

CNWRA
CONTROLLED
COPY 425

Project
NOTEBOOK NO. 20-01402-661
ISSUED TO Melissa Hill MA
ON 9/1/00
DEPARTMENT 20 CNWRA
RETURNED _____

—SCIENTIFIC NOTEBOOK CO.—
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P.O. BOX 238
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616-429-8285

INSTRUCTIONS

1. The primary purpose of this notebook is to protect your and the Company's Patent-Rights by keeping records of all original work in a form acceptable as evidence if any legal conflict arises.
2.
 - When starting a page, enter the title, project number, and book number.
 - Use ink for permanence -- avoid pencil.
 - Record your work as you progress, including any spur-of-the-moment ideas which may be developed later.
 - Avoid making notes on loose paper to be recopied.
 - Record your work in such a manner that a co-worker can continue from where you stop. You might be ill and to protect your priority it could be urgent that the work continue while you are absent.
3.
 - Give a complete account of your experiments and the results, both positive and negative, including your observations.
 - Record all diagrams, layouts, plans, procedures, new ideas, or anything pertinent to your work including the details of any discussions with suppliers, or other people outside the Company.
 - Do not try to erase any incorrect entries; draw lines deleting them, note the corrections, sign and date the changes. This extra care is worthwhile because of the necessity of original data to prove priority of new discoveries.
4.
 - After entering your data, sign and date the entries.
 - Explain your work to at least two wit-

nesses who are not co-inventors, and have them sign and date the pages in the place provided.

- Record the names of operators and witnesses present during any demonstration and have at least two witnesses sign the page. If no witnesses are present during an experiment of importance, repeat it in the presence of two witnesses.

5. Since computer programs can be patented these instructions apply to the development of computer software. In this case a description of the structure and operation of the program should be recorded in the notebook, together with a basic flow diagram which illustrates the essential features of the program. In the course of developing the code, the number of lines of code written each day should be recorded in the notebook, together with a statement of the portion of the flow diagram to which the section of code is directed.

6. This notebook and its contents are the exclusive property of the Company. It is confidential and the contents are not to be disclosed to anyone unless authorized by the Company. You must return it when completed, upon request, or upon termination of employment. It should be kept in a protected place. **If loss occurs, notify your supervisor immediately, and make a written report describing the circumstances of the loss.**

[illegible]

From Page No.

9/1/00 This notebook is a continuation of notebook #220. It contains results of numerical simulations performed for the Thermal Effects on flow (TEF) KTI. Initial entry by Melissa Hill.

MF 9/1/00

To Page No.

Witnessed & Understood by me,

Date _____

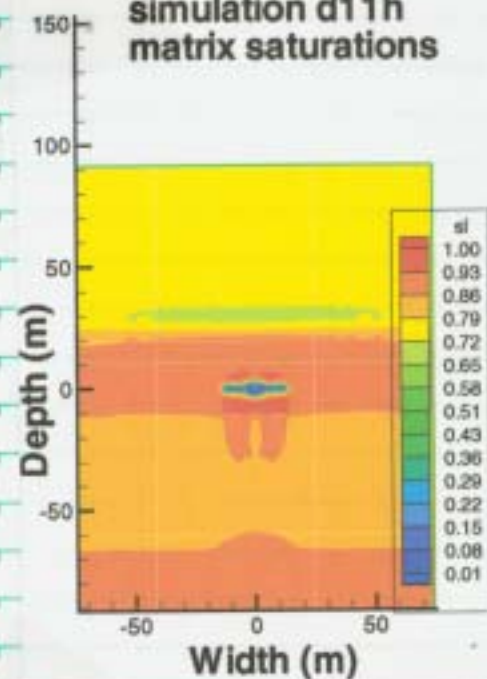
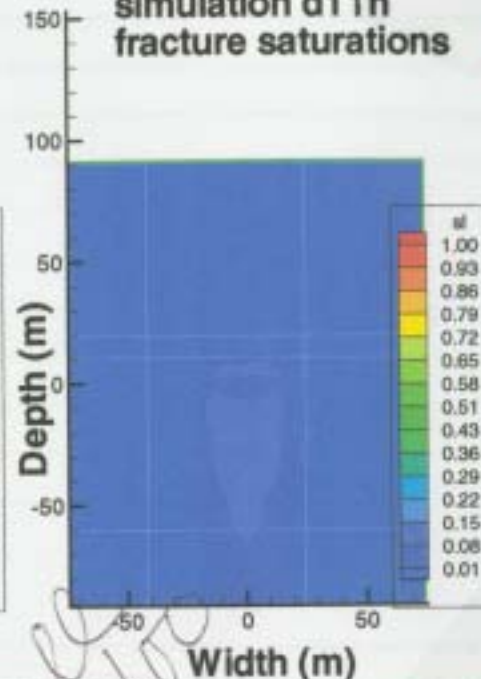
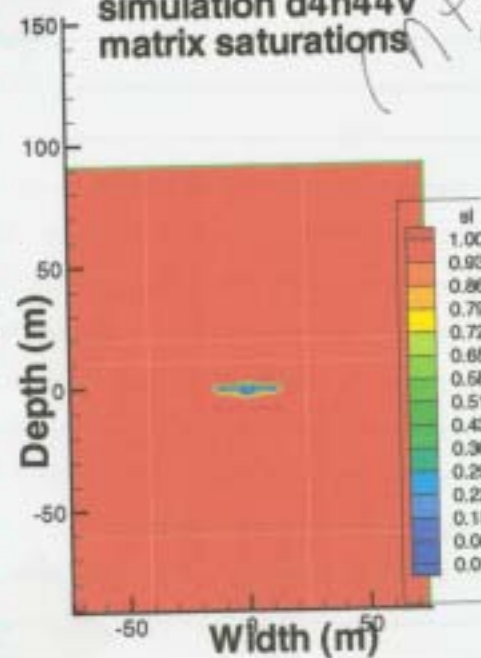
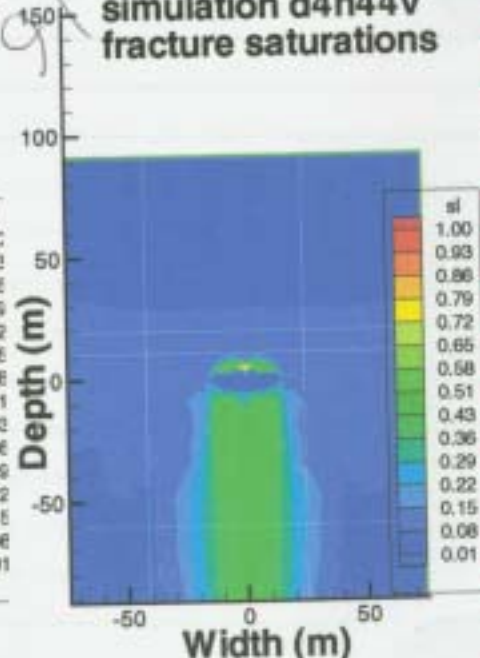
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From Page No. _____

9/1/00 Continuation of plots for
TEF August 2000 deliverable (see
notebook #220 for additional
plots p 301-304).

simulation d11h
matrix saturationssimulation d11h
fracture saturationssimulation d4h44v
matrix saturationssimulation d4h44v
fracture saturations

To Page No. _____

Witnessed & Understood by me, _____

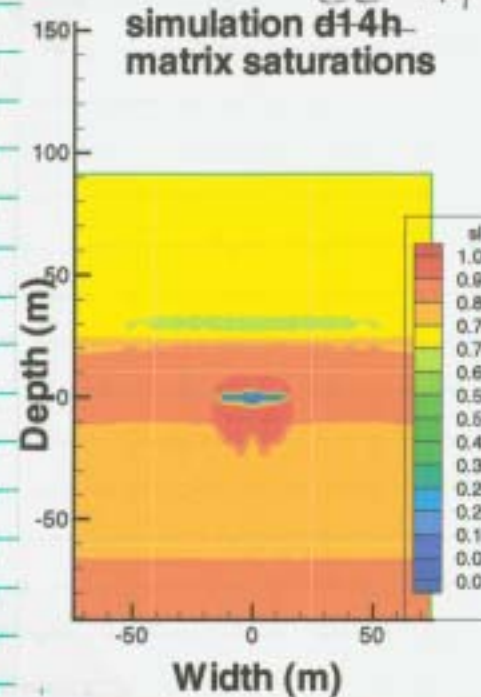
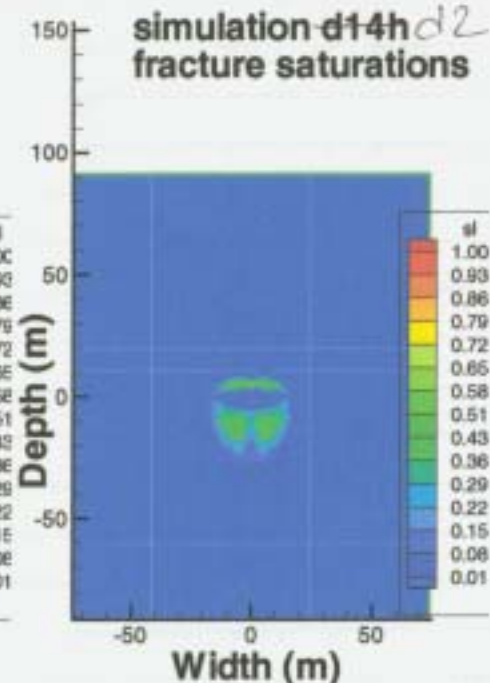
Date _____

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Date _____

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From Page No. _____

simulation d14h
matrix saturationssimulation d14h
fracture saturations

MA d2 9/1/00

To Page No. _____

Witnessed & Understood by me, _____

Date _____

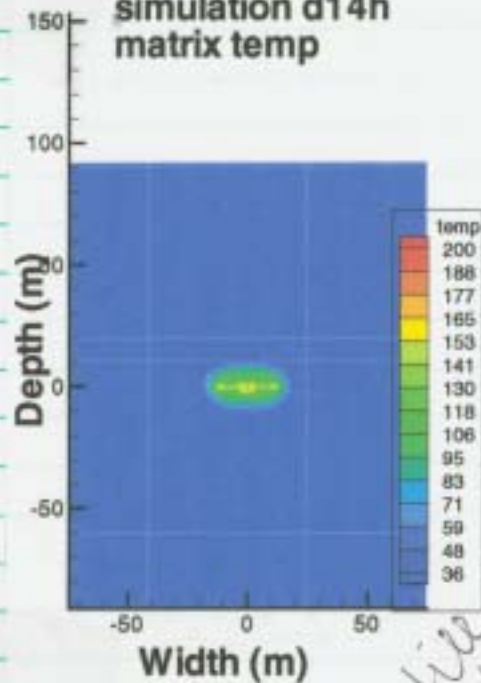
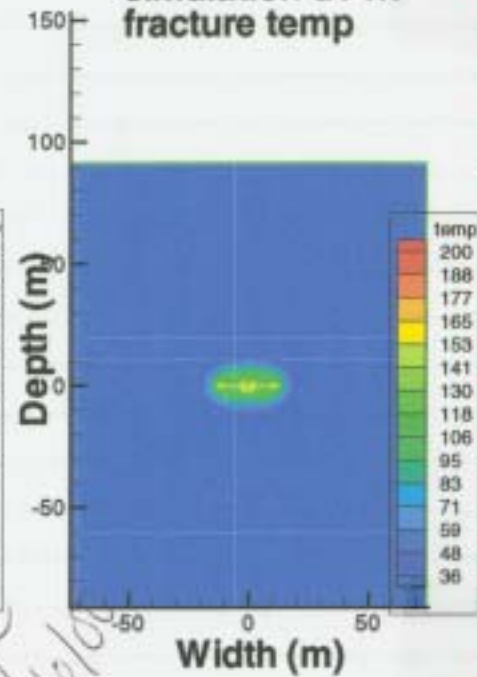
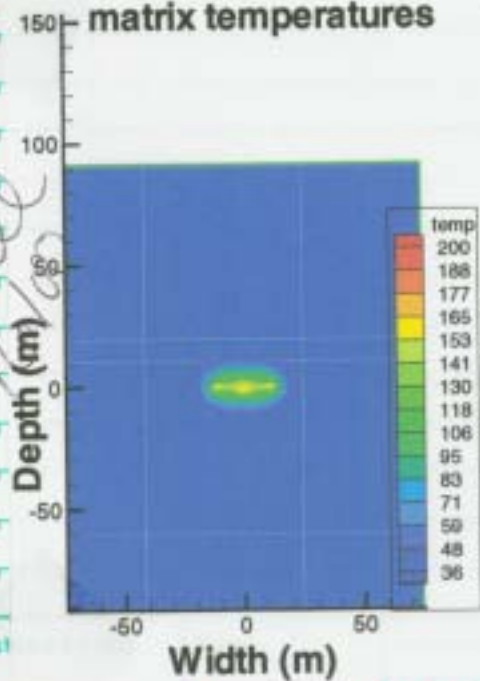
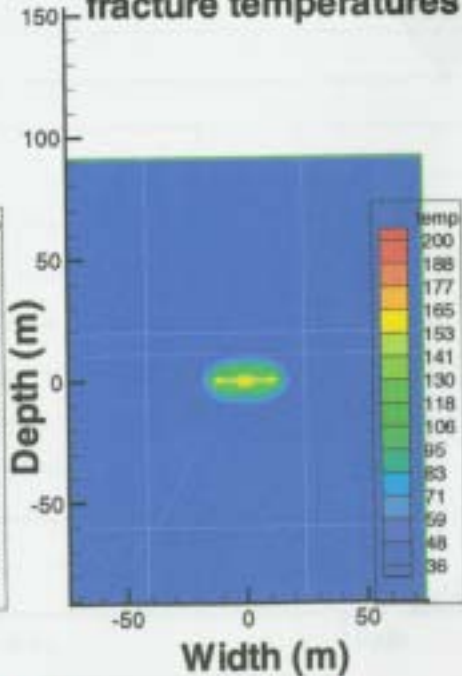
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From Page No. _____

9/6/00 Continuation of plots for TEF
August 2000 deliverable (See notebook
220 for additional plots p 301-304).

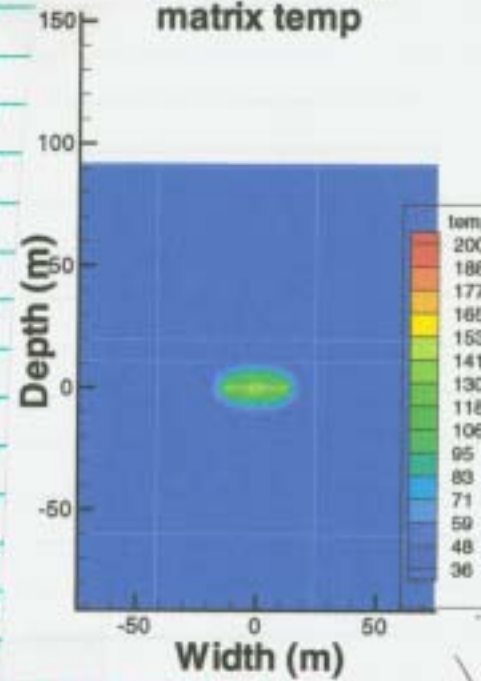
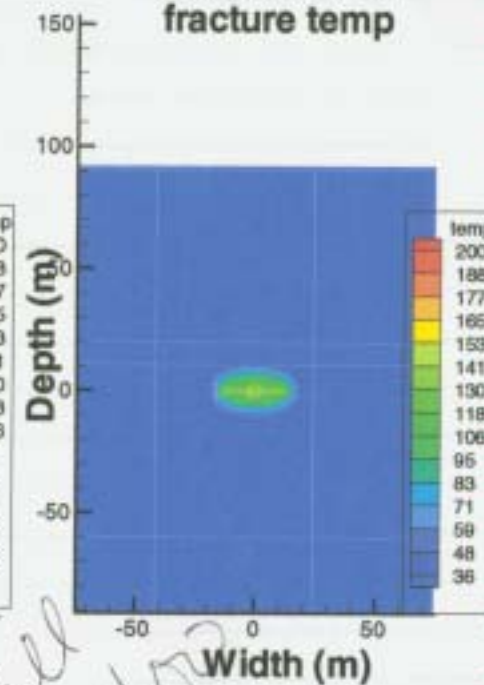
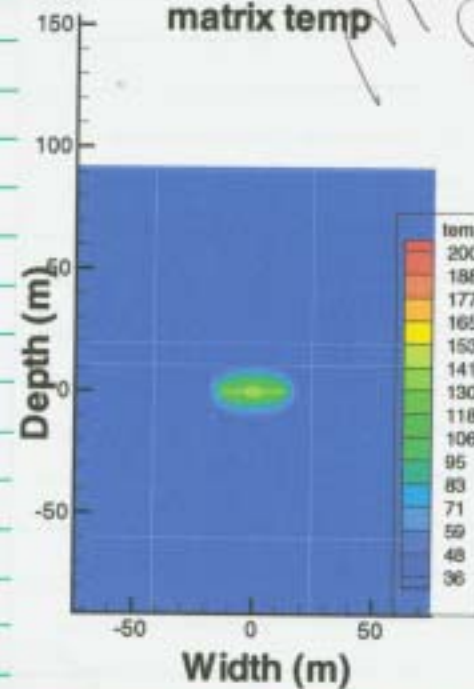
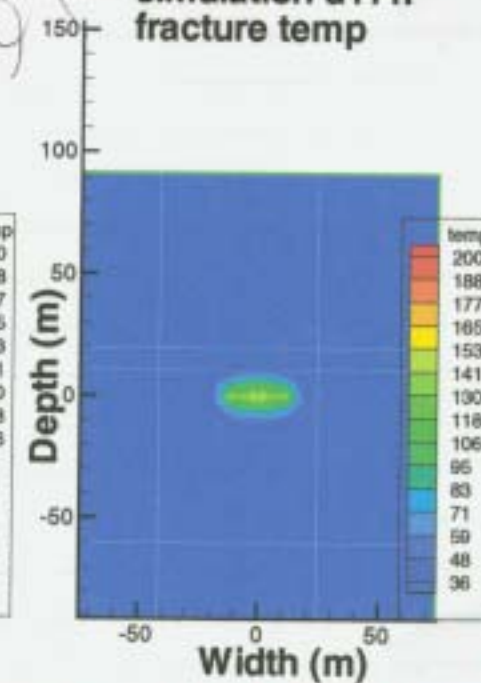
simulation d14h
matrix tempsimulation d14h
fracture tempsimulation d13
matrix temperaturessimulation d13
fracture temperatures

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To Page No. _____

From Page No. _____

simulation d5
matrix tempsimulation d5
fracture tempsimulation d17h
matrix tempsimulation d17h
fracture temp

Witnessed & Understood by me,

Date

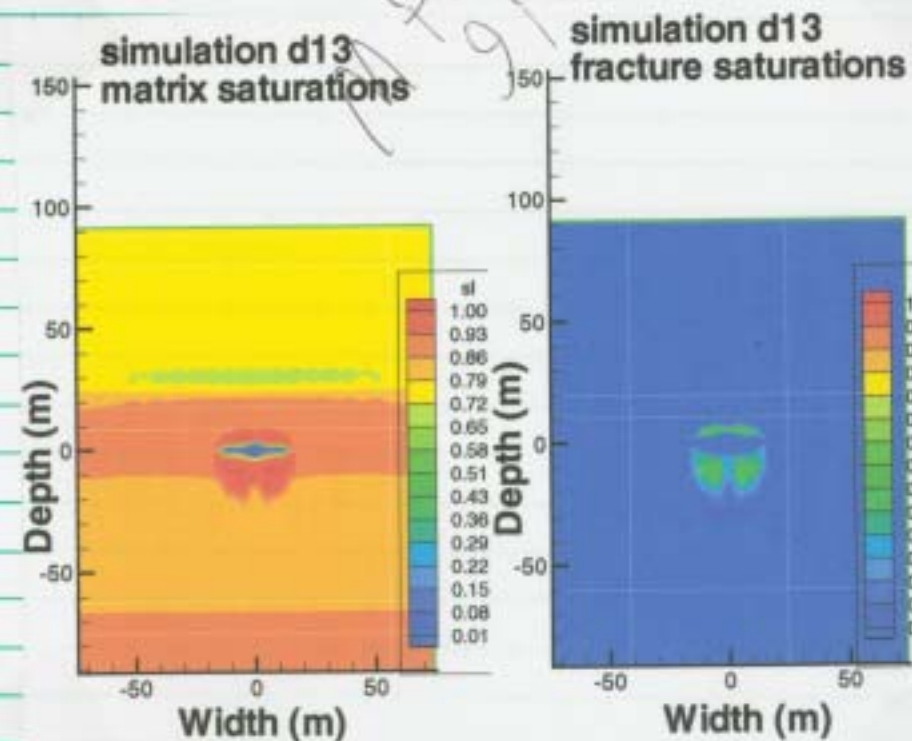
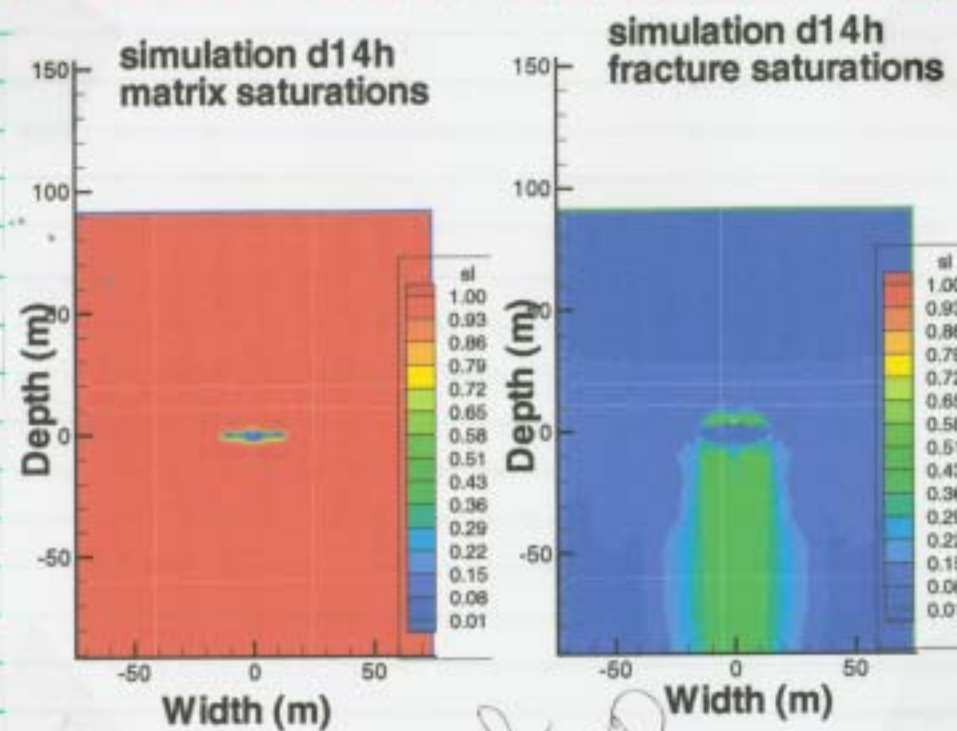
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To Page No. _____

From Page No. _____



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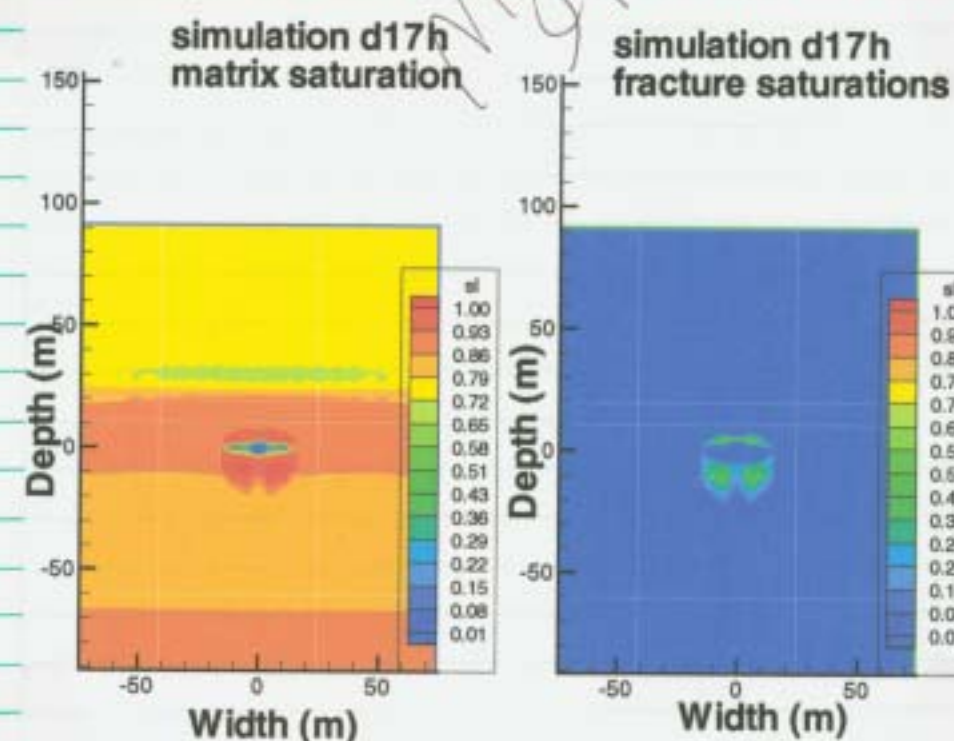
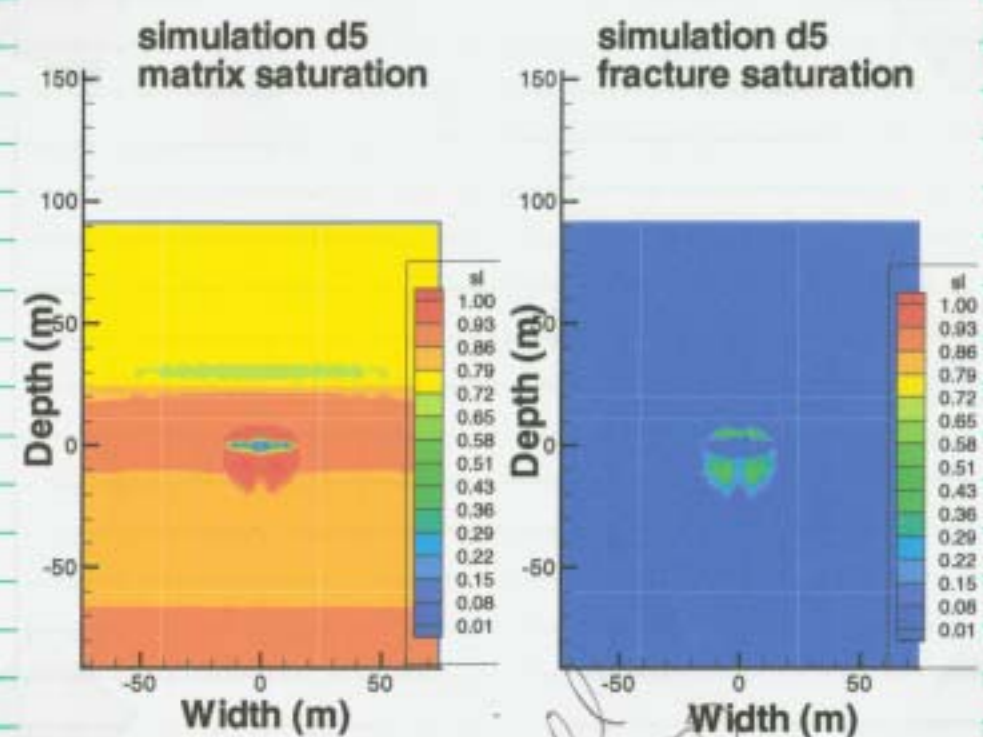
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From Page No. _____



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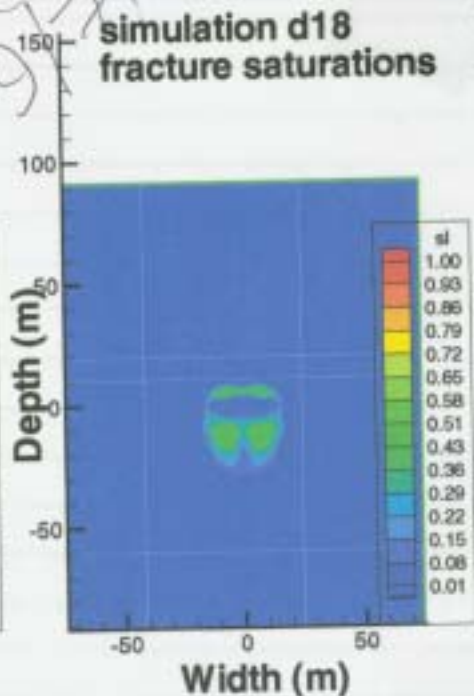
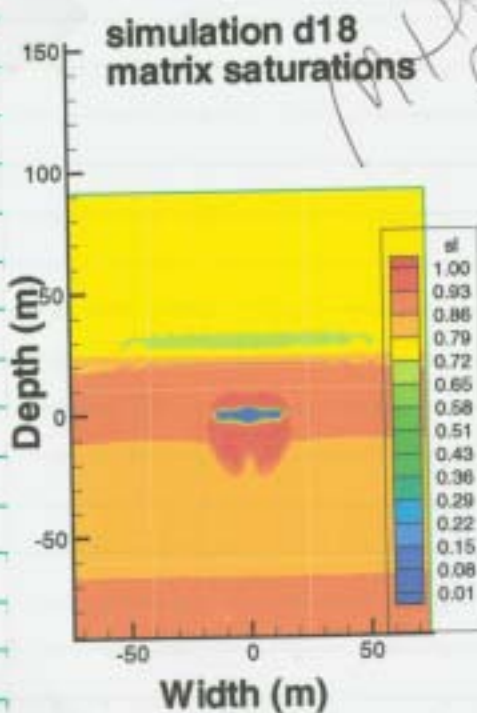
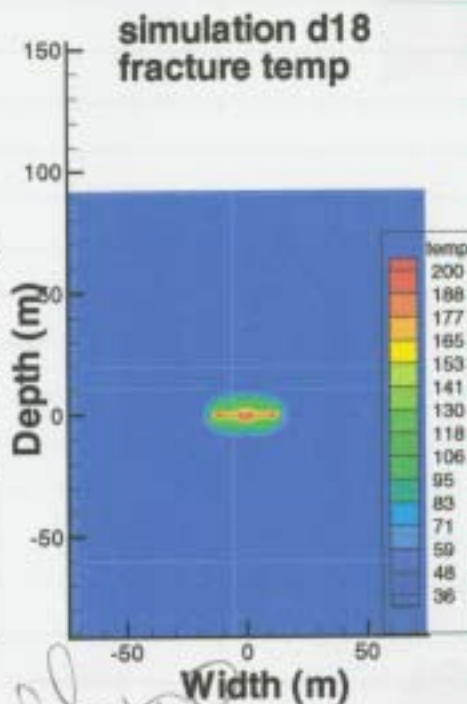
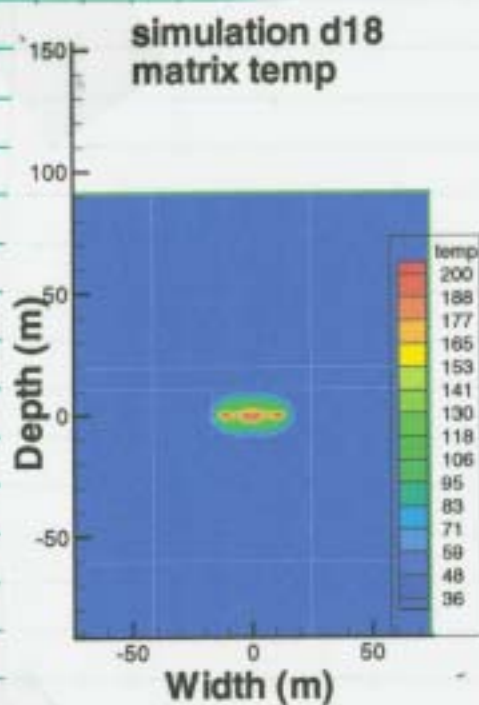
Recorded by

To Page No. _____

M. Hall
9/6/00

From Page No. _____

9/7/00 Continuation of plots for TEF
 August 2000 deliverable (see notebook
 # 220 for additional plots p301-304).



To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

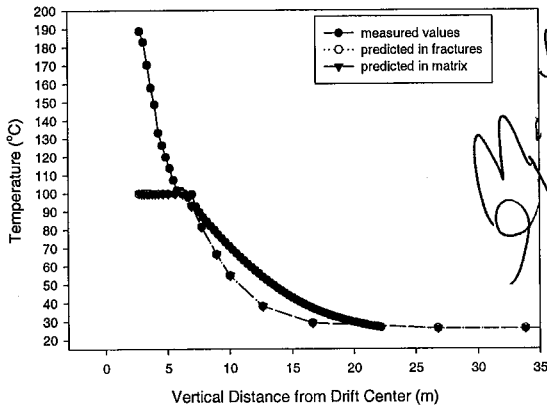
Recorded by _____

TITLE _____

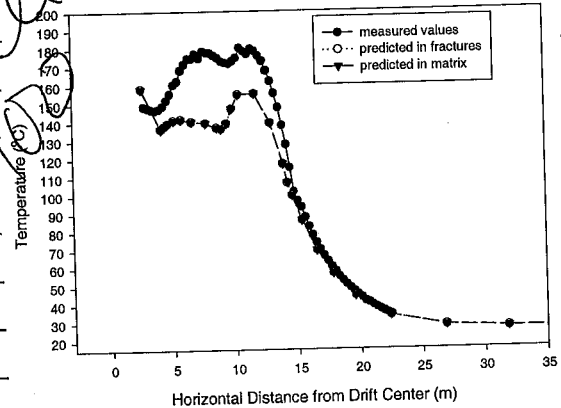
From Page No. _____

9/11/00 Continuation of plots for TEF
August 2000 deliverable (see notebook #220
for additional plots p 301-304).

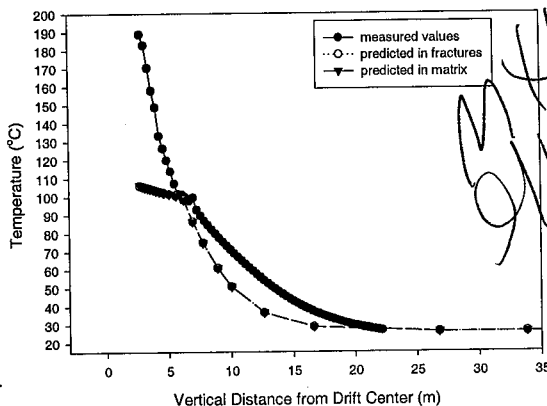
Temperature vs. Distance Borehole 158
simulation dst45b 1yr
dst45bfldf1.xyp & dst45bfldm1.xyp
vulcan/home/mhill/ron
filename: 45b1581y.jnb



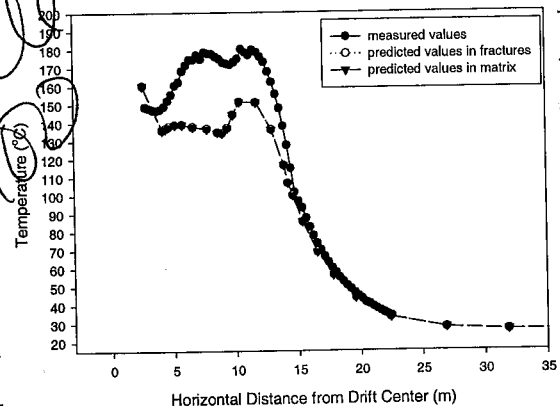
Temperature vs. Distance Borehole 160
simulation 45b 1yr
dst45bfldf1.xyp & dst45bfldm1.xyp
vulcan/home/mhill/ron
filename: 45b1601y.jnb



Temperature vs. Distance Borehole 158
simulation d14h 1yr
d14hbfldf1.xyp & d14hbfldm1.xyp
vulcan/home/mhill/ron
filename: d14h1581y.jnb



Temperature vs. Distance Borehole 160
simulation d14h 1yr
d14hbfldf1.xyp & d14hbfldm1.xyp
vulcan/home/mhill/ron
filename: d14h1601y.jnb



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Date _____

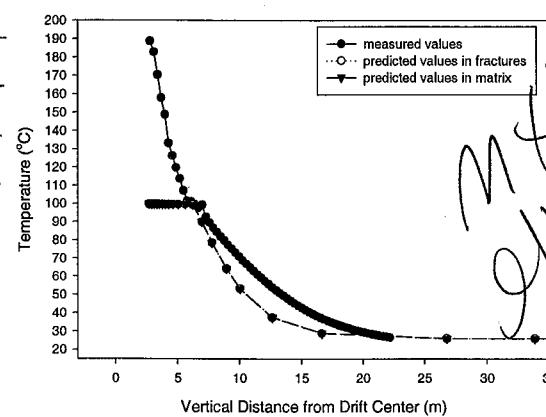
Invented by _____

Date _____

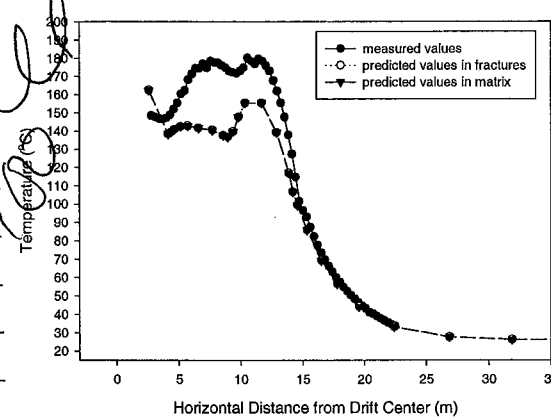
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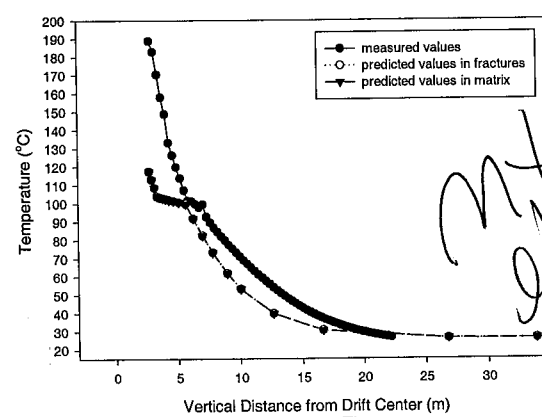
Temperature vs. Distance Borehole 158
simulation d11h 1yr
d11hfidf1.xyp & d11hfidm1.xyp
vulcan/home/mhill/ron
filename: d11h1581y.jnb



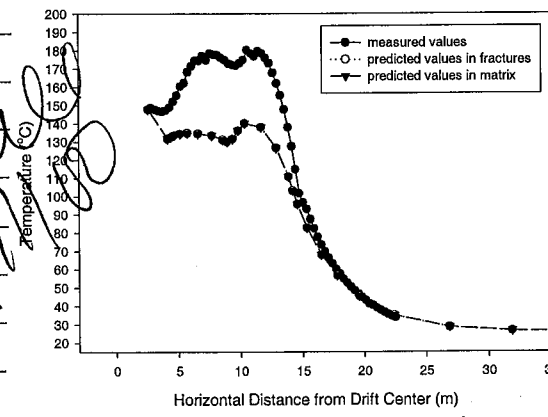
Temperature vs. Distance Borehole 160
simulation d11h 1yr
d11hfidf1.xyp & d11hfidm1.xyp
vulcan/home/mhill/ron
filename: d11h1601y.jnb



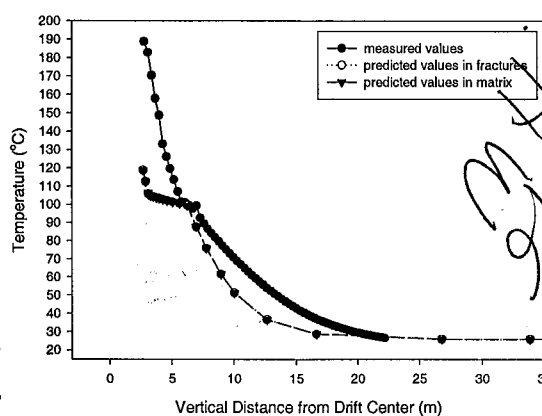
Temperature vs. Distance Borehole 158
simulation d5h44v 1yr
d5h44vfidf1.xyp & d5h44vfidm1.xyp
vulcan/home/mhill/ron
filename: d5hv1581y.jnb



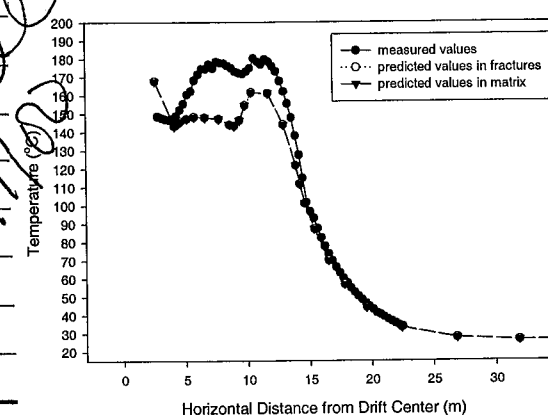
Temperature vs. Distance Borehole 160
simulation d5h44v 1yr
d5h44vfidf1.xyp & d5h44vfidm1.xyp
vulcan/home/mhill/ron
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Temperature vs. Distance Borehole 158
simulation d1h44v 1yr
d1h44vfidf1.xyp & d1h44vfidm1.xyp
vulcan/home/mhill/ron
filename: d1h44v1581y.jnb



Temperature vs. Distance Borehole 160
simulation d1h44v 1yr
d1h44vfidf1.xyp & d1h44vfidm1.xyp
vulcan/home/mhill/ron
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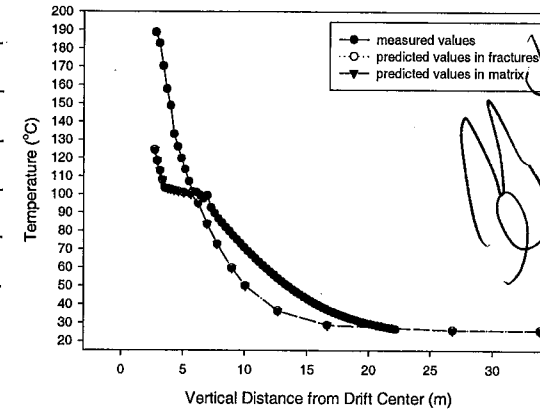
Witnessed & Understood by me, _____ Date _____

Invented by _____

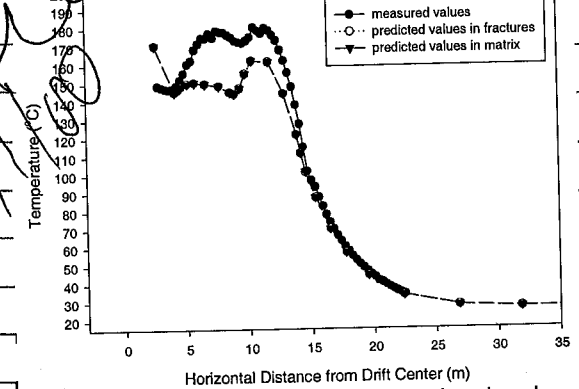
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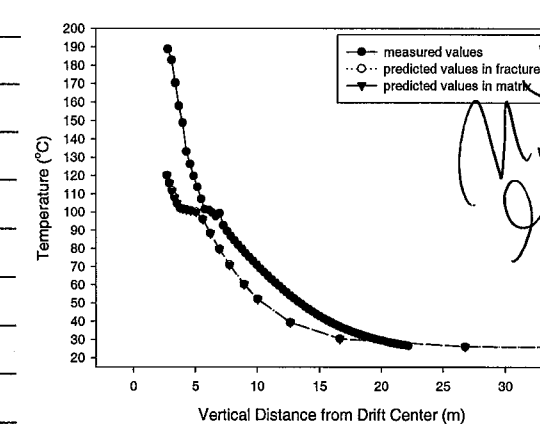
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simulation d13h 1yr
d13hfidf1.xyp & d13hfidm1.xyp
vulcan/home/mhill/ron
filename: d13h1581y.jnb



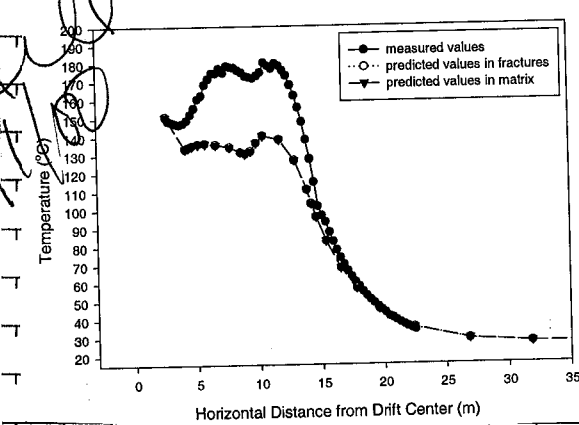
Temperature vs. Distance Borehole 160
simulation d13h 1yr
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vulcan/home/mhill/ron
filename: d13h1601y.jnb



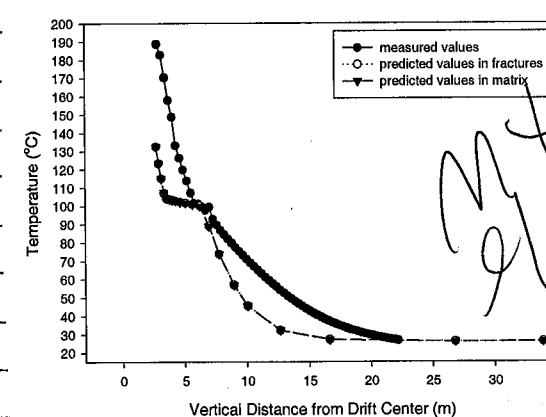
Temperature vs. Distance Borehole 158
simulation d17h 1yr
d17hfidf1.xyp & d17hfidm1.xyp
vulcan/home/mhill/ron
filename: d17h1581y.jnb



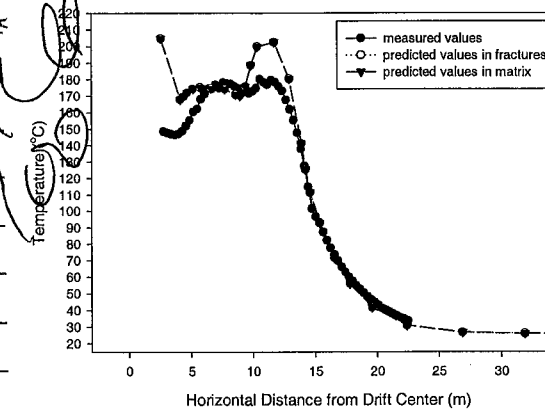
Temperature vs. Distance Borehole 160
simulation d17h 1yr
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vulcan/home/mhill/ron
filename: d17h1601y.jnb



Temperature vs. Distance Borehole 158
simulation d18h 1yr



Temperature vs. Distance Borehole 160
simulation d18h 1yr



Witnessed & Understood by me, _____ Date _____

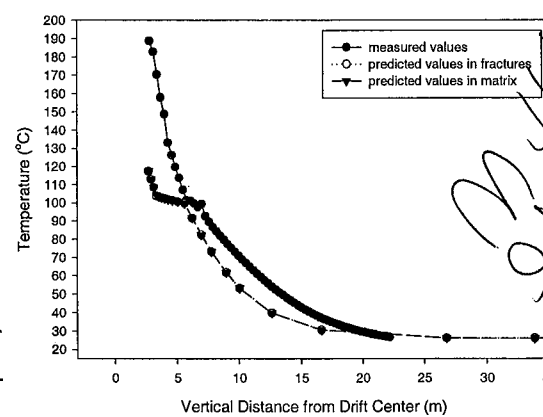
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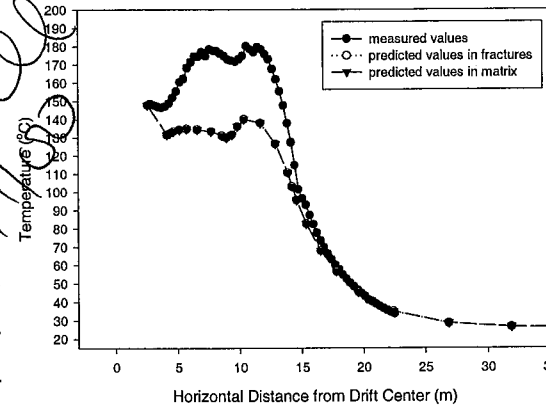
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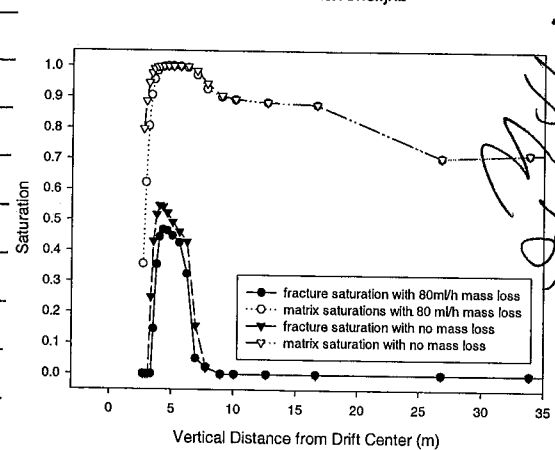
Temperature vs. Distance Borehole 158
simulation d6h44v 1yr
d6h44vldf1.xyp & d6h44vldm1.xyp
vulcan/home/mhill/ron
filename: d6h44v1581y.jnb



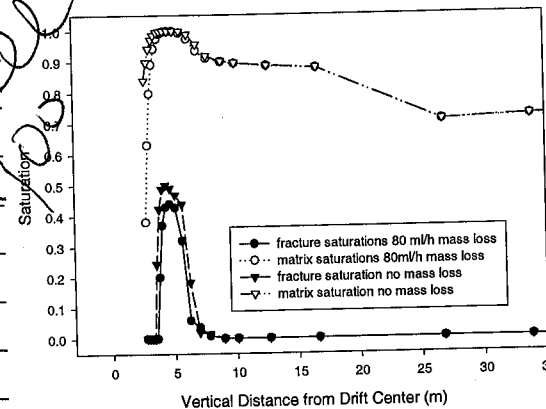
Temperature vs. Distance Borehole 160
simulation d6h44v 1yr
d6h44vldf1.xyp & d6h44vldm1.xyp
vulcan/home/mhill/ron
filename: d6h44v1601y.jnb



Saturation vs. Distance Borehole 158
simulations d1h&d13h 1yr
vulcan/home/mhill/ron
filename: d1h&d13hsl.jnb



Saturation vs. Distance
sld5&17



To Page No. _____

Witnessed & Understood by me, _____

Date _____

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Date _____

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Directions for processing data for dsht model results

TEF August 2000 deliverable**For vertical/horizontal profiles**In one directory: (copy from vulcan/home/mhill/ron)

Step 1: write contents of col158.dat to profile.pts

Step 2: type Plotf — program written in Fortran by D. Hushon Mtt. 9/11/00

Step 3: type filename

Step 4: save plotf.dat file under different name

Step 5: type vertprof — program written in Fortran by D. Hushon Mtt 9/11/00

Step 6: type plotf.dat

Step 7: save vertprof.dat file under different name

Step 8: copy renamed vertprof.dat file to own directory

Step 9: cut and paste column B from fnfldf.xyp (z-coordinates) to a new excel spreadsheet

Step 10: cut and paste column B from fnfldm.xyp (z-coordinates) to the excel worksheet opened in step 9

Step 11: sort data in B column in ascending order

Step 12: open file 158-1year file which contains measured values and sort column B in ascending order

Step 13: cut from file 160-1.9y original and corrected (+2.5m) distances and paste to file discussed in step 12

Step 14: cut predicted values from models processed in steps 10&11 and paste to file discussed in step 13 and save file as .xls worksheet

Step 15: open .xls file in Sigmaflop and plot up results

Step 16: write contents of col160.dat to profile.pts and repeat steps 2-16. Note: in steps 9&10 cut and paste column A and in step 11 sort column A. In step 12, open file 160-1year which contains measured values and sort column B in ascending order

For contour plotsIn a separate directory: (copy from vulcan/home/mhill/80)

Step 1: type Plotf

Step 2: type filename

Step 3: save plotf.dat file under different name

Step 4: type cat tecplot.head renamed plotf.dat file from step 4 > new filename

Step 5: type preplot new filename created in step 5

Step 6: type tecplot8

Step 7: load data file preplotted in step 6

Step 8: play macro (m2.mcr)

Step 9: to adjust legend go to field/contour legend/format (integers/temp, float/saturation)

Step 10: to adjust contour levels go to field/contour levels

Step 11: to adjust contour variable go to field/contour variable

Step 12: print setup/format (postscript, check color)

Step 13: print file (change .cps to .eps)

Step 14: open .eps file in adobe irritator

Step 15: go to document setup (check deskjet 895)

Step 16: print file

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

From Page No. _____

9/18/00

Summary of parameter values assigned to thermal-hydrological simulations of the Drift-Scale Heater Test & simulations for T&E August 2000 deliverable.
 Simulation M+ 9/18/00

Permeability (m ²)	Infiltration Rate (mm/yr)	Bulkhead Mass Loss (mL/hr)	Thermal Conductivity (W/m·°C)
Basecase values dst 45 b	0.036	None	Basecase values
Basecase values d11 h	0.036	80	Basecase values
10 ⁻² reduction d4 h 44 v or 3.6 d 5 h 44 v		None	Basecase values
10 ⁻² reduction d14 h or 3.6 d 7 h 44 v		80	Basecase values
10 ⁻² reduction d1 h 44 v or 0.036 d 2 h 44 v		None	Basecase values
10 ⁻² reduction d13 h	0.036	80	Basecase values
10 ⁻² reduction d5 or 6 h 44 v	0.036	None	one-third increase in κ_i
10 ⁻² reduction d17 h	0.036	80	one-third increase in κ_i
10 ⁻² reduction d18 h	0.036	80	one-third decrease in κ_i

M+ 9/18/00

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

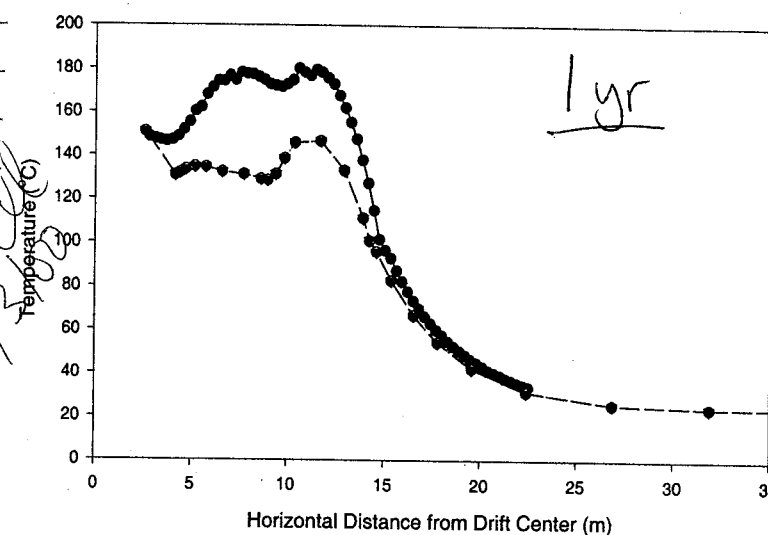
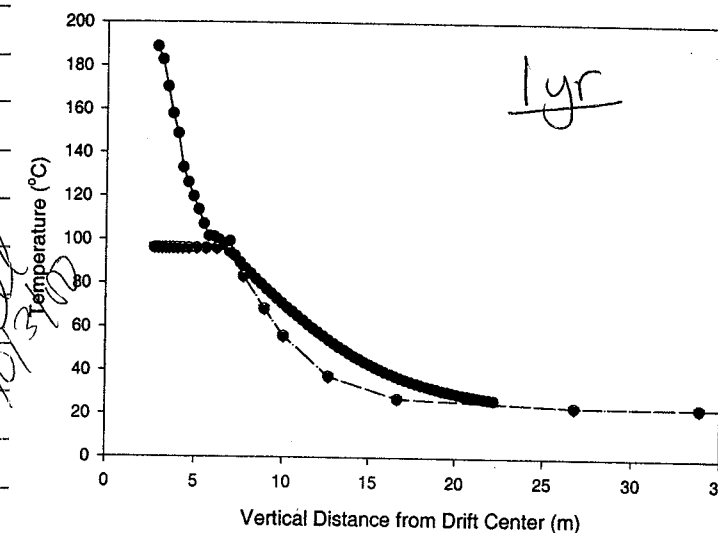
9/18/00

From Page No. _____

10/3/00

Provided the following files by R. Green

rdt11af1dm1.xyp
 rdt11afk1f1.xyp



M+ 10/3/00

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

From Page No. _____

10/6/00 Given files by R.T. Green:

Infiltration ^{mm/y}	filename	Area Modf	Block size
3.6	rdt16.dat	1.0	5.0e-4 0.25
	rdt17.dat		0.5
	rdt18.dat		1.0
	rdt19.dat		2.0
	rdt20.dat		3.0
	rdt21.dat		4.0
	rdt22.dat		5.0
	rdt23.dat		7.2 (file crashed)
	rdt24.dat		10
3.6	rdt25.dat	1.0	5.0e-4 20

Amended files as recorded in chart above.

Set up a second set of runs as follows:

Infiltration ^{mm/y}	filename	Area modf	Block size
0.072	rdt16b.dat	1.0	5.0e-4 0.25
	rdt17b.dat		0.5
	rdt18b.dat		1.0 (file crashed)
	rdt19b.dat		2.0
	rdt20b.dat		3.0
	rdt21b.dat		4.0
	rdt22b.dat		5.0
	rdt23b.dat		7.2
	rdt24b.dat		10
0.072	rdt25b.dat	1.0	5.0e-4 20

All of the above files are located on net/vulcan/
home/mhill/barewolf/

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

TITLE _____

From Page No. _____

Set up a third set of runs as follows:

Infiltration ^{mm/y}	filename	Area Modf	Block size
3.6	rdt16c.dat	1.0	1.0 0.25
	rdt17c.dat		0.5
	rdt18c.dat		1.0
	rdt19c.dat		2.0
	rdt20c.dat		3.0
	rdt21c.dat		4.0
	rdt22c.dat		5.0
	rdt23c.dat		7.2
	rdt24c.dat		10
3.6	rdt25c.dat	1.0	1.0 20

MHill 10/6/00

10/9/00

Set up a fourth set of runs as follows:

Infiltration ^{mm/y}	filename	Area modf	Block size
0.072	rdt16d.dat	1.0	1.0 0.25
	rdt17d.dat		0.5
	rdt18d.dat		1.0
	rdt19d.dat		2.0
	rdt20d.dat		3.0
	rdt21d.dat		4.0
	rdt22d.dat		5.0
	rdt23d.dat		7.2
	rdt24d.dat		10
0.072	rdt25d.dat	1.0	1.0 20

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

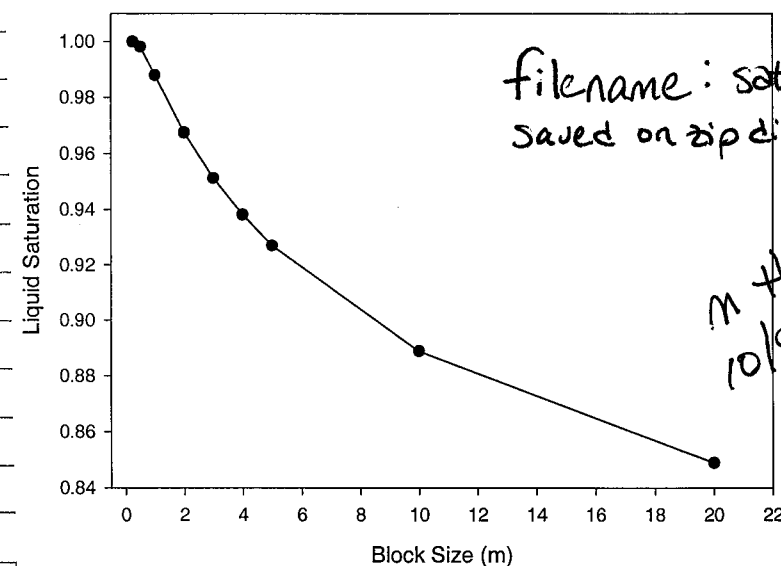
Date _____

Recorded by _____

From Page No. _____

Filename sg at element 1101
 rdt16-out $7.6030e-5$
 rdt17-out $1.8920e-3$
 rdt18-out $1.2076e-2$
 rdt19-out $3.2501e-2$
 rdt20-out $4.8798e-2$
 rdt21-out $6.1970e-2$
 rdt22-out $7.3064e-2$
 rdt23-out CRASHED
 rdt24-out $1.1114e-1$
 rdt25-out $1.5109e-1$

Steady-State Liquid Saturation in Matrix 3.6mm/yr
 Areamodf 1.0/5.0e-4
 files: rdt16-25.dat



Filename sg at element 1101
 rdt16b-out $8.2764e-2$
 rdt17b-out $8.2803e-2$
 rdt18b-out CRASHED
 rdt19b-out $8.2640e-2$
 rdt20b-out $8.2832e-2$

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

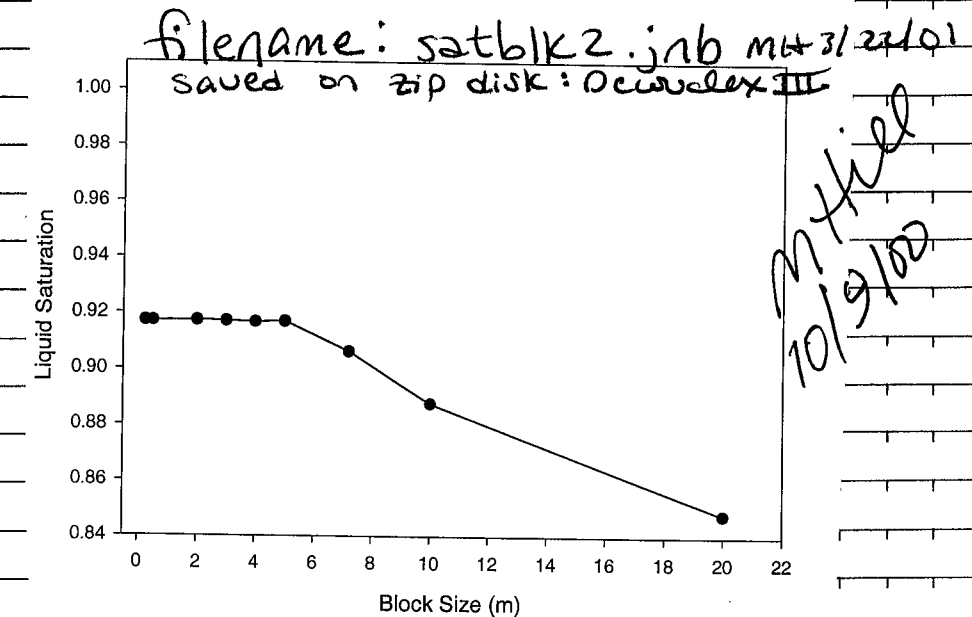
To Page No. _____

TITLE _____

From Page No. _____

rdt21b-out $8.3121e-2$
 rdt22b-out $8.3000e-2$
 rdt23b-out $9.3622e-2$
 rdt24b-out $1.1221e-1$
 rdt25b-out $1.5199e-1$

Steady State Liquid Saturation in Matrix vs. Block Size 0.072mm/y
 Areamodf 1.0/5.0e-4
 files rdt16b-25b_out



M Hill 10/9/00

10/11/00

Filename sg at element 1101
 rdt16c-out $7.3264e-5$
 rdt17c-out $7.6504e-5$
 rdt18c-out $5.6852e-5$
 rdt19c-out $5.9538e-5$
 rdt20c-out $2.1509e-4$
 rdt21c-out $1.1573e-3$
 rdt22c-out $2.7374e-3$

Witnessed & Understood by me, _____

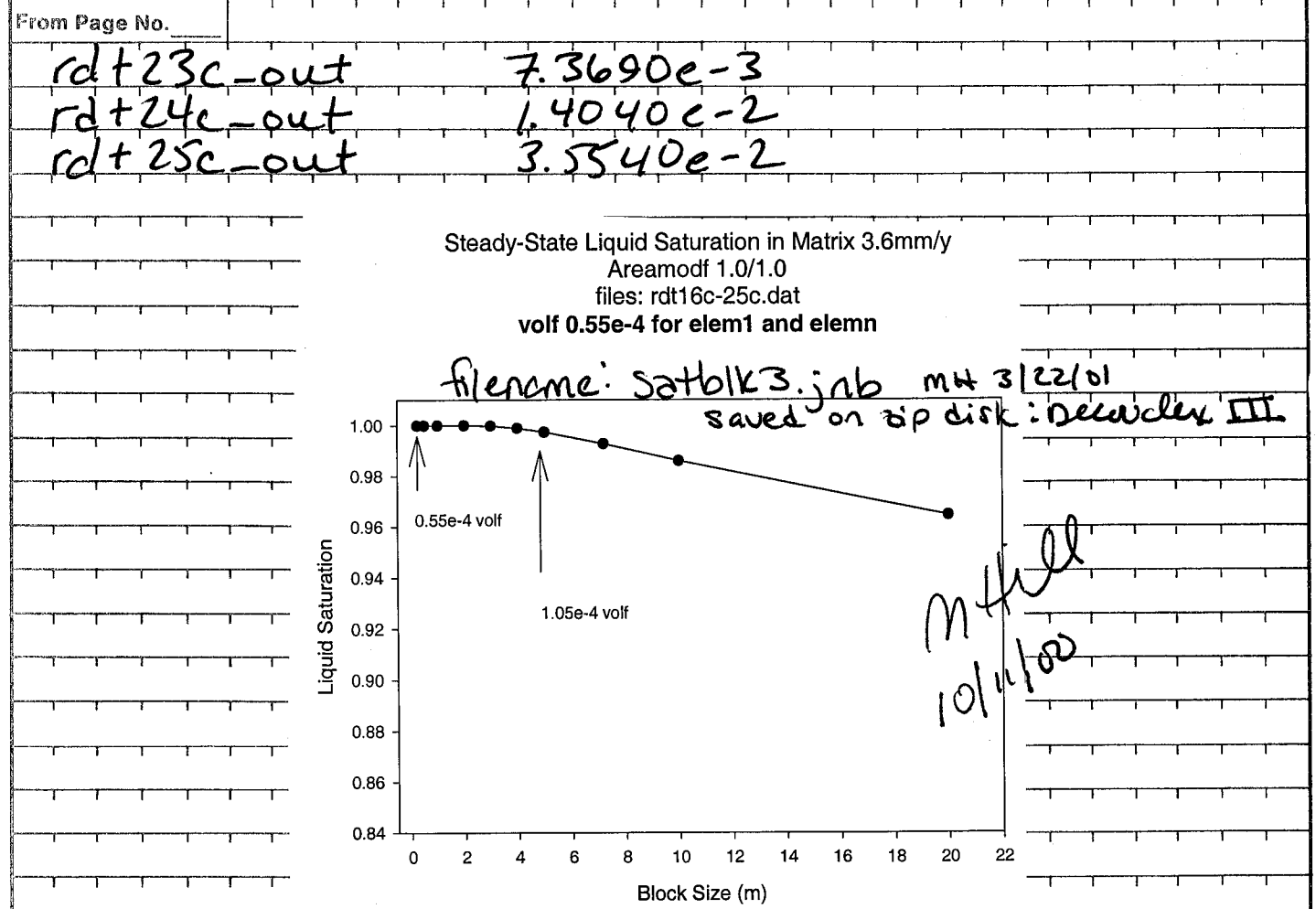
Date _____

Invented by _____

Date _____

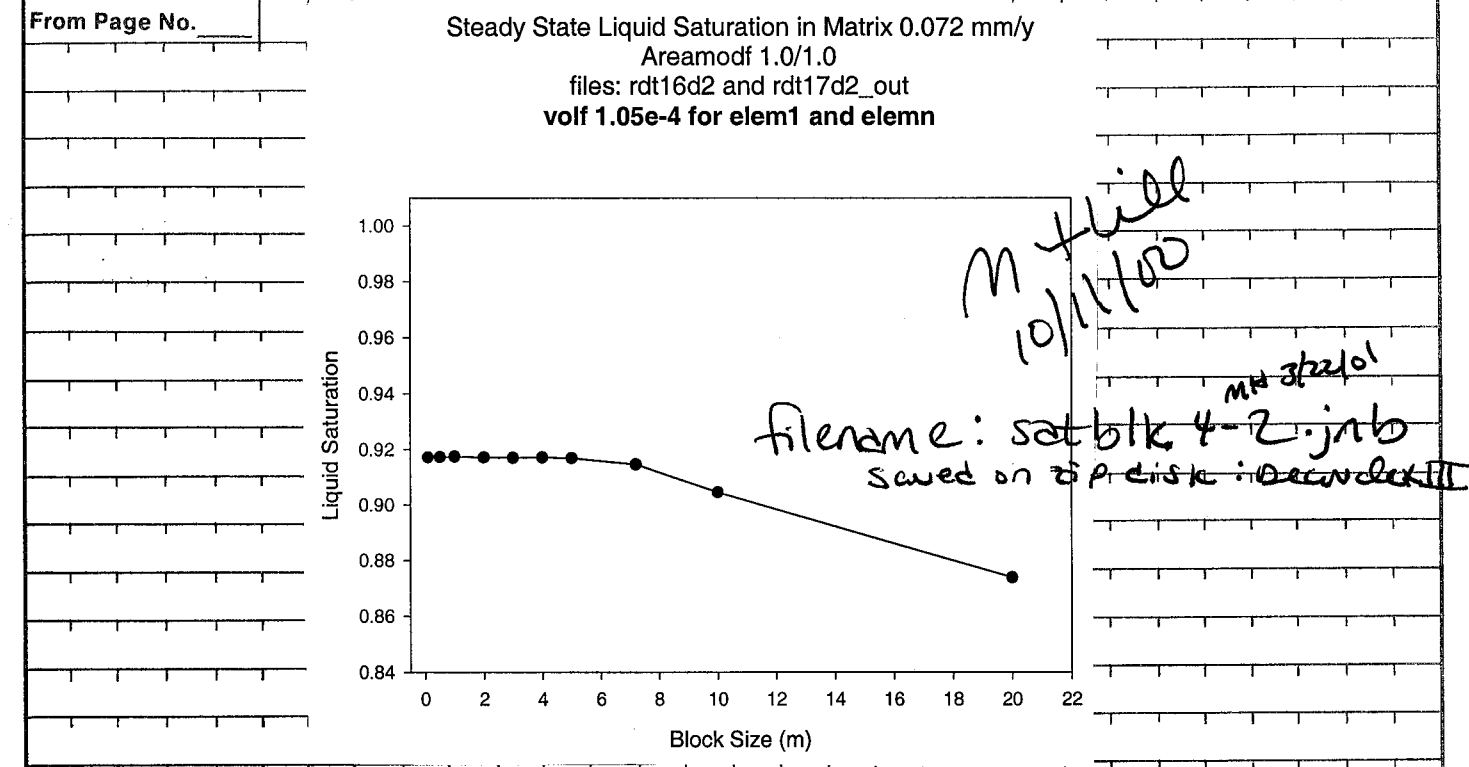
Recorded by _____

To Page No. _____



Peran input files rdt16c.dat & rdt17c.dat
after changing volf from 0.55e-4 to 1.05e-4.
New files saved as rdt16c2.dat & rdt17c2.dat

Filename → rdt16c2-out sg at element 1101
rdt16c2-out 5.3398e-5
rdt17c2-out 5.4784e-5 plot on p 22 of this notebook



Filename sg at element 1101
rdt16d-out 1.1106e-1
rdt17d-out 1.1104e-1
rdt18d-out 8.2554e-2
rdt19d-out 8.2779e-2
rdt20d-out 8.2937e-2
rdt21d-out 8.2910e-2
rdt22d-out 8.3141e-2
rdt23d-out 8.5415e-2
rdt24d-out 9.5497e-2 plot on p 22
rdt25d-out 1.2614e-1 of this notebook

Top of this page
(plot on a next page, 22 of this notebook) m# 3/22/01
10/11/00

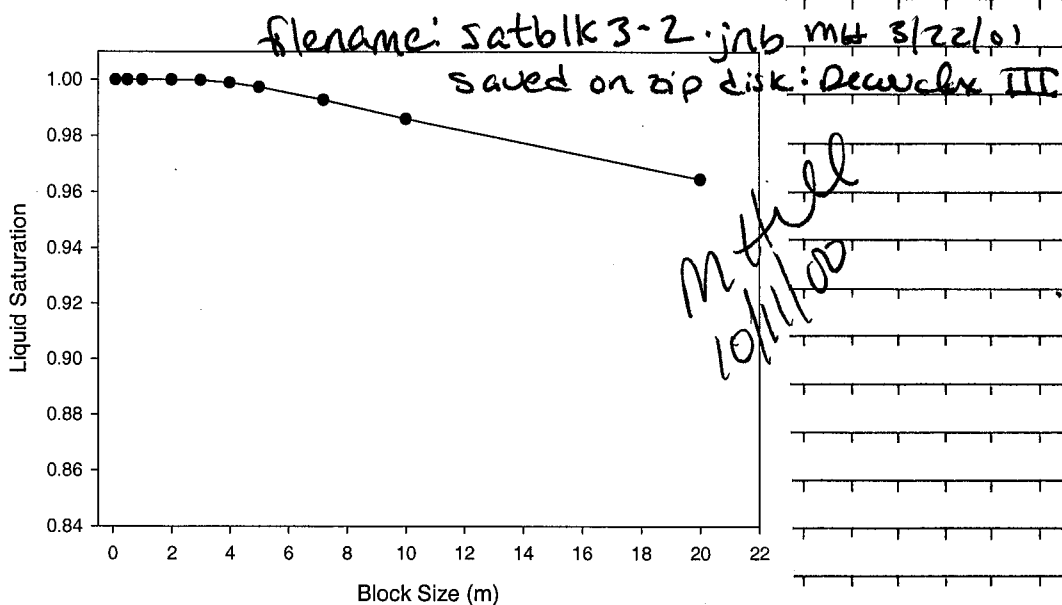
From Page No. _____

Steady State Liquid Saturation in Matrix 3.6 mm/y

Areamodf 1.0/1.0

files: rdt16c2 & rdt17c2_out

volf 1.05e-4 for elem1 and elemn

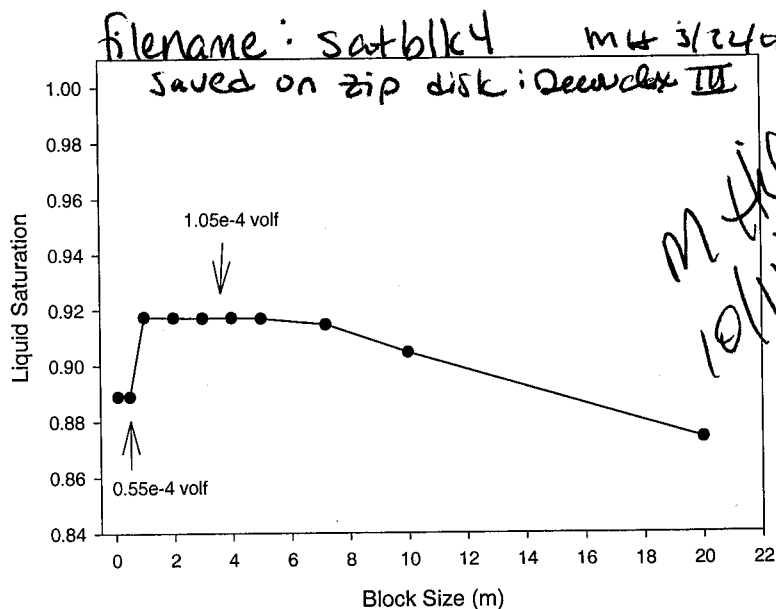


Steady State Liquid Saturation in Matrix 0.072mm/yr

Areamodf 1.0/1.0

files: rdt16d-25d_out

volf 0.55e-4 for elem1 and elemn



To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

TITLE _____

Book No. _____

From Page No. _____

Filename sg at element 1101
 rd+16d2-out $8.2819e-2$ plot on p21
 rd+17d2-out $8.2691e-2$ of this
 notebook

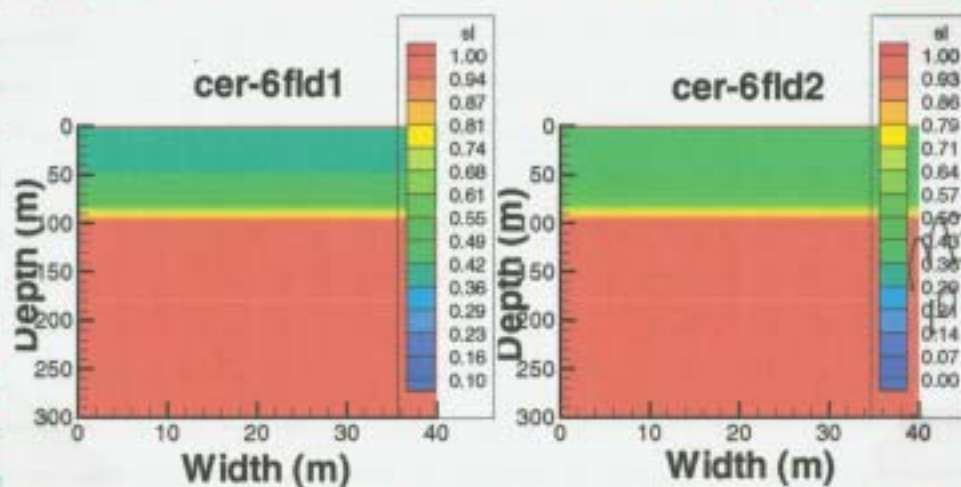
The plots represented on p 20-22 of this notebook demonstrate the sensitivity of $mt_{10/11/00}$ volt on simulation results at ~~highest~~ lower infiltration rates (i.e. ~~13.6 mm/yr~~ $mt_{10/11/00}$ 0.072 mm/y)

M Hill 10/11/00

10/18/00 Given 2 more files by R. Green

- cer-6fld1.xyp
- cer-6fld2.xyp

files located on vulcan/home/mhill/chuck



M Hill 10/18/00

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

From Page No. _____

11/16/00

MT 11/16/00

Provided input file: ~~afm15.fld~~
afm15.dat by R. Green. Modified
input file as follows:

- x_{lm} (block size) = ~~5.0~~ 2.0
- infiltration = 0.5 mm/y
- $\alpha_{reamod F} = 5e-4$
- K_t = thermal conductivity of basecase

MT 11/16/00

ran to steady state file named afm17.dat
From file: afm17_out element 1101 liquid
saturation at 0.95.

turned on heat saved as file afm17h.dat

160

plotf afm17fldf1.xyp
plotf.dat \Rightarrow af17.dat
vertprof plotf.dat
vertprof.dat \Rightarrow afm17.dat

plotf afm17fldm1.xyp
plotf.dat \Rightarrow am17.dat
vertprof plotf.dat
vertprof.dat \Rightarrow afmm17.dat

158

plotf afm17fldf1.xyp
plotf.dat \Rightarrow af172.dat
vertprof plotf.dat
vertprof.dat \Rightarrow afmf172.dat

plotf afm17fldm1.xyp MT 11/16/00
plotf.dat \Rightarrow am172.dat 1.dat
vertprof plotf.dat

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

From Page No. _____

MT 11/16/00

vertprof.dat \Rightarrow ~~afm172.dat~~ 111.dat

158

plotf afm17hfd1.xyp
plotf.dat \Rightarrow 2.dat
vertprof plotf.dat
vertprof.dat \Rightarrow 22.dat

plotf afm17hfdm1.xyp
plotf.dat \Rightarrow 3.dat
vertprof plotf.dat
vertprof.dat \Rightarrow 33.dat

160

plotf afm17hfd1.xyp
plotf.dat \Rightarrow 4.dat
vertprof plotf.dat
vertprof.dat \Rightarrow 44.dat

plotf afm17hfdm1.xyp
plotf.dat \Rightarrow 5.dat
vertprof plotf.dat
vertprof.dat \Rightarrow 55.dat

MT 11/16/00

11/17/00 Modified input file afm17.dat as
follows:

- $x_{lm} = 5.0$
- infiltration = 1.5 mm/yr

ran to steady state after saving under
new filename afm20.dat. File crashed
prior to completion.

Set up another input file as follows:

- $x_{lm} = 5.0$
- infiltration = 2.0 mm/yr

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

From Page No. _____

saved as file afm21.dat & ran to steady state.

Turned on heat & ran simulation for one time step (1yr) after saving under new file name: afm21h.dat.

MH 11/17/00
158

File (afm21h.dat) crashed with heat turned on.

Set up 2 new input files as follows:

afm22.dat

- xlm = 5.0
- infiltration = 1.0 mm/y

afm23.dat

- xlm = 5.0
- infiltration = 0.5 mm/y

afm22.dat reached steady state. Turned on heat & ran simulation after renaming as file afm22h.dat. afm22h.dat crashed.

afm23.dat crashed prior to reaching steady state.

MH 11/17/00

Set up new file as follows:

afm24.dat

- xlm = 5.0
- infiltration = 2.5 mm/y

File (afm24.dat) ran to steady state. Cut & pasted steady state conditions,

To Page No. _____

Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	

TITLE _____

From Page No. _____

turned on heat & ran simulation after renaming as file afm24.dat. afm24h.dat crashed.

Set up new file as follows:

afm26.dat

- xlm = 5.0
- infiltration = 3.0 mm/y

afm27.dat

- xlm = 5.0
- infiltration = 3.5 mm/y

MUH 11/17/00

11/27/00 Set up new file afm29.dat changed xlm to 10.0 ran to steady state.

Cut & pasted initial conditions. Ambient saturation at element 1101 is 88%. Turned on heat after saving as new file afm29h.dat.

MUH 11/27/00

11/28/00

Filename	Amb Saturation	frac perm	xlm	infiltration (mm/y)
crashed afm 29h	.888	$\sqrt{1000}$	10	3.6
afm 30	.888	$\sqrt{1000}$	10	.218
afm 31	.877	$\sqrt{1000}$	12	To Page No. 218

Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	

From Page No. _____

afm 32 .882 $\sqrt{1000}$ 11 .218crashed afm 33 - $\sqrt{1000}$ 8 .218crashed afm 34 - $\sqrt{1000}$ 6 .218afm 35 .888 $\sqrt{1000}$ 10 1.0afm 36 .888 $\sqrt{1000}$ 10 2.0afm 37 .888 $\sqrt{1000}$ 10 2.5afm 38 .88 $\sqrt{1000}$ 10 3.0afm 39 .849 $\sqrt{1000}$ 20 .218crashed afm 40 - $\sqrt{1000}$ 5 .218

M Hill 11/28/00

11/29/00

crashed afm 41 - $\sqrt{1000}$ (.) 5 .218

crashed afm 42 (modified fracture permeability ran with heat on) - originally afm 02.dat 10 3.6

afm 43 .88 (duplicate of afm 42, but with heat off)

crashed afm 44 - $\sqrt{1000}$ (inserted steady state) 10 3.6afm 45 .849 $\sqrt{1000}$ 20 3.6.926 afm 46 .926 $\sqrt{1000}$ 5 3.6

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

TITLE _____

From Page No. _____

afm 47 .967 $\sqrt{1000}$ 2 3.6afm 48 .966 $\sqrt{1000}$ 2 .218

M Hill 11/29/00

11/30/00

afm 49 .926 $\sqrt{1000}$ 5 3.0afm 50 .926 $\sqrt{1000}$ 5 2.0afm 51 .926 $\sqrt{1000}$ 5 0.5crashed afm 52 - $\sqrt{1000}$ 5 .218crashed afm 51h $\sqrt{1000}$ 5 0.5 with heat $\ln 3-6.bc = 1.08724e-03$ ✓ $\ln 0.5.bc = 2.17448e-04$ $\ln 1.0.bc = 4.34896e-04$ $\ln 1.5.bc = 6.52344e-04$ $\ln 1.8.bc = 5.4362e-04$ ✓ $\ln 2.0.bc = 8.69792e-04$ $\ln 2.5.bc = 1.08724e-03$ $\ln 2.8.bc = 6.5836e-05$? $\ln 3.0.bc = 1.30469e-03$ $\ln 3.5.bc = 1.52214e-03$ Incorrect
M Hill 12/4/00Incorrect
M Hill 12/4/00

M Hill 11/30/00

12/1/00

afm 53

ivplwr

0

 $\sqrt{1000}$

5

0.5

(heat on)

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

From Page No. _____

atm54 ivplwr 0 $\sqrt{1000}$ 5 0.5
(running to Steady State)

crashed atm55 0 $\sqrt{1000}$ 5 0.5
(heat on)

ok atm58 1 $\sqrt{1000}$ 5 0.5
(steady state)

crashed atm59 1 $\sqrt{1000}$ 5 0.5
(heat on)

Ran files atm58 & atm59 to see if they crashed again with ivplwr set at 1 when heat on. Asked Stefan Mayer to look at files. Atm58 completes (steady state conditions, but atm59 crashes (heat on) atm59 errs gives messages, "water density derivatives bad, errors in water/steam properties."

M Hill 12/11/00

12/4/00

Cut & pasted Steady State conditions for file: atm35.dat turned on heat after saving file under new name: atm35h.dat

Observed that some of the infiltration rates used were incorrect (p 29 of this notebook).

To Page No. _____

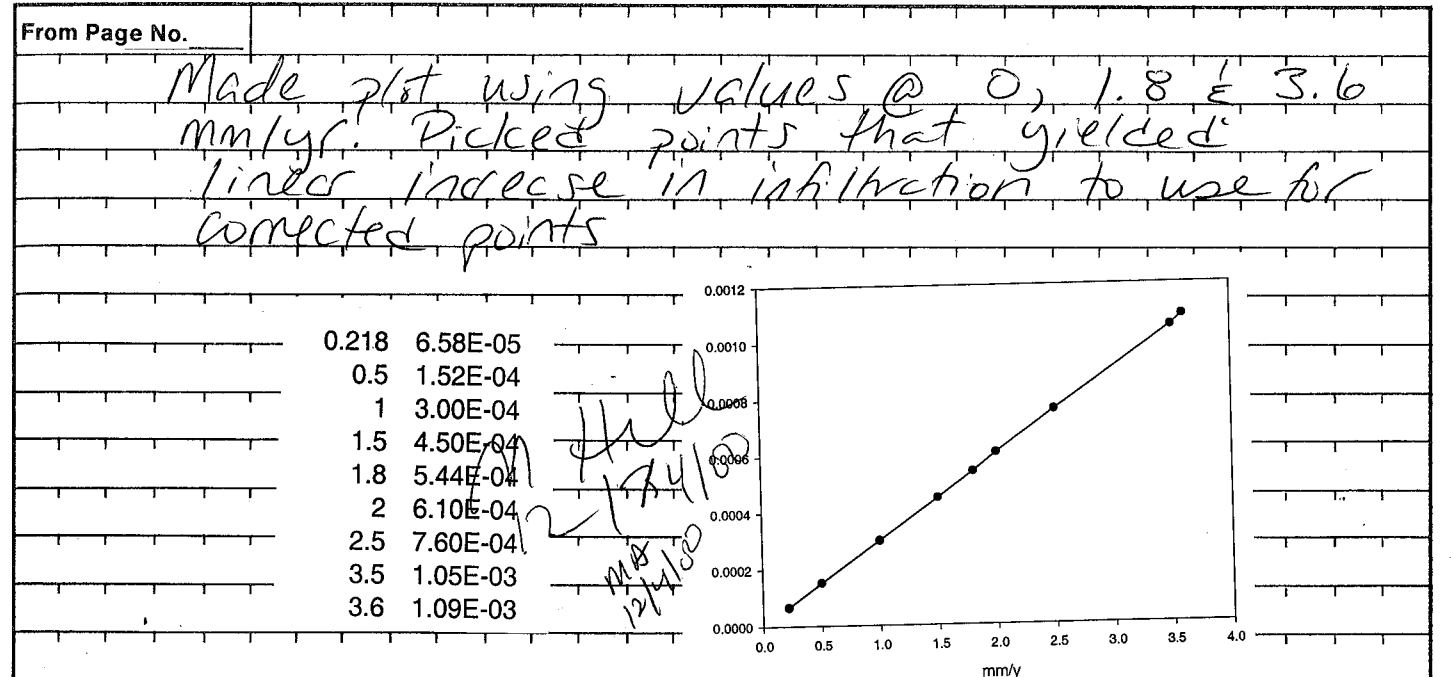
Witnessed & Understood by me,

Date

Invented by

Date

Recorded by



crashed atm60 $\sqrt{1000}$ to 5 0.5r
M Hill 12/4/00 (ran to steady state)
used corrected infiltration

M Hill 12/4/00

12/5/00

crashed atm61 $\sqrt{1000}$ 5 0.5r
(but reversed order)

Killed atm62 $\sqrt{1000}$ 5 0.5r
let run overnight (commented out 1st line with value of never reached 1624 in frac. permeabilities)
steady state

93 atm63 assumed error in 1st data 5 0.5r
point (# abnormally \uparrow compared to rest 51.36) assumed 15.36 $\sqrt{1000}$ = 486 which is more reasonable # so substituted 486 into data set

To Page No. _____

Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

From Page No. _____

changed measured data in plots (used data from file: dstout-0133.pdat located on vulcan/home/rgreen/dst-scans/decovaler/afm)

Borehole 158
X=0, y=23

Borehole 160
z=0 y=23

z	temp (°C)	X	temp (°C)
0	157.50	0	157.50
1	161.22	1	154.53
2	154.26	2	146.34
3	132.61	3	144.30
4	108.13	4	142.57
5	92.64	5	156.81
6	81.56	6	165.57
7	72.39	7	167.53
8	64.18	8	173.37
9	56.35	9	175.51
10	49.38	10	175.69
11	43.58	11	175.31
12	38.66	12	170.02
13	34.62	13	158.31
14	31.61	14	126.30
15	29.27	15	95.85
16	27.50	16	87.29
17	26.16	17	71.64
18	25.29	18	60.35
19	24.51	19	51.35
20	24.03	20	44.84
21	23.69	21	40.17
22	23.61	22	34.56
23	22.78	23	36.66

To Page No. _____

Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

TITLE _____

From Page No. _____

.91 afm 64 J1000/486 5 0.5r
killed mth 12/5/00 (turned on heat without substituting steady state)
crashed afm 65 J1000/486 5 0.5r
(heat on, steady state conditions)

.93 afm 66 J1000/486 5 0.5r
changed sg under init from 9.7×10^{-1} to 9.9×10^{-1}

.91 afm 67 J1000/486 5 0.5r
changed sg under init from 9.7×10^{-1} to 9.9×10^{-1} turned on heat (without steady state conditions)

M Will 12/5/00

12/6/00

crashed afm 68 J1000/486 5 0.5r

amended file 63.int as follows:
changed value for sg from 9.9999×10^{-1} to 9.7000×10^{-1} & saved as 63r.int
Used 63r.int in afm 68.dat

original afm 02.dat runs with heat but has cap. pressure values of 0
4th column for 8 & 9 fracture permeabilities under pckr

To Page No. _____

Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

34

Project No. _____
Book No. _____

TITLE _____

From Page No. _____

crashed afm69 $\sqrt{1000}/486$ 5 3.6
(heat on) not prev
run to steady state

crashed afm70 ~~5200~~ $\sqrt{1000}/486$ 5 .218
MH 12/6/00
(heat on)

.93 afm71 $\sqrt{1000}/486$ 5 .218
(ran to ss)

crashed afm72 $\sqrt{1000}/486$ 5 .218
(inserted ss conditions)
turned on heat

.93 afm73 $\sqrt{1000}/2$ 5 .218
2 divided by 2 (heat off)
not previously run to
ss with updated
cap press

crashed afm74 $\frac{\sqrt{1000}}{2}$ 5 .218
(heat on)
not previously run to ss
with updated cap press

crashed afm75 $\frac{\sqrt{1000}}{2}$ 5 0.5

crashed afm76 0 5 0.5 (heat on)
did not run to ss

.93 afm77 0 5 0.5 (ran to)
ss

crashed afm78 0 5 0.5
cut & pasted ss conditions
heat on

To Page No. _____

Witnessed & Understood by me, _____
Date _____
Invented by _____
Recorded by _____
Date _____

Project No. _____
Book No. _____

TITLE _____

From Page No. _____

crashed afm79 0 5 0.5
(ss conditions pasted)
heat on

12/13/00 158
plot f heat2cfldf1.xyp
plotf.dat => o2.dat
vertprof plotf.dat
vertprof.dat => o2f.dat

plotf heat2cfldm1.xyp
plotf.dat => p2.dat
vertprof plotf.dat
vertprof.dat => p2m.dat

160
plotf heat2cfldf1.xyp
plotf.dat => n2.dat
vertprof plotf.dat
vertprof.dat => n2f.dat

plotf heat2cfldm1.xyp
plotf.dat => y2.dat
vertprof plotf.dat
vertprof.dat => y2m.dat

160
plotf heat2aflcdf1.xyp
plotf.dat => la.dat
vertprof plotf.dat
vertprof.dat => la2f.dat

To Page No. _____

Witnessed & Understood by me, _____
Date _____
Invented by _____
Recorded by _____
Date _____

From Page No. _____

plot f heet2a fld ml. xyp
plot f. dat => ta. dat
vertpnf plot f. dat
vertpnf. dat => ta2. dat

158
plot f heet2a fld ml. xyp
plot f. dat => ha. dat
vertpnf plot f. dat
vertpnf. dat => ha2. dat

plot f heet2a fld ml. xyp
plot f. dat => ua. dat
vertpnf plot f. dat
vertpnf. dat => ua2. dat

158
plot f rd+13 fld ml. xyp
plot f. dat => pi. dat
vertpnf plot f. dat
vertpnf. dat => pi2. dat

plot f rd+13 fld ml. xyp
plot f. dat => omega. dat
vertpnf plot f. dat
vertpnf. dat => omega2. dat

160
plot f rd+13 fld ml. xyp
plot f. dat => omnicon. dat
vertpnf plot f. dat
vertpnf. dat => omnicon2. dat

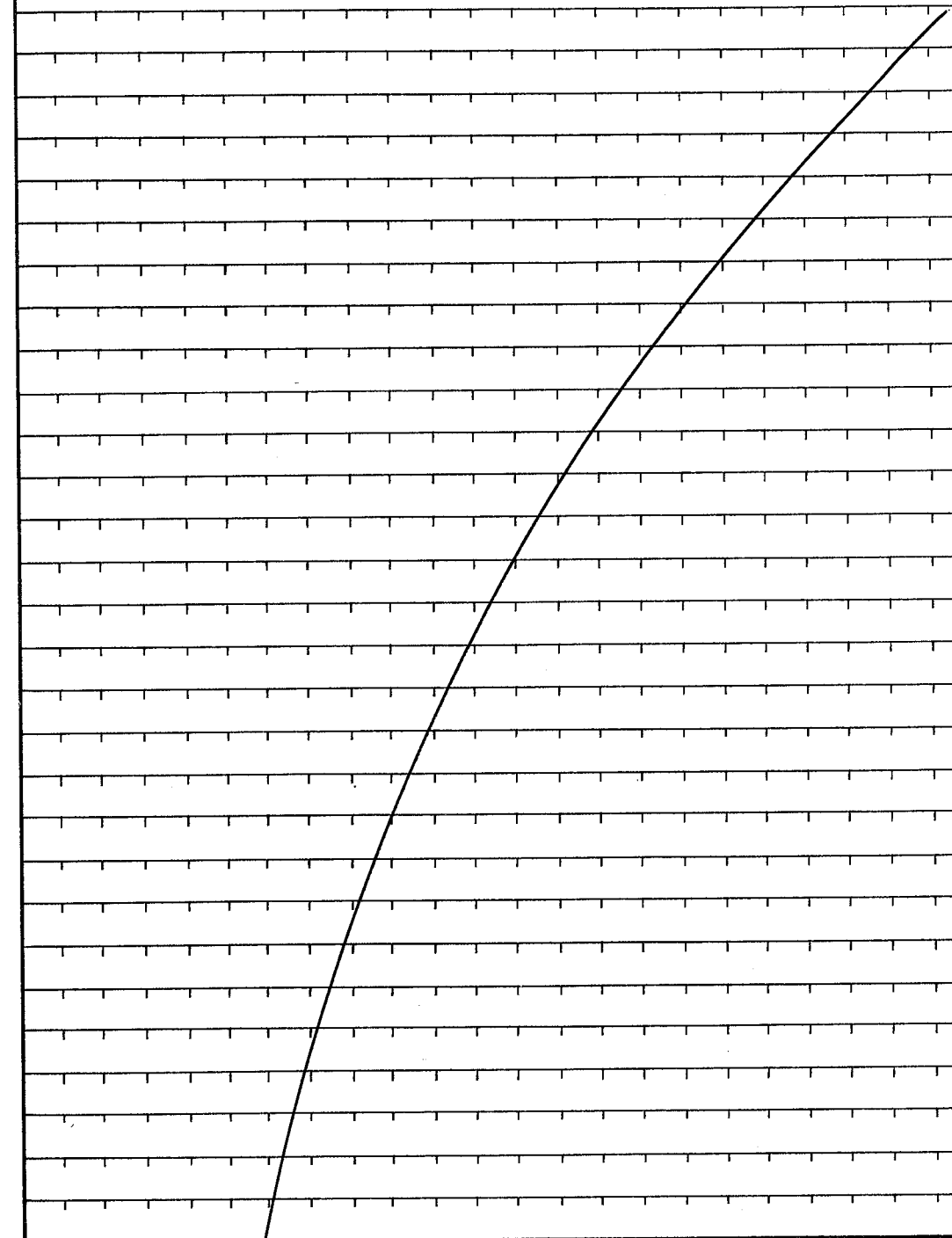
To Page No. _____

Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	

From Page No. _____

plot f rd+13 fld ml. xyp
plot f. dat => luke. dat
vertpnf plot f. dat
vertpnf. dat => luke2. dat

M lue 12/13/00



To Page No. _____

Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	

From Page No. _____

M Hill Decovalex runs

AMF

xlm

CONN

PHIK

Ambient saturation

1.0 5e-4

AFM

multi

0.072

heat2a.dat

1.0

"

"

"

"

.93

h2as.dat

" heat on

"

h2a.dat

.25 5e-4

AFM

multi

0.072

heat2c.dat

1.0

"

"

"

"

.93

h2cs.dat

" heat on

"

h2c.dat

.25 5e-4

multi

multi

0.072

heat2e.dat

1.0

"

"

"

"

.92

h2es.dat

" heat on

"

h2e.dat

.25 1.0

multi

multi

0.072

r13b.dat

5e-4

"

"

"

"

.93

r13bs.dat

" heat on

"

r13b.dat

Witnessed & Understood by me, _____

Date _____

Invented by _____

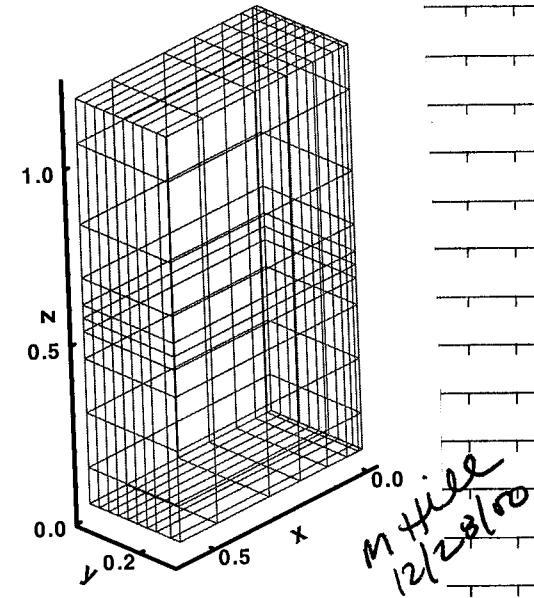
Recorded by _____

Date _____

TITLE _____

From Page No. _____

Mesh grid for file dcm-sm98fldm1.xyp
 Plotted using Tecplot 8 saved as wordperfect
 meta file & inserted file into wordperfect.



M Hill 12/28/00

12/29/00

158

plot f h2afldf1.xyp

plotf.dat => a1.dat

vertprof plotf.dat

vertprof.dat => a2.dat

plot f h2afldm1.xyp

plotf.dat => a3.dat

vertprof plotf.dat

vertprof.dat => a4.dat

Witnessed & Understood by me, _____

Date _____

Invented by _____

Recorded by _____

Date _____

To Page No. _____

From Page No. _____

160

Plot f h2a f1d f1.xyp

plotf.dat => a5.dat

vertprof plotf.dat

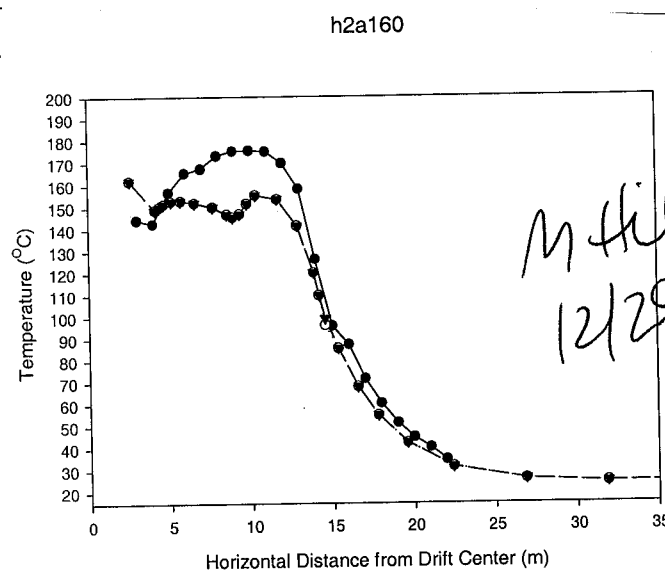
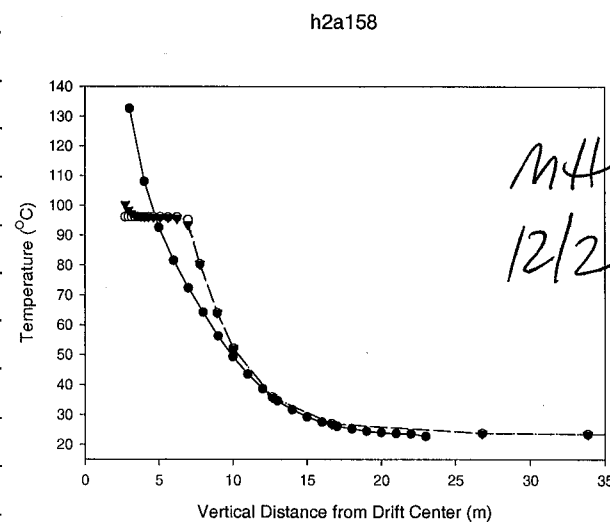
vertprof.dat => a6.dat

plotf h2a f1d m1.xyp

plotf.dat => a7.dat

vertprof plotf.dat

vertprof.dat => a8.dat



To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

TITLE _____

From Page No. _____

160

Plot f h2c f1d f1.xyp

plotf.dat => a9.dat

vertprof plotf.dat

vertprof.dat => a10.dat

plotf h2c f1d m1.xyp

plotf.dat => a11.dat

vertprof plotf.dat

vertprof.dat => a12.dat

158

plotf h2c f1d f1.xyp

plotf.dat => a13.dat

vertprof plotf.dat

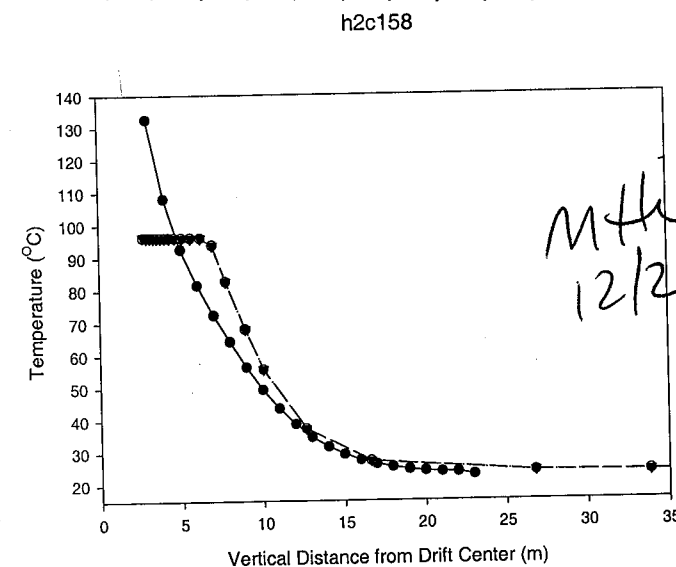
vertprof.dat => a14.dat

plotf h2c f1d m1.xyp

plotf.dat => a15.dat

vertprof plotf.dat

vertprof.dat => a16.dat



To Page No. _____

Witnessed & Understood by me, _____

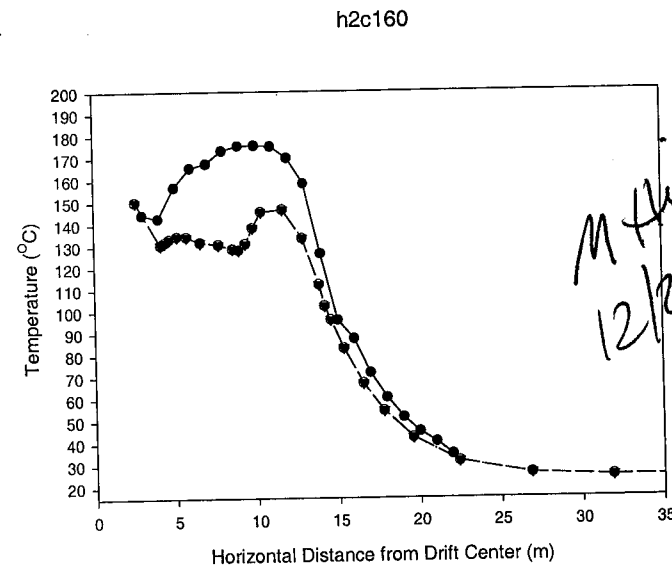
Date _____

Invented by _____

Date _____

Recorded by _____

From Page No. _____



M Hill
12/29/00

158

plotf r13b1dfl1.xyp

plotf.dat ⇒ a17.dat

vertprof ~~dat~~ plotf.dat

vertprof.dat ⇒ a18.dat

plotf r13b1dml1.xyp

plotf.dat ⇒ a19.dat

vertprof plotf.dat

vertprof.dat ⇒ a20.dat

160

plotf r13b1dfl1.xyp

plotf.dat ⇒ a21.dat

vertprof plotf.dat

vertprof.dat ⇒ a22.dat

M Hill
12/29/00

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

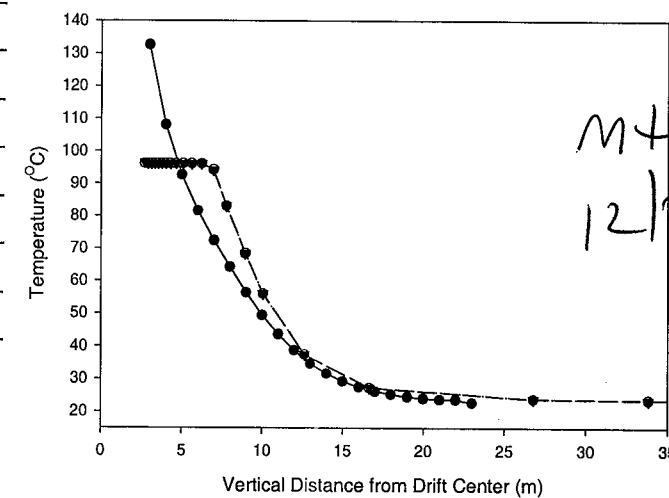
Date _____

Recorded by _____

From Page No. _____

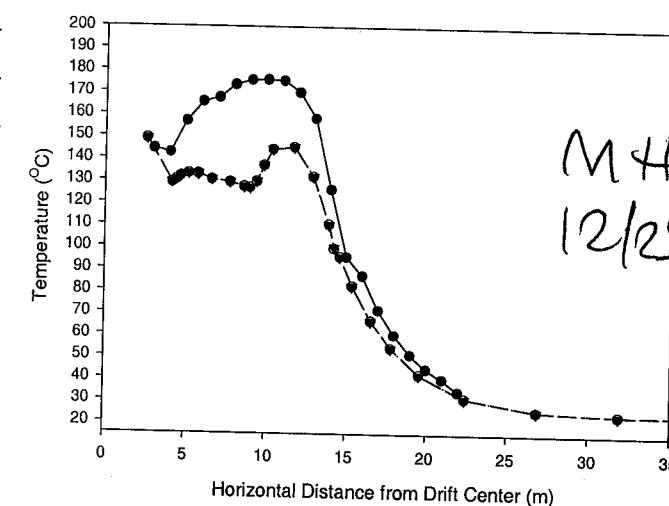
plotf r13b1dml1.xyp
plotf.dat ⇒ a23.dat
vertprof plotf.dat
vertprof.dat ⇒ a24.dat

r13b158



M Hill
12/29/00

r13b160



M Hill
12/29/00

Note: plots on pgs 40-43 the symbols represent the following:

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

From Page No. _____

- closed circles (measured values)
- open circles (predicted values in fractures)
- ▼ closed upside down triangles (predicted values in matrix)

M Hill 12/29/00

1/4/01

Filename Amb. saturation infil. Phik xlm aremodf

afm58d.dat 0.5 multi 5 1.0

58ds.dat .93 corrected 0.5 " "

killed 58d.dat " heat on

h2ds.dat .92 0.072 $\leftarrow e^{-12}$ mk3afm.phk .25 1.0

CRASHED h2d.dat " heat on

h3ds.dat .92 " mk4afm (e^{-11})

CRASHED h3d.dat " heat on

h2fs.dat .92 0.072 mk3afm .25 $5e^{-4}$

CRASHED h2f.dat " heat on

h3fs.dat .92 " mk4afm

✓ h3f.dat " heat on

h4ds.dat .92 " mk1afm .25 1.0

✓ h4d.dat " heat on

h4fs.dat 92.92 $\leftarrow e^{-10}$ mk1afm .25 $5e^{-4}$

✓ h4f.dat " heat on

M Hill 1/4/01

To Page No. _____

Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

From Page No. _____

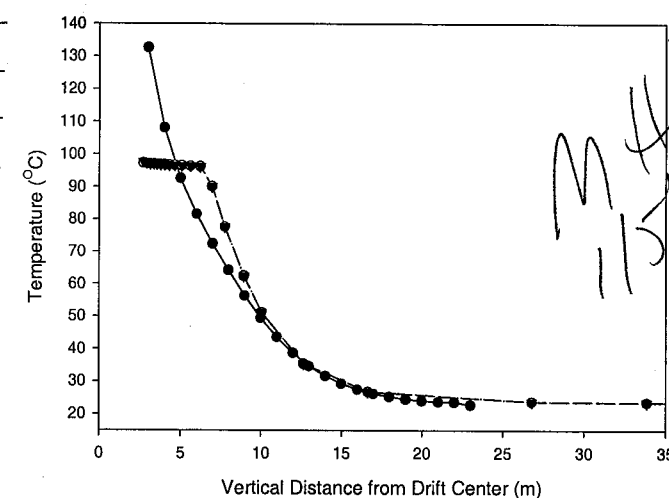
1/5/01 160 h4dfldfl.xyp
 plot f h4dfldfl.xyp mlt 1/5/01
 plotf.dat \Rightarrow a25.dat
 vertprof plotf.dat
 vertprof.dat \Rightarrow a26.dat

plot f h4dfldml.xyp
 plotf.dat \Rightarrow a27.dat
 vertprof plotf.dat
 vertprof.dat \Rightarrow a28.dat

158
 plotf h4dfldfl.xyp
 plotf.dat \Rightarrow a29.dat
 vertprof plotf.dat
 vertprof.dat \Rightarrow a30.dat

plotf h4dfldml.xyp
 plotf.dat \Rightarrow a31.dat
 vertprof plotf.dat
 vertprof.dat \Rightarrow a32.dat

h4d158



To Page No. _____

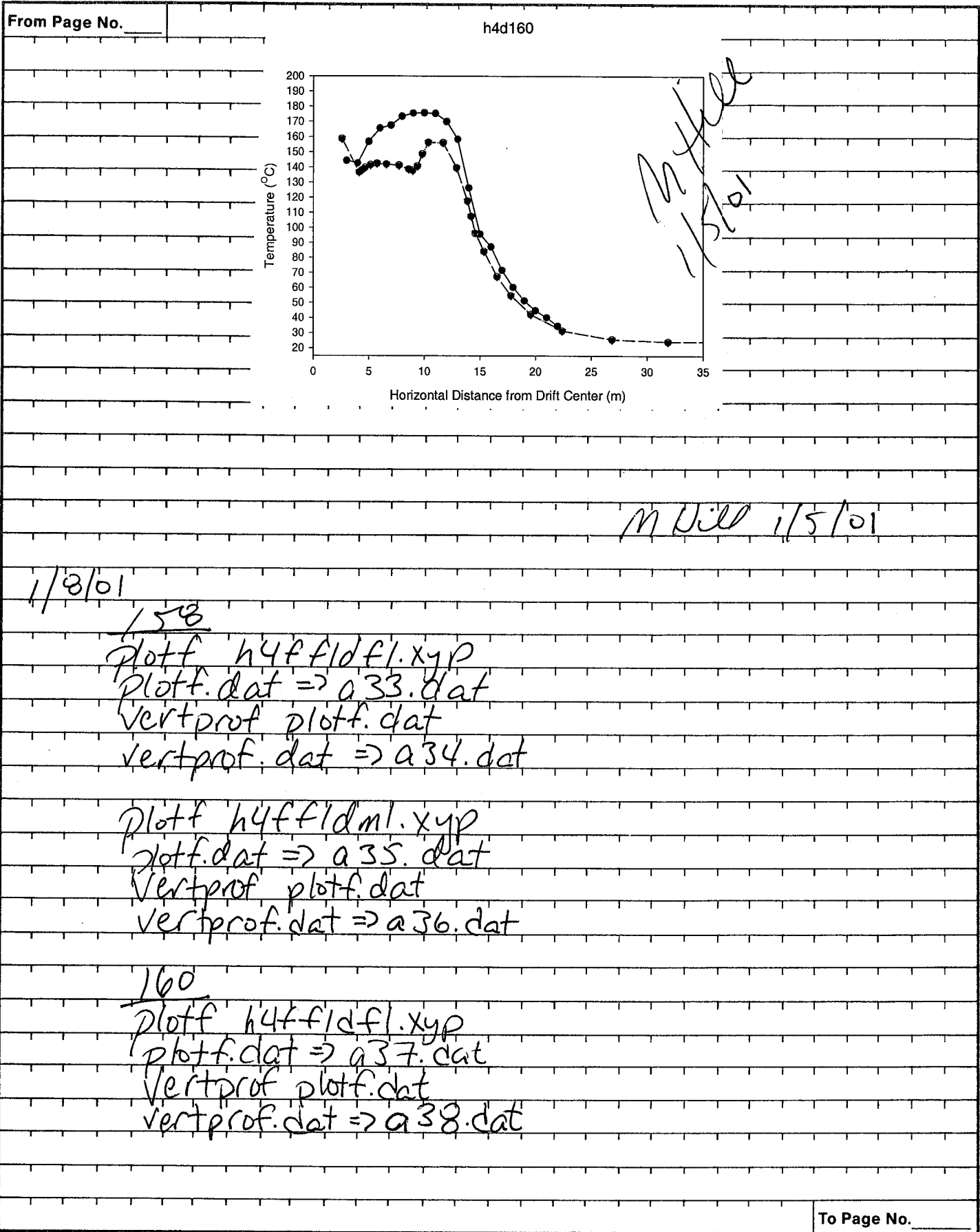
Witnessed & Understood by me,

Date

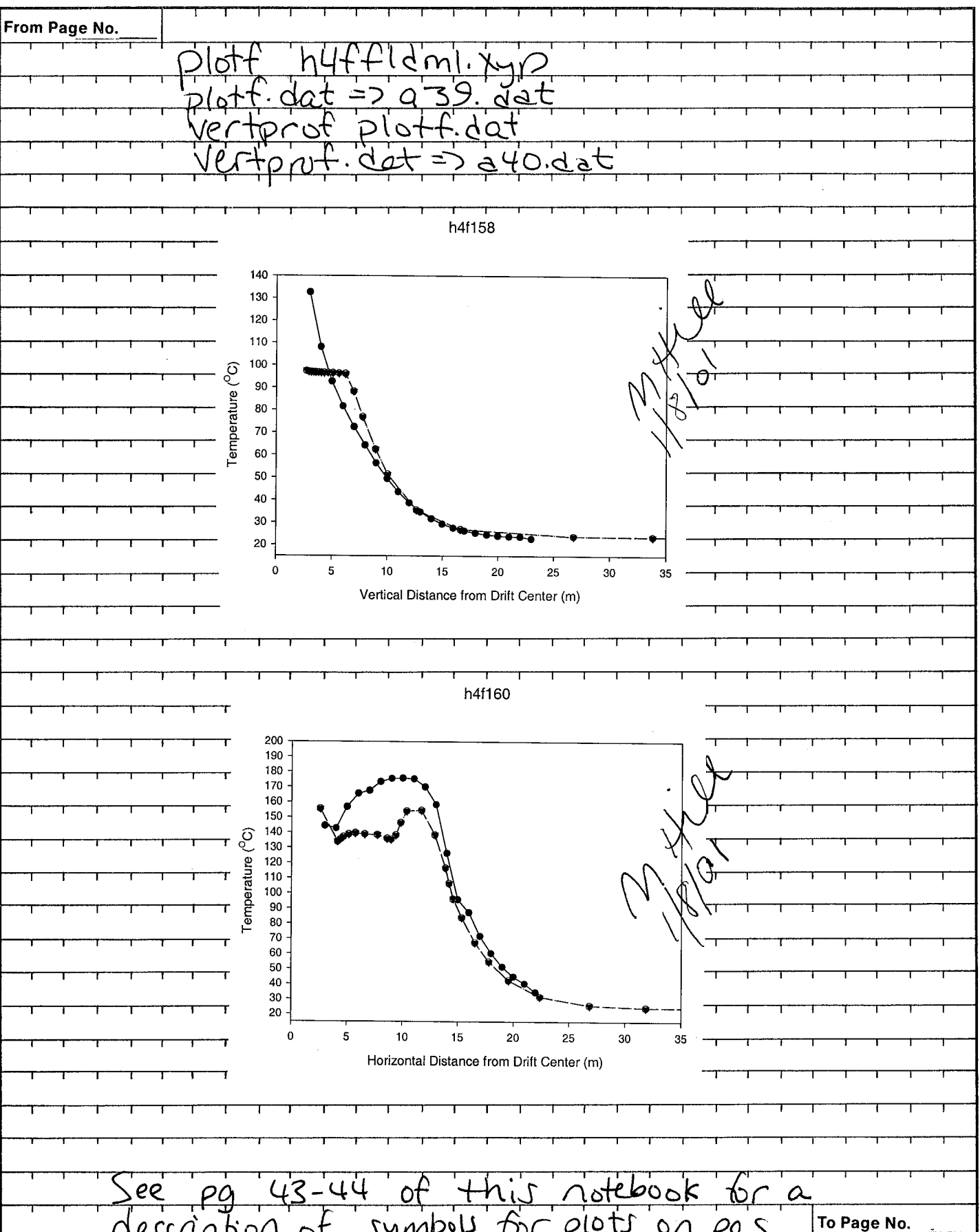
Invented by

Date

Recorded by



Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	



Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	

From Page No. _____

45-47.

160

plotf h3ffldf1.xyp

plotf.dat => a41.dat

vertprof plotf.dat

vertprof.dat => a42.dat

plotf h3ffldm1.xyp

plotf.dat => a43.dat

vertprof plotf.dat

vertprof.dat => a44.dat

158

plotf h3ffldf1.xyp

plotf.dat => a45.dat

vertprof plotf.dat

vertprof.dat => a46.dat

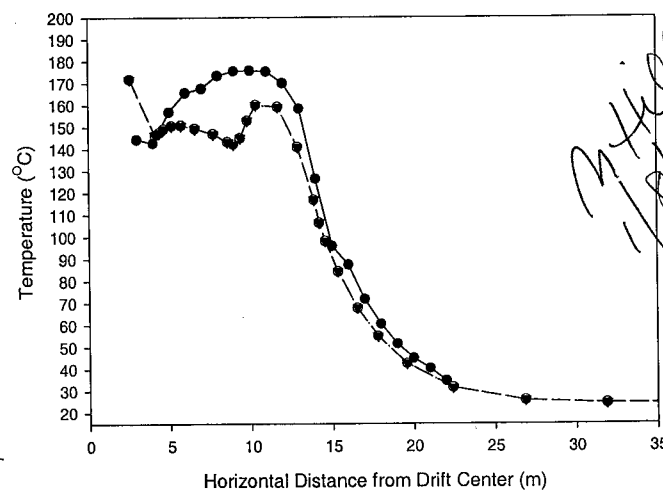
plotf h3ffldm1.xyp

plotf.dat => a47.dat

vertprof plotf.dat

vertprof.dat => a48.dat

h3f160



To Page No. _____

Witnessed & Understood by me, _____

Date _____

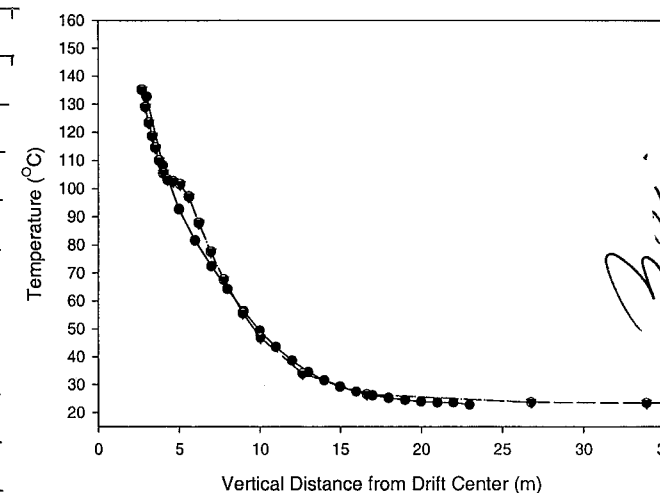
Invented by _____

Date _____

Recorded by _____

From Page No. _____

h3f158



Myhill 1/8/01

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

From Page No. _____

Description of properties for Decoupled Simulations

1/15/01

Filename Infil Phik xlm AreaModF

rdt13 ~0.072 muk-3 (e^{-12}) NoAFM .25 1
 afm58b ~~0.072~~ multi (e^{-9}) AFM 5 Se-4
 afm58d ~~0.072~~ multi AFM 5 1
 heat2a 0.072 .93 multi AFM 1 Se-4
 heat2c 0.072 .93 multi AFM .25 Se-4
 heat2e 0.072 .92 muk-3 (e^{-12}) NoAFM .25 Se-4
 rdt13b 0.072 .93 ~~multi~~ ^{multi} NoAFM .25 1.0
 h3f 0.072 .92 mk4afm (e^{-11}) AFM .25 Se-4
 h4d 0.072 .92 mk1afm (e^{-10}) AFM .25 1.0
 h4f 0.072 .92 mk1AFM (e^{-10}) AFM .25 Se-4
 h2a 0.072 .93 multi AFM 1 1
 h2c 0.072 .93 multi AFM .25 1
 ambient saturations @ element 1101

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Recorded by _____

Date _____

TITLE _____

From Page No. _____

Description of properties for Decoupled Simulations (cont.)

h2e 0.072 .92 muk-3 NoAFM .25 1
 r13b 0.072 .93 murdt (e^{-9}) NoAFM .25 Se-4
 r13d 0.072 .93 muk-3 NoAFM .8kt .25 1
 r9kt 0.072 .93 murdt NoAFM .8kt .25 1
 h2drt 0.072 mk3afm AFM .8kt .25 1
 Steady state ran / heat crashed m 1/18/01

Filename Infil Phik AFM xlm AreaModF

58ds 0.5 .93 multi AFM 5 1
 58d Killed (too many using vulcan)

h2ds 0.072 .92 mk3afm (e^{-12}) AFM .25 1
 h2d CRASHED

h3ds 0.072 .92 mk4afm (e^{-11}) AFM .25 1
 h3d CRASHED

h2fs 0.072 .92 mk3afm AFM .25 Se-4
 h2f CRASHED

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Recorded by _____

Date _____

From Page No.

158

plottf rdt15f1dfl.xyp
plottf.dat => a49.dat
vertprof plottf.dat
vertprof.dat => a50.dat

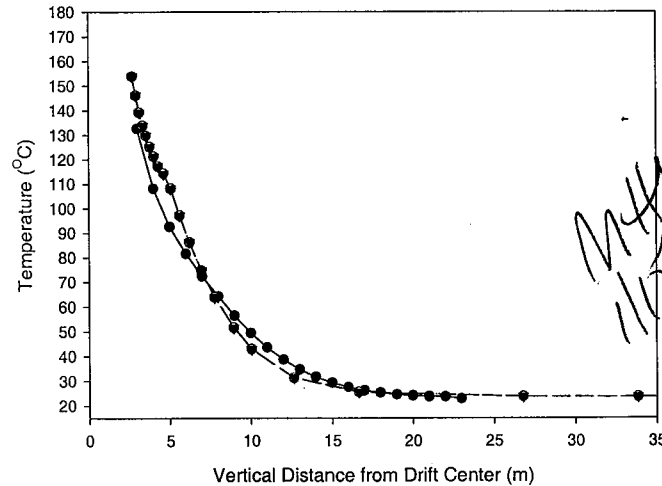
plottf rdt15f1dml.xyp
plottf.dat => a51.dat
vertprof plottf.dat
vertprof.dat => a52.dat

160

plottf rdt15f1dfl.xyp
plottf.dat => a53.dat
vertprof plottf.dat
vertprof.dat => a54.dat

plottf rdt15f1dml.xyp
plottf.dat => a55.dat
vertprof plottf.dat
vertprof.dat => a56.dat

rdt15158



Mull
1/15/01

To Page No.

Witnessed & Understood by me,

Date

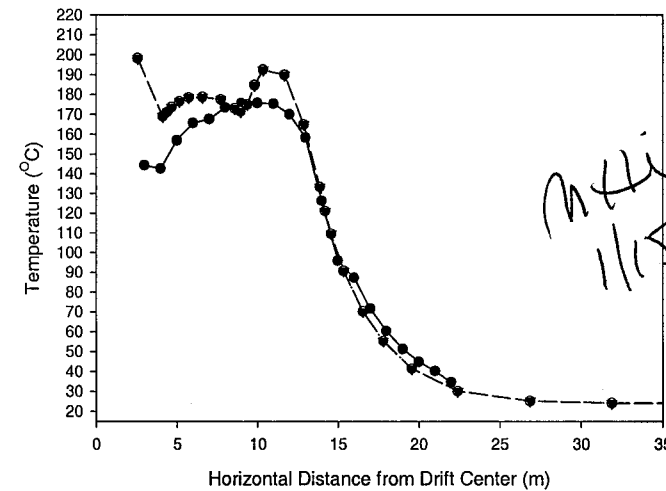
Invented by

Date

Recorded by

From Page No.

rdt15160



Mull
1/15/01

Mull 1/15/01

1/17/01

160

plottf r9ktf1dfl.xyp
plottf.dat => a57.dat
vertprof plottf.dat
vertprof.dat => a58.dat

plottf r9ktf1dml.xyp
plottf.dat => a59.dat
vertprof plottf.dat
vertprof.dat => a60.dat

158

plottf r9ktf1dfl.xyp
plottf.dat => a61.dat
vertprof plottf.dat
vertprof.dat => a62.dat

To Page No.

Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

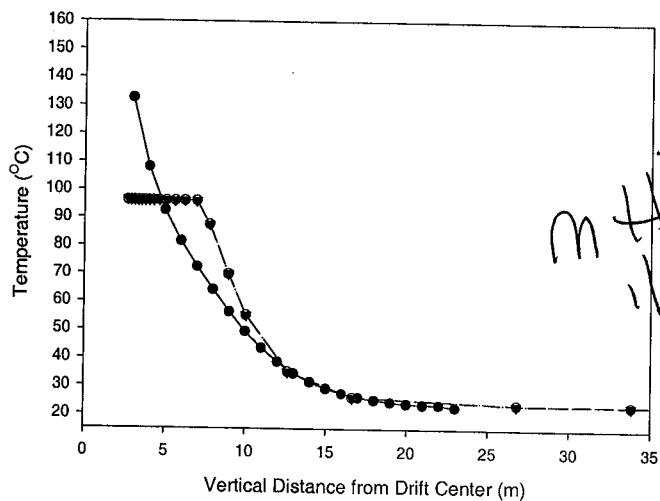
From Page No. _____

plotf r9ktfldml.xyp
plotf.dat => ab3.dat
vertprof plotf.dat
vertprof.dat => ab4.dat

M Hill 1/17/01

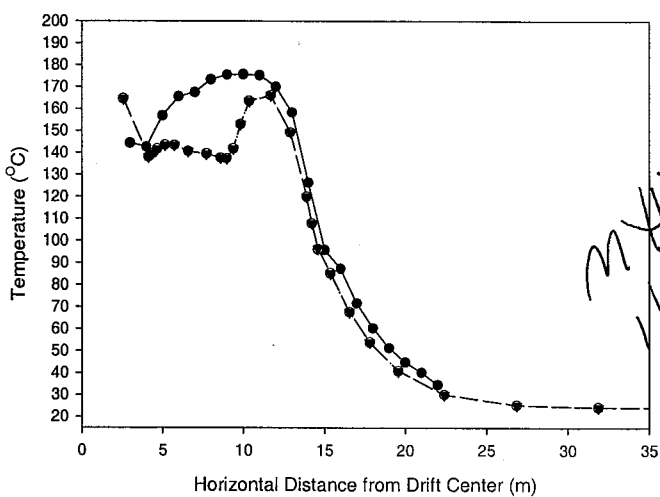
M Hill 1/18/01

r9kt158



M Hill
1/18/01

r9kt160



M Hill
1/18/01

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

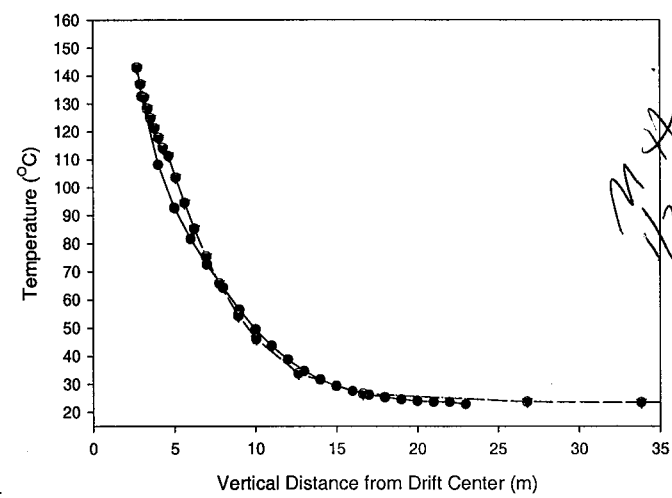
Recorded by _____

M Hill 1/18/01

TITLE _____

From Page No. 1/22/01

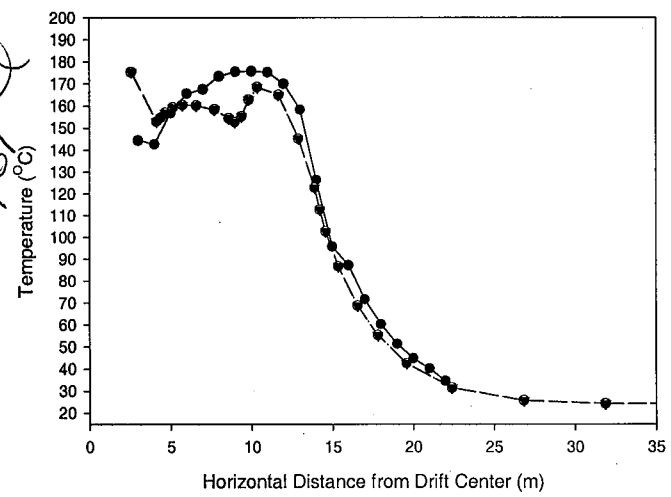
rdt13158



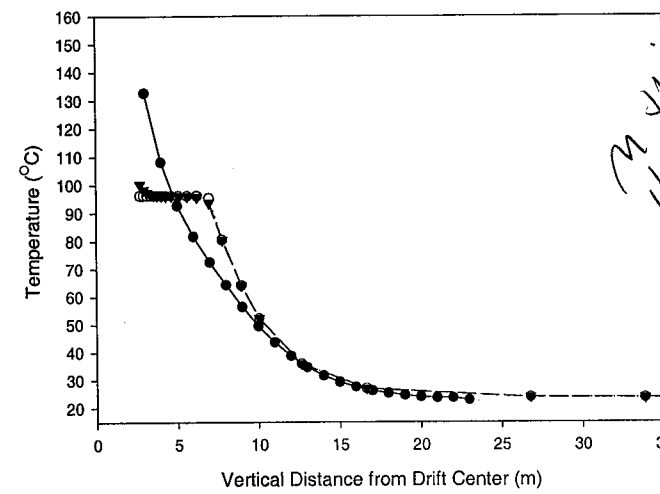
Temperature vs. Distance Borehole 158
heat2a

M Hill
1/22/01

rdt13160

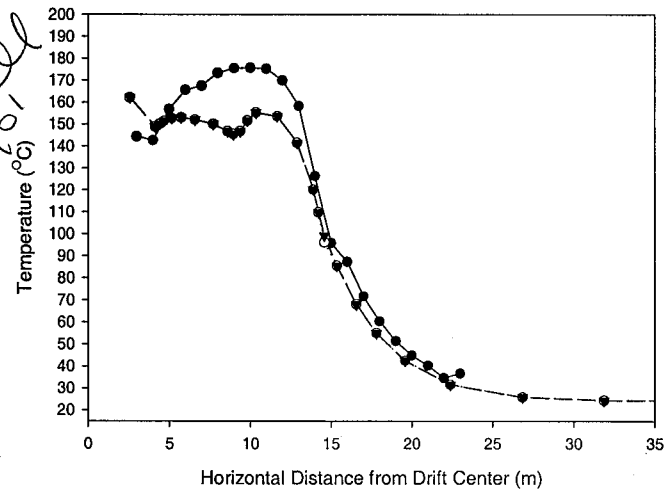


Temperature vs. Distance Borehole 160
heat2a

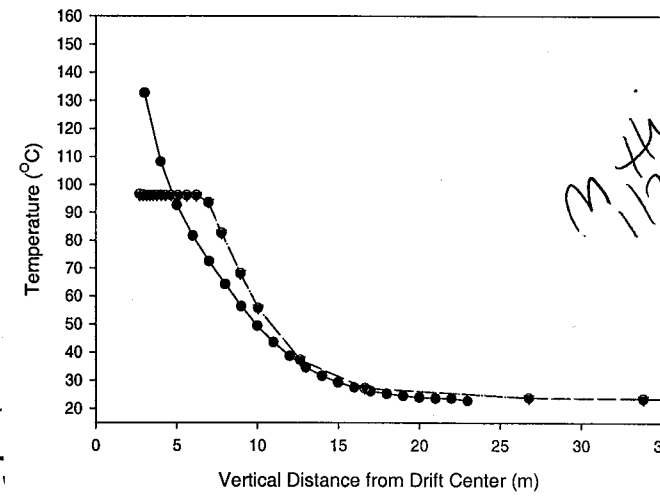


heat2c158

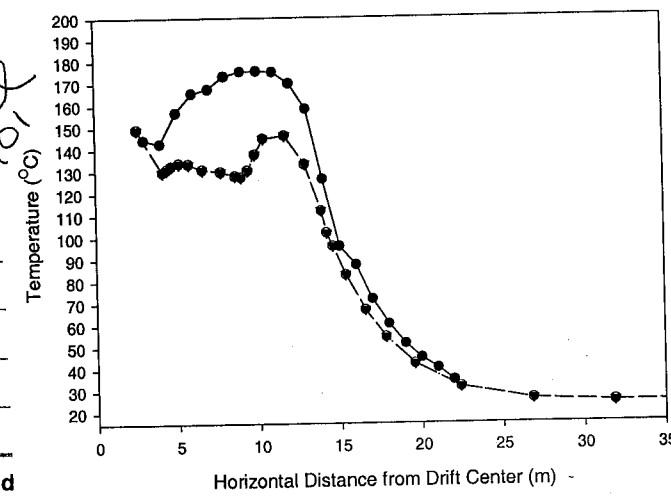
M Hill
1/22/01



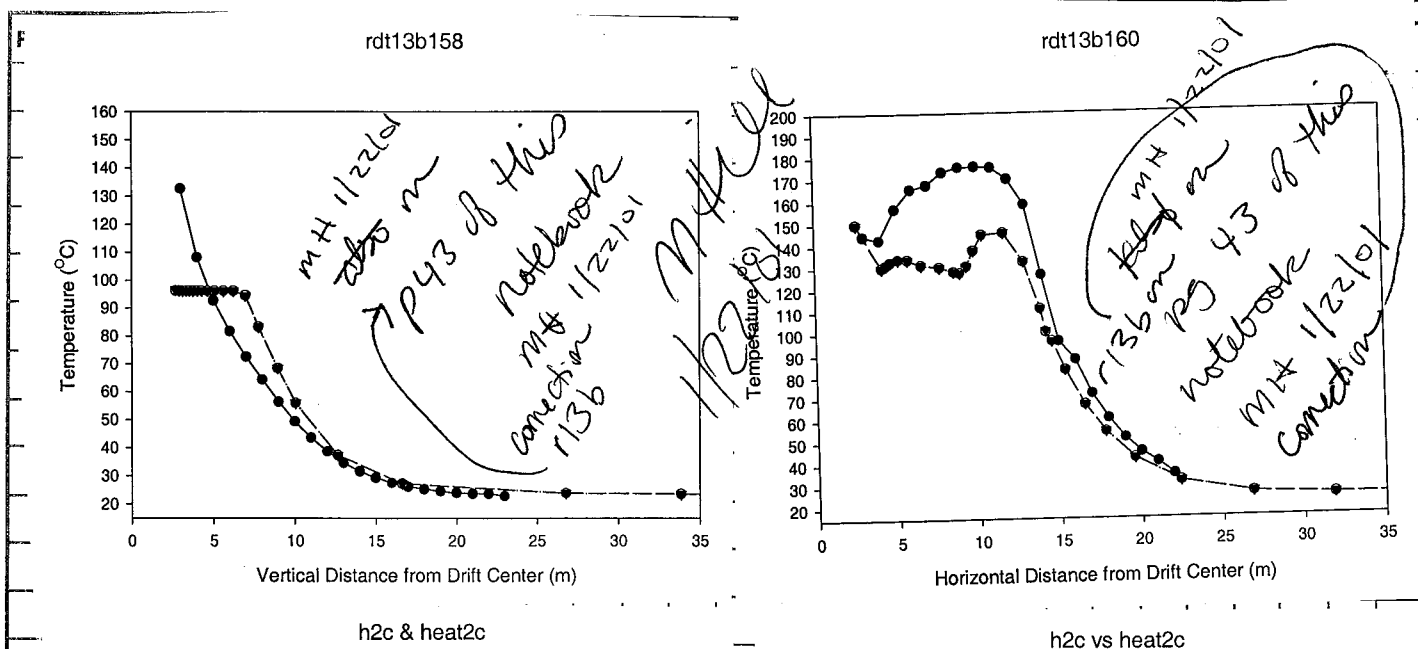
heat2C160



M Hill
1/22/01

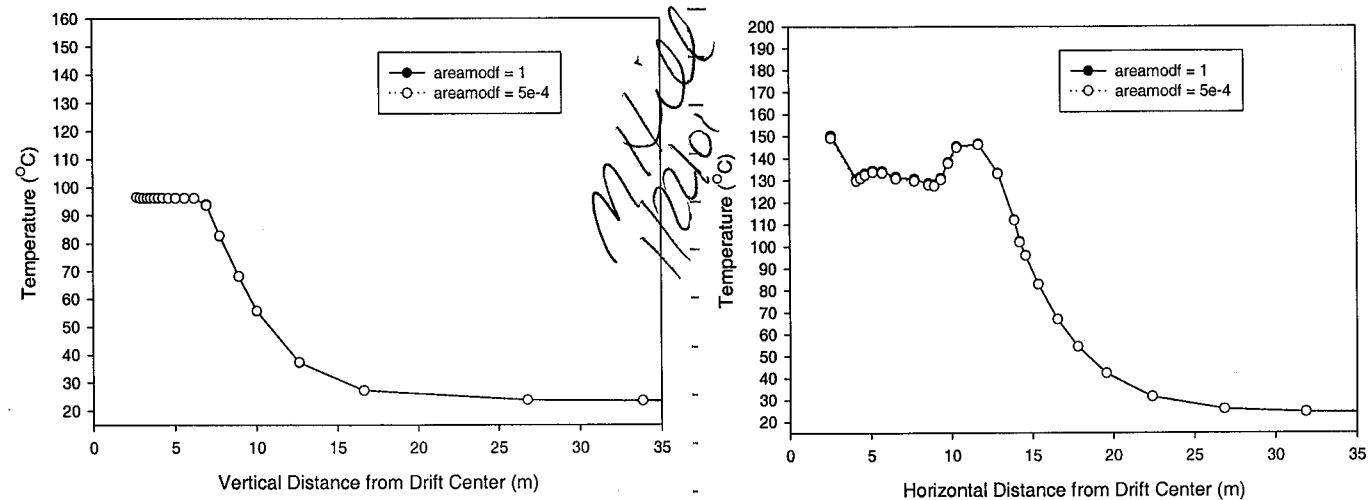


Recorded by _____



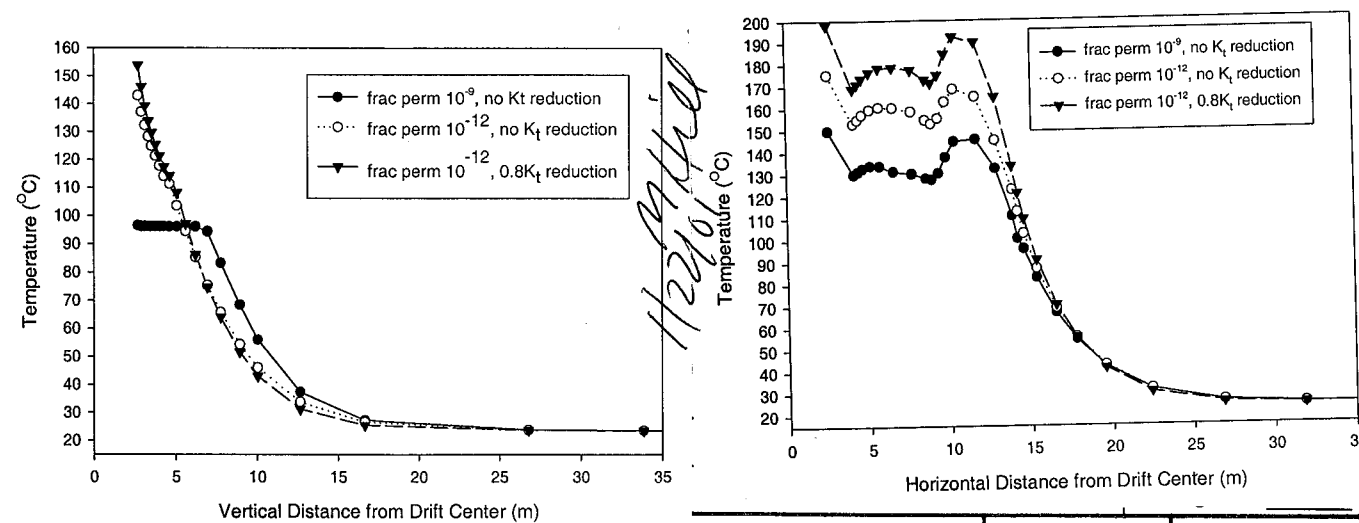
h2c & heat2c

h2c vs heat2c



matrix temperatures vs. distance rdt13b, rdt13, rdt15

matrix temperatures vs. distance rdt13b, rdt13, rdt15



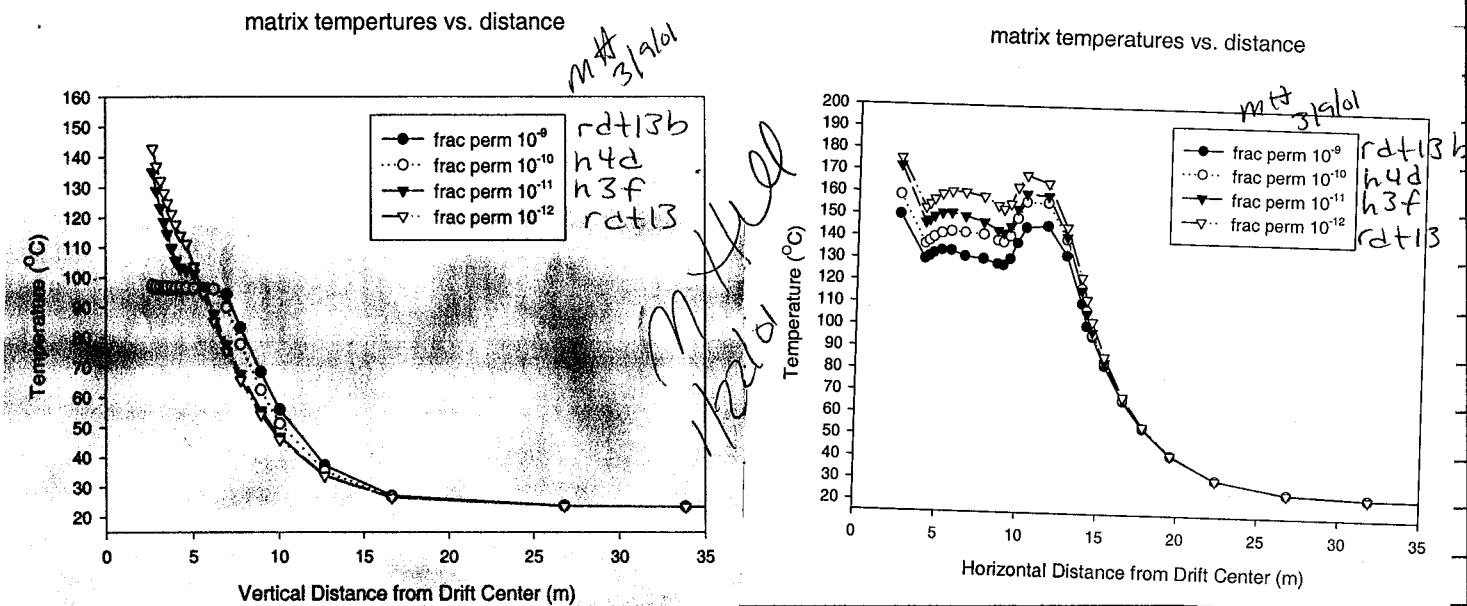
Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____



See pgs 43-44 of this notebook for a description of symbols for plots on pgs 48-49, 52, 53, 54-56 that do not already have a legend.

Plots saved on zip disks titled: Dewvalex plots I, II, III + IV. Zip disks stored in fire-proof cabinet in bldg 51.

M+ 1/22/01

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

From Page No. _____

Fracture permeability data used in DOE DST analyses. Fracture permeabilities are believed to be expressed as bulk permeability.

TSPA-VA TBD near-Field/Altered-Zone Models Report UCRL-ID-129179

Tptpul vert perm 2.63e-11 hort perm 8.91e-13 porosity 1.05e-4

Tptpmn vert perm 6.76e-12 hort perm 4.27e-13 porosity 1.24e-4

Tptpll vert perm 3.80e-12 hort perm 9.12e-13 porosity 3.29e-4

This gives intrinsic permeabilities of:

Tptpul vert perm 2.50e-7 and hort perm 8.49e-9

Tptpul vert perm 5.45e-8 and hort perm 3.44e-9

Tptpul vert perm 1.15e-8 and hort perm 2.77e-9

These are the basecase for CNWRA simulations

Tsang, Y.W. and J.T. Birkholzer. 1999. Predictions and observations of the thermal-hydrological conditions in the Single Heater Test. *Journal of Contaminant Hydrology*. 38:385-425.

Tptpmn

Low perm background 5.85e-14 m² intrinsic perm=2.41e-10

High perm background 5.2e-12 m² intrinsic perm=2.14e-8

porosity 0.000243

Birkholzer, J.T. and YW. Tsang. 2000. Modeling the thermal-hydrologic processes in a large-scale underground heater test in partially saturated fractured tuff. *Water Resources Research* 36(6):1431-1447.

The following values are taken: Birkholzer, J.T. and Y.W. Tsang. 1997. Pretest analysis of the thermal-hydrological conditions of the ESF drift scale test. Level 4 Milestone SP9322M4. Berkeley: CA: Lawrence Berkeley National Laboratory. Data calibrated to infiltration of 0.36 mm/yr.

Tptpul perm 0.635e-12 m² porosity 0.000171 intrinsic perm=3.71e-9

Tptpmn perm 0.100e-12 m² porosity 0.000263 intrinsic perm=3.80e-10

Tptpll perm 0.187e-11 m² porosity 0.000329 intrinsic perm=5.68e-9

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

From Page No. _____

3/20/01

MA 3/20/01
Processed files h4d-nofldml.xyp
h3f-znofldml.xyp for plotting as follows:

MA 3/20/01
plotf h4d-nofldml.xyp
plotf.dat => h4d-1.dat
vertprof plotf.dat
vertprof.dat => h4d-no.dat h4d-120.dat

plotf h3f-nofldml.xyp
plotf.dat => h3f-2.dat
vertprof plotf.dat
vertprof.dat => h3f-zno.dat

160
plotf h4d-nofldml.xyp
plotf.dat => h4d-no.dat
vertprof plotf.dat
vertprof.dat => h4de/no.dat

plotf h3f-nofldml.xyp
plotf.dat => h4de.dat
vertprof plotf.dat
vertprof.dat => h4df.dat

To Page No. _____

Witnessed & Understood by me, _____

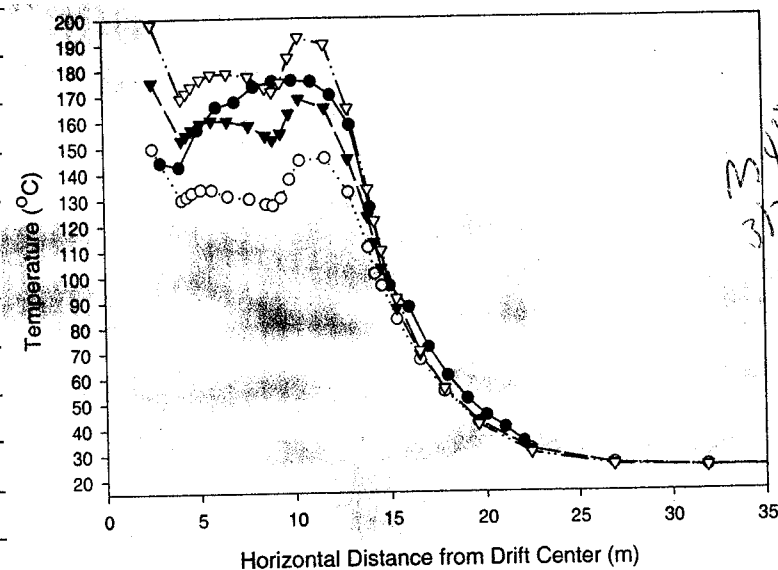
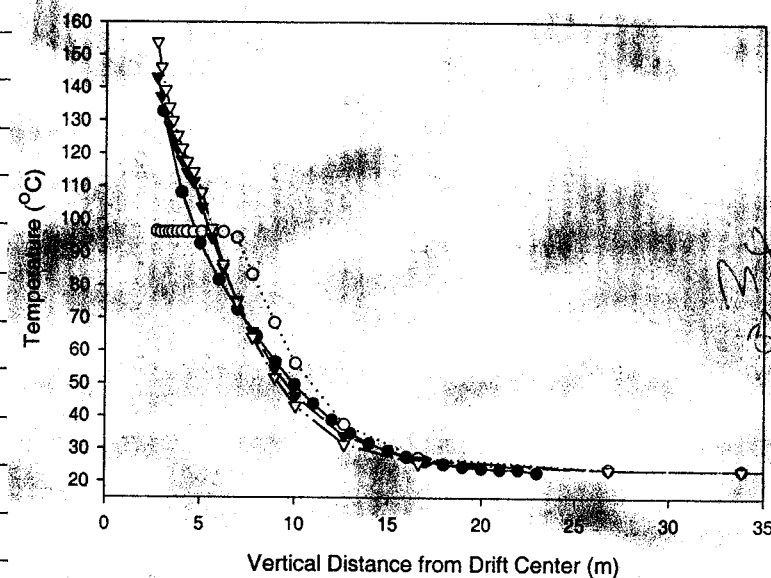
Date _____

Invented by _____

Date _____

Recorded by _____

From Page No. _____



To Page No. _____

Witnessed & Understood by me, _____

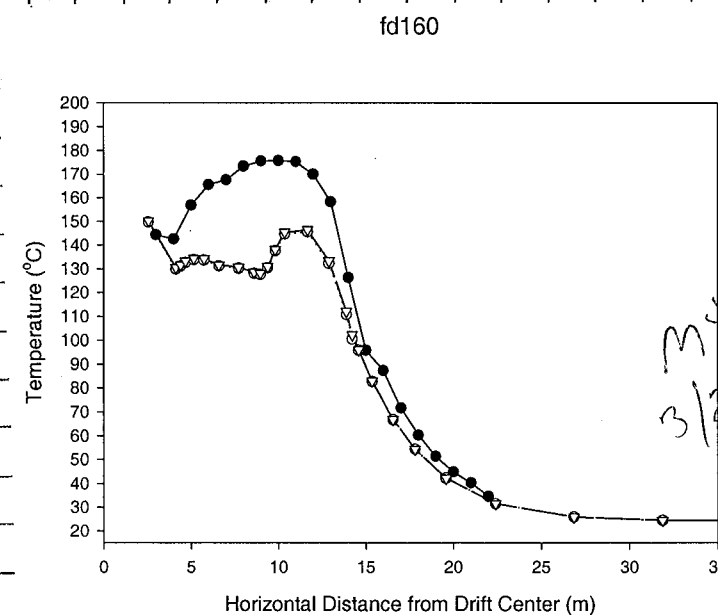
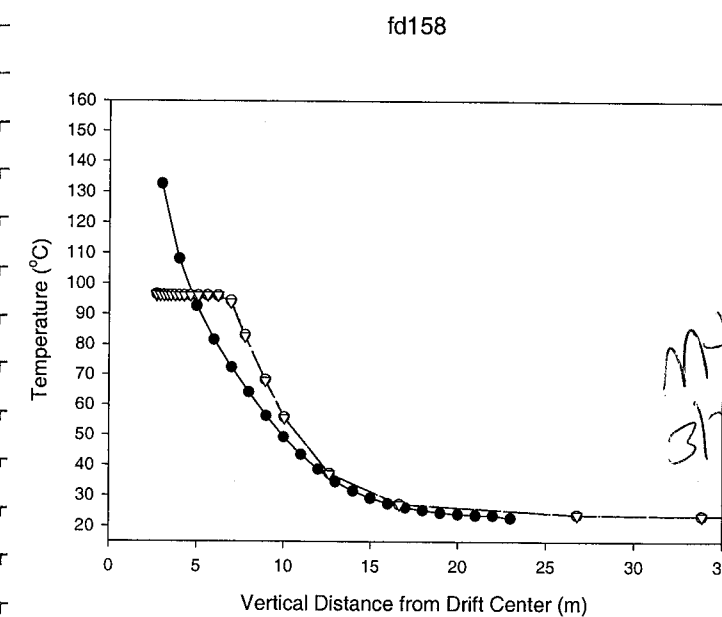
Date _____

Invented by _____

Date _____

Recorded by _____

From Page No. _____



To Page No. _____

Witnessed & Understood by me, _____

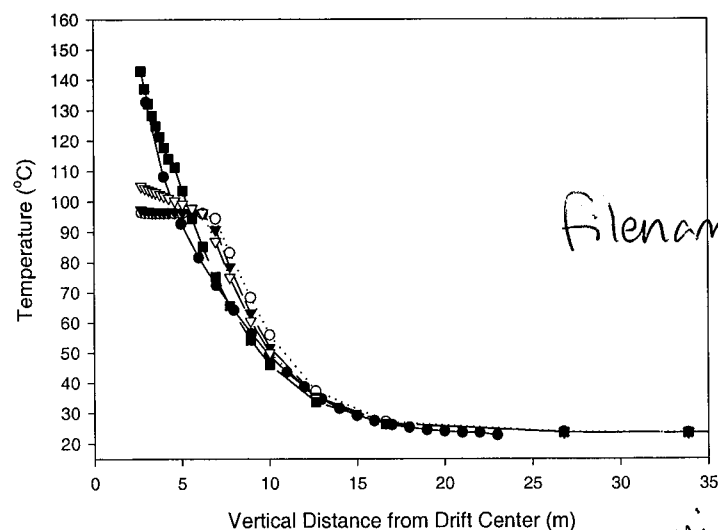
Date _____

Invented by _____

Date _____

Recorded by _____

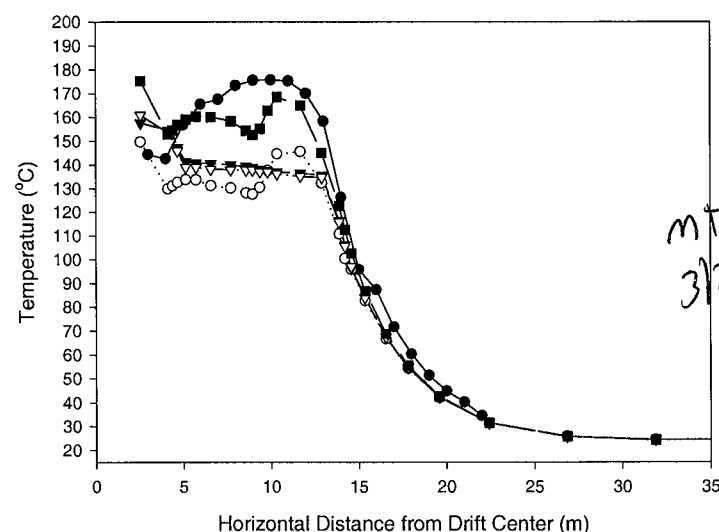
From Page No. _____



filename: 4frac.jnb

mt
3/20/01

4frac160

mt
3/20/01

To Page No. _____

Witnessed & Understood by me, _____

Date _____

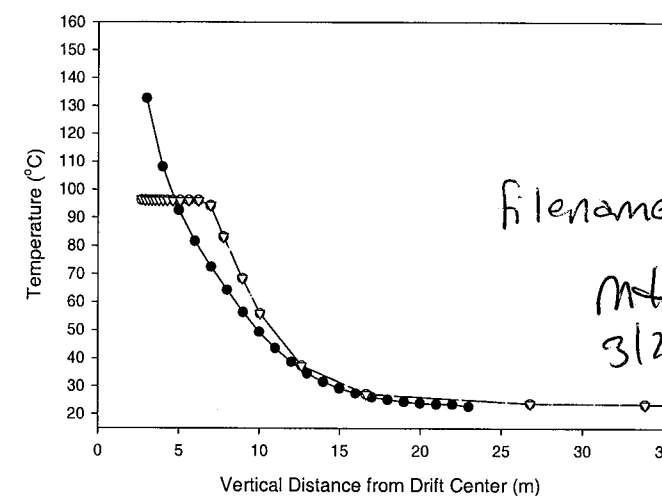
Invented by _____

Date _____

Recorded by _____

From Page No. _____

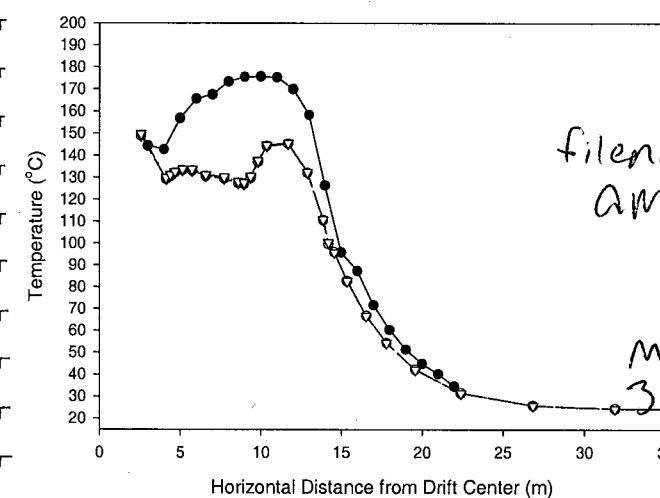
measured, r13bfrac, r13bmat, rdt13bmatrix



filename: am.jnb

mt
3/20/01

measured, r13bfrac, r13bmat, rdt13bmatrix

filename:
am160.jnbmt
3/20/01

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

mt
3/20/01

From Page No. _____

Note: files on p 60-63 of this notebook saved on zip disk labeled: Deindex I-IV. Zip disks are stored in fire-proof cabinet in bldg 51.

MH 3/20/01

5/23/01 Provided the following files by R. Green:

- rdt22f1df1.plt xyp MH 5/23/01
- ~~rdt22m~~ MH 5/23/01
- rdt22f1dml.plt xyp 5/23/01

160

Plotf rdt22f1df1.xyp
 Plotf.dat \Rightarrow r22f.xyp
 vertprof plotf.dat
 vertprof plotf.dat MH 5/23/01
 vertprof.dat \Rightarrow r22fv.dat

158

Plotf rdt22f1dml.xyp
 Plotf.dat \Rightarrow r22m.xyp
 vertprof plotf.dat
 vertprof.dat \Rightarrow r22mv.dat

158

Plotf rdt22f1df1.xyp
 Plotf.dat \Rightarrow r22ff.dat
 vertprof plotf.dat
 vertprof.dat \Rightarrow r22ffv.dat

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

From Page No. _____

160

Plotf rdt22f1dml.xyp
 Plotf.dat \Rightarrow r22mm.xyp
 vertprof plotf.dat
 vertprof.dat \Rightarrow r22mmv.dat

M. W. 5/23/01

7/5/01

Provided the following files by R. Green:

later "L"
 not #1 \rightarrow

- 1b1k2f1df1.xyp
- 1b1k2f1dml.xyp
- 1b1k MH 7/5/01

MH 7/5/01

158 160

Plotf 1b1k2f1df1.xyp
 Plotf.dat \Rightarrow p1b1k2.dat
 vertprof plotf.dat
 vertprof.dat \Rightarrow v1b1k2.dat

158

Plotf 1b1k2f1df1.xyp
 Plotf.dat \Rightarrow pf1b1k2.dat
 vertprof plotf.dat
 vertprof.dat \Rightarrow v2b1k2.dat

158

Plotf 1b1k2f1dml.xyp
 Plotf.dat \Rightarrow pm1b1k2.dat
 vertprof plotf.dat
 vertprof.dat \Rightarrow mm1b1k2.dat

To Page No. _____

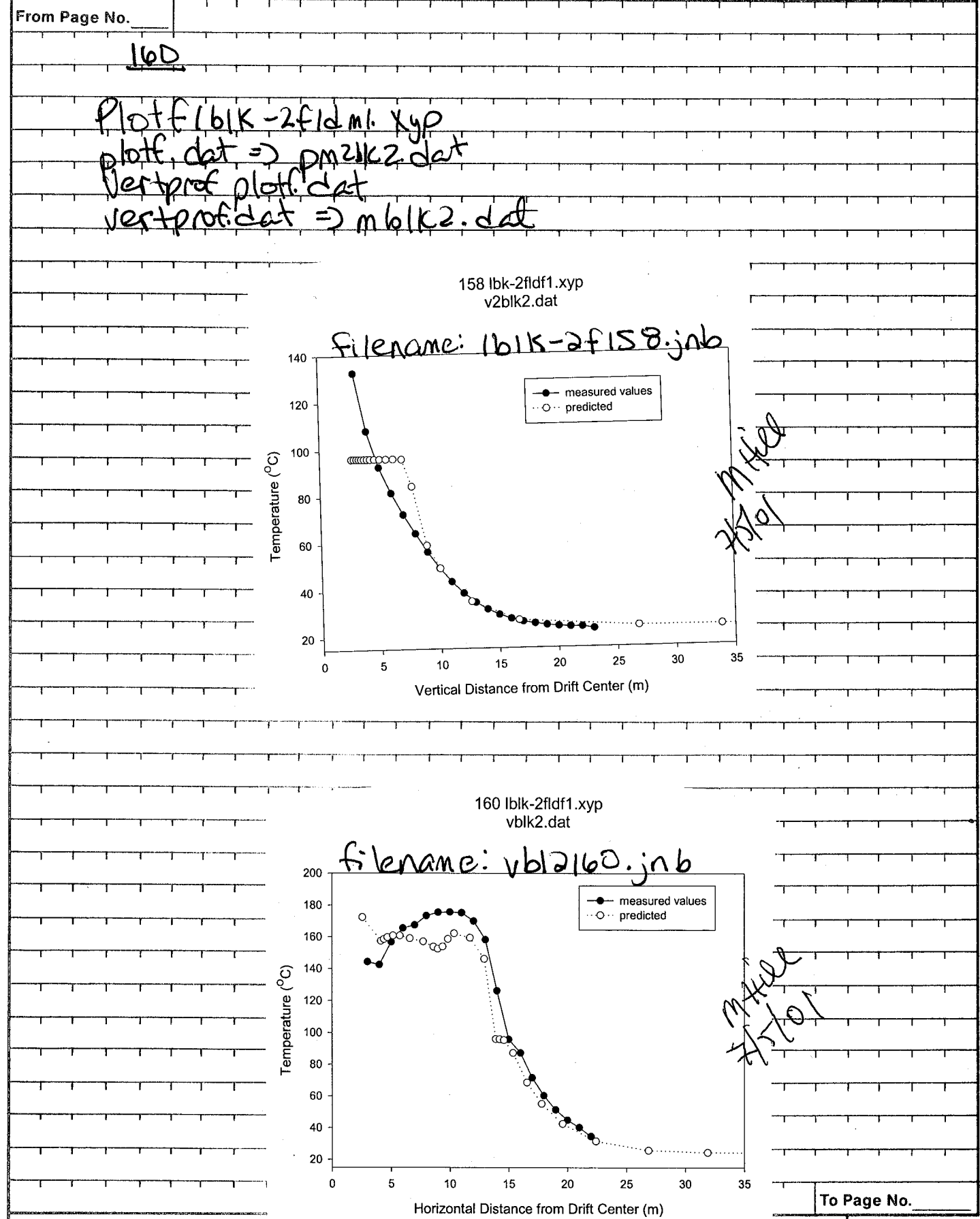
Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

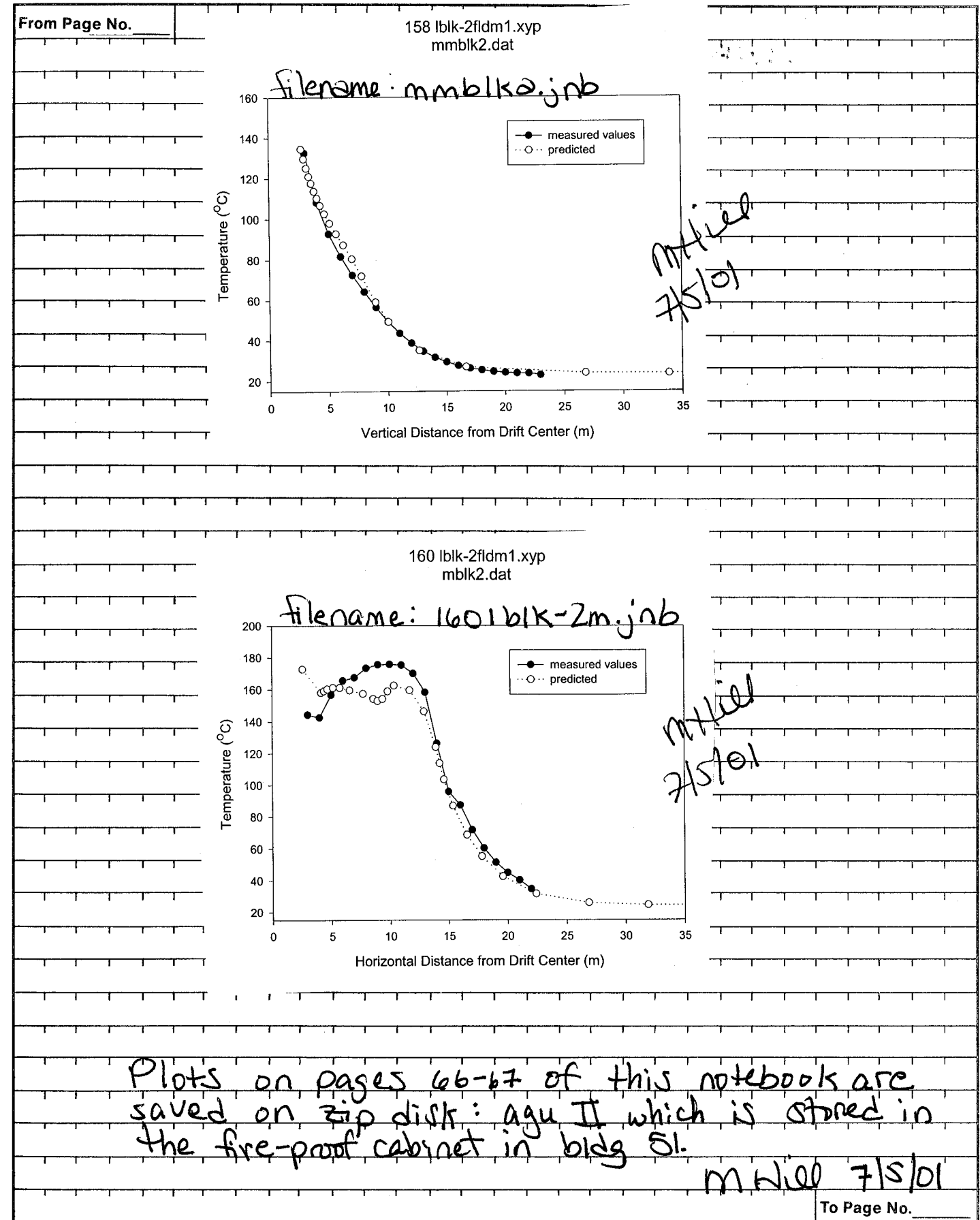
Recorded by _____



Witnessed & Understood by me, _____ Date _____

Invented by _____ Date _____

Recorded by _____



Plots on pages 66-67 of this notebook are saved on zip disk: agu II which is stored in the fire-proof cabinet in bldg 51.

M. Hill 7/5/01

Witnessed & Understood by me, _____ Date _____

Invented by _____ Date _____

Recorded by _____



From Page No. _____

FINAL ENTRY!

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

E.C. [Signature] 4/2/2002

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____