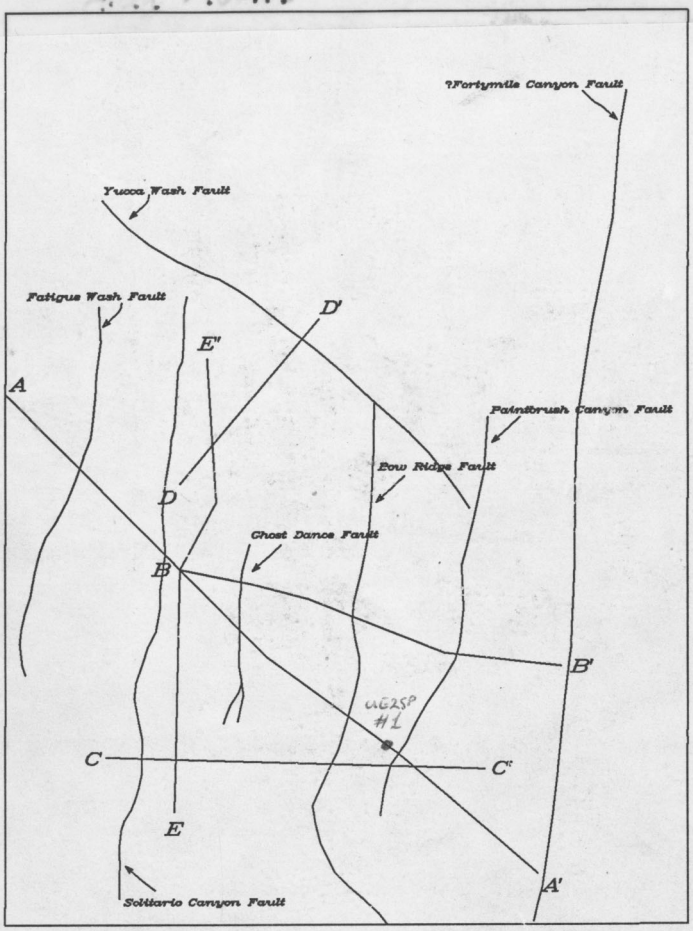

Scientific notebooks numbers 33, 54, and 154 form a continuous record of work done in the Tectonics Processes in the Central Basin and Range Research Project and the SDS KTI. The work record in these notebooks was performed between November 1991 and May 1996 principally by consultant Alan Paul Morris under the supervision of Steve Young (1992-1995) and David Ferrill (1995-1996).

The work has been completed in these books and they are archived effective 4/18/97.

I have reviewed these scientific notebooks, 33, 54, and 154 and find them in general compliance with QAP-001, however, the technical information is present in varying degrees of quantity and quality so that another qualified individual (structural geologist) may be able to repeat the some activities more easily others.

H. Lawrence McKague
4/18/97

SHAW'S
PIONEERS SINCE 1831

CNWRA
Washington DC
Speed call - 298

account book S149

Available in 150 and 300 pages

Alan Morris

Yucca Project
Log Book
Nov. '91 → Aug. '92

CNWRA
CONTROLLED
COPY 33

Pages 1 through 160 of this Scientific Notebook were reviewed for compliance with QAP-001 in response to Corrective Action Request 94-02. Corrections and clarifications were made as appropriate. In some cases, the date of a change will reflect the date of this review rather than the date of the original Scientific Notebook entry.

Randy Fedor
SwRI - QA
12/02/94

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CHECKED + SIGNED

BY ALAN MORRIS

OCTOBER - NOVEMBER

1994

Alan Morris

NOVEMBER 1991

Data sources:
(1) Seismic reflection line AV1 - USGS Amargosa Valley, Nye County, Nevada

(2) Maps- USGS open file report 84-494 Sheet 1 - Scott + Bonk 1984 + Misc. Investigations series USGS Map I-2046

(3) Seismic refraction lines (Ackermann et al., Geologic and Hydrologic Investigations, Yucca Mountain, Nevada, p.23-33)

(4) Scott and Bonk - USGS

Key decisions/assumptions
Footwall cutoffs of key horizons, 2

Depth to detachment, 3

Deformation mechanism's of hangingwall

Fault orientations 2, 4

Presence of 40-mile Canyon Fault, 1

Alan Morris

Scie
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und
199

The
4/1

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is p
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easi

Nov/Dec 1991

Plot of upper part of B+A

Section B+A

→ 40 ml. conjugate Fault + Pairbrook Canyon Fault

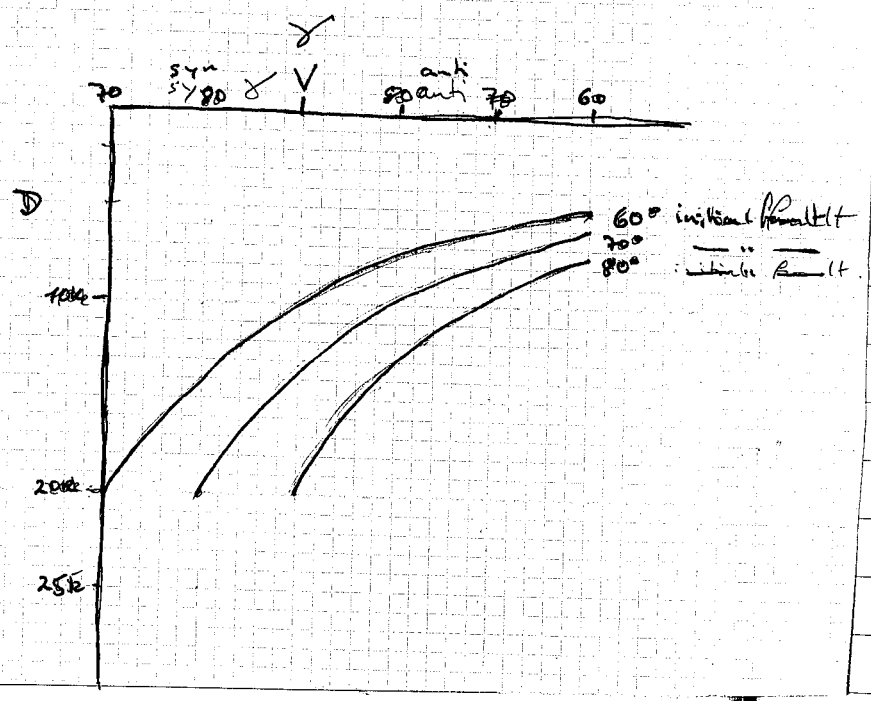
Model these on the basis of:

+ highest + closest fwo c.o.s

+ shear angle

+ Slip

+ Fault angle



xinitosh

/home/geosec/home/

Yucca Project

Section Catalogue

YuccaB-1.db - Bob's B section

swri-1.db - original compilation

swri-master.db - cleaned up compilation

2.db - start work

yucca-c-fw.db - old forward modelling of C

swri-master2.db - contains all new + old info.

Karl Mon

YuccaB-1 - Bob's BB' section

ab-don-cherg - Plots for Don Cherg

modified-heave - construction for modified heave

swri-1 - original compilation of well + section data

swri-ab-combined - AA'+BB' combined

swri-apm-modelling-1. - forward modelling / fault-prediction start

——— ——— 2 - ——— " ——— continued

swri-gls-1990-interp-ab-c-ab - Boulder interpretation of AA' BB' CC' + (A+B)

swri-master - cleaned up compilation - all data

swri-master2 - starting work on clean compilation (includes upp data)

yucca-a-really plotready - Boulder interpretation of AA'

yucca-c-fw - old forward modelling / fault prediction CC'

yucca-c-plotready - Boulder interpretation of CC'

yucca-c1 - ——— " ——— 's of CC'

yucca-c2 - ——— " ———

swri-apm-modelling-40mile-plot - section w/ forward modelling of 40 mile Canyon fault

swri-base-mtn-modelling - just what it says using AA'+BB' spliced

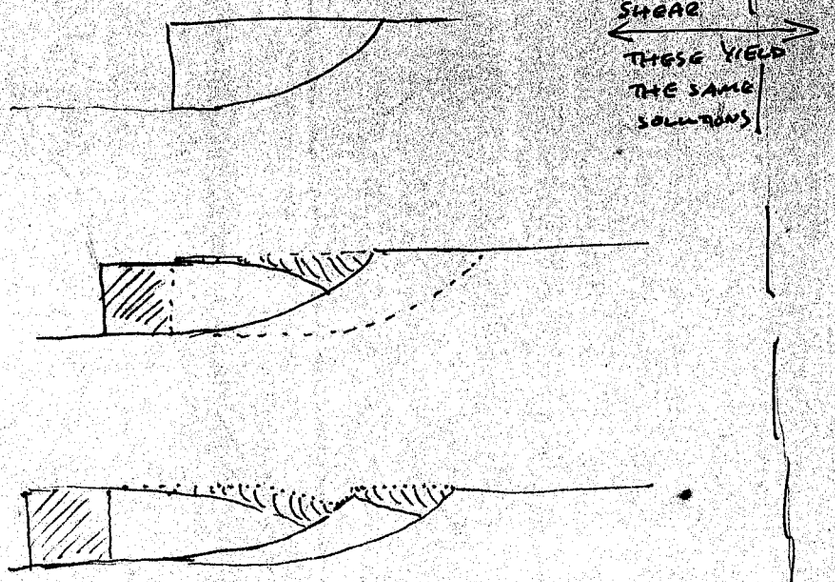
4 Mark Maes

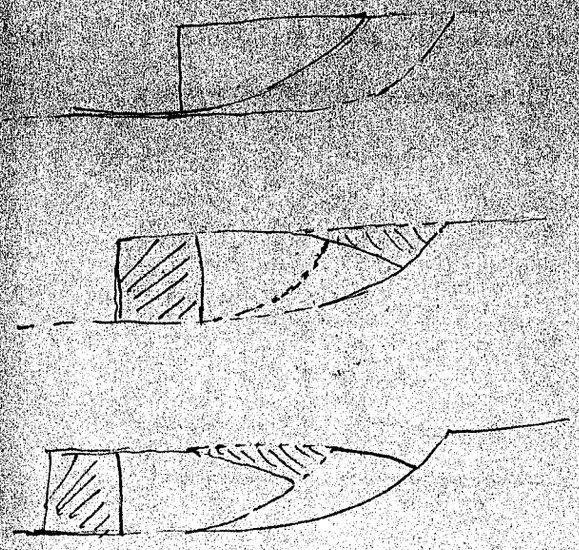
12 Dec 1991

FW break

FOR VERTICAL SHEAR THESE YIELD THE SAME SOLUTIONS

HW break



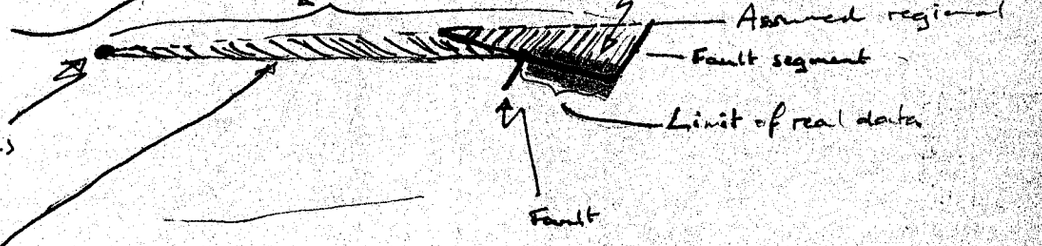


ALSO

Max depth solution

In case of Yucca Mt. this is the limit of data

This must lie above all other hw segments of index horizon



FOR A GIVEN FAULT AND REGIONAL, A MAX + MIN DEPTH TO DETACHMENT CAN BE COMPUTED BASED ON THE ESTIMATED EXTENSION OF THE DEFORMED ROLLOVER GEOMETRY TO THE REGIONAL

also for flexural slip

Alan Morris

APM
COI cleared today

13th. Dec 1991

Modelling on sections AA'/BB' (Scott+Bonk modified by Young et al) combined continues.

Faults to be considered "major" - i.e. reaching some detachment and with "significant" displacement:

WNW					ESE
Fatigue Wash Flt.	Solitario Canyon Flt	Bow Ridge Fault	Midway Valley Flt	Paint Brush Can. Flt	40-Mile Canyon Flt

Each of these six faults will be modelled for trajectory + detachment depth according to:

1. Rollover geometry from original section
2. Fault trace from original section
3. Fault orientation (at or near the surface) varying :- the range 80° 70° 60° WNW dip
4. Higher regional (elevation = 1768 m)
   Lower regional (elevation = 1572 m)
   (These regionals are derived from geological maps of the area and represent our best estimates for the highest possible undeformed regional level of the TPTW (top) (Topopah Springs member, Paintbrush Tuff)
5. Hangingwall deformation mechanism:

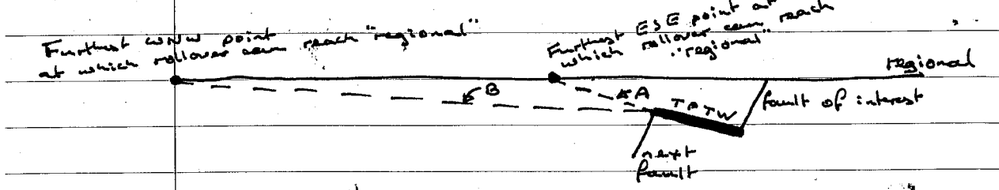
Vert/ Oblique	60°	70°	80°	Vertical	80°	60°
	antithetic shear				synthetic shear	

Also for flexural slip

[contd →]

6. Max depth to detachment
Min depth to detachment

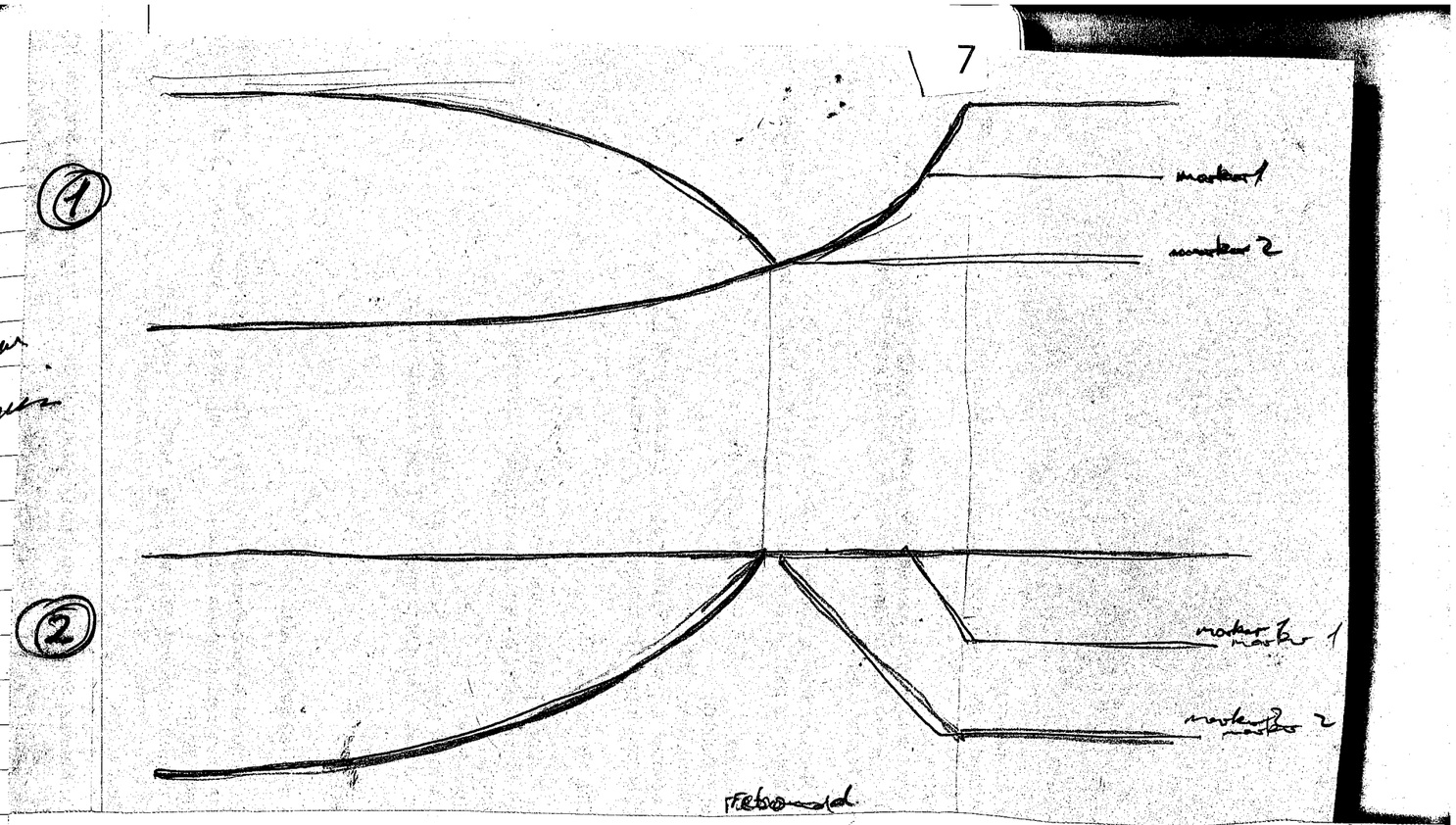
For a given regional, fault, and partial rollover geometry thus:

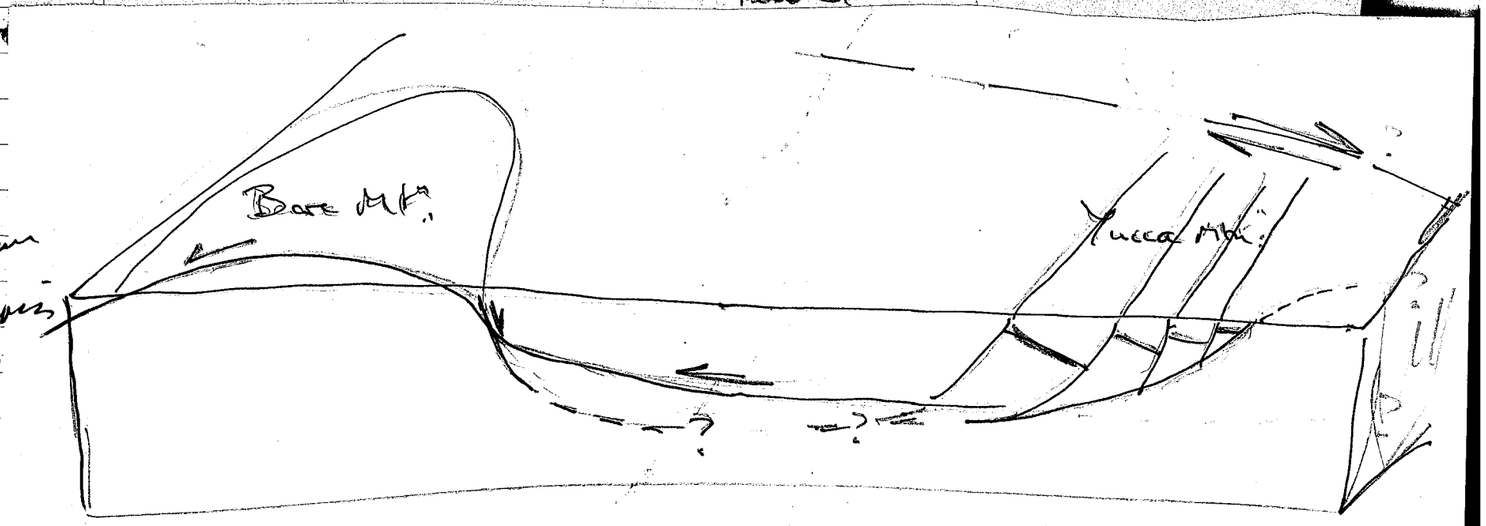


Rollover geometry A gives min. depth to detachment
Rollover geometry B gives max. depth to detachment
(see notes on page 4)

NOTE: TRY THE ISOSTATIC MODIFICATION OF FAULTS. ALSO INCORPORATE BARE MT. FAULT (page 7)

ALSO: TO MAKE THE BEAM-BENDING ARGUMENT WE PROBABLY NEED TO FIND A FLEX-SLIP SOLUTION - PREFERABLY ONE THAT IS CLOSE TO A SHEAR SOLUTION?!





16th. Dec 1991

Plots for Don Cheng arrived.

(page 9)

Alan Morris

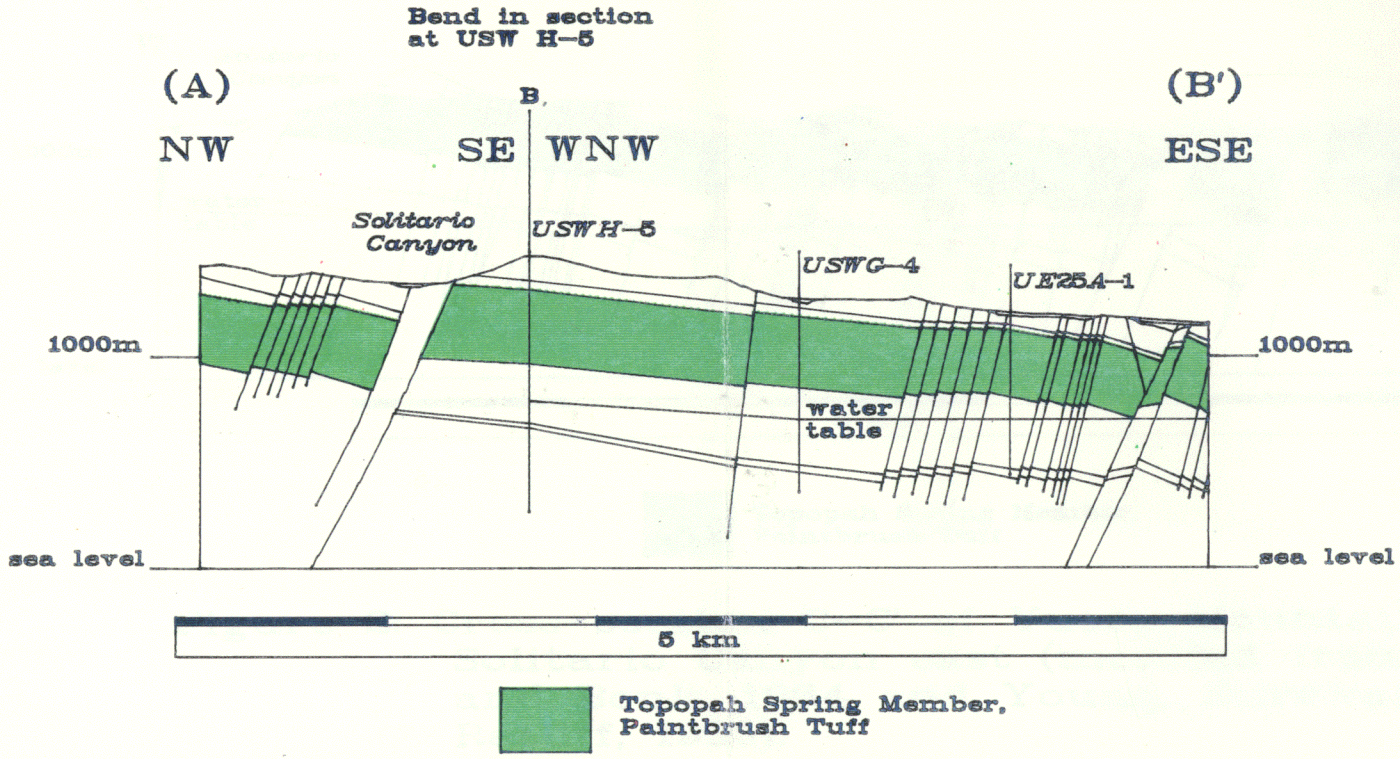


Figure 1: Composite cross-section A-A' and B-B' of Yucca Mountain from Solitario Canyon east (modified from Scott and Bonk, 1984 and Young, Stirewalt and Ratliff, 1990)

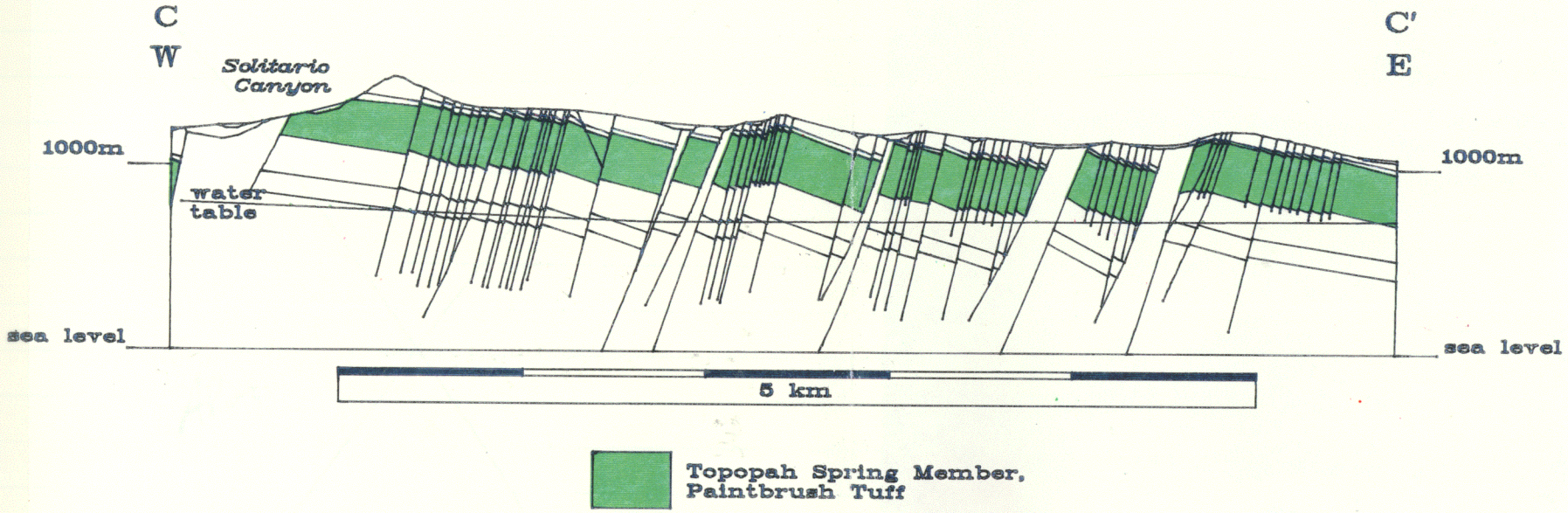


Figure 2: Cross-section C–C′ of Yucca Mountain from Solitario Canyon east (modifed from Scott and Bonk, 1984 and Young, Stirewalt and Ratliff, 1990).

Alan Hanna

17th. Dec 1991

Add fault dip = 66° to dip spectrum

ANALOGUE MODELLING OF "CHAOS" IN FAULTS

+ GELATIN ?

+ SANDBOX ?

MEASURE : DISPLACEMENT

SEQUENCE CHRONOLOGY

{ SPACING
{ DENSITY

ORIENTATION

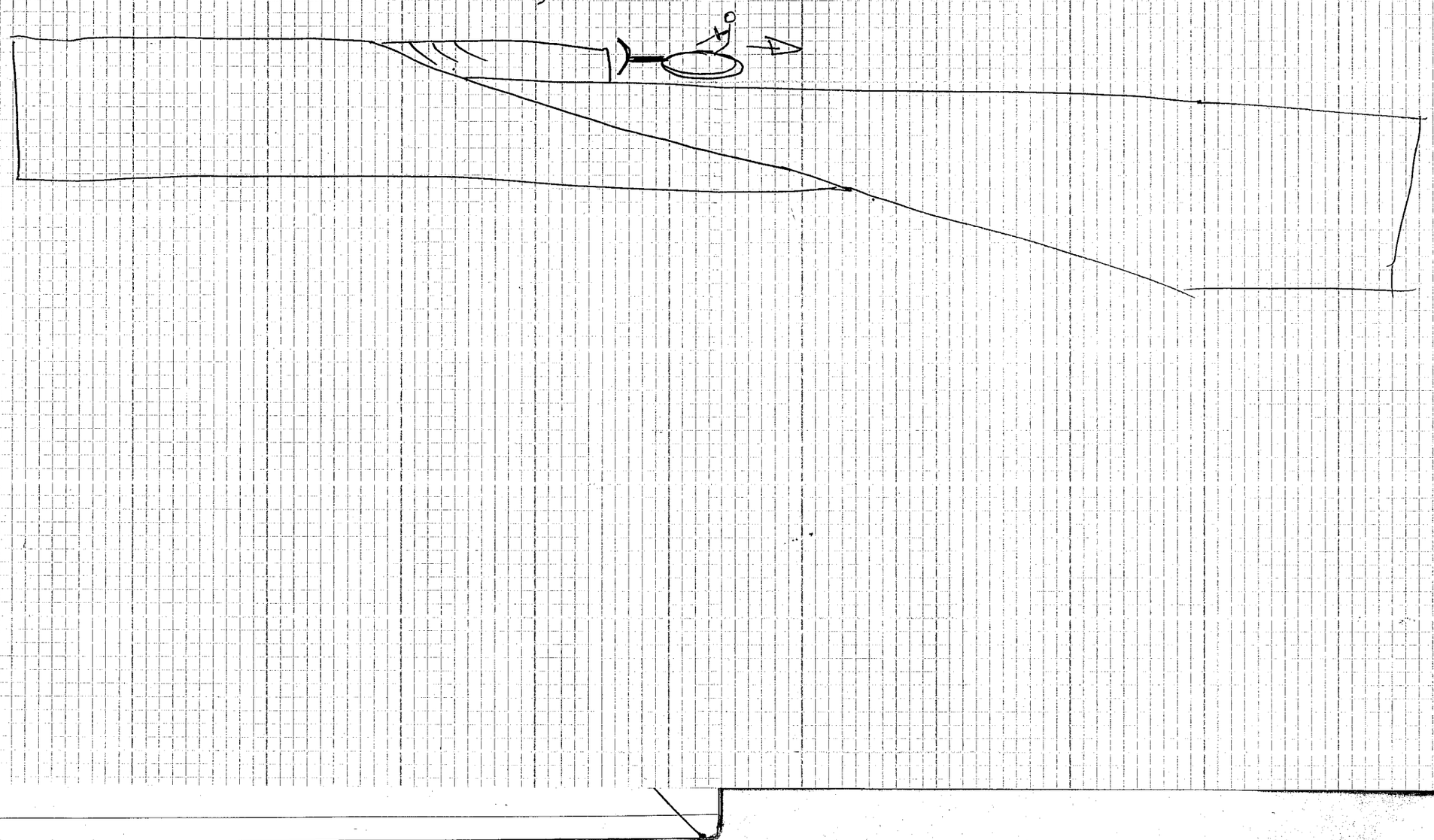
LENGTH.

AHM

Main Mass

+ CHAOS IN FAULTS

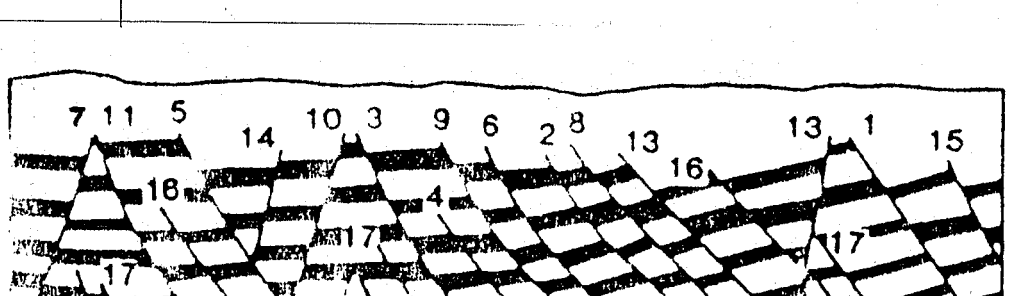
Displacement
Sequence
Spacing
Density
Orientation



(--- 17 Dec 1991)

Playing w/ McClay + Ellis 1987 data.
--- not enough data.

Page 13 →



C 35% EXTENSION

2 CM

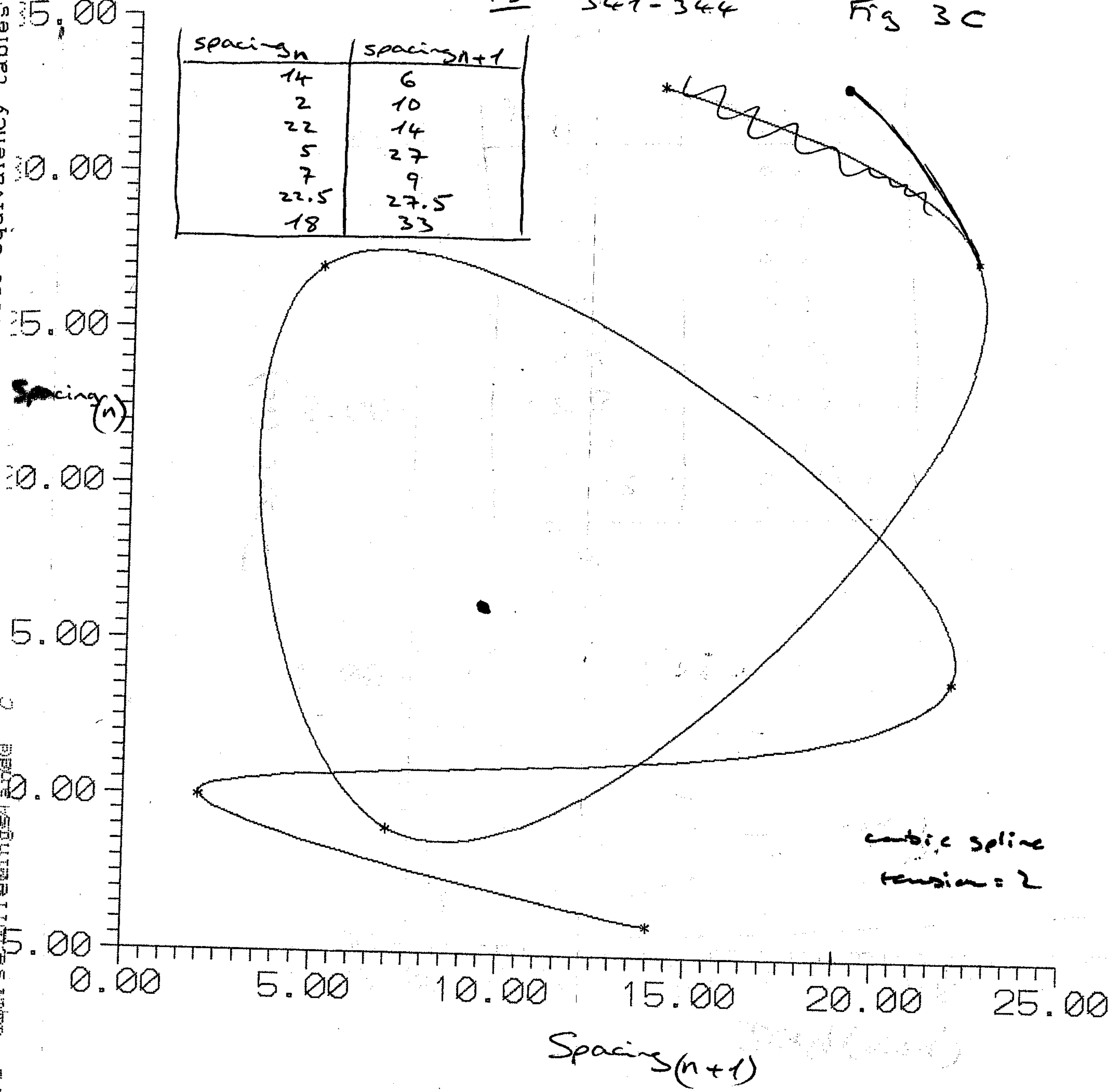
Alan Mac

McClay + Ellis 1987

GEOLOGY 15 341-344

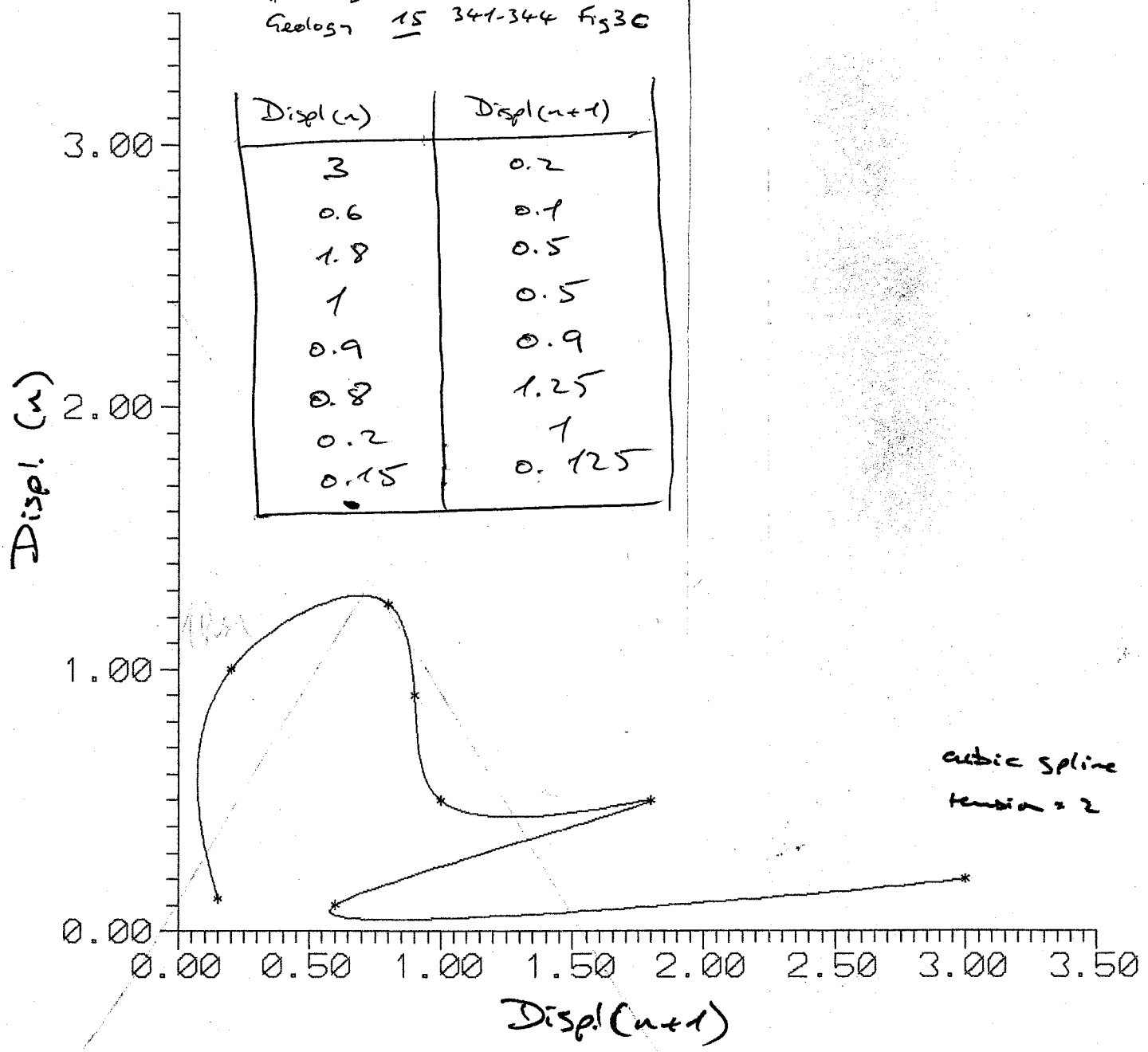
Fig 3C

spacing n	spacing n+1
14	6
2	10
22	14
5	27
7	9
22.5	27.5
18	33



McClay + Ellis 1987
Geology 15 341-344 Fig 3c

Displ (n)	Displ (n+1)
3	0.2
0.6	0.1
1.8	0.5
1	0.5
0.9	0.9
0.8	1.25
0.2	1
0.15	0.125



19 Dec 1991

Thumbnail sketch for depth to detachment:

(1) 40 mile rollover

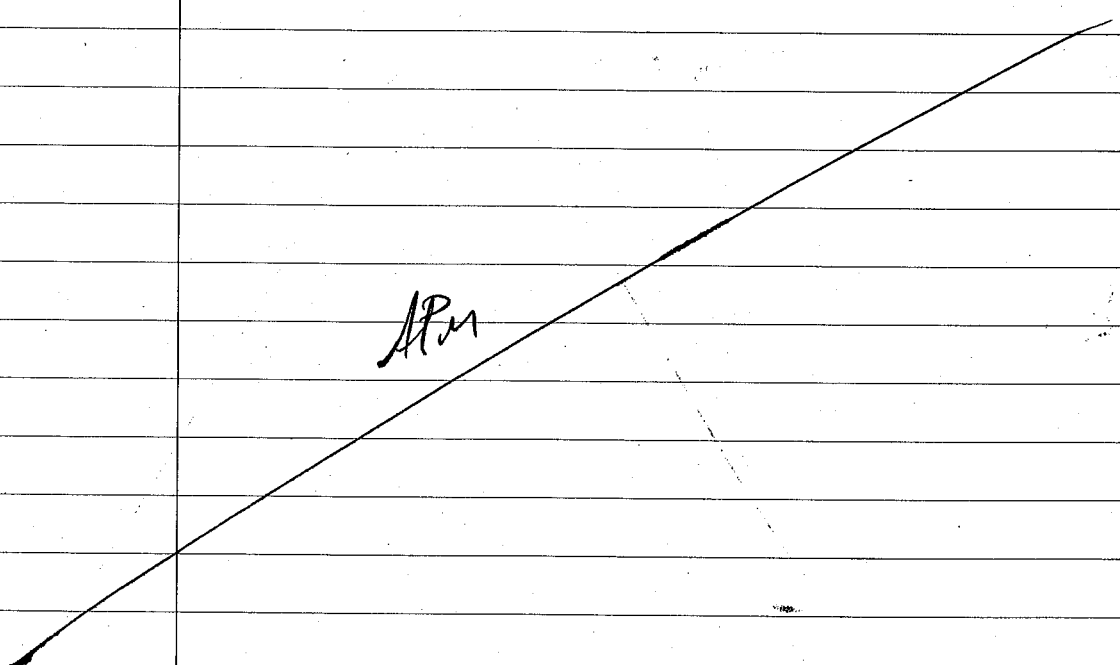
(2) PB Canyon rollover (smoothed)

(3) Vertical shear

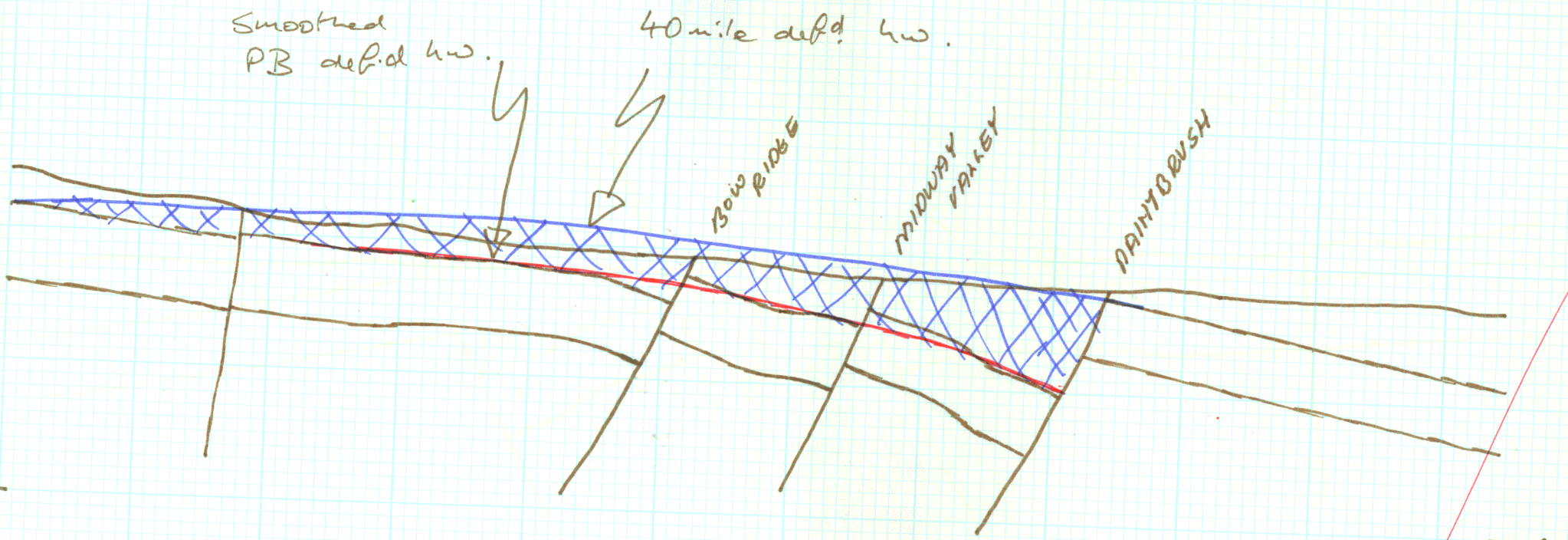
↳ depth to detachment from surface = ~5km.

p. 15

Possible models ~~[illegible]~~ incorporating Baca Mt. → pages 17 + 18

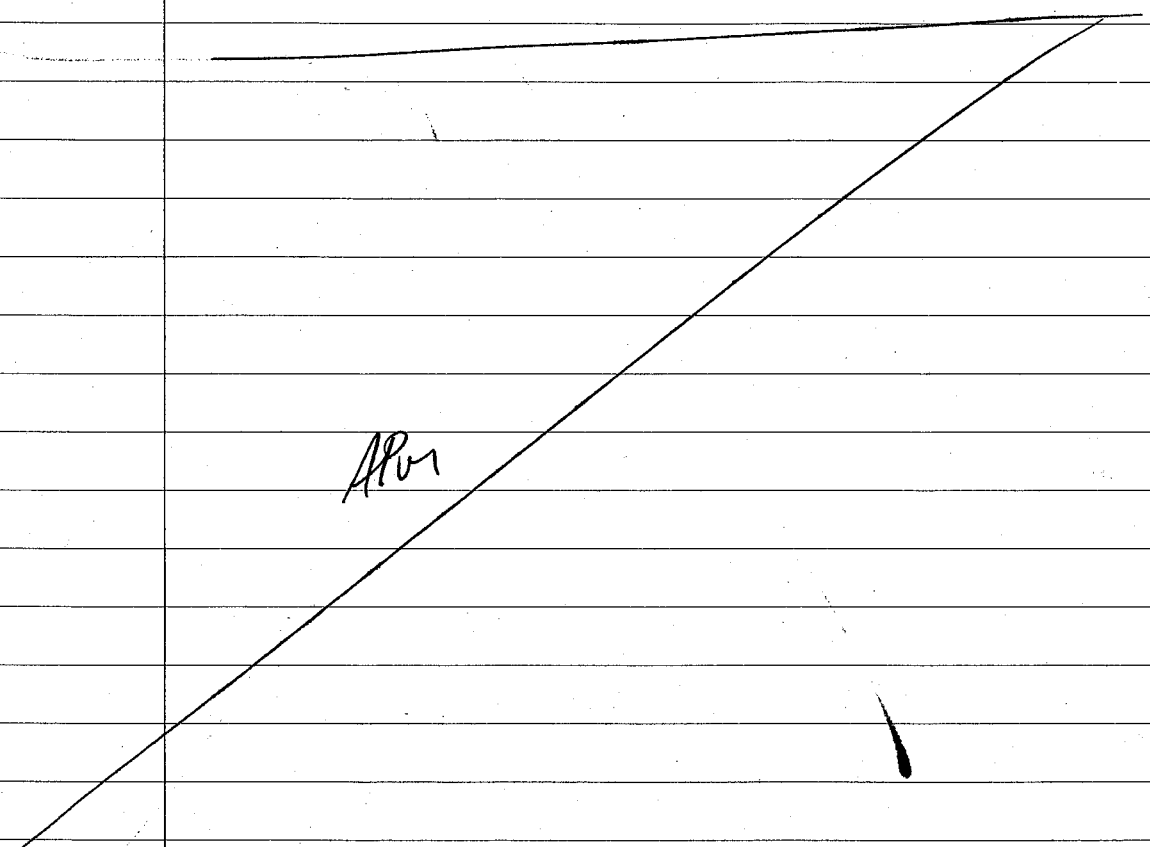


19 Dec 1991

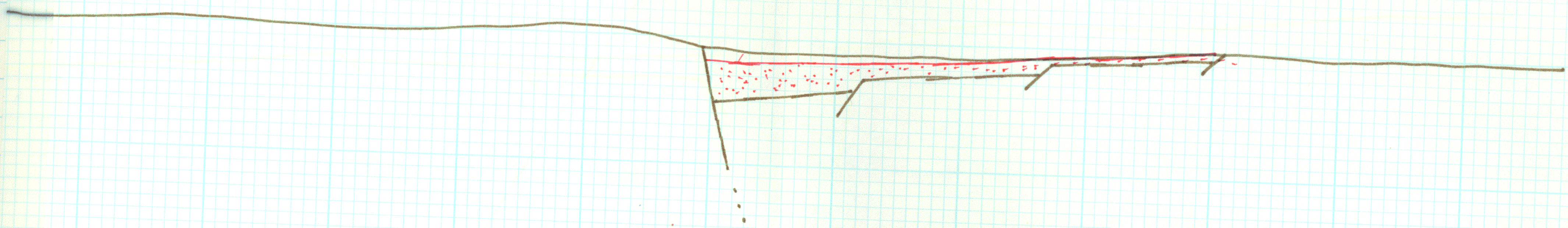


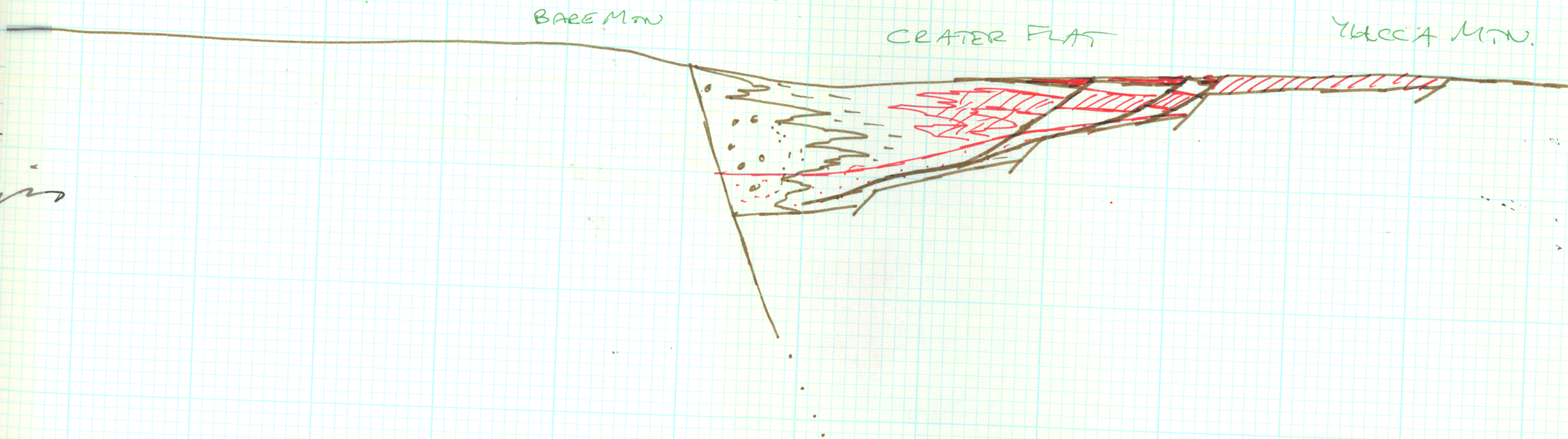
gives depth to detachment from surface of ~ 5 Km.

"GROWTH" MODEL
ON BARE MTN.



18 DEC 1991

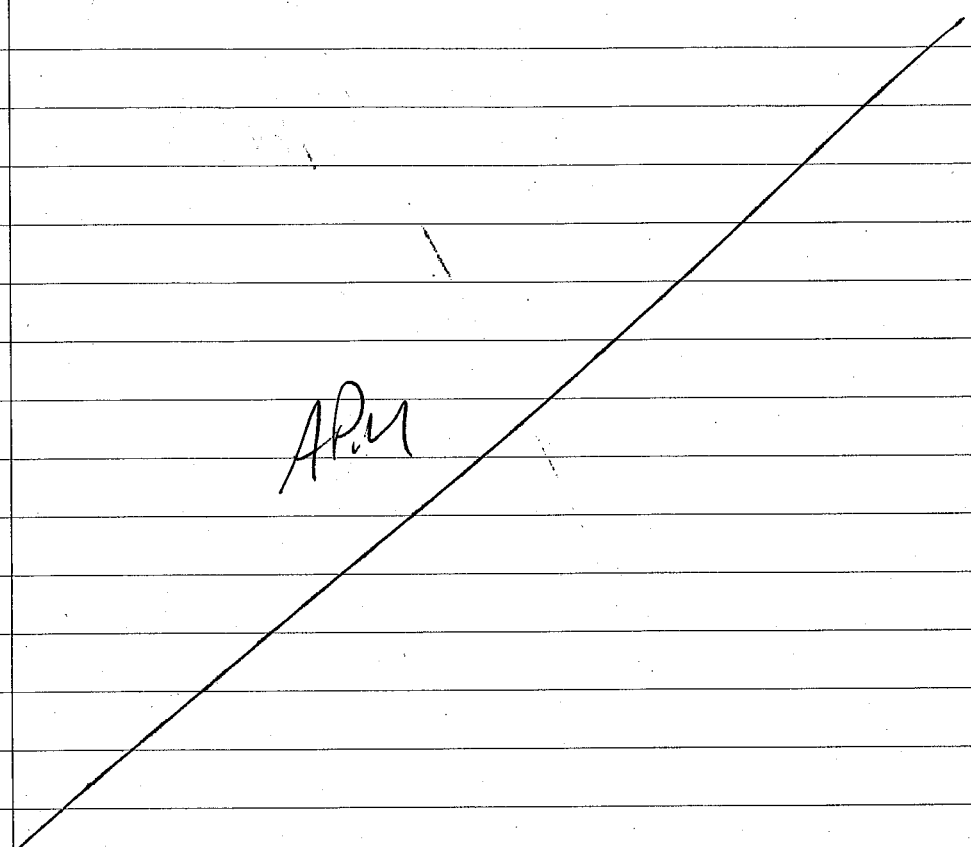




Alan Morris

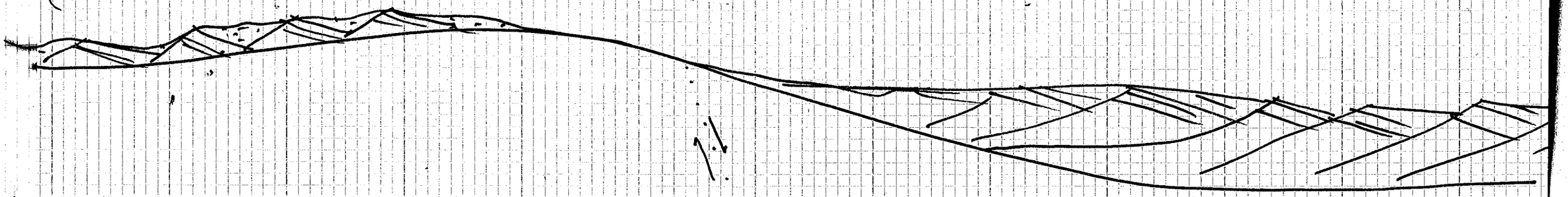
ISOSTATIC REBOUND

UNDER BARE MTN. →

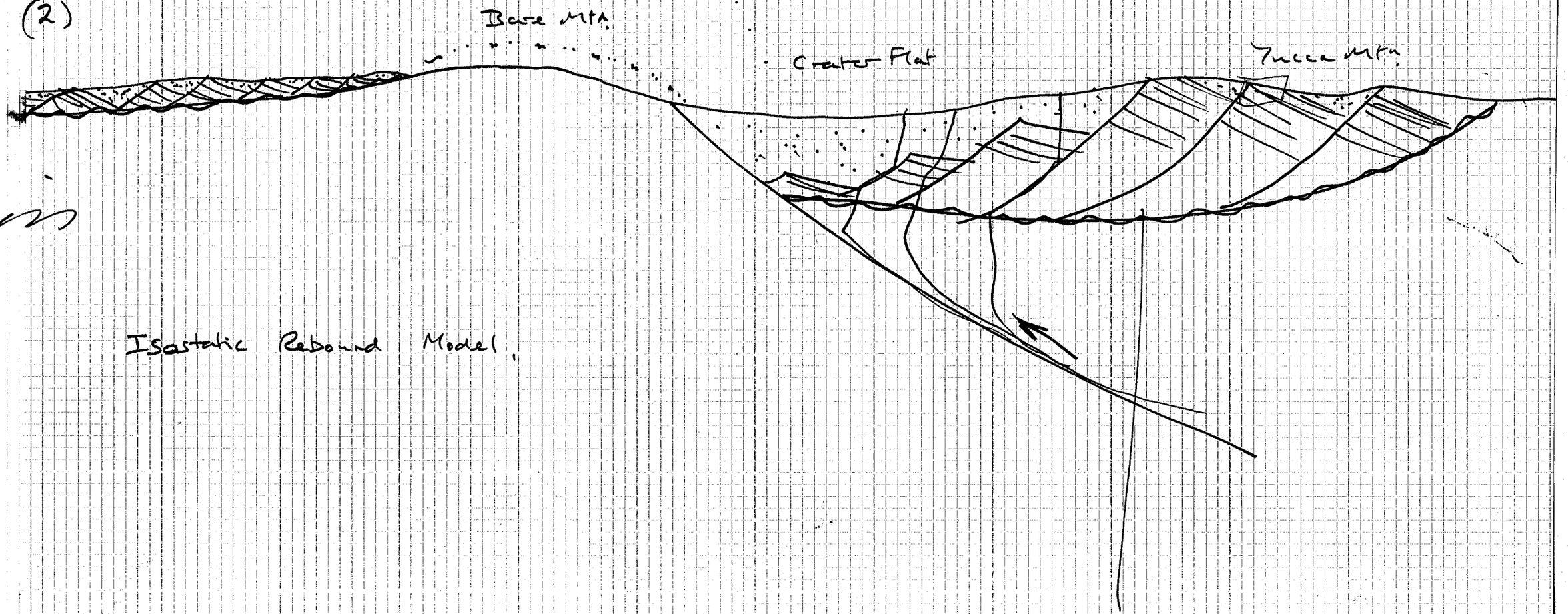


19 Dec 1991

(1)



(2)



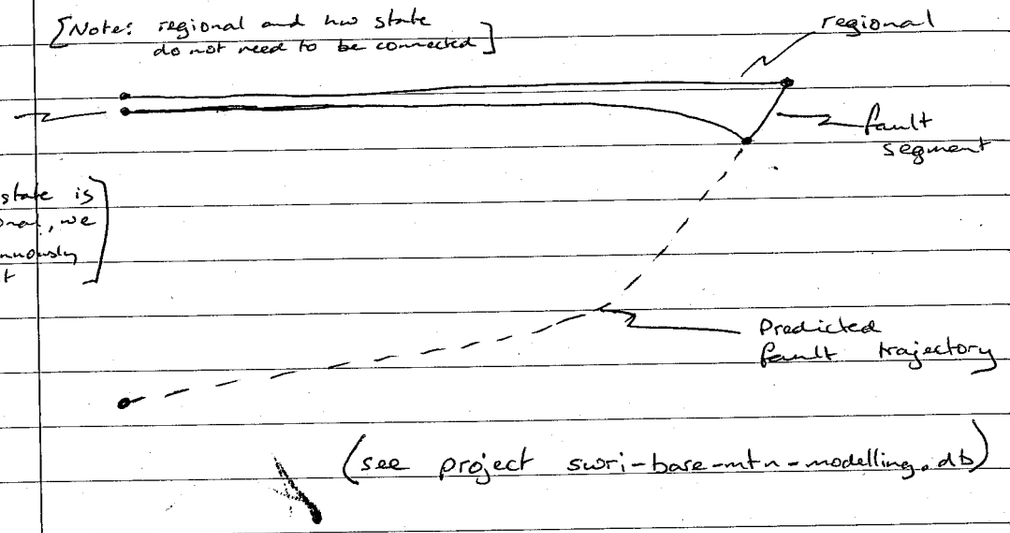
Isostatic Rebound Model

Alan Morris

20th Dec 1991

It is possible in GEOSEC to use fault predict to obtain continuously dipping faults:

[Note: regional and hw state do not need to be connected]



[Note: if hw state is below regional, we get a continuously dipping fault]

(see project swri-base-mtn-modelling.db)

Choices for sections AA' - BB' - CC' tied to EE'

1 Upper Regional
2 Dipping (west) early detachment
3 Vertical shear
4 66° fault dips (Taken from UE25A-1 well data on PB/Yucca Ridge Fm)

Sections to produce: AA', BB' - CC' A+B combined and strike section (EE')

Project names for March 2nd Report

swri-milestone1-A	—	section AA'
—·— -B	—	section BB'
—··— -C	—	section CC'
—·—·— -E	—	section EE'
—·— -AB	—	sections A+B combined

NOTE March 2nd Report must be completed by 17 FEB

PROJECT swri-milestone1-AB.db

section ab-working-1 — start work, higher regional, but problems (see ⊛ page 22)

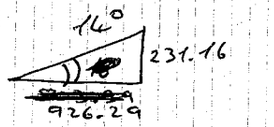
ab-working-2 — continue, intermediate regional (see ⊛⊛ page 22)

Mon Mons

Fault dip = 66°

Throw	Fault	Heave	%
1079.49 (upper reg.)	40 mile.	477.53 (upper reg.)	0.52 ✓
[redacted] 464.30	PBC	[redacted] 229.01	0.[redacted]25 ✓
88.67	Mid Vall	37.55	0.04
139.81	Bow Ridge	54.48	0.06
213.40	Sdit. Cany.	95.73	0.10
71.42	Fatigue crack	[redacted] 31.99	0.03
1791.60	TOTALS	926.29 [redacted]	

Total subsidence of hanging wall must be ≤ 231.16m.



I chose 120m which gives detachment dip of 8°

∴ Max dip of detachment = [redacted] 14°

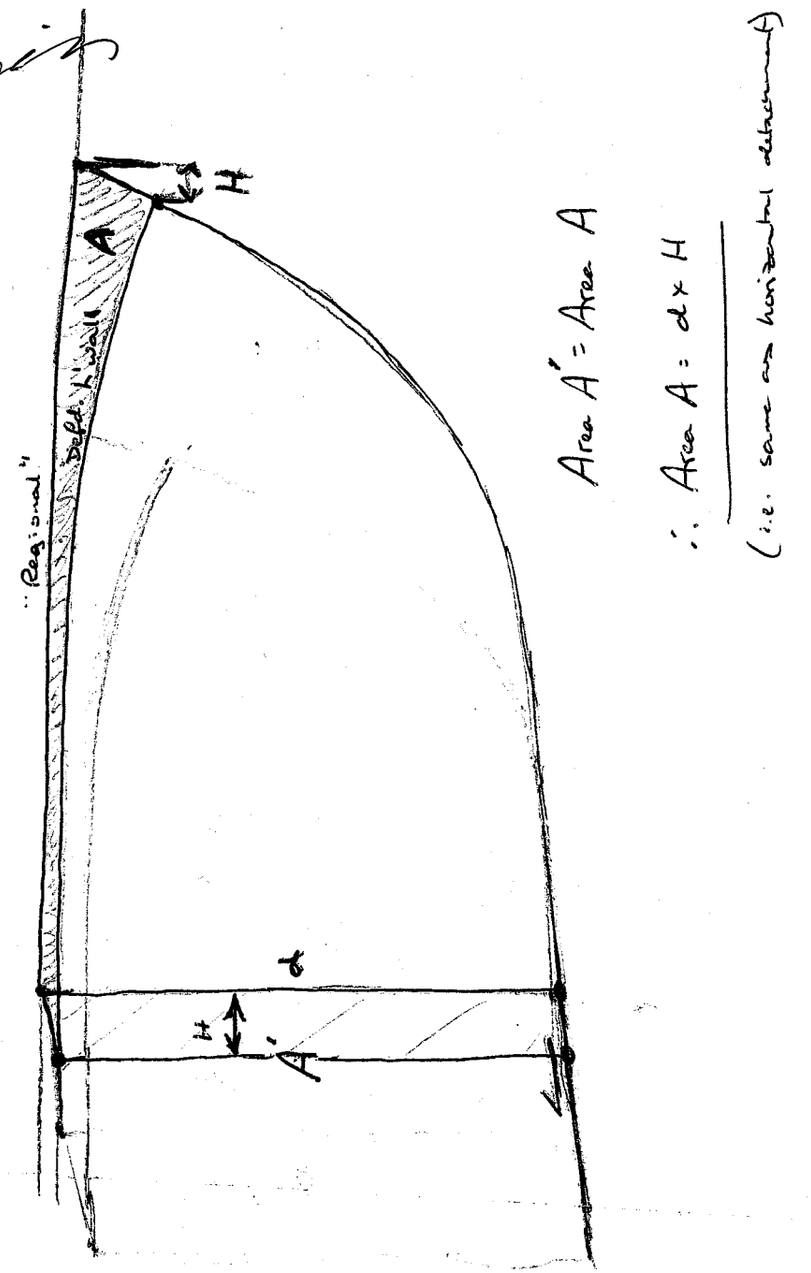
✳ I THINK THE HIGHER REGIONAL IS TOO HIGH, AN THE LOWER REGIONAL IS TOO LOW — I NEED A COMPROMISE.

✳✳ IF I KEEP DETACHMENT DIP TO ~8° AND HONOUR THE LAST DATA POINT AT WEST END OF SECTION, I OBTAIN A REGIONAL AT 1656m

40 Mile Canyon flt

Intermediate Regional { Heave – 428.36m
Throw – 969.02m [redacted]

Mon Mons



Alan Morris

7th Jan 199x

Start - 8:50am
Finish - 5:20pm.
Hours - 8.5hrs.
+2@ HTSA

Work on [swri-milestone-1-AB.db] see section ab-working-2

For modelling parameters see page 20.

Goals:

+ obtain detachment and fault geometries that will match all near-surface data
+ attempt to keep detachment within 10km of surface
+ allow detachment a c/w dip of 8°.

Problems:

+ Fatigue Wash Fault has very small displacement and no interpretative leeway in its cut-offs, this does not allow a detachment deeper than about 5km below surface, which cannot be made compatible with other faults, especially 40 Mile Canyon Fault.
+ 40 Mile Canyon Fault cannot be made to fit a detachment shallower than about 8-8.5km below surface.

Resolution:

+ Decided to ignore Fatigue Wash Fault and incorporate its geometry into the hWall of Solitario Canyon Fault.

+ Then it is possible to fit faults to a single W-dipping detachment. The small fudges necessary to smooth the faults do not significantly alter the forward-modelled geometries obtained from fault-slip fold.

Plots arrived from GLS - very poor - see note from Schuman:

Alan, this section is a disaster. 5 hrs have been spent to figure text ~~font~~ size, scale, moving things around. etc. Hope they are useful! SW.

- Thurs 30 Jan - I worked on Morris section and plotted it with no difficulties!

What's its problem? it really shouldn't be too difficult to figure it out

Alan Morris 8th Jan 1992

Start 9:45am
Finish 5:45pm.
Total 8 hrs
+2 @ UTSA

Working on swri-milestone1-AB.db.

Plotting → Finally got to speak to John Mottershaw (CSD-713 630-3841)

Plotting now makes an HPFile.dat where it is supposed to. The problem was that ".../hpfile-ertis" was a directory not a file.

Will check sending this file to plotter later.

New Project: swri-milestone1-ABsum.db — summary of AB work (section ab-working-2)

Checked with Steve - results in this project look good and can be used as a basis for other sections

Note + section ab-final-1 in project swri-milestone1-ABsum is beginning of cleanup for final presentation.
+ added wells to section (section line on WNW-ESE)

Conceptual models for D+R near Yucca Mtn

Alan Morris

Information potentially subject to copyright protection was redacted from this location. The redacted material (development of a metamorphic core complex) is from the following reference:

Lister, G.S. and G.A. Davis. Figure 20. Journal of Structural Geology. Vol. 11. pp. 65-94. 1989.

Information potentially subject to copyright protection was redacted from this location. The redacted material (interpretation of Cordilleran detachment faults as evolving shear zones) is from the following reference:

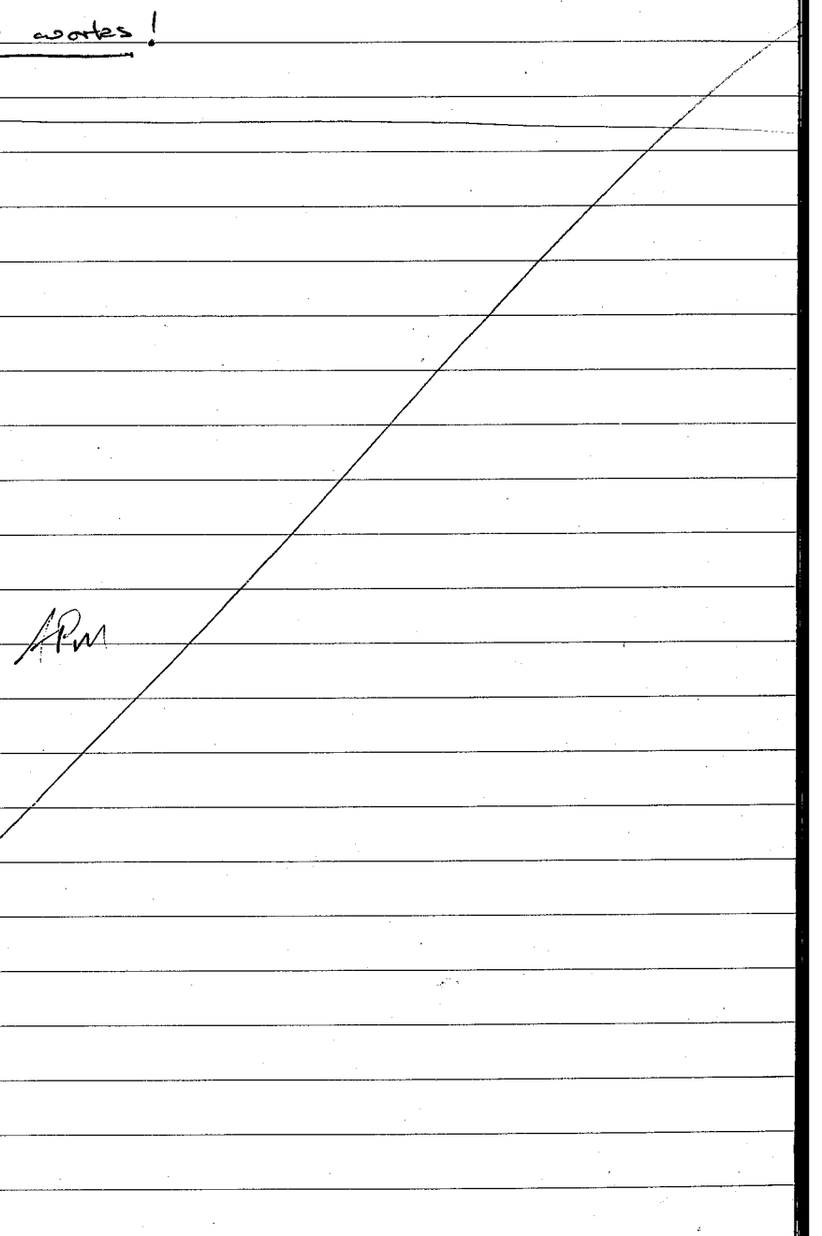
Lister, G.S. and G.A. Davis. Figure 3. GSA Special Paper No. 218 pp. 133-159. 1988.

9th Jan 1992

Start - 8:40am
First - 7:00pm
Total - 11.5hrs
+2 at UTSA

- Which comes first - {extension / melting} ?

Plotting now works!



10 Jan 1992

Start 9:50 am
Finish 6:00 pm
Total :- 8 hrs
+1/2 hr @ WTSA

swri-milestone1-ABsum.db

section ab-final-2 — final revised interpretation of present day

section ab-restored-TPTW — final restoration on top of TPTW - derived from ab-final-2 using vertical shear

swri-milestone1-B.db

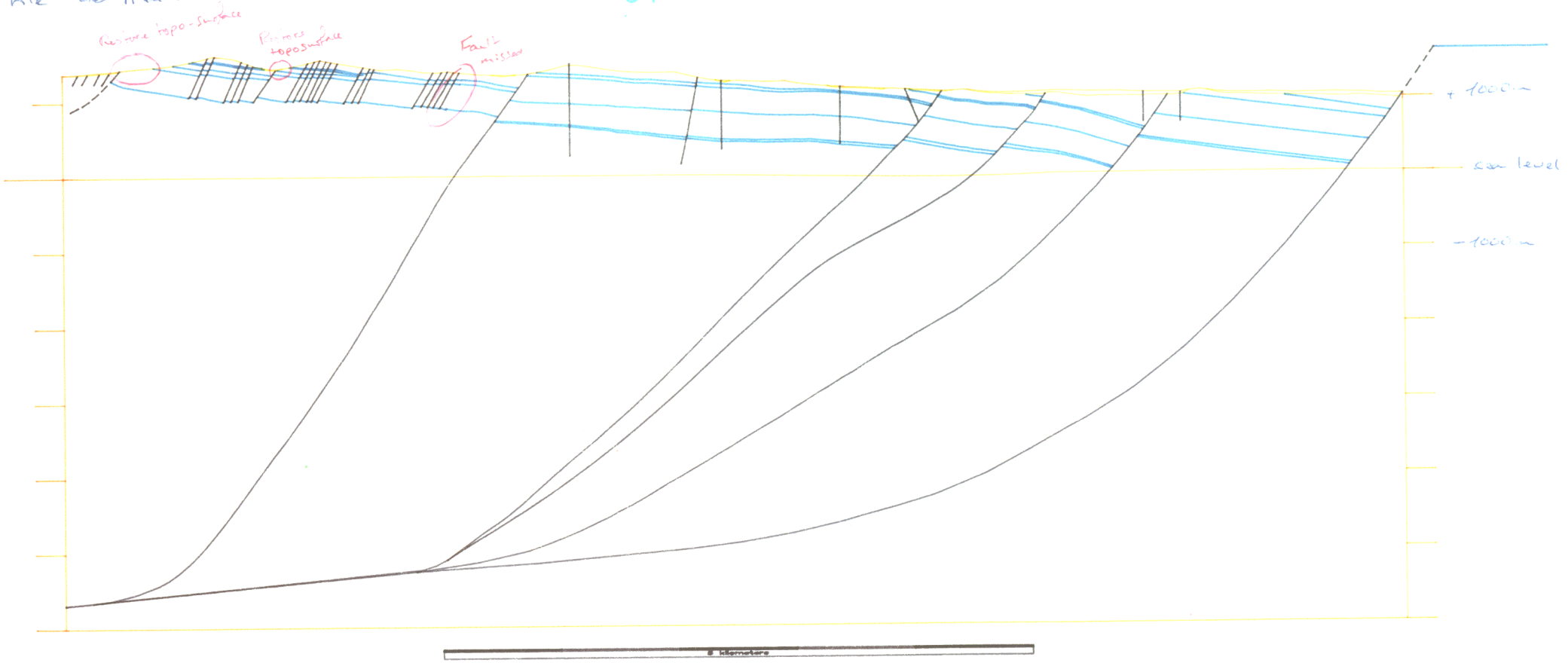
cleaned out but contains:

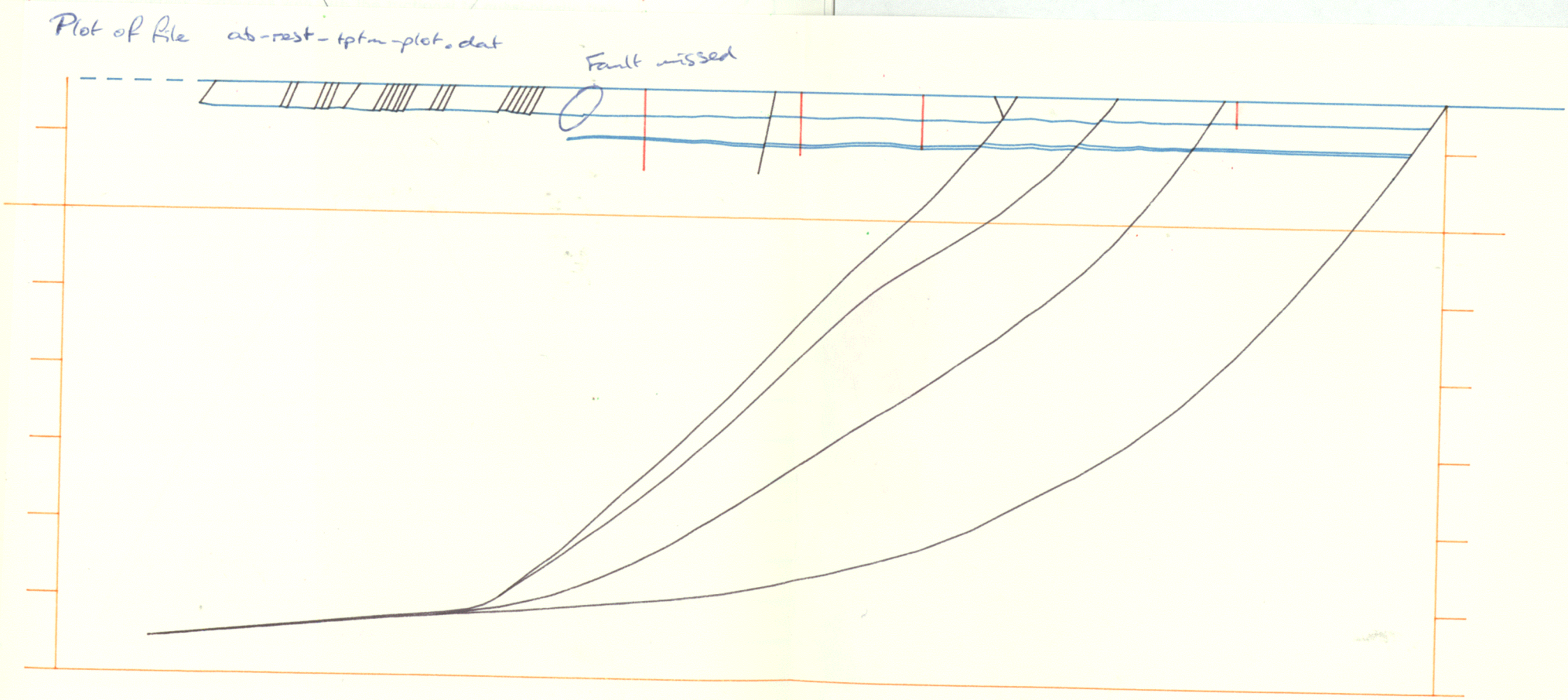
section lines - N-S (plus wells)
WNW-ESE (plus a wells)
map

sections - YuccaB-90defn - Bob's original reinterpretation.
- b-final - derived from the work I did on AB
- b-restored-TPTW - — " —

Note
Check the heaves on AB and B.
heaves checked and correct

Plot of file ab-find-2-plot.dat




Plot of file ab-rest-tptm-plot.dat
Fault missed

14 Jan 1992

Start 8:50am
Finish 6:50 pm
Total, 10 hrs.

Working on swri-milestone 1-B.db

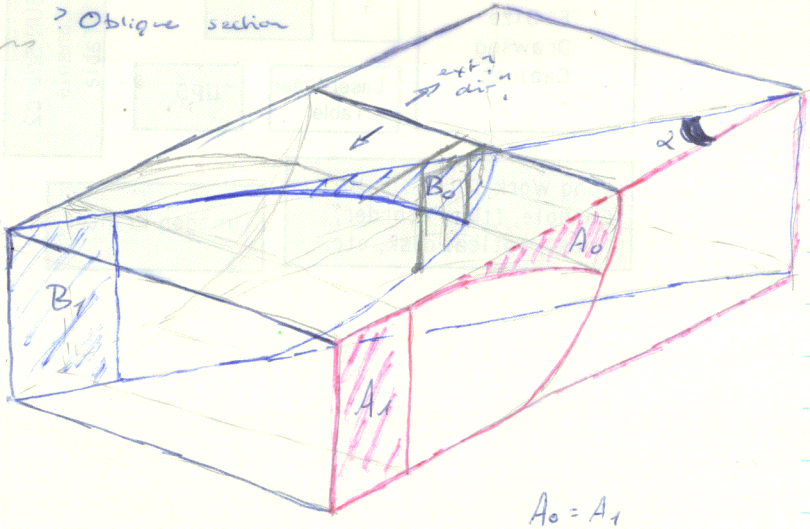
Heaves checked and corrected

Possible support for 7-8 km detachment depths

(page 33)

Alan Maden

> Oblique section



$A_0 = A_1$

but also $B_0 = B_1$?

Bulletin of the Seismological Society of America, Vol. 72, No. 1, pp. 151–163, February 1982

33

FAULT ZONE MODELS, HEAT FLOW, AND THE DEPTH DISTRIBUTION OF EARTHQUAKES IN THE CONTINENTAL CRUST OF THE UNITED STATES

By Richard H. Sibson

ABSTRACT

Information potentially subject to copyright protection was redacted from this location. The redacted material (Figures 1 and 2 of the abstract) is from the reference information listed above.

More support for 7-8 km detachment depths

(p 35)

AFM

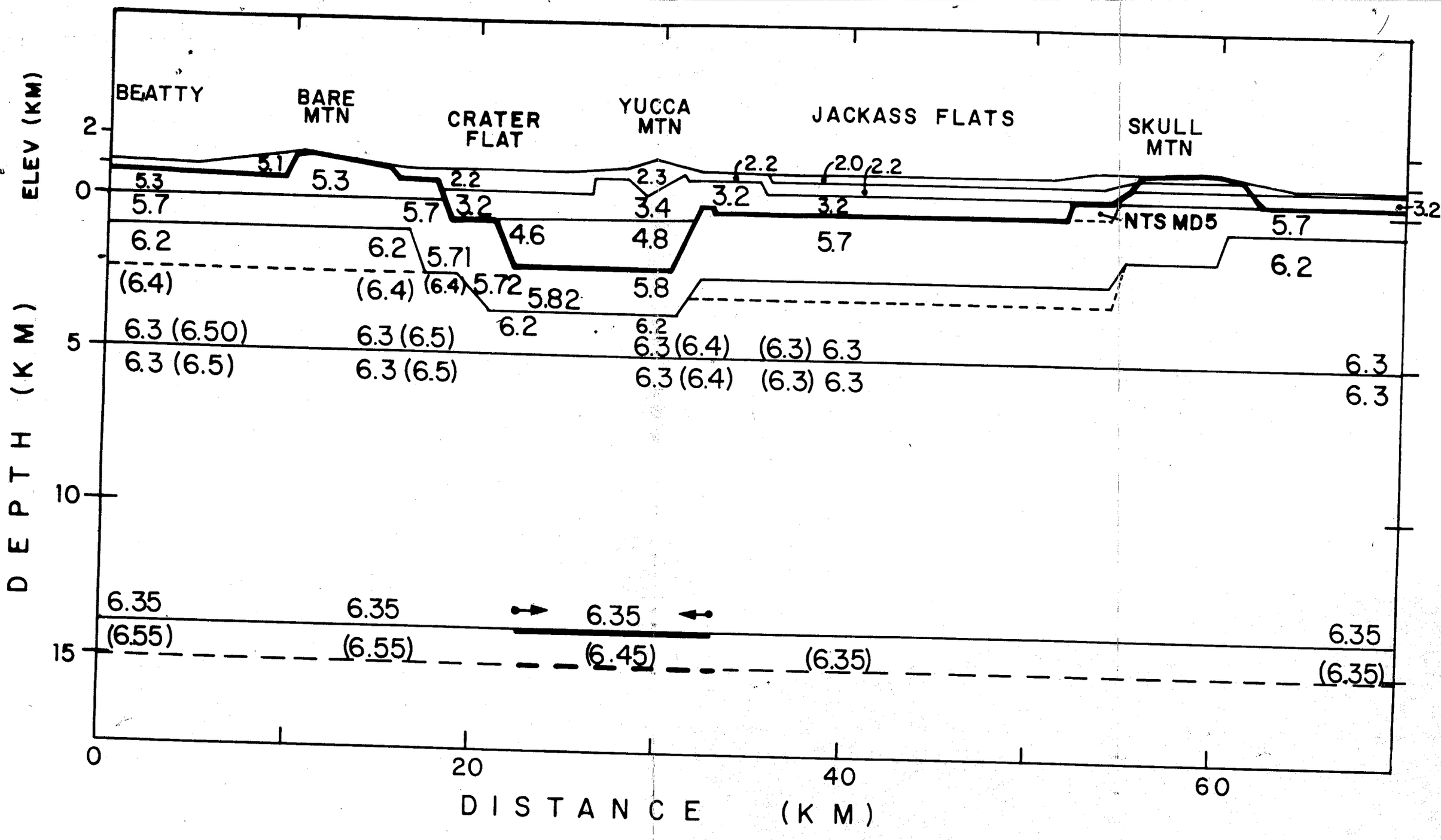


Figure 10. Crustal velocity model derived from shot point 4 data. Average layer velocities are indicated in km/s. Solid lines are layer boundaries, and dashed lines are alternative boundary depths calculated for the average layer velocities in parentheses. The heavy solid line above a depth of 5 km is the volcanic/pre-volcanic boundary. The mid-crustal boundary below 15 km is indicated by a heavy line where the depth is controlled by the seismic data (c.f., Figure 9). The depth to pre-volcanic rocks (velocity greater than 5.0 km/s) is 3.2 km (10,500 ft) beneath eastern Crater Flat.

Start: 8:30
Finish: 6:30
Total - 10 hrs
+ 1 hr @ WTSA

Alan Hull 16 Jan 1992

Working on line A.

Note
Technical Review Session
ssp
29, 30, 31 Jan.
Also Tect + Volc
Feb 12, 13, 14
Invite Eric (Swanson) to this meeting

Line A complete - but see * below

Start work on C

Dune Wash Flt.
(Ghost Dance) Flt
Solitario Canyon Fault
Bow Ridge Fault
Point Bn.
Fran Ridge
40

* Problems tying A and C:
* Therefore use C and make it close to B (at eastern end) then force A to conform to C and let A fall out of balance at SE end.

Bring in USW-H3 to C.

Remember
tan (apparent dip) = tan (real dip) × cos (at. difference in dip direction)

I imported 40 mile Fault from the completed section AB combined - now work with this in C then take the tie points back into A.

sections { AB combined. / B / C } will balance

Section A will not and should not be shown restored.

AHM

Alan Morris

Start 8:45am
Finish 5:45pm.
Total: 9 hours

20 Jan 1992

Working on section C

swri - milestone 1 - C. db

C almost finished.

'Flu started!

APM

Start 9:00am
Finish 6:00 pm
Total: 9 hrs

23 Jan 1992

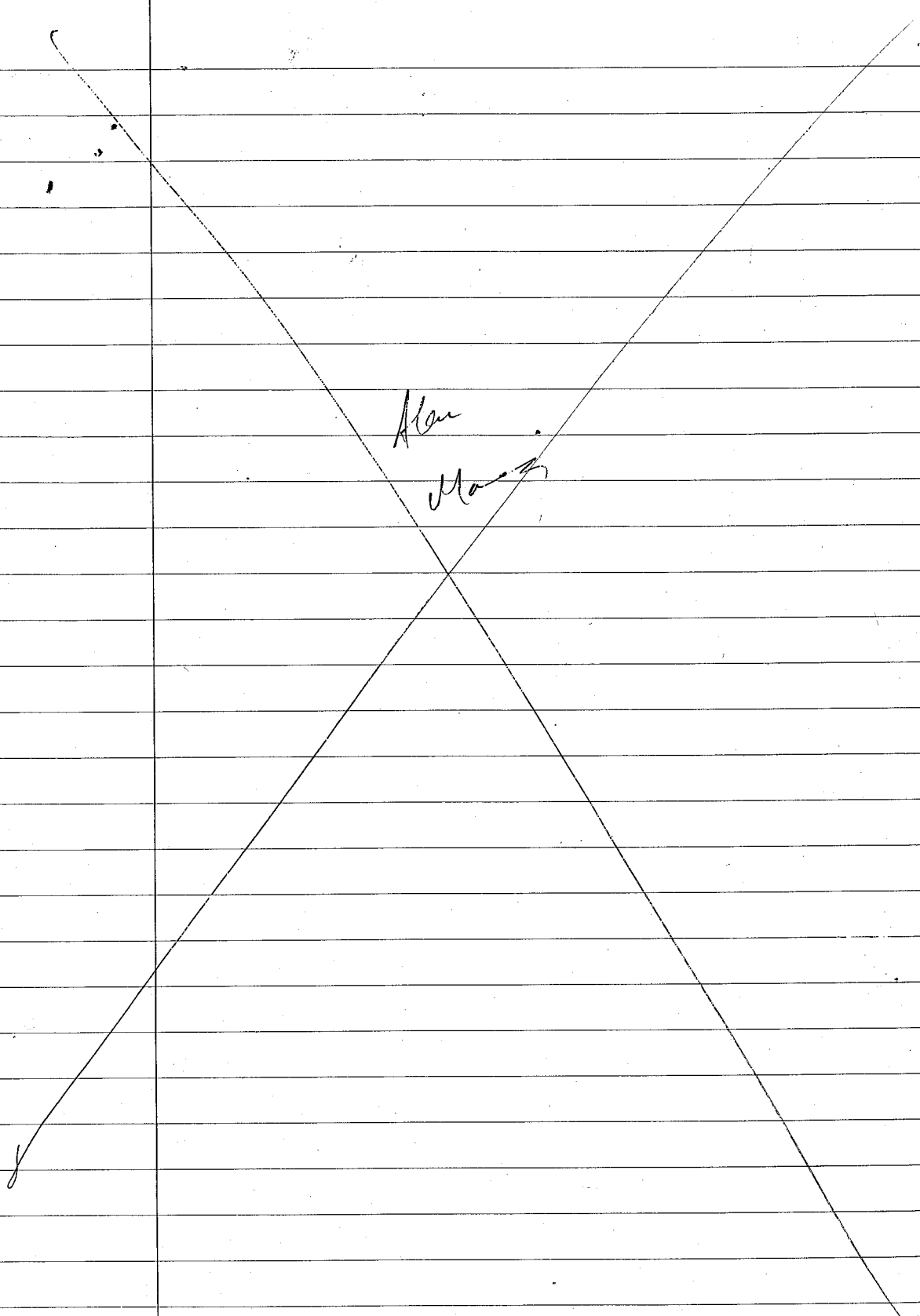
Great demo by Ron Martin using the population dynamics equation.

Application to Yucca Mt. - Steve suggested we get eiquake data for western US and try plotting times or magnitudes or locations in the same way and see how it falls out.

Finally finished C and fixed A to fit.

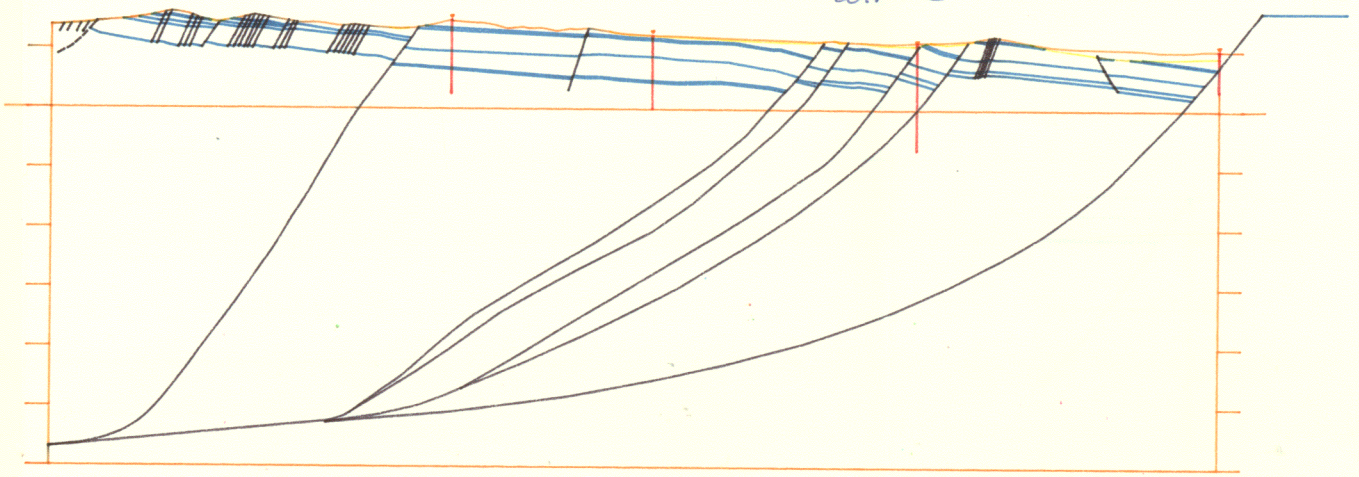
Made rough plots → see following pages

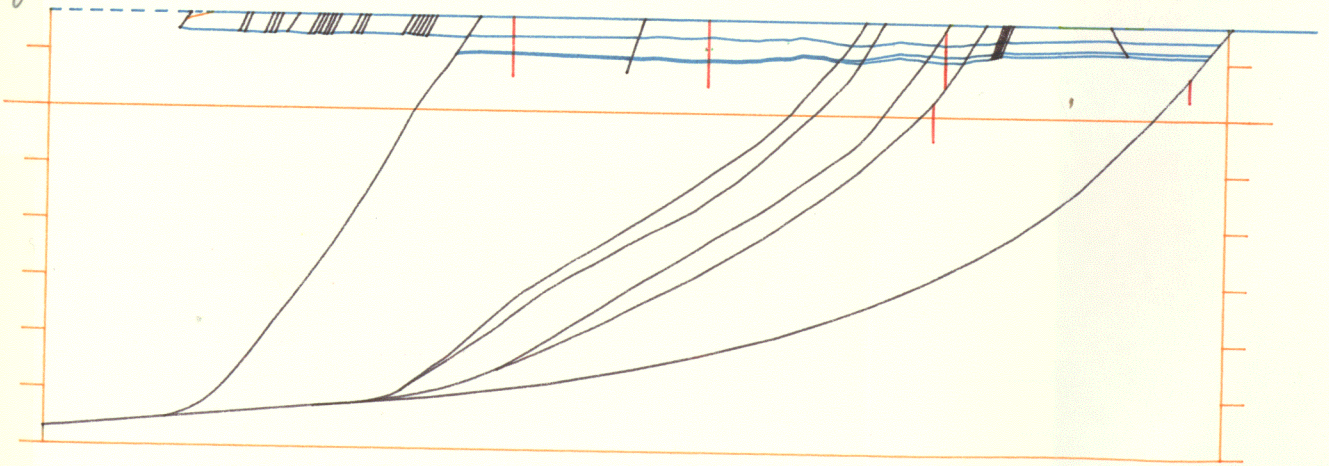
APM

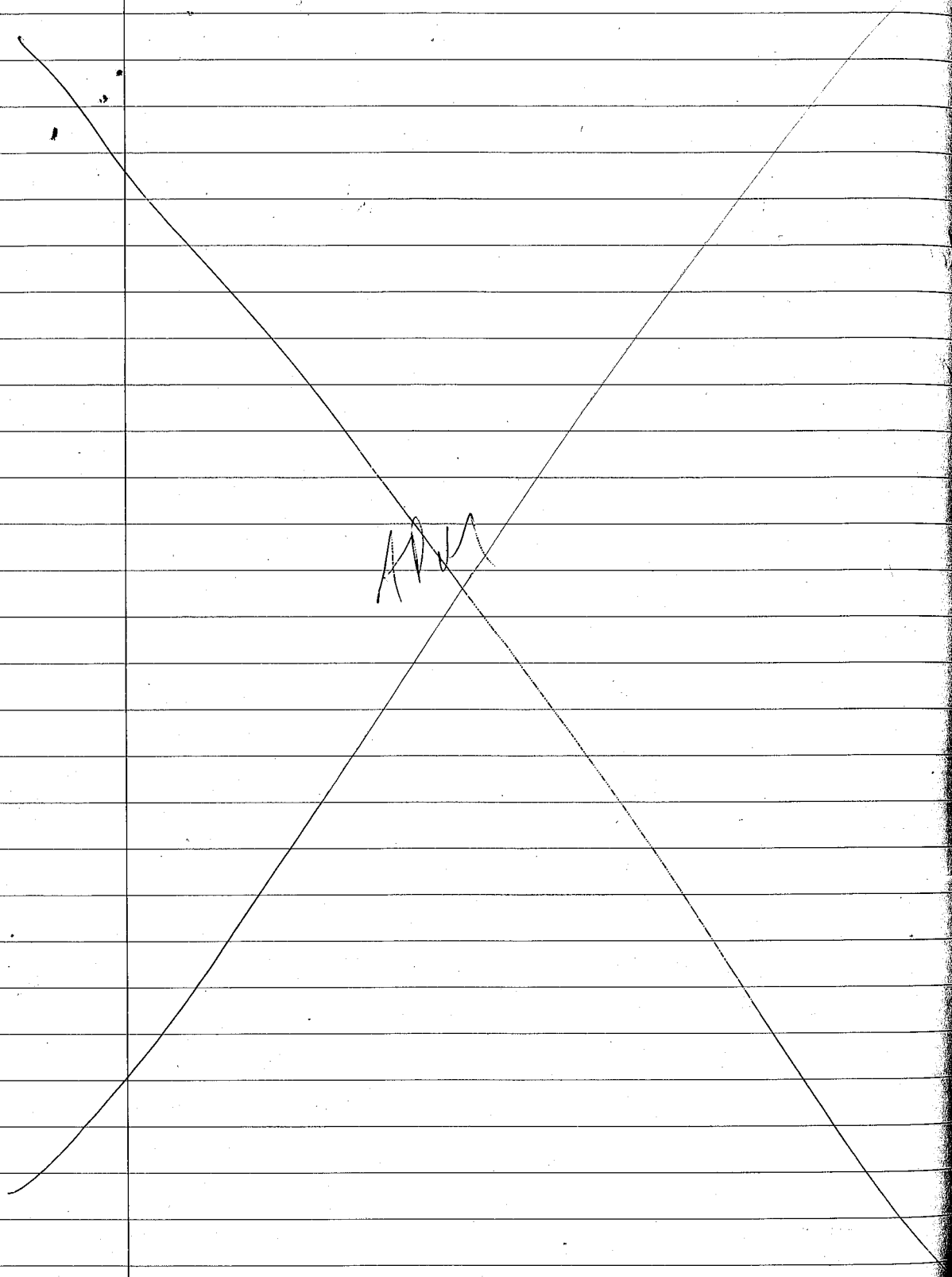


A-A'

Add crossing Pt. with C and E and B



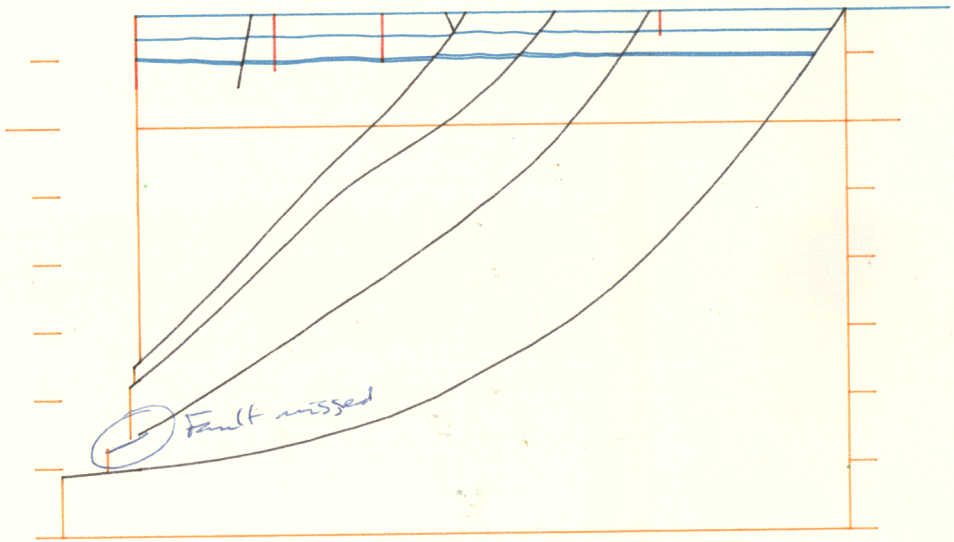




BB' rest

Restored, revised interpretation – top TPTW

Add crossing point with A and E



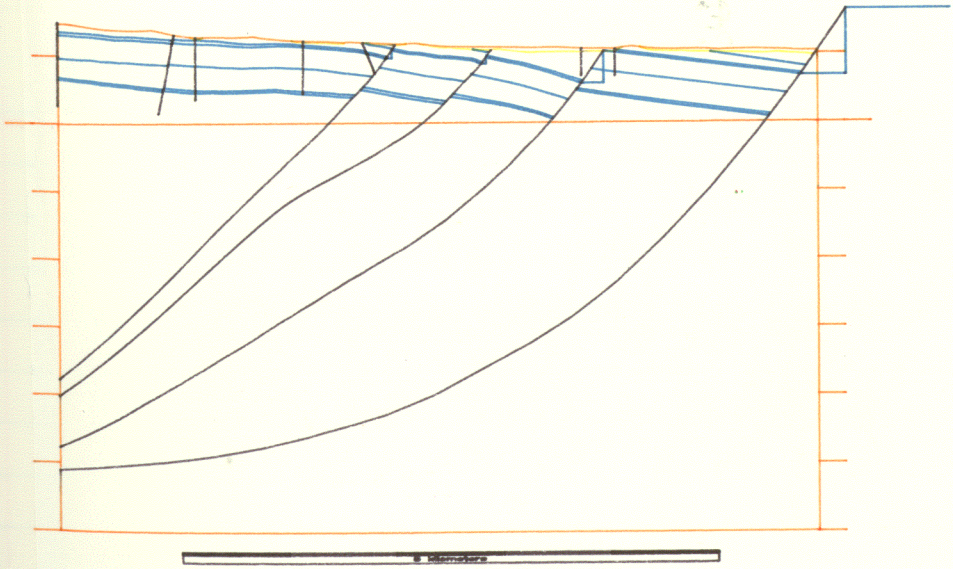
B-B' next

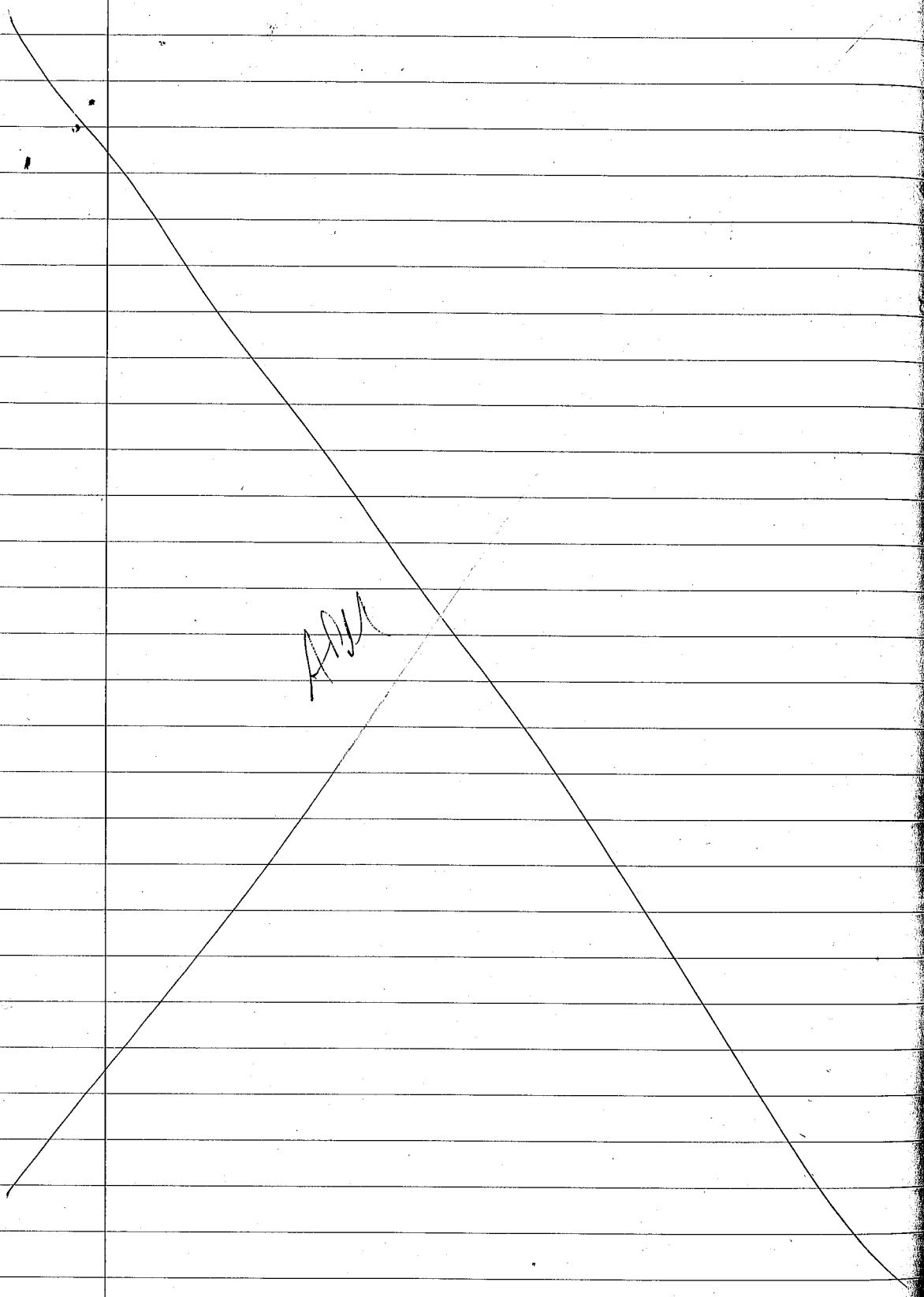
Restored, revised interpretation – top TPTW

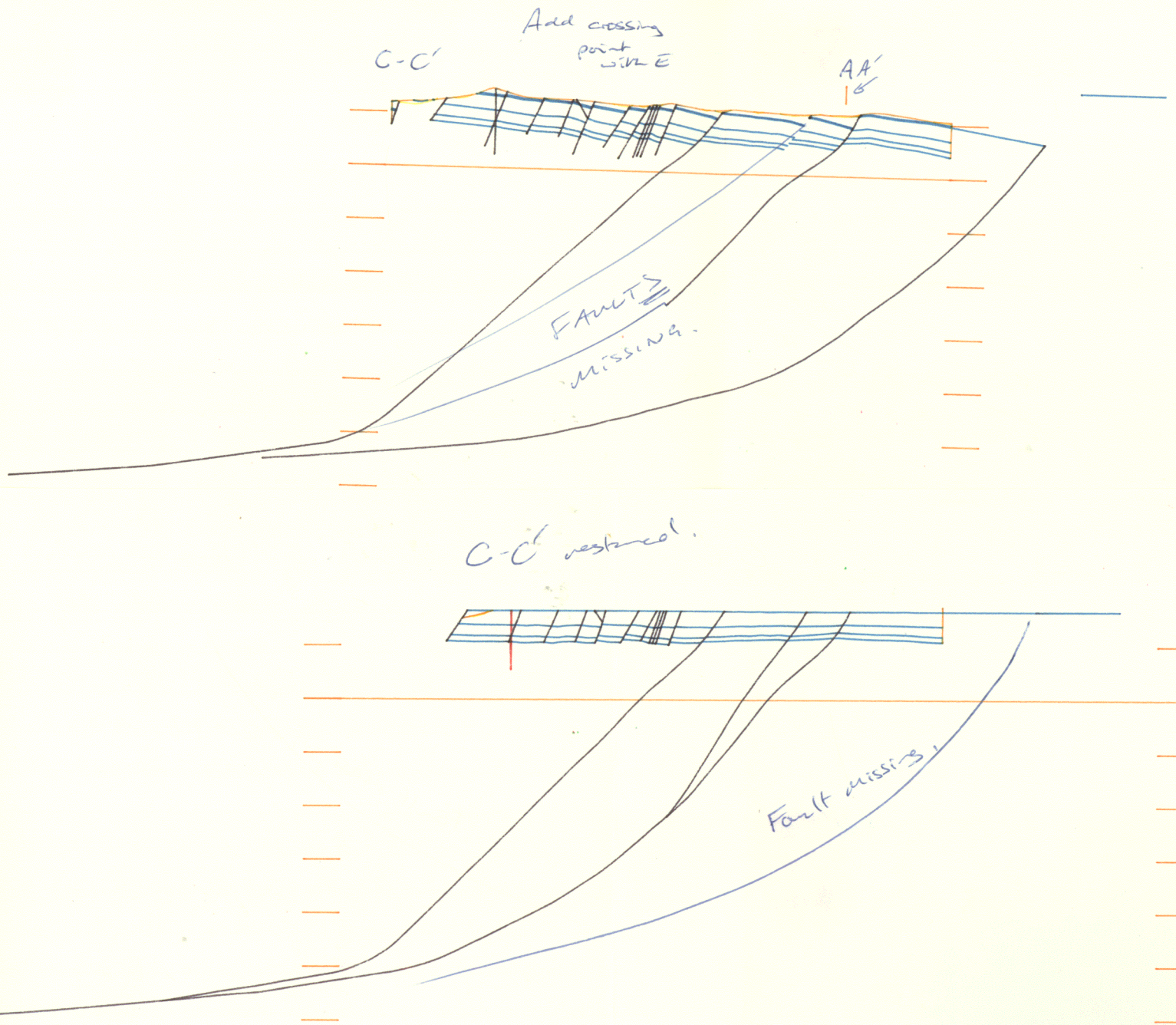
Add crossing point with A and E

BB'

Revised present-day interpretation






Add crossing point with E
C-C'
A-A'
FAULT?
MISSING.
C-C' vertical.
Fault missing.

Alan Moon

Sunday 26 Jan 1992

When we arrived (~ 11:00am):

- All power to Sun was on
- Monitor switch on front of monitor was off
- Power strip on back of desk was attached to the desk
- We turned on the power switch on the front of the monitor
- Screen lit with boot, continue, screen
- We hit c to continue, but it gave us the same, so
- We hit b to boot
- Screen went blank and stayed that way despite our efforts. (e.g. power off/on, L1-A)

Sun technical support:

1-800-872-4786

5am - 5pm Western time.

The problem was → an un-seated network card! - pulled out by its cable

Ron spotted it and fixed it on Mon 27

Start: 1:30pm

Finish: 7:00pm

Total: 5.5hrs

Alan Moon

Tues 28 Jan 1992

"Chaotic Vibrations" - Francis Moon - Wiley Interscience

Note: Feb 12 (Wednesday) meeting w/ Brian Warnicke

All day - make arrangements

Started generating plots

ab-pres-plot.dat, ab-rest-plot.dat	10" x 15"	1:42308	$X_{min} = -22332$ $X_{max} = -7409$ $Y_{min} = -17252$ $Y_{max} = -7092$
ab-pres-bigplot.dat, ab-rest-bigplot.dat	20" x 32"	1:21154	$X_{min} = -22332$ $Y_{min} = -17252$ $X_{max} = 7516$ $Y_{max} = 3068$
c-pres-plot.dat, c-rest-plot.dat	10" x 15"	1:42308	$X_{min} = -22332$ $X_{max} = -9108$ $Y_{min} = -17252$ $Y_{max} = -7181$
c-pres-bigplot.dat, c-rest-bigplot.dat	20" x 32"	1:21154	$X_{min} = -22332$ $X_{max} = 4117$ $Y_{min} = -17252$ $Y_{max} = 2889$

(10" x 15") 1:42308

map.dat - $X_{min} = -22332$ $X_{max} = -8805$

$Y_{min} = -17252$ $Y_{max} = -415$

Note: to plot these at 1:1, the first two lines of the HPGL file (filename.dat) should be:

```
IN;
SC-Xmin, Xmax, Ymin, Ymax, 1;
```

This should always work(!) [Yeah - right]

Start: 8:15am
Finish: 6:30pm
Total: 10.25hrs

Alan Morris Thurs. 30th. Jan

Modelling plots from:

' modelling-40mile-plot.db

mod1.dat } 1:? Xmin = -22332 Xmax = -7144 { Graphs of depth of detachment for vert/oblique + flat slip
mod2.dat } Ymin = -17252 Ymax = -10972

mod3...11.dat - 1:247070 { Xmin = -22332 Xmax = -1208 ; Ymin = -17252 Ymax = -4690 }

↳ patchworks of the fault trajectories for vert/oblique shear solutions.

Note
Interpretation of reflection seismic line due April 6 1992

Note plotting as-is does not give 1:1 scales -
this needs a lot of thought - check the HP manual
for "freezing" the scaling

Meeting

Make sure we have full justifications for going out on a limb (e.g. 40mile fault)

Gold associated w/ detachment / or Tertiary-Palaeozoic contact?
Gold mining is a scenario for future intrusion

Alan Morris Sunday 2nd Feb

I was worried about the nature of the highly extended region west and NW of Bare Mountain (in the Bullfrog Hills). The thicknesses of the Tertiary Volcanic Sequence appeared there might be too thin to accommodate our west- or WNW-dipping detachment.

However, reading Maldonado's paper (GSA Bull. 1990 102 992-1006) he suggests a 5.5km thickness for the Tertiary volc. sequence and his Figure 10 indicates a depth to detachment (for pre-isostatic rise of Bullfrog Hills - and by analogy Bare Mtn) of greater than 6km (closer to 7km).

This is a crucial paper for developing the regional section to the west.

See over →

Alan

Structural geology of the upper plate of the Bullfrog Hills detachment fault system, southern Nevada

FLORIAN MALDONADO *U.S. Geological Survey, M.S. 913, Box 25046, Denver Federal Center, Denver, Colorado 80225*

ABSTRACT

Information potentially subject to copyright protection was redacted from this location. The redacted material is from the reference information listed above.

Information potentially subject to copyright protection was redacted from this location.
The redacted material (Figure 10: Palinspastic restoration of geologic section...)
is from the following reference:

Maldonado, F. "Structural Geology of the Upper Plate of the Bullfrog Hills Detachment Fault System Southern Nevada." Denver, Colorado: U.S. Geological Survey. p. 1,004. Year unknown.

Alan Morris

Start: 8:30am.
Finish: 8:45pm
Total: 12.25hrs

Tuesday 4th. Feb!

+ Plotting problems - mostly solved, 1:1 plots are no problem (see page 47); I haven't yet addressed the problem of obtaining plots at specific scales chosen in Geosec.

a-pres-plot.dat 10"x15" 1:47389
a-rest-plot.dat " "

a-pres-bigplot.dat 32"x20" 1:25133
a-rest-bigplot.dat " "

b-pres-bigplot.dat 32"x20" 1:22348 APM
b-rest-bigplot.dat " "

b-rest-plot.dat 10"x15" 1:40725 APM
b-pres-plot.dat " "

Work for 17 Feb
(2) + Regional section through
(3) + Stratigraphy below N1
(1) + Flex slip modelling ✓

e-pres-plot.dat 10"x15" 1:44388
e-pres-bigplot.dat 32"x20" 1:29592

Start: 8:15am
Finish: 7:30pm
Total: 11.25hrs

Alan Morris

Thursday Feb 6. 1992

Another "plotting note":

For two plots to be at the same scale:

- $\begin{cases} \Delta X_1 = \Delta X_2 \\ \Delta Y_1 = \Delta Y_2 \end{cases}$
- the view windows to be plotted must be displayed in Geosec at the same scale,
- the view windows to be plotted must be very close to the same size and shape
- the scale ratio displayed by Geosec will only approximate the actual, plotted scale ratio - so always use horiz + vert. scales

Set-up scale boxes so that all sections can be plotted at the same scale.

Returned to work on the flex-slip modelling.

Finished flex-slip modelling -

see project swri-apm-modelling-40mile-plot.db

Start: 12:15pm
Finish: 6:00pm
Total 5.75hrs.

Alan Morris

Sunday Feb 9 1992

Add stratigraphy and attempt to constrain growth.

Project swri-mi-ABstrat.db

[Note: don't forget J13]

- Depth to Paleozoics taken from refraction line(s)
- Tptw thickness constrained from wells VH1 + VH2
- Place most growth in ~~Bullfrog Hills Tptp~~ ABM below Top of Conformable Flat *
- Use Maldonado's sections from Bullfrog Hills area to get for constraint?
- Use UE25P-1 to constrain depth to Pal. in E.

* - Using Maldonado's section (p. 1001 Table 1) - his units Tbs and Tas will be used as potential growth horizons.

- Use well G-1 to constrain thicknesses at H-5 location (which is where AA', BB' and EE' all cross)

Now
(*) Work on growth model using AB-composite. (swri-mi-ABstrat.db)

- We "Rugged" Carr's + Scott's stratigraphy + Carr's from well UE25P#1 - to obtain sub-Tcbw stratigraphy. (see page 57)

56

Start: 8:45am
Finish: 7:00pm
Total; 10.25hrs

Alan Morris

Tuesday 11 Feb 1992

Work on growth - swri-mi-ABstat.db

In the sub-Tcbw stratigraphy we are going to place most growth in the sub-TLR section

Plotted modelling results. { model1o.dat / model3o.dat

Section ABstat.

⊛ Depth to Paleozoic at west end is fixed by seismic refraction data and Snyder + Carr (1984) - JGR 89 gravity data at ≈ 1.8 km below sea level.

To guestimate growth:

- sum all fault throws for TPTW, $= T \; (= \Sigma t_1 + t_2 + \ldots)$
- estimate total growth $= G$
- growth on fault (1), $g_1 = G\left(\frac{t_1}{T}\right)$

In fw of 40 mile Pzu elev. ≈ 1200m (from map)

	Fault					
	Solitario C	Bow Ridge	Midway	PB Canyon	40 mile	T
t =	217	123	98	476	963	1877
t/T =	0.12	0.07	0.05	0.25	0.51	G
g =	399	233	166	832	1698	3328

Alan Maxwell

57

UE25P#1

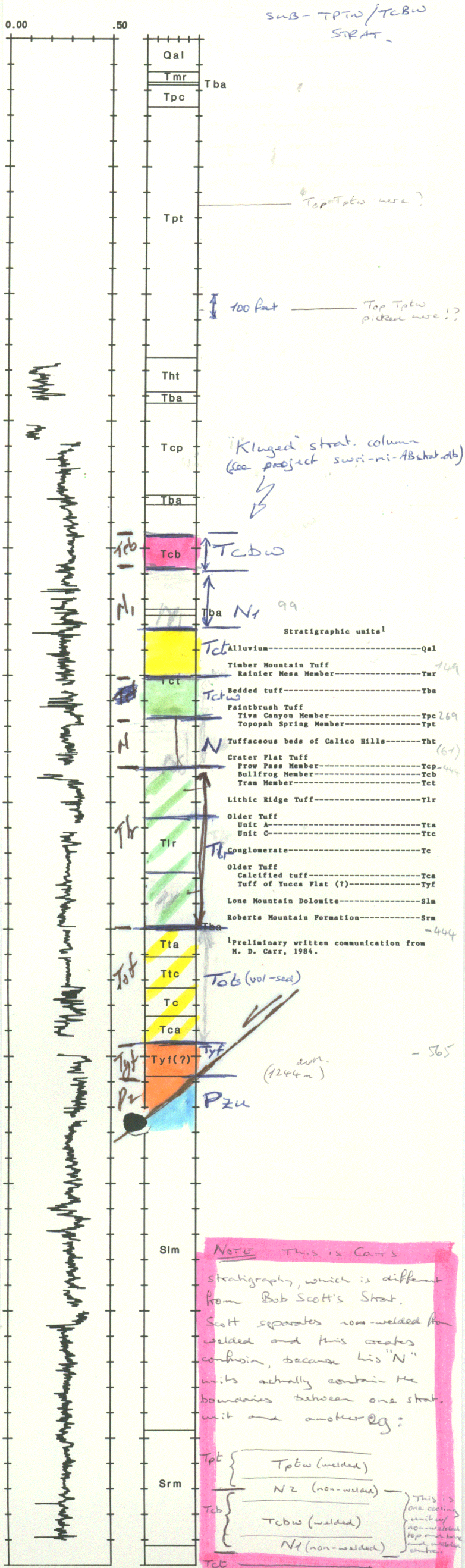
OPEN FILE REPORT

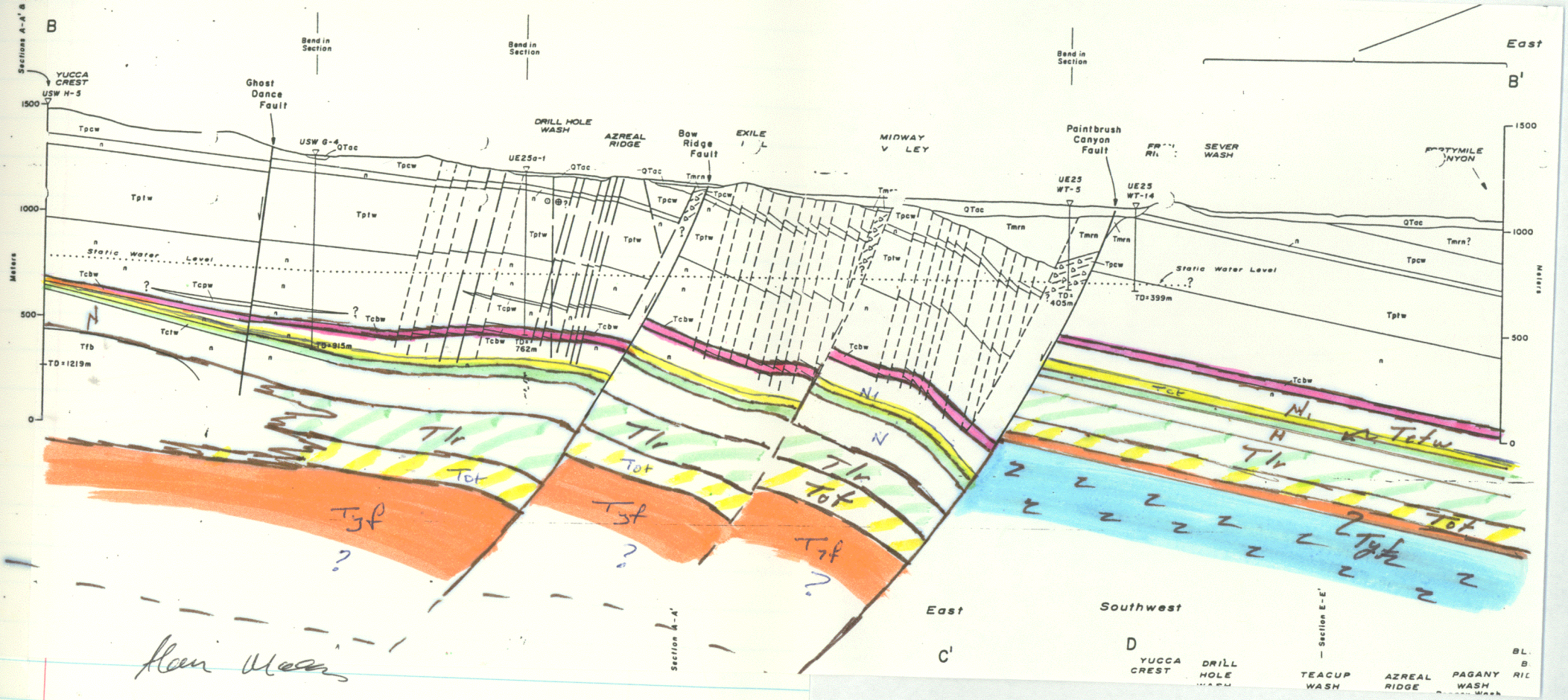
PLATE 1

SHEET 1 OF 2

POISSON'S RATIO STRATIGRAPHY

USED TO CONSTRAIN SUB-TPTW/TCBW STRAT.




West
B
Sections A-A' & E-E'
Bend in Section
Bend in Section
Bend in Section
East
B'
YUCCA CREST
USW H-5
Ghost Dance Fault
USW G-4
QTac
DRILL HOLE WASH
AZREAL RIDGE
Bow Ridge Fault
EXILE
MIDWAY VALLEY
Paintbrush Canyon Fault
UE25a-1
UE25 WT-5
UE25 WT-14
SEVER WASH
FORTYMILE CANYON
Tpcw
Tptw
Tcbw
Tctw
Tmrn
Tfb
Static Water Level
TD=1219m
TD=915m
TD=762m
TD=405m
TD=399m
Meters
1500
1000
500
0
Tlr
Tot
Tyf
N
Section A-A'
East
Southwest
C'
D
YUCCA CREST
DRILL HOLE WASH
TEACUP WASH
AZREAL RIDGE
PAGANY WASH
Section E-E'

Information potentially subject to copyright protection was redacted from this location. The redacted material (Figure: Isostatic residual gravity...) is from the following reference:

Snyder and Carr. “Gravity Data in Volcano-Tectonic Setting.” Journal of Geophysical Research. Vol. 89, No. B12. Figure 4c. pp. 10, 193-10,206. 1984.

APRL

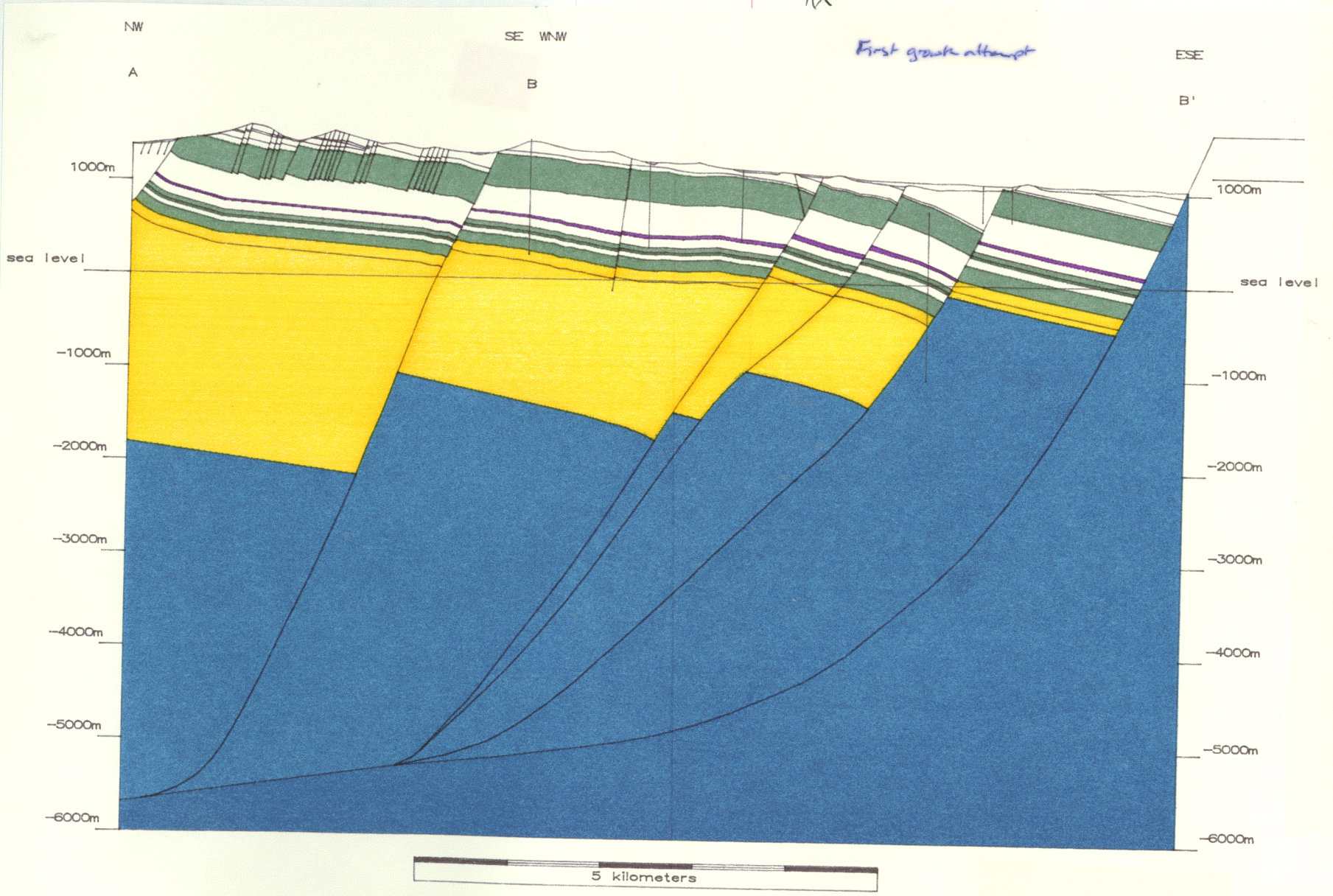
59

10.2022

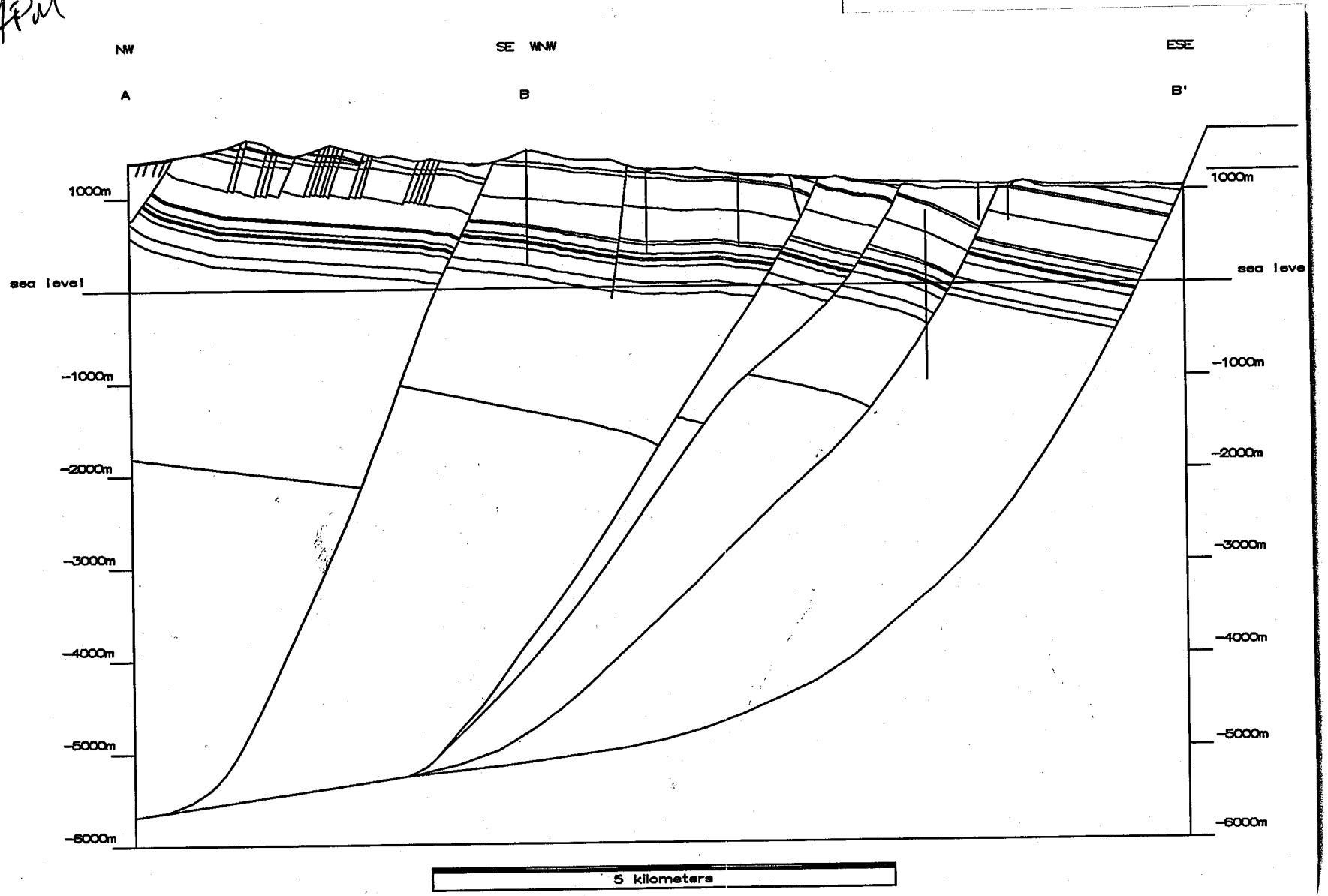
Information potentially subject to copyright protection was redacted from this location.
The redacted material (Figure: Gravity, geologic, and seismic refraction...) is from the following reference:

Snyder and Carr. "Gravity Data in Volcano-Tectonic Setting." Journal of Geophysical Research. Vol. 89, No. B12. Figure 5. p. 10,202. 1984.

1PM


NW
A
SE WNW
B
First growth attempt
ESE
B'
1000m
sea level
-1000m
-2000m
-3000m
-4000m
-5000m
-6000m
1000m
sea level
-1000m
-2000m
-3000m
-4000m
-5000m
-6000m
5 kilometers

APM


NW
A
SE WNW
B
ESE
B'
1000m
sea level
-1000m
-2000m
-3000m
-4000m
-5000m
-6000m
1000m
sea leve
-1000m
-2000m
-3000m
-4000m
-5000m
-6000m
5 kilometers

Start 8:00 am
Finish 7:00 pm

Wednesday 12 Feb 1992

Meeting w/ Brian Warnicke
Larry McKague
John Trapp
Phil Justice APM
Gerry Shirwalt

Brian has "no objections" to our semi-regional model, but see notes for details of where he puts Yucca Mt.

See notes →

APM

Alan Hoover

My talk

BASIC ASSUMPTIONS

Brian Wernicke + Lenny McCoig? Present

(1)

1) LINKED FAULT SYSTEM

2) CONSISTENT DEFM. MECHANISM

JUSTIFICATION - + YUCCA MTN. "HEADWALL" OF SYSTEM - LEAST EXTENDED (7-10%) AT TPTW.

+ BULLFROG HILLS DETACHMENTS

MODELLING INPUT VARIABLES

1) SHEAR ANGLE / OR OTHER MECHANISM

2) "REGIONAL" ELEVATION

3) SURFACE FAULT DIPS

4) HANGINGWALL GEOMETRY

DATA SOURCES

1) • "ANASTOMOSING" FAULT PATTERNS
   • ITERATIVE FEED-BACK

2) • GEOLOGICAL MAPS - CALICO HILLS
   • EXPOSURES S. OF JACKASS FLATS

3) • UE25P#1 WELL
   • GEOLOGICAL MAPS

4) • EXISTING SECTIONS (MAPS, FIELD WORK, WELLS)

12 Feb 1992 NOTES -1

12 Feb 1992 my talk

(2)

1L

"NEW" DATA

- 40-MILE CANYON FAULT - + AV 1
  + MAPS

MODELLING APPROACHES

1) VARIABLE SHEAR ANGLES
2) VARIABLE REGIONAL
3) VARIABLE FAULT ANGLE
4) FLEXURAL SLIP

SENSITIVITY

1) SHEAR ANGLE (ERP SYNTHETIC)
2) SURFACE FAULT ANGLES
3) REGIONAL

→ NOTE CONVERGENCE OF FLEX SLIP + VERT SHEAR SOLNS

MORE DETAILED MODELLING

LINES: { ABB' — , CC' — , EE' } Balanced by trial + error fault-prediction and modification of two-geometries w/in data limits using 66° fault dip / vertical shear

DATA CONVERGENCE

DEPTH TO DETACHMENT -

- NEO - MICRO - SEISMICITY
- SEISMIC VELOCITY PROFILES
- BULLFROG HILLS SECTIONS

FURTHER → GROWTH.

12 Feb 1992 NOTES - 1

1L

+ Pinch-outs against faults for piercing points
- some pinch-outs do exist (along Mc-agm).

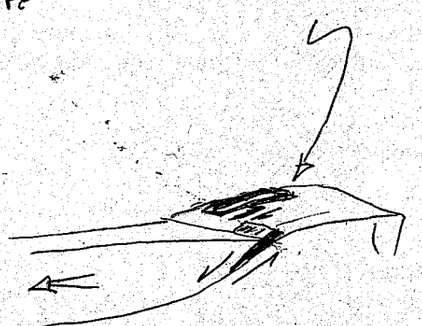
Ask aim for details.

+ "Gravity Fault" to the south -? a combination of 40 mile Flt
+ Also, to the north along same trend is a fault with 1km of displacement.
+ use base of Tpt as modelling horizon.
+ Faultplane sol^ns - John Trop. asks min
Ryall.
+ Thermal structure of the crust and its evolution
+ Thicker continental crust will have shallower isotherms, therefore lots of flow in extending crust. Thinner crust will be more brittle (eg Red Sea)
+ Gilmore + Carr - USGS open file. subsidence

Wernicke

"Apparent" strike-slip motion - accommodational tear faults.

σ_3 - horiz EW
σ_1 + σ_2 flip-flop



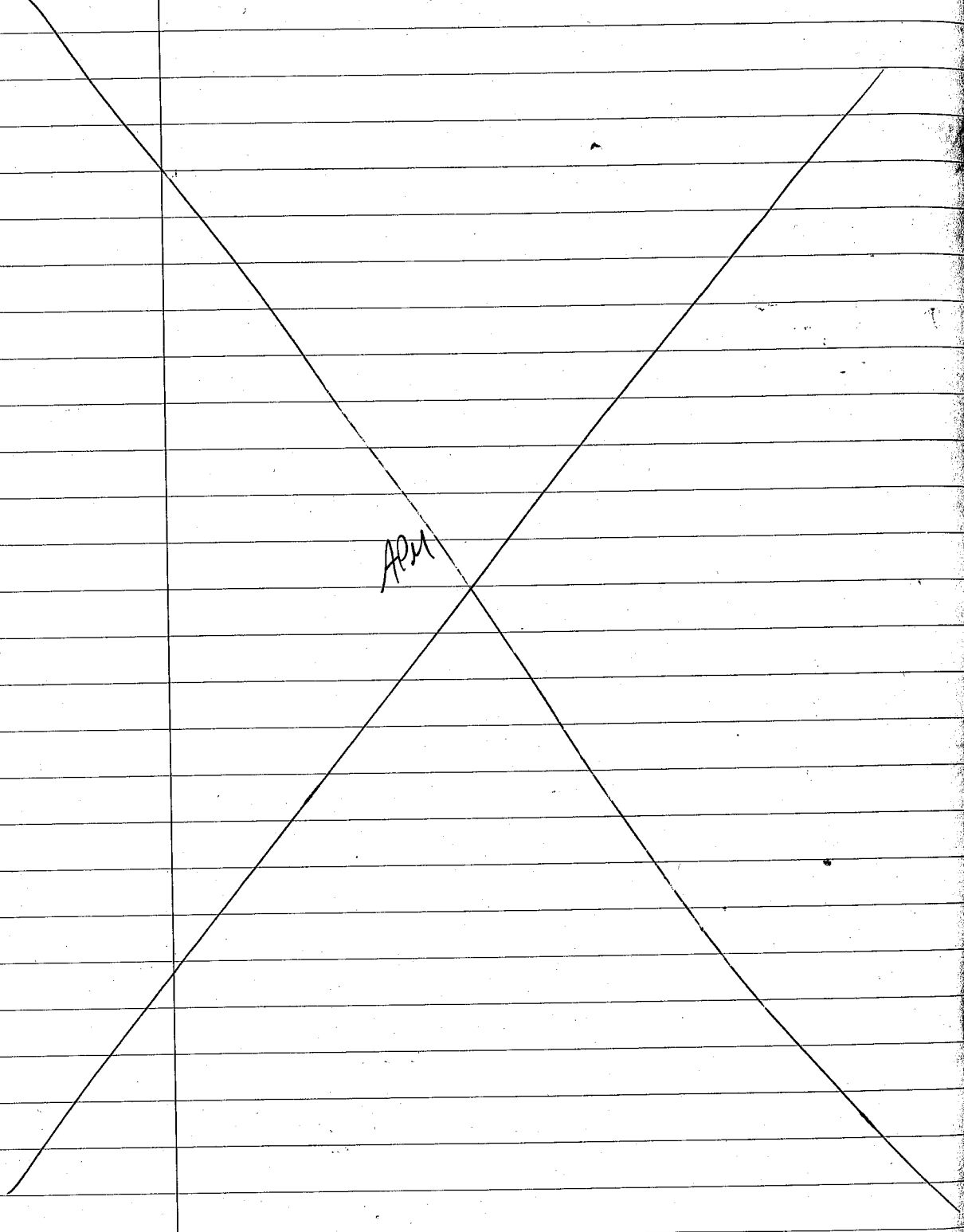
can also shed light on basaltic magmatism.

Sub Tertiary structures can be traced through a series of widely separated blocks (trading 5° E-ward and 1 W-ward structures)
Also Sub-Tertiary structural trends under YM are 90° to Tertiary structural trends.

Using GPS to confirm differential kinematics

Crustal extension limited by mantle material and cooling crust causing the crust to strengthen. At this point deep-cutting faults such as Bare-Mtn. form.

Timber Mtn caldera occurred just as the major zone of extension was migrating through to the west.
So Yucca Mtn sits on already denuded crust - probably only 2-3km of Paleozoic rocks under Yucca Mtn. Yucca Mtn faults are small splays from the main detachment, Bare Mtn Fault is later and cuts off that system.


APM

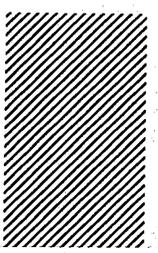
Start 8:15am
Finish 6:00pm
Total 9.75hrs

Alan Morris

Thursday 13 1992

⊛ Path Canyon pinches out - test this for piercing points on major faults.

MEETING NOTES:



13 Feb 1992 Wernicke

(1)

Yucca Mtn.

Craton / basin Paleozoic wedge line runs through Castle Peak

Also lies in transition from Northern to Southern B&R.

⊛ There was no magmatism until the onset of extension.

⊛ Bare Mtn is a "slope" Silurian section - more distal than the surrounding shelf sections.

He is trying to use facies changes and paleogeography as basin markers. Also his E-vergent and W-vergent set of structures that he uses to demonstrate displacement on the major faults of the region. These structures essentially give piercing points.

⊛ Bare Mtn does contain the W-verging structure.

(1) Reassembling these thin slivers left behind during ext'n gives 25 km of ext'n.

The obliquity between Mesozoic thrusts and Paleozoic paleogeography provides a means of uniquely placing these scattered fragments back into a palinspastic reconstruction.

Rotation of slivers during extension can be dated by fission-track dating. These slivers are mountain scale - eg 15 km long.

Black Mtns CA - may be an analogue for what is under Yucca Mtn.

Major B&R ext'n ends at ~117°30'W. - i.e. west of Bare Mtn. The "upending" of slivers migrated westwards to that point. (Wernicke 1988)

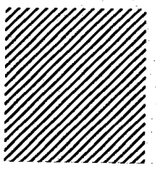
Bare Mtn / Yucca Mtn is E of the limit of ext'n - i.e. it has experienced major ext'n and tilts extended into it.

Start 8:15am
Finish 6:00pm
Total 9.75 hrs

Alan Morris Thursday 13 1992

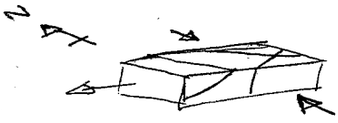
(*) Path Canyon pinches out - test this for piercing points on major faults.

MEETING NOTES:



13 Feb 1992 evernden (2)

Contemporaneous with EW extension is a N-S shortening, and the strike-slip faults may accommodate this. He also claims that there are folds with axes // to extension direction (eg. Furnace Creek). He also thinks that some normal faults are folded.



ie. overall constrictional strain

(*) 250-300 km of displacement through here - why so little subsidence? why no oceanic basin? The compensating flow cannot be mantle asthenosphere it must have roughly the same density as the continental crust.

He also points out that the Moho is essentially flat

16? 20 km

upper crust	2.7
fluid crustal layer	2.85
lower crust	3.0
upper mantle	3.3

← Mid-crustal "asthenosphere"? fluid layer. This is what does the compensating not the mantle.

(link w/ decompression and ease of melting compared w/ mantle - also if originally thicker - then also hotter)

Start 8:15am
Finish 6:00pm
Total 9.75 hrs

Alan Mauss

Thursday 13 1992

(*) Path Canyon pinches out - test this for piercing points on major faults.

MEETING NOTES:

13 Feb 1992 Warnicke

(3)

The Sr 0.704, 0.706 line is ~ 5km wide west of Yucca Mt. i.e. a very steep gradient marking the cratonic edge.

ϵ Nd shows later basalts sampling depleted mantle? silicic volc. samples old crust.

In Yucca Mt. area basaltic magmatism has ϵNd -8 to -11 that may be the result of melting Proterozoic upper mantle?

He thinks some of his ϵNd values are from sub-Sierra Nevada crust.

ϵNd -8 from sub Sierra Nevada
ϵNd -11 from directly under region

Recent Geology DePaolo +

The lateral flow of mid-crustal layer actually causes thickening of the crust under, say, Yucca Mt.

Alan Morris Thursday 13 1992

(*) Path Canyon pinches out - test this for piercing points on major faults.

MEETING NOTES:

13 Feb 1992 McKague (1)

Volc. Stratigraphy of Yucca Mt.

Sub-volcanic terrain:

1) Conglomerates in south

2) N. Test Site topographic highs - relief ≥ 900'

i.e. not flat surface

Volc. Activity

Silent Canyon - Source

1 To - older volcanics { - 15.1 Ma - Tuff of Yucca Flat; 15.7, 15.1 Ma Redrock Valley Tuff

2 Timber Mt. Source

oldest → Tram Ridge Group

Litic Ridge Tuff 13.85 Ma

3 Silent Canyon source

Grouse Canyon Tuff 13.6 Ma

Bullfrog Tuff 13.1 Ma

switching of vents - chaotic?

4 Wahmonie Centre

Wahmonie Fm. 13.1 Ma

5 Silent Canyon

Calico Hills Fm. 12.9 Ma

6 Timber Mt.

Topopah 12.8 Ma

Tiva Canyon 12.7 Ma

Yucca Mt. Tuff pinch out => does a lower unit Path Canyon pinch out is a possibility it is exposed a surface

8:15am
6:00pm
9.75hrs

Alan Morris Thursday 13 1992

(*) Park Canyon pinches out - test this for piercing points on major faults.

MEETING NOTES:

13 Feb 1992 McKague (2)

7 Timber Mt.

Rainier Mesa Tuff 11.6Ma

Ammonia Tanks 11.45Ma

8 ——"—— Beatty Wash Fm 9.5Ma

9 ~~Sarcobatus~~ Black Mt.

Rocket Wash Tuff 9.4Ma

10 Stonewall Mountain Caldera

Stonewall Mtn. Tuff 7.5Ma

USW G-1 } ? Total tuff thickness
TD 1830m } under Yucca Mt.

14 Feb 92

GEOSEC NOTE

Decompaction errors in:

- Baldwin + Butler shale
- Sclater + Christie sand

call Bob Ratliff for the Fix.

APM

Start 8:45am.
Finish 3:00pm

Tuesday 18 Feb 1992

(*) Fix the "J-1 problem" ✓

Not done → (*) "Clean" the restored states to remove growth from the base of Tptw (I heard Gerry Stirewalt say it looks odd (!))

Started Bare Mtn. Regional model - bare-mt².db

APM

Start 1:30
Finish 4:00 pm

Alan Morris

Wednesday 19 Feb 1992

Worked on Milestone 1 report.

Start 8:45am | Weekly report writing.
Finish 6:15pm

Thursday 20 Feb 1992

Work on Milestone 1 Report.

Message for Joyce

Book published by Aerial Press —
408 425 8619

They do own a copy — IL loan.

Judy Steen 408 459 2802/2234

Start 12:30pm
Finish 6:30

Tuesday Feb 25 1992

Full colours plots for the report - use the revised, extended stratigraphy.

	Full Name	Colour	Pen #
QTAC	Quaternary alluv./coll.	Yellow	3
TMRN	Rainier Mesa Mmbr. of Timber Mt. Tuff	White	
TPCW	Tiva Canyon Mmbr. of Paintbrush Tuff	Orange ~~Violet~~	~~4~~
N3		~~Violet~~	2
TPYW	Yucca Mt. Mmbr. Paintb. Tuff	~~White~~	
TPTW	Topopah Spring — " —	Green	8
N2		~~White~~ Aqua	7
TCBW	Bullfrog Mmbr. Crater Flat Tuff	~~Violet~~ Violet	2
N1		White	
TCT(N)	Tram Mmbr. Crater Flat	Orange ~~White~~ ~~Brown~~	4 ~~5~~
TCTW	"	White ~~Violet~~	
N		~~Violet~~ Blue	5
TLR	Lithic Ridge Tuff	Red viol. ~~Orange~~ ~~Brown~~	= ~~6~~ 6
TOT(n)	Older Tuffs.	Yellow	3
TYF	Tuff of Yucca Flat	~~Orange~~	4
PZU	Undiff Paleozoic rocks.	Blue	5
BASE			

N = non welded
W = welded

Corrections checked - Alan Morris

Strat. col. plot → strat.dat

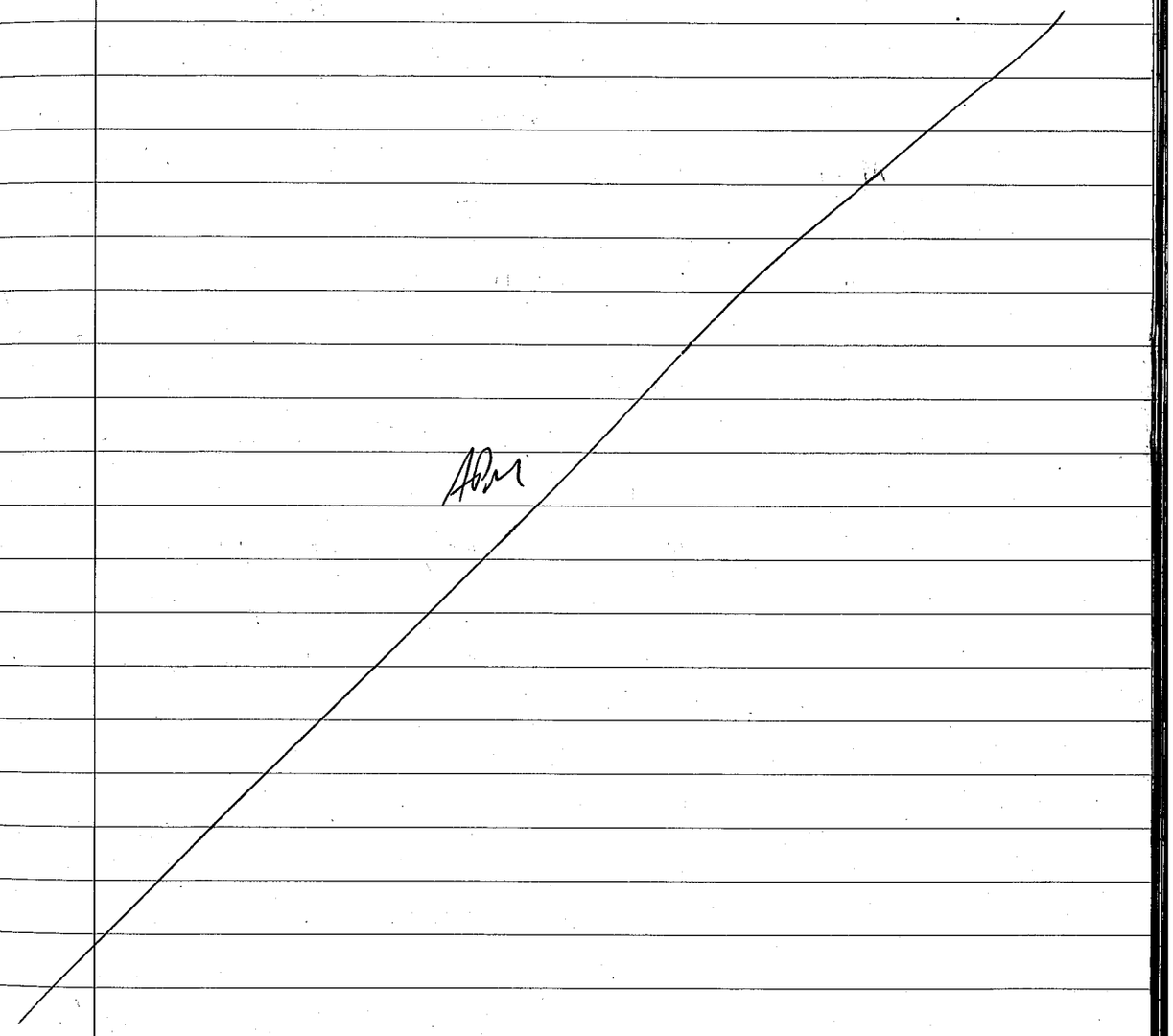
Final version of AB is in:

swri-milestone1-ABstrat.dat

ABB' Project : swri-milestone1-ABstrat.dat

"final" corrected version

Plot files: abdefcol.dat - 10"x15" colour fill
Alan Morris ~~abdeftext.dat~~ ~~text~~
abrest_col.dat - 10"x15" colour + text



Start: 8:45am
Finish 7:45am

Thursday 27 Feb 1992

Colour-matching (see page 70)

swri-milestone1-APlot.db - final form

Corrections and smoothing:

swri-milestone1-ABstrat.db - complete

swri-milestone1-Aplot.db - complete

Matching w/ Sandia sections

Sandia Sect	StB sect		
PP'	AA'	swri-3D-AP.db	3d1plt.dat

In USWH-5:

Sandia Strat		S+B (modified) Strat
PT_n	⟷	N_3
$TSw1$	⟷	$TPTW$
Add in. $TSw2$		
CH_n1	⟷	N_2
PPw		
CFU_n		
end unit → ? ‖ BF_w ✗		
		$TCBW$ ✓
CFM_n	⟷	N_1
		$TCTN$
TR_w	⟷	$TCTW$
		N

In USWH-4:

Sandia Strat		S+B (modified strat)
PT_n	⟷	N_3
$TSw1$	⟷	$TPTW$
add. $TSw2$		
CH_n1	⟷	N_2
PPw		
CFU_n		
end unit → ? ‖ BF_w		
		$TCBW$
CFM_n	⟷	N_1
		$TCTN$
TR_w		
		$TCTW$
		N

LL'	BB'	swri-3D-BL.db	3d2plt.dat
MM'	EE'	swri-3D-EM.db	3d3plt.dat

Start: 8:30am.
Finish: 7:00pm

Tuesday 3 March 1992

Generating plots for PA. Alan Morris

~~3d2AP...dat~~ ~~plot colour~~

swri-3D-AP.db

3d APcolour.dat
3d BLcolour.dat
3d EMcolour.dat

Corrections checked APM

Colour	Pen	Unit
Aqua	4	n3-PTn
Green	3	Tptw-TSw1
Red Violet (~~Yellow~~ ~~Red Violet~~)	8	TSw2
Yellow (~~Red Violet~~)	5	CHn1-n2
Red (~~Red~~ ~~Yellow~~)	~~2~~ 2	~~CHn3~~ PPw
Violet	~~2~~ 7	~~RG~~ CFUn
Blue	6	Tcbw

APM

Colours for welded/non-welded

~~3D1AP1.dat~~ - ~~non/weld~~

Colour	Pen	Unit
Yellow	5	n3-PTn
Green	3	Tptw-TSw1
Green	3	TSw2
Yellow	5	CHn1-n2
Green	3	PPw
Yellow	5	CFUn
Green	3	Tcbw

APM

~~3d1surf.dat~~ ~~surface plot~~

welded/non-welded:

plotfiles
- 3dEMweld.dat APM
- ~~3dAPweld.dat~~ 3dweldAP.dat
- 3d BLweld.dat

Note: 1. Ac
2. Ad

SECTION P-P'

ELEVATION IN METERS

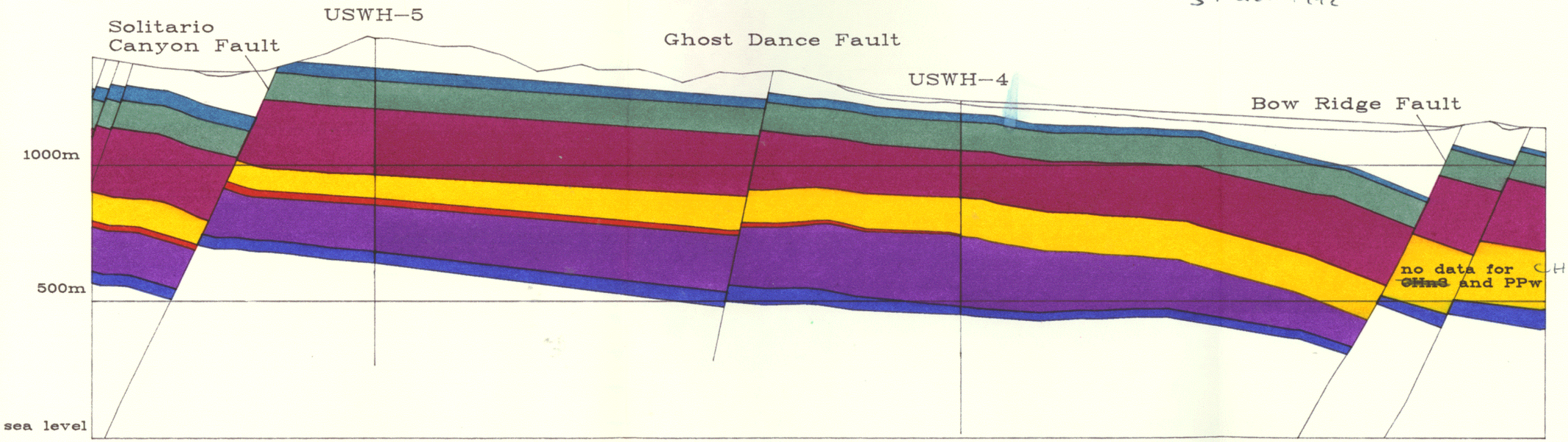
ELEVATION IN FEET

Information potentially subject to copyright protection was redacted from this location. The redacted material is a line drawing. The only information available is the date, which was February 1985.

Note: 1. Ac
2. Add

Section AA' and PP'

3 March 1992



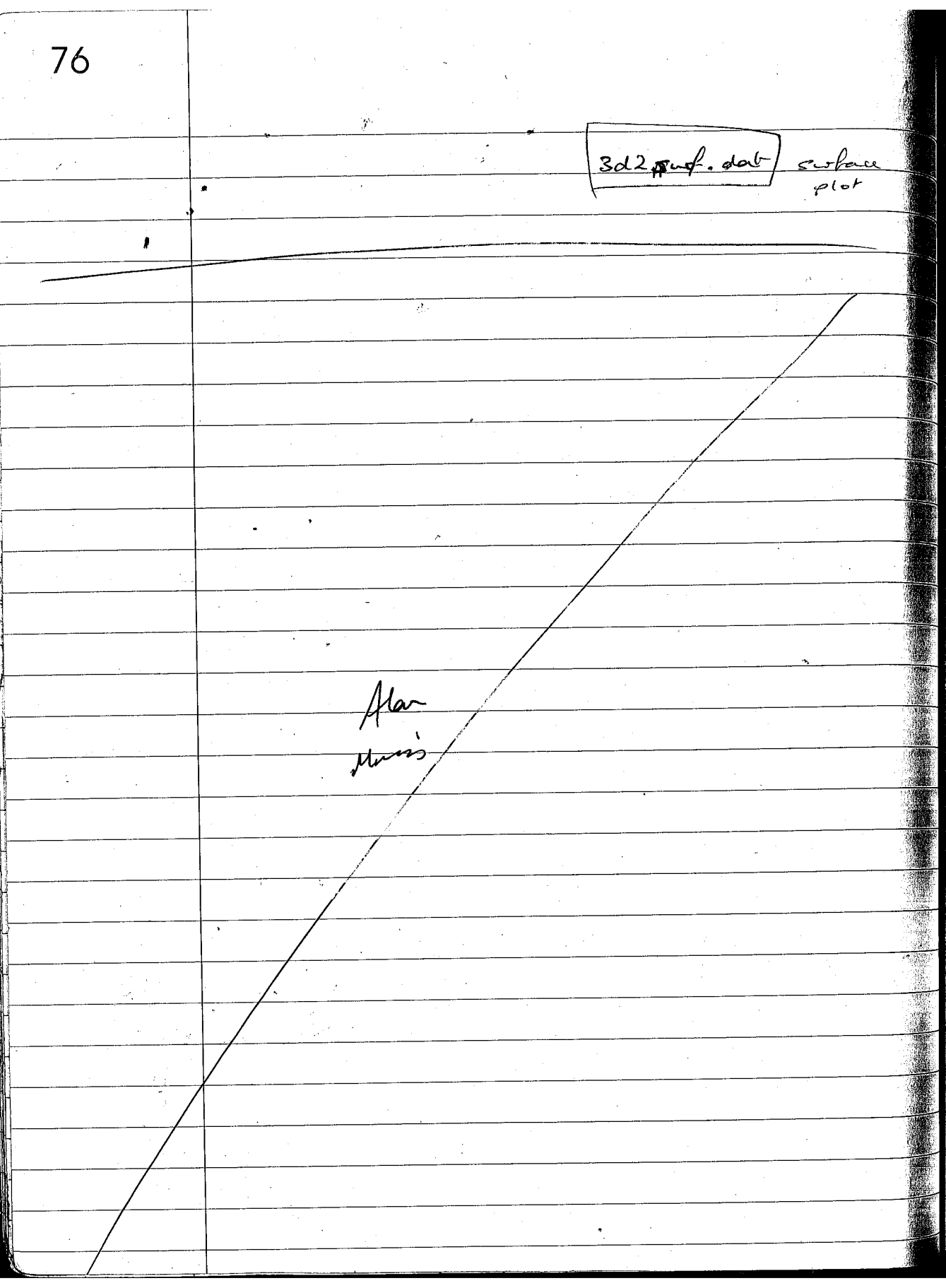
n3–PTn: non–welded tuff
Tptw–TSW1: Topopah Spring Member, Paintbrush Tuff, welded
TSw2+3: Topopah Spring Member, Paintbrush Tuff, welded, zone of flattened lithophysae
CHn1–n2: Calico Hills, non–welded tuff
~~CHn3: Calico Hills, non–welded tuff~~
PPw: Prow Pass, welded tuff
Tcbw: Bullfrog Member, Crater Flat Tuff

Drop.
Add CFUn.

Nov

Note: 1. Add base of Calico Hills 1:50p Prow Pass (marker = CHw 3).
2. Add base of Prow Pass (marker = PPw).
3. Add base of Bull Frog (marker = BFw).
4. Produce full-color plot of result for show to PA.
5. (?) Can we get a little more of the Bow Ridge footwall?

3d2surf.dat surface plot



SECTION L-L'

ELEVATION IN METERS

ELEVATION IN FEET

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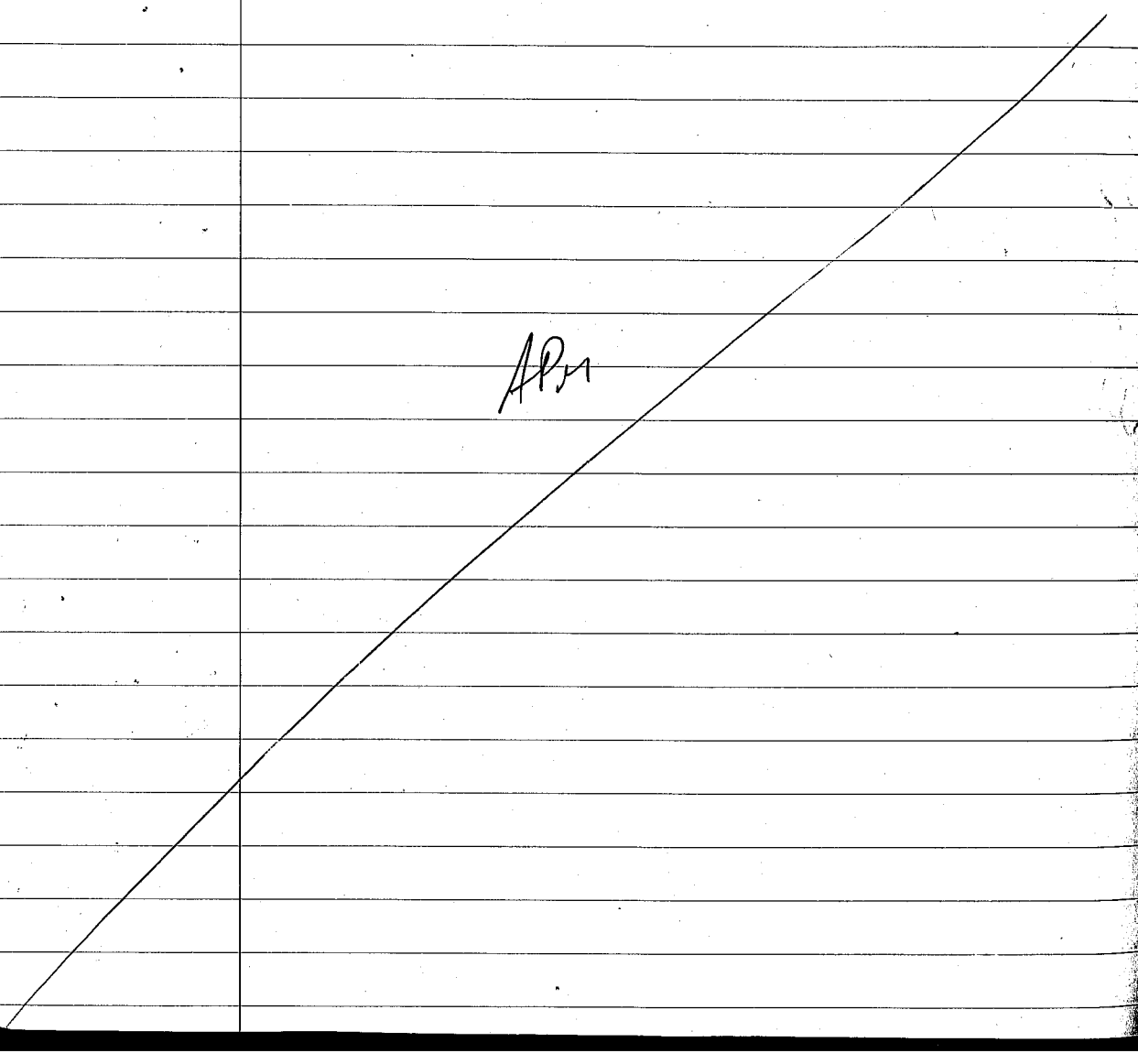
The redacted material is a line drawing. The only information available is the date,
which is February 1985.

3d3surf.dat surf. plot



ELEVATION IN METERS

Section M-M

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ELEVATION IN FEET