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Berkeley Seismological Laboratory Seismic Moment Tensor Report for the August 6, 2007 M3.9 Seismic event in central Utah

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Disclaimer

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We have performed a complete moment tensor analysis of the seismic event, which occurred on Monday August 6, 2007 at 08:48:40 UTC 21 km from Mt.Pleasant, Utah. In our analysis we utilized complete three-component seismic records recorded by the USArray, University of Utah, and EarthScope seismic arrays. The seismic waveform data was integrated to displacement and filtered between 0.02 to 0.10 Hz following instrument removal. We used the Song et al. (1996) velocity model to compute Green's functions used in the moment tensor inversion. A map of the stations we used and the location of the event is shown in Figure 1.

In our moment tensor analysis we assumed a shallow source depth of 1 km consistent with the shallow depth reported for this event. As shown in Figure 2 the results point to a source mechanism with negligible double-couple radiation and is composed of dominant CLVD and implosive isotropic components. The total scalar seismic moment is 2.12e22 dyne cm corresponding to a moment magnitude (Mw) of 4.2. The long-period records are very well matched by the model (Figure 2) with a variance reduction of 73.4%. An all dilational (down) first motion radiation pattern is predicted by the moment tensor solution, and observations of first motions are in agreement.

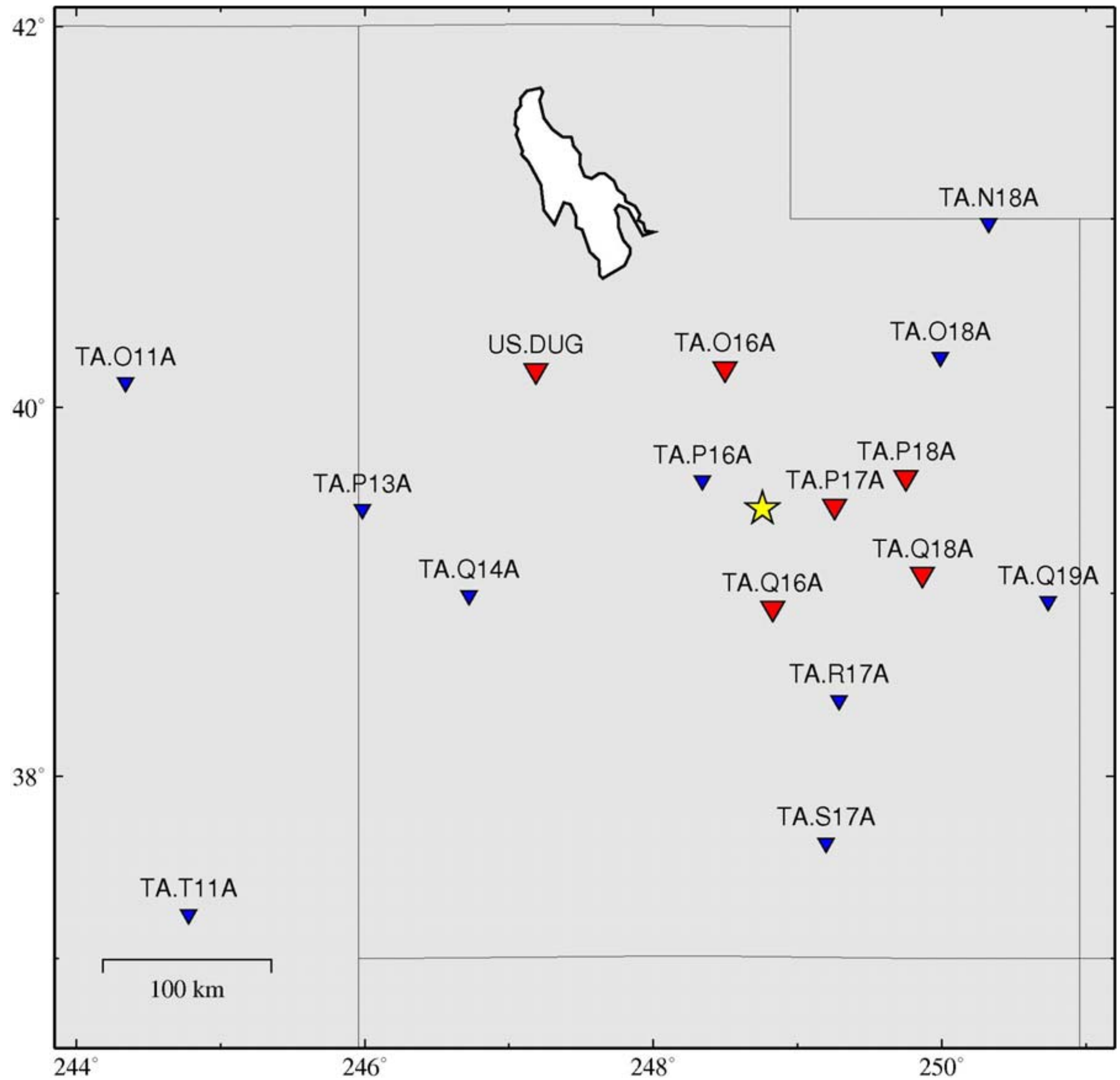

Figure 1. Map showing event location (yellow star) and stations used (triangles). The red triangles show the near stations that we show in Figure 2, and the blue triangles show the stations used in Figure 3.

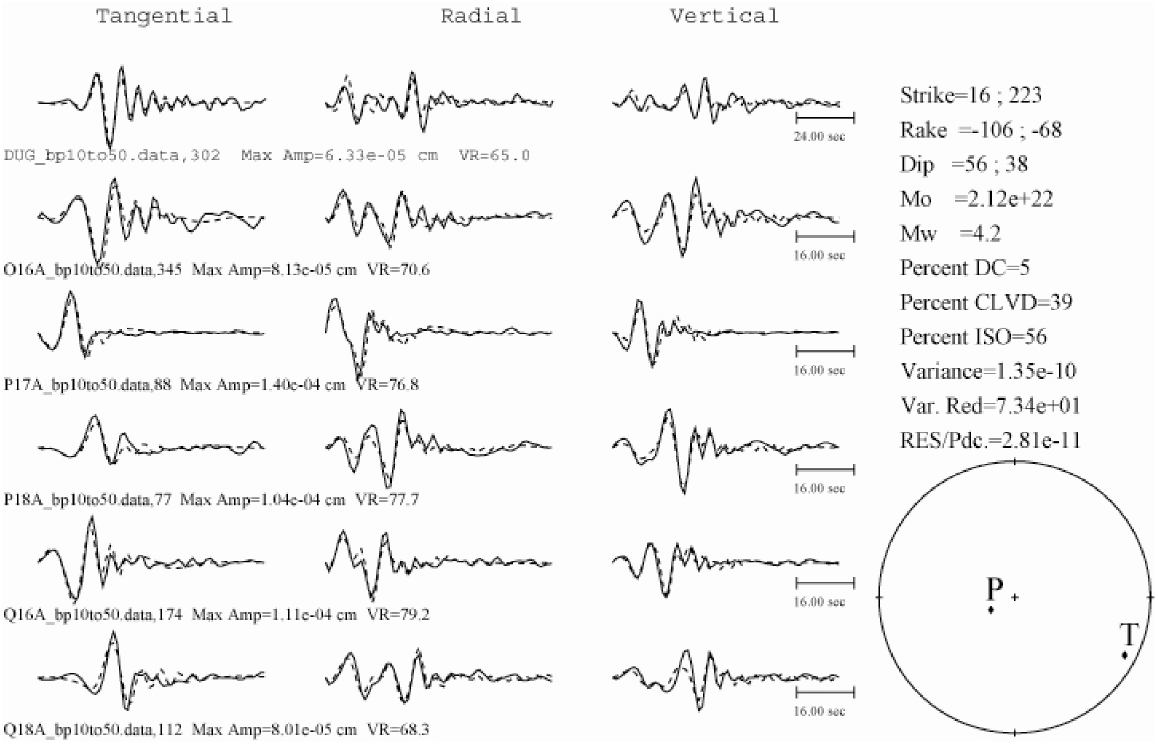

Figure 2. Moment tensor solution using six regional stations. The observations are solid lines and the synthetic seismograms are dashed. The P wave radiation pattern is plotted together with the orientation of the compressive axis.

The results in Figure 1 using 6 close stations is the same as the result we obtained using 16 stations (Figure 3). We also performed a deviatoric moment tensor inversion in which volumetric source are disallowed. The results of this inversion (Figure 4) indicated much poorer fit (only a 41.8% variance reduction), and a P-wave first motion radiation pattern that is inconsistent with the observed first motions.

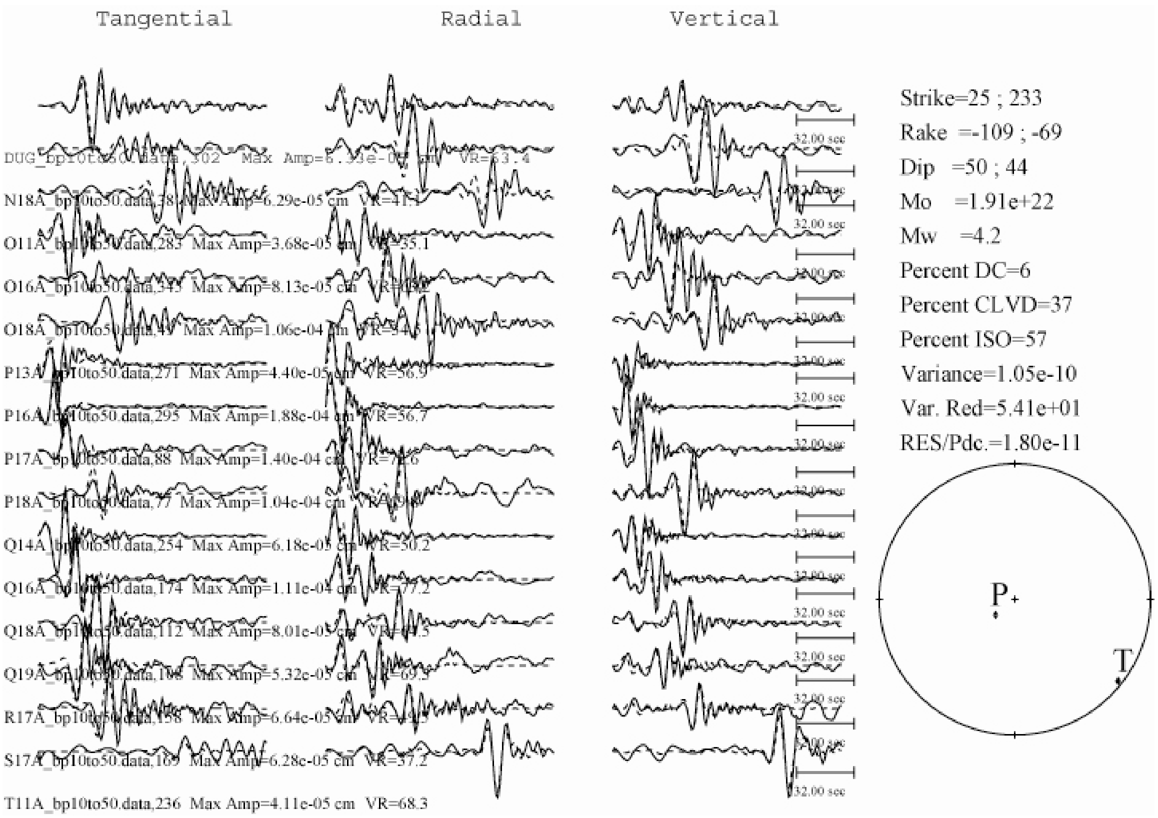

Figure 3. Same as Figure 2 for the inversion utilizing 16 regional distance stations.

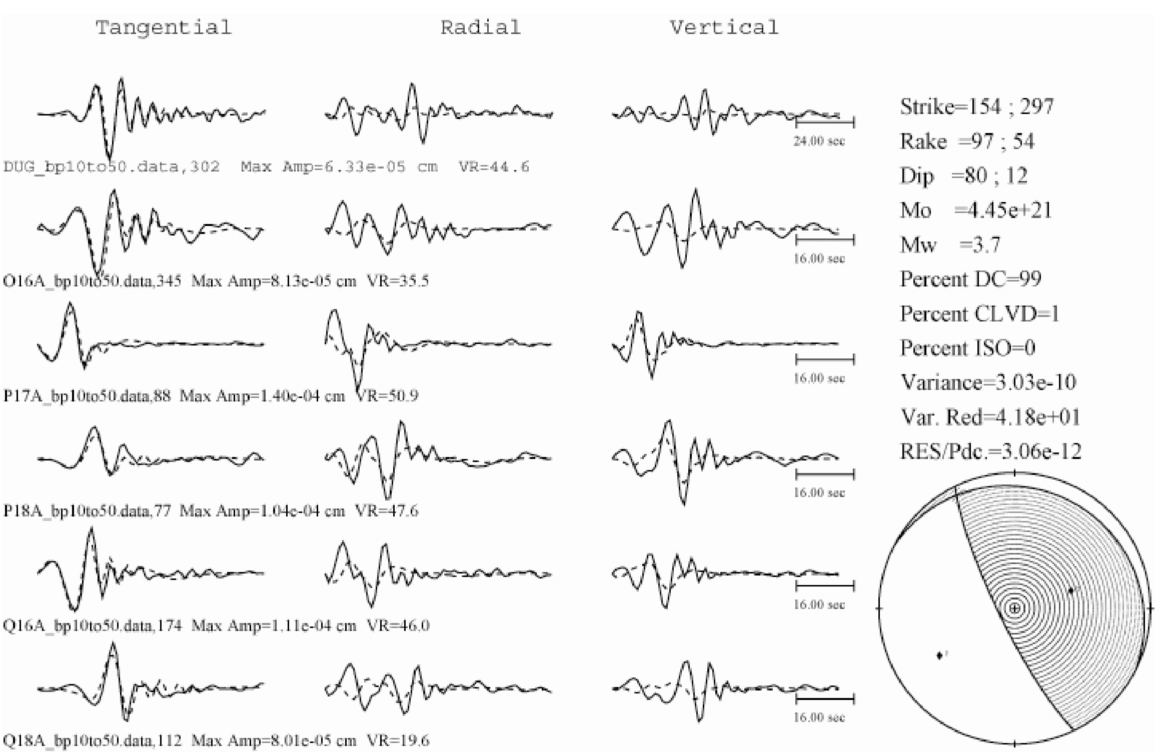

Figure 4. Deviatoric moment tensor solution using the same stations in Figure 2. Note that the fit of the data is significantly worse than in Figure 2.

The obtained source mechanism is consistent with the collapse of an underground cavity.

Background on Moment Tensor Solutions

The seismic moment tensor is able to describe tectonic earthquakes or double-couples (DC), and a variety of non-double-couple (non-DC) seismic events associated with geothermal, volcanic and human-induced causes. These non-DC events including isotropic events that can model changes in source volume in the elastic medium that might result from man-made explosions or natural processes in geothermal and volcanic environments. It can also describe the opening or closing of planar cracks in the Earth. The solution obtained above is consistent with the closure of a roughly horizontal crack. Figure 5 compares the basic types of seismic sources.

Acknowledgements
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