

Petrogenesis of mafic lavas and intrusions from the Agulhas Plateau in the SW Indian Ocean: Results from IODP Expedition 392

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Mafic lavas and intrusions were recovered from three sites (U1579, U1580, and U1582) on the Agulhas Plateau in the SW Indian Ocean during IODP Expedition 392. The mafic intrusions were collected as sills penetrating into Cretaceous sediments from Sites U1579 and U1580. Pillow lavas with fresh glassy rinds intercalated with Cretaceous sediments were collected from Site U1582. Olivine, plagioclase, and clinopyroxene form the main constituent minerals or phenocrysts, and magnetite, apatite, and rare chromian spinel are also present as accessory minerals. It is worth noting that the thickest sill (>38 m thick) from Site U1580 contains dissolved plagioclase, intergrowth of quartz and sodic feldspar, and hydrous minerals (amphibole and biotite), implying the formation from hydrous basaltic magma. Ca-rich plagioclase and Fe³⁺-rich chromian spinel are consistent with the crystallization from hydrous magmas.

The Agulhas mafic rocks show a tholeiitic trend in a FeO*/MgO-SiO₂ space. The variations in major and trace element compositions are attributed to the fractionation of olivine, plagioclase, and clinopyroxene. The REE patterns of mafic rocks from Site U1579 and U1582 are depleted in light REE, similar to those of mid-ocean ridge basalt (MORB). On the other hand, those from Site U1580 exhibit enrichment in light REE and depletion in heavy REE. The REE ratios of the Agulhas mafic rocks indicate that they were produced by the different degrees of partial melting of spinel- and garnet-peridotites. The Zr/Y and Nb/Y ratios are consistent with the Iceland array, indicating that the Agulhas mafic rocks are derived from a mantle plume. Large low-shear-velocity provinces (LLSVPs) are present beneath the African continent, and the involvement of LLSVPs could have contributed to the formation of the hydrous magmas that formed the Agulhas Plateau.