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Southern Great Basin seismic network operations

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Southern Great Basin Seismic Network Operations

**PI's: John Anderson - Glenn Biasi – Ken Smith**

Review: January 18, 2007

Subtasks

- 1. Record and archive data from the permanent seismic network.

- 2. Process seismic data into a preliminary earthquake bulletin.

- 3.* Maintain the seismic stations, the strong-motion stations, the telemetry network, and the computing lab.

- 4.* Prepare and submit a seismicity report on a yearly basis

- 5.* Maintain and collect data from 3 north-portal boreholes.

- 6.* Report on borehole accelerometers.

- 7. Estimate Kappa at network stations.

- 8.* Implement a recording system at borehole UZ16.

- 9.* Prepare and submit high-quality papers to peer-reviewed journals on seismic data and interpretations in the YM region.

- 10. Perform a multi-year telemetry and station upgrade.

Yucca Mountain Area Earthquake Monitoring Network
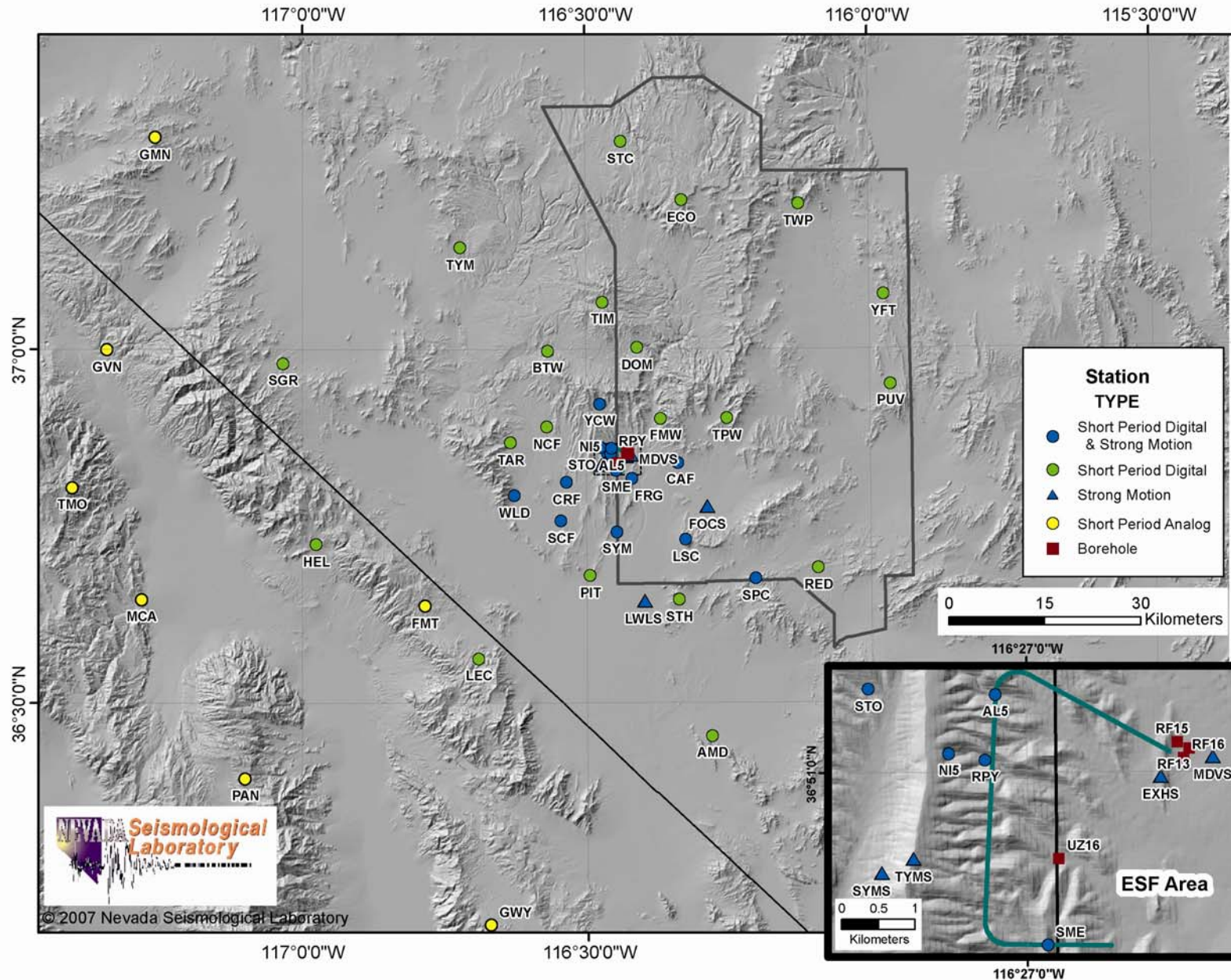
2004-2006 Preliminary Earthquake Locations
within 65 km of YM
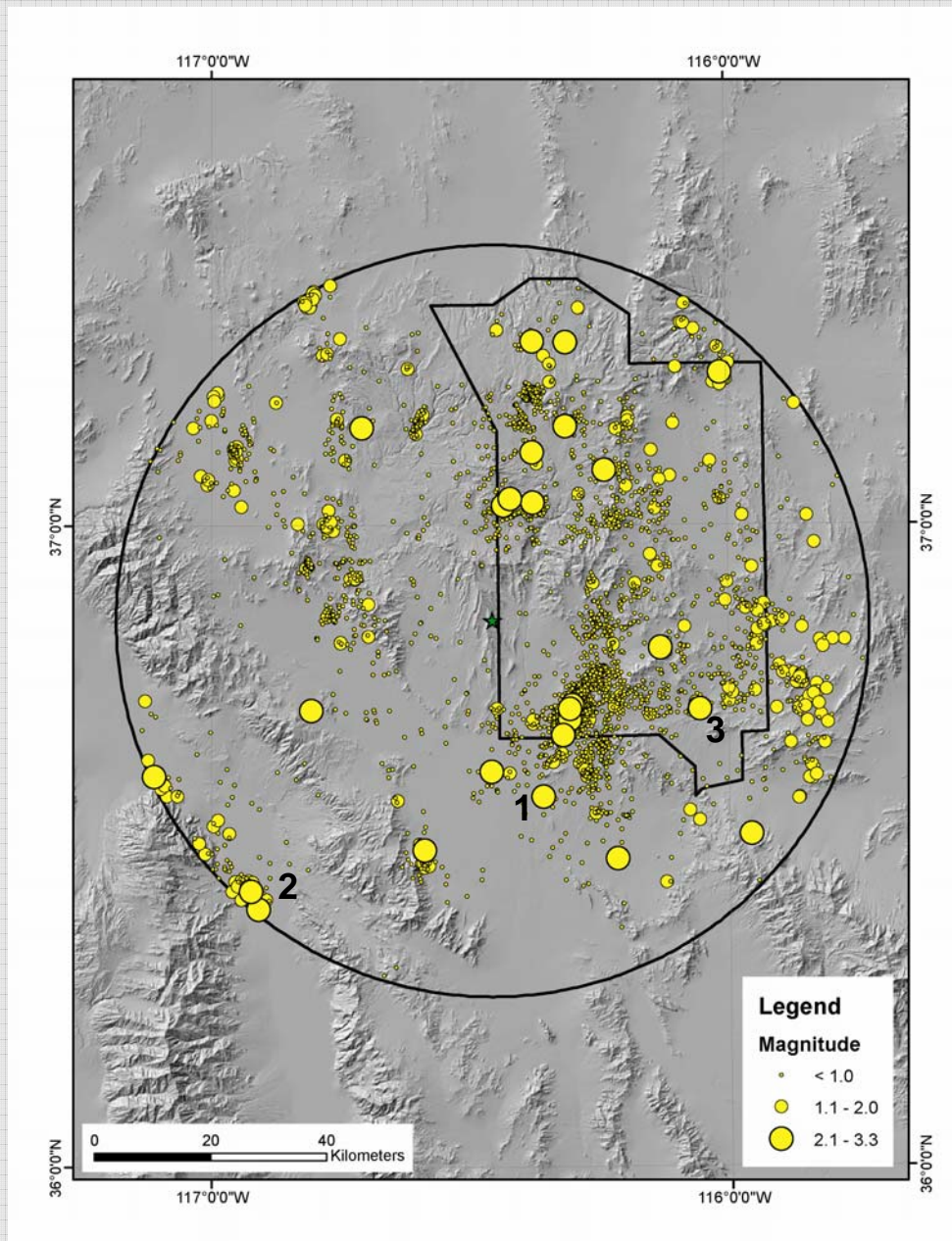
- 5413 earthquakes located

- Complete to ~M -0.5 near YM

- LSM aftershock sequence
  primary source area

- Similar to historical patterns

- Seismicity rates decreasing
  to pre-LSM levels

- Some small events in YM block

Largest Events 2004-2006

	M	Location	Date/Time
1.	2.8	36.49 -116.58	4/26/2004 23:26
2.	3.2	36.40 -116.90	11/30/2006 20:12
3.	3.3	36.71 -116.05	4/17/2006 20:14

Seismic Network IP Upgrade and Network Subtasks:

➢ *Existing network communications frequencies could be auctioned*
➢ *1980's seismic instrumentation no longer supported by vendor*   *Justification*

- Implement IP communications
- Replace data loggers
- Install 3 ESF/Surface pairs
- Instrument 3 Pad boreholes
- Install data acquisition system at borehole UZ-16

Network Status:

➢ IP communications from UNR to Skull Mountain, Yucca Mountain, ESF
➢ 23 new data loggers in place; 23 older instruments in operation
➢ 11 instruments are prepped to install
➢ Angel Peak to Skull Mountain link in place
➢ UZ-16 data acquisition system operational
➢ Borehole accelerometers in operation
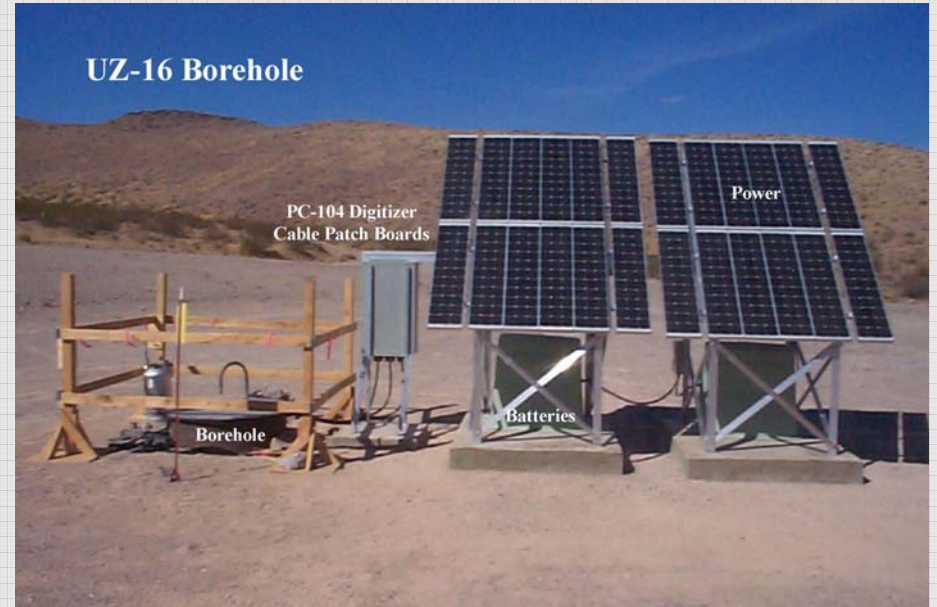➢ ESF/Surface Pairs in operation

Planned:

- Shoshone Peak Harris IP radio for access to northern NTS stations
- Angel Peak to UNLV Canopy backhaul 30 Meg radio
- Sober Peak IP Harris radio
- Priority - all stations in Yucca-Skull com-link

ESF-PAD Borehole Accelerometers
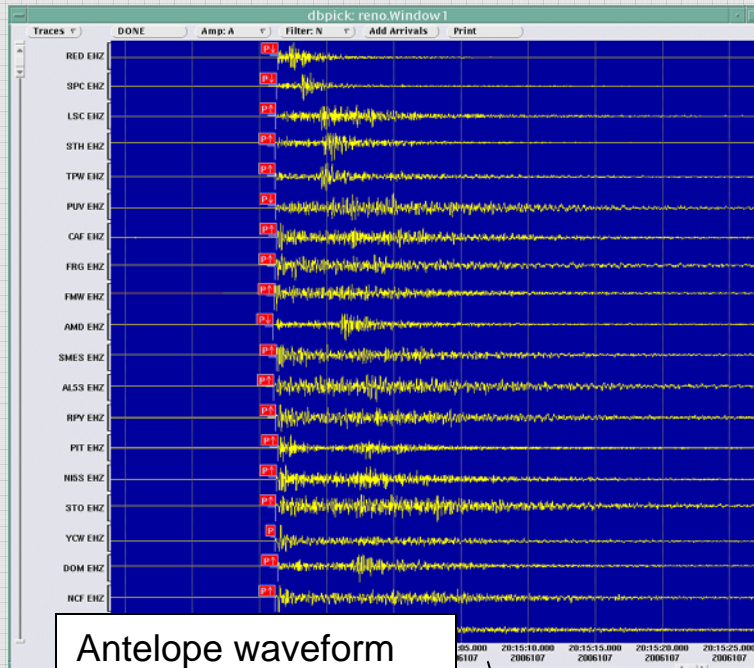

UZ-16 Borehole Data Collection System

UZ-16 Borehole

PC-104 Digitizer
Cable Patch Boards

Power

Borehole

Batteries

Yucca Mountain Telemetry Node

Montezuma Peak Microwave Node

Nevada Seismological Laboratory

Antelope Seismic Software Application

Antelope waveform display of largest event on NTS, 04-06; M 3.3 near Mercury on April 17, 2006. Earthquake focal mechanism shown.

➤ Receives "live" data from YM stations
➤ 2-3 Gigabytes per day of waveform data
➤ Automatic real-time locations and magnitudes
➤ Relational database data management system
➤ Interactive event location tools for event review
➤ Event and continuous waveform archives
➤ Preliminary auto-event locations are broadcast via email and posted on the web

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➤ Data submittals to the project under IPR-001

➤ Software qualification for version 4.8 underway

➤ Developing remote communications tools for some routine maintenance and network operations activities under PHP

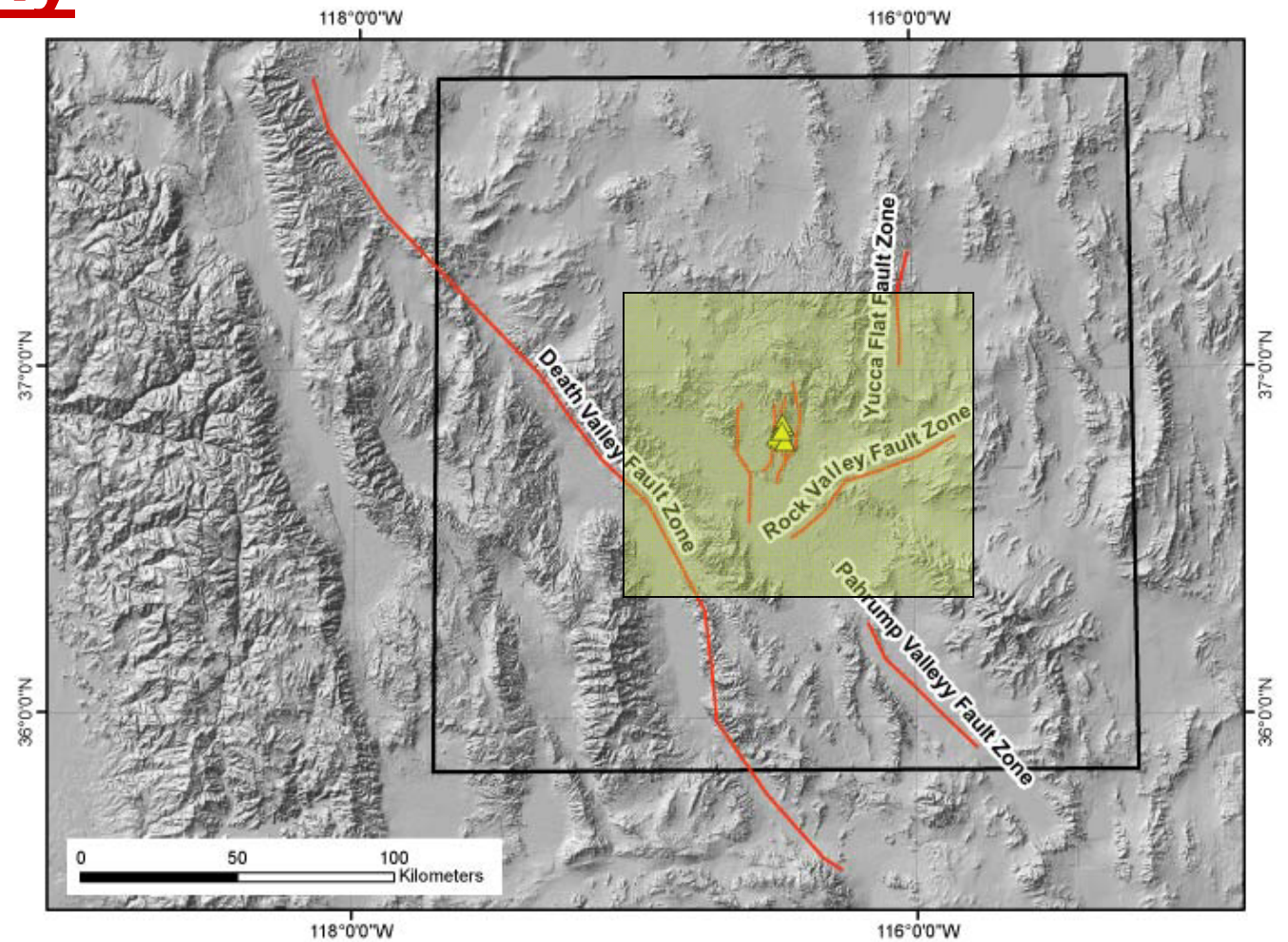➤ Procedures are being rewritten to adapt to new IP environment and new technologies

Analysis Results

- **<u>Tomography</u>**
- Backwall
- UZ16
- Kappa

P-wave — Depth Section: 0km

S-wave — Depth Section: 0km
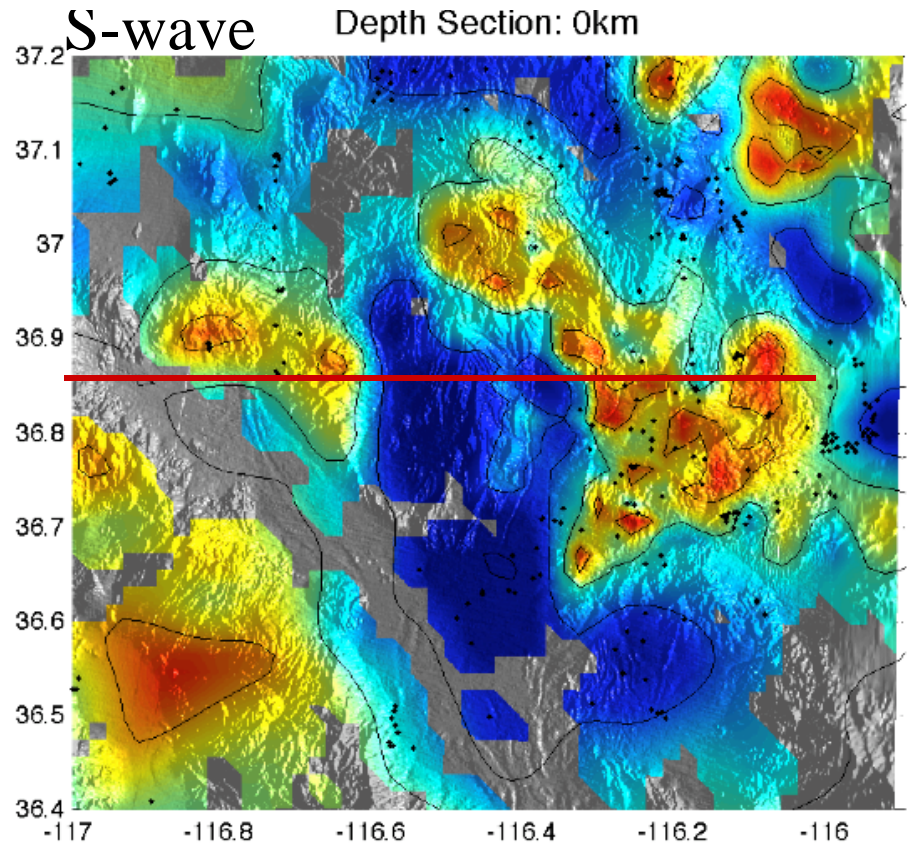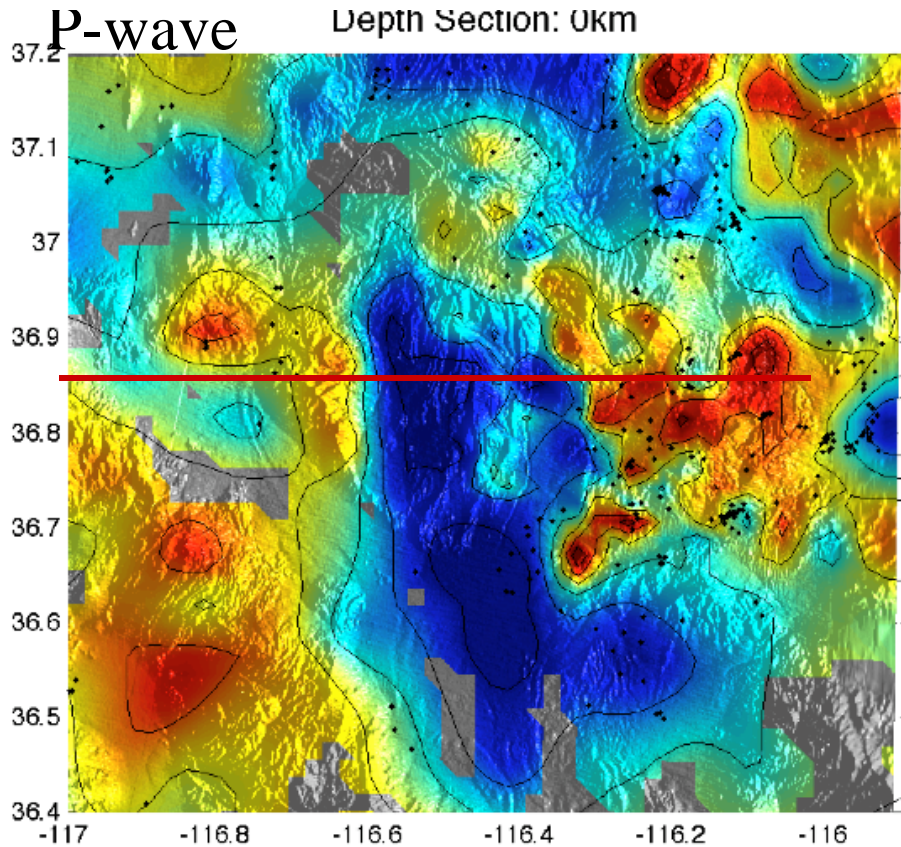
Cross Section at 36.85N +/- 0.05°
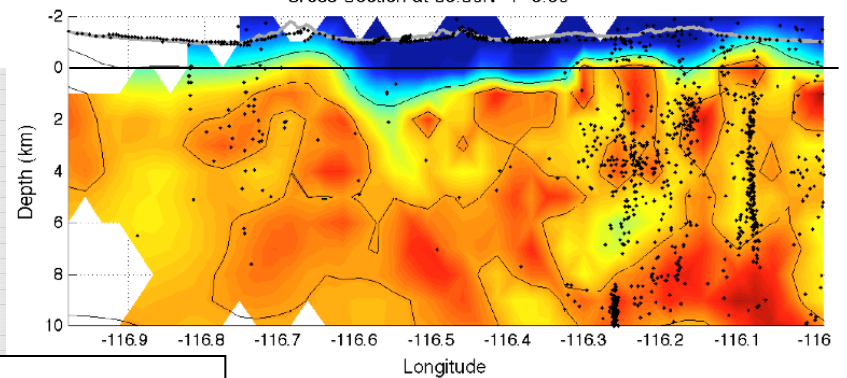
Crustal Tomography
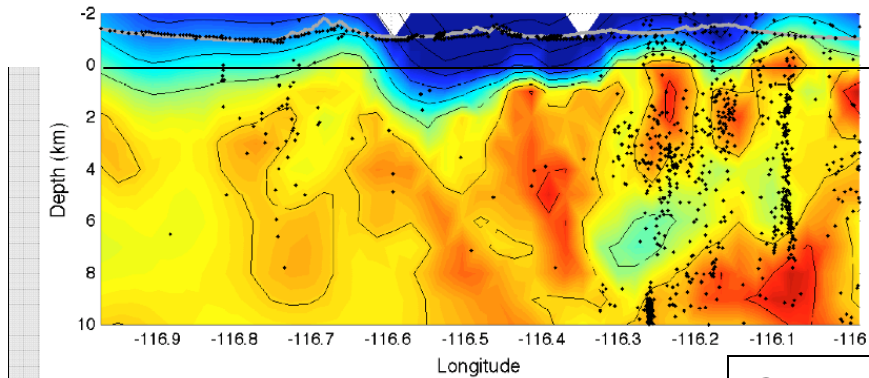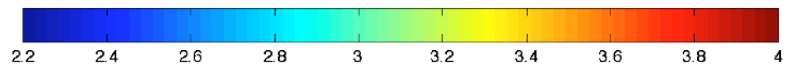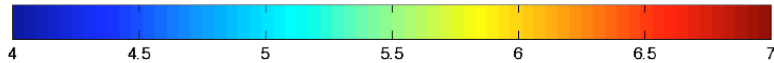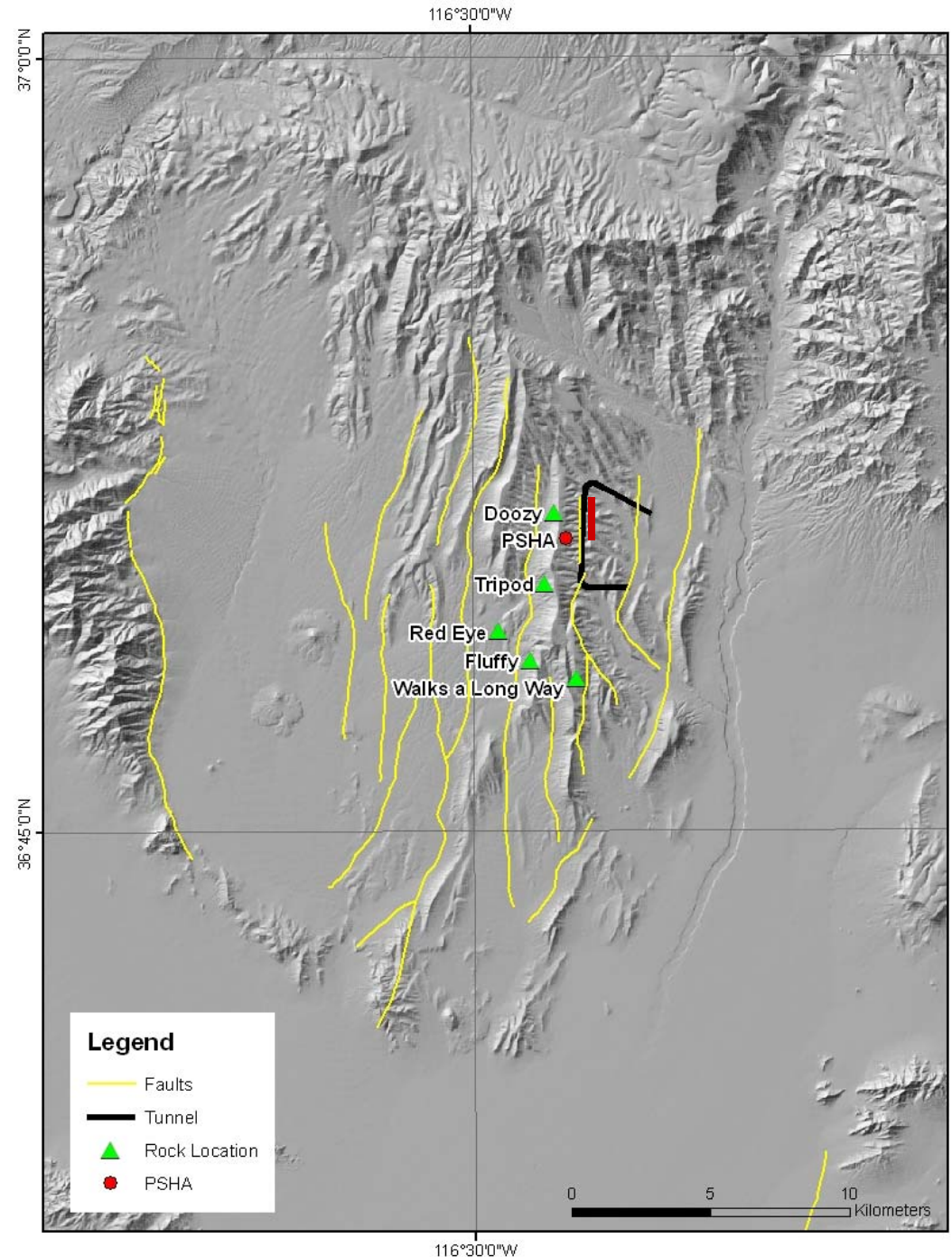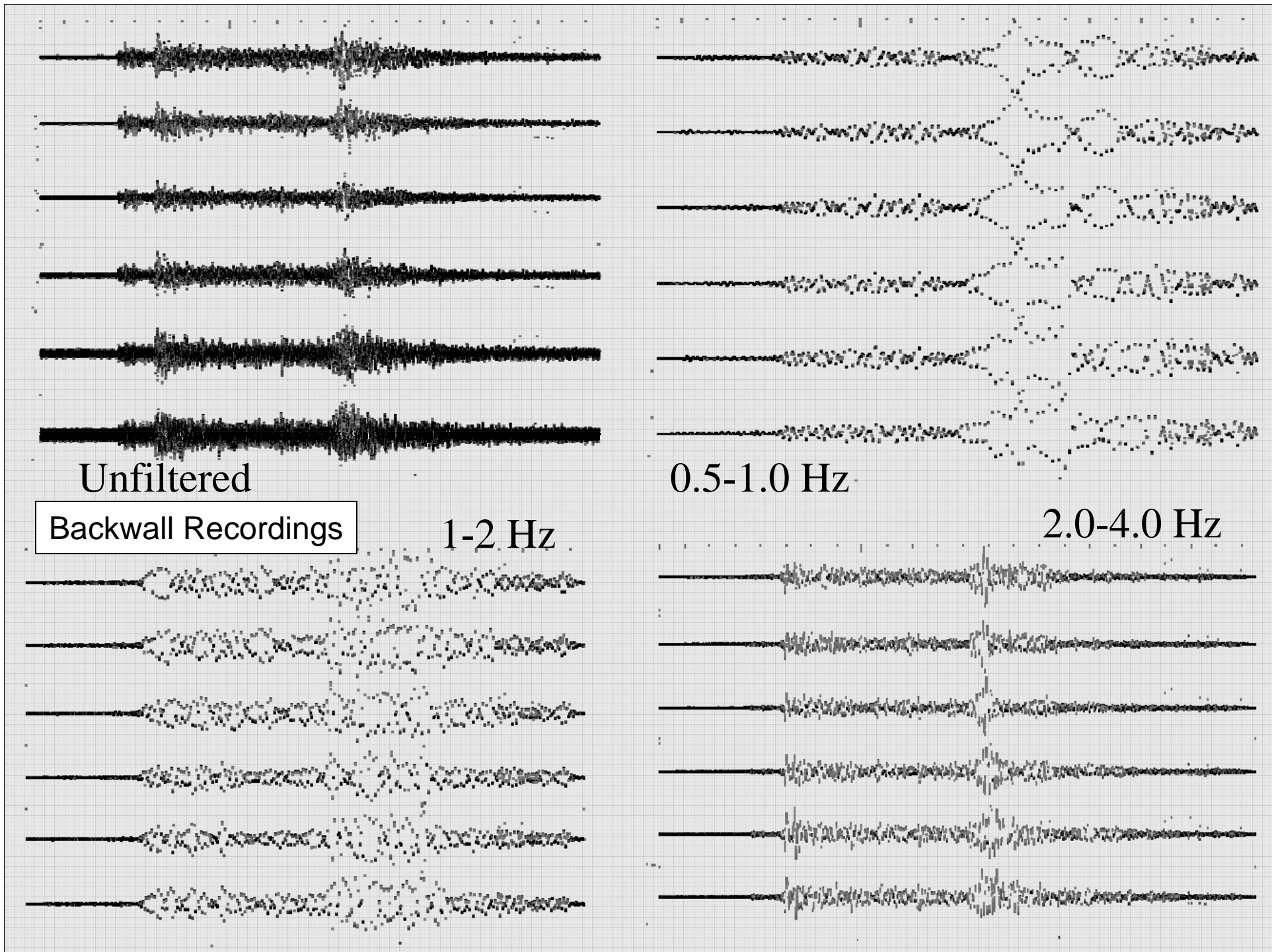
Analysis Results

- Tomography
- **Backwall**
- UZ16
- Kappa

Unfiltered

Backwall Recordings

0.5-1.0 Hz

1-2 Hz

2.0-4.0 Hz
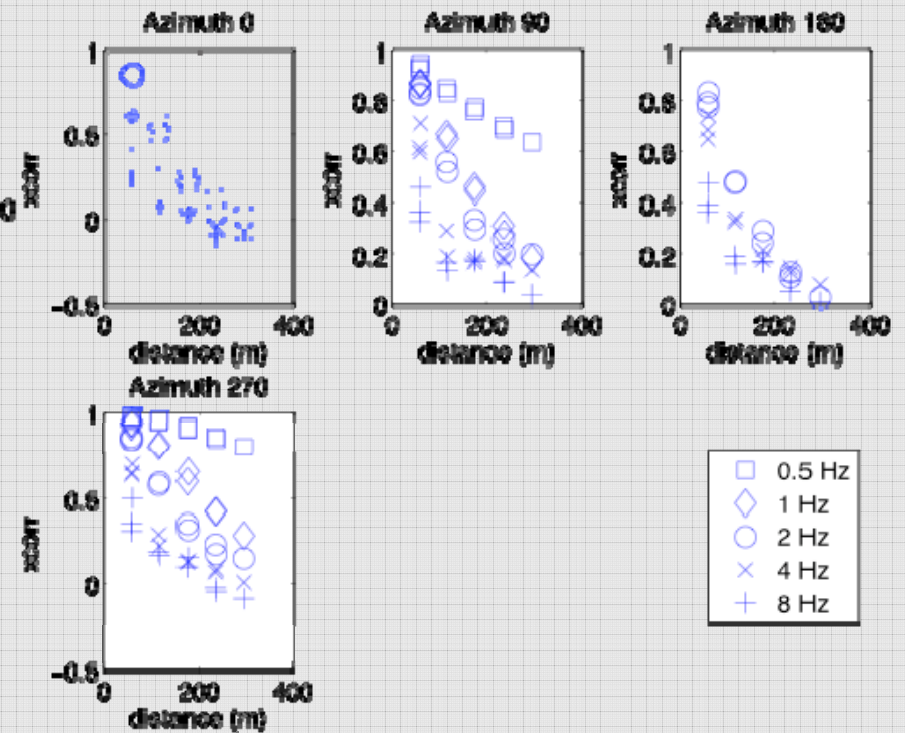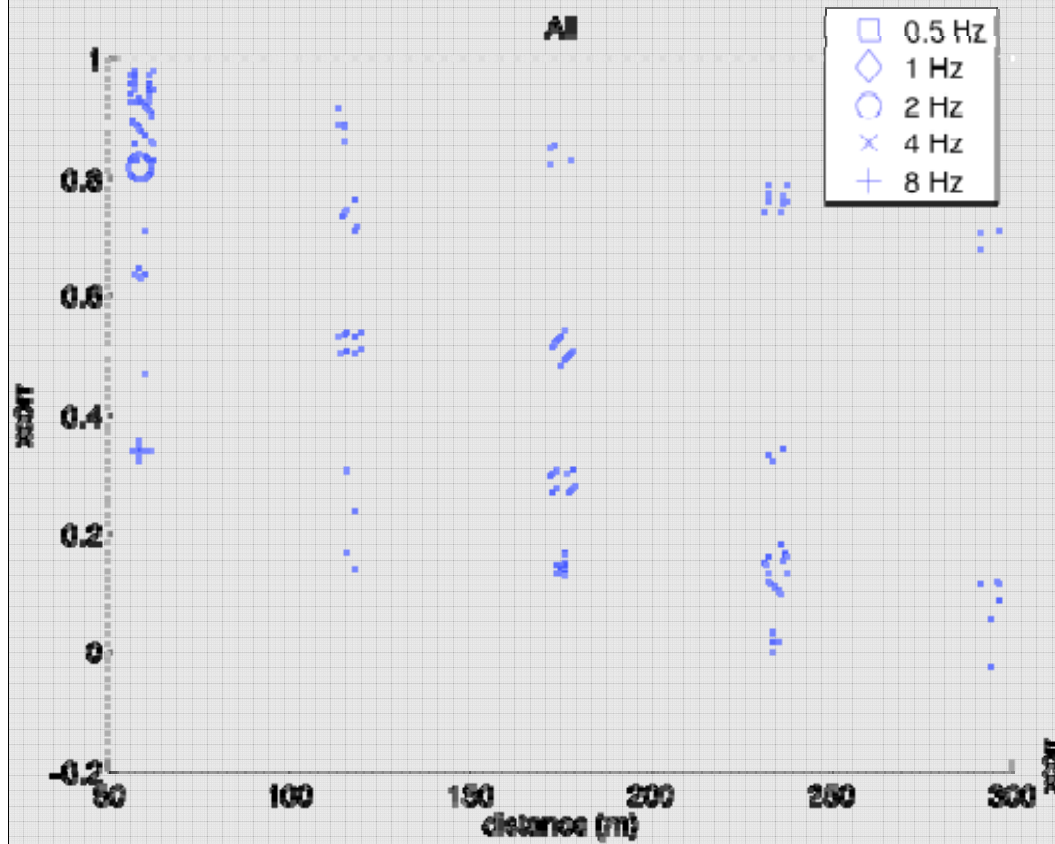
Coherence
(record similarity with phase lag)
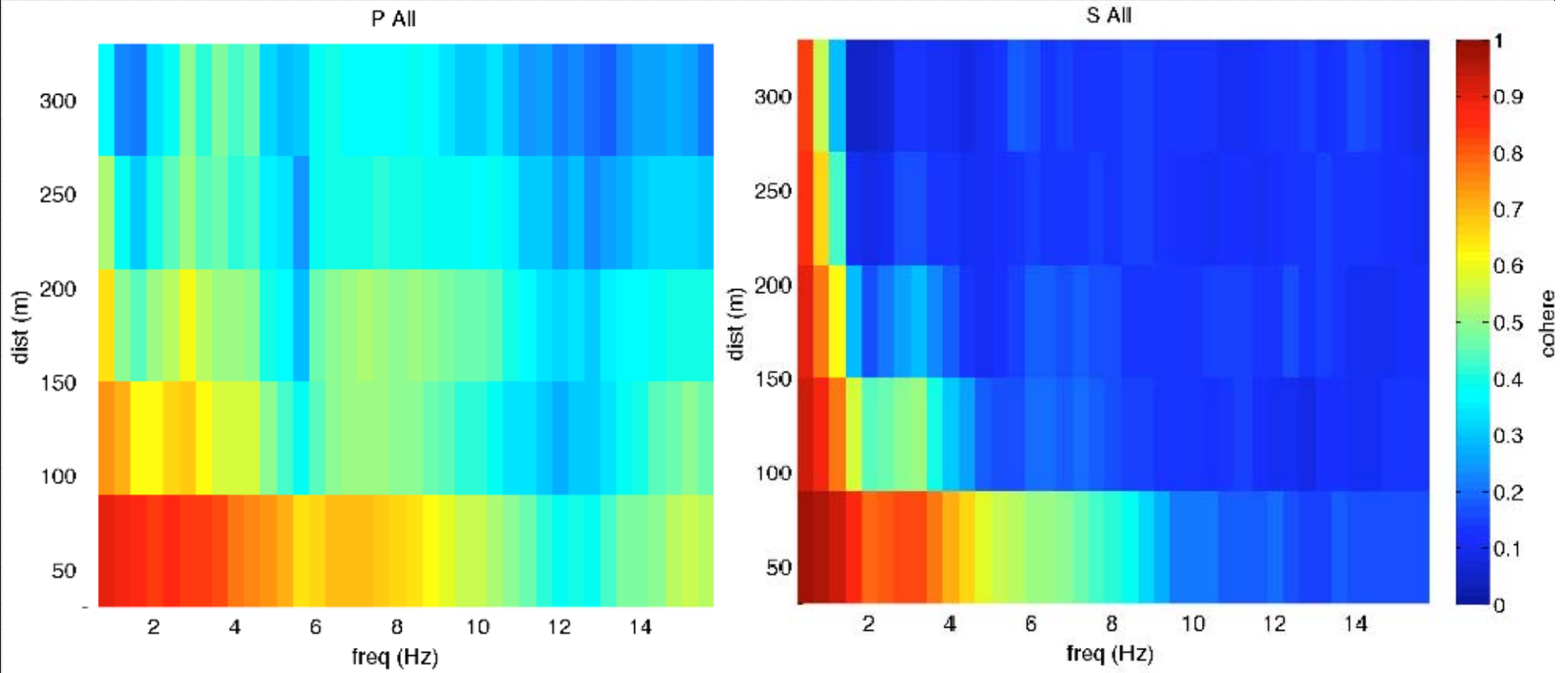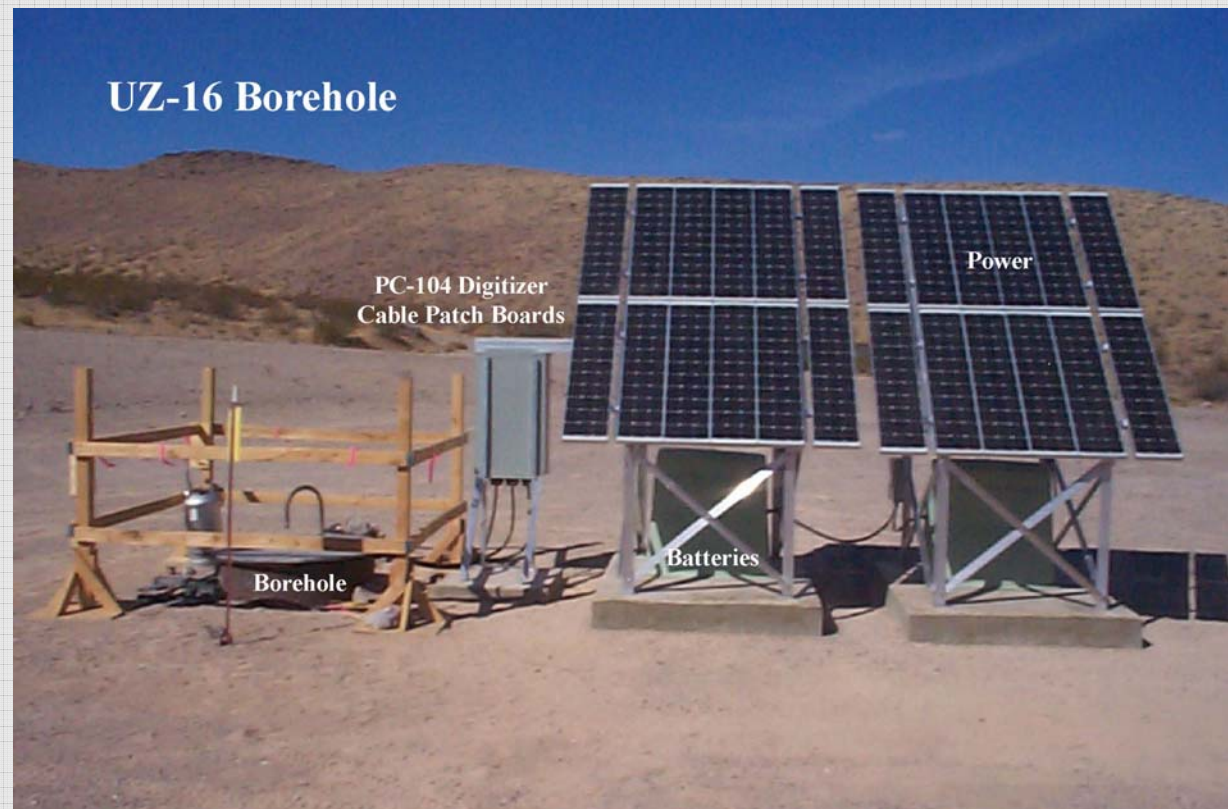

Backwall Verticals 60 m Spacing

Cross Correlations with Zero Lag
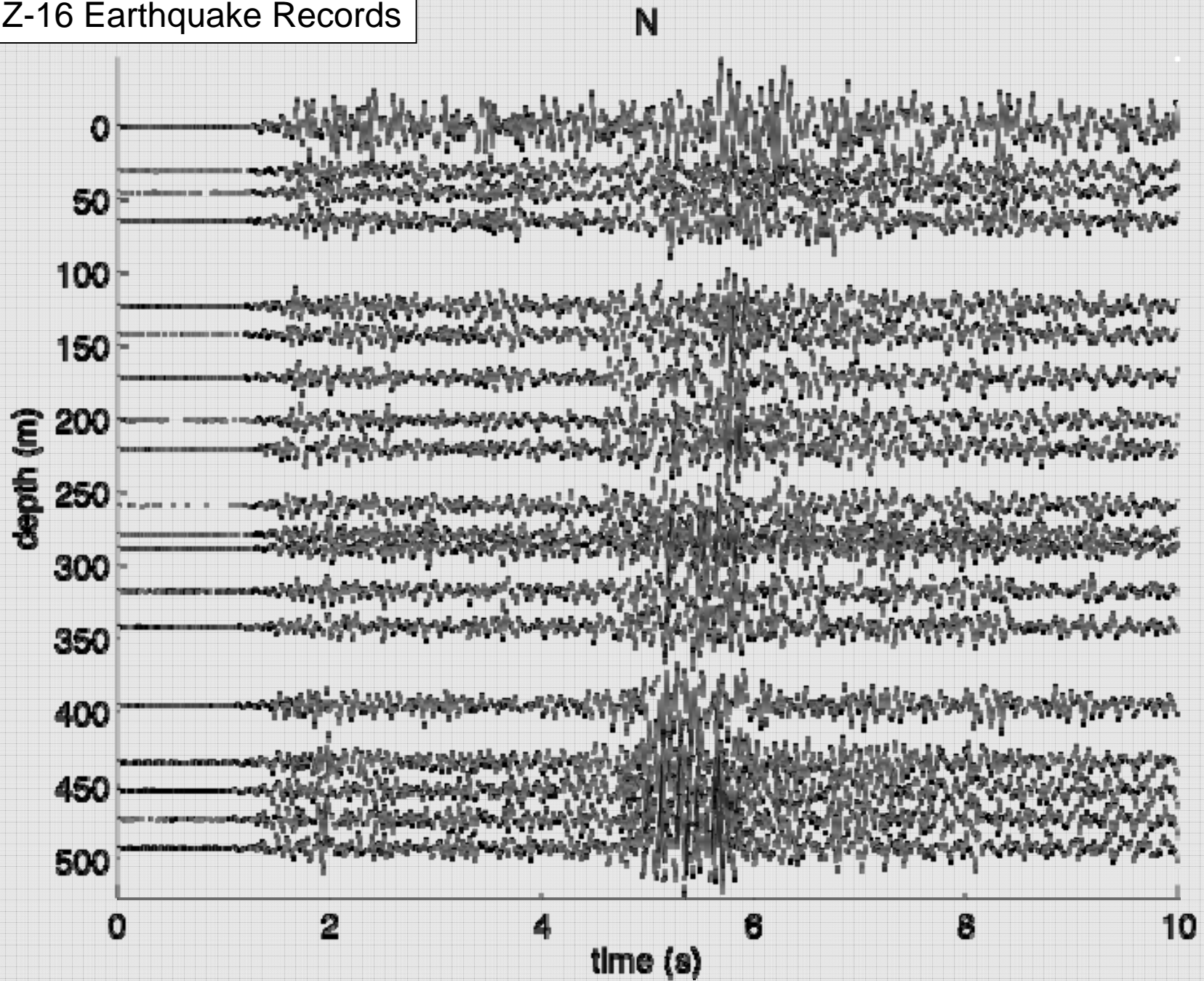
Backwall Verticals
60 m Spacing

Analysis Results

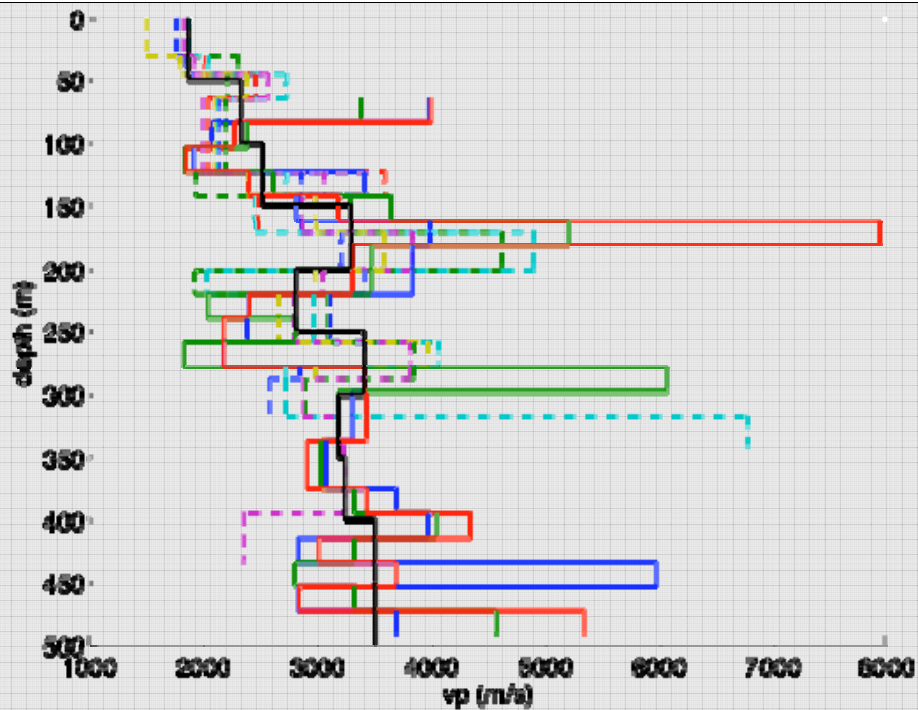- Tomography
- Backwall
- **UZ-16**
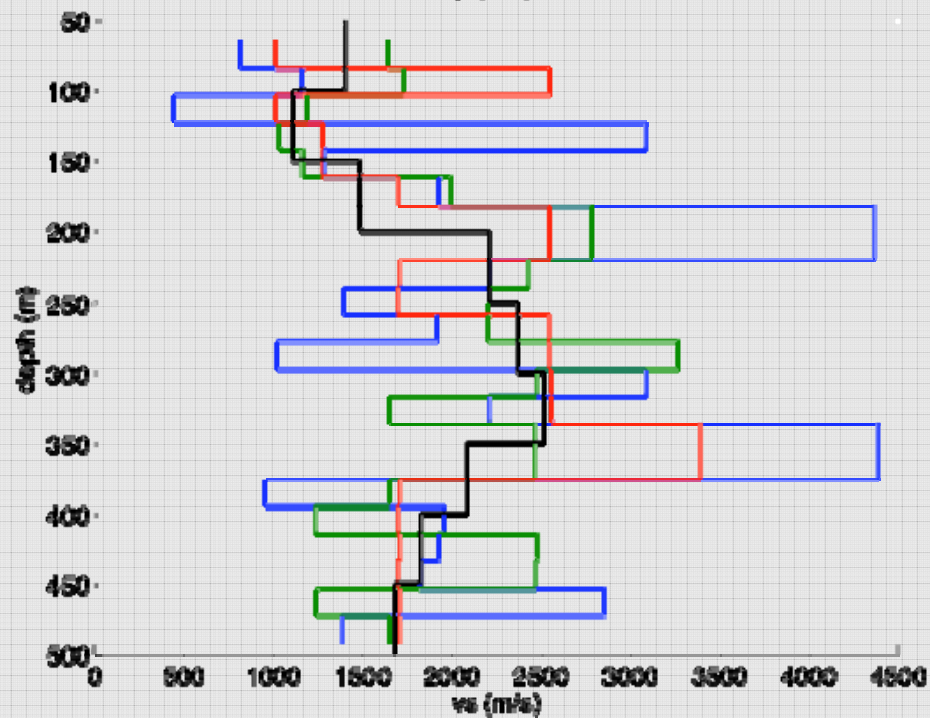- Kappa

UZ-16 Earthquake Records

N

P-wave velocity

UZ-16 Earthquake Records

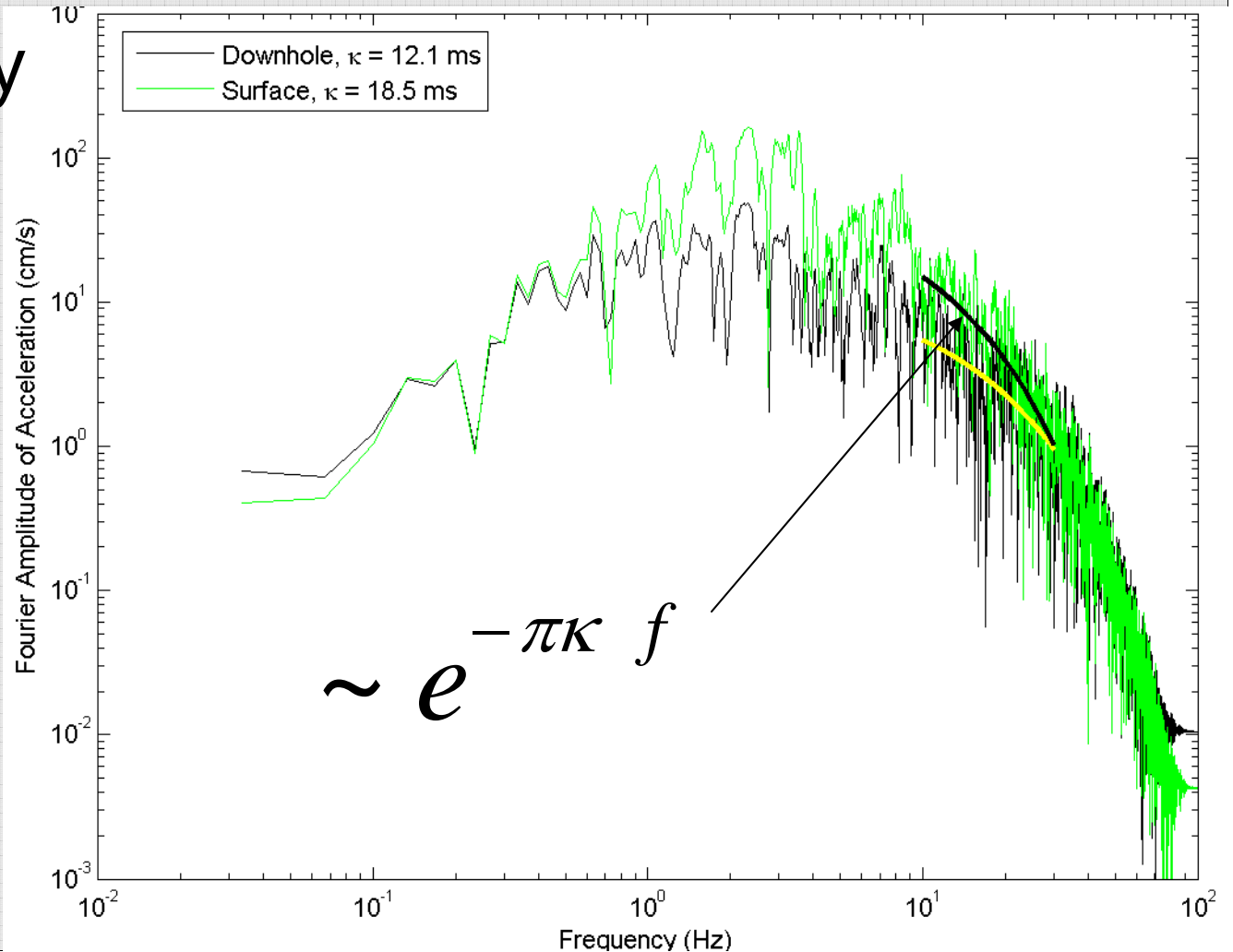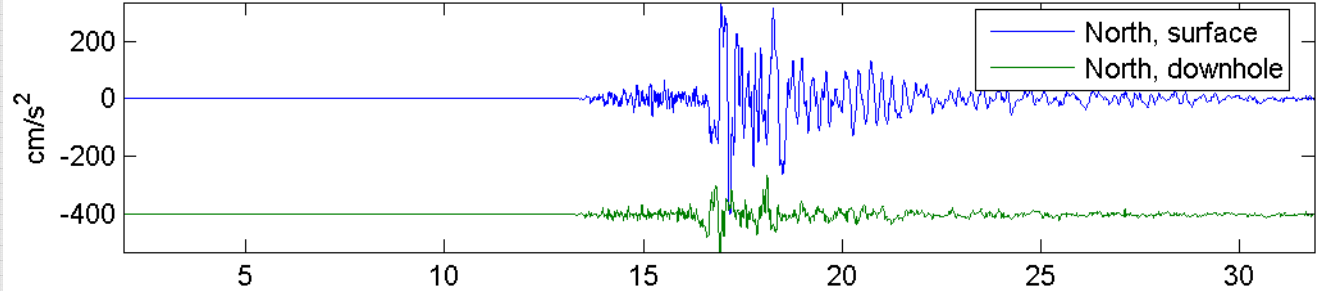S-wave velocity

Analysis Results

- Tomography
- Backwall
- UZ16
- Kappa

$$\sim e^{-\pi\kappa\ f}$$

Preliminary, non-Q kappa estimates, for constrained stress drop and specialized assumptions

Station	Model 9				
AL5	30.1	LWLS	36.3	STO	37.4
AMD	36	MDVS	31.5	SYM	28.6
BTW	15.4	NCF	33.8	SYMS	37.1
BYMS	28.8	PUV	22.9	TAR	37.4
CAF	25.1	RED	13.8	THC	44.1
CRF	42.1	RPY	41.7	TIM	42.4
DOM	38.4	SCF	47	TPW	34.4
EXHS	31.5	SGR	21.9	TWP	29.5
FMW	28.8	SHP	33.7	TYM	22.9
FOCS	29.7	SPC	36.4	TYMS	41
FRG	30.5	SPRS	33.7	WCTS	29.4
LEC	33.9	STC	27.5	WLD	30.1
LSC	38.7	STH	23.2	YCW	36.5

Kappa is in units of milliseconds

Testing different ways to measure kappa.
It is difficult for small earthquakes

UNR Moderates With Strong Motion Records, 95-02: BYMS:NE
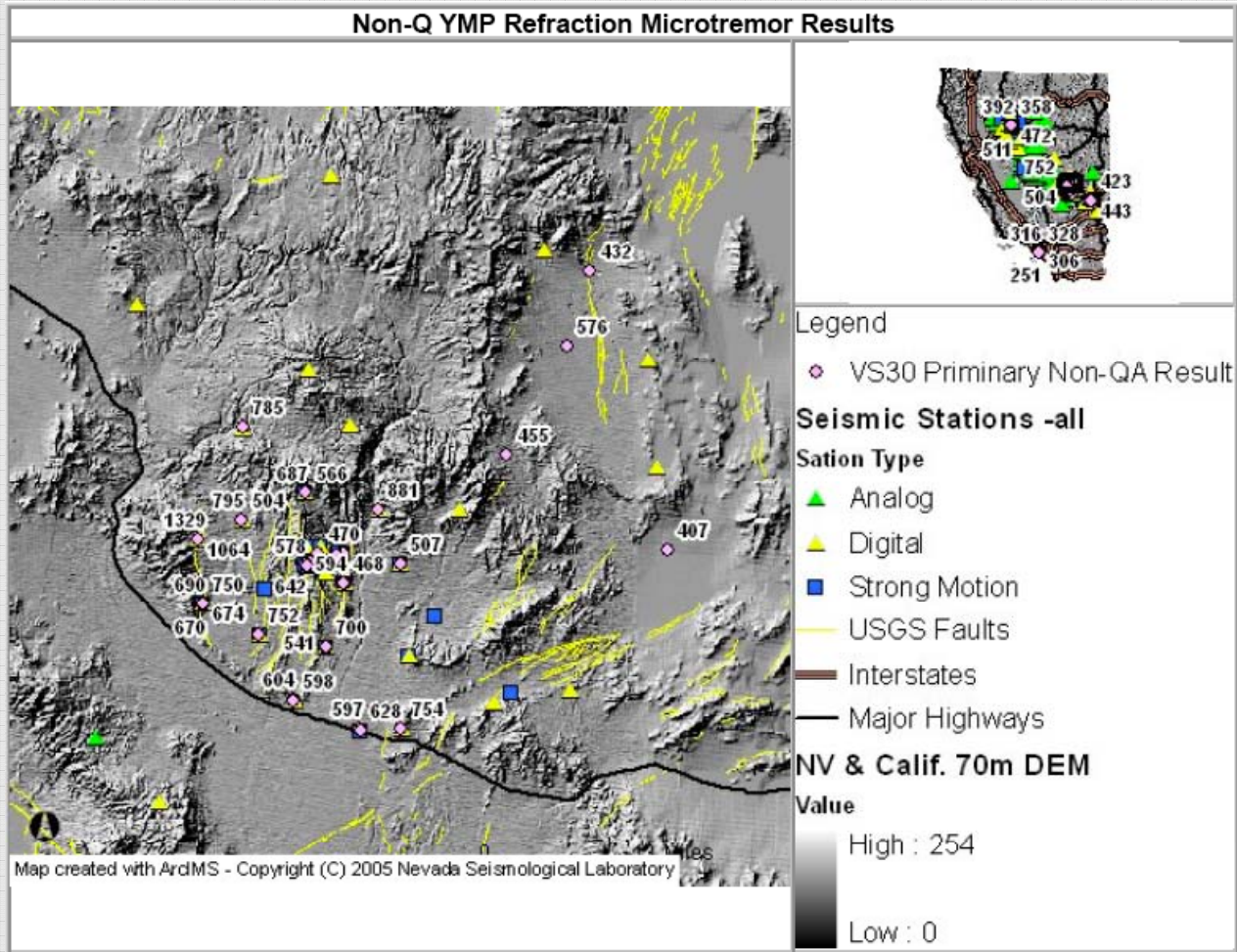median kappa AH (seconds): 0.021
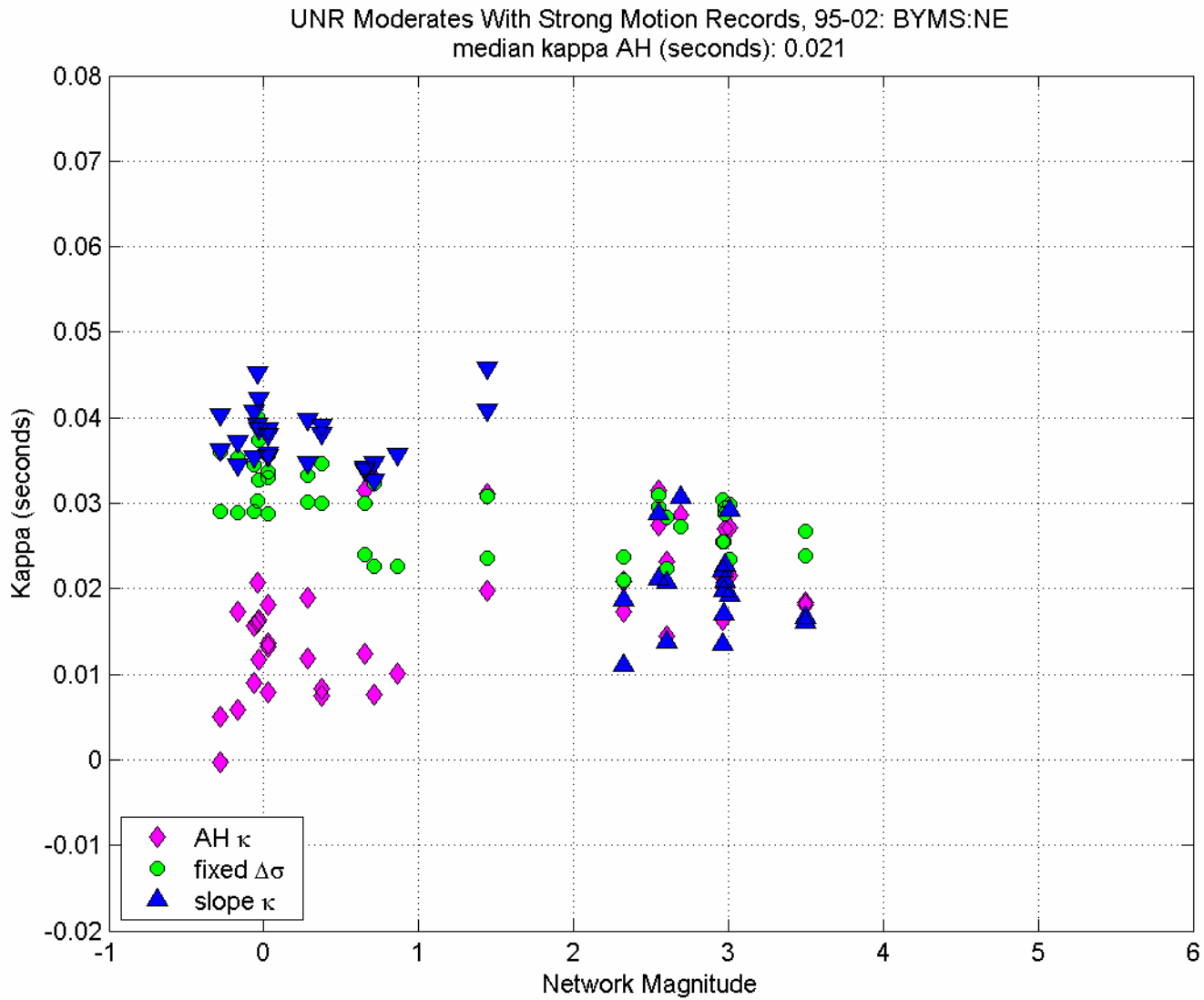
Some Issues

- Is there magnitude dependence?
- Does smaller kappa --> larger ground motions?
- Is there a source term?
- Are we measuring the same thing at M~1,4,7?
- Relationship to site conditions

Vs30 Results for YM Area Locations

- Web display and mapping of results
  - http://mapserver.library.unr.edu/website/seismoweb/VS30/viewer.htm

Non-Q YMP Refraction Microtremor Results

Summary

- **Seismic network data allows us to obtain results that are important for seismic design of the repository**

- Network upgrade is on schedule; dependent on yearly funding
- UZ-16 and borehole accelerometer activities are complete and Q
- Data has been submitted to project
- Consolidation of seismic network software QA is underway
- Procedures are being adapted to new network environment