

Supplemental Material

Network

Local seismometers deployed prior to Event B recorded at 100 sps, and were switched to 250 sps after Event B. All local seismometers deployed after Event B recorded at 250 sps. Seismometers from the University of Oklahoma and from the PASSCAL RAMP pool were removed at the end of March, 2012. The Transportable Array stations were deployed in the region from early 2010 to early 2012.

Velocity model

Our one-dimensional velocity model (**Figure DR1**) was determined by inversion methods that solve jointly for P- and S- velocities and hypocenters (Abers and Roecker, 1991), for aftershocks recorded on >15 stations. The model was constrained to include two sedimentary layers with boundaries at the top and bottom of the Arbuckle group, and to allow gradual velocity variations within basement. Initial velocities in the sediment were taken from sonic logs and lithologically-relevant laboratory measurements (for shear waves), and from regional studies for midcontinent basement (Bassin et al., 2000). Several inversions were calculated with varying starting models and layer depths, within the variability of sonic log data. The best-fitting stable model was chosen, and included station corrections for TA but not temporary stations. The resulting P velocities and P to S velocity ratios are consistent with those measured and predicted for the local lithologies (Castagna et al., 1993; Christensen and Mooney, 1995; Jambunathan, 2008).

Location error and event selection

Locations were rejected if (a) less than 5 phases were picked, (b) initial location was more than 15 km from the middle of the array, and (c) the condition number of the final location step exceeded 120 (the ratio of largest to smallest singular value in the hypocentral inversion).

Hypocenters for the three large events are less well-constrained than the aftershocks (**Table DR1**); Event A occurred before local stations were deployed and S waves are within offscale P coda for Events B and C.

References

- Bassin, C., Laske, G. & Masters, G., The Current Limits of Resolution for Surface Wave Tomography in North America, *EOS Trans AGU*, **81**, F897 (2000)
- Castagna, J.P., Batzle, M.L., and Kan, T.K. Rock physics; the link between rock properties and AVO response: in J.P. Castagna and M.M. Backus, Eds., *Offset-Dependent Reflectivity – Theory and Practice of AVO Analysis*, Society of Exploration Geophysicists (1993)
- Christensen N. & Mooney, W. Seismic velocity structure and composition of the continental crust: A global view. *J. Geophys Res.* **100**, doi:10.1029/95JB00259 (1995)
- Global Centroid Moment Tensor Catalog, G. Ekstrom and M. Nettles, Columbia University, Jan. 4 2013, <http://www.globalcmt.org/CMTsearch.html>
- Jambunathan, V. *Study of mechanical properties of carbonates*, Master's Thesis, University of Oklahoma (2008)

Oklahoma Geological Survey Catalog, Jan. 4 2013,

<http://www.okgeosurvey1.gov/pages/earthquakes/catalogs.php>

Saint Louis University CMT Catalog, Jan. 4 2013,

http://www.eas.slu.edu/eqc/eqc_mt/MECH.NA/20100227222227/index.html

Event	Date	Origin time (GMT)	Magnitude (M _w)	Latitude	Latitude uncertainty (km)	Longitude	Longitude uncertainty (km)	Depth (km)	Depth uncertainty (km)	Orientation/dip of inferred fault plane	Orientation/dip of inferred auxiliary plane
A	11/05/2011	07:12	5.0 ¹	35.534 ²	6.8 ²	-96.766 ²	5.6 ²	3.4 ^{2,†}	*	27/73 ¹	299/85 ¹
B	11/06/2011	03:53	5.7 ¹	35.522 ³	0.5 ³	-96.779 ³	0.3 ³	4.0 ³	0.4 ³	54/88 ¹	324/88 ¹
C	11/08/2011	02:46	5.0 ¹	35.517 ³	0.2 ³	-96.799 ³	0.2 ³	4.6 ³	0.3 ³	91/74 ¹	359/84 ¹
2010	02/27/2010	22:22	4.1 ²	35.551 ²	4.6 ²	-96.756 ²	4.7 ²	5.0 ²	4.0 ²	40/80 ⁴	306/70 ⁴

¹ Global CMT solutions ²Oklahoma Geol. Survey [†]Depth poorly constrained (no local stations) *Not reported ³This study ⁴Saint Louis Univ. CMT catalog

Table DR1: Main seismic events near Prague, Oklahoma, in 2010-2011.

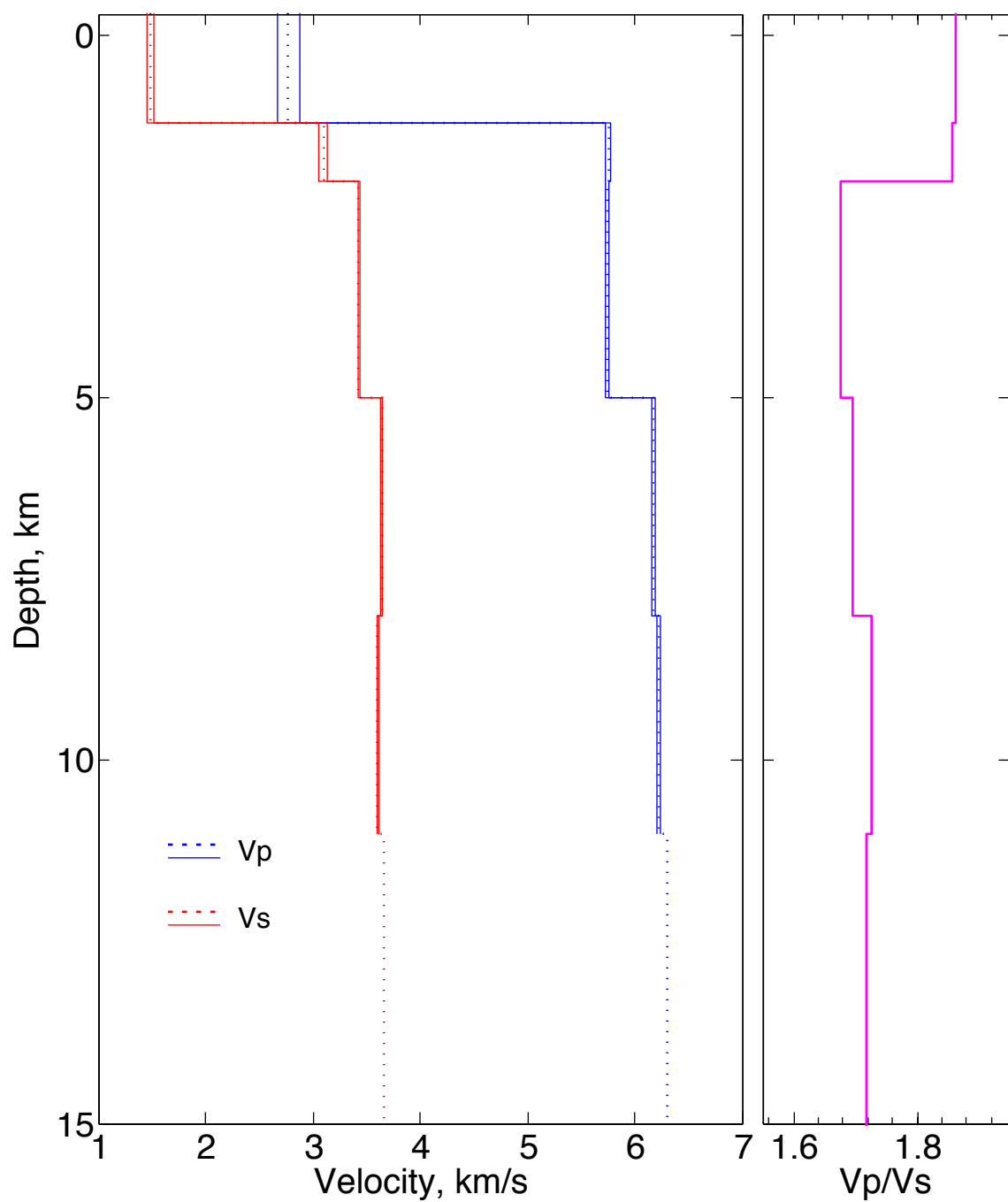


Figure DR1. Best fitting velocity model (dashed lines) and minimum and maximum acceptable models (solid lines) using full ranges of *a priori* data (sonic logs), and Vp/Vs ratio.

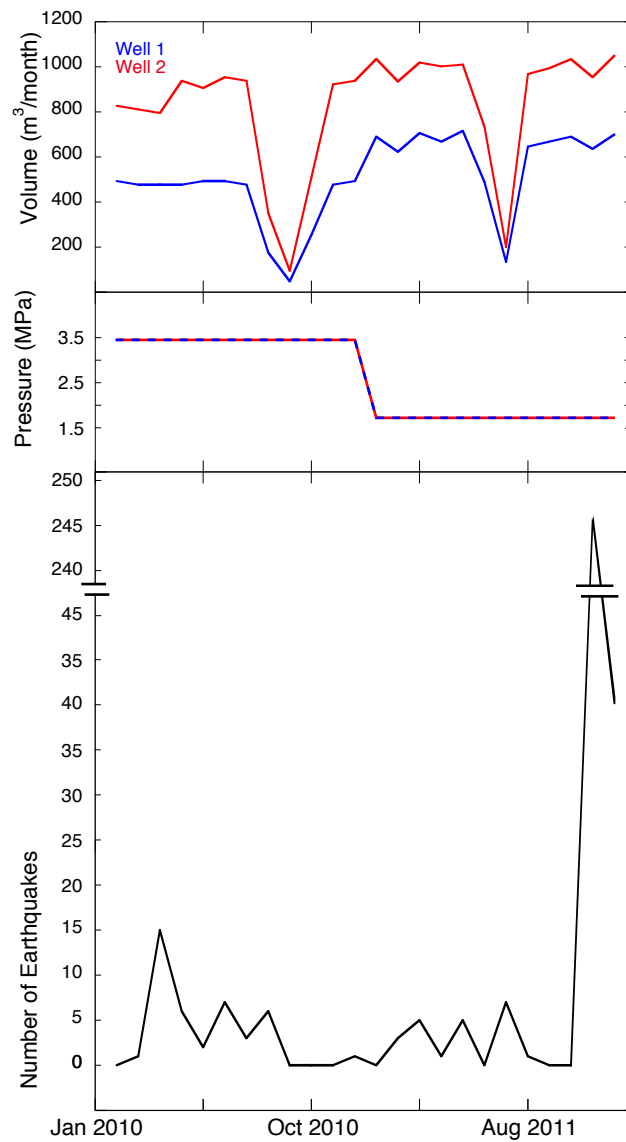


Figure DR2. Injection rate and injection pressure compared to earthquake rate from the beginning of 2010 through the end of 2011. No short-term correlation between injection parameters and seismicity is evident in these data. For consistency, earthquakes throughout the two years are those reported in the Oklahoma Geological Survey catalog, of M1.5+, occurring within the region of Figure 1.