Heterogeneous MORB mantle source caused by recycling of oceanic crust in the upper mantle at the Macquarie Ridge Complex, SW Pacific

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The Macquarie Ridge Complex (MRC), located at the Australian–Pacific plate boundary south of New Zealand, was produced by the proto–Macquarie spreading ridge between ca. 40 and 6 Ma. Mid-ocean ridge basalts (MORB) from the only emerged portion of the MRC (Macquarie Island) show various enrichments in incompatible elements with compositions ranging from normal MORB to enriched MORB and unusual high μ (μ=$^{238}U/^{204}Pb$; HIMU) mantle isotopic signature [1].

New geochemical and Sr-Nd-Pb isotopic data show that the rest of the MRC similarly ranges from N-MORB to enriched MORB. Preliminary $^{40}Ar/^{39}Ar$ plateau ages of plagioclase, pyroxene and glass separates from the MRC seamount basalts range from ca. 26 to 1.5 Ma but do not reveal systematic temporal trends in mantle source contributions.

Monte Carlo source mixing simulations indicate that the MRC basalts were not produced by mixing of a DMM source and the nearby Balleny or Scott mantle plume sources. Instead, the MRC basalts are best modeled by a simple binary mixture of a MORB-like mantle and a HIMU-type component. Relatively high Fe/Mn and Zn/Fe ratios and a garnet signature in REE partial melting modelling suggest that the HIMU component could be represented by recycled garnet-bearing pyroxenite veins in the primary DMM source.

The ubiquitous presence of the isotopically distinct basalts along the 1700 km-long, NE-SW trending MRC coupled with recent study [2] reveal a much broader distribution range of the Zealandia-type HIMU in the Zealandia–Antarctic mantle domain.

[1] Kamenetsky et al.(2000) Journal of Petrology. [2] Park et al. (2019) Nature Geoscience.