

Composition, evolution and sources of magmas of Changbaishan Tianchi volcano (China-North Korea)

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Based on original geochemical data on the rocks of Changbaishan Tianchi volcano, China-North Korea, and results obtained by studying melt and fluid inclusions, we present characterization of the composition of the parental magmas that participated in the formation of Changbaishan Tianchi volcano and estimate the differentiation of the magmas.

It was determined that the lavas composing the shield platform of Changbaishan Tianchi volcano are weakly differentiated basic rocks whose geochemical characteristics are generally similar. All the alkaline salic rocks composing the cone of the volcano are characterized by conformable normalized trace element patterns. The concentrations of rare earth elements in these rocks are high and amount up to 1000 ppm. The character of the distribution of trace elements in the basic rocks of Changbaishan Tianchi volcano is close to that in the OIB-type basalts. Within the series from basalts to pantellerites, the rocks are enriched in REE and Zr, but depleted in Ba, Sr, and Eu.

According to our geochemical data, it was shown that the rock series of Changbaishan Tianchi volcano, varying from basalts to trachytes and pantellerites, comprises compositions geochemically interrelated by the processes of crystal fractionation. The parental magma for the rocks of the volcano was derived from plume sources of the same type as those of OIB and sources of the Late Cenozoic intraplate province of East Asia.

Study of melt and fluid inclusions in minerals from trachytes of the volcano indicated that intermediate evolutionary episode of the magmatic system corresponded to profoundly differentiated alkaline melts significantly enriched in Hf, Nb, Zr, Ta, Th, Rb, Y and REE. These melts evolved in the temperature range of 1020-1060°C. The concentrations of H₂O, F and Cl there amounted 0.1-0.5 wt. %, 0.2-0.5 wt. %, and 0.2-0.3 wt. % respectively. Crystallization of melts was accompanied by the degassing process in response to an external pressure decrease.

Changbaishan Tianchi volcano thus represents a natural model of an ore-magmatic system in which the evolution of melts led to the accumulation of concentrations of trace elements sufficient to produce ores during the magmatic process.