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Evidence for Nucleogenic Neon in High $^{3}He/^{4}He$ Lavas from the Manus Back-arc Basin

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We report new neon isotope data obtained for basaltic glasses from the Manus back-arc Basin, located in the eastern Bismarck Sea behind the New Britain arc. Fresh volcanic glass was obtained from the Central Manus Spreading Centre (CMSC), and the east-striking Extensional Transform Zone (ETZ). Previous helium isotope studies on this sample suite (Macpherson et al., 1998) have identified a plume component (mean $^{3}He/^{4}He$ ~$12R_A$) in these lavas, and oxygen isotopes on the same samples (Macpherson et al., 2000) have anomalously low ^{18}O values (5.3-5.8 per mil) which have been attributed to either a recycled altered oceanic crustal component and/or admixture with a component residing at or within the D'' layer.

Neon concentration and isotopic measurements were made on a VG 5400 mass spectrometer using a step-heating approach where the gas yields at the 800ºC and 1200ºC release steps represented the vesicle and dissolved components respectively. The samples have been analysed taking into account corrections for blanks and contributions to ^{20}Ne and ^{22}Ne, due to doubly charged ^{40}Ar and CO_2 respectively. Best-fit correlations as a function of H_2 and CO_2 concentrations were used to estimate the contributions of doubly charged ^{40}Ar and CO_2.

In plots of $^{20}Ne/^{22}Ne$ versus $^{21}Ne/^{22}Ne$, data sets plot along linear arrays passing through the atmospheric value ($^{20}Ne/^{22}Ne$ =9.80 and $^{21}Ne/^{22}Ne$ =0.029). The Manus lavas plot on a correlation line that has a slope less than the MORB correlation line (Sarda et al., 1988). This is in contrast to high $^{3}He/^{4}He$ samples from Loihi (and elsewhere) that fall on correlation lines with steeper slopes than the MORB trend (Honda et al., 1993). Therefore, this study reports the unusual occurrence of samples possessing high $^{3}He/^{4}He$ ratios and a linear correlation in three-isotope Ne space with a gradient lower than the MORB-line (i.e. samples show higher $^{21}Ne/^{22}Ne$ ratios relative to MORB for a given $^{20}Ne/^{22}Ne$ ratio).

The anomalously nucleogenic neon component observed in Manus Basin lavas can be attributed to either: 1) crustal contamination en route to the surface; 2) the addition of slab-derived neon from old recycled oceanic lithosphere which has become entrained by the Manus plume; or 3) a deep mantle plume component having anomalous nucleogenic neon isotope systematics which are decoupled from the helium isotope systematics. A complicating factor is volatile degassing, which would act to reduce intrinsic Ne and He concentrations relative to U and Th contents. This would result in an ageing effect, which would lead to lower $^{3}He/^{4}He$ and higher $^{21}Ne/^{22}Ne$ ratios as a function of time and extent of degassing.

We can dismiss the first of the three possibilities with a high degree of confidence given that the CMSC and ETZ are sited on young oceanic crust unlikely to have grown-in sufficient ^{4}He and ^{21}Ne to modify source $^{3}He/^{4}He$ and $^{21}Ne/^{22}Ne$ ratios. In the second case, ancient subducted oceanic crust would have a high $^{21}Ne/^{22}Ne$ ratio and a low $^{3}He/^{4}He$ ratio due to the addition of nucleogenic neon and radiogenic helium from U and Th decay. Therefore, we would anticipate coupling of low $^{3}He/^{4}He$ ratios with nucleogenic neon ratios. The Manus samples have $^{3}He/^{4}He$ ratios much higher (up to $15R_A$) than would be anticipated for such a source. This might imply that the $^{3}He/^{4}He$ ratio of the plume source was initially much higher and has been contaminated by a low $^{3}He/^{4}He$ ancient subducted slab component prior to eruption. Finally, if the He and Ne systematics are decoupled, it would indicate that the lower mantle shows heterogeneities in neon isotopes akin to that of He (i.e. OIB world-wide varies from 5 to $37R_A$). Each of these scenarios will be addressed in the presentation.

Honda M, McDougall I & Patterson D, *Lithos*, **30**, 257-265, (1993).

Macpherson CG, Hilton DR, Sinton JM, Poreda RJ & Craig H, *Geology*, **26**, 1007-1010, (1998).

Macpherson CG, Hilton DR, Mattey DP & Sinton JM, *Earth and Planetary Science Letters*, **176**, 171-183, (2000).

Sarda P, Staudacher T & Allègre, C, *Earth and Planetary Science Letters*, **91**, 73-88, (1988).