The stability of Si-rich triphylite in granitic pegmatites : an experimental investigation of the Li(Fe,Mn)(PO4)-(Fe,Mn)2(SiO4) olivine-type solid solution

Frederic Hatert[1], Olivier Namur[2], Maxime Baijot[1]
[1]Laboratory of Mineralogy B18, University of Liège, Liège, [2]Departement of Aard- and Omgevingswetenschappen, Katholieke Universiteit Leuven, Leuven, Belgium

Triphylite, $LiFe(PO_4)$, is the most common primary iron phosphate occurring in granitic pegmatites. The petrogenetic significance of this mineral has been well documented in the literature, and several experimental investigations were recently conducted to better understand the incorporation mechanism of Na in triphylite (Hatert et al., 2011), and to determine the stability conditions of the triphylite + sarcopside $[Fe_3(PO_4)_2]$ assemblage observed in some pegmatites (Hatert et al., 2016). Recently, electron-microprobe analyses of triphylites from the Pøibyslavice metagranite, Czech Republic (Škoda et al., 2013), and from the Sapucaia pegmatite, Brazil (Baijot, 2015), indicated high amounts of Si in this phosphate, reaching 17 wt. % SiO_2. Consequently, we decided to investigate hydrothermally the $LiFe(PO_4)$-$Fe_2(SiO_4)$ system, which represents solid solutions between olivine-type minerals triphylite and fayalite. Experiments were performed in cold-seal pressure vessels at 1 kbar and between 300 and 700°C, with an oxygen fugacity constrained by the Ni-NiO buffer. Electron-microprobe analyses of the synthetic phases indicate that a complete solid-solution exists between triphylite and fayalite above 550°C, while a miscibility gap is observed below this temperature. For the Mn-rich compositions of the $LiMn(PO_4)$-$Mn_2(SiO_4)$ system, corresponding to the lithiophilite-tephroite solid solution, the miscibility gap appears below 650°C. The temperatures, calculated from these experimental data for the crystallization of pegmatitic Si-rich triphylites, are between 200 and 200°C, significantly below the temperatures generally admitted for the formation of these phosphates (Hatert, 2011, 2016). This mismatch is due to the unexpectedly low Si-content of triphylites, which can be considered as a strong argument confirming the immiscibility between phosphates and silicates in pegmatitic melts.

References

[1] Baijot, M. (2015). Pétrographie des phosphates Fe-Mn du Minas Gerais, Brésil. Unpublished PhD thesis, University of Liège.
[2] Hatert, F., Ottolini, L. & Schmid-Beurmann, P., 2011. Contributions to Mineralogy and Petrology, 161, 531-546.
[3] Hatert, F., Roda-Robles, E., Ottolini, L., Schmid-Beurmann, P., Baijot, M. & Dal Bo, F., 2016. Canadian Mineralogist, 54, 827-845.
[4] Škoda, R., Novák, M., Havránek, V. & Lens C., 2013. GAC-MAC Winnipeg, Abstract Book, 2.