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Thickness and composition of the crust in southern Africa

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We present new results on structure, thickness, and composition of the crust in southern Africa based on 6300 seismic receiver functions at 85 stations. Application of Hk-stacking to the entire SASE dataset and use of multi-frequency bands improve resolution substantially. We observe a highly heterogeneous crustal structure with short wavelength variations in thickness (H), Vp/Vs-ratio (composition), and Moho sharpness, which defines ~20 blocks that do not everywhere coincide with surface tectonic features. In the Zimbabwe Craton, the Tokwe block has H = 35–38 km and Vp/Vs = 1.74–1.79 whereas the thicker crust in the Tati block (H = 47– 51 km)may be related to deformation of the Archean crust along the cratonic margin. Two distinct crustal blocks with similar crustal thickness (42–46 km) but significantly different Vp/Vs-ratios are recognized in the Limpopo Belt. Extreme values of 1.90–1.94 at the dyke swarms in eastern Limpopo, and 1.84 at the Olifants River Dyke Swarm and easternmost Bushveld Intrusion Complex (BIC) indicate voluminous magmatic intrusions in the whole crust. We find no evidence for magmatic intrusions in the central (inferred) part of BIC, where the crust is thick (45–50 km) and Vp/Vs is low (1.68–1.70). This thick crustal root may have deflected rising magmas to form the two BIC lobes. Most of central Kaapvaal has thin (35–40 km) crust and Vp/Vs ~ 1.74. These characteristics are similar to the Tokwe block in Zimbabwe Craton and may indicate delamination of pre-existing lower crust, which is further supported by a very sharp Moho transition. The exposed cross-section in the Vredefort impact crater is non-representative of cratonic crust due to shallow Moho (34 km) and high Vp/Vs ~ 1.80 attributed to shock metamorphism. High Vp/Vs = 1.76 is typical of the Witwatersrand Basin, and anomalously low Vp/Vs = 1.66–1.67 marks the Kaapvaal–Kheis–Namaqua transition. Highly heterogeneous crust, both in thickness and Vp/Vs-ratio is typical of the Namaqua–Natal and Cape Fold Belts.

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