August/September 2009 New Mexico Earthquake Swarm in the Central Rio Grande Rift

Courtesy Jana Pursley, NMT

Seismicity in central New Mexico, southwestern United States, is dominated by earthquakes occurring above the mid-crustal Socorro Magma Body (SMB). The SMB is a sill-like feature ≥ 3400 km² in area, with a top surface at 19-km depth spanning the inner Rio Grande rift half-graben system. Inflation of the magma body at rates of several mm/year, perhaps coupled with shallow transport of aqueous fluids, is the prevailing model for the region’s long-standing and anomalous seismicity. Clustered swarms of small magnitude earthquakes have been noted since the 1860’s throughout this region, and have been recorded instrumentally since the early 1960’s (Figure 1, blue squares, Sanford et al., 2002).

Beginning in late August 2009, a very productive swarm of over 580 earthquakes (as of September 17, 2009) marks the most active period since 2005. Preliminary locations of over 50 of the largest events (local magnitude ML > 0.5) highlight a very small volume (~ 12 km³), suggesting that this swarm has occurred along an isolated portion of a rift-parallel fault. Locations of 124 earthquakes are shown in Figure 1. Three earthquakes, approximately 3 km northeast of Socorro, occurred a few days before the main swarm. The main swarm itself locates about 12 km northeast of Socorro. Depths are well-resolved through the use of top-side magma body reflections, and most of these events have depth between 5 and 6 km, although a few occurred at shallower depths. Felt and heard reports have been filed for several of the larger (ML > 1.9) events.

In response to the increased seismicity, New Mexico Tech Seismic Lab, in cooperation with the local IRIS/PASSCAL Instrument Center, installed a temporary seismic station near the swarm location (station DUNB, Figure 2). This stations will record seismic waves as well as the audio signals produced by the earthquakes.

Figure 1: Seismicity near Socorro, NM. Shown are locations of historic earthquakes in this region from Sanford et al., 2002 (blue squares), the August 2009 swarm and the events preceding it (stars). Also shown are the locations of stations in the Socorro Seismic Network, plus DUNB, the temporary PASSCAL RAMP deployment, as well as station Y22D, an Earthscope Transportable Array test station at the IRIS/PASSCAL Instrument Center.

Figure 2: Images from the installation of DUNB. a) Trillium 3-component intermediate-band seismometer.
b) Mike Fort, Associate Director of the IRIS/PASSCAL Instrument Center, testing the installed station.

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