Source of Volatiles in Earth's Deep Mantle from Neon Isotope Systematics in the South Atlantic

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The noble gases play an important role in understanding Earth's accretion and subsequent evolution. Neon isotopes in particular have the potential to distinguish between distinct sources of Earth's volatiles e.g., acquisition of nebular gas, solar wind implanted materials or chondritic meteorites and their components. The neon isotopic composition of the deep mantle remains subject to debate with the majority of mantle-derived basalts displaying maximum $^{20}Ne/^{22}Ne$ ratios less than 12.5, similar to values determined for the convective mantle ($^{20}Ne/^{22}Ne$ = 12.49 +/- 0.04; [1]). These values are also much lower than those of solar wind ($^{20}Ne/^{22}Ne$ = 13.8; [2,3]) and estimates of the nebular gas ($^{20}Ne/^{22}Ne$ = 13.4; [4]) but comparable to solar wind implanted meteoritic materials ($^{20}Ne/^{22}Ne$ = 12.5-12.7; [5]). Here we determine the neon isotopic composition of mantle-derived materials from the south Atlantic. These samples display strong linear correlations in $^{20}Ne/^{22}Ne$-$^{21}Ne/^{22}Ne$ space with maximum $^{20}Ne/^{22}Ne$ ratios that are resolvable from and higher than materials derived from the convecting mantle as well as models of solar wind implantation. These results supplement a growing database of mantle materials characterized by $^{20}Ne/^{22}Ne$ ratios greater than 12.5, challenging the notion that the entire mantle acquired volatiles from solar wind implanted meteoritic materials. In this presentation we will explore alternative origins for these volatiles and provide testable predictions for each scenario.

[1] G. Holland, C.J. Ballentine.. Nature 441 (2006), 186–191. [2] A. Gimberg et al. GCA 72 (2008), 626-645. [3] V.S. Heber et al. GCA 73 (2009), 7414–7432. [4] V. S. Heber et al. ApJ 759 (2012), 121. [5] R. Wieler in: D. Porcelli, C.J. Ballentine, R. Wieler (Eds.), Reviews in Mineralogy and Geochemistry 47 (2002), 21–70.

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