Geophysical Research Abstracts
Vol. 20, EGU2018-5463-2, 2018
EGU General Assembly 2018

Whole-mantle upwelling beneath the Reunion hotspot, western Indian Ocean: structural imaging results from the RHUM-RUM experiment

Karin Sigloch (1), Guilhem Barruol (2,3), Maria Tsekhmistrenko (1), Alessandro Mazzullo (2), John-Robert Scholz (2,3), Kasra Hosseini (1), Satish Maurya (2), Eléonore Stutzmann (2), Jean-Paul Montagner (2), Fabrice R. Fontaine (3), Sergey Kiselev (4), and Laurent Michon (3)

(1) University of Oxford, Earth Sciences, Oxford, United Kingdom (karin.sigloch@earth.ox.ac.uk), (2) Institut de Physique du Globe de Paris, Sorbonne Paris Cité, CNRS UMR 7154, Paris, France, (3) Laboratoire de Geosciences, Universite de La Réunion, Institut de Physique du Globe de Paris, Sorbonne Paris Cité, CNRS UMR 7154, Saint-Denis, France, (4) Institute of Physics of the Earth, Moscow, Russia

We present a synopsis of geophysical imaging results from the RHUM-RUM experiment (2011-2015), integrating the findings of whole-mantle body-wave tomography, anisotropic surface-wave tomography, and shear-wave splitting analyses. In one of the largest attempts to image an oceanic mantle plume from crust to core, RHUM-RUM deployed almost 90 broadband seismometers on 2000 x 2000 km2 of seafloor and islands surrounding the La Réunion hotspot, including 57 broadband ocean-bottom seismometers for 13 months.

Our finite-frequency P-waveform tomography embeds RHUM-RUM data in a fully global data set and inversion setup, which includes core-diffracted P-waves for improved resolution of the lower third of the mantle. Effectively, RHUM-RUM data illuminate the upper half of the mantle under the western Indian Ocean, and global data fill in the lower half. We confidently resolve a continuum of slow seismic velocity anomalies – presumably hot upwelling – from the eastern lobe of the African Large Low Velocity Province up to the oceanic hotspot. The lower-mantle conduit is massive and tilted northeastward, consistent with geodynamic predictions, and splits into narrower structures in the transition zone or just below.

Rayleigh-wave tomography (Mazzullo et al. 2017) and SKS splitting analysis detect the upwelling plume material as it spreads in the asthenosphere. The two methods yield independent measurements of azimuthal anisotropy, a proxy for lateral mantle flow. Both kinds of observations directly support the long-standing hypothesis of hotspot-ridge interaction, i.e. channeled asthenospheric flow from plume (heat source) to the adjacent mid-ocean ridge (heat sink). The closest segment of the Central Indian Ridge (CIR) protrudes toward the hotspot, is geochemically anomalous, and has thus long been suspected of plume influence, consistent with our mantle observations. The surface-wave tomography indicates that hot material also spreads northward of the hotspot, where it ponds beneath the Mascarene Basin. Eastward flow from there to the spreading ridge also seems to occur north of the most anomalous CIR segment, which would explain plume-influenced basalt compositions observed along a longer section of the CIR.

References:

Mazzullo, A., Stutzmann, E., Montagner, J.-P., Kiselev, S., Maurya, S., Barruol, G., & Sigloch, K. (2017). Anisotropic tomography around Réunion Island from Rayleigh waves. Journal of Geophysical Research: Solid Earth, 122, 9132–9148. https://doi.org/10.1002/2017JB014354

Scholz, J.-R., Barruol, G., Fontaine, F.R.; Mazzullo, A.; Montagner, J.-P.; Stutzmann, E.; Michon, L.; Sigloch, K. SKS splitting in the Western Indian Ocean from land and seafloor seismometers: Plume, Plate and Ridge signatures. Earth and Planetary Science Letters, in revision.