Applying Cross-Correlation Methods to Broadband and Nodal Data to Detect and Locate Earthquakes Associated with the Socorro Magma Body



Rhiannon E. Vieceli Susan L. Bilek



UNM Lindsay Lowe-Worthington, UNM Brandon Schmandt,

Richard Aster

Background

 2nd largest known mid-crustal magma body



Geology of the SMB Region

- Dikes
- Volcanic Vents
- Faults
- SMB
- -- SSA



Outstanding Questions and Efforts





LOS velocities (mm/v

Tomography **P094** [Nishath Ranasinghe; UNM]



Attenuation [Jon Schmidt; NMT]



Emplacement?

Duration?

Migrating?

Thickness?

Geometry?

Magneto-telluric [Matt Folsom; NMT] [Jeff Pepin; NMT]

Geomorphology [Brad Sion; NMT]



Motivation

- Known associated earthquakes
 - The Socorro Seismic Anomaly
 - \sim 23% all NM M ≥ 2.0 events
 - Swarms every 8 10 yrs
- Potential volcanism
- Is there a magma diapir extending upwards from the SMB?



Morton MS thesis NMT [2013]

Earthquake History & Regional Stations







Data

February 2015 deployment

 largest of its kind in SMB region



- 7 Broadband Stations
 - operated ~1 month
 - 500 Hz
 - 3 component



804 Nodal Instruments - operated ~2 weeks

- 250 Hz

- Z only





Geology of the SMB Region



Detect Earthquakes Using Cross Correlation

Cross Correlation:

A measure of similarity between two signals as a function of a time lag applied to either of the signals, relative to the other



Detect Earthquakes Using Cross Correlation

Template Waveform \rightarrow Cross Correlation Threshold \rightarrow Possible Detection



Obtain Initial Locations Using 1D Seismic Velocity Model



Horizontal Offset (km)

Hartse et al. [1992]

Develop 3D Seismic Velocity Model Using Tomography

Seismic Tomography:

Use measured travel times to solve an inverse problem to obtain seismic velocities.



Relocate Events Using 3D Seismic Velocity Model

Preliminary Results



Initial Results			
Template	Station	CC Threshold	# Verified Events
1 М 2.34 10 Feb 2015 00:26:53 итс 34.7 _N , 106.9w	BAR CAR MCKS POPO	0.45* 0.60	4 0
2 M 0.87 10 Feb 2015 05:46:54 utc 34.3n, 106.7w	BAR CAR SBY MCKS POPO BLSP BFTO PIC1	0.45* 0.45*	14 9
3 М -0.32 11 Feb 2015 09:17:35 итс 34.2 _N , 106.9w	BAR CAR MCKS BLSP BFTO PIC1 1728	0.45* 0.52	5 3
4 M -0.39 18 Feb 2015 17:40:15 utc 34.3n, 106.6w	BAR CAR MCKS BLSP BFTO	$0.41 \\ 0.45^*$	4 12

Preliminary Results Example



Example Nodal Recordings of Template 3 (M -0.32)



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2 minutes



Thank You!

Questions?