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Evidence for oxidised sulfur in the mantle beneath the Western Canary Islands revealed by the sulfur isotopic composition of melt inclusions

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El Hierro, located in the western Canary Islands, is known to erupt extremely volatile-rich magmas, with melt inclusions recording undegassed S contents in excess of 4000 ppm, similar to arc magmas. However, the origin of this volatile enrichment is ambiguous. We present sulfur isotope data measured in olivine-hosted melt inclusions and lava samples from El Hierro to distinguish between possible scenarios that may drive sulfur-enrichment at ocean islands, such as low degree melting of a primitive mantle accompanied by total sulfide exhaustion, or the presence of previously subducted sulfur-rich lithologies. Sulfur isotope ratios in melt inclusions and matrix glasses are between -20.5‰ to +8.9‰, with more positive $\delta^{34}S$ values measured in S-rich inclusions. Using degassing modelling, we constrained the sulfur content (5000 ppm) and sulfur isotope ratio ($\delta^{34}S = +4 \pm 0.75$‰) of El Hierro primary magmas, the latter indicating ^{34}S enrichment compared to normal upper mantle (~ -1‰). El Hierro magmas are characterised by low Cu content (<150 ppm) that cannot be explained without the presence of sulfide in the mantle source. However, our primary melt S abundance estimate is too high for mantle source containing only sulfide, as such mantle would produce sulfide saturated melts with <2000 ppm S under asthenospheric pressure conditions. We show that high S content coupled with low Cu content can be reproduced if the El Hierro mantle source contains both sulfide and sulfate, the latter being stored in metasomatised peridotite veins that formed via reactions of primitive mantle and an oxidised volatile-rich fluid or melt originating from a previously subducted oceanic lithospheric mantle. We estimate that at least 30% of the total S budget of the mantle beneath El Hierro is in sulfate form. Melting modelling suggests the sulfur content of ocean island basalts is ultimately controlled by the presence or absence of sulfate in the mantle source. Our results indicate sulfate can be retained in subducting slabs and later resurface during intraplate magmatism. Subduction of sulfate provides pathway for oxidised surface material to enter the mantle and cause widespread redox heterogeneity in the deep Earth.