# Ultra-refractory residues of hydrous melting from a mid-ocean ridge setting

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The 14-17ºN region of the Mid-Atlantic Ridge has long been an enigma for mantle geochemists. This slow-spreading region (~25km•$Ma^{-1}$) contains highly refractory peridotites (indicative of high degrees of melting) exposed directly on the seafloor, and yet basalts recovered in the area display minor enrichments in incompatible and light rare earth elements with respect to normal mid-ocean ridge basalt (MORB), suggesting low degrees of melting. This decoupling between peridotite and MORB chemistry has been attributed to inherited mantle heterogeneity, whereby more fertile (and radiogenic) domains contribute disproportionately large portions to the melting regime compared to refractory mantle domains (higher solidus temperature), the latter of which could be oversampled at mid-ocean ridge settings. However, the provenance of these ultra-refractory domains remains an open question, since melting at a mid-ocean ridge is often limited by the thickness of the lithospheric lid and mantle fertility, consequently restricting melting at slow-spreading regions. We use clinopyroxene (Cpx) grains from 16ºN harzburgites to show that hydrous melting is required to explain their ultra-refractory heavy rare earth element (HREE) and Ti concentrations, suggesting that parcels of entrained mantle can in fact be recycled from the arc mantle wedge to mid-ocean ridges. The buoyant, refractory arc mantle at 16ºN should represent a rifted rise similar to the Azores, yet this is not the case. Instead, the relict arc mantle is likely compensated at depth by more dense, possibly garnet-rich material as inferred from geophysical observations.