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Upper mantle seismic discontinuities in the area of the Indian Ocean Geoid Low

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We are investigating the upper mantle seismic discontinuities at 410 and 660 km depth beneath the southern tip of India, where the Indian Ocean Geoid Low (IOGL) is located. We use PP and SS waves and their precursors, which reflect off the underside of these seismic discontinuities midway between source and receiver, to map the topography of the two discontinuities bounding the mantle transition zone. Our dataset consists of 9604 events with magnitude 5.8 or higher recorded at 57 different arrays distributed around the Indian Ocean. This results in a dense coverage of reflection points across our area of interest. 599 events out of this dataset show a good PP or SS signal. To enhance the signal-to-noise-ratio for better visibility of the weak precursor signals and to identify out-of-plane arrivals we use array seismology methods. We obtain the depth of the discontinuities by measuring the differential travel time between the main phase and the precursor signal, comparing it with theoretical travel times through the 1D reference Earth model ak135 and correcting the measured travel times for crustal and tomographic features. Most of the signals we observe reflect off the 410 km discontinuity, which is caused by the solid-solid phase transition from olivine to wadsleyite. The 660 km discontinuity, which exists due to the phase transformation from ringwoodite to bridgmanite and magnesiowustite, also causes some visible reflections in our dataset. Besides those two discontinuities we also see few reflections both from shallower and deeper structure. The best quality data show a deepened 410 in the centre of the IOGL as well as an overall elevated 660 km discontinuity. The combined observation of the IOGL, its sensitivity kernel and the behaviour of the mantle transition zone seismic discontinuities can be interpreted as a hot upwelling that currently resides in the mantle transition zone.