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Ni and Cr fractionation in ophiolite as indication of the island arc and spreading back-arc magmatism maturity: an example from Central Kazakhstan.

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Two last decades brought us significant data on chemistries and origin of the Central Kazakhstan ophiolites. Knowledge on the trace element distribution in geologically dated Ordovician basalts and mafic-ultramafic ophiolite series displayed major features of geochemical evolution and revealed relationships existing between the chemical compositions of volcanic and plutonic rocks and relevant geodynamic settings (Stepanets, 1993).

The conclusions drawn from information obtained from the high-temperature gas chromatography, major and trace element chemistries, and mineralogical studies, are as follows (Stepanez et al., 2002): 1. Plutonic varieties of island arc (IA) ophiolite oversaturated in Ti, Fe, and Y, as well as relevant insular arc volcanics, REE and HFSE-poor and Nb, (Ni), and Cr-rich, display a monotonous fractionation trend of rock-forming components, whereas their late differentiates are not Fe and Ti-rich. 2. IA-ophiolites originate from Mg-Fe melts and their chemistries are those of completely fractionated pristine asthenospheric mantle. An early crystallization stage of the latter results in production of Mg-olivine and Mg-pyroxene, Ti-magnetite, magnetite, and spinel. 3. Pillow basalt varieties of riftogenic ophiolites (rich in Fe, Ti, REE, and HFSE, and poor in Ni and Cr), along with relevant plutonic rocks poor in Fe, (Ti), and Y, originate from a liquation type of differentiation. 4. Plutonic varieties of riftogenic ophiolites (Mg and high-Al melt differentiates) are the crystallization products of the asthenospheric mantle liquation; during the course of their early crystallization stage, high-Mg picotite is accumulated. 5. Mafic riftogenic ophiolite varieties are poor in Fe, Ti, and

Y, whereas their later differentiates are rich in these chemical elements, what gives direct evidence of the asthenospheric mantle liquation.

Figure 1 displays N-MORB-normalized (Tarney al et., 1981) contents of trace elements in ophiolites. The curves clearly display Ni and Cr fractionation in contrast to stable HFSE contents (Y is especially indicative).

A genetic relationship was found to occur between Mg, (Ni), and Cr lows and Na (K) heights in basalt, as well as presence of high-Mg chromites bodies in associated cumulative dunite varieties of mafic-ultramafic riftogenic ophiolites. An increased proportion of the olivine and spinel phases in cumulative dunite (Pearce al et., 1984) along with low-Mg, Cr, and high-Na, (K) contents in basalt, is probably controlled by interaction of asthenospheric mantle substrate with chlorides from adjoining subduction zone as components of seawater, unconsolidated bottom sediments, and, in part, hydrated basalt.

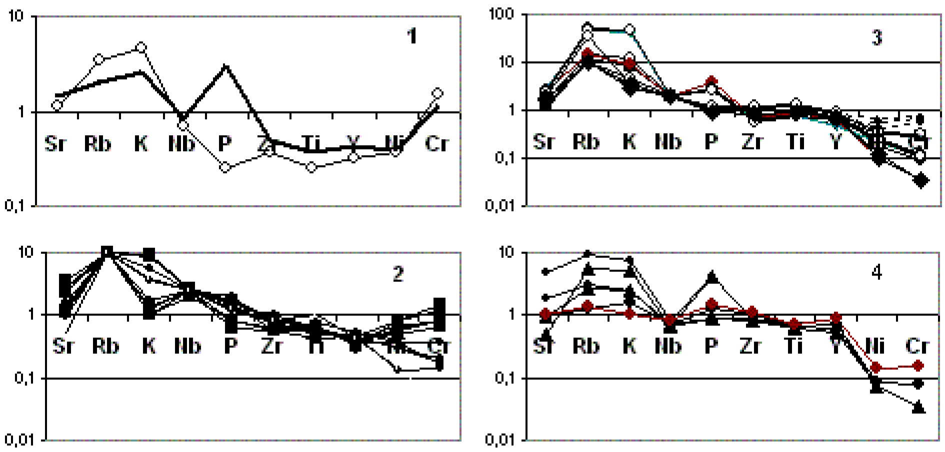

Figure 1. N-MORB-normalized trace element contents in the Central Kazakhstan ophiolites of Ordovician age. **1**-gabbronorites and boninites (Caradocian), island arc, Karaulcheku massif, 2 samples; **2**-basaltoids (Llanvirnian), island arc, Maikain mine, 12 samples; **3**-ferrobasalts (Llanvirnian), back-arc spreading basin, Maisor massif, 14 samples; **4**-keratophyr – spilite – diabases (Arenigian), ocean rifts adjoining the subduction zone, Karaulcheku and Tolpak massifs, 22 samples.

This process resembles chlorination used in the base metal metallurgy to generate fugitive metal chlorides (Glinka, 1974). A direct indication of this process is Cl fractionation in the melt and fluid inclusions observed in Cenozoic volcanics from spreading back-arc basins (Aggrey et al., 1988).

Studies of the fluid and inclusions in the Kazakhstan ophiolites are of major theoretical importance in studies of magmatic processes, which occur in the subduction zones at levels inaccessible to actualistic observations.

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