Geophysical Research Abstracts
Vol. 18, EGU2016-17327, 2016
EGU General Assembly 2016

Determining Ocean-Bottom Seismometer Orientations from the RHUM-RUM experiment from P-wave and Rayleigh wave polarizations

John-Robert Scholz (1), Guilhem Barruol (1), Fabrice R. Fontaine (1), and Karin Sigloch (2)

(1) Laboratoire GéoSciences Réunion, Université de La Réunion, Institut de Physique du Globe de Paris, Sorbonne Paris Cité, UMR 7154 CNRS 15 avenue René Cassin, 97744 Saint Denis de La Réunion, France (fabrice.fontaine@univ-reunion.fr), (2) Dept. of Earth Sciences, University of Oxford, South Parks Road, Oxford OX1 3AN, United Kingdom (karin.sigloch@earth.ox.ac.uk)

To image the upper mantle structure beneath La Réunion hotspot, a large-scale seismic network has been deployed on land and at sea in the frame of the RHUM-RUM project (Réunion Hotspot and Upper Mantle - Réunions Unterer Mantel). This French-German passive seismic experiment was designed to investigate and image the deep structure beneath La Réunion, from crust to core, to precise the shape and depth origin of a mantle plume, if any, and to precise the horizontal and vertical mantle flow associated to a possible plume upwelling, to its interaction with the overlying plate and with the neighboring Indian ridges. For this purpose, 57 Ocean-Bottom Seismometers (OBS) were installed around La Réunion and along the Central and Southwest Indian ridges.

Broad-band instruments were deployed with the French R/V Marion Dufresne in late 2012 (cruise MD192), and recovered 13 months later by the German R/V Meteor (cruise M101). The pool of OBS was complemented by ∼60 terrestrial stations, installed on different islands in the western Indian Ocean, such as La Réunion, Madagascar, Mauritius, Seychelles, Mayotte and the Îles Éparses in the Mozambique channel.

The OBS installation is a free-fall down to the seafloor, where they landed in an unknown orientation. Since seismologic investigations of crustal and upper mantle structure (e.g., receiver functions) and azimuthal anisotropy (e.g., SKS-splitting and Rayleigh waves) rely on the knowledge of the correct OBS orientation with respect to the geographic reference frame, it is of importance to determine the orientations of the OBS while recording on the seafloor.

In an isotropic, horizontally homogeneous and non-dipping layered globe, the misorientation of each station refers to the offset between theoretical and recorded back-azimuth angle of a passive seismic event. Using large earthquakes (MW > 5.0), it is possible to establish multiple successful measurements per station and thus to determine with good confidence the sensor orientations. In this study, we analyzed particle motions of P-waves (P-pol) and of Rayleigh waves (R-pol) to quantify the orientation of each of the 57 OBS. We performed 213 polarization measurements based on 35 earthquakes for P-pol, and 381 polarization measurements based on 48 earthquakes for R-pol. This allowed us to successfully determine the North/South orientations for 40 out of 57 OBS: 13 stations were devoid of usable data and 4 stations were too noisy. From twice the standard deviation (95% confidence interval), we estimate the errors between 1° and 20°.