Regional Three-Dimensional Seismic Velocity Model of the Crust and Uppermost Mantle of Northern California

Haijiang Zhang, Department of Earth, Atmospheric and Planetary Sciences
Massachusetts Institute of Technology

Clifford Thurber, Dept. of Geology and Geophysics, University of Wisconsin-Madison

Thomas Brocher and Victoria Langenheim, U.S. Geological Survey, Menlo Park

We present a 3D tomographic model of the P-wave velocity (Vp) structure of northern California. We employed a regional-scale double-difference tomography algorithm that incorporates a finite-difference travel time calculator and spatial smoothing constraints. Arrival times from earthquakes and travel times from controlled-source explosions, recorded at network and/or temporary stations, were inverted for Vp on a 3D grid with horizontal node spacing of 10 to 20 km and vertical node spacing of 3 to 8 km. Our model provides an unprecedented, comprehensive view of the regional-scale structure of northern California, putting many previously identified features into a broader regional context and improving the resolution of a number of them, and revealing a number of new features, especially in the middle and lower crust, that have never before been reported. Examples of the former include the complex subducting Gorda slab, a steep, deeply penetrating fault beneath the Sacramento River Delta, crustal low-velocity zones beneath Geysers-Clear Lake and Long Valley, and the high-velocity ophiolite body underlying the Great Valley. Examples of the latter include a detachment fault beneath the East Bay and mid-crustal low-velocity zones beneath Mount Shasta and north of Lake Tahoe.