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N-Ar-He-CO_2 systematics and H_2O, Cl, K abundances in MORB glasses: Evidence for interaction of magmatic and hydrothermal systems in the MAR at 16°07'-17°11'N

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Stepwise crushing data on nitrogen and argon isotopic compositions and He-Ar-N-C(CO_2) elemental ratios in fresh basaltic glasses of the N-MORB family from Mid-Atlantic ridge rift valley at 16°07'-17°11' N are discussed. The bulk nitrogen isotopic composition in the samples varies from $\delta^{15}N_{(total)}$ = -5.2±0.2 ‰ (i.e., typical for MORB glasses) to $\delta^{15}N_{(total)}$ = +4.6±0.3 ‰ (pointing to the presence of organic nitrogen). The $\delta^{15}N$ variations in the crushing steps are wider and range from -13.8 to +8.3 ‰. The $^{40}Ar/^{36}Ar$ ratios in the crushing steps vary from the value close to that in the atmosphere (~296) and up to 11100±590 (the bulk values cover range from 355±11 to 2799±159). Correlations between argon and nitrogen isotopic and elemental ratios imply mixing between an N-MORB type mantle component and a surface-derived component enriched in ^{15}N. Carbon (CO_2) – nitrogen systematic suggests that the most plausible source for isotopically heavy nitrogen is the organic matter brought into the fluid source. Strong relationships between Ar and N isotopic compositions and Cl, H_2O, and K concentrations (Silantyev et al., 2008), as well as Ar-N_2, N_2-CO_2 and Ar-He-CO_2 systematics, indicate that melt degassing and contamination with atmospheric Ar and organic nitrogen are the two dominant processes responsible for elemental and isotopic variations. The contamination of magmatic melts with surface related noble gases and organic nitrogen most probably occurred through their interaction with high salinity hydrothermal brines. We believe that this contamination mechanism may be universal and largely responsible for the observed wide variations in the isotopic composition for a number of volatile elements in MORB glasses.

Silantyev S.A., Danyushevsky L. V., Plechova A. A. et al. (2008) Geochemical and isotopic signatures of magmatic products in the MAR rift valley at 12°49′–17°23′ N and 29°59′–33°41′ N: Evidence of Two contrasting sources of the parental melts. Petrology 16(1): 36-62.