

Socorro Magma Body Array: Using mixed mode array to study shallow magma body

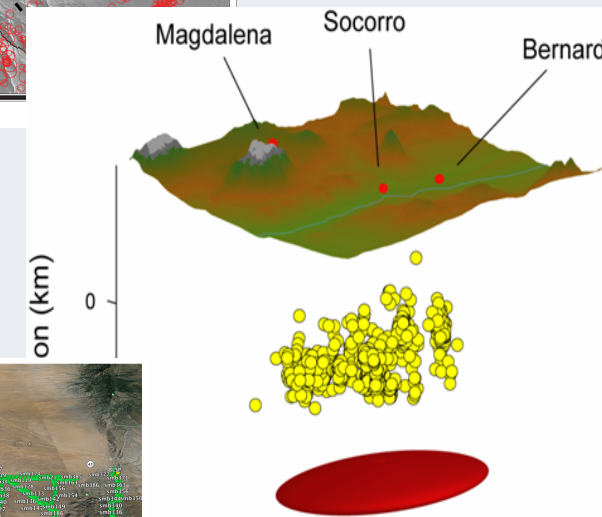
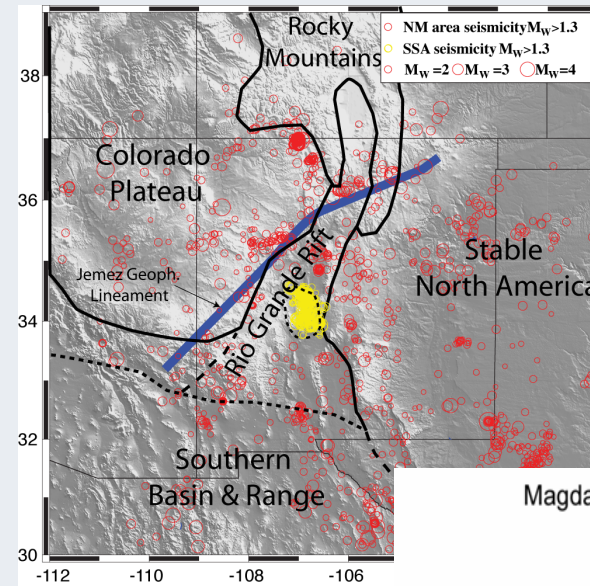
Susan Bilek
New Mexico Tech

Brandon Schmandt, Lindsay Worthington, UNM

Rick Aster, Colorado State

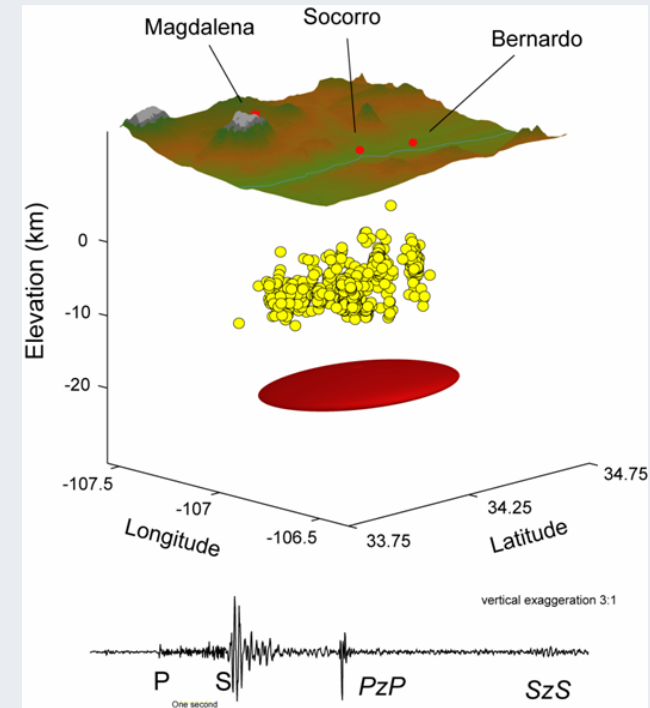
Dan Hollis, Mitch Barklage, NodalSeismic

PIC Staff (Greg Chavez, Pnina Miller, Eric Makarawicz, Alissa Scire, Michael Johnson, Lloyd Carothers, Mouse Reusch, George Slad, Brit O'Neill)

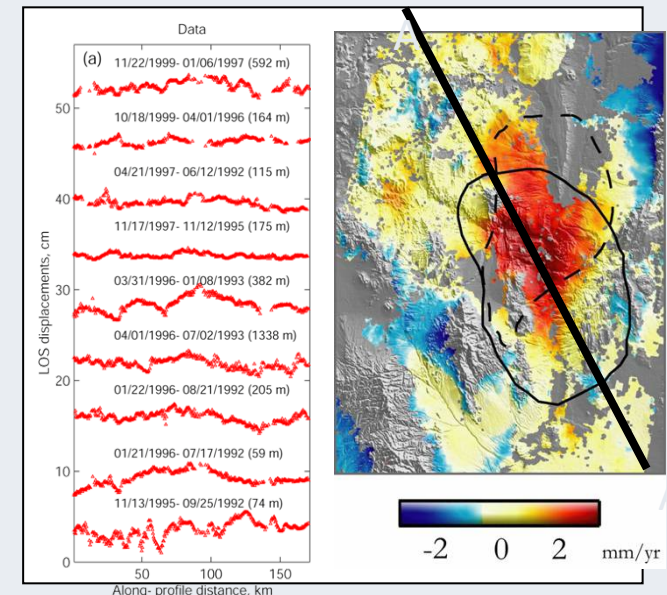


Socorro Magma Body

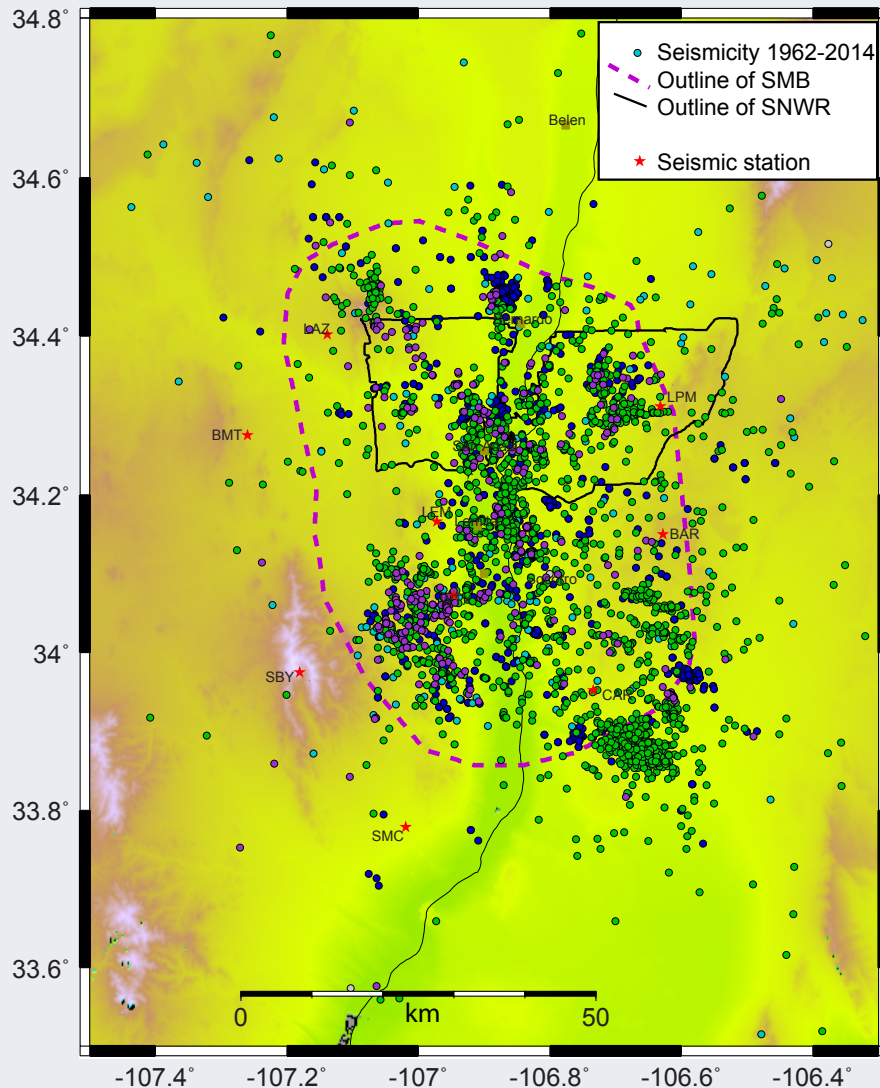
- Model for the SMB - sill-like feature of $\sim 3000 \text{ km}^2$ at 19 km depth
- Relatively flat and thin ($\sim 150 \text{ m}$)
- Seismicity above it due to crustal extension as the body inflates
- Fialko and Simons (2001) stacked 9 InSAR pairs between 1992-1999 and resolved 2-3 mm/yr uplift, other GPS and leveling studies suggest similar uplift
- Spatial heterogeneity in the uplift patterns suggest possible variations in SMB structure, diapir structure?



Courtesy New Mexico Tech Geophysics program



Socorro Magma Body: Seismicity



Short period seismic network in place since 1960s

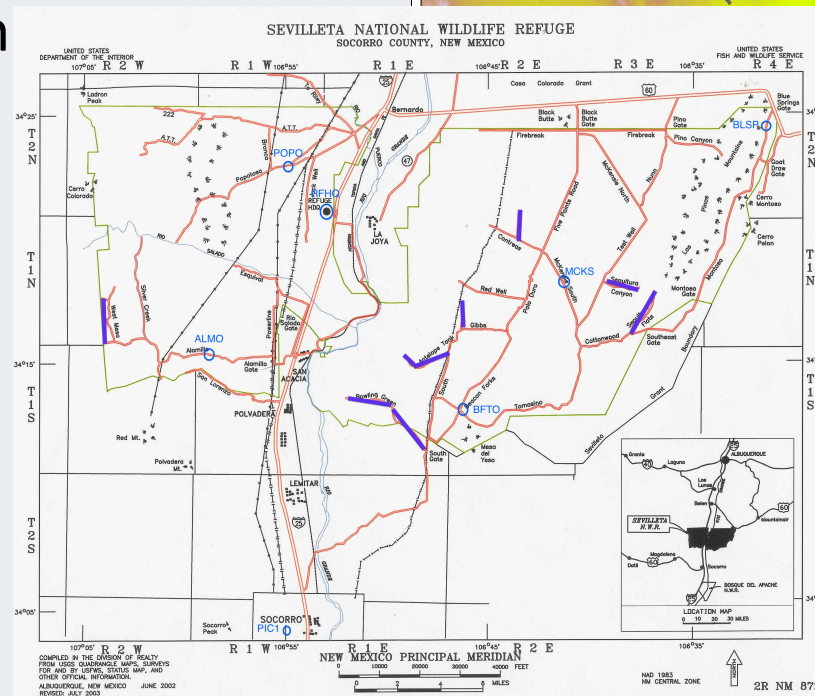
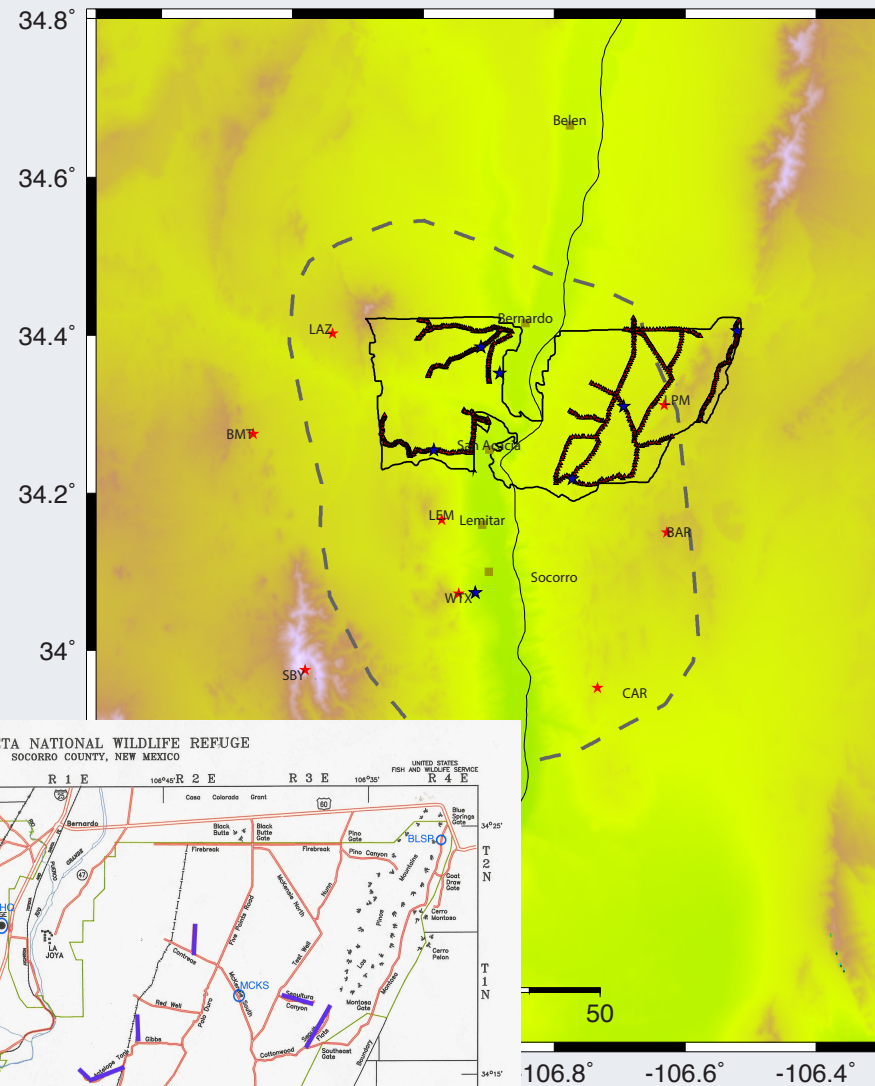
NM seismicity – large concentration in the central portion related to SMB deformation

Magnitudes generally less than M 3

Faults in the area largely ~N-S normal faults, limited focal mechanisms from swarms suggest normal faulting

Feb 2015 Deployment

- Area: Sevilleta National Wildlife Refuge
 - Limited access, greater security
 - Road access covering large portion of area
- Covers northern portion of SMB
 - over area of maximum uplift
 - extends beyond eastern edge
 - fills gap in short period network coverage



2015 Deployment

- Broadband Stations
 - 7 stations, 1 month
 - CMG 3Ts + RT130s
 - 500 Hz recording
 - Quick deploy boxes



2015 Deployment

Video credit: J. Johnson/IRIS

- NodalSeismic Instruments
 - Zland single channel nodes
 - Size: ~5 lb coffee-can
 - Cable-less system including geophone sensor, digitizer, GPS timing, , Li-ion battery power for 12 days operation



Total of 812 nodes, training for deployment, 2 field personnel (including vehicle) for both deploy and retrieval, data download from nodes, product of SEG-D data on eSATA disks

2015 Deployment

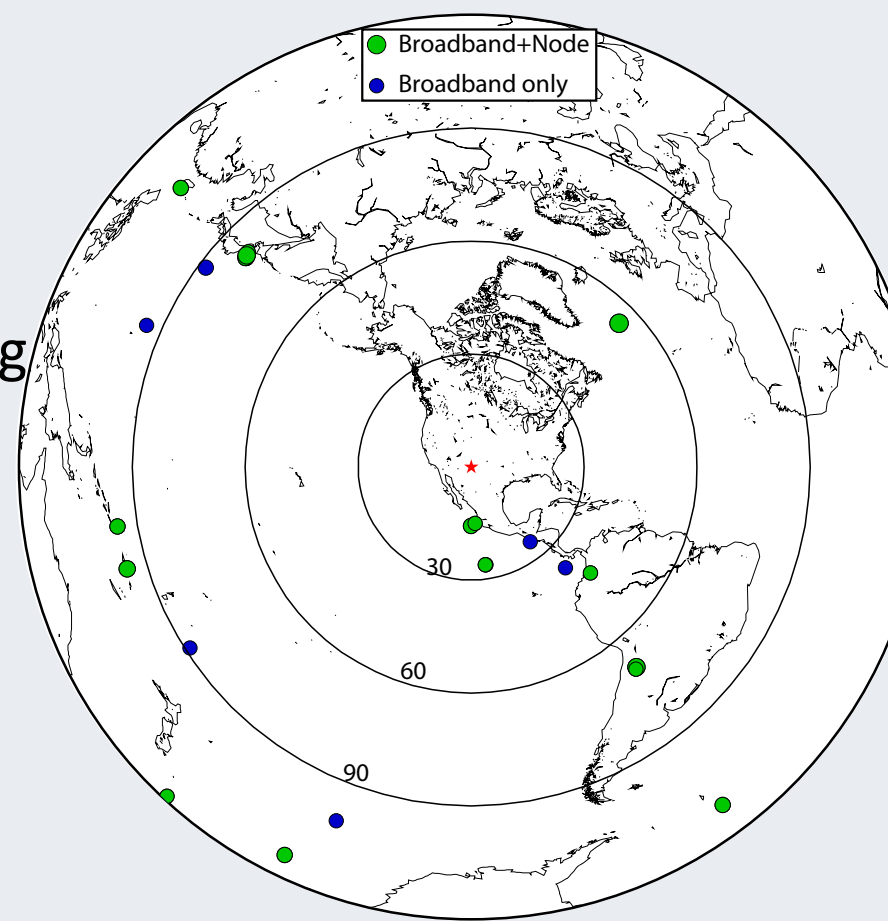
- Nodal Instruments
 - 804 deployed in SNWR, ~300 m spacing
 - 250 Hz recording
 - Cluster of 4-6 nodes around 6 of the 7 broadband sites
 - 4 had no data return (2 failed GPS lock, 2 internal malfunction)
 - 6 nodes on PIC pier with L22 and 3T



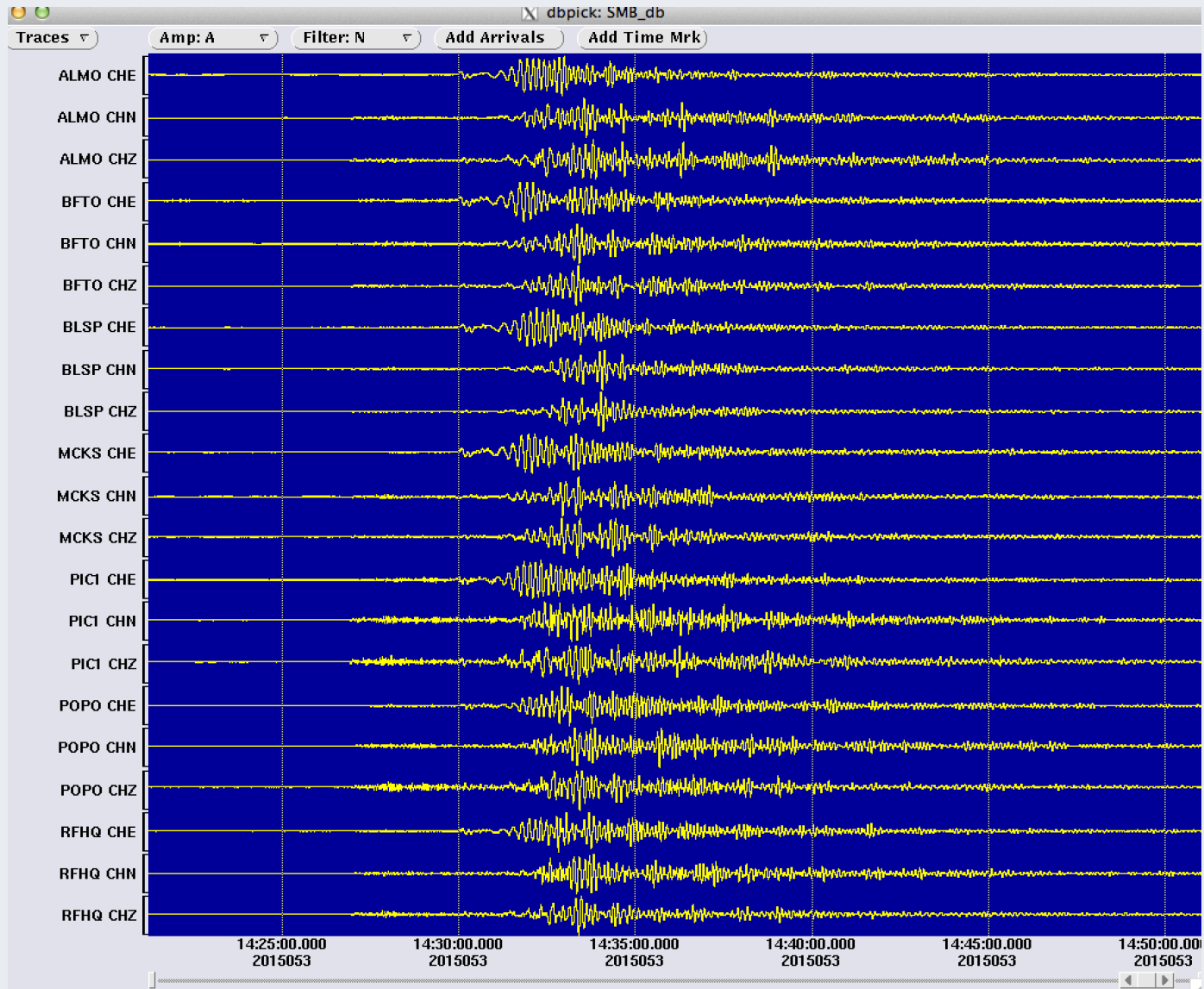
All 810 instruments deployed were recovered

Data: Sources

- 20 $M > 5.5$ global earthquakes during node deployment
- Local earthquakes
- Underground explosions (4 near PIC, have location, time, size from Weston Geophysics)
- PIC PEG “Thumper” source (along northwestern section of array), 45 shots at 500 m spacing, 10 repeats at each location, L22 for timing

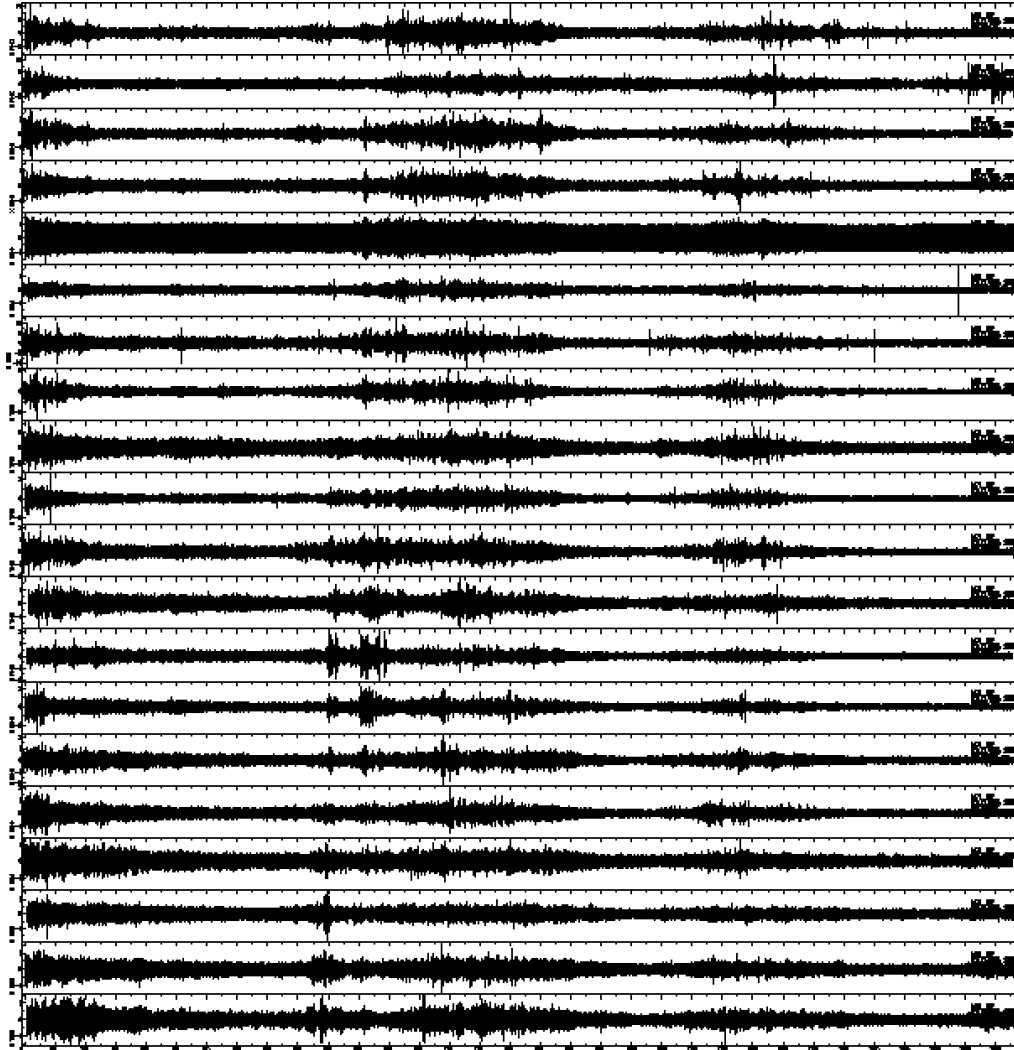


2015 Feb 22 14:23:12 M_w 6.2 Mexico earthquake



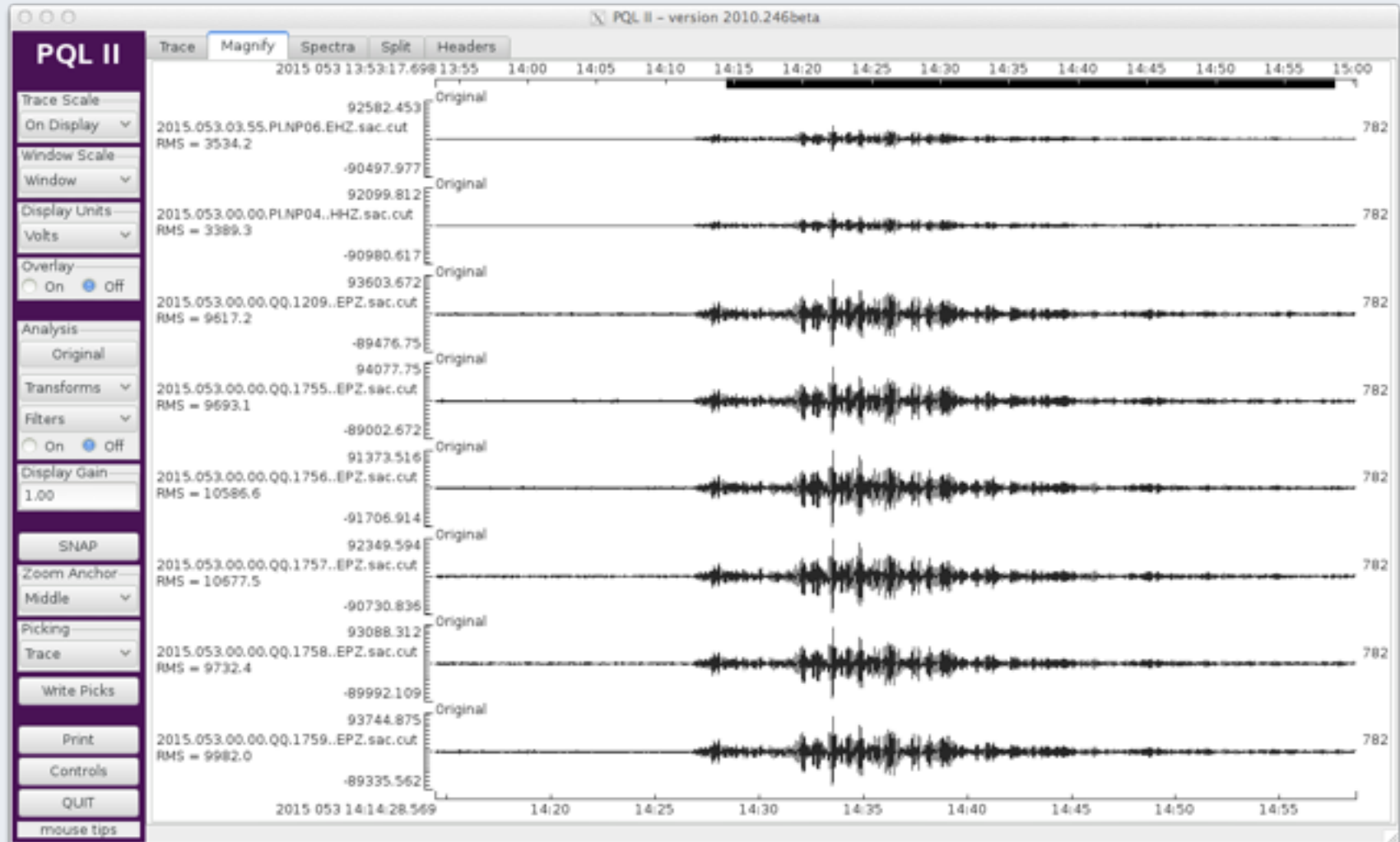
Broadband stations

2015 Feb 22 14:23:12 M_w 6.2 Mexico earthquake



Subset of 20 of the
804 nodes, raw
data

2015 Feb 22 14:23:12 M_w 6.2 Mexico earthquake



From Katyliz/Noel at the PIC –instrument-corrected data from co-located pier 3T, L-22, and 6 nodes

Deployment Issues

- **Permits & Access**
 - Required for any activity in refuge, limited opportunities to apply, but only 1 permit needed (no need for multiple landowner approval)
 - Nodes were easy to permit because no digging, placed along roads although some roads/sections off-limits
 - Broadbands – more difficult, permit approved, but needed to get archeology clearance for each site
 - Node placement near roads – grader operating during deployment
 - Site access secured by locked gates, could be limited by weather and refuge restrictions
- **Logistics**
 - 5 deployment teams, 2-4 per vehicle, 1.5 day deployment
 - 2-3 recovery teams, 2 per vehicle, 1.5 days
 - Handheld deployment units tied to specific node sets during deployment, needed to be matched with recovery teams
- **Broadband instrumentation**
 - Quick-deploy BIHO boxes and small vault footprint made deployment quick and easy
- **Node Instrumentation**
 - Overall very easy to deploy, little pre-deployment training required
 - Connections/communication between handheld unit and nodes could be difficult at times

Data Issues

- Instrument corrections for nodes may be an issue (amplitudes on instrument corrected data $\sim 2\times$ larger than co-located broadbands)
- Data volume and transfer to DMC
 - ~ 877 Gb in SEG-D
 - ~ 330 Gb in PH5
 - Loading data to PH5 took almost 2 weeks using current methods
 - Transfer to DMC only few days