The Na-rich phosphate minerals from Malpensata granitic pegmatite, Piona, Lecco province, Italy

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The Malpensata pegmatitic dike occurs intruded into the high-grade metapelites of the Dervio-Olgiasca Zone (crystalline basement of the Southern Alps). In the field, the Malpensata dike displays an asymmetrical zoned structure composed of different units: 1) a wall zone; 2) an intermediate zone composed of medium-grained white albite and layers of medium grained black tourmaline + garnet + muscovite; 3) a main zone of blocky albite unit (megacryst plagioclase zone) with quartz + tourmaline + garnet graphic textures and many accessory phases as Li-Fe-Mn phosphates, oxides of Nb-Ta-Sn, zircon, uraninite, and many secondary uranium bearing minerals; 4) a roof zone composed of coarse white albite + quartz + muscovite. Masses of phosphates up to 25 cm in diameter were found in the intermediate zone and, mainly, in the blocky albite unit.

Careful investigations of thin sections, EMP chemical analysis and X-ray powder diffraction resulted in the identification of two different phosphates assemblages:

I) Graftonite + sarcopside + triphylite which characterizes the intermediate zone and the marginal part of the blocky albite unit; ferrisicklerite, heterosite, and vivianite are the main secondary phosphates.

II) Graftonite + triphylite + ferrowyllieite + arrojadite + a Na-rich iron phosphate (still under investigation) + sarcopside only observed in the central part of the blocky albite unit; ferrisicklerite, heterosite, Mn-rich vivianite, jahnsite-(CaMnFe), jahnsite-(CaMnMn), metaswitzerite, fairfieldite, rockbridgeite, and mitridatite(?) are the main secondary phosphates.

The usual assemblage I is very simple and Na-free: It is associated with poorly evolved accessory minerals like uraninite, zircon, ferrocolumbite and Th-rich monazite-(Ce). Assemblage II is more complex and particularly rich in Na-bearing phosphates as indicated by the presence of abundant ferrowyllieite, arrojadite, and of this interesting Na-rich iron phosphate. These phosphates are in very close association with highly evolved accessory phases like cassiterite, Sn-bearing zircon, ferrotantalite, ferrotapiolite and three different types of microlite, representing enrichment in Na and U. A Na-free microlite and one with a low Na-content form octahedrons showing an oscillatory zoning, whereas Na- and U-bearing microlite form fracture-fillings. These chemical features of microlite indicate a low temperature of crystallization [2]. We can infer that the primary phosphates belonging to association II crystallized together with the Sn-Ta-Nb-U mineral assemblage at a lower temperature in respect to phosphate association I formed from a fractionated melt strongly enriched in P. As proposed by London et al. [3], the high concentration of P allows the destabilization of albite that we can consider as the sources of Na and Al.

[1] Vignola, P & Diella, V. (2007) in Martin, T. & Vieira, R. (eds.) *Granitic pegmatites: the state of the art. Book of abstracts*. **8**, 102-103. [2] Vignola, P. et al. (2008) *Geophys. Res. Abstr.*, **10**, EGU2008-A-03866. [3] London, D. et al. (1999) *J. Petrol.*, **40**, 215-240.

Paragenetic evolution of Be minerals (silicates and phosphates) from the Nanping No. 31 pegmatite dyke, SE China

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The No. 31 dyke is the most evolved one in the Nanping pegmatite district in southeastern China. It is strongly mineralized in rare elements with crystallizations of cassiterite, columbite-tantalite, microlite, wodginite, spodumene, amblogonite, beryl, pollucite, etc. [1].

Beryllium minerals in the Nanping No. 31 pegmatite dyke exhibit complex parageneses of silicates and phosphates, including beryl, phenakite, herderite, hurlbutite and euclase. Moreover, they show distinct paragenetic features in different internal zones of the pegmatite dyke. In the quartz – albite – muscovite zone (zone I) are found small beryl crystals with fine inclusions of phenakite. These Be silicates are all included in quartz or garnet, or interstitial to albite. Occasionally, vein-like beryl occurs along muscovite cleavages. Be minerals are likely very complex in the saccharoidal albite ± muscovite zone (zone II). Although discrete beryl interstitial to saccharoidal albite can be observed, Be minerals are dominated by beryllosilicate + berryllophosphate + apatite assemblages as cavity-filling among rock-forming minerals, suggestive of a P-saturated environment of crystallization. Large crystals of beryl appear in the quartz – coarse albite – spodumene zone (zone III) and quartz – spodumene – amblygonite zone (zone IV), and chemically are rich in Cs. They exhibit considerably late-generation hydrothermal alteration. Secondary beryl is depleted in Cs, but Cs-dominated muscovite (nanpingite) is closely associated with it.

The study suggests that crystallization of beryllium minerals in the Nanping No. 31 pegmatite dyke followed changes in magma conditions, considerably controlled by P activities on one hand, and by hydrothermal fluids in the late stage on the other.

[1] Rao, C et al. (2009) *Can. Mineral.*, 47, 1195-1212.