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# He-Ne Systematics in MORB, Loihi, Iceland and Pitcairn: Constraints on He Loss in OIB

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We compare helium and neon data obtained on glasses from mid oceanic ridges, Loihi seamount, Iceland and Bounty seamount (Pitcairn). We selected samples with $^{20}Ne/^{22}Ne$ higher than 11 to decrease the influence of the atmospheric contamination. Helium contents are systematically higher in MORB samples whereas the $^{22}Ne$ content (corrected for atmospheric contamination) is higher in OIB glasses. The systematically higher $^{3}He/^{22}Ne$ ratio in MORB can be viewed in term of $^{3}He$ excess or $^{22}Ne$ deficit, whereas the $^{3}He/^{22}Ne$ ratios (corrected for atmospheric contamination) measured in OIB are similar to the mantle estimate (3-5), except for Bounty seamount samples (lower). The extremely low $^{3}He$ content of some Bounty seamount samples (< 2 x10-13 ccSTP/g) can be viewed as a strong helium loss whereas the neon is not lost. The way the helium is lost from the magma is still not clear and can be related to the well known "helium paradox". However, we show in this study that the neon isotopic systematics is a more powerful tool to trace lower mantle derived plumes than the helium one. As an example, the $^{4}He/^{3}He$ ratio of the Bounty seamount samples is higher than 355,000 (R/Ra<2.1) whereas the $^{21}Ne/^{22}Ne$ ratio (corrected for atmospheric contamination) is lower than the Loihi ratio (0.041). This radiogenic helium signature reflects certainly $^{4}He$ production in a zero helium magma chamber. The nucleogenic neon that should be associated to the radiogenic helium is not seen because neon is not lost (i.e. the (U+Th)/Ne ratio is low enough to keep the primordial $^{21}Ne/^{22}Ne$ ratio). Our study shows that the helium can be extremely lost from OIB magma without changing the neon content. This is not consistent with a solubility controlled degassing process because helium is more soluble in magma than neon. In contrast, the He/Ne ratios in MORB can be explained by a simple solubility controlled degassing model. The neon systematics is compatible with the classical model of mantle structure, where the lower mantle is less degassed than the upper mantle. A helium loss occurs near the surface, either during melting, magma transport or during crystallisation in magma chamber. This loss can be due to the high helium diffusion rate in magma or to a higher helium solid/liquid partition coefficient.