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MINERALOGY OF EXTREMELY FRACTIONATED PHOSPHORUS-RICH GRANITE – PODLESI, CZECH REPUBLIC

by

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The Podlesí granite system represents one of the best known examples of a highly fractionated peraluminous fluorine- and phosphorus-rich Li, Rb, Sn, W, Nb, Ta-bearing granite. Well exposed outcrops and several drillings from this granite define an outstanding object for study of nature and structural evolution of P-rich granite.

Geological setting

The Podlesí granite system (0.1 km^2) is situated in the western part of the Krušné Hory Mts., Czech Republic. It is the youngest intrusion of the multistage late-Variscan peraluminous tin-specialised Eibenstock-Nejdek pluton.

The main rock type is an albite-protolithionite-topaz granite (stock granite). Within a depth of 40 - 100 m the stock granite is intercalated by flat layers of albite-zinnwaldite-topaz granite (dyke granite).

Prominent manifestation of unidirectional solidification textures (UST) has been recently found in the upper part of a major flat dyke. Individual Q-Afs laminae are separated by comb quartz layers and/or by layers of oriented fan-like zinnwaldite aggregates. Two pegmatite-like layers with oriented megacrysts of Kfs up to 6 cm long have been found in the uppermost part of the dyke. The UST consist also of crenulated quartz layers, segregations of Mn-rich apatite and small pegmatite pods

Both types of granites were later transformed into greisen but only a in small scale: the dyke granite was transformed to massive mica-poor quartz-topaz greisen, the stock granite into joint-related mica-rich quartz-biotite-apatite-topaz greisen.

Li-F-rich micas

Micas are the best mirror of evolution of crystallising melt and/or fluids interaction. Magmatic fractionation from the biotite granite of the Eibenstock-Nejdek pluton through the stock granite to the dyke granite is well documented by enrichment of fluorine and lithium (and also of Rb and Cs) in the micas: they range from Li-biotite through protolithionite to zinnwaldite (Fig. 1).

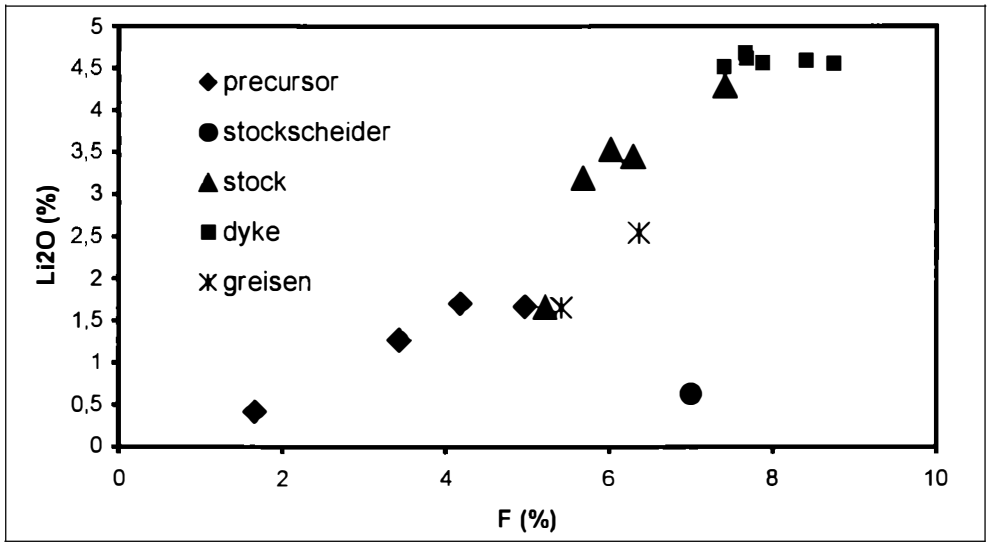

Fig. 1

The Li_2O vers. F relations in micas from Podlesí (chemical analyses of mineral concentrates, laboratory of Czech Geological Survey, Praha). Precursor – biotite granite of the Nejdek massif foregoing the Podlesí intrusion, stockscheider – border pegmatite, stock – stock granite, dyke – dyke granite, greisen – dark mica-rich greisen.

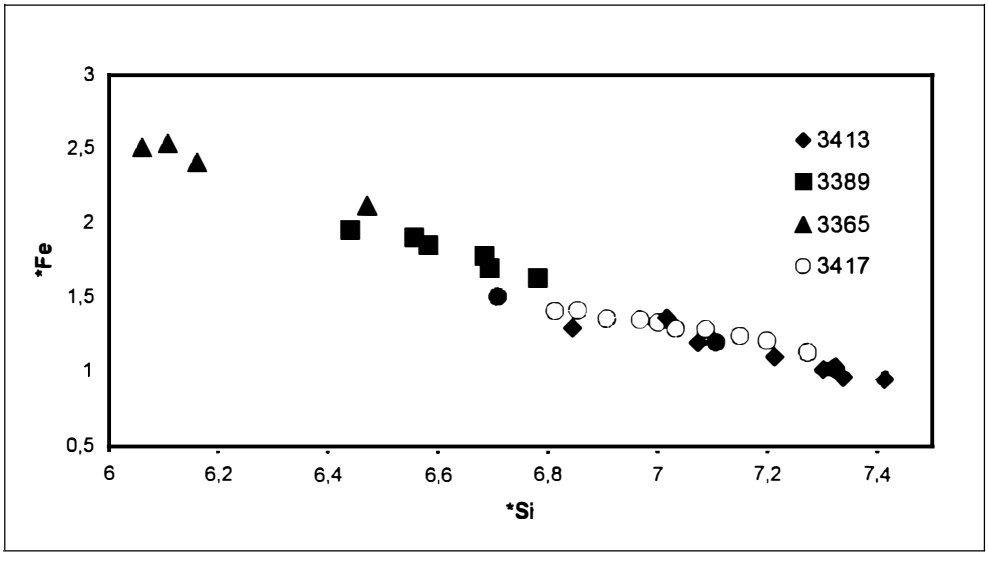

Fig. 2

Si vs. Fe plot for Li-rich micas from the Podlesí intrusion (expressed in atoms per formula unit). 3365 – dark mica-rich greisen, 3389 – light mica-poor greisen, 3413 – dyke granite, 3417 – dyke granite with the UST. (EMPA analyses in University Wien).

During greisenisation, again protolithionite and biotite appear in greisens. This documents that the F- and mainly Li-contents of micas decrease with decreasing temperature in fluids during greisenisation stage. This is well documented also by the decrease of Si and the increase of Fe in structural formulae of the micas (Fig. 2).

Feldspars

Alkali feldspars are generally rich in phosphorus (1 - 2 wt.% of P_2O_5) and rubidium (0.2 - 0.5 wt.% of Rb). They are often distinctly zoned. Rubidium is firmly bound in the Kfs-lattice and preserves well its magmatic signature during post-magmatic processes. In contrast, phosphorus can be easily released from the feldspar lattice and the P-content serves as a sensitive indicator of the late- and/or post-magmatic fluid-related reactions.

Apatite

Apatite is full-saturated in fluorine. The Mn-content significantly increase during magmatic evolution (up to 3.5 wt.% of MnO) and decrease later during greisenisation.

Topaz

Topaz is also close to the F-endmember. Often we found unexpected contents of phosphorus, locally reaching up to 0.3 - 0.4 wt.% of P_2O_5.

Conclusions

The high grade of fluorine saturation in micas, topaz and apatite and the high content of phosphorus in alkali feldspars prove the unusually high concentration of F and P in the crystallising melt. High amount of phosphorus in the melt seems to favour also the incorporation of P into the crystal lattice of topaz. The contents of rubidium in the Kfs preserve well its magmatic signature during post-magmatic processes. In contrast, phosphorus can be easily released from the feldspar and is a sensitive indicator of the late- and/or post-magmatic fluid-related reactions forming greisens.

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