
| 50 | 21.21 | 26.33 | 0.00 | 0.69 | 9.39 | 10.09 |
| 51 | 26.63 | 92.93 | 0.01 | 2.45 | 42.60 | 45.07 |
| 52 | 35.87 | 206.80 | 0.05 | 5.45 | 115.67 | 121.18 |
| 53 | 48.18 | 354.27 | 0.20 | 9.35 | 233.88 | 243.44 |
| 54 | 61.56 | 515.33 | 0.61 | 13.60 | 410.75 | 424.97 |
| 55 | 76.48 | 688.73 | 1.56 | 18.18 | 549.16 | 568.91 |
| 56 | 94.59 | 848.07 | 3.66 | 22.38 | 763.06 | 789.10 |
| 57 | 103.12 | 909.27 | 5.12 | 24.26 | 916.04 | 945.43 |
| 58 | 21.66 | 12.13 | 0.0 | 7.15 | 65.70 | 72.86 |
| 59 | 23.42 | 20.47 | 0.0 | 12.07 | 103.95 | 116.03 |
| 60 | 26.46 | 34.27 | 0.0 | 20.21 | 195.50 | 215.73 |
| 61 | 38.16 | 46.00 | 0.0 | 27.14 | 330.12 | 357.27 |
| 62 | 45.50 | 55.87 | 0.0 | 32.96 | 430.94 | 463.93 |
| 63 | 59.59 | 64.33 | 0.0 | 37.95 | 659.40 | 697.42 |
| 64 | 52.88 | 7.67 | 0.0 | 34.02 | 544.97 | 579.04 |
| 65 | 31.41 | 33.73 | 0.0 | 19.90 | 258.48 | 278.39 |
| 66 | 19.72 | 24.73 | 0.0 | 14.59 | 151.84 | 166.43 |

To get $Q_{Rad}$ use following eq (from deliverable to NRC 20-5708-661-720) from paper of thermal conductivity (see Manteufel, 1997) submitted to International Journal of Heat & Mass Transfer)

$$Q_{rad} = \epsilon \, d_p \, \sigma \, 4 \, T^3 \, \nabla T$$

where $\epsilon = 0.8$

$d_p = 0.028$ m

$\sigma = 5.67 \times 10^{-8}$ W/m²-K⁴

$T = T_{avg}$

for test 8

$T_{avg} = 109.62$

$\nabla T = 1111.13$

$Q_{rad} = 7.43$ W/m²

and to get $Q_{conv}$

$Q_{conv} = Q_{Total} - Q_{rad} - Q_{cond}$

$Q_{conv} = 357.20 - 7.43 - 287.33 = 62.42$ W/m²

RH
5/13/97

To determine the convection coefficient, the following equation was used

$$Q_{conv} = c'_{conv} \; D^{1/4} \, \nabla T^{5/4}$$

where $D$ = depth of convection cell
$D = 0.1524$ m

RH 5/21/97

| Test No. | $T_{avg}$ (C) | ∇T (K/m) | $Q_{conv}$ (W/m²) | $c'_{conv}$ ✓ |
|---|---|---|---|---|
| 1 | 46.86 | 312.40 | -0.04 | -0.007 |
| 2 | 46.05 | 307.00 | 0.81 | 0.001 |
| 3 | 36.66 | 244.40 | 4.14 | 0.007 |
| 4 | 52.01 | 346.73 | 11.56 | 0.012 |
| 5 | 64.68 | 431.20 | 3.95 | 0.003 |
| 6 | 13.75 | 91.67 | -2.97 | -0.017 |
| 7 | 140.05 | 933.67 | 54.91 | 0.017 |
| 8 | 166.67 | 1111.13 | 62.42 | 0.016 |
| 9 | 140.62 | 937.47 | 32.63 | 0.010 |
| 10 | 114.98 | 766.53 | 8.73 | 0.003 |
| 11 | 93.83 | 625.53 | 0.48 | 0.0002 |
| 12 | 69.52 | 463.47 | -6.75 | -0.005 |
| 13 | 47.05 | 313.67 | -11.21 | -0.014 |
| 14 | 28.18 | 187.87 | -8.65 | -0.020 |
| 15 | 163.62 | 1090.80 | 51.18 | 0.013 |
| 16 | 142.74 | 951.60 | 66.55 | 0.020 |
| 17 | 112.55 | 750.33 | 2.18 | 0.001 |
| 18 | 95.14 | 634.27 | 13.86 | 0.007 |
| 19 | 72.97 | 486.47 | 6.40 | 0.004 |
| 20 | 52.82 | 352.13 | 3.46 | 0.004 |
| 21 | 31.18 | 207.87 | -1.66 | -0.003 |
| 22 | 37.29 | 248.60 | -8.01 | -0.013 |
| 23 | 109.18 | 727.87 | 27.51 | 0.011 |
| 24 | 46.07 | 83.67 | 697.03 | 4.409 |
| 25 | 5.79 | 38.60 | 445.73 | 7.415 |
| 26 | 10.93 | 72.87 | 1014.16 | 7.624 |
| 27 | 8.73 | 58.20 | 786.86 | 7.834 |
| 28 | 6.66 | 44.40 | 350.98 | 4.901 |

Fully unset (1–23)

Fully set (24–28)

c' for 1-23
avg = 2.1826e-3



RH 5/21/97

| Test No. | $T_{avg}$ (C) | ∇T (K/m) | $Q_{conv}$ (W/m²) | $c'_{conv}$ ✓ |
|---|---|---|---|---|
| 29 | 5.63 | 37.53 | 344.55 | 5.936 |
| 30 | 4.34 | 28.93 | 248.85 | 5.936 |
| 31 | 3.80 | 25.33 | 94.81 | 5.486 |
| 32 | 3.18 | 21.20 | 44.51 | 5.085 |
| 33 | 6.28 | 41.87 | 94.60 | 8.936 |
| 34 | 8.67 | 57.80 | 42.28 | 8.459 |
| 35 | 14.54 | 96.93 | 3.57 | 0.019 |
| 36 | 26.32 | 175.47 | 18.23 | 0.046 |
| 37 | 36.58 | 243.87 | 84.74 | 0.141 |
| 38 | 32.64 | 217.60 | 38.12 | 0.073 |
| 39 | 40.66 | 271.07 | 107.45 | 0.156 |
| 40 | 46.45 | 309.67 | 160.18 | 0.197 |
| 41 | 48.75 | 325.00 | 237.53 | 0.275 |
| 42 | 50.49 | 336.60 | 580.51 | 0.644 |
| 43 | 70.70 | 471.33 | 420.23 | 0.306 |
| 44 | 10.49 | 69.93 | -6.87 | -0.054 |
| 45 | 24.79 | 165.27 | -12.50 | -0.034 |
| 46 | 35.18 | 234.53 | 11.70 | 0.020 |
| 47 | 45.17 | 301.13 | 57.79 | 0.074 |
| 48 | 53.17 | 354.47 | 118.03 | 0.122 |
| 49 | 64.33 | 428.87 | 249.31 | 0.204 |
| 50 | 3.95 | 26.33 | 9.39 | 0.252 |
| 51 | 13.94 | 92.93 | 2.60 | 0.236 |
| 52 | 31.02 | 206.80 | 115.67 | 0.236 |
| 53 | 53.14 | 354.27 | 233.88 | 0.244 |
| 54 | 77.3 | 515.33 | 410.75 | 0.268 |
| 55 | 103.31 | 688.73 | 549.16 | 0.249 |
| 56 | 127.21 | 848.07 | 763.06 | 0.267 |
| 57 | 137.89 | 919.27 | 916.04 | 0.290 |

Fully set (29–34)

matrix-only (35–49)

Air (50–57)

c' for 29-34
avg = 7.2021

c' for 35-49
avg = 1.4593e-1

c' for 50-57
avg = 2.5525e-1

RH 5/21/97

| Test No. | $T_{avg}$ (C) | ∇T (K/m) | $Q_{conv}$ (W/m²) | $c'_{conv}$ ✓ |
|---|---|---|---|---|
| 58 | 1.82 | 12.13 | 65.70 | 4.644 |
| 59 | 3.07 | 20.47 | 103.95 | 3.822 |
| 60 | 5.14 | 34.27 | 195.50 | 3.774 |
| 61 | 6.90 | 46.00 | 330.12 | 4.411 |
| 62 | 48.38 | 55.87 | 430.94 | 4.516 |
| 63 | 9.65 | 64.33 | 659.40 | 5.792 |
| 64 | 8.65 | 57.67 | 544.97 | 5.489 |
| 65 | 5.06 | 33.73 | 258.48 | 5.089 |
| 66 | 3.71 | 24.73 | 151.84 | 4.406 |

water (58–66)

c' for 58-66
avg = 0.4603

Sample calculation for $c'_{conv}$ for test 8

$$c'_{conv} = \frac{Q}{D^{1/4} \, \nabla T^{5/4}} = \frac{62.42}{(0.1524)^{1/4}(1111.13)^{5/4}} = 0.0156 \approx 0.016$$

/27/97 RH

A laboratory-scale heater drip test has been designed and constructed to evaluate depression of the boiling isotherm by water infiltrating down a fracture. A description of the experiment is contained in Notebook # 222. Working on the experiment is: Jim Prybyl, Sonny Leppala and Ron Green. Ron Green is responsible for the analyses contained in this notebook unless otherwise noted:

The objectives can be stated for the lab-scale heater test as follows

## Objectives of the Laboratory-Scale Heater Test

Provide insight for the design of the DOE ESF Drift-Scale Heater Test.

Provide insight into heat and mass transfer mechanisms that will be observed under repository conditions {Information derived from laboratory-scale test will be available prior to the TSPA-VA and the LA, the DST will not be completed prior to either the TSPA-VA or the LA}.

Investigate the depression of the boiling isotherm using water infiltrating down a fracture. Quantifiable and observable results of the depression of the boiling isotherm will be used in assessing/calibrating a mechanistic refluxing model.

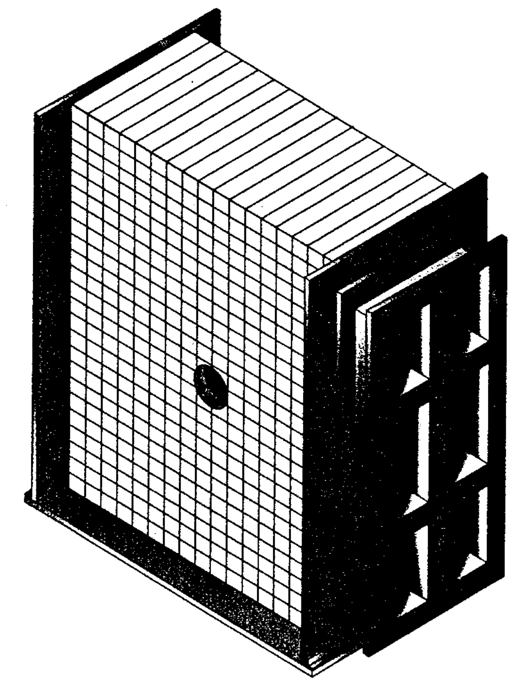
Evaluate the ability of instrumentation to detect liquid water infiltrating into an open adit. Possible instrumentation includes water detection integrated circuits and thermocouples.

Provide geochemical information of the thermally driven transport and redistribution of minerals found in the concrete blocks used as the medium in the laboratory-scale heater test.

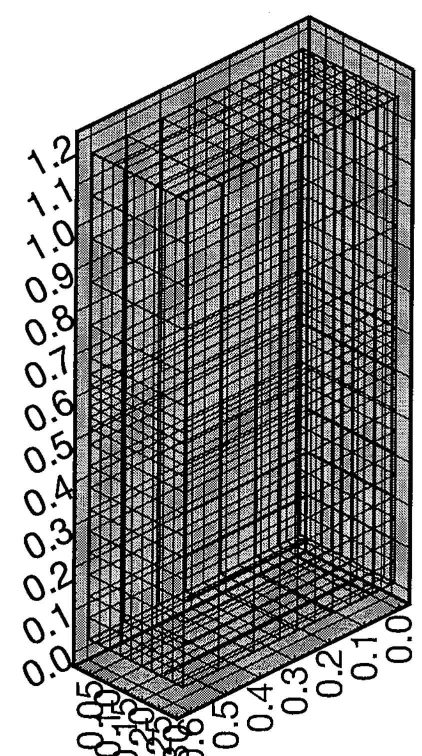


RH 6/27/97

The apparatus looks like:



This was two planes of symmetry




The model finite difference grid appears as:

x = 14 elements
y = 10 "
z = 22 "

The fracture is modeled as a discrete feature, the remainder of the medium is a single continuum, both have the same van Genuchten parameters

7/1/97
RFF

A preliminary input file for metra appears:
(home/sneezy/rgreen/drip/drip5.dat)

```
      Simulation of laboratory-scale dripping experiment - Bldg 51 CNWRA
           No initialization at this time -  July 01, 1997
: drip5.dat
: heater set at 5.50e+1
: no heat loss at boundaries included
RSTART  0
:
:       XYZ                          = 1 table look-up,; pref = ref. press.
:       RADIAL                       = 0 correlations;   tref = ref temp.
:       OTHER
:
:grid  geometry  nx ny  nz ivplwr ipvtab  iout    pref tref  href
Grid   XYZ       14 10  22  1       1      3       0    0
:
Monitor 154
         data taken from sandia report:Green et al. 1995, NUREG/CR-6348
Pckr                         :relative perm and pc keyword
:   i  type-curv swir  rpm(lamda)  alpham  swext  sgc  iecm
    1  Van-Gen   0.05  .2717       6.36e-7   0     0.1  0    ! ecm
    2  Van-Gen   0.05  .6667       2.e-4     0     0.   0    ! emplacement drift
0            :blank line
:
Debug  1
0
Thermal-prop
: no rho         cpr    ckdry  cksat    crp  crt    tau  cdiff    cexp  enbd
  1  1.600e+03 840.0    0.50    1.0      0    0     .5  2.13e-5  1.8   0. 0 !ecm
  2  2.600e+03 717.     7.      7.       0    0     .5  2.13e-5  1.8   0. 0 !drift
  3  1.600e+03 1.0e+3  0.50    0.50     0    0     .5  2.13e-5  1.8   0. 0 !bounda
0
:      igrid    rw      re
DXYZ    0
: (dx(i),i=1,nx)
.0001 .0001 .0254 .0254 .0254 .0254 .0508 .0508 .0508 .0508
.0508 .1016 .1016 .1016
: (dy(j),j=1,ny)
.0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304
: (dz(k),k=1,nz)
.0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508
.0254 .0254 .0254 .0254 .0254 .0254 .0508 .1016 .1016 .1016
.1016 .1016
PhiK
: i1  i2 j1 j2  k1 k2 iist  ithrm vb   por permx  permy   permz  pormm permm
   1  14  1 10   1  22 1     1      0. 0.42 2.e-18 2.e-18 2.e-18 0.42  2.e-18
   1   3  1 10  11  16 2     2      0. 0.99 1.e-14 1.e-14 1.e-14 0.99  1.e-14
   4   4  1 10  12  15 2     2      0. 0.99 1.e-14 1.e-14 1.e-14 0.99  1.e-14
   5   5  1 10  13  14 2     2      0. 0.99 1.e-14 1.e-14 1.e-14 0.99  1.e-14
: 1   14 10 10   1  22 1     3 1.0e+4 0.42 2.e-18 2.e-18 2.e-18 0.42  2.e-18
:14   14  1 10   1  22 1     3 1.0e+4 0.42 2.e-18 2.e-18 2.e-18 0.42  2.e-18
: 1   14  1 10   1   1 1     3 1.0e+4 0.42 2.e-18 2.e-18 2.e-18 0.42  2.e-18
: 1   14  1 10  22  22 1     3 1.0e+4 0.42 2.e-18 2.e-18 2.e-18 0.42  2.e-18
   0
:
Init
:  i1   i2   j1   j2   k1   k2     p          t     sg    x2   sgm
    1   14   1    10    1   22   1.0315e5  20.0   0.52  0.    .50
0
:
:Equil   depth   pdepth    tdepth    tgrad   param iequil
:Equil   169.    101325    20.          0.    0.     -1
```



RFF
7/1/97

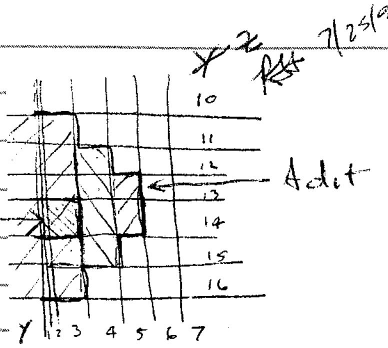
drip5.dat cont

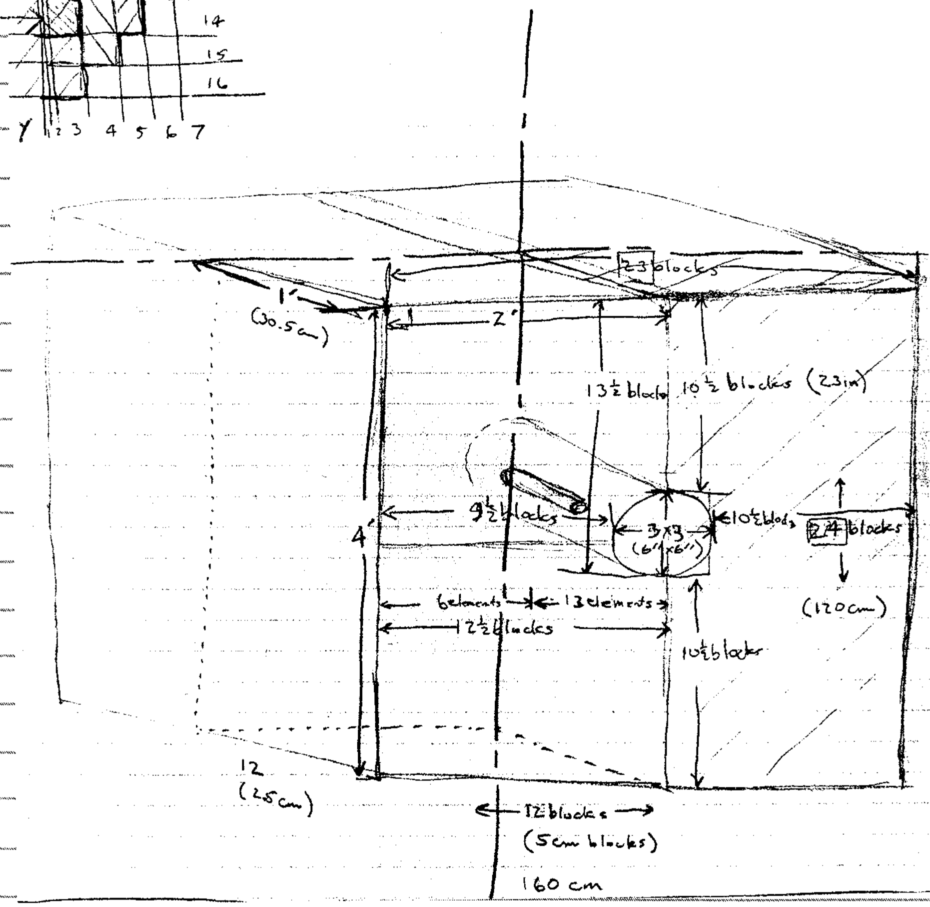
```
:
Recurrent
:Skip
: Limit  1.e5  .08  10.  1.e5  1.e-8  1.e5
Solve  3
Rstart  1
: Steady[y]  1.e-4  1.e-4  1.e-4
Rstart  0
:Noskip
:        ns      fach       facm  (fach and facm are multipliers to
:                                        read-in values of qht and qmt)
Source   1      1.          1.
:  is1  is2 js1 js2 ks1 ks2  istyp
    1   3   1   3   14  14   33
 0      5.50e+1
1.e+10 5.50e+1
0
:Noskip
Output   C=-10 Q=-10   T=1   G=1   P=1
:
:  isolv  newtnmn  newtnmx
Solve 4     2         7         2
:
:AUTO-step  DPMXE    DSMXE  DTMPMXE   DP2MXe
AUTO-step   5.0E+4   0.03    5.0       1.e4
:
:TOLR TOLP  TOLS  TOLT  TOLP2  TOLM  TOLA  TOLE
Tolr   1. 1.e-4  1.e-3  1.    1.e-3 1.e-3 1.e-3  1.e-12  1.e-12   1.e-12
:
:Limit dpmx    dsmx dtmpmx dp2mx dtmn dtmx icutmx
LIMIT  1.e5    .08     10.    1.e5 1.e-9 .1
:
:       target  dt    dpmx    dsmx   dp2mx   dtmpmx
:
:        print all at every target time
PLOTS 1
Time[d]  1.e-7      1.e-7
Time[d]  0.10
Time[d]  0.50
Time[d]  1.
Time[d]  2.
Time[d]  5.
Ends
```

The April 4, 1997 version of metra is used. It is referred to as metra14 on sneezy. This is version METRA 1.00.00

Preliminary drip runs are conducted to determine suitable heat loss boundary conditions. There will be heat loss through the sides of the experiment, however, this is a difficult parameter to determine a priori

7/2/97
RH




Schematic of apparatus w/ dimensions

Z-plane through heater

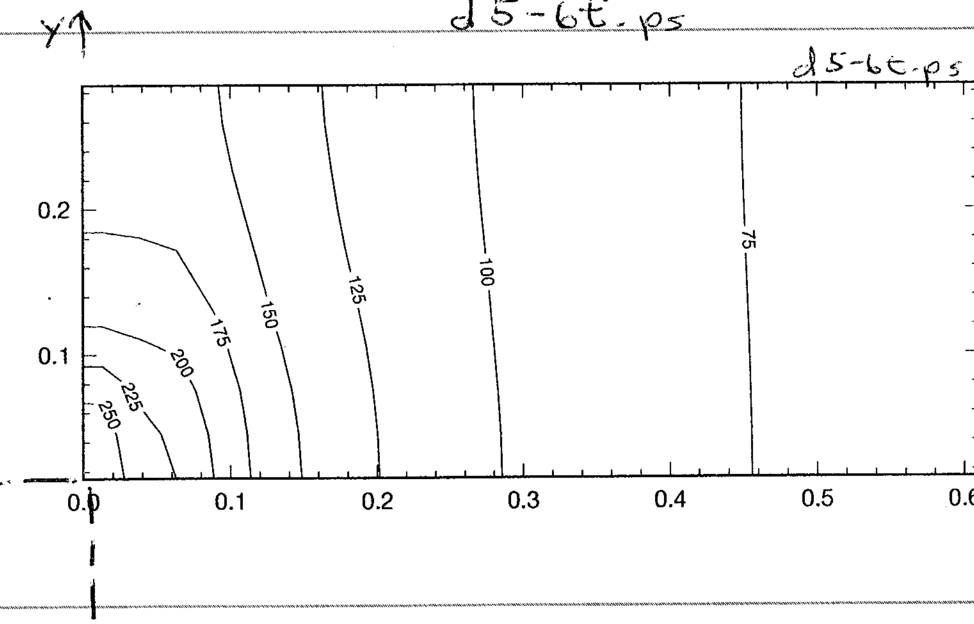
Z-plane through heater



RH
7/2/97

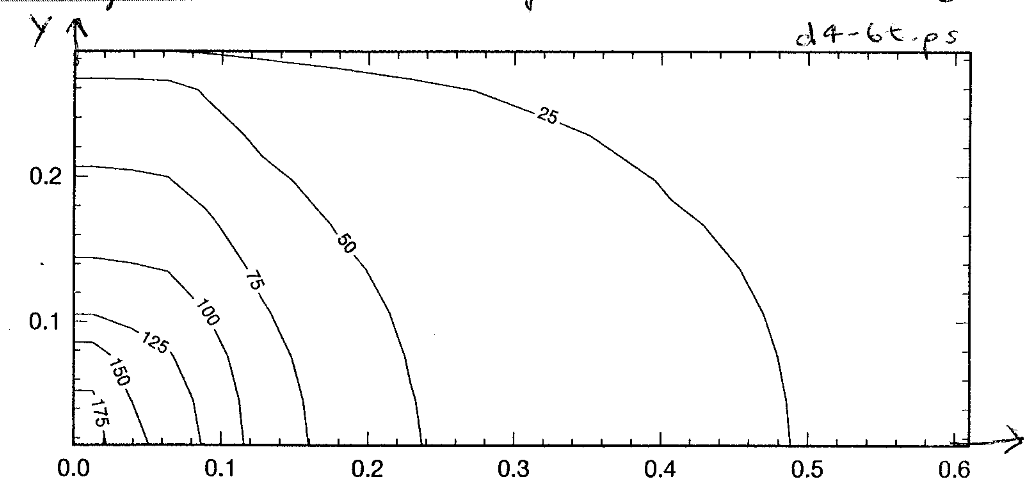
Various computer runs conducted to determine how much heat loss should be modeled into boundary elements

drip5.dat no heat loss, adiabatic surface
5 days heat source steady at 5.5e+1
d5-6t.ps



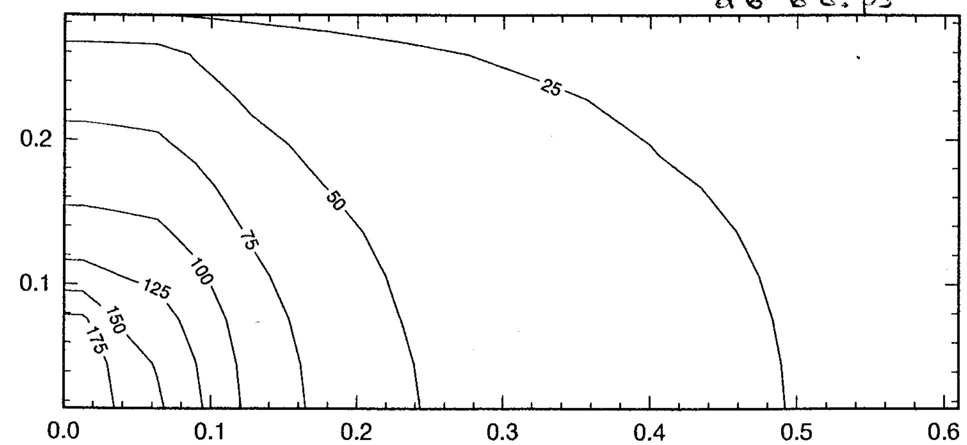

boundary elements:
cd = 1e+4
cp = 1e+3

drip4.dat some heat loss on all sides cp = 1.0e+3
5 days heat source steady at 5.5e+1 d4-6t.ps



not much difference from drip4.dat, need to make boundary elements even smaller

d6-6t.ps




reduced vol of boundary elements to 1e2 from 1e4
" cp " " " " 1e1 from 1e3



7/17/97 RH

Ran conduction-only with no infiltration to get baseline temperature contours

/home/sneezy/rgreen/multi/drip/drip21.dat

```
    Simulation of laboratory-scale dripping experiment - Bldg 51 CNWRA
         July 16, 1997
: drip21.dat
: heater set at 5.50e+1
: put  in invert with same properties as cement
: heat loss at boundaries included
: boundary elements at 1e-2
: heat capacity of boundary elements at 840
: no water, to get steady-state heat conduction
: ipvtab set to 1
: fract por = 0.5 from 0.99
: fract perm up to 1e12 from 1e14
: increased alpha of frac from 6.36e-4 to 2.0e-4
: changed cp of drift from 717 to 10
: changed density of drift from 2600 to 1
: changed n of drift to 0.6667
RSTART  0
:
:      XYZ                          = 1 table look-up,; pref = ref. press.
:      RADIAL                       = 0 correlations;   tref = ref temp.
:      OTHER                           ^
:                                      |
:grid  geometry  nx ny  nz ivplwr ipvtab  iout    pref tref  href
Grid   XYZ       14 10  22  1        1      3       0    0
:
Monitor 154
:       data taken from sandia report:Green et al. 1995, NUREG/CR-6348
Pckr                               :relative perm and pc keyword
:   i  type-curv swir   rpm(lamda)  alpham  swext  sgc  iecm
    1  Van-Gen   0.05  .2717        6.36e-7   0     0.1  0     ! ecm
    2  Van-Gen   0.05  .6667        2.e-4     0     0.1  0     ! emplacement drift
0             :blank line
:
Debug  1
0
Thermal-prop
: no rho        cpr    ckdry  cksat    crp  crt    tau  cdiff    cexp  enbd
  1  1.600e+03 840.0   0.50    1.0      0    0     .5  2.13e-5  1.8  0. 0 !ecm
  2  1.000e+01  10.     7.      7.      0    0     .5  2.13e-5  1.8  0. 0 !drift
  3  1.600e+03 840.0   0.50   0.50      0    0     .5  2.13e-5  1.8  0. 0 !bounda
0
:     igrid   rw      re
DXYZ   0
: (dx(i),i=1,nx)
.0001 .0001 .0254 .0254 .0254 .0254 .0508 .0508 .0508 .0508
.0508 .1016 .1016 .1016
: (dy(j),j=1,ny)
.0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304
: (dz(k),k=1,nz)
.0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508
.0254 .0254 .0254 .0254 .0254 .0254 .0508 .1016 .1016 .1016
.1016 .1016
PhiK
: i1 i2 j1 j2 k1 k2 iist ithrm vb  por permx  permy  permz  pormm permm
  1  14  1 10  1  22 1    1     0. 0.42 2.e-18 2.e-18 2.e-18 0.42  2.e-18
  1   3  1 10  11 14 2    2     0. 0.50 1.e-12 1.e-12 1.e-12 0.50  1.e-12
  4   4  1 10  12 15 2    2     0. 0.50 1.e-12 1.e-12 1.e-12 0.50  1.e-12
  5   5  1 10  13 14 2    2     0. 0.50 1.e-12 1.e-12 1.e-12 0.50  1.e-12
  1  14 10 10   1 22 1    3 1.0e-2 0.42 2.e-18 2.e-18 2.e-18 0.42  2.e-18
 14  14  1 10   1 22 1    3 1.0e-2 0.42 2.e-18 2.e-18 2.e-18 0.42  2.e-18
```

7/17/97

```
  1  14  1 10   1  1 1   3 1.0e-2 0.42 2.e-18 2.e-18 2.e-18 0.42  2.e-18
  1  14  1 10  22 22 1   3 1.0e-2 0.42 2.e-18 2.e-18 2.e-18 0.42  2.e-18
   0
:
Init
:  i1  i2  j1  j2  k1  k2   p         t     sg   x2   sgm
    1  14  1   10   1  22  1.0315e5 20.0  0.52 0.   .50
0
:
:Equil  depth  pdepth   tdepth   tgrad  param iequil
:Equil   169.   101325    20.       0.    0.     -1
:
Recurrent
:Skip
: Limit  1.e5  .08  10.  1.e5  1.e-8  1.e5
Solve  3
Rstart  1
: Steady[y]  1.e-4  1.e-4  1.e-4
Rstart  0
:Noskip
:         ns     fach        facm  (fach and facm are multipliers to
:                                       read-in values of qht and qmt)
Source   1      1.          1.
:  is1 is2 js1 js2 ks1 ks2  istyp
    1   3   1  3   14  14    33
 0     5.50e+1
1.e+10 5.50e+1
0
skip
:  is1 is2 js1 js2 ks1 ks2  istyp
    1   3   1  4    1   1   13
2.59e5 20.0   1.0e-5
1.e+10 20.0   1.0e-5
0
Noskip
Output   C=-10 Q=-10   T=1   G=1   P=1
:
:  isolv  newtnmn  newtnmx
Solve 4      2        7        2
:
:AUTO-step  DPMXE    DSMXE  DTMPMXE   DP2MXe
AUTO-step   5.0E+4   0.03    5.0        1.e4
:
:TOLR TOLP  TOLS  TOLT  TOLP2  TOLM  TOLA  TOLE
Tolr   1. 1.e-4  1.e-3  1.    1.e-3 1.e-3 1.e-3  1.e-12  1.e-12   1.e-12
:
:Limit dpmx    dsmx dtmpmx dp2mx dtmn dtmx icutmx
LIMIT  1.e5    .08    10.   1.e5 1.e-9 .1
:
:        target  dt     dpmx   dsmx   dp2mx   dtmpmx
:
:         print all at every target time
PLOTS 1
Time[d]  1.e-7     1.e-7
Time[d]  1.
Time[d]  2.
Time[d]  3.
Time[d]  4.
Time[d]  5.
Time[d]  6.


Time[d]  7.
Time[d] 10.
Ends
```

at 1 day

at z = 0.5967

at 1 day

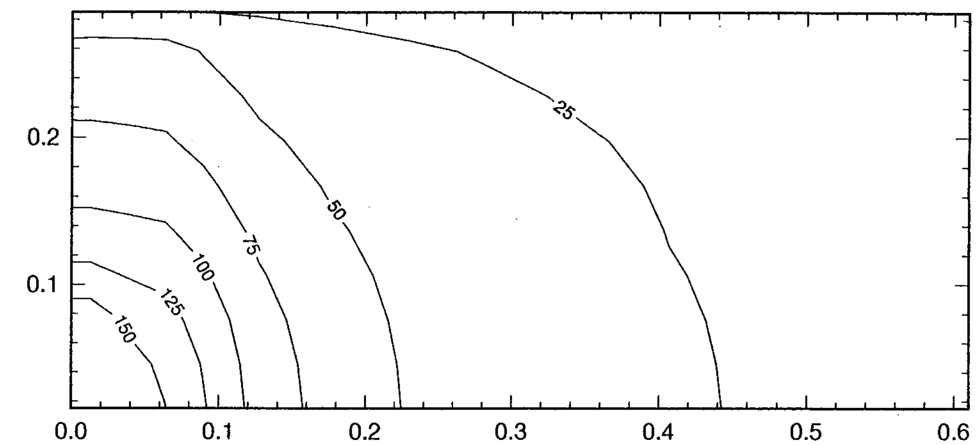
X=0.0001



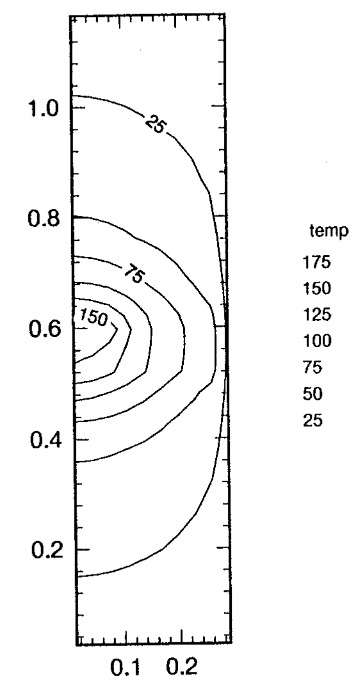
7/17/97

Results from dvip21.dat: heat conduction only
used metra 14 (QA version 1.0 from April 4, 1997)

d21xy-2t.ps



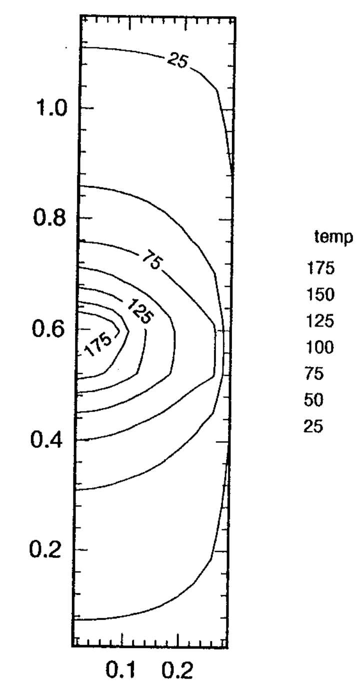

d21z-2t.ps




at day 8

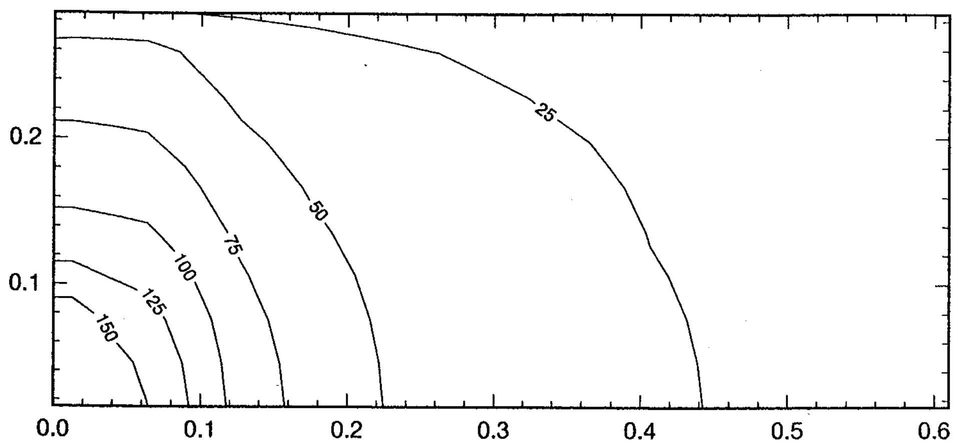
X=.0001

d21z-8.ps



at day 8

Z = 0.5967




12/11/97 RH Several scoping runs resulted in following input file

location /home/sneezy/rgreen/multi/drip2/drip64.dat

```
      Simulation of laboratory-scale dripping experiment - Bldg 51 CNWRA
            dec 11, 1997
: drip64.dat
: this run is to test sat of matrix, fract & drift for heat that ran ok in drip38
: put in invert with same properties as cement
: heat loss at boundaries included
: boundary elements at 1e-2
: heat capacity of boundary elements at 840
: infiltration rate of 1e-5 for two columns
: ipvtab set to 0
: fract por = 0.5 from 0.99
: fract perm up to 1e12 from 1e14
: increased alpha of frac from 6.36e-4 to 2.0e-4
: changed cp of drift from 10 to 840
: changed density of drift from 2600 to 1600
: changed drift and fracture to linear capillary function
: removed heater from drift properties
: set porosity of fracture to 0.7 and drift to 0.99
: set sgc in ecm to 0.0
: set heater porosity to 0.0
: set residual saturation in fracture and drift to 0.0
: modified infiltration to start after 3 days
: changed from correlations to table look up
: decreased thermal conductivity of air from 20 to 15
: set air perm to e-12
: set matrix perm to 2e-17 fro 2e-18
: set max Pa to 1.0 from 0.005 in linear models
: ramped up heat over 5e4 seconds to 7.00e+1
: changed init sat to 0.99 in matrix and 0.10 in fracture and drift
: changed matrix porosity to 0.05 and fracture to 0.99
: set infiltration up to 5.0e-4
: but ramped up from 2.60 to 3.60e5 sec
: reduced fracture porosity from 0.40 to 0.10
: increased porosity back to 0.42
: increased matrix saturation from 0.3 to 0.4, adjusted sats.
: modified sgm in init
: decreased fracture perm to 1e-12 and filled in matrix perm (was default)
: same as drip63 but with fract thermal set to drift
RSTART  0
:
:      XYZ                      = 1 table look-up,; pref = ref. press.
:      RADIAL                   = 0 correlations;   tref = ref temp.
:      OTHER                       ^
:                                  |
:grid  geometry  nx ny  nz ivplwr ipvtab  iout    pref tref  href
Grid   XYZ       14 10  22  1       1       3       0    0
```

RH 12/11/97



```
:
Monitor 154
:        data taken from sandia report:Green et al. 1995, NUREG/CR-6348
Pckr                              :relative perm and pc 0eyword
:   i  type-curv swir   rpm(lamda)  alpham  swext   sgc  iecm
    1  Van-Gen   0.05   .3717       6.36e-7   0      0.0  1     ! ecm-matrix block
:                swirf  rpf(lamda)  alphaf  phim     phif   permm   permf
                 0.08   0.7619      1.3e-4   0.42    1.0e-3 2.0e-17 1.e-12
:   i  type-curv swrim unused  unused      p@0-sat sgc    iecm
    2  linear    0.00  0.000      0.00      1.0     0.0  0     ! emplacement drift
:   i  type-curv swrim unused  unused      p@0-sat sgc    iecm
    3  linear    0.00  0.000      0.00      1.0     0.0  0     ! primary fracture
0            :blank line
:
: Debug  1
: 0
Thermal-prop
: no rho         cpr     ckdry  cksat    crp   crt    tau  cdiff    cexp  enbd
  1  1.600e+03 840.0    0.50     1.0      0     0     .5  2.13e-5  1.8  0. 0 !ecm
  2  1.600e+03 840.     15.      15.      0     0     .5  2.13e-5  1.8  0. 0 !drift

  3  1.600e+03 840.0    0.50     0.50     0     0     .5  2.13e-5  1.8  0. 0 !boundaries
0
:     igrid   rw      re
DXYZ   0
: (dx(i),i=1,nx)
.0001 .0001 .0254 .0254 .0254 .0254 .0508 .0508 .0508 .0508
.0508 .1016 .1016 .1016
: (dy(j),j=1,ny)
.0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304
: (dz(k),k=1,nz)
.0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508
.0254 .0254 .0254 .0254 .0254 .0254 .0508 .1016 .1016 .1016
.1016 .1016
PhiK
: i1 i2 j1 j2 k1 k2 iist ithrm vb  por permx  permy  permz  pormm permm
  1  14  1 10  1  22 1   1      0. 0.42 1.e-17 1.e-17 1.e-17 0.42  1.e-17 ! matrix
  1  14 10 10   1 22 1   3 1.0e-2 0.05                                    ! front
 14  14  1 10   1 22 1   3 1.0e-2 0.05                                    ! side
  1  14  1 10   1  1 1   3 1.0e-2 0.05                                    ! top
  1  14  1 10  22 22 1   3 1.0e-2 0.05                                    ! bottom
  1   2  1 10   1 22 3   2      0. 0.10 1.e-12 1.e-12 1.e-12 0.10  1.e-12 ! fracture
  1   3  1 10  11 16 2   2      0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 ! drift
  4   4  1 10  12 15 2   2      0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 ! drift
  5   5  1 10  13 14 2   2      0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 ! drift
  1   3  1  3  14 14 1   1      0. 0.00 1.e-17 1.e-17 1.e-17 0.00  1.e-17 ! heater
   0
:
Init
:  i1   i2  j1   j2  k1  k2    p          t    sg    x2   sgm
    1  14   1    10   1  22   1.0315e5 20.0  0.60 0.   .60 ! matrix
    1   2   1    10   1  22   1.0315e5 20.0  0.99 0.   .99 ! fracture
    1   3   1    10  11  16   1.0315e5 20.0  0.99 0.   .99 ! drift
    4   4   1    10  12  15   1.0315e5 20.0  0.99 0.   .99 ! drift
    5   5   1    10  13  14   1.0315e5 20.0  0.99 0.   .99 ! drift
0
:
:Equil   depth  pdepth   tdepth   tgrad  param ieequil
:Equil   1.00    103150    20.       0.    0.    -1
:
Recurrent
:Skip
:       ns      fach        facm  (fach and facm are multipliers to
:                                  read-in values of qht and qmt)
Source   2      1.          1.
:  is1 is2 js1 js2 ks1 ks2  istyp
     1   3   1  3   14  14   33
 0      0.0
5.e+4  7.00e+1
1.e+10 7.00e+1
0
: skip
:  is1 is2 js1 js2 ks1 ks2  istyp
     1   2   1  4    1   1   13
0.0    20.0   0.0
2.60e5 20.0   0.0
3.60e5 20.0   5.0e-4
1.e+10 20.0   5.0e-4
0
skip
Bcon  1
: ityp fac   i1 i2 j1 j2
    3  TOP   1  2  1  4
: time  vel(m/yr)  p      T      sg
   0.      50.    1.e5    20.     .2
   1.e10  50.     1.e5    20.     .2
   0
```

RH 12/11/97

 RF

12/11/97

```
noskip
Output   C=-10 Q=-10   T=1   G=1   P=1
:
:  isolv  newtnmn  newtnmx
Solve 4     2        7        2
:
:AUTO-step  DPMXE    DSMXE  DTMPMXE   DP2MXe
AUTO-step   5.0E+4   0.04    5.0       5.e4
:
:TOLR TOLP  TOLS  TOLT  TOLP2  TOLM  TOLA  TOLE
Tolr   10. 1.e-4  1.e-3  10.   1.e-3 1.e-2 1.e-3  1.e-12  1.e-12   1.e-12
:
:Limit dpmx    dsmx dtmpmx dp2mx dtmn dtmx icutmx
LIMIT  1.e5    .08    10.   1.e5 1.e-9 .1
:
:      target  dt    dpmx   dsmx   dp2mx   dtmpmx
:
:       print all at every target time
PLOTS 1
Time[d]  1.e-5     1.e-5
Time[d]  1.
Time[d]  2.
Time[d]  3.
Time[d]  4.
Time[d]  5.
Time[d]  6.
Time[d]  7.
Time[d] 10.
Ends
```

RF 12/11/97

12/12/97 RF

drip64.dat would not run beyond 1e-3 days

drip66.dat had initial gas saturation reduced from 0.6 to 0.95. It ran to 3.2 days then stopped.



2/12/98 RF

drip127.dat - current basecase for experiment on dripping.
infiltration = 1,000 ml/day
heat = 142 Watts

```
        Simulation of laboratory-scale dripping experiment - Bldg 51 CNWRA
              Feb 03, 1998
: drip127.dat
: this run is to test sat of matrix, fract & drift for heat that ran ok in drip38
: put in invert with same properties as cement
: heat loss at boundaries included
: boundary elements at 1e-2
: heat capacity of boundary elements at 840
: infiltration rate of 1e-5 for two columns
: ipvtab set to 0
: fract por = 0.5 from 0.99
: fract perm up to 1e12 from 1e14
: increased alpha of frac from 6.36e-4 to 2.0e-4
: changed cp of drift from 10 to 840
: changed density of drift from 2600 to 1600
: changed drift and fracture to linear capillary function
: removed heater from drift properties
: set porosity of fracture to 0.7 and drift to 0.99
: set sgc in ecm to 0.0
: set heater porosity to 0.0
: set residual saturation in fracture and drift to 0.0
: modified infiltration to start after 3 days
: changed from correlations to table look up
: decreased thermal conductivity of air from 20 to 15
: set air perm to e-12
: set matrix perm to 2e-17 fro 2e-18
: set max Pa to 1.0 from 0.005 in linear models
: ramped up heat over 5e4 seconds to 7.00e+1
: changed init sat to 0.99 in matrix and 0.10 in fracture and drift
: changed matrix porosity to 0.05 and fracture to 0.99
: set infiltration up to 5.0e-4
: but ramped up from 2.60 to 3.60e5 sec
: reduced fracture porosity from 0.40 to 0.10
: increased porosity back to 0.42
: increased matrix saturation from 0.3 to 0.4, adjusted sats.
: modified sgm in init
: decreased fracture perm to 1e-12 and filled in matrix perm (was default)
: same as drip63 but with fract thermal set to drift
: further increased matrix saturation from 0.4 to 0.5
: further increased matrix saturation from 0.5 to 0.5
: changed matrix to single continuum
: matrix alpha increased by 100x to e-5 - undone
: set back to ECM for matrix
: set heater porosity to 0.01 w/ k=e-27
: set to calc not table
: set gas saturation of matrix to .60
: reduced water infil to 2.955e-6 kg/s = 1 l/day
: increased volume of boundary elements to 1e-2 from 1e-1 w.r.t drip87
: increase thermal k of bc from 0.5 to 0.7 to 1.7
: set k of bc to 0.0 and cp to 1e5 then back to 1e4
: increased time of simulation to 35 days
: moved water injection to z=2 since bc k=0
: decreased vol of bc to 1e0
: increased heat for 7 to 8 and again to 9 then back to 8.5 then back to 8.0 back to 8.5
: increased alpha of frac in medium to 1.3e-1 to reduce drainage
: changed top & bottom to insulating bc & made sides less conductive
: increased no. of elements in x-direction from 14 to 17
: increased heat from 8.5 to 9.5 back to 8.5 back to 7.0 back to 5.5 up to 6.0 back to 5.5
: decreased thermal k of side & front bc from e4 to e3
: reduced size of side and front from .5 to .1 to 1e-3
: reduced thermal k on top & bottom from 1 to 0.5
: reduced heat at 4.23e5 from 5.5 to 4.25 then to 3.5 at 10 days
: made top & bottom conducting using large element size of 1e-3
: decreased vol of top & bottom to 1e-2, then inc bot to 1e-1
: drip124 put time up to 50 days
: drip124 put steady heat source of 5.0e+1
```

 RG
2/12/98

```
: drip125 reduced heat to 4.3e+1
: drip126 increased infiltration by 8x
: drip127 set infil back to 1x and heat to 142/4
RSTART  0
:
:       XYZ                        = 1 table look-up,; pref = ref. press.
:       RADIAL                     = 0 correlations;   tref = ref temp.
:       OTHER                        ^
:                                    |
:grid  geometry  nx ny  nz ivplwr ipvtcal iout    pref tref  href
Grid   XYZ       17 10  22  1       1      3        0    0
:
Monitor 154
:       data taken from sandia report:Green et al. 1995, NUREG/CR-6348
Pckr                              :relative perm and pc 0eyword
:   i  type-curv swir   rpm(lamda)  alpham  swext  sgc  iecm
    1  Van-Gen   0.05   .3717       6.36e-7   0      0.0  1    ! ecm-matrix block
:                swirf  rpf(lamda)  alphaf  phim    phif   permm   permf
                 0.08   0.7619      1.3e-1   0.42   1.0e-3 2.0e-17 1.e-12
:   i  type-curv swir   rpm(lamda)  alpha    swext  sgc  iecm
:   1  Van-Gen   0.05   .3717       6.36e-7   0.       0.  0  ! concrete
:   1  Van-Gen   0.05   .3717       6.35e-7   0.       0.  0  ! concrete
:   i  type-curv swrim unused  unused     p@0-sat sgc   iecm
    2  linear    0.00  0.000     0.00      1.0     0.0  0     ! emplacement drift
:   i  type-curv swrim unused  unused     p@0-sat sgc   iecm
    3  linear    0.00  0.000     0.00      1.0     0.0  0     ! primary fracture
0          :blank line
:
: Debug  1
: 0
Thermal-prop
: no rho       cpr    ckdry  cksat    crp  crt   tau  cdiff    cexp  enbd
  1  1.600e+03 840.0   0.50   1.0      0    0    .5  2.13e-5  1.8   0. 0 !ecm
  2  1.600e+03 840.0   15.0   15.0     0    0    .5  2.13e-5  1.8   0. 0 !drift
  3  1.600e+03 1.0e+3  1.70   1.70     0    0    .5  2.13e-5  1.8   0. 0 !side boundaries
  4  1.600e+03 840.0   0.50   0.50     0    0    .5  2.13e-5  1.8   0. 0 !top & bottom bounda
0
:      igrid   rw      re
DXYZ   0
: (dx(i),i=1,nx)
.0001 .0001 .0005 .001  .005  .0189 .0254 .0254 .0254 .0508
.0508 .0508 .0508 .0508 .1016 .1016 .1016
: .0001 .0001 .0254 .0254 .0254 .0254 .0508 .0508 .0508 .0508
: .0508 .1016 .1016 .1016
: (dy(j),j=1,ny)
.0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304
: (dz(k),k=1,nz)
.0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508
.0254 .0254 .0254 .0254 .0254 .0254 .0508 .1016 .1016 .1016
.1016 .1016
PhiK
: i1 i2 j1 j2 k1 k2 iist ithrm vb  por permx  permy  permz  pormm permm
  1  17  1 10  1  22 1   1      0. 0.42 1.e-17 1.e-17 1.e-17 0.42  1.e-17 ! matrix
  1  17 10 10   1 22 1   3 1.0e-3 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 ! front
 17  17  1 10   1 22 1   3 1.0e-3 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 ! side
  1  17  1 10   1  1 1   4 1.0e-2 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 ! top
  1  17  1 10  22 22 1   4 1.0e-1 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00.! bottom
  1   2  1 10   1 22 3   2      0. 0.10 1.e-12 1.e-12 1.e-12 0.10  1.e-12 ! fracture
  1   6  1 10  11 16 2   2      0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 ! drift
  7   7  1 10  12 15 2   2      0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 ! drift
  8   8  1 10  13 14 2   2      0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 ! drift
: 1   3  1  3  14 14 1   1      0. 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 ! heater
   0
:
Init
:  i1  i2  j1  j2  k1  k2   p         t    sg   x2  sgm

    1  17  1   10   1  22  1.0315e5 20.0  0.60 0.  .60 ! matrix
    1   2  1   10   1  22  1.0315e5 20.0  0.99 0.  .99 ! fracture
    1   6  1   10  11  16  1.0315e5 20.0  0.99 0.  .99 ! drift
    7   7  1   10  12  15  1.0315e5 20.0  0.99 0.  .99 ! drift
    8   8  1   10  13  14  1.0315e5 20.0  0.99 0.  .99 ! drift
0
:
:Equil  depth  pdepth   tdepth   tgrad  param iequil
:Equil  1.00   103150    20.        0.   0.     -1
:
Recurrent
:Skip
:       ns      fach       facm  (fach and facm are multipliers to
:                                      read-in values of qht and qmt)
Source   2      1.            1.
:  is1 is2 js1 js2 ks1 ks2  istyp
    1   6   1  3   14  14   33
  0     0.0
skip
5.e+4  5.50e+1
4.22e5 5.50e+1
```


RG
7/12/98

```
4.23e5 4.25e+1
8.45e5 4.25e+1
8.46e5 3.50e+1
1.e+10 3.50e+1
noskip
5.e+4  3.51e+1
1.e+10 3.51e+1
0
: skip
:  is1 is2 js1 js2 ks1 ks2  istyp
    1   2   1  4    2   2   13
0.0    20.0   0.0
2.60e5 20.0   0.0
3.60e5 20.0  2.955e-6
1.e+10 20.0  2.955e-6
0
skip
Bcon  1
: ityp fac   i1 i2 j1 j2
    3  TOP   1  2  1  4
: time  vel(m/yr)  p       T       sg
   0.      50.     1.e5    20.      .2
   1.e10  50.      1.e5    20.      .2
   0
noskip
Output   C=-10 Q=-10   T=1   G=1   P=1
:
:  isolv  newtnmn  newtnmx
Solve 4     2        7         2
:
:AUTO-step  DPMXE    DSMXE  DTMPMXE   DP2MXe
AUTO-step   5.0E+4   0.04    5.0       5.e4
:
:TOLR TOLP  TOLS  TOLT  TOLP2  TOLM  TOLA  TOLE
Tolr   10. 1.e-4  1.e-3  10.   1.e-3 1.e-2 1.e-3  1.e-12  1.e-12   1.e-12
:
:Limit dpmx    dsmx dtmpmx dp2mx dtmn dtmx icutmx
LIMIT  1.e5    .08    10.   1.e5 1.e-9 .1
:
:        target  dt    dpmx   dsmx   dp2mx   dtmpmx
:
:         print all at every target time
PLOTS 1
: Time[d]  1.e-5     1.e-5
Time[d]  1.
Time[d]  5.
Time[d] 10.
Time[d] 20.
Time[d] 30.
Time[d] 40.
Time[d] 50.
Ends
```

7/13/98 RG

Modified drip model for reflux experiment to be dcm. First case that was run was a 2D in /home/sneezy/rgreen/multi/drip2/dcm/dcm-~~2dd~~-2d.dat 7/13/98 RG

This input file is as follows:

It was modified from drip131.dat

 RH
7/13/98

```
    Simulation of laboratory-scale dripping experiment - Bldg 51 CNWRA
        July 08, 1998
: dcm-2d.dat
: smaller model to fit in metra element dimension limitation
: This run statred with drip131 converted to DCM
: this run is to test sat of matrix, fract & drift for heat that ran ok in drip38
: put in invert with same properties as cement
: heat loss at boundaries included
: boundary elements at 1e-2
: heat capacity of boundary elements at 840
: infiltration rate of 1e-5 for two columns
: ipvtab set to 0
: fract por = 0.5 from 0.99
: fract perm up to 1e12 from 1e14
: increased alpha of frac from 6.36e-4 to 2.0e-4
: changed cp of drift from 10 to 840
: changed density of drift from 2600 to 1600
: changed drift and fracture to linear capillary function
: removed heater from drift properties
: set porosity of fracture to 0.7 and drift to 0.99
: set sgc in ecm to 0.0
: set heater porosity to 0.0
: set residual saturation in fracture and drift to 0.0
: modified infiltration to start after 3 days
: changed from correlations to table look up
: decreased thermal conductivity of air from 20 to 15
: set air perm to e-12
: set matrix perm to 2e-17 fro 2e-18
: set max Pa to 1.0 from 0.005 in linear models
: ramped up heat over 5e4 seconds to 7.00e+1
: changed init sat to 0.99 in matrix and 0.10 in fracture and drift
: changed matrix porosity to 0.05 and fracture to 0.99
: set infiltration up to 5.0e-4
: but ramped up from 2.60 to 3.60e5 sec
: reduced fracture porosity from 0.40 to 0.10
: increased porosity back to 0.42
: increased matrix saturation from 0.3 to 0.4, adjusted sats.
: modified sgm in init
: decreased fracture perm to 1e-12 and filled in matrix perm (was default)
: same as drip63 but with fract thermal set to drift
: further increased matrix saturation from 0.4 to 0.5
: further increased matrix saturation from 0.5 to 0.5
: changed matrix to single continuum
: matrix alpha increased by 100x to e-5 - undone
: set back to ECM for matrix
: set heater porosity to 0.01 w/ k=e-27
: set to calc not table
: set gas saturation of matrix to .60
: reduced water infil to 2.955e-6 kg/s = 1 1/day
: increased volume of boundary elements to 1e-2 from 1e-1 w.r.t drip87
: increase thermal k of bc from 0.5 to 0.7 to 1.7
: set k of bc to 0.0 and cp to 1e5 then back to 1e4
: increased time of simulation to 35 days
: moved water injection to z=2 since bc k=0
: decreased vol of bc to 1e0
: increased heat for 7 to 8 and again to 9 then back to 8.5 then back to 8.0 back to 8.5
: increased alpha of frac in medium to 1.3e-1 to reduce drainage
: changed top & bottom to insulating bc & made sides less conductive
: increased no. of elements in x-direction from 14 to 17
: increased heat from 8.5 to 9.5 back to 8.5 back to 7.0 back to 5.5 up to 6.0 back to 5.5
: decreased thermal k of side & front bc from e4 to e3
: reduced size of side and front from .5 to .1 to 1e-3
: reduced thermal k on top & bottom from 1 to 0.5
: reduced heat at 4.23e5 from 5.5 to 4.25 then to 3.5 at 10 days
: made top & bottom conducting using large element size of 1e-3
: decreased vol of top & bottom to 1e-2, then inc bot to 1e-1
: drip124 put time up to 50 days
: drip124 put steady heat source of 5.0e+1
: drip125 reduced heat to 4.3e+1
: drip126 increased infiltration by 8x
: drip127 set infil back to 1x and heat to 142/4
: drip129 increase infiltration to 2x
: drip130 increase infiltration to 8x
: drip131 set infiltration to 4x
: dcm-sm set fracture and drift fracture to 4
: dcm-2d reduced to x-z
RSTART  0
:
:       XYZ                     = 1 table look-up,; pref = ref. press.
:       RADIAL                  = 0 correlations;   tref = ref temp.
:       OTHER                     ^
:                                 |
:grid  geometry  nx ny  nz ivplwr ipvtcal iout    pref tref  href
Grid   DCMXYZ     9  1  11   1       1      1      0       0    0    0
:
```

 RH
7/13/98

```
:       data taken from sandia report:Green et al. 1995, NUREG/CR-6348
Pckr                           :relative perm and pc
:   i  type-curv swirm  rpmm(lamda)  alpham  swext  sgc  iecm
    1  Van-Gen   0.05   .3717        6.36e-7   0     0.0  0     ! matrix block
:
:   i  type-curv swrim unused  unused     p@0-sat sgc    iecm
    2  linear    0.00  0.000      0.00     1.0     0.0  0     ! emplacement drift
:
:   i  type-curv swrim unused  unused     p@0-sat sgc    iecm
    3  linear    0.00  0.000      0.00     1.0     0.0  0     ! primary fracture
:
:   i  type-curv swirf  rpmf(lamda)  alphaf  swext  sgc  iecm
    4  Van-Gen  0.08   0.7619      1.3e-1    0.0    0.0   0   ! matrix fractures
0            :blank line
:
: Debug  1
: 0
Thermal-prop
: no rho        cpr    ckdry  cksat    crp  crt   tau  cdiff   cexp  enbd
   1  1.600e+03 840.0   0.50    1.0     0     0    .5  2.13e-5  1.8  0.  0 !matrix
   2  1.600e+03 840.0   15.0   15.0     0     0    .5  2.13e-5  1.8  0.  0 !drift
   3  1.600e+03 1.0e+3  1.70   1.70     0     0    .5  2.13e-5  1.8  0.  0 !side boundaries
   4  1.600e+03 840.0   0.50   0.50     0     0    .5  2.13e-5  1.8  0.  0 !top & bottom bounda
0
:      igrid   rw       re
DXYZ   0
: (dx(i),i=1,nx)
.0002 .0015 .0239 .0508 .0762 .1016 .1016 .1016 .2032
: (dy(j),j=1,ny)
0.6
:.0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304
: (dz(k),k=1,nz)
.1016 .1016 .1016 .1016 .1016 .0508 .0508 .0508 .1524 .2032
.2032
:.0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508
:.0254 .0254 .0254 .0254 .0254 .0254 .0508 .1016 .1016 .1016
:.1016 .1016
PhiK
: i1 i2 j1 j2 k1 k2 ist ithrm vb   porf permxf permyf permzf pormm permm  istm ithrmm
  1   9  1  1  1  11 4   1      0.  0.42 1.e-17 1.e-17 1.e-17 0.42  1.e-17 1     1 ! matrix
  1   9  1  1   1 11 4   3 1.0e-3 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1     3 ! front
  9   9  1  1   1 11 4   3 1.0e-3 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1     3 ! side
  1   9  1  1   1  1 4   4 1.0e-2 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1     4 ! top
  1   9  1  1  11 11 4   4 1.0e-1 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1     4 ! bottom
: 1   1  1 10   1 11 3   4      0.  0.10 1.e-12 1.e-12 1.e-12 0.10  1.e-12 4     2 ! fracture
: 1   3  1 10   6  8 2   4      0.  0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4     2 ! drift
: 3   3  1 10   6  8 2   4      0.  0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4     2 ! drift

: 4   4  1 10   7  7 2   4      0.  0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4     2 ! drift
: 1   1  1 10   1 11 3   2      0.  0.10 1.e-12 1.e-12 1.e-12 0.10  1.e-12 4     2 ! fracture
  1   3  1  1   6  8 2   2      0.  0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4     2 ! drift
  3   3  1  1   6  8 2   2      0.  0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4     2 ! drift
  4   4  1  1   7  7 2   2      0.  0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4     2 ! drift
  1   3  1  1   7  7 1   1      0.  0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1     1 ! heater
   0
:
Init
: i1   i2   j1   j2   k1   k2  p          t      sg    xg2 pm     tm    sgm xgm
    1    9   1    1    1   11  1.0315e5 20.0   0.60 0.   1.0e5 20.0 .60 0. ! matrix
    1    1   1    1    1   11  1.0315e5 20.0   0.99 0.   1.0e5 20.0 .99 0. ! fracture
    1    3   1    1    6    8  1.0315e5 20.0   0.99 0.   1.0e5 20.0 .99 0. ! drift
    3    3   1    1    6    8  1.0315e5 20.0   0.99 0.   1.0e5 20.0 .99 0. ! drift
    4    4   1    1    7    7  1.0315e5 20.0   0.99 0.   1.0e5 20.0 .99 0. ! drift
0
DCMPARA
: i1 i2 j1 j2 k1 k2   volf  areamodf  xlm    ylm    zlm
   1  9  1 1   1 11   0.002 100.0     .0005 0.000 .0005 ! matrix
skip
   1  1  1 1   1 11   0.10     0.01   .0001 .0304 .0254 ! fracture
   1  1  1 1   6  8   0.99     1.0    .0001 .0304 .0254 ! drift
   2  2  1 1   6  8   0.99     1.0    .0005 .0304 .0254 ! drift
   2  2  1 1   6  8   0.99     1.0    .0010 .0304 .0254 ! drift
   3  3  1 1   6  8   0.99     1.0    .0050 .0304 .0254 ! drift
   3  3  1 1   6  8   0.99     1.0    .0189 .0304 .0254 ! drift
   4  4  1 1   6  8   0.99     1.0    .0254 .0304 .0254 ! drift
   4  4  1 1   7  7   0.99     1.0    .0254 .0304 .0254 ! drift
   1  3  1 1   2  2   0.02  1000.0    .05   0.6   .05   ! water injection
noskip
0
:
:Equil  depth  pdepth   tdepth   tgrad  param iequil
:Equil   1.00   103150    20.          0.     0.    -1
:
Recurrent
:Skip
:        ns      fach        facm  (fach and facm are multipliers to
:                                     read-in values of qht and qmt)
```

RH
7/13/98

this should be 1.0
reset to 1.0 in dcm-2d18.dat

```
Source   2    1.        4
:  isl is2 jsl js2 ksl ks2  istyp
   1   3   1   1   7   7    33
 0    0.0
skip
5.e+4  5.50e+1
4.22e5 5.50e+1
4.23e5 4.25e+1
8.45e5 4.25e+1
8.46e5 3.50e+1
1.e+10 3.50e+1
noskip
5.e+4  3.51e+1
1.e+10 3.51e+1
0
: skip
:  isl is2 jsl js2 ksl ks2  istyp
   1   1   1   1   2   2    13
*0.0    20.0   0.0
2.60e5 20.0   0.0
3.60e5 20.0  2.955e-6
1.e+10 20.0  2.955e-6
0
Output   C=-10 Q=-10   T=1   G=1   P=1
:
:      isolv  newtnmn  newtnmx  north  nitmax  level
Solve 3       2        112      2      100
:
:AUTO-step  DPMXE    DSMXE  DTMPMXE   DP2MXe TACCEL   IAUTODT  FAC1
AUTO-step   5.0E+4   0.03    5.0       1.e4  1.0e-3     0       0
:
:TOLR TOLP  TOLS  TOLT  TOLP2  TOLM  TOLA  TOLE rtwotol  rmxtol   smxtol
Tolr   1. 5.e-4  5.e-3  1.     1.e-3 1.e-3 1.e-3  1.e-12  1.e-12   1.e-12
:
:Limit dpmx    dsmx dtmpmx dp2mx dtmn dtmx icutmx
LIMIT  1.e5    .08    10.    1.e5 1.e-9 .1
:
:      target  dt    dpmx   dsmx   dp2mx   dtmpmx
:
:       print all at every target time
PLOTS 1
: Time[d]  1.e-5     1.e-5
Time[d]  1.
Time[d]  5.
Time[d]  10.
Time[d]  20.
Time[d]  30.
Time[d]  40.
Time[d]  50.
Ends
```

heat w/ no mass for total region

Mass of water for total region

dcm-2d stalled at 3.1 days.

dcm-2d1.dat changed from correlation to tables lookups, still stalled after ~3.1 days.

dcm-2d2.dat modified SOLVE to be WATSOLV with CGSTAB acceleration, reduced NITMAX to 12, stalled at 3.076 days (2.6577E5 sec). This is at the time that water is introduced as infiltration

dcm 2d3.dat reduced areamodF from 100.0 to 10.0, still stalled @ 3+ days



RH
7/13/98

RH 7/13/98

dcm-2d5.dat ~~reduc~~ increased VOFF from 0.002 to 0.2, still stalled at 3.0 days

dcm-2d8.dat set rest of dcmpara, set xlm & zlm to 0.05 from 0.002. still stalls early

dcm-2d10.dat reduced size of xlm & zlm in injection in fracture to 0.0002 & 0.0254, still stalls at 3.1+ days

dcm-2d11.dat reduced infiltration to 1 element x=1, z=2 still stalls at 3.1+ days.

dcm-2d12.dat increased zlm in fracture & drift to 0.1016 & increased infiltration element areamodF to 100.0

dcm-2d13.dat reduced areamodF to 0.1 in infiltration element x=1, z=2

7/14/98 dcm-2d14.dat replaced linear capillary model in ~~ptop~~ RH 7/14/98 primary fracture with the same VG model one assigned to native fractures → Ran in ~400 sec

Noticed error in nodal locations in output, added space to each line of DXYZ, works fine but slowed computation down considerably, possibly due to relative increase in infiltration due to smaller element size.

dcm-2d16.dat had same input as 14 but with corrected element dimensions. Ran to 8.1+ days then crashed

7/15/98 RJH

dcm-2d17.dat removed primary fracture from dcmpara, replaced w/ matrix properties everywhere. reduced areamodf from 100 to 1.0 for matrix block. Still slowed down after 7.1+ days.

dcm-2d18.dat checked & modified water injection

For 2 planes of symmetry 1 l/day = 1 kg/day
or 0.25 kg/day for model
$\Rightarrow$ 2.8935e-6 kg/s

x-coordinates are 0.0002, 0.0015, 0.0239

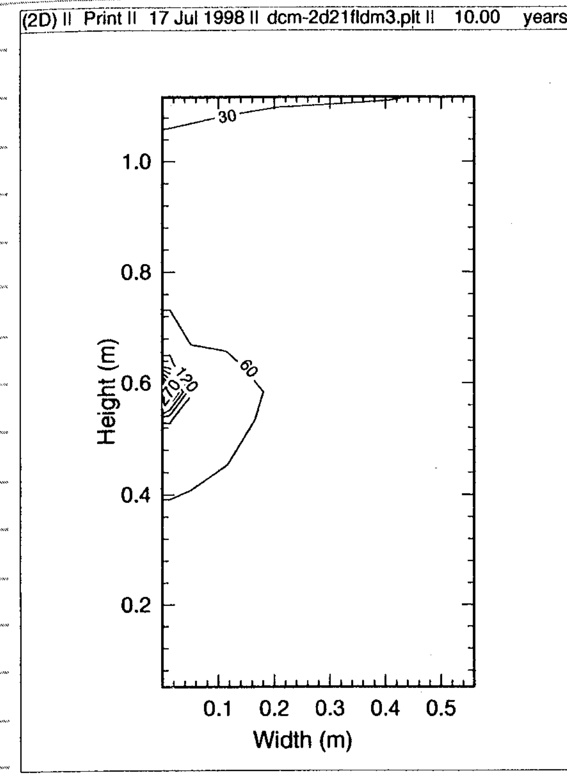
Found error in input. SCALM was set to 4.0, reset to 1.0 in dcm-2d18.dat

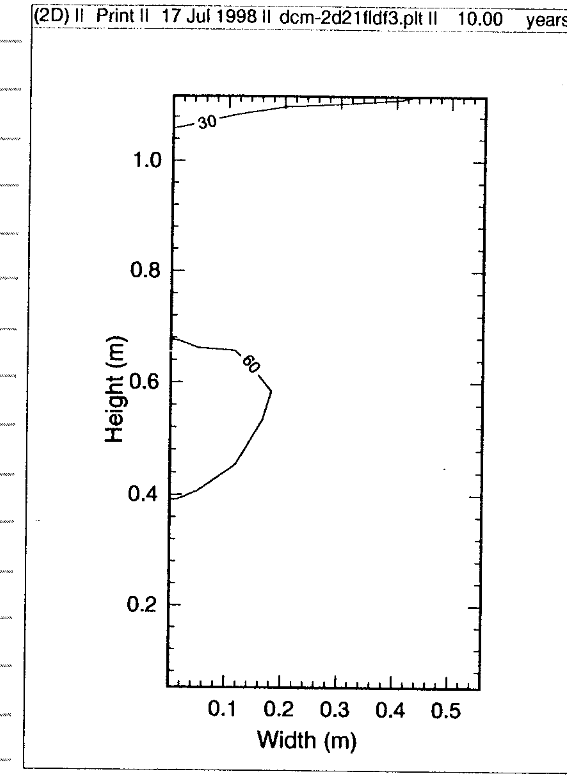
dcm-2d18 ran to 18.1+ days then stalled. There was a big difference between temperatures in matrix & fracture near the heater (ie ~270 C in matrix, 80 in fracture)

dcm-2d19.dat reduced heater zone from 1-3 in x-direction to 1-2 in x-direction

RJH






RJH 7/15/98

7/31/98 RH First successful 3-D DCM run was dcm-sm3.dat in /home/sneezy/rgreen/multi/drip2/dcm

```
Simulation of laboratory-scale dripping experiment - Bldg 51 CNWRA
       July 29, 1998
: dcm-sm3.dat
: smaller model to fit in metra element dimension limitation
: This run statred with drip131 converted to DCM
: this run is to test sat of matrix, fract & drift for heat that ran ok in drip38
: put in invert with same properties as cement
: heat loss at boundaries included
: boundary elements at 1e-2
: heat capacity of boundary elements at 840
: infiltration rate of 1e-5 for two columns
: ipvtab set to 0
: fract por = 0.5 from 0.99
: fract perm up to 1e12 from 1e14
: increased alpha of frac from 6.36e-4 to 2.0e-4
: changed cp of drift from 10 to 840
: changed density of drift from 2600 to 1600
: changed drift and fracture to linear capillary function
: removed heater from drift properties
: set porosity of fracture to 0.7 and drift to 0.99
: set sgc in ecm to 0.0
: set heater porosity to 0.0
: set residual saturation in fracture and drift to 0.0
: modified infiltration to start after 3 days
: changed from correlations to table look up
: decreased thermal conductivity of air from 20 to 15
: set air perm to e-12
: set matrix perm to 2e-17 fro 2e-18
: set max Pa to 1.0 from 0.005 in linear models
: ramped up heat over 5e4 seconds to 7.00e+1
: changed init sat to 0.99 in matrix and 0.10 in fracture and drift
: changed matrix porosity to 0.05 and fracture to 0.99
: set infiltration up to 5.0e-4
: but ramped up from 2.60 to 3.60e5 sec
: reduced fracture porosity from 0.40 to 0.10
: increased porosity back to 0.42
: increased matrix saturation from 0.3 to 0.4, adjusted sats.
: modified sgm in init
: decreased fracture perm to 1e-12 and filled in matrix perm (was default)
: same as drip63 but with fract thermal set to drift
: further increased matrix saturation from 0.4 to 0.5
: further increased matrix saturation from 0.5 to 0.5
: changed matrix to single continuum
: matrix alpha increased by 100x to e-5 - undone
: set back to ECM for matrix
: set heater porosity to 0.01 w/ k=e-27
: set to calc not table
: set gas saturation of matrix to .60
: reduced water infil to 2.955e-6 kg/s = 1 l/day
: increased volume of boundary elements to 1e-2 from 1e-1 w.r.t drip87
: increase thermal k of bc from 0.5 to 0.7 to 1.7
: set k of bc to 0.0 and cp to 1e5 then back to 1e4
: increased time of simulation to 35 days
: moved water injection to z=2 since bc k=0
: decreased vol of bc to 1e0
: increased heat for 7 to 8 and again to 9 then back to 8.5 then back to 8.0 back to 8.5
: increased alpha of frac in medium to 1.3e-1 to reduce drainage
: changed top & bottom to insulating bc & made sides less conductive
: increased no. of elements in x-direction from 14 to 17
: increased heat from 8.5 to 9.5 back to 8.5 back to 7.0 back to 5.5 up to 6.0 back to 5.5
: decreased thermal k of side & front bc from e4 to e3
: reduced size of side and front from .5 to .1 to 1e-3
: reduced thermal k on top & bottom from 1 to 0.5
: reduced heat at 4.23e5 from 5.5 to 4.25 then to 3.5 at 10 days
: made top & bottom conducting using large element size of 1e-3
: decreased vol of top & bottom to 1e-2, then inc bot to 1e-1
```



```
: drip124 put time up to 50 days
: drip124 put steady heat source of 5.0e+1
: drip125 reduced heat to 4.3e+1
: drip126 increased infiltration by 8x
: drip127 set infil back to 1x and heat to 142/4
: drip129 increase infiltration to 2x
: drip130 increase infiltration to 8x
: drip131 set infiltration to 4x
: dcm-sm set fracture and drift fracture to 4
: dcm-sm2 set ylm to 0.3
: dcm-sm3 set ylm to 0.03
RSTART  0
:
:       XYZ                            = 1 table look-up,; pref = ref. press.
:       RADIAL                         = 0 correlations;   tref = ref temp.
:       OTHER                            ^
:                                        |
:grid  geometry  nx ny  nz ivplwr ipvtcal iout    pref tref  href
Grid   DCMXYZ     9 10  11    1      1      3     0         0    0      0
:
:        data taken from sandia report:Green et al. 1995, NUREG/CR-6348
Pckr                          :relative perm and pc
:   i  type-curv  swirm  rpmm(lamda)  alpham  swext  sgc  iecm
    1  Van-Gen   0.05   .3717      6.36e-7    0     0.0  0    ! matrix block
:
:   i  type-curv swrim unused  unused      p@0-sat sgc   iecm
    2  linear    0.00  0.000       0.00     1.0     0.0  0    ! emplacement drift
:
:   i  type-curv swrim unused  unused      p@0-sat sgc   iecm
    3  linear    0.00  0.000       0.00     1.0     0.0  0    ! primary fracture
:
:   i  type-curv swirf  rpmf(lamda)  alphaf  swext  sgc  iecm
    4  Van-Gen  0.08   0.7619      1.3e-1    0.0    0.0   0   ! matrix fractures
0             :blank line
:
  Debug  1
  0
Thermal-prop
: no rho         cpr     ckdry  cksat     crp   crt    tau   cdiff    cexp   enbd
  1  1.600e+03 840.0     0.50    1.0       0     0     .5   2.13e-5   1.8    0. 0 !matrix
  2  1.600e+03 840.0    15.0    15.0       0     0     .5   2.13e-5   1.8    0. 0 !drift
  3  1.600e+03 1.0e+3    1.70    1.70      0     0     .5   2.13e-5   1.8    0. 0 !side boundaries
  4  1.600e+03 840.0     0.50    0.50      0     0     .5   2.13e-5   1.8    0. 0 !top & bottom bounda
0
:      igrid   rw       re
DXYZ   0
: (dx(i),i=1,nx)
0.0002 .0015 .0239 .0508 .0762 .1016 .1016 .1016 .2032
: (dy(j),j=1,ny)
0.0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304
: (dz(k),k=1,nz)
0.1016 .1016 .1016 .1016 .1016 .0508 .0508 .0508 .1524 .2032
0.2032
:.0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508 .0508
:.0254 .0254 .0254 .0254 .0254 .0254 .0508 .1016 .1016 .1016
:.1016 .1016
PhiK
: i1 i2 j1 j2 k1 k2 ist ithrm vb   porf permxf permyf permzf pormm permm  istm ithrmm
  1   9  1 10  1  11 4   1      0. 0.42 1.e-17 1.e-17 1.e-17 0.42  1.e-17 1     1 ! matrix
  1   9 10 10   1 11 4   3 1.0e-3 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1     3 ! front
  9   9  1 10   1 11 4   3 1.0e-3 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1     3 ! side
  1   9  1 10   1  1 4   4 1.0e-2 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1     4 ! top
  1   9  1 10  11 11 4   4 1.0e-1 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1     4 ! bottom
: 1   1  1 10   1 11 4   2      0. 0.10 1.e-12 1.e-12 1.e-12 0.10  1.e-12 4     2 ! fracture
  1   3  1 10   6  8 2   4      0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4     2 ! drift
  3   3  1 10   6  8 2   4      0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4     2 ! drift

  4   4  1 10   7  7 2   4      0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4     2 ! drift
: 1   1  1 10   1 11 3   2      0. 0.10 1.e-12 1.e-12 1.e-12 0.10  1.e-12 4     2 ! fracture
: 1   3  1 10   6  8 2   2      0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4     2 ! drift
: 3   3  1 10   6  8 2   2      0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4     2 ! drift
: 4   4  1 10   7  7 2   2      0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4     2 ! drift
: 1   3  1  3   7  7 1   1      0. 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1     1 ! heater
   0
:
Init
:  i1   i2   j1   j2   k1   k2   p           t      sg    xg2 pm      tm    sgm xgm
    1    9    1   10    1   11  1.0315e5 20.0   0.60 0.   1.0e5 20.0 .60 0. ! matrix
    1    1    1   10    1   11  1.0315e5 20.0   0.99 0.   1.0e5 20.0 .99 0. ! fracture
    1    3    1   10    6    8  1.0315e5 20.0   0.99 0.   1.0e5 20.0 .99 0. ! drift
    3    3    1   10    6    8  1.0315e5 20.0   0.99 0.   1.0e5 20.0 .99 0. ! drift
    4    4    1   10    7    7  1.0315e5 20.0   0.99 0.   1.0e5 20.0 .99 0. ! drift
0
```

 RH

7/13/98

```
DCMPARA
: i1 i2 j1 j2 k1 k2   volf  areamodf  xlm   ylm   zlm
   1  9  1 10  1 11   0.002    1.0      .05   0.03   .05   ! matrix
skip
:  1  1  1 10  1 11   0.10    10.0     .0001 .0304 .0254 ! fracture
   1  1  1 10  6  8   0.99e-1 1.0      .0001 .0304 .0254 ! drift
   2  2  1 10  6  8   0.99e-1 1.0      .0005 .0304 .0254 ! drift
   2  2  1 10  6  8   0.99e-1 1.0      .0010 .0304 .0254 ! drift
   3  3  1 10  6  8   0.99e-1 1.0      .0050 .0304 .0254 ! drift
   3  3  1 10  6  8   0.99e-1 1.0      .0189 .0304 .0254 ! drift
   4  4  1 10  6  8   0.99e-1 1.0      .0254 .0304 .0254 ! drift
   4  4  1 10  7  7   0.99e-1 1.0      .0254 .0304 .0254 ! drift
   1  3  1  3  2  2   0.02 1000.0      .05   0.6   .05   ! water injection
noskip
0
:Equil  depth  pdepth   tdepth   tgrad  param iequil
:Equil   1.00   103150    20.        0.    0.    -1
:
Recurrent
:Skip
:        ns      fach        facm  (fach and facm are multipliers to
:                                      read-in values of qht and qmt)
Source   2      1.          1.
:  is1 is2 js1 js2 ks1 ks2  istyp
    1   3   1  3    7   7   33
 0      0.0
skip
5.e+4  5.50e+1
4.22e5 5.50e+1
4.23e5 4.25e+1
8.45e5 4.25e+1
8.46e5 3.50e+1
1.e+10 3.50e+1
noskip
5.e+4  3.51e+1
1.e+10 3.51e+1
0
 : skip
 :  is1 is2 js1 js2 ks1 ks2  istyp
     1   1   1  4    2   2   13
0.0     20.0   0.0
2.60e5 20.0   0.0
3.60e5 20.0  2.894e-6
1.e+10 20.0  2.894e-6
0
Output   C=-10 Q=-10   T=1   G=1   P=1
 :
 :     isolv  newtnmn  newtnmx  north  nitmax  level
Solve 4       2         12       4      100
 :

:AUTO-step  DPMXE     DSMXE  DTMPMXE   DP2MXe TACCEL    IAUTODT  FAC1
AUTO-step   5.0E+4   0.03    5.0        1.e4  1.0e-3      0       0
:
:TOLR TOLP  TOLS  TOLT  TOLP2  TOLM  TOLA  TOLE rtwotol  rmxtol   smxtol
Tolr   1. 5.e-4  5.e-3  1.    1.e-3 1.e-3 1.e-3  1.e-12  1.e-12   1.e-12
:
:Limit dpmx    dsmx dtmpmx dp2mx dtmn dtmx icutmx
LIMIT  1.e5     .08    10.    1.e5 1.e-9 .1
:
:      target  dt    dpmx   dsmx   dp2mx   dtmpmx
:
:       print all at every target time
PLOTS 1
: Time[d]  1.e-10    1.e-10
Time[d] 1.
Time[d] 5.
Time[d] 10.
Time[d] 20.
Ends
```

← actual run was to 50 days

CPU for dcm-sm3 was ~ 4.5 hrs on sneezy.



8/14/98 RH More modifications done to 3D dcm model

8/29/98 RH Most recent input follow

dcm-sm38.dat had decent results

```
Simulation of laboratory-scale dripping experiment - Bldg 51 CNWRA
    August 12, 1998
: dcm-sm38.dat
: smaller model to fit in metra element dimension limitation
: This run statred with drip131 converted to DCM
: this run is to test sat of matrix, fract & drift for heat that ran ok in drip3
: put in invert with same properties as cement
: heat loss at boundaries included
: boundary elements at 1e-2
: heat capacity of boundary elements at 840
: infiltration rate of 1e-5 for two columns
: ipvtab set to 0
: fract por = 0.5 from 0.99
: fract perm up to 1e12 from 1e14
: increased alpha of frac from 6.36e-4 to 2.0e-4
: changed cp of drift from 10 to 840
: changed density of drift from 2600 to 1600
: changed drift and fracture to linear capillary function
: removed heater from drift properties
: set porosity of fracture to 0.7 and drift to 0.99
: set sgc in ecm to 0.0
: set heater porosity to 0.0
: set residual saturation in fracture and drift to 0.0
: modified infiltration to start after 3 days
: changed from correlations to table look up
: decreased thermal conductivity of air from 20 to 15
: set air perm to e-12
: set matrix perm to 2e-17 fro 2e-18
: set max Pa to 1.0 from 0.005 in linear models
: ramped up heat over 5e4 seconds to 7.00e+1
: changed init sat to 0.99 in matrix and 0.10 in fracture and drift
: changed matrix porosity to 0.05 and fracture to 0.99
: set infiltration up to 5.0e-4
: but ramped up from 2.60 to 3.60e5 sec
: reduced fracture porosity from 0.40 to 0.10
: increased porosity back to 0.42
: increased matrix saturation from 0.3 to 0.4, adjusted sats.
: modified sgm in init
: decreased fracture perm to 1e-12 and filled in matrix perm (was default)
: same as drip63 but with fract thermal set to drift
: further increased matrix saturation from 0.4 to 0.5
: further increased matrix saturation from 0.5 to 0.5
: changed matrix to single continuum
: matrix alpha increased by 100x to e-5 - undone
: set back to ECM for matrix
: set heater porosity to 0.01 w/ k=e-27
: set to calc not table
: set gas saturation of matrix to .60
: reduced water infil to 2.955e-6 kg/s = 1 l/day
: increased volume of boundary elements to 1e-2 from 1e-1 w.r.t drip87
: increase thermal k of bc from 0.5 to 0.7 to 1.7
: set k of bc to 0.0 and cp to 1e5 then back to 1e4
: increased time of simulation to 35 days
: moved water injection to z=2 since bc k=0
: decreased vol of bc to 1e0
: increased heat for 7 to 8 and again to 9 then back to 8.5 then back to 8.0 bac
: increased alpha of frac in medium to 1.3e-1 to reduce drainage
: changed top & bottom to insulating bc & made sides less conductive
: increased no. of elements in x-direction from 14 to 17
: increased heat from 8.5 to 9.5 back to 8.5 back to 7.0 back to 5.5 up to 6.0 b
: decreased thermal k of side & front bc from e4 to e3
: reduced size of side and front from .5 to .1 to 1e-3
: reduced thermal k on top & bottom from 1 to 0.5
: reduced heat at 4.23e5 from 5.5 to 4.25 then to 3.5 at 10 days
: made top & bottom conducting using large element size of 1e-3
: decreased vol of top & bottom to 1e-2, then inc bot to 1e-1
: drip124 put time up to 50 days
: drip124 put steady heat source of 5.0e+1
: drip125 reduced heat to 4.3e+1
: drip126 increased infiltration by 8x
: drip127 set infil back to 1x and heat to 142/4
: drip129 increase infiltration to 2x
: drip130 increase infiltration to 8x
: drip131 set infiltration to 4x
```

```
: dcm-sm set fracture and drift fracture to 4
: dcm-sm2 set ylm to 0.3
: dcm-sm3 set ylm to 0.03
: dcm-sm4 same as sm3 but out to 125 yrs
: dcm-sm5 revised BC, moved infil to top z=1
: dcm-sm6 increased heat source by 1.25x
: dcm-sm7 increased heat source by 1.75x
: dcm-sm8 moved heater down 0.1016 m, no flow in fractures
: dcm-sm9 set h2o inj to x=1,2 y=1,4 z=1,1, still no flow in fractures
: dcm-sm10 inc areamodf to 1e5 for inj
: dcm-sm11 dec k of bc from e-12 to e-17
: dcm-sm12 inc k of matrix from e-17 to e-12
: dcm-sm13 added frac to dcmpara with areamodf=0.01
: dcm-sm14 inc frac k to e-10 and dec frac por to 0.01
: dcm-sm15 inc frac por to 1.0 from 0.01
: dcm-sm16 reduced heat load to 1.50 from 1.75
: dcm-sm17 inc mat k to 5e-17, frac k to 1e-9
: dcm-sm18 inc vol of bc, dec k of frac to 1e-10, inc heat to 1.6
: dcm-sm19 dec size of bc from e-2 to e-4, frac k back to e-10
: dcm-sm20 inc heat to 1.75
: dcm-sm21 dec bc to e-5, dec kt to 1.0 & dt to 1e4 of bc
: dcm-sm22 dec heat to 1.25 from 1.75
: dcm-sm23 inc bc back to 5e-4 from e-5
: dcm-sm24 inc bc kt from e4 to e5
: dcm-sm25 dec heat ramp-up time, dec kt of bc to 5e4 from e5
: dcm-sm26 red vb to 0, inc kt to 5e5 from 5e4
: dcm-sm27 red kt of bc to 5e4
: dcm-sm28 red unsat kt of bc to 0.5 from 1.0, dec unsat kt of matrix to 0.2
: dcm-sm29 dec sat kt of mat to 0.6, dec kt of drift to 5 from 15
: dcm-sm30 dec heat to 1.00
: dcm-sm31 inc kt of drift from 5. to 10.
: dcm-sm32 adjusted coords to better approx test cell & heater
: dcm-sm33 gave heater matrix props, adj x-dim of heater, dec sat from 0.4 to 0.
: dcm-sm34 inc sat from 0.3 to 0.4
: dcm-sm35 removed heater as matrix properties
: dcm-sm36 red size of all boundary elements to 0.0001
: dcm-sm37 inc cp of bc from 5e4 to 5e5
: dcm-sm38 inc size of top element, dec ck of top
RSTART  0
:
:        XYZ                          = 1 table look-up,; pref = ref. press.
:        RADIAL                       = 0 correlations;   tref = ref temp.
:        OTHER
:
:grid  geometry  nx ny  nz ivplwr ipvtcal iout    pref tref  href
Grid   DCMXYZ     9 10  11    1      1      2      0        0    0     0
:
:       data taken from sandia report:Green et al. 1995, NUREG/CR-6348
Pckr                              :relative perm and pc
:   i  type-curv swirm  rpmm(lamda)  alpham  swext  sgc   iecm
    1  Van-Gen  0.05   .3717        6.36e-7    0     0.0  0     ! matrix block
:
:   i  type-curv swrim unused  unused     p@0-sat sgc    iecm
    2  linear   0.00  0.000      0.00      1.0     0.0  0    `! emplacement drift
:
:   i  type-curv swrim unused  unused     p@0-sat sgc    iecm
    3  linear   0.00  0.000      0.00      1.0     0.0  0     ! primary fracture
:
:   i  type-curv swirf  rpmf(lamda)  alphaf  swext  sgc   iecm
    4  Van-Gen  0.08   0.7619      1.3e-1    0.0    0.0   0   ! matrix fractures
0           :blank line
:
  Debug  1
  0
Thermal-prop
: no rho         cpr      ckdry  cksat     crp   crt    tau   cdiff    cexp   enbd
  1  1.600e+03 840.0    0.20     0.6       0     0      .5   2.13e-5  1.8   0. 0 !matrix
  2  1.600e+03 840.0    10.0    10.0       0     0      .5   2.13e-5  1.8   0. 0 !drift
  3  1.600e+03 5.0e+5   0.50    1.00       0     0      .5   2.13e-5  1.8   0. 0 !side b
  4  1.600e+03 5.0e+5   0.50    1.00       0     0      .5   2.13e-5  1.8   0. 0 !bottom
  5  1.600e+03 5.0e+3   0.50    1.00       0     0      .5   2.13e-5  1.8   0. 0 !top bo
0
:      igrid    rw       re
DXYZ   0
: (dx(i),i=1,nx)
0.0002 .0015 .0239 .0508 .0762 .1016 .1016 .2410 .0001
: (dy(j),j=1,ny)
0.0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304 .0607 .0001
: (dz(k),k=1,nz)
0.1000 .1032 .2032 .1016 .0508 .0254 .0508 .1016 .2032 .2539
0.0001
: 0.0001 .2031 .2032 .1016 .0508 .0254 .0508 .1016 .1016 .1524
: 0.2032
: 0.1016 .1016 .2032 .1016 .1016 .0508 .0508 .0508 .1016 .1524
: 0.2032
```

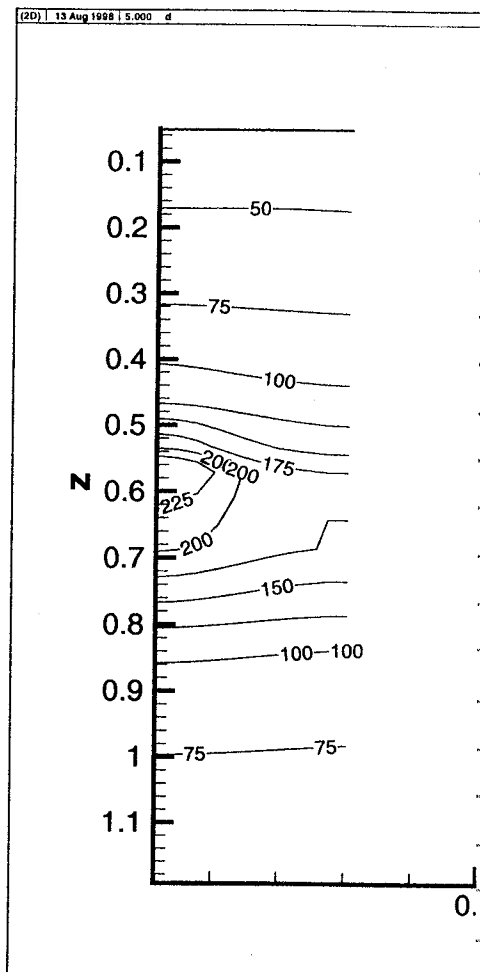


```
PhiK
: i1 i2 j1 j2 k1 k2 ist ithrm vb  porf permxf permyf permzf pormm permm  istm it
  1   9  1 10  1  11 4   1      0. 1.00 1.e-10 1.e-10 1.e-10 0.42  5.e-17 1    1
: 1   9 10 10   1 11 4   3 1.0e-3 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1    3
: 9   9  1 10   1 11 4   3 1.0e-3 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1    3
: 1   9  1 10   1  1 4   4 1.0e-2 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1    4
: 1   9  1 10  11 11 4   4 1.0e-1 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1    4
  1   9 10 10   1 11 4   3      0. 1.00 1.e-10 1.e-10 1.e-10 0.42  5.e-17 1    3
  9   9  1 10   1 11 4   3      0. 1.00 1.e-10 1.e-10 1.e-10 0.42  5.e-17 1    3
  1   9  1 10   1  1 4   5      0. 1.00 1.e-10 1.e-10 1.e-10 0.42  5.e-17 1    5
  1   9  1 10  11 11 4   4      0. 1.00 1.e-10 1.e-10 1.e-10 0.42  5.e-17 1    4
: 1   1  1 10   1 11 4   2      0. 1.00 1.e-12 1.e-12 1.e-12 0.10  1.e-12 4    2
  1   3  1 10   6  8 2   4      0. 1.00 1.e-10 1.e-10 1.e-10 0.99  1.e-12 4    2
  3   3  1 10   6  8 2   4      0. 1.00 1.e-10 1.e-10 1.e-10 0.99  1.e-12 4    2
  4   4  1 10   7  7 2   4      0. 1.00 1.e-10 1.e-10 1.e-10 0.99  1.e-12 4    2
: 1   1  1 10   1 11 3   2      0. 0.10 1.e-12 1.e-12 1.e-12 0.10  1.e-12 4    2
: 1   3  1 10   6  8 2   2      0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4    2
: 3   3  1 10   6  8 2   2      0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4    2
: 4   4  1 10   7  7 2   2      0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4    2
: 1   3  1  3   6  6 4   1      0. 1.00 1.e-10 1.e-10 1.e-10 0.42  5.e-17 1    1
   0

:
Init
:  i1  i2  j1  j2  k1  k2  p          t      sg   xg2.pm    tm   sgm xgm
    1   9  1   10   1  11  1.0315e5 20.0  0.60 0.   1.0e5 20.0 .60 0. ! matrix
    1   1  1   10   1  11  1.0315e5 20.0  0.99 0.   1.0e5 20.0 .99 0. ! fracture
    1   3  1   10   6   8  1.0315e5 20.0  0.99 0.   1.0e5 20.0 .99 0. ! drift
    3   3  1   10   6   8  1.0315e5 20.0  0.99 0.   1.0e5 20.0 .99 0. ! drift
    4   4  1   10   7   7  1.0315e5 20.0  0.99 0.   1.0e5 20.0 .99 0. ! drift
0
DCMPARA
: i1 i2 j1 j2 k1 k2    volf  areamodf  xlm   ylm   zlm
   1  9  1 10  1 11    0.002     1.0      .05   0.03   .05    ! matrix
skip
   1  1  1 10  1 11    0.10     0.01     .0001 .0304 .0254 ! fracture
   1  1  1 10  6  8    0.99e-1 1.0       .0001 .0304 .0254 ! drift
   2  2  1 10  6  8    0.99e-1 1.0       .0005 .0304 .0254 ! drift
   2  2  1 10  6  8    0.99e-1 1.0       .0010 .0304 .0254 ! drift
   3  3  1 10  6  8    0.99e-1 1.0       .0050 .0304 .0254 ! drift
   3  3  1 10  6  8    0.99e-1 1.0       .0189 .0304 .0254 ! drift
   4  4  1 10  6  8    0.99e-1 1.0       .0254 .0304 .0254 ! drift
   4  4  1 10  7  7    0.99e-1 1.0       .0254 .0304 .0254 ! drift
   1  2  1  4  1  1    0.02 1.e+5        .05   0.6   .05   ! water injection
noskip
0
:Equil  depth  pdepth   tdepth   tgrad  param iequil
:Equil   1.00   103150    20.        0.   0.     -1
:
Recurrent
:Skip
:          ns     fach       facm  (fach and facm are multipliers to
:                                       read-in values of qht and qmt)
Source   2     1.00        1.
:  is1 is2 js1 js2 ks1 ks2  istyp
    1   3   1  3    6   6   33
0.0     0.0
1.e+4  3.51e+1
1.e+10 3.51e+1
0
:  is1 is2 js1 js2 ks1 ks2  istyp
    1   2   1  4    1   1   13
0.0    20.0   0.0
2.60e5 20.0   0.0
3.60e5 20.0  2.894e-6
1.e+10 20.0  2.894e-6
0
Output   C=-10 Q=-10    T=1    G=1    P=1
:
:        isolv  newtnmn  newtnmx  north  nitmax  level
Solve 4       2          12       4      100
:
:AUTO-step  DPMXE    DSMXE  DTMPMXE    DP2MXe TACCEL    IAUTODT  FAC1
AUTO-step   5.0E+4   0.03    5.0         1.e4  1.0e-3      0       0
:
:TOLR TOLP  TOLS  TOLT   TOLP2  TOLM  TOLA  TOLE rtwotol   rmxtol    smxtol
Tolr   1. 5.e-4  5.e-3  1.     1.e-3 1.e-3 1.e-3  1.e-12  1.e-12    1.e-12
:
:Limit dpmx    dsmx dtmpmx dp2mx dtmn dtmx icutmx
LIMIT  1.e5     .08    10.    1.e5 1.e-9 .1
:
:       target dt    dpmx    dsmx    dp2mx   dtmpmx
```

```
:
:      print all at every target time
PLOTS 1 0 4
1 2 55 56
: Time[d]  1.e-10     1.e-10
Time[d] 1.
Time[d] 5.
Time[d] 10.
Time[d] 20.
Time[d] 30.
Time[d] 50.
Time[d] 80.
Time[d] 110.
Time[d] 130.
Ends
```

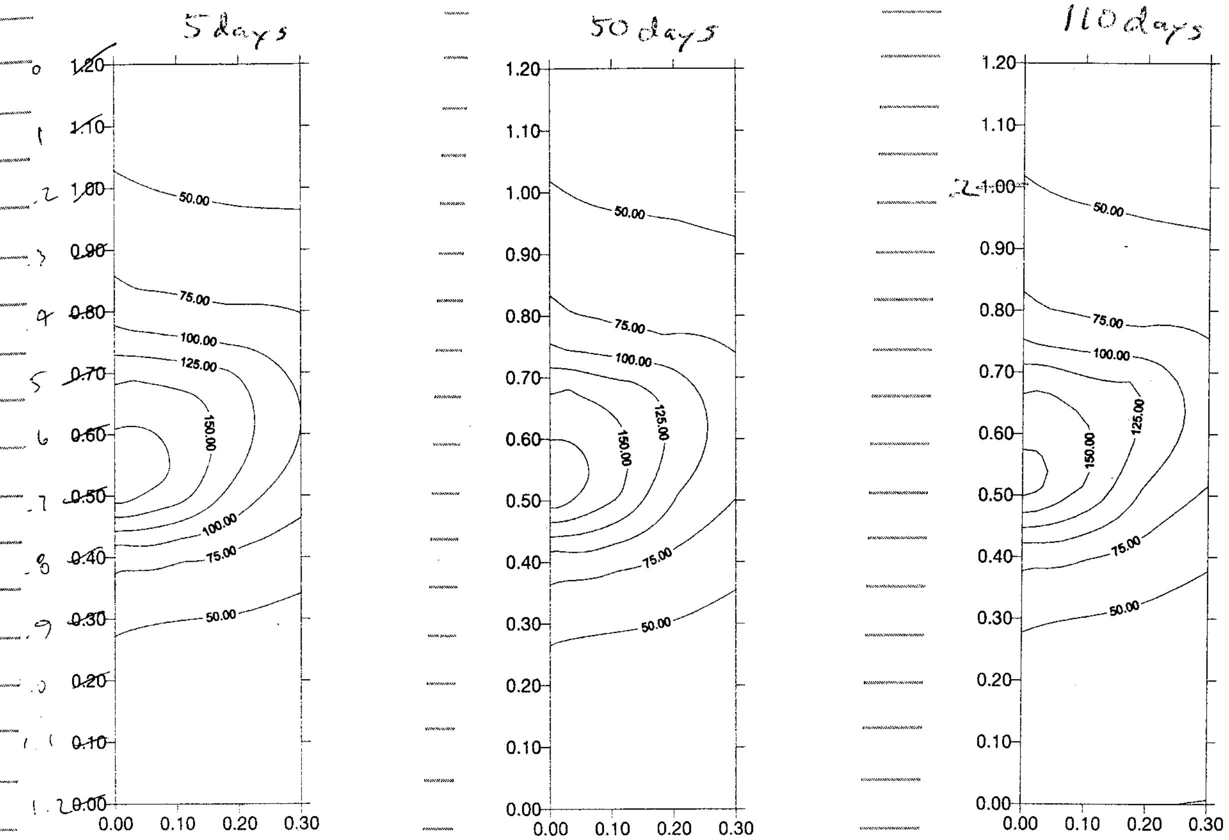
Temperature @ 5 days
for dcm-sm38.dat

Heat up of upper portion of
plot delayed by small $K_T$
assigned to matrix






Plotted temperatures for first heater experiment
plotted by Jim Prikryl



```
     Simulation of laboratory-scale dripping experiment - Bldg 51 CNWRA
        August 24, 1998
 : dcm-sm67.dat
 : smaller model to fit in metra element dimension limitation
 : This run statred with drip131 converted to DCM
```

Same lines as dcm-sm38.dat on pg 39-42 RF 8/24/98

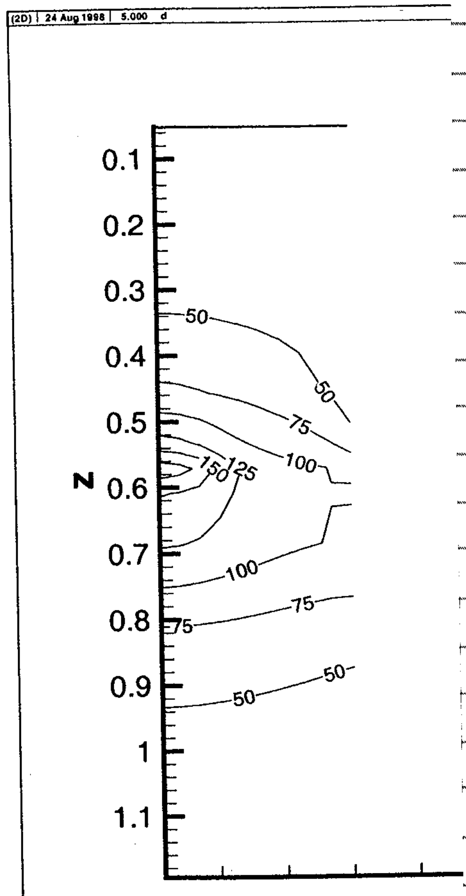
```
: dcm-sm34 inc sat from 0.3 to 0.4
: dcm-sm35 removed heater as matrix properties
: dcm-sm36 red size of all boundary elements to 0.0001
: dcm-sm37 inc cp of bc from 5e4 to 5e5
: dcm-sm38 inc size of top element, dec ck of top
: dcm-sm43 inc cp at side at heater (y=1-4,z=4-6)
: dcm-sm44 inc size of high cp zone on side (y=1-4,z=4-8)
: dcm-sm45 dec size of high cp zone on side to y=1-4,z=5-7
: dcm-sm46 inc cp of side bc to 5e7, added monitor on drift, stalled at 25.5 d
: dcm-sm47 dec cp of side to e6, inc size to z=4-8
: dcm-sm48 inc cp of side to 5e6, inc size to z=3-9, ran past 6.1 d
: dcm-sm49 inc cp of side to e7, still too hot
: dcm-sm50 inc cp of side to e8, inc kt to 1.5, 2, still too hot
: dcm-sm51 inc cp of side to e9, 5e6, inc size to z=2,10
: dcm-sm52 inc kt of matrix to 0.4, 0.8 from 0.2, 0.6, very sensitive to kt
: dcm-sm53 dec kt of matrix to 0.3, 0.8
: dcm-sm54 rev cp of top & bot
: dcm-sm55 set cp of top & bot to 5e4, set matrix kt to 0.4, 0.6
: dcm-sm56 inc cp of top & bot to 5e6, set tmax from 0.1 to 0.2
: dcm-sm57 moved high heat loss to front from side, corr drift therm to 2, inc b
: dcm-sm58 dec cp of front from 1e9 to 5e7, dec z= 4,8
: dcm-sm59 inc fract k to e-8 from e-10, inc bot cp to e8, inc sat kt of mat to
: dcm-sm60 inc sat kt of matrix to 1., dec frac k to e-9 from e-8
: dcm-sm61 dec mat kt to .4-.7, dec frac k to e-10, dec mat k to 2e-18, adj wat
: dcm-sm64 inc mat k to 2e-17 from 2e-18
: dcm-sm66 dec heat to 0.9 for heat loss
: dcm-sm67 inc areamodf of mat to 10.0 from 0.1
RSTART  0
:
:       XYZ                        = 1 table look-up,; pref = ref. press.
:       RADIAL                     = 0 correlations;   tref = ref temp.
:       OTHER                        ^
:                                    |
:grid  geometry  nx ny  nz ivplwr ipvtcal iout    pref tref  href
Grid   DCMXYZ     9 10  11    1       1     2      0      0    0     0
:
:          data taken from sandia report:Green et al. 1995, NUREG/CR-6348
Pckr                            :relative perm and pc
:    i  type-curv swirm  rpmm(lamda)  alpham  swext  sgc  iecm
     1  Van-Gen   0.05   .3717      6.36e-7    0     0.0  0      ! matrix block
:
:    i  type-curv swrim unused  unused     p@0-sat sgc    iecm
     2  linear    0.00 0.000     0.00       1.0    0.0  0     ! emplacement drift
:
:    i  type-curv swrim unused  unused     p@0-sat sgc    iecm
     3  linear    0.00 0.000     0.00       1.0    0.0  0     ! primary fracture
:
:    i  type-curv swirf  rpmf(lamda)  alphaf  swext  sgc  iecm
     4  Van-Gen  0.08   0.7619     1.3e-1    0.0    0.0  0    ! matrix fractures
0          :blank line
:
  Debug  1
  0
Thermal-prop
: no rho        cpr     ckdry  cksat    crp  crt    tau  cdiff    cexp  enbd
   1  1.600e+03 840.0    0.40   0.70     0     0     .5  2.13e-5  1.8  0. 0 !matrix
   2  1.600e+03 840.0   10.0   10.0      0     0     .5  2.13e-5  1.8  0. 0 !drift
   3  1.600e+03 5.0e+6  0.50   1.00      0     0     .5  2.13e-5  1.8  0. 0 !side b
   4  1.600e+03 1.0e+8  0.50   1.00      0     0     .5  2.13e-5  1.8  0. 0 !bottom
   5  1.600e+03 5.0e+6  0.50   1.00      0     0     .5  2.13e-5  1.8  0. 0 !top bo
   6  1.600e+03 5.0e+7  1.50   2.00      0     0     .5  2.13e-5  1.8  0. 0 !front
0
:      igrid   rw       re
DXYZ   0
: (dx(i),i=1,nx)
0.0002 .0015 .0239 .0508 .0762 .1016 .1016 .2410 .0001
: (dy(j),j=1,ny)
0.0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304 .0607 .0001
: (dz(k),k=1,nz)
0.1000 .1032 .2032 .1016 .0508 .0254 .0508 .1016 .2032 .2539
0.0001
: 0.0001 .2031 .2032 .1016 .0508 .0254 .0508 .1016 .1016 .1524
: 0.2032
```



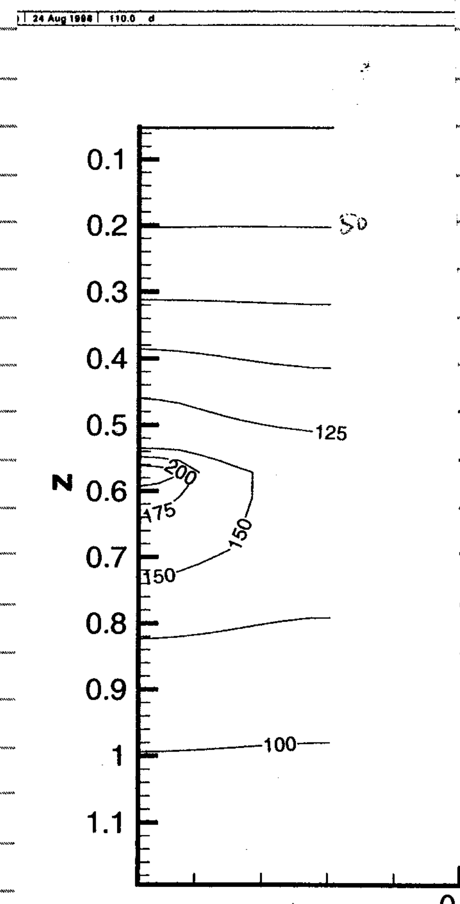
```
: 0.1016 .1016 .2032 .1016 .1016 .0508 .0508 .0508 .1016 .1524
: 0.2032
PhiK
: i1 i2 j1 j2 k1 k2 ist ithrm vb   porf permxf permyf permzf pormm permm  istm it
  1   9  1 10  1  11 4   1       0. 1.00 1.e-10 1.e-10 1.e-10 0.42  2.e-17 1    1
: 1   9 10 10   1 11 4   3 1.0e-3 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1    3
: 9   9  1 10   1 11 4   3 1.0e-3 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1    3
: 1   9  1 10   1  1 4   4 1.0e-2 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1    4
: 1   9  1 10  11 11 4   4 1.0e-1 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1    4
  1   9 10 10   1 11 4   3       0. 1.00 1.e-10 1.e-10 1.e-10 0.42  2.e-17 1    3
  9   9  1 10   1 11 4   3       0. 1.00 1.e-10 1.e-10 1.e-10 0.42  2.e-17 1    3
  1   4 10 10   4  8 4   6       0. 1.00 1.e-10 1.e-10 1.e-10 0.42  2.e-17 1    6
  1   9  1 10   1  1 4   5       0. 1.00 1.e-10 1.e-10 1.e-10 0.42  2.e-17 1    5 TOP
  1   9  1 10  11 11 4   4       0. 1.00 1.e-10 1.e-10 1.e-10 0.42  2.e-17 1    4 BOTOM
: 1   1  1 10   1 11 4   2       0. 1.00 1.e-12 1.e-12 1.e-02 0.10  1.e-12 4    2
  1   3  1 10   6  8 2   2       0. 1.00 1.e-10 1.e-10 1.e-10 0.99  1.e-12 4    2
  3   3  1 10   6  8 2   2       0. 1.00 1.e-10 1.e-10 1.e-10 0.99  1.e-12 4    2
  4   4  1 10   7  7 2   2       0. 1.00 1.e-10 1.e-10 1.e-10 0.99  1.e-12 4    2
: 1   1  1 10   1 11 3   2       0. 0.10 1.e-12 1.e-12 1.e-12 0.10  1.e-12 4    2
: 1   3  1 10   6  8 2   2       0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4    2
: 3   3  1 10   6  8 2   2       0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4    2
: 4   4  1 10   7  7 2   2       0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4    2
: 1   3  1  3   6  6 4   1       0. 1.00 1.e-10 1.e-10 1.e-10 0.42  2.e-18 1    1
   0
:
Init
:  i1  i2  j1  j2  k1  k2  p          t     sg   xg2 pm     tm   sgm xgm
    1   9  1   10   1  11  1.0315e5 20.0  0.60 0.   1.0e5 20.0 .60 0. ! matrix
    1   1  1   10   1  11  1.0315e5 20.0  0.99 0.   1.0e5 20.0 .99 0. ! fracture
    1   3  1   10   6   8  1.0315e5 20.0  0.99 0.   1.0e5 20.0 .99 0. ! drift
    3   3  1   10   6   8  1.0315e5 20.0  0.99 0.   1.0e5 20.0 .99 0. ! drift
    4   4  1   10   7   7  1.0315e5 20.0  0.99 0.   1.0e5 20.0 .99 0. ! drift
0
DCMPARA
: i1 i2 j1 j2 k1 k2    volf  areamodf  xlm    ylm    zlm
   1  9  1 10  1 11    0.002   10.0     .05    0.03   .05    ! matrix
skip
   1  1  1 10  1 11    0.10     0.01    .0001 .0304 .0254 ! fracture
   1  1  1 10  6  8    0.99e-1 1.0      .0001 .0304 .0254 ! drift
   2  2  1 10  6  8    0.99e-1 1.0      .0005 .0304 .0254 ! drift
   2  2  1 10  6  8    0.99e-1 1.0      .0010 .0304 .0254 ! drift
   3  3  1 10  6  8    0.99e-1 1.0      .0050 .0304 .0254 ! drift
   3  3  1 10  6  8    0.99e-1 1.0      .0189 .0304 .0254 ! drift
   4  4  1 10  6  8    0.99e-1 1.0      .0254 .0304 .0254 ! drift
   4  4  1 10  7  7    0.99e-1 1.0      .0254 .0304 .0254 ! drift
noskip
   1  2  1  4  1  1    0.02 1.e+5       .05    0.03   .05    ! water injection
0
:Equil   depth  pdepth    tdepth    tgrad  param iequil
:Equil   1.00   103150    20.         0.    0.     -1
:
Recurrent
:Skip
:          ns      fach        facm  (fach and facm are multipliers to
:                                        read-in values of qht and qmt)
Source   2      0.90        1.
:  is1 is2 js1 js2 ks1 ks2  istyp
     1   3   1  3    6   6   33
0.0     0.0
1.e+4  3.51e+1


1.e+10 3.51e+1
0
:  is1 is2 js1 js2 ks1 ks2  istyp
     1   2   1  4    1   1   13
0.0     20.0   0.0
2.60e5 20.0    0.0
3.60e5 20.0   2.894e-6
1.e+10 20.0   2.894e-6
0
Output   C=-10 Q=-10   T=1   G=1   P=1
:
:        isolv  newtnmn  newtnmx  north  nitmax  level
Solve 4      2          12        4      100
:
:AUTO-step  DPMXE     DSMXE  DTMPMXE   DP2MXe TACCEL   IAUTODT  FAC1
AUTO-step   5.0E+4    0.03    5.0        1.e4  1.0e-3      0       0
:
:TOLR TOLP  TOLS  TOLT   TOLP2  TOLM  TOLA  TOLE rtwotol   rmxtol    smxtol
Tolr   1. 5.e-4  5.e-3  1.    1.e-3 1.e-3 1.e-3  1.e-12  1.e-12    1.e-12
:
```

8/24/98

```
:Limit dpmx    dsmx dtmpmx dp2mx dtmn dtmx icutmx
LIMIT  1.e5    .08    10.    1.e5 1.e-9 .2
:
:      target  dt    dpmx   dsmx   dp2mx   dtmpmx
:
:      print all at every target time
PLOTS 1 0 4
1 2 451 541
: Time[d]   1.e-10    1.e-10
Time[d] 1.
Time[d] 5.
Time[d] 10.
Time[d] 20.
Time[d] 30.
Time[d] 50.
Time[d] 80.
Time[d] 110.
Time[d] 130.
Ends
```




dcm-Sm67 at 5 days




dcm-~~Sm~~ m67 at 110 days

cpu = 5.78 hrs

8/25/98 ~~Rad~~ RL 8/25/98
RL

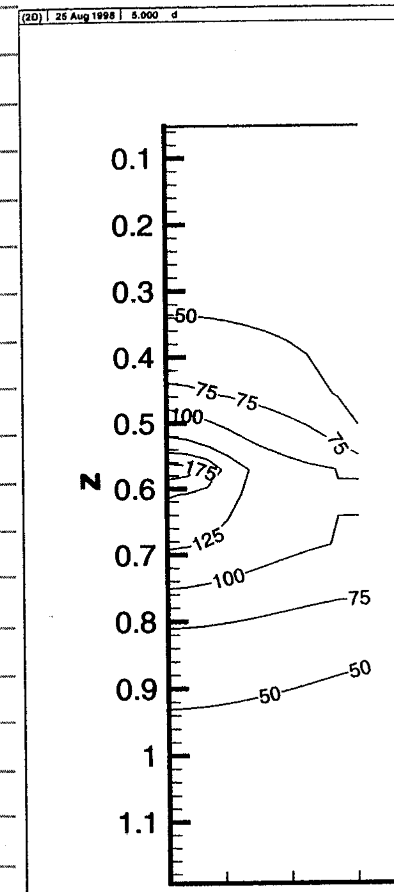
Tried several modifications to reduce temperature of bottom of cell at late times.



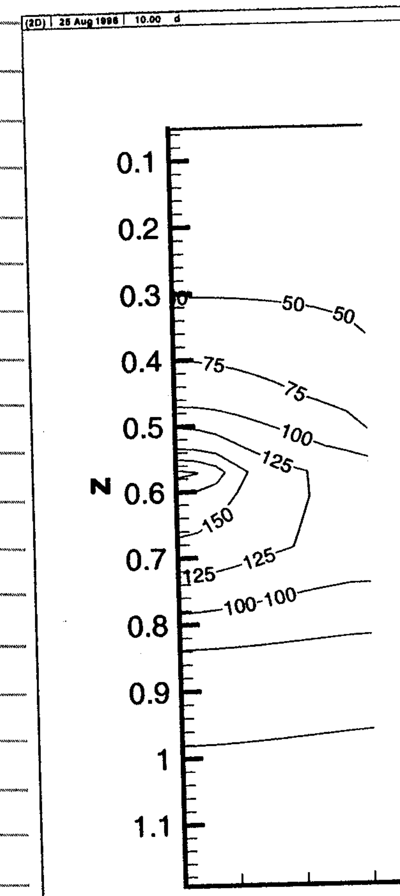
8/25/98

Increase of k for matrix from 2e-17 m² to 2e-15 m² did not reduce temperature in dcm-Sm68.dat

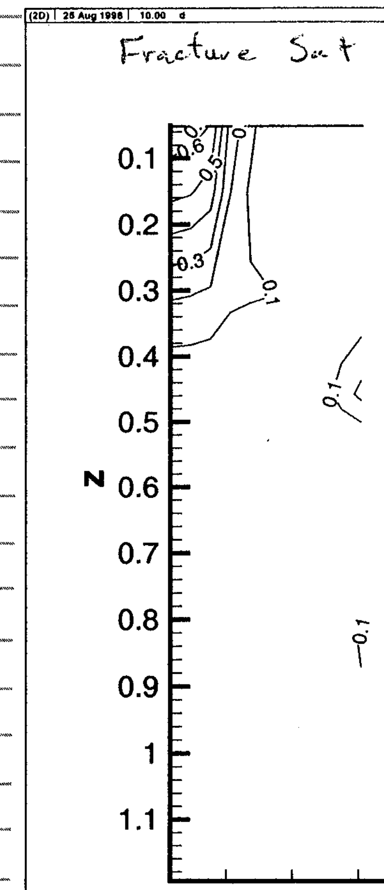
Increased vb of bottom layer to 1e-1 in dcm-Sm69.dat this looks promising




dcm-Sm69 at 5 days



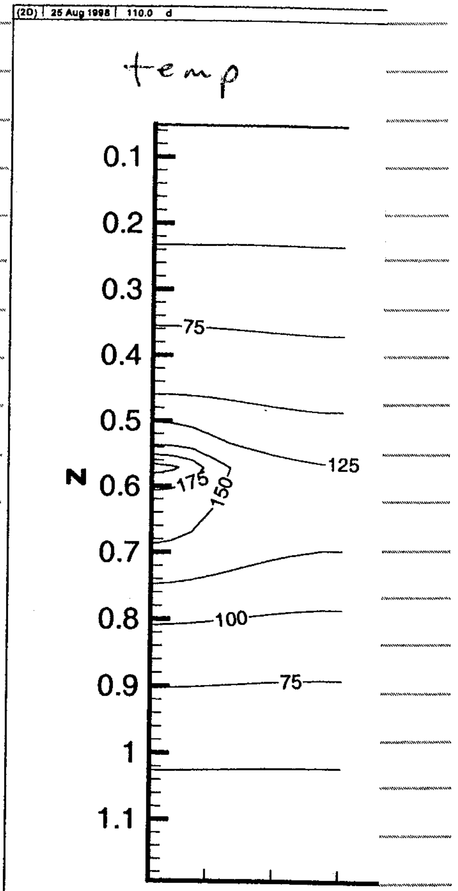

dcm-Sm69 at 10 days



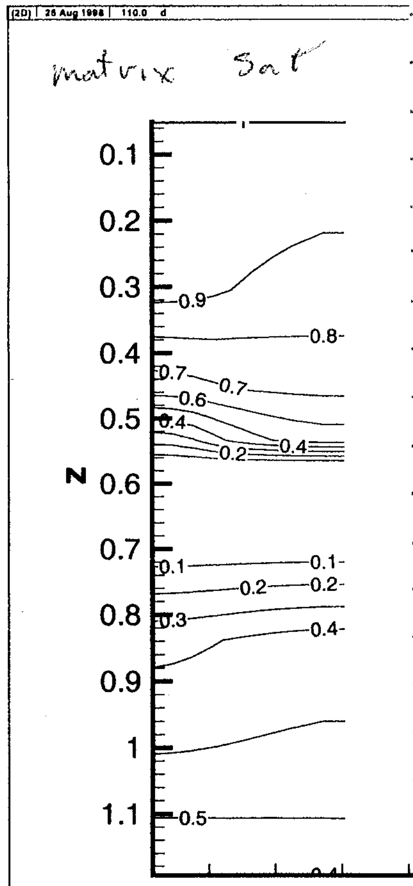

dcm-Sm69 at 10 days

areamodF = 1.0 in dcm-Sm69.dat

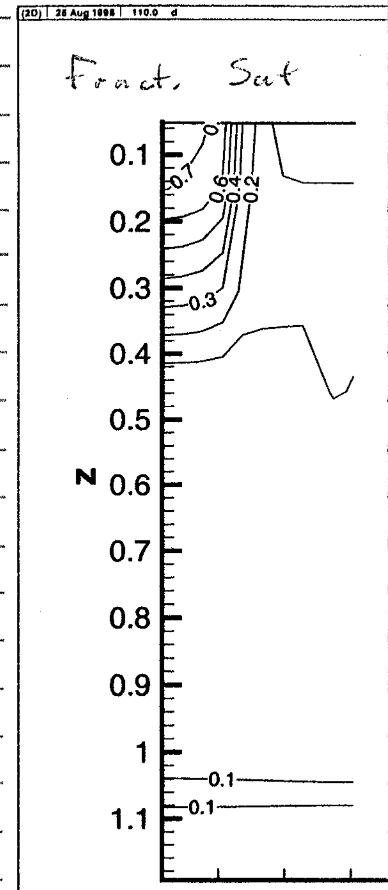
This suggests greater heat loss in bottom than in either top or sides




dcm-Sm 69 at 110d




dcm-Sm 69 at 110d




dcm-Sm 69 at 110d

8/28/98 RH Used results from 3 runs in the Pisa paper
dcm-sm69.dat areamodF = 1.0
dcm-sm70.dat areamodF = 1e-4
dcm-sm71.dat areamodF = 1e-2

all located in /home/sneezy/rgreen/multi/dripz/dcm

```
: dcm-sm64 inc mat k to 2e-17 from 2e-18
: dcm-sm66 dec heat to 0.9 for heat loss
: dcm-sm67 inc areamodf of mat to 10.0 from 0.1
: dcm-sm69 inc size of bot to keep cool, set areamodf back to 1.0
: dcm-sm70 dec areamodf for mat from 1.0 to 1e-4
: dcm-sm71 inc areamodf from e-4 to e-2, inc dt from .2 to .4
RSTART  0
:
```

2/8/99 RH

To get slice from 3D ~~RH~~ 6/21/99

/data/ ~~Create zone~~ extract / ~~slice~~ ~~extract~~ slice / ~~enter~~ x-plane / enter 0.01

? / " / " / contour RH 2/8/99

turn off 3D

Re-plotted graphs used in Pisa conference paper

from /home/sneezy/rgreen/multi/dripz/dcm/

Fig6.lay Fig7.lay

need to print these using tecplot into *.ps

then print using lpr file.ps

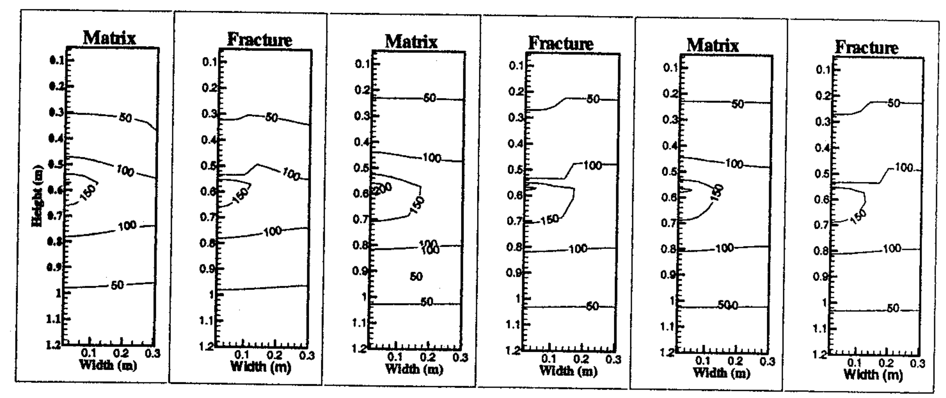



Fig6.lay

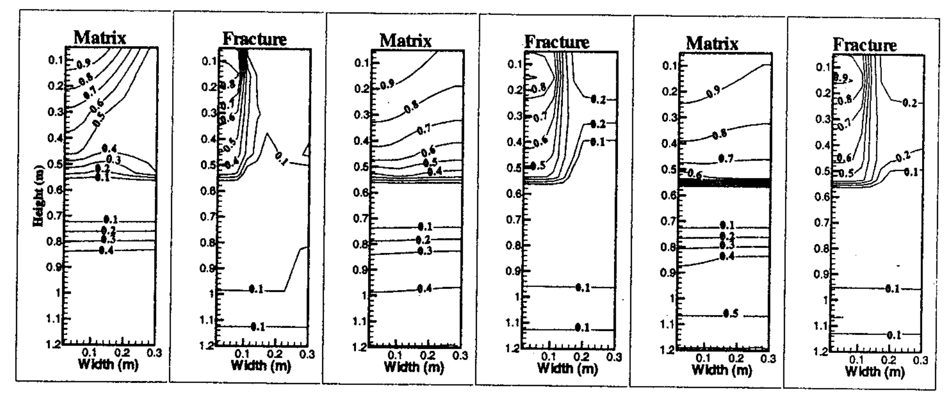
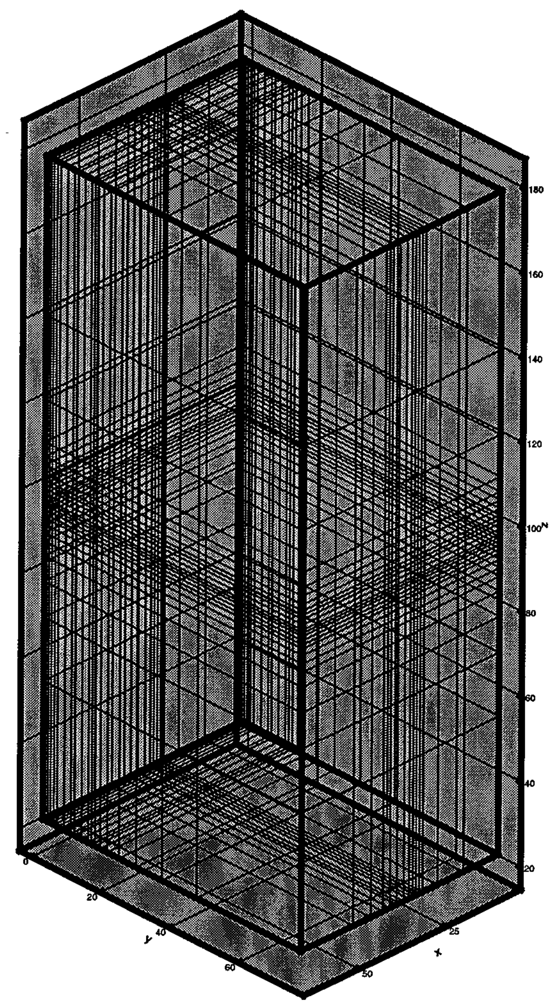



Fig7.lay

3/22/99 Started new set of runs: 3D Drift-scale test analysis using DCM
RFF

2 vertical planes of symmetry



← heater horizon

used data properties provided by Debra Hughson taken from TSPA-VA TBD TH data set


3/22/99

Input data-set: (taken from old gt3)

```
        Simulation of DST Experiment Using DCM with floor and wing heater
                       Initialization used from gt3.dat
: gt3-9-3.dat
: March 16, 1999
:     Also, the outer wing heater is set to 1500 w from 1000 in gt2.dat
:          Watsolv tolerance changed from 1.e-15 to 1.e-12.
: use DOE TH data set, taken from D. Hughson
:
RSTART  0
:
:     XYZ                          = 1 table look-up,; pref = ref. press.
:     RADIAL                       = 0 correlations;   tref = ref temp.
:     OTHER                           ^
:                                     |
:grid  geometry  nx ny   nz ivplwr ipvtab  iout
GRID    DCMXYZ   15 20   25  0       0      1
:
:grid  geometry  nx ny   nz ivplwr ipvcal  iout  gravity  pref tref  href^M
:Grid   DCMXYZ     34  1   56   1       1      1      0        0    0    0^M
:
: Monitor 154
:        data taken from sandia report:san94-2011, UC - 814
Pckr                                 :relative perm and pc keyword
:   i  type-curv    swirm   rpmm(lamda) alpham       swext   sgc      iecm
:
: (TSw33 - matrix)
   1  Van-Gen       0:06     0.2479       6.21e-6    -1.0e+8   0.0       0
:
: (TSw33 - fracture)
   2  Van-Gen       0.01     0.667        1.73e-3    -0.0e+8   0.0       0
:
: (TSw34 - matrix)
   3  Van-Gen       0.18     0.3212       1.19e-6    -1.0e+8   0.0       0
:
: (TSw34 - fracture)
   4  Van-Gen       0.01     0.643        9.34e-4    -0.0e+8   0.0       0
:
: (TSw35 - matrix)
   5  Van-Gen       0.08     0.1983       4.01e-6    -1.0e+8   0.0       0
:
: (TSw35 - fracture)
   6  Van-Gen       0.01     0.667        1.26e-3    -0.0e+8   0.0       0
:
   7 TABular  0.01  0.  0.  0.  0.  0
                        .0000   .000E+00  1.000E+00  0
                        .0100   .000E+00  1.000E+00  0
                        .0500  1.031E-05  1.000E+00  0
                        .1000  1.579E-04  9.998E-01  0
                        .1500  7.021E-04  9.993E-01  0
                        .2000  1.978E-03  9.980E-01  0
                        .2500  4.387E-03  9.956E-01  0
                        .3000  8.397E-03  9.916E-01  0
                        .3500  1.455E-02  9.855E-01  0
                        .4000  2.346E-02  9.765E-01  0
                        .4500  3.584E-02  9.642E-01  0
                        .5000  5.253E-02  9.475E-01  0
                        .5500  7.449E-02  9.255E-01  0
                        .6000  1.029E-01  8.971E-01  0
                        .6500  1.391E-01  8.609E-01  0
                        .7000  1.850E-01  8.150E-01  0
                        .7500  2.428E-01  7.572E-01  0
                        .8000  3.155E-01  6.845E-01  0
                        .8500  4.080E-01  5.920E-01  0
                        .9000  5.278E-01  4.722E-01  0
                        .9500  6.916E-01  3.084E-01  0
 .
 .
 :
:Debug  1
Thermal-prop
: no rho        cpr     ckdry  cksat    crp  crt   tau  cdiff   cexp  enbd
: (TSw33 - matrix)
  1 2.510e+03 883       0.71   1.80     0     0    .5  2.13e-5  1.8  0.
: (TSw34 - matrix)
  2 2.530e+03 948       1.56   2.33     0     0    .5  2.13e-5  1.8  0.
: (TSw35 - matrix)
  3 2.540e+03 900       1.20   2.02     0     0    .5  2.13e-5  1.8  0.
: (drift)
  4 1.2        57.4     20.0   20.0     0     0    .5  2.13e-5  1.8  0.
/
```

```
:
:     igrid   rw      re
DXYZ   0
: (dx(i),i=1,nx)
 12.5 7.5  7.5 1. 1. 1. 1. 1.  2.  2.
 2. 2.  5. 5. 25.
: 2. 2.  5. 5. 5. 5.  10. 10. 20. 50.
: 50. 50.  1.e20
: (dy(j),j=1,ny)
0.66  0.66  0.67  1.  1.  1.  3.  1.  1.  3.
1. 1.  1.  2.  2.  5.  5.  10.  10. 50.
:50. 100. 1.e20
: (dz(k),k=1,nz)
  45. 20. 10.  7.  5.  2.  2.  2.  1. 1.
  1.  1.  .5  1.  1.5  1.  1.   1.  2.  2.
  2.  5.  15.  25. 50.
PhiK
: i1 i2 j1 j2  k1 k2 iist ithrm vb  porf  permxf   permyf   permzf   pormm permm
  1  15  1  20  1  3  1   1    0.  1.0000 8.49e-09 8.49e-09 2.50e-07 0.135 2.04e
  1  15  1  20  4 23  1   1    0.  1.0000 3.44e-09 3.44e-09 5.45e-08 0.089 4.08e
  1  15  1  20 24 25  1   1    0.  1.0000 2.77e-09 2.77e-09 1.16e-08 0.115 2.22e
  1   3  1  3  12 15  2   2    0   1.0000 3.44e-09 3.44e-09 5.45e-08 1.0   4.08e
/
:
Init
: i1  i2  j1  j2  k1  k2          p          t         sg         xg2        pm
   1  15   1  20   1  25 9.33812E+04   18.0676 9.7155E-01 0.0000E+00 9.3346E+04
.
:        ns     fach        facm  (fach and facm are multipliers to
:                                   read-in values of qht and qmt)
:Equil  depth  pdepth   tdepth   tgrad  param iequil
:Equil   169.   101325    20.       0.   0.     -1
:
:
DCMPARA
: i1 i2 j1 j2 k1 k2   volf  areamodf  xlm ylm zlm
:
  1   15  1 20  1   3  1.05e-4  5.00e-4  0.5  0.5  0.5  : TSw33
  1   15  1 20  4  23  1.24e-4  1.23e-3  0.5  0.5  0.5  : TSw34
  1   15  1 20 24  25  3.29e-4  5.00e-4  0.5  0.5  0.5  : TSw35

  1    3  1  3  1  25  1.24e-4  1.00e+0  0.1  0.1  0.1  : drift
/
Recurrent
Skip
Limit  1.e5  .08  10.  1.e5  1.e-8  1.e5
Solve  3
Rstart  1
Steady[y]  1.e-4  1.e-4  1.e-4
Rstart  0
Noskip
Source   3   25.   1.
:  is1 is2 js1 js2 ks1 ks2   istyp
    1   3   1  1   15  15    33
  0              250.
  6.3072e7       250.
  9.4608e7       250.
  1.2614e8       250.
  1.2614001e8    0.
  1.5768e8       0.
0
:  is1 is2 js1 js2 ks1 ks2   istyp
    1   3   6  8    13  13    33
  0              400.
  6.3072e7       400.
  9.4608e7       400.
  1.2614e8       400.
  1.2614001e8    0.
  1.5768e8       0.
0
:  is1 is2 js1 js2 ks1 ks2   istyp
    1   3  9    11  13  13    33
  0               1500.
  6.3072e7        1500.
  9.4608e7        1500.
  1.2614e8        1500.
  1.2614001e8     0.
  1.5768e8        0.
0
```



```
Output   C=-10 Q=-10   T=1   G=1   P=1
:
:  isolv  newtnmn  newtnmx
Solve 4    2        7       2
:
:AUTO-step  DPMXE    DSMXE  DTMPMXE    DP2MXe
AUTO-step   5.0E+4   0.03    5.0        1.e4
:
:TOLR TOLP  TOLS  TOLT  TOLP2  TOLM  TOLA  TOLE
Tolr   1. 1.e-4  1.e-3  1.    1.e-3 1.e-3 1.e-3  1.e-12  1.e-12   1.e-12
:
:Limit dpmx    dsmx dtmpmx dp2mx dtmn dtmx icutmx
LIMIT  1.e5    .08    10.   1.e5 1.e-9 .1
:
:        target  dt    dpmx   dsmx   dp2mx   dtmpmx
:
:         print all at every target time
PLOTS 1
Time[y]  1.e-7     1.e-7
Time[y]  1.
Time[y]  2.
Time[y]  3.
Time[y]  4.
Time[y]  5.
Ends
```

This model ran in 2½ days cpu on foxtrot

ran as /home/skippy/spainter/bin/metra gt3-9-3

gt3-9-4.dat extended time to 8 yrs, increased QHT (heater factor) by 10% from 25. to 27.5

8/4/99 RF

Back to lab heater experiments multiflo runs. Started w/ dcm-sm11-dat and continued modifications: Major parts of dcm-sm84.dat are as follows

Located on saccary /home/rgreen/multi/drip2/dcm/.

Simulation of laboratory-scale dripping experiment - Bldg 51 CNWRA
August 4, 1999
: dcm-sm84.dat
: smaller model to fit in metra element dimension limitation
: This run statred with drip131 converted to DCM
: this run is to test sat of matrix, fract & drift for heat that ran ok in drip38
: put in invert with same properties as cement
: heat loss at boundaries included
: boundary elements at 1e-2
: heat capacity of boundary elements at 840
: infiltration rate of 1e-5 for two columns
: ipvtab set to 0
: fract por = 0.5 from 0.99
: fract perm up to 1e12 from 1e14
: increased alpha of frac from 6.36e-4 to 2.0e-4
: changed cp of drift from 10 to 840
: changed density of drift from 2600 to 1600
: changed drift and fracture to linear capillary function

several lines omitted , see pg 39-42; pg 44 ;

```
: dcm-sm64 inc mat k to 2e-17 from 2e-18
: dcm-sm66 dec heat to 0.9 for heat loss
: dcm-sm67 inc areamodf of mat to 10.0 from 0.1
: dcm-sm69 inc size of bot to keep cool, set areamodf back to 1.0
: dcm-sm70 dec areamodf for mat from 1.0 to 1e-4
: dcm-sm71 inc areamodf from e-4 to e-2, inc dt from .2 to .4
: dcm-sm74 put in heat loss at bc and inc heat from 0.9 to 1.0, stalled at 5.7 days
: dcm-sm75 reduced size of bc by 10x, stalled at 3.6 days, need to make elements bigger by 100x
: dcm-sm76 inc bc by 100 percent, crashed at 22 days
: dcm-sm77 set bc vol to default, inc th-diff bc by 10x
: dcm-sm78 inc time to 210 days
: dcm-sm79 ran at 142 W for 167 days then ramped down to 37 W at 210 days
: dcm-sm80 reduced areamodf from 1e-2 to 1e-4
: dcm-sm81 reduced areamodf from 1e-4 to 1e-6
: dcm-sm82 inc th-diff of bc by 10x to reduce bc temp, inc dtmx from .4 to .8, crashed at >172 d
: dcm-sm83 dec dtmx from .4 to .8
: dcm-sm84 dec th-dif of by by 5x to inc bc temp
RSTART 0
:
:    XYZ              = 1 table look-up,; pref = ref. press.
:    RADIAL           = 0 correlations;  tref = ref temp.
:    OTHER                 ^
:                   |
:grid  geometry  nx ny  nz ivplwr ipvtcal iout   pref tref  href
Grid  DCMXYZ   9 10 11  1    1   2   0     0  0  0
:
:    data taken from sandia report:Green et al. 1995, NUREG/CR-6348
Pckr                  :relative perm and pc
:  i  type-curv swirm  rpmm(lamda)  alpham  swext  sgc  iecm
   1  Van-Gen  0.05  .3717     6.36e-7   0    0.0  0   ! matrix block
:
:  i  type-curv swrim unused  unused     p@0-sat sgc  iecm
   2  linear   0.00 0.000    0.00   1.0    0.0  0   ! emplacement drift
:
:  i  type-curv swrim unused  unused     p@0-sat sgc  iecm
   3  linear   0.00 0.000    0.00   1.0    0.0  0   ! primary fracture
:
:  i  type-curv swirf  rpmf(lamda)  alphaf  swext  sgc  iecm
   4  Van-Gen  0.08   0.7619    1.3e-1   0.0   0.0  0   ! matrix fractures
0          :blank line
:
 Debug  1
 0
Thermal-prop
: no rho        cpr    ckdry  cksat   crp  crt   tau  cdiff   cexp  enbd
  1  1.600e+03 840.0  0.40  0.70    0    0   .5  2.13e-5  1.8  0. 0 !matrix
  2  1.600e+03 840.0  10.0  10.0    0    0   .5  2.13e-5  1.8  0. 0 !drift
  3  1.600e+03 1.0e+8  0.50  1.00   0    0   .5  2.13e-5  1.8  0. 0 !side boundaries
  4  1.600e+03 2.0e+9  0.50  1.00   0    0   .5  2.13e-5  1.8  0. 0 !bottom boundary
  5  1.600e+03 1.0e+8  0.50  1.00   0    0   .5  2.13e-5  1.8  0. 0 !top boundary
  6  1.600e+03 1.0e+9  1.50  2.00   0    0   .5  2.13e-5  1.8  0. 0 !front bc near heater
0
:    igrid   rw      re
DXYZ  0
: (dx(i),i=1,nx)
0.0002 .0015 .0239 .0508 .0762 .1016 .1016 .2410 .0001
: (dy(j),j=1,ny)
0.0304 .0304 .0304 .0304 .0304 .0304 .0304 .0304 .0607 .0001
: (dz(k),k=1,nz)
0.1000 .1032 .2032 .1016 .0508 .0254 .0508 .1016 .2032 .2539
0.0001
: 0.0001 .2031 .2032 .1016 .0508 .0254 .0508 .1016 .1016 .1524
: 0.2032
: 0.1016 .1016 .2032 .1016 .1016 .0508 .0508 .0508 .1016 .1524
: 0.2032
```



```
PhiK
: i1 i2 j1 j2 k1 k2 ist ithrm vb  porf permxf permyf permzf pormm permm  istm ithrmm
  1   9  1 10  1  11 4   1     0. 1.00 1.e-10 1.e-10 1.e-10 0.42  2.e-17, 1    1 ! matrix
: 1   9 10 10   1 11 4   3 1.0e-2 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1    3 ! front
: 9   9  1 10   1 11 4   3 1.0e-2 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1    3 ! side
: 1   9  1 10   1  1 4   4 1.0e-1 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1    4 ! top
: 1   9  1 10  11 11 4   4 1.0e-0 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1    4 ! bottom
: 1   9 10 10   1 11 4   3 1.0e-3 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1    3 ! front
: 9   9  1 10   1 11 4   3 1.0e-3 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1    3 ! side
: 1   9  1 10   1  1 4   4 1.0e-2 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1    4 ! top
: 1   9  1 10  11 11 4   4 1.0e-1 0.01 0.e-00 0.e-00 0.e-00 0.01  0.e-00 1    4 ! bottom
  1   9 10 10   1 11 4   3     0. 1.00 1.e-10 1.e-10 1.e-10 0.42  2.e-17 1    3 ! front
  9   9  1 10   1 11 4   3     0. 1.00 1.e-10 1.e-10 1.e-10 0.42  2.e-17 1    3 ! side
  1   4 10 10   4  8 4   6     0. 1.00 1.e-10 1.e-10 1.e-10 0.42  2.e-17 1    6 ! front at heater
  1   9  1 10   1  1 4   5     0. 1.00 1.e-10 1.e-10 1.e-10 0.42  2.e-17 1    5 ! top
  1   9  1 10  11 11 4   4 1.0e-1 1.00 1.e-10 1.e-10 1.e-10 0.42  2.e-17 1    4 ! bottom
: 1   1  1 10   1 11 4   2     0. 1.00 1.e-12 1.e-12 1.e-02 0.10  1.e-12 4    2 ! fracture
  1   3  1 10   6  8 2   2     0. 1.00 1.e-10 1.e-10 1.e-10 0.99  1.e-12 4    2 ! drift
  3   3  1 10   6  8 2   2     0. 1.00 1.e-10 1.e-10 1.e-10 0.99  1.e-12 4    2 ! drift
  4   4  1 10   7  7 2   2     0. 1.00 1.e-10 1.e-10 1.e-10 0.99  1.e-12 4    2 ! drift
: 1   1  1 10   1 11 3   2     0. 0.10 1.e-12 1.e-12 1.e-12 0.10  1.e-12 4    2 ! fracture
: 1   3  1 10   6  8 2   2     0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4    2 ! drift
: 3   3  1 10   6  8 2   2     0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4    2 ! drift
: 4   4  1 10   7  7 2   2     0. 0.99 1.e-12 1.e-12 1.e-12 0.99  1.e-12 4    2 ! drift
  1   3  1  3   6  6 4   1     0. 1.00 1.e-10 1.e-10 1.e-10 0.42  2.e-18 1    1 ! heater
  0

nit
 i1  i2  j1  j2  k1  k2  p        t    sg   xg2 pm    tm   sgm xgm

   1  9  1  10   1  11  1.0315e5 20.0  0.60 0.  1.0e5 20.0 .60 0. ! matrix
   1  1  1  10   1  11  1.0315e5 20.0  0.99 0.  1.0e5 20.0 .99 0. ! fracture
   1  3  1  10   6   8  1.0315e5 20.0  0.99 0.  1.0e5 20.0 .99 0. ! drift
   3  3  1  10   6   8  1.0315e5 20.0  0.99 0.  1.0e5 20.0 .99 0. ! drift
   4  4  1  10   7   7  1.0315e5 20.0  0.99 0.  1.0e5 20.0 .99 0. ! drift
0
DCMPARA
: i1 i2 j1 j2 k1 k2   volf  areamodf  xlm   ylm   zlm
  1  9  1 10  1 11   0.002   1e-6    .05  0.03  .05   ! matrix
skip
  1  1  1 10  1 11   0.10    0.01    .0001 .0304 .0254 ! fracture
  1  1  1 10  6  8   0.99e-1 1.0     .0001 .0304 .0254 ! drift
  2  2  1 10  6  8   0.99e-1 1.0     .0005 .0304 .0254 ! drift
  2  2  1 10  6  8   0.99e-1 1.0     .0010 .0304 .0254 ! drift
  3  3  1 10  6  8   0.99e-1 1.0     .0050 .0304 .0254 ! drift
  3  3  1 10  6  8   0.99e-1 1.0     .0189 .0304 .0254 ! drift
  4  4  1 10  6  8   0.99e-1 1.0     .0254 .0304 .0254 ! drift
  4  4  1 10  7  7   0.99e-1 1.0     .0254 .0304 .0254 ! drift
noskip
  1  2  1  4  1  1   0.02  1.e+5     .05   0.03  .05   ! water injection
0
:Equil  depth  pdepth  tdepth  tgrad  param iequil
:Equil   1.00   103150   20.      0.  0.   -1
:
Recurrent
:Skip
:      ns    fach      facm  (fach and facm are multipliers to
:                              read-in values of qht and qmt)
```

8/9/99

```
Source  2    1.00     1.
:  is1 is2 js1 js2 ks1 ks2  istyp
    1  3  1  3   6  6  33
0.0   0.0
1.e+4  3.51e+1
1.e+10 3.51e+1
0
:  is1 is2 js1 js2 ks1 ks2  istyp
    1  2  1  4   1  1  13
0.0   20.0   0.0
2.60e5 20.0   0.0
3.60e5 20.0  2.894e-6
1.486e7 20.0  2.894e-6     day 172
1.815e7 20.0  7.534e-7     day 210
1.e+10 20.0  7.534e-7
0
Output  C=-10 Q=-10  T=1  G=1  P=1

:
:    isolv  newtnmn  newtnmx  north  nitmax  level
Solve 4    2       12     4      100
:
:AUTO-step  DPMXE   DSMXE  DTMPMXE   DP2MXe TACCEL   IAUTODT  FAC1
AUTO-step  5.0E+4  0.03   5.0      1.e4  1.0e-3    0     0
:
:TOLR TOLP  TOLS  TOLT  TOLP2  TOLM  TOLA  TOLE rtwotol  rmxtol   smxtol
Tolr  1. 5.e-4  5.e-3  1.    1.e-3 1.e-3 1.e-3  1.e-12  1.e-12   1.e-12
:
:Limit dpmx    dsmx dtmpmx dp2mx dtmn dtmx icutmx
LIMIT  1.e5    .08    10.   1.e5 1.e-9 .4
:
:     target dt    dpmx   dsmx   dp2mx   dtmpmx
:
:       print all at every target time
PLOTS 1 0 4
1 2 451 541
: Time[d]  1.e-10    1.e-10
Time[d] 5.
Time[d] 10.
Time[d] 50.
Time[d] 110.
Time[d] 172.
Time[d] 210.
Ends
```

Biggest changes from earlier (i.e. before dcm-sm79) were to inc b/c therml diffusivity to dec bc temperatures, and to dec area modF to $10^{-4}$ and $10^{-6}$. The simulation goes for 210 to be consistent w/ Test 2. Heat is tapered down starting on day 172 linearly from 142 Watts on day 172 to 37 Watts on day 210. This equates to 2.894e-6 J/m³/s to 7.534e-7 on day 210

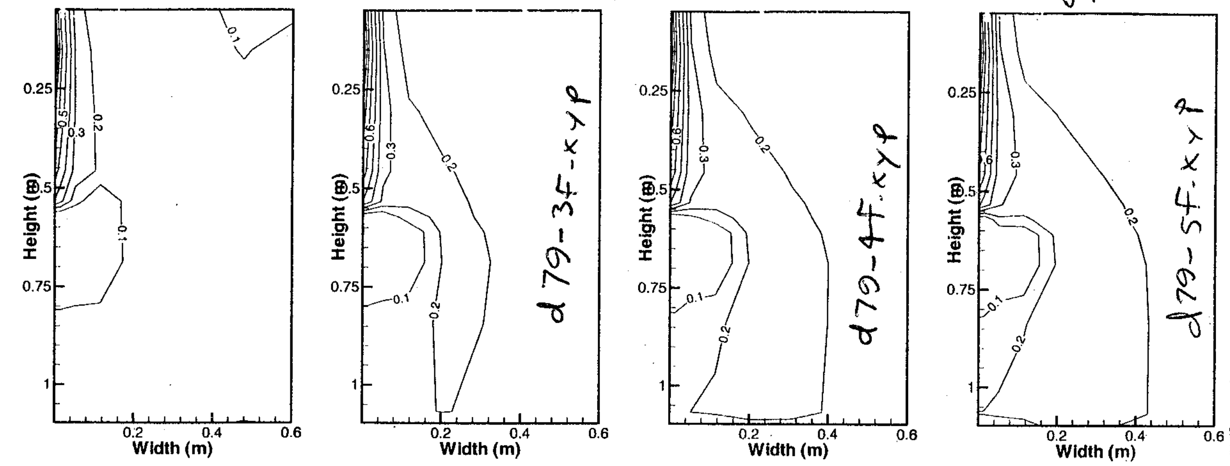
Various plotted results follow

d79-2F.xyp 8/9/99

d79-*m.xyp *=2,3,4,5

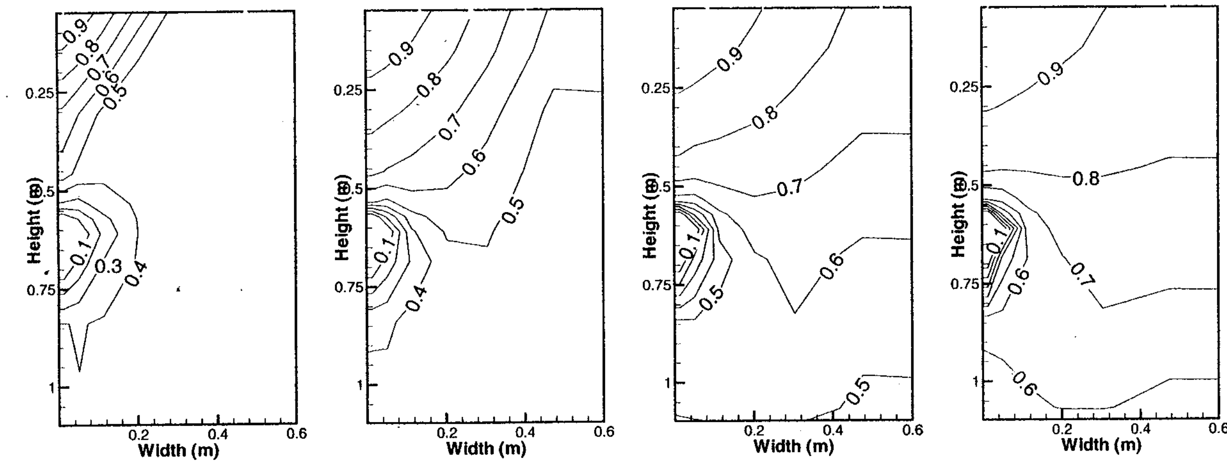
d79-*m.xyp *=2,3,4,5





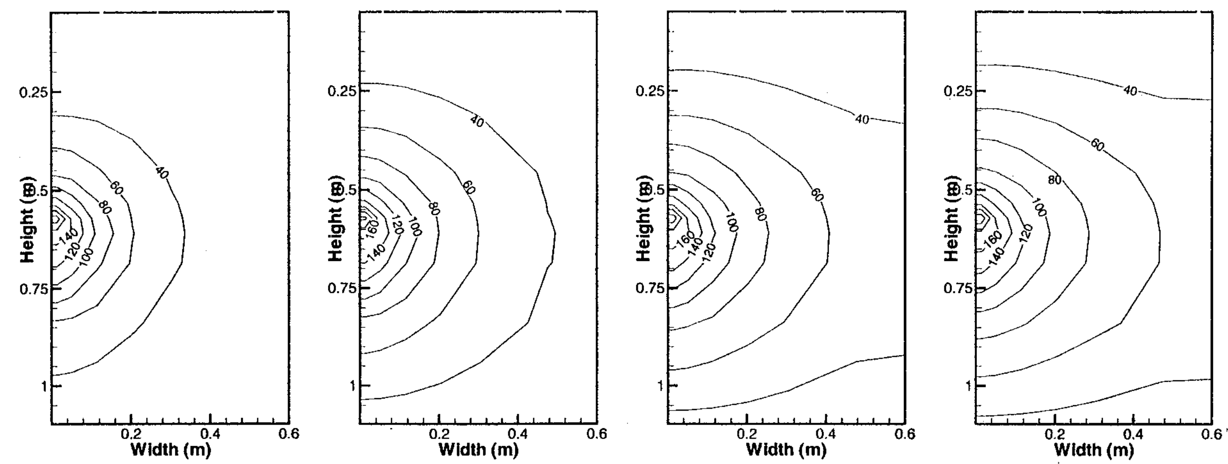

10 50 110 172

dcm-sm79 fracture saturation




10 50 110 172

dcm-sm79 matrix sat



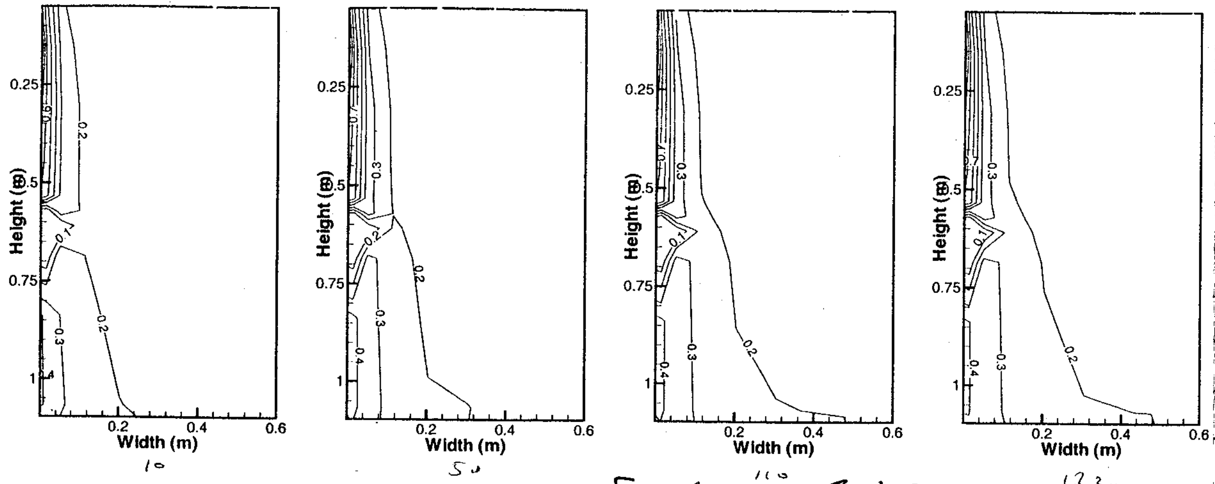

10 50 110 172

dcm-sm79 matrix temp

dcm-sm79 matrix temp

These are x z slices w/ Y = 0.0166 and macro 3d-2dxz-sat.mcr on 3d output (temp)

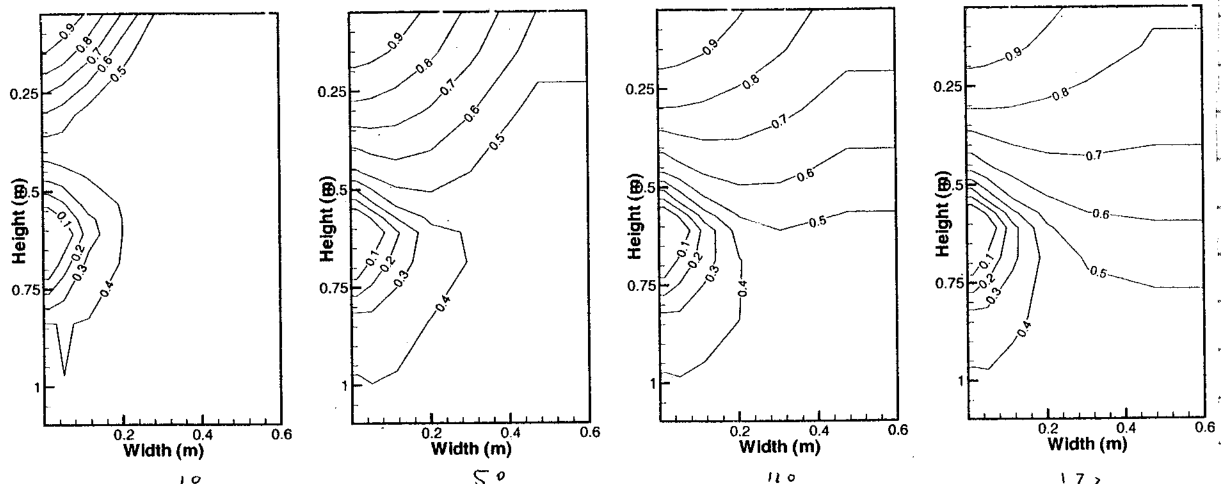
* = 2,3,4,5
d80-*-4-xyp



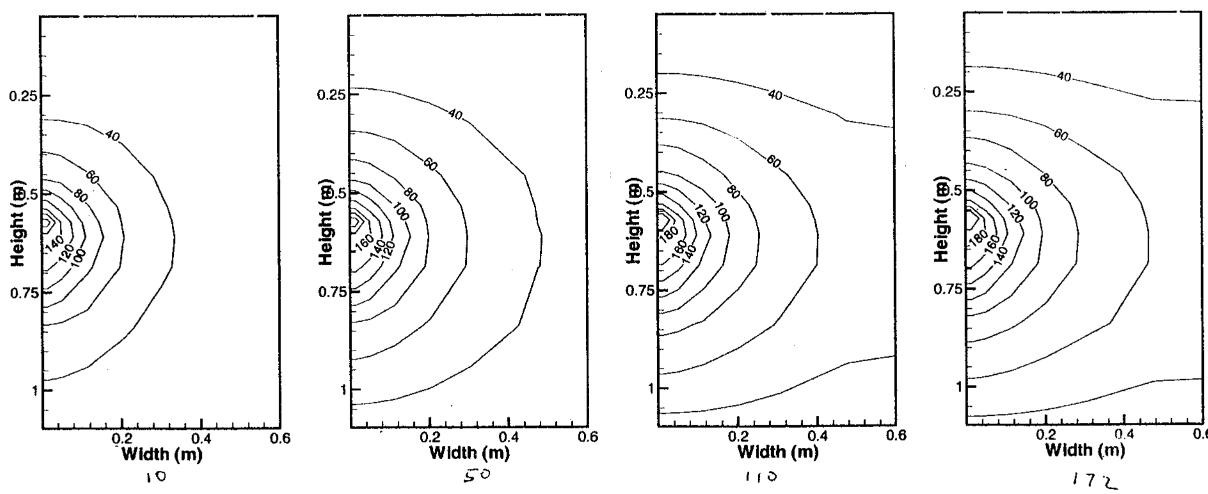

dcm-sm80 fracture Sat

xz slice
y = 0.0166 m

* = 2,3,4,5
d80-*m-xyp




dcm-sm80 matrix sat

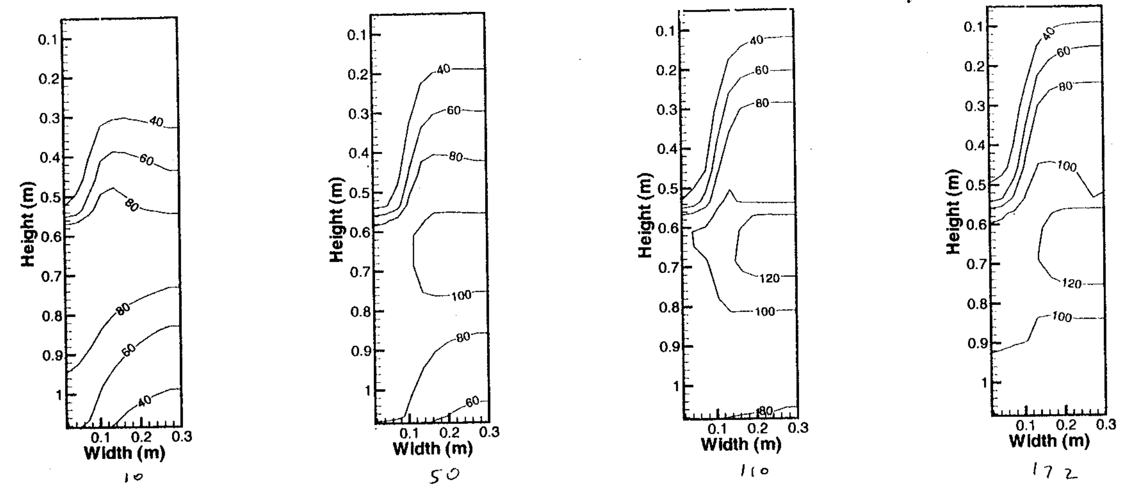



dcm-sm80 matrix temp

axis dimension in tecplot
13
90
95
11



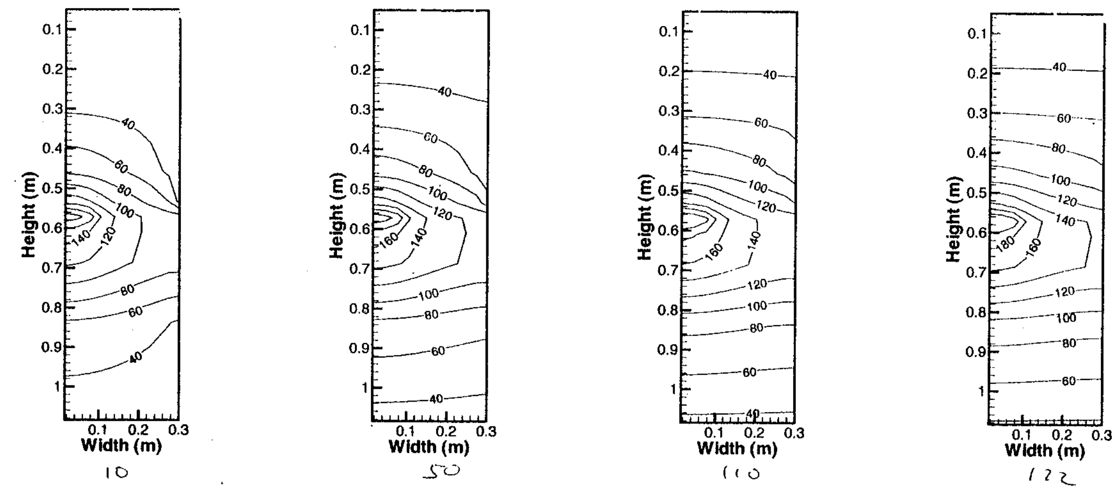
* = 2,3,4,5
d80-*-4-xyp




dcm-sm80 Fracture temp

yz slice
x = 0.003 m

* = 2,3,4,5
d80-*m-xyp




dcm-sm80 matrix temp

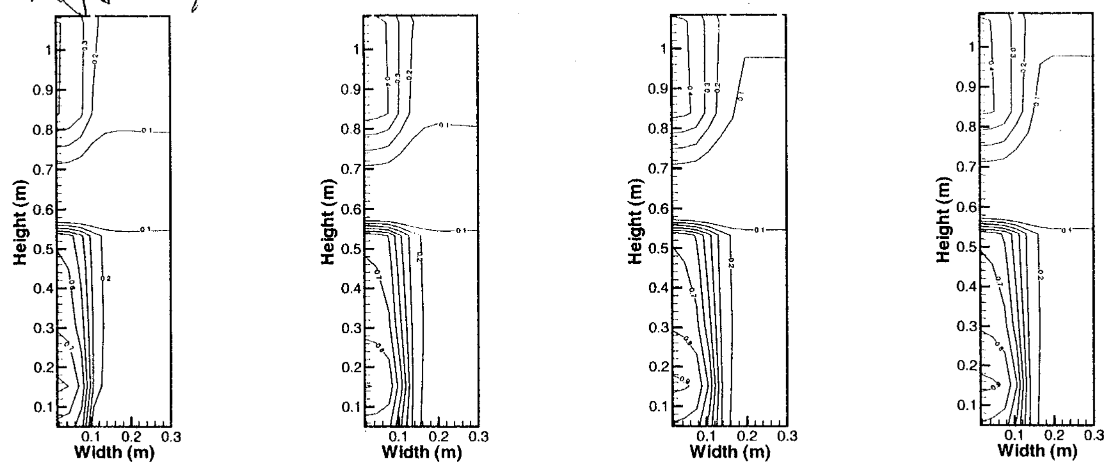
Used macro: 3d-2dyz-temp.mcr

axis dimensions for tecplot 13
60
95
11

| | | |
|---|---|---|
| layout | LS | 0.5 → 8 |
| | TS | 0.25 |
| | width | 2.5 |
| | height | 4 |

YZ slice

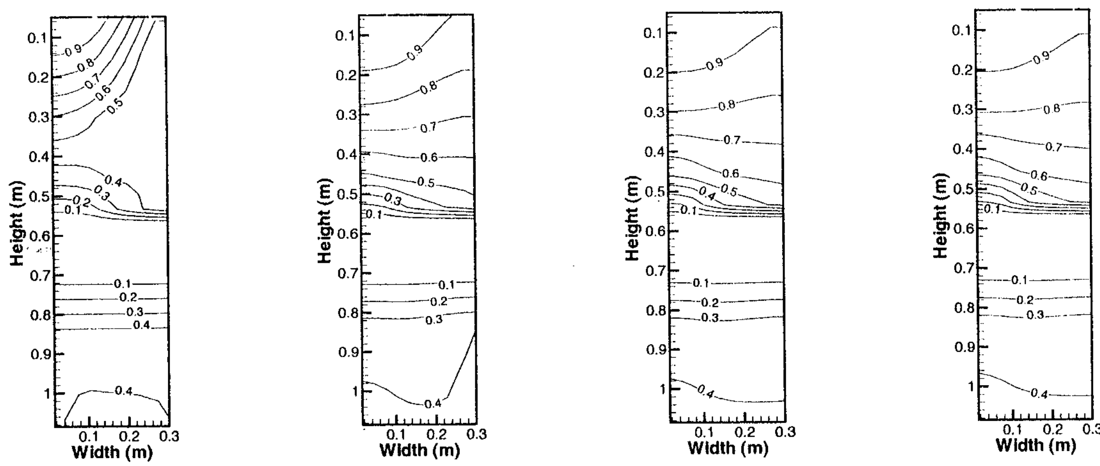
*=2,3,4,5
d80-*f-xyp




10 50 110 172

dcm - sm 80 Fract. sat

*=2,3,4,5
d80-*m-xyp

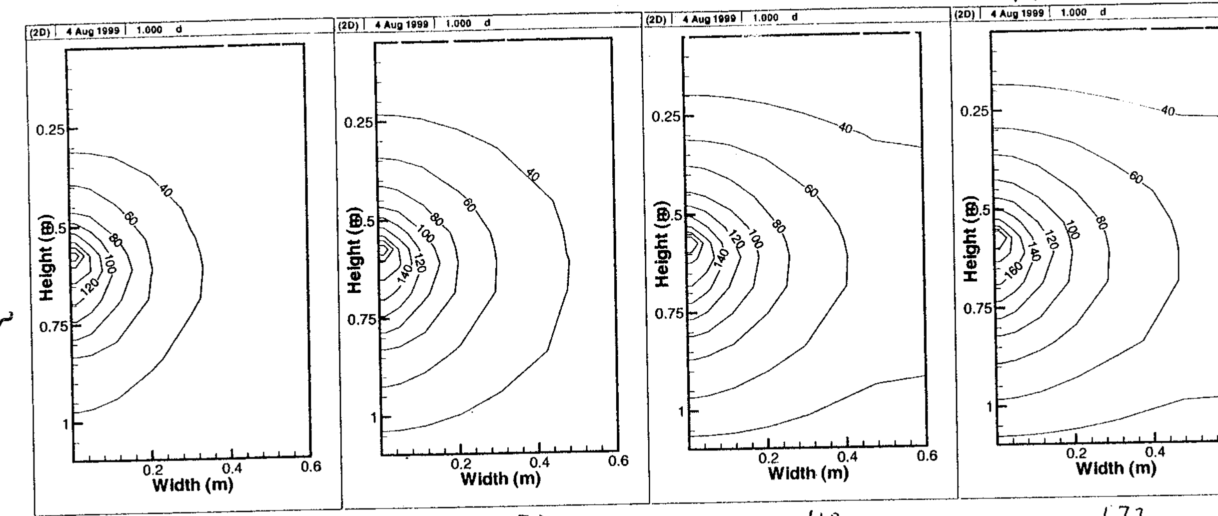



dcm - sm 80 matrix sat



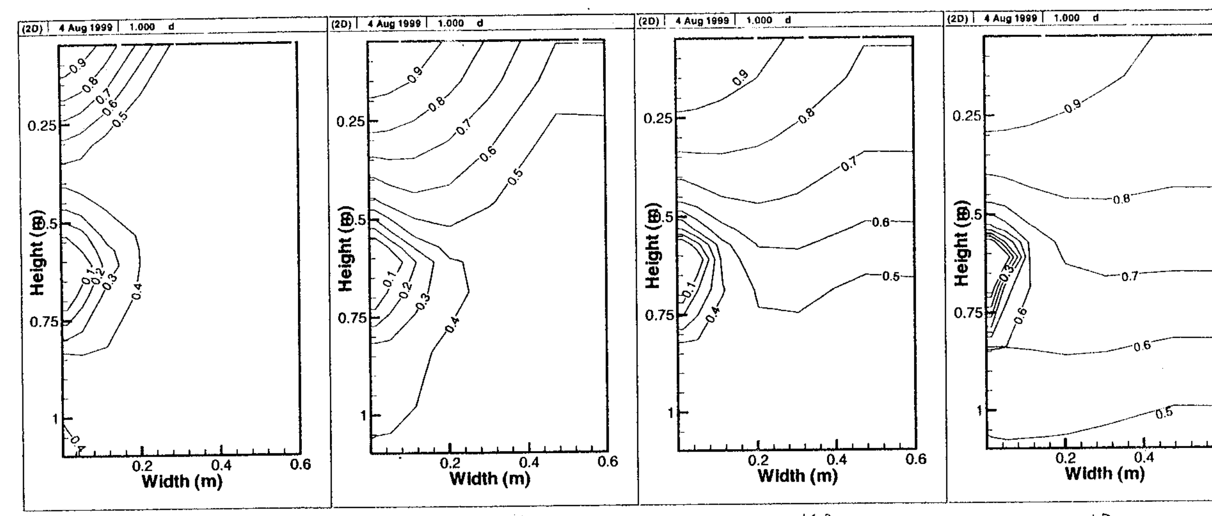
XZ slice

d81-*m-xyp
*=2,3,4,5




10 50 110 172

dcm - sm 81 matrix temp




10 50 110 172

dcm.sm 81 matrix sat

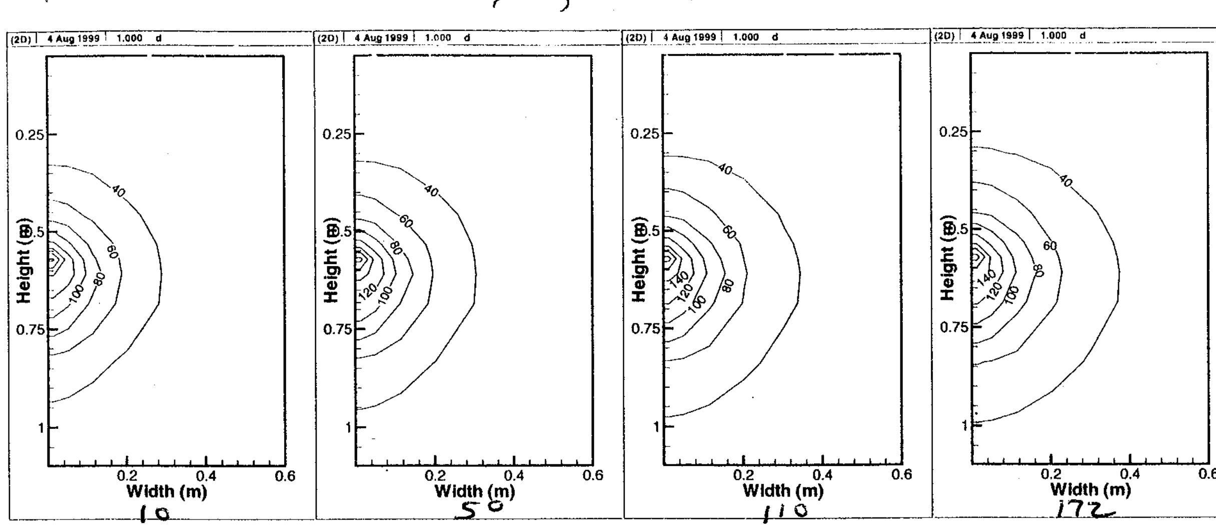
b c temps too high → need to inc
b.c. therml diffusivity

8/4/99

/home/sneezy/multi/drip2/dcm

on sneezy, soft link to vulcan

x-z slice
* = 2,3,4,5
d83-*m-xyp




10 50 110 172

matrix temp

dcm-sm83 bc th-diff inc by 10x

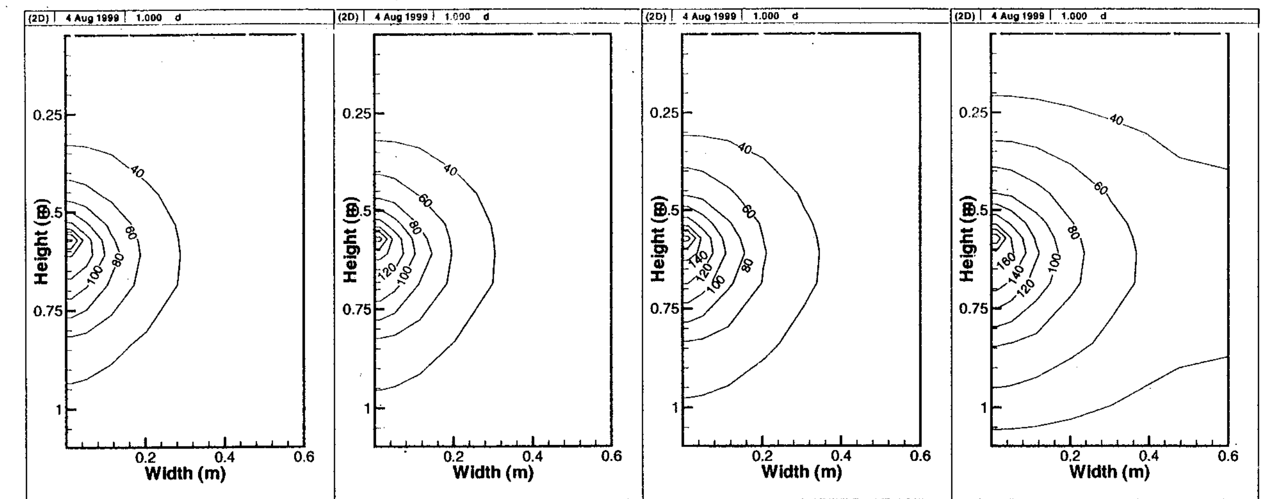
Thermal diffusivity increased too high

RH



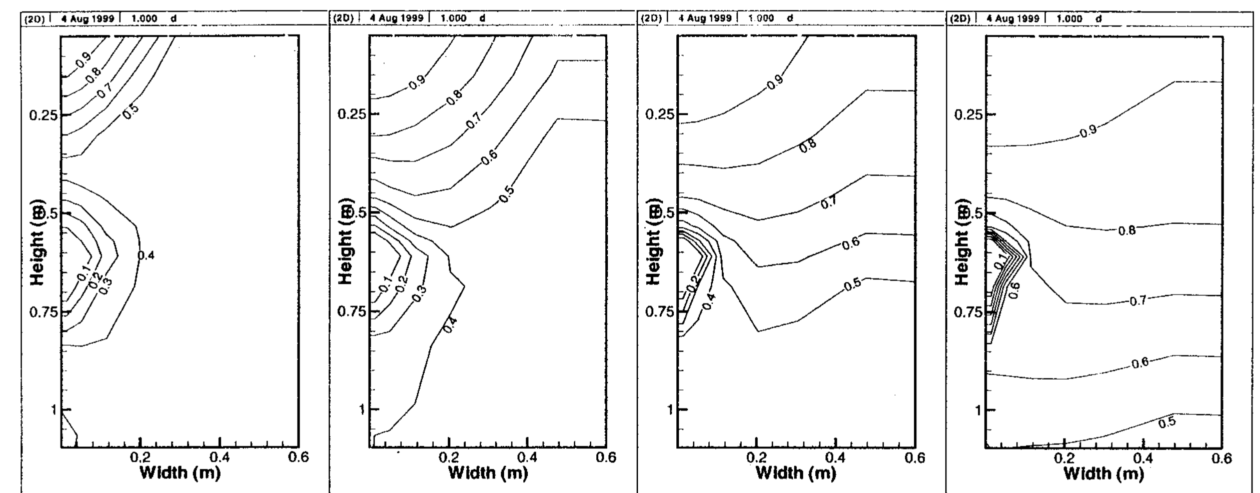
8/4/99 RH

x-z slice
* = 2,3,4,5
dcm-*m-xyp




10 50 110 172

dcm-sm84 matrix temp




10 50 110 172

dcm-sm84 matrix sat

temp looks good but sat is off.

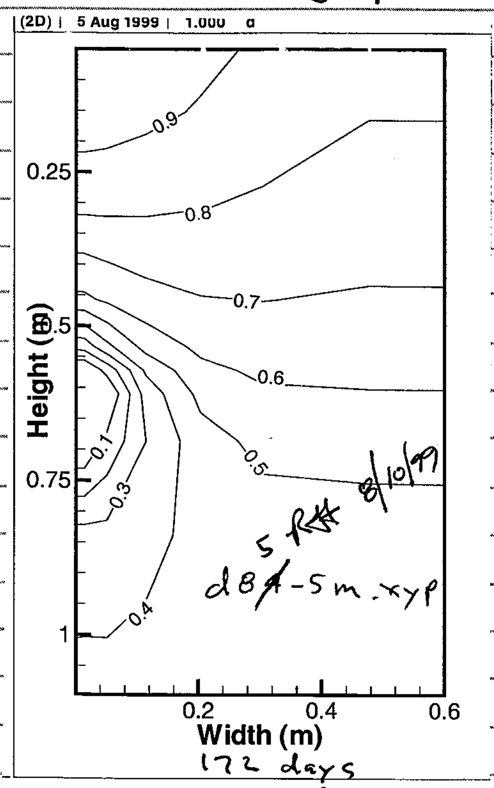
areamodf = 1e-6

volF = 0.002

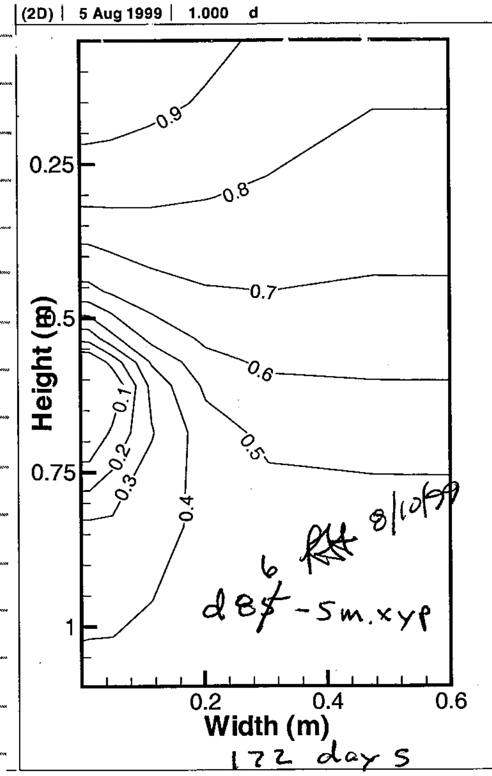
volf = 0.01 areamodf = e-4

volf = 0.02 areamodf = e-4

8/5/99 RFF




172 days




172 days

~~d84 had volf = 0.01~~ RFF 8/10/99

d8~~5~~ had volf = 0.02

6 ~~RFF~~ 8/10/99

There is not visible difference in the saturation at 172 days with a 2x change in volf.

Summary of recent work as it appears in dcm-sm89.dat

```
Simulation of laboratory-scale dripping experiment - Bldg 51 CNWRA
   August 5, 1999
: dcm-sm89.dat

: dcm-sm80 reduced areamodf from 1e-2 to 1e-4
: dcm-sm81 reduced areamodf from 1e-4 to 1e-6
: dcm-sm82 inc th-diff of bc by 10x to reduce bc temp, inc dtmx from .4 to .8, crashed at >172 d
: dcm-sm83 dec dtmx from .4 to .8
: dcm-sm84 dec th-dif of by by 5x to inc bc temp
: dcm-sm85 inc areamodf from e-6 to e-4 and volf from 0.002 to 0.010
: dcm-sm86 inc volf from 0.01 to 0.02
: dcm-sm87 returned volf to 0.01 and dec areamodf to e-5
: dcm-sm88 inc areamodf from e-5 to e-3, crashed very early
: dcm-sm89 set volf back to 0.002 from 0.01
RSTART  0

DCMPARA
: i1 i2 j1 j2 k1 k2   volf  areamodf  xlm   ylm   zlm
  1  9  1 10  1 11   0.002   1e-3    .05  0.03  .05   ! matrix
```

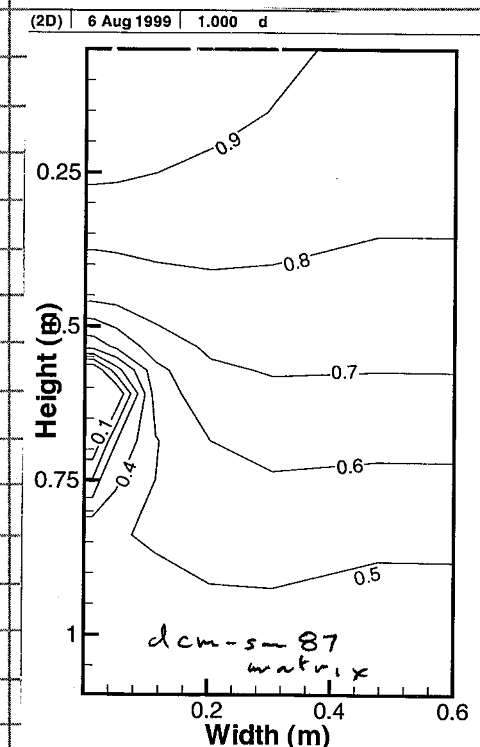
RFF 
8/5/99

Note: dcm-sm88 volF = 0.01 and aeramodF = e-3 resulted in a crash

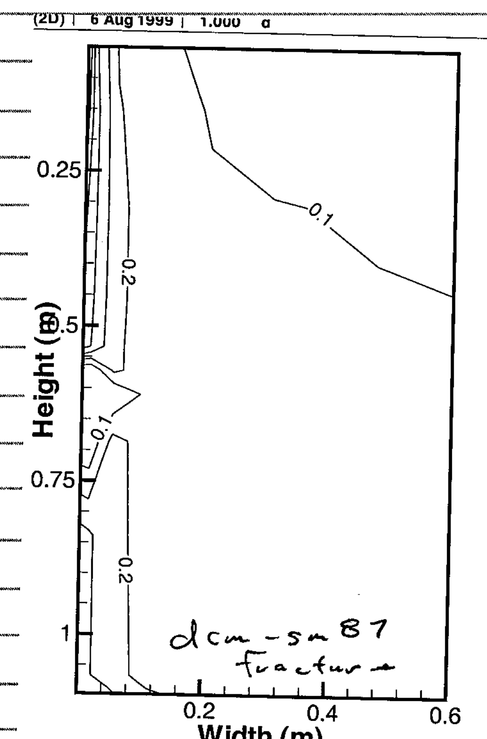
This crash was avoided when volF was set back to 0.002 in ~~dcm-8~~ RFF 8/5/99 dcm-sm89.dat

dcm-sm89.dat w/ volF = 0.002 and areamodF e-3 crashed @ 6.64 days

8/6/99 RFF




172 days

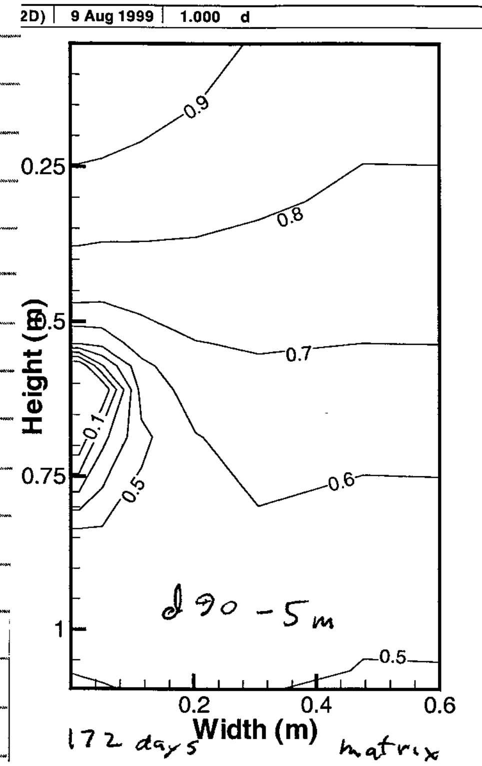



172 days

areamodF = e-5

volF = 0.01

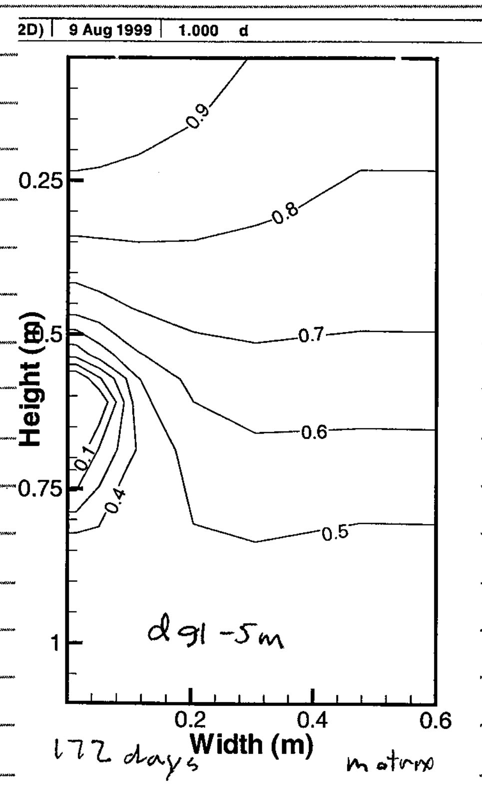
8/9/99
Rff




dcm-sm90.dat
e-3 ← areamodF
0.001 ← volF

Note e-3 ran here,
but did not run for
volF = 0.01 or 0.002 ~
dcm-sm88 or dcm-sm89
respectively

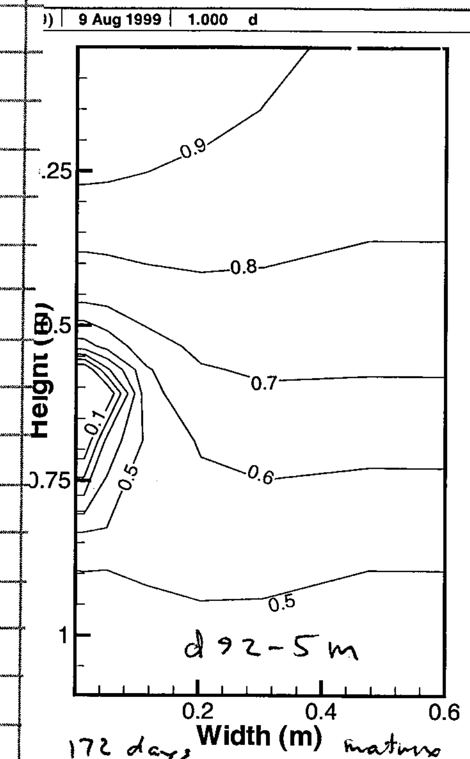
~~dcm-sm9~~ Rff 8/9/99




dcm-sm91.dat
areamodF = e-5
volF = 0.001

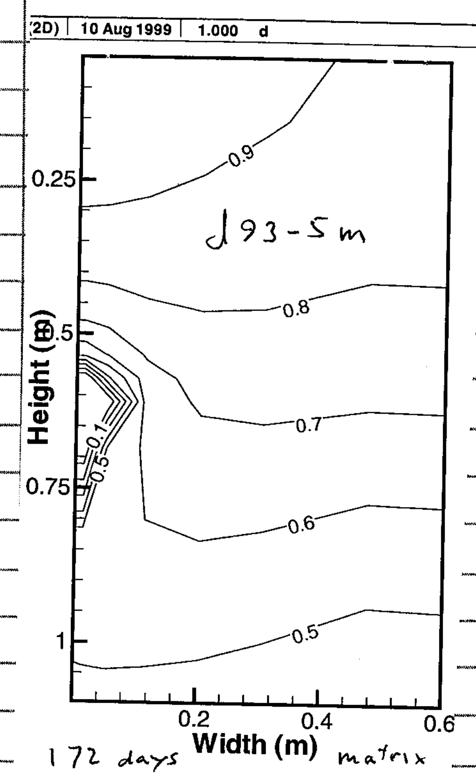
dcm-sm91 crashed at 202 days


Rff



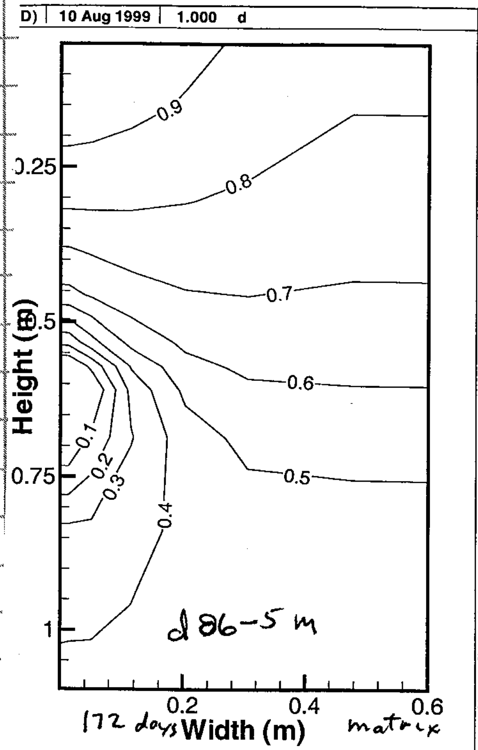

dcm-sm92
areamodF = e-5
volF = 0.0005

8/10/99
Rff




dcm-sm93
areamodF = e-6
volF = 0.0005

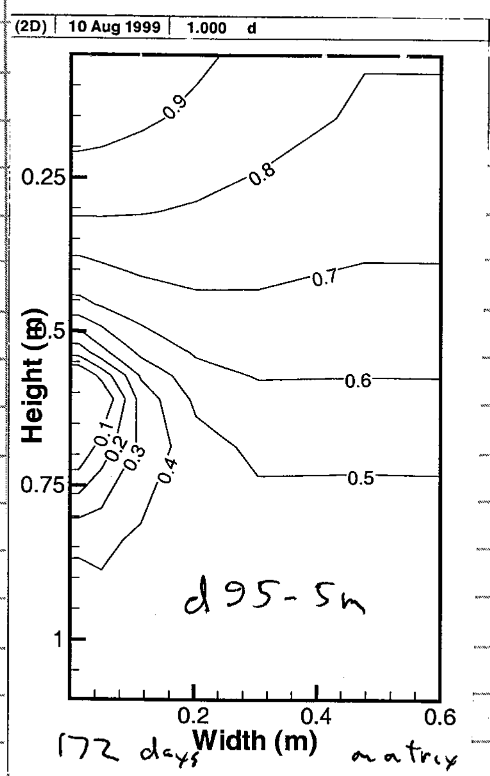
8/9/99




dcm-sm86
areamodf = 1e-4
volf = 0.02

(same as converted on pg 64)

dcm-sm94 areamodf = 1e-4 volf = 0.0005
crashed @ 0.527 days

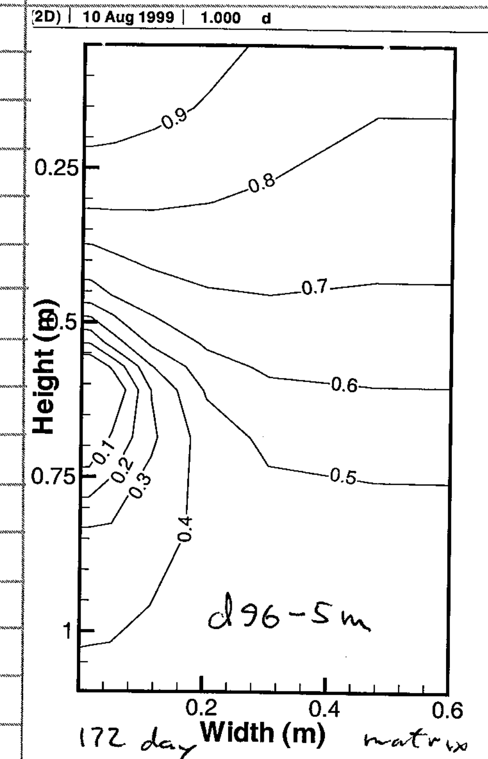



dcm-sm95
areamodf = 1e-4
volf = 0.001

Comparison of
dcm-sm86 & dcm-sm95
suggest greater
volf is better



/home/rgreen/multi/drip2/dcm 8/9/99
on sneezy, soft link to vulcan

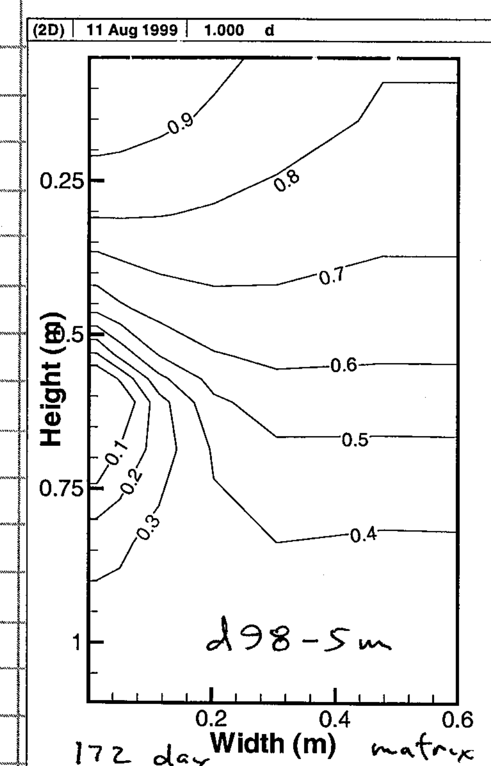



dcm-sm96
areamodf : 1e-4
volf : 0.05

similar to dcm-sm86
which had areamodf = 1e-4
& volf = 0.02

At this time it appears dcm-sm86.dat is
best fit for Test 2

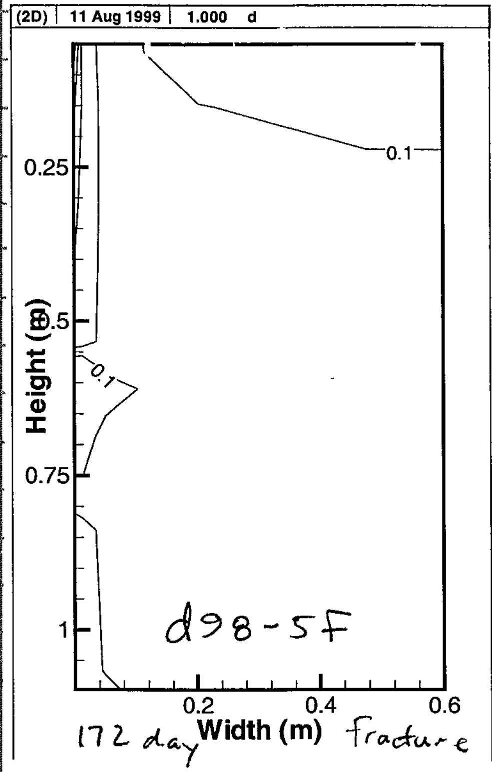
8/11/99




dcm-sm98
areamodf : 1e-4
volf : 0.05
initial sat dec from 0.4 to
0.35

This is an improvement over
dcm-sm86

8/9/99 Killed dcm-99.dat early




dcm-sm98.dat

fracture is dry, due to 1e-4 at point of infiltration

Storage of Files

put input files on zip RTG Ø1
dcm-sm50.dat to dcm-sm100.dat
also assorted *.xyp files

Copied all of /home/sneezy/multi/drip2/dcm onto stygion under D:personal/multi/dcm



8/18/99 RG tpa runs

using TPA 3.2 August 6, 1999 to do systems-level sensitivity runs of TEF

files stored in /home/rgreen/tparun on sneezy but w/ soft link to Vulcan

There are to be, at least initially, 3 TPA runs to look at TEF/dripping and 3 TPA runs to assess REFLUX3

RG 8/18/99
3 TPA runs are located in sub-directories in ~/tparun

~/tparun/tpa-base/ Set A — base case tpa w/ 250 realizations

~/tparun/tpa-drip/ Set B — basecase w/ modification for drip effects 250 realizations

This table will be in 9/10/99 deliverable

Table 1. EBSFAIL module parameter values modified to incorporate the effects of dripping. Included are base case and modified values.

| Parameter | Base Case Value | Modified Value |
|---|---|---|
| CriticalRelativeHumidityHumidAirCorrosion | 0.55 | 0.10 |
| CriticalRelativeHumidityAqueousCorrosion | [0.75, 0.85] | [0.15, 0.25] |
| ThicknessOfWaterFilm[m | [0.001,0.003] | [0.00001, 0.00003] |
| ChlorideMultFactor | [1.0, 30.0] | [29.0, 30.0] |

~/tparun/tpa625/ basecase w/ modification for drip effects and corrosion at closure welds

ble 2. EBSFAIL module parameter values modified to incorporate the effects of WPs
h container material weaknesses at closure welds or due to other possible container
terial weakness. Included are base case and modified values.

| arameter | Base Case Value | Modified Value |
|---|---|---|
| nnerOverpackErpIntercept | [1040.0, 1240.0] | [48.5, 148.5] |
| nnerOverpackErpSlope | 0.0 | -160.8 |
| CritChloideConcForSecondLayer[moL/L] | 1.0 | 3.0e-2 |

8/20/99 Also tested REFLUX3 w/ TPA 3.2
RH

Table 3. Listing of sub-module REFLUX3 input parameters and assigned base case values

| Parameter | Base Case Value | |
|---|---|---|
| WPUnitCellWidth[m] | 22.5 | |
| FractionOfCondensateRemoved[1/yr] | [1.0e-8, 1.0] | 1 |
| FractionOfCondensateTowardRepository[1/yr] | [0.0, 1.0] | 2 |
| FractionOfCondensateTowardRepositoryRemoved[1/yr] | [1.0e-8, 1.0] | 3 |
| DensityOfWaterAtBoiling[kg/m^3] | 960.5 | |
| EnthalpyOfPhaseChangeForWater[J/kg] | 2.4e6 | |
| TemperatureGradientInVicinityOfBoilingIsotherm[K/m] | [1.0, 100.0] | 4 |

files are located in

/home/rgreen/tparun/tpa-reflux3

3 runs in sub directories RH 8/20/99

/tpa-reflux~~3~~-base

/tpa-reflux~~3~~-drip

/tpa-reflux~~3~~-625

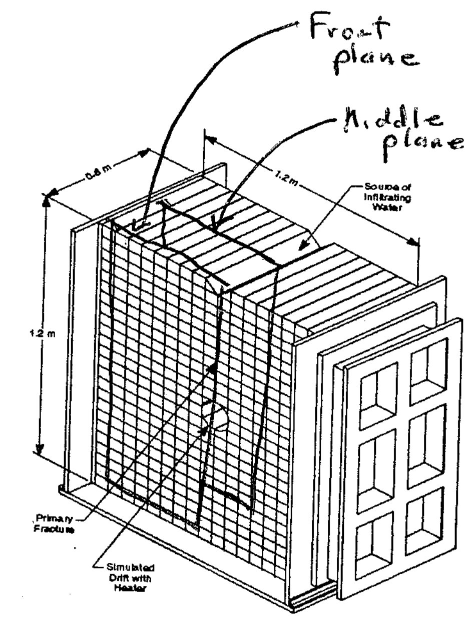
all were run using tpa.inp-meanvalues
but w/ 1, 2, 3, 4 set to distributions, not mean values
base case set

tpa-reflux-drip also had RH thresholds, chloride mult factor and $H_2O$ thickness set to extreme values

tpa-reflux-625 same as drip but also set material properties in Table 2 to modified values



9/29/99 Summary of saturation measurements of samples
RH taken from Test 2 at the conclusion of the experiment. There were 40 samples collected at two planes for a total of 80 samples. The samples were broken out from the concrete blocks for measurement.




1) Upon removal and collection each sample was weighed after first being labeled with an identification mark

2) Samples were dried in oven @ 105°C for several days & reweighed.

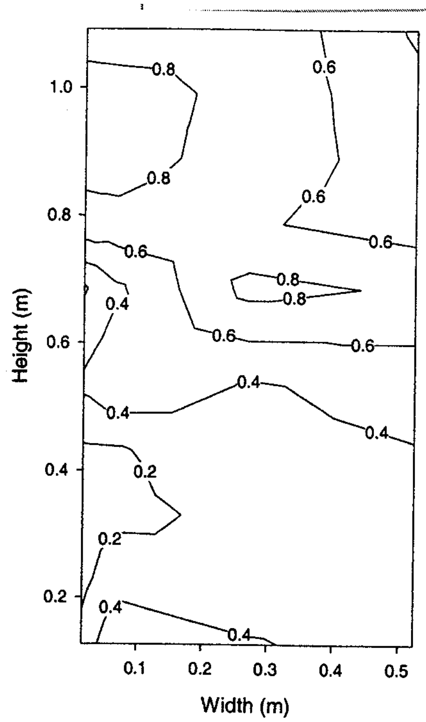
3) Samples were dipped in molten paraffin, excess was removed, then submerged in graduated cylinder to determine volume

Measurements on next two pages

9/29/99

Edge Plane data for saturation at end of Test 2

| Sample | Mass *in-situ* | Dry Mass | Mass *in situ*-Dry mass | Volume | Saturation | x-coor | y-coor | x-coor cm | y-coor cm | x-coord m | y-coord m | | 0.60 m - X |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | grams | grams | grams | mL | | | | | | | | | |
| B2F | 254.4 | 232.8 | 21.6 | 140 | 0.37 | 3 | 43 | 7.62 | 109.22 | 0.0762 | 1.0922 | 0.37 | 0.5238 |
| B7F | 307.4 | 256.3 | 51.1 | 160 | 0.76 | 13 | 43 | 33.02 | 109.22 | 0.3302 | 1.0922 | 0.76 | 0.2698 |
| B11F | 376.6 | 322.8 | 53.8 | 190 | 0.67 | 21 | 43 | 53.34 | 109.22 | 0.5334 | 1.0922 | 0.67 | 0.0666 |
| B12F | 451 | 386.2 | 64.8 | 220 | 0.70 | 23 | 43 | 58.42 | 109.22 | 0.5842 | 1.0922 | 0.70 | 0.0158 |
| D2F | 508.4 | 458.4 | 50 | 260 | 0.46 | 3 | 39 | 7.62 | 99.06 | 0.0762 | 0.9906 | 0.46 | 0.5238 |
| D7F | 297 | 251.2 | 45.8 | 150 | 0.73 | 13 | 39 | 33.02 | 99.06 | 0.3302 | 0.9906 | 0.73 | 0.2698 |
| D11F | 368.8 | 300.6 | 68.2 | 180 | 0.90 | 21 | 39 | 53.34 | 99.06 | 0.5334 | 0.9906 | 0.90 | 0.0666 |
| D12F | 452.7 | 369.7 | 83 | 220 | 0.90 | 23 | 39 | 58.42 | 99.06 | 0.5842 | 0.9906 | 0.90 | 0.0158 |
| F2F | 313.1 | 278 | 35.1 | 160 | 0.52 | 3 | 35 | 7.62 | 88.9 | 0.0762 | 0.889 | 0.52 | 0.5238 |
| F7F | 312.3 | 269 | 43.3 | 150 | 0.69 | 13 | 35 | 33.02 | 88.9 | 0.3302 | 0.889 | 0.69 | 0.2698 |
| F11F | 296.5 | 243.4 | 53.1 | 140 | 0.90 | 21 | 35 | 53.34 | 88.9 | 0.5334 | 0.889 | 0.90 | 0.0666 |
| F12F | 369.5 | 304.5 | 65 | 180 | 0.86 | 23 | 35 | 58.42 | 88.9 | 0.5842 | 0.889 | 0.86 | 0.0158 |
| H2F | 293.2 | 260.7 | 32.5 | 150 | 0.52 | 3 | 31 | 7.62 | 78.74 | 0.0762 | 0.7874 | 0.52 | 0.5238 |
| H7F | 295.3 | 256.5 | 38.8 | 150 | 0.62 | 13 | 31 | 33.02 | 78.74 | 0.3302 | 0.7874 | 0.62 | 0.2698 |
| H11F | 361.5 | 306 | 55.5 | 180 | 0.73 | 21 | 31 | 53.34 | 78.74 | 0.5334 | 0.7874 | 0.73 | 0.0666 |
| H12F | 312.5 | 262.8 | 49.7 | 160 | 0.74 | 23 | 31 | 58.42 | 78.74 | 0.5842 | 0.7874 | 0.74 | 0.0158 |
| J2F | 289.8 | 244.7 | 45.1 | 140 | 0.77 | 3 | 27 | 7.62 | 68.58 | 0.0762 | 0.6858 | 0.77 | 0.5238 |
| J7F | 256.7 | 213.5 | 43.2 | 120 | 0.86 | 13 | 27 | 33.02 | 68.58 | 0.3302 | 0.6858 | 0.86 | 0.2698 |
| J11F | 280.2 | 256.8 | 23.4 | 150 | 0.37 | 21 | 27 | 53.34 | 68.58 | 0.5334 | 0.6858 | 0.37 | 0.0666 |
| J12F | 154.1 | 148.1 | 6 | 80 | 0.18 | 23 | 27 | 58.42 | 68.58 | 0.5842 | 0.6858 | 0.18 | 0.0158 |
| M2F | 303.3 | 271.5 | 31.8 | 160 | 0.47 | 3 | 21 | 7.62 | 53.34 | 0.0762 | 0.5334 | 0.47 | 0.5238 |
| M7F | 261.2 | 238.8 | 22.4 | 140 | 0.38 | 13 | 21 | 33.02 | 53.34 | 0.3302 | 0.5334 | 0.38 | 0.2698 |
| M12F | 288.6 | 253 | 35.6 | 150 | 0.57 | 21 | 21 | 53.34 | 53.34 | 0.5334 | 0.5334 | 0.57 | 0.0666 |
| M11F | 220.4 | 200.1 | 20.3 | 110 | 0.44 | 23 | 21 | 58.42 | 53.34 | 0.5842 | 0.5334 | 0.44 | 0.0158 |
| O2F | 256.3 | 233.6 | 22.7 | 140 | 0.39 | 3 | 17 | 7.62 | 43.18 | 0.0762 | 0.4318 | 0.39 | 0.5238 |
| O7F | 166.4 | 153.1 | 13.3 | 90 | 0.35 | 13 | 17 | 33.02 | 43.18 | 0.3302 | 0.4318 | 0.35 | 0.2698 |
| O11F | 184.9 | 177.3 | 7.6 | 100 | 0.18 | 21 | 17 | 53.34 | 43.18 | 0.5334 | 0.4318 | 0.18 | 0.0666 |
| O12F | 143.8 | 135.4 | 8.4 | 120 | 0.17 | 23 | 17 | 58.42 | 43.18 | 0.5842 | 0.4318 | 0.17 | 0.0158 |
| Q2F | 210.2 | 196.9 | 13.3 | 120 | 0.26 | 3 | 13 | 7.62 | 33.02 | 0.0762 | 0.3302 | 0.26 | 0.5238 |
| Q7F | 246.6 | 232.8 | 13.8 | 130 | 0.25 | 13 | 13 | 33.02 | 33.02 | 0.3302 | 0.3302 | 0.25 | 0.2698 |
| Q11F | 264.4 | 255.6 | 8.8 | 140 | 0.15 | 21 | 13 | 53.34 | 33.02 | 0.5334 | 0.3302 | 0.15 | 0.0666 |
| Q12F | 72.5 | 70.6 | 1.9 | 40 | 0.11 | 23 | 13 | 58.42 | 33.02 | 0.5842 | 0.3302 | 0.11 | 0.0158 |
| S2F | 97.1 | 92 | 5.1 | 50 | 0.24 | 3 | 9 | 7.62 | 22.86 | 0.0762 | 0.2286 | 0.24 | 0.5238 |
| S7F | 138.6 | 131.9 | 6.7 | 80 | 0.20 | 13 | 9 | 33.02 | 22.86 | 0.3302 | 0.2286 | 0.20 | 0.2698 |
| S11F | 181 | 167.2 | 13.8 | 100 | 0.33 | 21 | 9 | 53.34 | 22.86 | 0.5334 | 0.2286 | 0.33 | 0.0666 |
| S12F | 102.5 | 99 | 3.5 | 60 | 0.14 | 23 | 9 | 58.42 | 22.86 | 0.5842 | 0.2286 | 0.14 | 0.0158 |
| U2F | 127.2 | 119.4 | 7.8 | 70 | 0.27 | 3 | 5 | 7.62 | 12.7 | 0.0762 | 0.127 | 0.27 | 0.5238 |
| U7F | 84.2 | 77 | 7.2 | 40 | 0.43 | 13 | 5 | 33.02 | 12.7 | 0.3302 | 0.127 | 0.43 | 0.2698 |
| U11F | 374.6 | 331 | 43.6 | 190 | 0.55 | 21 | 5 | 53.34 | 12.7 | 0.5334 | 0.127 | 0.55 | 0.0666 |
| U12F | 146.1 | 137.1 | 9 | 80 | 0.27 | 23 | 5 | 58.42 | 12.7 | 0.5842 | 0.127 | 0.27 | 0.0158 |



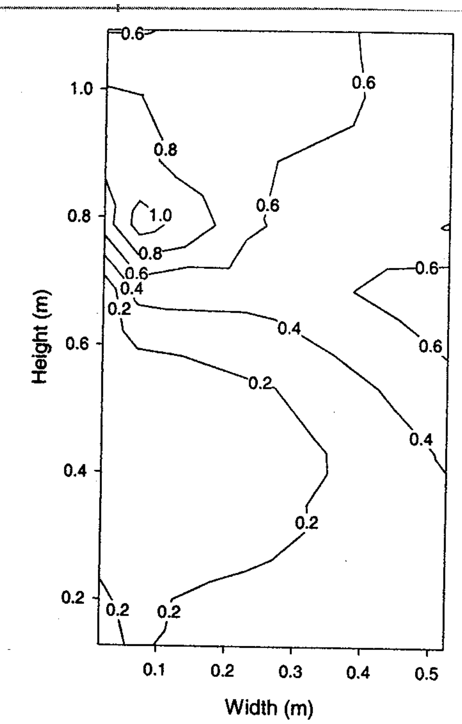

Edge Plain plotted



9/29/99

middle plane data for saturation at end of test 2

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| B2M | 443 | 389.3 | 53.7 | 240 | 0.53 | 3 | 43 | 7.62 | 109.22 |
| B7M | 413.4 | 333.4 | 80 | 220 | 0.87 | 13 | 43 | 33.02 | 109.22 |
| B11M | 805.4 | 682.3 | 123.1 | 420 | 0.70 | 21 | 43 | 53.34 | 109.22 |
| B12M | 470 | 399.1 | 70.9 | 240 | 0.70 | 23 | 43 | 58.42 | 109.22 |
| D2M | 484.4 | 427.4 | 57 | 260 | 0.52 | 3 | 39 | 7.62 | 99.06 |
| D7M | 568 | 461.7 | 106.3 | 280 | 0.90 | 13 | 39 | 33.02 | 99.06 |
| D11M | 624.3 | 496.2 | 128.1 | 320 | 0.95 | 21 | 39 | 53.34 | 99.06 |
| D12M | 618 | 493.4 | 124.6 | 300 | 0.99 | 23 | 39 | 58.42 | 99.06 |
| F2M | 391.5 | 341 | 50.5 | 200 | 0.60 | 3 | 35 | 7.62 | 88.9 |
| F7M | 370.8 | 316.8 | 54 | 180 | 0.71 | 13 | 35 | 33.02 | 88.9 |
| F11M | 767.8 | 609.9 | 157.9 | 380 | 0.99 | 21 | 35 | 53.34 | 88.9 |
| F12M | 526.6 | 417.3 | 109.3 | 260 | 1.00 | 23 | 35 | 58.42 | 88.9 |
| H2M | 403.3 | 360.2 | 43.1 | 220 | 0.47 | 3 | 31 | 7.62 | 78.74 |
| H7M | 644.8 | 549.8 | 95 | 340 | 0.67 | 13 | 31 | 33.02 | 78.74 |
| H11M | 511.5 | 423.8 | 87.7 | 160 | 1.31 | 21 | 31 | 53.34 | 78.74 |
| H12M | 465.2 | 380.7 | 84.5 | 240 | 0.84 | 23 | 31 | 58.42 | 78.74 |
| J2M | 442.9 | 361.1 | 81.8 | 220 | 0.89 | 3 | 27 | 7.62 | 68.58 |
| J7M | 403.3 | 345.3 | 58 | 240 | 0.58 | 13 | 27 | 33.02 | 68.58 |
| J11M | 268.1 | 235.2 | 32.9 | 140 | 0.56 | 21 | 27 | 53.34 | 68.58 |
| J12M | 250.8 | 246.8 | 4 | 140 | 0.07 | 23 | 27 | 58.42 | 68.58 |
| M2M | 352.6 | 304.5 | 48.1 | 180 | 0.64 | 3 | 21 | 7.62 | 53.34 |
| M7M | 295.1 | 279.2 | 15.9 | 160 | 0.24 | 13 | 21 | 33.02 | 53.34 |
| M12M | 390.2 | 387 | 3.2 | 240 | 0.03 | 21 | 21 | 53.34 | 53.34 |
| M11M | 350.8 | 343.9 | 6.9 | 210 | 0.08 | 23 | 21 | 58.42 | 53.34 |
| O2M | 464.3 | 409.6 | 54.7 | 260 | 0.50 | 3 | 17 | 7.62 | 43.18 |
| O7M | 365.5 | 354.3 | 11.2 | 220 | 0.12 | 13 | 17 | 33.02 | 43.18 |
| O11M | 294.8 | 287.7 | 7.1 | 180 | 0.09 | 21 | 17 | 53.34 | 43.18 |
| O12M | 452.2 | 443.5 | 8.7 | 280 | 0.07 | 23 | 17 | 58.42 | 43.18 |
| Q2M | 453.2 | 408.2 | 45 | 260 | 0.41 | 3 | 13 | 7.62 | 33.02 |
| Q7M | 228.4 | 217 | 11.4 | 140 | 0.19 | 13 | 13 | 33.02 | 33.02 |
| Q11M | 360.6 | 349.8 | 10.8 | 220 | 0.12 | 21 | 13 | 53.34 | 33.02 |
| Q12M | 209.9 | 204.1 | 5.8 | 120 | 0.12 | 23 | 13 | 58.42 | 33.02 |
| S2M | 381.8 | 350 | 31.8 | 210 | 0.36 | 3 | 9 | 7.62 | 22.86 |
| S7M | 300 | 280.2 | 19.8 | 180 | 0.26 | 13 | 9 | 33.02 | 22.86 |
| S11M | 202.4 | 191.9 | 10.5 | 120 | 0.21 | 21 | 9 | 53.34 | 22.86 |
| S12M | 343.2 | 323.1 | 20.1 | 200 | 0.24 | 23 | 9 | 58.42 | 22.86 |
| U2M | 360.1 | 329.8 | 30.3 | 200 | 0.36 | 3 | 5 | 7.62 | 12.7 |
| U7M | 358.1 | 328.1 | 30 | 200 | 0.36 | 13 | 5 | 33.02 | 12.7 |
| U11M | 228.9 | 217 | 11.9 | 130 | 0.22 | 21 | 5 | 53.34 | 12.7 |
| U12M | 410.1 | 381.3 | 28.8 | 230 | 0.30 | 23 | 5 | 58.42 | 12.7 |




Middle plane plotted

11/17/99
RF

Starting to construct a new 3D DST MULTIFLO model in support of DECOVALEX and TEF.

Heat load will be smeared rectangular prisms, one each for each inner and outer wing heater and one for the heater drift floor heaters.

All are 48 m long. Outer wing heaters are 5 m wide and inner heaters are 5 m wide. Floor heater is 3 m wide.

Areas are as follows

| | | one side | both |
|---|---|---|---|
| inner wing heater | 48 x 5 | 240 $m^2$ | 480 $m^2$ |
| outer wing heater | 48 x 5 | 240 $m^2$ | 480 $m^2$ |
| floor heater | 48 x 3 | 144 $m^2$ | |

Total power is ~ 185 Kw of which
133 KW is to the wing heaters and → 135 Kw
52 KW is to the floor heaters → 50 KW

There are 50 wing heaters on ~~each side~~ total RF 11/17/99

| | | |
|---|---|---|
| outer heaters | ~ 1.5 - 1.65 KW | ~ 1.55 KW |
| inner heater | ~ 1.1 - 1.2 Kw | ~ 1.15 KW |

| | | |
|---|---|---|
| total from outer wing heater | 50 (1.55) | 77.5 KW |
| total from inner wing heater | 50 (1.15) | 57.5 KW |
| | | 135.0 |

Average for outer wing heater is $\frac{77.5\,KW}{480\,m^2} = 0.1615\,KW/m^2$

Average for inner wing heater is $\frac{57.5\,KW}{480\,m^2} = 0.1198\,KW/m^2$

Average for floor heaters is $\frac{50\,KW}{144\,m^2} = 0.3472\,KW/m^2$



Tentative grid dimensions of 3D DST model

```
DXYZ  0
: (dx(i),i=1,nx)
25. 20. 15. 10. 5. 4. 3. 2. 2. 1
1. 1. 1. 2. 2. 4. 4. 5. 5. 5.      HD
5. 4. 4. 2. 2. 1. 1. 1. 1. 1.      BH
1. 1. 2. 3. 2. 2. 2. 3. 5. 10.
15. 20. 25.
: (dy(j),j=1,ny)                   outer   inner
30. 20. 10. 7. 4. 2. 2. 1. 1. 1.
1. 2. 2 2. 2. 1. 1. 1. 1. 1.       floor
1. 1. 1. 1. 2. 2 2. 2. 1 1.
1. 1. 1. 2. 2. 2. 2. 2. 5. 10.
20. 30.
: (dz(k),k=1,nz)
30. 20. 20. 15. 8. 5. 5. 4. 4. 3.
3. 3. 2. 2. 2. 1. 1. 1. 1. 1.
1. 1. 1. 2. 2. 2. 3. 3. 3. 4.
4. 5. 5. 8. 15. 20. 20. 30.
:
```

RF

1/31/00 RJ Started generating 2-D unstructured mesh for DST analysis

The basic procedure to assemble unstructured a grid is as follows

1) sketch basic grid on un-lined paper

2) scan in image

3) use arcview to set points at intersections

4) used awk script to strip point locations (i.e. POINTD) from arcview output file and put points into a separate file

5) use amesh (by Scott Painter) to assemble segments, connections, and elements from points.

6) Only connections (i.e. CONNE) is used to construct input files needed by MULTIFLO. This step is done by amesh2mFlo, also by Scott Painter.

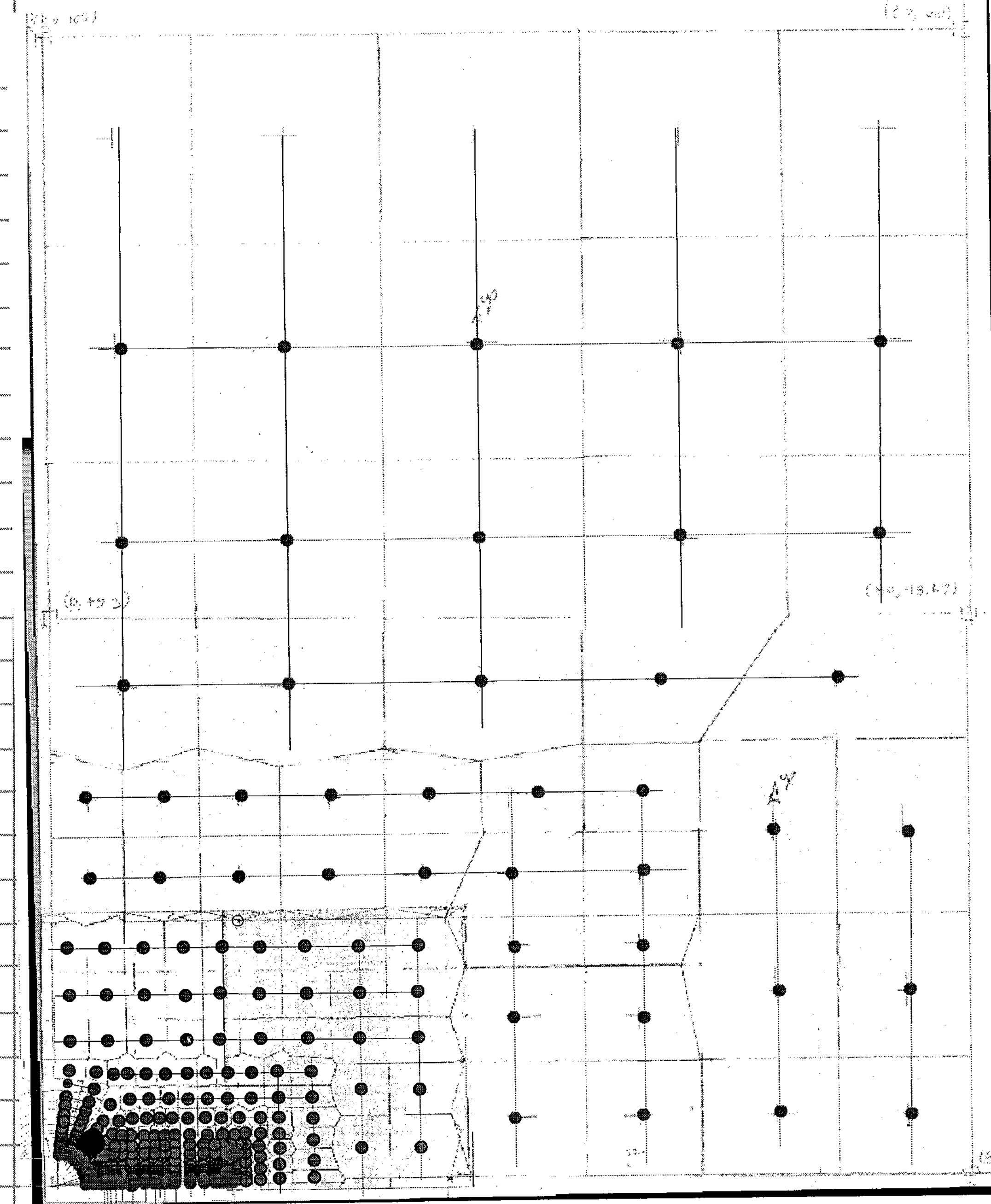
MULTIFLO Version 1.2.3 used [illegible] 5/10/01 RJ

Following are details of this process applied to a vertical 2D mesh (unstructured) for the DST.

The grid is loosely structured after the Birkholzer & Tsang grid presented at the quarterly thermal workshop meetings.



1/31/00



This is a one quadrant image taken from arcview, used to create unstructured mesh

The arcview file is located @

vulcan home/rgreen/dst_scans/cents.apr

also on zip: dst model 1/31/00

RH 1/31/00

used awk script to strip points from cents.apr

awk script: vulcan /home/rgreen/dst_scans/strip-pts1-0.nwk

also on zip: dst model 1/31/00

```
#!/bin/sh -e
# -----------------------------------------------------------------------
#
#  abstract: shell script will extract XY pairs from ArcView *.apr
#            file.
#
#  revised:  01-Apr-96  new create by:
#
#               Ronald H Martin / #20
#               6220 Culebra Rd.
#               San Antonio TX 78238 usa
#               210-522-5541 (phone)
#               210-522-5155 (fax)
#               E-mail: roland@swri.edu
#
#  Notes:  to run and store output in file xy.dat, type:
#
#      ./apr2xy_extract.nwk centroids.apr > xy.dat
#
# Revised January 31 2000 by R. Green to create input file for amesh
#
#
# -----------------------------------------------------------------------
#
#  Target/desired input looks like:
#....+....1....+....2....+....3....+....4....+....5....+....6....+....7
#(PointD.21
#      x:     1.83210675959121
#      y:     4.67769253460075
#)

if ( test $# -ne '1' ) then
    echo Usage: $0 "<infile>"
    exit
fi

if ( test ! -f $1 ) then
    echo File: $1 not found.
    exit
fi

/bin/nawk 'BEGIN {
               }
{
# This puts points into proper format for amesh
#
  if ( substr($0,2,6) == "PointD" ) {
    getline
    xx = $2
    getline
    yy = $2
    one = 1
    zero = 0.
    width = 1.
    ++count
    # ---- quadrant (+,+) [ne] ----
    printf ( "%-5i %i %s %s %s %5.1f %5.1f \n", count, one, "     ", xx, yy, zero, width )
    ++count
    # ---- quadrant (-,+) [nw] ----
    printf ( "%-5i %i %s -%s %s %5.1f %5.1f \n", count, one, "     ", xx, yy, zero, width )
    ++count
    # ---- quadrant (-,-) [sw] ----
    printf ( "%-5i %i %s -%s -%s %5.1f %5.1f \n", count, one, "     ", xx, yy, zero, width )
    ++count
    # ---- quadrant (+,-) [se] ----
    printf ( "%-5i %i %s %s -%s %5.1f %5.1f \n", count, one, "     ", xx, yy, zero, width )
  }
}
END {
   } '$1

exit
```

This script strips POINT D x and y locations from the cents.apr (arcview File) and puts them into output File in correct format for amesh
need to edit & replace locat in first line in

> strip-pts1-0.nwk cents.apr > output.fil

RH 1/31/00

this ~~fee~~ script takes upper right quadrant and puts in other 3 quadrants - Assumes 0,0 is at lower left corner of sketch.

Note: is made to have a first line of >locat followed by data



RH 1/31/00

Used amesh to create segments, connections, and elements for unstructured grid.

amesh is by Scott Painter in vulcan

/home/spainter/amesh/amesh.vulcan

also on zip dst model 1/31/00

input file for amesh.vulcan is called in
copied output.fil out of strip-pts1-0.nwk into in

> amesh.vulcan

Three output files are generated

eleme
conne
segmt

each file starts w/ keyword, i.e. eleme, conne, segmt, also all extraneous nodes must be removed from all 3 before using amesh2mfl to

Then use amesh2mflo to get data in format for MULTIFLO

drift ~~RH~~ 1/31/00

vulcan /home/spainter/ym/near~~field~~drift/amesh2mflo

Need to input (submit) as

RH 1/31/00

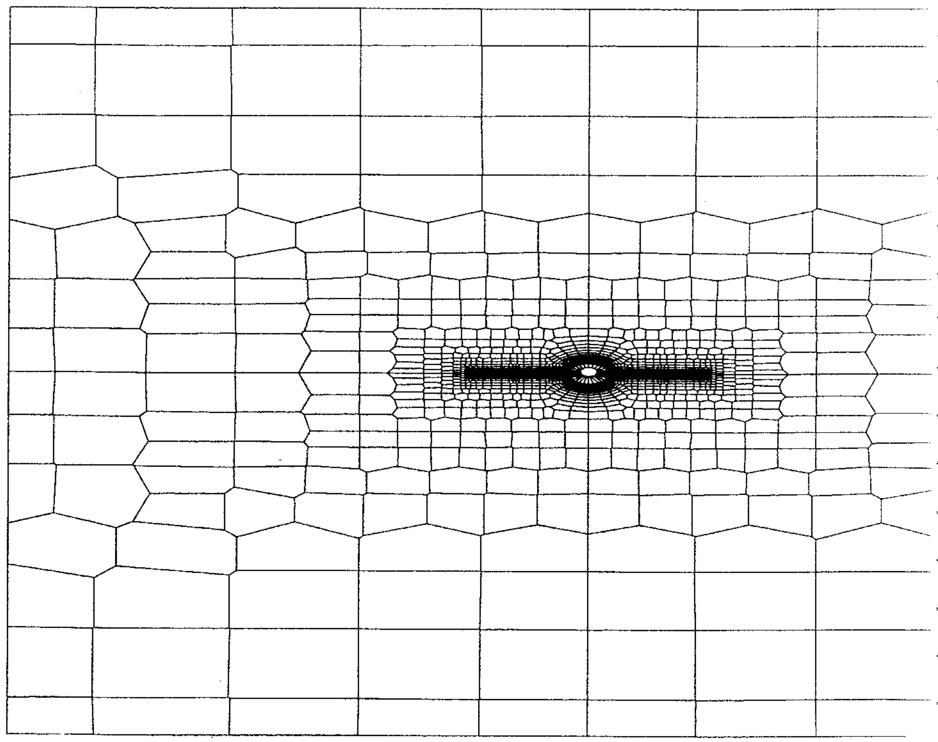
> amesh2mflo 0 xz dcm
(also in zip: dst model 1/31/00)

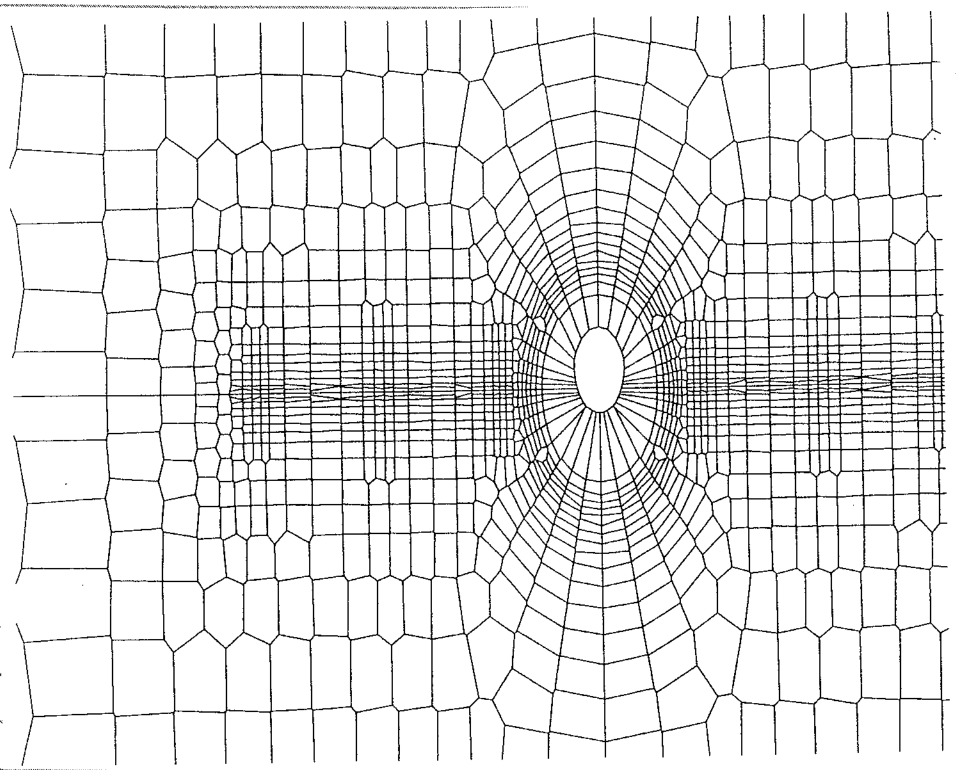
Scott used a mathematica notebook to print out the grid to see if they look reasonable. Following is the grid at two different scales. These are not finals but are close to the final

output of amesh2mflo is:

multi.con
multi.phk

 RH
1/31/00





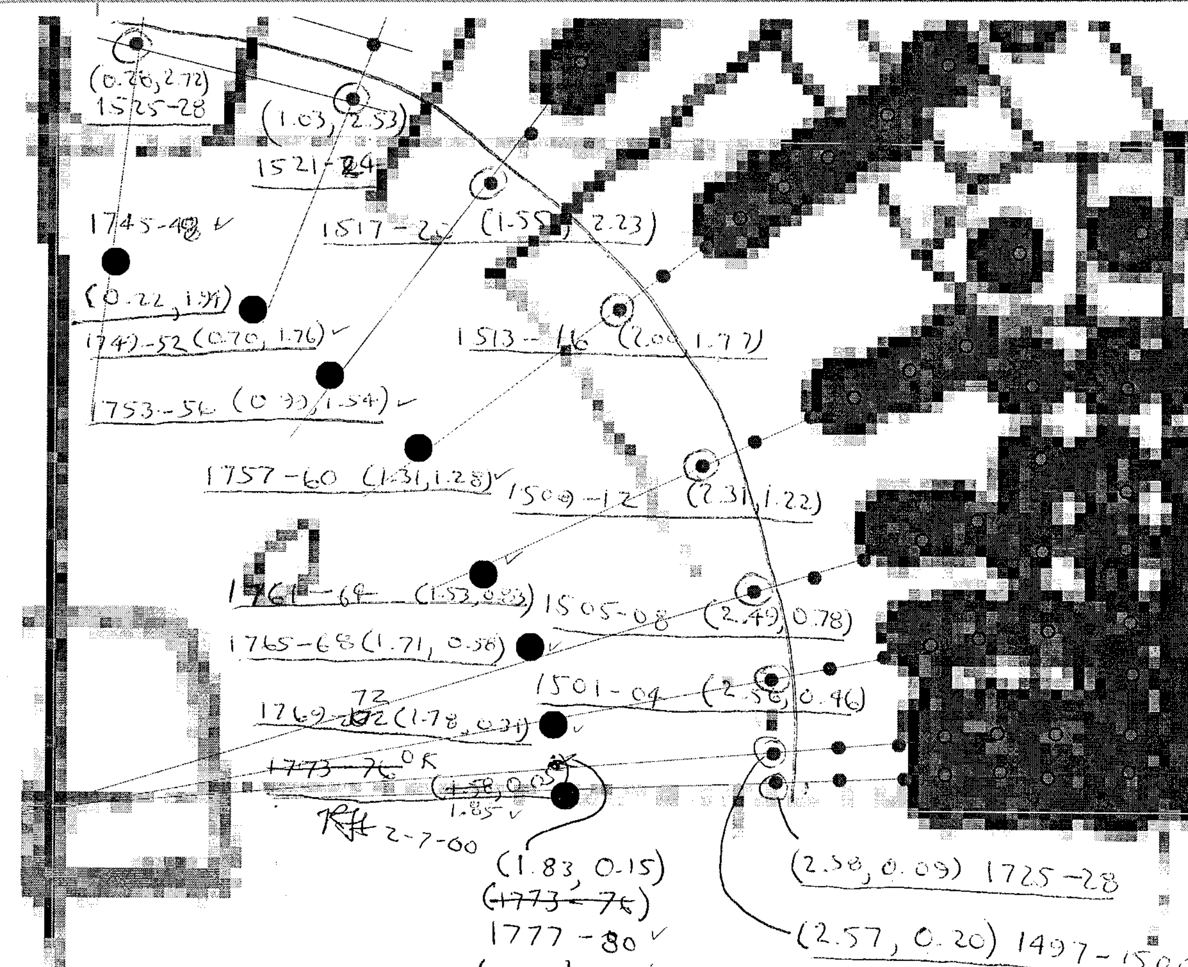


2/3/00 RH

When dealing w/ a model zone with a concave surface, dummy nodes are required to insure that errant connections aren't included. These dummy nodes are indicated below by the large black dots. After conne is created by amesh.vulcan, all connections to those nodes must be removed. In this case, it is all ~~[illegible]~~ RH 2/3/00 connections with nodes:

1745-48, 1749-52, 1753-56, 1757-60, 1761-64, 1765-68, 1769-72, 1773-76 or $\boxed{1745 - \cancel{1776}}$ 1780

added 1 more pt RH 2/7/00




Cannister heaters
9 elements

2/7/00 RH

Ron Martin generated a small awk script to strip the conne file of extraneous points : Filter_list.nawk . Put a copy on zip drive dst model 1/31/00 also in Vulcan home/rgreen/ dst_scans/ .

```
#
# Tesselation Input looks like:
#From  To              etc.
#node  node
#====  ====            == ========= ========= =========
#1714  1715            1 7.150e-02 7.150e-02 3.772e-01
#1715  1719            1 2.370e-01 2.370e-01 1.001e-01
#1716  1720            1 2.370e-01 2.370e-01 1.001e-01
#1716  1717            1 2.351e-01 2.351e-01 4.158e-33
#1717  1720            1 5.861e-02 5.861e-02 5.343e-01
#1717  1721            1 2.934e-01 2.934e-01 6.167e-02
#1718  1722            1 2.934e-01 2.934e-01 6.167e-02
#1718  1719            1 5.861e-02 5.861e-02 5.343e-01
#1719  1723            1 2.934e-01 2.934e-01 6.167e-02
#1720  1724            1 2.934e-01 2.934e-01 6.167e-02
#1721  1724            1 7.924e-02 7.924e-02 7.126e-01
#1722  1723            1 7.924e-02 7.924e-02 7.126e-01
#1725  1729            1 1.144e-01 1.144e-01 1.633e-01
#1725  1728            1 1.005e-01 1.005e-01 4.899e-01
#
BEGIN {
    # -- set up some stuff --
    hitlist[ 1] = "1154"
    hitlist[ 2] = "1155"
    hitlist[ 3] = "1156"
    hitlist[ 4] = "1157"
    hitlist[ 5] = "1158"
    hitlist[ 6] = "1159"
    hitlist[ 7] = "1160"
    hitlist[ 8] = "1161"
    hitlist[ 9] = "1162"
    hitlist[10] = "1163"
  }
{
 if ( NF == 6 ) {
  killme = 0
  for ( kk = 0; kk < 11; kk++ ) {
   if ( $1 == hitlist[kk] ) {
     killme = 1
   }
   if ( $2 == hitlist[kk] ) {
     killme = 1
   }
  }
  if ( killme == 0 ) print $0

 }
}
END {
   # -- summarize some stuff --
}
```

points to be removed are hard-wired into script.

Filter_list.nawk input fil > output fil

need to proceed this w/ nawk -f

or can put compile commands into script such as:



← denotes compiler

RH 2/7/00

```
#!/bin/sh -e
# -----------------------------------------------------------
#
#  Abstract: Script will strip cell centers from conne (connectivity)
#        and print input for tesselation.
#
#  Revised:  07-Feb-2000  new create by:
#
#           Ronald T Green / #20
#           6220 Culebra Rd.
#           San Antonio TX 78238 usa
#           210-522-5541 (phone)
#           210-522-5155 (fax)
#           E-mail: roland@swri.edu
#
# -----------------------------------------------------------
#

if ( test $# -ne '1' ) then
  echo Usage: $0 "<infile>"
  exit
fi

if ( test ! -f $1 ) then
  echo File: $1 not found.
  exit
fi

# Tesselation Input looks like:
#From  To              etc.
#node  node
#====  ====            == ========= ========= =========
#1714  1715            1 7.150e-02 7.150e-02 3.772e-01
#1715  1719            1 2.370e-01 2.370e-01 1.001e-01
#1716  1720            1 2.370e-01 2.370e-01 1.001e-01
#1716  1717            1 2.351e-01 2.351e-01 4.158e-33
#1717  1720            1 5.861e-02 5.861e-02 5.343e-01
#1717  1721            1 2.934e-01 2.934e-01 6.167e-02
#1718  1722            1 2.934e-01 2.934e-01 6.167e-02
#1718  1719            1 5.861e-02 5.861e-02 5.343e-01
#1719  1723            1 2.934e-01 2.934e-01 6.167e-02
#1720  1724            1 2.934e-01 2.934e-01 6.167e-02
#1721  1724            1 7.924e-02 7.924e-02 7.126e-01
#1722  1723            1 7.924e-02 7.924e-02 7.126e-01
#1725  1729            1 1.144e-01 1.144e-01 1.633e-01
#1725  1728            1 1.005e-01 1.005e-01 4.899e-01
#
nawk '
BEGIN {
    # -- set up some stuff --
    hitlist[ 1] = "1745"
    hitlist[ 2] = "1746"
    hitlist[ 3] = "1747"
    hitlist[ 4] = "1748"
    hitlist[ 5] = "1749"
    hitlist[ 6] = "1750"
    hitlist[ 7] = "1751"
    hitlist[ 8] = "1752"
    hitlist[ 9] = "1753"
    hitlist[10] = "1754"
    hitlist[11] = "1755"
    hitlist[12] = "1756"
    hitlist[13] = "1757"
    hitlist[14] = "1758"
    hitlist[15] = "1759"
    hitlist[16] = "1760"
    hitlist[17] = "1761"
```

These are the (nodes) ~~elements that will be~~ removed from conne or segmt

Nodes are easily removed from eleme, but if not, a similar script can be set up to address eleme als.

this is in filter-list.nawk

put into

Filter-conne.nawk
also
Filter-segmt.nawk
to remove nodes from segmt

Note: these scripts were updated to be sufficiently general to accommodate the boundary conditions 2/16/00 RH

program is set between ' '

2/7/00
RJJ

```
hitlist[18] = "1762"
hitlist[19] = "1763"
hitlist[20] = "1764"
hitlist[21] = "1765"
hitlist[22] = "1766"
hitlist[23] = "1767"
hitlist[24] = "1768"
hitlist[25] = "1769"
hitlist[26] = "1770"
hitlist[27] = "1771"
hitlist[28] = "1772"
hitlist[29] = "1773"
hitlist[30] = "1774"
hitlist[31] = "1775"
hitlist[32] = "1776"
hitlist[33] = "1777"
hitlist[34] = "1778"
hitlist[35] = "1779"
hitlist[36] = "1780"
}
{
 if ( NF == 6 ) {

 killme = 0
 for ( kk = 0; kk < 37; kk++ ) {
  if ( $1 == hitlist[kk] ) {
   killme = 1
  }
  if ( $2 == hitlist[kk] ) {
   killme = 1
  }
 }
 if ( killme == 0 ) print $0
 }
}
END {
 # -- summarize some stuff --
}$1

exit
```

must be + 1 more than number of nodes in hitlist.

end of program

2/9/00
RJJ

Assigning heat load in source when using a non-structural grid is not exactly straight forward.

The volume of each element that is heated must be factored into size of the heat load assigned to the elements.



RJJ
2/9/00

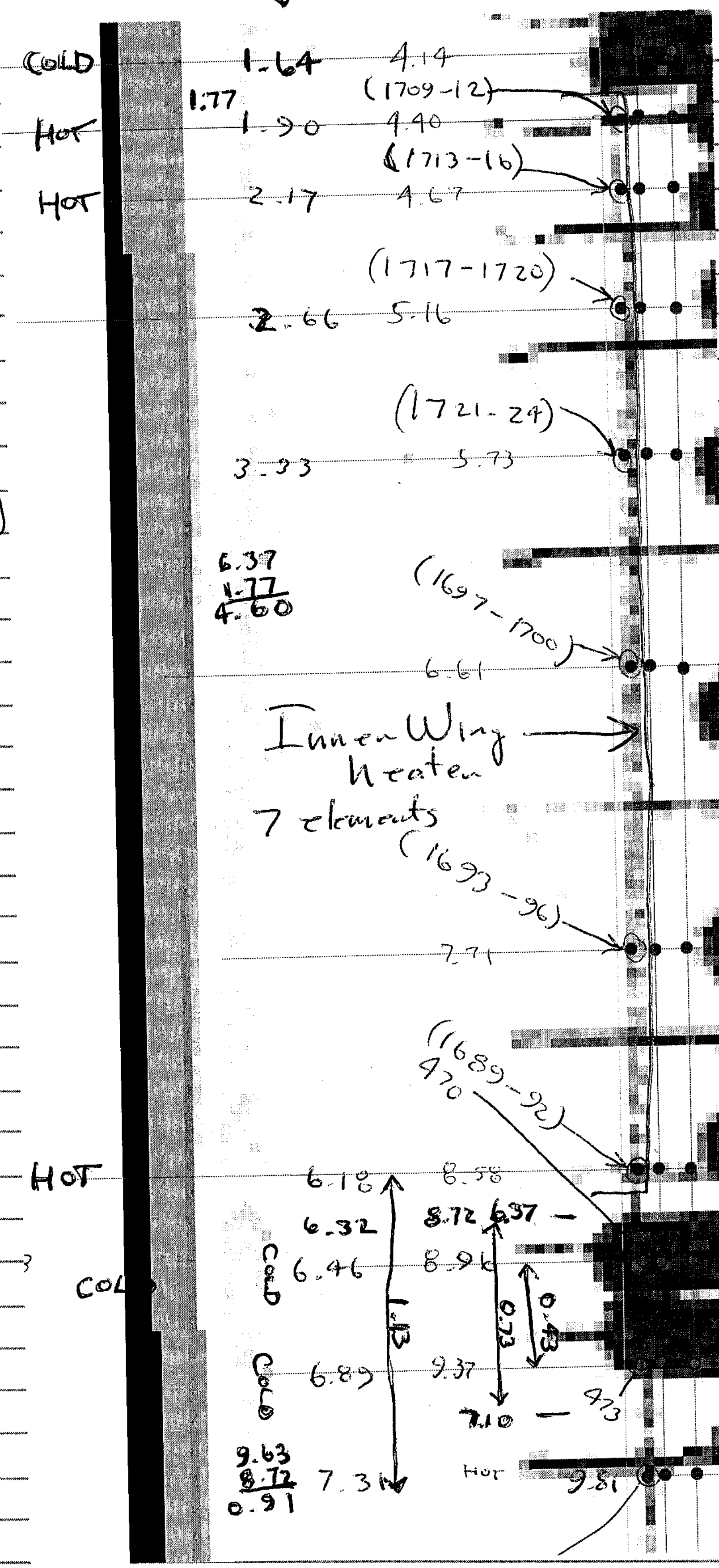
Inner wing heater

Node numbers are denoted by: (1709 - 1712) which includes all four quadrants

heated elements (nodes) for inner wing heater:

1709 - 12
1713 - 16
1717 - 1720
1721 - 1724
1697 - 1700
1693 - 1696
1689 - 1692

Total: 28 nodes

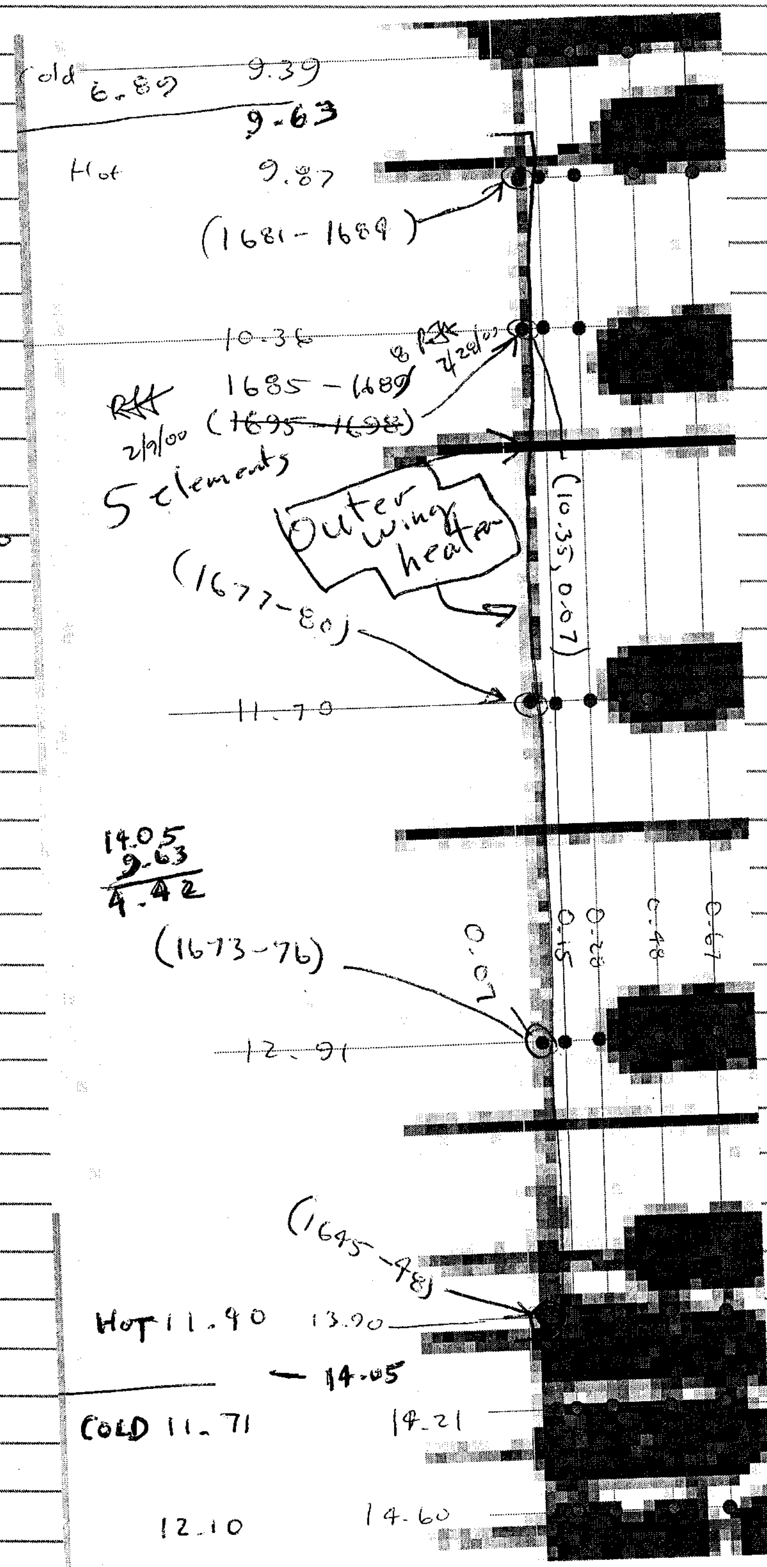


outer wing heater

heated nodes in outer wing heater

1681 - 1684
1695 - 1698
1677 - 1680
1673 - 16~~78~~76 RH 2/9/00
1645 - 1648

Total = 20 nodes






The design (dimensions) of the wing heaters is taken from the as-built report (July, 1998)

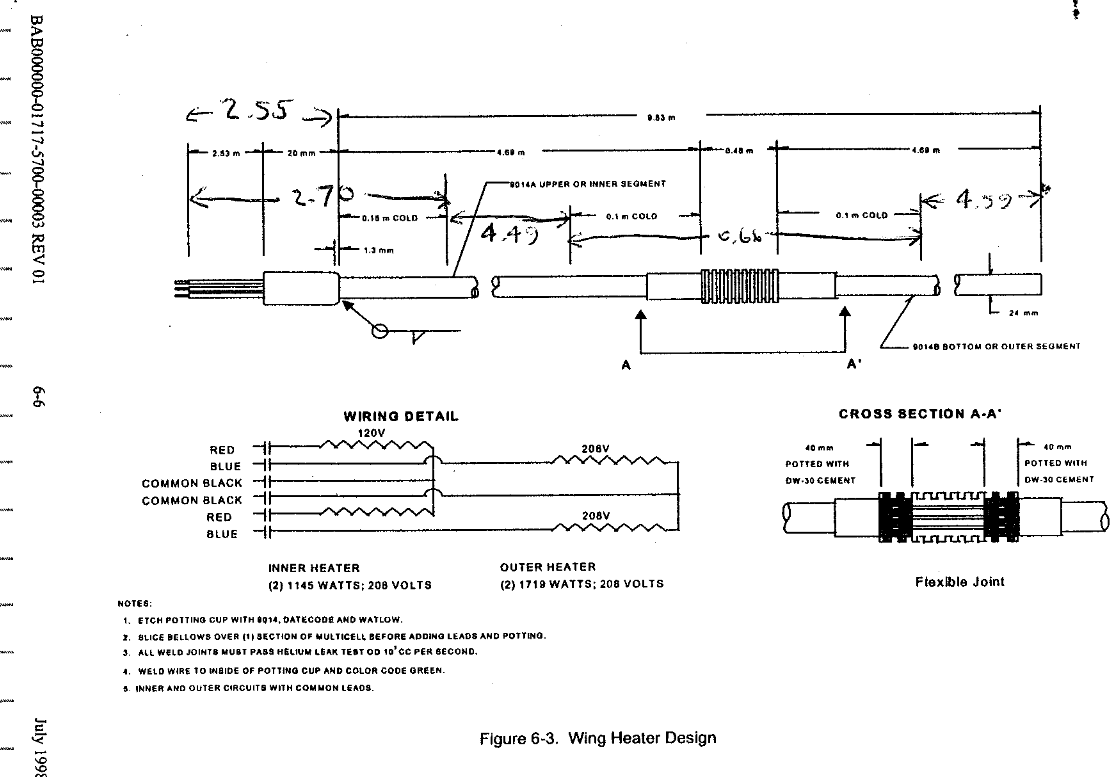



Figure 6-3. Wing Heater Design

Drift-Scale Test As-Built Report
BAB000000-0717-5700-0003 Rev 01 by TRW

Need volume of heated nodes - get from eleme
Need this for canister, inner wing, outer wing heaters

| Canister (9x4=36) | vol | Inner (7x4=28) | vol | Outer (5x4=20) | vol |
|---|---|---|---|---|---|
| 1525 - 1528 | 3.221e-1 | 1709 - 1712 | 3.110e-2 | 1681 - 1684 | 5.860e-2 |
| 1521 - 1524 | 3.363e-1 | 1713 - 1716 | 4.078e-2 | RH 2/9/00 ~~1695~~ 1685 - ~~1698~~ 1688 | 1.065e-1 |
| 1517 - 1520 | 3.254e-1 | 1717 - 1720 | 5.184e-2 RH 2/9/00 | 16~~8~~7 - 1680 | 1.469e-1 |
| 1513 - 1516 | 3.176e-1 | 1721 - 1724 | 2.867e-2 | 1673 - 1676 | 1.242e-1 |
| 1509 - 1512 | 2.893e-1 | 1697 - 1700 | 1.118e-1 | 1645 - 1648 | 8.092e-2 |
| 1505 - 1508 | 1.958e-1 | 1693 - 1696 | 1.065e-1 | | 5.1712e-1 |
| 1501 - 1504 | 1.360e-1 | 1689 - 1692 | 6.515e-2 | | |
| 1497 - 1500 | 9.502e-2 | | 4.8584e-1 | | |
| 1725 - 1728 | 6.866e-2 | | | | |
| | 2.0862 | | | | |

volumes taken from eleme

 RH
2/9/00

Total volumes of elements are as follows

Canister 4 x 2.0862 = 8.3447 $m^3$
Inner Wing 4 x 4.8584e-1 = 1.9434 $m^3$
Outer Wing 4 x 5.1712e-1 = ~~2.685~~ 2.0685 $m^3$ RH 2/9/00

Heat load in test is (from as-built report ref pg 89)

Canister 68 KW
Inner Wing / Outer Wing } 143 KW → 85.8 KW / 57.2 KW RH 2/9/00 outer heater as built

Therefore each element has the following proportion of the total heat load, for example element w/node 1525

$\frac{3.221e-1}{8.3447} = 3.8599e-2$ (68 KW) = 2625 W for node 1525

but must also divide by 47.5 m (total length of drift) for this 1-m deep slice ⇒ 55.26 W for node 1525

Apply this to all heater nodes

RH 2/9/00

| Canister | Watts/element | Inner Wing | W/elem | Outer Wing | W/elem | |
|---|---|---|---|---|---|---|
| 1525-1528 | 55.26 | 1709 - 1712 RH | 19.27 | 1681-1684 | ~~39.42~~ | 51.17 |
| 1521-1524 | 57.69 | 1713 - 1716 | 25.27 | 1685-1688 ~~1695-1698~~ | ~~71.65~~ | 93.00 |
| 1517-1520 | 55.82 | 1717 - 1720 | 32.12 | 1677-1680 | ~~98.89~~ | ~~100.15~~ 128.28 |
| 1513-1516 | 54.49 | 1721 - 1724 | 48.75 | 1673-1677 | ~~83.56~~ | 108.46 |
| 1509-1512 | 49.63 | 1697 - 1700 | 69.28 | 1645-1648 | ~~54.94~~ | 70.66 |
| 1505-1508 | 33.59 | 1693 - 1696 | 65.99 | | ~~347.89~~ | 451.57 |
| 1501-1504 | 23.33 | 1689 - 1692 | 40.37 | | | |
| 1497-1500 | 16.30 | | 301.05 | | | |
| 1725-1728 | 11.78 | | | | | |

RH 2/9/00

Factor is 171.56 → 357.89   Factor is 0.61964e3   Factor is ~~672.74~~ 873.25

RH 2/9/00

 RH
2/9/00

To check these heat loads

357.89 W x 4 quadrants x 47.5 m = 67,999 W
(301.05)(4)(47.5) = 57,200 W
(451.57)(4)(47.5) = 85,798 W

2/16/00 RH Needed script to break strings in original segment files. There was strings running together w/o a space which caused a problem. This script breaks those strings & puts spaces between each field
brk_cols.awk on gyp dst model 1/31/00

Header should actually read:
#!/bin/sh -e
# Abstract: Script will seperate strings that run together
# and print seperated fields as ouput.
RH 2/24/00

```
#!/bin/sh -e
# ---------------------------------------------------------------
#
# Abstract: Script will trip extraneous points from segmt
#      and print input for tesselation.
#
# Revised: 07-Feb-2000 new create by:
#
#      Ronald T Green / #20
#      6220 Culebra Rd.
#      San Antonio TX 78238 usa
#      210-522-5541 (phone)
#      210-522-5155 (fax)
#      E-mail: roland@swri.edu
#
#
# ---------------------------------------------------------------


if ( test $# -ne '1' ) then
   echo Usage: $0 "<infile>"
   exit
fi

if ( test ! -f $1 ) then
   echo File: $1 not found.
   exit
fi

# Well behaved input looks like:
#   $1          $2          $3          $4        $5 $6  $7
#   -1.3491592  -5.19342196  -1.21045443  -4.71319154 1 3  175
#  -1.21045443  -4.71319154  -1.21063736  -4.70514646 1 3  171
#   2.37124427  -4.24704436   1.21063736  -4.70514646 1 4  16
#   1.21063736  -4.70514646   1.21045443  -4.71319154 1 4  172
#
# Less well behaved input looks like:
#   $1          $2          $3          $4        $5 $6  $7
#....+....1....+....2....+....3....+....4....+....5....+....6....+....7....+
#  -0.647043656  -3.40116165-2.22044605e-16  -3.44176932 1 151 155
#   0.864103319  -3.32556831  0.831102606  -3.20821646 0 152 148
#   0.831102606  -3.20821646  0.822256118  -3.19018007 1 152 1588
#   0.822256118  -3.19018007          0  -3.28216734 1 152 1592
#            0  -3.28216734-2.52763064e-33  -3.28216734 1 152 1591
#-2.52763064e-33  -3.28216734-2.32653246e-33  -3.44176932 0 152 151
#-2.32653246e-33  -3.44176932  0.867643417  -3.38731708 1 152 156
```

continuation of
brk_cols.nwk

```
#   0.90280679   3.52128453-4.80991154e-17   3.73225143  1  153  157
#-4.80991154e-17   3.73225143-5.55111512e-17   3.44176932  1  153  154
#-5.55111512e-17   3.44176932 1.11022302e-16   3.44176932  0  153  150
#-2.22044605e-16   3.44176932            0   3.44176932  0  154  149
#   -0.81611142   2.94730933  -0.734247864   2.82519671  0  1782 1534
#  -0.894517772   3.17380046   -0.81611142   2.94730933  0  1783 1586
#   -0.81611142   2.94730933  -0.734247864   2.82519671  0  1783 1534
#  -0.734247864  -2.82519671   -0.81611142  -2.94730933  0  1784 1535
#....+....1....+....2....+....3....+....4....+....5....+....6....+....7....+....8
#   -29.3781635       100.05   -46.4286173       100.05  0  128  *  22
#   -46.4286173      -100.05   -29.3781635      -100.05  0  128  *  23
#    29.3781635      -100.05    46.4286173      -100.05  0  128  *  24
#          79.6   64.1884269          79.6   82.0114146  0  130  *  25
#         -79.6   82.0114146         -79.6   64.1884269  0  130  *  26
#         -79.6  -64.1884269         -79.6  -82.0114146  0  130  *  27


nawk '
BEGIN {
      # -- set up some stuff --
      }
{
 if ( NF > 2 ) {
   if ( $7 == "*" ) {
     print $0
   } else {
     col1 = substr($0, 1,15)
     col2 = substr($0,16,15)
     col3 = substr($0,31,15)
     col4 = substr($0,46,15)
     col5 = substr($0,61, 3)
     col6 = substr($0,64, 6)
     col7 = substr($0,70, 6)
     printf ("%s %s %s %s %s %s %s\n", col1, col2, col3, col4, col5, col6, col7)
   }
 }
}
END {
   # -- summarize some stuff --
   } '$1

exit
```

Following is Filter-conne.nwk to strips pts on hitlist from original conne file. on zip dst model 1/31/00

```
#!/bin/sh -e
# -----------------------------------------------------------------
#
#  Abstract: Script will strip cell centers from conne (connectivity)
#         and print input for tesselation.
#
#  Revised:  07-Feb-2000  new create by:
#
#           Ronald T Green / #20
#           6220 Culebra Rd.
#           San Antonio TX 78238 usa
#           210-522-5541 (phone)
#           210-522-5155 (fax)
#           E-mail: roland@swri.edu
#
# -----------------------------------------------------------------
#
```

Note: filter-conne.nwk was updated to be able to include lines w/ * (i.e. bc elements) in output. See revised script on pg 97 RH 2/24/00



```
if ( test $# -ne '1' ) then
   echo Usage: $0 "<infile>"
   exit
fi

if ( test ! -f $1 ) then
   echo File: $1 not found.
   exit
fi

# Tesselation Input looks like:
#From  To                  etc.
#node  node
#====  ====            == ========= ========= =========
#1714  1715            1 7.150e-02 7.150e-02 3.772e-01
#1715  1719            1 2.370e-01 2.370e-01 1.001e-01
#1716  1720            1 2.370e-01 2.370e-01 1.001e-01
#1716  1717            1 2.351e-01 2.351e-01 4.158e-33
#1717  1720            1 5.861e-02 5.861e-02 5.343e-01
#1717  1721            1 2.934e-01 2.934e-01 6.167e-02
#1718  1722            1 2.934e-01 2.934e-01 6.167e-02
#1718  1719            1 5.861e-02 5.861e-02 5.343e-01
#1719  1723            1 2.934e-01 2.934e-01 6.167e-02
#1720  1724            1 2.934e-01 2.934e-01 6.167e-02
#1721  1724            1 7.924e-02 7.924e-02 7.126e-01
#1722  1723            1 7.924e-02 7.924e-02 7.126e-01

#1725  1728            1 1.005e-01 1.005e-01 4.899e-01
#

nawk '
BEGIN {
      # -- set up some stuff --
      hitlist[ 1] = "1745"
      hitlist[ 2] = "1746"
      hitlist[ 3] = "1747"
      hitlist[ 4] = "1748"
      hitlist[ 5] = "1749"
      hitlist[ 6] = "1750"
      hitlist[ 7] = "1751"
      hitlist[ 8] = "1752"
      hitlist[ 9] = "1753"
      hitlist[10] = "1754"
      hitlist[11] = "1755"
      hitlist[12] = "1756"
      hitlist[13] = "1757"
      hitlist[14] = "1758"
      hitlist[15] = "1759"
      hitlist[16] = "1760"
      hitlist[17] = "1761"
      hitlist[18] = "1762"
      hitlist[19] = "1763"
      hitlist[20] = "1764"
      hitlist[21] = "1765"
      hitlist[22] = "1766"
      hitlist[23] = "1767"
      hitlist[24] = "1768"
      hitlist[25] = "1769"
      hitlist[26] = "1770"
      hitlist[27] = "1771"
      hitlist[28] = "1772"
      hitlist[29] = "1773"
      hitlist[30] = "1774"
      hitlist[31] = "1775"
      hitlist[32] = "1776"
      hitlist[33] = "1777"
      hitlist[34] = "1778"
      hitlist[35] = "1779"
      hitlist[36] = "1780"
      hitlist[37] = "1781"
      hitlist[38] = "1782"
```

2/16/00

```
        hitlist[40] = "1784"
    }
  {
  if ( NF == 6 ) {
    killme = 0
    for ( kk = 0; kk < 41; kk++ ) {
      if ( $1 == hitlist[kk] ) {
        killme = 1
      }
      if ( $2 == hitlist[kk] ) {
        killme = 1
      }
    }
  if ( killme == 0 ) print $0
  }
}
END {
   # -- summarize some stuff --
   } '$1

exit
```

This has been revised + see pg 97 RH 2/29/00

Following is script Filter-segmt-nwk to strip extraneous points listed on hitlist from original segmt file

also on zip dst 1/31/00

```
#!/bin/sh -e
# ----------------------------------------------------------------
#
#  Abstract: Script will trip extraneous points from segmt
#           and print input for tesselation.
#
#  Revised:  07-Feb-2000  new create by:
#
#            Ronald T Green / #20
#            6220 Culebra Rd.
#            San Antonio TX 78238 usa
#            210-522-5541 (phone)
#            210-522-5155 (fax)
#            E-mail: roland@swri.edu
#
# ----------------------------------------------------------------
#

if ( test $# -ne '1' ) then
   echo Usage: $0 "<infile>"
   exit
fi

if ( test ! -f $1 ) then
   echo File: $1 not found.
   exit
fi

# Input looks like:
#   $1           $2           $3           $4          $5 $6  $7
#   -1.21045443   4.71319154  -1.3491592    5.19342196  1
#   -1.3491592    5.19342196  -1.35054071   5.1952645   1  2
#   -1.35054071   5.1952645   -2.59806303   4.6910611   1  2
#   -2.59806303   4.6910611   -2.58695442   4.61657869  1
#   -2.58695442   4.61657869  -2.37124427   4.24704436  1
#   -1.21063736  -4.70514646  -2.37124427  -4.24704436  1
#   -2.37124427  -4.24704436  -2.58695442  -4.61657869  1
#   -2.58695442  -4.61657869  -2.59806303  -4.6910611   1
#   -2.59806303  -4.6910611   -1.35054071  -5.1952645   1
#   -1.35054071  -5.1952645   -1.3491592   -5.19342196  1
#   -1.3491592   -5.19342196  -1.21045443  -4.71319154  1
#   -1.21045443  -4.71319154  -1.21063736  -4.70514646  1
#    2.37124427  -4.24704436   1.21063736  -4.70514646  1
#    1.21063736  -4.70514646   1.21045443  -4.71319154  1
```



2/16/00

```
nawk '
BEGIN {
      # -- set up some stuff --
      hitlist[ 1] = "1745"
      hitlist[ 2] = "1746"
      hitlist[ 3] = "1747"
      hitlist[ 4] = "1748"
      hitlist[ 5] = "1749"
      hitlist[ 6] = "1750"
      hitlist[ 7] = "1751"
      hitlist[ 8] = "1752"
      hitlist[ 9] = "1753"
      hitlist[10] = "1754"
      hitlist[11] = "1755"
      hitlist[12] = "1756"
      hitlist[13] = "1757"
      hitlist[14] = "1758"
      hitlist[15] = "1759"
      hitlist[16] = "1760"
      hitlist[17] = "1761"
      hitlist[18] = "1762"
      hitlist[19] = "1763"
      hitlist[20] = "1764"
      hitlist[21] = "1765"
      hitlist[22] = "1766"
      hitlist[23] = "1767"
      hitlist[24] = "1768"
      hitlist[25] = "1769"
      hitlist[26] = "1770"
      hitlist[27] = "1771"
      hitlist[28] = "1772"
      hitlist[29] = "1773"
      hitlist[30] = "1774"
      hitlist[31] = "1775"
      hitlist[32] = "1776"
      hitlist[33] = "1777"
      hitlist[34] = "1778"
      hitlist[35] = "1779"
      hitlist[36] = "1780"
      hitlist[37] = "1781"
      hitlist[38] = "1782"
      hitlist[39] = "1783"
      hitlist[40] = "1784"
      }

  if ( NF == 7 ) {
    killme = 0
    for ( kk = 0; kk < 41; kk++ ) {
      if ( $6 == hitlist[kk] ) {
        killme = 1
      }
      if ( $7 == hitlist[kk] ) {
        killme = 1
      }
    }
    if ( killme == 0 ) print $0
  }
  if ( NF == 8 ) {
    for ( kk = 0; kk < 41; kk++ ) {
    }
    if ( NF == 8 ) print $0
  }
}
END {
   # -- summarize some stuff --
   } '$1

exit
```

← this is the line with an * in the 7th column which is on the boundary

2/16/00

Following is the procedure to include a boundary condition (i.e. BCON in MULTIFLO)

1) add 4 corners in counter clockwise direction to end of in file for amesh-vulcan

in file

```
1783  1    --0.48836176525014 -3.15564510332814  0.0  1.0
1784  1     -0.48836176525014 -3.15564510332814  0.0  1.0

boundary
79.60 100.05
-79.60 100.05
-79.60 -100.05
79.60 -100.05
```

required if using BCON in MULTIFLO

these 4 pts must be limits of model, all pts must be contained

2) Need bcon_a file

1 - X
2 - Y
3 - Z
} denotes direction

denotes B.C. type

5 - mixed
1 - Dirichlet

matrix
fracture

```
1265 3  5 1.0e-9 93361. 20. 0.1
5.06e-7 93361. 20. 0.95
1266 3  5 1.0e-9 93361. 20. 0.1
5.06e-7 93361. 20. 0.95
1269 3  5 1.0e-9 93361. 20. 0.1
5.06e-7 93361. 20. 0.95
1270 3  5 1.0e-9 93361. 20. 0.1
5.06e-7 93361. 20. 0.95
1281 3  5 1.0e-9 93361. 20. 0.1
5.06e-7 93361. 20. 0.95
1282 3  5 1.0e-9 93361. 20. 0.1
5.06e-7 93361. 20. 0.95
1273 3  5 1.0e-9 93361. 20. 0.1
5.06e-7 93361. 20. 0.95
1274 3  5 1.0e-9 93361. 20. 0.1
5.06e-7 93361. 20. 0.95
1277 3  5 1.0e-9 93361. 20. 0.1
5.06e-7 93361. 20. 0.95
1278 3  5 1.0e-9 93361. 20. 0.1
5.06e-7 93361. 20. 0.95
```

top

```
1267 3  1 1.0e-9 101325. 30. 0.05
0.0 101325. 30. 0.9
1268 3  1 1.0e-9 101325. 30. 0.05
0.0 101325. 30. 0.9
1271 3  1 1.0e-9 101325. 30. 0.05
0.0 101325. 30. 0.9
1272 3  1 1.0e-9 101325. 30. 0.05
0.0 101325. 30. 0.9
1283 3  1 1.0e-9 101325. 28. 0.05
0.0 101325. 30. 0.9
1284 3  1 1.0e-9 101325. 28. 0.05
0.0 101325. 30. 0.9
1275 3  1 1.0e-9 101325. 30. 0.05
0.0 101325. 30. 0.9
1276 3  1 1.0e-9 101325. 30. 0.05
0.0 101325. 30. 0.9
1279 3  1 1.0e-9 101325. 30. 0.05
0.0 101325. 30. 0.9
1280 3  1 1.0e-9 101325. 30. 0.05
0.0 101325. 30. 0.9
```

bottom

pressure    gas sat

boundary condition → flux    temperature



2/16/00

phik_a looks like

```
1 1744 1 1  0.90 3.44e-09 3.44e-09 5.45e-08
0.089 4.08e-18   2 1  :TSW34
```

use # of elements after extraneous points have been stripped

Run amesh2mflo ␣ * ␣ RH 2/15/00
→ ␣ * ␣ dcm

* denotes geometry, i.e. XZ

to get multi_con
multi_phk
and multi_bc ← this must have sufficient lines for all bc points
→ 2 lines per boundary node for dcm

Note: amesh2mflo requires bcon_a & phik_a

2/24/00 RH

Revised filter-conne.nwk is below

Zip disk dst model 1/31/00 was updated

```
     hitlist[40] = "1784"
   }
{
 if ( NF == 6 ) {
   killme = 0
   for ( kk = 0; kk < 41; kk++ ) {
     if ( $1 == hitlist[kk] ) {
       killme = 1
     }
     if ( $2 == hitlist[kk] ) {
       killme = 1
     }
   }
   if ( killme == 0 ) print $0
 }
 if ( NF == 7) {
   for ( kk = 0; kk < 41; kk++ ) {
   }
   if ( NF == 7 ) print $0
   }
}
END {
   # -- summarize some stuff --
   } '$1

exit
```

Revised script for:

filter-conne.nwk

|| this allows inclusion of lines w/ * (i.e. b.c. elements) into the output

Values for bcon-a are listed here:

This accounts for steady state infiltration through medium.

An infiltration rate of 3.6 mm/yr is converted to Kg/m²-s

3.6 mm/yr = 3.6e-3 m/yr

$$\left[3.6e{-3}\ \frac{m}{yr}\right]\left[\frac{3.15e7\,s}{yr}\right]^{-1} = 1.1416e{-10}\ m/s$$

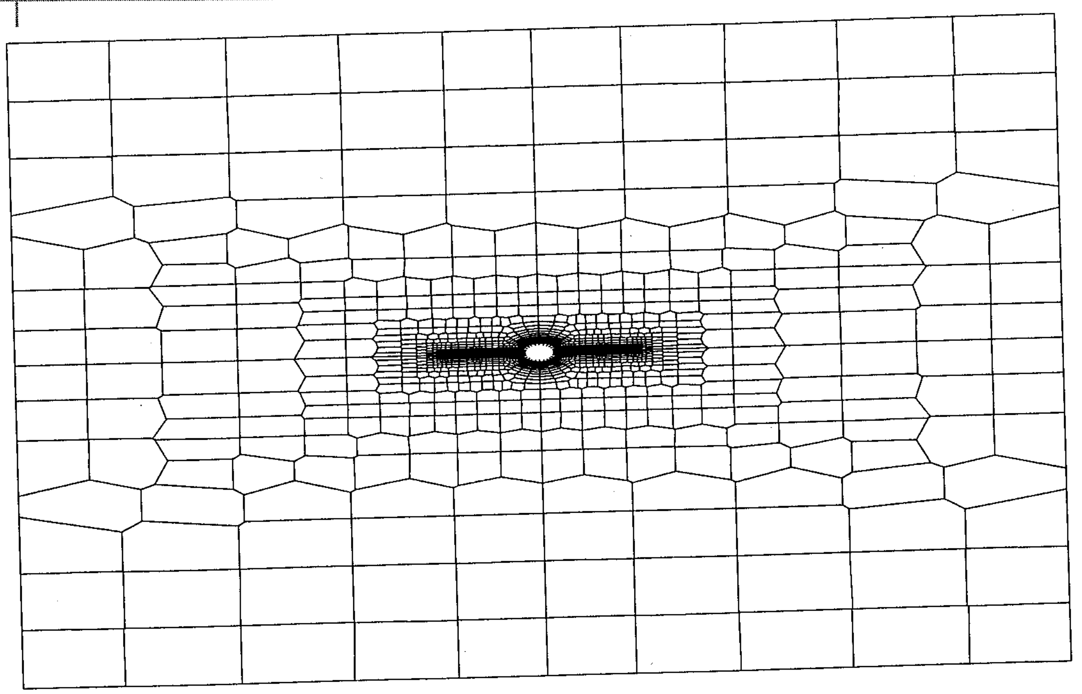
$$\left[1.1416e{-10}\ \frac{m}{s}\right]\left[\frac{1e3\ Kg}{m^3}\right] = 1.1416e{-7}\ Kg/s\text{-}m^2$$

2/28/00 RH note: the Fracture flux value must be divided by the intrinsic fracture porosity. Thus, for a fracture porosity of 1e-4, for example, bcon is given a fracture flux of 1.14e-3 Kg/s-m²

this goes into bcon-a which goes into multi.bc

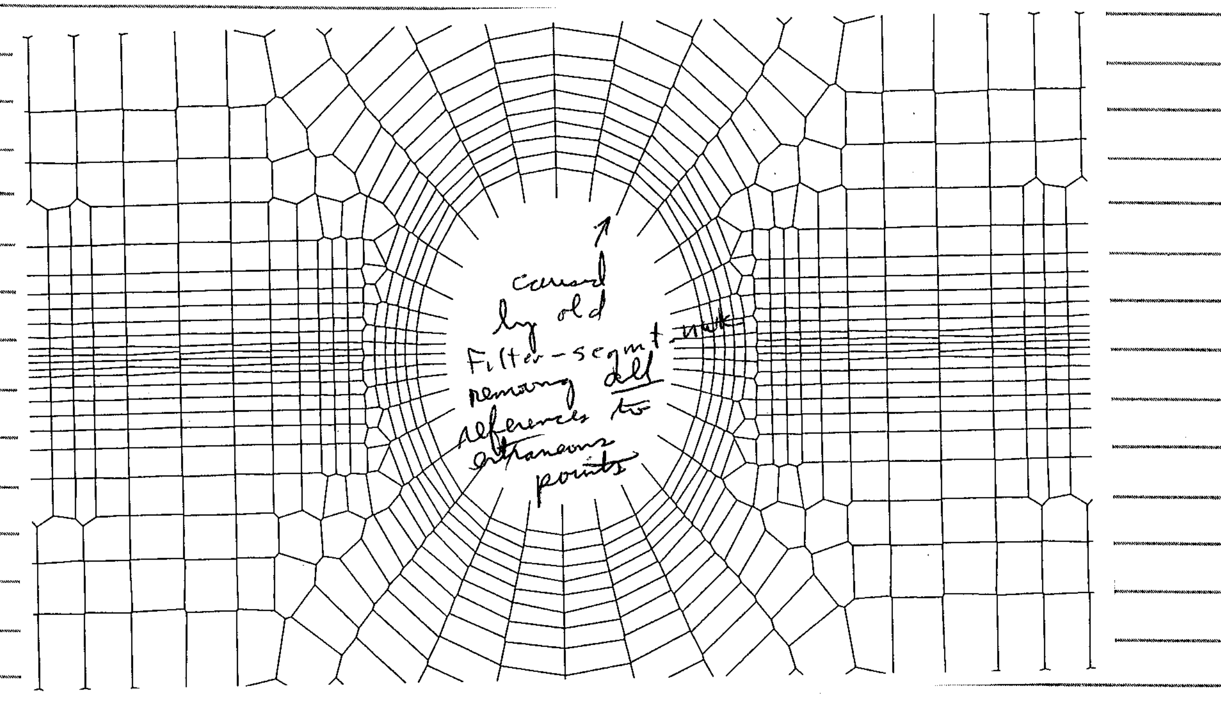
The grid was cleaned up using arcview

The final grid looks like:





with a closeup:




These plots were made using a mathematica notebook by Scott Painter, the segmt file was plotted

The original file with node x z locations is in cents2-1.apr, stored on zip dst model date of zip 1/31/00 RH

2/28/00 Revised Volumes of heater elements since cleaned up node placement

| Canister | Vol | Inner | Vol | Outer | Vol |
|---|---|---|---|---|---|
| 1525-1528 | 3.118e-1 | 1709-1712 | 2.814e-2 | 1681-1684 | 5.325e-2 |
| 1521-1524 | 3.154e-1 | 1713-1716 | 4.042e-2 | 1685-1688 | 9.712e-2 |
| 1517-1520 | 3.033e-1 | 1717-1720 | 5.550e-2 | 1677-1680 | 1.329e-1 |
| 1513-1516 | 3.269e-1 | 1721-1724 | 7.440e-2 | 1673-1676 | 1.138e-1 |
| 1509-1512 | 2.958e-1 | 1697-1700 | 9.950e-2 | 1645-1648 | 7.312e-2 |
| 1505-1508 | 2.079e-1 | 1693-1696 | 1.055e-1 | | 4.7019e-1 m³ |
| 1501-1504 | 1.503e-1 | 1689-1692 | 6.492e-2 | | 4x(4.7019e-1) = 1.8808 m³ |
| 1497-1500 | 9.634e-2 | | 4.6838e-1 m³ | | |
| 1725-1728 | 8.272e-2 | | 4x(4.6838e-1) = 1.8735 m³ | | |
| | 2.0905 m³ | | | | |

4 x (2.0905) = 8.3618 m³

2/28/00

| Canisters | Watts element | Inner | Watts element | Outer | Watts element |
|---|---|---|---|---|---|
| (21) 1525-1528 | 53.38 | (6) 1709-1712 | 18.09 | (1) 1681-1684 | 51.14 |
| (20) 1521-1524 | 54.00 | (7) 1713-1716 | 25.98 | (2) 1685-1688 | 93.27 |
| (19) 1517-1520 | 51.93 | (8) 1717-1720 | 35.67 | (3) 1677-1680 | 127.64 |
| (18) 1513-1516 | 55.97 | (9) 1721-1724 | 47.82 | (4) 1673-1676 | 109.29 |
| (17) 1509-1512 | 50.64 | (10) 1697-1700 | 63.95 | (5) 1645-1648 | 70.22 |
| (16) 1505-1508 | 35.59 | (11) 1693-1696 | 67.81 | | 415.56 |
| (15) 1501-1504 | 25.73 | (12) 1689-1692 | 41.73 | | |
| (14) 1497-1500 | 16.49 | | 301.05 | | |
| (13) 1725-1728 | 14.16 | | | | |
| | 357.90 W per quadrant per 1-m thick slice in y-direction | | | | |

Total heat load

4 x 357.90 x 47.5 = 68,000 Watts canister
4 x 301.05 x 47.5 = 57,200 Watts inner wing
4 x 415.56 x 47.5 = 85,797 Watts outer wing

3/8/00 RFF

The procedure of unstructured grid preparation described on pg 78-100 appears sound. But the segmt file will not plot correctly. Scott Painter recommended a modified approach. The entire procedure is summarized below.

Step 1. Use arcview to create grid, store information in file, i.e. cents.apr

Step 2. Strip points (i.e. x,y or x,z) from cents.apr using nawk script

> strip-pts1-0.nwk cents.apr > in



3/8/00

Step 3. Edit in, add locat to first line and if there are boundary conditions, add four pts the encompass grid (counterclockwise)

end of file
<space>
boundary
x1, y1
-x1, y1
-x1, -y1
x1, -y1

note: these coordinates cannot lie on the boundary nodes, they have to go beyond otherwise MULTIFLO will have a problem RFF 6/6/01

tolerance 1.0e-8 to remove very small connections RFF 4/20/01

Step4. > amesh.vulcan

this creates conne
segmt
eleme

Extra effort is required at this point if extraneous pts have to be removed.

a) eleme - simply remove those pts, usually structured to be at the end of the file.

~~b) use filter-segmt.nwk to strip pts from segmt~~ RFF 3/8/00
~~i.e. >filter-segmt.nwk segmt > segmt.stp~~
omit RFF 3/8/00

b) use filter-conne.nwk to strip all reference to extraneous pts

* need to add conne to first line of conne

filter-conne.nwk conne-orig > conne

 RH
3/8/00

Note before step c) need to break columns in original seg file using brk_cols.nwk segmt > new.segmt
see pg 91 RH 4/28/00

c) use Filter-seg-nF6.nwk
to strip only extraneous points in field 6 from segmt
i.e.
> Filter-seg-nF6.nwk segmt > segmt.stp

this will remove all segments defining polygons around extraneous pts, but leaves intact those segments around remaining pts but that reference

this script is the same as Filter-segmt.nwk w/ the following exception

this is the only difference from pg 95

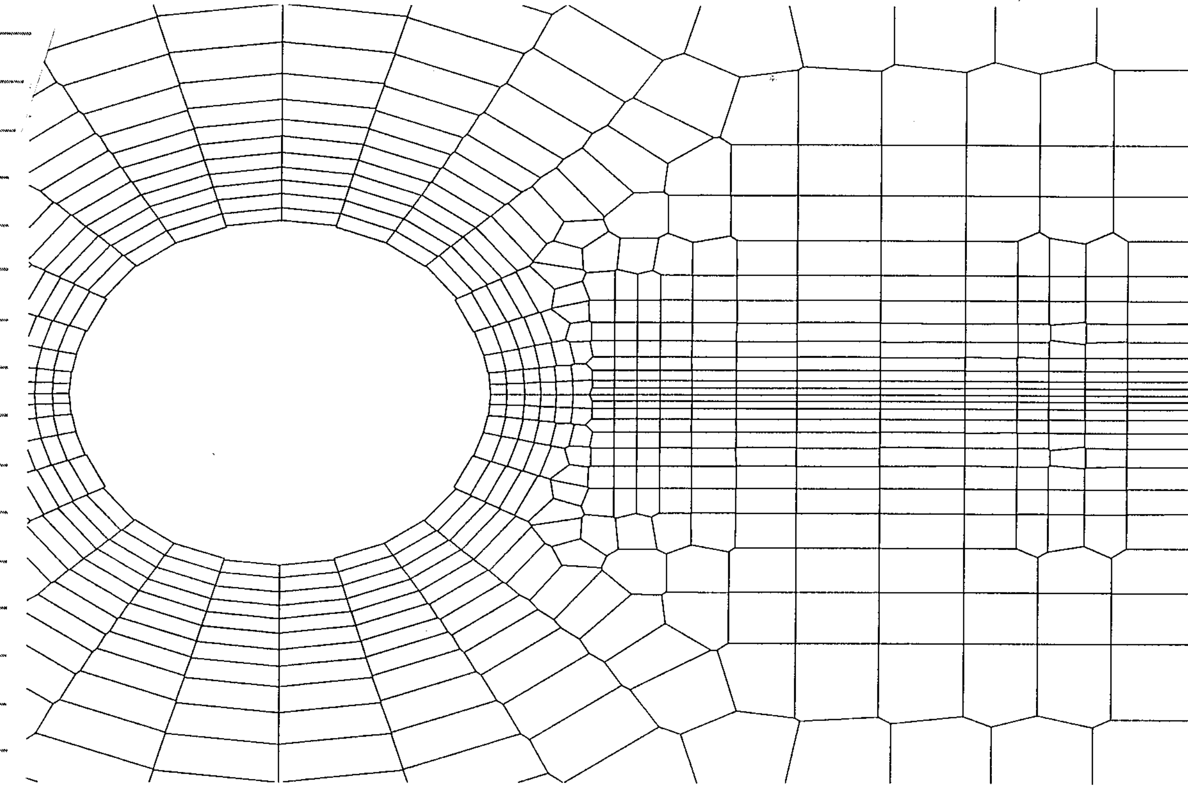
```
if ( NF == 7 ) {
  killme = 0
  for ( kk = 0; kk < 41; kk++ ) {
    if ( $6 == hitlist[kk] ) {
      killme = 1
    }
#   if ( $7 == hitlist[kk] ) {
#     killme = 1
#   }
  }
  if ( killme == 0 ) print $0
}
if ( NF == 8 ) {
  for ( kk = 0; kk < 41; kk++ ) {
  }
  if ( NF == 8 ) print $0
}
}
END {
  # -- summarize some stuff --
} '$1

exit
```

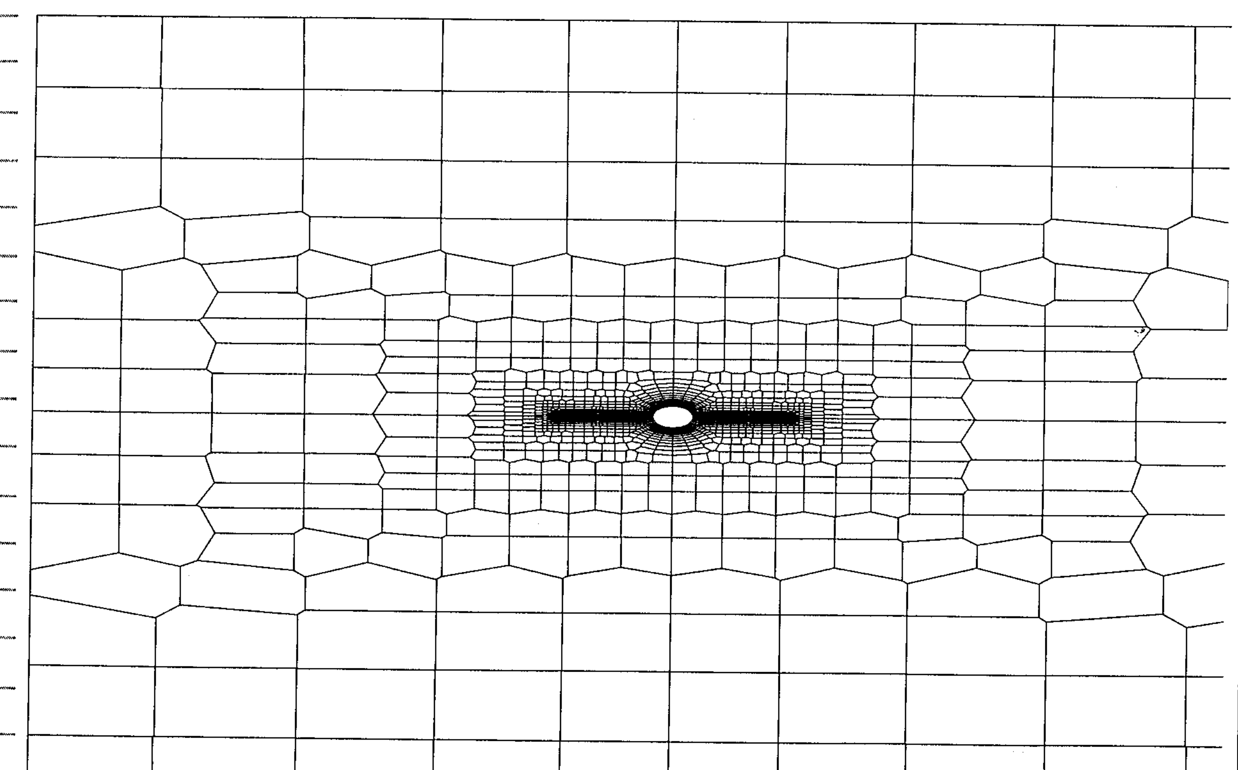
compare to pg 95
the difference is that removal of extraneous pts from field 7 has been commented out.

* need to add segmt to first line of segmt file

 RH 3/8/00

These are mathematica images of the resulting grid
~/dst_scans/new 3-7a/ * also on dst models 1/31/00 zip





Step 5. Create ~~RH~~ 3/8/00 MULTIFLO input files using amesh2mFlo (only if there are boundary conditions)

Note bcon_a and phk_d input files must be present when doing this, as are conne, segmt, eleme

> amesh2mFlo xz dcm

this creates the following files

multi.con
multi.phk
multi.bc

be sure to reference multi.x appropriately when running MULTIFLO or METRA

There are several sets of runs

~/dst_scans/new3-8

dst2d50.dat no heat steady state run for fracture infiltration of 3.6 mm/yr, fracture porosity of 1.24e-4

heat load is as follows per calculations on pg 99-100 (taken from dst2d50.dat, same as earlier runs)



```
: wing heater (outer) at 51.14 W/element
:
0.0     0.0
10.0     1.0
100.0    2.0
1000.0   3.0
2000.0   4.0
3000.0   5.0
4000.0   6.0
5000.0   8.0
6000.0  10.0
7000.0  13.0
8000.0  16.0
9000.0  20.0
10000.0 25.0
11000.0 30.0
12000.0 35.0
13000.0 40.0
14000.0 45.0
15000.0 50.0
15100.0 51.14
1.26e+8  51.14
1.261e+8 0.0
/
: elem1 elem2 inc  istyp
  1685 1688 1   31
:
: wing heater (outer) at 93.27 W/element
:
0.0     0.0
10.0     1.0
100.0    5.0
1000.0  10.0
2000.0  15.0
3000.0  20.0
4000.0  25.0
5000.0  30.0
6000.0  35.0
7000.0  40.0
8000.0  45.0
9000.0  50.0
10000.0 55.0
11000.0 60.0
12000.0 65.0
13000.0 70.0
14000.0 80.0
15000.0 90.0
15100.0 93.27
1.26e+8  93.27
1.261e+8 0.0
/
: elem1 elem2 inc  istyp
  1677 1680 1   31
:
: wing heater (outer) at 127.64 W/element
:
0.0     0.0
10.0     1.0
100.0    5.0
1000.0  10.0
2000.0  15.0
3000.0  20.0
4000.0  25.0
5000.0  30.0
6000.0  35.0
7000.0  40.0
8000.0  50.0
9000.0  60.0
10000.0 70.0
11000.0 80.0
12000.0 90.0
13000.0 100.0
14000.0 110.0
15000.0 120.0
15100.0 127.64
1.26e+8  127.64
1.261e+8 0.0
/
: elem1 elem2 inc  istyp
  1673 1676 1   31
:
: wing heater (outer) at 109.29 W/element
:
0.0     0.0
10.0     1.0
100.0    5.0
1000.0  10.0
2000.0  15.0
3000.0  20.0
4000.0  25.0
5000.0  30.0
6000.0  35.0
7000.0  40.0
8000.0  45.0
9000.0  50.0
10000.0 55.0
11000.0 60.0
12000.0 70.0
13000.0 80.0
14000.0 90.0
15000.0 100.0
15100.0 109.29
1.26e+8  109.29
1.261e+8 0.0
/
: elem1 elem2 inc  istyp
  1645 1648 1   31
:
: wing heater (outer) at 70.22 W/element
:
0.0     0.0
10.0     1.0
100.0    2.0
1000.0   3.0
2000.0   4.0
3000.0   5.0
4000.0   6.0
5000.0   8.0
6000.0  10.0
7000.0  13.0
8000.0  16.0
9000.0  20.0
10000.0 25.0
11000.0 30.0
12000.0 35.0
13000.0 40.0
14000.0 50.0
15000.0 60.0
15100.0 70.22
1.26e+8  70.22
1.261e+8 0.0
/
: elem1 elem2 inc  istyp
  1709 1712 1   31
:
:wing heater (inner) at 18.09 W/element
:
0.0     0.0
10.0     1.0
100.0    2.0
1000.0   3.0
2000.0   4.0
3000.0   5.0
4000.0   6.0
5000.0   7.0
6000.0   9.0
7000.0  11.0
8000.0  13.0
9000.0  15.0
10000.0 17.0
11000.0 18.09
1.26e+8  18.09
1.261e+8 0.0
/
: elem1 elem2 inc  istyp
  1713 1716 1   31
:
: wing heater (inner) at 25.89 W/Relement
:
0.0     0.0
10.0     1.0
100.0    2.0
1000.0   3.0
2000.0   4.0
3000.0   6.0
4000.0   8.0
5000.0  10.0
6000.0  12.0
7000.0  15.0
8000.0  18.0
9000.0  21.0
10000.0 23.0
11000.0 25.89
1.26e+8  25.89
1.261e+8 0.0
/
: elem1 elem2 inc  istyp
  1717 1720 1   31
:
: wing heater (inner) at 35.67 W/element
:
0.0     0.0
10.0     1.0
100.0    2.0
1000.0   4.0
2000.0   6.0
3000.0   8.0
4000.0  11.0
5000.0  14.0
6000.0  17.0
7000.0  20.0
8000.0  23.0
9000.0  26.0
10000.0 29.0
11000.0 35.67
1.26e+8  35.67
1.261e+8 0.0
/
: elem1 elem2 inc  istyp
  1721 1724 1   31
:
: wing heater (inner) at 47.82 W/element
:
0.0     0.0
10.0     1.0
100.0    2.0
1000.0   4.0
2000.0   7.0
3000.0  10.0
4000.0  15.0
5000.0  20.0
6000.0  25.0
7000.0  30.0
8000.0  35.0
9000.0  40.0
10000.0 44.0
11000.0 47.82
1.26e+8  47.82
1.261e+8 0.0
/
: elem1 elem2 inc  istyp
  1697 1700 1   31
:
: wing heater (inner) at 63.95 W/element
:
0.0     0.0
10.0     1.0
100.0    5.0
1000.0  10.0
2000.0  15.0
3000.0  20.0
4000.0  25.0
5000.0  30.0
6000.0  35.0
7000.0  40.0
8000.0  45.0
9000.0  50.0
10000.0 60.0
11000.0 63.95
1.26e+8  63.28
1.261e+8 0.0
/
: elem1 elem2 inc  istyp
  1693 1696 1   31
:
: wing heater (inner) at 67.81 W/element
:
0.0     0.0
10.0     1.0
100.0    5.0
1000.0  10.0
2000.0  15.0
3000.0  20.0
4000.0  25.0
5000.0  30.0
6000.0  35.0
7000.0  40.0
8000.0  45.0
9000.0  50.0
10000.0 57.0
11000.0 67.81
1.26e+8  67.81
1.261e+8 0.0
/
: elem1 elem2 inc  istyp
  1689 1692 1   31
:
: wing heater (inner) at 41.73 W/element
:
0.0     0.0
10.0     1.0
100.0    2.0
1000.0   4.0
2000.0   6.0
3000.0   8.0
4000.0  11.0
5000.0  14.0
6000.0  17.0
7000.0  20.0
8000.0  25.0
9000.0  30.0
10000.0 35.0
11000.0 41.73
1.26e+8  41.73
1.261e+8 0.0
/
:
: elem1 elem2 inc  istyp
  1725 1728 1   31
:
: floor heater at 14.16 W/element
:
:
0.0     0.0
10.0     0.5
100.0    1.0
1000.0   1.5
2000.0   2.0
3000.0   2.5
4000.0   3.0
5000.0   3.5
6000.0   4.0
7000.0   4.5
8000.0   5.0
9000.0   5.5
10000.0  6.0
11000.0  7.0
12000.0  8.0
13000.0  9.0
14000.0 10.0
15000.0 11.0
15100.0 14.16
1.26e+8  14.16
1.261e+8 0.0
/
:
: elem1 elem2 inc  istyp
  1497 1500 1   31
:
: floor heater at 16.49 W/element
:
0.0     0.0
10.0     0.5
100.0    1.0
1000.0   1.5
2000.0   2.0
3000.0   3.0
4000.0   4.0
5000.0   5.0
6000.0   6.0
7000.0   7.0
8000.0   8.0
9000.0   9.0
10000.0 10.0
11000.0 11.0
12000.0 12.0
13000.0 13.0
14000.0 14.0
15000.0 15.0
15100.0 16.49
1.26e+8  16.49
1.261e+8 0.0
/
:
: elem1 elem2 inc  istyp
  1501 1504 1   31
:
: floor heater at 25.73 W/element
:
0.0     0.0
10.0     1.0
100.0    2.0
1000.0   3.0
2000.0   4.0
3000.0   5.0
4000.0   6.0
5000.0   7.0
6000.0   8.0
7000.0   9.0
8000.0  10.0
9000.0  11.0
10000.0 13.0
11000.0 15.0
12000.0 17.0
13000.0 19.0
14000.0 21.0
15000.0 23.0
15100.0 25.73
1.26e+8  25.73
1.261e+8 0.0
/
:
: elem1 elem2 inc  istyp
  1505 1508 1   31
:
```

3/8/00

```
: floor heater at 35.59
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  10.0
8000.0  12.0
9000.0  15.0
10000.0 18.0
11000.0 21.0
12000.0 24.0
13000.0 27.0
14000.0 30.0
15000.0 33.0
15100.0 35.59
1.26e+8 35.59
1.261e+8 0.0
/
:
: elem1 elem2 inc istyp
  1509 1512 1 31
:
: floor heater at 50.64 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  10.0
8000.0  13.0
9000.0  17.0
10000.0 21.0
11000.0 25.0
12000.0 30.0
13000.0 35.0
14000.0 40.0
15000.0 45.0
15100.0 50.64
1.26e+8 50.64
1.261e+8 0.0
/
:
: elem1 elem2 inc istyp
  1513 1516 1 31
:
: floor heater at 55.97 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  11.0
8000.0  15.0
9000.0  20.0
10000.0 25.0
11000.0 31.0
12000.0 37.0
13000.0 43.0
14000.0 49.0
15000.0 54.0
15100.0 55.97
1.26e+8 55.97
1.261e+8 0.0
/
:
: elem1 elem2 inc istyp
  1517 1520 1 31
:
: floor heater at 51.93 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  11.0
8000.0  15.0
9000.0  20.0
10000.0 25.0
11000.0 31.0
12000.0 37.0
13000.0 43.0
14000.0 49.0
15000.0 54.0
15100.0 51.93
1.26e+8 51.93
1.261e+8 0.0
/
:
: elem1 elem2 inc istyp
  1521 1524 1 31
:
: floor heater at 54.00 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  11.0
8000.0  15.0
9000.0  20.0
10000.0 26.0
11000.0 32.0
12000.0 38.0
13000.0 44.0
14000.0 50.0
15000.0 56.0
15100.0 54.00
1.26e+8 54.00
1.261e+8 0.0
/
:
: elem1 elem2 inc istyp
  1525 1528 1 31
:
: floor heater at 53.38 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  11.0
8000.0  15.0
9000.0  20.0
10000.0 25.0
11000.0 31.0
12000.0 37.0
13000.0 43.0
14000.0 49.0
15000.0 54.0
15100.0 53.38
1.26e+8 53.38
1.261e+8 0.0
/
: noskip
:
```



3/11/00 Started simulation to assess moisture loss out of drift through bulkhead.

Need to divide mass loss through bulkhead up for 36 drift wall elements. First determine what fraction each element is of entire volume of inner row of elements. Total volume of 36 elements is $4(2.0905\ m^3) = 8.242\ m^3$ from pg 99, volume of each element is also on pg 99. Multiply fraction by 2.2222e-4 kg/s

| | | |
|---|---|---|
| 1525-1528 | 3.7288 e-2 | 8.2861 e-6 kg/s |
| 1521-1524 | 3.7718 e-2 | 8.3818 e-6 |
| 1517-1520 | 3.6270 e-2 | 8.0600 e-6 |
| 1513-1516 | 3.9093 e-2 | 8.6873 e-6 |
| 1509-1512 | 3.5375 e-2 | 7.8611 e-6 |
| 1505-1508 | 2.4863 e-2 | 5.5251 e-6 |
| 1501-1504 | 1.7974 e-2 | 3.9942 e-6 |
| 1497-1500 | 1.1521 e-2 | 2.5602 e-6 |
| 1525-1528 | 9.89204 e-2 | 2.1982 e-6 |
| | fraction of total volume of inner ring of each element | for 800 ml/h mass loss through bulkhead. |

For 800 ml/hr = 0.8 l/hr = 2.2222e-4 l/s

$\frac{1\ kg}{l} \Rightarrow 2.2222e{-4}\ kg/s$

The mass loss calculations are printed & included on pg 108, taken from dst2d58.dat

 3/11/00 RH

```
:
: elem1 elem2 inc istyp
  1725 1728 1 31
:
: floor heater at 14.16 W/element and 2.1982e-6 kg/s mass removal
:
:
0.0 0.0
10.0 0.5
100.0 1.0
1000.0 1.5
2000.0 2.0
3000.0 2.5
4000.0 3.0
5000.0 3.5
6000.0 4.0
7000.0 4.5
8000.0 5.0
9000.0 5.5
10000.0 6.0
11000.0 7.0
12000.0 8.0
13000.0 9.0
14000.0 10.0
15000.0 13.0
15100.0 14.16 -2.1982e-6
1.26e+8 14.16 -2.1982e-6
1.261e+8 0.0 -2.1982e-6
/
:
: elem1 elem2 inc istyp
  1497 1500 1 31
:
: floor heater at 16.49 W/element and 2.5602e-6 mass removal
:
0.0 0.0
10.0 0.5
100.0 1.0
1000.0 1.5
2000.0 2.0
3000.0 3.0
4000.0 4.0
5000.0 5.0
6000.0 6.0
7000.0 7.0
8000.0 8.0
9000.0 9.0
10000.0 10.0
11000.0 11.0
12000.0 12.0
13000.0 13.0
14000.0 14.0
15000.0 15.0
15100.0 16.49 -2.5602e-6
1.26e+8 16.49 -2.5602e-6
1.261e+8 0.0 -2.5602e-6
/
:
: elem1 elem2 inc istyp
  1501 1504 1 31
:
: floor heater at 25.73 W/element and 3.9942e-6 mass removal
:
0.0 0.0
10.0 1.0
100.0 2.0
1000.0 3.0
2000.0 4.0
3000.0 5.0
4000.0 6.0
5000.0 7.0
6000.0 8.0
7000.0 9.0
8000.0 10.0
9000.0 11.0
10000.0 13.0
11000.0 15.0
12000.0 17.0
13000.0 19.0
14000.0 21.0
15000.0 23.0
15100.0 25.73 -3.9942e-6
1.26e+8 25.73 -3.9942e-6
1.261e+8 0.0 -3.9942e-6
/
```

A

A

```
:
: elem1 elem2 inc istyp
  1505 1508 1 31
:
: floor heater at 35.59 and 5.5251e-6 mass removal
:
0.0 0.0
10.0 1.0
100.0 2.0
1000.0 3.0
2000.0 4.0
3000.0 5.0
4000.0 6.0
5000.0 7.0
6000.0 8.0
7000.0 10.0
8000.0 12.0
9000.0 15.0
10000.0 18.0
11000.0 21.0
12000.0 24.0
13000.0 27.0
14000.0 30.0
15000.0 33.0
15100.0 35.59 -5.5251e-6
1.26e+8 35.59 -5.5251e-6
1.261e+8 0.0 -5.5251e-6
/
:
: elem1 elem2 inc istyp
  1509 1512 1 31
:
: floor heater at 50.64 W/element and 7.8611e-6 mass removal
:
0.0 0.0
10.0 1.0
100.0 2.0
1000.0 3.0
2000.0 4.0
3000.0 5.0
4000.0 6.0
5000.0 7.0
6000.0 8.0
7000.0 10.0
8000.0 13.0
9000.0 17.0
10000.0 21.0
11000.0 25.0
12000.0 30.0
13000.0 35.0
14000.0 40.0
15000.0 45.0
15100.0 50.64 -7.8611e-6
1.26e+8 50.64 -7.8611e-6
1.261e+8 0.0 7.8611e-6
/
:
: elem1 elem2 inc istyp
```

B

B

```
  1513 1516 1 31
:
: floor heater at 55.97 W/element and 8.6873e-6 mass removal
:
0.0 0.0
10.0 1.0
100.0 2.0
1000.0 3.0
2000.0 4.0
3000.0 5.0
4000.0 6.0
5000.0 7.0
6000.0 8.0
7000.0 11.0
8000.0 15.0
9000.0 20.0
10000.0 25.0
11000.0 31.0
12000.0 37.0
13000.0 43.0
14000.0 49.0
15000.0 54.0
15100.0 55.97 -8.6873e-6
1.26e+8 55.97 -8.6873e-6
1.261e+8 0.0 -8.6873e-6
/
:
: elem1 elem2 inc istyp
  1517 1520 1 31
:
: floor heater at 51.93 W/element and 8.0600e-6 mass removal
:
0.0 0.0
10.0 1.0
100.0 2.0
1000.0 3.0
2000.0 4.0
3000.0 5.0
4000.0 6.0
5000.0 7.0
6000.0 8.0
7000.0 11.0
8000.0 15.0
9000.0 20.0
10000.0 25.0
11000.0 31.0
12000.0 37.0
13000.0 43.0
14000.0 49.0
15000.0 54.0
15100.0 51.93 -8.0600e-6
1.26e+8 51.93 -8.0600e-6
1.261e+8 0.0 -8.0600e-6
/
:
: elem1 elem2 inc istyp
  1521 1524 1 31
:
: floor heater at 54.00 W/element and 8.3818e-6 mass removal
:
0.0 0.0
10.0 1.0
100.0 2.0
1000.0 3.0
2000.0 4.0
3000.0 5.0
4000.0 6.0
5000.0 7.0
6000.0 8.0
7000.0 11.0
8000.0 15.0
9000.0 20.0
10000.0 26.0
11000.0 32.0
12000.0 38.0
13000.0 44.0
14000.0 50.0
15000.0 52.0
15100.0 54.00 -8.3818e-6
1.26e+8 54.00 -8.3818e-6
1.261e+8 0.0 -8.3818e-6
/
:
: elem1 elem2 inc istyp
  1525 1528 1 31
:
: floor heater at 53.38 W/element and 8.2861e-6 mass removal
:
0.0 0.0
10.0 1.0
100.0 2.0
1000.0 3.0
2000.0 4.0
3000.0 5.0
4000.0 6.0
5000.0 7.0
6000.0 8.0
7000.0 11.0
8000.0 15.0
9000.0 20.0
10000.0 25.0
11000.0 31.0
12000.0 37.0
13000.0 43.0
14000.0 49.0
15000.0 52.0
15100.0 53.38 -8.2861e-6
1.26e+8 53.38 -8.2861e-6
1.261e+8 0.0 -8.2861e-6
/
: noskip
```

3/11/00 
RH

To get mass removal for 1600 ml/hr change SCALM from 1.0 to 2.0 likewise for 2400.0 ml/hr (SCALM = 3.0) and 3200 ml/hr (SCALM = 4.0)

Summary of relevant runs

dst2d51 infil @ 3.6 mm/yr (multi.bc → 9.206e-4)
vapor pressure lowering on, up to 1.727 yrs
on 3/11 @ 2:07pm in ~/dst_scans/new3-8/*
48 hrs + cpu

killed 3/11/00

dst2d54 infil @ 0.36 mm/yr (multi.bc → 9.206e-5)
vapor pressure lowering off, up to 0.257 yrs
on 3/11 @ 2:09pm in ~/dst_scans/new3-8/*
32 hrs + cpu

dst2d55 infil @ 3.6 mm/yr same as dst2d51
but vapor pressure lowering off, up to 0.253
32 hrs + cpu on 3/11 @ 2:13
~/dst_scans/new3-8

dst2d58 infil @ ~~3.6~~ 0.36 RH 3/11/00 mm/yr same as
dst2d54 but will new phik → 3 layers
vapor pressure lowering off
800 ml/hr removed ~/dst_scans/new3-10/*

dst2d59 infil @ 3.6mm/yr, vapor press lowering on
800 ml/hr removed ~/dst_scans/new3-11/*

Note 800ml/h is for all 47.5 m of heated drift, need to reduce by a factor of 47.5

dst2d60 same as dst2d59, but with
scalm = 2.1052 e-2 ~/dst_scans/new3-11/*

3/11/00

dst2d61 same as dst2d60 but with
scalm = 4.2105e-2 for 1600 ml/hr

dst2d62 same as dst2d60 but with
scalm = 6.318e-2 for 2400 ml/hr

dst2d63 same as dst2d60 but with
scalm = 8.42105e-2 for 3200 ml/hr

3/11/00 RR
Tables w/ properties used in the dst2d up to 63

Model property assignment

Property values for the three geomechanical units of primary interest to this modeling exercise (i.e., Tptpul, Tptpmn, and Tptpll) were taken from the TSPA-VA (TRW Environmental Safety Systems Inc. 1998a). The particular values from the TSPA-VA were taken from the TH hydrologic parameter set that was calibrated against the SHT. These values are summarized in Tables 1 to 3.

Table 1. Matrix hydraulic properties taken from TSPA-VA TH hydrologic parameter set that was calibrated against the SHT (TRW Environmental Safety Systems Inc. 1998a)]

| Unit | Porosity | Permeability ($m^2$) | α ($Pa^{-1}$) | m |
|---|---|---|---|---|
| Tptpul | 0.135 | 2.04e-17 | 6.21e-6 | 0.2479 |
| Tptpmn | 0.089 | 4.08e-18 | ~~1.16e-6~~ | 0.3212 |
| Tptpll | 0.115 | 2.22e-17 | 4.01e-6 | 0.1983 |

1.19e-6
RR
5/10/01

Table 2. Fracture hydraulic properties taken from TSPA-VA TH hydrologic parameter set that was calibrated against the SHT (TRW Environmental Safety Systems Inc. 1998a)

| Unit | Porosity | Permeability x ($m^2$) | Permeability y ($m^2$) | Permeability z ($m^2$) | α ($Pa^{-1}$) | m |
|---|---|---|---|---|---|---|
| Tptpul | 1.05e-4 | 8.49e-9 | 8.49e-9 | 2.50e-7 | 1.73e-3 | 0.667 |
| Tptpmn | 1.24e-4 | 3.44e-9 | 3.44e-9 | 5.45e-8 | 9.34e-4 | 0.643 |
| Tptpll | 3.29e-4 | 2.77e-9 | 2.77e-9 | 1.16e-8 | 1.26e-3 | 0.667 |

Table 3. Matrix thermal and physical properties [taken from TSPA-VA (TRW Environmental Safety Systems Inc. 1998a)]

| Unit | Thermal Conductivity-Wet (J/s/m-K) | Thermal Conductivity-Dry (J/s/m-K) | Rock Specific Heat (J/kg-K) | Rock Density ($kg/m^3$) |
|---|---|---|---|---|
| Tptpul | 1.80 | 0.71 | 883 | 2510 |
| Tptpmn | 2.33 | 1.56 | 948 | 2530 |
| Tptpll | 2.02 | 1.20 | 900 | 2540 |

This is typical of these runs:
/home/rgreen/dst_scans/cleaner/ex/dst15a.dat



5/12/00 RR
Update of MULTIFLO DST Runs

for infiltration in bcon_a, need the following for infiltration into the Tptpul w/ fracture porosity of 1.05e-4 (see pg 99)

$3.6\ mm/yr \Rightarrow \frac{1.1416e-7}{1.05e-4} = 1.087e-3$

Run different steady state simulations to check effect of different infiltration rates and xlm block size

5/17/00 RR
Following are the base case runs with variable block sizes. Note that vapor pressure lowering is 'on' for all runs. The new areamodf formulation is used. Infiltration is 3.6 mm/yr. Top B.C. is a type 5.

```
DCM model of Drift-Scale heater test, 2D
May 15, 2000
: dst15a.dat
:

: dst1 started with dst2d58, turned off heat, new segmt with very small segmts removed
: dst3 same as dst1 but with xlm, ylm, zlm inc from 0.5 to 3.0, no heat, new areamodf
: dst5 same as dst3, but some question on dst3 input files, repeat, no heat
: dst11 newer input, hopefully without segmt problems
: dst13 same as dst11 but with 3 layer dcm
: dst14 with IC from dst13, no mass loss, heat on
: dst15 3 layer phik, heat off, xlm reduced from 3.0 to 1.0
: dst15a same as dst15, but with vapor pressure lowering on
:
RSTART 0
:
:grid geometry    nx  ny nz ivplwr ipvcal iout  gravity pref tref  href
Grid  DCMUNST     1744 1 1    1     3    0       0    0
:
: ************************************************************
: i = sequential number of material types
: type = the characteristic curves (Van-Gen, Linear, tabular, and corey)
: swirm = irreducible liquid saturation for the matrix
: rpmm = Van Genuchten parameter for matrix
: alpham = Van Genuchten parameter for matrix
: swext = liquid saturation below which the capillary pressure is calculated based
:        on the slope dPcw/dSw evaluated at SWEXT.
: sgc = residual (immobile) gas saturation, fraction
: iecm = Equivalent Continuum Model (ECM) formulation (0 do not invoke, 1 invoke, 2 ECM with
tables)
```

older comments removed

 RH
5/17/00

```
: swirf = residual liquid saturation for fracture, fraction
: alphaf = parameter in Van-Genuchten equation for fracture (1/Pa)
: phim = matrix porosity (fraction)
: phif = fracture porosity (fraction)
: permm = intinsic matrix permeability (m^2)
: permf = intrinsic fracture permeability
:
Pckr                    :relative perm and pc keyword
:  i type-curv   swirm  rpmm(lamda) alpham     swext  sgc      iecm
:
: (TSw34 - matrix)
  1 Van-Gen    0.18   0.3212     1.19e-6   -1.0e+8  0.0     0

:
: (TSw34 - fracture)
  2 Van-Gen    0.01   0.643      9.34e-4   -0.0e+8  0.0     0
:
: (TSw33 - matrix)
  3 Van-Gen    0.06   0.2479     6.21e-6   -1.0e+8  0.0     0
:
: (TSw33 - fracture)
  4 Van-Gen    0.01   0.667      1.73e-3   -0.0e+8  0.0     0
:
: (TSw35 - matrix)
  5 Van-Gen    0.08   0.1983     4.01e-6   -1.0e+8  0.0     0
:
: (TSw35 - fracture)
  6 Van-Gen    0.01   0.667      1.26e-3   -0.0e+8  0.0     0
:
  7 TABular  0.01  0.  0.  0.  0.  0
             .0000  .000E+00  1.000E+00  0
             .0100  .000E+00  1.000E+00  0
             .0500  1.031E-05  1.000E+00  0
             .1000  1.579E-04  9.998E-01  0
             .1500  7.021E-04  9.993E-01  0
             .2000  1.978E-03  9.980E-01  0
             .2500  4.387E-03  9.956E-01  0
             .3000  8.397E-03  9.916E-01  0
             .3500  1.455E-02  9.855E-01  0
             .4000  2.346E-02  9.765E-01  0
             .4500  3.584E-02  9.642E-01  0
             .5000  5.253E-02  9.475E-01  0
             .5500  7.449E-02  9.255E-01  0
             .6000  1.029E-01  8.971E-01  0
             .6500  1.391E-01  8.609E-01  0
             .7000  1.850E-01  8.150E-01  0
             .7500  2.428E-01  7.572E-01  0
             .8000  3.155E-01  6.845E-01  0
             .8500  4.080E-01  5.920E-01  0
             .9000  5.278E-01  4.722E-01  0
             .9500  6.916E-01  3.084E-01  0
 /
 0
 : ***************
 :  Debug options
 : ***************
 : Debug  1
 : 0

:
: ********************
:  Thermal properties
: ********************
: no = sequential number of data set
: rho = rock density (kg/m^3)
: cpr = rock specific heat (J/kg-K)
: ckdry = thermal conductivity of dry rock (J/s/m-K)
: cksat = thermal conductivity of liquid saturated rock (J/s/m-K)
: crp = pore compressibility with pressure at constant T (1/Pa)
: crt = absolute value of pore compressibility with pressure at constant T (1/Pa)
: tau = tortuosity for binary diffusion
: cdiff = vapor-dir diffusion coefficient, (m^2/s)
: cexp = exponent for binary diffusion
: enbd = enhanced binary diffusion coefficient
```


RH
5/17/00

```
:
Thermal-prop
: no rho       cpr   ckdry cksat   crp  crt   tau  cdiff   cexp  enbd
 1 2.530e+03  948    1.56  2.33    0    0    .5  2.13e-5  1.8   0.   :TSw34-matrix
 2 2.510e+03  883    0.71  1.80    0    0    .5  2.13e-5  1.8   0.   :TSw33-matrix
 3 2.540e+03  900    1.20  2.02    0    0    .5  2.13e-5  1.8   0.   :TSw35-matrix
0
:
: fracture permeabilities modified from Buscheck by dividing by fracture porosity
:
PHIK multi
:
CONN multi
:
: skip
Init
:
: elem1 elemn   inc  p            t        sg        xg2       pm          tm          sgm   xgm
 1    1744    1    9.33812e+04  22.0000  9.7155e-01 0.000e+00  9.3346e+04 1.8069e+01  0.1   0.0
:
0
: noskip
: Init dst13
:
```

Same as fracture porosity

```
DCMPARA
: elem1 elemn inc  volf    areamodf xlm  ylm  zlm
1    1744 1 1.24e-4 1.0 1.0 1.0 1.0 1.23e-3 : TSw34
1265 1390 1 1.05e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw33
1433 1446 1 1.05e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw33
847  848  1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
851  852  1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
855  856  1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
875  876  1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
879  880  1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1051 1052 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1055 1056 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1187 1188 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1191 1192 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1195 1196 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1199 1200 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1203 1204 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1207 1208 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1211 1212 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1215 1216 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1219 1220 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1223 1224 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1227 1228 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1231 1232 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1235 1236 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1239 1240 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1243 1244 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1247 1248 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1251 1252 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1255 1256 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1259 1260 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1263 1264 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1267 1268 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1271 1272 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1275 1276 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1279 1280 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1283 1284 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1287 1288 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1291 1292 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1295 1296 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1299 1300 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1303 1304 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1307 1308 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1311 1312 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1315 1316 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1319 1320 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1323 1324 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1327 1328 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1331 1332 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1335 1336 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1339 1340 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
```

```
1343 1344 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1347 1348 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1351 1352 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1355 1356 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1359 1360 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1363 1364 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1367 1368 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1371 1372 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1375 1376 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1379 1380 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1383 1384 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1387 1388 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1391 1392 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1395 1396 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1399 1400 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1403 1404 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1423 1424 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1427 1428 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1431 1432 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1435 1436 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1439 1440 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1443 1444 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
1447 1448 1 3.29e-4 1.0 1.0 1.0 1.0 5.00e-4 : TSw35
0
:
Recurrent
:
BCON 20 multi
:
skip
Source 21  1.0  0.0
: elem1 elem2 inc  istyp
  1681  1684  1   31
```

```
5 3 1265 1265 1 8.771 13.59 8.771
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 9.20600e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
5 3 1266 1266 1 8.771 13.59 8.771
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 9.20600e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
5 3 1267 1267 1 8.771 13.59 -8.771
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
1 3 1268 1268 1 8.771 13.59 -8.771
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
5 3 1269 1269 1 8.812 15.79 8.812
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 9.20600e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
5 3 1270 1270 1 8.812 15.79 8.812
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 9.20600e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
1 3 1271 1271 1 8.812 15.79 -8.812
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
1 3 1272 1272 1 8.812 15.79 -8.812
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
5 3 1273 1273 1 8.94 17.61 8.94
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 9.20600e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
```

this is the multi-bc used in the dst15a - dst15i series

all are type 5 upper B.C.



```
.
5 3 1274 1274 1 8.94 17.61 8.94
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 9.20600e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
1 3 1275 1275 1 8.94 17.61 -8.94
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
1 3 1276 1276 1 8.94 17.61 -8.94

0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
5 3 1277 1277 1 8.812 15.56 8.812
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 9.20600e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
5 3 1278 1278 1 8.812 15.56 8.812
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 9.20600e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
1 3 1279 1279 1 8.812 15.56 -8.812
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
1 3 1280 1280 1 8.812 15.56 -8.812
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
5 3 1281 1281 1 8.968 17.05 8.968
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 9.20600e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
5 3 1282 1282 1 8.968 17.05 8.968
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 9.20600e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
1 3 1283 1283 1 8.968 17.05 -8.968
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
1 3 1284 1284 1 8.968 17.05 -8.968
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
```

Following are input files for 3.6mm/yr; vapor press on, type 5 BC
this is for element 1101 located at (1.091, 8.947)

| | x/m | mat sat | fract sat | |
|---|---|---|---|---|
| dst15a.dat | 1.0 | 98.767 | 4.57e-2 | *100 |
| dst15b.dat | 0.5 | 99.774 | 4.10e-2 | |
| dst15c.dat | 3.0 | 95.412 | 4.636e-2 | |
| ~~dst15d.dat~~ | ~~2.0~~ RH 5/17/00 | | | |
| dst15e.dat | ~~1.5~~ 2.0 | 96.823 | 4.619e-2 | |
| dst15F.dat RH 5/17/00 | ~~4.0~~ 1.5 | 97.730 | 4.602e-2 | |
| dst15g.dat | ~~5.0~~ 4.0 | 94.286 | 4.645e-2 | |
| dst15h.dat | ~~10.0~~ 5.0 | 93.436 | 4.649e-2 | |
| dst15i.dat | ~~0.25~~ 10.0 | 90.961 | 4.657e-2 | |
| dst15j.dat | 0.25 RH 5/17/00 | 99.97 ~~99.691~~ | 2.593e-2 | |
| dst15k.dat | 20.0 | 89.531 | 4.655e-2 | |
| dst24.dat | 7.2 | 92.142 | 4.640e-2 | |

also on zip
dst model 1/31/00

phik_a data set used in dst15* runs
/home/vgreen/dst_scans/decovalex/phik_a

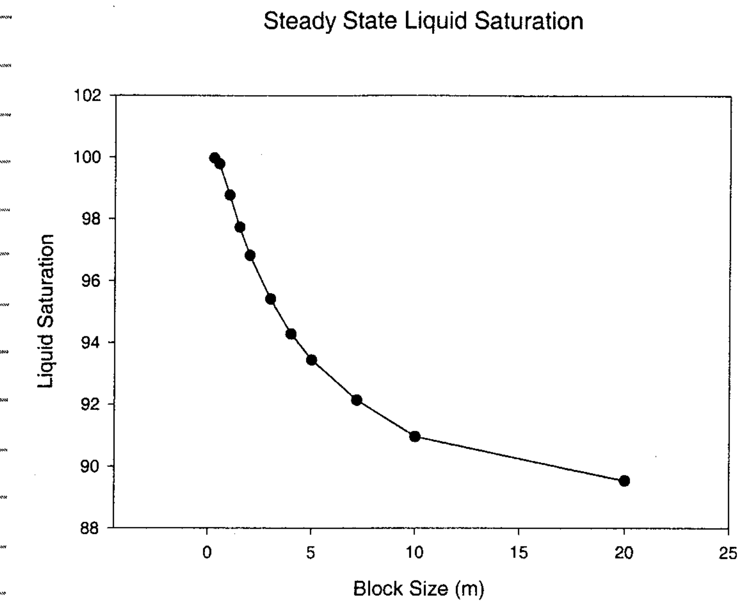
5/18/00
RH

```
1 1744 2 1  1.00 3.44e-09 3.44e-09 5.45e-08
 0.089 4.08e-18  1 1  :TSW34
1265 1390 4 2  1.00 8.49e-09 8.49e-09 2.50e-07
 0.135 2.04e-17  3 2  :TSW33
1433 1446 4 2  1.00 8.49e-09 8.49e-09 2.50e-07
 0.135 2.04e-17  3 2  :TSW33
847  848  6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
851  852  6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
855  856  6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
875  876  6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
879  880  6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1051 1052 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1055 1056 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1187 1188 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1191 1192 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1195 1196 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1199 1200 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1203 1204 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1207 1208 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1211 1212 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1215 1216 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1219 1220 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1223 1224 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1227 1228 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1231 1232 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1235 1236 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1239 1240 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1243 1244 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1247 1248 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1251 1252 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1255 1256 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1259 1260 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1263 1264 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1267 1268 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1271 1272 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1275 1276 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1279 1280 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1283 1284 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1287 1288 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1291 1292 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1295 1296 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1299 1300 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1303 1304 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1307 1308 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1311 1312 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1315 1316 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1319 1320 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1323 1324 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1327 1328 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1331 1332 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1335 1336 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1339 1340 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1343 1344 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1347 1348 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1351 1352 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1355 1356 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1359 1360 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1363 1364 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1367 1368 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1371 1372 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1375 1376 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1379 1380 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1383 1384 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1387 1388 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1391 1392 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1395 1396 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1399 1400 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1403 1404 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1423 1424 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1427 1428 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1431 1432 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1435 1436 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1439 1440 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1443 1444 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
1447 1448 6 3  1.00 2.77e-09 2.77e-09 1.16e-08
 0.115 2.22e-17  5 3  :TSW35
```

These values are from TSPA-VA TBD thermohydrology data set



5/18/00
RH




infil = 14.4 mm/yr

plot of steady state saturation at element 1101 (1.091, 8.947) located in the Tptpmn above the heater drift as a function of block size (x/m, y/m, z/m)

dst24a.dat    vap press lowering on,    x/m = 7.2
infiltration = 14.4 mm/y

1101    mat sat 92.126    fract sat 5.76

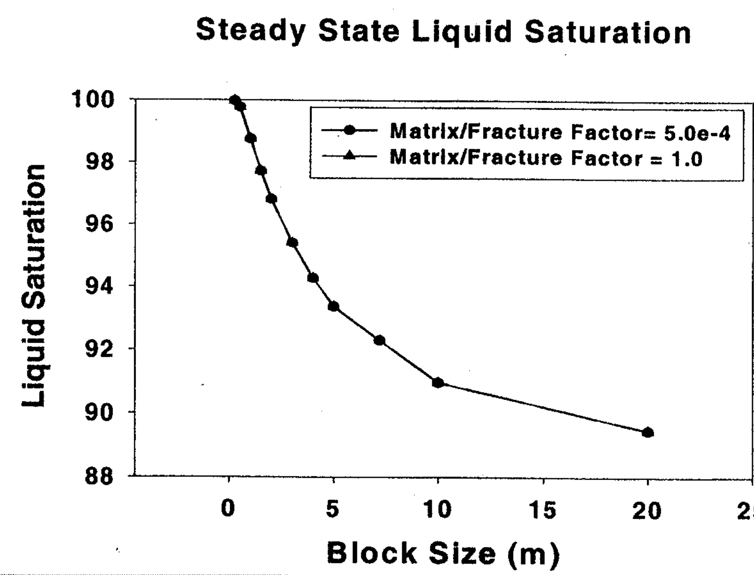
dst24b.dat    vap press lowering on,    x/m = 7.2
infiltration = 3.6 mm/y    ,    areamodf = 1.0

1101 mat sat 92.388    fract sat 4.64

Ambient Saturation - Block Size

6/20/00
RF

these values are for element 1101, located directly above drift crown at (1.091, 8.947)




graph is located in Vulcan /home/rgreen/dst_scans/decovalex/ ss-sat.jnb

This is same graph as pg 117 but also has results of similar runs but w/ areamodF = ~~5.0~~ 1.0 RF 6/20/00

MULTIFLO runs to get steady state saturation for areamodF = 1.0 for the various block sizes can be found in vulcan: /home/rgreen/dst_scans/decovalex/dec7.2/areamodF/* and in directory /areamodF on zip dst model 1/31/00 rgreen

| | |
|---|---|
| dst30a-025.dat | xlm = 0.25 |
| dst30a-05.dat | xlm = 0.5 |
| dst30a-1.dat | xlm = 1.0 |
| dst3-a-1-5.dat | xlm = 1.5 |
| dst30a-2.dat | xlm = 2.0 |
| dst30a-3.dat | xlm = 3.0 |
| dst30a-4.dat | xlm = 4.0 |
| dst-30a-5.dat | xlm = 5.0 |
| dst-30d.dat | xlm = 7.2 |
| dst-30a-10.dat | xlm = 10.0 |
| dst-30a-20.dat | xlm = 20.0 |

fracture sats for all are 9.53e-1 (liq sat = 4.7e-2)

/home/rgreen/dst_scans/decovalex/dec7.2/dst28/dst28.dat
also on zip dst model 1/31/00



6/20/00
RF

except 0.25 & 0.5 which is about 9.59e-1

With xlm = 7.2 m & infiltration of 3.6 mm/yr, all results were similar → large heat pipe in terms of temperature. Example is dst28.dat

Also dst28 has mass loss of 3200 ml/hr

```
     DCM model of Drift-Scale heater test, 2D
     May 31, 2000
: dst28.dat
:
: heat was turned on
: Infiltration rate = 3.6 mm/yr.
: dst1 started with dst2d58, turned off heat, new segmt with very small se
removed
: dst3 same as dst1 but with xlm, ylm, zlm inc from 0.5 to 3.0, no heat, n
areamodf
: dst5 same as dst3, but some question on dst3 input files, repeat, no hea
: dst11 newer input, hopefully without segmt problems
: dst13 same as dst11 but with 3 layer dcm
: dst14 with IC from dst13, no mass loss, heat on
: dst15 3 layer phik, heat off, xlm reduced from 3.0 to 1.0
: dst15b, same as dst15a or dst15 w/ vap press low on, xlm to 0.5, same as
dst2d50
: dst1bc, same as dt15b, xlm = 3.0
: dst24, same as dst15c, xlm = 7.2
: dst25, w/heat, dst24.int
: dst28, same as dst25, but with Time = 1.9, mass loss at 3200ml/hr
:
RSTART  0
:
:grid  geometry       nx   ny nz ivplwr ipvcal iout  gravity pref tref  hre
Grid   DCMUNST        1744 1  1  1      1      3      0       0    0
:
: *****************************************************************
: i = sequential number of material types
: type = the characteristic curves (Van-Gen, Linear, tabular, and corey)
: swirm = irreducible liquid saturation for the matrix
: rpmm = Van Genuchten parameter for matrix
: alpham = Van Genuchten parameter for matrix
: swext = liquid saturation below which the capillary pressure is calculat
based
:        on the slope dPcw/dSw evaluated at SWEXT.
: sgc = residual (immobile) gas saturation, fraction
: iecm = Equivalent Continuum Model (ECM) formulation (0 do not invoke, 1
invoke, 2 ECM with tables)
: swirf = residual liquid saturation for fracture, fraction
: alphaf = parameter in Van-Genuchten equation for fracture (1/Pa)
: phim = matrix porosity (fraction)
: phif = fracture porosity (fraction)
: permm = intinsic matrix permeability (m^2)
: permf = intrinsic fracture permeability
:
Pckr                              :relative perm and pc keyword
:   i  type-curv    swirm   rpmm(lamda) alpham      swext    sgc      iecm
:
: (TSw34 - matrix)
   1  Van-Gen      0.18    0.3212      1.19e-6    -1.0e+8   0.0      0
:
: (TSw34 - fracture)
   2  Van-Gen      0.01    0.643       9.34e-4    -0.0e+8   0.0      0
:
: (TSw33 - matrix)
   3  Van-Gen      0.06    0.2479      6.21e-6    -1.0e+8   0.0      0
```

6/20/60

```
:
: (TSw33 - fracture)
  4  Van-Gen      0.01     0.667       1.73e-3     -0.0e+8   0.0       0
:
: (TSw35 - matrix)
  5  Van-Gen      0.08     0.1983      4.01e-6     -1.0e+8   0.0       0
:
: (TSw35 - fracture)
  6  Van-Gen      0.01     0.667       1.26e-3     -0.0e+8   0.0       0
:
  7 TABular  0.01  0.  0.  0.  0.  0
                        .0000   .000E+00  1.000E+00  0
                        .0100   .000E+00  1.000E+00  0
                        .0500  1.031E-05  1.000E+00  0
                        .1000  1.579E-04  9.998E-01  0
                        .1500  7.021E-04  9.993E-01  0
                        .2000  1.978E-03  9.980E-01  0
                        .2500  4.387E-03  9.956E-01  0
                        .3000  8.397E-03  9.916E-01  0
                        .3500  1.455E-02  9.855E-01  0
                        .4000  2.346E-02  9.765E-01  0
                        .4500  3.584E-02  9.642E-01  0
                        .5000  5.253E-02  9.475E-01  0
                        .5500  7.449E-02  9.255E-01  0
                        .6000  1.029E-01  8.971E-01  0
                        .6500  1.391E-01  8.609E-01  0
                        .7000  1.850E-01  8.150E-01  0
                        .7500  2.428E-01  7.572E-01  0
                        .8000  3.155E-01  6.845E-01  0
                        .8500  4.080E-01  5.920E-01  0
                        .9000  5.278E-01  4.722E-01  0
                        .9500  6.916E-01  3.084E-01  0
/
0
: ***************
:  Debug options
: ***************
: Debug  1
: 0
:
: ********************
:  Thermal properties
: ********************
: no = sequential number of data set
: rho = rock density (kg/m^3)
: cpr = rock specific heat (J/kg-K)
: ckdry = thermal conductivity of dry rock (J/s/m-K)
: cksat = thermal conductivity of liquid saturated rock (J/s/m-K)
: crp = pore compressibility with pressure at constant T (1/Pa)
: crt = absolute value of pore compressibility with pressure at constant T
(1/Pa)
: tau = tortuosity for binary diffusion
: cdiff = vapor-dir diffusion coefficient, (m^2/s)
: cexp = exponent for binary diffusion
: enbd = enhanced binary diffusion coefficient
:
Thermal-prop

: no rho        cpr     ckdry  cksat    crp  crt    tau  cdiff    cexp  enbd
  1 2.530e+03  948     1.56   2.33     0    0      .5  2.13e-5  1.8   0.
:TSw34-matrix
  2 2.510e+03  883     0.71   1.80     0    0      .5  2.13e-5  1.8   0.
:TSw33-matrix
  3 2.540e+03  900     1.20   2.02     0    0      .5  2.13e-5  1.8   0.
:TSw35-matrix
0
:
: fracture permeabilities modified from Buscheck by dividing by fracture
porosity
:
PHIK multi
:
CONN multi
:
skip
Init
:
: elem1 elemn    inc   p               t          sg          xg2         pm
tm           sgm   xgm
 1     1744      1     9.33812e+04  22.0000   9.7155e-01 0.000e+00  9.3346e
1.8069e+01  0.1    0.0
:
0
noskip
Init dst24
:
```



6/20/60

```
DCMPARA
: eleml elemn inc  volf     areamodf  xlm  ylm  zlm
1    1744 1 1.24e-4 1.0 7.2 7.2 7.2 1.23e-3 : TSw34
1265 1390 1 1.05e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw33
1433 1446 1 1.05e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw33
847  848  1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
851  852  1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
855  856  1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
875  876  1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
879  880  1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1051 1052 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1055 1056 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1187 1188 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1191 1192 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1195 1196 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1199 1200 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1203 1204 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1207 1208 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1211 1212 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1215 1216 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1219 1220 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1223 1224 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1227 1228 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1231 1232 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1235 1236 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1239 1240 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1243 1244 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1247 1248 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1251 1252 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35

1255 1256 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1259 1260 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1263 1264 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1267 1268 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1271 1272 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1275 1276 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1279 1280 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1283 1284 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1287 1288 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1291 1292 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1295 1296 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1299 1300 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1303 1304 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1307 1308 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1311 1312 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1315 1316 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1319 1320 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1323 1324 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1327 1328 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1331 1332 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1335 1336 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1339 1340 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1343 1344 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1347 1348 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1351 1352 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1355 1356 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1359 1360 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1363 1364 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1367 1368 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1371 1372 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1375 1376 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1379 1380 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1383 1384 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1387 1388 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1391 1392 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1395 1396 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1399 1400 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1403 1404 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1423 1424 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1427 1428 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1431 1432 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1435 1436 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1439 1440 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1443 1444 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
1447 1448 1 3.29e-4 1.0 7.2 7.2 7.2 5.00e-4 : TSw35
0
:
Recurrent
:
BCON 20 multi
:
:  skip
Source  21   1.0  4.0
:  elem1 elem2 inc  istyp
   1681  1684  1     31
:
: wing heater (outer) at 51.14 W/element
```

 RH
6/20/00

```
:
0.0        0.0
10.0       1.0
100.0      2.0
1000.0     3.0
2000.0     4.0
3000.0     5.0
4000.0     6.0
5000.0     8.0
6000.0    10.0
7000.0    13.0
8000.0    16.0
9000.0    20.0
10000.0   25.0
11000.0   30.0
12000.0   35.0
13000.0   40.0
14000.0   45.0
15000.0   50.0
15100.0   51.14
1.26e+8   51.14
1.261e+8  0.0
/
:  elem1 elem2 inc 1   31
:
: floor heater at 14.16 W/element and 2.1982e-6 kg/s mass removal
:

0.0        0.0
10.0       0.5
100.0      1.0
1000.0     1.5
2000.0     2.0
3000.0     2.5
4000.0     3.0
5000.0 .   3.5
6000.0     4.0
7000.0     4.5
8000.0     5.0
9000.0     5.5
10000.0    6.0
11000.0    7.0
12000.0    8.0
13000.0    9.0
14000.0   10.0
15000.0   13.0
15100.0   14.16 -2.1982e-6
1.26e+8   14.16 -2.1982e-6
1.261e+8  0.0 -2.1982e-6
/
:
:  elem1 elem2 inc istyp
   1497  1500  1   31
:
: floor heater at 16.49 W/element and 2.5602e-6 mass removal
:
0.0        0.0
10.0       0.5
100.0      1.0
/
: noskip
:
Output C=-10 Q=-10 T=1 G=1 P=1
:
:  isolv  newtnmn  newtnmx  north  nitmax  level
Solve 4      2        12       2     100      1
:
:AUTO-step  DPMXE    DSMXE  DTMPMXE  DP2MXe TACCEL   IAUTODT  FAC1
AUTO-step   5.0E+3   0.04    2.       5.e4  1.0e-3      0       0
:
:TOLR TOLP  TOLS  TOLT  TOLP2  TOLM  TOLA  TOLE rtwotol  rmxtol  smxtol
Tolr   1.0e1 1.e-4 1.e-3 1.0el 1.e-4 1.e-5 1.e-4 1e-12 1e-12 1e-12
:
:Limit dpmx    dsmx dtmpmx dpamx    dtmn    dtmx   dtfac
LIMIT  2.7e+4    .1    5.  3.e+5    1.e-8  1.e5   .334
:
RSTArt 1
:
Plots 1 0 4
1525  1645  1265 1677
Time[y] 1.0
Time[y] 1.9
Time[y] 2.0
Time[y] 3.0
: Time[y] 4.0
: Time[y] 5.0
: Time[y] 6.0
: Time[y] 7.0
: Time[y] 8.0
:
STEADY[y] 1.0E-6 1.0E-07 1.0E-8
:
Ends
```


6/20/00
RH

Temperature for profile above drift plotted

149
153
157
161
165
169
173
1097
1101
1105
1109
1113
1117
1185
1189
1265
1285
1305
1325
1345
1369
1525
1529
1589

bore158

These are element locations above drift used for profiles: in ~~/home/dst_scans~~ RH 6/20/00 /home/rgreen/dst_scans/decovalex/plots/profile_pts

this is profile_pts

data are stripped from *.xyp files using plotF* , file eleme has to be present ~~w/ the profile.pts file~~. The *.xyp is read in after typing plotF

not needed here 6/20/00 RH

```
      character filen*64
      integer nodes(100)
      open(unit=28,file='profile.pts')
      j=1
      do while(.true.)
         read(28,*,end=9) nodes(j)
c         print*,nodes(j)
         j=j+1
      enddo
 9    continue
      j=j-1
      write(*,*) 'filename ?'
      read(*,'(A)') filen
      open(unit=29,file=filen)
      open(unit=30,file='vertprof.dat')
      i=1
      n=0
      do while(.true.)
         n=n+1
         read(29,*,end=11) x,z,pres,temp,sat,pc,rh
         if(nodes(i).eq.n)then
            write(30,*)x,z,pres,temp,sat,pc,rh
            i=i+1
         endif
      enddo
 11   continue
      close(29)
      close(30)
      end
```

this is vertprof, ~~not plotF~~ see next pg

RH 6/20/00

plotF.F written by Debra Hughson vulcan in ~/plots/

This gives output file called plotF.dat

6/20/00
RJT

Use vertprof.F to strip only those pts needed for profile, requires profile.pts, need to type in plotf.dat

```
      character filen*64,trash*64
      parameter(max=50000)
      real x(max),z(max)
      open(unit=29,file='eleme')
      read(29,'(A)') trash
      i=1
      do while(.true.)
         read(29,5,end=11) trash,x(i),z(i),skip1
c         write(*,*)i, x(i),z(i)
         i=i+1
      enddo
 11   continue
 5    format(a45,f15.3,f11.3,f10.3)
      i=i-2
      close(29)
      write(*,*) i ,' nodes'
      write(*,*) 'file to be plotted'
      read(*,*) filen
      open(unit=30,file=filen)
      open(unit=31,file='plotf.dat')
      read(30,*) filen
      read(30,*) filen
      slmax=0.
      do n=1,i
        read(30,*) skip,press,temp,sl,sg,xairl,xairg,pcap,rh,psat,rhol
     c,rhog,por
        if(sl.gt.slmax)then
           slmax=sl
           nodeslmax=n
        endif
         write(31,*) x(n),z(n),press,temp,sl,pcap,rh
      enddo
      write(*,*)'Maximum saturation ',slmax,' at node ',nodeslmax
      close(30)
      close(31)
      end
```

vertprof.F
written by
Debra Hughson ~
~/plots/*

output is in
vertprof.dat

This is plotf.F not vertprof.F see previous pg RJT 6/20/00

Data in vertprof.dat are not in numerically ascending order. Must port to excel & sort! Resulting data can be plotted versus observed if desirable

Data for vertical profile above drift crown can be taken from Borehole 158, for example. Recorded data for borehole provided by Debra Hughson, put into 158at1yr.dat and 158at1_9yr.dat

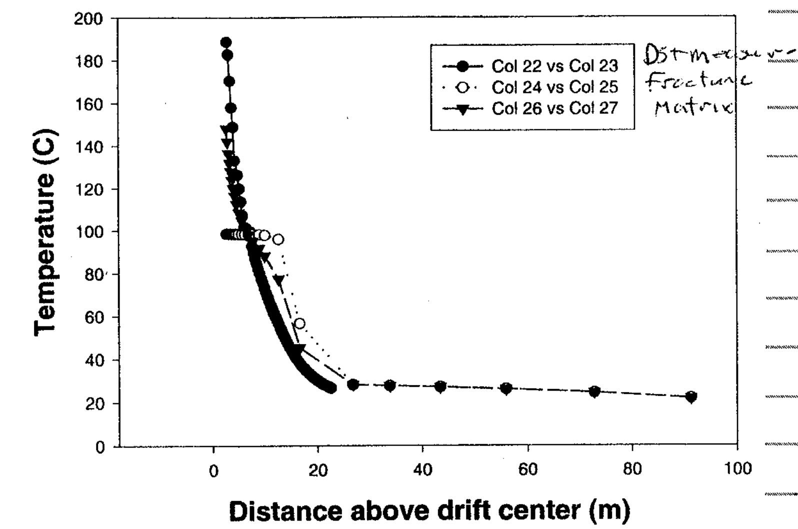
These are plotted versus dst28.dat



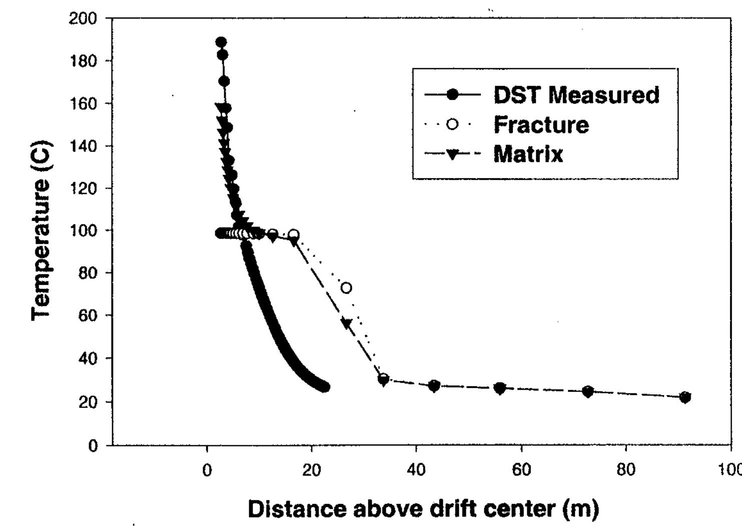
6/20/00
RJT

Results for dst 28 versus DST observed at 1.0 & 1.9 yrs.

1.0 year

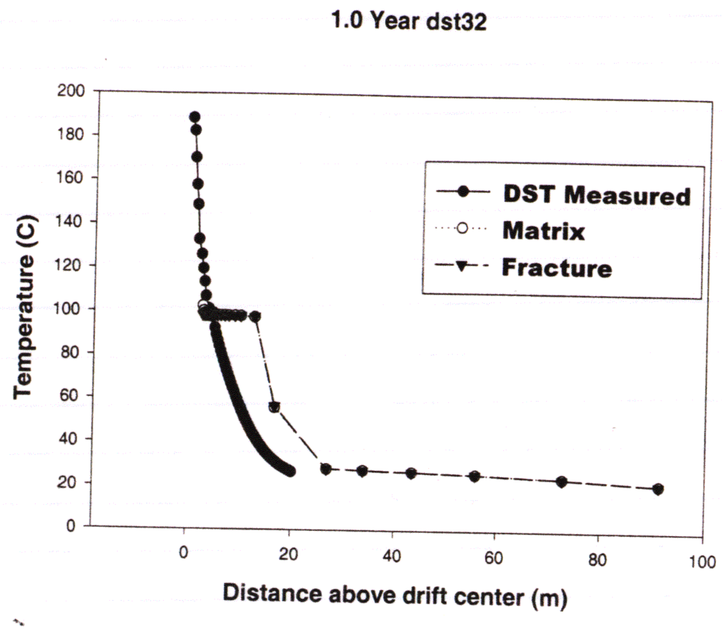



1.9 years




all results are similar →
dst28.dat xlm = 7.2, areamodF = 5e-4, no mass loss
dst30.dat xlm = 7.2, areamodF = 1.0, no mass loss
dst31.dat xlm = 7.2, areamodF = 1.0, 3200ml/hr loss
all copied on dst model 1/31/00 rgreen zip
→ large heat pipe → attributed to large block size

6/20/00
RJJ




This is for dst32.dat xl/m = 1.0, areamodf = 5e-4

on zip dstmodel 1/31/00 ~/decovalex/dst32

dst33.dat is xl/m = 1.0, areamodf = 1.0
ran to steady state, saturation @ 1101 is 98.89 %

7/6/00
RJJ

Problems have been encountered with simulations with smaller block sizes, no success in getting block size to xl/m of 1.0 or 2.0 with either areamodf of 1.0 or 5e-4 (for fracture → matrix mass flow)

Contacted Mohan Seth. He believes problem is with elements becoming fully saturated (i.e. 1D not 2D) and is looking into the problem/fix.

tried to reduce tolerances (from 1.0e-7 to 1.0e-5) but didn't resolve problem (i.e. see dst34.dat
/home/rgreen/dst_scans/decovalex/xl/m1.0/dst34
& on zip rgreen dst models 1/31/00



7/6/00

Increasing block size to 2.0 m in dst35.dat did not help - model still fails about 0.38-0.42 years into simulation.

The actual heater loads for the DST have been less than the design heat loads. Below is a chart of the first 700 days of heating (taken from the 4th Thermal Test Progress Report

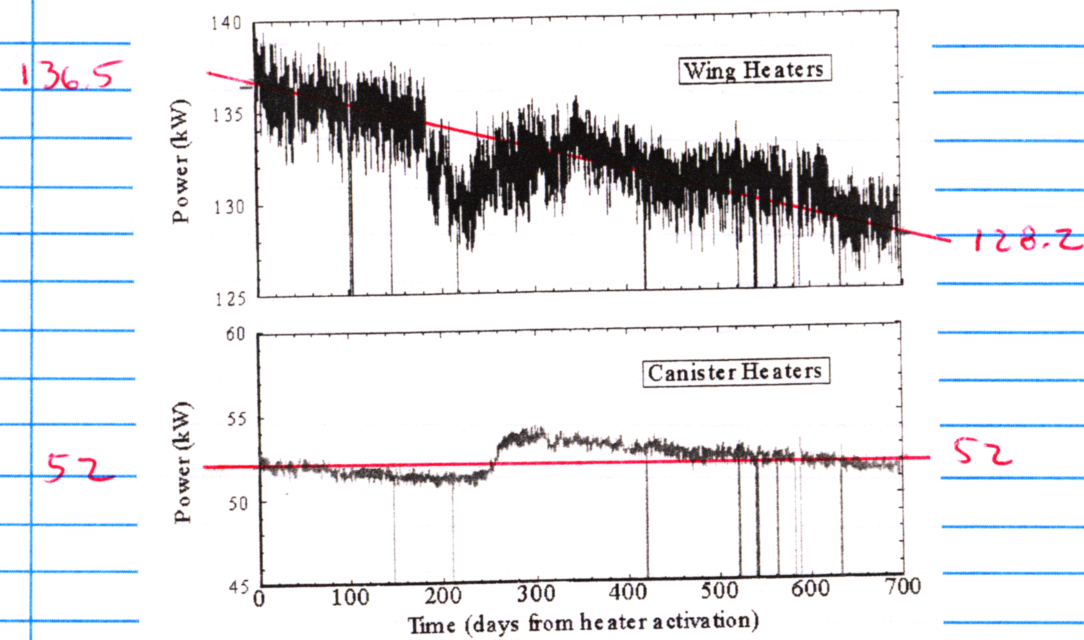



Figure 2.1-1 Total power measurements (Q) for the wing heaters and canister heaters.

A discussion of the heat loads observed and the selected heat loads for the simulations follows

RJJ 7/12/00

TH Simulations

The design thermal load for the DST was 68.0 kW for the canister heaters and 143.0 kW for the cumulative wing heaters (85.8 kW at the outer wing heater and 57.2 kW for the inner wing heaters) for a total of 211 kW (TRW Environmental Safety Systems, 1998d). The DST has experienced measured heat loads that deviate significantly (less) from the levels of the design heat loads since energizing in December 1997. At the time of energizing, the canister heat load was about 52.8 kW and the cumulative wing heater heat load was about 137 kW (TRW Environmental Safety Systems, 1998b). These power levels decreased after heating started, although the magnitude of decrease is not well constrained. Conflicting measurements between qualified and non-qualified data suggest the heat load values decrease to between 49.4 (non-qualified) to 51.8 (qualified) kW for the canisters and between 130.8 (non-qualified) to 133.3 (qualified) kW for the wing heaters by day 179 after heating started. Qualified canister heat load measurements continued to decrease to about 51 kW on day 244, but then increased to about 53.5 kW over the next 26 days (until day 270)(TRW Environmental Safety Systems, 1998c). After day 270, the canister heat load resumed a gradual, consistent decline, decreasing to 51.5 kW by day 700 (TRW Environmental Safety Systems, 1999b). The canister heat load increase over days 244 to 270 is attributed to a modification in the access drift and heat drift (outside the thermal bulkhead) ventilation system. The wing heaters also experienced an increase in heat load soon after day 244, however, this increase followed a rather precipitous decrease in the (qualified) heater load from about 133 kW at day 185 to less than 130 kW by day 244 (TRW Environmental Safety Systems, 1998c). The cause of this precipitous heat load decrease is attributed to the loss of power to wing heater 29. Measured (qualified) heater load values continued to decrease to about 52.3 kW for the canisters and to slightly over 130 kW for the wing heaters by day 480 (TRW Environmental Safety Systems, 1999a) and to about 51.5 kW for the canisters and 128.2 kW for the wing heaters by day 700 (TRW Environmental Safety Systems, 1999b).

Two separate sets of heat loads were assigned to the model in the TH evaluations. In both sets of simulations, the thermal loads were ramped up to their starting power levels over a period of about 4.2 hours to avoid stability problems. The first set established the heat loads at the design levels (i.e., 68 kW for the canisters, 57.2 kW for the inner wing heaters, and 85.8 kW for the outer wing heaters). The second set established the heat loads to resemble the (qualified) heat loads measured for the first 1.9 years of heating (TRW Environmental Safety Systems, 1999b). The measured cumulative heat load for the canister heaters was estimated to remain constant at 52 kW up to day 700 of the test. Transient effects from deviations in the canister heat load from 52 kW, which decreased to about 51 kW about day 230 and increased to about 53.8 kW about day 280 are presumed to be negligible with respect to the scale of investigation.

The overall reduction in the cumulative canister heat load from 68 to 52 kW (23.5 percent), however, is considered significant. The measured cumulative heat load for the wing heaters demonstrated a defined decreasing trend, with some deviation, for the first 700 days of heating. Deviations from a linear decline in cumulative wing heater heat load between days 180 to 240 have been neglected and a constant linear decrease in cumulative wing heater heat load from 136.5 kW at the onset of heating to 128.2 kW at day 700 was assumed. A constant heat load of 128.2 kW was assigned to the wing heaters for the during of heating which continues for an addition 2.1 years. It was assumed that decrease in cumulative heat load for the wing heaters occurred uniformly over both the inner and outer wing heaters. Accordingly, the inner wing heaters decreased from 54.60 to 51.28 kW and the outer wing heaters decreased from 81.90 to 76.92 kW during the first 1.9 years of heating. The decrease in heating of the wing heaters varied from a 4.5 percent decrease from the design heat of 143 kW at the start of heating to a 10.3 percent decrease at 700 days.



RJJ 7/12/00

7/12/00 RJJ

Run series of simulations to evaluate effect of infiltration on initial saturation. let xlm = 1.0

/home/rgreen/dst_scans/decovalex/xlm1.0/varyinfil/

series under dst38*.dat where * = a, b, c...

heat off, only thing that varies is bc in mu38*.bc for example: mu38a.bc

mu38a.bc for infiltration of 0.36 mm/yr

Only thing that changes — for upper b.c.

```
5 3 1265 1265 1 8.771 13.59 8.771
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 1.08724e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
5 3 1266 1266 1 8.771 13.59 8.771
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.   matrix
0. 1.08724e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.   Fracture
.
1 3 1267 1267 1 8.771 13.59 -8.771
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
1 3 1268 1268 1 8.771 13.59 -8.771
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
5 3 1269 1269 1 8.812 15.79 8.812
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 1.08724e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
5 3 1270 1270 1 8.812 15.79 8.812
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 1.08724e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
1 3 1271 1271 1 8.812 15.79 -8.812
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
1 3 1272 1272 1 8.812 15.79 -8.812
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
5 3 1273 1273 1 8.94 17.61 8.94
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 1.08724e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
5 3 1274 1274 1 8.94 17.61 8.94
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 1.08724e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
1 3 1275 1275 1 8.94 17.61 -8.94
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
1 3 1276 1276 1 8.94 17.61 -8.94
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
5 3 1277 1277 1 8.812 15.56 8.812
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 1.08724e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
5 3 1278 1278 1 8.812 15.56 8.812
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 1.08724e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
1 3 1279 1279 1 8.812 15.56 -8.812
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
1 3 1280 1280 1 8.812 15.56 -8.812
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
5 3 1281 1281 1 8.968 17.05 8.968
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 1.08724e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
5 3 1282 1282 1 8.968 17.05 8.968
0. 1.00000e-09 9.33610e+04 2.00000e+01 1.00000e-01 0.
0. 1.08724e-04 9.33610e+04 2.00000e+01 9.50000e-01 0.
.
1 3 1283 1283 1 8.968 17.05 -8.968
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
1 3 1284 1284 1 8.968 17.05 -8.968
0. 1.00000e-09 1.01325e+05 3.00000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 3.00000e+01 9.00000e-01 0.
.
```

Calculations on next page

Calculations on next page

$$3.6\,mm/yr = 3.6e{-3}\ m/yr$$

$$\left[3.6e{-3}\ \frac{m}{Y}\right]\left[\frac{3.15e7\ s}{Y}\right]^{-1} = 1.1416e{-10}\ m/s$$

$$\left[1.1416e{-10}\ \frac{m}{s}\right]\left[\frac{1e3\ Kg}{m^3}\right] = 1.1416e{-7}\ \frac{Kg}{s{-}m^2}$$

this is in the units for MULTIFLO, however, since it is input into fracture continuum, must divide by the fracture porosity. The fracture porosity for the Tptpul or TSw33 is 1.05e-4

$$\frac{1.1416e{-7}}{1.05e{-4}} = 1.08724e{-3} \quad \text{for } 3.6\ mm/yr$$

note dst38a.dat & mu38a.bc is for 0.36 mm/yr

Type 5 upper boundary condition

Results:

xlm = 1.0, areamodF = 1.0

| | | Matrix | | Fracture | |
|---|---|---|---|---|---|
| dst38a | 0.36mm/yr | 1.1686e-2 | 98.83 | 9.6080e-1 | 3.92 ~~0.03~~ 7/12/00 RH |
| dst38b | 0.036mm/yr | 1.1769e-2 | 98.82 | 9.6188e-1 | 3.81 |
| dst38c | 0.0036mm/yr | 1.1782e-2 | 98.82 | 9.6199e-1 | 3.80 |
| dst38d | 0.0036mm/yr matrix infl red. by $10^3$ | 1.2128e-2 | 98.79 | 9.6208e-1 | 3.79 |
| dst38e | 0.0036mm/yr matrix infil ~~to~~ $10^{15}$ | 1.2124e-2 | 98.79 | 9.6208e-1 | 3.79 |
| dst38F | 0.00036mm/yr matrix infil at | 1.2124e-2 | 98.79 | 9.6209e-1 | 3.79 |
| dst38g | 0.00036mm/yr 20-30 BC type 2 not 5 | 2.0966e-1 | 79.03 | 1.000e0 | 0.0 |
| dst38h | 0.036m/yr BC type2, temp grad to 22°-26°C | 1.1439e-1 | 88.57 | 1.000e0 | 0.0 |

Type 2 areamod = 1.0



The DOE ~~'Thermal tests~~ Thermal-Hydrological Analyses/Model Report' (AMR) identified wing heater heat loads different from the design loads and the heat loads I've been using.

Total heat power to canister heaters and cumulative wing heaters taken from the 4th Thermal Test Progress Report (see pg 127)

Using the ratio of $\frac{85.8\ KW}{57.2\ KW}$ for the outer to inner wing heaters as stated in the design heat loads of 1.5 gives

$\left(\frac{136.5}{143}\right)(57.2) = 54.60\,KW$ for inner @ 0 yrs

$\left(\frac{136.5}{143}\right)(85.8) = 81.90\,KW$ for outer @ 0 yrs

$\left(\frac{128.2}{143}\right)(57.2) = 51.28\,KW$ for inner @ 1.9 yrs

$\left(\frac{128.2}{143}\right)(85.8) = 76.92\,KW$ for outer @ 1.9 yrs

The canister heaters are kept constant @ 52KW

These values were used in dst41.dat
/home/rqueen/dst_scans/decovalex/xlm1.0/actualheat/*

The DOE AMR on Thermal tests, however, indicate the outer to inner heater heat load is 1.32 not 1.50

The end pt heat loads @ 0 & 1.9 yrs become:

| | inner | outer |
|---|---|---|
| 0 yrs | 58.84 | 77.66 |
| 1.9 yrs | 55.26 | 72.94 |

The revised heat loads are copied on the next pg

**132** RH 7/12/00

/home/bgreen/dst_scans/decovalex/xln1.0/actualheat/dst92_dat

```
BCON 20 multi
:
: skip
Source 21 1.0 4.0
: elem1 elem2 inc istyp
  1681 1684 1 31
:
: wing heater (outer) at 51.14 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  8.0
6000.0  10.0
7000.0  13.0
8000.0  16.0
9000.0  20.0
10000.0 25.0
11000.0 30.0
12000.0 35.0
13000.0 40.0
14000.0 43.0
15000.0 46.0
15100.0 46.29
5.9918e7 43.48
1.26e+8  43.48
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1685 1688 1 31
:
: wing heater (outer) at 93.27 W/element
:
0.0     0.0
10.0    1.0
100.0   5.0
1000.0  10.0
2000.0  15.0
3000.0  20.0
4000.0  25.0
5000.0  30.0
6000.0  35.0
7000.0  40.0
8000.0  45.0
9000.0  50.0
10000.0 55.0
11000.0 60.0
12000.0 65.0
13000.0 70.0
14000.0 80.0
15000.0 84.0
15100.0 84.42
5.9918e7 79.29
1.26e+8  79.29
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1677 1680 1 31
:
: wing heater (outer) at 127.64 W/element
:
0.0     0.0
10.0    1.0
100.0   5.0
1000.0  10.0
2000.0  15.0
3000.0  20.0
4000.0  25.0
5000.0  30.0
6000.0  35.0
7000.0  40.0
8000.0  50.0
9000.0  60.0
10000.0 70.0
11000.0 80.0
12000.0 90.0
13000.0 100.0
14000.0 110.0
15000.0 115.0
15100.0 115.54
5.9918e7 108.51
1.26e+8  108.51
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1673 1676 1 31
:
: wing heater (outer) at 109.29 W/element
:
0.0     0.0
10.0    1.0
100.0   5.0
1000.0  10.0
2000.0  15.0
3000.0  20.0
4000.0  25.0
5000.0  30.0
6000.0  35.0
7000.0  40.0
8000.0  45.0
9000.0  50.0
10000.0 55.0
11000.0 60.0
12000.0 70.0
13000.0 80.0
14000.0 90.0
15000.0 98.0
15100.0 98.90
5.9918e7 92.89
1.26e+8  92.89
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1645 1648 1 31
:
: wing heater (outer) at 70.22 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  8.0
6000.0  10.0
7000.0  13.0
8000.0  16.0
9000.0  20.0
10000.0 25.0
11000.0 30.0
12000.0 35.0
13000.0 40.0
14000.0 50.0
15000.0 60.0
15100.0 63.56
5.9918e7 59.69
1.26e+8  59.69
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1709 1712 1 31
:
:wing heater (inner) at 18.09 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  9.0
7000.0  11.0
8000.0  13.0
9000.0  15.0
10000.0 17.5
11000.0 18.57
5.9918e7 17.44
1.26e+8  17.44
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1713 1716 1 31
:
: wing heater (inner) at 25.89 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  6.0
4000.0  8.0
5000.0  10.0
6000.0  12.0
7000.0  15.0
8000.0  18.0
9000.0  22.0
10000.0 25.0
11000.0 26.63
5.9918e7 25.01
1.26e+8  25.01
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1717 1720 1 31
:
: wing heater (inner) at 35.67 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  4.0
2000.0  6.0
3000.0  8.0
4000.0  11.0
5000.0  14.0
6000.0  17.0
7000.0  20.0
8000.0  25.0
9000.0  30.0
10000.0 35.0
11000.0 36.64
5.9918e7 34.46
1.26e+8  34.46
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1721 1724 1 31
:
: wing heater (inner) at 47.82 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  4.0
2000.0  7.0
3000.0  10.0
4000.0  15.0
5000.0  20.0
6000.0  25.0
7000.0  30.0
8000.0  35.0
9000.0  40.0
10000.0 46.0
11000.0 49.19
5.9918e7 46.20
1.26e+8  46.20
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1697 1700 1 31
:
: wing heater (inner) at 63.95 W/element
:
0.0     0.0
10.0    1.0
100.0   5.0
1000.0  10.0
2000.0  15.0
3000.0  20.0
4000.0  25.0
5000.0  30.0
6000.0  35.0
7000.0  40.0
8000.0  45.0
9000.0  50.0
10000.0 63.0
11000.0 63.78
5.9918e7 61.78
1.26e+8  61.78
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1693 1696 1 31
:
: wing heater (inner) at 67.81 W/element
:
0.0     0.0
10.0    1.0
100.0   5.0
1000.0  10.0
2000.0  15.0
3000.0  20.0
4000.0  25.0
5000.0  30.0
6000.0  35.0
7000.0  40.0
8000.0  45.0
9000.0  52.0
10000.0 63.0
11000.0 69.76
5.9918e7 65.51
1.26e+8  65.51
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1689 1692 1 31
:
: wing heater (inner) at 41.73 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  4.0
2000.0  6.0
3000.0  8.0
4000.0  11.0
5000.0  14.0
6000.0  17.0
7000.0  20.0
8000.0  25.0
9000.0  32.0
10000.0 39.0
11000.0 42.92
5.9918e7 40.31
1.26e+8  40.31
1.261e+8 0.0
/
:
: elem1 elem2 inc istyp
  1725 1728 1 31
:
: floor heater at 14.16 W/element and 2.1982e-6 k
:
:
0.0     0.0
10.0    0.5
100.0   1.0
1000.0  1.5
2000.0  2.0
3000.0  2.5
4000.0  3.0
5000.0  3.5
6000.0  4.0
7000.0  4.5
8000.0  5.0
9000.0  5.5
10000.0 6.0
11000.0 7.0
12000.0 8.0
13000.0 9.0
14000.0 9.5
15000.0 10.0
15100.0 10.83 -2.1982e-6
1.26e+8  10.83 -2.1982e-6
1.261e+8 0.0 -2.1982e-6
/
:
: elem1 elem2 inc istyp
  1497 1500 1 31
:
: floor heater at 16.49 W/element and 2.5602e-6
:
0.0     0.0
10.0    0.5
100.0   1.0
1000.0  1.5
2000.0  2.0
3000.0  3.0
4000.0  4.0
5000.0  5.0
6000.0  6.0
7000.0  7.0
8000.0  8.0
9000.0  9.0
10000.0 10.0
11000.0 10.5
12000.0 11.0
13000.0 11.5
14000.0 12.0
15000.0 12.5
15100.0 12.61 -2.5602e-6
1.26e+8  12.61 -2.5602e-6
1.261e+8 0.0 -2.5602e-6
/
:
: elem1 elem2 inc istyp
  1501 1504 1 31
:
: floor heater at 25.73 W/element and 3.9942e-6 mass removal
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  9.0
8000.0  10.0
9000.0  11.0
10000.0 13.0
11000.0 15.0
12000.0 17.0
13000.0 18.0
14000.0 19.0
15000.0 19.5
15100.0 19.68 -3.9942e-6
1.26e+8  19.68 -3.9942e-6
1.261e+8 0.0 -3.9942e-6
/
:
: elem1 elem2 inc istyp
  1505 1508 1 31
:
: floor heater at 35.59 and 5.5251e-6 mass removal
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  10.0
8000.0  12.0
9000.0  15.0
10000.0 18.0
11000.0 21.0
12000.0 24.0
13000.0 25.0
14000.0 26.0
15000.0 27.0
15100.0 27.22 -5.5251e-6
1.26e+8  27.22 -5.5251e-6
1.261e+8 0.0 -5.5251e-6
/
:
: elem1 elem2 inc istyp
  1509 1512 1 31
:
: floor heater at 50.64 W/element and 7.8611e-6 mass removal
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  10.0
8000.0  13.0
9000.0  17.0
10000.0 21.0
11000.0 25.0
12000.0 30.0
13000.0 32.5
14000.0 35.0
15000.0 38.0
15100.0 38.72 -7.8611e-6
1.26e+8  38.72 -7.8611e-6
1.261e+8 0.0 7.8611e-6
/
:
: elem1 elem2 inc istyp
  1513 1516 1 31
:
: floor heater at 55.97 W/element and 8.6873e-6 mass removal
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  11.0
8000.0  15.0
9000.0  20.0
10000.0 25.0
11000.0 31.0
12000.0 35.0
13000.0 38.0
14000.0 40.0
15000.0 42.0
15100.0 42.80 -8.6873e-6
1.26e+8  42.80 -8.6873e-6
1.261e+8 0.0 -8.6873e-6
/
:
: elem1 elem2 inc istyp
  1517 1520 1 31
:
: floor heater at 51.93 W/element and 8.0600e-6 mass removal
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  11.0
8000.0  15.0
9000.0  20.0
10000.0 25.0
11000.0 31.0
12000.0 33.0
13000.0 35.0
14000.0 37.0
15000.0 39.0
15100.0 39.71 -8.0600e-6
1.26e+8  39.71 -8.0600e-6
1.261e+8 0.0 -8.0600e-6
/
:
: elem1 elem2 inc istyp
  1521 1524 1 31
:
: floor heater at 54.00 W/element and 8.3818e-6 mass removal
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  11.0
8000.0  15.0
9000.0  20.0
10000.0 26.0
11000.0 32.0
12000.0 35.0
13000.0 37.0
14000.0 39.0
15000.0 41.0
15100.0 41.29 -8.3818e-6
1.26e+8  41.29 -8.3818e-6
1.261e+8 0.0 -8.3818e-6
/
:
: elem1 elem2 inc istyp
  1525 1528 1 31
:
: floor heater at 53.38 W/element and 8.2861e-6 mass removal
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  11.0
8000.0  15.0
9000.0  20.0
10000.0 25.0
11000.0 31.0
12000.0 34.0
13000.0 36.0
14000.0 38.0
15000.0 40.0
15100.0 40.82 -8.2861e-6
1.26e+8  40.82 -8.2861e-6
1.261e+8 0.0 -8.2861e-6
/
```

RH 7/12/00

7/13/00
RH

/home/dst_scans/decovalex/xlm1.0/actualheat/mu42a.~~b~~c

```
2 3 1265 1265 1 8.771 13.59 8.771
0. 1.00000e-15 9.33610e+04 2.20000e+01 1.00000e-01 0.
0. 1.08724e-03 9.33610e+04 2.20000e+01 9.50000e-01 0.
.
2 3 1266 1266 1 8.771 13.59 8.771
0. 1.00000e-15 9.33610e+04 2.20000e+01 1.00000e-01 0.
0. 1.08724e-03 9.33610e+04 2.20000e+01 9.50000e-01 0.
.
1 3 1267 1267 1 8.771 13.59 -8.771
0. 1.00000e-15 1.01325e+05 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 2.60000e+01 9.00000e-01 0.
.
1 3 1268 1268 1 8.771 13.59 -8.771
0. 1.00000e-15 1.01325e+05 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 2.60000e+01 9.00000e-01 0.
.
2 3 1269 1269 1 8.812 15.79 8.812
0. 1.00000e-15 9.33610e+04 2.20000e+01 1.00000e-01 0.
0. 1.08724e-03 9.33610e+04 2.20000e+01 9.50000e-01 0.
.
2 3 1270 1270 1 8.812 15.79 8.812
0. 1.00000e-15 9.33610e+04 2.20000e+01 1.00000e-01 0.
0. 1.08724e-03 9.33610e+04 2.20000e+01 9.50000e-01 0.
.
1 3 1271 1271 1 8.812 15.79 -8.812
0. 1.00000e-15 1.01325e+05 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 2.60000e+01 9.00000e-01 0.
.
1 3 1272 1272 1 8.812 15.79 -8.812
0. 1.00000e-15 1.01325e+05 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 2.60000e+01 9.00000e-01 0.
.
2 3 1273 1273 1 8.94 17.61 8.94
0. 1.00000e-15 9.33610e+04 2.20000e+01 1.00000e-01 0.
0. 1.08724e-03 9.33610e+04 2.20000e+01 9.50000e-01 0.
.
2 3 1274 1274 1 8.94 17.61 8.94
0. 1.00000e-15 9.33610e+04 2.20000e+01 1.00000e-01 0.
0. 1.08724e-03 9.33610e+04 2.20000e+01 9.50000e-01 0.
.
1 3 1275 1275 1 8.94 17.61 -8.94
0. 1.00000e-15 1.01325e+05 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 2.60000e+01 9.00000e-01 0.
.
1 3 1276 1276 1 8.94 17.61 -8.94
0. 1.00000e-15 1.01325e+05 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 2.60000e+01 9.00000e-01 0.
.
2 3 1277 1277 1 8.812 15.56 8.812
0. 1.00000e-15 9.33610e+04 2.20000e+01 1.00000e-01 0.
0. 1.08724e-03 9.33610e+04 2.20000e+01 9.50000e-01 0.
.
2 3 1278 1278 1 8.812 15.56 8.812
0. 1.00000e-15 9.33610e+04 2.20000e+01 1.00000e-01 0.
0. 1.08724e-03 9.33610e+04 2.20000e+01 9.50000e-01 0.
.
1 3 1279 1279 1 8.812 15.56 -8.812
0. 1.00000e-15 1.01325e+05 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 2.60000e+01 9.00000e-01 0.
.
1 3 1280 1280 1 8.812 15.56 -8.812
0. 1.00000e-15 1.01325e+05 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 2.60000e+01 9.00000e-01 0.
.
2 3 1281 1281 1 8.968 17.05 8.968
0. 1.00000e-15 9.33610e+04 2.20000e+01 1.00000e-01 0.
0. 1.08724e-03 9.33610e+04 2.20000e+01 9.50000e-01 0.
.
2 3 1282 1282 1 8.968 17.05 8.968
0. 1.00000e-15 9.33610e+04 2.20000e+01 1.00000e-01 0.
0. 1.08724e-03 9.33610e+04 2.20000e+01 9.50000e-01 0.
.
1 3 1283 1283 1 8.968 17.05 -8.968
0. 1.00000e-15 1.01325e+05 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 2.60000e+01 9.00000e-01 0.
.
1 3 1284 1284 1 8.968 17.05 -8.968
0. 1.00000e-15 1.01325e+05 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 1.01325e+05 2.60000e+01 9.00000e-01 0.
.
```

This is the file for the revised bc

this is a type 2 B.C. at the surface Neumann B.C (constant liquid flux) through TSW33 @ 3.6mm/yr

Temp is 22° C at surface & 26°C at base

Fracture infiltration is low at 1e-15 Kg/m²-s

Sat (matrix) at base B C is set at 0.90, fracture at 0.05

(air) Pressure at surface B.C set at 9.3361e4 Pa, at base = 1.01325e5 Pa



RH 7/13/00

Ran new series of ambient saturation ~~abc~~ analyses RH 7/13/00
These are for a type 2 B.C. at top – described on pg 134
Referred to as dst43*.dat  * = a, b, c ...
with variable infiltration specified in mu43*.bc

Type 2 BC
Xlm=1.0

/home/rgreen/dst_scans/decovalex/xlm1.0/~~vary~~ RH 7/13/00
varyinfil/type2/*

| | Matrix | | Fracture | |
|---|---|---|---|---|
| areamodF = 1.0: dst43a, mu43a 0.36mm/y | 2.2967e-2 | 97.70 | 1.0 | 0.0 |
| dst43b, mu43b 0.036mm/y | 1.1390e-1 | 88.61 | 1.0 | 0.0 |
| dst43c, mu43c 0.072mm/y | 8.3919e-2 | 91.61 | 1.0 | 0.0 |
| 5e-4: dst43d, mu43c areamodF = 5.0e4 | 8.3752e-2 | 91.62 | 1.0 | 0.0 |

8/11/00
RH

Starting with dst43e.dat, ratio of heat load of ~~outer~~ to inner wing heater reduced from 1.5 to 1.32 to agree w/ the Thermal Test AMR
dst43e.dat is located in /home/rgreen/dst_scans/decovalex/xlm1.0/varyinfil/type2

Starting with d7h44v.dat, mass removal was separated from heat source. Total # of elements in source was increased from 21 (x4 = 84) to 30 (x4 = 120) because the 9 heater drift source elements were doubled from 9 to 18, 1 each for heat source & mass sinks. d7h44v.dat is in /home/rgreen/dst_scans/decovalex/~~xlm1.0~~/varyinfil/type2/xlm5/type5/lowK
The resulting source input is as follows:

 RH 8/11/00

```
: skip
Source 30 1.0 0.10
: elem1 elem2 inc istyp
  1681 1684 1 31
:
: wing heater (outer) at 51.14 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  8.0
6000.0  10.0
7000.0  13.0
8000.0  16.0
9000.0  20.0
10000.0 25.0
11000.0 30.0
12000.0 35.0
13000.0 40.0
14000.0 45.0
15000.0 48.0
15100.0 48.82
5.9918e7 45.85
1.26e+8 45.85
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1685 1688 1 31
:
: wing heater (outer) at 93.27 W/element
:
0.0     0.0
10.0    1.0
100.0   5.0
1000.0  10.0
2000.0  15.0
3000.0  20.0
4000.0  25.0
5000.0  30.0
6000.0  35.0
7000.0  40.0
8000.0  45.0
9000.0  50.0
10000.0 55.0
11000.0 60.0
12000.0 65.0
13000.0 70.0
14000.0 80.0
15000.0 89.0
15100.0 89.03
5.9918e7 83.62
1.26e+8 83.62
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1677 1680 1 31
:
: wing heater (outer) at 127.64 W/element
:
0.0     0.0
10.0    1.0
100.0   5.0
1000.0  10.0
2000.0  15.0
3000.0  20.0
4000.0  25.0
5000.0  30.0
6000.0  35.0
7000.0  40.0
8000.0  50.0
9000.0  60.0
10000.0 70.0
11000.0 80.0
12000.0 90.0
13000.0 100.0
14000.0 110.0
15000.0 120.0
15100.0 121.84
5.9918e7 114.43
1.26e+8 114.43
1.261e+8 0.0
,
: elem1 elem2 inc istyp
  1673 1676 1 31
:
: wing heater (outer) at 109.29 W/element
:
0.0     0.0
10.0    1.0
100.0   5.0
1000.0  10.0
2000.0  15.0
3000.0  20.0
4000.0  25.0
5000.0  30.0
6000.0  35.0
7000.0  40.0
8000.0  45.0
9000.0  50.0
10000.0 55.0
11000.0 60.0
12000.0 70.0
13000.0 80.0
14000.0 90.0
15000.0 100.0
15100.0 104.30
5.9918e7 97.96
1.26e+8 97.96
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1645 1648 1 31
:
: wing heater (outer) at 70.22 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  8.0
6000.0  10.0
7000.0  13.0
8000.0  16.0
9000.0  20.0
10000.0 25.0
11000.0 30.0
12000.0 35.0
13000.0 40.0
14000.0 50.0
15000.0 60.0
15100.0 67.03
5.9918e7 62.95
1.26e+8 62.95
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1709 1712 1 31
:
:wing heater (inner) at 18.09 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  9.0
7000.0  11.0
8000.0  13.0
9000.0  15.0
10000.0 17.0
11000.0 17.23
5.9918e7 16.18
1.26e+8 16.18
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1713 1716 1 31
:
: wing heater (inner) at 25.89 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  6.0
4000.0  8.0
5000.0  10.0
6000.0  12.0
7000.0  15.0
8000.0  18.0
9000.0  21.0
10000.0 23.0
11000.0 24.71
5.9918e7 23.21
1.26e+8 23.21
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1717 1720 1 31
:
: wing heater (inner) at 35.67 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  4.0
2000.0  6.0
3000.0  8.0
4000.0  11.0
5000.0  14.0
6000.0  17.0
7000.0  20.0
8000.0  23.0
9000.0  29.0
10000.0 33.0
11000.0 34.05
5.9918e7 31.98
1.26e+8 31.98
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1721 1724 1 31
:
: wing heater (inner) at 47.82 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  4.0
2000.0  7.0
3000.0  10.0
4000.0  15.0
5000.0  20.0
6000.0  25.0
7000.0  30.0
8000.0  35.0
9000.0  40.0
10000.0 44.0
11000.0 45.65
5.9918e7 42.87
1.26e+8 42.87
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1697 1700 1 31
:
: wing heater (inner) at 63.95 W/element
:
0.0     0.0
10.0    1.0
100.0   5.0
1000.0  10.0
2000.0  15.0
3000.0  20.0
4000.0  25.0
5000.0  30.0
6000.0  35.0
7000.0  40.0
8000.0  45.0
9000.0  50.0
10000.0 60.0
11000.0 61.04
5.9918e7 57.33
1.26e+8 57.33
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1693 1696 1 31
:
: wing heater (inner) at 67.81 W/element
:
0.0     0.0
10.0    1.0
100.0   5.0
1000.0  10.0
2000.0  15.0
3000.0  20.0
4000.0  25.0
5000.0  30.0
6000.0  35.0
7000.0  40.0
8000.0  45.0
9000.0  52.0
10000.0 60.0
11000.0 64.73
5.9918e7 60.79
1.26e+8 60.79
1.261e+8 0.0
/
: elem1 elem2 inc istyp
  1689 1692 1 31
:
: wing heater (inner) at 41.73 W/element
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  4.0
2000.0  6.0
3000.0  8.0
4000.0  11.0
5000.0  14.0
6000.0  17.0
7000.0  20.0
8000.0  25.0
9000.0  32.0
10000.0 38.0
11000.0 39.83
5.9918e7 37.41
1.26e+8 37.41
1.261e+8 0.0
/
:
: elem1 elem2 inc istyp
  1725 1728 1 11
:
: floor heater 2.1982e-6 kg/s mass removal
:
:
15100.0 0.0 -2.1982e-6
1.26e+8 0.0 -2.1982e-6
/
:
: elem1 elem2 inc istyp
  1725 1728 1 31
:
: floor heater at 14.16 W/element and 2.1982e-6 k
:
:
0.0     0.0
10.0    0.5
100.0   1.0
1000.0  1.5
2000.0  2.0
3000.0  2.5
4000.0  3.0
5000.0  3.5
6000.0  4.0
7000.0  4.5
8000.0  5.0
9000.0  5.5
10000.0 6.0
11000.0 7.0
12000.0 8.0
13000.0 9.0
14000.0 9.5
15000.0 10.0
15100.0 10.83 -2.1982e-6
1.26e+8 10.83 -2.1982e-6
1.261e+8 0.0 -2.1982e-6
/
:
```

 RH 8/11/00

```
: elem1 elem2 inc istyp
  1497 1500 1 11
:
: floor heater at 2.5602e-6 mass removal
:
15100.0 0.0 -2.5602e-6
1.26e+8 0.0 -2.5602e-6
/
: elem1 elem2 inc istyp
  1497 1500 1 31
:
: floor heater at 16.49 W/element and 2.5602e-6 mass removal
:
0.0     0.0
10.0    0.5
100.0   1.0
1000.0  1.5
2000.0  2.0
3000.0  3.0
4000.0  4.0
5000.0  5.0
6000.0  6.0
7000.0  7.0
8000.0  8.0
9000.0  9.0
10000.0 10.0
11000.0 10.5
12000.0 11.0
13000.0 11.5
14000.0 12.0
15000.0 12.5
15100.0 12.61 -2.5602e-6
1.26e+8 12.61 -2.5602e-6
1.261e+8 0.0 -2.5602e-6
/
:
: elem1 elem2 inc istyp
  1501 1504 1 11
:
: floor heater at 3.9942e-6 mass removal
:
15100.0 0.0 -3.9942e-6
1.26e+8 0.0 -3.9942e-6
/
: elem1 elem2 inc istyp
  1501 1504 1 31
:
: floor heater at 25.73 W/element and 3.9942e-6 mass remova
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  9.0
8000.0  10.0
9000.0  11.0
10000.0 13.0
11000.0 15.0
12000.0 17.0
13000.0 18.0
14000.0 19.0
15000.0 19.5
15100.0 19.68 -3.9942e-6
1.26e+8 19.68 -3.9942e-6
1.261e+8 0.0 -3.9942e-6
/
:
: elem1 elem2 inc istyp
  1505 1508 1 11
:
: floor heater at 5.5251e-6 mass removal
:
15100.0 0.0 -5.5251e-6
1.26e+8 0.0 -5.5251e-6
/
: elem1 elem2 inc istyp
  1505 1508 1 31
:
: floor heater at 35.59 and 5.5251e-6 mass removal
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  10.0
8000.0  12.0
9000.0  15.0
10000.0 18.0
11000.0 21.0
12000.0 24.0
13000.0 25.0
14000.0 26.0
15000.0 27.0
15100.0 27.22 -5.5251e-6
1.26e+8 27.22 -5.5251e-6
1.261e+8 0.0 -5.5251e-6
/
:
: elem1 elem2 inc istyp
  1509 1512 1 11
:
: floor heater at 7.8611e-6 mass removal
:
15100.0 0.0 -7.8611e-6
1.26e+8 0.0 -7.8611e-6
/
: elem1 elem2 inc istyp
  1509 1512 1 31
:
: floor heater at 50.64 W/element and 7.8611e-6 mass removal
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  10.0
8000.0  13.0
9000.0  17.0
10000.0 21.0
11000.0 25.0
12000.0 30.0
13000.0 32.5
14000.0 35.0
15000.0 38.0
15100.0 38.72 -7.8611e-6
1.26e+8 38.72 -7.8611e-6
1.261e+8 0.0 7.8611e-6
/
:
: elem1 elem2 inc istyp
  1513 1516 1 11
:
: floor heater at 8.6873e-6 mass removal
:
15100.0 0.0 -8.6873e-6
1.26e+8 0.0 -8.6873e-6
/
: elem1 elem2 inc istyp
  1513 1516 1 31
:
: floor heater at 55.97 W/element and 8.6873e-6 mass removal
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  11.0
8000.0  15.0
9000.0  20.0
10000.0 25.0
11000.0 31.0
12000.0 35.0
13000.0 38.0
14000.0 40.0
15000.0 42.0
15100.0 42.80 -8.6873e-6
1.26e+8 42.80 -8.6873e-6
1.261e+8 0.0 -8.6873e-6
/
:
: elem1 elem2 inc istyp
  1517 1520 1 11
:
: floor heater at 8.0600e-6 mass removal
:
15100.0 0.0 -8.0600e-6
1.26e+8 0.0 -8.0600e-6
/
: elem1 elem2 inc istyp
  1517 1520 1 31
:
: floor heater at 51.93 W/element and 8.0600e-6 mass removal
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  11.0
8000.0  15.0
9000.0  20.0
10000.0 25.0
11000.0 31.0
12000.0 33.0
13000.0 35.0
14000.0 37.0
15000.0 39.0
15100.0 39.71 -8.0600e-6
1.26e+8 39.71 -8.0600e-6
1.261e+8 0.0 -8.0600e-6
/
:
: elem1 elem2 inc istyp
  1521 1524 1 11
:
: floor heater at 8.3818e-6 mass removal
:
15100.0 0.0 -8.3818e-6
1.26e+8 0.0 -8.3818e-6
/
: elem1 elem2 inc istyp
  1521 1524 1 31
:
: floor heater at 54.00 W/element and 8.3818e-6 mass removal
:
0.0     0.0
10.0    1.0
100.0   2.0
1000.0  3.0
2000.0  4.0
3000.0  5.0
4000.0  6.0
5000.0  7.0
6000.0  8.0
7000.0  11.0
8000.0  15.0
9000.0  20.0
10000.0 26.0
11000.0 32.0
12000.0 35.0
13000.0 37.0
14000.0 39.0
15000.0 41.0
15100.0 41.29 -8.3818e-6
1.26e+8 41.29 -8.3818e-6
1.261e+8 0.0 -8.3818e-6
/
:
: elem1 elem2 inc istyp
  1525 1528 1 11
:
: floor heater at 8.2861e-6 mass removal
:
15100.0 0.0 -8.2861e-6
```

RH
8/11/00

```
1.26e+8  0.0  -8.2861e-6
/
: elem1 elem2 inc istyp
  1525  1528  1   31
:
: floor heater at 53.38 W/element and 8.2861e-6 mass removal
:
0.0      0.0
10.0     1.0
100.0    2.0
1000.0   3.0
2000.0   4.0
3000.0   5.0
4000.0   6.0
5000.0   7.0
6000.0   8.0
7000.0   11.0
8000.0   15.0
9000.0   20.0
10000.0  25.0
11000.0  31.0
12000.0  34.0
13000.0  36.0
14000.0  38.0
15000.0  40.0
15100.0  40.82 -8.2861e-6
1.26e+8  40.82 -8.2861e-6
1.261e+8 0.0 -8.2861e-6
/
: noskip
:
```

The source (sink) of mass loss is equivalent to 800 ml/hr, scaling = 0.1, so the actual removal was 80 ml/hr

Ran multiple simulations: Key property changes are listed below. Included is matrix saturation at a pt 8.9 m above heater drift (element 1101)

RH 8/11/00

| 43e | xlm | Amod | infil | type BC | | sat |
|---|---|---|---|---|---|---|
| dst ~~44e~~ (used dst43c) | 1.0 | 1.0 | 0.072 mm/yr | type 2 | wrong ratio 1.32 Heat on | |
| dst43F | 1.0 | 5e-4 | 0.072 | " | ' " | " |
| dst43g | 1.0 | 1.0 | 0.0036 | " | | 0.8100 |
| dst43j | 1.0 | 1.0 | 0.0036 | " | bottom b.c. to 0.92 in fact | 0.8097 |
| dst43K | 1.0 | 1.0 (Fracture sat = 0) | 0.0036 | | | 0.8048 |
| | | | | | | 0.8057 |
| dst43l | 1.0 | 1.0 | 0.0036 | | I.C. at bottom 0.95 | |
| dst43m | 1.0 | 1.0 | 0.0036 | type 5 | | 98.78 |
| dst43n | dst43m but w/ heat on | | | | | |

note: expressed as saturation, not %



RH 8/11/00
~~dst43~~

| | xlm | Amod | infil (mm/yr) | BC type | |
|---|---|---|---|---|---|
| dst44a | 0.25 | 5e-4 | 0.036 | type 2 | 85.93 |
| dst44b | " | " | 0.36 | " | 95.49 |
| dst44c | " | " | 3.6 | " | 99.97 |
| dst44d | " | " | 0.26 (7.8523e-5 Kg/m²-s) | " | 94.23 |
| dst44e | " | 1.0 | " | " | 94.23 |
| dst44f | 1.0 | 1.0 | 0.01157 (3.5e-5) | " | 88.66 |
| dst44g | " | " | 0.0165 (5e-5) | " | 92.4 |
| dst44h | same as dst44g w/ heat | | | | |
| dst44i | reduced K by 100x — only fracture k reduced and only in TSw34, not TSw33 & TSw35 | | | | |
| dst44K | 0.25 | 5e-4 | 0.036 | type 5 | 99.82 |
| dst44L | " | " | 3.6 | " | 99.97 |
| dst44m w/ mut5a.bc | 0.25 | 1.0 | 0.036 | " | 99.97 |
| dst44n w/mut5b.bc | 0.25 | 1.0 | 0.00036 | " | 99.78 |
| dst44o w/mut2a.bc | " | " | " | type 2 | 79.27 |
| dst44p w/mut2b.bc | " | " | 3.6 | " | 99.97 |

RH 8/11/00

| | x/m | Amod | infil | bc type | |
|---|---|---|---|---|---|
| dst 44q | 0.25 | 1.0 | 0.00036 | 5 | 99.98 |
| reduced k of fractures in all 3 units by 10X | | | | muk-1.phk | |
| dst 44r | 0.25 | 1.0 | 0.00036 | 5 | 99.98 |
| reduced k of fractures in all 3 units by 100X | | | | muk-2-phk | |
| dst 44s | 0.25 | 1.0 | 3.6 | type 2 | 99.99 |
| muk-2.phk | mut2b.bc | | | | |
| dst 44t | 0.25 | 1.0 | 0.00036 | type 2 | 79.20 |
| muk-2.phk | mut2a.bc | | | | |
| dst 44u | 0.25 | 1.0 | 0.00036 | " | 79.17 |
| muk-3.phk has 1000X reduction in all 3 units fracture perm | | | | | |
| dst 44v | 0.25 | 1.0 | 0.036 | " | 88.59 |
| muk-2.phk | mut2c.bc → 0.036 (e-5) | | | | |
| dst 44w | 0.25 | 1.0 | 0.00036 | " | 79.21 |
| muk-1.phk | | | mut2a.bc | | |
| dst 44x | 0.25 | 1.0 | 3.6 | " | 99.99 |
| muk-3.phk | | | mut2b.bc | | |
| dst 44y | 0.25 | 1.0 | 0.00036 | " | 88.64 |
| muk-1.phk | | | mut2a.bc | dcme-2.dat | |
| dst 44z | 0.25 | 1.0 | 3.6 | | 99.41 |
| muk-1.phk | | | mut2b.bc | dcme-2 | |

dcme-2.dat ~~reduced~~ RH 8/11/00 increased fracture porosity by 100X and reduced fracture k by only 10X to see if it had same effect as dst 44u.dat

Note:

muk-1.phk has fracture perm reduced by 10X
muk-2.phk " " " " 100X
muk-3.phk " " " " 1000X

mut2a.bc type 2 w/ 0.00036 mm/yr
mut2b.bc type 2 w/ 3.6 mm/yr infiltration
mut5a.bc type 5 w/ ~~0.00036~~ 3.6 mm/yr RH 8/11/00
mut5b.bc type 5 w/ 0.00036 mm/yr
mut2c.bc type 2 w/ 0.036 mm/yr



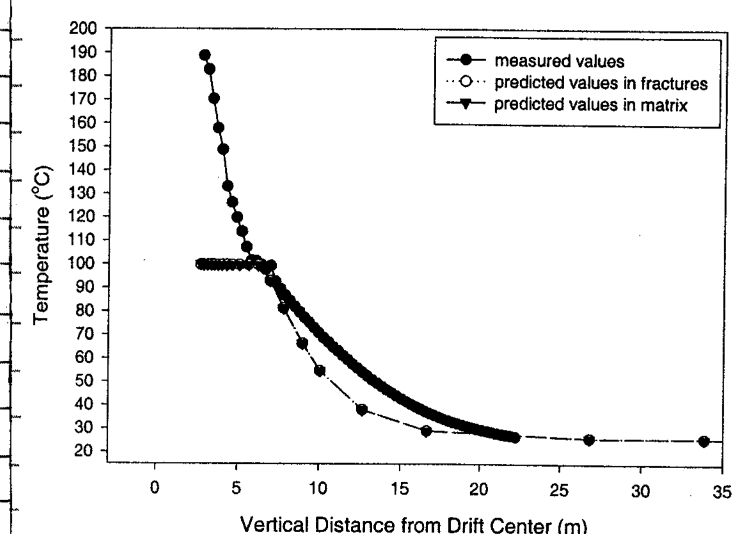
8/15/00 RH

Series of TH runs to simulate heat & mass transfer in the presence of Heater phase of DST

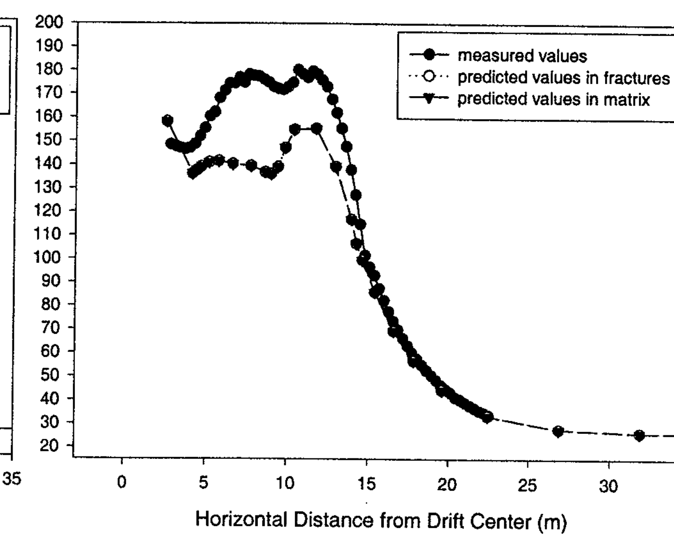
dst45b.dat 0.036 mm/yr infiltration, no mass loss through bulkhead. basecase values
bc in mut2c.bc

in /home/rgreen/dst_scans/decovalex/xlm1-0/varyinfil/type2 x/m25/type5/dst45b.dat

Temperature vs. Distance Borehole 158
simulation dst45b 1yr
dst45bfldf1.xyp & dst45bfldm1.xyp
vulcan/home/mhill/ron
filename: 45b1581y.jnb




Temperature vs. Distance Borehole 160
simulation 45b 1yr
dst45bfldf1.xyp & dst45bfldm1.xyp
vulcan/home/mhill/ron
filename: 45b1601y.jnb

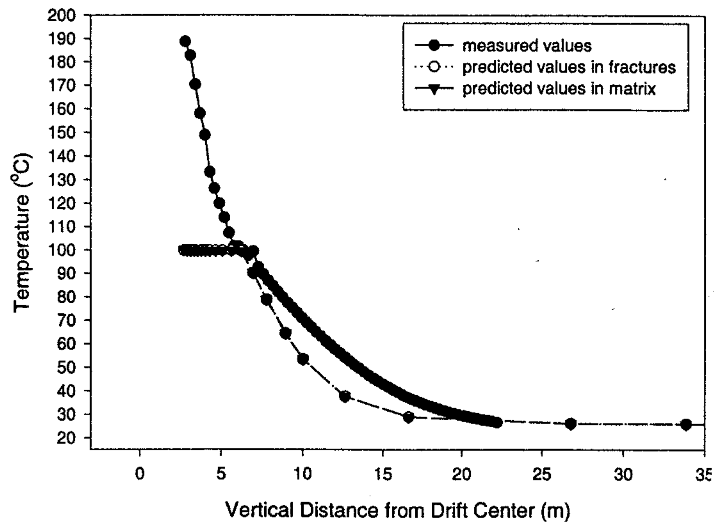



Note large heat pipe

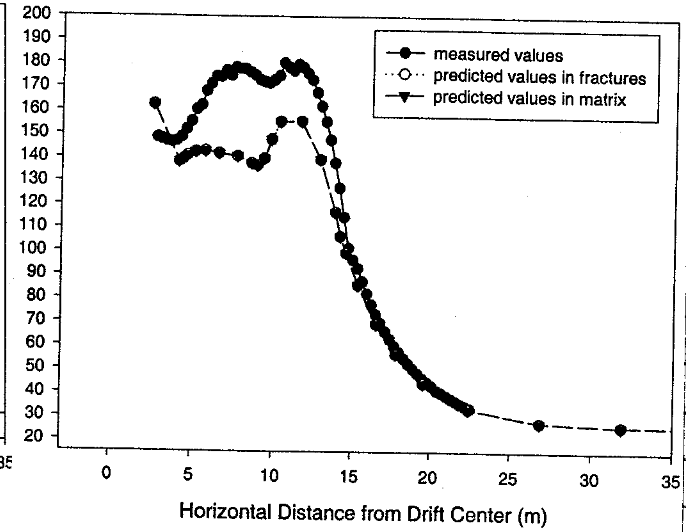
Ran same but with 80 ml/hr mass loss per source listed on pgs 136 - 138 in
/home/rgreen/dst_scans/decovalex/xlm1.0/varyinfil/type2/rev-source/d11h.dat i.c. in dst45a.dat
0.036 mm/yr base case properties

 RH 8/15/00

Temperature vs. Distance Borehole 158
simulation d11h 1yr
d11hfldf1.xyp & d11hfldm1.xyp
vulcan/home/mhill/ron
filename: d11h1581y.jnb



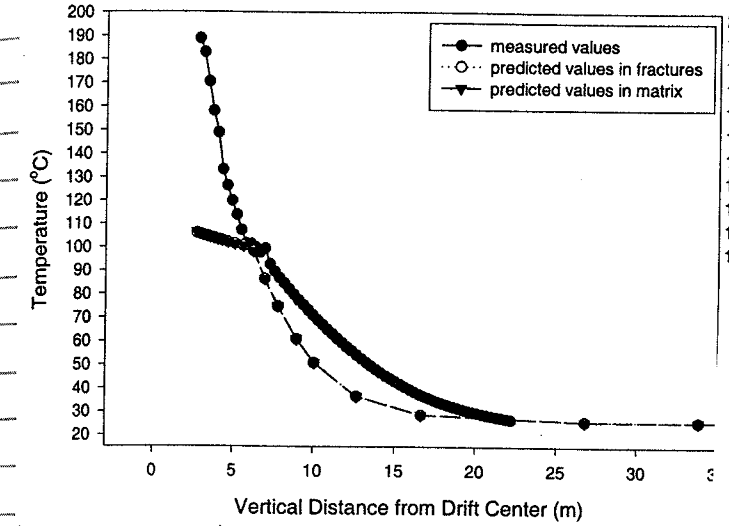

Temperature vs. Distance Borehole 160
simulation d11h 1yr
d11hfldf1.xyp & d11hfldm1.xyp
vulcan/home/mhill/ron
filename: d11h1601y.jnb



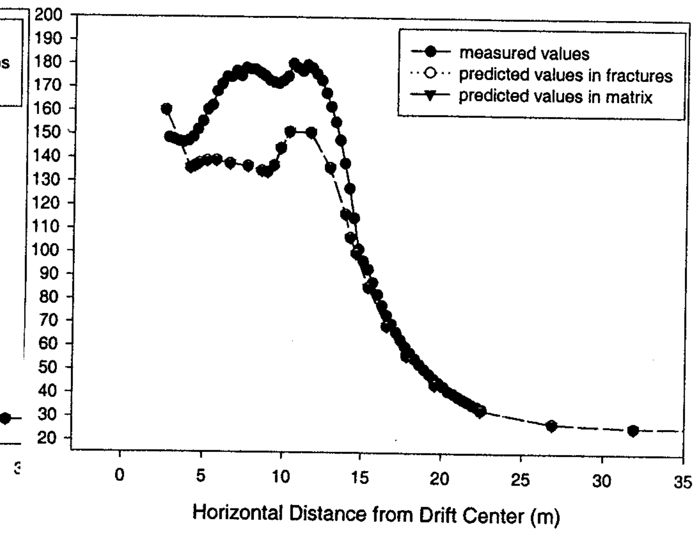



Same as h4h44v.dat but w/ 80ml/hr mass loss
in /home/ngreen/dst_scans/decovalex/xlm1.0/varyinfil/type2/~~xlm25~~
/rav-source/d14h-dat RH 8/15/00

Temperature vs. Distance Borehole 158
simulation d14h 1yr
d14hfldf1.xyp & d14hfldm1.xyp
vulcan/home/mhill/ron
filename: d14h1581y.jnb



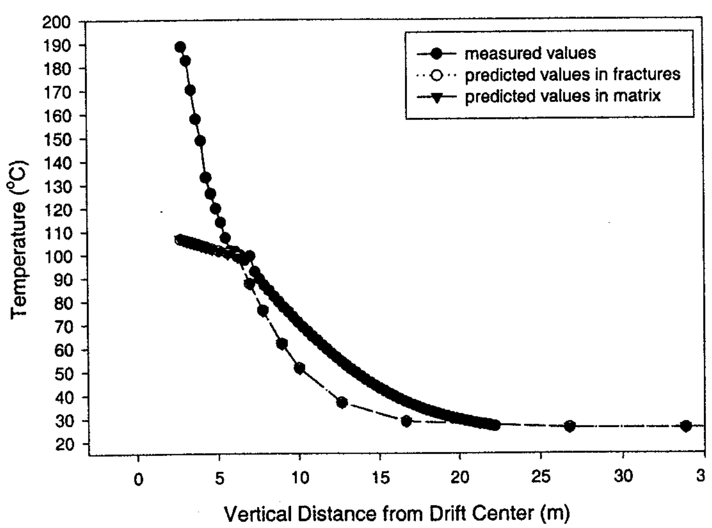

Temperature vs. Distance Borehole 160
simulation d14h 1yr
d14hfldf1.xyp & d14hfldm1.xyp
vulcan/home/mhill/ron
filename: d14h1601y.jnb



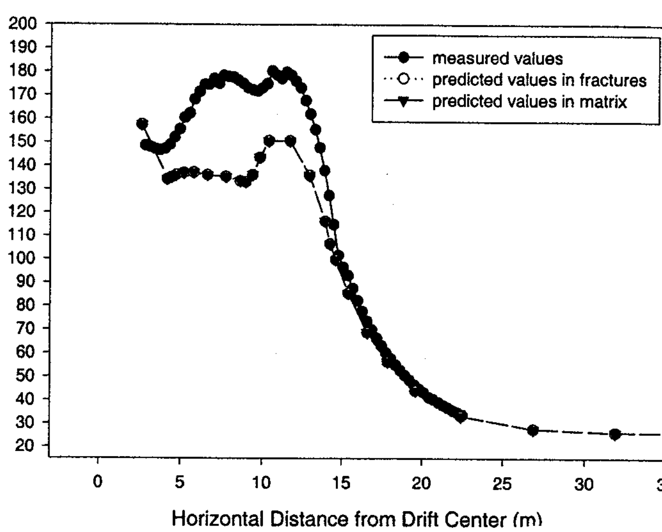

Next set: reduced fracture permeability by 100X in all 3 units   3.6 mm/yr infiltration

reduced infil ~~to~~ 0.036, i.c. in dst44v.int, low fracture permeability by 100X muk-2.phk, bc in mut2c.bc

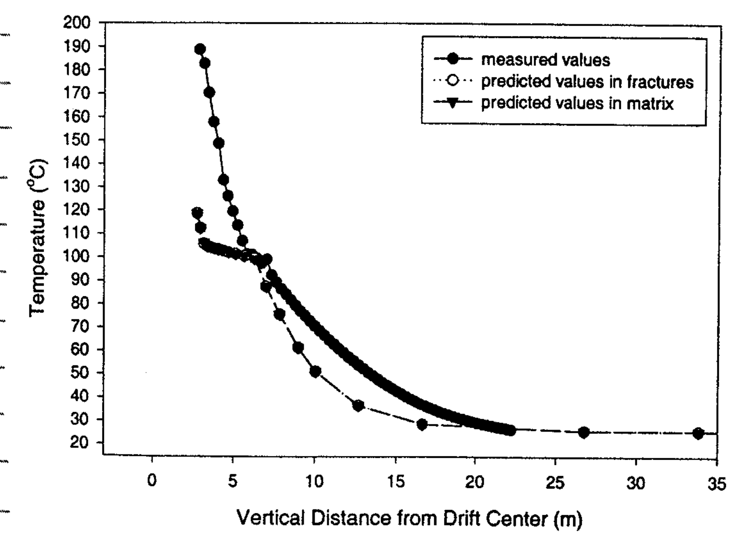
Temperature vs. Distance Borehole 158
simulation d4h44v 1yr
d4h44vfldf1.xyp & d4h44vfldm1.xyp
vulcan/home/mhill/ron
filename: d4h441581y.jnb



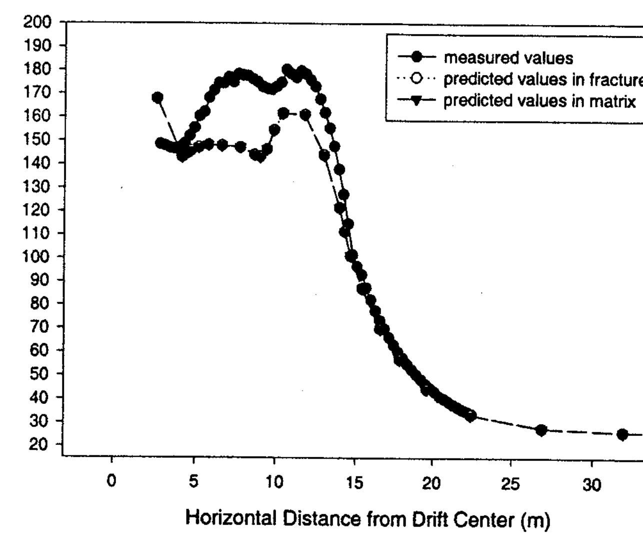

Temperature vs. Distance Borehole 160
simulation d4h44v 1yr
d4h44vfldf1.xyp & d4h44vfldm1.xyp
vulcan/home/mhill/ron
filename: d4h441601y.jnb




Temperature vs. Distance Borehole 158
simulation d2h44v 1yr
d2h44vfldf1.xyp & d2h44vfldm1.xyp
vulcan/home/mhill/ron
filename: d2h441581y.jnb



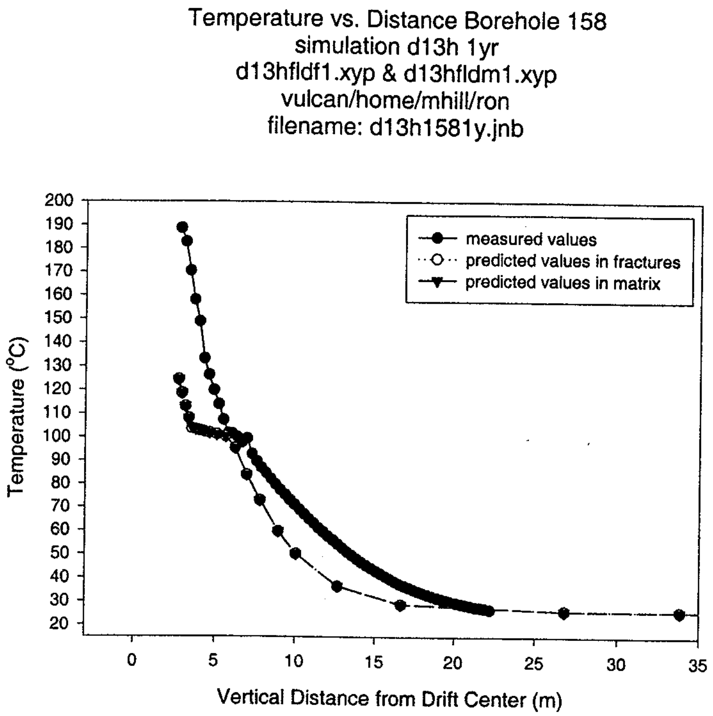

simulation d2h44 1yr
d2h44vfldf1.xyp & d2h44vfldm1.xyp
vulcan/home/mhill/ron
filename: d2hv1601y.jnb

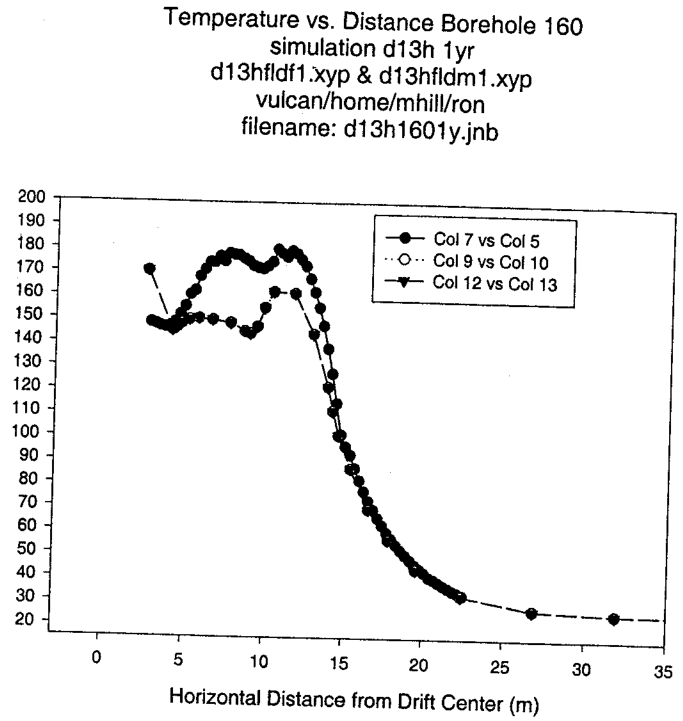



/home/ngreen/dst_scans/decovalex/xlm1.0/varyinfil/type2/xlm25/
type5/lowk/d4h44v.dat

/home/ngreen/dst_scans/decovalex/xlm1.0/varyinfil/type2/xlm25/
type5/lowk/d2h44v.dat

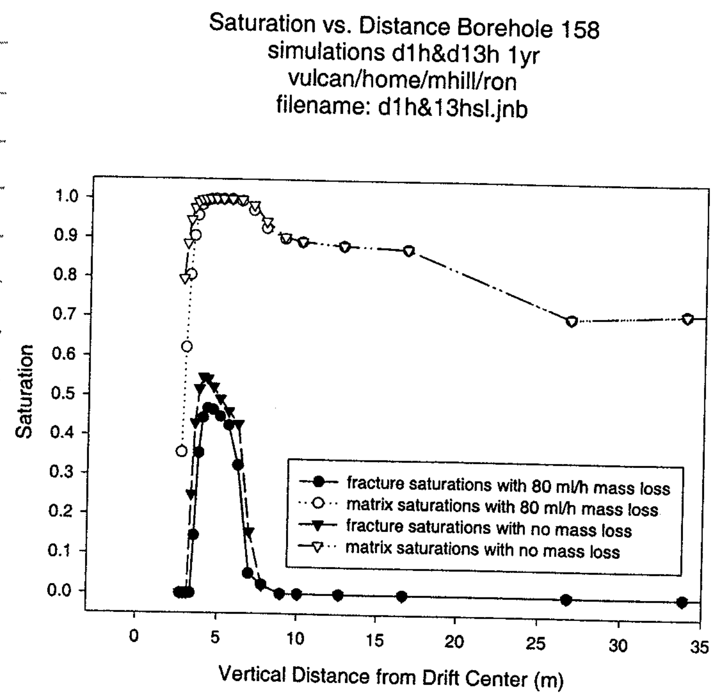
RH 8/15/00 Same as d2h44v.dat but w/ 80 ml/hr mass loss per pg 136-138




/home/rgreen/dst_scans/decovalex/xla1.0/vary infil/type2/rev-source/
d13h.dat    i.c. in dst45r.int , muk-2.phk
bc in mut2c.bc → 0.036 mm/yr

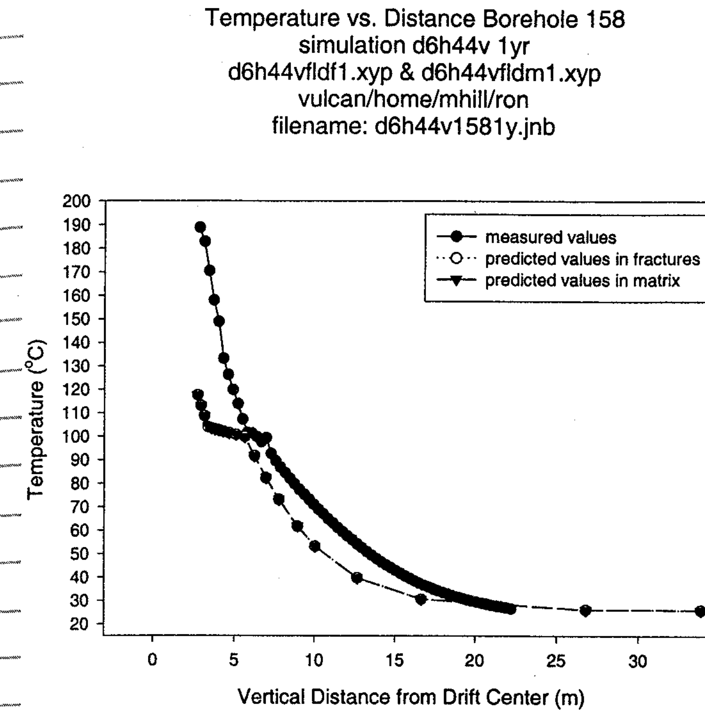
Note: d1h.dat is similar to d2h.dat (identical)

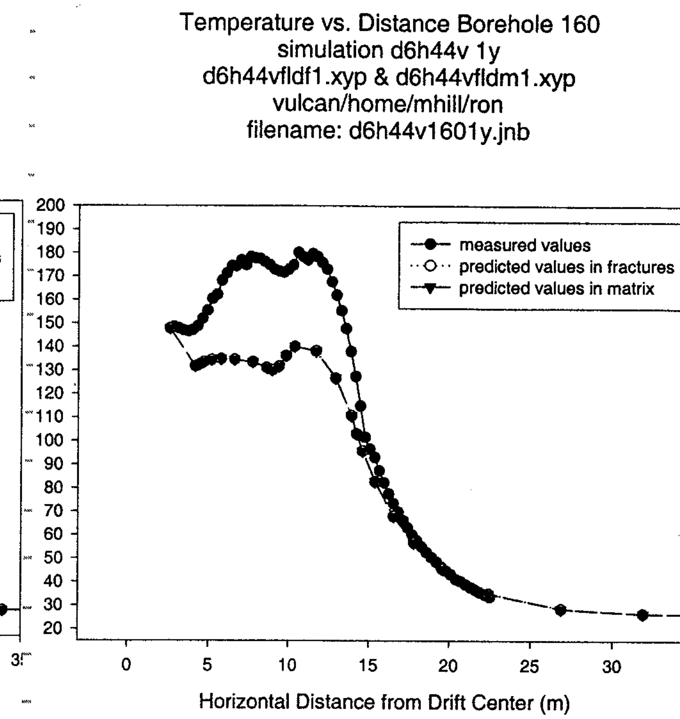



comparison of no mass loss w/ mass loss for low-fracture permeability w/ 0.036 mm/yr



Next set: 1/3 increase in thermal conductivity    RH 8/15/00



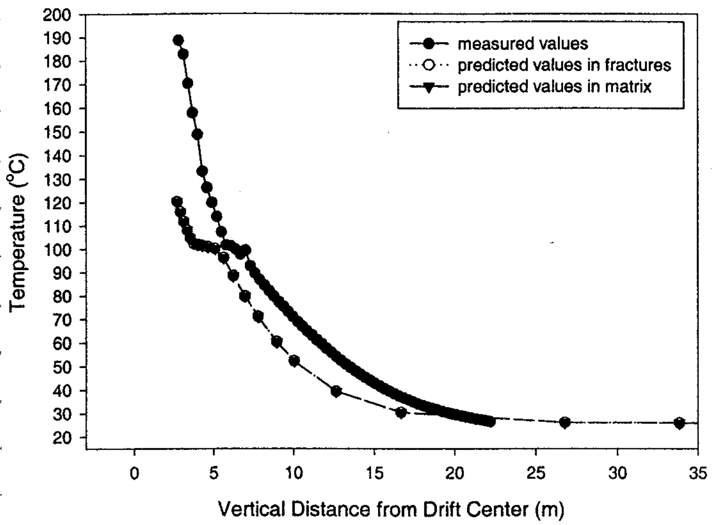

Thermal-prop

| : no | rho | cpr | ckdry | cksat | crp | crt | tau | cdiff | cexp | enbd | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 2.530e+03 | 948 | 2.07 | 3.10 | 0 | 0 | .5 | 2.13e-5 | 1.8 | 0. | :TSw34-matrix |
| 2 | 2.510e+03 | 883 | 0.94 | 2.39 | 0 | 0 | .5 | 2.13e-5 | 1.8 | 0. | :TSw33-matrix |
| 3 | 2.540e+03 | 900 | 1.60 | 2.69 | 0 | 0 | .5 | 2.13e-5 | 1.8 | 0. | :TSw35-matrix |
| 0 | | | | | | | | | | | |

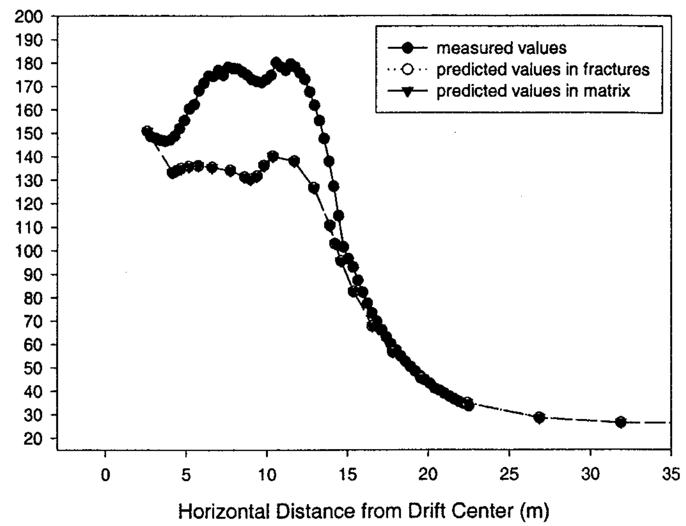
Revised values of $K_T$ in d6h44v.dat
/home/dst_scans/decovalex/xla1.0/vary infil/type2/lowK/thermal/
d6h44v.dat    0.036 mm/yr in mut2c.bc
muk-2.phk low fracture K , i.c. in dst44v.int

RH 8/15/00 ~~reduced~~ increased $K_T$ helps temperature profile along heater drift but gives poorer match above wing heaters

Temperature vs. Distance Borehole 158
simulation d17h 1yr
d17hfldf1.xyp & d17hfldm1.xyp
vulcan/home/mhill/ron
filename: d17h1581y.jnb



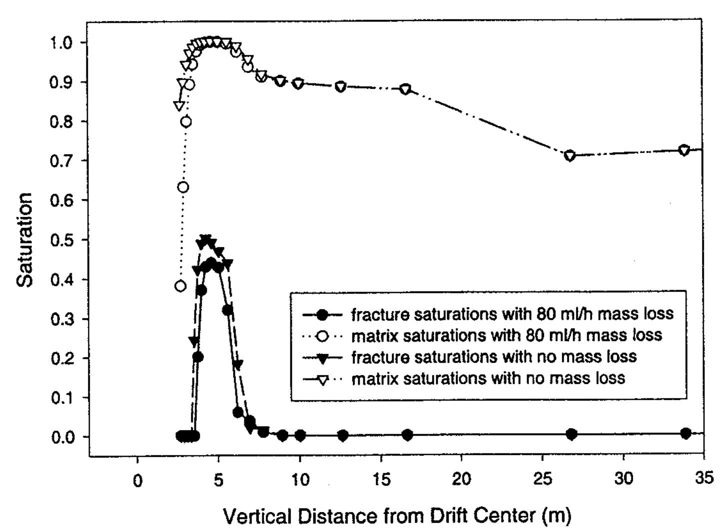

Temperature vs. Distance Borehole 160
simulation d17h 1yr
d17hfldf1.xyp & d17hfldm1.xyp
vulcan/home/mhill/ron
filename: d17h1601y.jnb




Same as d6h44v.dat but w/ 80ml/hr mass loss per pg 136-138
/home/rgreen/dst_scans/decovalex/xlm1.0/varyinfil/type2/rev-source/d17h.dat
1/3 increase in $K_T$, low fracture k by 100X
0.036 mm/yr, 80ml/hr mass loss
RH 5/18/00

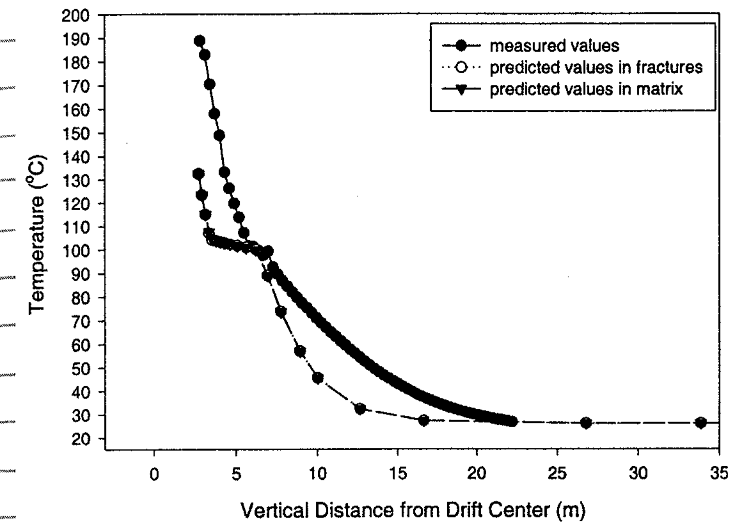
Note: ~~d5h4dc~~ d5h44v.dat is same as d6h44v.dat

Saturation vs. Distance
sld5&17

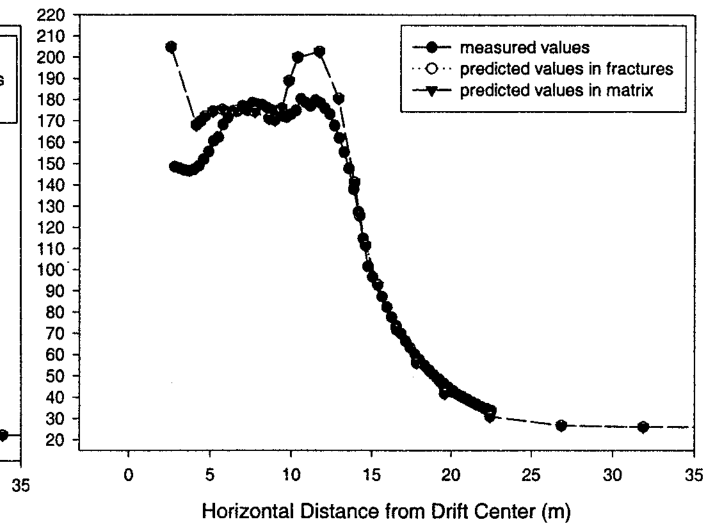





Temperature vs. Distance Borehole 158
simulation d18h 1yr




Temperature vs. Distance Borehole 160
simulation d18h 1yr




↑ This set is 1/3 decrease in $K_T$

Thermal-prop

| : no | rho | cpr | ckdry | cksat | crp | crt | tau | cdiff | cexp | enbd | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| : 1 | 2.530e+03 | 948 | 1.56 | 2.33 | 0 | 0 | .5 | 2.13e-5 | 1.8 | 0. | :TSw34-matrix |
| : 2 | 2.510e+03 | 883 | 0.71 | 1.80 | 0 | 0 | .5 | 2.13e-5 | 1.8 | 0. | :TSw33-matrix |
| : 3 | 2.540e+03 | 900 | 1.20 | 2.02 | 0 | 0 | .5 | 2.13e-5 | 1.8 | 0. | :TSw35-matrix |
| : below are thermal conducitivities raised by 1/3 | | | | | | | | | | | |
| : 1 | 2.530e+03 | 948 | 2.07 | 3.10 | 0 | 0 | .5 | 2.13e-5 | 1.8 | 0. | :TSw34-matrix |
| : 2 | 2.510e+03 | 883 | 0.94 | 2.39 | 0 | 0 | .5 | 2.13e-5 | 1.8 | 0. | :TSw33-matrix |
| : 3 | 2.540e+03 | 900 | 1.60 | 2.69 | 0 | 0 | .5 | 2.13e-5 | 1.8 | 0. | :TSw35-matrix |
| : below are thermal conducitivities decreased by 1/3 | | | | | | | | | | | |
| 1 | 2.530e+03 | 948 | 1.05 | 1.56 | 0 | 0 | .5 | 2.13e-5 | 1.8 | 0. | :TSw34-matrix |
| 2 | 2.510e+03 | 883 | 0.48 | 1.21 | 0 | 0 | .5 | 2.13e-5 | 1.8 | 0. | :TSw33-matrix |
| 3 | 2.540e+03 | 900 | 0.80 | 1.35 | 0 | 0 | .5 | 2.13e-5 | 1.8 | 0. | :TSw35-matrix |

} basecase $K_T$
} 1/3 increase in $K_T$
} 1/3 decrease in $K_T$

/home/rgreen/dst_scans/decovalex/xlm1.0/varyinfil/type2/rev-source/d18h.dat
1/3 decrease in $K_T$, 0.036 mm/yr infiltration in mut2c.bc
low fracture permeability in muk-2-phk, i.e. in d5+45v.i...
80 ml/hr mass loss as per pages 136-138

Better match at wing heaters but not as good above heat pipe along borehole 158

9/12/00 RJJ

Continued simulation of DST, these calculations are reported in a document to be prepared for DECOVALEX III Task 2 in RDTME

Variables explored in these analyses were a reduced fracture permeability and a reduced thermal conductivity. These two parameter reductions resulted in better agreement between test (DST) observations and simulation results

Thermal conductivity was reduced by 20% in all 3 units:

```
: no rho       cpr   ckdry  cksat   crp  crt   tau  cdiff    cexp  enbd
: 1 2.530e+03  948   1.56   2.33    0    0     .5   2.13e-5  1.8   0.   :TSw34-matrix
: 2 2.510e+03  883   0.71   1.80    0    0     .5   2.13e-5  1.8   0.   :TSw33-matrix
: 3 2.540e+03  900   1.20   2.02    0    0     .5   2.13e-5  1.8   0.   :TSw35-matrix
: below are thermal conductivities decreased by 0.2
  1 2.530e+03  948   1.25   1.86    0    0     .5   2.13e-5  1.8   0.   :TSw34-matrix
  2 2.510e+03  883   0.57   1.44    0    0     .5   2.13e-5  1.8   0.   :TSw33-matrix
  3 2.540e+03  900   0.96   1.62    0    0     .5   2.13e-5  1.8   0.   :TSw35-matrix
0
```

and fracture permeability was reduced by a factor of 1000x in all 3 units, these values are in mvk-3.phk, the 3 values extracted from the 1740 line input file appear:

```
1 1  1  2 1 0.6462 1 3.44e-12 3.44e-12 5.45e-11 0.089 4.08e-18 1 1

1207 1207  1  6 3 13.31 1 2.77e-12 2.77e-12 1.16e-11 0.115 2.22e-17 5 3

1337 1337  1  4 2 172.9 1 8.49e-12 8.49e-12 2.5e-10 0.135 2.04e-17 3 2
```

The upper Boundary Condition is mixed (type 5) w/ infiltration rate of 0.072 mm/yr in nupr6.bc



RJJ

this equals 0.072 mm/yr (see pg 130)

nupr6.bc

```
5 3 1265 1265 1 8.771 13.59 8.771
0. 1.00000e-15 8.7000e+04 2.20000e+01 1.00000e-01 0.
0. 2.17450e-05 8.7000e+04 2.20000e+01 9.50000e-01 0.
.
5 3 1266 1266 1 8.771 13.59 8.771
0. 1.00000e-15 8.7000e+04 2.20000e+01 1.00000e-01 0.
0. 2.17450e-05 8.7000e+04 2.20000e+01 9.50000e-01 0.
.
1 3 1267 1267 1 8.771 13.59 -8.771
0. 1.00000e-15 8.91560e+04 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 8.91560e+04 2.60000e+01 9.30000e-01 0.
.
1 3 1268 1268 1 8.771 13.59 -8.771
0. 1.00000e-15 8.91560e+04 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 8.91560e+04 2.60000e+01 9.30000e-01 0.
.
5 3 1269 1269 1 8.812 15.79 8.812
0. 1.00000e-15 8.7000e+04 2.20000e+01 1.00000e-01 0.
0. 2.17450e-05 8.7000e+04 2.20000e+01 9.50000e-01 0.
.
5 3 1270 1270 1 8.812 15.79 8.812
0. 1.00000e-15 8.7000e+04 2.20000e+01 1.00000e-01 0.
0. 2.17450e-05 8.7000e+04 2.20000e+01 9.50000e-01 0.
.
1 3 1271 1271 1 8.812 15.79 -8.812
0. 1.00000e-15 8.91560e+04 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 8.91560e+04 2.60000e+01 9.30000e-01 0.
.
1 3 1272 1272 1 8.812 15.79 -8.812
0. 1.00000e-15 8.91560e+04 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 8.91560e+04 2.60000e+01 9.30000e-01 0.
.
5 3 1273 1273 1 8.94 17.61 8.94
0. 1.00000e-15 8.7000e+04 2.20000e+01 1.00000e-01 0.
0. 2.17450e-05 8.7000e+04 2.20000e+01 9.50000e-01 0.
.
5 3 1274 1274 1 8.94 17.61 8.94
0. 1.00000e-15 8.7000e+04 2.20000e+01 1.00000e-01 0.
0. 2.17450e-05 8.7000e+04 2.20000e+01 9.50000e-01 0.
.
1 3 1275 1275 1 8.94 17.61 -8.94
0. 1.00000e-15 8.91560e+04 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 8.91560e+04 2.60000e+01 9.30000e-01 0.
.
1 3 1276 1276 1 8.94 17.61 -8.94
0. 1.00000e-15 8.91560e+04 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 8.91560e+04 2.60000e+01 9.30000e-01 0.
.
5 3 1277 1277 1 8.812 15.56 8.812
0. 1.00000e-15 8.7000e+04 2.20000e+01 1.00000e-01 0.
0. 2.17450e-05 8.7000e+04 2.20000e+01 9.50000e-01 0.
.
5 3 1278 1278 1 8.812 15.56 8.812
0. 1.00000e-15 8.7000e+04 2.20000e+01 1.00000e-01 0.
0. 2.17450e-05 8.7000e+04 2.20000e+01 9.50000e-01 0.
.
1 3 1279 1279 1 8.812 15.56 -8.812
0. 1.00000e-15 8.91560e+04 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 8.91560e+04 2.60000e+01 9.30000e-01 0.
.
1 3 1280 1280 1 8.812 15.56 -8.812
0. 1.00000e-15 8.91560e+04 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 8.91560e+04 2.60000e+01 9.30000e-01 0.
.
5 3 1281 1281 1 8.968 17.05 8.968
0. 1.00000e-15 8.7000e+04 2.20000e+01 1.00000e-01 0.
0. 2.17450e-05 8.7000e+04 2.20000e+01 9.50000e-01 0.
.
5 3 1282 1282 1 8.968 17.05 8.968
0. 1.00000e-15 8.7000e+04 2.20000e+01 1.00000e-01 0.
0. 2.17450e-05 8.7000e+04 2.20000e+01 9.50000e-01 0.
.
1 3 1283 1283 1 8.968 17.05 -8.968
0. 1.00000e-15 8.91560e+04 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 8.91560e+04 2.60000e+01 9.30000e-01 0.
.
1 3 1284 1284 1 8.968 17.05 -8.968
0. 1.00000e-15 8.91560e+04 2.60000e+01 5.00000e-02 0.
0. 0.00000e+00 8.91560e+04 2.60000e+01 9.30000e-01 0.
.
```

9/12/00

Input Boundary condition file. nupr6.bc in /home/rgvean/dst_scans/decovalex/xlm1-0/varyinFil/type2/xlm25/type5/lowk/rdtme/nupr6.bc

Gas pressure calculated as follows:

A 200 m tall column of air weighs (at STP)

$$\rho g h = \left[\frac{1.1\ kg}{m^3}\right]\left[9.8\ \frac{m}{s^2}\right]\left[200\ m\right]$$

$$= 2156\ \frac{kg\ m}{s^2}\ \frac{1}{m^2}$$

$$= 2156\left[10^5\ dyne\right]\left[\frac{1}{m^2}\right]$$

$$= 21{,}560\ bar\ \left[10^{-6}\right]$$

$$= 2.156e{-2}\ bar$$

$$= \frac{2.156e3\ Pa}{200\ m} = 10.78\ Pa/m$$

Assume $P_a$ of 8.7e4 Pa at ground surface then $P_a$ at model base is 8.7e4 + 2156 Pa = 8.915e4 Pa at model base

type 5 B.C. at surface (mixed)

type 1 B.C. at base (Dirichlet)

9/13/00 RH

Four final runs completed as this part of the exercise. All had areamodf = 1.0; fracture permeability reduced by 1000x,

RH 9/13/00

| | | | |
|---|---|---|---|
| Fig 6, 7 | rdt 11.dat ← repeated in rdt13.dat | no mass loss |
| Fig 8, 9 | rdt 12.dat | 80 mL/hr mass removal |
| Fig 12, 13 | rdt 14.dat | 0.2 reduction in $K_T$, 80 mL/hr loss |
| Fig 10, 11 | rdt 15.dat | 0.2 reduction in $K_F$, no mass loss |

All used initial conditions in rdt10.int output from rdt10.dat

all files in /home/dst_scans/decovalex/xlm1.0/varyinfil/type2/xlm25/type5/lowk/rdtme

Following are figures w/ these results

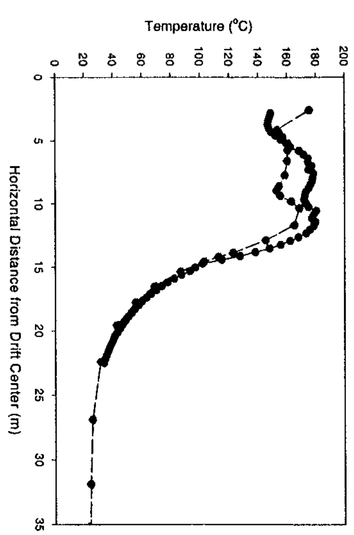


Figure 4-6b. Comparison of measured temperatures (solid circle) versus simulated temperatures in the matrix (closed triangle) and fracture (open circle) for horizontal borehole 160 for basecase property values except for a 1000x reduction fracture permeability

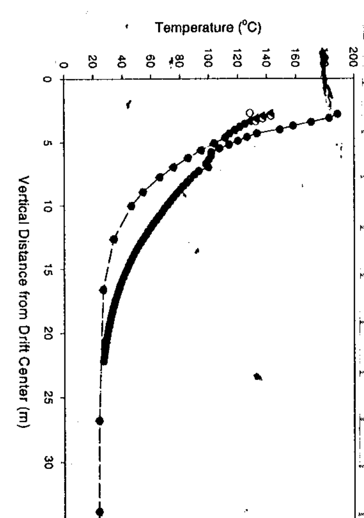


Figure 4-6a. Comparison of measured temperatures (solid circle) versus simulated temperatures in the matrix (closed triangle) and fracture (open circle) for vertical borehole 158 for basecase property values except for a 1000x reduction fracture permeability



9/13/00 RH

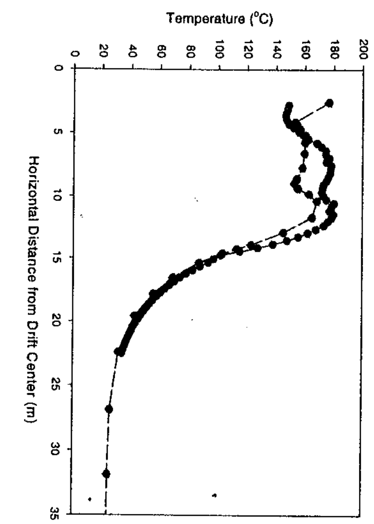


Figure 4-8b. Comparison of measured temperatures (solid circle) versus simulated temperatures in the matrix (closed triangle) and fracture (open circle) for horizontal borehole 160 for basecase property values except for a 1000x reduction fracture permeability

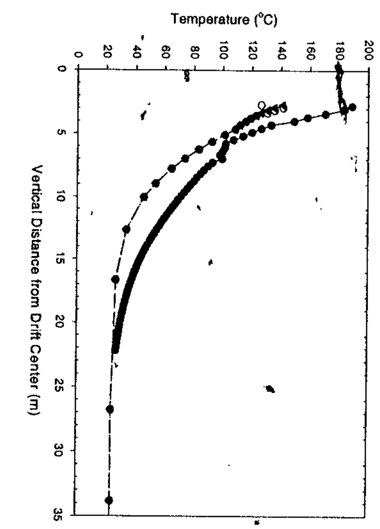


Figure 4-8a. Comparison of measured temperatures (solid circle) versus simulated temperatures in the matrix (closed triangle) and fracture (open circle) for vertical borehole 158 for basecase property values except for a 1000x reduction fracture permeability

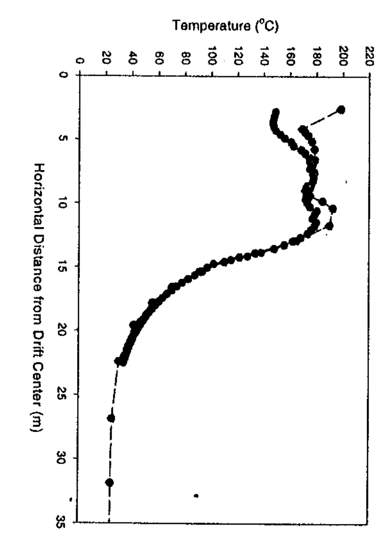


Figure 4-10b. Comparison of measured temperatures (solid circle) versus simulated temperatures in the matrix (closed triangle) and fracture (open circle) for horizontal borehole 160 for basecase property values except for a 1000x reduction fracture permeability and a 20-percent reduction in

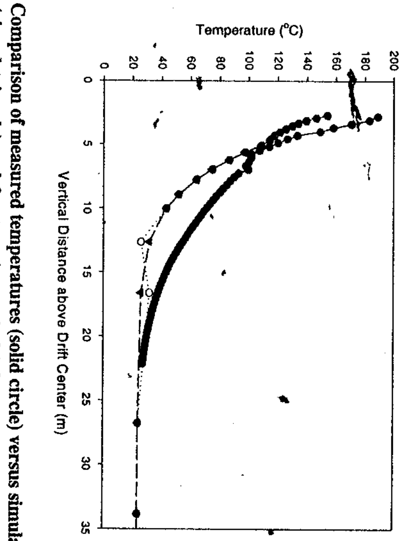


Figure 4-10a. Comparison of measured temperatures (solid circle) versus simulated temperatures in the matrix (closed triangle) and fracture (open circle) for vertical borehole 158 for basecase property values except for a 1000x reduction fracture permeability and a 20-percent reduction in

9/13/00
RJ

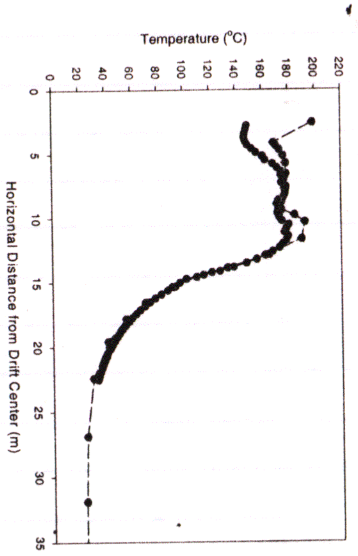



Figure 4-12b. Comparison of measured temperatures (solid circle) versus simulated temperatures in the matrix (closed triangle) and fracture (open circle) for horizontal borehole 160 for basecase property values except for a 1000x reduction fracture permeability, a 20-percent reduction in thermal conductivity, and a mass loss of 80mL/hr

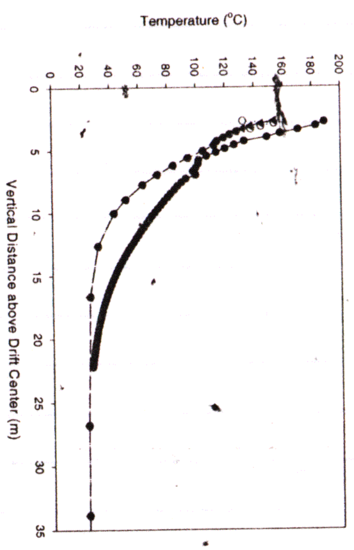



Figure 4-12a. Comparison of measured temperatures (solid circle) versus simulated temperatures in the matrix (closed triangle) and fracture (open circle) for vertical borehole 158 for basecase property values except for a 1000x reduction fracture permeability, a 20-percent reduction in thermal conductivity, and amass loss of 80mL/hr

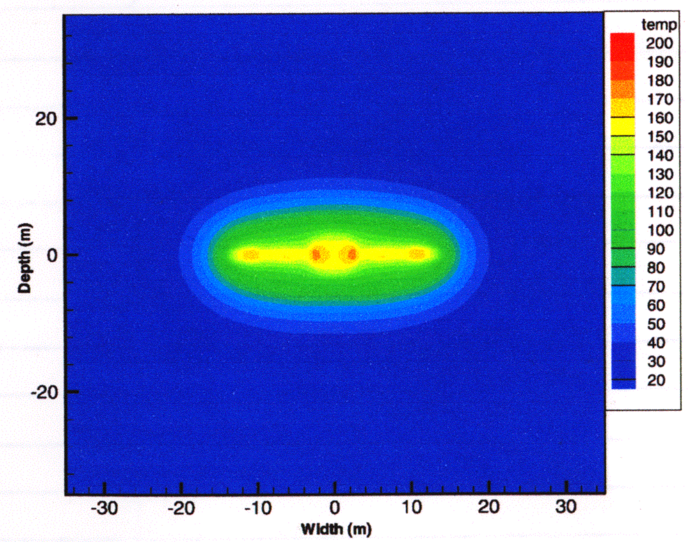



Figure 4-9a. Contour plot of simulated matrix temperature for basecase property values except for a 1000x reduction fracture permeability and a mass loss of 80mL/hr



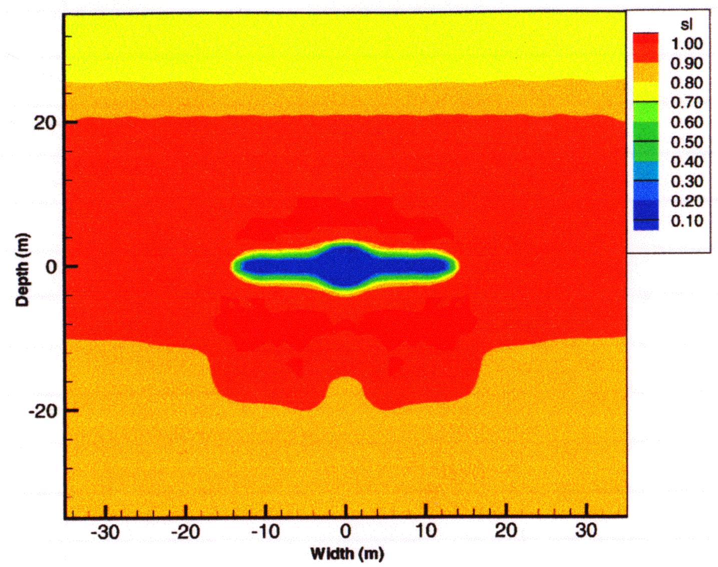



Figure 4-9b. Contour plot of simulated matrix saturation for basecase property values except for a 1000x reduction fracture permeability and a mass loss of 80mL/hr

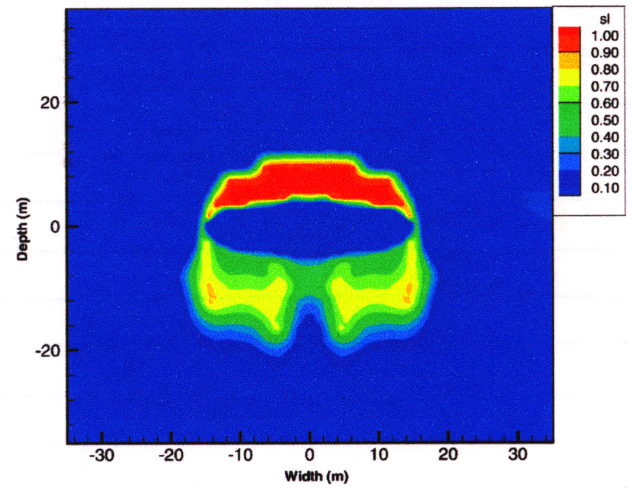



Figure 4-9c. Contour plot of simulated fracture saturation for basecase property values except for a 1000x reduction fracture permeability and a mass loss of 80mL/hr

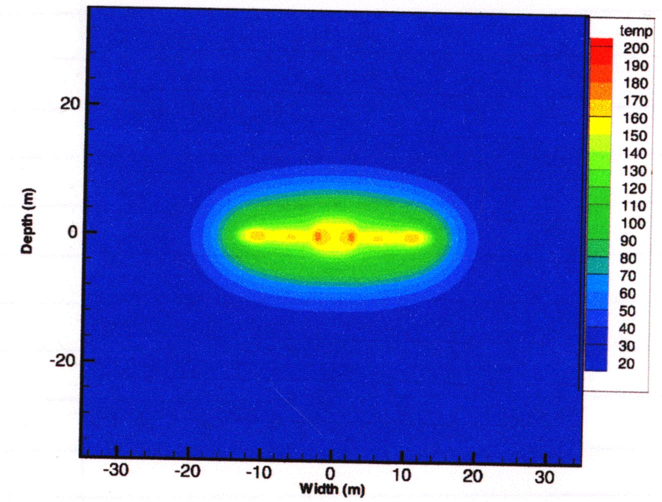



Figure 4-7a. Contour plot of simulated matrix temperature for basecase property values except for a 1000x reduction fracture permeability

 AH 9/13/00

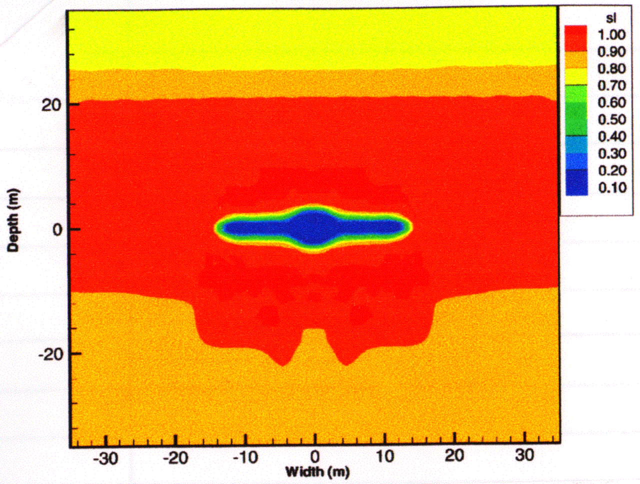



**Figure 4-7b. Contour plot of simulated matrix saturation for basecase property values except for a 1000x reduction fracture permeability**

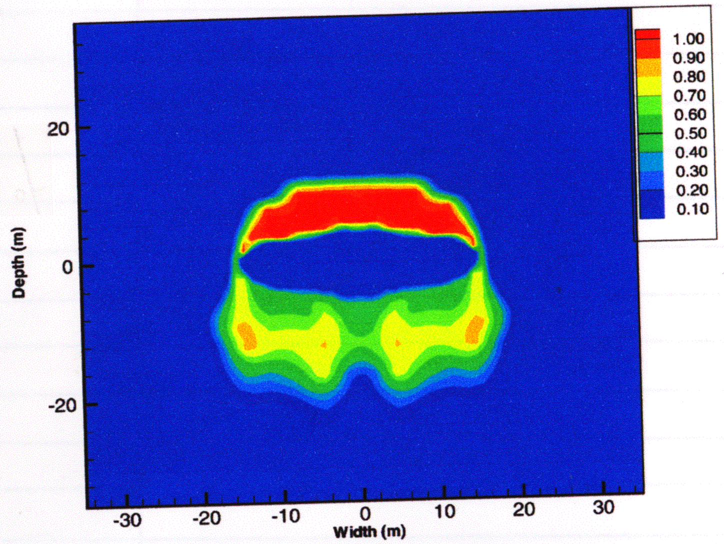



**Figure 4-7c. Contour plot of simulated fracture saturation for basecase property values except for a 1000x reduction fracture permeability**

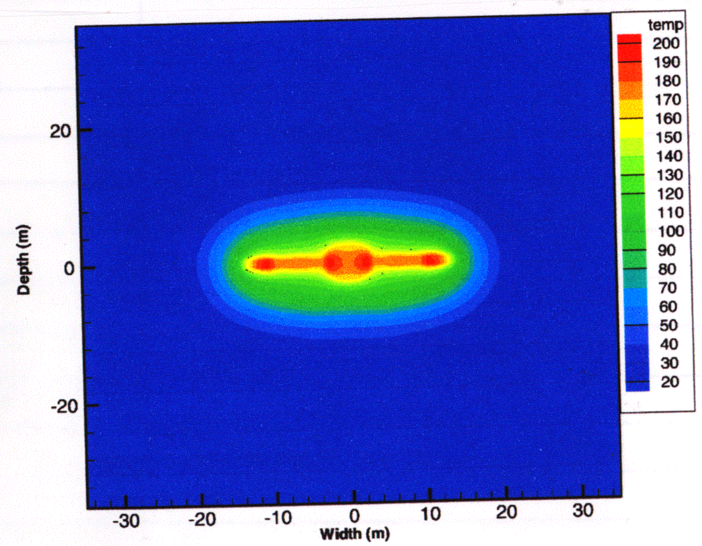



**Figure 4-11a. Contour plot of simulated matrix temperature for basecase property values except for a 1000x reduction fracture permeability and a 20-percent reduction in thermal conductivity**

9/13/00 / AH 

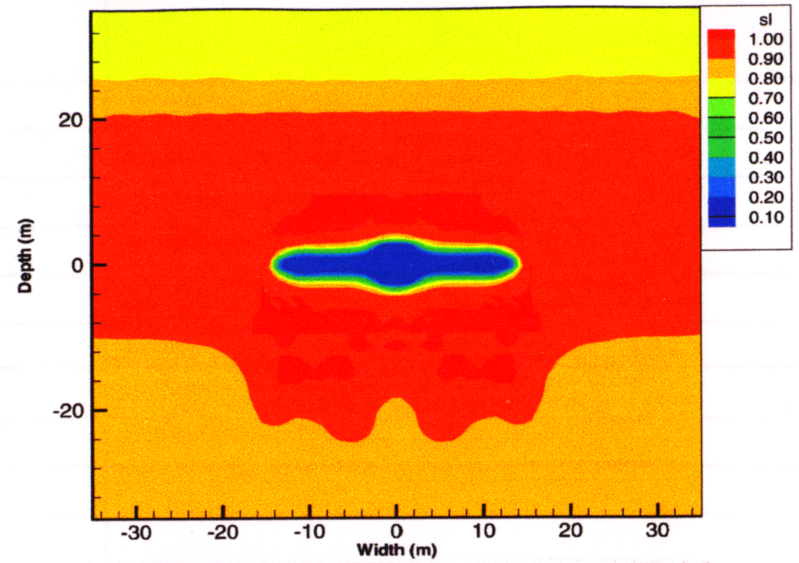



**Figure 4-11b. Contour plot of simulated matrix saturation for basecase property values except for a 1000x reduction fracture permeability and a 20-percent reduction in thermal conductivity**

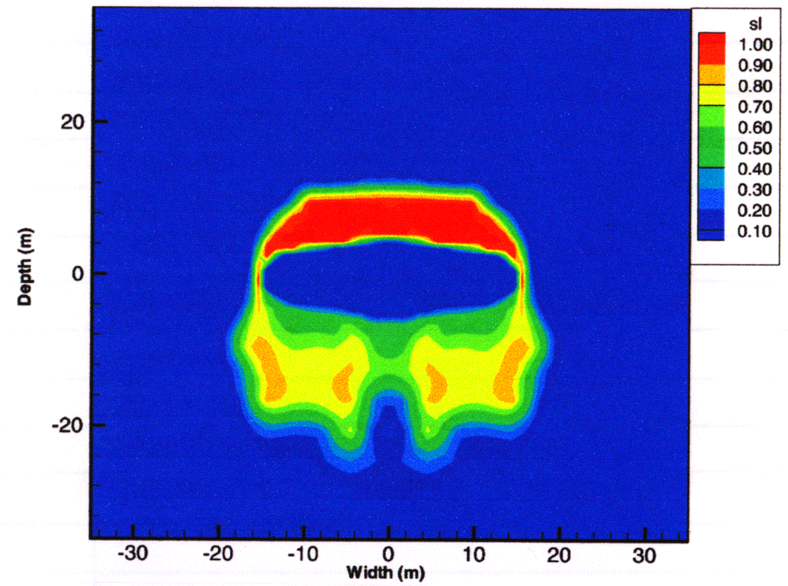



**Figure 4-11c. Contour plot of simulated fracture saturation for basecase property values except for a 1000x reduction fracture permeability and a 20-percent reduction in thermal conductivity**

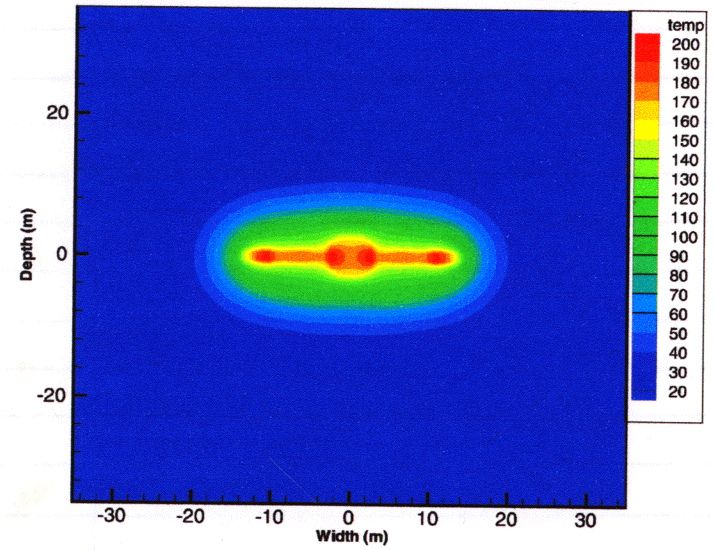



**Figure 4-13a. Contour plot of simulated matrix temperature for basecase property values except for a 1000x reduction fracture permeability, a 20-percent reduction in thermal conductivity, and a mass loss of 80mL/hr**

 9/13/00 RJJ

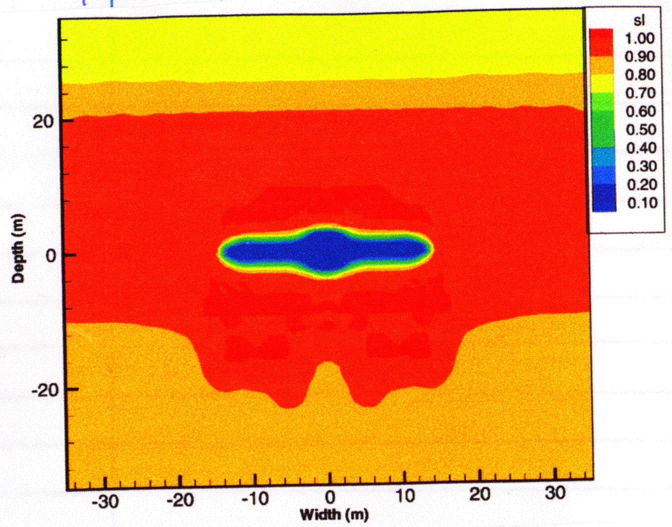



**Figure 4-13b.** Contour plot of simulated matrix saturation for basecase property values except for a 1000x reduction fracture permeability, a 20-percent reduction in thermal conductivity, and a mass loss of 80mL/hr

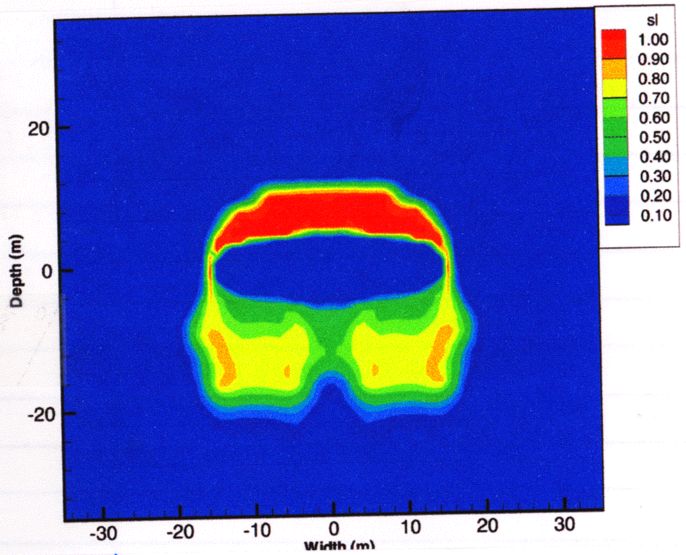



**Figure 4-13c.** Contour plot of simulated fracture saturation for basecase property values except for a 1000x reduction fracture permeability, a 20-percent reduction in thermal conductivity, and a mass loss of 80mL/hr

RJJ 9/13/00



9/15/00 RJJ Repeat exercise to evaluate effect of block size on steady state matrix saturation at element 1101 for revised boundary conditions i.e. $\Delta P_a = 2156$ Pa as initially stated in nupr6_bc

Directory = /home/vgreen/dst_scans/decovalex/sat-calc2/

areamodF = 1.0

new b.c. in m3-6.bc w/ 3.6 mm/yr 9/15/00 RJJ

| | x/m | 1101 matrix |
|---|---|---|
| rdt16.dat | 0.25 | ~~94.66%~~ |
| | | 99.90% |
| rdt17.dat | 20.0 | 84.89% |
| rdt18.dat | 10.0 | |

9/26/00 RJJ There are different DOE references for matrix saturation of the TSw

Possible data sources

Thermal Tests Thermal-Hydrological AMR 2000

pg 23 Single Heater tests data set

TSw 34 (Tptpmn) matrix saturation 0.924

cites SNT05071897001.002 - Base Case Thermal Property Data for TSPA-VA. VA Supporting data set 02/12/1998

This data set is for wet/dry $K_T$, specific heat of grains, density of grains, & tortuosity only - no saturation

9/26/00 RH

2nd reference cited in AMR is LB971212001254.001 – DKM Basecase Parameter Set for UZ Model w/ Mean Fracture Alpha, Present day infiltration, and estimated Welded, non-welded, and zeolitic FMX 12/12/97

This is only an input file / w/output no discussion of data source

A second source for TSw matrix saturation was provided by Robin Datta in a DECOVALEX email: following is the table he emailed on ~~9/2~~ RH 9/26/00 9/6/00

**Table1 Yucca Mountain Drift Scale Test Rock Properties**

| | TCw | Ptn | TSw1 | TSw2 Tptpmn | TSw2 Tptpll | TSw2 Tptpln | TSw3 | CHn |
|---|---|---|---|---|---|---|---|---|
| **Grain Density** [1] (kg/m$^3$) | 2530±30 | 2380±80 | 2550±20 | 2530±20 | 2560±20 | 2560±40 | 2370±10 | 2310 [2] |
| **Bulk Density** [1] (kg/m$^3$) | 2160±220 | 1280±210 | 2160±80 | 2250±70 | 2250±60 | 2300±90 | 2350±0 | 2360 |
| **Porosity** [1] (%) | 14.23±9.48 | 46.68±8.38 | 15.90±4.03 | 10.99±2.85 | 12.47±2.83 | 10.13±3.01 | 1.15±0.31 | N/A |
| **Young's Modulus** [3] (GPa) | 29.36±10.80 | 2.54±4.02 | 20.36±6.75 | 32.93±5.47 | 27.54±7.49 | 35.48±5.45 | 37.43±15.02 | 5.63±1.55 |
| **Poisson's Ratio** [4] | 0.21±0.11 | 0.23±0.17 | 0.23±0.07 | 0.21±0.03 | 0.21±0.06 | 0.24±0.05 | 0.24±0.13 | 0.17±0.12 |
| **Cohesion** [5] (MPa) | 33.9 | 1.3* | 9.3 | 42.8 | 36.9 | 22.7 | 3.5 | N/A |
| **Angle of Friction** [5] (degrees) | 60 | 48* | 52 | 55 | 53 | 58 | 47 | N/A |
| **Thermal Conductivity** [6] **for T <100°C (W/m°K)** | 0.98 | 0.88 | 1.72 | 2.33 | 2.02 | 1.84 | 2.08 | 1.93 |
| **Thermal Conductivity** [6] **for T >100°C (W/m°K)** | 0.54 | 0.39 | 0.84 | 1.56 | 1.20 | 1.42 | 1.69 | 1.50 |
| **Coefficient of Thermal Expansion** [7] **MCTE 25-50 °C (μs/°C)** | 6.60±1.49 | 4.55±0.74 | 6.29±1.22 | 6.89±1.45 | 6.41±0.75 | 6.55±1.29 | N/A | N/A |
| **Coefficient of Thermal Expansion** [7] **MCTE 50-150 °C (μs/°C)** | 8.29±0.99 to 12.69±1.55 | -4.78±11.12 to 6.46±0.98 | 7.60±1.02 to 10.37±1.38 | 8.45±0.30 to 10.12±0.36 | 8.15±0.37 to 9.87±0.68 | 8.24±0.57 to 10.65±2.17 | N/A | N/A |
| **Coefficient of Thermal Expansion** [7] **MCTE 150-250°C (μs/°C)** | 14.90±1.91 to 29.64±21.88 | -2.98±9.12 to 5.69±1.41 | 15.51±4.53 to 34.24±20.30 | 10.95±0.52 to 19.45±3.47 | 10.75±1.01 to 25.19±27.61 | 11.56±2.75 to 13.87±1.11 | N/A | N/A |
| **Specific Heat** [6] (J/kg.k) | 857 | 1086 | 876 | 948 | 900 | 865 | 984 | 998 |
| **Fracture Frequency** [8] (1/m) | 1.37 | 0.58 | 0.81 | 1.88 | 1.81 | 2.10 | 2.88 | 0.24 |
| **Saturation** [9] | 0.631 | 0.527 | N/A | 0.951 | N/A | N/A | N/A | N/A |
| **Matrix Permeability** [10] (m$^2$) | $2.02\times10^{-18}$ | $1.94\times10^{-13}$ | $1.13\times10^{-15}$ | $8.03\times10^{-18}$ | $2.81\times10^{-17}$ | $7.54\times10^{-18}$ | $7.23\times10^{-18}$ | $8.77\times10^{-18}$ |
| **Fracture Permeability** [10] (m$^2$) | $4.51\times10^{-12}$ | $5.29\times10^{-13}$ | $8.31\times10^{-13}$ | $6.07\times10^{-13}$ | $1.29\times10^{-12}$ | $1.25\times10^{-12}$ | $1.20\times10^{-12}$ | $2.51\times10^{-14}$ |

See notes below for data sources



9/26/00 RH

Source Data:

[1] Table 2-3 in Yucca Mountain Site Geotechnical Report, B00000000-01717-5705-00043 Revision 01 Volume I of II March 1997.
[2] Source data: Data Tracking NumberLB990861233129.001
[3] Table 2-7 in Yucca Mountain Site Geotechnical Report, B00000000-01717-5705-00043 Revision 01 Volume I of II March 1997.
[4] Table 2-8 in Yucca Mountain Site Geotechnical Report, B00000000-01717-5705-00043 Revision 01 Volume I of II March 1997.
[5] Table 5-32 in Yucca Mountain Site Geotechnical Report, B00000000-01717-5705-00043 Revision 01 Volume I of II March 1997.
[6] Table 4-2 in report, *Ground Control For Emplacement Drifts for SR*," ANL-EBS-GE-000002, Revision 00, April 17, 2000.
[7] Table 5-5-15 and 5-17 in Yucca Mountain Site Geotechnical Report, B00000000-01717-5705-00043 Revision 01 Volume I of II March 1997.
[8] Table 7-7 and Table 7-10 in report *The Site-Scale Unsaturated Zone Model of Yucca Mountain, Nevada, for The Viability Assessment*, June 1997.
[9] Table 6.2.10-1 in report *The Site-Scale Unsaturated Zone Model of Yucca Mountain, Nevada, for The Viability Assessment*, June 1997.
[10] Table 6.5.3-1 in report *The Site-Scale Unsaturated Zone Model of Yucca Mountain, Nevada, for The Viability Assessment*, June 1997.
* Estimated properties from Rock Mass Rating (RMR) values.

**Table 6.2.10-1 ESF Alcove Saturation and Water Potential Data (StDev=Standard Deviation)**

| ALCOVE | HYDRO. UNIT (GEOL.)/FAULT | AVE. SAT. | STDEV. | GEOM. AVE POT. (BARS) | LOG STDEV. |
|---|---|---|---|---|---|
| 2 | TCw (Tpcpxx) / Bow Ridge | 0.631 | 0.210 | 3.6 | 0.7 |
| 3a | TCw(Tpcpln) | 0.795 | 0.093 | 4.6 | 0.5 |
| 3b | PTn(Tpcpv1) | 0.522 | 0.084 | 2.0 | 0.5 |
| 4 | PTn (Tptrv3) | 0.529 | 0.161 | 1.65 | 0.5 |
| 5 | TSw(Tptpmn) | 0.951 | 0.039 | - | - |
| 6 | TSw(Tptpmn)/ Ghost Dance | 0.866 | 0.078 | - | - |

Taken from 1997 UZ site-scale model of YM

Alcoves 2 and 6 in the ESF are located near faults, and the collected data may provide an indication of the effect of faults on UZ ambient conditions. The relatively low average saturation calculated from the data obtained in Alcove 2 may be a result of increased air flow through the more fractured TCw near the Bow Ridge Fault. The alcove saturation data are consistent, however, with core sample saturation data from boreholes in regions with relatively low infiltration rates.

RH 9/26/00

9/27/00
RH

Got the following email from Robin Datta

**Ron Green**

| | |
|---|---|
| **From:** | Robin_Datta@notes.ymp.gov |
| **Sent:** | Tuesday, September 26, 2000 10:45 AM |
| **To:** | rgreen@swri.edu |
| **Cc:** | Deborah_Barr@notes.ymp.gov; Mysore Nataraja (mnataraja); Jeffrey Phole (jpohle); Chad Glenn (cglenn); ndfranc@sandia.gov; Yvonne_Tsang@notes.ymp.gov; William_Boyle@notes.ymp.gov; Ralph_Wagner@notes.ymp.gov |
| **Subject:** | RE: Thermal Test workshop and saturation values |

Ron,

The initial saturation of 0.924 given on page 23 of the AMR is, as it says there, for the Single Heater Test model. The number is based on lab measurements of samples from SHT block. For the TH simulation of the SHT (by TOUGH), the initial saturation at the bottom of the block was set at 0.924 and the model was allowed to equilibrate without heat, before applying the heat.

On the next two pages of the AMR, pages 24 and 25, you will notice that there are no intial saturation in the input list for the TH simulations of the Drift Scale Test by TOUGH and NUFT. For the TH simulations of the DST, the initialization/equilibration run was an 1-D model without heat with inputs of various hydrologic properties "but initial saturation". Whatever initial saturation the 1-D model equilibrated to was the initial saturation at the start of heating (the 3-D DST model).

The value 0.951 given in the list of rock properties I recently distributed to DECOVALEX Task 2 research teams is based on data from the hole SD-9 . SD-9 is closest to the DST block for which various rock properties data are available.

I don't know what initialization/equilibration process you are using for the TH simulation of DST for DECOVALEX. If you are using the one Nick Francis used for the SHT(described above), an intial satuartion of 0.951 seems to be appropriate. If you have already used a different number, don't fret, the simulation results i.e predicted temperatures and saturations will not be much different as long as the number is close to but below full saturation, say 0.9 or thereabout.

Robin

10/25/00
RH

Started to incorporate the 'Active Fracture Model' into the simulations of the DST.

Based on Liu, H.H., C. Doughty, and G.S. Bodvarsson 'An active fracture model for unsaturated flow and transport in fractured rock' WRR 34(10) 1998 pg 2633-2646

Based on the paper, the van Genuchten relation is modified in the active fracture model.


RH

The standard van Genuchten relation for the capillary pressure:

$$(\text{Eq } 5) \quad P_c(S_e) = \frac{1}{\alpha}\left[S_e^{-\frac{1}{m}} - 1\right]^{\frac{1}{n}}$$

is modified to

$$(\text{Eq } 6) \quad P_c(S_e) = \frac{1}{\alpha}\left[S_e^{\frac{\gamma-1}{m}} - 1\right]^{\frac{1}{n}}$$

$-\frac{1-\gamma}{m}$ 12/8/00 RH

likewise the relative permeability function is modified to

$$(\text{Eq } 9) \quad k_r = S_e^{\frac{1+\gamma}{2}}\left[1 - \left\{1 - S^{\frac{1-\gamma}{m}}\right\}^m\right]^2$$

Note this is only for the fracture continuum in a DCM

Also note that replacing the fracture spacing with the effective fracture spacing changes the block size and the effective interface area between the fracture and matrix continua

Liu et al state the active fracture spacing is 1.85 to 7.2m (this equates to block size in MULTIFLO)

The interface area reduction factor is given by Liu et al to be 0.003 to 0.1 (this is comparable to the area modif factor in MULTIFLO)

10/25/00
RJJ

layer TSw4 in Liu et al is the Tptpmn
This layer has an active fracture spacing of
2.08 – 2.70 and a interface reduction
ratio of 0.005 – 0.011

likewise Tptpul in TSw3 has a
blocksize of 6.00 – 7.20 m and reduction
factor of 0.004 to 0.009

Tptpll is TSw5 with blocksize 2.00 – 2.70 m
and reduction factor of 0.005 – 0.012

Two sets of $\gamma$ used in sensitivity analyses
by Liu et al. In all cases same $\gamma$ for
TSw3, TSw4, TSw5

$\gamma \Rightarrow 0.427$ & $0.8$

10/26/00
RJJ

Note: following values are used in the DST

Matrix

| | $\alpha$ ($Pa^{-1}$) | m |
|---|---|---|
| TSw33 (TSw3) | $6.21 \times 10^{-6}$ | 0.2479 |
| TSw34 (TSw4) | $1.19 \times 10^{-6}$ | 0.3212 |
| TSw35 (TSw5) | $4.01 \times 10^{-6}$ | 0.1983 |

Fracture

$m = 1 - \frac{1}{n}$

| | | $m = \lambda$ | $n = b$ |
|---|---|---|---|
| TSw3 | $1.73 \times 10^{-3}$ | 0.667 | 3.00 |
| TSw4 | $9.34 \times 10^{-4}$ | 0.643 | 2.80 |
| TSw5 | $1.26 \times 10^{-3}$ | 0.667 | 3.00 |



11/6/00
RJJ

Write Mathematica routine to calculate
Eq 5, 6 & 9 from pg 161, also
Brooks-Corey for gas permeability for fractures

```
In[1964]:= $Version

Out[1964]= 4.0 for Microsoft Windows (April 21, 1999)

In[943]:= Off[General::"spell"]
          Off[General::"spell1"]

In[945]:= $Path

Out[945]= {C:\Program Files\Common Files\Mathematica\4.0\Kernel,
           C:\Program Files\Common Files\Mathematica\4.0\AddOns\Autoload,
           C:\Program Files\Common Files\Mathematica\4.0\AddOns\Applications,
           ., d:\, C:\PROGRA~1\WOLFRA~1\MATHEM~1\4.0\AddOns\StandardPackages,
           C:\PROGRA~1\WOLFRA~1\MATHEM~1\4.0\AddOns\StandardPackages\StartUp,
           C:\PROGRA~1\WOLFRA~1\MATHEM~1\4.0\AddOns\Autoload,
           C:\PROGRA~1\WOLFRA~1\MATHEM~1\4.0\AddOns\Applications,
           C:\PROGRA~1\WOLFRA~1\MATHEM~1\4.0\AddOns\ExtraPackages,
           C:\PROGRA~1\WOLFRA~1\MATHEM~1\4.0\SystemFiles\Graphics\Packages,
           C:\PROGRA~1\WOLFRA~1\MATHEM~1\4.0\Configuration\Kernel}

In[946]:= Directory[]

Out[946]= C:\PROGRA~1\WOLFRA~1\MATHEM~1\4.0

In[947]:= SetDirectory["Math.Packages"]

        SetDirectory::cdir : Cannot set current directory to Math.Packages.

Out[947]= C:\PROGRA~1\WOLFRA~1\MATHEM~1\4.0

In[948]:= $Path

Out[948]= {C:\Program Files\Common Files\Mathematica\4.0\Kernel,
           C:\Program Files\Common Files\Mathematica\4.0\AddOns\Autoload,
           C:\Program Files\Common Files\Mathematica\4.0\AddOns\Applications,
           ., d:\, C:\PROGRA~1\WOLFRA~1\MATHEM~1\4.0\AddOns\StandardPackages,
           C:\PROGRA~1\WOLFRA~1\MATHEM~1\4.0\AddOns\StandardPackages\StartUp,
           C:\PROGRA~1\WOLFRA~1\MATHEM~1\4.0\AddOns\Autoload,
           C:\PROGRA~1\WOLFRA~1\MATHEM~1\4.0\AddOns\Applications,
           C:\PROGRA~1\WOLFRA~1\MATHEM~1\4.0\AddOns\ExtraPackages,
           C:\PROGRA~1\WOLFRA~1\MATHEM~1\4.0\SystemFiles\Graphics\Packages,
           C:\PROGRA~1\WOLFRA~1\MATHEM~1\4.0\Configuration\Kernel}

    Directory[]

    /ipx2/bashful/lichtner/Math.Packages

    $Path

    {., ~, /ipx3/mathematica/Install/Preload,
     /ipx3/mathematica/StartU   p, /ipx3/mathematica/Packages}
```

11/6/00

```
Needs["Graphics`Graphics`"]
Needs["Graphics`Colors`"]
$DefaultFont = {"Helvetica-Bold", 14}

{Helvetica-Bold, 14}

$DefaultFont = {"Times-Bold", 16}

{Times-Bold, 16}

$MachinePrecision

16
```

## ■ Active fracture model for Van Genuchten and brooks-Corey equations fracture relative permeability, TSw3 and TSw5, bf=3.0

```
In[1989]:= Clear[krl, krg, hf, hm, head0, krlf, krlm, krel, pcap, sfmin, hb, sf, hbulk];

In[2285]:= tmp = OpenRead["H:\\rgreen\\math\\sat1.dat"];
           data = ReadList[tmp, {Number}] ;
           fsat = data

           af = 1 x 10^-3;
           γ = 0.427;      ← taken from Liu et al.
           sgresf = 0.01;
           slresf = 0.01;
           bf = 3.0;  = n
```

$$\text{caphf} = \frac{\left(-1 + \text{fsat}^{(\gamma-1)\left(\frac{bf}{bf-1}\right)}\right)^{1/bf}}{af}$$

$$\text{kacrlf} = \text{fsat}^{(1-\gamma)/2}\left(1 - \left(1 - \text{fsat}^{(1-\gamma)\left(\frac{bf}{bf-1}\right)}\right)^{\frac{bf-1}{bf}}\right)^2$$

$$\text{sstarf} = \frac{\text{fsat} - \text{slresf}}{1 - \text{slresf} - \text{sgresf}};$$

```
kbcgf = (1 - sstarf^2) (1 - sstarf)^2
kbclf = sstarf^4          Brooks-Corey   Krg

Out[2287]= {{1.×10^-7}, {0.05}, {0.1}, {0.15}, {0.2}, {0.25}, {0.3}, {0.35}, {0.4}, {0.45},
           {0.5}, {0.55}, {0.6}, {0.65}, {0.7}, {0.75}, {0.8}, {0.85}, {0.9}, {0.95}, {1.}}

Out[2293]= {{101274.}, {2297.61}, {1840.64}, {1601.41}, {1440.34}, {1318.49}, {1219.72},
           {1135.82}, {1062.07}, {995.442}, {933.858}, {875.773}, {819.937}, {765.234},
           {710.552}, {654.615}, {595.727}, {531.225}, {455.945}, {355.881}, {0.}}

Out[2294]= {{4.06741×10^-15}, {0.00112187}, {0.00460684}, {0.0106185},
           {0.0193263}, {0.0309149}, {0.0455895}, {0.0635822}, {0.0851594},
           {0.110632}, {0.140366}, {0.174807}, {0.2145}, {0.260138}, {0.312627},
           {0.373201}, {0.443649}, {0.526782}, {0.627653}, {0.757938}, {1.}}

Out[2296]= {{1.02041}, {0.918501}, {0.817804}, {0.7197}, {0.625407},
           {0.535983}, {0.452321}, {0.375154}, {0.305051}, {0.242418}, {0.1875},
           {0.140377}, {0.100969}, {0.0690315}, {0.0441577}, {0.0257785},
           {0.0131622}, {0.00541441}, {0.00147797}, {0.000133222}, {-2.13581×10^-6}}

Out[2297]= {{1.08412×10^-8}, {2.77546×10^-6}, {0.0000711321}, {0.000416493},
           {0.0014129}, {0.003597}, {0.0076681}, {0.0144881}, {0.0250815},
           {0.0406356}, {0.0625}, {0.0921872}, {0.131372}, {0.181893}, {0.245749},
           {0.325104}, {0.422283}, {0.539775}, {0.68023}, {0.846461}, {1.04145}}
```



11/6/00

This is how the active fracture model of Brooks-Corey data looks when input into MULTIFLO in Pckr section

```
/
: fracture permeability for Tsw34
  8 TABular  0.01  0.  0.  0.  0.  0
               .0000  0.000e-04  1.000E+00  101274.
               .0500  8.614e-04  9.185e-01  2297.61
               .1000  3.698e-03  8.178e-01  1840.64
               .1500  8.753e-03  7.197e-01  1601.41
               .2000  1.623e-02  6.254e-01  1440.34
               .2500  2.638e-02  5.360e-01  1318.49
               .3000  3.940e-02  4.523e-01  1219.72
               .3500  5.557e-02  3.752E-01  1135.82
               .4000  7.518e-02  3.051E-01  1062.07
               .4500  9.857e-02  2.424E-01  995.442
               .5000  1.261e-01  1.875E-01  933.858
               .5500  1.584e-01  1.404E-01  875.773
               .6000  1.959e-01  1.010E-01  819.937
               .6500  2.394e-01  6.903e-02  765.234
               .7000  2.899e-01  4.416e-02  710.552
               .7500  3.488e-01  2.578e-02  654.615
               .8000  4.179e-01  1.316e-02  595.727
               .8500  5.006e-01  5.414e-03  531.225
               .9000  6.023e-01  1.478e-03  455.945
               .9500  7.363e-01  1.332e-04  355.881
              1.0000  1.000e+01  0.000e-00  0.0
/
: fracture permeability for TSw33 and TSw35
  9 TABular  0.01  0.  0.  0.  0.  0
               .0000  0.000e-04  1.000E+00  101274.
               .0500  1.122e-03  9.185e-01  2297.61
               .1000  4.607e-03  8.178e-01  1840.64
               .1500  1.062e-02  7.197e-01  1601.41
               .2000  1.932e-02  6.254e-01  1440.34
               .2500  3.091e-02  5.360e-01  1318.49
               .3000  4.559e-02  4.523e-01  1219.72
               .3500  6.358e-02  3.752E-01  1135.82
               .4000  8.516e-02  3.051E-01  1062.07
               .4500  1.106e-01  2.424E-01  994.442
               .5000  1.404e-01  1.875E-01  933.858
               .5500  1.748e-01  1.404E-01  875.773
               .6000  2.145e-01  1.010E-01  819.937
               .6500  2.601e-01  6.903e-02  765.234
               .7000  3.126e-01  4.416e-02  710.552
               .7500  3.732e-01  2.578e-02  654.615
               .8000  4.436e-01  1.316e-02  595.727
               .8500  5.268e-01  5.414e-03  531.225
               .9000  6.276e-01  1.478e-03  455.945
               .9500  7.579e-01  1.332e-04  355.881
              1.0000  1.000e+01  0.000e-00  0.0
```

11/6/00

11/07/00
RJJ

```
DCMPARA
: elem1 elemn inc  volf      areamodf  xlm  ylm  zlm
1     1744 1 1.24e-4 1.0 0.25 0.25 0.25 1.0      : TSw34
1265 1390 1 1.05e-4 1.0 0.25 0.25 0.25 1.0 : TSw33
1433 1446 1 1.05e-4 1.0 0.25 0.25 0.25 1.0 : TSw33
847  848  1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
851  852  1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
855  856  1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
875  876  1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
879  880  1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1051 1052 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1055 1056 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1187 1188 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1191 1192 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1195 1196 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1199 1200 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1203 1204 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1207 1208 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1211 1212 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1215 1216 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1219 1220 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1223 1224 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1227 1228 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1231 1232 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1235 1236 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1239 1240 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1243 1244 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1247 1248 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1251 1252 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1255 1256 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1259 1260 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1263 1264 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1267 1268 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1271 1272 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1275 1276 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1279 1280 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1283 1284 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1287 1288 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1291 1292 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1295 1296 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35

1299 1300 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1303 1304 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1307 1308 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1311 1312 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1315 1316 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1319 1320 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1323 1324 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1327 1328 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1331 1332 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1335 1336 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1339 1340 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1343 1344 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1347 1348 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1351 1352 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1355 1356 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1359 1360 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1363 1364 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1367 1368 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1371 1372 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1375 1376 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1379 1380 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1383 1384 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1387 1388 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1391 1392 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1395 1396 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1399 1400 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1403 1404 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1423 1424 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1427 1428 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1431 1432 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1435 1436 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1439 1440 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1443 1444 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
1447 1448 1 3.29e-4 1.0 0.25 0.25 0.25 1.0 : TSw35
0
```

These are the DCM data input for basecase active fracture model.

11/7/00
RJJ



```
5  3  1265  1265 1 8.771 13.59 8.771
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  6.5836e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
5  3  1266  1266 1 8.771 13.59 8.771
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  6.5836e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
1  3  1267  1267 1 8.771 13.59 -8.771
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
1  3  1268  1268 1 8.771 13.59 -8.771
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
5  3  1269  1269 1 8.812 15.79 8.812
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  6.5836e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
5  3  1270  1270 1 8.812 15.79 8.812
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  6.5836e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
1  3  1271  1271 1 8.812 15.79 -8.812
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
1  3  1272  1272 1 8.812 15.79 -8.812
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
5  3  1273  1273 1 8.94 17.61 8.94
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  6.5836e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
5  3  1274  1274 1 8.94 17.61 8.94
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  6.5836e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
1  3  1275  1275 1 8.94 17.61 -8.94
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
1  3  1276  1276 1 8.94 17.61 -8.94
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
5  3  1277  1277 1 8.812 15.56 8.812
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  6.5836e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
5  3  1278  1278 1 8.812 15.56 8.812
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  6.5836e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
1  3  1279  1279 1 8.812 15.56 -8.812


0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
1  3  1280  1280 1 8.812 15.56 -8.812
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
5  3  1281  1281 1 8.968 17.05 8.968
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  6.5836e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
5  3  1282  1282 1 8.968 17.05 8.968
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  6.5836e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
1  3  1283  1283 1 8.968 17.05 -8.968
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
1  3  1284  1284 1 8.968 17.05 -8.968
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
```

This file is infZ18.bc w/ a infiltration rate of 0.218 mm/yr

$$\left[.218\ \frac{mm}{y}\right]\left[\frac{3.1536e7\ s}{y}\right]^{-1}$$

$$= 6.9127e-9\ \frac{mm}{y}\ s$$

RJJ 10/10/02

$$= 6.9127e-12\ \frac{m}{s}\left[\frac{1e3\ kg}{m^3}\right]$$

$$= 6.9127e-9\ \frac{Kg}{s\text{-}m^2}$$

need to divide by fracture porosity

TSw33 ⇒ 1.05e-4

$$= 6.5836e-5\ \frac{Kg}{s\text{-}m^2}$$

infZ18.bc

0.218 mm/yr is the infiltration rate used by LLBL/Nagh - the Thermal Tests AMR DST model

/home/rgreen/dst_scans/decovalex/afm/infZ18.bc

12/8/00

RH

home/rgreen/dst_scans/decovalex/agu/0.072.bc

```
5  3  1265  1265 1 8.771 13.59 8.771
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  2.17686e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
5  3  1266  1266 1 8.771 13.59 8.771
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  2.17686e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
1  3  1267  1267 1 8.771 13.59 -8.771
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
1  3  1268  1268 1 8.771 13.59 -8.771
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
5  3  1269  1269 1 8.812 15.79 8.812
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  2.17686e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
5  3  1270  1270 1 8.812 15.79 8.812
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  2.17686e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
1  3  1271  1271 1 8.812 15.79 -8.812
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
1  3  1272  1272 1 8.812 15.79 -8.812
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
5  3  1273  1273 1 8.94 17.61 8.94
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  2.17686e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
5  3  1274  1274 1 8.94 17.61 8.94
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  2.17686e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
1  3  1275  1275 1 8.94 17.61 -8.94
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
1  3  1276  1276 1 8.94 17.61 -8.94
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
5  3  1277  1277 1 8.812 15.56 8.812
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  2.17686e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
5  3  1278  1278 1 8.812 15.56 8.812
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  2.17686e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
1  3  1279  1279 1 8.812 15.56 -8.812
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
1  3  1280  1280 1 8.812 15.56 -8.812
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
5  3  1281  1281 1 8.968 17.05 8.968
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  2.17686e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
5  3  1282  1282 1 8.968 17.05 8.968
0.  1.00000e-15  8.7000e+04  2.20000e+01  1.00000e-01 0.
0.  2.17686e-05  8.7000e+04  2.20000e+01  9.50000e-01 0.
.
1  3  1283  1283 1 8.968 17.05 -8.968
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
1  3  1284  1284 1 8.968 17.05 -8.968
0.  1.00000e-15  8.91560e+04  2.60000e+01  5.00000e-02 0.
0.  0.00000e+00  8.91560e+04  2.60000e+01  9.30000e-01 0.
.
```

This is ~~the~~ *.bc file for 0.072 mm/yr basecase file.

very close to nuprb.bc on pg 149



12/13/00

RH

```
1261 1261  1  2 1 15.62 1 3.44e-09 3.44e-09 5.45e-08 0.089 4.08e-18 1 1
1262 1262  1  2 1 15.62 1 3.44e-09 3.44e-09 5.45e-08 0.089 4.08e-18 1 1
1263 1263  1  6 3 15.62 1 2.77e-09 2.77e-09 1.16e-08 0.115 2.22e-17 5 3
1264 1264  1  6 3 15.62 1 2.77e-09 2.77e-09 1.16e-08 0.115 2.22e-17 5 3
1265 1265  1  4 2 244.4 1 8.49e-09 8.49e-09 2.5e-07 0.135 2.04e-17 3 2
1266 1266  1  4 2 244.4 1 8.49e-09 8.49e-09 2.5e-07 0.135 2.04e-17 3 2
1
```

Tptpmn

Tptpll

Tptpul

this is a selection from murdt.phk basecase *.phk file. w/ three units' values. see pg 110

rdt13b.dat

basecase 0.072 mm/yr
no AFM
basecase fracture properties
blocksize 0.25m
DCM of 5e-4 (see pg 113)

RH 12/13/00

2/26/01
RH

Decovalex report is to have the following runs in March report

Basecase = rdt13b.dat

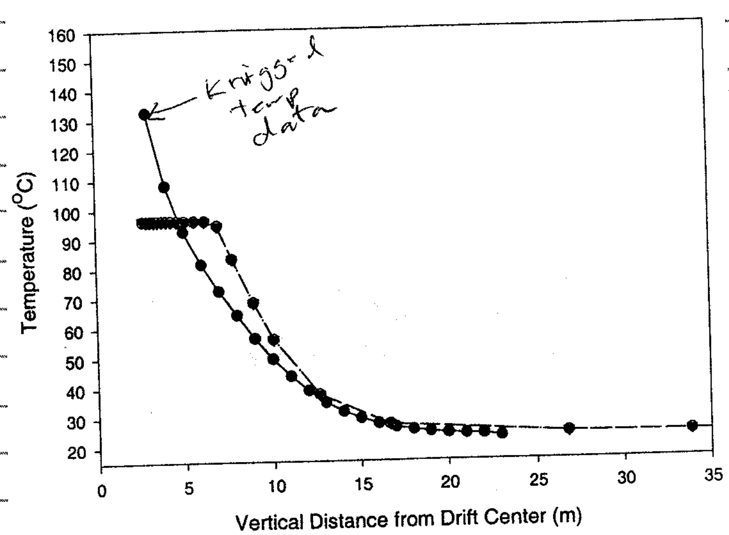
0.072 mm/yr infiltration
No AFM
block size 0.25 m
areamodf = 1.0
no reduction in fracture permeability

output is compared with krigged temperature data provided to the DECOVALEX project

data are compared with locations consistent w/ boreholes 158 (vertical) and 160 (horizontal)

Basecase predictions after 1-yr of heating are:

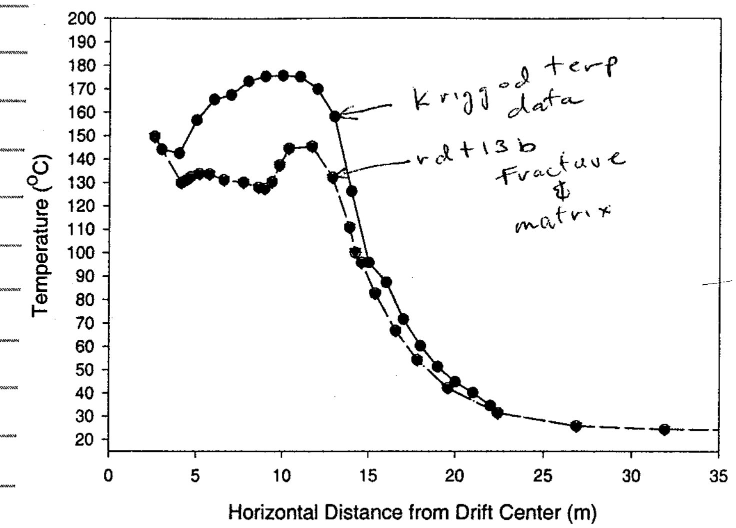
Borehole 158




Sigmaplot files are in ~~/home/rgreen/~~ RH 3/22/01
Stygian D:/Personal/text/DECOVALEX/deco3-1-Figs/
rdt13b158.JNB

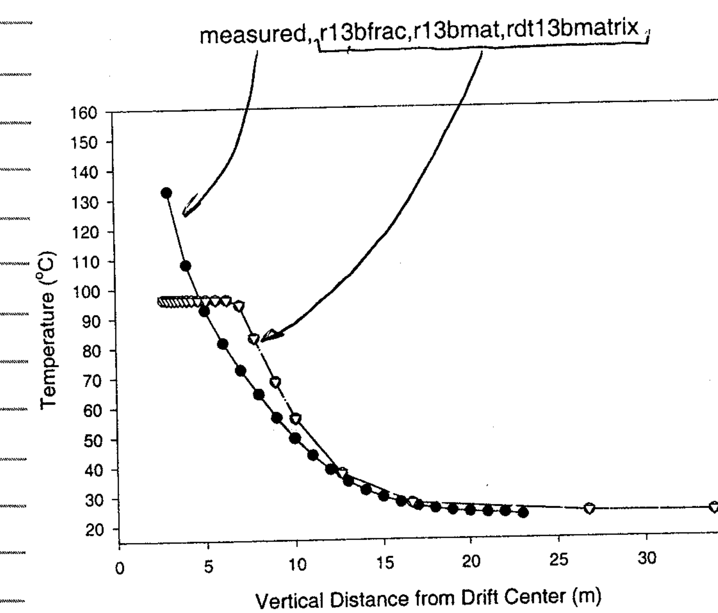


2/26/01
RH
Borehole 160




rdt13b160.JNB

Set two is to compare basecase to case w/ reduced areamodf (r13b.dat), sigmaplot file ≥ am.JNB



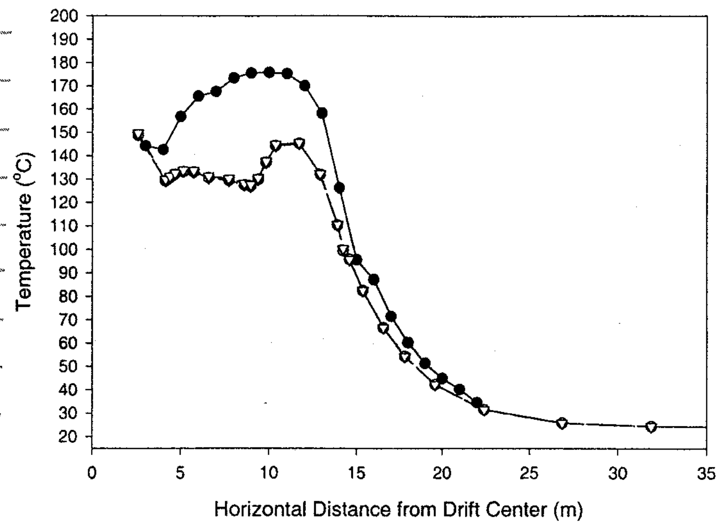

no difference w/ reduced areamodf

r13b158.JNB
r13b160.JNB } in /dst_scans/decovalex/barcelona/ & on zip barcelona 8/01

RH
9/16/01

2/26/01
RJf

measured, r13bfrac, r13bmat, rdt13bmat




am160.JNB

Next set looks at effect of reduction in fracture permeability.

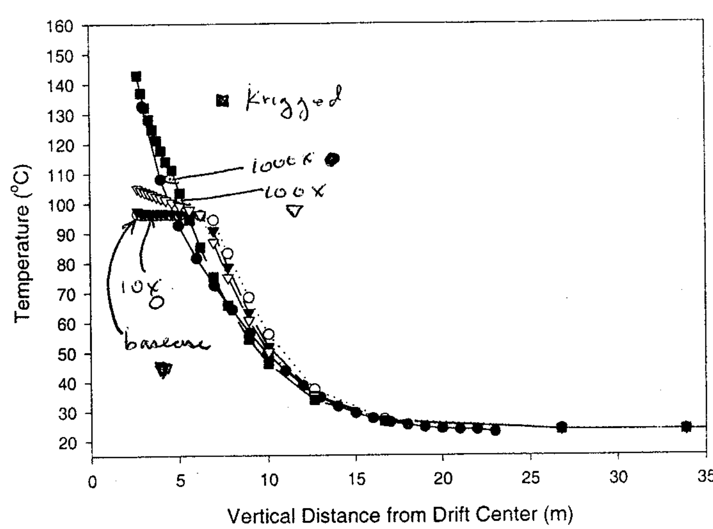
Notebooks x JNB are also on up:barcelona 8/01

| | | |
|---|---|---|
| rdt13b | basecase | |
| h4d-1-no | 10x | reduction in frac perm. |
| h3F-2-no | 100x | " " " |
| rdt13 | 1000x | " " " |

9/16/01
RJf

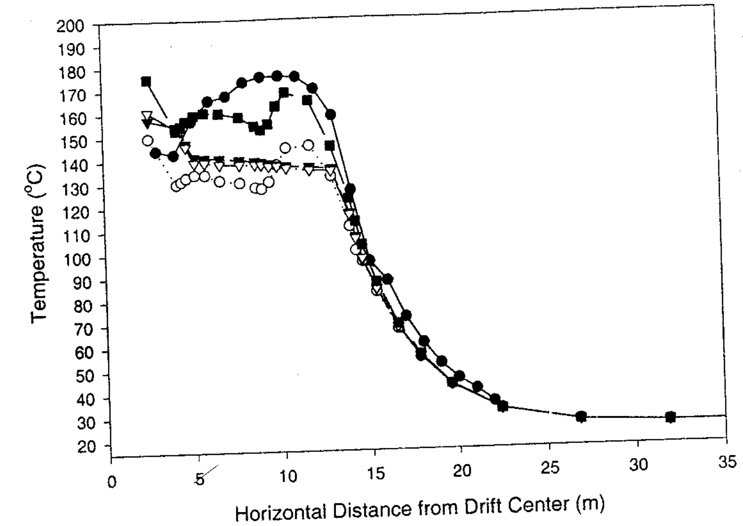
Sigmaplot = 4frac.JNB

Note: matrix & fracture data are essentially identical






2/26/01
RJf

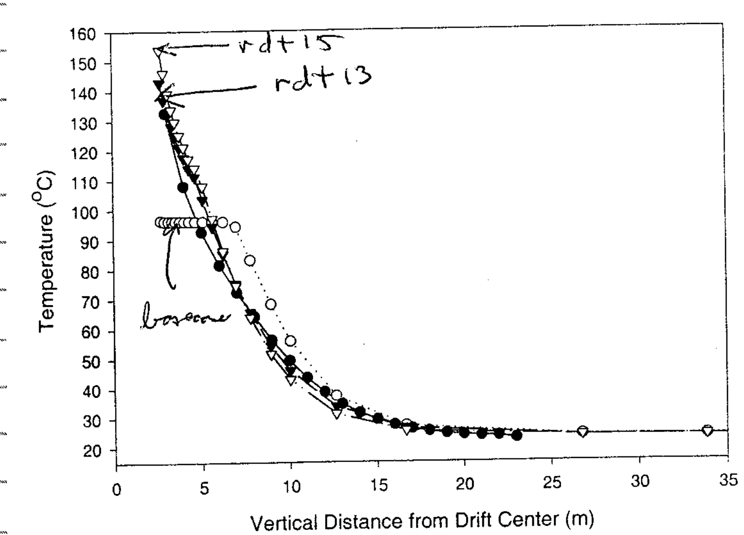



Sigmaplot: 4Frac160.JNB

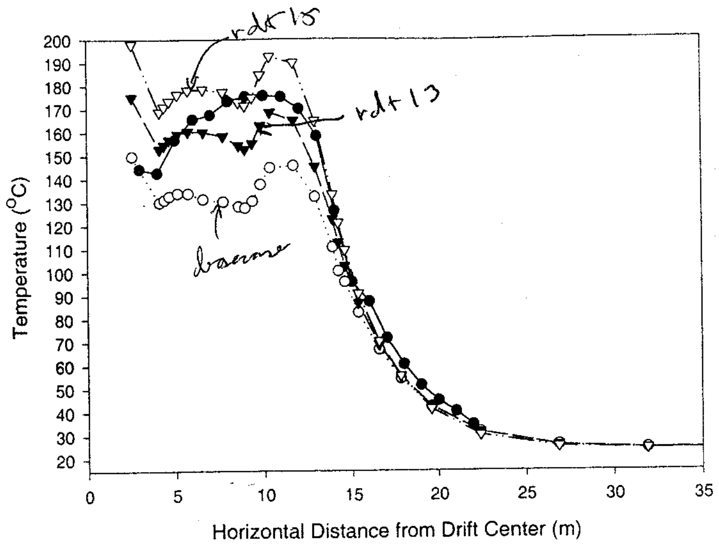
Next set compares effect of 20% reduction in $K_T$

rdt13b - basecase
rdt13 - 1000x reduction in k
rdt15 - 1000x reduction in k + 0.8 $K_T$

Sigmaplot: 3m1582.JNB



2/26/01
RH

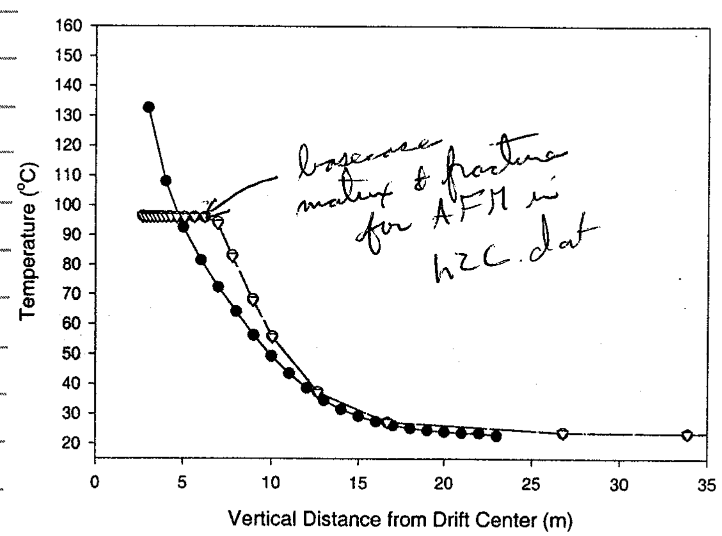



sigmaplot 3m1602.JNB

Next set evaluate effect of active fracture model
rdt136 — basecase
h2C — matrix
Fracture

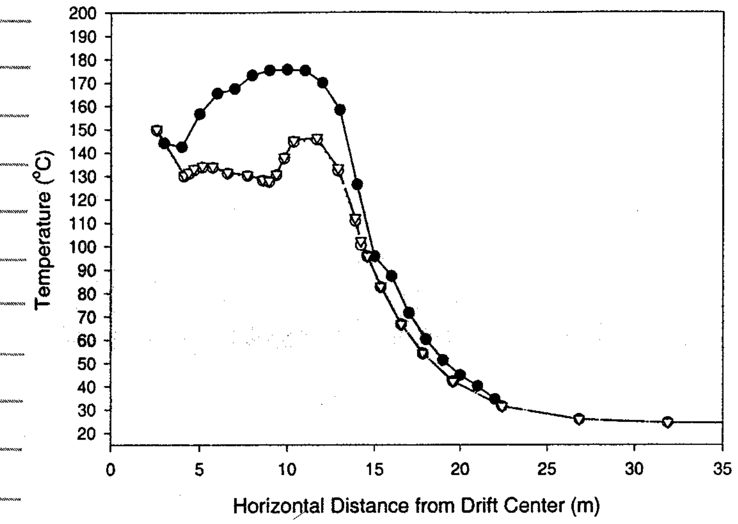
also on zip as *JNB
barcelona 8/01
RH
9/6/01

sigmaplot fd158.JNB






2/26/01
RH




AFM vs
No AFM

sigmaplot fd160.JNB

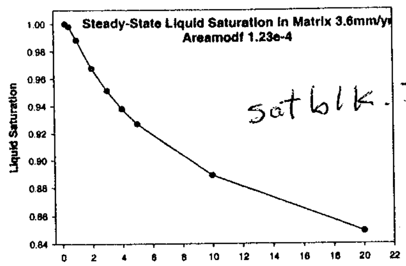
Note: *.phk file as follows

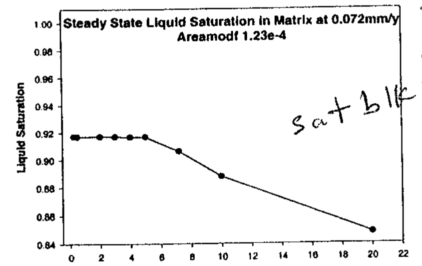
| | |
|---|---|
| murdt.phk | basecase perm, no AFM |
| m-1-no.phk | 10x reduction in k, no AFM |
| m-2-no.phk | 100x reduction in k, no AFM |
| muk-3-phk | 1000x reduction in k, no AFM |
| multi.phk | basecase perm, AFM |
| mk1aFm.phk | 10x reduction in k, AFM |
| mK4 aFm.phk | 100x reduction in k, AFM |
| mK3 aFm.phk | 1000x reduction in k, AFM |

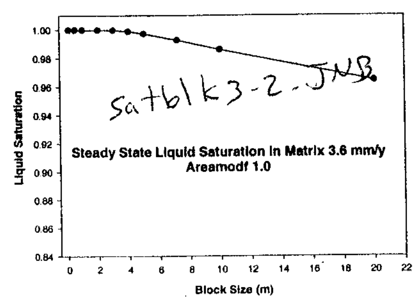
all on /home/mhill/agu/*

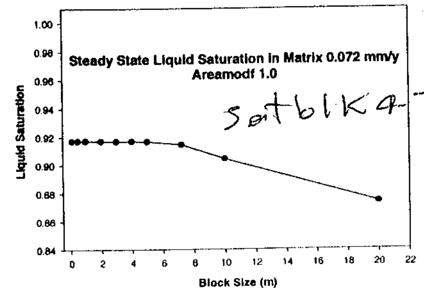
Additional discussion of these simulations can be found in Notebook 425 by Melissa Hill

3/22/01
RJF




these sigmaplot files are included in powerpoint file
stygian:D/personal/text/DECOVALEX/workshop-3.ppt

these calculations were all from steady-state simulations w/ no heat load

* Note all DECOVALEX files are on a zip drive labeled DECOVALEX 3/22/01

3/22/01



8/9/01
RJF

Additional dst runs

went out to 3 yrs, first is ~~dst RJF 8/9/01~~
1bk-2d.dat, which is base case
but w/ block size of 7.2m

in ~/dst_scans/decovalex/barcelona/*

3rd yr in 1bk-2d fldm2.xyp

needed to get temp data off of DOE website

started w/ zz_sep_173016.zip
unzipped to zz_sep_173016.txt

cut out all 158 & 160 data for nov 2000 into hd-158

cut out 158 data for one reading into
158-3yr.temp & 158-3yr.temp.xls

similarly for 160
160-3yr.temp & 160-3yr.temp.xls

in ~/dst_scans/dst-temp/*

these are most current: copied *xls to ~/dst_scans/decovalex/barcelona

sorted data (ascending spatially)

there are 67 sensors in borehole 158 - 20.04m
" " " " 160 - 20.11

8/9/01 Model element numbers are –
col158.dat & col160.dat

RH

| Borehole 158 vertical | Borehole 160 horizontal |
|---|---|
| 149 | 293 |
| 153 | 297 |
| 157 | 341 |
| 161 | 345 |
| 165 | 349 |
| 169 | 353 |
| 173 | 385 |
| 1097 | 409 |
| 1101 | 453 |
| 1105 | 457 |
| 1109 | 505 |
| 1113 | 509 |
| 1117 | 553 |
| 1185 | 577 |
| 1189 | 641 |
| 1265 | 661 |
| 1285 | 685 |
| 1305 | 689 |
| 1325 | 729 |
| 1345 | 737 |
| 1369 | 769 |
| 1525 | 793 |
| 1529 | 797 |
| 1589 | 833 |
| | 1405 |
| | 1409 |
| | 1413 |
| | 1417 |
| | 1501 |

Separation between sensors in borehole 158

$$\Delta y = \frac{20.04}{67} = 0.2991 \text{ m}$$

separation between sensors in borehole 160

$$\Delta x = \frac{20.11}{67} = 0.3001 \text{ m}$$



8/9/01

RH

160

| | | |
|---|---|---|
| 203.2823 | 1 | 2.8001 |
| 203.4169 | 2 | 3.1002 |
| 204.4851 | 3 | 3.4003 |
| 206.288 | 4 | 3.7004 |
| 208.1221 | 5 | 4.0005 |
| 210.8718 | 6 | 4.3006 |
| 214.3315 | 7 | 4.6007 |
| 217.7021 | 8 | 4.9008 |
| 222.8809 | 9 | 5.2009 |
| 226.597 | 10 | 5.501 |
| 230.1703 | 11 | 5.8011 |
| 233.1559 | 12 | 6.1012 |
| 235.6675 | 13 | 6.4013 |
| 236.1346 | 14 | 6.7014 |
| 237.8145 | 15 | 7.0015 |
| 237.6824 | 16 | 7.3016 |
| 238.9097 | 17 | 7.6017 |
| 238.5262 | 18 | 7.9018 |
| 238.0011 | 19 | 8.2019 |
| 235.5766 | 20 | 8.502 |
| 235.1359 | 21 | 8.8021 |
| 232.9727 | 22 | 9.1022 |
| 231.7559 | 23 | 9.4023 |
| 270.404 | 24 | 9.7024 |
| 230.8273 | 25 | 10.0025 |
| 232.011 | 26 | 10.3026 |
| 233.2509 | 27 | 10.6027 |
| 232.9241 | 28 | 10.9028 |
| 232.9237 | 29 | 11.2029 |
| 230.7268 | 30 | 11.503 |
| 228.985 | 31 | 11.8031 |
| 225.3484 | 32 | 12.1032 |
| 221.3678 | 33 | 12.4033 |
| 215.8429 | 34 | 12.7034 |
| 209.4868 | 35 | 13.0035 |
| 202.9322 | 36 | 13.3036 |
| 195.1149 | 37 | 13.6037 |
| 185.932 | 38 | 13.9038 |
| 175.7517 | 39 | 14.2039 |
| 163.9785 | 40 | 14.504 |
| 151.638 | 41 | 14.8041 |
| 140.4923 | 42 | 15.1042 |
| 130.7213 | 43 | 15.4043 |
| 121.662 | 44 | 15.7044 |
| 114.1774 | 45 | 16.0045 |
| 107.0806 | 46 | 16.3046 |
| 101.7714 | 47 | 16.6047 |
| 98.50698 | 48 | 16.9048 |
| 96.56401 | 49 | 17.2049 |
| 93.67453 | 50 | 17.505 |
| 90.46091 | 51 | 17.8051 |
| 87.99946 | 52 | 18.1052 |
| 85.21907 | 53 | 18.4053 |
| 82.83964 | 54 | 18.7054 |
| 80.41435 | 55 | 19.0055 |
| 78.23904 | 56 | 19.3056 |
| 75.9419 | 57 | 19.6057 |
| 73.92807 | 58 | 19.9058 |
| 71.8581 | 59 | 20.2059 |
| 69.52496 | 60 | 20.506 |
| 68.09212 | 61 | 20.8061 |
| 66.22509 | 62 | 21.1062 |
| 64.44165 | 63 | 21.4063 |
| 62.79852 | 64 | 21.7064 |
| 61.11923 | 65 | 22.0065 |
| 59.51937 | 66 | 22.3066 |
| 57.9452 | 67 | 22.6067 |

These are the measured temperature recorded
during November 2000 (various days)
at the DST, location along regular spacing

158

| | | |
|---|---|---|
| 203.7765 | 1 | 2.7991 |
| 198.9911 | 2 | 3.0982 |
| 188.9415 | 3 | 3.3973 |
| 178.425 | 4 | 3.6964 |
| 170.5533 | 5 | 3.9955 |
| 156.3503 | 6 | 4.2946 |
| 149.7529 | 8 | 4.8928 |
| 143.6633 | 9 | 5.1919 |
| 138.9155 | 10 | 5.491 |
| 133.405 | 11 | 5.7901 |
| 128.3832 | 12 | 6.0892 |
| 123.4976 | 13 | 6.3883 |
| 118.9842 | 14 | 6.6874 |
| 114.4877 | 15 | 6.9865 |
| 110.42 | 16 | 7.2856 |
| 106.4688 | 17 | 7.5847 |
| 103.5003 | 18 | 7.8838 |
| 100.7779 | 19 | 8.1829 |
| 99.35921 | 20 | 8.482 |
| 97.65248 | 21 | 8.7811 |
| 97.49883 | 22 | 9.0802 |
| 94.66576 | 23 | 9.3793 |
| 92.82479 | 24 | 9.6784 |
| 91.15659 | 25 | 9.9775 |
| 89.40794 | 26 | 10.2766 |
| 87.60867 | 27 | 10.5757 |
| 86.00382 | 28 | 10.8748 |
| 84.31021 | 29 | 11.1739 |
| 82.74908 | 30 | 11.473 |
| 81.00489 | 31 | 11.7721 |
| 79.51084 | 32 | 12.0712 |
| 77.80501 | 33 | 12.3703 |
| 76.41907 | 34 | 12.6694 |
| 74.66462 | 35 | 12.9685 |
| 74.29489 | 36 | 13.2676 |
| 71.67146 | 37 | 13.5667 |
| 71.38379 | 38 | 13.8658 |
| 68.64647 | 39 | 14.1649 |
| 67.19092 | 40 | 14.464 |
| 65.75828 | 41 | 14.7631 |
| 64.19541 | 42 | 15.0622 |
| 62.79857 | 43 | 15.3613 |
| 61.22768 | 44 | 15.6604 |
| 59.82775 | 45 | 15.9595 |
| 58.29308 | 46 | 16.2586 |
| 58.03552 | 47 | 16.5577 |
| 55.38332 | 48 | 16.8568 |
| 55.12837 | 49 | 17.1559 |
| 52.42342 | 50 | 17.455 |
| 52.12833 | 51 | 17.7541 |
| 49.58017 | 52 | 18.0532 |
| 48.11216 | 53 | 18.3523 |
| 47.95313 | 54 | 18.6514 |
| 45.43265 | 55 | 18.9505 |
| 44.22152 | 56 | 19.2496 |
| 42.93535 | 57 | 19.5487 |
| 41.84527 | 58 | 19.8478 |
| 40.69885 | 59 | 20.1469 |
| 47.14364 | 60 | 20.446 |
| 38.70306 | 61 | 20.7451 |
| 37.79177 | 62 | 21.0442 |
| 37.67948 | 63 | 21.3433 |
| 36.03952 | 64 | 21.6424 |
| 36.06392 | 65 | 21.9415 |
| 34.51368 | 66 | 22.2406 |
| 34.47721 | 67 | 22.5397 |

These columns are appended to the *.xyp.xls output from MULTIFLO runs

8/9/01 To extract output from *.xyp output file

> plotf need eleme file present

> type in *.xyp file

output in plotf.dat

> vertprof2 (new version w/ modified output format)

make sure correct element column data are in profile_pts (i.e. col158.dat or col160.dat)

output in vertprof.dat

append measured temperature data from page 179 to back end of vertprof.dat.xls

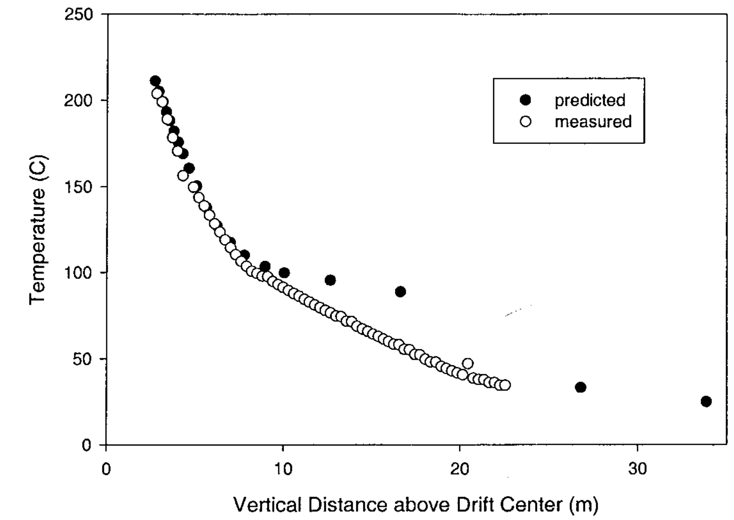
close *.xls

go to sigmaplot 2000 & plot

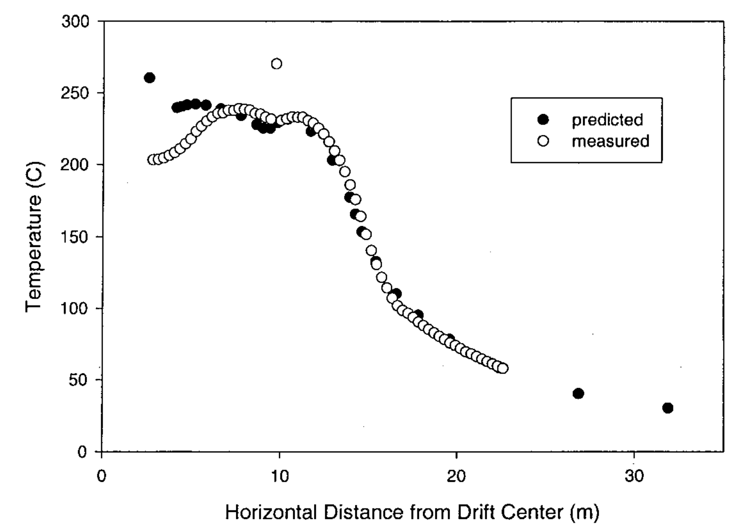
for dst run 1bk-2a output get following



8/9/01




1bk-2a-v.JNB




sigmaplot file

1bk-2a-1.JNB

This is basecase but w/ 7.2m blocks

1bk-2a output plots

in ~/dst_scans/barcelona/*

also on DST Barcelona 8/01 Zip

8/10/01 RH Additional DST runs planned
Using Metra Version 1.5

all in ~/dst_scans/decovalex/barcelona/*

1bk-4  7.2 block size, 1000X
reduction in fracture k → this run
died early

1bk-5  7.2 block size, 100X reduction
in fracture k  died @ 1.206e-1
on vulcan → property errors

base01  this is the basecase
rdt136 run out to 3yrs
0.25 ~~flock~~ RH 8/10/01 block
w/ 0.072 mm/yr infiltration
on Idaho

1bk-6  7.2 block size, 10X reduction in frac k
on vulcan

9/14/01 RH Plotted and filed results from these runs
are as follows

The only 3yr successful run to date
is 1bk-2a.dat

this is a 7.2 m block size model, all else
is same as basecase

located at /home/rgreen/dst_scans/decovalex/
barcelona/*
& on zip barcelona 9/01

outputs for 1yr & 3yr
1bk-2afld F1.xyp } 1yr
1bk-2afld m1.xyp
1bk-2a fld f2.xyp } 3yr
1bk-2a fld m2.xyp



9/14/01 RH stripped data per pg 180 are in xls files in

These files are in ~/barcelona/*
additionally on zip barcelona 9/01

| | | |
|---|---|---|
| 1bk-2a-160-m1.xls | yr 1 | 160 |
| 1bk-2a-160-f1.xls | | |
| 1bk-2a-158-m1.xls | | 158 |
| 1bk-2a-158-~~f1~~.xls | | |
| 1bk-2a-160-3m.xls | yr 3 | 160 |
| 1bk-2a-160-3F.xls | | |
| 1bk-2a-158-3m.xls | | 158 |
| 1bk-2a-158-3F.xls | | |

Actual measured temperature data for year 3 are
from DOE website for month of
Nov ~~45~~ 2000. data are stripped from
RH 9/14/01
large file (taken from random days in Nov)
in put into

158-3yr-temp.lxs
160-3yr-temp.lxs

Kruggel measured data for yr 1 are in

158 revised.xls
160 revised.xls

RH 9/14/01

9/14/01
RH

| 158 | | |
|---|---|---|
| Zuncor(m) | Zcorr (m) | temp (C) |
| 0 | | 157.5 |
| 1 | | 161.22 |
| 2 | | 154.26 |

| | |
|---|---|
| 3 | 132.61 |
| 4 | 108.13 |
| 5 | 92.64 |
| 6 | 81.56 |
| 7 | 72.39 |
| 8 | 64.18 |
| 9 | 56.35 |
| 10 | 49.38 |
| 11 | 43.58 |
| 12 | 38.66 |
| 13 | 34.62 |
| 14 | 31.61 |
| 15 | 29.27 |
| 16 | 27.5 |
| 17 | 26.16 |
| 18 | 25.29 |
| 19 | 24.51 |
| 20 | 24.03 |
| 21 | 23.69 |
| 22 | 23.61 |
| 23 | 22.78 |

158revised.xls

Kriged measured

| 160 | | |
|---|---|---|
| Zuncor(m) | Zcorr (m) | temp(C) |
| 0 | | 157.5 |
| 1 | | 154.53 |
| 2 | | 146.34 |
| | 0.5 | |
| | 1.5 | |
| | 2.5 | |
| | 3.5 | |
| | 4.5 | |
| | 5.5 | |
| | 6.5 | |
| | 7.5 | |
| | 8.5 | |
| | 9.5 | |
| | 10.5 | |
| | 11.5 | |
| | 12.5 | |
| | 13.5 | |
| | 14.5 | |
| | 15.5 | |
| | 16.5 | |
| | 17.5 | |
| | 18.5 | |
| | 19.5 | |
| | 20.5 | |

| | |
|---|---|
| 3 | 144.3 |
| 4 | 142.57 |
| 5 | 156.81 |
| 6 | 165.57 |
| 7 | 167.53 |
| 8 | 173.37 |
| 9 | 175.51 |
| 10 | 175.69 |
| 11 | 175.31 |
| 12 | 170.02 |
| 13 | 158.31 |
| 14 | 126.3 |
| 15 | 95.85 |
| 16 | 87.29 |
| 17 | 71.64 |
| 18 | 60.35 |
| 19 | 51.35 |
| 20 | 44.84 |
| 21 | 40.17 |
| 22 | 34.56 |
| 23 | 36.66 |

1m separation

160revised.xls

Kriged measured



9/14/01
RH

| | | | | | |
|---|---|---|---|---|---|
| 84604 ESF-HD-158-TEMP13-RTD-1 | 11/30/00 | 12:08:39 | 203.7765 | 1 | 2.7991 |
| 283372 ESF-HD-158-TEMP13-RTD-2 | 11/30/00 | 18:08:51 | 198.9911 | 2 | 3.0982 |
| 312960 ESF-HD-158-TEMP13-RTD-3 | 11/30/00 | 0:07:42 | 188.9415 | 3 | 3.3973 |
| 87725 ESF-HD-158-TEMP13-RTD-4 | 11/1/00 | 18:07:44 | 178.425 | 4 | 3.6964 |
| 88805 ESF-HD-158-TEMP13-RTD-5 | 11/1/00 | 0:07:56 | 170.5533 | 5 | 3.9955 |
| 89885 ESF-HD-158-TEMP13-RTD-6 | 11/2/00 | 0:06:42 | 156.3503 | 6 | 4.2946 |
| 90725 ESF-HD-158-TEMP13-RTD-8 | 11/1/00 | 18:07:53 | 149.7529 | 8 | 4.8928 |
| 90845 ESF-HD-158-TEMP13-RTD-9 | 11/1/00 | 0:08:04 | 143.6633 | 9 | 5.1919 |
| 84724 ESF-HD-158-TEMP13-RTD-10 | 11/30/00 | 18:09:08 | 138.9155 | 10 | 5.491 |
| 84844 ESF-HD-158-TEMP13-RTD-11 | 11/30/00 | 12:09:00 | 133.405 | 11 | 5.7901 |
| 84964 ESF-HD-158-TEMP13-RTD-12 | 11/30/00 | 18:09:12 | 128.3832 | 12 | 6.0892 |
| 85084 ESF-HD-158-TEMP13-RTD-13 | 11/30/00 | 0:08:01 | 123.4976 | 13 | 6.3883 |
| 85204 ESF-HD-158-TEMP13-RTD-14 | 11/30/00 | 18:09:16 | 118.9842 | 14 | 6.6874 |
| 85324 ESF-HD-158-TEMP13-RTD-15 | 11/30/00 | 6:08:56 | 114.4877 | 15 | 6.9865 |
| 85444 ESF-HD-158-TEMP13-RTD-16 | 11/30/00 | 18:09:20 | 110.42 | 16 | 7.2856 |
| 85564 ESF-HD-158-TEMP13-RTD-17 | 11/30/00 | 12:09:13 | 106.4688 | 17 | 7.5847 |
| 85684 ESF-HD-158-TEMP13-RTD-18 | 11/30/00 | 18:09:24 | 103.5003 | 18 | 7.8838 |
| 85804 ESF-HD-158-TEMP13-RTD-19 | 11/30/00 | 0:08:13 | 100.7779 | 19 | 8.1829 |
| 296314 ESF-HD-158-TEMP13-RTD-20 | 11/30/00 | 6:09:08 | 99.35921 | 20 | 8.482 |
| 85805 ESF-HD-158-TEMP13-RTD-21 | 11/2/00 | 6:07:41 | 97.65248 | 21 | 8.7811 |
| 264214 ESF-HD-158-TEMP13-RTD-22 | 11/30/00 | 18:09:31 | 97.49883 | 22 | 9.0802 |
| 85925 ESF-HD-158-TEMP13-RTD-23 | 11/1/00 | 12:10:22 | 94.66576 | 23 | 9.3793 |
| 86045 ESF-HD-158-TEMP13-RTD-24 | 11/1/00 | 0:08:35 | 92.82479 | 24 | 9.6784 |
| 86165 ESF-HD-158-TEMP13-RTD-25 | 11/1/00 | 18:08:28 | 91.15659 | 25 | 9.9775 |
| 86285 ESF-HD-158-TEMP13-RTD-26 | 11/1/00 | 0:08:39 | 89.40794 | 26 | 10.2766 |
| 86405 ESF-HD-158-TEMP13-RTD-27 | 11/2/00 | 6:07:55 | 87.60867 | 27 | 10.5757 |
| 86525 ESF-HD-158-TEMP13-RTD-28 | 11/1/00 | 0:08:43 | 86.00382 | 28 | 10.8748 |
| 86645 ESF-HD-158-TEMP13-RTD-29 | 11/1/00 | 12:10:33 | 84.31021 | 29 | 11.1739 |
| 86765 ESF-HD-158-TEMP13-RTD-30 | 11/1/00 | 18:08:38 | 82.74908 | 30 | 11.473 |
| 86885 ESF-HD-158-TEMP13-RTD-31 | 11/1/00 | 0:08:49 | 81.00489 | 31 | 11.7721 |
| 87005 ESF-HD-158-TEMP13-RTD-32 | 11/2/00 | 6:08:04 | 79.51084 | 32 | 12.0712 |
| 87125 ESF-HD-158-TEMP13-RTD-33 | 11/1/00 | 0:08:52 | 77.80501 | 33 | 12.3703 |
| 87245 ESF-HD-158-TEMP13-RTD-34 | 11/1/00 | 12:10:43 | 76.41907 | 34 | 12.6694 |
| 87365 ESF-HD-158-TEMP13-RTD-35 | 11/1/00 | 0:08:56 | 74.66462 | 35 | 12.9685 |
| 264334 ESF-HD-158-TEMP13-RTD-36 | 11/30/00 | 18:09:58 | 74.29489 | 36 | 13.2676 |
| 87485 ESF-HD-158-TEMP13-RTD-37 | 11/1/00 | 0:09:00 | 71.67146 | 37 | 13.5667 |
| 313080 ESF-HD-158-TEMP13-RTD-38 | 11/30/00 | 18:10:02 | 71.38379 | 38 | 13.8658 |
| 87605 ESF-HD-158-TEMP13-RTD-39 | 11/1/00 | 0:09:04 | 68.64647 | 39 | 14.1649 |
| 87845 ESF-HD-158-TEMP13-RTD-40 | 11/1/00 | 0:09:06 | 67.19092 | 40 | 14.464 |
| 87965 ESF-HD-158-TEMP13-RTD-41 | 11/1/00 | 18:08:59 | 65.75828 | 41 | 14.7631 |
| 88085 ESF-HD-158-TEMP13-RTD-42 | 11/1/00 | 0:09:10 | 64.19541 | 42 | 15.0622 |
| 88205 ESF-HD-158-TEMP13-RTD-43 | 11/2/00 | 0:07:53 | 62.79857 | 43 | 15.3613 |
| 88325 ESF-HD-158-TEMP13-RTD-44 | 11/1/00 | 0:09:13 | 61.22768 | 44 | 15.6604 |
| 88445 ESF-HD-158-TEMP13-RTD-45 | 11/1/00 | 12:11:03 | 59.82775 | 45 | 15.9595 |
| 88565 ESF-HD-158-TEMP13-RTD-46 | 11/1/00 | 0:09:17 | 58.29308 | 46 | 16.2586 |
| 283492 ESF-HD-158-TEMP13-RTD-47 | 11/30/00 | 18:10:19 | 58.03552 | 47 | 16.5577 |
| 88685 ESF-HD-158-TEMP13-RTD-48 | 11/1/00 | 0:09:21 | 55.38332 | 48 | 16.8568 |
| 264454 ESF-HD-158-TEMP13-RTD-49 | 11/30/00 | 18:10:23 | 55.12837 | 49 | 17.1559 |
| 88925 ESF-HD-158-TEMP13-RTD-50 | 11/1/00 | 12:11:12 | 52.42342 | 50 | 17.455 |
| 264574 ESF-HD-158-TEMP13-RTD-51 | 11/30/00 | 0:09:10 | 52.12833 | 51 | 17.7541 |
| 89045 ESF-HD-158-TEMP13-RTD-52 | 11/1/00 | 18:09:20 | 49.58017 | 52 | 18.0532 |
| 89165 ESF-HD-158-TEMP13-RTD-53 | 11/1/00 | 0:09:30 | 48.11216 | 53 | 18.3523 |
| 313200 ESF-HD-158-TEMP13-RTD-54 | 11/30/00 | 18:10:33 | 47.95313 | 54 | 18.6514 |
| 89285 ESF-HD-158-TEMP13-RTD-55 | 11/1/00 | 0:09:34 | 45.43265 | 55 | 18.9505 |
| 89405 ESF-HD-158-TEMP13-RTD-56 | 11/1/00 | 12:11:24 | 44.22152 | 56 | 19.2496 |
| 89525 ESF-HD-158-TEMP13-RTD-57 | 11/1/00 | 0:09:37 | 42.93535 | 57 | 19.5487 |
| 89645 ESF-HD-158-TEMP13-RTD-58 | 11/1/00 | 18:09:32 | 41.84527 | 58 | 19.8478 |
| 89765 ESF-HD-158-TEMP13-RTD-59 | 11/1/00 | 0:09:41 | 40.69885 | 59 | 20.1469 |
| 90005 ESF-HD-158-TEMP13-RTD-60 | 11/1/00 | 0:09:43 | 47.14364 | 60 | 20.446 |
| 90125 ESF-HD-158-TEMP13-RTD-61 | 11/1/00 | 12:11:31 | 38.70306 | 61 | 20.7451 |
| 90245 ESF-HD-158-TEMP13-RTD-62 | 11/1/00 | 0:09:46 | 37.79177 | 62 | 21.0442 |
| 283612 ESF-HD-158-TEMP13-RTD-63 | 11/30/00 | 18:10:50 | 37.67948 | 63 | 21.3433 |
| 90365 ESF-HD-158-TEMP13-RTD-64 | 11/1/00 | 0:09:50 | 36.03952 | 64 | 21.6424 |
| 264694 ESF-HD-158-TEMP13-RTD-65 | 11/30/00 | 18:10:54 | 36.06392 | 65 | 21.9415 |
| 90485 ESF-HD-158-TEMP13-RTD-66 | 11/1/00 | 0:09:53 | 34.51368 | 66 | 22.2406 |
| 264814 ESF-HD-158-TEMP13-RTD-67 | 11/30/00 | 18:10:57 | 34.47721 | 67 | 22.5397 |

1

158-3yr-temp.xls

From DOE website
dstout ~~158~~ 182.pdat
RH 9/14/01

data were for 2 days
this day 364 & 363 are
in dstout_182.pdat

9/14/01
RH

| | | | | | | |
|---|---|---|---|---|---|---|
| 313441 | ESF-HD-160-TEMP15-RTD-1 | 11/1/00 | 0:03:08 | 203.2823 | 1 | 2.8001 |
| 265295 | ESF-HD-160-TEMP15-RTD-2 | 11/2/00 | 0:06:27 | 203.4169 | 2 | 3.1002 |
| 99605 | ESF-HD-160-TEMP15-RTD-3 | 11/1/00 | 0:03:14 | 204.4851 | 3 | 3.4003 |
| 100445 | ESF-HD-160-TEMP15-RTD-4 | 11/1/00 | 18:02:24 | 206.288 | 4 | 3.7004 |
| 101405 | ESF-HD-160-TEMP15-RTD-5 | 11/1/00 | 0:03:18 | 208.1221 | 5 | 4.0005 |
| 102605 | ESF-HD-160-TEMP15-RTD-6 | 11/1/00 | 18:02:29 | 210.8718 | 6 | 4.3006 |
| 103325 | ESF-HD-160-TEMP15-RTD-7 | 11/1/00 | 0:03:23 | 214.3315 | 7 | 4.6007 |
| 103445 | ESF-HD-160-TEMP15-RTD-8 | 11/2/00 | 6:02:58 | 217.7021 | 8 | 4.9008 |
| 103565 | ESF-HD-160-TEMP15-RTD-9 | 11/1/00 | 0:03:28 | 222.8809 | 9 | 5.2009 |
| 97445 | ESF-HD-160-TEMP15-RTD-10 | 11/1/00 | 12:02:41 | 226.597 | 10 | 5.501 |
| 97565 | ESF-HD-160-TEMP15-RTD-11 | 11/1/00 | 0:03:33 | 230.1703 | 11 | 5.8011 |
| 97685 | ESF-HD-160-TEMP15-RTD-12 | 11/1/00 | 18:02:45 | 233.1559 | 12 | 6.1012 |
| 97805 | ESF-HD-160-TEMP15-RTD-13 | 11/1/00 | 0:03:38 | 235.6675 | 13 | 6.4013 |
| 97925 | ESF-HD-160-TEMP15-RTD-14 | 11/2/00 | 0:06:49 | 236.1346 | 14 | 6.7014 |
| 98045 | ESF-HD-160-TEMP15-RTD-15 | 11/1/00 | 0:03:44 | 237.8145 | 15 | 7.0015 |
| 98165 | ESF-HD-160-TEMP15-RTD-16 | 11/1/00 | 12:02:55 | 237.6824 | 16 | 7.3016 |
| 98285 | ESF-HD-160-TEMP15-RTD-17 | 11/1/00 | 0:03:48 | 238.9097 | 17 | 7.6017 |
| 98405 | ESF-HD-160-TEMP15-RTD-18 | 11/1/00 | 18:03:00 | 238.5262 | 18 | 7.9018 |
| 98525 | ESF-HD-160-TEMP15-RTD-19 | 11/1/00 | 0:03:54 | 238.0011 | 19 | 8.2019 |
| 284095 | ESF-HD-160-TEMP15-RTD-20 | 11/1/00 | 12:03:02 | 235.5766 | 20 | 8.502 |
| 98645 | ESF-HD-160-TEMP15-RTD-21 | 11/1/00 | 12:03:04 | 235.1359 | 21 | 8.8021 |
| 98765 | ESF-HD-160-TEMP15-RTD-22 | 11/1/00 | 0:04:01 | 232.9727 | 22 | 9.1022 |
| 252497 | ESF-HD-160-TEMP15-RTD-23 | 11/1/00 | 18:03:13 | 231.7559 | 23 | 9.4023 |
| 98885 | ESF-HD-160-TEMP15-RTD-24 | 11/1/00 | 0:04:06 | 270.404 | 24 | 9.7024 |
| 99005 | ESF-HD-160-TEMP15-RTD-25 | 11/2/00 | 0:07:11 | 230.8273 | 25 | 10.0025 |
| 99125 | ESF-HD-160-TEMP15-RTD-26 | 11/1/00 | 0:04:10 | 232.011 | 26 | 10.3026 |
| 99245 | ESF-HD-160-TEMP15-RTD-27 | 11/1/00 | 12:03:13 | 233.2509 | 27 | 10.6027 |
| 99365 | ESF-HD-160-TEMP15-RTD-28 | 11/1/00 | 0:04:15 | 232.9241 | 28 | 10.9028 |
| 99485 | ESF-HD-160-TEMP15-RTD-29 | 11/1/00 | 18:03:28 | 232.9237 | 29 | 11.2029 |
| 99725 | ESF-HD-160-TEMP15-RTD-30 | 11/2/00 | 0:07:21 | 230.7268 | 30 | 11.503 |
| 99845 | ESF-HD-160-TEMP15-RTD-31 | 11/1/00 | 0:04:23 | 228.985 | 31 | 11.8031 |
| 99965 | ESF-HD-160-TEMP15-RTD-32 | 11/1/00 | 12:03:21 | 225.3484 | 32 | 12.1032 |
| 100085 | ESF-HD-160-TEMP15-RTD-33 | 11/1/00 | 0:04:29 | 221.3678 | 33 | 12.4033 |
| 265415 | ESF-HD-160-TEMP15-RTD-34 | 11/1/00 | 18:03:41 | 215.8429 | 34 | 12.7034 |
| 284215 | ESF-HD-160-TEMP15-RTD-35 | 11/1/00 | 18:03:43 | 209.4868 | 35 | 13.0035 |
| 100205 | ESF-HD-160-TEMP15-RTD-36 | 11/2/00 | 0:07:33 | 202.9322 | 36 | 13.3036 |
| 300865 | ESF-HD-160-TEMP15-RTD-37 | 11/1/00 | 12:03:30 | 195.1149 | 37 | 13.6037 |
| 299189 | ESF-HD-160-TEMP15-RTD-38 | 11/1/00 | 12:03:31 | 185.932 | 38 | 13.9038 |
| 100325 | ESF-HD-160-TEMP15-RTD-39 | 11/1/00 | 0:04:43 | 175.7517 | 39 | 14.2039 |
| 100565 | ESF-HD-160-TEMP15-RTD-40 | 11/1/00 | 0:04:45 | 163.9785 | 40 | 14.504 |
| 100685 | ESF-HD-160-TEMP15-RTD-41 | 11/2/00 | 0:07:42 | 151.638 | 41 | 14.8041 |
| 100805 | ESF-HD-160-TEMP15-RTD-42 | 11/1/00 | 0:04:50 | 140.4923 | 42 | 15.1042 |
| 100925 | ESF-HD-160-TEMP15-RTD-43 | 11/1/00 | 12:03:39 | 130.7213 | 43 | 15.4043 |
| 101045 | ESF-HD-160-TEMP15-RTD-44 | 11/1/00 | 0:04:55 | 121.662 | 44 | 15.7044 |
| 300983 | ESF-HD-160-TEMP15-RTD-45 | 11/1/00 | 18:04:09 | 114.1774 | 45 | 16.0045 |
| 101165 | ESF-HD-160-TEMP15-RTD-46 | 11/1/00 | 0:05:00 | 107.0806 | 46 | 16.3046 |
| 101285 | ESF-HD-160-TEMP15-RTD-47 | 11/2/00 | 0:07:53 | 101.7714 | 47 | 16.6047 |
| 284335 | ESF-HD-160-TEMP15-RTD-48 | 11/1/00 | 12:03:46 | 98.50698 | 48 | 16.9048 |
| 265535 | ESF-HD-160-TEMP15-RTD-49 | 11/1/00 | 12:03:48 | 96.56401 | 49 | 17.2049 |
| 101525 | ESF-HD-160-TEMP15-RTD-50 | 11/1/00 | 18:04:21 | 93.67453 | 50 | 17.505 |
| 101645 | ESF-HD-160-TEMP15-RTD-51 | 11/1/00 | 0:05:13 | 90.46091 | 51 | 17.8051 |
| 252619 | ESF-HD-160-TEMP15-RTD-52 | 11/4/00 | 18:06:20 | 87.99946 | 52 | 18.1052 |
| | | | | | | |
| 101765 | ESF-HD-160-TEMP15-RTD-53 | 11/1/00 | 0:05:17 | 85.21907 | 53 | 18.4053 |
| 101885 | ESF-HD-160-TEMP15-RTD-54 | 11/1/00 | 12:03:59 | 82.83964 | 54 | 18.7054 |
| 102005 | ESF-HD-160-TEMP15-RTD-55 | 11/1/00 | 0:05:23 | 80.41435 | 55 | 19.0055 |
| 102125 | ESF-HD-160-TEMP15-RTD-56 | 11/1/00 | 18:04:37 | 78.23904 | 56 | 19.3056 |
| 102245 | ESF-HD-160-TEMP15-RTD-57 | 11/1/00 | 0:05:28 | 75.9419 | 57 | 19.6057 |
| 102365 | ESF-HD-160-TEMP15-RTD-58 | 11/2/00 | 0:08:15 | 73.92807 | 58 | 19.9058 |
| 102485 | ESF-HD-160-TEMP15-RTD-59 | 11/1/00 | 0:05:32 | 71.8581 | 59 | 20.2059 |
| 102725 | ESF-HD-160-TEMP15-RTD-60 | 11/1/00 | 0:05:34 | 69.52496 | 60 | 20.506 |
| 102845 | ESF-HD-160-TEMP15-RTD-61 | 11/1/00 | 18:04:49 | 68.09212 | 61 | 20.8061 |
| 102965 | ESF-HD-160-TEMP15-RTD-62 | 11/1/00 | 0:05:39 | 66.22509 | 62 | 21.1062 |
| 103085 | ESF-HD-160-TEMP15-RTD-63 | 11/2/00 | 0:08:32 | 64.44165 | 63 | 21.4063 |
| 103205 | ESF-HD-160-TEMP15-RTD-64 | 11/1/00 | 0:05:45 | 62.79852 | 64 | 21.7064 |
| 301103 | ESF-HD-160-TEMP15-RTD-65 | 11/1/00 | 12:04:19 | 61.11923 | 65 | 22.0065 |
| 265658 | ESF-HD-160-TEMP15-RTD-66 | 11/1/00 | 18:05:01 | 59.51937 | 66 | 22.3066 |
| 284453 | ESF-HD-160-TEMP15-RTD-67 | 11/1/00 | 18:05:04 | 57.9452 | 67 | 22.6067 |

160-3yr-temp.xls

9/14/01
RH

These are *.xls files from 1 & 3 yr output of 1bk-2a.dat

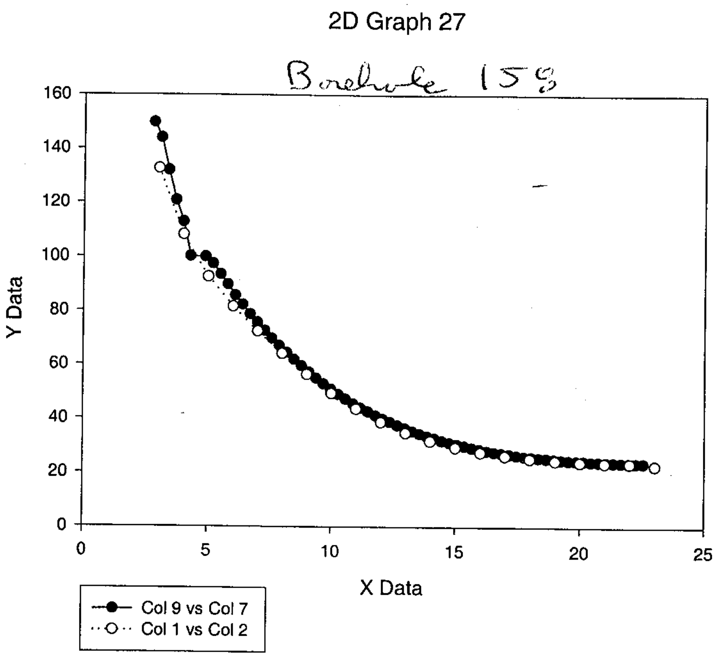


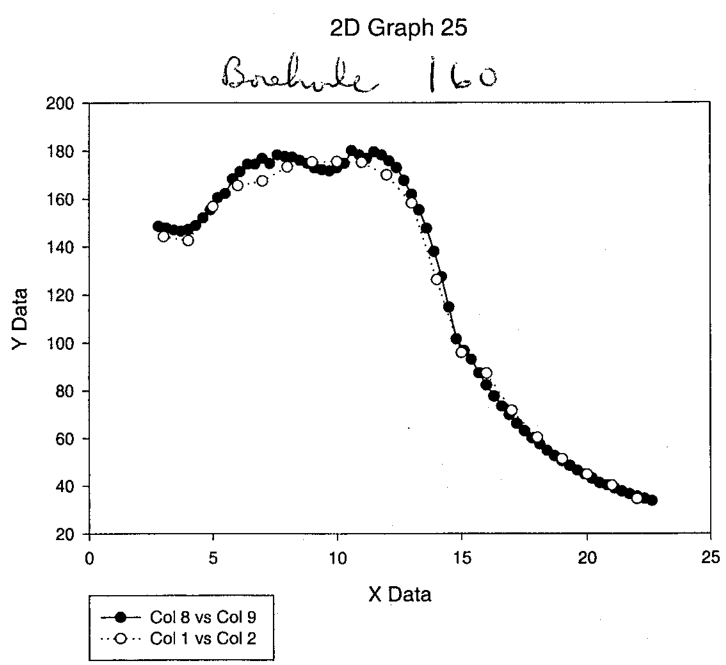
| 1bk-2a-160-m1.xls | | 1bk-2a-160-1F.xls | | 1bk-2a-160-3m.xls | | 1bk-2a-160-3F.xls | |
|---|---|---|---|---|---|---|---|
| 2.571 | 172.7 | 2.571 | 172.4 | 2.571 | 260.4 | 2.571 | 260.2 |
| 4.136 | 158.1 | 4.136 | 157.5 | 4.136 | 239.5 | 4.136 | 239.4 |
| 4.393 | 159.1 | 4.393 | 158.6 | 4.393 | 240.4 | 4.393 | 240.2 |
| 4.681 | 160.3 | 4.681 | 159.8 | 4.681 | 241.4 | 4.681 | 241.2 |
| 5.153 | 161.2 | 5.153 | 160.8 | 5.153 | 242 | 5.153 | 241.8 |
| 5.738 | 161.2 | 5.738 | 160.8 | 5.738 | 241.4 | 5.738 | 241.2 |
| 6.587 | 159.6 | 6.587 | 159.1 | 6.587 | 238.8 | 6.587 | 238.6 |
| 7.718 | 157.5 | 7.718 | 157.1 | 7.718 | 234 | 7.718 | 233.8 |
| 8.596 | 154.2 | 8.596 | 153.8 | 8.596 | 227.8 | 8.596 | 227.7 |
| 8.959 | 152.9 | 8.959 | 152.5 | 8.959 | 225.3 | 8.959 | 225.1 |
| 9.379 | 154.2 | 9.379 | 153.9 | 9.379 | 225.4 | 9.379 | 225.2 |
| 9.82 | 158.9 | 9.82 | 158.7 | 9.82 | 229.3 | 9.82 | 229.1 |
| 10.358 | 162.5 | 10.358 | 162.3 | 10.358 | 231.6 | 10.358 | 231.4 |
| 11.69 | 159.6 | 11.69 | 159.5 | 11.69 | 223.2 | 11.69 | 223 |
| 12.901 | 146.3 | 12.901 | 146.2 | 12.901 | 203.3 | 12.901 | 203.2 |
| 13.89 | 123.9 | 13.89 | 96.03 | 13.89 | 177.4 | 13.89 | 177.4 |
| 14.219 | 113.7 | 14.219 | 95.94 | 14.219 | 165.6 | 14.219 | 165.6 |
| 14.588 | 103.5 | 14.588 | 95.41 | 14.588 | 153.5 | 14.588 | 153.5 |
| 15.363 | 86.8 | 15.363 | 87.3 | 15.363 | 132.9 | 15.363 | 132.9 |
| 16.546 | 68.58 | 16.546 | 68.61 | 16.546 | 110.1 | 16.546 | 96.13 |
| 17.809 | 55.16 | 17.809 | 55.16 | 17.809 | 95.23 | 17.809 | 94.61 |
| 19.584 | 42.47 | 19.584 | 42.47 | 19.584 | 78.35 | 19.584 | 78.71 |
| 22.407 | 31.5 | 22.407 | 31.5 | 22.407 | 58.45 | 22.407 | 58.45 |
| 26.866 | 25.79 | 26.866 | 25.79 | 26.866 | 40.26 | 26.866 | 40.26 |
| 31.879 | 24.38 | 31.879 | 24.38 | 31.879 | 30.23 | 31.879 | 30.23 |
| 40.21 | 24.11 | 40.21 | 24.11 | 40.21 | 25.21 | 40.21 | 25.21 |
| 51.498 | 24.1 | 51.498 | 24.1 | 51.498 | 24.22 | 51.498 | 24.22 |
| 63.132 | 24.1 | 63.132 | 24.1 | 63.132 | 24.11 | 63.132 | 24.11 |
| 74.279 | 24.1 | 74.279 | 24.1 | 74.279 | 24.1 | 74.279 | 24.1 |

| 1bk-2a-158-1m.xls | | 1bk-2a-158-1f.xls | | 1bk-2a158-3m.xls | | 1bk-2a-158-3F.xls | |
|---|---|---|---|---|---|---|---|
| 2.708 | 134.6 | 2.708 | 96.11 | 2.708 | 211.1 | 2.708 | 211 |
| 2.917 | 129.7 | 2.917 | 96.11 | 2.917 | 205 | 2.917 | 204.9 |
| 3.133 | 125.1 | 3.133 | 96.11 | 3.133 | 199 | 3.133 | 198.9 |
| 3.343 | 121 | 3.343 | 96.11 | 3.343 | 193.3 | 3.343 | 193.1 |
| 3.537 | 117.6 | 3.537 | 96.1 | 3.537 | 188.2 | 3.537 | 187.8 |
| 3.777 | 113.7 | 3.777 | 96.1 | 3.777 | 182 | 3.777 | 181.4 |
| 4.019 | 110.2 | 4.019 | 96.1 | 4.019 | 175.8 | 4.019 | 175.1 |
| 4.291 | 106.6 | 4.291 | 96.09 | 4.291 | 169.1 | 4.291 | 168.2 |
| 4.64 | 102.5 | 4.64 | 96.09 | 4.64 | 160.7 | 4.64 | 159.6 |
| 5.078 | 97.86 | 5.078 | 96.08 | 5.078 | 150.4 | 5.078 | 149.2 |
| 5.625 | 92.65 | 5.625 | 96.07 | 5.625 | 137.9 | 5.625 | 101.1 |
| 6.228 | 87.2 | 6.228 | 96.05 | 6.228 | 127.2 | 6.228 | 96.23 |
| 6.961 | 80.41 | 6.961 | 95.91 | 6.961 | 117.6 | 6.961 | 96.22 |
| 7.771 | 71.9 | 7.771 | 84.28 | 7.771 | 110.1 | 7.771 | 96.21 |
| 8.947 | 59 | 8.947 | 59.12 | 8.947 | 103.4 | 8.947 | 96.19 |
| 10.041 | 49.3 | 10.041 | 49.3 | 10.041 | 99.59 | 10.041 | 96.17 |
| 12.652 | 35.04 | 12.652 | 35.05 | 12.652 | 95.29 | 12.652 | 96.12 |
| 16.647 | 26.85 | 16.647 | 26.85 | 16.647 | 88.67 | 16.647 | 96.01 |
| 26.789 | 23.78 | 26.789 | 23.78 | 26.789 | 33.21 | 26.789 | 33.21 |
| 33.851 | 23.57 | 33.851 | 23.57 | 33.851 | 25 | 33.851 | 25 |
| 43.486 | 23.34 | 43.486 | 23.34 | 43.486 | 23.46 | 43.486 | 23.46 |
| 55.938 | 23.05 | 55.938 | 23.05 | 55.938 | 23.06 | 55.938 | 23.06 |
| 72.784 | 22.66 | 72.784 | 22.66 | 72.784 | 22.66 | 72.784 | 22.66 |
| 91.279 | 22.22 | 91.279 | 22.22 | 91.279 | 22.21 | 91.279 | 22.21 |

1bk-2a-158-1F.xls

9/14/01
RH




This is a comparison of data (temperatures) at 1yr from keggel at 1-m intervals (○) with measured data (●)
measured data are in



in ~/barcelona & on zip barcelona 8/01

9/14/01
RH

158-1yr.temp.xls

| | | | | |
|---|---|---|---|---|
| HD-158-TEMP13-RTD-1 | 12/3/98 | 0:10:03 | 149.7793 | 1 |
| HD-158-TEMP13-RTD-2 | 12/3/98 | 0:10:04 | 144.0188 | 2 |
| HD-158-TEMP13-RTD-3 | 12/3/98 | 0:10:06 | 131.9152 | 3 |
| HD-158-TEMP13-RTD-4 | 12/3/98 | 0:10:07 | 120.8665 | 4 |
| HD-158-TEMP13-RTD-5 | 12/3/98 | 0:10:09 | 112.8633 | 5 |
| HD-158-TEMP13-RTD-6 | 12/3/98 | 0:10:10 | 100.1929 | 6 |
| HD-158-TEMP13-RTD-7 | 12/3/98 | 0:10:11 | -242.4323 | 7 |
| HD-158-TEMP13-RTD-8 | 12/3/98 | 0:10:13 | 97.49848 | 8 |
| HD-158-TEMP13-RTD-9 | 12/3/98 | 0:10:14 | 93.48909 | 9 |
| HD-158-TEMP13-RTD-10 | 12/3/98 | 0:10:16 | 89.75165 | 10 |
| HD-158-TEMP13-RTD-11 | 12/3/98 | 0:10:17 | 85.73711 | 11 |
| HD-158-TEMP13-RTD-12 | 12/3/98 | 0:10:18 | 82.2942 | 12 |
| HD-158-TEMP13-RTD-13 | 12/3/98 | 0:10:20 | 78.82926 | 13 |
| HD-158-TEMP13-RTD-14 | 12/3/98 | 0:10:22 | 75.80698 | 14 |
| HD-158-TEMP13-RTD-15 | 12/3/98 | 0:10:24 | 72.71938 | 15 |
| HD-158-TEMP13-RTD-16 | 12/3/98 | 0:10:25 | 69.89283 | 16 |
| HD-158-TEMP13-RTD-17 | 12/3/98 | 0:10:27 | 67.17295 | 17 |
| HD-158-TEMP13-RTD-18 | 12/3/98 | 0:10:29 | 64.58699 | 18 |
| HD-158-TEMP13-RTD-19 | 12/3/98 | 0:10:31 | 61.99599 | 19 |
| HD-158-TEMP13-RTD-20 | 12/3/98 | 0:10:33 | 59.64552 | 20 |
| HD-158-TEMP13-RTD-21 | 12/3/98 | 0:10:35 | 57.26634 | 21 |
| HD-158-TEMP13-RTD-22 | 12/3/98 | 0:10:37 | 55.11068 | 22 |
| HD-158-TEMP13-RTD-23 | 12/3/98 | 0:10:39 | 52.99799 | 23 |
| HD-158-TEMP13-RTD-24 | 12/3/98 | 0:10:41 | 51.05159 | 24 |
| HD-158-TEMP13-RTD-25 | 12/3/98 | 0:10:42 | 49.06358 | 25 |
| HD-158-TEMP13-RTD-26 | 12/3/98 | 0:10:44 | 47.33788 | 26 |
| HD-158-TEMP13-RTD-27 | 12/3/98 | 0:10:46 | 45.64447 | 27 |
| HD-158-TEMP13-RTD-28 | 12/3/98 | 0:10:47 | 44.06419 | 28 |
| HD-158-TEMP13-RTD-29 | 12/3/98 | 0:10:49 | 42.61311 | 29 |
| HD-158-TEMP13-RTD-30 | 12/3/98 | 0:10:51 | 41.21796 | 30 |
| HD-158-TEMP13-RTD-31 | 12/3/98 | 0:10:52 | 39.88793 | 31 |
| HD-158-TEMP13-RTD-32 | 12/3/98 | 0:10:54 | 38.72918 | 32 |
| HD-158-TEMP13-RTD-33 | 12/3/98 | 0:10:56 | 37.53228 | 33 |
| HD-158-TEMP13-RTD-34 | 12/3/98 | 0:10:57 | 36.48773 | 34 |
| HD-158-TEMP13-RTD-35 | 12/3/98 | 0:10:59 | 35.32029 | 35 |
| HD-158-TEMP13-RTD-36 | 12/3/98 | 0:11:02 | 34.43621 | 36 |
| HD-158-TEMP13-RTD-37 | 12/3/98 | 0:11:03 | 33.5045 | 37 |
| HD-158-TEMP13-RTD-38 | 12/3/98 | 0:11:07 | 32.68481 | 38 |
| HD-158-TEMP13-RTD-39 | 12/3/98 | 0:11:08 | 31.78856 | 39 |
| HD-158-TEMP13-RTD-40 | 12/3/98 | 0:11:09 | 31.07289 | 40 |
| HD-158-TEMP13-RTD-41 | 12/3/98 | 0:11:10 | 30.49031 | 41 |
| HD-158-TEMP13-RTD-42 | 12/3/98 | 0:11:10 | 29.8263 | 42 |
| HD-158-TEMP13-RTD-43 | 12/3/98 | 0:11:11 | 29.18702 | 43 |
| HD-158-TEMP13-RTD-44 | 12/3/98 | 0:11:12 | 28.68152 | 44 |
| HD-158-TEMP13-RTD-45 | 12/3/98 | 0:11:13 | 28.14298 | 45 |
| HD-158-TEMP13-RTD-46 | 12/3/98 | 0:11:13 | 27.66158 | 46 |
| HD-158-TEMP13-RTD-47 | 12/3/98 | 0:11:14 | 27.2592 | 47 |
| HD-158-TEMP13-RTD-48 | 12/3/98 | 0:11:15 | 26.84943 | 48 |
| HD-158-TEMP13-RTD-49 | 12/3/98 | 0:11:15 | 26.404 | 49 |
| HD-158-TEMP13-RTD-50 | 12/3/98 | 0:11:16 | 26.13049 | 50 |
| HD-158-TEMP13-RTD-51 | 12/3/98 | 0:11:17 | 25.89721 | 51 |
| HD-158-TEMP13-RTD-52 | 12/3/98 | 0:11:18 | 25.61843 | 52 |
| HD-158-TEMP13-RTD-53 | 12/3/98 | 0:11:18 | 25.37113 | 53 |
| HD-158-TEMP13-RTD-54 | 12/3/98 | 0:11:19 | 25.10522 | 54 |
| HD-158-TEMP13-RTD-55 | 12/3/98 | 0:11:20 | 24.95897 | 55 |
| HD-158-TEMP13-RTD-56 | 12/3/98 | 0:11:21 | 24.71183 | 56 |
| HD-158-TEMP13-RTD-57 | 12/3/98 | 0:11:21 | 24.51055 | 57 |
| HD-158-TEMP13-RTD-58 | 12/3/98 | 0:11:22 | 24.45363 | 58 |
| HD-158-TEMP13-RTD-59 | 12/3/98 | 0:11:23 | 24.23413 | 59 |
| HD-158-TEMP13-RTD-60 | 12/3/98 | 0:11:24 | 24.17365 | 60 |
| HD-158-TEMP13-RTD-61 | 12/3/98 | 0:11:24 | 24.02206 | 61 |
| HD-158-TEMP13-RTD-62 | 12/3/98 | 0:11:25 | 23.93885 | 62 |
| HD-158-TEMP13-RTD-63 | 12/3/98 | 0:11:26 | 23.86215 | 63 |
| HD-158-TEMP13-RTD-64 | 12/3/98 | 0:11:27 | 23.70673 | 64 |
| HD-158-TEMP13-RTD-65 | 12/3/98 | 0:11:27 | 23.68318 | 65 |
| HD-158-TEMP13-RTD-66 | 12/3/98 | 0:11:28 | 23.66104 | 66 |
| HD-158-TEMP13-RTD-67 | 12/3/98 | 0:11:29 | 23.4806 | 67 |

160-1yr-temp.xls

| | | |
|---|---|---|
| HD-160-TEMP15-RTD-1 | 148.5405 | 1 |
| HD-160-TEMP15-RTD-2 | 147.8097 | 2 |
| HD-160-TEMP15-RTD-3 | 146.99 | 3 |
| HD-160-TEMP15-RTD-4 | 146.5672 | 4 |
| HD-160-TEMP15-RTD-5 | 147.2446 | 5 |
| HD-160-TEMP15-RTD-6 | 148.8843 | 6 |
| HD-160-TEMP15-RTD-7 | 152.0568 | 7 |
| HD-160-TEMP15-RTD-8 | 155.4678 | 8 |
| HD-160-TEMP15-RTD-9 | 160.5073 | 9 |
| HD-160-TEMP15-RTD-10 | 162.3024 | 10 |
| HD-160-TEMP15-RTD-11 | 168.274 | 11 |
| HD-160-TEMP15-RTD-12 | 171.4244 | 12 |
| HD-160-TEMP15-RTD-13 | 174.5129 | 13 |
| HD-160-TEMP15-RTD-14 | 174.4545 | 14 |
| HD-160-TEMP15-RTD-15 | 176.933 | 15 |
| HD-160-TEMP15-RTD-16 | 174.7886 | 16 |
| HD-160-TEMP15-RTD-17 | 178.3156 | 17 |
| HD-160-TEMP15-RTD-18 | 177.7407 | 18 |
| HD-160-TEMP15-RTD-19 | 177.4855 | 19 |
| HD-160-TEMP15-RTD-20 | 176.1231 | 20 |
| HD-160-TEMP15-RTD-21 | 174.9096 | 21 |
| HD-160-TEMP15-RTD-22 | 172.9514 | 22 |
| HD-160-TEMP15-RTD-23 | 172.2325 | 23 |
| HD-160-TEMP15-RTD-24 | 171.7313 | 24 |
| HD-160-TEMP15-RTD-25 | 173.025 | 25 |
| HD-160-TEMP15-RTD-26 | 174.8895 | 26 |
| HD-160-TEMP15-RTD-27 | 180.2061 | 27 |
| HD-160-TEMP15-RTD-28 | 178.4545 | 28 |
| HD-160-TEMP15-RTD-29 | 176.9426 | 29 |
| HD-160-TEMP15-RTD-30 | 179.6788 | 30 |
| HD-160-TEMP15-RTD-31 | 178.3919 | 31 |
| HD-160-TEMP15-RTD-32 | 175.8506 | 32 |
| HD-160-TEMP15-RTD-33 | 173.0913 | 33 |
| HD-160-TEMP15-RTD-34 | 167.7214 | 34 |
| HD-160-TEMP15-RTD-35 | 162.0114 | 35 |
| HD-160-TEMP15-RTD-36 | 155.3919 | 36 |
| HD-160-TEMP15-RTD-37 | 147.6767 | 37 |
| HD-160-TEMP15-RTD-38 | 137.9348 | 38 |
| HD-160-TEMP15-RTD-39 | 127.4265 | 39 |
| HD-160-TEMP15-RTD-40 | 114.811 | 40 |
| HD-160-TEMP15-RTD-41 | 101.5801 | 41 |
| HD-160-TEMP15-RTD-42 | 96.60455 | 42 |
| HD-160-TEMP15-RTD-43 | 93.04686 | 43 |
| HD-160-TEMP15-RTD-44 | 87.37909 | 44 |
| HD-160-TEMP15-RTD-45 | 82.32231 | 45 |
| HD-160-TEMP15-RTD-46 | 77.68214 | 46 |
| HD-160-TEMP15-RTD-47 | 73.5037 | 47 |
| HD-160-TEMP15-RTD-48 | 69.84053 | 48 |
| HD-160-TEMP15-RTD-49 | 66.23298 | 49 |
| HD-160-TEMP15-RTD-50 | 63.14495 | 50 |
| HD-160-TEMP15-RTD-51 | 60.09805 | 51 |
| HD-160-TEMP15-RTD-52 | 57.58702 | 52 |
| HD-160-TEMP15-RTD-53 | 54.90146 | 53 |
| HD-160-TEMP15-RTD-54 | 52.61586 | 54 |
| HD-160-TEMP15-RTD-55 | 50.46761 | 55 |
| HD-160-TEMP15-RTD-56 | 48.47599 | 56 |
| HD-160-TEMP15-RTD-57 | 46.47585 | 57 |
| HD-160-TEMP15-RTD-58 | 44.80376 | 58 |
| HD-160-TEMP15-RTD-59 | 43.12421 | 59 |
| HD-160-TEMP15-RTD-60 | 41.20523 | 60 |
| HD-160-TEMP15-RTD-61 | 40.26613 | 61 |
| HD-160-TEMP15-RTD-62 | 38.98335 | 62 |
| HD-160-TEMP15-RTD-63 | 37.7351 | 63 |
| HD-160-TEMP15-RTD-64 | 36.63998 | 64 |
| HD-160-TEMP15-RTD-65 | 35.555 | 65 |
| HD-160-TEMP15-RTD-66 | 34.62224 | 66 |
| HD-160-TEMP15-RTD-67 | 33.70419 | 67 |

9/16/01

RH

158-meas.xls ~~measured~~ RH 9/16/01

| 1yr | | 158 | 3yr | |
|---|---|---|---|---|
| 149.7793 | 1 | 203.7765 | 1 | 2.7991 |
| 144.0188 | 2 | 198.9911 | 2 | 3.0982 |
| 131.9152 | 3 | 188.9415 | 3 | 3.3973 |
| 120.8665 | 4 | 178.425 | 4 | 3.6964 |
| 112.8633 | 5 | 170.5533 | 5 | 3.9955 |
| 100.1929 | 6 | 156.3503 | 6 | 4.2946 |
| -242.4323 | 7 | 149.7529 | 8 | 4.8928 |
| 97.49848 | 8 | 143.6633 | 9 | 5.1919 |
| 93.48909 | 9 | 138.9155 | 10 | 5.491 |
| 89.75165 | 10 | 133.405 | 11 | 5.7901 |
| 85.73711 | 11 | 128.3832 | 12 | 6.0892 |
| 82.2942 | 12 | 123.4976 | 13 | 6.3883 |
| 78.82926 | 13 | 118.9842 | 14 | 6.6874 |
| 75.80698 | 14 | 114.4877 | 15 | 6.9865 |
| 72.71938 | 15 | 110.42 | 16 | 7.2856 |
| 69.89283 | 16 | 106.4688 | 17 | 7.5847 |
| 67.17295 | 17 | 103.5003 | 18 | 7.8838 |
| 64.58699 | 18 | 100.7779 | 19 | 8.1829 |
| 61.99599 | 19 | 99.35921 | 20 | 8.482 |
| 59.64552 | 20 | 97.65248 | 21 | 8.7811 |
| 57.26634 | 21 | 97.49883 | 22 | 9.0802 |
| 55.11068 | 22 | 94.66576 | 23 | 9.3793 |
| 52.99799 | 23 | 92.82479 | 24 | 9.6784 |
| 51.05159 | 24 | 91.15659 | 25 | 9.9775 |
| 49.06358 | 25 | 89.40794 | 26 | 10.2766 |
| 47.33788 | 26 | 87.60867 | 27 | 10.5757 |
| 45.64447 | 27 | 86.00382 | 28 | 10.8748 |
| 44.06419 | 28 | 84.31021 | 29 | 11.1739 |
| 42.61311 | 29 | 82.74908 | 30 | 11.473 |
| 41.21796 | 30 | 81.00489 | 31 | 11.7721 |
| 39.88793 | 31 | 79.51084 | 32 | 12.0712 |
| 38.72918 | 32 | 77.80501 | 33 | 12.3703 |
| 37.53228 | 33 | 76.41907 | 34 | 12.6694 |
| 36.48773 | 34 | 74.66462 | 35 | 12.9685 |
| 35.32029 | 35 | 74.29489 | 36 | 13.2676 |
| 34.43621 | 36 | 71.67146 | 37 | 13.5667 |
| 33.5045 | 37 | 71.38379 | 38 | 13.8658 |
| 32.68481 | 38 | 68.64647 | 39 | 14.1649 |
| 31.78856 | 39 | 67.19092 | 40 | 14.464 |
| 31.07289 | 40 | 65.75828 | 41 | 14.7631 |
| 30.49031 | 41 | 64.19541 | 42 | 15.0622 |
| 29.8263 | 42 | 62.79857 | 43 | 15.3613 |
| 29.18702 | 43 | 61.22768 | 44 | 15.6604 |
| 28.68152 | 44 | 59.82775 | 45 | 15.9595 |
| 28.14298 | 45 | 58.29308 | 46 | 16.2586 |
| 27.66158 | 46 | 58.03552 | 47 | 16.5577 |
| 27.2592 | 47 | 55.38332 | 48 | 16.8568 |
| 26.84943 | 48 | 55.12837 | 49 | 17.1559 |
| 26.404 | 49 | 52.42342 | 50 | 17.455 |
| 26.13049 | 50 | 52.12833 | 51 | 17.7541 |
| 25.89721 | 51 | 49.58017 | 52 | 18.0532 |
| 25.61843 | 52 | 48.11216 | 53 | 18.3523 |
| 25.37113 | 53 | 47.95313 | 54 | 18.6514 |
| 25.10522 | 54 | 45.43265 | 55 | 18.9505 |
| 24.95897 | 55 | 44.22152 | 56 | 19.2496 |
| 24.71183 | 56 | 42.93535 | 57 | 19.5487 |
| 24.51055 | 57 | 41.84527 | 58 | 19.8478 |
| 24.45363 | 58 | 40.69885 | 59 | 20.1469 |
| 24.23413 | 59 | 47.14364 | 60 | 20.446 |
| 24.17365 | 60 | 38.70306 | 61 | 20.7451 |
| 24.02206 | 61 | 37.79177 | 62 | 21.0442 |
| 23.93885 | 62 | 37.67948 | 63 | 21.3433 |
| 23.86215 | 63 | 36.03952 | 64 | 21.6424 |
| 23.70673 | 64 | 36.06392 | 65 | 21.9415 |
| 23.68318 | 65 | 34.51368 | 66 | 22.2406 |
| 23.66104 | 66 | 34.47721 | 67 | 22.5397 |
| 23.4806 | 67 | | | |

160-meas.xls

| 1yr | | 160 | 3yr | |
|---|---|---|---|---|
| 148.5405 | 1 | 203.2823 | 1 | 2.8001 |
| 147.8097 | 2 | 203.4169 | 2 | 3.1002 |
| 146.99 | 3 | 204.4851 | 3 | 3.4003 |
| 146.5672 | 4 | 206.288 | 4 | 3.7004 |
| 147.2446 | 5 | 208.1221 | 5 | 4.0005 |
| 148.8843 | 6 | 210.8718 | 6 | 4.3006 |
| 152.0568 | 7 | 214.3315 | 7 | 4.6007 |
| 155.4678 | 8 | 217.7021 | 8 | 4.9008 |
| 160.5073 | 9 | 222.8809 | 9 | 5.2009 |
| 162.3024 | 10 | 226.597 | 10 | 5.501 |
| 168.274 | 11 | 230.1703 | 11 | 5.8011 |
| 171.4244 | 12 | 233.1559 | 12 | 6.1012 |
| 174.5129 | 13 | 235.6675 | 13 | 6.4013 |
| 174.4545 | 14 | 236.1346 | 14 | 6.7014 |
| 176.933 | 15 | 237.8145 | 15 | 7.0015 |
| 174.7886 | 16 | 237.6824 | 16 | 7.3016 |
| 178.3156 | 17 | 238.9097 | 17 | 7.6017 |
| 177.7407 | 18 | 238.5262 | 18 | 7.9018 |
| 177.4855 | 19 | 238.0011 | 19 | 8.2019 |
| 176.1231 | 20 | 235.5766 | 20 | 8.502 |
| 174.9096 | 21 | 235.1359 | 21 | 8.8021 |
| 172.9514 | 22 | 232.9727 | 22 | 9.1022 |
| 172.2325 | 23 | 231.7559 | 23 | 9.4023 |
| 171.7313 | 24 | 270.404 | 24 | 9.7024 |
| 173.025 | 25 | 230.8273 | 25 | 10.0025 |
| 174.8895 | 26 | 232.011 | 26 | 10.3026 |
| 180.2061 | 27 | 233.2509 | 27 | 10.6027 |
| 178.4545 | 28 | 232.9241 | 28 | 10.9028 |
| 176.9426 | 29 | 232.9237 | 29 | 11.2029 |
| 179.6788 | 30 | 230.7268 | 30 | 11.503 |
| 178.3919 | 31 | 228.985 | 31 | 11.8031 |
| 175.8506 | 32 | 225.3484 | 32 | 12.1032 |
| 173.0913 | 33 | 221.3678 | 33 | 12.4033 |
| 167.7214 | 34 | 215.8429 | 34 | 12.7034 |
| 162.0114 | 35 | 209.4868 | 35 | 13.0035 |
| 155.3919 | 36 | 202.9322 | 36 | 13.3036 |
| 147.6767 | 37 | 195.1149 | 37 | 13.6037 |
| 137.9348 | 38 | 185.932 | 38 | 13.9038 |
| 127.4265 | 39 | 175.7517 | 39 | 14.2039 |
| 114.811 | 40 | 163.9785 | 40 | 14.504 |
| 101.5801 | 41 | 151.638 | 41 | 14.8041 |
| 96.60455 | 42 | 140.4923 | 42 | 15.1042 |
| 93.04686 | 43 | 130.7213 | 43 | 15.4043 |
| 87.37909 | 44 | 121.662 | 44 | 15.7044 |
| 82.32231 | 45 | 114.1774 | 45 | 16.0045 |
| 77.68214 | 46 | 107.0806 | 46 | 16.3046 |
| 73.5037 | 47 | 101.7714 | 47 | 16.6047 |
| 69.84053 | 48 | 98.50698 | 48 | 16.9048 |
| 66.23298 | 49 | 96.56401 | 49 | 17.2049 |
| 63.14495 | 50 | 93.67453 | 50 | 17.505 |
| 60.09805 | 51 | 90.46091 | 51 | 17.8051 |
| 57.58702 | 52 | 87.99946 | 52 | 18.1052 |
| 54.90146 | 53 | 85.21907 | 53 | 18.4053 |
| 52.61586 | 54 | 82.83964 | 54 | 18.7054 |
| 50.46761 | 55 | 80.41435 | 55 | 19.0055 |
| 48.47599 | 56 | 78.23904 | 56 | 19.3056 |
| 46.47585 | 57 | 75.9419 | 57 | 19.6057 |
| 44.80376 | 58 | 73.92807 | 58 | 19.9058 |
| 43.12421 | 59 | 71.8581 | 59 | 20.2059 |
| 41.20523 | 60 | 69.52496 | 60 | 20.506 |
| 40.26613 | 61 | 68.09212 | 61 | 20.8061 |
| 38.98335 | 62 | 66.22509 | 62 | 21.1062 |
| 37.7351 | 63 | 64.44165 | 63 | 21.4063 |
| 36.63998 | 64 | 62.79852 | 64 | 21.7064 |
| 35.555 | 65 | 61.11923 | 65 | 22.0065 |
| 34.62224 | 66 | 59.51937 | 66 | 22.3066 |
| 33.70419 | 67 | 57.9452 | 67 | 22.6067 |



9/16/01

RH

160-base.xls

| | Matrix | | Fracture |
|---|---|---|---|
| 2.571 | 149.7 | 2.571 | 149.7 |
| 4.136 | 129.9 | 4.136 | 129.9 |
| 4.393 | 131.1 | 4.393 | 131.1 |
| 4.681 | 132.6 | 4.681 | 132.6 |
| 5.153 | 133.8 | 5.153 | 133.8 |
| 5.738 | 133.7 | 5.738 | 133.7 |
| 6.587 | 131.2 | 6.587 | 131.2 |
| 7.718 | 130.2 | 7.718 | 130.2 |
| 8.596 | 128.1 | 8.596 | 128.1 |
| 8.959 | 127.5 | 8.959 | 127.5 |
| 9.379 | 130.4 | 9.379 | 130.4 |
| 9.82 | 137.6 | 9.82 | 137.6 |
| 10.358 | 144.7 | 10.358 | 144.7 |
| 11.69 | 145.6 | 11.69 | 145.6 |
| 12.901 | 132.3 | 12.901 | 132.3 |
| 13.89 | 110.8 | 13.89 | 110.8 |
| 14.219 | 100.5 | 14.219 | 100.1 |
| 14.588 | 95.83 | 14.588 | 95.92 |
| 15.363 | 82.65 | 15.363 | 82.65 |
| 16.546 | 66.72 | 16.546 | 66.72 |
| 17.809 | 54.31 | 17.809 | 54.31 |
| 19.584 | 42.2 | 19.584 | 42.2 |
| 22.407 | 31.46 | 22.407 | 31.46 |
| 26.866 | 25.8 | 26.866 | 25.8 |
| 31.879 | 24.39 | 31.879 | 24.39 |
| 40.21 | 24.11 | 40.21 | 24.11 |
| 51.498 | 24.1 | 51.498 | 24.1 |
| 63.132 | 24.1 | 63.132 | 24.1 |
| 74.279 | 24.1 | 74.279 | 24.1 |

158-base.xls

| | Matrix | | Fracture |
|---|---|---|---|
| 2.708 | 96.45 | 2.708 | 96.17 |
| 2.917 | 96.19 | 2.917 | 96.16 |
| 3.133 | 96.16 | 3.133 | 96.15 |
| 3.343 | 96.15 | 3.343 | 96.15 |
| 3.537 | 96.14 | 3.537 | 96.14 |
| 3.777 | 96.13 | 3.777 | 96.13 |
| 4.019 | 96.13 | 4.019 | 96.13 |
| 4.291 | 96.12 | 4.291 | 96.12 |
| 4.64 | 96.11 | 4.64 | 96.11 |
| 5.078 | 96.1 | 5.078 | 96.1 |
| 5.625 | 96.09 | 5.625 | 96.09 |
| 6.228 | 96.05 | 6.228 | 96.07 |
| 6.961 | 94.37 | 6.961 | 94.46 |
| 7.771 | 83.15 | 7.771 | 83.16 |
| 8.947 | 68.4 | 8.947 | 68.4 |
| 10.041 | 55.94 | 10.041 | 55.94 |
| 12.652 | 37.34 | 12.652 | 37.34 |
| 16.647 | 27.26 | 16.647 | 27.26 |
| 26.789 | 23.79 | 26.789 | 23.79 |
| 33.851 | 23.57 | 33.851 | 23.57 |
| 43.486 | 23.34 | 43.486 | 23.34 |
| 55.938 | 23.05 | 55.938 | 23.05 |
| 72.784 | 22.66 | 72.784 | 22.66 |
| 91.279 | 22.22 | 91.279 | 22.22 |

from rdt136 results

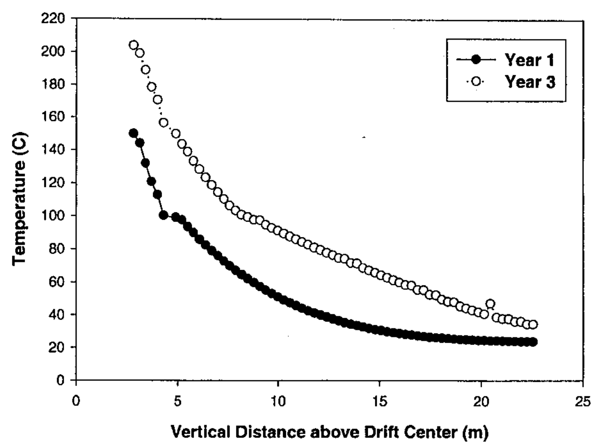
RH 9/16/01

9/16/01
RJ

## Measured Temperatures at Year 1 and Measured Temperatures at Year 3

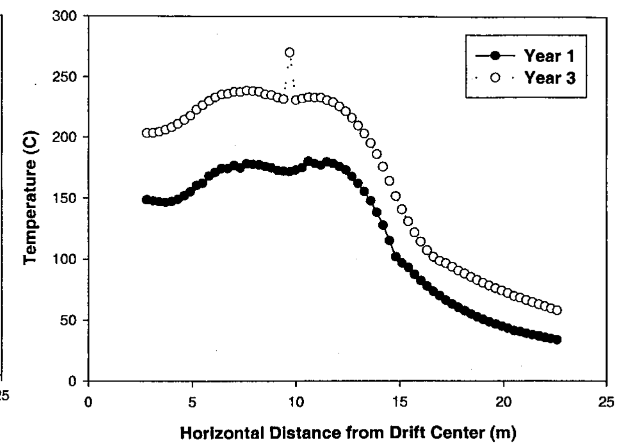
**Borehole 158**

158-meas.JNB




**Borehole 160**

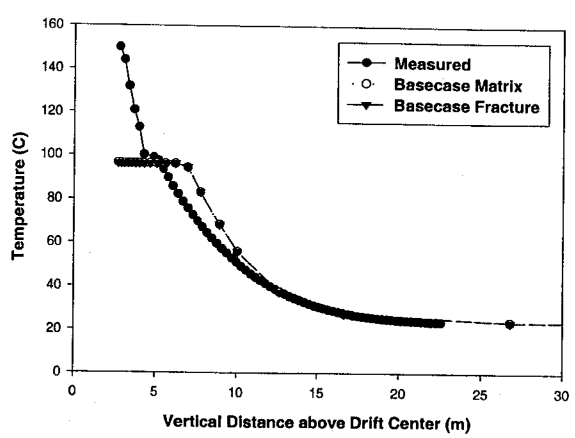
160-meas.JNB




## Measured Temperatures versus Basecase Simulation at Year 1

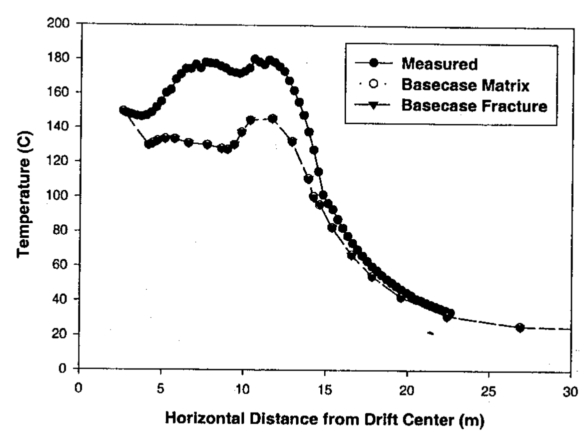
158-base.JNB

**Borehole 158**




160-base.JNB

**Borehole 160**




9/16/01
RJ

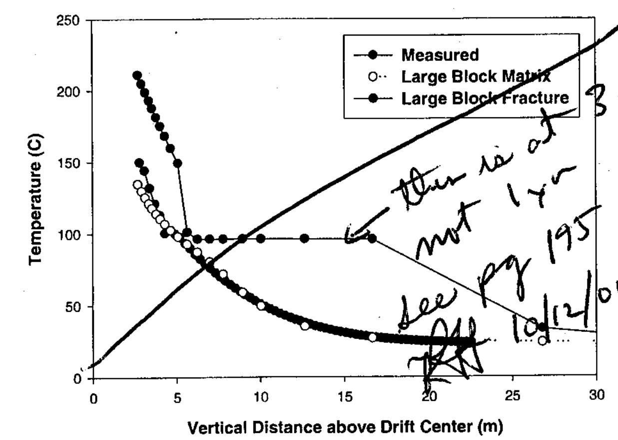
all in ~/dst_scans/decovalex/barcelona/*
also on zip barcelona 9/01



## Measured Temperature versus Large Block Simulation at Year 1

lbk-2a-1y158.JNB

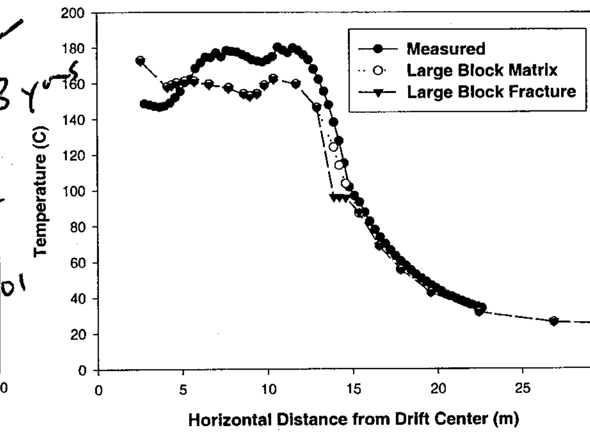
**Borehole 158**




this is at 3 yrs not 1 yr see pg 195
RJ 10/12/01

lbk-2a-1y160.JNB

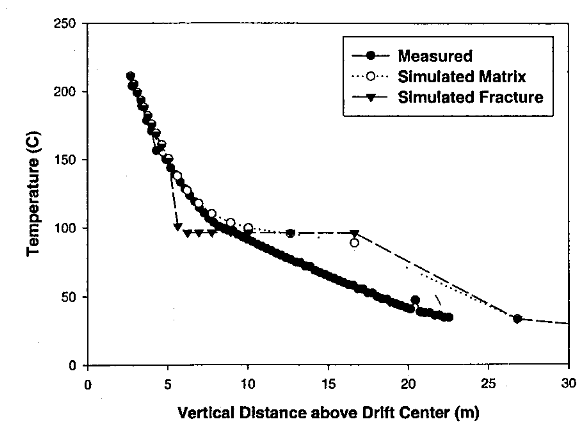
**Borehole 160**




## Measured Temperature versus Large Block Simulation at Year 3

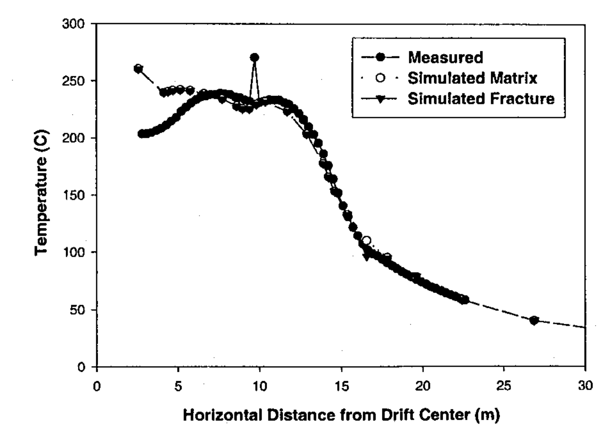
lbk-2a-3-158.JNB

**Borehole 158**




lbk-2a-3-160.JNB

**Borehole 160**



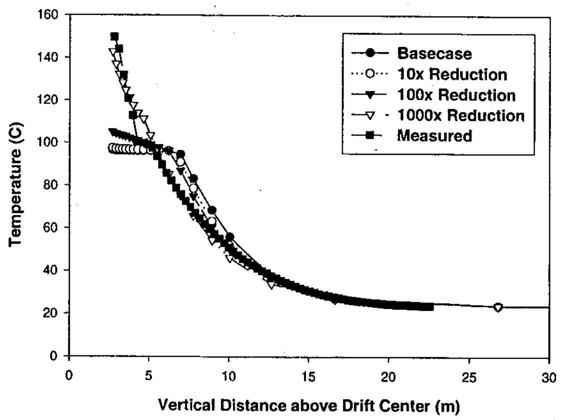
9/18/01
RH

# Effect of Intrinsic Fracture Permeability

## Year 1

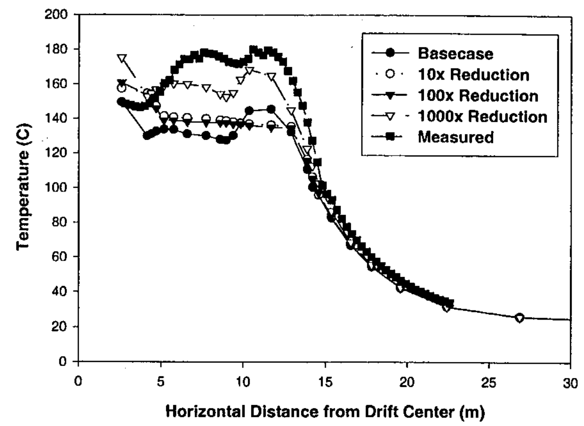
4Frac158.JNB

### Borehole 158




4Frac160.JNB

### Borehole 160




4Frac158.JNB

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 96.45 | 2.708 | 97.39 | 2.708 | 105.1 | 2.708 | 142.9 | 149.7793 | 1 | 203.7765 | 1 | 2.7991 |
| 96.19 | 2.917 | 97.02 | 2.917 | 104.4 | 2.917 | 137 | 144.0188 | 2 | 198.9911 | 2 | 3.0982 |
| 96.16 | 3.133 | 96.92 | 3.133 | 103.9 | 3.133 | 132.2 | 131.9152 | 3 | 188.9415 | 3 | 3.3973 |
| 96.15 | 3.343 | 96.85 | 3.343 | 103.4 | 3.343 | 128.2 | 120.8665 | 4 | 178.425 | 4 | 3.6964 |
| 96.14 | 3.537 | 96.8 | 3.537 | 103 | 3.537 | 124.8 | 112.8633 | 5 | 170.5533 | 5 | 3.9955 |
| 96.13 | 3.777 | 96.73 | 3.777 | 102.4 | 3.777 | 121.2 | 100.1929 | 6 | 156.3503 | 6 | 4.2946 |
| 96.13 | 4.019 | 96.66 | 4.019 | 101.8 | 4.019 | 117.7 | 99 | 7 | 149.7529 | 8 | 4.8928 |
| 96.12 | 4.291 | 96.59 | 4.291 | 101.2 | 4.291 | 114 | 97.49848 | 8 | 143.6633 | 9 | 5.1919 |
| 96.11 | 4.64 | 96.5 | 4.64 | 100.3 | 4.64 | 111.2 | 93.48909 | 9 | 138.9155 | 10 | 5.491 |
| 96.1 | 5.078 | 96.4 | 5.078 | 99.19 | 5.078 | 103.5 | 89.75165 | 10 | 133.405 | 11 | 5.7901 |
| 96.09 | 5.625 | 96.27 | 5.625 | 97.78 | 5.625 | 94.4 | 85.73711 | 11 | 128.3832 | 12 | 6.0892 |
| 96.05 | 6.228 | 96.08 | 6.228 | 96.25 | 6.228 | 85.21 | 82.2942 | 12 | 123.4976 | 13 | 6.3883 |
| 94.37 | 6.961 | 90.85 | 6.961 | 86.89 | 6.961 | 75.21 | 78.82926 | 13 | 118.9842 | 14 | 6.6874 |
| 83.15 | 7.771 | 78.63 | 7.771 | 75.01 | 7.771 | 65.63 | 75.80698 | 14 | 114.4877 | 15 | 6.9865 |
| 68.4 | 8.947 | 63.26 | 8.947 | 60.65 | 8.947 | 54.27 | 72.71938 | 15 | 110.42 | 16 | 7.2856 |
| 55.94 | 10.041 | 51.79 | 10.041 | 50.08 | 10.041 | 46 | 69.89283 | 16 | 106.4688 | 17 | 7.5847 |
| 37.34 | 12.652 | 35.59 | 12.652 | 35 | 12.652 | 33.76 | 67.17295 | 17 | 103.5003 | 18 | 7.8838 |
| 27.26 | 16.647 | 26.83 | 16.647 | 26.72 | 16.647 | 26.52 | 64.58699 | 18 | 100.7779 | 19 | 8.1829 |
| 23.79 | 26.789 | 23.7 | 26.789 | 23.7 | 26.789 | 23.7 | 61.99599 | 19 | 99.35921 | 20 | 8.482 |
| 23.57 | 33.851 | 23.49 | 33.851 | 23.49 | 33.851 | 23.49 | 59.64552 | 20 | 97.65248 | 21 | 8.7811 |
| 23.34 | 43.486 | 23.27 | 43.486 | 23.27 | 43.486 | 23.27 | 57.26634 | 21 | 97.49883 | 22 | 9.0802 |
| 23.05 | 55.938 | 22.99 | 55.938 | 22.99 | 55.938 | 22.99 | 55.11068 | 22 | 94.66576 | 23 | 9.3793 |
| 22.66 | 72.784 | 22.61 | 72.784 | 22.61 | 72.784 | 22.61 | 52.99799 | 23 | 92.82479 | 24 | 9.6784 |
| 22.22 | 91.279 | 22.2 | 91.279 | 22.2 | 91.279 | 22.2 | 51.05159 | 24 | 91.15659 | 25 | 9.9775 |
| basecase | | 10x | | 100x | | 1000x | 49.06358 | 25 | 89.40794 | 26 | 10.2766 |
| | | | | | | | 47.33788 | 26 | 87.60867 | 27 | 10.5757 |
| | | | | | | | 45.64447 | 27 | 86.00382 | 28 | 10.8748 |
| | | | | | | | 44.06419 | 28 | 84.31021 | 29 | 11.1739 |
| | | | | | | | 42.61311 | 29 | 82.74908 | 30 | 11.473 |
| | | | | | | | 41.21796 | 30 | 81.00489 | 31 | 11.7721 |
| | | | | | | | 39.88793 | 31 | 79.51084 | 32 | 12.0712 |
| | | | | | | | 38.72918 | 32 | 77.80501 | 33 | 12.3703 |
| | | | | | | | 37.53228 | 33 | 76.41907 | 34 | 12.6694 |
| | | | | | | | 36.48773 | 34 | 74.66462 | 35 | 12.9685 |
| | | | | | | | 35.32029 | 35 | 74.29489 | 36 | 13.2676 |
| | | | | | | | 34.43621 | 36 | 71.67146 | 37 | 13.5667 |
| | | | | | | | 33.5045 | 37 | 71.38379 | 38 | 13.8658 |

1 yr
measured



9/19/01
RH

Continuation of 4Frac158.JNB

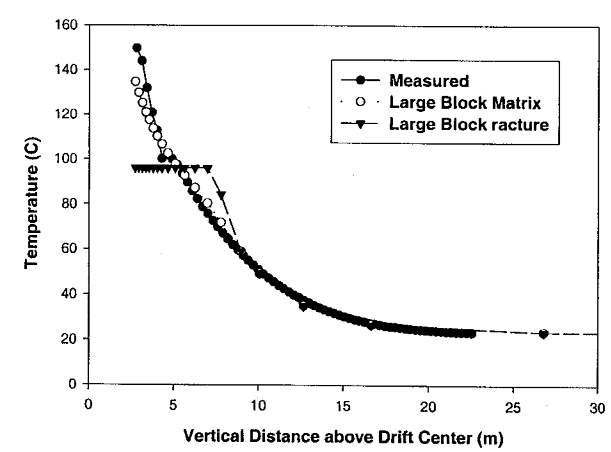
| | | | | |
|---|---|---|---|---|
| 32.68481 | 38 | 68.64647 | 39 | 14.1649 |
| 31.78856 | 39 | 67.19092 | 40 | 14.464 |
| 31.07289 | 40 | 65.75828 | 41 | 14.7631 |
| 30.49031 | 41 | 64.19541 | 42 | 15.0622 |
| 29.8263 | 42 | 62.79857 | 43 | 15.3613 |
| 29.18702 | 43 | 61.22768 | 44 | 15.6604 |
| 28.68152 | 44 | 59.82775 | 45 | 15.9595 |
| 28.14298 | 45 | 58.29308 | 46 | 16.2586 |
| 27.66158 | 46 | 58.03552 | 47 | 16.5577 |
| 27.2592 | 47 | 55.38332 | 48 | 16.8568 |
| 26.84943 | 48 | 55.12837 | 49 | 17.1559 |
| 26.404 | 49 | 52.42342 | 50 | 17.455 |
| 26.13049 | 50 | 52.12833 | 51 | 17.7541 |
| 25.89721 | 51 | 49.58017 | 52 | 18.0532 |
| 25.61843 | 52 | 48.11216 | 53 | 18.3523 |
| 25.37113 | 53 | 47.95313 | 54 | 18.6514 |
| 25.10522 | 54 | 45.43265 | 55 | 18.9505 |
| 24.95897 | 55 | 44.22152 | 56 | 19.2496 |
| 24.71183 | 56 | 42.93535 | 57 | 19.5487 |
| 24.51055 | 57 | 41.84527 | 58 | 19.8478 |
| 24.45363 | 58 | 40.69885 | 59 | 20.1469 |
| 24.23413 | 59 | 47.14364 | 60 | 20.446 |
| 24.17365 | 60 | 38.70306 | 61 | 20.7451 |
| 24.02206 | 61 | 37.79177 | 62 | 21.0442 |
| 23.93885 | 62 | 37.67948 | 63 | 21.3433 |
| 23.86215 | 63 | 36.03952 | 64 | 21.6424 |
| 23.70673 | 64 | 36.06392 | 65 | 21.9415 |
| 23.68318 | 65 | 34.51368 | 66 | 22.2406 |
| 23.66104 | 66 | 34.47721 | 67 | 22.5397 |
| 23.4806 | 67 | | | |

10/02/01
RH

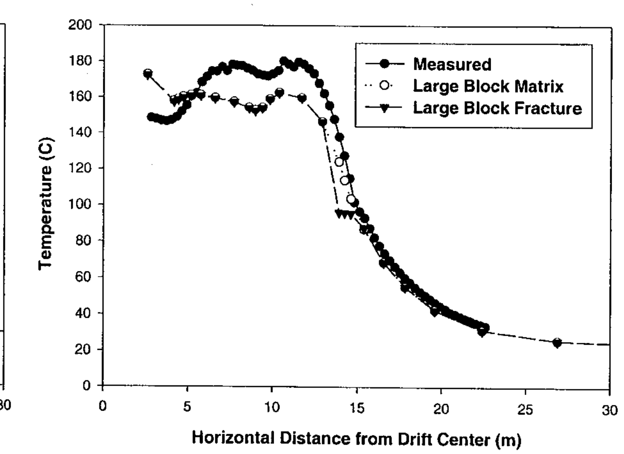
This is the corrected plot from pg 193

# Measured Temperatures versus 7.2-m Block Simulation at Year 1

### Borehole 158




### Borehole 160



RH

4/24/02 Started new 3D grid for the DST to be able to evaluate the effects of 3D geometry and the correct drift wall boundary condition (i.e constant pressure)

The heater drift is 47.5m long. The 3D model will use 2 planes of symmetry (i.e. two vertically oriented planes of symmetry) so that only 1/4 of the DST will be evaluated.

An extruded grid will be used with the extrusion oriented in the y-direction.

There will be a determined number of vertical grid planes: possible number of planes are: → total model drift length is $\frac{47.5}{2}$ = 23.75m plus at least 20m beyond the end of the drift.

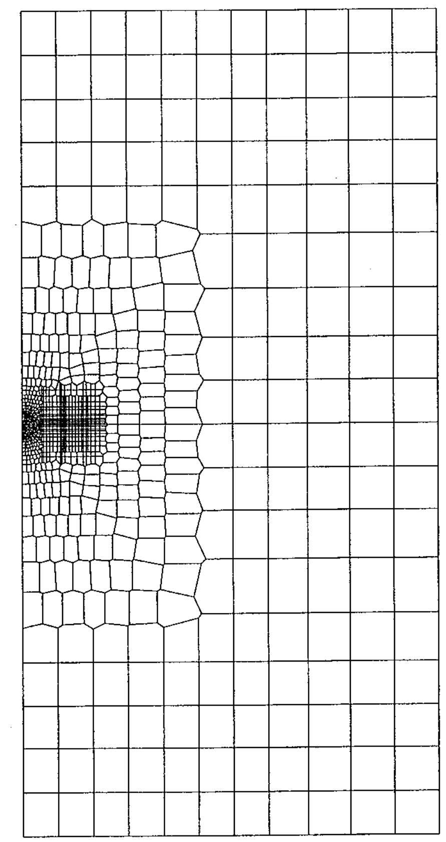
5/16/02 RH Started mathematica notebook to generate grid pts for the 3D model

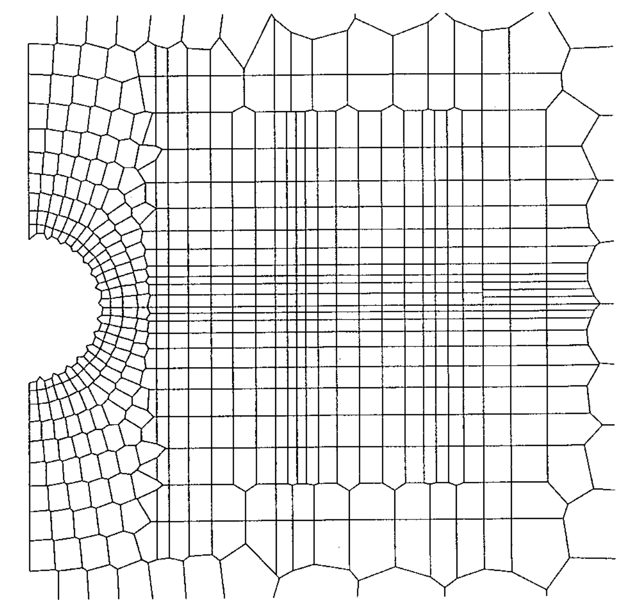
5/30/02 RH



6/20/02 RH

The 2D grid for the 3D-extrusion model looks like (plotted w/ mathematica notebook mesh2.nb





The source files are in /net/spock/home/rgreen/dst_scans/3d/2d/segmt

The notebook defining the grid is in: DST2D_no_drift.nb

6/29/02
RH

There are no drift nodes in this grid
w/ a total of 1113 nodes

There are 30 ghost nodes on interior of
drift wall

Heater nodes in wings will be
located at elements (nodes):
inner 382-388
outer 391-397

The volume for these elements (2-m thick) are
taken from eleme

| element | vol |
|---|---|
| 382 | 7.040e-1 |
| 383 | 8.320e-1 |
| 384 | 9.600e-1 |
| 385 | 1.152e-0 |
| 386 | 1.440e-0 |
| 387 | 1.600e-0 |
| 388 | 4.800e-1 |
| | 7.168 $m^3$ |
| 391 | 4.960e-1 |
| 392 | 7.040e-1 |
| 393 | 8.320e-1 |
| 394 | 9.600e-1 |
| 395 | 1.152 e-0 |
| 396 | 1.440 e-0 |
| 397 | 1.600 e-0 |
| | 7.184 $m^3$ |

This row is at z = 0.125 m above mid plane
the row above is @ 0.375 and below is
-0.125, total thickness goes from 0.25 to 0
for a thickness of 0.25 m.



6/29/02
RH

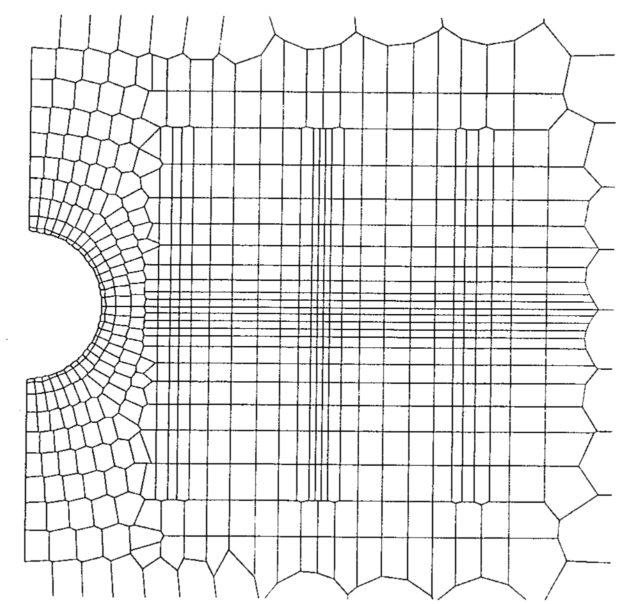
The inner wing heater goes from the mid pt RH 6/2/02
point of elements 381-382 (4.27 to 4.58) or ~~8~~ 4.425
to 388-389 (8.70 to 9.02) or 8.86 for a
length of 4.435
Likewise the outer wing heater is 390-391 (9.35 to 9.68) or
9.54 to 397-398 (13.70 to 14.12) or ~~4.455~~ 13.995
for 4.455 RH 6/2/02
The cross sectional areas are (0.25)(4.435) = 1.1088 $m^2$
and (0.25)(4.455) = 1.1138 $m^2$

→ There is some discrepancy in these areas

6/29/02
RH

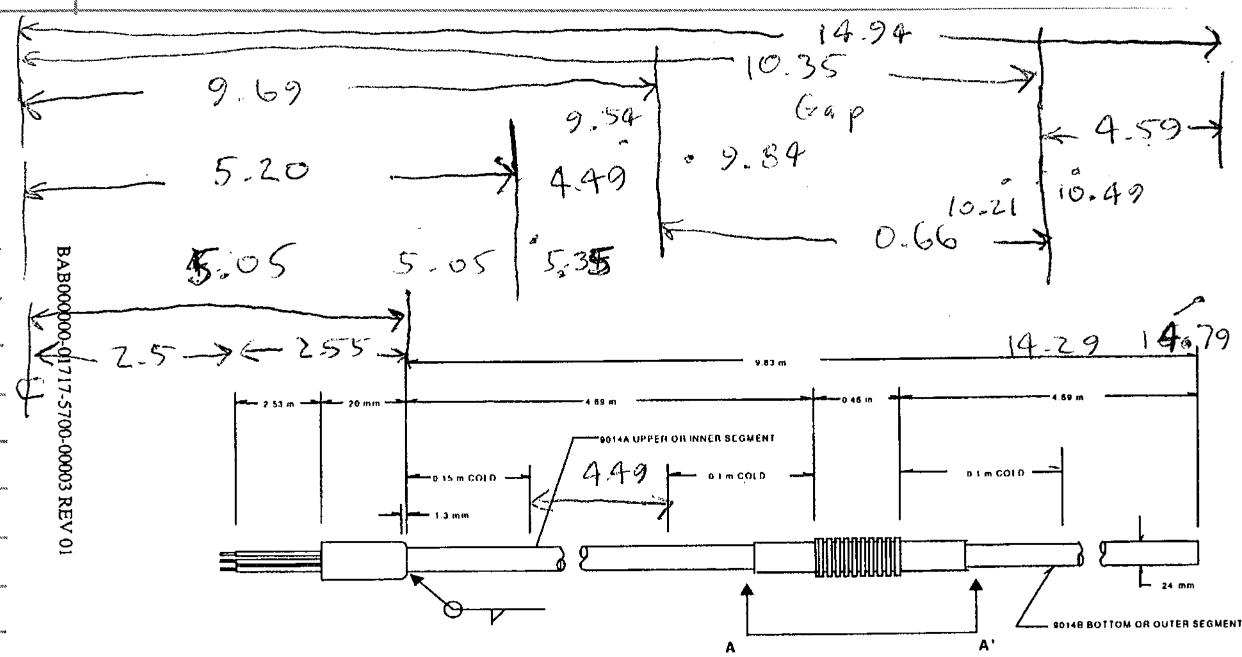
Re-drafted grid with better control and
resolution near wing heaters

New grid appears (near drift & wing area)



Grid was generated
using mathematica
notebook DST2D_no
_drift.nb
in /net/spock/home/
rgreen/dst_scans/3D
/2D/nodrift/*

6/26/02 RH Spacing of nodes at wing heaters is as follows [refer to figure on pg 89 and copied here]




All distances in meters from drift center, assumes drift diameter of 2.5 m

node location is as follows:

765 766 767 | 768 inner wing heater

4.25, 4.65, 5.05 | 5.35 5.85 6.60 7.445

5.20

inner wing | 778 outer wing

8.29 9.04 9.54 774 9.69 | 9.84 10.~~45~~ 0.25 10.21 | 10.49 10.35

RH 6/26/02

inner wing length [9.69 − 5.20] = 4.49

outer wing

10.99 11.74 12.64 13.54 14.29 | 14.79 784 14.94 | 15.09

15.59 16.09

outer wing length [14.94 − 10.35] = 4.59



6/26/02 RH There will be 7 nodes in the inner wing heater and 7 nodes in the outer wing heater. In notebook DST2D_no_drf+6-26.ul there will be nodes 766 − 772 and 778 − 784

Canister heater nodes will be one node in from drift wall, in the second row of nodes. These nodes are: 1, 13, 25, 37, 49, 61, 72, 83, 92, 100, 107, 113, 119, 125, 131, 137, 143, 149, 155, 161, 167, 174, 182, 191, 202, 213, 225, 237, 249, 261

These were taken from the conne file by seeing which nodes connect with the inner wing.

These all (wing + canister) will be heat source with no mass, with a rate for each grid block in the region [J/s]

⇒ Need a volume for each one, similar to pg 89. Volumes are listed below

RH 6/27/02

wing nodes

| Inner Wing | | Outer wing | |
|---|---|---|---|
| 766 | 2.00e-1 | 778 | 1.950e-1 |
| 767 | 1.75 e-1 | 779 | 3.125e-1 |
| 768 | 2.00 e-1 | 780 | 4.125e-1 |
| 769 | 3.125 e-1 | 781 | 4.500 e-1 |
| 770 | 3.988 e-1 | 782 | 4.125 e-1 |
| 771 | 4.225e-1 | 783 | 3.125 e-1 |
| 772 | 3.987e-1 | 784 | 2.000e-1 |
| | 2.1075 $m^3$ | | 2.295 $m^3$ |

→ heater nodes should be 768 − 774 & 778 − 784 corrections on next pg

6/27/02
RF

| Inner Wing Heater (A) | | | Outer Wing Heater (B) | | |
|---|---|---|---|---|---|
| node | volume | % of total | node | volume | % of total |
| 768 | 2.000e-1 | 8.9087e-2 | 778 | 1.950e-1 | 8.4967e-2 |
| 769 | 3.125e-1 | 1.3920e-1 | 779 | 3.125e-1 | 1.3617e-1 |
| 770 | 3.988e-1 | 1.7764e-1 | 780 | 4.125e-1 | 1.7974e-1 |
| 771 | 4.225e-1 | 1.882e-1 | 781 | 4.500e-1 | 1.9608e-1 |
| 772 | 3.987e-1 | 1.7759e-1 | 782 | 4.125e-1 | 1.7974e-1 |
| 773 | 3.125e-1 | 1.3920e-1 | 783 | 3.125e-1 | 1.3617e-1 |
| 774 | 2.000e-1 | 8.9087e-2 | 784 | 2.000e-1 | 8.7146e-2 |
| | 2.2450 $m^3$ | 1.000e0 | | 2.2950 $m^3$ | 1.000 |

RF 6/27/02

length = 4.49m
width = 0.25m
depth = 2m

volume = 2.245$m^3$

length = 4.59 m
width = 0.25m
depth = 2m

volume = 2.295$m^3$

Wing heaters - assume total length heated by wing heaters is 46m, ½ would be 23m
Therefore, this 2-m deep slice constitutes $\frac{2}{23}$ of one half section or $\frac{2}{46}$ of total ~~canister~~ wing heat load $\frac{2}{46}$ = 0.0435 to one side RF 6/27/02

Per pg 90: inner wing heaters 57.2 KW
outer wing heaters 85.8 KW
143.0 KW total

One half this goes to each side of drift

inner wing heater: 28.6 KW
outer wing heater: 42.9 KW

A 2-m wide section would get the following:

heat load [ inner wing heater: 1.2435 KW
outer wing heater: 1.8652 KW



6/27/02
RF

Wing Heater heat load, expressed in KW per element

| node | KW (A) * heat load | node | KW (B) * heat load |
|---|---|---|---|
| 768 | 1.1078e-1 | 778 | 1.5848e-1 |
| 769 | 1.7310e-1 | 779 | 2.5398e-1 |
| 770 | 2.2090e-1 | 780 | 3.3525e-1 |
| 771 | 2.3403e-1 | 781 | 3.6573e-1 |
| 772 | 2.2090e-1 | 782 | 3.3525e-1 |
| 773 | 1.7310e-1 | 783 | 2.5398e-1 |
| 774 | 1.1078e-1 | 784 | 1.6254e-1 |
| | 1.2436 KW | | 1.8652 KW |

Note: this is for total wing heat load = 143 KW
Note: 1.1078e-1 KW = 110.78 W
This is the value entered in Source in Multiflo.

Similarly for the canister (drift wall) heat nodes

| node | vol | % of total | node | | |
|---|---|---|---|---|---|
| 1 | 2.353e-1 | 3.2629e-2 | 137 | 2.032e-1 | 2.8178e-2 |
| 13 | 2.376e-1 | 3.2948e-2 | 143 | 2.051e-1 | 2.8441e-2 |
| 25 | 2.425e-1 | 3.3627e-2 | 149 | 2.091e-1 | 2.8996e-2 |
| 37 | 2.494e-1 | 3.4584e-2 | 155 | 2.150e-1 | 2.9814e-2 |
| 49 | 2.593e-1 | 3.5957e-2 | 161 | 2.232e-1 | 3.0951e-2 |
| 61 | 2.744e-1 | 3.8051e-2 | 167 | 2.357e-1 | 3.2684e-2 |
| 72 | 2.912e-1 | 4.0381e-2 | 174 | 2.513e-1 | 3.4848e-2 |
| 83 | 2.734e-1 | 3.7912e-2 | 182 | 2.734e-1 | 3.7912e-2 |
| 92 | 2.513e-1 | 3.4848e-2 | 191 | 2.912e-1 | 4.0381e-2 |
| 100 | 2.357e-1 | 3.2684e-2 | 202 | 2.744e-1 | 3.8051e-2 |
| 107 | 2.232e-1 | 3.0951e-2 | 213 | 2.593e-1 | 3.5957e-2 |
| 113 | 2.150e-1 | 2.9814e-2 | 225 | 2.494e-1 | 3.4584e-2 |
| 119 | 2.091e-1 | 2.8996e-2 | 237 | 2.425e-1 | 3.3627e-2 |
| 125 | 2.051e-1 | 2.8441e-2 | 249 | 2.376e-1 | 3.2948e-2 |
| 131 | 2.032e-1 | 2.8178e-2 | 261 | 2.353e-1 | 3.629e-2 |
| | 3.6057$m^3$ | 5.0000e-1 (C) | | 3.6057$m^3$ | 5.0000e-1 (C) |

Total volume = 7.2114 $m^3$

6/27/02
RH

Canister heat load is 52 KW or 26 KW per side or $\frac{2}{46}(26) = 1.1304$ KW per 2-m wide slice.

| node | © * 1.1304 KW | W |
|---|---|---|
| 1, 261 | 3.6885e-2 | 36.89 |
| 13, 249 | 3.7246e-2 | 37.25 |
| 25, 237 | 3.8013e-2 | 38.01 |
| 37, 225 | 3.9095e-2 | 39.10 |
| 49, 213 | 4.0647e-2 | 40.65 |
| 61, 202 | 4.3014e-2 | 43.01 |
| 72, 191 | 4.5648e-2 | 45.65 |
| 83, 182 | 4.2857e-2 | 42.86 |
| 92, 174 | 3.9393e-2 | 39.39 |
| 100, 167 | 3.6906e-2 | 36.91 |
| 107, 161 | 3.4988e-2 | 34.99 |
| 113, 155 | 3.3703e-2 | 33.70 |
| 119, 149 | 3.2778e-2 | 32.78 |
| 125, 143 | 3.2151e-2 | 32.15 |
| 131, 137 | 3.1853e-2 | 31.85 |
| | 5.6518e-1 KW | |

Combined nodes due to symmetry

$2 * (5.6518e-1) = 1.1304$ KW $= 1130.4$ W

Wing heat loads need to be scaled to agree w/ actual heat loads. Assume that the decrease from 136.5 KW to 128.2 KW decrease observed in 1.9 yrs continues linearly for the 4 yrs of heating

$\frac{136.5 - 128.2}{1.9} = 4.368$ KW decrease per year

or $4(4.368 \text{ KW}) = 17.47$ KW reduction

$136.5 - 17.47 = 119.03$ KW at end of 4 yr heating



6/27/02
RH

Heat load in wing heaters at start is

$\frac{136.5}{143.0} = 0.9545$

and at 4 yrs

$\frac{119.03}{143.0} = 0.8324$

These were revised 7/6/02 RH

Need to scale heat loads on pg 203 to these levels

| | node | @100% (W) | start @ 95.45% | 4 yrs @ 83.24 |
|---|---|---|---|---|
| | 768 | 110.78 | 105.74 | 92.21 |
| | 769 | 173.10 | 165.23 | 144.08 |
| | 770 | 220.90 | 210.86 | 183.87 |
| inner wing | 771 | 234.03 | 223.39 | 202.29 |
| | 772 | 220.90 | 210.23 | 183.87 |
| | 773 | 173.10 | 165.10 | 144.08 |
| | 774 | 110.78 | 105.74 | 92.21 |
| | | | 1,185.53 | 1,042.61 |
| | 778 | 158.48 | 151.28 | 131.92 |
| | 779 | 253.98 | 242.44 | 211.41 |
| outer wing | 780 | 335.25 | 320.01 | 279.05 |
| | 781 | 365.73 | 349.11 | 304.43 |
| | 782 | 335.25 | 320.01 | 279.25 |
| | 783 | 253.98 | 242.44 | 211.41 |
| | 784 | 162.54 | 155.15 | 135.29 |
| | | | 1,780.44 | 1,552.96 |
| | | | 2.966 KW | 2.596 KW |
| | | | 68.2 KW | ⇒ 59.7 KW full length, 2 sides |

RH 6/27/02

7/2/02
RH

New refined grid w/ invert, different grid from pg 204

Heater nodes are as follows

Ghost nodes in drift wall

| ↓ | Heater node | volume ($m^3$) | % of total vol | heat load (W) |
|---|---|---|---|---|
| 1158 | 237 | 2.353e-1 | 4.0866e-2 | 46.195 |
| 1157 | 225 | 2.375e-1 | 4.1248e-2 | 46.627 |
| 1156 | 213 | 2.423e-1 | 4.2081e-2 | 47.568 |
| 1155 | 202 | 2.494e-1 | 4.3314e-2 | 48.962 |
| 1154 | 192 | 2.593e-1 | 4.5034e-2 | 50.906 |
| 1153 | 183 | 2.744e-1 | 4.7656e-2 | 53.870 |
| 1152 | 174 | 2.912e-1 | 5.0574e-2 | 57.169 |
| 1151 | 167 | 2.734e-1 | 4.7483e-2 | 53.675 |
| 1150 | 161 | 2.513e-1 | 4.3644e-2 | 49.335 |
| 1149 | 155 | 2.357e-1 | 4.0935e-2 | 46.273 |
| 1148 | 149 | 2.232e-1 | 3.8764e-2 | 43.819 |
| 1147 | 143 | 2.149e-1 | 3.7323e-2 | 42.190 |
| 1146 | 137 | 2.090e-1 | 3.6298e-2 | 41.031 |
| 1145 | 131 | 2.049e-1 | 3.5586e-2 | 40.226 |
| 1144 | 125 | 2.031e-1 | 3.5273e-2 | 39.873 |
| 1143 | 119 | 2.031e-1 | 3.5273e-2 | 39.873 |
| 1142 | 113 | 2.049e-1 | 3.5586e-2 | 40.226 |
| 1141 | 107 | 2.090e-1 | 3.6298e-2 | 41.031 |
| 1140 | 101 | 2.149e-1 | 3.7323e-2 | 42.190 |
| 1139 | 95 | 2.232e-1 | 3.8764e-2 | 43.819 |
| | | 4.6600 | ~~8.8050e-1~~ 8.0932e-1 | 914.858 |

RH 7/2/02

% of volume example: heater node 237 $\frac{2.353e-1}{5.7579}$

$= 4.0866e-2$



7/2/02
RH

Ghost nodes on top of invert

| | Heater node | vol | % of total vol | heat load (W) |
|---|---|---|---|---|
| 1159 | 1117 | 1.750e-1 | 3.0393e-2 | 34.356 |
| 1160 | 1118 | 1.5000e-1 | 2.6051e-2 | 29.448 |
| 1161 | 1119 | 1.500e-1 | 2.6051e-2 | 29.448 |
| 1162 | 1120 | 1.500e-1 | 2.6051e-2 | 29.448 |
| 1163 | 1121 | 1.500e-1 | 2.6051e-2 | 29.448 |
| 1164 | 1122 | 1.500e-1 | 2.6051e-2 | 29.448 |
| 1165 | 1123 | 1.729e-1 | 3.0028e-2 | 33.944 |
| | | 1.0979 | 1.9068e-1 | 215.540 |

Total volume of heaters in drift 4.6600 + 1.0979 = 5.7579 $m^3$

Check: 1.9068e-1 + 8.0932e-1 = 1.0000

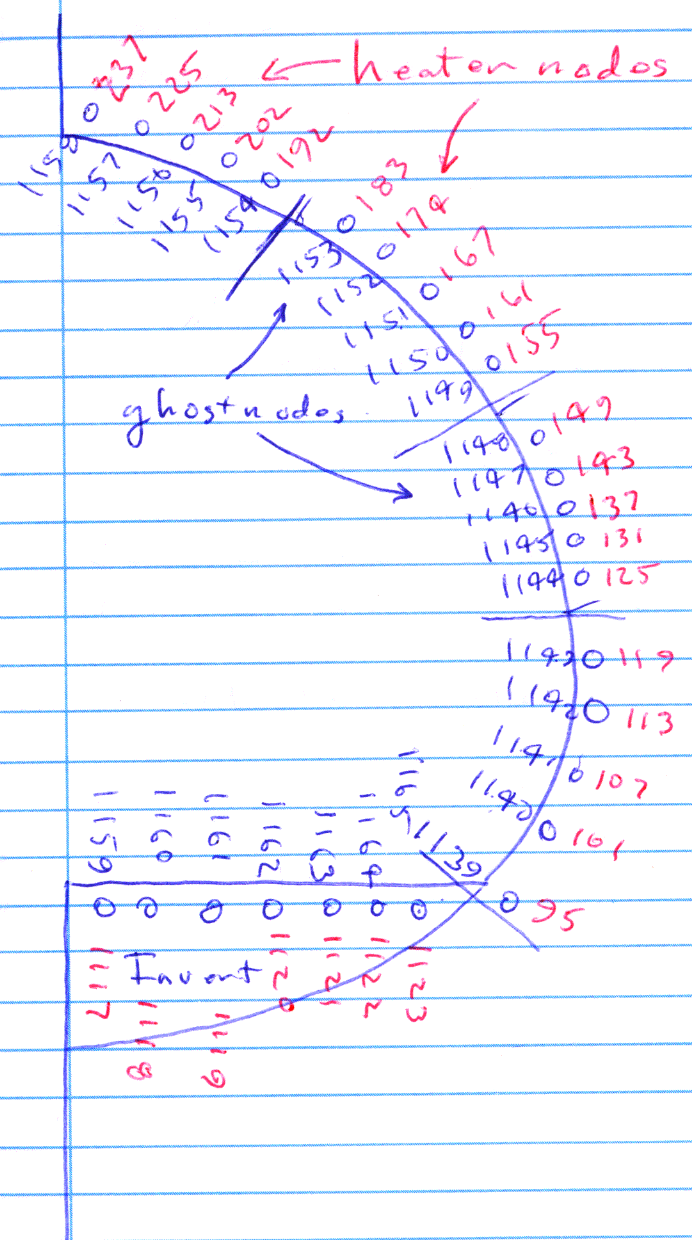
As on pg 204, a 2-m wide slice gets $\frac{2}{46}$ (26 kW) = 1.1304 kW or 1130.4 W

Check 914.858 + 215.540 = 1130.4 W

RH
7/2/02

7/3/02 RH

The arrangement of ghost nodes (assigned boundary conditions) and source nodes (assigned heat load) immediately inside the ghost nodes is as follows ~~for the~~ drift wall.






7/11/02 RH

Row for Borehole 160 will be just above heater row

Heater row starts at drift wall @
1143, 119, 285, 120, 741 — 761
this gets it out to x = 15.59

The row above heater is:
1144, 125 (2.746, +0.144), 286 (3.258, 0.171),
126 (3.769, 0.198),

the row above heater row is @ y = 0.125

7/16/02 RH

| | |
|---|---|
| 323 (4.250, 0.125) | |
| 342 (4.650, 0.125) | 900 (16.090, 0.125) |
| 361 (5.050, 0.125) | 920 (17.000, 0.125) |
| 380 (5.350, 0.125) | 940 (18.500, 0.125) |
| 399 (5.850, 0.125) | 127 (19.624, 1.028) |
| 418 (6.600, 0.125) | 128 (24.023, 1.259) ↑ |
| 437 (7.445, 0.125) | 129 (29.301, 1.536) |
| 456 (8.290, 0.125) | 130 (35.635, 1.868) |
| 475 (9.040, 0.125) | 963 (44.000, 5.000) |
| 494 (9.540, 0.125) | 971 (52.000, 5.000) |
| 513 (9.840, 0.125) | 979 (60.000, 5.000) |
| 532 (10.025, 0.125) | 987 (70.000, 5.000) |
| 551 (10.210, 0.125) | 995 (80.000, 5.000) |
| 570 (10.490, 0.125) | 1003 (90.000, 5.000) |
| 589 (10.990, 0.125) | |
| 608 (11.740, 0.125) | |
| 627 (12.640, 0.125) | |
| 646 (13.540, 0.125) | |
| 665 (14.290, 0.125) | |
| 684 (14.790, 0.125) | |
| 703 (15.090, 0.125) | |
| 722 (15.590, 0.125 | |

7/12/02 Need source file (multi-src) with heat in

7/13/02 Nodes ~~that~~ correspond w/ Borehole 158 (up) and 162 (down)

| node # | Borehole 162 (down) | Borehole 158 (up) |
|---|---|---|
| 1 | (0.144, -2.746) | 237 |
| 2 | (0.208, -3.971) | 238 |
| 3 | (0.285, -5.491) | 239 |
| 4 | (0.378, -7.208) | 240 |
| 5 | (0.489, -9.321) | 241 |
| 6 | (0.622, -11.861) | 242 |
| 7 | (0.781, -14.909) | 243 |
| 8 | (0.973, -18.566) | 244 |
| 9 | (1.203, -22.953) | 245 |
| 10 | (1.479, -28.222) | 246 |
| 11 | (1.810, -34.542) | 247 |
| 12 | (2.208, -42.125) | 248 |

7/14/02 Also need to plot time histories at 5 sensors in Borehole 158 & 160
3, 9, 23, 44, 55

radius locations 7/14/02

| | 158 | node | 160 | Multiflo node |
|---|---|---|---|---|
| 3 | ~~2.433~~ ~~3.586~~ 3.0095 | 237 | 2.825 | 125 |
| 9 | 4.736 | 239 | 4.630 | 342 |
| 23 | 8.9246 | 241 | 8.846 | 475 |
| 44 | 15.200 | 243 | 15.168 | 703 |
| 55 | 18.492 | 244 | 18.48 | 940 |

From DOE ~~excel~~ File



7/16/02 Boundary Condition nodes for 3D DST model

There are 667 total boundary condition nodes in the 3D model

top boundary (mixed type = 5)
11 ~~9~~ per plane 16 planes ~~144~~ 176
located at nodes 1106-1116 7/16/02

bottom boundary (type 1 Dirichlet)
11 per plane 16 planes 176
located @ nodes 1095-1105

There are 45 B.C. nodes per plane in the drift planes, even though there are only 27 drift boundary condition nodes, i.e. some boundary nodes have more than one boundary condition

7/28/02 Scott worked on 3D model during the past week

I copied his current version into

spock/home/rgreen/dst-scans/3D/scott7-2/

Will change block size to 0.4 m in DCM and reduce infiltration in multi-bc by 10x

put reversed bc in multi2-bc

7/30/02 RH Checked results – there are elements near drift wall w/ excessively high matrix pressures.

Will try to alleviate this problem by increasing the matrix permeability, physically justified because this is within the damaged layer around the drift. These nodes include the following.

| | | |
|---|---|---|
| 89 | | |
| 95 | | |
| 101 ~~107~~ RH 7/30/02 | 102 | $P \simeq 1.75e5$ Pa |
| 107 | 106 | has $P > 2$ Bar |
| 113 | 114 | $P > 2$ Bar |
| 119 | 120 | |
| 125 | 126 | |
| 131 | 132 | |
| 137 | 138 | |
| 143 | 144 | |
| 149 | 150 | ($P \approx 1.88e5$ Pa) |
| 155 | | |
| 161 | | |
| 167 | | |
| 174 | | |
| 183 | | |
| 192 | | |
| 202 | | |
| 213 | | |
| 225 | | |
| 237 | | |

After inspecting output files (i.e. *.xyp) I noticed that all nodes w/ elevated temperatures (>100C) had high pressures (as high as 4-5e5 Pa) thus increasing permeability of drift wall will not be a reasonable fix



7/31/02 RH Compared input file of volumes used to compute heat loads.

Final files for model are in:

/net/spock/home/rgreen/dst_scans/3d/2d/Final_heat/

eleme7-11
segmt7-11
conne7-11

with 1165 nodes. Drift wall heat nodes w/ volumes are:

| | vol($m^3$) |
|---|---|
| 237 | 1.176e-1 |
| 225 | 1.187e-1 |
| 213 | 1.212e-1 |
| 202 | 1.247e-1 |
| 192 | 1.296e-1 |
| 183 | 1.372e-1 |
| 174 | 1.456e-1 |
| 167 | 1.367e-1 |
| 161 | 1.257e-1 |
| 155 | 1.179e-1 |
| 149 | 1.116e-1 |
| 143 | 1.075e-1 |
| 131 > 137 | 1.025e-1 > 1.045e-1 |
| 125 | 1.016e-1 |
| 119 | 1.016e-1 |
| 113 | 1.025e-1 |
| 107 | 1.095e-1 |
| 101 | 1.075e-1 |
| 95 | 1.116e-1 |

8/1/02 RH

Con't heat node volumes

| | |
|---|---|
| 1117 | 8.750 e-2 |
| 1118 | 7.500 e-2 |
| 1119 | 7.500 e-2 |
| 1120 | 7.500 e-2 |
| 1121 | 7.500 e-2 |
| 1122 | 7.500 e-2 |
| 1123 | 8.645 e-2 |

To check wing heaters

| | |
|---|---|
| 768 | 7.373 e-1 |
| 769 | 1.928 e+0 |
| 770 | |
| 771 | |
| 772 | |
| 773 | |
| 774 | |
| 778 | |
| 779 | |
| 780 | |
| 781 | |
| 782 | |
| 783 | |
| 784 | |

Note these are out-of-date wing heater node numbers



8/1/02 RH

Current heat node numbers for wing heaters

| | | |
|---|---|---|
| 744 | 1.00e-1 | |
| 745 | 1.562 e-1 | |
| 746 | 1.994 e-1 | |
| 747 | 2.112 e-1 | inner wing |
| 748 | 1.994 e-1 | |
| 749 | 1.562 e-1 | |
| 750 | 1.000 e-1 | |
| | | |
| 754 | 9.750 e-2 | |
| 755 | 1.562 e-1 | |
| 756 | 2.063 e-1 | |
| 757 | 2.250 e-1 | outer wing |
| 758 | 2.062 e-1 | |
| 759 | 1.562 e-1 | |
| 760 | 1.000 e-1 | |

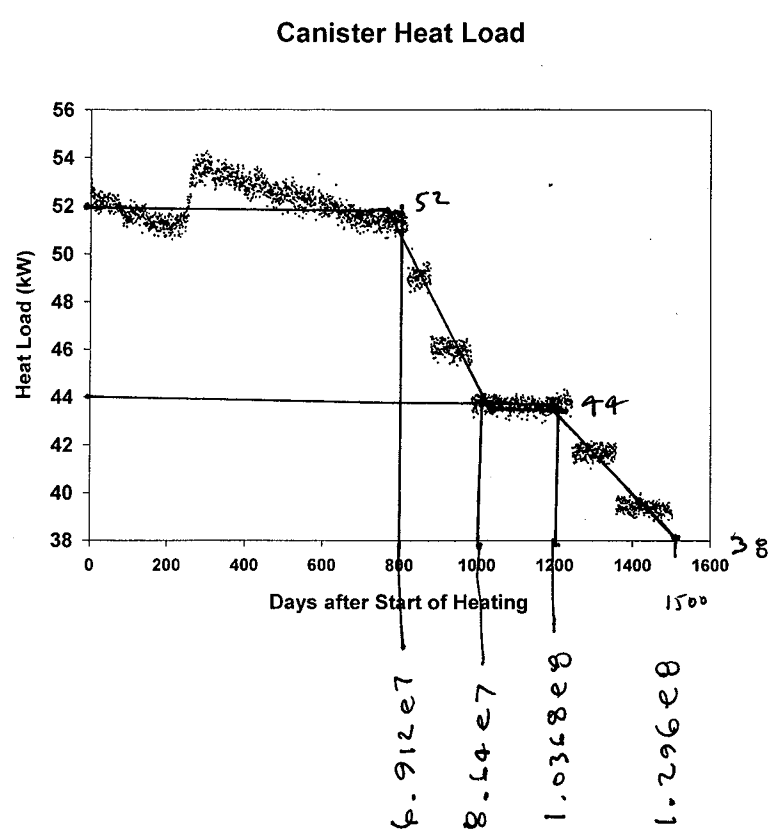
8/2/02 RH

The heat loads (actual) were provided by Robin Datta of DECOVALEX

These are located in heater_power.txt in ~/dst_scans/3d/.

They are listed as two files, one for canister and one for wing heaters.

These are the assumptions for heat load




in ~~wing~~ can_heat_load.JNB
RH 8/2/02

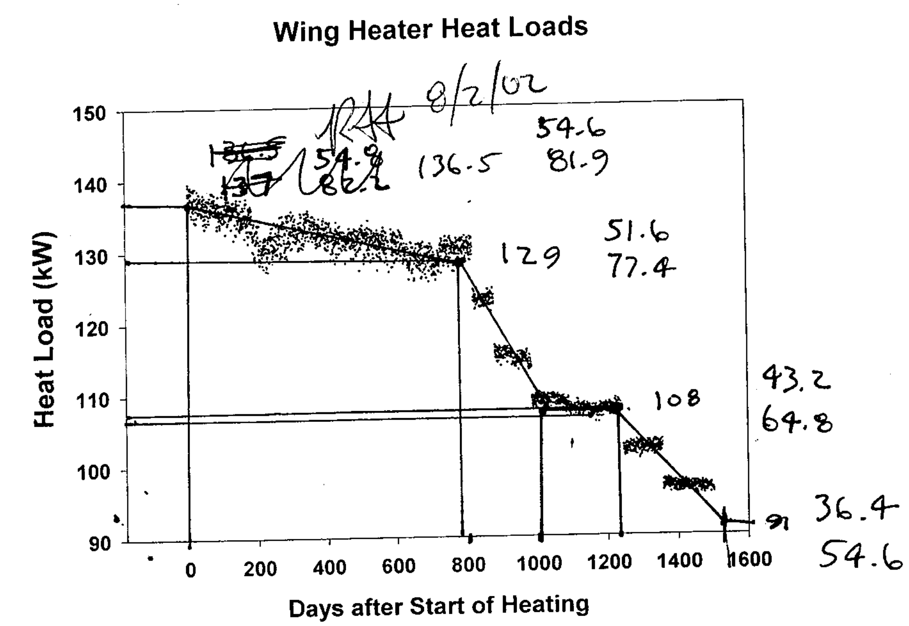
on D: drive D:/personal/text/decovalex/



8/2/02 RH

Following is from wing_heat_load.JNB on:
D/personal/text/decovalex/

inner wing 40%
outer wing 60%




These values are in KW. Assumed breakdown is 40% for inner wing heater and 60% for outer wing heater

8/2/02
RH

Following is a list of heater nodes

| node # | | vol (m^3) | % tot vol | start 54.6 kW | 800 days 51.6 kW | 1000 days 43.2 kW | 1200 days 43.2 kW | 1500 days 36.4 kW |
|---|---|---|---|---|---|---|---|---|
| 744 | 110.78 | 0.1 | 0.044057 | 104.5869 | 98.84035 | 82.75006 | 82.75006 | 69.72459 |
| 745 | 173.1 | 0.1562 | 0.068817 | 163.3647 | 154.3886 | 129.2556 | 129.2556 | 108.9098 |
| 746 | 220.9 | 0.1994 | 0.087849 | 208.5462 | 197.0877 | 165.0036 | 165.0036 | 139.0308 |
| 747 | 234.03 | 0.2112 | 0.093048 | 220.8875 | 208.7508 | 174.7681 | 174.7681 | 147.2583 |
| 748 | 220.9 | 0.1994 | 0.087849 | 208.5462 | 197.0877 | 165.0036 | 165.0036 | 139.0308 |
| 749 | 173.1 | 0.1562 | 0.068817 | 163.3647 | 154.3886 | 129.2556 | 129.2556 | 108.9098 |
| 750 | 110.78 | 0.1 | 0.044057 | 104.5869 | 98.84035 | 82.75006 | 82.75006 | 69.72459 |
| inner total | | 1.1224 | | 1173.883 | 1109.384 | 928.7867 | 928.7867 | 782.5888 |
| node # | | | | 81.9 kW | 77.4 kW | 64.8 kW | 64.8 kW | 54.6 kW |
| 754 | 158.48 | 0.0975 | 0.042955 | 152.9583 | 144.554 | 121.022 | 121.022 | 101.9722 |
| 755 | 253.98 | 0.1562 | 0.068817 | 245.0471 | 231.5829 | 193.8834 | 193.8834 | 163.3647 |
| 756 | 335.25 | 0.2063 | 0.090889 | 323.6441 | 305.8615 | 256.0701 | 256.0701 | 215.7627 |
| 757 | 365.73 | 0.225 | 0.099128 | 352.9807 | 333.5862 | 279.2815 | 279.2815 | 235.3205 |
| 758 | 335.25 | 0.2062 | 0.090845 | 323.4872 | 305.7132 | 255.9459 | 255.9459 | 215.6582 |
| 759 | 253.98 | 0.1562 | 0.068817 | 245.0471 | 231.5829 | 193.8834 | 193.8834 | 163.3647 |
| 760 | 162.54 | 0.1 | 0.044057 | 156.8803 | 148.2605 | 124.1251 | 124.1251 | 104.5869 |
| outer total | | 1.1474 | 1 | 1800.045 | 1701.141 | 1424.211 | 1424.211 | 1200.03 |
| total wing | | | | 2973.928 | 2810.525 | 2352.998 | 2352.998 | 1982.619 |

| node # | 52 kW | vol (m^3) | % tot vol | 52kW | 44kW | 38KW |
|---|---|---|---|---|---|---|
| 95 | 46.195 | 0.1116 | 0.03876 | 43.81441 | 37.07364 | 32.01816 |
| 101 | 46.627 | 0.1075 | 0.037336 | 42.20474 | 35.71162 | 30.84187 |
| 107 | 47.568 | 0.1045 | 0.036294 | 41.02693 | 34.71501 | 29.98117 |
| 113 | 48.962 | 0.1025 | 0.0356 | 40.24173 | 34.05061 | 29.40736 |
| 119 | 50.906 | 0.1016 | 0.035287 | 39.88839 | 33.75163 | 29.14915 |
| 125 | 53.82 | 0.1016 | 0.035287 | 39.88839 | 33.75163 | 29.14915 |
| 131 | 57.169 | 0.1025 | 0.0356 | 40.24173 | 34.05061 | 29.40736 |
| 137 | 53.675 | 0.1045 | 0.036294 | 41.02693 | 34.71501 | 29.98117 |
| 143 | 49.335 | 0.1075 | 0.037336 | 42.20474 | 35.71162 | 30.84187 |
| 149 | 46.273 | 0.1116 | 0.03876 | 43.81441 | 37.07364 | 32.01816 |
| 155 | 43.819 | 0.1179 | 0.040948 | 46.2878 | 39.16651 | 33.82564 |
| 161 | 42.19 | 0.1257 | 0.043657 | 49.3501 | 41.75768 | 36.06347 |
| 167 | 41.031 | 0.1367 | 0.047478 | 53.66873 | 45.41189 | 39.21938 |
| 174 | 40.226 | 0.1456 | 0.050569 | 57.16289 | 48.36848 | 41.7728 |
| 183 | 39.873 | 0.1372 | 0.047651 | 53.86503 | 45.57799 | 39.36283 |
| 192 | 39.873 | 0.1296 | 0.045012 | 50.88125 | 43.05326 | 37.18238 |
| 202 | 40.226 | 0.1247 | 0.04331 | 48.9575 | 41.42548 | 35.77657 |
| 213 | 41.031 | 0.1212 | 0.042094 | 47.58339 | 40.26277 | 34.77241 |
| 225 | 42.19 | 0.1187 | 0.041226 | 46.60189 | 39.43227 | 34.05516 |
| 237 | 43.819 | 0.1176 | 0.040844 | 46.17002 | 39.06685 | 33.73957 |
| 1117 | 34.356 | 0.0875 | 0.03039 | 34.3527 | 29.0676 | 25.10385 |
| 1118 | 29.448 | 0.075 | 0.026048 | 29.44517 | 24.91508 | 21.51758 |
| 1119 | 29.448 | 0.075 | 0.026048 | 29.44517 | 24.91508 | 21.51758 |
| 1120 | 29.448 | 0.075 | 0.026048 | 29.44517 | 24.91508 | 21.51758 |
| 1121 | 29.448 | 0.075 | 0.026048 | 29.44517 | 24.91508 | 21.51758 |
| 1122 | 29.448 | 0.075 | 0.026048 | 29.44517 | 24.91508 | 21.51758 |
| 1123 | 33.944 | 0.08645 | 0.030025 | 33.94046 | 28.71878 | 24.8026 |
| | | 2.87925 | 1 | 1130.4 | 956.49 | 826.06 |

Note: these are in watts not kilo-Watts

Based on these numbers, 2.973 KW is put into the wing heaters and 1.130 KW into canister heaters. This is for a 2m wide slice

It is assumed that the length of drift heated is 46-m long. Since only one half (side) of the DST is modeled, the total heat into the model is $\left(\frac{1.130}{2}\right)46 = 25.99$ KW and
$\left(\frac{2.973}{2}\right)46 = 68.38$ KW



8/2/02
RH

These are consistent with the graphs on pgs 216-217

Used build_source.f to extrude heat source into layers 2 through 7

```
      character header*25
        integer eleme1,eleme2,inc,lay,levels
        integer istyp,count
        real time,heat,lay_thick

      open(unit=10,file='thick')
      open(unit=30,file='multi.src')

        lay = 0
        levels = 6
        count = 1

      do while(.true.)

        read(10,*,end=99) lay_thick
          lay = lay + 1
        write(*,*) lay
      open(unit=20,file='source.in')

        do ll=1,41

          read(20,'(A)') header
          write(30,'(A)') header
          read(20,*) eleme1,eleme2,inc,istyp

                eleme1 = eleme1 + 1165*(lay-1)
                eleme2 = eleme2 + 1165*(lay-1)

          write(30,*) eleme1,eleme2,inc,istyp

          read(20,'(A)') header
          write(30,'(A)') header

          read(20,'(A)') header
          write(30,'(A)') header

          read(20,'(A)') header
          write(30,'(A)') header

          do i=1,levels

                read(20,*) time, heat
                write(30,*) time, (heat/2.0)*lay_thick

          enddo

          read(20,'(A)') header
          write(30,'(A)') header

        count = count + 1
        write(*,*) count

        enddo
        write(*,*) "close source.in"

        close(20)
        write(*,*) "close source.in"
        enddo

 99     continue
```

This built a multi_src file with heater sources for all 7 layers.

8/2/02 RF

The 2D plane used in 3D model is in segmt 7-11 in ~/dst_scans/3d/2d/Final_heat

segmt has 1165 elements
also located in same directory is eleme 7-11 and conne 7-11

Used mathematica notebook DST2D_final 7-11.nb to generate nodes for planes crossing drift (1165 nodes) and through all rock (1217 nodes)

located in ~/dst_scans/3d/2d/Final heat.

8/5/02 RF

Also located in ~/Final_heat are the files for the planes w/o the drift w/ 1217 elements:

eleme 1217
segmt 1217
conne 1217

the in files for these are located in the same directory

| | |
|---|---|
| in 7-11 | 1165 elements |
| in 1217 | 1217 elements |

The eleme, segmt, and conne files were created using amesh_spock



8/5/02 RF

The final grid for 2D plane, both w/ & w/o drift was generated w/ mathematica notebook DST2D_Final 7-11.nb (located at ~/dst_scans/3d/2d/Final heat) Output was written to temp. file.

temp file was converted from dos to unix using dos2unix

converted file was re-formatted for amesh_spock using Format-in.

Added Bound and toler to end of in before running amesh_spock

also added locat to front of file before running amesh_spock

The multi.* files (i.e. *.con, *.phk, *.bc) were generated using 2 different routines, one for the drift planes and one for the no-drift planes.

This allows for drift bc elements in the drift extruded planes.

8/7/02 RH Sumit Mukhopadhyay / LBL sent an e-mail indicating that distance from the drift center to the start of the heated part of the inner wing heater is 4.17 m, not 5.0 m

Generated a modified mathematica notebook with a revised grid. Split out TSw33 & TSw35

→ DST2D_Final8-6.nb
in ~/dst_scans/3D/2D/revised_grid/

this has 1123 nodes in drift plane & 1175 in rock plane

Steady state files are in:

~/dst_scans/3d/2d/revised_grid/
ss_rev_grid/

There are 2 sets of in, and conne, segmt, elem for the 2 different planes

Steady state run w/ ds56.dat, cut & paste initial conditions are in ds56.int

Copied Scott's extrude c-code over to io, re-compiled with new node sizes

the revised initial condition extrude code is in extrude_1123 in

~/dst_scans/3d/2d/revised_grid/heated

the new extruded initial conditions are in big.int



8/7/02 RH Need to create new heat source file:

Start with surface-averaged heat source file in mu12d.src in ~/heated

Need new heat node locations: The heat nodes will be next to the ghost nodes: 1097-1116

| | ghost node | connections | | | | | |
|---|---|---|---|---|---|---|---|
| (2.298, -1.171) | 1097 | $\boxed{85}$ | 90 | 867 | 1123 | 1163 | 1098 |
| (2.407, -0.924) | 1098 | $\boxed{95}$ | 1097 | 1163 | 1164 | 1099 | |
| (2.491, -0.667) | 1099 | $\boxed{100}$ | 1098 | 1164 | 1100 | | |
| (2.547, -0.403) | 1100 | $\boxed{105}$ | 1099 | 93 | 1101 | 94 | |
| (2.575, -0.135) | 1101 | $\boxed{110}$ | 1100 | 95 | 1102 | 96 | |
| (2.575, 0.135) | 1102 | $\boxed{115}$ | 1101 | 97 | 1103 | 98 | |
| (2.547, 0.403) | 1103 | 120 | | | | | |
| (2.491, 0.667) | 1104 | 125 | RH 8/7/02 | | | | |
| (2.407, 0.924) | 1105 | 13~~8~~0 | | | | | |
| (2.298, 1.171) | 1106 | 135 | | | | | |
| (2.163, 1.404) | 1107 | 140 | | | | | |
| (2.004, 1.623) | 1108 | 140 | $\boxed{145}$ | | | | |
| (1.823, 1.823) | 1109 | 151 | | | | | |
| (1.623, 2.004) | 1110 | $\boxed{159}$ | 167 | | | | |
| (1.404, 2.163) | 1111 | 167 | | | | | |
| (1.171, 2.298) | 1112 | 175 | | | | | |
| (0.924, 2.407) | 1113 | 184 | | | | | |
| (0.667, 2.491) | 1114 | 194 | | | | | |
| (0.403, 2.547) | 1115 | 205 | | | | | |
| (0.135, 2.575) | 1116 | 217 | | | | | |
| (0.2, -1.2) | 1117 | 861 | | | | | |
| (0.5, -1.2) | 1118 | 862 | | | | | |
| (0.8, -1.2) | 1119 | 863 | | | | | |
| (1.1, -1.2) | 1120 | 864 | | | | | |
| (1.4, -1.2) | 1121 | 865 | | | | | |
| (1.7, -1.2) | 1122 | 866 | | | | | |
| (2.0, -1.2) | 112~~2~~3 | 867 | | | | | |

RH 8/7/02

This column contains the node numbers for drift wall heating

8/7/02
RF

Per the mathematica notebook,

Wing heater nodes are:

inner: 702-708
outer: 712-718

Revised multi-src from source.in is
w/heated
used build_source.f (modified to 1123)
to get new multi_src

The heated simulation w/ revised grid will be
ds57.dat

Need to modify ghost nodes:
→ dcm parameters

the ghost nodes are 1097-1123 in the first plane
2220-2246 2nd plane
3343-3369 3rd plane
4466-4492 4th plane
5589-5615 5th plane
6712-6738 6th plane
7835-7861 7th plane

gave dcm parameter properties of:

| VolF | GroundF | x/x | y/n | z/m | |
|---|---|---|---|---|---|
| 0.5 | 1.0 | 5 | 8 | 5 | 1.0 |



8/7/02
RF

Need to identify nodes along boreholes
158, 160, ~~162~~ used for ~~time~~ series analyses
RF 8/7/02

Sensor locations 3, 9, 23, 44, 55

The sensor locations are as below

160 horizontal

| Instrument | X | Y | Z | Radius |
|---|---|---|---|---|
| ESF-HD-160-TEMP15-RTD-1 | -2.22 | 22.87 | -0.01 | 2.22 |
| ESF-HD-160-TEMP15-RTD-5 | -3.43 | 22.88 | 0.00 | 3.43 |
| ESF-HD-160-TEMP15-RTD-10 | -4.93 | 22.88 | 0.01 | 4.93 |
| ESF-HD-160-TEMP15-RTD-15 | -6.44 | 22.89 | 0.02 | 6.44 |
| ESF-HD-160-TEMP15-RTD-20 | -7.94 | 22.89 | 0.03 | 7.94 |
| ESF-HD-160-TEMP15-RTD-25 | -9.45 | 22.90 | 0.03 | 9.45 |
| ESF-HD-160-TEMP15-RTD-30 | -10.95 | 22.91 | 0.04 | 10.95 |
| ESF-HD-160-TEMP15-RTD-35 | -12.46 | 22.91 | 0.05 | 12.46 |
| ESF-HD-160-TEMP15-RTD-40 | -13.96 | 22.92 | 0.06 | 13.96 |
| ESF-HD-160-TEMP15-RTD-45 | -15.47 | 22.93 | 0.07 | 15.47 |
| ESF-HD-160-TEMP15-RTD-50 | -16.98 | 22.93 | 0.08 | 16.98 |
| ESF-HD-160-TEMP15-RTD-55 | -18.48 | 22.94 | 0.08 | 18.48 |
| ESF-HD-160-TEMP15-RTD-60 | -19.99 | 22.95 | 0.09 | 19.99 |
| ESF-HD-160-TEMP15-RTD-65 | -21.49 | 22.95 | 0.10 | 21.49 |
| ESF-HD-160-TEMP15-RTD-67 | -22.09 | 22.95 | 0.10 | 22.09 |

158 up

| Instrument | X | Y | Z | Radius |
|---|---|---|---|---|
| ESF-HD-158-TEMP13-RTD-1 | 0.762 | 22.845 | 2.311 | 2.433 |
| ESF-HD-158-TEMP13-RTD-5 | 0.741 | 22.855 | 3.509 | 3.586 |
| ESF-HD-158-TEMP13-RTD-10 | 0.715 | 22.868 | 5.007 | 5.058 |
| ESF-HD-158-TEMP13-RTD-15 | 0.689 | 22.881 | 6.505 | 6.541 |
| ESF-HD-158-TEMP13-RTD-20 | 0.664 | 22.894 | 8.002 | 8.030 |
| ESF-HD-158-TEMP13-RTD-25 | 0.638 | 22.907 | 9.5 | 9.521 |
| ESF-HD-158-TEMP13-RTD-30 | 0.612 | 22.92 | 10.997 | 11.014 |
| ESF-HD-158-TEMP13-RTD-35 | 0.586 | 22.933 | 12.495 | 12.509 |
| ESF-HD-158-TEMP13-RTD-40 | 0.56 | 22.946 | 13.993 | 14.004 |
| ESF-HD-158-TEMP13-RTD-45 | 0.535 | 22.959 | 15.49 | 15.499 |
| ESF-HD-158-TEMP13-RTD-50 | 0.509 | 22.972 | 16.988 | 16.996 |
| ESF-HD-158-TEMP13-RTD-55 | 0.483 | 22.985 | 18.486 | 18.492 |
| ESF-HD-158-TEMP13-RTD-60 | 0.457 | 22.998 | 19.983 | 19.988 |
| ESF-HD-158-TEMP13-RTD-65 | 0.431 | 23.011 | 21.481 | 21.485 |
| ESF-HD-158-TEMP13-RTD-67 | 0.421 | 23.017 | 22.08 | 22.084 |

8/7/02 RH

Interpolating the sensor locations gives the following coordinates

160

RH 8/12/02

Wrong see pg 236

| sensor | | 177 Node # from revised grid | |
|---|---|---|---|
| ~~3~~ | ~~(2.825, 5.325)~~ | ~~171~~ | ~~(2.630, 5.161)~~ |
| ~~9~~ | ~~(4.630, 7.130)~~ | ~~787~~ | ~~(4.220, 6.750)~~ |
| ~~23~~ | ~~(8.846, 11.346)~~ | ~~896~~ | ~~(8.210, 11.750)~~ |
| ~~44~~ | ~~(15.168, 17.668)~~ | ~~162~~ | ~~(14.697, 18.150)~~ |
| ~~55~~ | ~~(18.48, 20.98)~~ | ~~163~~ | ~~(18.295, 22.592)~~ |

158

| sensor | (x = 0) Z-location | | |
|---|---|---|---|
| 3 | 3.0095 | 277 | (0.176, 3.359) |
| 9 | 4.7636 | 278 | (0.247, 4.706) |
| 23 | 8.9296 | 279 | (0.433, 8.263) |
| 44 | 15.200 | 223 | (0.781, 14.969) |
| 55 | 18.492 | 224 | (0.973, 18.566) |

These were put into ds57.dat

Noted that the elema file does not call out all TSw33 & TSw35 from early part of file. If 3 layer model is to be used then the following elements need to be explicitly modeled in the multi.pbk file

This assumes break between units is between ±8.25 (TSw34) and +10 (TSw 34) −10 (TSw35) 3

RH 8/7/02

use ± 9 m



Red indicates modification using eleme_drift 8/9/02 RH

8/7/02 RH

| TSw 33 | TSw 35 |
|---|---|
| 129 132-134 | 5-11 12 |
| 136-139 | 17-24 |
| 141-144 | 29-35 |
| 146-150 | 40-45 |
| 153-158 | 49-54 |
| 161-166 | 57-62 |
| 169-174 | 65-70 |
| 178-183 | 73-78 |
| 188-193 | 80-84 |
| 198-204 | 86-89 |
| 209-216 | 91 92-94 |
| 221-228 | 97 98-99 |

The revised phik_a for the drift looks like:
phik_a_drift

note ghost nodes

```
1 1123 1 1  0.9 2.76e-11 2.76e-11 2.76e-11
 0.110 4.07e-18   2 1  :TSW34
132 134 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
136 139 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
141 144 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
146 150 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
153 158 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
161 166 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
169 174 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
178 183 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
188 193 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
198 204 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
209 216 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
221 228 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
883 989 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
  5  11  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 17  24  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 29  35  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 40  45  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 49  54  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 57  62  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 65  70  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 73  78  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 80  84  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 86  89  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 92  94  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 98  99  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
990 1096 6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
1097 1123 3 2  0.9 2.76e-11 2.76e-11 2.76e-11
 0.110 4.07e-18   3 2  :drift wall
```

8/7/02
Rff

This is phik_a_rock in ~/dst_scas/3d/2d/rev_grid/
55_rev_grid

```
1 1175 1 1  0.9 2.76e-11 2.76e-11 2.76e-11
 0.110 4.07e-18   2 1  :TSW34
132 134 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
136 139 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
141 144 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
146 150 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
153 158 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
161 166 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
169 174 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
178 183 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
188 193 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
198 204 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
209 216 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
221 228 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
883 989 5 1  0.9 8.33e-11 8.33e-11 8.33e-11
 0.154 3.08e-17   7 1  :TSW33
  5  11  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 17  24  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 29  35  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 40  45  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 49  54  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 57  62  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 65  70  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 73  78  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 80  84  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 86  89  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 92  94  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
 98  99  6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
990 1096 6 1  0.9 1.173e-101.173e-10 1.173e-10
 0.131 3.04e-17   8 1  :TSW35
1097 1123 1 1  0.9 2.76e-11 2.76e-11 2.76e-11
 0.110 4.07e-18   2 1  :drift wall
```

located @ ~/dst_scans/3d/2d/revised_grid/heated/*



8/7/02
Rff

Need to get ghost nodes in drift ~~that~~ will be part of bcon_a for drift planes. ghost nodes are numbered 1097-1123. Note ghost nodes can have multiple bc assigned to them

Used following code : $\boxed{\text{extrude-bc.f}}$ ~~to~~ take 2D multi.bc and extrude into 3rd dimension. Did this for both multi.bc – front & back

Need to first generate multi.bc using amesh2mFlo then extrude both output going into mul3d.bc

```
 character header*65
   integer eleme1,eleme2,inc,lay,levels
   integer ist
   real lay_thick,area,del,del2

 open(unit=10,file='thick')
 open(unit=30,file='mul3d.bc')   <- output *bc file

   lay = 0
   levels = 6
   count = 1

 do while(.true.)

   read(10,*,end=99) lay_thick
     lay = lay + 1
   write(*,*) lay
 open(unit=20,file='multi.bc')

   do ll=1,22
                                    make this 1123
                                    for drift planes
     read(20,*) ist,is2,eleme1,eleme2,inc,del,area,del2

           eleme1 = eleme1 + 1175*(lay-1)
           eleme2 = eleme2 + 1175*(lay-1)
           area = area*lay_thick

     write(30,*) ist,is2,eleme1,eleme2,inc,del,area,-del2

     read(20,'(A)') header
     write(30,'(A)') header

     read(20,'(A)') header
     write(30,'(A)') header

     read(20,'(A)') header
     write(30,'(A)') header


   enddo
   write(*,*) "close multi.bc"

   close(20)
   write(*,*) "close mulit.bc"
   enddo

99    continue

   end
```

8/9/02 Used script to extrude source into 3rd dimension
RH Need to run twice, once for drift planes, once for nodrift planes

~/dst_scans/3d/2d/revised_grid/heater/*

build-source.F

~~Need to run~~ RH 8/9/02

~~Need to construct input file from scratch~~

```
character header*25
  integer eleme1,eleme2,inc,lay,levels
  integer istyp,count
  real time,heat,lay_thick

open(unit=10,file='thick')
open(unit=30,file='multi.src')

  lay = 0
  levels = 6
  count = 1

do while(.true.)

  read(10,*,end=99) lay_thick
    lay = lay + 1
  write(*,*) lay
open(unit=20,file='source.in')

  do ll=1,41

    read(20,'(A)') header
    write(30,'(A)') header
    read(20,*) eleme1,eleme2,inc,istyp

          eleme1 = eleme1 + 1123*(lay-1)
          eleme2 = eleme2 + 1123*(lay-1)

    write(30,*) eleme1,eleme2,inc,istyp

    read(20,'(A)') header
    write(30,'(A)') header

    read(20,'(A)') header
    write(30,'(A)') header

    read(20,'(A)') header
    write(30,'(A)') header

    do i=1,levels

          read(20,*) time, heat
          write(30,*) time, (heat/2.0)*lay_thick

    enddo

    read(20,'(A)') header
    write(30,'(A)') header

  count = count + 1
  write(*,*) count

  enddo
  write(*,*) "close source.in"

  close(20)
  write(*,*) "close source.in"
  enddo

99  continue
    end
```

File w/ thickness of planes

input in form of multi.src



8/9/02 Used script to extrude initial conditions
RH ~/dst_scans/3d/2d/revised_grid/heated/*

extrude_1123.c

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <ctype.h>
#include <math.h>

main( int argc, char *argv[])
{
int con, i1,i2,i3,i4,i5,i6,i7;
int nx=17891;
char buf[1024];
float x,y,w,z,xx,yy,zz,ww;
char *cp;
FILE *fp;
if( (fp=fopen(argv[1], "r")) == NULL)
      { printf("failed at opening file\n"); exit(1); }

con=0;
   do
   {
con++;
cp=fgets(buf,1024,fp); if(!cp) exit(0);
sscanf(buf,"%d %d %d %f %f %f %f %f %f %f %f ", &i1, &i2, &i3, &x,&y,&w,&z,&xx,&

if(i1 <= 1123)
{
i2=1123*6+i1; i3=1123;
printf("%d %d %d %g %g %g %g %g %g %g %g\n", i1, i2, i3, x,y,w,z,xx,yy,ww,zz );
i1=1123*7+i1; i2=i1+1175*6; i3=1175;
printf("%d %d %d %g %g %g %g %g %g %g %g\n", i1, i2, i3, x,y,w,z,xx,yy,ww,zz );
}
else
{
i1=1123*7+i1; i2=i1+1175*6; i3=1175;
printf("%d %d %d %g %g %g %g %g %g %g %g\n", i1, i2, i3, x,y,w,z,xx,yy,ww,zz );
}


   } while(con < 100000);

}
```

# of nodes in drift plane

# of nodes in no drift plane

8/9/02
RJJ

Results from recent runs

ds61.dat increased volume of ghost nodes from 10 to 100 $m^3$, but had bottom bc designated as -6 not 6, Scott thinks it might reset bottom bc to 1

Fixed -6 to 6 & re-submitted as ds 62.dat

Both in ~/dst_scans/3d/2d/revised_grid/heated

Got steady state initial saturation from 2d run ds60.dat in ~/dst_scans/3d/2d/revised_grid/heated

cut & pasted ds60.dat results into ds60_2d.int

used extrude_1123 ds60_2d.int ds60.int

to get results for all initial conditions in the absence of a drift → no-shadow effect

8/10/02
RJJ

Modified build_source_f to reduced drift wall heat load by 10% & 20%

This is to evaluate the loss of conducted heat through bulkhead.

mul-10.src drift wall heat load reduced by 10%

mul-20.src drift wall heat load reduced by 20%

mul-30.src " " by 30%



8/10/02
RJJ

build_red_source.f is as follows

in ~/dst_scans/3d/2d/revised_grid/heated/*

```
      character header*25
        integer eleme1,eleme2,inc,lay,levels
        integer istyp,count
        real time,heat,lay_thick

      open(unit=10,file='thick')
      open(unit=30,file='multi.src')

        lay = 0
        levels = 6
        count = 1

      do while(.true.)

        read(10,*,end=99) lay_thick
          lay = lay + 1
        write(*,*) lay
      open(unit=20,file='source.in')

        do ll=1,41

          read(20,'(A)') header
          write(30,'(A)') header
          read(20,*) eleme1,eleme2,inc,istyp

                eleme1 = eleme1 + 1123*(lay-1)
                eleme2 = eleme2 + 1123*(lay-1)

          write(30,*) eleme1,eleme2,inc,istyp

          read(20,'(A)') header
          write(30,'(A)') header

          read(20,'(A)') header
          write(30,'(A)') header

          read(20,'(A)') header
          write(30,'(A)') header

          do i=1,levels

                read(20,*) time, heat
                        if(ll.gt.14)heat=heat*0.7
                write(30,*) time, (heat/2.0)*lay_thick

          enddo

          read(20,'(A)') header
          write(30,'(A)') header

        count = count + 1
        write(*,*) count

        enddo
        write(*,*) "close source.in"
        close(20)

        enddo

 99     continue
```

% of reduction
0.7 means 30% reduction in drift wall heat load

8/10/02 RH — Submitted 3 runs to evaluate effect of conductive heat loss from shaft wall.

mul-10.svc is in ds63.dat

mul-20.svc is in ds64.dat

mul-30.svc is in ds65.dat

8/11/02 RH — Need to redo dst_2d_plots.wb to reflect new (revised) grid

Get new element # for Borehole 160 (horizontal)

z = 0 for x = [0, 22.5] get all # w/ z < |1.0|

| # | (x, z) | |
|---|---|---|
| 120 | (2.716, 0.430) | |
| 125 | (2.656, 0.712) | |
| 130 | (2.567, 0.986) | also a ghost node |
| 290 | (3.420, -0.375) | 1102 (2.575, 0.135) |
| 300 | (3.820, 0.125) | |
| 319 | (4.220, 0.125) | |
| 338 | (4.520, 0.125) | |
| 357 | (5.020, 0.125) | |
| 376 | (5.770, 0.125) | |
| 395 | (6.615, 0.125) | |
| 414 | (7.460, 0.125) | |
| 433 | (8.210, 0.125) | |
| 452 | (8.710, 0.125) | |
| 471 | (9.010, 0.125) | |
| 490 | (9.195, 0.125) | |
| 509 | (9.380, 0.125) | |
| 528 | (9.660, 0.125) | |
| 547 | (10.160, 0.125) | |
| 566 | (10.910, 0.125) | |
| 585 | ~~(10~~ RH 8/11/02 | |

don't use (125, 130, 290)

This is a revision of Pg 209



8/11/02 RH

| # | (x, z) |
|---|---|
| 585 | (11.810, 0.125) |
| 604 | (12.710, 0.125) |
| 623 | (13.460, 0.125) |
| 642 | (13.960, 0.125) |
| 661 | (14.260, 0.125) |
| 680 | (14.760, 0.125) |
| 722 | (15.260, 0.125) |
| 742 | (16.170, 0.125) |
| 762 | (17.670, 0.125) |
| 116 | (19.624, 1.028) |
| 117 | (24.023, 1.028) |

Borehole 158 (up) x = 0, z = [0, 22.5]

| # | (x, z) | Borehole 162 (down) |
|---|---|---|
| 217 | (0.144, 2.746) | 1 |
| 218 | (0.208, 3.971) | 2 |
| 219 | (0.285, 5.441) | 3 |
| 220 | (0.378, 7.205) | 4 |
| 221 | (0.489, 9.321) | 5 |
| 222 | (0.622, 11.861) | 6 |
| 223 | (0.781, 14.909) | 7 |
| 224 | (0.973, 18.566) | 8 |
| 225 | (1.203, 22.955) | 9 |
| 226 | (1.479, 28.222) | 10 |
| 227 | (1.810, 34.542) | 11 |
| 228 | (2.208, 42.125) | 12 |

8/11/02
RH

Need to plot out results at sensor locations versus time for 0 - 4 yrs

For Boreholes 158 and 160 → information is on pg 226 for revised grid.

8/12/02
RH

Node locations for Borehole 160 are wrong

Node locations for sensors - 3, 9, 23, 44, 55 in Borehole 160

From DOE *.xls file: z = 0

| sensor | x = | nearest location in model |
|---|---|---|
| 3 | 2.885 | 125 @ (2.656, 0.712) |
| 9 | 4.630 | 338 @ (4.520, 0.125) |
| 23 | 8.846 | 452 @ (8.760, 0.125) |
| 44 | 15.168 | 722 @ (15.260, 0.125) |
| 55 | 18.48 | 762 @ (17.670, 0.125) |

For Borehole 158

| sensor | z | wrt x=0<br>nearest location in model |
|---|---|---|
| 3 | 3.0095 | 217 @ (0.144, 2.746) |
| 9 | 4.7636 | 278 @ (0.247, 4.706) |
| 23 | 8.9246 | 221 @ (0.489, 9.321) |
| 44 | 15.200 | 223 @ (0.781, 14.909) |
| 55 | 18.492 | 224 @ (0.973, 18.566) |



8/12/02
RH

Revised thermal properties using the DOE AMR on Multiscale TH models by Buscheck et al.

Only one unit is used in the model - TSw34

Submitted 4 jobs:

ds66.dat  basecase w/ 5-m block
ds67.dat  " " w/ 10% reduction in drift heat
ds68.dat  " 20 "
ds69.dat  " 30 "

Heat loads are in the following
multi_src
mul-10-~~dat~~ src  RH 8/12/02
mul-20_src
mul-30_src

as described on pg 232

These are all in ~/dst_scans/3d/2d/revised_grid/
Aug12/*

9/4/02 RJ There are 5 runs of interest, plus 2 more later runs by Scott

Scotts runs were:

ds102
Small block 0.4 m ds102R20 20% heat reduction
ds103
ds103R20 20% heat reduction

My runs were

ds73 one layer - remove from analysis in report
large block 5.0 m ds78
ds80

All six runs have 3 layers, ds73 has only one layer.

ds78 & ds80 have different properties for the borehole for the wing heaters. These are elements:
110, 699-720

Borehole properties are:

fracture perm increased by $10^3$ from 2.76e-11
9/4/02 RJ to 2.76e-8
matrix perm increased by $10^4$ from 4.07e-18
to 4.07e-14

also ~~fracture~~ matrix VG (relative perm) changed from
TSw34 matrix 0.19 0.291 3.86e-6
0.08 0.500 1.00e-4
which compared to TSw34 fracture VG properties
0.01 0.608 5.16e-4



9/4/02 RJ Thus borehole (heater wing) are something like fracture properties.

ds78 & ds80 *.pltk are in mul-A.pltk in ~/dst_scans/3d/2d/rev_grid/aug14/more_heat/

9/27/04 RJ This notebook is closed. Work on the drift-scale heater test is continued and recorded in notebook E542.

I have reviewed this SN and determined that it complies with QAP-001. A well trained scientist with expertise in modelling 2-phase, non-isothermal flow in porous-fractured media should be able to follow and replicate the analyses described herein.

Gordon Wittmeyer 9/27/2004