

# **Petrography and geochemistry of a calcite- and zeolite-cemented basalt-clast talus breccia from Site U1557, South Atlantic Transect, IODP Expeditions 390/393**

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International Ocean Discovery Program (IODP) Expeditions 390/393 recovered oceanic basement from seven sites drilled from a single ridge segment on the western flank of the mid-Atlantic ridge, spanning crustal ages of 6.6 to 61.2 Ma. The aim is to investigate the timing and resultant chemical fluxes associated with alteration of oceanic crust. An unexpected discovery is the presence of a thick, clast-supported, poorly sorted sedimentary talus breccia located on ~61 Ma crust at Site U1557. Drilling advanced 109.1 m into the deposit and recovered 71.28 m of highly altered aphyric basalt clasts variously cemented by calcite and zeolite.

Cementation in the upper ~40 m is dominated by calcite, which ranges from thin and clast-rimming to coarse calcite spar that can be associated with significant vuggy porosity. Basalt detritus-rich areas are typically cemented by zeolite ( $\pm$  calcite). The zeolite (phillipsite) is coarse grained, subhedral to euhedral, with a bladed habit in which the blades grow perpendicular to clast surfaces. This is seen primarily in association with altered basaltic glass, supporting the hypothesis that alteration of the glass provides the dissolved silica required for phillipsite growth. Petrographic analysis shows that zeolite formation precedes sparry calcite cementation during diagenesis. Zeolite abundance increases with depth and dominates over calcite in the bottom ~40 m of the deposit.

Hydrothermal alteration of basaltic glass is thought to result in near complete loss of Si and alkali elements to seawater [1], which has significant implications for the composition of subducted crust and global geochemical cycles. However, analysis of the phillipsite shows that it contains up to 7.7 wt% Na<sub>2</sub>O, 8.8 wt% K<sub>2</sub>O and 58 wt% SiO<sub>2</sub>, significantly higher than the concentrations in unaltered glass from the same site (1.9 wt%, 0.1 wt%, 50.5 wt%, respectively). Preliminary data also suggest enrichment in some trace elements (e.g., Ba, Sr, La). Thus, elements thought to be lost during hydrothermal alteration of basaltic glass (Si, alkalis, LILEs) may be retained in phillipsite and therefore available to be recycled back into the mantle in altered oceanic crust.