Compositional heterogeneity near the base of the mantle transition zone beneath Hawaii

Robert D. van der Hilst[1*], Chunquan Yu[1,2], Elizabeth A. Day[1,3], Maarten V. de Hoop[4], Michel Campillo[1,5], Saskia Goes[3], Rachel A. Blythe[3]

[1] *Department of Earth, Atmospheric and Planetary Sciences, Massachusetts Institute of Technology, Cambridge, MA 02139, USA*
[2] *Seismological Laboratory, California Institute of Technology, Pasadena, CA 91125, USA*
[3] *Department of Earth Science and Engineering, Imperial College, London, SW7 2BP, UK*
[4] *Department of Computational & Applied Mathematics, Rice University, Houston, Texas 77005, USA*
[5] *Institut des Sciences de la Terre, Université Joseph Fourier, BP 53X, 38041 Grenoble, France*

Mantle transition zone (MTZ) discontinuities due to phase transitions in silicate minerals near 410 and 660 km play an important role in modulating mantle flow. Mantle convection is foremost a thermally driven system and most seismological MTZ studies focus on *410* and *660* topography to map variations in temperature. Compositional variations must also exist, but expressions of variations in bulk composition have so far remained elusive. We use novel seismic array analysis to observe *SS* waves reflecting off the *410* and *660* below the Hawaiian hotspot over larger source-receiver distances than was previously possible. The *SS* travel times do not reveal substantial topography of the MTZ discontinuities [1], but variation in reflectivity with distane imply lateral variations in wave-speed and density contrasts across *660* for which thermodynamic modeling precludes a thermal origin [2]. No such variations are found along the *410*. The inferred *660* contrasts suggest mantle composition varying from average pyrolitic mantle beneath Hawaii to a mixture with more melt-depleted harzburgite southeast of the hotspot. Such compositional segregation was predicted, from petrological and numerical convection studies, to occur near hot deep mantle upwellings like the one often invoked to cause volcanic activity on Hawaii.

[1] Yu et al. (2017) *J. Geophys. Res.* Doi: 10.1002/ 2017JB014327. [2] Yu et al. (2018) *Nat. Comm.* doi: 10.1038/s41467-018-03654-6