Oklahoma researchers' studies on Pawnee quake focus of peer-reviewed journal

Seismological Research Letters, an internationally recognized peer-reviewed journal, is dedicating a special issue to scientific studies related to the 5.8 magnitude earthquake that struck near Pawnee last September — the largest recorded seismic event in Oklahoma history.

Contributions included the work of researchers at the Oklahoma Geological Survey (OGS), the Conoco-Phillips School of Geology and Geophysics (CPSGG) at the University of Oklahoma, and the Boone Pickens School of Geology (BPSG) at Oklahoma State University. Xiaowei Chen and Nori Nakata, both of CPSGG, were guest editors of the volume.

Several of the studies were supported by a grant from the Oklahoma Governor's Emergency Fund that was dedicated to the study of seismicity in Oklahoma.

The studies exhibit the multi-disciplinary approach required to understand this historic event and the need for continuing contributions from a broad range of scientific fields to understand the risks of induced seismicity throughout the region.

The special volume featured the following studies by Oklahoma researchers:

- Kyle Murray (OGS) and others reported results from a network monitoring pressure in shut-in disposal wells for salt water produced from oil and gas operations that they established with assistance from well operators. These results show changes in well pressures due to the main shock. The results were used to estimate rock properties that will aid in modeling how disposal of wastewater in the Arbuckle Group affects pressure at the depth where earthquakes are happening.
- Eric Fielding of Jet Propulsion Laboratory in Pasadena, Jefferson Chang (OGS) and others used satellites to estimate the displacement of the solid earth, mainly deep within the crust, caused by the earthquake. This technique is commonly used for larger earthquakes, but the authors applied it to track deformation of about three centimeters caused by the Pawnee earthquake.
- Jake Walter (OGS) applied a sophisticated filtering technique that revealed many more foreshocks than originally detected by OGS. These foreshocks suggest that the stress along the Sooner Lake fault that moved in the Pawnee earthquake may have been increasing in the months leading up to the main shock.
- CPSGG graduate student, Colin Pennington, and his graduate advisor Xiaowei Chen (CPSGG) demonstrated a stress increase on the Sooner Lake fault from some of the larger foreshocks, which would have promoted main shock failure.
- Folarin Kolawole, Estella Atekwana, and Ahmed Ismail (BPSG) used electrical resistivity to further investigate areas that exhibited soil liquefaction features called *sand blows* during the main shock, showing that areas underlain by uncompacted sediment were susceptible to enhanced shaking compared to bedrock areas.

The studies can be found at: http://srl.geoscienceworld.org/content/early/recent.

A detailed bibliography of the contributions by Oklahoma scientists is below:

Oklahoma Geological Survey:

Kroll, K. A., Cochran, E. S., and **Murray, K. E**., 2017, Poroelastic Properties of the Arbuckle Group in Oklahoma Derived from Well Fluid Level Response to the 3 September 2016 M_W 5.8 Pawnee and 7 November 2016 Mw 5.0 Cushing Earthquakes, *Seismol. Res. Lett.*, 88(4), *10.1785/0220160228*

Fielding, E.J., Sangha, S.S., Bekaert, D.P.S., Samsonov, S.V., and **Chang, J.C.**, 2017, Surface Deformation of North-Central Oklahoma Related to the 2016 M_W 5.8 Pawnee Earthquake from SAR Interferometry Time Series, *Seismol. Res. Lett.*, 88(4), doi:10.1785/0220170010

Walter, J. I., **Chang, J. C.**, and **Dotray, P. J.**, 2017, Foreshock Seismicity Suggests Gradual Differential Stress Increase in the Months Prior to the 3 September 2016 M_W 5.8 Pawnee Earthquake, *Seismol. Res. Lett*, 88(4), doi:10.1785/0220170007.

Conoco-Phillips School of Geology and Geophysics at the University of Oklahoma:

Pennington, C., and **Chen, X.**, 2017, Coulomb Stress Interactions during the M_W 5.8 Pawnee Sequence, *Seismol. Res. Lett.*, 88(4), doi:10.1785/0220170011.

Chen, X., and **Nakata, N.**, 2017, Preface to the Focus Section on the 3 September 2016 Pawnee, Oklahoma, Earthquake, *Seismol. Res. Lett.*, 88(4), doi:10.1785/0220170078.

Boone Pickens School of Geology at Oklahoma State University:

Kolawole, F., Atekwana, E.A., and **Ismail, A.**, 2017, Near-Surface Electrical Resistivity Investigation of Coseismic Liquefaction-Induced Ground Deformation Associated with the 2016 M_W 5.8 Pawnee, Oklahoma, Earthquake, *Seismol. Res. Lett.*, 88(4), 10.1785/0220170004