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Evolving MORB compositions between 61 and 7 Ma along the South Atlantic Transect (SAT: IODP Expeditions 390 and 393): shipboard data insights into source and process

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Basement drilling along a mantle flow line on the western flank of the Mid-Atlantic Ridge at ≈30°S recovered sequences of basaltic lavas at five sites, representing crustal ages between 61.2 and 6.6 Ma, and half spreading rates between 13.5 and 25.5 mm/yr. Shipboard geochemical results on the recovered basalts show strong evidence for seafloor alteration (elevated K_2O, variable MgO: [1][2]), so we have examined their immobile element variations (Cr, Ti, V, Sc, Y, Zr) to draw inferences about their eruptive chemistries.

Basalts from four sites (U1558, U1583, U1560, U1559; ages 49.2, 30.6 15.2, and 6.6 Ma) are MORB-like, with low TiO_2 and Zr, and Ti/V>20 (i.e.,[3]). Recovered basalts from Site U1556 (61.2 Ma) include a thick upper section of trace element enriched lavas, underlain by a sequence of MORB-like, low Ti basalts that are similar to basaltic clasts in a sedimentary breccia sequence recovered nearby at Site U1557 (60.7 Ma). Ti/V ratios in the basal Site U1556 and Site U1557 basalts are <20, falling outside the MORB field on the V-Ti tectonic discrimination plot [3].

Mean V/Ti, Zr/Ti and V/Y in basalts from the different SAT sites correlate broadly with spreading rate, with V/Y and V/Ti decreasing, and Zr/Ti increasing, as spreading rate becomes greater. Cr/TiO_2, used to proxy for MgO in altered basalts [4], also decreases with increasing spreading rate, suggesting that fresh lavas from the slower spreading periods may have been overall more magnesian. Lower downhole chemical heterogeneity in recovered basalts from slower spreading periods, and extreme Ti and Zr depletions in the oldest MORB-like lavas, point to a complex interplay between mantle source characteristics and melting and crystallization effects in the petrogenesis of South Atlantic MORBs since 61 Ma.

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