Deep structure of Southern California

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We used 214,210 P-wave arrival times from 7536 local earthquakes and 16,470 travel time residuals from 332 teleseismic events recorded by the Southern California Seismic Network to determine a detailed three-dimensional (3-D) P-wave velocity structure of the crust and mantle down to 600 km depth beneath Southern California. In this study, we have taken into account the Moho topography under this region determined by a previous receiver function study. We found that the undulations of the Moho discontinuity affect considerably the tomographic images of the lower crust and uppermost mantle. When the Moho topography is taken into account, ray paths and travel times can be computed more accurately and the resulting 3-D velocity model fits the data better. The tomographic images show a very heterogeneous structure in the crust and upper mantle under Southern California. The velocity structure in the shallow depth correlates well with the surface geological features. Sedimentary basins and batholiths correspond to the low and high velocity anomalies, respectively. Three major anomalies in the upper mantle are revealed clearly beneath the southern Sierra Nevada, Salton Trough, and Transverse Ranges. The Isabella anomaly beneath the southern Sierra Nevada appears as a high-velocity zone extending down to about 300 km depth. The main part of this anomaly is offset to the west of San Joaquin Valley. The Transverse Ranges feature is a slab-like, east-trending and north-dipping high-velocity anomaly. The two major high-velocity anomalies in the upper mantle may be caused by the convergence of the Pacific plate and the North America plate. The Salton Trough exhibits prominent low velocities which extend down to about 100 km depth.