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Carbon-Uptake in Upper Oceanic Crust via Ridge Flank Hydrothermal Exchange: Insights from the South Atlantic Transect - IODP Expeditions 390/393

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The formation, alteration and eventual recycling of crust formed at mid-ocean ridges (MORs) constitutes a significant component of the long-term global carbon cycle. The hydrothermal circulation of seawater-derived fluids through the oceanic crust results in the chemical alteration of not only the rock, but also the hydrothermal fluids. This alteration manifests as hydrothermal minerals, including calcium carbonate ($CaCO_3$) which precipitates in pore space and replaces primary phases. As a result, carbon is fixed as the oceanic crust traverses across the flanks of MORs towards subduction zones. However, uncertainties remain regarding both the extent and duration of hydrothermal exchange across the vast MOR flanks, due to the sparse sampling of ocean crust aged 20–100 Ma. Consequently, the extent to which alteration impacts atmospheric CO_2 concentrations, and thereby climate, remains poorly quantified.

International Ocean Discovery Program (IODP) Expeditions 390/393 drilled the South Atlantic Transect (SAT), across the western flank of the slow-spreading southern Mid-Atlantic ridge, sampling basaltic ocean crust aged 7, 15, 31, 49 and 61 Ma along a crustal flowline at 31˚S. The SAT addresses biases in previous scientific oceanic drilling sites regarding crustal age, spreading rate and sediment thickness to enable the investigation of both the extent and duration of hydrothermal exchange across the ridge flanks of the MOR. Here we present variations in carbon concentrations of SAT cores as a function of age and in the context of varying extents of basalt alteration, to quantify carbon-uptake in the aging South Atlantic oceanic crust.