

San Jacinto Fault Zone and Sage Brush Flat High Frequency Experiments

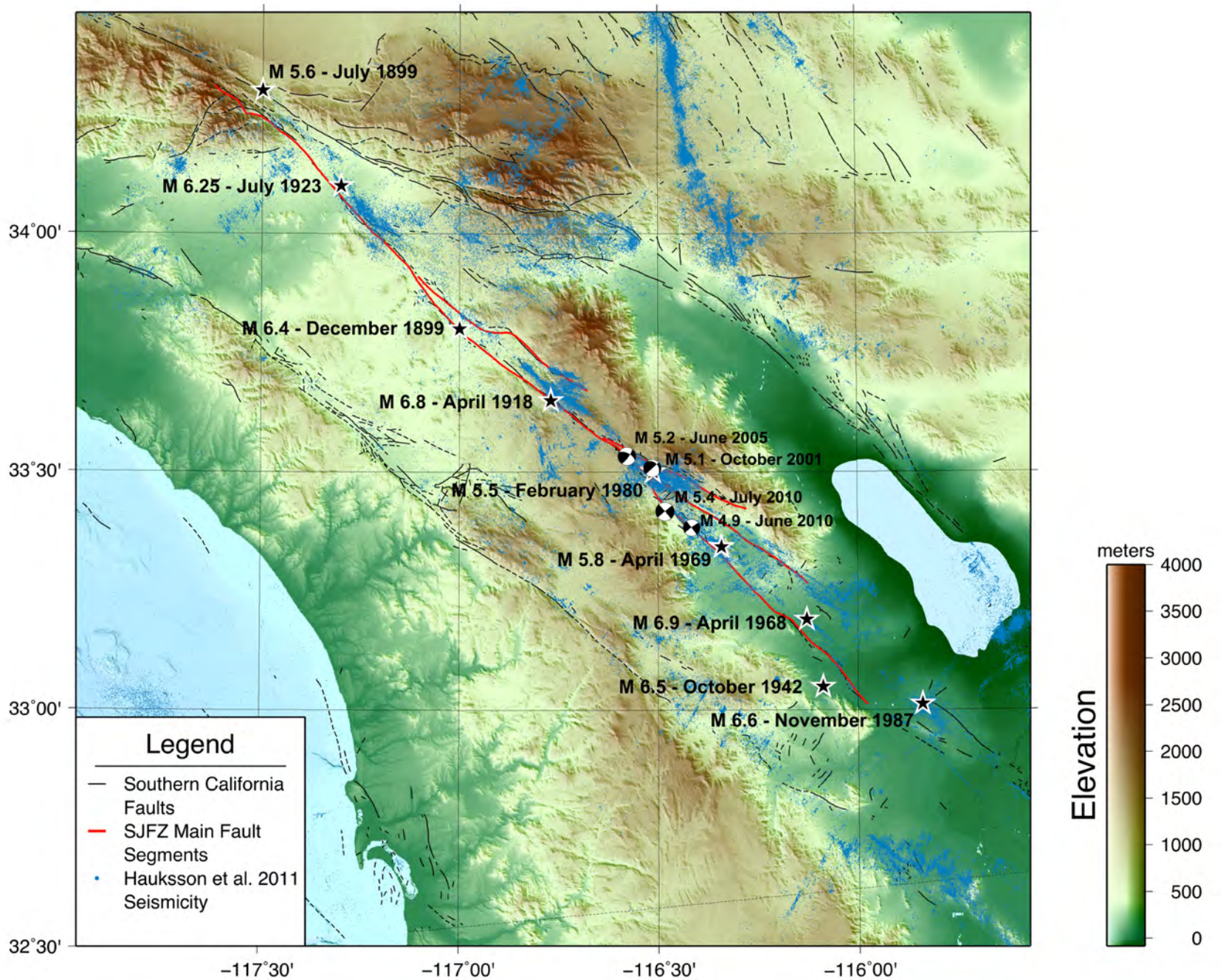
Frank Vernon

Scripps Institution of Oceanography
University of California, San Diego

2015 UCSD AUG
16 January 2015



San Jacinto Fault Zone

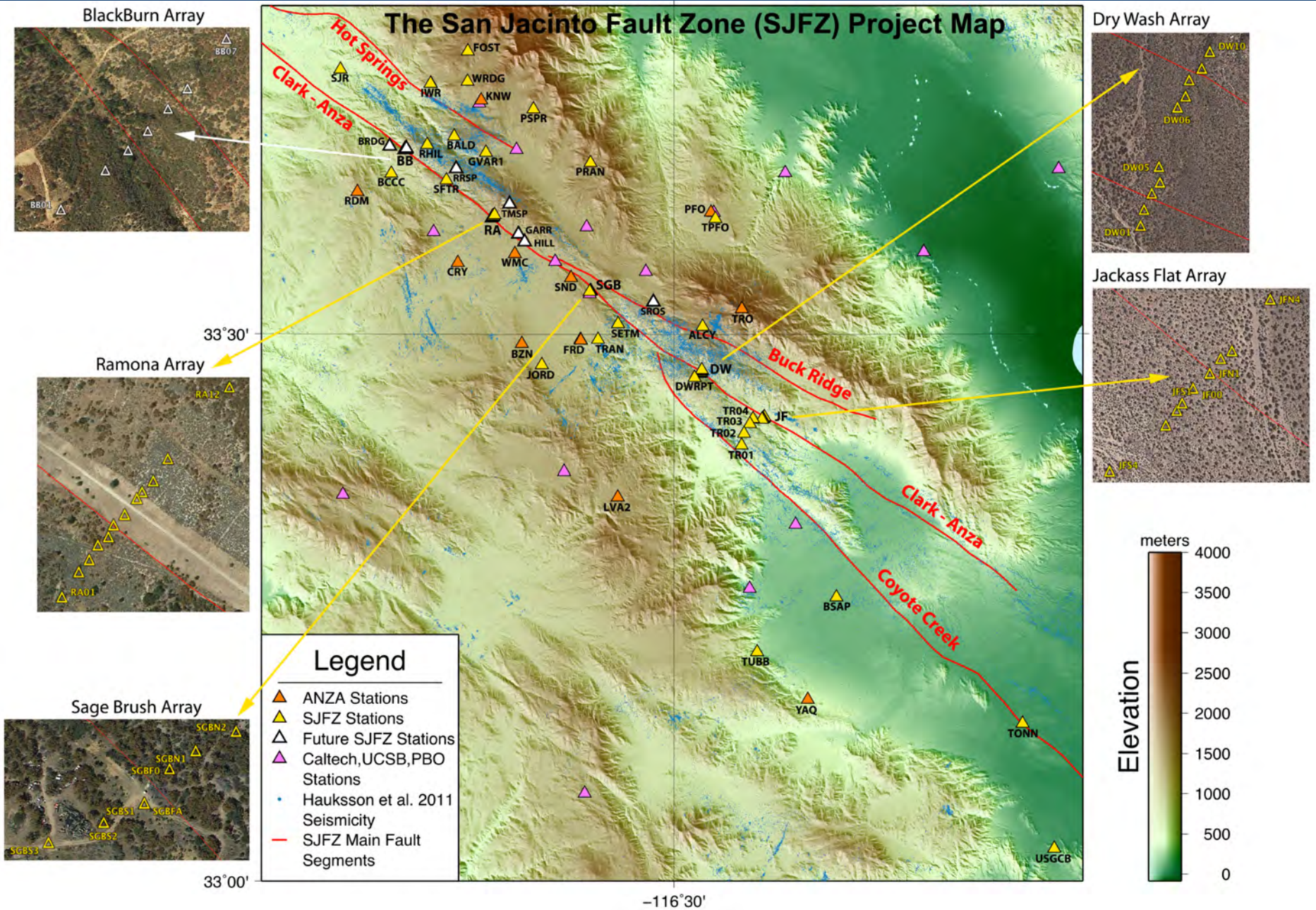


San Jacinto Fault Zone Realtime Virtual Observing Network

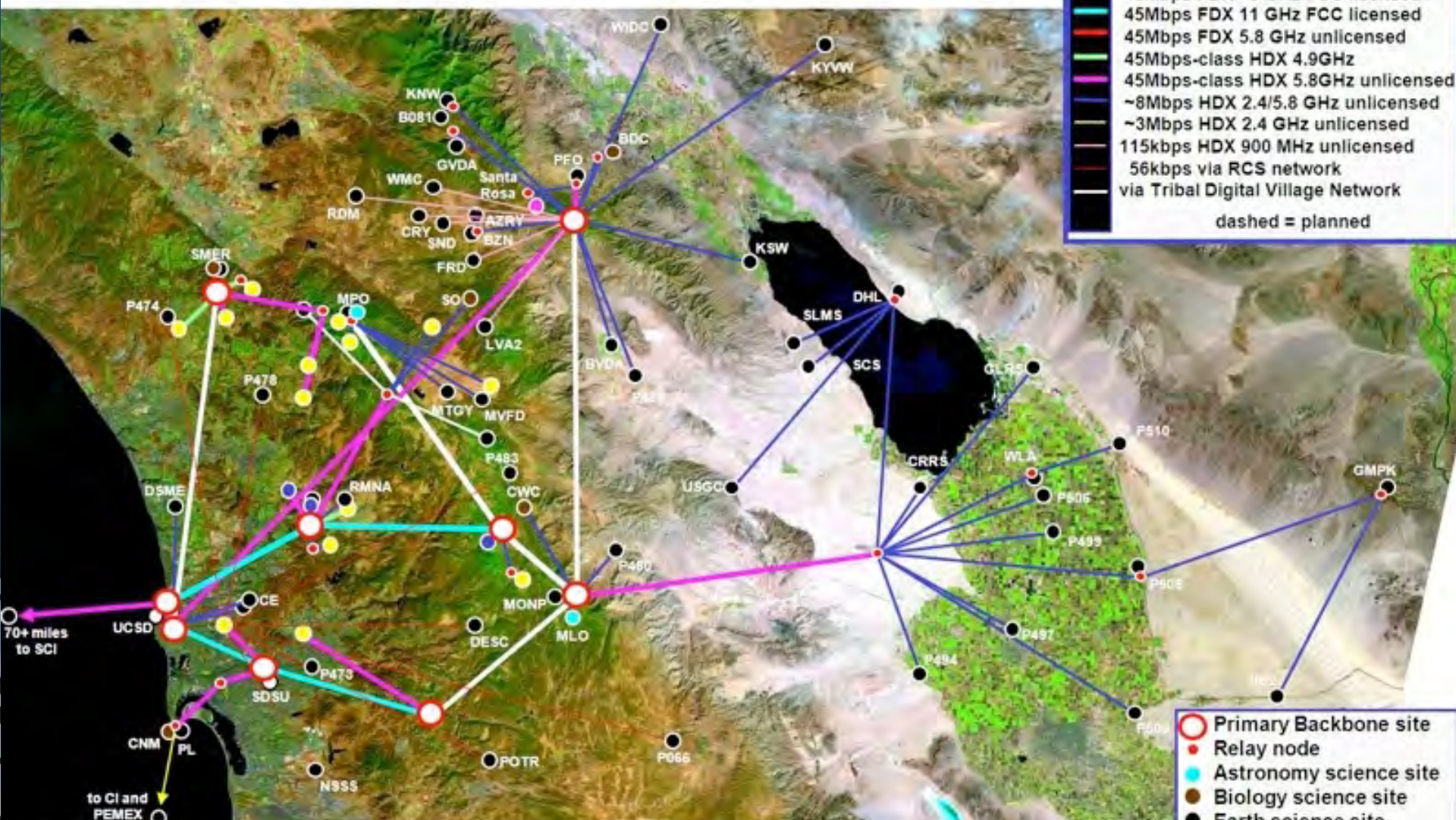
- ANZA Seismic Network (24)
- Plate Boundary Observatory (8)
- Southern California Seismic Network (~30)
- UC Santa Barbara (3)
- PASSCAL
 - 5 Linear Fault Crossing Arrays
 - 45 total elements
 - 20 stand alone stations
 - 8 Borehole Strainmeters
 - 12 Permanent GPS



The SJFZ Project Deployment Map



HPWREN topology – January 2012



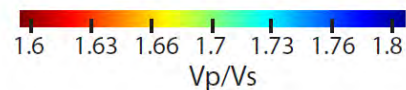
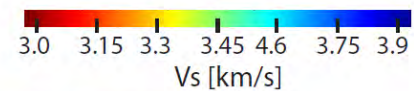
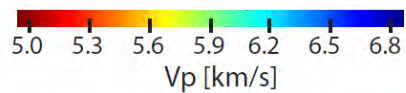
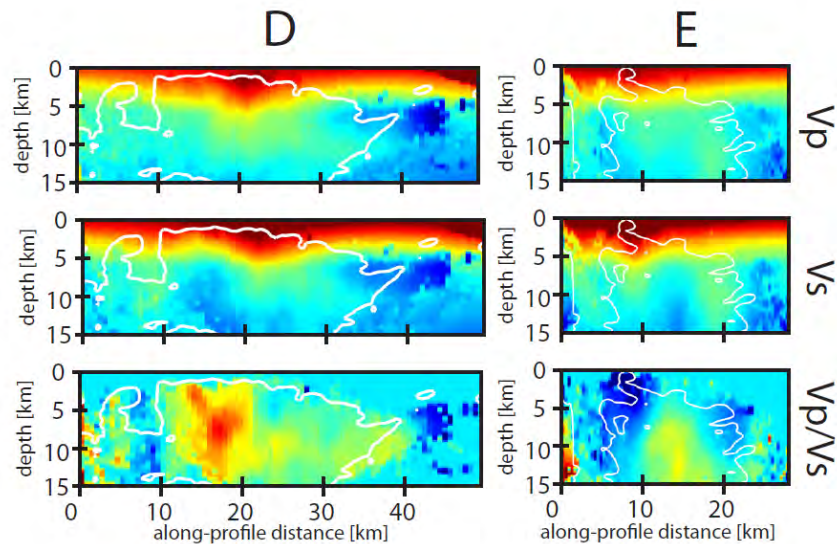
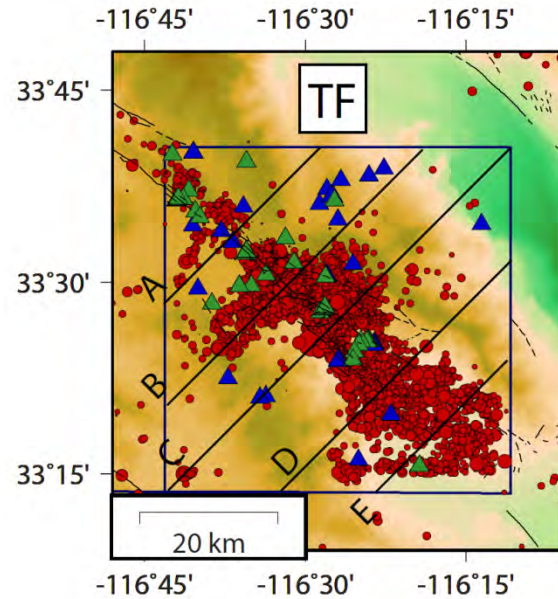
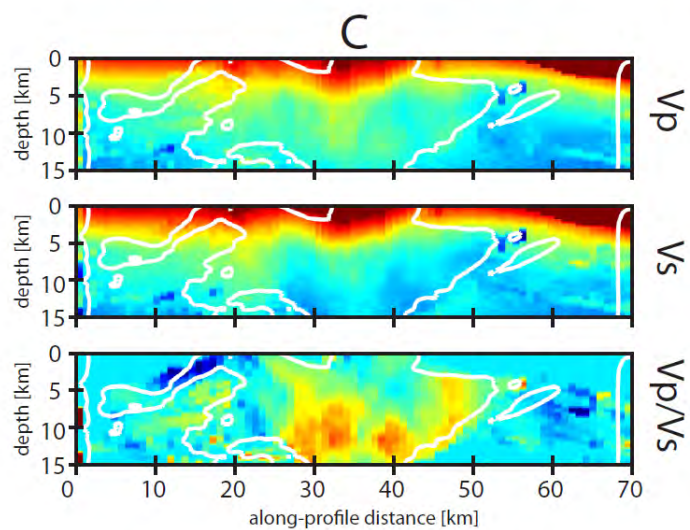
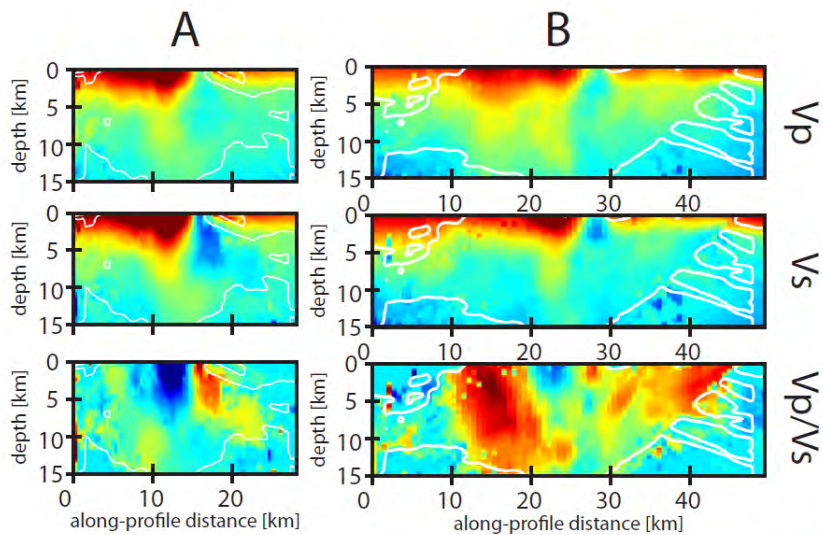
- 155Mbps FDX 6 GHz FCC licensed
- 155Mbps FDX 11 GHz FCC licensed
- 45Mbps FDX 6 GHz FCC licensed
- 45Mbps FDX 11 GHz FCC licensed
- 45Mbps FDX 5.8 GHz unlicensed
- 45Mbps-class HDX 4.9GHz
- 45Mbps-class HDX 5.8GHz unlicensed
- ~8Mbps HDX 2.4/5.8 GHz unlicensed
- ~3Mbps HDX 2.4 GHz unlicensed
- 115kbps HDX 900 MHz unlicensed
- 56kbps via RCS network
- via Tribal Digital Village Network
- dashed = planned

- Primary Backbone site
- Relay node
- Astronomy science site
- Biology science site
- Earth science site
- University site
- Researcher location
- Native American site
- Public Safety site

← approximately 50 miles: →

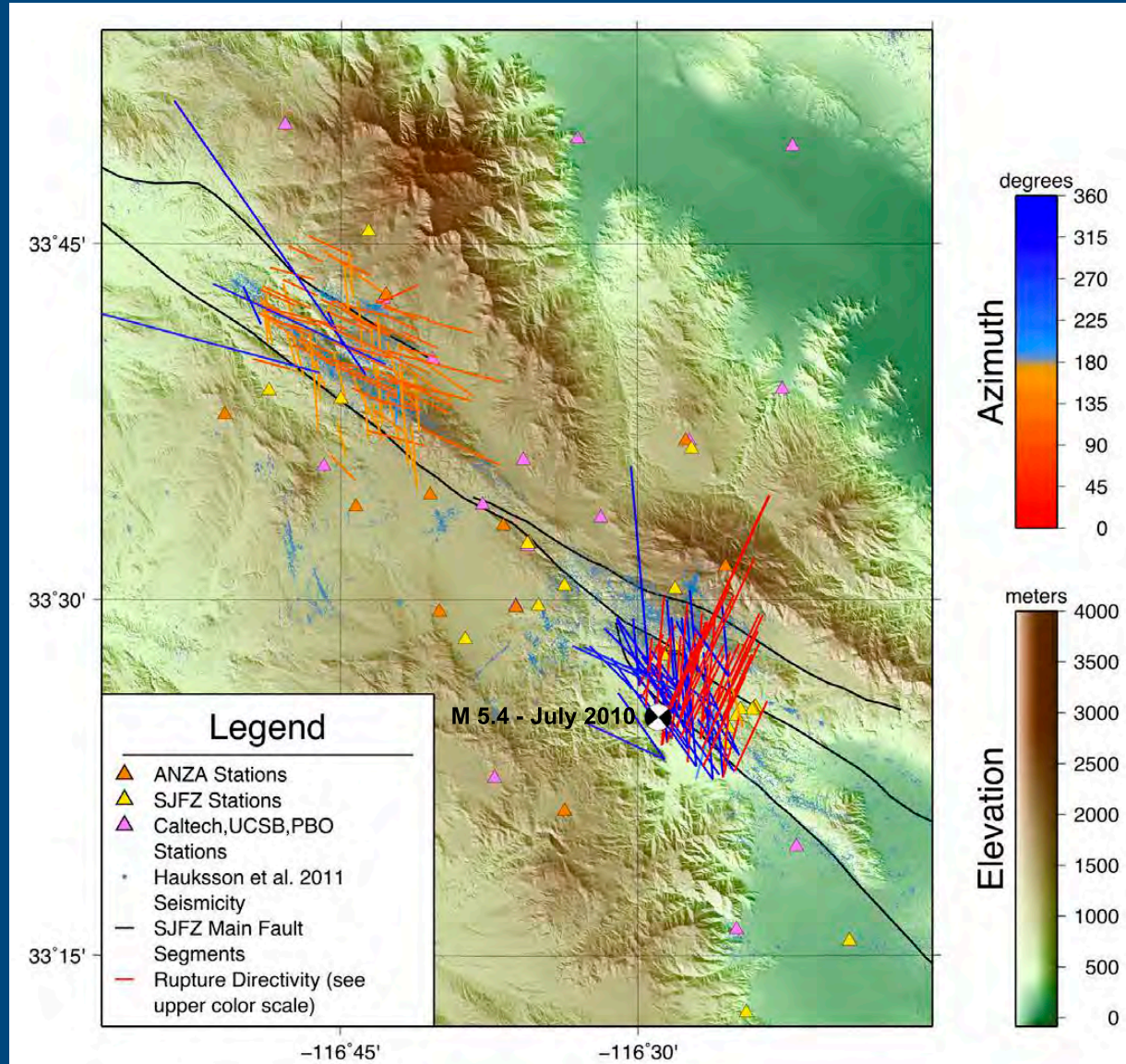
Note: locations are approximate

Trifurcation Area



Directivity Observations

- M_l 5.9 July 2010 aftershocks
- Hot Springs Cluster December 2011
- Kurzon et al. submitted

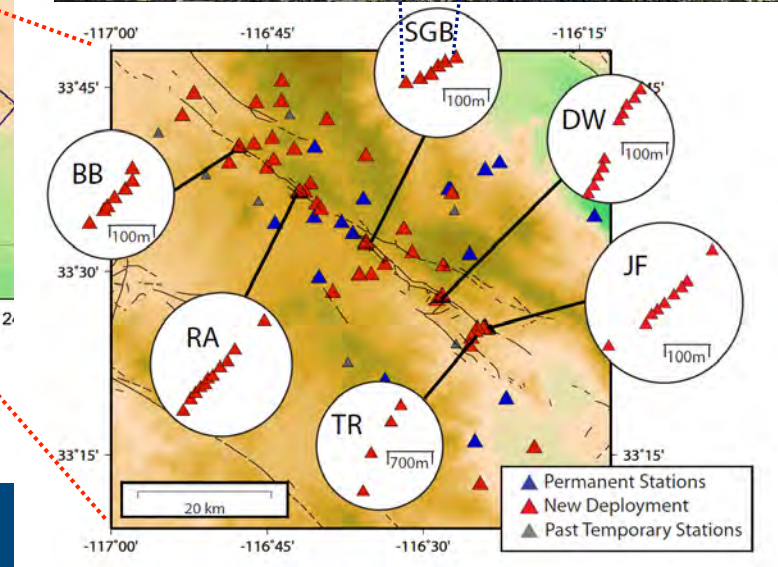
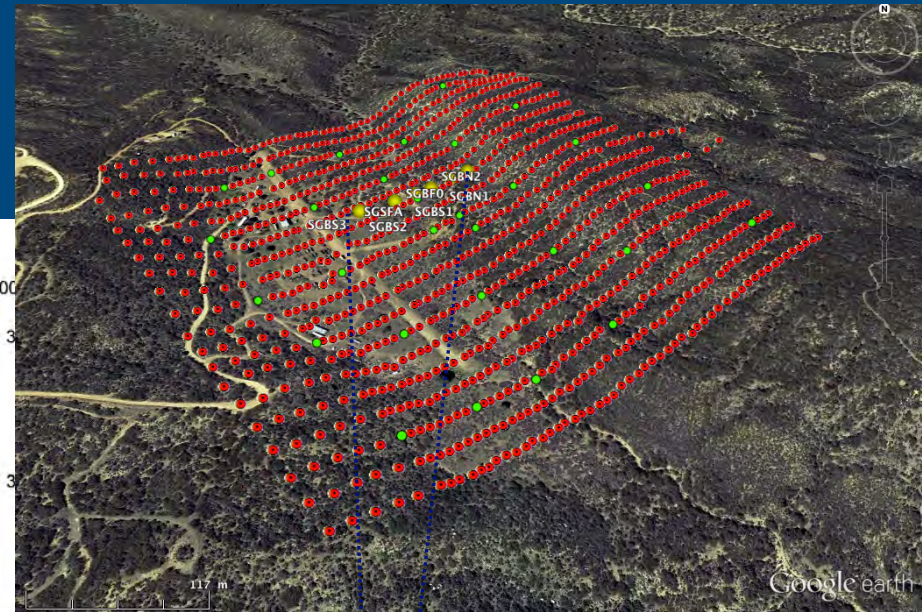
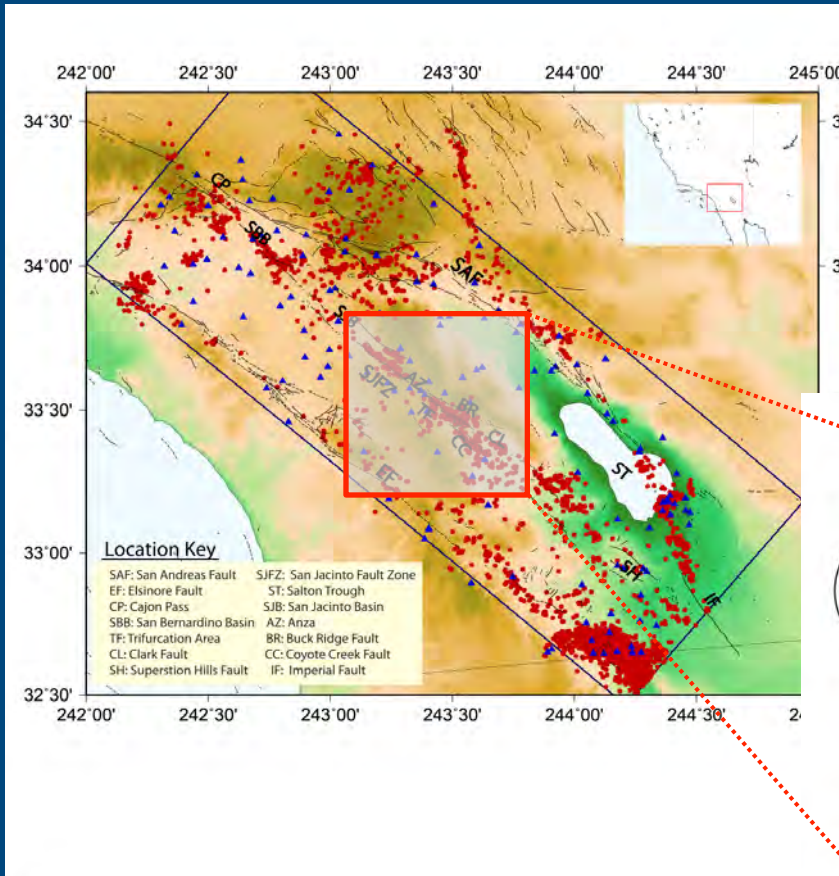


Sage Brush Flats Nodal Deployment

- SJFZ experiment
 - 70 seismic stations
 - 5 linear fault crossing arrays
 - 2010 through present
- Sage Brush Flats
 - Clark Fault surface trace
 - Large amount of local seismicity
 - Accessible



San Jacinto Fault Zone Dense Array



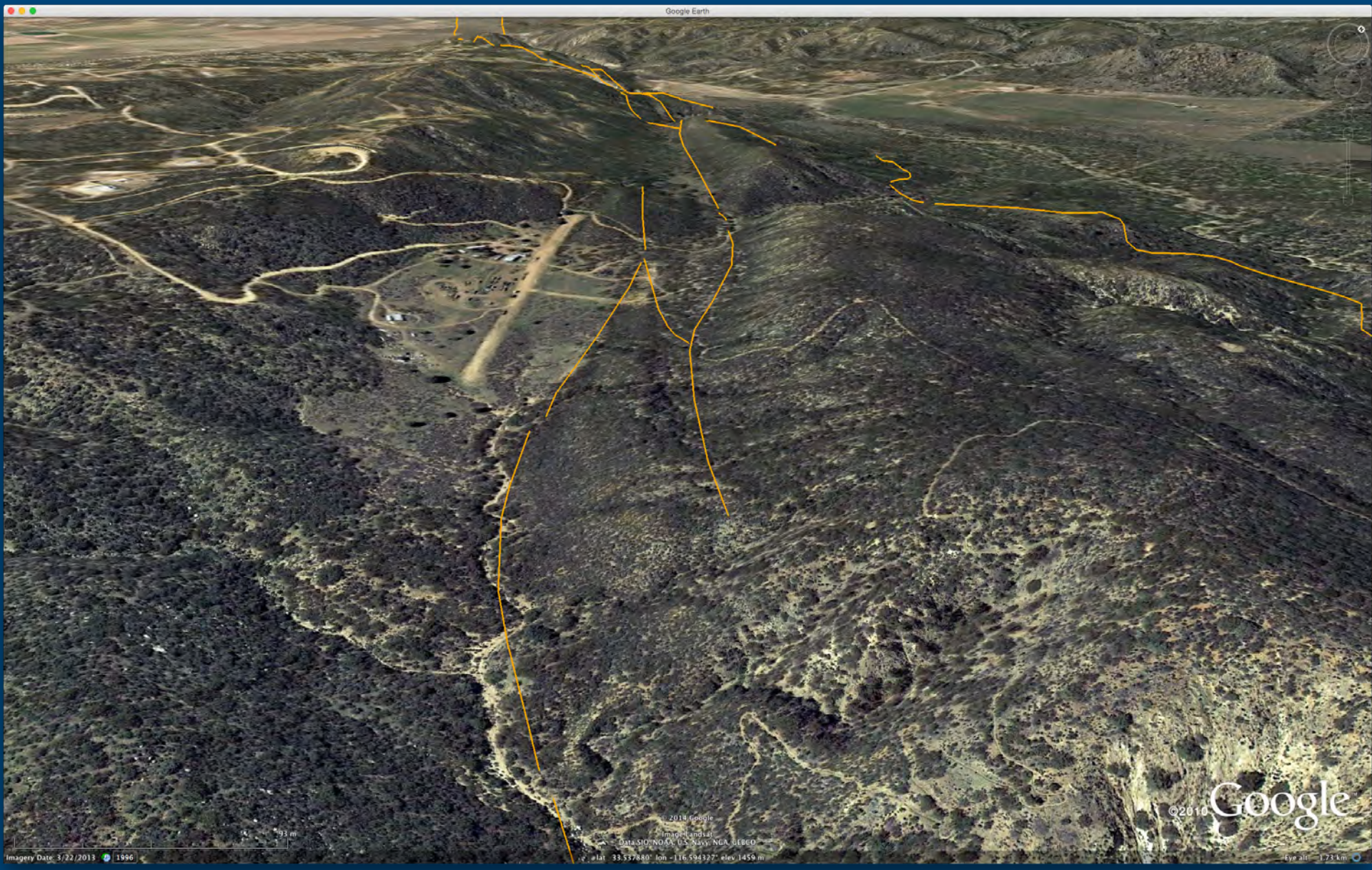
(Left) Regional seismic stations (blue triangles) and seismicity (red circles) of plate-boundary region in southern California. (Bottom right) Over 70 additional (red triangles) instruments and dense linear arrays across and around the SJFZ. (Top right) Highly-dense rectangular array with 1108 vertical-component nodes. The green dots are locations of "Betsy" gun shots.

Scientific targets include:

- Detailed imaging of the fault zone damage on the top few 100m with noise, explosions and earthquake data
- Detailed imaging of deeper sections with head and trapped waves
- Quantifying the coherency of high frequency wave propagation near the surface
- Construction of very detailed local event catalog



Sage Brush Flats - Clark Fault



Google Earth



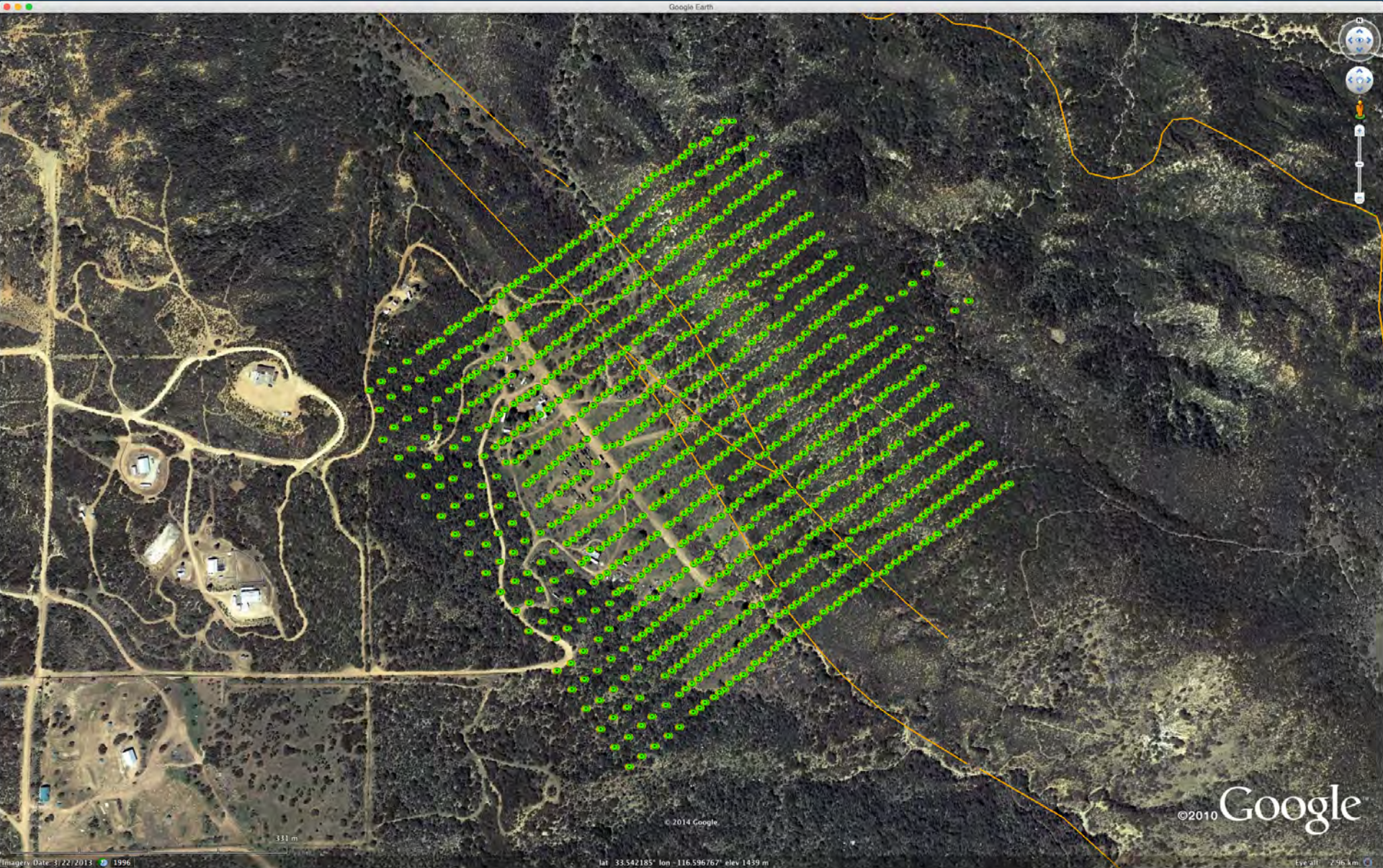
©2010 Google

2010 Google
Imagery and/or
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
lat: 33.537780° lon: -116.594327° elev: 1459 m

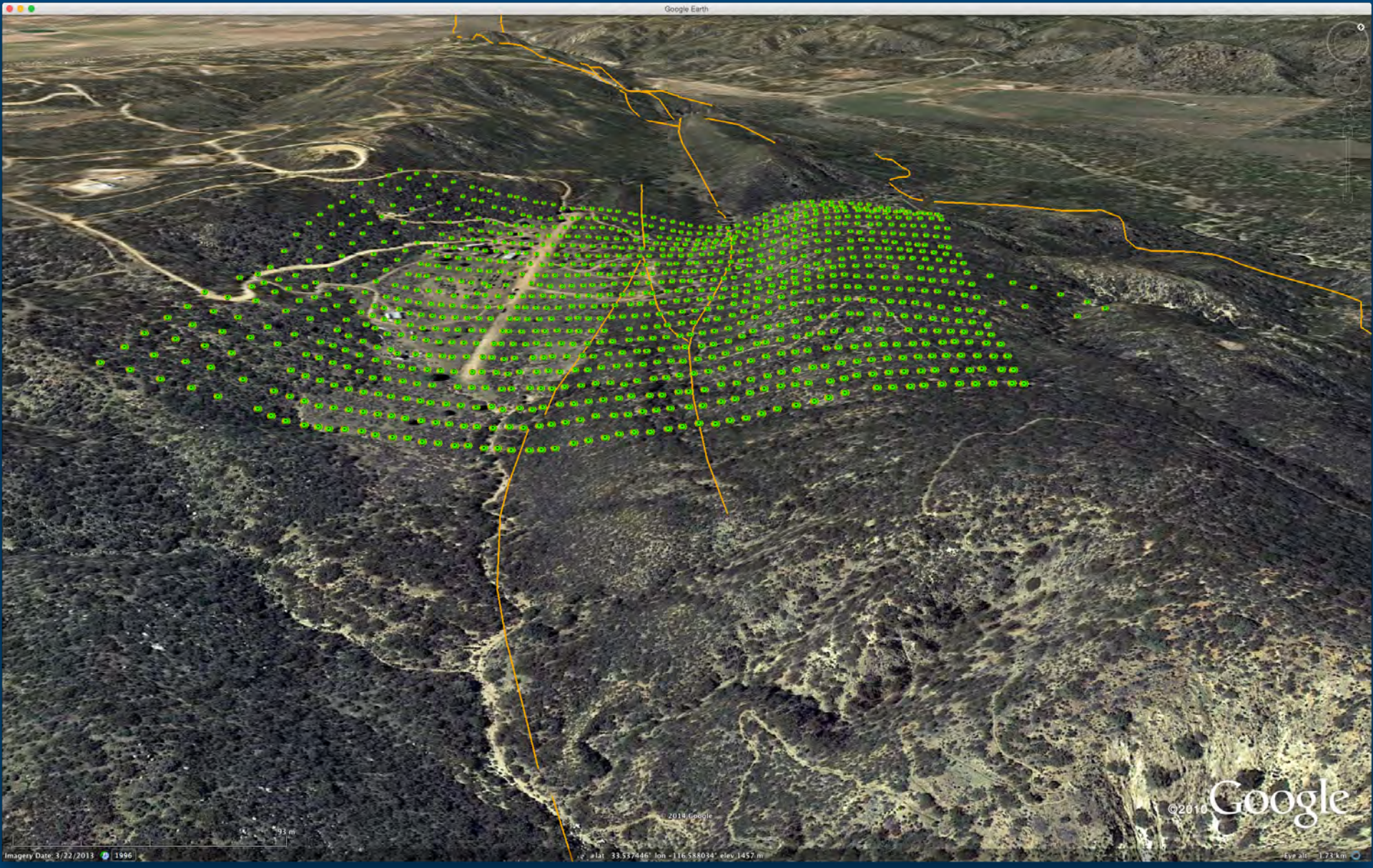
Imagery Date: 3/22/2013 1996

Eye alt: 1.73 km

Sage Brush Flats - Nodal Array



Sage Brush Flats - Oblique View



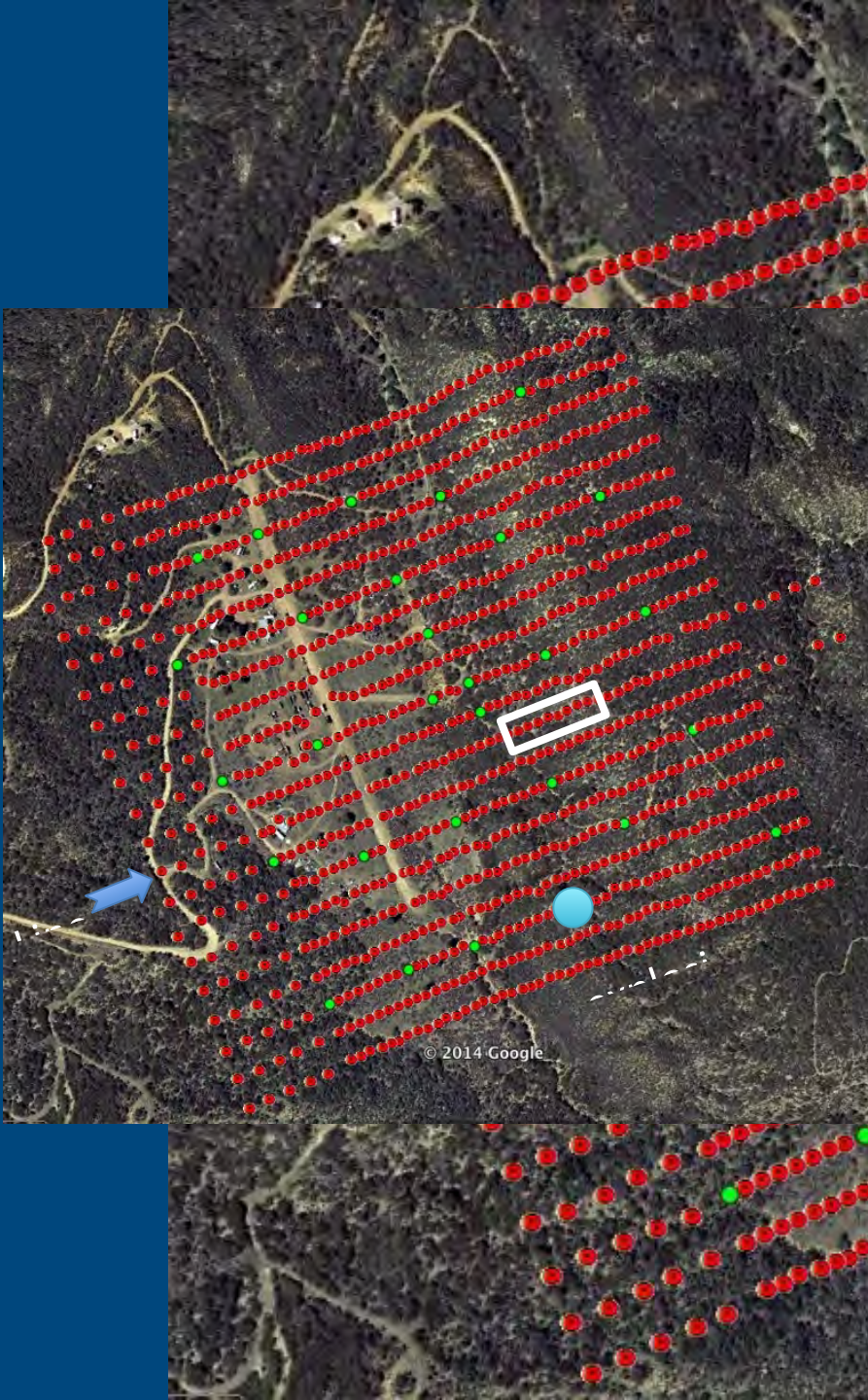
Google Earth

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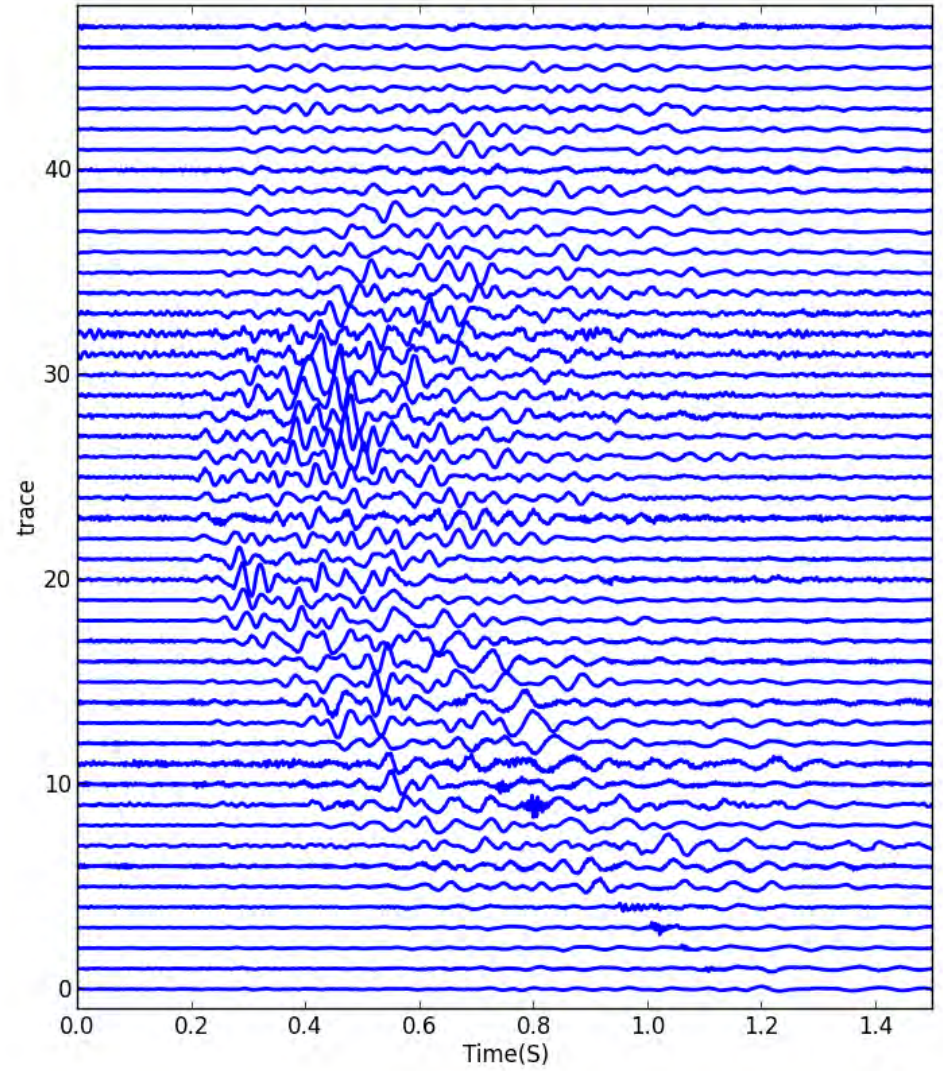
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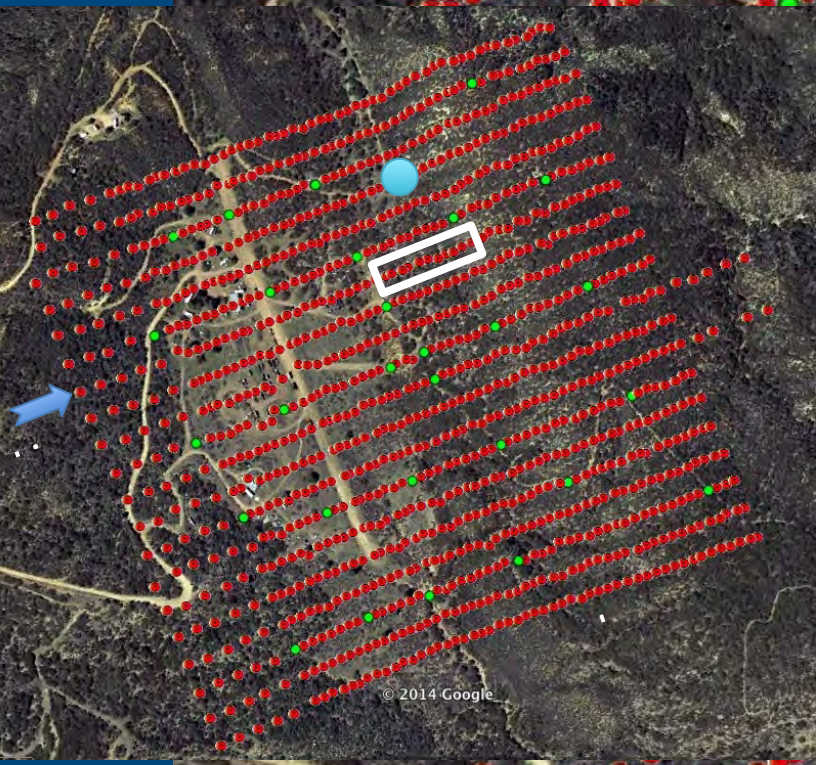
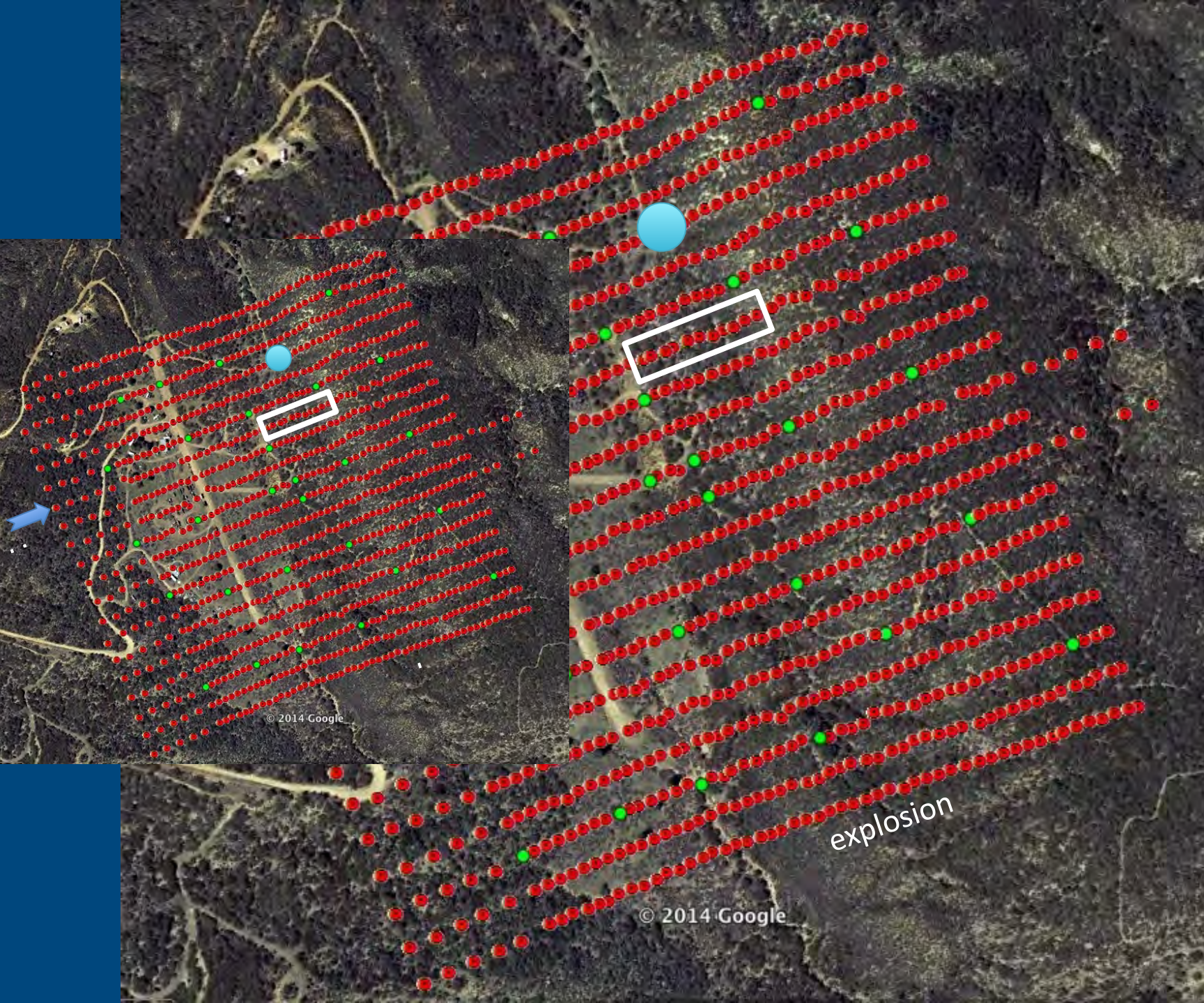
lat 33.537746 lon -116.588034 elev 1452 m

Eye alt: 1.23 km



Potential trapped waves





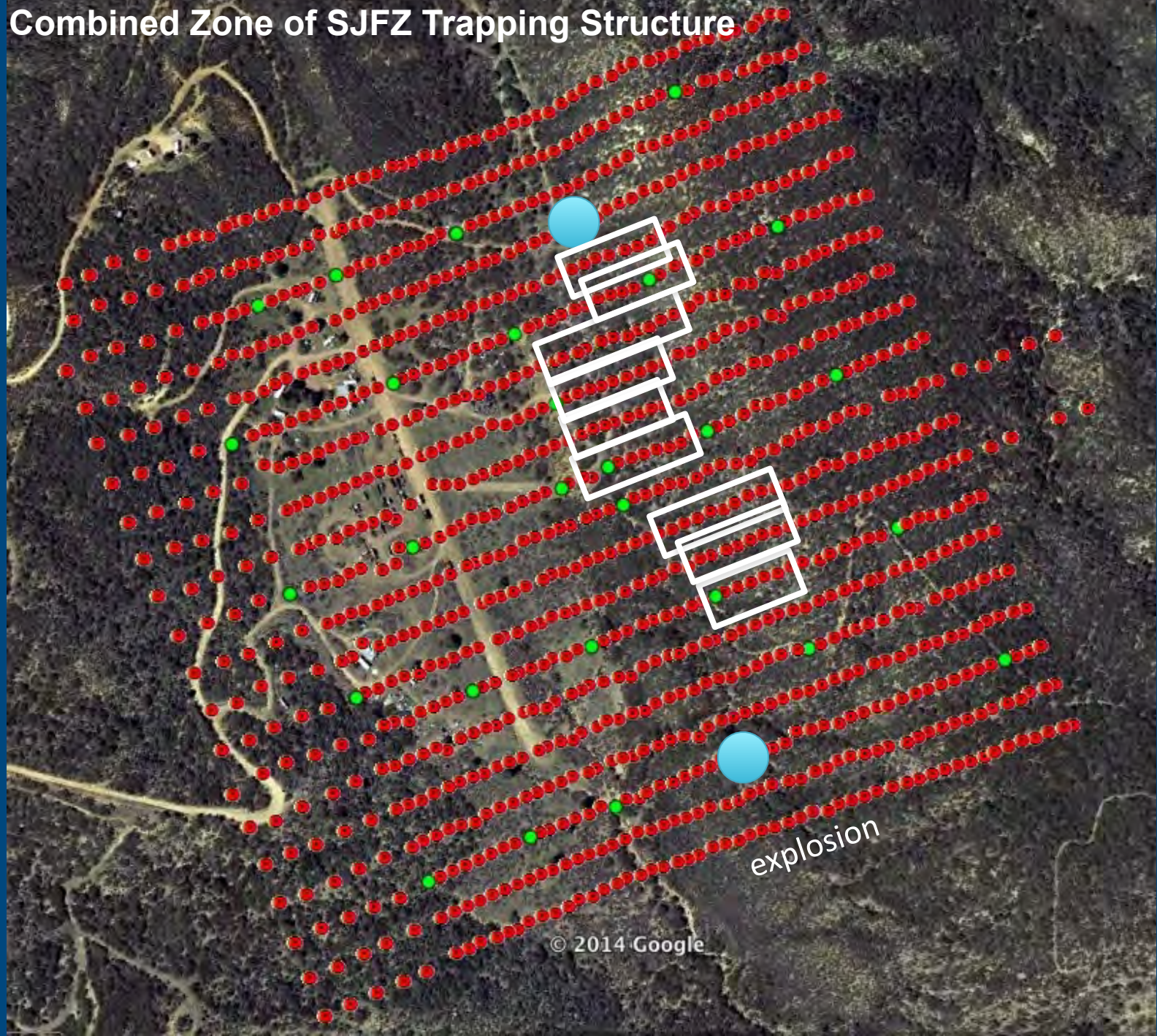
1.4

explosion

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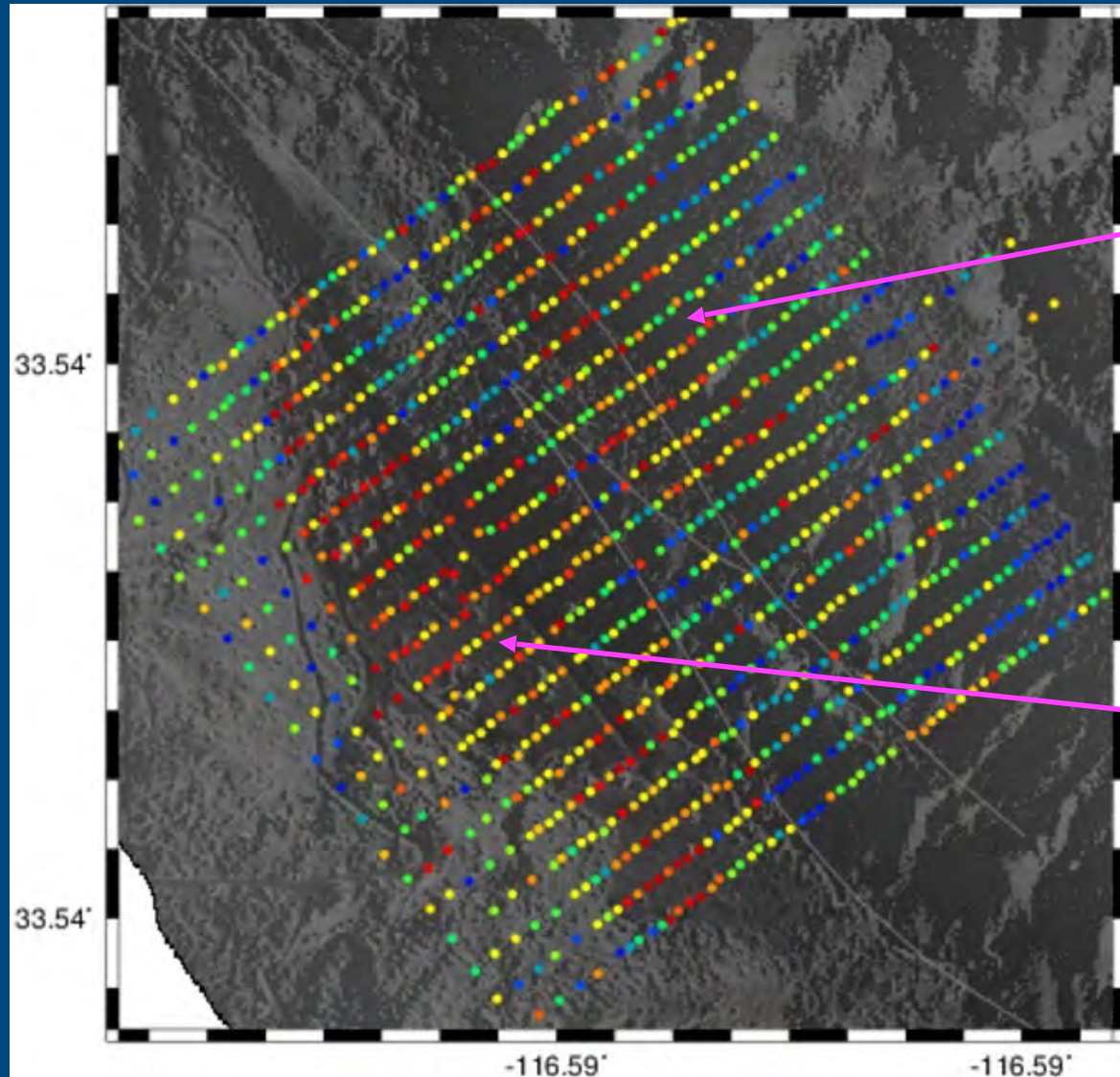
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Combined Zone of SJFZ Trapping Structure



explosion

Median power (amplitude squared) recorded for duration of experiment

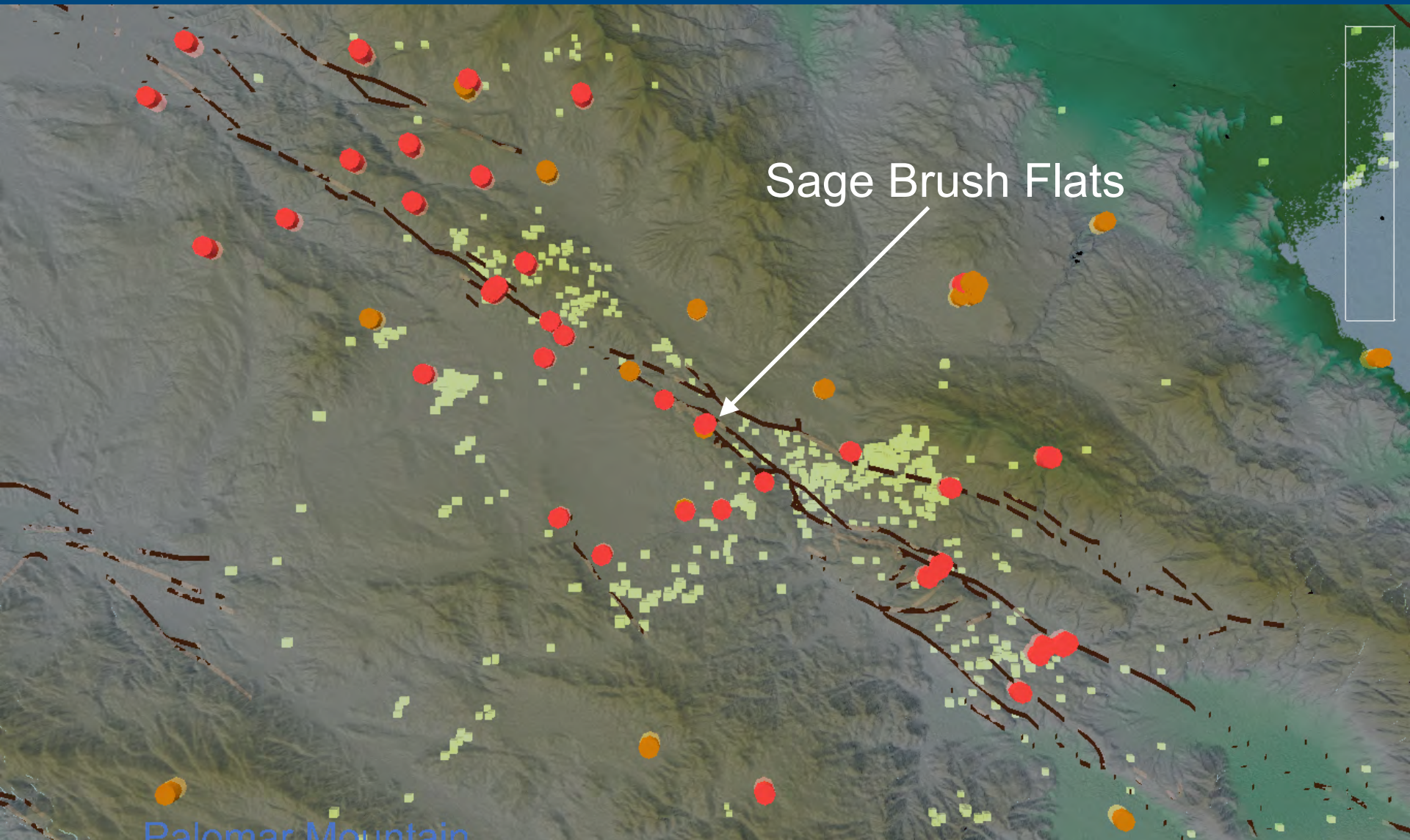


This zone of amplified motion is associated with possible trapping structure (see next slides)

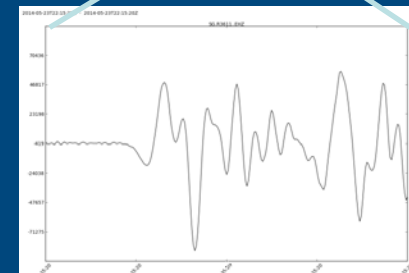
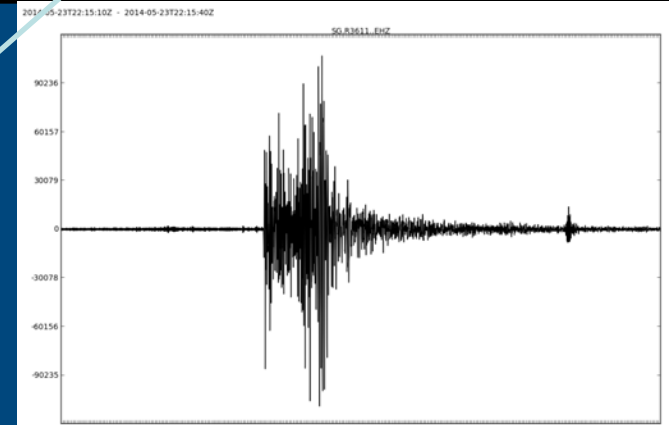
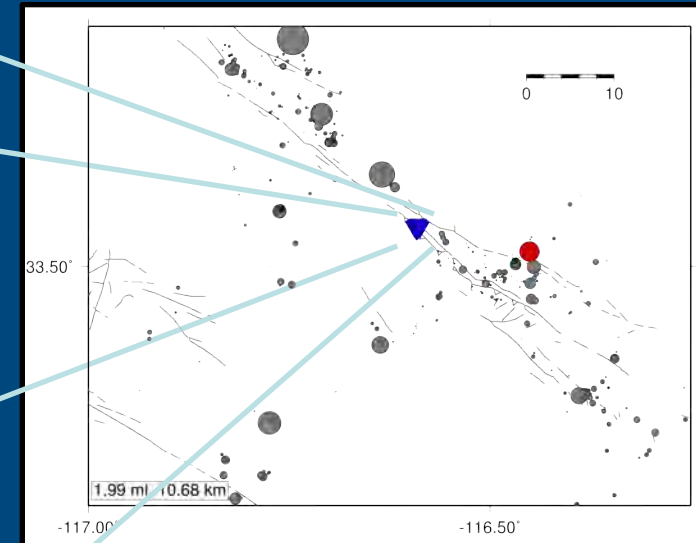
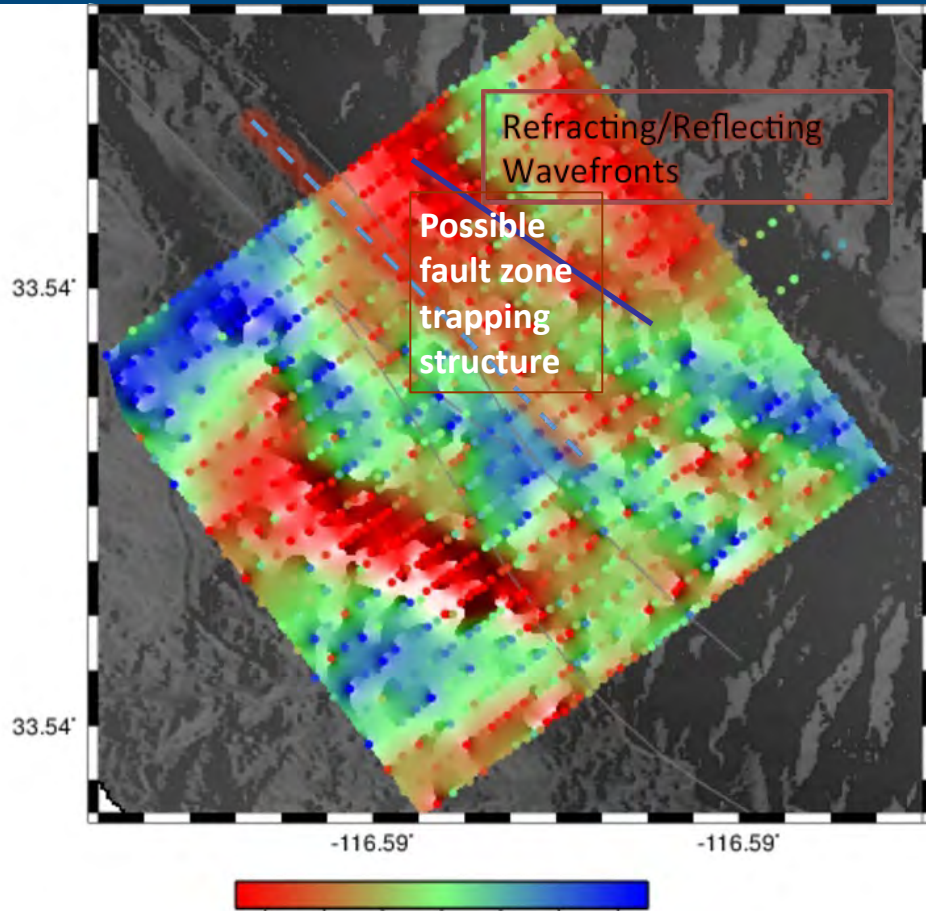
This zone is associated with landowners home and machines (cultural noise), plus possible small sedimentary basin



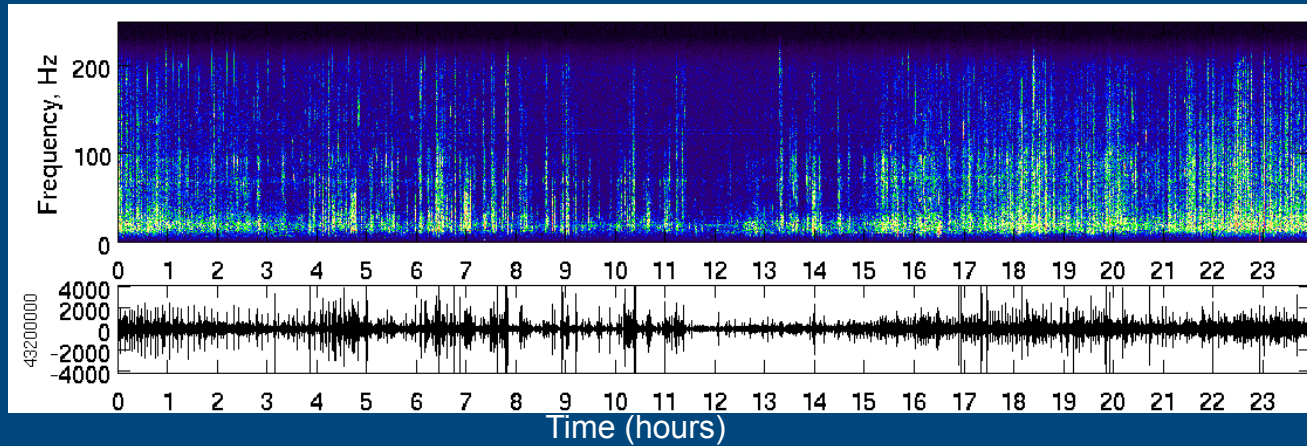
Seismicity during Nodal Experiment



M2 Event, Distance: 10.68 km



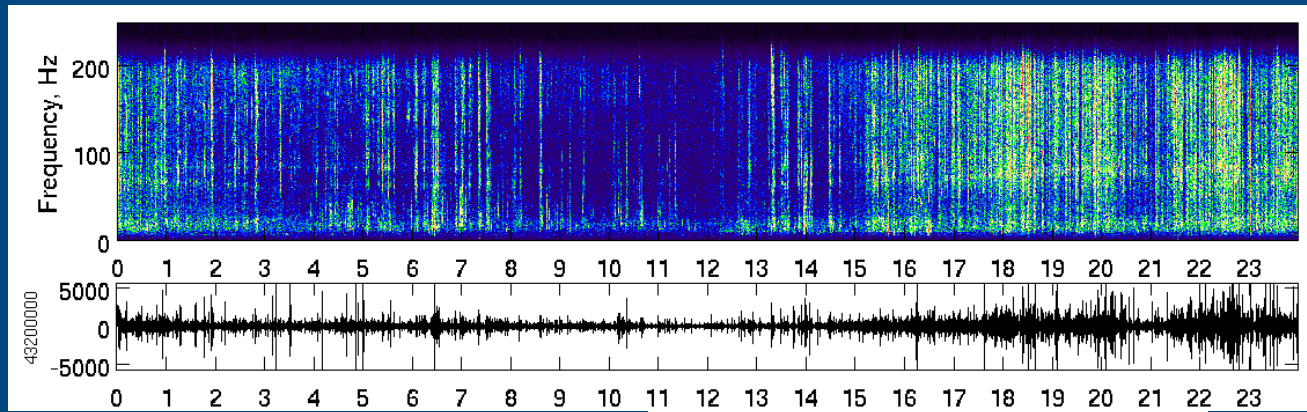
Example data and correlations from the dense deployment



Station R3413

Spectrogram for day 145

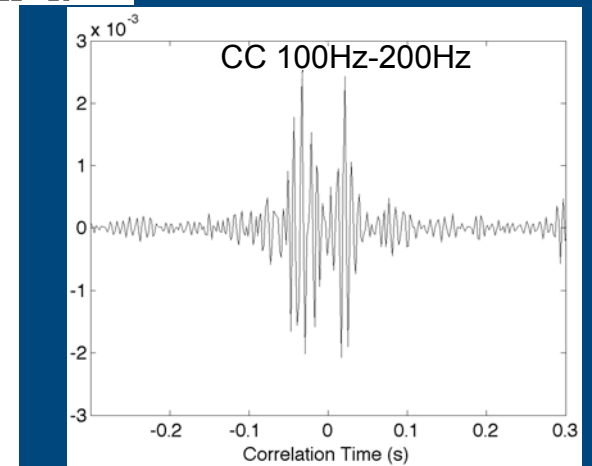
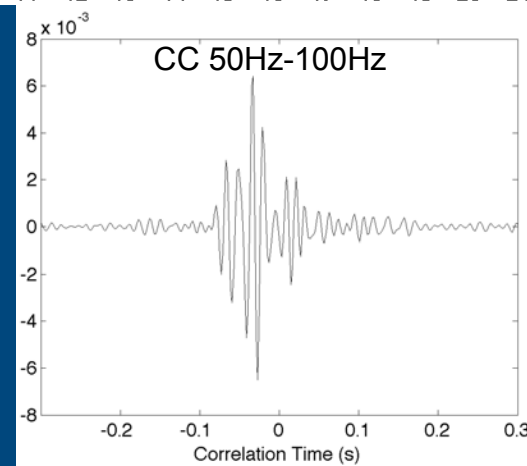
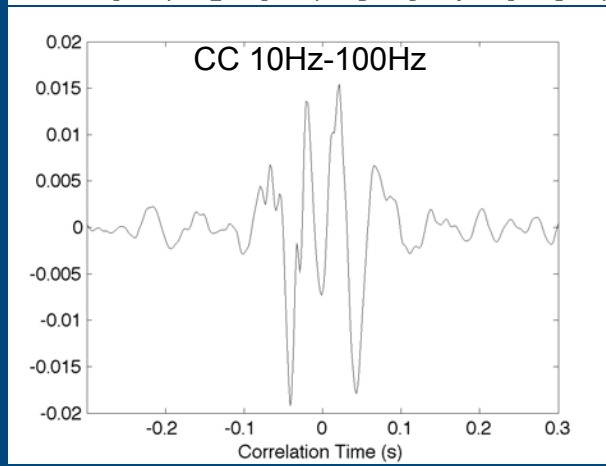
24h data for day 145



Station R3513

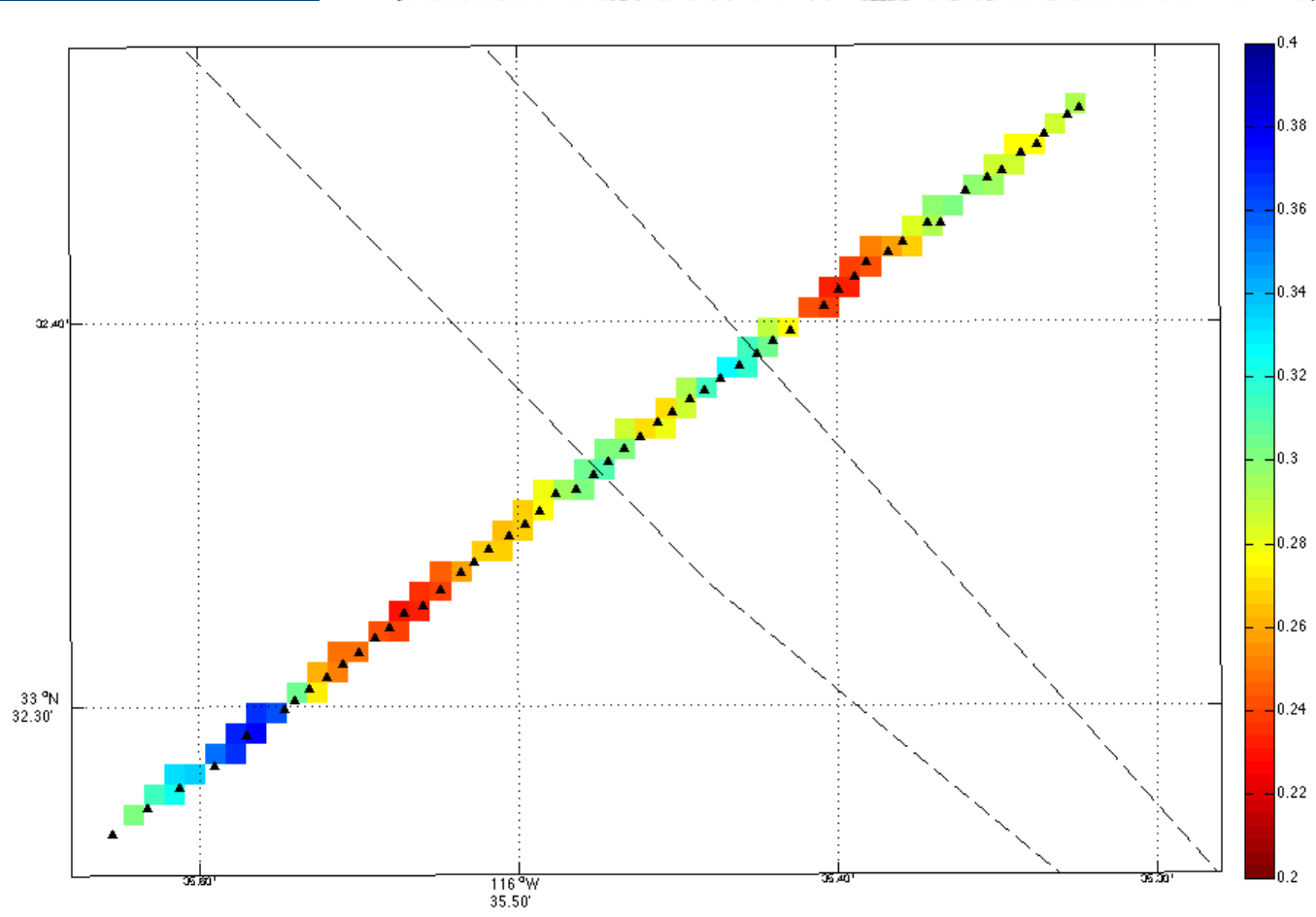
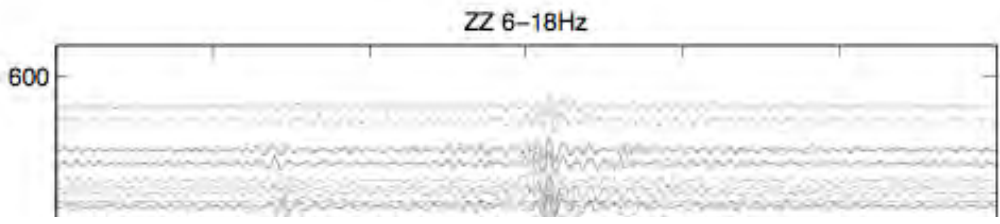
Spectrogram for day 145

24h data for day 145

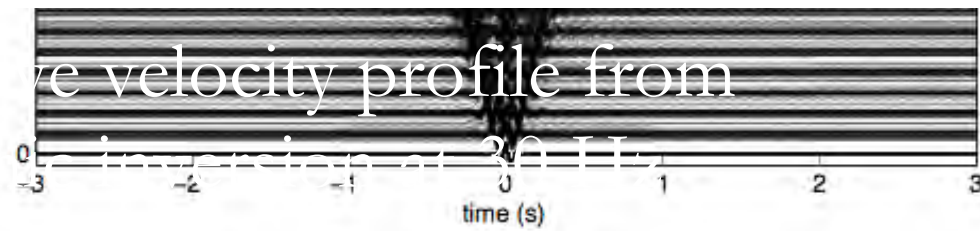


Ambient Noise Cross-correlation

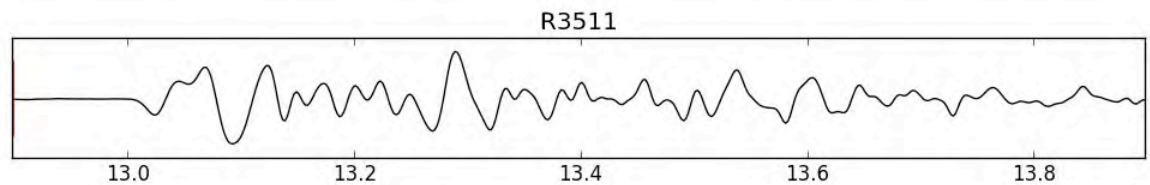
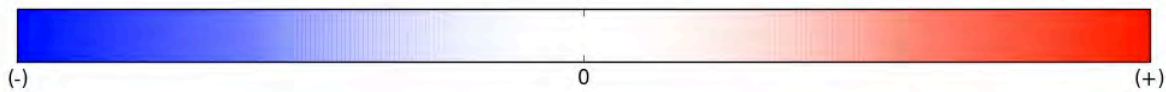
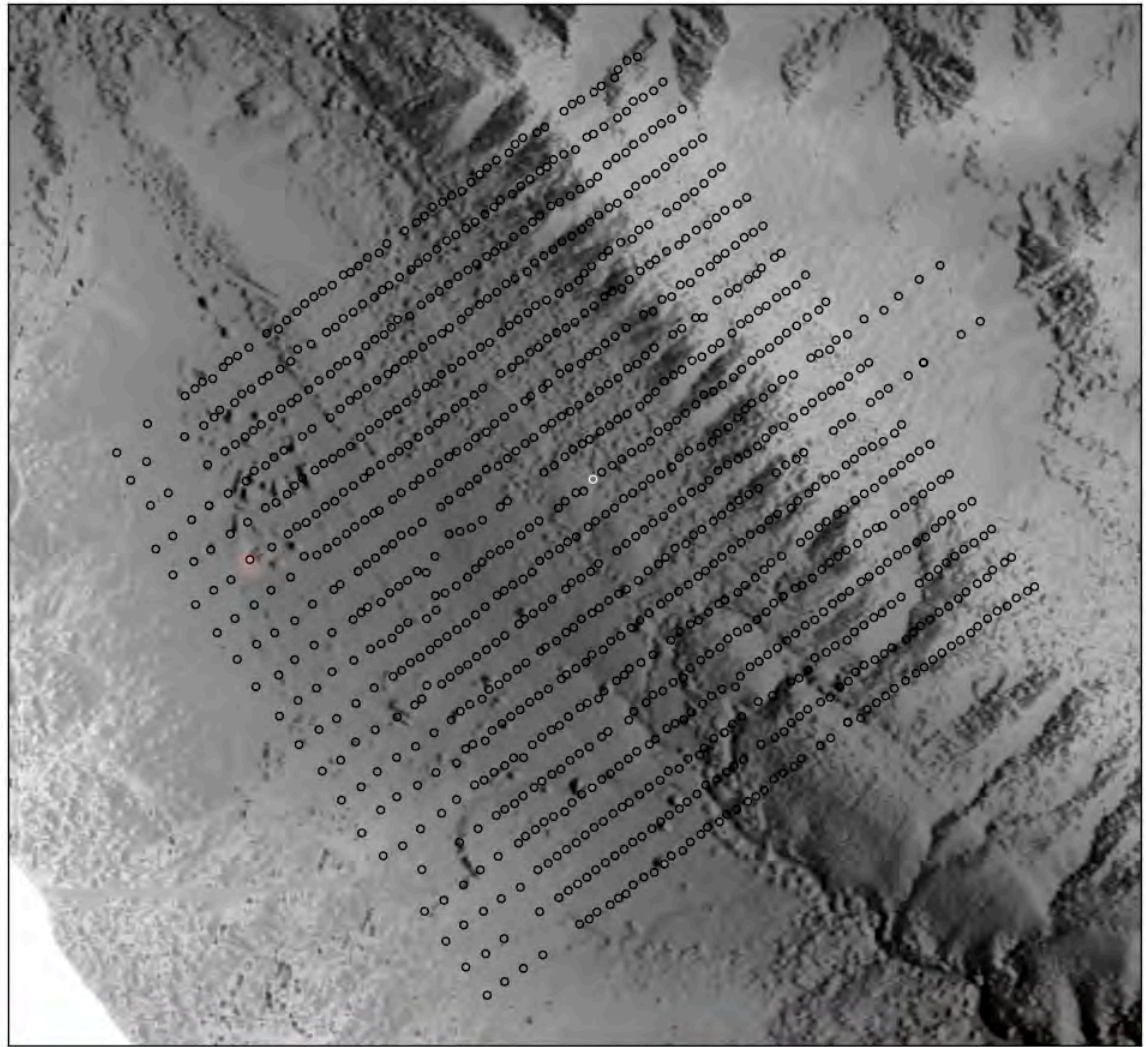
- Preliminary
- Line 13
- 600 meters
- 55 elements
- 6-18 Hz



Surface wave velocity profile from
tomography inversion at 20 Hz



- P wave
- M_L 1.5
- Epicentral distance 11.3 km
- Azimuth 120°



- P wave
- M_L 2.3
- Epicentral distance 7 km
- Azimuth 329°

