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Imaging the Lithosphere-Asthenosphere Boundary beneath South Africa and Madagascar using S receiver functions

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South Africa's lithosphere preserves a nearly un-interrupted geological history of more than 3.5 billion years. It was formed during the break-up of the supercontinent Gondwana over a period of 80 million years and therefore is the longest, best-preserved geological record of the planet Earth. Investigation of the thickness of continental roots, which migrate coherently with plates, therefore belongs to the most systematic keys in order to understand the continental evolution. This goal will be achieved using the novel technique of S receiver function. This technique employing S-to-P conversions appears promising for detecting the LAB and has already proven its power for mapping the LAB in the tectonically different regions. We used the available data from more than 85 temporary and permanent broadband stations in South Africa and Madagascar to detect the lithosphere-asthenosphere boundary (LAB). Our results obtain detailed images of the LAB with improved resolution.

S receiver functions clearly resolve the Moho boundary at depths ranging between 35 and 45 km beneath South Africa in good agreement with the previous studies. Even though we can not find any correlation between the crustal thickness and the age of the terrains. Deeper structure can be also well imaged by S receiver functions. Our results clearly show the presence of more than one negative converted phase beneath Kalahari Craton. On the other hand, they reveal the presence of two distinct lithospheric layers throughout the stable part of the South African continent. The first discontinuity can be seen at depths ranging between 160-230 km beneath the Archean Cratons and surrounding Phanerozoic belts, whereas the deeper discontinuity at 300 km can be only imaged beneath the Archean Cratons. We interpret the deeper boundary at 300 km as the LAB of the old Archean Craton beneath South Africa. The shallower discontinuity at 160-230 km depth may show a mid-lithospheric boundary, which probably reveals a relict of the old mantle lithosphere. Our results obtained from the stations located in Madagascar can only confirm the presence of the mid-lithopheric boundary at 170 km depth.