Structure and Thermal Characteristics of the Dixie Valley Geothermal Field

Back to Agenda

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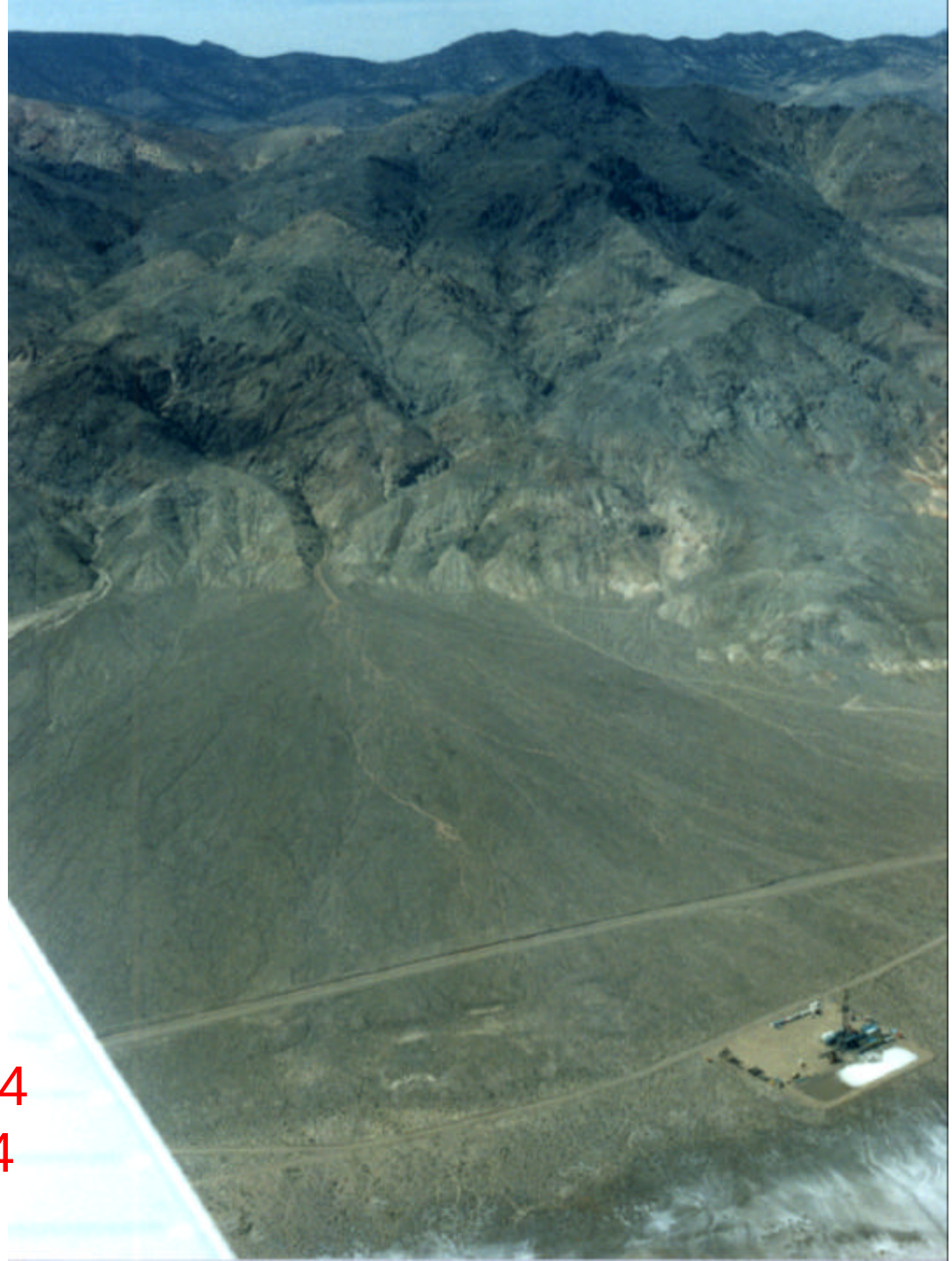
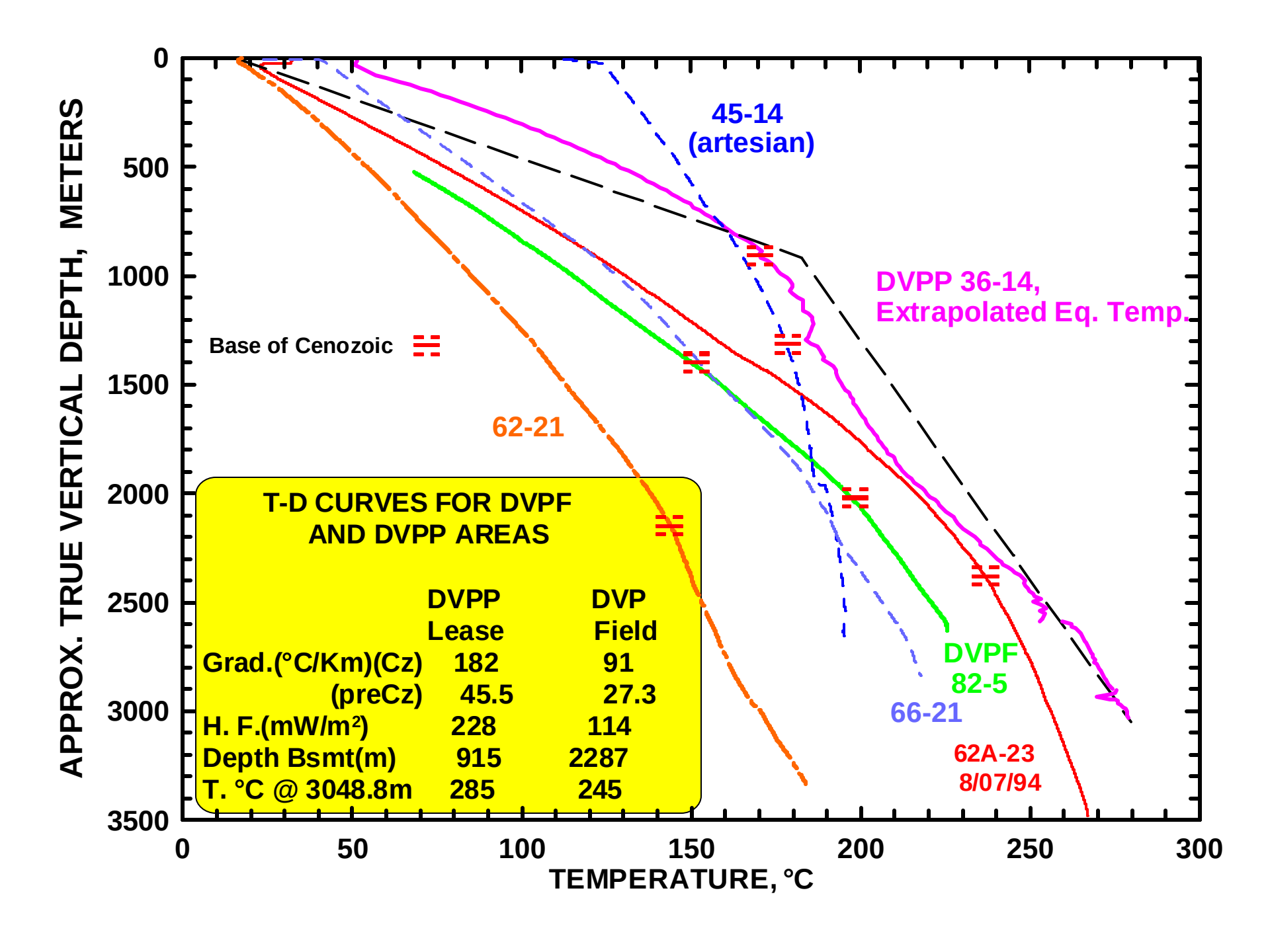
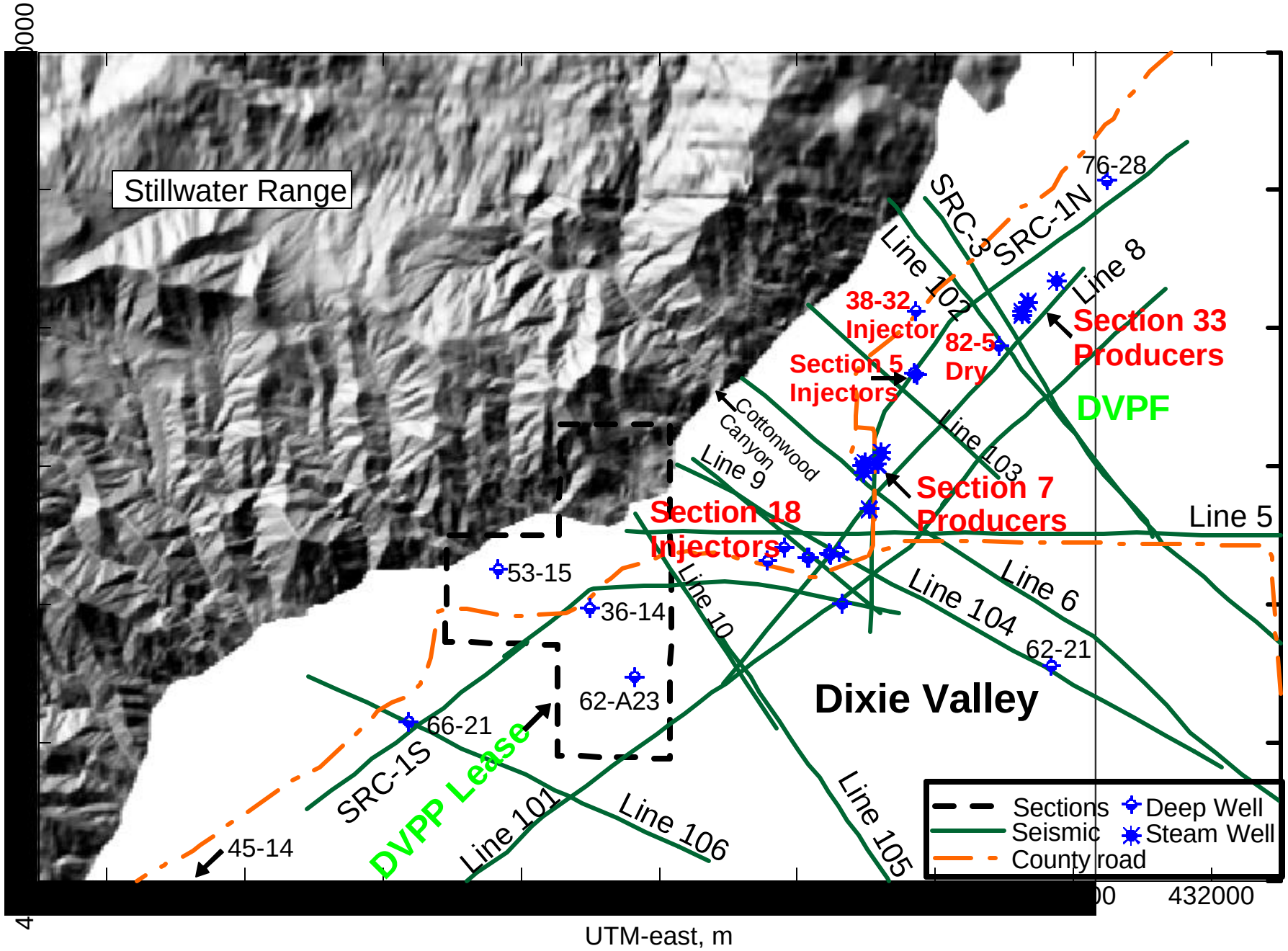
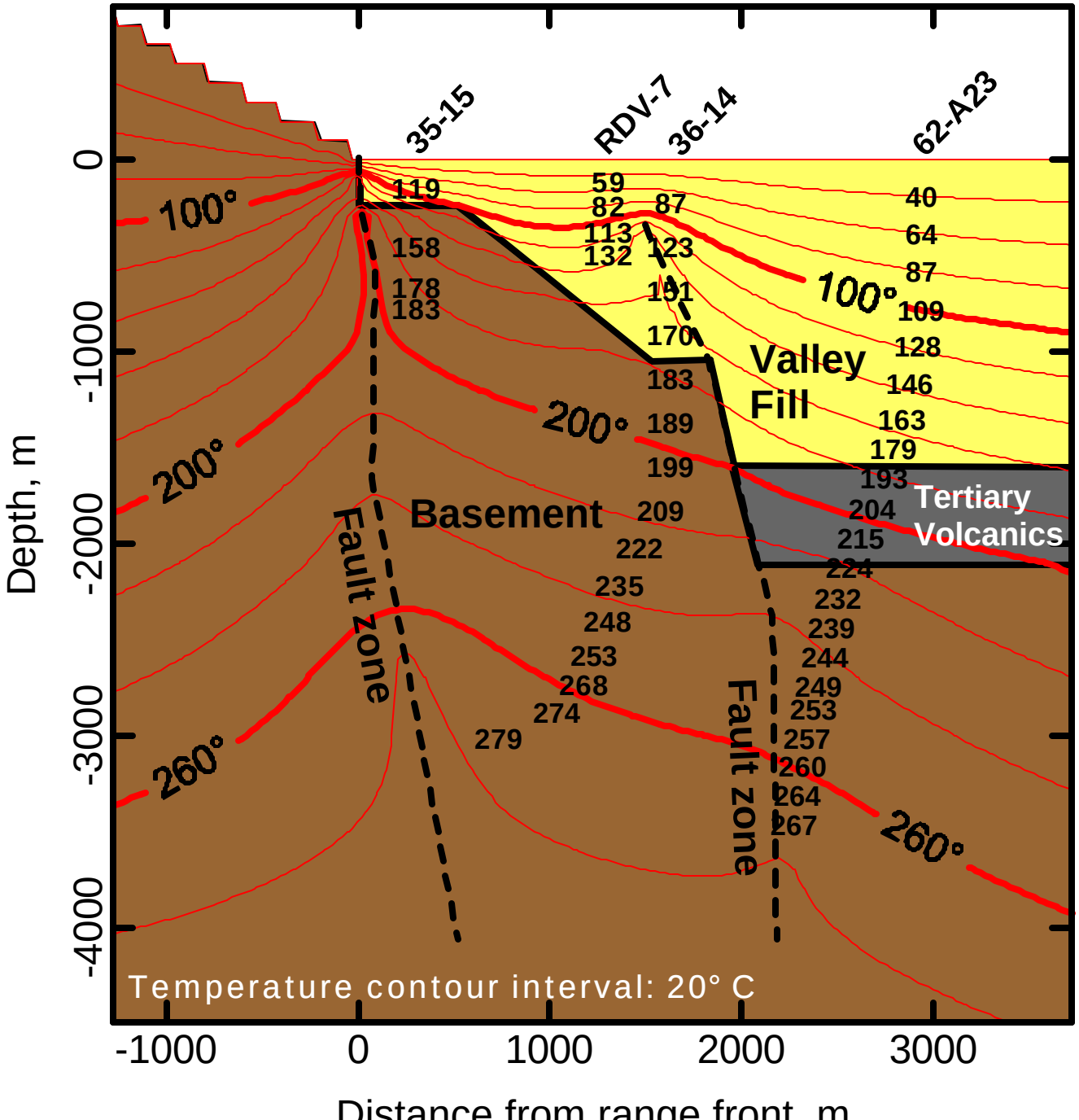
East Face of Stillwater Range from Geothermal Power Plant



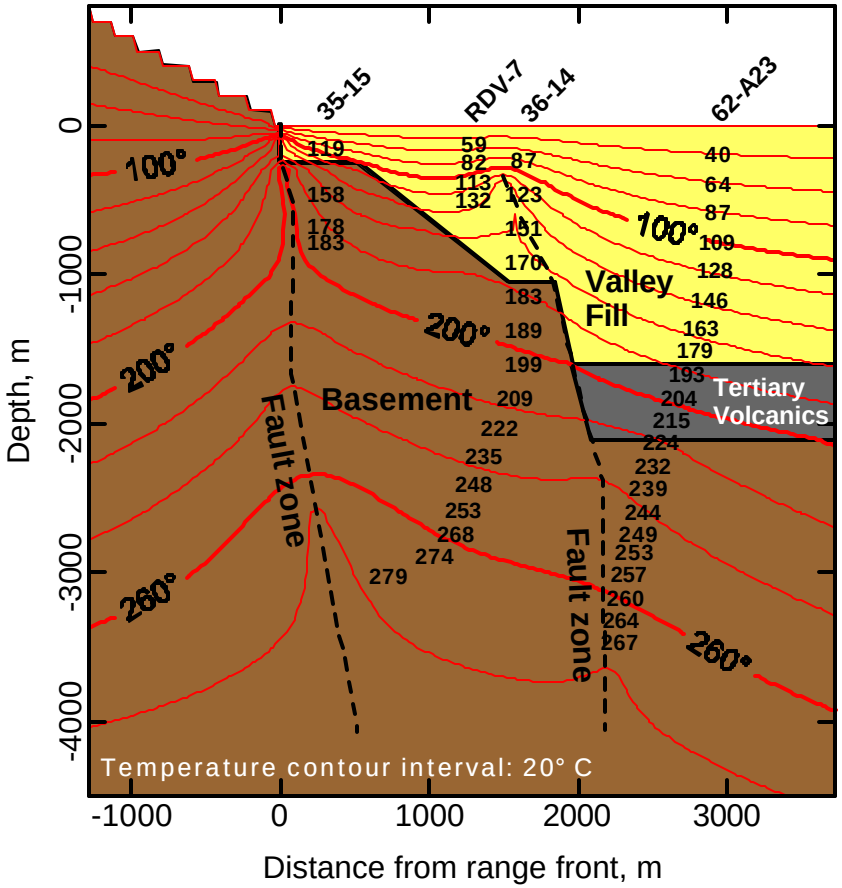
Dixie
Valley
DVPP
Well 36-14
July, 1994

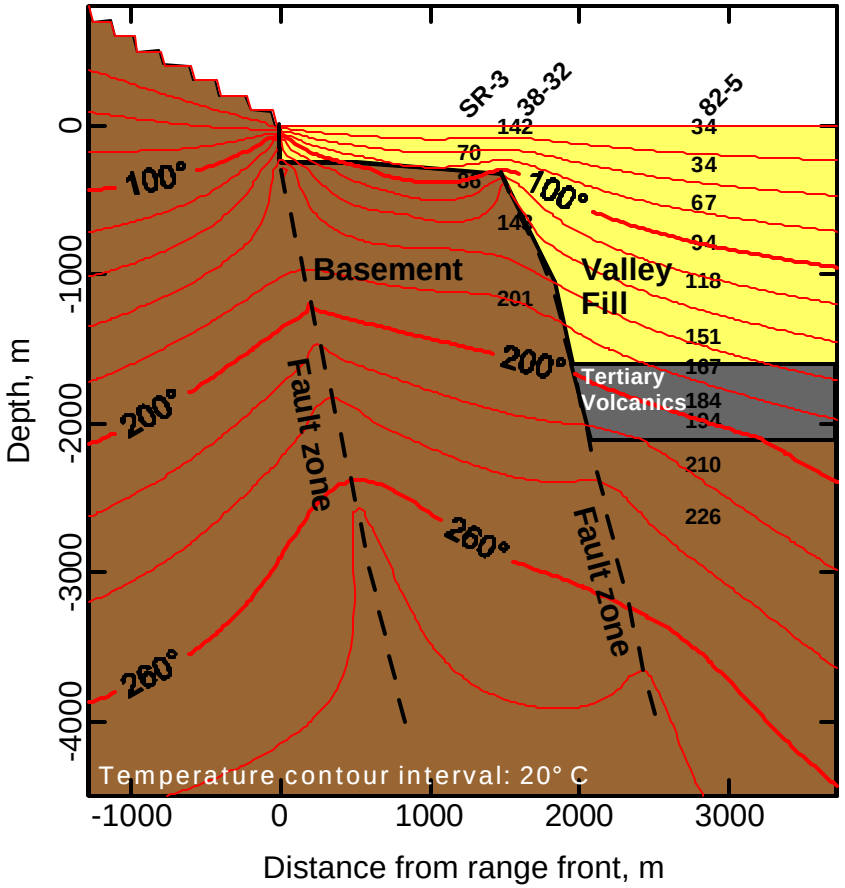

APPROX. TRUE VERTICAL DEPTH, METERS
0
500
1000
1500
2000
2500
3000
3500
0
50
100
150
200
250
300
TEMPERATURE, °C
45-14
(artesian)
DVPP 36-14,
Extrapolated Eq. Temp.
Base of Cenozoic
62-21
DVPF
82-5
66-21
62A-23
8/07/94
T-D CURVES FOR DVPF
AND DVPP AREAS
DVPP
Lease
DVP
Field
Grad.(°C/Km)(Cz) 182 91
(preCz) 45.5 27.3
H. F.(mW/m²) 228 114
Depth Bsmt(m) 915 2287
T. °C @ 3048.8m 285 245

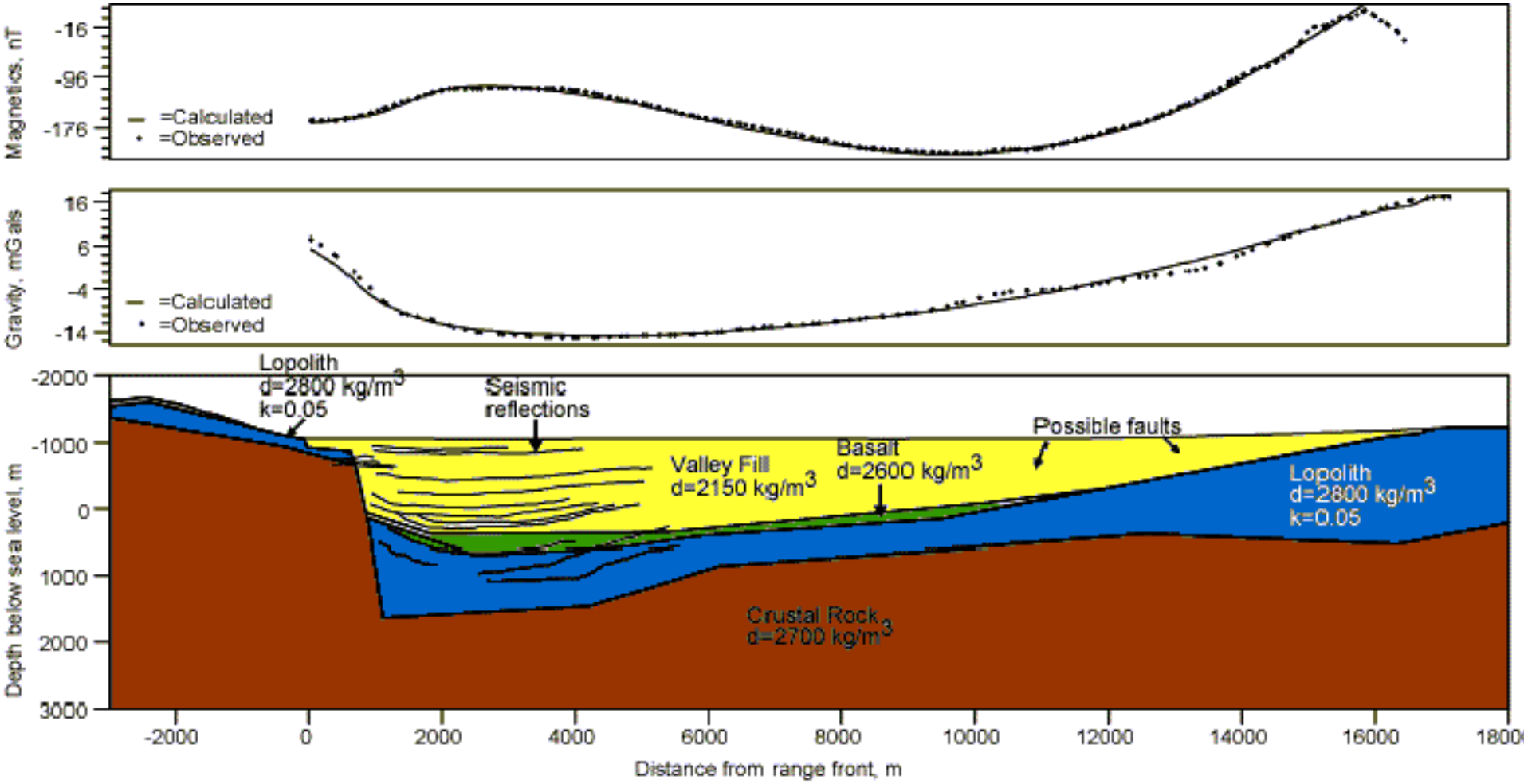

Stillwater Range
76-28
SRC-3
SRC-1N
Line 102
Line 8
38-32
Injector
82-5
Dry
Section 5
Injectors
Section 33
Producers
DVPF
Cottonwood
Canyon
Line 9
Line 103
Section 18
Injectors
Section 7
Producers
Line 5
53-15
36-14
Line 10
Line 6
Line 104
62-21
62-A23
Dixie Valley
66-21
SRC-1S
DVPP Lease
45-14
Line 101
Line 106
Line 105
Sections
Deep Well
Seismic
Steam Well
County road
UTM-north, m
UTM-east, m
432000

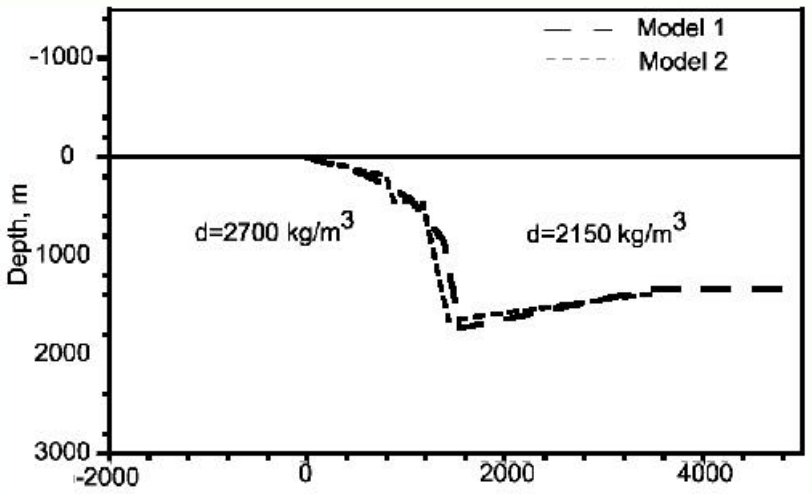

35-15
RDV-7
36-14
62-A23
100°
200°
260°
Valley Fill
Basement
Tertiary Volcanics
Fault zone
Fault zone
Temperature contour interval: 20° C
Depth, m
0
-1000
-2000
-3000
-4000
-1000
0
1000
2000
3000
Distance from range front, m

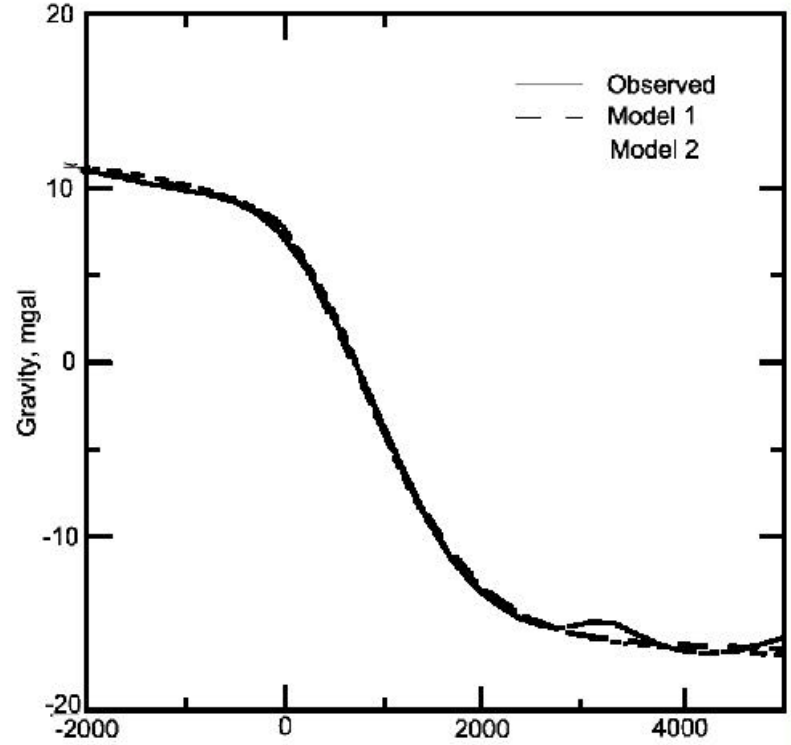
Comparison of the Thermal Regimes, DVPA & DVPP

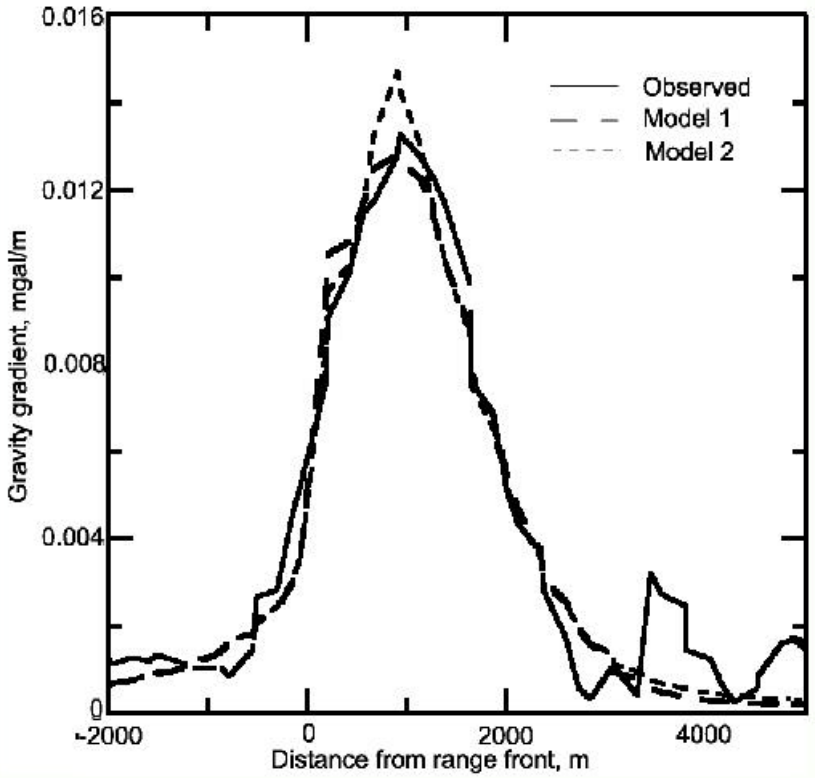


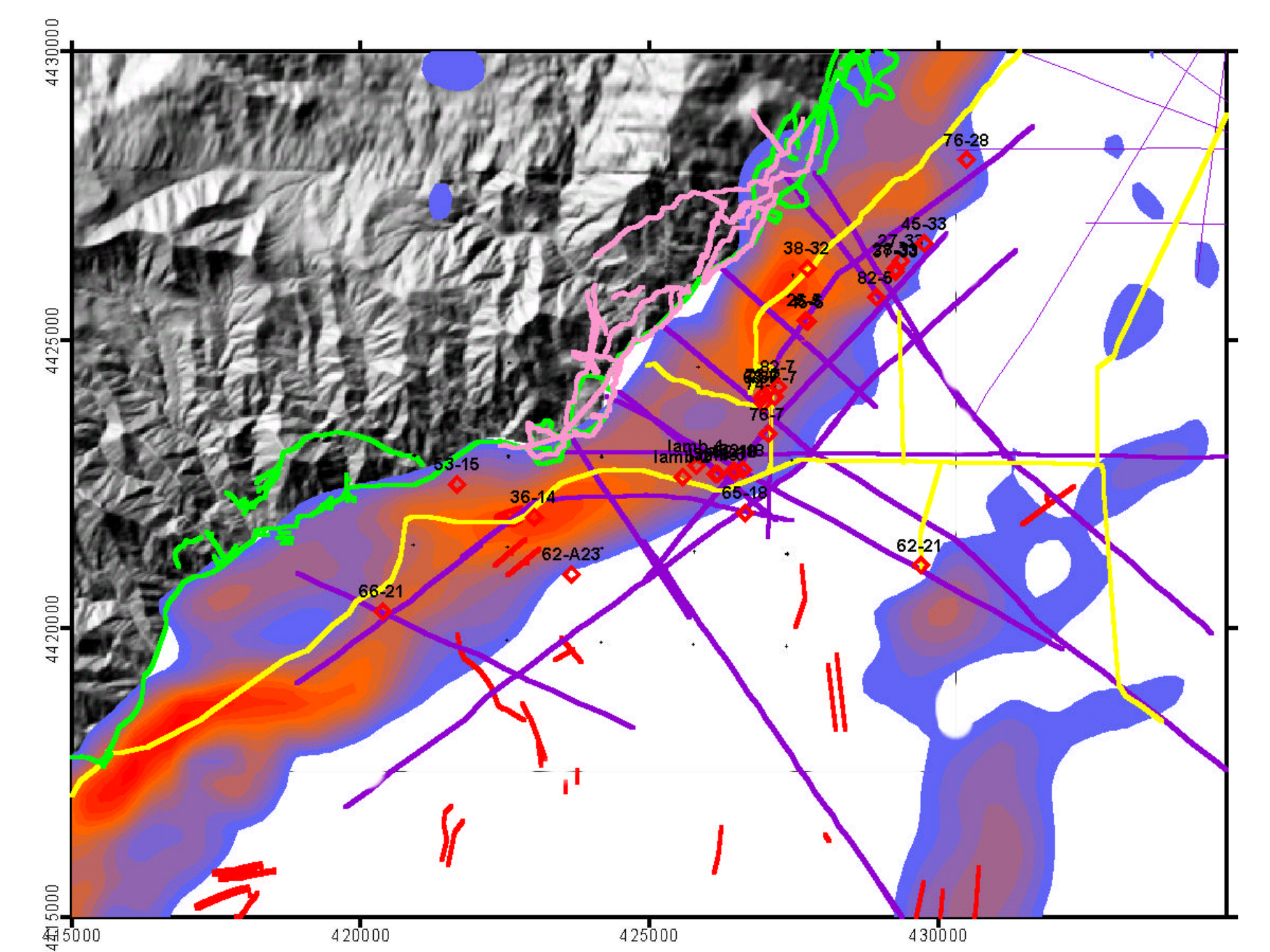



Magnetics, nT
-16
-96
-176
=Calculated
=Observed
Gravity, mGals
16
6
-4
-14
=Calculated
=Observed
Depth below sea level, m
-2000
-1000
0
1000
2000
3000
Lopolith
d=2800 kg/m3
k=0.05
Seismic
reflections
Valley Fill
d=2150 kg/m3
Basalt
d=2600 kg/m3
Possible faults
Lopolith
d=2800 kg/m3
k=0.05
Crustal Rock
d=2700 kg/m3
-2000
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Distance from range front, m


Model 1
Model 2
-1000
0
1000
2000
3000
Depth, m
d=2700 kg/m3
d=2150 kg/m3
-2000
0
2000
4000

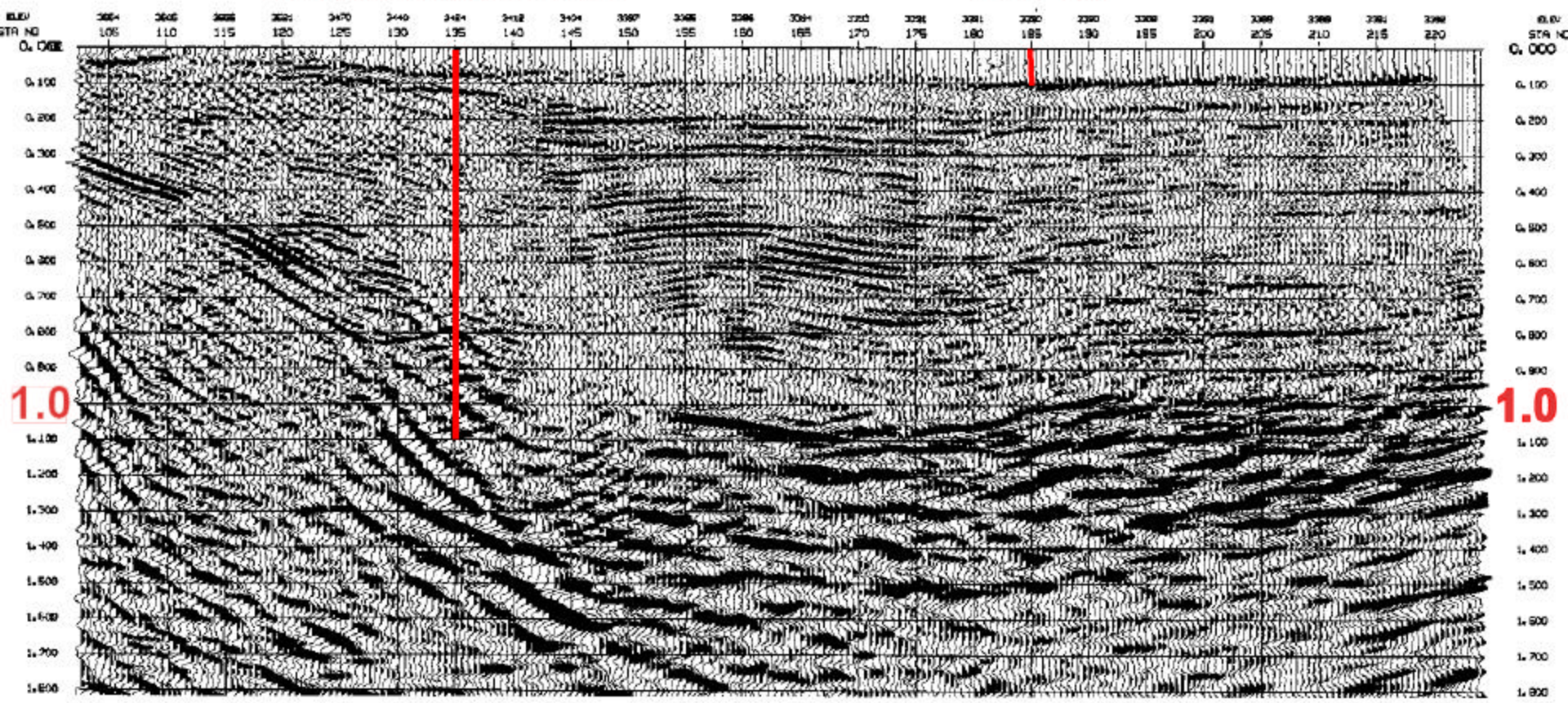

Observed
Model 1
Model 2
20
10
0
-10
-20
Gravity, mgal
-2000
0
2000
4000

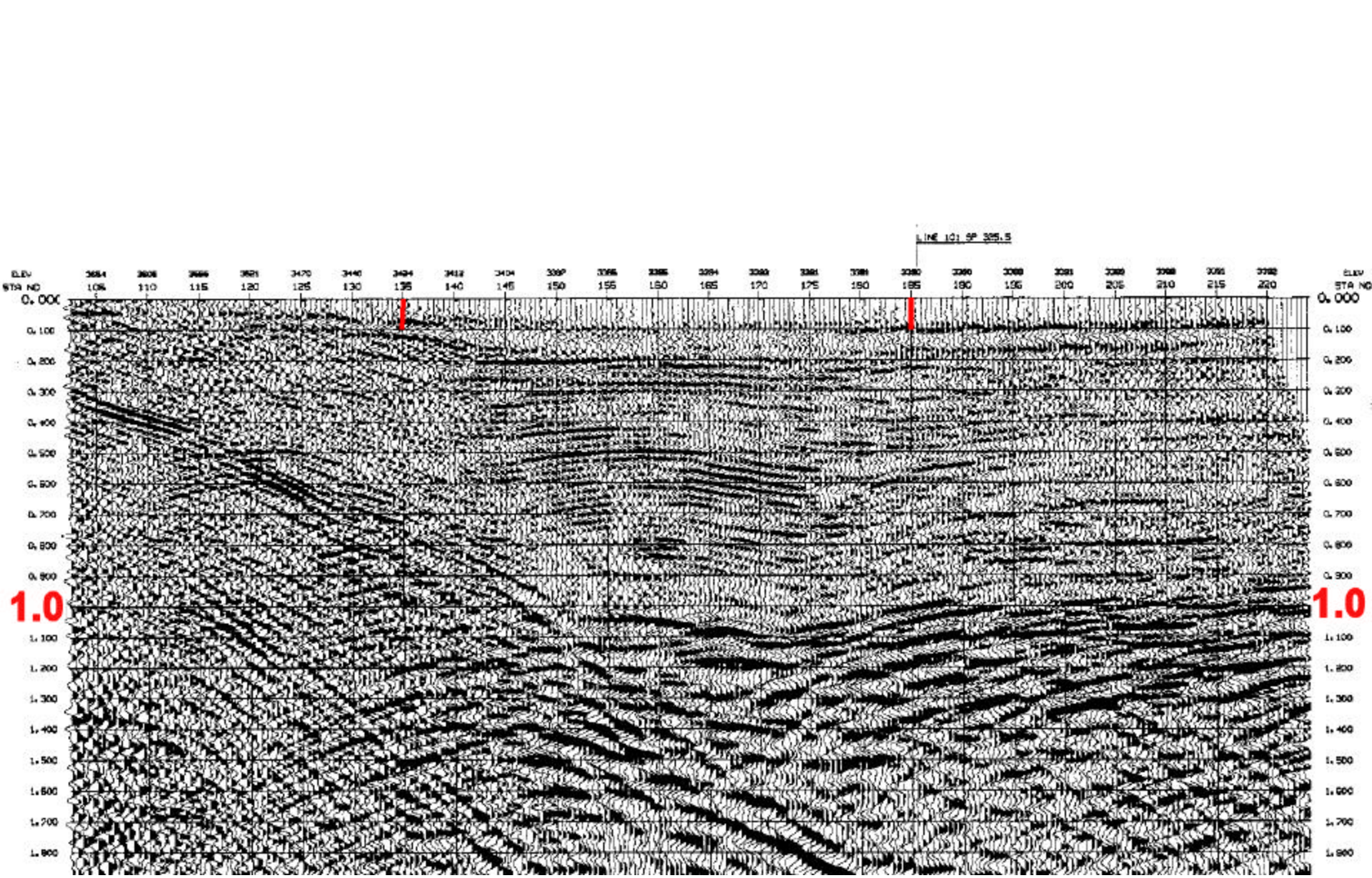

Observed
Model 1
Model 2
0.016
0.012
0.008
0.004
0
Gravity gradient, mgal/m
-2000
0
2000
4000
Distance from range front, m

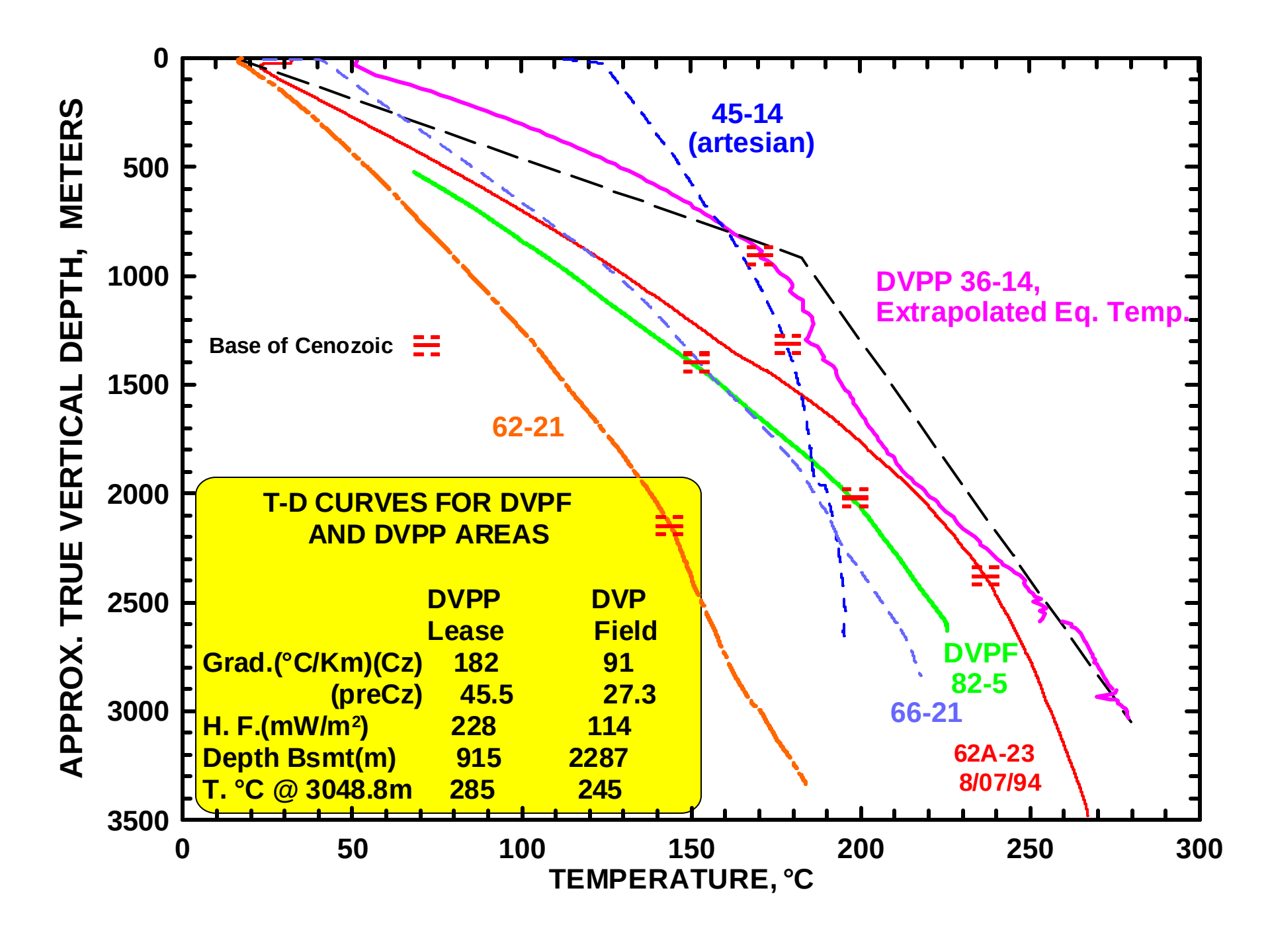

4430000
4425000
4420000
4415000
415000
420000
425000
430000
76-28
45-33
38-32
82-5
82-7
76-7
53-15
36-14
62-A23
66-21
65-18
62-21

PROBLEMS WITH SEISMIC REFLECTION DATA

- Large Lateral Velocity Variations
- Side Reflections on Structure Parallel Orientations
- Steeply Dipping Structures
- Older Data and Processing
- Focus on Deep Structure (2-3 km, 6,000-10,000 ft)


Line SRC-1S & 66-21
Line 101
1.0
1.0


LINE 101 SP 395.5
ELEV
STA NO
0.000
1.0
1.0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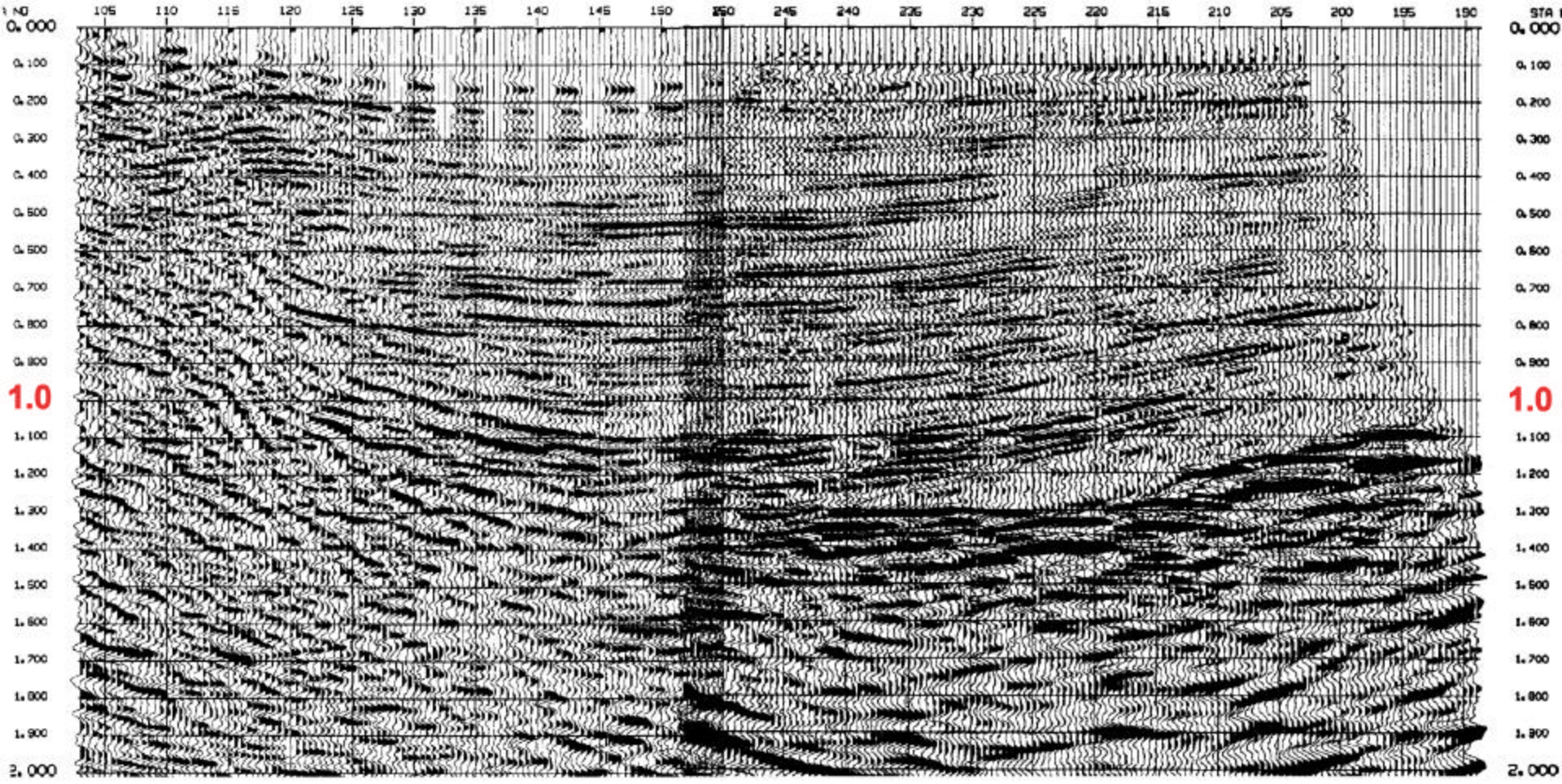
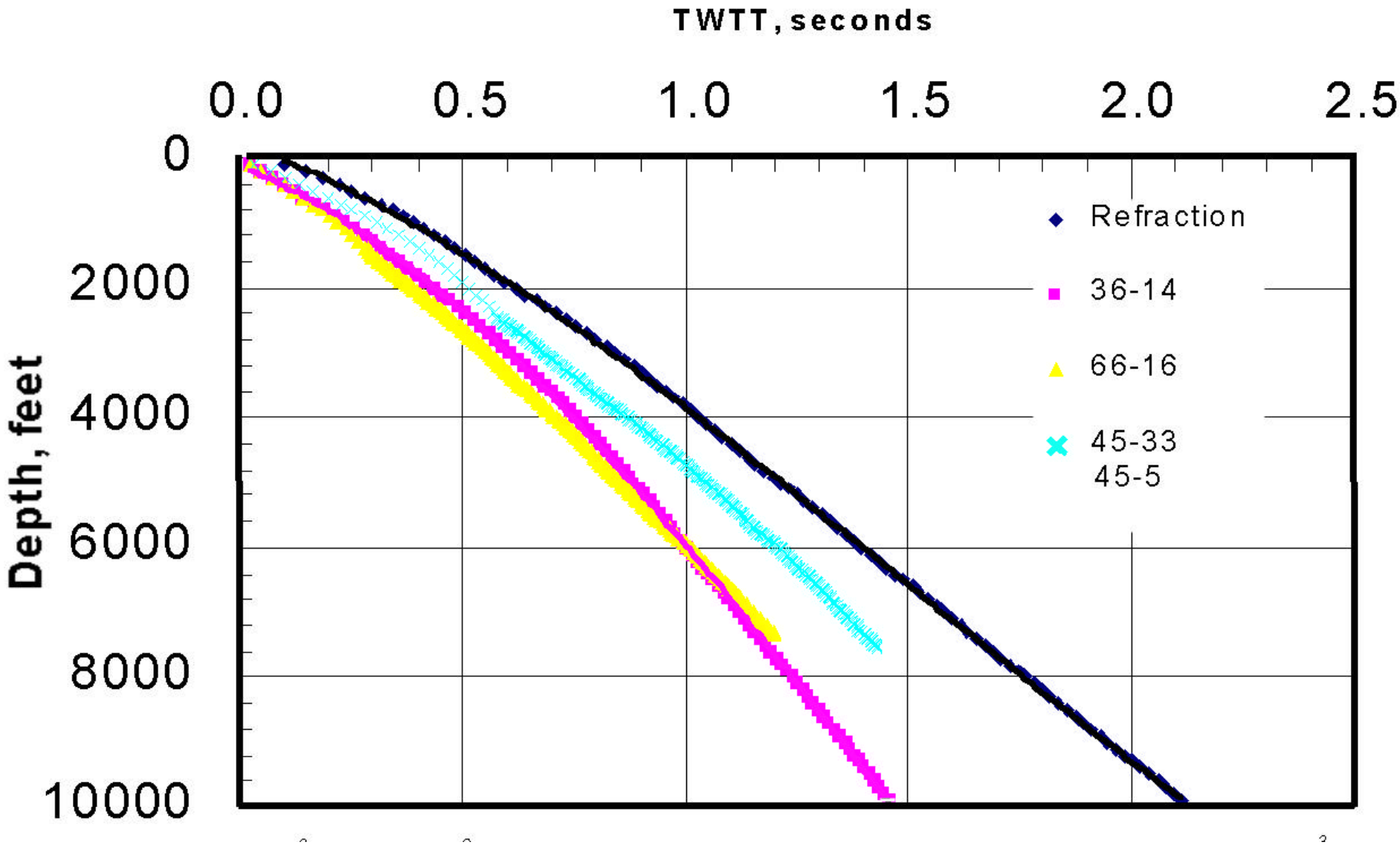
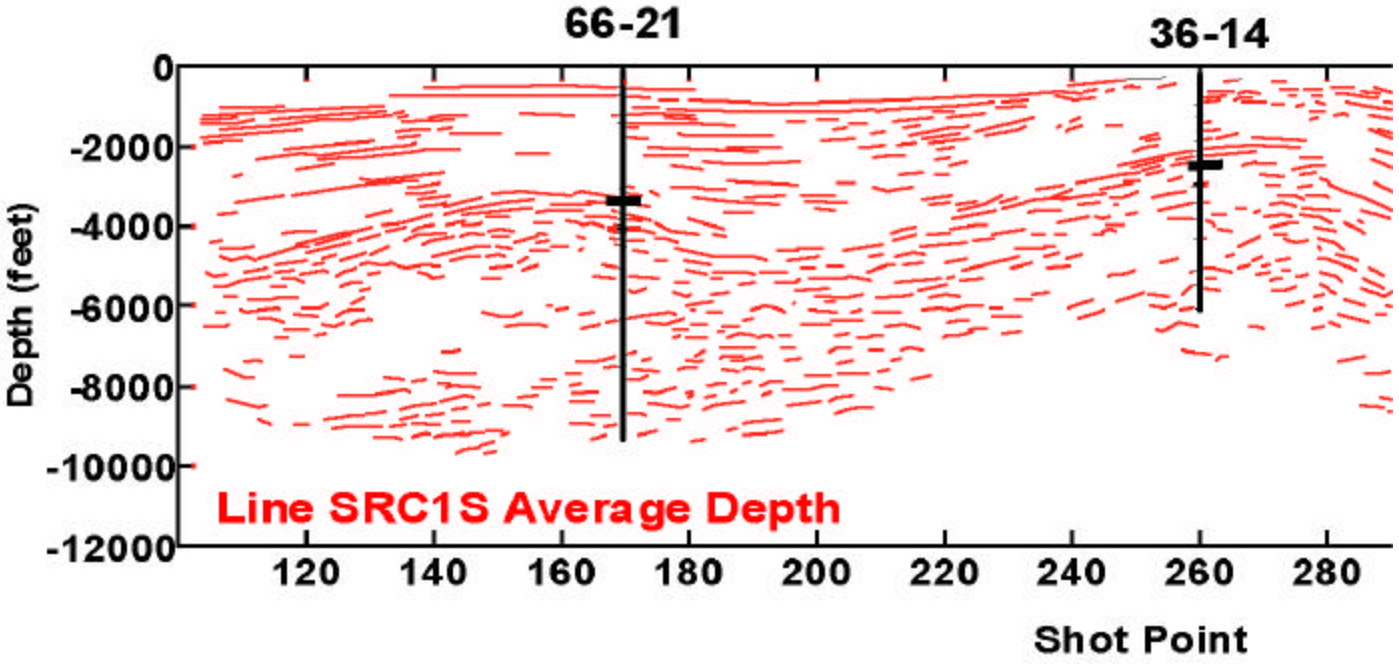
H. F.(mW/m²) 228 114
Depth Bsmt(m) 915 2287
T. °C @ 3048.8m 285 245

Line 10

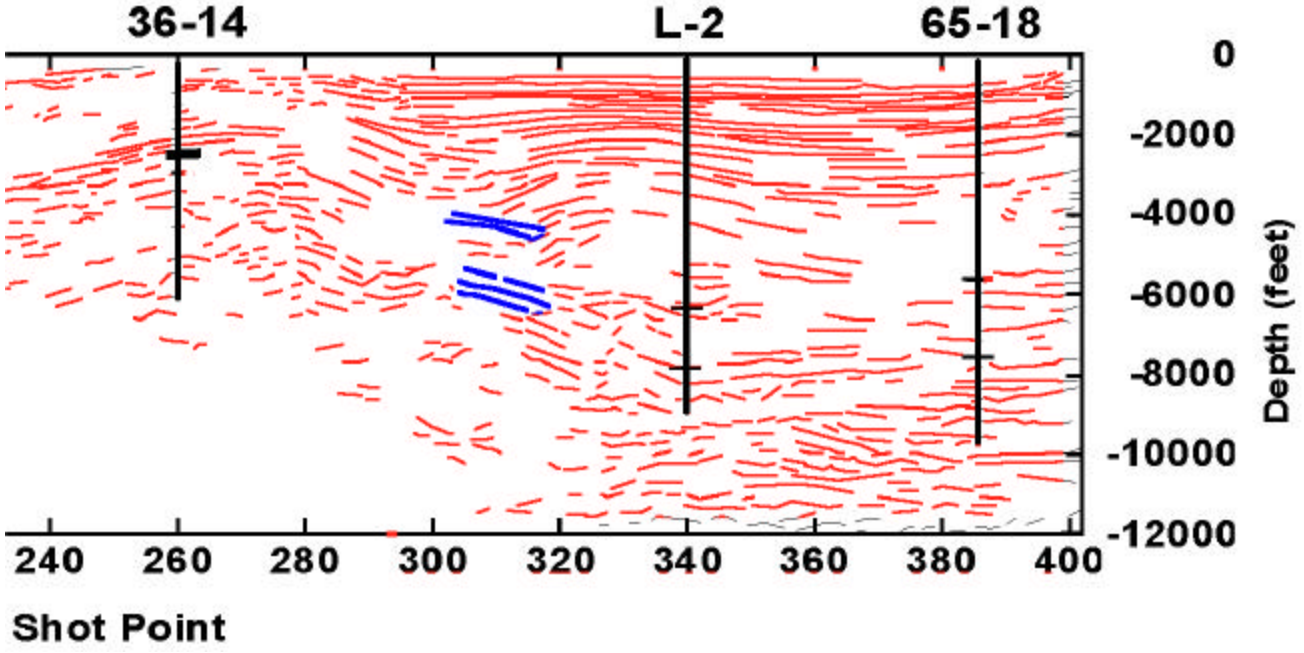
Line 105 Migrated

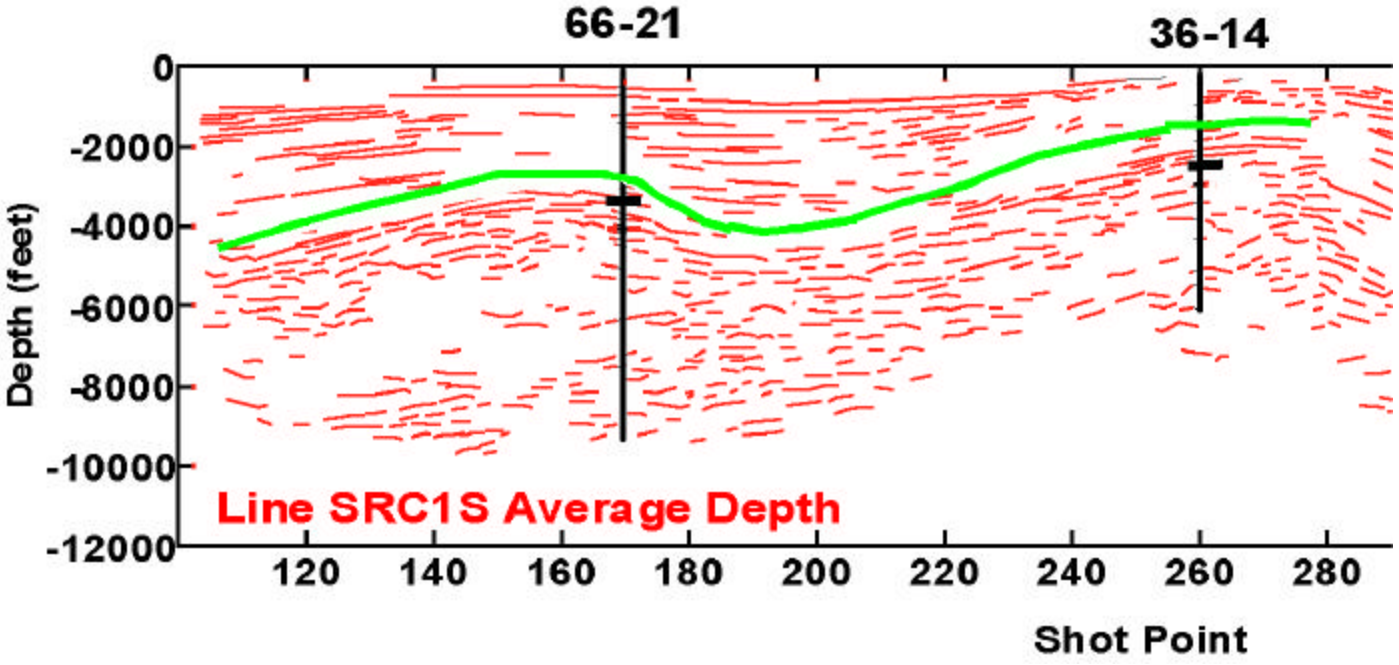



TWTT, seconds
0.0
0.5
1.0
1.5
2.0
2.5
Depth, feet
0
2000
4000
6000
8000
10000
Refraction
36-14
66-16
45-33
45-5

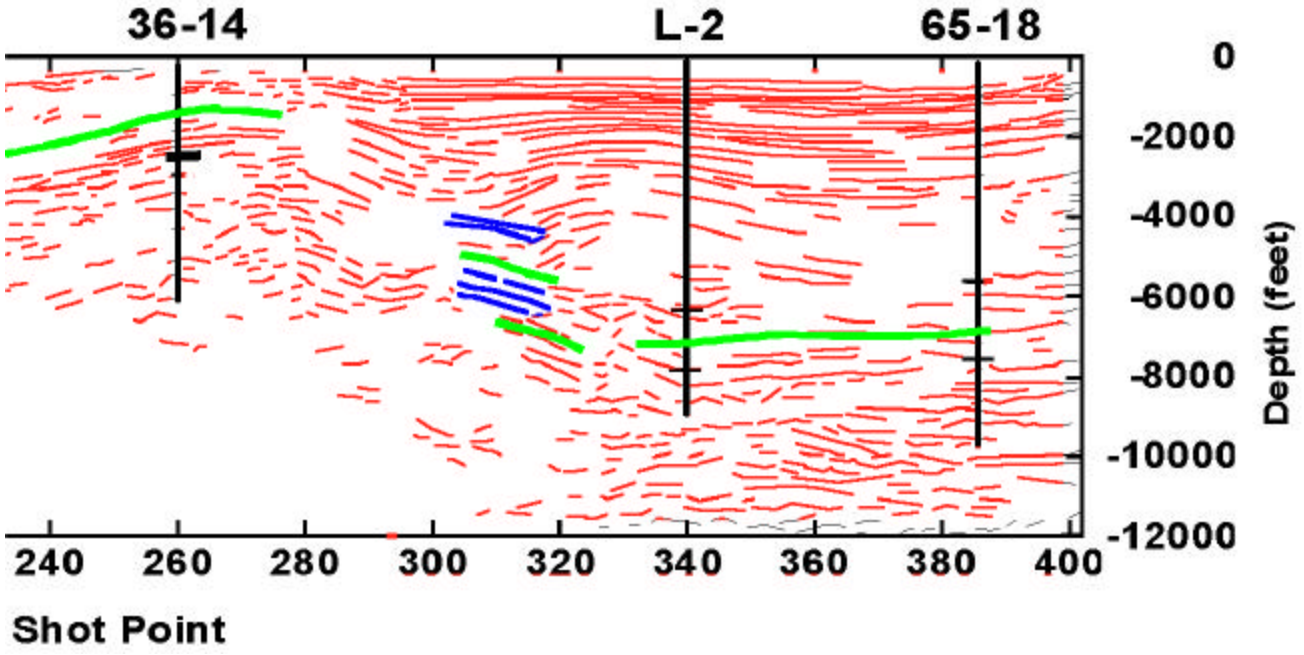


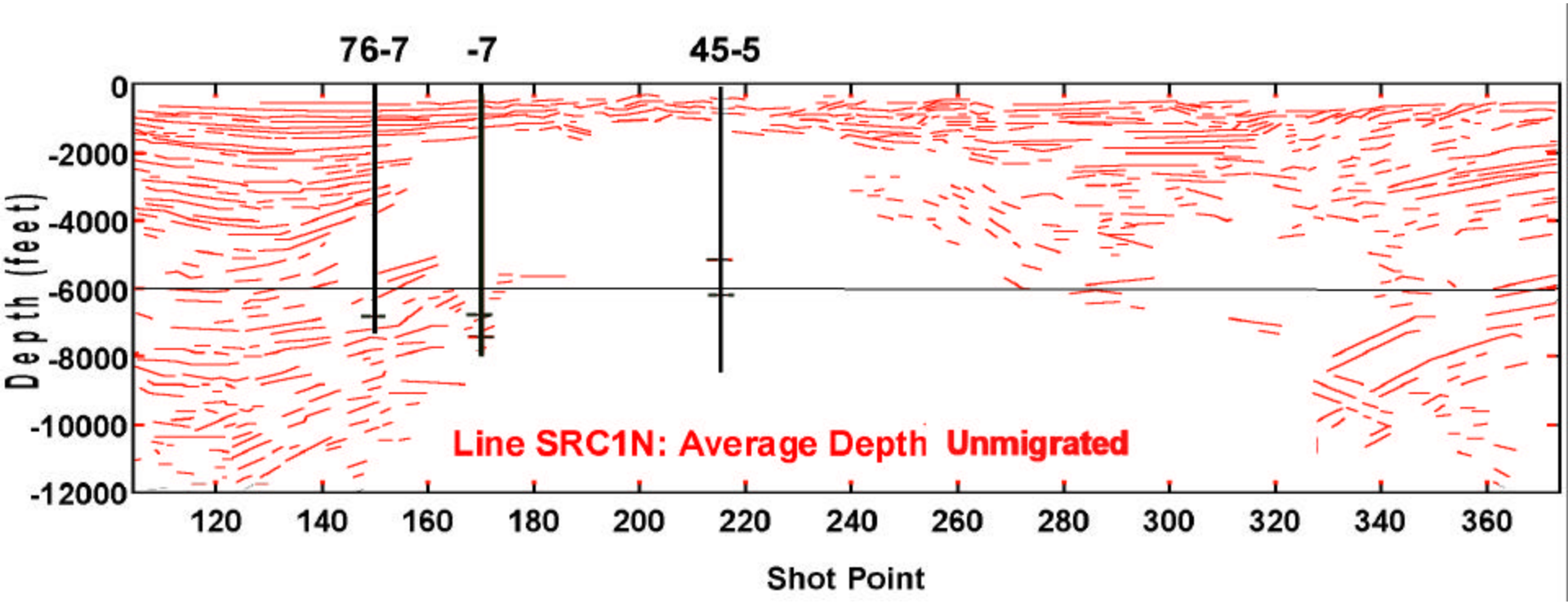
Fault, Syncline, "side" reflections



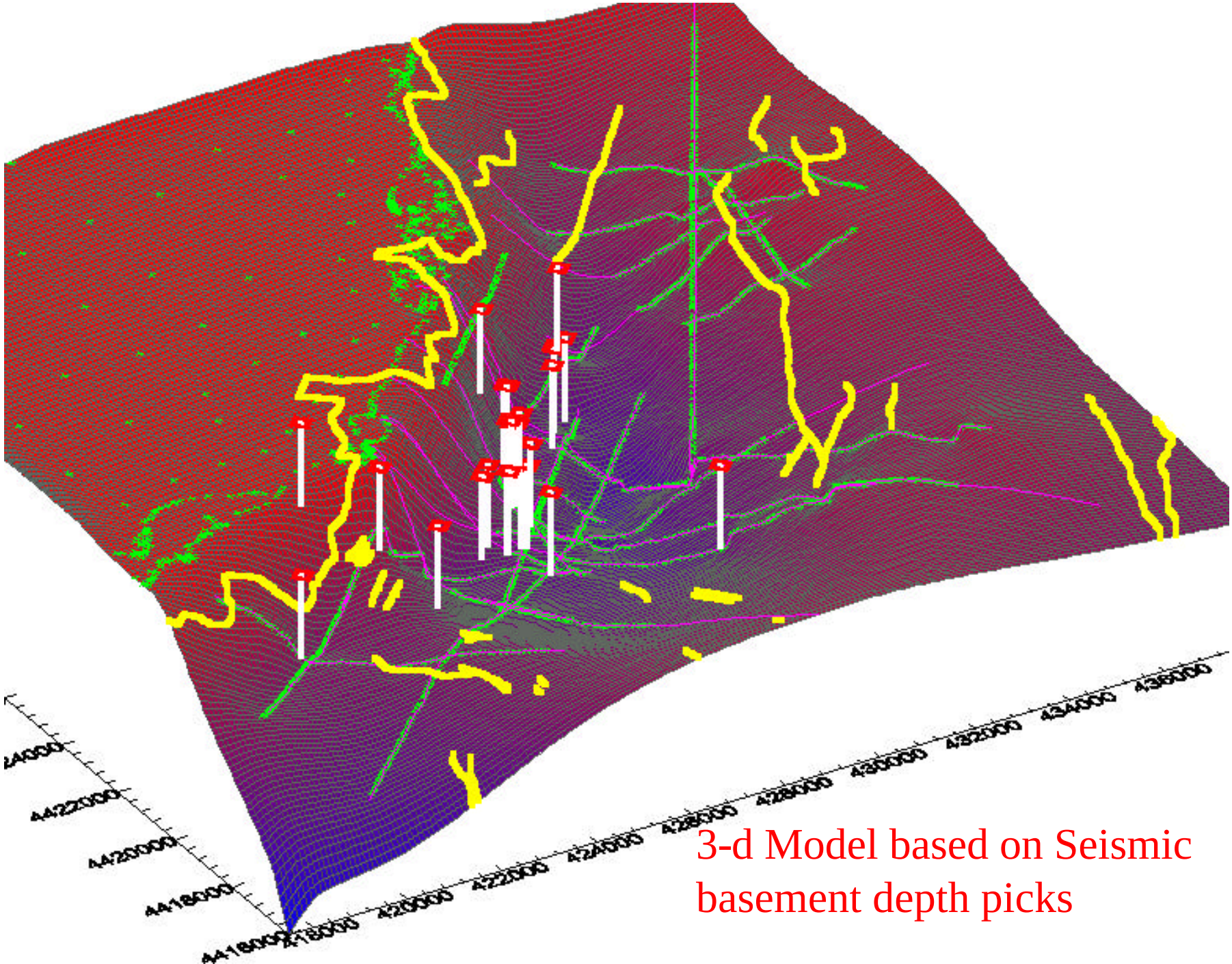


Basement lines in green





Synthetic and antithetic dips, lack of reflectors in center

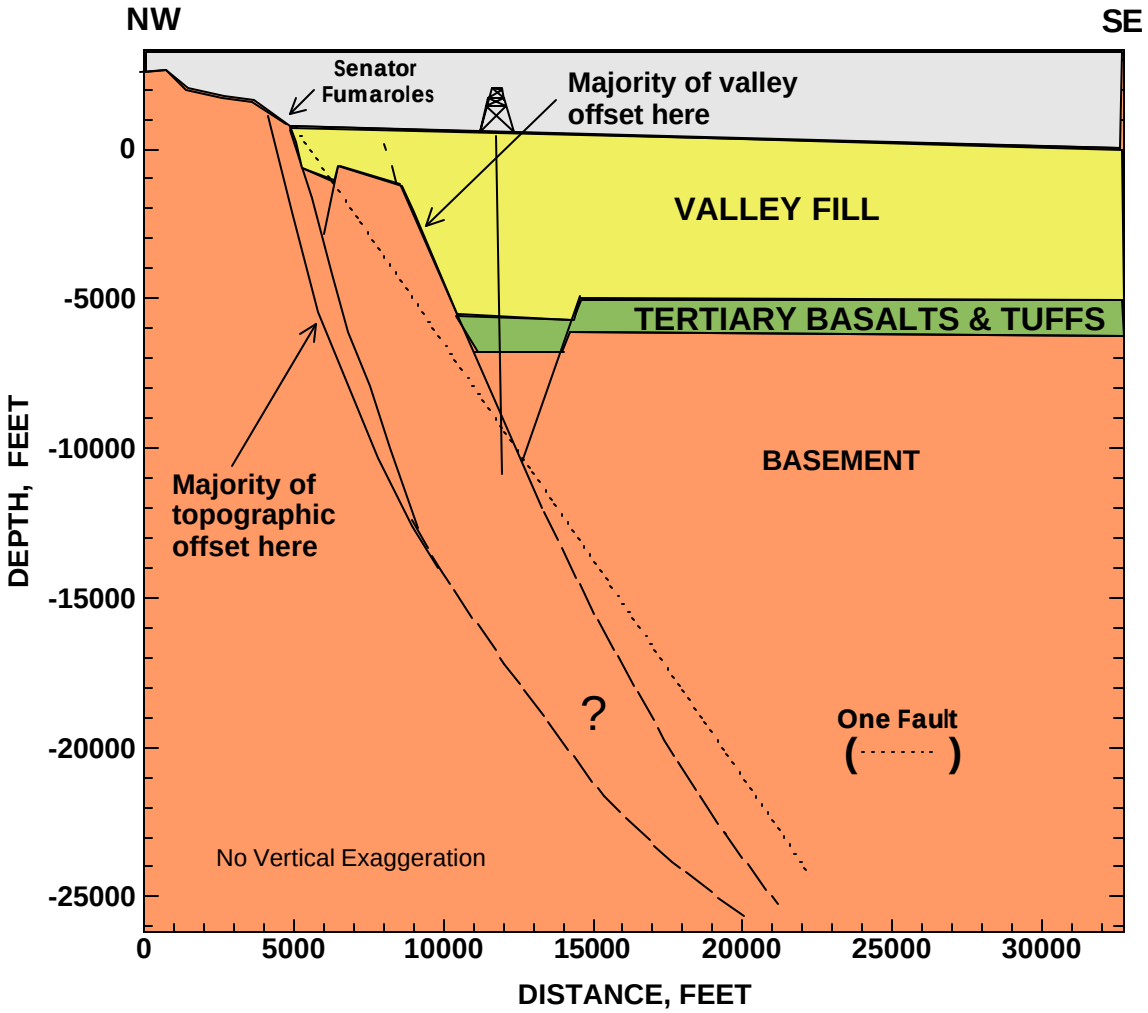


3-d Model based on Seismic basement depth picks

How are the observations reconciled? The nature of B$R Faults

- 2-3 km wide zone at surface (1 to 2 km deep) of extensionally fractured (shattered) basement rock in the valley and the range
- Common ideas of segmentation may not be appropriate (surface trace has little to do with deeper structure, shallow inhomogeneties)
- Ramp structures are very common
- Drape Folds
- Faults in Range, steep to 45 °, slump shaped (not seen in historic quakes because not looked for-how about Hebgen Lake?)
- Over steepened slopes and thick and thin slumps (erosion of piedmont block)
- Mechanics of failure-shallow to deep- extension, shear, flow; Upper parts are near vertical and shattered (low pressure deformation)
- Maximum subsidence may not be at edge of valley, facies are complicated
- Most of Valley displacement is taken up by valley (piedmont) faults, changes with time?

Idealized Dixie Valley Structure Model Based on Gravity, Seismic and Well Data



To Be Continued