Oriented triphylite rods in apatite (Stankuvatske Li deposit, Ukraine): result of pegmatite–wall rock interaction

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Introduction. Exomorphic haloes found around pegmatites in the Stankuvatske Li deposit (SLD) (Ukraine) are enriched in Rb, Cs, Li, Be, Nb and Ta, and such types of haloes around evolved magmatic systems are important for the concentration of critical mineral sources. Metasomatic processes in the SLD can be an example for the formation of apatite as a geochemical barrier with metallogenetic implications, which takes place at the contact between a rare-metal pegmatite and amphibolite. The aim of current report is to describe the unique occurrence at the SLD of oriented triphylite rods in green apatite, resulting from the interaction between pegmatite- and amphibolite-derived fluids. A genetic interpretation of a two-way directed element mobility in an evolved pegmatite are presented here for the first time.

Geological background. The petalite- and spodumene-pegmatite dykes of the SLD are located in the NW part of the Lypniazhka Dome Structure in the western part of the Inhul Domain in the Ukrainian Shield. Pegmatite dykes intruded amphibolite and ultrabasic rocks and were subsequently overprinted by tectonic activity forming metapegmatites. According to the classification of Černý &Ercit (2005), the studied pegmatite dykes show affinity to the rare-element class, and the petalite or spodumene subtype of the LCT family. The general characteristics of the pegmatites have already been reported (Syomka et al. 2022; Kurylo et al. 2022).

Results and discussion. The contact zone was investigated by the drill core materials (No 61-89) on a complete cross section from the host amphibolite to the adjacent metapegmatite dyke. A parallel mineral layering in the metapegmatite endocontact with host amphibolite was formed in the contact zone.

The exocontact *biotite zone* (BT) in the host amphibolite was formed as a result of metasomatic alteration of rock-forming amphibolite by the intruded pegmatite; newly formed biotite (with up to 2.5 wt.% of Rb_2O) and holmquistite are characteristic minerals in this zone. The pegmatite endocontact has a width of ca 8 cm and consists of four thin zones: (1) *aplitic* (APL), (2) *fluorapatite* (AP), which contains apatite with tiny, needle-shaped and oriented parallel c-axis inclusions of triphylite (Figure 1), (3) *triphylite (TR)*, and (4) *transitional zone* (TRN). Within of the endocontact, Nb-Ta-Sn oxides, ilmenite, gahnite, native bismuth, chrysoberyl, and relics of zircon rimmed by brabantite or thorite have been identified. The adjacent metapegmatite (PGM) represents petalite and spodumene bearing metapegmatite. A detailed description of all zones is currently in preparation.

Two stages of metasomatic alteration can be distinguished in the studied metapegmatite – wall-rock amphibolite system: (i) K-Rb-F metasomatism at low P activity, and (ii) the metasomatic Li-P precipitation. The analysis of the studied metasomatic contact zone provides evidence for a two-way directed interaction between host-amphibolite and pegmatite, whereby a fluid derived from the amphibolite infiltrated the adjacent pegmatite while a fluid derived from the pegmatite dykes migrated into the amphibolite.

The presence of TR, AP, and APL zones in the endocontact of the pegmatite offers an understanding of the mobility of Ca, P, and Li in a pegmatite-amphibolite geochemical system. The main source for Ca represents the host amphibolite, which released Ca by alteration of hornblende to biotite. The Ca-enriched fluid was driven towards the pegmatite, which was primarily enriched in P and Li as an evolved system. The interaction of these two fluid systems, one enriched in Ca, the second in P and Li led to the formation of apatite, which represent a geochemical barrier and preserved Li from further migration outside of pegmatite. In such terms, apatite became the main geochemical barrier for the Li flow from the pegmatite towards the host-rock amphibolite, which also indicates the formation of triphylite clusters at the contact with the apatite layer.

Figure 1. Apatite with needles of oriented triphylite (under plane-polarized light).

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