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MiFil: a method to characterize seafloor swells with application to the South Central

A. Bonneville, C. Adam, V. Vidal

Institut de Physique du Globe - CNRS, 4, place Jussieu, Paris, 75252 France

We propose a new filtering method to characterize large-scale depth anomalies such as seafloor swells associated to intraplate volcanism. Young hotspot volcanoes within plate interiors are frequently surrounded by smooth, broad regions of shallow seafloor termed midplate swells. These swells are typically hundreds of kilometers wide and can be more than a kilometer in elevation. The most frequently invoked explanation for these swells is that they represent the thermal and dynamic surface uplift from rising mantle plumes but they can also be caused by underplating. Wathever their origin be, these swells need to be precisely characterized and we present here a simple method to do the job. This method that we called MiFil, for Minimization and Filtering, requires two stages: a first one to roughly remove the volcano component by minimizing the depth anomaly; a second one to smooth the shape and totally remove the small spatial length scale remaining topography using a median filter. The strength of this method, directly applicable on bathymetry or seafloor depth anomaly grids is that it does not require any assumption on the location, amplitude or width of the large-scale feature to characterize, except its minimal width. Application to hotspot volcanic chains of the South Central Pacific is presented and the results lead to a better understanding of the tectonics and volcanism emplacement of the zone. For each chain, we determine the associated seafloor swell and its main characteristics : (1) the Society is the only 'classical' hotspot that corresponds to the simple interaction of a plume with the lithosphere and for which a buoyancy flux of 1.58 ± 0.15 Mg s^{-1} can be obtained; (2) the Marquesas volcanic chain, although quite comparable, presents a swell morphology that prevents such interpretation and quantification; (3) for the Tuamotu, Pitcairn and Cook-Austral volcanic chains, no reliable quantification can be made because the depth and geoid anomalies are caused by several phenomena occurring at different depths that cannot be separated.