Geophysical Research Abstracts, Vol. 9, 03920, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-03920
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Helium and neon isotopes as tracers of mantle evolution, mantle dynamics and mantle reservoirs

N. A. Stroncik (1), S. Niedermann (1) and K. M. Haase (2)

(1) GeoForschungsZentrum Potsdam, Telegrafenberg, D-14473 Potsdam, Germany, (nicole@gfz-potsdam.de / +49 (0) 331 288 1474 / +49 (0) 331 288 1423) (2) Department of Earth Sciences, University of Aarhus, C. F. Møllers Allé 110, DK-8000 Aarhus C, Denmark

He isotopic and abundance studies of mid-ocean ridge basalts (MORB) and ocean island basalts (OIB) have provided important insights into the formation, evolution and composition of the Earth's mantle. Basic concepts on mantle structure and evolution, such as two-layer mantle convection or any other "layered mantle models", are primarily based on the interpretation of mantle ^{3}He as reflecting primordial, undegassed mantle material. Primordial He isotopic ratios in terrestrial matter are largely thought to be solar-like, with the deviation from those solar-like ratios increasing during Earth's history caused by the production of radiogenic ^{4}He. Thus high ^{3}He/^{4}He ratios are interpreted to represent deep mantle material, whereas ratios around 8 R_A (R_A stands for the atmospheric ^{3}He/^{4}He ratio of 1.39 x 10^{-6}) are thought to be representative for the upper mantle. Based on He, Ne and Ar fusion data of fresh, submarine volcanic glasses of a number of Mid-Atlantic Ridge off-axis seamounts we show that He isotopes can be susceptible to interferences during melt formation and evolution resulting in a decoupled behavior of He from other elements, such as e.g. Ne or Pb. All obtained He data are indistinguishable from the MORB range. In contrast, Ne isotopic compositions are much more primitive than MORB. Combined He, Ne and Ar systematics show that the source region of these seamounts experienced a preferential loss of He compared to Ne and Ar. This He loss, combined with subsequent ^{4}He production, resulted in the decoupling of the He isotope systematics from Ne and Pb. Thus, among He and Ne only Ne has preserved the evidence that a primitive mantle component contributed to the formation of the investigated seamounts. As these seamounts are not fed from a mantle plume being derived from the deep mantle, the primitive Ne component resides within the upper mantle, implying that primitive no-

ble gases are not necessarily indicative for deep mantle material. Our studies point out the necessity of obtaining Ne data in addition to He for the modeling of mantle formation and evolution and correct source characterization.