Assembling a 3D Geologic Model for the Delta

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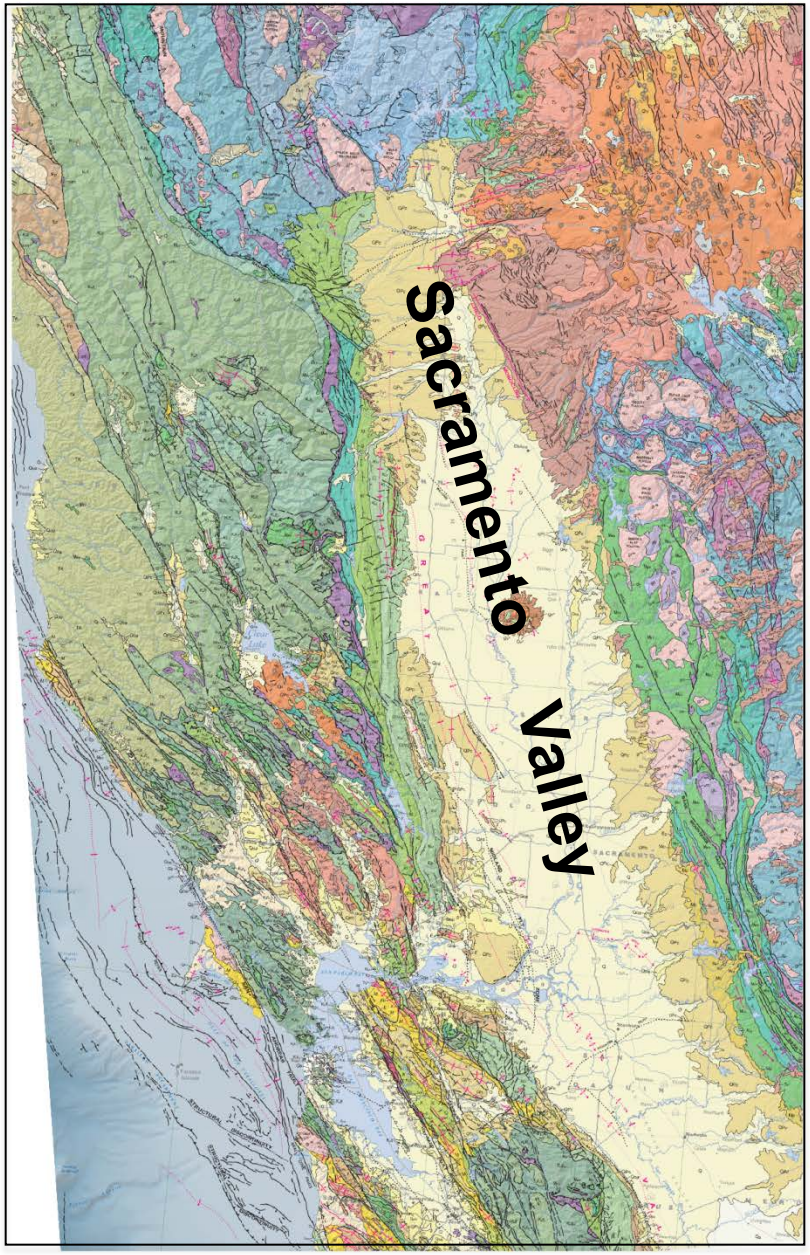
http://www.sacramentoriverdelta.net/photos/

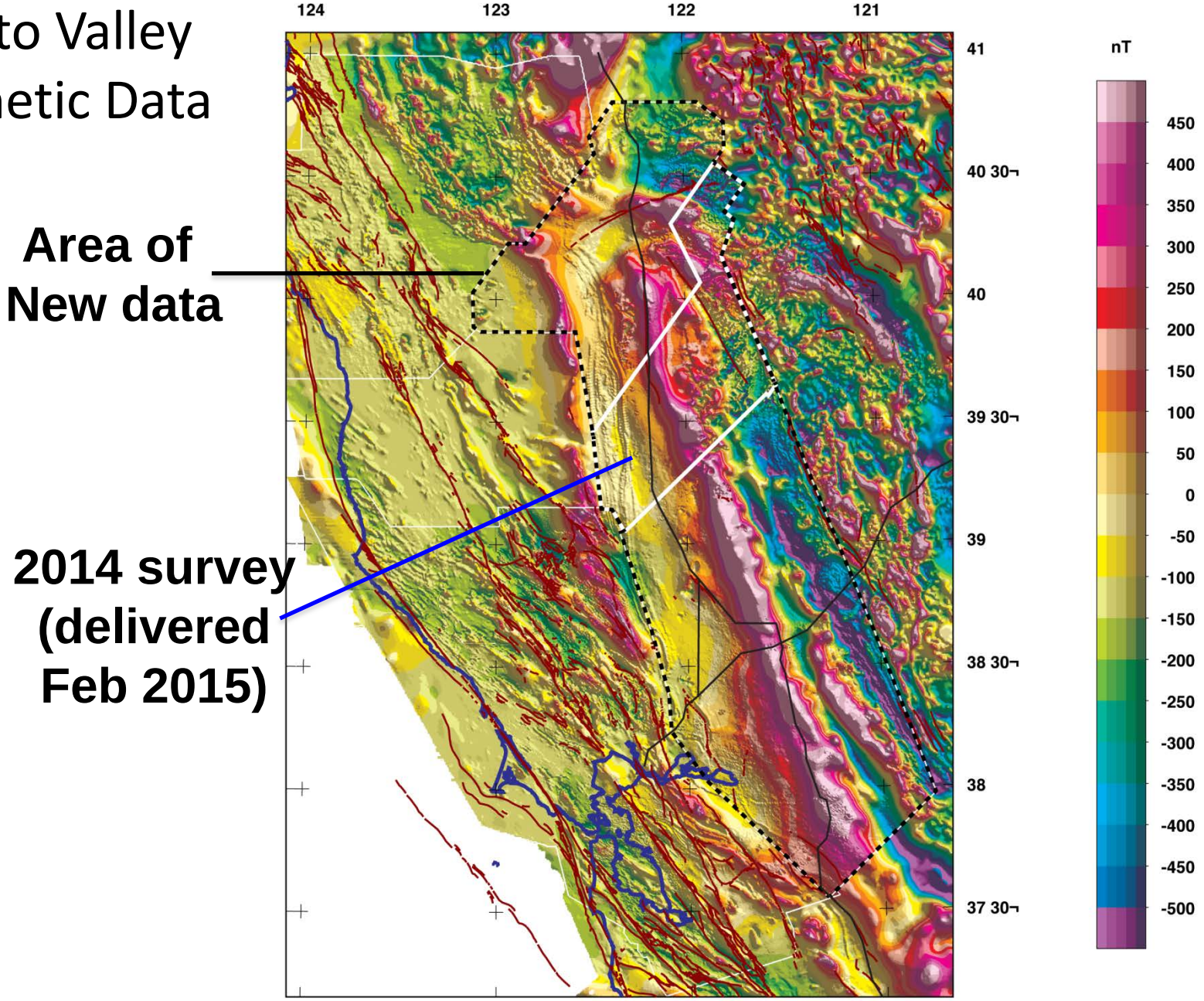
GMEG Study Area

- Geophysical setting of the Delta Region
- Data
- 3D Model of the Delta Region



CGS, 2010

Sacramento Valley Aeromagnetic Data



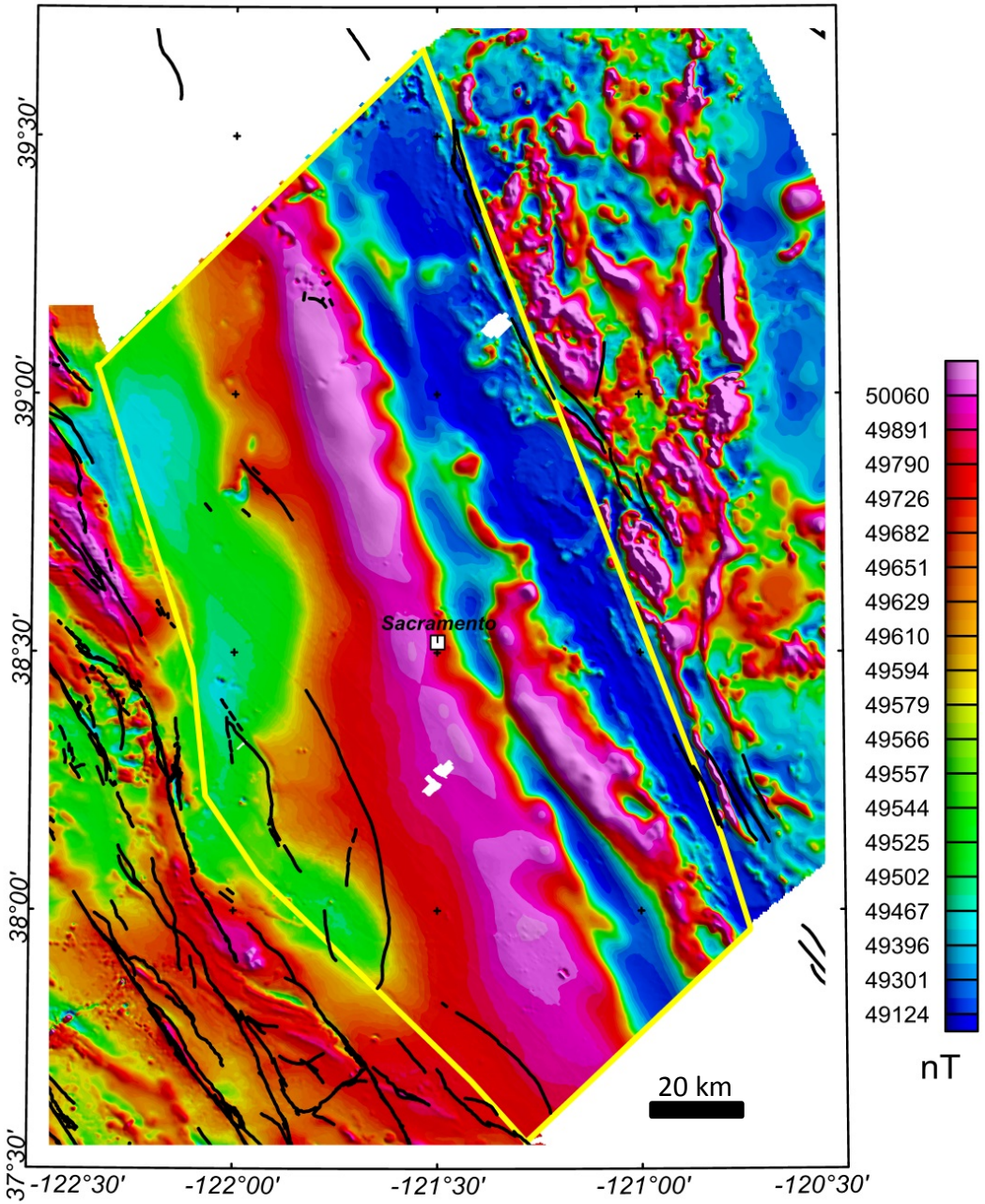
USGS science for a changing world

Langenheim, USGS OFR 2015-1186

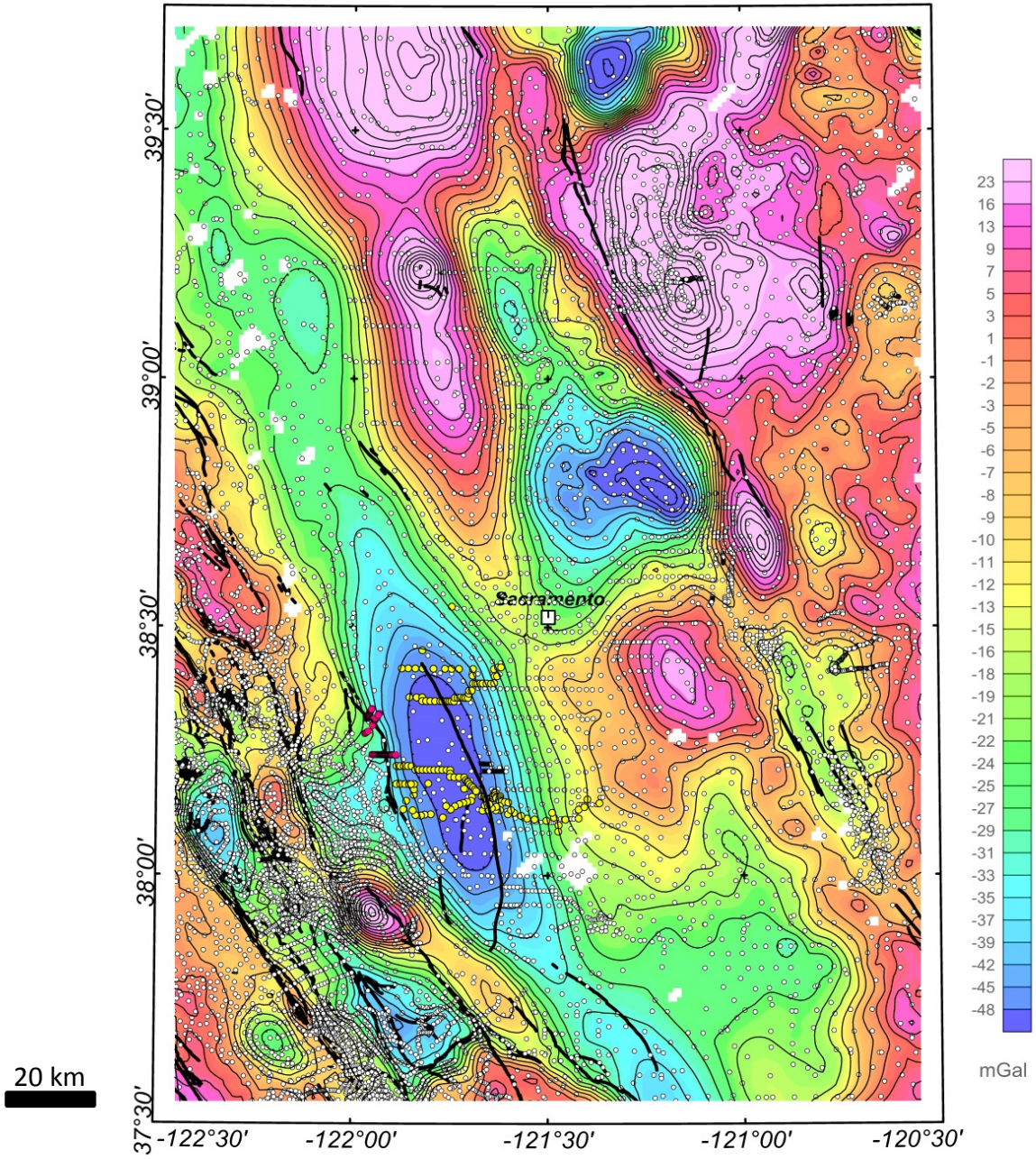
Aeromagnetic Map: Delta Region

2011 Aeromagnetic survey:

- NE-SW flight direction
- 800 m line spacing
- ~244 m draped altitude

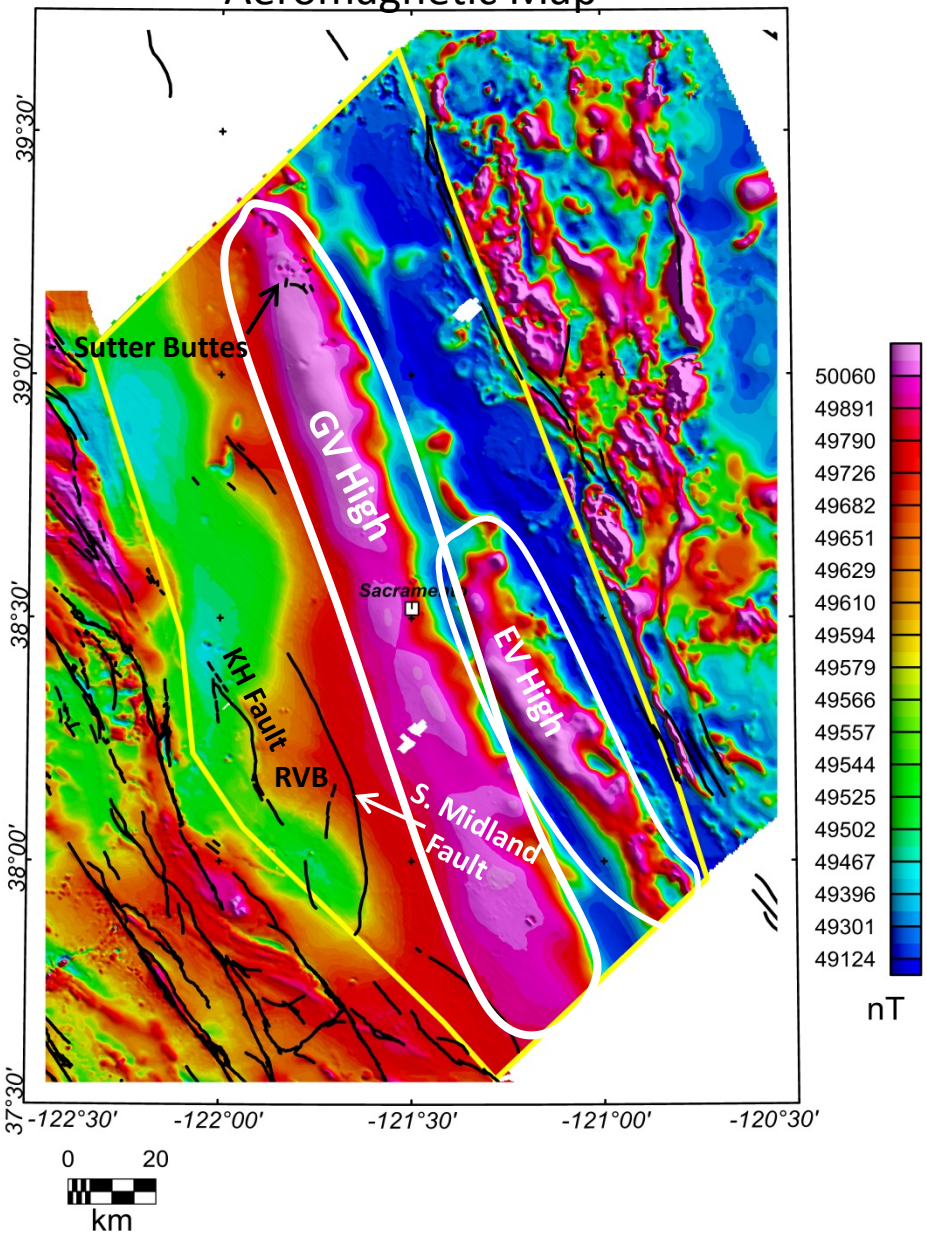


Gravity Map

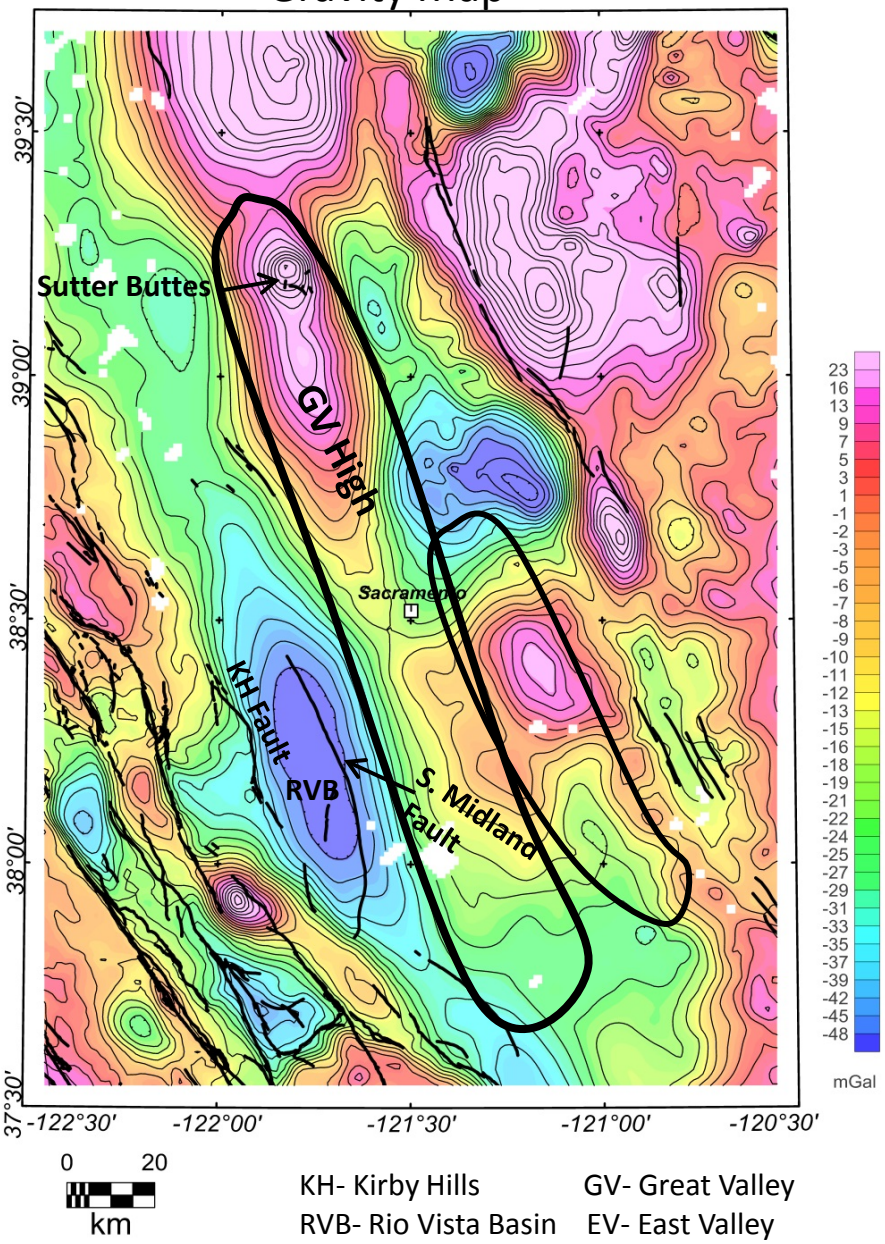

39°30′
39°00′
38°30′
38°00′
37°30′
-122°30′
-122°00′
-121°30′
-121°00′
-120°30′
Sacramento
20 km
23
16
13
9
7
5
3
1
-1
-2
-3
-5
-6
-7
-8
-9
-10
-11
-12
-13
-15
-16
-18
-19
-21
-22
-24
-25
-27
-29
-31
-33
-35
-37
-39
-42
-45
-48
mGal

Geophysical Setting of the Delta Region

Aeromagnetic Map



Gravity Map

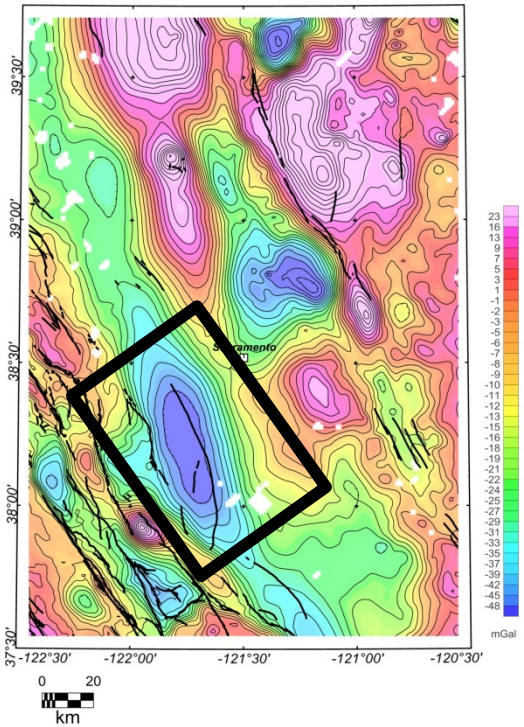


KH- Kirby Hills
RVB- Rio Vista Basin
GV- Great Valley
EV- East Valley

3D Model Components

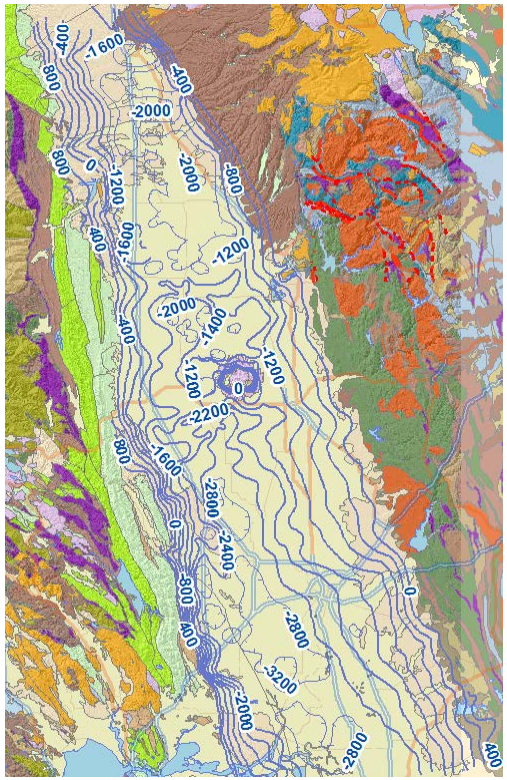
wells
- Quaternary layer
- Mio-Pliocene (non-marine)
- Paleogene
- Upper Cretaceous

Geophysics
- Lower Cretaceous
- Basement
- Faults (KHF, Midland F.)

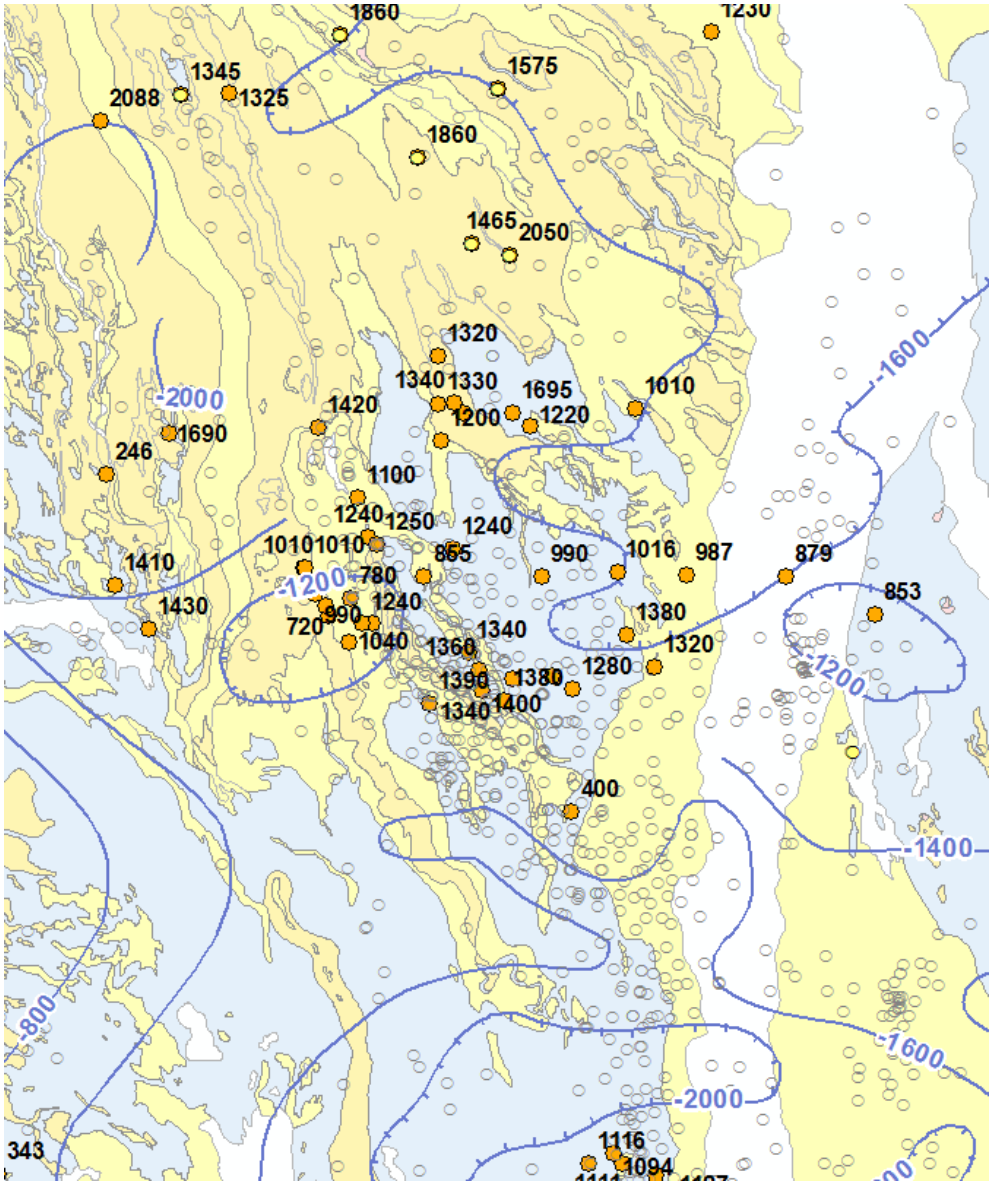


- Incorporate substantial amount of stratigraphic data from oil & gas wells
- Continue digitization of geophysical logs, refine density depth relationships, geophysical modeling
- Refine fault geometry of KHF, more gravity data collection
- EarthVision

Subsurface – Post-Eocene continental deposits



- Base post-Eocene
- Colored dots: base picked in oil & gas wells
- Open circles, not picked
- Little correlation



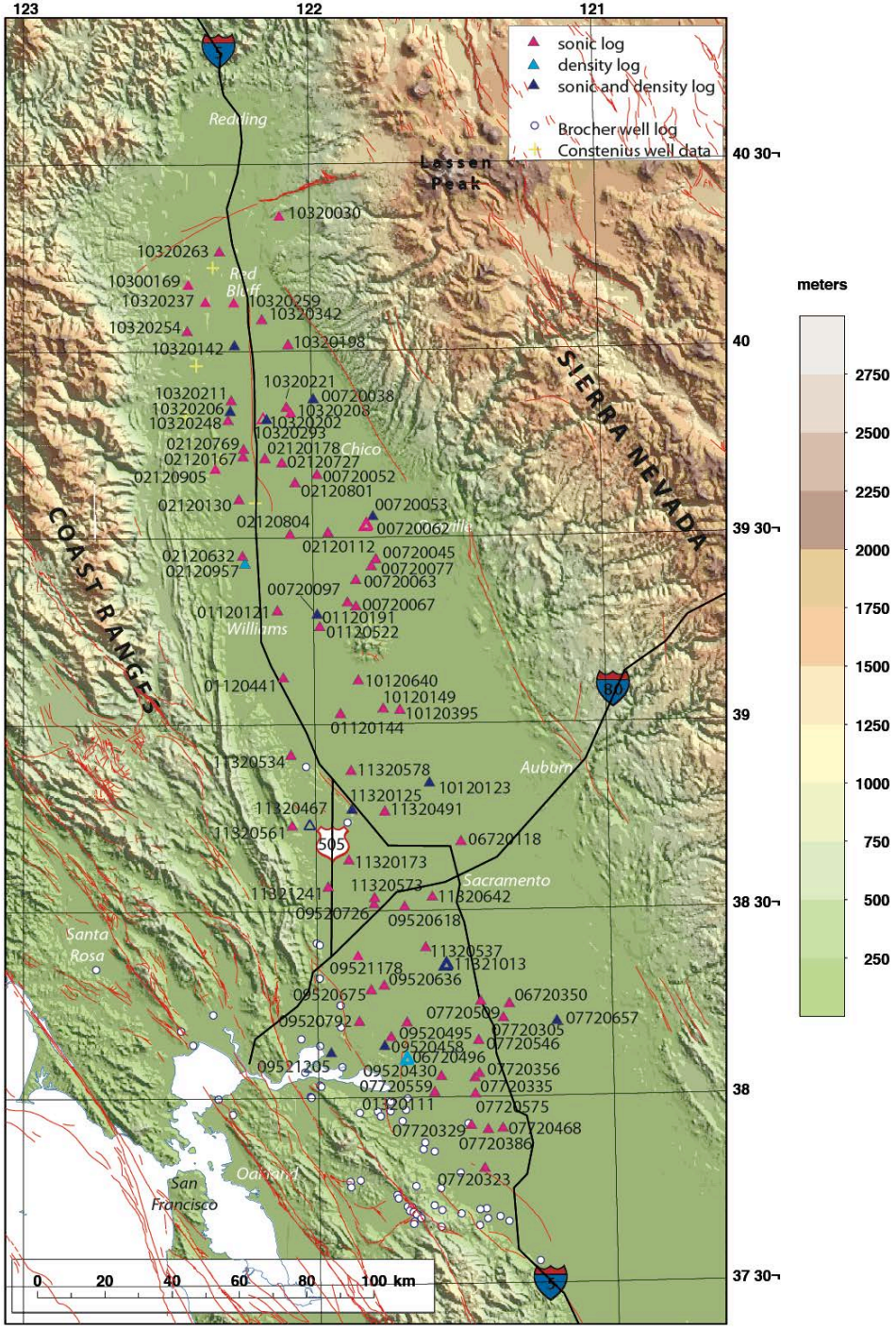
Base post-Eocene (blue contours) from USGS WRI 45-73 (1974)

Sacramento Valley Geophysical logs

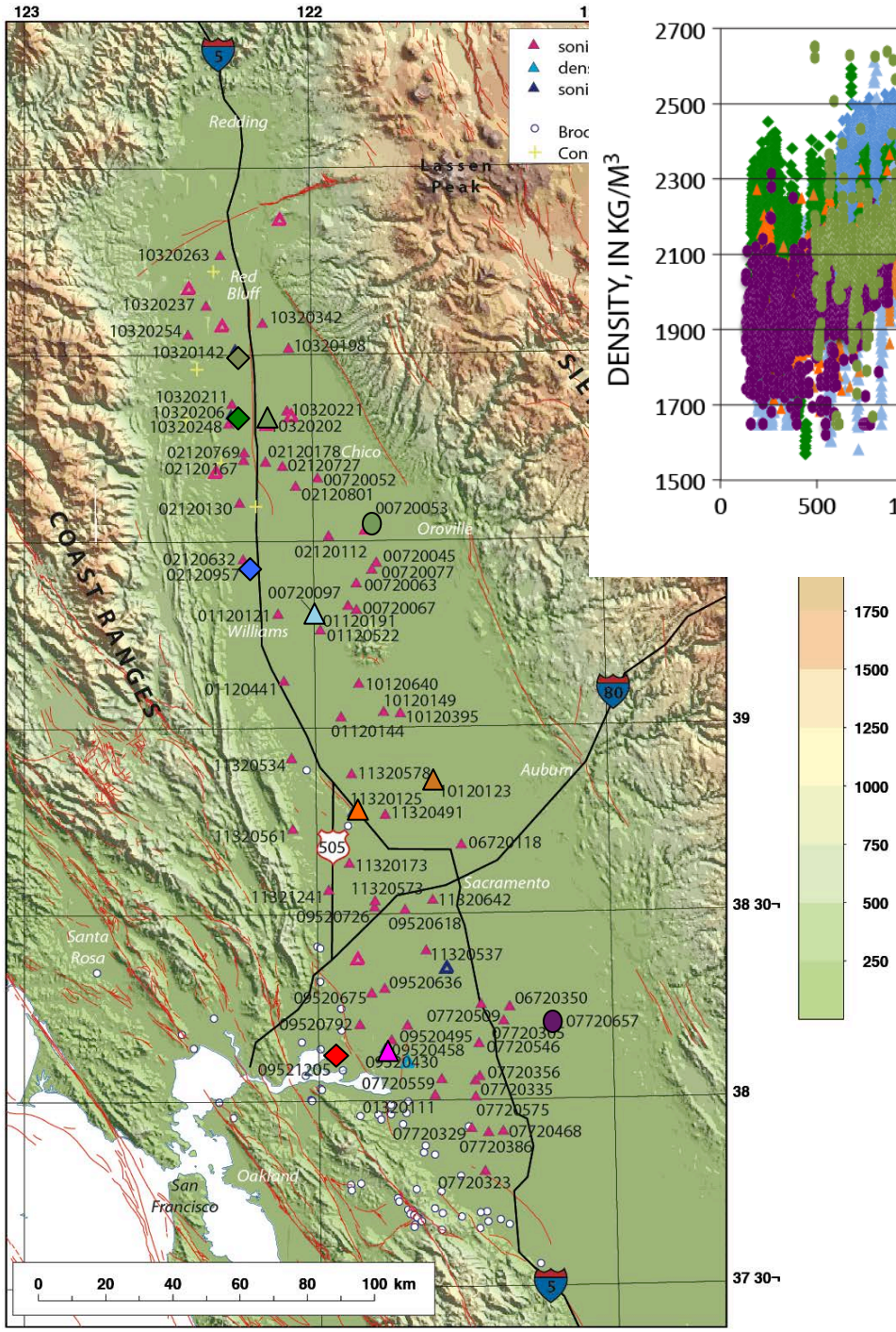
80 wells have logs that have been digitized (either sonic or density or both):

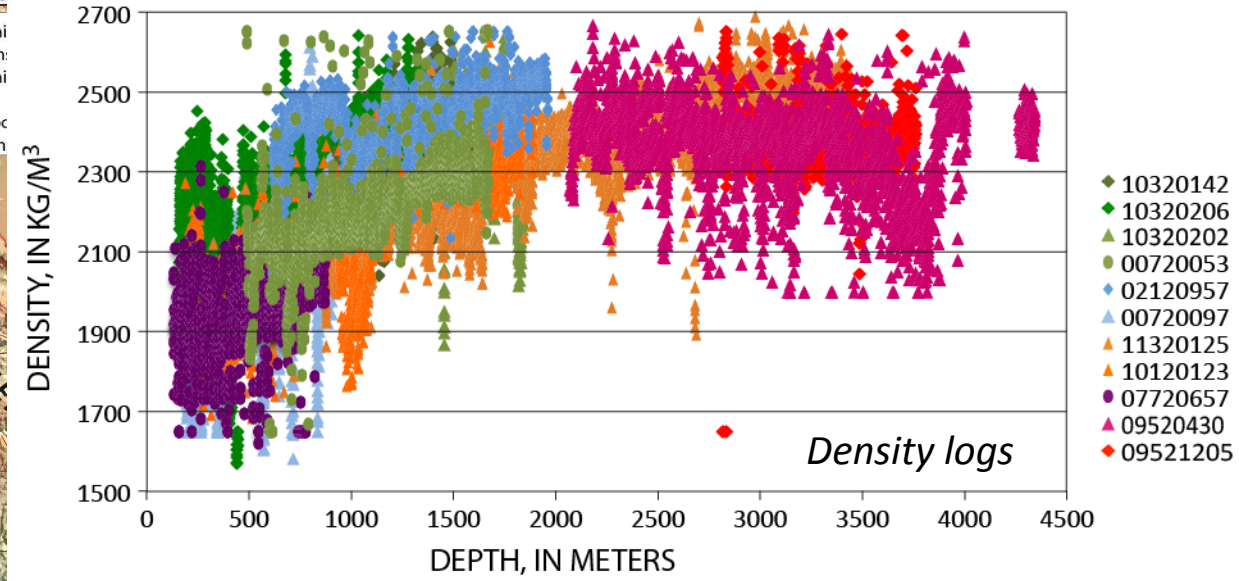
10 density
78 sonic

Another 5 in the works

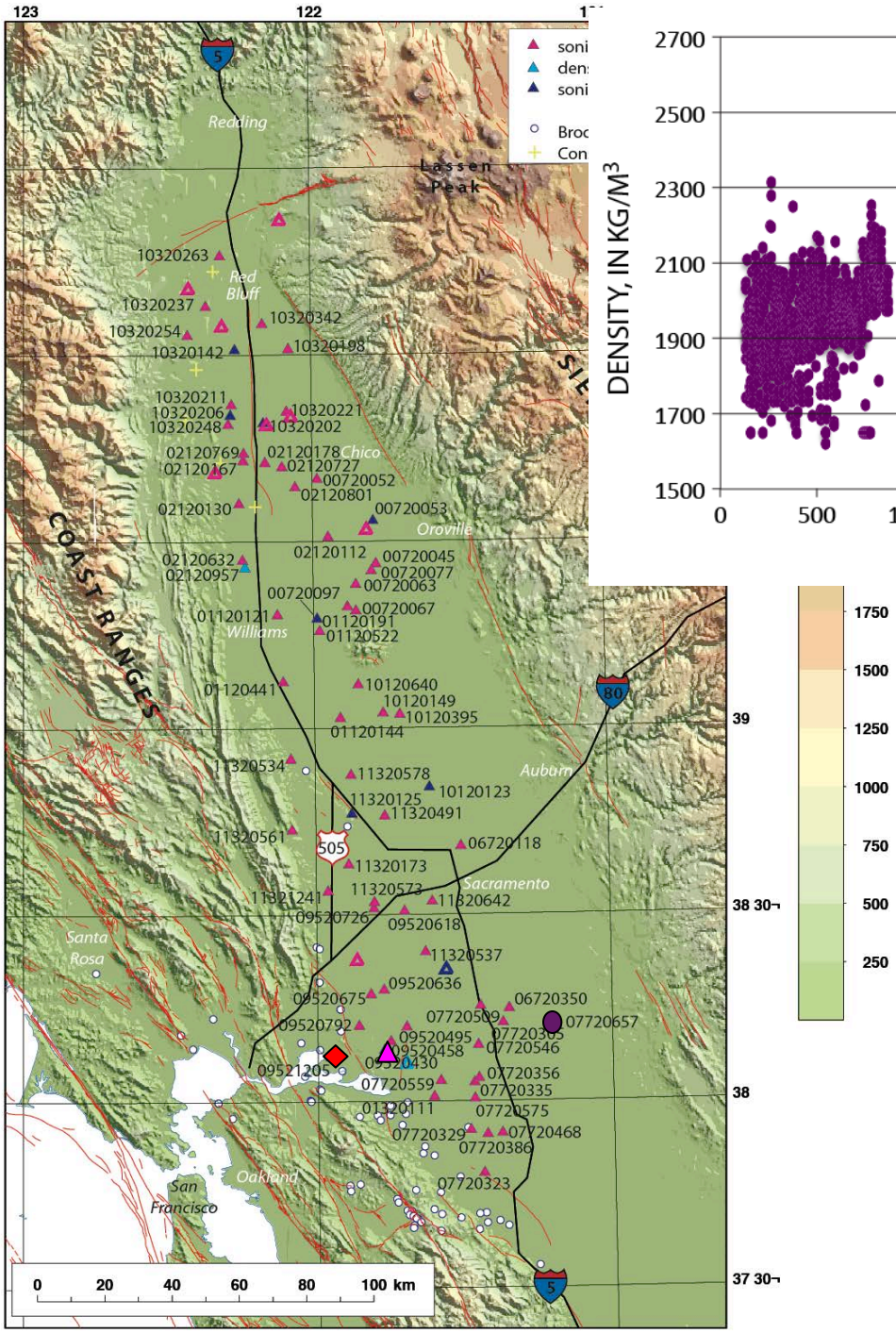


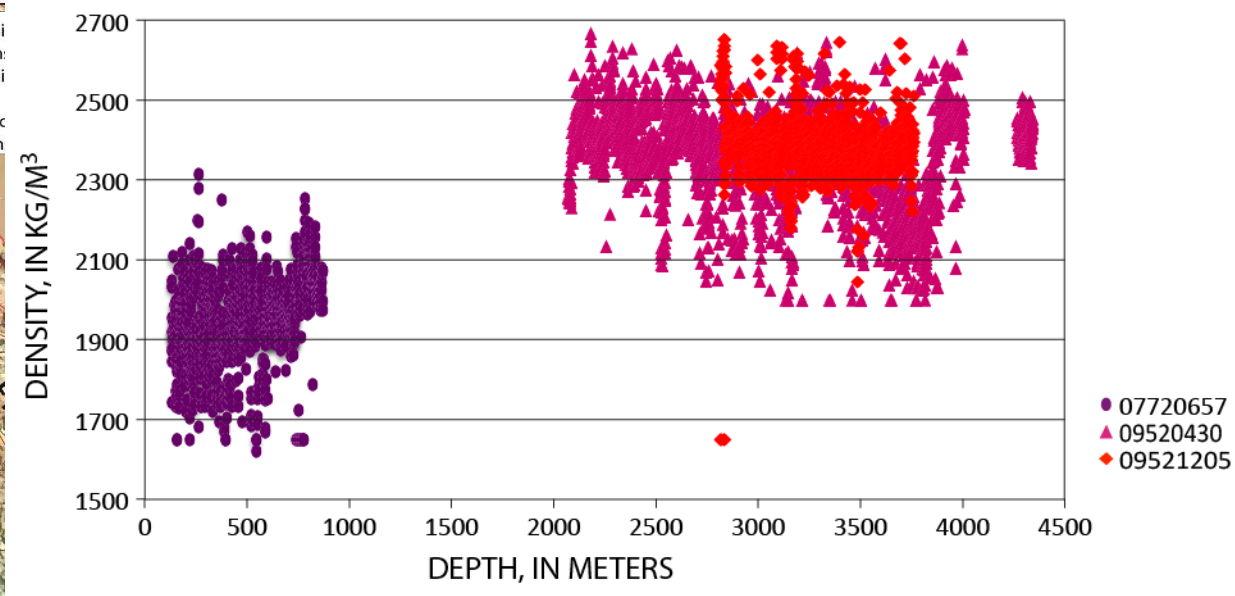
from V. Langenheim





Draft, from V. Langenheim





Southern wells

P=0.1543z + 1864.8 (R^2=.07)

P=-0.522z + 2521.7 (R^2=.08)

P=-0.0344z + 2495 (R^2=.016)

Ave 1940+/-126

Ave 2362 +/- 115

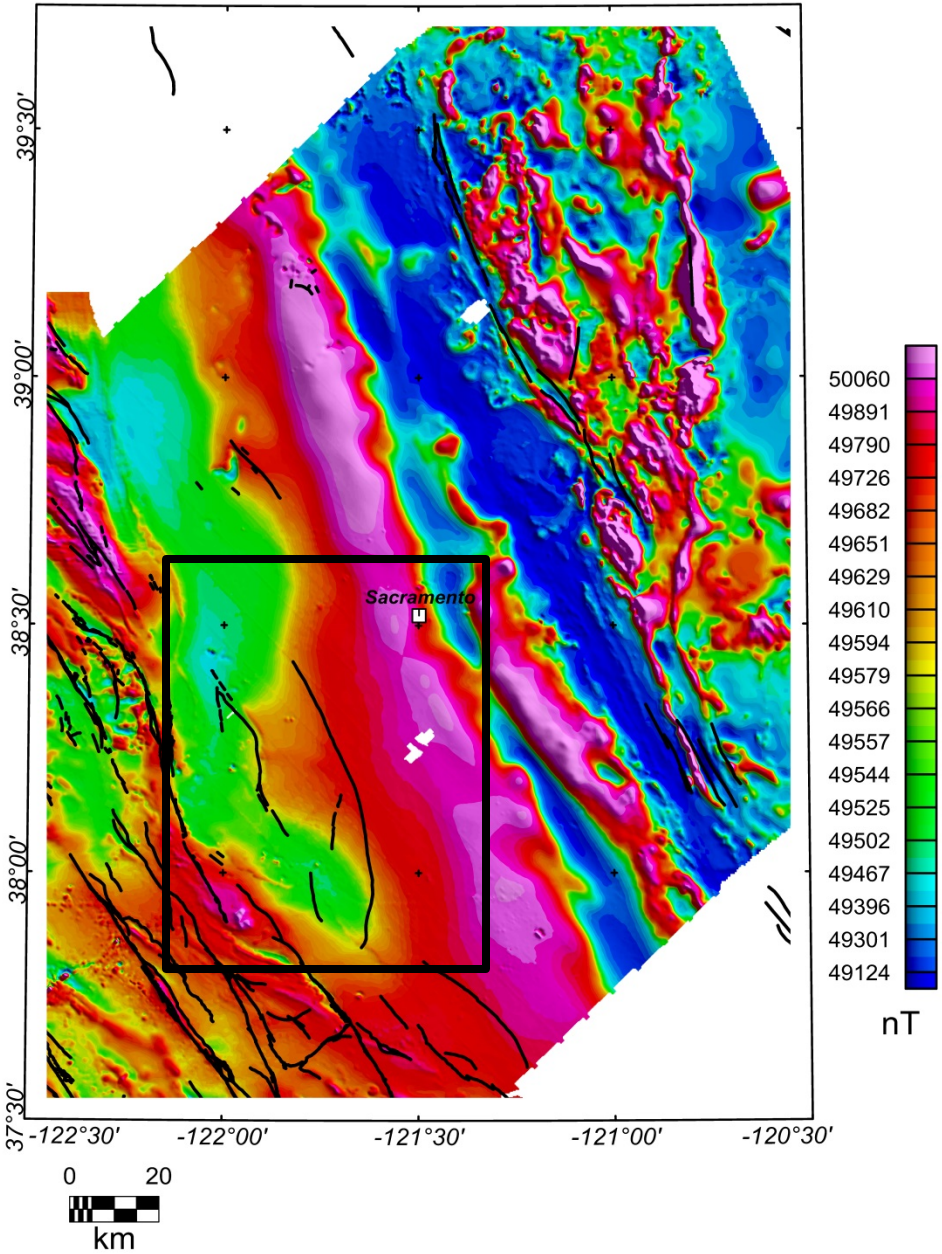
Ave 2382+/-75

P=density; Ave=average P in kg/m^3

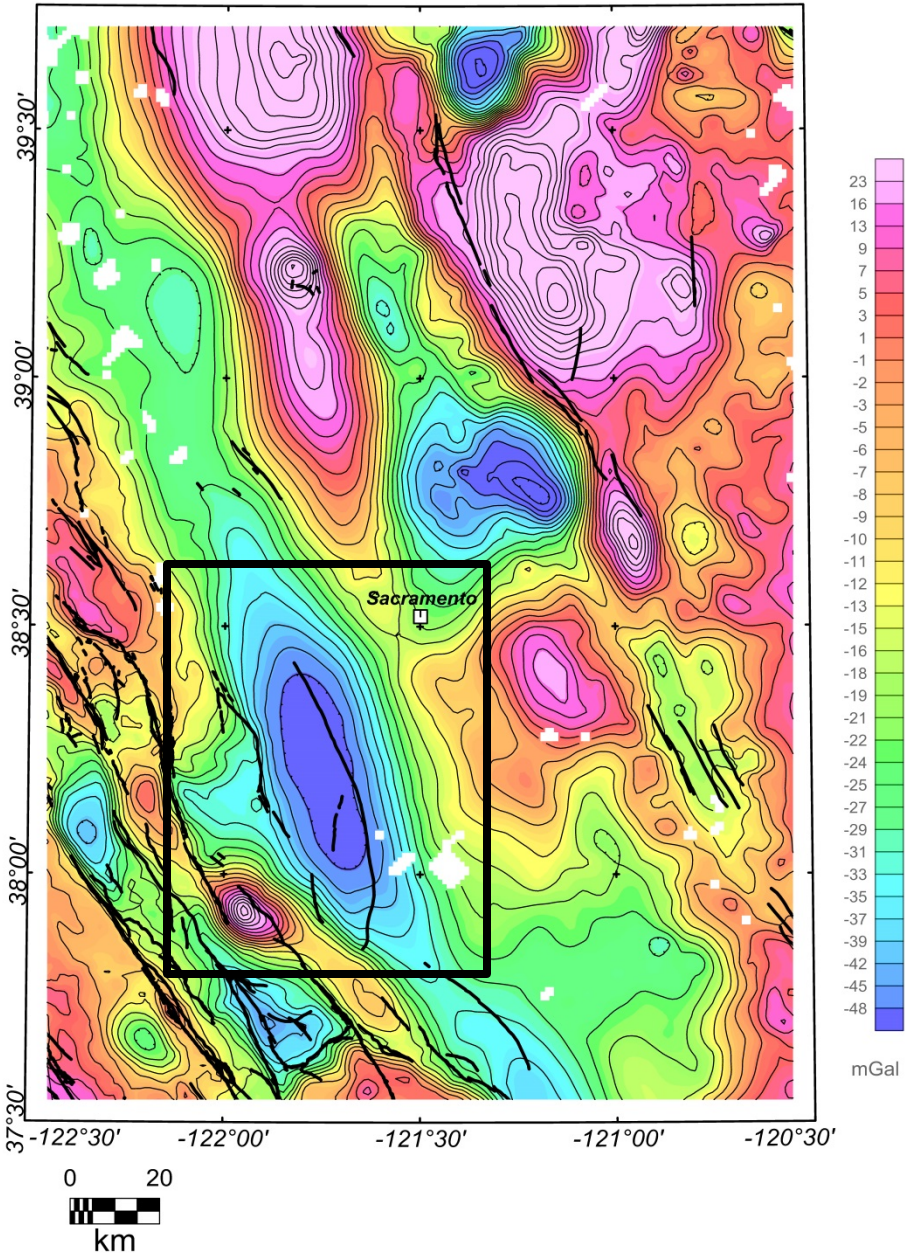
Draft, from V. Langenheim

Study Area

Aeromagnetic Map

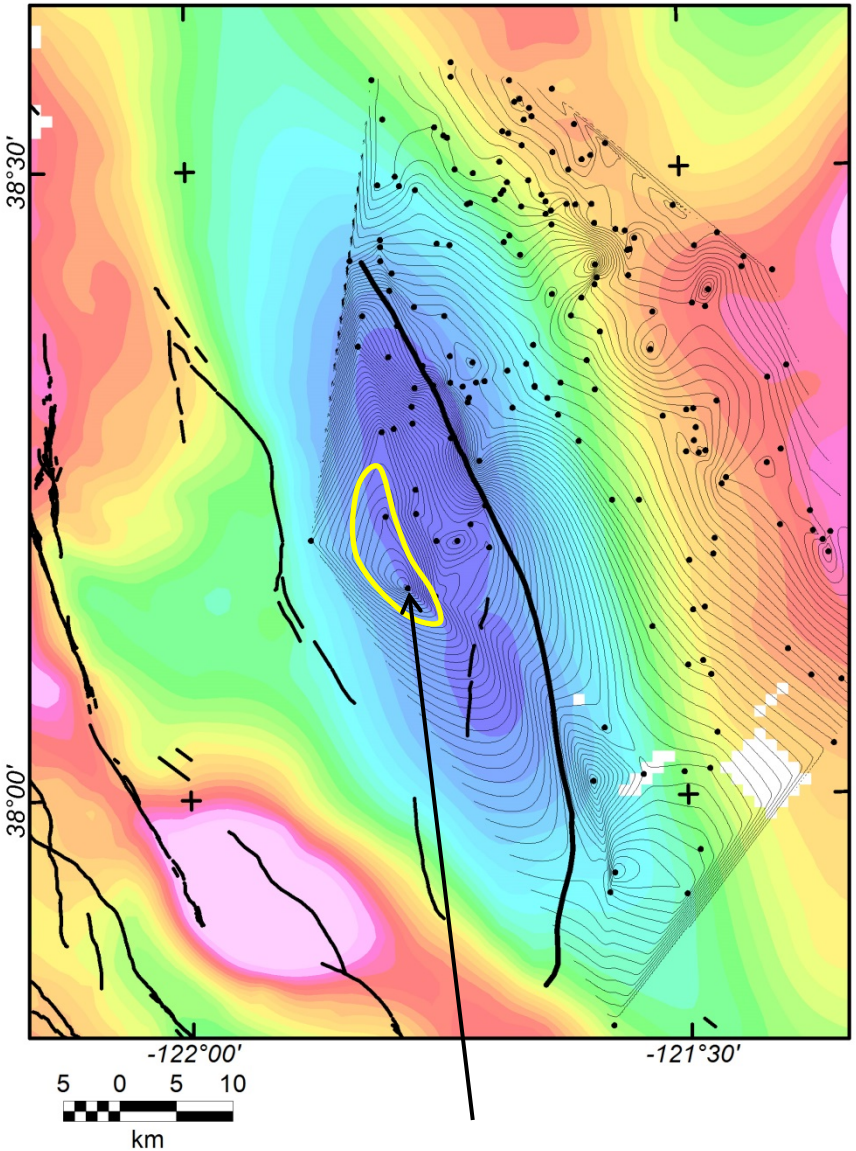


Gravity Map



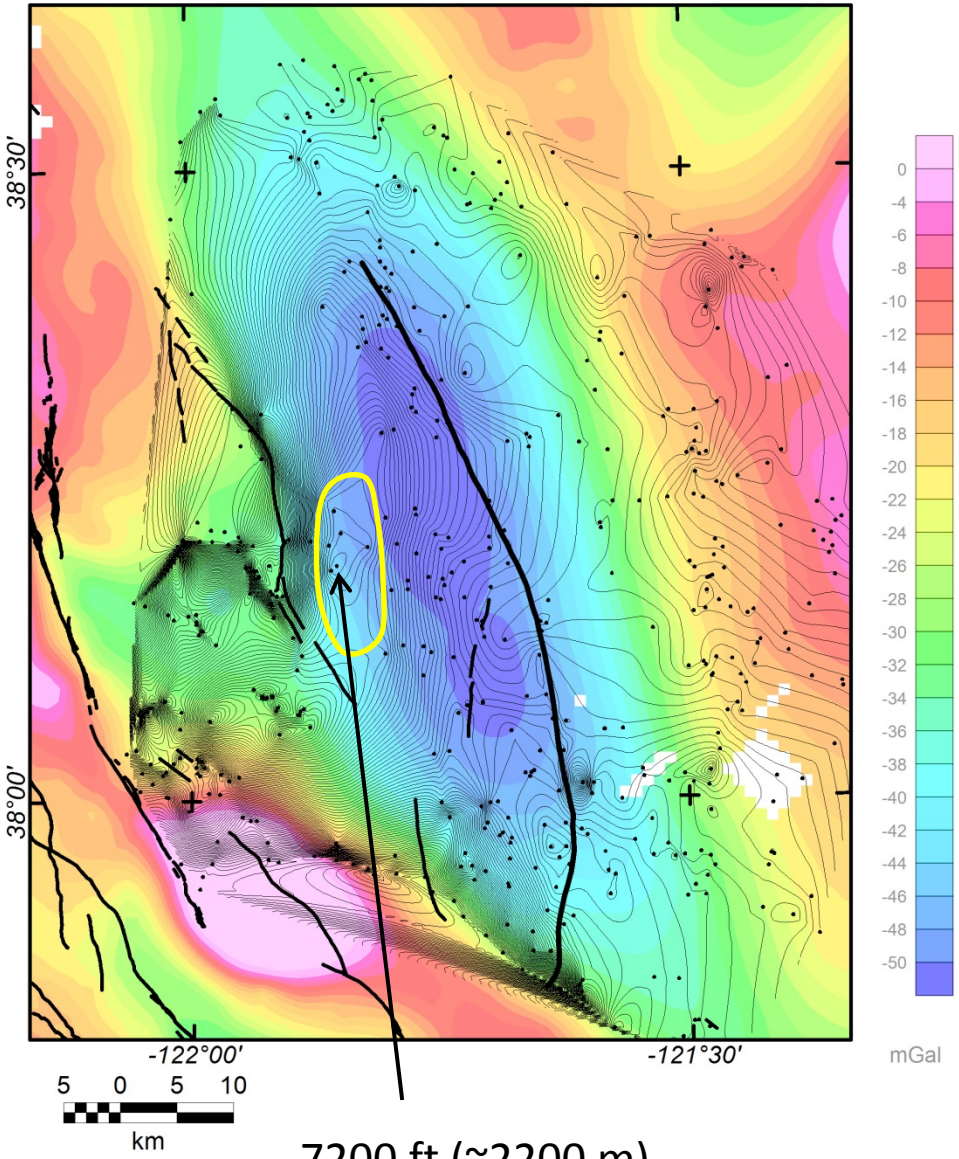
Surface contours based on well data

Top of H&T



10,500 ft (3200 m)

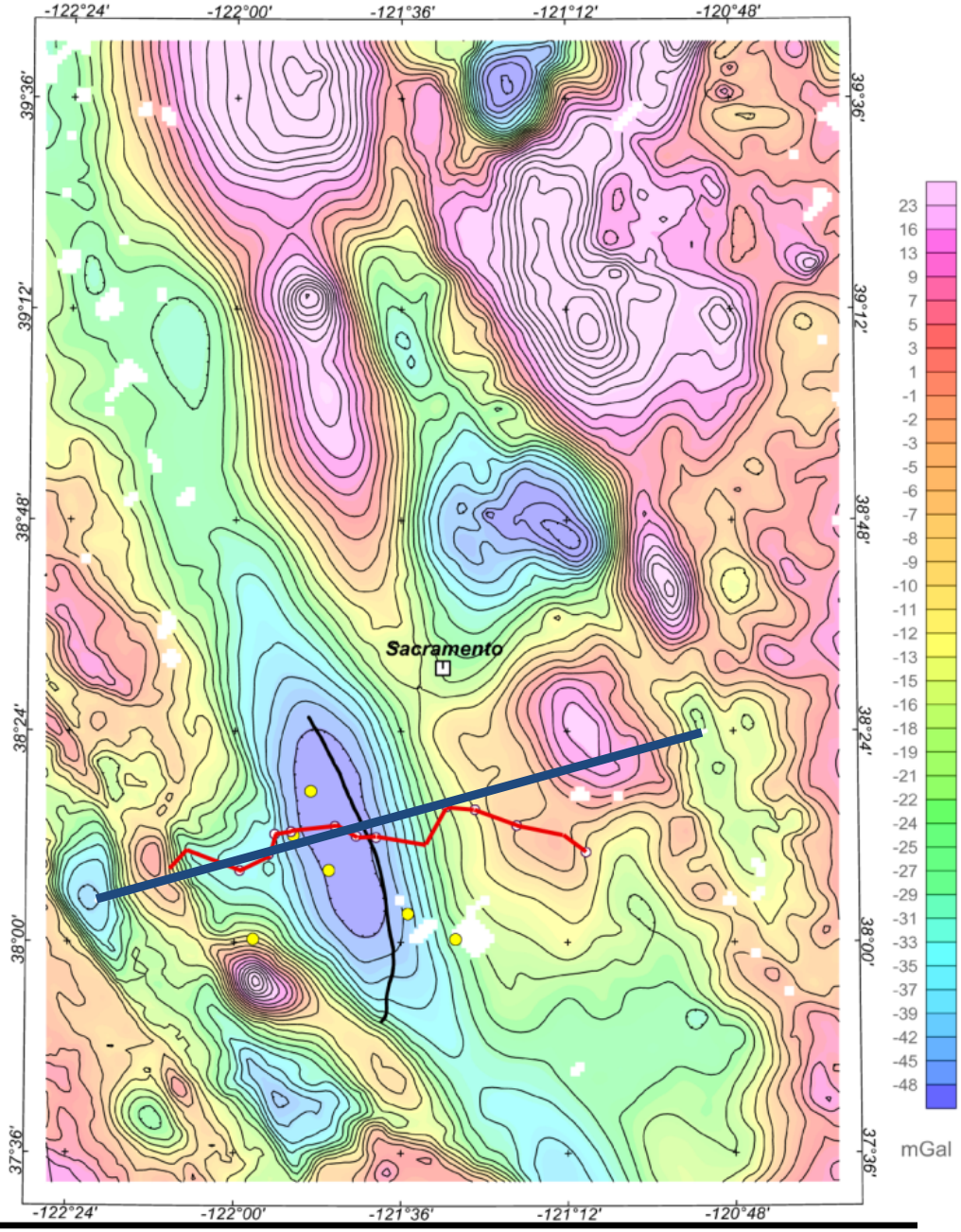
Top of Domengine



7200 ft (~2200 m)

Contours courtesy of R. Graymer

Profile across the Rio Vista Basin



Profile RVB- 2D model (Blue)

Profile 15- Suisun Bay to Lodi (Red)

AAPG Pacific Section, 2009-Sacramento Valley Central from T4N/R1W to T4N/R7E (Suisun Bay to Lodi)(1967)

Midland Fault (Black)

20 km

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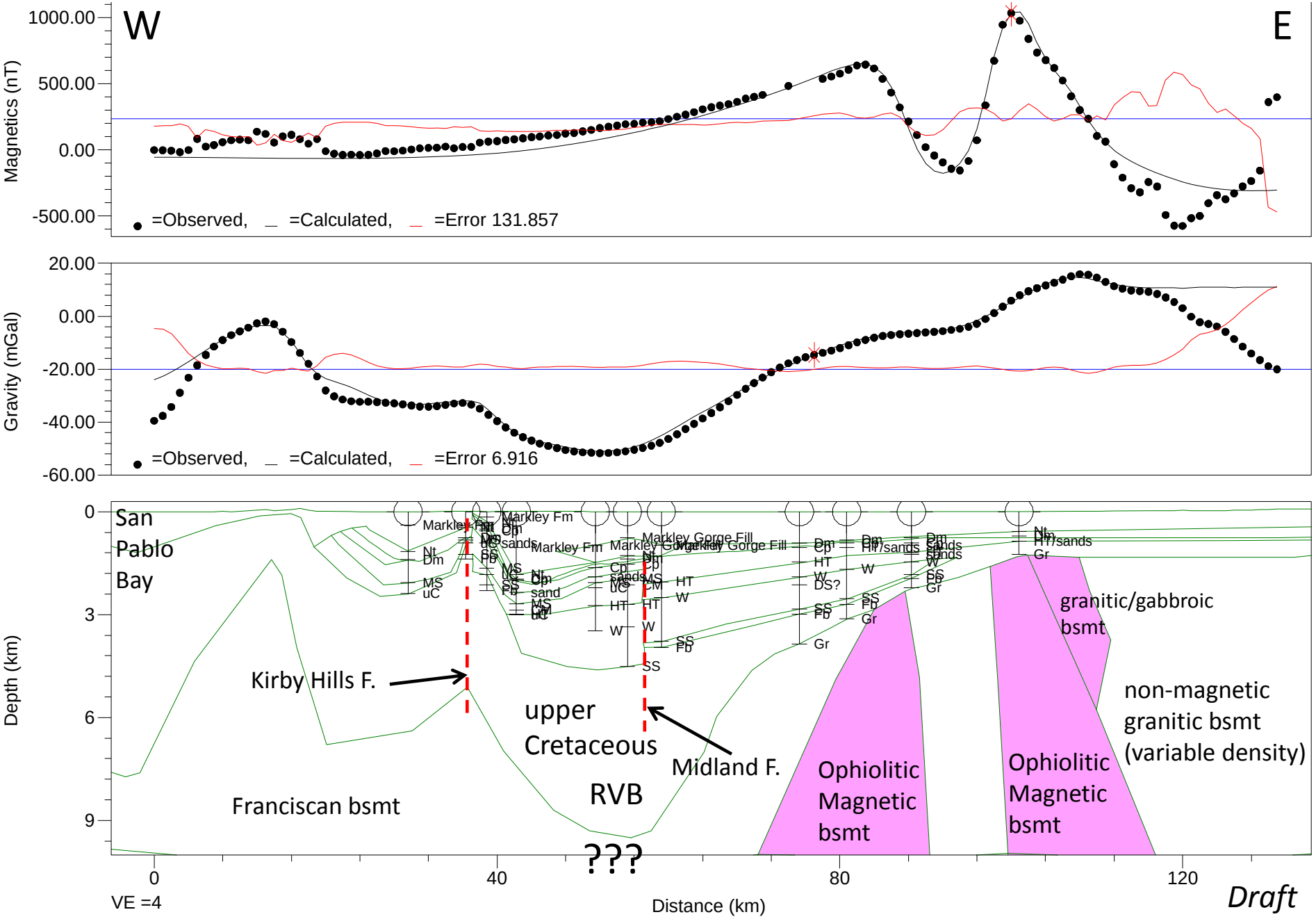
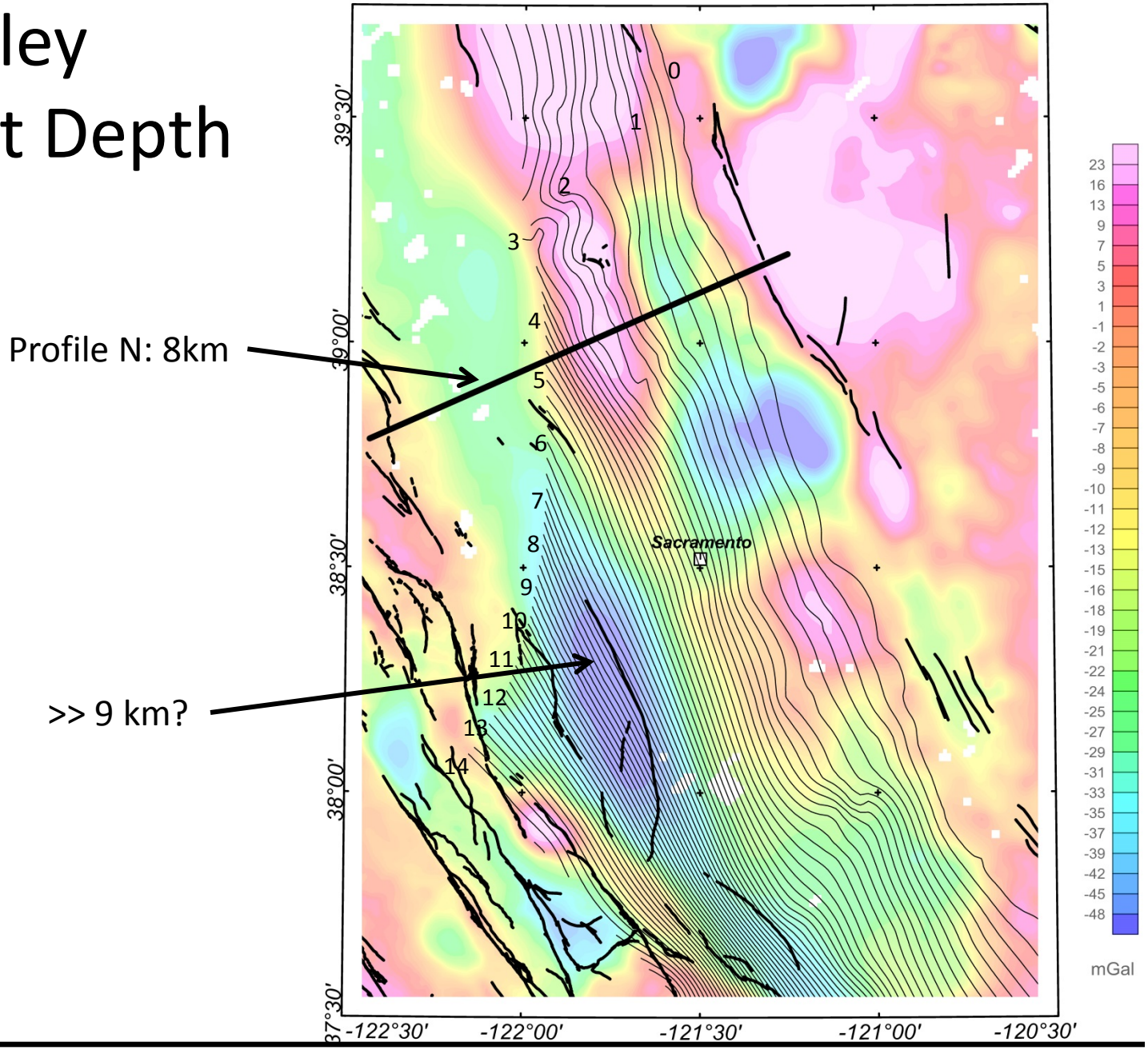
2D gravity/mag forward model



Great Valley Basement Depth



Depth to basement contours from Wentworth et al., 1995

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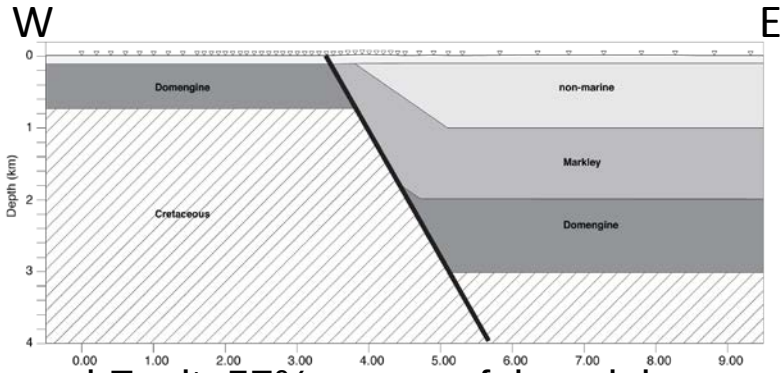
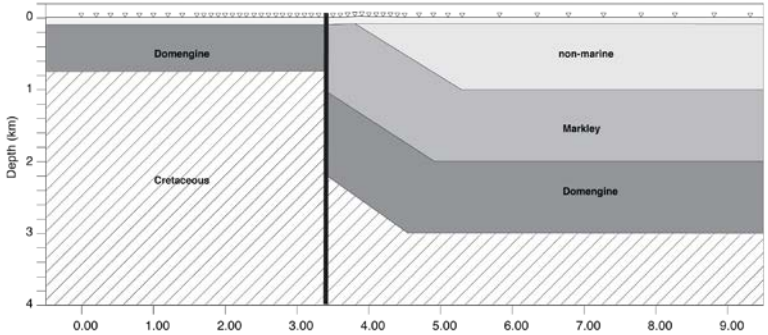
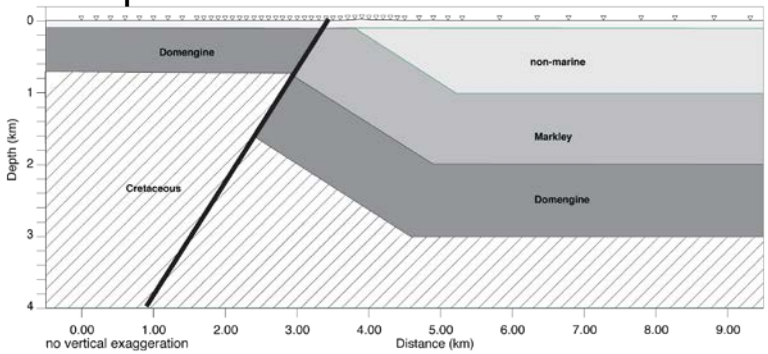
Modeling the Kirby Hills Fault



Normal Fault: 57% successful models



Strike-slip Fault: 43% successful models



Reverse Fault: 1 successful model (<1%)

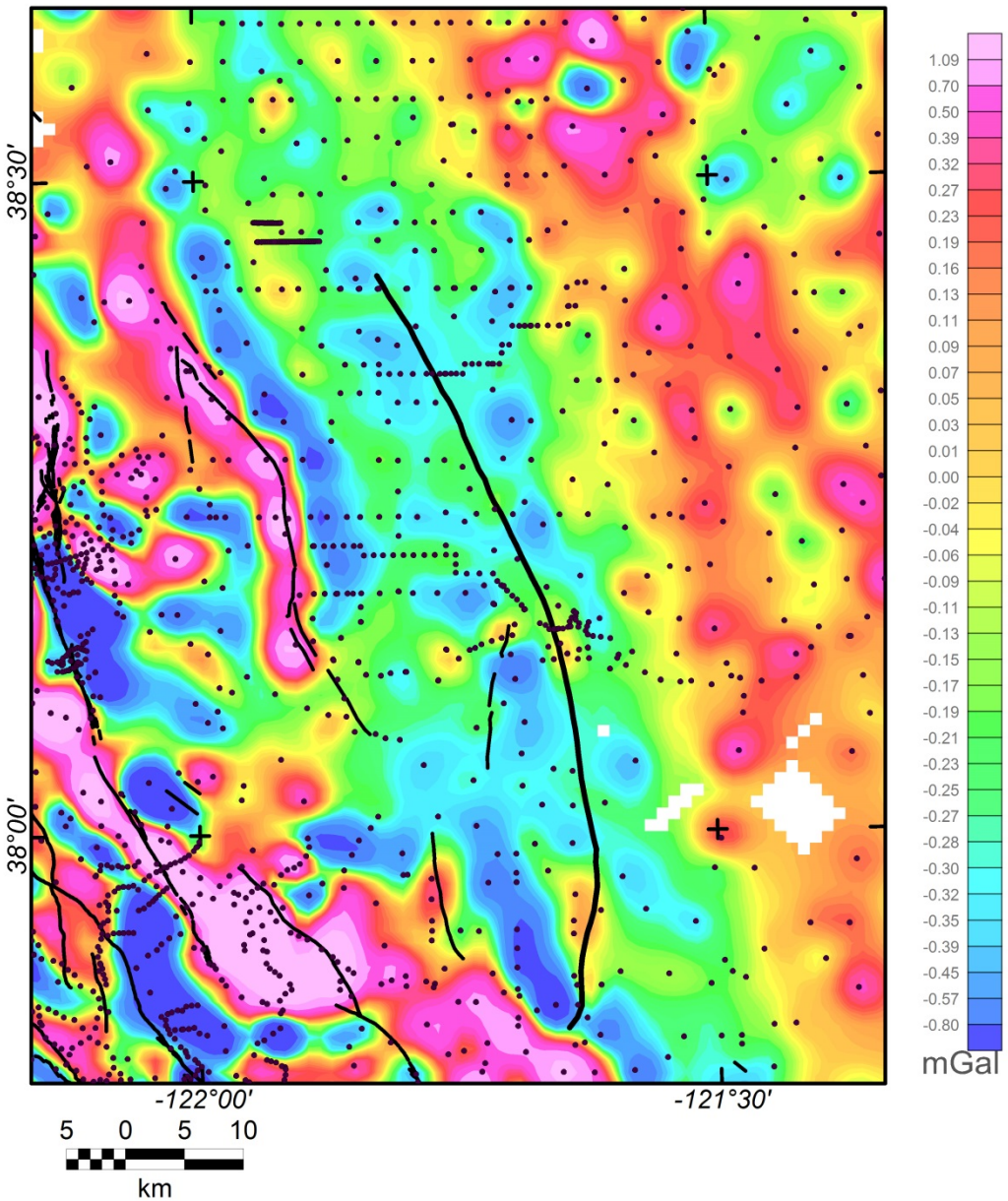
Method:

- Generate geologically reasonable alternative cross-sections
- Relax restricting assumption of homogeneously dense rock bodies
- Populate with geologically reasonable density variations (from data)
- Forward model many realizations and examine distribution of results (successful models: Standard Dev < 0.3)
- Convert realizations to geologically meaningful answers

East dipping normal fault scenario is most likely for KHF

Draft, from Geoff Phelps

Filtered Gravity Data, Kirby Hills Fault



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