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Structure of Africa and Surrounding Regions Revealed by Earthquake and Ambient Noise Surface Wave Tomography

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To advance the understanding of the tectonic processes shaping the African continent, we construct the first continental-scale shear-wave velocity (Vs) model of the lithosphere from the joint analysis of ambient seismic noise and earthquake data recorded by ~1529 seismic stations in and around Africa. We apply the widely used ambient noise cross-correlation and earthquake two-station methods to retrieve the Rayleigh-wave group and phase velocity dispersions which are jointly inverted for a new three-dimensional Vs model. The inclusion of short-period dispersion data from ambient noise allows us to obtain a more accurate model than previous global and continental-scale studies, revealing lithospheric structures that correlate well with known tectonic features. In sparsely instrumented regions of north-central Africa, our model provides seismic evidence for the existence of cratonic remnants beneath thick sediments within the Sahara Metacraton and reveals unique mantle upwelling beneath hotspots suggesting that they may be fed by unconnected plumes. The estimated crustal thickness varies among and within tectonic provinces and shows no clear evidence for the secular variation in crustal genesis. Our new model has the potential to serve as a reference velocity model for Africa and is useful for practical applications including monitoring of the Comprehensive Nuclear-Test-Ban Treaty.

Promotional text

We present the first 3D model of the lithosphere beneath Africa and surrounding regions from joint analysis of ambient seismic noise and earthquake data. New constraints on structures in sparsely instrumented regions of North Africa makes it valuable for monitoring of the CTBT.

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