

Seismic Detection of Sediment Interface Beneath the Moat Regions of the Valles Caldera, New Mexico

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Abstract

We examine seismic refraction data from the Jemez Tomography Experiment centered over the Valles Caldera, New Mexico. The Valles Caldera formed 1.2 Ma with a plinian eruption of the Bandelier Tuff and was preceded 1.6 Ma by the formation of the Toledo Caldera. After the initial collapse of the caldera, a resurgent dome formed in the central region bordered by subsided caldera moats, or valleys, along the periphery of the ring fracture zone. Six active seismic sources were used to analyze the shallow (<6 km) subsurface beneath the caldera. P-wave and P-S converted phase arrival times are identified and the difference between these traveltimes is used to compute the thickness of the caldera fill material. The most prominent secondary arrivals are centered on two moats within the region: the Valle Grande and the Valle San Antonio. These regions are free from the rhyolitic extrusions that occupy most of the caldera area and are believed to contain the most fill material. We interpret these secondary features as P-S conversions from a subsurface interface between 1 and 2.5 km depth. Previous work in the area has revealed a cyclic history of lake formation within the Toledo/Valles caldera complex throughout its 1.6 million year history. The strong secondary arrivals located beneath the moat regions denote lacustrine sediment interfaces, the boundary between lacustrine sediments and volcanic breccias, or the boundary between lacustrine sediments and the roof of the subsided caldera block.