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Contrast redox conditions and volatiles content in minerals of the upper mantle peridotites from Atlantic mid-ocean ridge

Alexey Goncharov, Anastasiya Karaman, and Nester Korolev
Saint Petersburg State University, Russian Federation (a.goncharov@spbu.ru)

In the studies of mantle xenoliths, the presence and amount of volatile components in the structure of nominally anhydrous mantle minerals usually show no correlation to the change in oxygen fugacity (e.g. Doucet et al., 2014, Goncharov et al., 2015), despite the fact that it may vary greatly. Another way of testing the connection between volatile content in NAMs and oxygen fugacity is serpentinisation of peridotites. And here we present the results of the investigation of redox condition in mantle peridotite assemblage during its serpentinisation within mid-ocean ridge settings. Three samples from the Semenov-1 hydrothermal field of mid-Atlantic ridge with 10-13 wt.% of LOI, 35-38 wt.% of MgO and 8-8.5 wt.% of FeOtotal shows partial serpentinisation with spinel (Cr# = 0.3-0.4) of at least two generation usually rimmed by magnetite (Cr# = 0.7) associated with serpentine group minerals. Olivine (Mg# = 0.90-0.91, FeOtotal = 9.2-9.7 wt.%) and orthopyroxene (Mg# = 0.90-0.92, FeOtotal = 3.0-6.0 wt.%) presented as relicts partially replaced by serpentine group minerals. Redox conditions were valued based on iron oxidation state in spinel, pyroxenes and olivine and studied using Mossbauer spectroscopy (at IPGG RAS, Saint-Petersburg) and flank approach with EMP analysis (at Freie University of Berlin). To evaluate volatiles content the FTIR spectra were collected (at St Petersburg University) for entire mineral assemblage with a focus on the core to rim zoning. Flank studies of iron oxidation state in spinel shows minimum redox contrast as for individual grans and grains of different composition as well. Fe3+/Fetotal varies from 0.18 to 0.22 which is common values for spinel from mantle xenoliths and supported by Mossbauer spectroscopy analysis made for whole sample mineral fraction. FTIR data indicates the presence of OH, H_2O and CO volatiles component in the structures of olivine and pyroxene relicts and shows a loss of its concertation compare to fresh mantle peridotite assemblage.

References:
Doucet et al., Geochimica et Cosmochimica Acta, Volume 137, 2014, Pages 159-187
Goncharov et al., Russian Geology and Geophysics, Volume 56, Issue 11, 2015, Pages 1578-1602