# An iron isotopic legacy of the Penrose sequence in OIB

O. NEBEL[1,2], P. A. SOSSI[2,3], R. J. ARCULUS[2] AND J. D. WOODHEAD[4]

[1]SEAS, Monash University, Melbourne, Australia
[2]RSES, Australian National University, Canberra, Australia
[3]IPGP, Paris, France
[4]School of Earth Sciences, Melbourne University, Australia

The so-called Penrose ophiolite sequence defines the distinct layers of the oceanic crust, comprising a sedimentary cover on top of basaltic extrusives underlain by sheeted dikes rooted in mafic to ultramafic cumulates, and the underlying, mostly melt-depleted, variably serpentinised harzburgite. Upon subduction, these layers are returned to, and recycled in the convecting, depleted mantle. Time-integrated radiogenic isotope signatures in oceanic island basalts (OIB) require parent-daughter ratios in their various sources that resemble some of these layers. The enriched mantle-1 (EM1) trajectory in multiple isotope space is best explained by a combination of compositionally diverse pelagic sediments, whereas OIB with a high-$\mu$ signature (i.e., high $^{238}U/^{204}Pb$ or HIMU) are often related to basaltic oceanic crust. Recycling of crustal components is required in stationary, hot mantle plumes, where low-degree melting of volumetrically small portions of enriched components in a primitive mantle matrix (termed FOZO) feed oceanic island volcanism. What remains unclear are the mechanisms of this recycling process. Models range from (i) whole slab component recycling to (ii) slab-derived (frozen) fluids in metasomatic pyroxenite dikes that are enriched in incompatible trace elements, to (iii) deep mantle metasomatism by cryptic carbonatitic melts. Here we present Fe isotope compositions (expressed as $\delta^{57}Fe$ relative to IRMM-014) for OIB from the EM1 and HIMU type-localities of the Pacific islands of Pitcairn and Mangaia respectively, all corrected to primary magmas (Mg# =73) in equilibrium with a mantle source of Mg# =90. EM1-type melts ($\delta^{57}Fe$~0.1) are isotopically distinct from FOZO-type melts ($\delta^{57}Fe$~0.2) and appear systematically lighter compared to HIMU lavas ($\delta^{57}Fe$~0.2-0.3). Isotope diversity outside of analytical uncertainty indicates source heterogeneity in $\delta^{57}Fe$ within the respective mantle components. Because Fe is a major element in the mantle and isotope variations require physical transfer of Fe, we conclude that entrainment of crustal sections, i.e., scenario (i), best explains $\delta^{57}Fe$ in the OIB sources. HIMU basalts are consistent with $\delta^{57}Fe$ of upper oceanic crust, whereas the EM-1 source at Pitcairn may reflect deeper, and isotopically lighter serpentinised crust (but not sediments), consistent with at least two sections of the Penrose sequence.