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Light element input to subduction zones; results from ODP leg 209 peridotites

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The samples presented in this study are serpentinised spinel harzburgites from ODP Leg 209 (sites 1272A and 1274A) at the Mid-Atlantic Ridge (MAR) between 14∞N and 16∞N (Paulick et al. 2006, Bach et al., 2004). The degree of serpentinisation varies between 70-100% in site 1272A and from 50-97% in site 1274A. Despite the high degree of serpentinisation primary phases are still preserved in the samples (olivine >= orthopyroxene >> clinopyroxene).

Light element mineral concentrations obtained by SIMS (Secondary Ion Mass Spectrometry) show lithium contents of olivine and orthopyroxene ranging between 0.45-1.3 ppm and 0.38-1.0 ppm, respectively. The Li contents of clinopyroxene (0.44–2.8 ppm) differ from published data for non-metasomatised mantle by their higher concentrations in clinopyroxene compared to olivine. This reverse Li partitioning could be explained by a reaction with a mafic silicate rich melt in the mantle or by an interaction with a high-temperature fluid under the ridge. B and Be abundances (e.g. orthopyroxene: 1-100 ppb for B and 0-4.2 ppb for Be) are near the detection limit but comparable to previously published data for unmetasomatised mantle minerals (Kaliwoda, 2004).

The average contents of serpentine minerals are 0.17 ppm (Li), 0.4 ppb (Be) and 30 ppm (B). Compared to the primary phases they are similar in Be, slightly depleted in Li and strongly enriched in B. The different behavior of the light elements could be explained by the different order of magnitude between the mineral-fluid partition coefficients of Li and B (Brenan et al., 1998) and the higher (20 times) enrichment of B in seawater compared to Li (e.g. Morozov 1968; Uppstroem 1974), while Be is not very fluid-mobile.

In order to constrain the enrichment of oceanic mantle in light elements by hydrothermal alteration and thus probably the major input of light elements in subduction zones we have calculated the light element budget of different ophiolitic cross sections. They show, that the altered mantle is a major carrier of Boron to depth, but that Lithium is mainly brought into subduction zones by altered oceanic basalts and sediments. Data from Mariana fore arc (Savov et al 2005) seems to show an enrichment in Li compared to our samples.

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