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Variations of Hales Discontinuity beneath South India

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Thermodynamic studies show the spinel-garnet transition in fertile and hot mantle should be relatively narrow and should show up in the seismological studies as a discontinuity. The evidence for a shallow lithospheric mantle discontinuity was first proposed by Hales (1969) based on seismological travel time measurement from the Early Rise experiment in the Central United States, where a ∼4% increase in the S-wave velocity at a depth of 75 km was observed. The recent studies show, in cratonic blocks with colder geotherms, that it appears at greater depths and over broader intervals, that is, from the Moho to 150 km depth. Different studies interpreted that Hales discontinuity may be due to seismic anisotropy or pervasive partial melts or cation ordering in mantle olivine. In the present study an attempt is made to model the Hales discontinuity in the South Indian shield, by jointly inverting group velocity dispersion and receiver functions, calculated from teleseismic earthquakes recorded at 20 broadband seismograph locations in the study region. South Indian shield is an amalgamation of several crustal blocks, namely, Eastern Dharwar Craton (EDC), Western Dharwar Craton (WDC), Southern Granulite Terrain (SGT) etc. Inversion modeling results show deeper Hales discontinuity (∼104-110 km depth) in the south of WDC and SGT, while in the north of Western Dharwar Craton and Eastern Dharwar Craton it varies from ∼70-80 km. It is also observed that the Hales Discontinuity is present at greater depth in the western part of Dharwar Craton, compared to the eastern part. Details of the depth, thickness, and the cause of the Hales discontinuity are also investigated.

Keywords: Hales Discontinuity, South Indian Shield, Receiver Function, Craton, Inversion modeling.