Fluid-induced redox processes at the slab-mantle interface: insights from ultrahigh-pressure garnet peridotites

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The slab-to-mantle volatile transfer is related to the fluid speciation, which in turn is a function of fO_2, in a system buffered by equilibria involving redox-sensitive elements. The redox processes taking place in the portion of mantle wedge on top of the subducting slab is poorly investigated and the oxidising power of fluids is still unknown.

A case study is represented by grt-orthopyroxenites and peridotites from Dabie-Shan (China) hosted by grt-coe gneisses which contain an association of opx + grt ± cpx ± ol, formed at the expenses of a previous grt-peridotite. Grt includes primary polyphase inclusions corresponding to a solute-rich aqueous fluid enriched in LILE and LREE. Orthopyroxenites represent metasomatic layers produced after the reaction of mantle peridotites with a Si-saturated fluid phase sourced by the associated crustal rocks. The trace element pattern of this fluid shows a peculiar LILE signature which is recorded by subduction grt-peridotites from Sulu (China). These samples show porphyroclastic grt, cpx and phl, and a younger paragenesis of fine-grained ol + cpx + opx + phl ± magnesite equilibrated with neoblastic grt.

We measured the Fe^{3+} distribution of the major phases of orthopyroxenite and peridotite with Flank Method electron probe microanalyses and EELS. Pyrope-rich metasomatic grt presents a complementary decrease in Al_2O_3, relative to the increase of Fe_2O_3. Diopsidic cpx contains $Fe^{3+}/\Sigma Fe$ up to 0.51 and high Na, requiring the incorporation of an aegirine component. The coupled Na-Fe^{3+} enrichment in cpx suggests a corresponding enrichment in the whole rock and could be favoured by the influx of alkali-rich metasomatic fluid phases. To investigate the role of deep fluids in the redox processes of the suprasubduction mantle we also measured the Fe^{3+} in the microprecipitates of polyphase inclusions using EELS on a TEM. The solute content of slab fluids may contain high Fe^{3+} concentrations and surprisingly inclusion phases such as phl may contain up to 0.70 of $Fe^{3+}/\Sigma Fe$. If net bulk rock oxidation can be demonstrated, silicate-alkali-rich C-bearing fluids could be regarded as potential carriers of oxidising components to the suprasubduction mantle.

Timing and distinct magma sources in ultramafic-mafic intrusions of the Taimyr Peninsula (Russia)

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It is commonly assumed that ultramafic-mafic intrusions and associated PGE-Cu-Ni sulphide deposits of Northern Siberia represent a small component of a major episode of mafic activity at ~250 Ma, which included formation of the most extensive flood-basalt province on Earth [1]. Recent studies, however, advocated protracted evolution of the ore-forming magmas parent to the Noril'sk-type intrusions [2-4].

This report presents the results of uranium-lead ages of zircons and whole-rock Nd-Sr isotope data for the same suite of lithologies from the Binyuda and Dyumtalei ultramafic-mafic intrusions located in the limits of the Taimyr Peninsula (Russian Arctic). The rocks investigated comprise sulphide-rich varieties of (1) melanotroctolite and (2) ferrogabbro (i.e. gabbro abnormally high in iron) occurring in bottom parts of the Binyuda and Dyumtalei intrusions, respectively.

Zircons are characterized by similar U-Pb ages (248.5±11 Ma at Binyuda and 244.4±2.4 Ma at Dyumtalei). In contrast, silicate material show distinct Sr-Nd isotope signatures (εNd=3.5±0.7 and $^{87}Sr/^{86}Sr_i$=0.70493±0.00021 at Dyumtalei, εNd=-3.4±0.3 and $^{87}Sr/^{86}Sr_i$=0.70585±0.00004 at Binyuda). The determined Nd-Sr variability is interpreted to represent a primary source signature of the lithological units. An important role of the juvenile component is clearly defined for the Dyumtalei intrusion, whereas a major contribution from a SCLM source is inferred for the Binyuda intrusion.

These signatures clearly manifest deviation from those typical for the ore-bearing intrusions of the Noril'sk Province, characterized by a significant time span of zircon and baddeleyite U-Pb ages (from ca. 350 to 230 Ma), relatively constant εNd values (+1.0±0.5) and heterogeneous radiogenic $^{87}Sr/^{86}Sr_i$ (from 0.70552 to 0.70798).

The study was supported by RFBR (grant 13-05-00671) and the Uralian Division of Russian Academy of Sciences (grant 12-5-9-019-Arctic).

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DOI:10.1180/minmag.2013.077.5.13