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Crust and Uppermost Mantle Structure Beneath Southern Africa Based on First P-Wave Travel Times from Seismograms Generated by Local, Regional and Mining-Induced Earthquakes

Three-dimensional seismic wavespeed structure of the crust and uppermost mantle in southern Africa was determined by tomographic inversion of absolute arrivaltimes of first P-waves picked from seismograms generated by tectonic earthquakes and mining-induced tremors recorded at local and regional distances by 82 broadband stations of the 1997–1999 Southern Africa Broadband Seismic Experiment, supplemented by 3 IMS stations located in the study area. The data used in the inversion comprised 496 well-located seismic events and more than 1500 P-wave times. The geotomograms were determined by applying a tomography method in which traveltimes and raypaths are calculated rapidly and accurately by a 3-D raytracer, and the linearized iterative inversion utilizes the conjugate gradient-type LSQR algorithm. The assumed seed model is a regional average 1-D velocity model taken from previous seismic studies of lithosphere beneath southern Africa. Checkerboard resolution test was performed to confirm the reliability of the main features in the tomographic images. The tomographic images show patterns of heterogeneity in the wavespeed structure below the study area. The velocity anomalies reflect a superposition of various effects including changes in composition and thermal structure as well as other perturbations imprinted during the complex evolution history of the southern Africa region.

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