

A hydrous mantle source for the Agulhas Plateau in the Southwest Indian Ocean: Insights from IODP Expedition 392

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The Agulhas Plateau in the Southwest Indian Ocean locates within the region where the southern edge of the Africa Large Low Shear Velocity Provinces (LLSVP) is projected to Earth's surface. The origin of this plateau remains unclear because direct sampling has been limited so far. Quantifying the water contents of the mantle source is critical to constrain the source features (wet or dry), and reveal the liquidus temperature of olivine and thus the mantle potential temperature, which is important to evaluate the role of a potential mantle plume.

During IODP Expedition 392, mafic lavas and intrusions were recovered from sites U1579, U1580 and U1582 on the center and northern edge of the plateau. We measured the water contents, H-B isotopic composition of quenched glasses, and constrained the water content of the magmas through the water contents of clinopyroxene phenocrysts in lava and intrusions. The results show that the H₂O/Ce ratios of the glasses are higher than 650, while the H-B isotopic data show no clear shallow seawater contamination. The water contents of the clinopyroxene phenocrysts varies from ~300 to 950 ppm, and the calculated water content of the parental magma could be higher than 5 wt.%. These results demonstrate that the mantle source of the Agulhas Plateau, both in the center and the edge, were largely hydrated, which stands in direct contrast to Ontong Java, the biggest oceanic volcanic plateau in the Pacific. Consequently, the formation of the Agulhas Plateau was closely associated with a hydrous reservoir in the deep mantle.