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Temporal variations in fast shear-wave polarisation direction observed during and after the 2011-2012 El Hierro eruption from local shear-wave splitting

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The Canary Islands, in the eastern North Atlantic, result from volcanism that is thought to be driven by an underlying mantle upwelling. Due to the movement of islands relative to the hotspot, these get progressively younger from east to west, with La Palma and El Hierro, situated in the north- and south-west of the archipelago being the most recent ones. In addition, those islands have experienced the most recent volcanism in the area (El Hierro: 2011/2012; La Palma: 2021), which was accompanied by large clusters of local seismicity. In the years since the eruption, further seismic clusters could be detected on El Hierro. A better understanding of crustal stress changes can help to monitor ongoing subsurface processes associated with future volcanism.

In this study we present a detailed investigation of crustal seismic anisotropy using shear-wave splitting of local events to estimate splitting parameters and investigate features such as crustal structure or stress due to aligned cracks. The study of anisotropy through shear-wave splitting is a commonly used method to observe dynamic subsurface processes and their influence on the regional stress field. The abundance of data over the last decade allows for a detailed study of temporal variation. Accordingly, using 5 broadband three-component seismic island stations of the IGN network (Instituto Geográfico Nacional) we were able to collect over 200 high quality measurements from 2010 to 2019, the majority of which correspond to syn-eruptive events. Still, nearly half of the events were recorded after 2012, revealing ongoing dynamic crustal processes.

Over the decade, results derived from event clusters show variation of distinct locations around the island. Whereas before and during the eruption results were focused on the northern part of the island, newer clusters were observed on- and offshore to the south of the island. Furthermore, we observe significantly varying fast shear-wave polarisation direction, which in a volcanic environment can be attributed to stress changes due to magma influx as it alters local stress in the crust, or a fabric induced by the lateral intrusion of sills at crustal level and/or beneath the island

edifice.

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