Geochemical features of titano-magnetite mineralization in the Arsentyev massif (Transbaikalia)

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The Arsentyev massif is confined to the intrusions of syenite-pyroxenite-gabbro formation of high titanium ultramafic-mafic association. These intrusions are related to rift-like structures of various ages and close to alkaline basalts by geochemical characteristics. The two intrusive phases, each of them being followed by formation of the dike complex rocks form the Arsentyev massif. The first phase consists of the stratified series of rocks that are represented by pyroxenite, olivine and kersutite gabbros, gabbros and anorthosites. The second phase includes the rocks of syenite series that vary by composition from syenites to monzonites with the small areas of gabbro-diorites, diorites and rocks of intermediate composition. The titanomagnetite-ilmenite mineralization is confined to the stratified gabbro-anorthosite series. This mineralization is subdivided into syngenetic and epigenetic by the conditions of localization and morphological features. The syngenetic mineralization, the most spread one, is represented by disseminated and net-textured ore types, and epigenetic mineralization – by the massive ones. The contacts of ore bodies with host gabbroids are tectonic as a rule.

The mineral composition of all ore types is nearly similar. They consist of magnetite, ilmenite, and insignificant sulfides (pyrrhotite, pyrite, chalcopyrite) present in them. In the disseminated ores, magnetite and ilmenite amounts are about the same, while magnetite predominates in the massive ones. In addition, the inclusions of olivine, plagioclase, augite, kersutite, biotite and apatite are fixed. Ilmenite forms both independent grains and lamellar structures in magnetite. Also needle- and emulsion-like extracts of spinel are widespread. Besides, ilmenite and magnetite from the dissolution structures are clearly enriched in Al_2O_3 and MgO compared to their idiomorphic grains.

Microprobe analysis shows that magnetite, ilmenite, amphibole and biotite of the massive ores are significantly richer in TiO_2, Al_2O_3, MgO and Na_2O than the minerals of the disseminated ores. It is revealed, that the massive ores are characterized by higher concentration of V (1400 – 1600 ppm), Zn (200 – 500 ppm), Cr (21 – 36 ppm) and low concentrations of Sr (60 – 210 wt %), Co (73 – 112 wt %) and P_2O_5 (0.06 - 0.21 wt %) compared to the disseminated ores at the very high concentrations of the main components (TiO_2, Fe_2O_3 and FeO). The revealed variations in ore compositions are evidently illustrated on the ratio plots of petrogenic and trace elements. An independent and later formation of the massive ores is indicated by significantly lower values of Cr/V and Ni/Co ratios than in the disseminated ores, these ratios being indicators of ore formation stages. By chemical composition, the ores of the Arsentyev massif belong to the iron – titanium-vanadium ones.

^{186}Os-^{187}Os enrichments in the Earth's mantle – Core-mantle interaction or recycling of marine ferromanganese crusts and nodules?

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^{186}Os enrichments in volcanic rocks and peridotite-derived iridosmine grains have been attributed to contributions from Earth's outer core to the mantle, and apparently constrains the scale of mantle convection and an early timing for inner-outer core segregation 4 Gyr ago. Typically, the argument used to assign ^{186}Os excesses to an outer core contribution is the apparent absence of any intra-mantle event that can produce large Pt-Os fractionations and, more importantly, the lack of lithospheric materials (recycled oceanic lithosphere, continental crust, sediments) with sufficiently high Pt/Os ratios and Pt-Os contents to generate large ^{186}Os excesses when recycled into the mantle. Here, we highlight that marine ferromanganese crusts and nodules are characterised by high Pt/Os ratios and Pt-Os contents that develop much larger ^{186}Os excesses over geological time (≥0.2%/Gyr) than those hypothesized for Earth's outer core (0.005-0.01%/Gyr). ^{187}Os/^{188}Os ratios in ferromanganese crusts are radiogenic due to sequestering of continental Os from seawater and, similarly, these materials will have ^{186}Os excesses (> 0.1%) as a result of high Pt/Os ratios in continental crust, *even* prior to in-growth of ^{186}Os. Past recycling of small amounts of these materials (< 1.5%) into the Earth's mantle will produce ^{187}Os-^{186}Os excesses and little change in platinum-group-element concentrations, as observed in Hawaiian picrites, and in contrast to the predicted result of outer core addition. ^{187}Os and ^{186}Os enrichments in the Hawaiian mantle source are consistent with it comprising recycled oceanic lithosphere, pelagic sediments and ferromanganese materials, and questions the notion that Os isotopes can be used to uniquely identify core-mantle interactions and the depth at which mantle sources for such volcanism originate.