High water content MORB at the Southwest Indian Ridge: Insights from the geochemical modeling of FeO* and Al_2O_3 variations

WEI WANG[123], FENGYOU CHU[13], ZHENGANG LI[1], KATHERINE.A. KELLEY[2], LING CHEN[1], XIAOHU LI[1]

[1]KLSG, Second Institute of Oceanography, State Oceanic Administration, Hangzhou, 310012 China
(*correspondence: 11638010@zju.edu.cn)
[2]GSO, University of Rhode Island, Narragansett, RI 02882 USA
[3]Zhejiang University, Hangzhou, 310012 China

The water content of MORBs and the mantle beneath mid-ocean ridges is critical for understanding magma generation, differentiation, and eruption, primarily as water affects the chemical and physical characteristics of the mantle. In the absence of pillow glass, melt inclusions, or clinopyroxene phenocrysts, however, constraining magmatic H_2O contents can be challenging. Here, we model the compositions of basalts from the Southwest Indian Ocean (SWIR; 46°E–52°E), which contain no phases that allow a direct measurement to constrain their H_2O contents. Instead, we assess the magmatic H_2O content through modeling variations in major elements during the fractional crystallization of anhydrous and hydrous basaltic magmas.

Our models, using Petrolog3, track variations in FeO* and Al_2O_3 during fractional crystallization under different magmatic water contents. These elements are sensitive to saturation of plagioclase, which itself is sensitive to magmatic H_2O. Comparison of these models to whole-rock data suggests delay of plagioclase saturation in a series of primitive magmas beneath this region of SWIR, with estimated water contents of 1.1–1.8 wt.% for primary basaltic magmas from the study area.

These high water content basalts are concentrated in an area of SWIR where the ridge axis is shallow, suggesting a relationship between magmatic water content and local magmatic production rates, and also linking the inferred high H_2O to the mantle source in this region.