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Unusual granitoid rocks rich in apatite- petrogenesis and implications for the cumulate rock forming processes in the Western Tatra Mts. (S-Poland, Western Carpathians)

K. Szopa (1), A. Gawęda (1), and A. Müller (2)

(1) University of Silesia, Geochemistry, Mineralogy and Patrology, Katowice, Poland (kszopa@us.edu.pl; aleksandra.gaweda@us.edu.pl), (2) Geological Survey of Norway (NGU), Leiv Eirikssons vei 39, 7040 Trondheim, Norway (axel.muller@ngu.no)

In the granitoid intrusion, exposed in the Western Tatra Mts., apatite cumulate granitic rocks occur as pseudo-layers and pockets between I-type hybrid mafic precursors and homogeneous S-type felsic granitoids. The apatite-rich rocks are peraluminous (ASI = 1.12-1.61), with P_2O_5 contents ranging from 0.05-3.41 wt% ($<$ 7.5 vol. % apatite), shoshonitic to high-K calc-alkaline. The mineralogical and geochemical features, and the rocks occurrence, indicate the I-type and S-type affinities of these rocks. Their presence may be linked to the continuous mixing of S-type and I-type magmas, creating unique phosphorus- and aluminium-rich magmas. The main minerals, governing fractional crystallization influencing the chemistry of the apatite-rich rocks were feldspars (albite plagioclase and K-feldspar) and apatite. Apatite is present in two different types of crystals: as (1) long-prismatic zoned crystals which are up to 1.2 mm in size and as (2) large xenomorphic unzoned crystals. The apatite zonation that is observed in CL and BSE images was determined by EMP and LA-ICP-MS analyses. Feldspar and apatite textural relations may reflect the interaction of the crystal planes of both minerals and support a model based on local saturation of e.g. P and Ca versus e.g. K, Na, Si, Al and Ba in the border zones. It is assumed that mineral crystallization within the phosphorus-rich magmas was governed by gravity-controlled separation of early formed minerals and the chemical boundary layer formed at apatite-feldspar junctions. Slow diffusion and subsequent admixture of the mafic component into the crystal mush led to the formation of cumulative textures in the separated crystal mush. The main process governing the internal development of the phosphorus-rich magma pockets was the fractional crystallization of the melt, controlled by the feldspar and apatite chemistry. Chondrite-normalized REE patterns for the apatite rocks and for pure apatite suggest that no significant change in REE contents occurred during fractional crystallisation. The studied rock samples reveal mineralogical, geochemical and textural similarities to enclaves in the High Tatra Mts.

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