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Pyroxenes and amphiboles as monitors of concentration and fractionation of major and trace elements in alkaline rocks of Murun complex, East Siberia

MS. EMILIA YU. DOKUCHITS, PHD[1], TATIANA A. RADOMSKAYA[2], SHAO-YONG JIANG[1], IRINA A. ZHUKOVA[1], ALEKSANDR S. STEPANOV[1], OSCAR C. NKWAZEMA[1] AND AMJAD HUSSAIN[1]

[1]China University of Geosciences (Wuhan)
[2]Vinogradov Institute of Geochemistry SB RAS
Presenting Author: emilia.dokuchits@gmail.com

The Murun complex is one of the largest complexes of Aldan shield, with Mesozoic K-alkaline magmatism widely developed within the area. Alkaline-carbonatite complexes are known for their relation to the presence of critical mineral resources such as Ta, Nb, Zr, REE, Y, Be, Sr, Ba, and others.

Major and trace-element composition and zoning were studied in amphibole- and pyroxene group minerals from charoitites, brookite-anatase-quartz-feldspar-fedorite rocks, Ba-Sr carbonatites and dianite rocks in the Murun complex.

Pyroxenes represent Na-Ca and Na compositions and form aegirine-diopside-hedenbergite solid solutions with a predominant aegirine component, evidencing the higher alkalinity of the rims related to cores in pyroxenes from charoitites, and the presence of two generations of pyroxenes from Ba-Sr carbonatites (Na and Ca-Na varieties). Pyroxenes from charoitites revealed multistage origin, characterized by increasing alkalis and decreasing of Ca and Mg content during crystallization. Pyroxenes from carbonatites are represented by an early Ca-rich and a late Na-rich varieties. Na-pyroxenes from brookite-anatase-quartz-feldspar-fedorite rocks most likely crystallized in low-temperature hydrothermal conditions.

Based on the classification of Hawthorne et al. [1], amphiboles are represented by Na-Ca and Na subgroups. Two generations of amphiboles from charoitites include coarse-grained amphiboles with potassic-fluoro-richterite and potassic-ferri-(fluoro)-katophorite cores and potassic-magnesio-fluoro-arfvedsonite rims, and late fine-grained potassic-richterite with elevated Mg-content, similar to richterite from dianite rocks. Zoned amphiboles from charoitites and dianite rocks are characterized by increasing alkalinity, where Na-Ca endmember in the cores turns to Na endmember in the rims. Early amphiboles are characterized by elevated contents of F and Li, while late have higher OH content.

The rocks were studied based on their proposed origin, magmatic for charoitites and carbonatites, late-magmatic to contact metasomatic for dianite rocks, and hydrothermal for brookite-anatase-quartz-feldspar-fedorite rocks.

The evidence from zoning showed that V, Sr, Zn, Co, Ni and Li (in amphiboles), V and Cr (in pyroxenes) acted as structural components. Pyroxenes serve as the main concentrators of V and Cr, and amphiboles are the main Li-concentrating minerals in the studied rocks.

References:

[1] Hawthorne, F.C., Oberti, R., Harlow, G.E., Maresch, W.V., Martin, R.F., Schumacher, J.C., Welch, M.D., 2012. Nomenclature of the amphibole supergroup. American Mineralogist 97, 2031–2048.