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Similarities between the Madeira and Canary Hotspots Revealed by Seismic Anisotropy from Teleseismic and Local Shear-Wave Splitting with the SIGHT Project

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The Madeira and Canary archipelagos, located in the eastern North Atlantic, are two of many examples of hotspot surface expressions, but a better understanding of the crust and upper mantle structure beneath these regions is needed to investigate their structure in more detail. With the study of seismic anisotropy, it is possible to assess the rheology and structure of asthenosphere and lithosphere that can reflect a combination of mantle and crustal contributions.

Here, as part of the SIGHT project (SeIsmic and Geochemical constraints on the Madeira HoTspot), we present the first detailed study of seismic anisotropy beneath both archipelagos, using data collected from over 60 local three-component seismic land stations. Basing our observations on both teleseismic SKS and local S splitting, we are able to distinguish between multiple layers of anisotropy. We observe significant changes in delay time and fast shear-wave orientation patterns on short length-scales on the order of tens of kilometres beneath the western Canary Islands and Madeira Island. In contrast, the eastern Canary Islands and Porto Santo the pattern is much more uniform. The detected delay time increase and more complex orientation patterns beneath the western Canary Islands and Madeira can be attributed to mantle flow disturbed and diverted on small-length scales by a strong vertical component. This is a clear indication of the existence of a plume at each of those archipelagos, nowadays exerting a strong influence on the western and younger islands. We therefore conclude that a plume-like feature beneath Madeira exists in a similar way to the Canary Island hotspot and that regional mantle flow models for the region should be reassessed.

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