Geochemistry of granitic aplite-pegmatite veins and sills and their minerals from Pega – Sabugal, Central Portugal

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ABSTRACT

Beryl-bearing aplite-pegmatite veins and sills and lepidolite-bearing aplite-pegmatite sills from Pega intruded a Variscan biotite>muscovite granite. Variation diagrams of major and trace elements of host granite and beryl-bearing aplite-pegmatite veins and sills show fractionation trends. The lepidolite-bearing aplite-pegmatite sills are highly differentiated. Ba decreases and P increases from K-feldspar of host granite to K-feldspar of aplite-pegmatite veins and sills. Ca of plagioclase decreases from host granite to albite of aplite-pegmatites. The host granite is the parental granite for aplite-pegmatites.

Keywords: *rare-element aplite-pegmatites, micas, feldspars, parental granite, columbite-tantalite.*

GEOLOGY AND PETROGRAPHY

The Pega (Sabugal) area is located within the Central Iberian Zone of the Iberian Massif, one of the largest segments of the European Hercynian fold belt. Aplite-pegmatite veins and sills from Pega crop out in a region dominated by syn-D3 Variscan granites, which intruded the Cambrian schist-metagraywacke complex (Fig. 1). Very coarse-grained porphyritic biotite>muscovite granite (G1), medium-grained muscovite>biotite granite (G6) and medium- to coarse-grained muscovite>biotite granite (G7) define a series of magmatic differentiation, while fine- to medium-grained porphyritic biotite>muscovite granite (G2) and coarse-grained porphyritic biotite>muscovite granite (G3) define another series. The medium-grained porphyritic biotite>muscovite granite (G4) and the medium-grained slightly porphyritic two-mica (muscovite=biotite) granite (G5) correspond to two distinct magmatic pulses (Silva *et al.*, 2003).

Aplite-pegmatite veins and sills from Pega intruded coarse-grained porphyritic biotite>muscovite granite (G3). Subvertical to inclined beryl-bearing aplite-

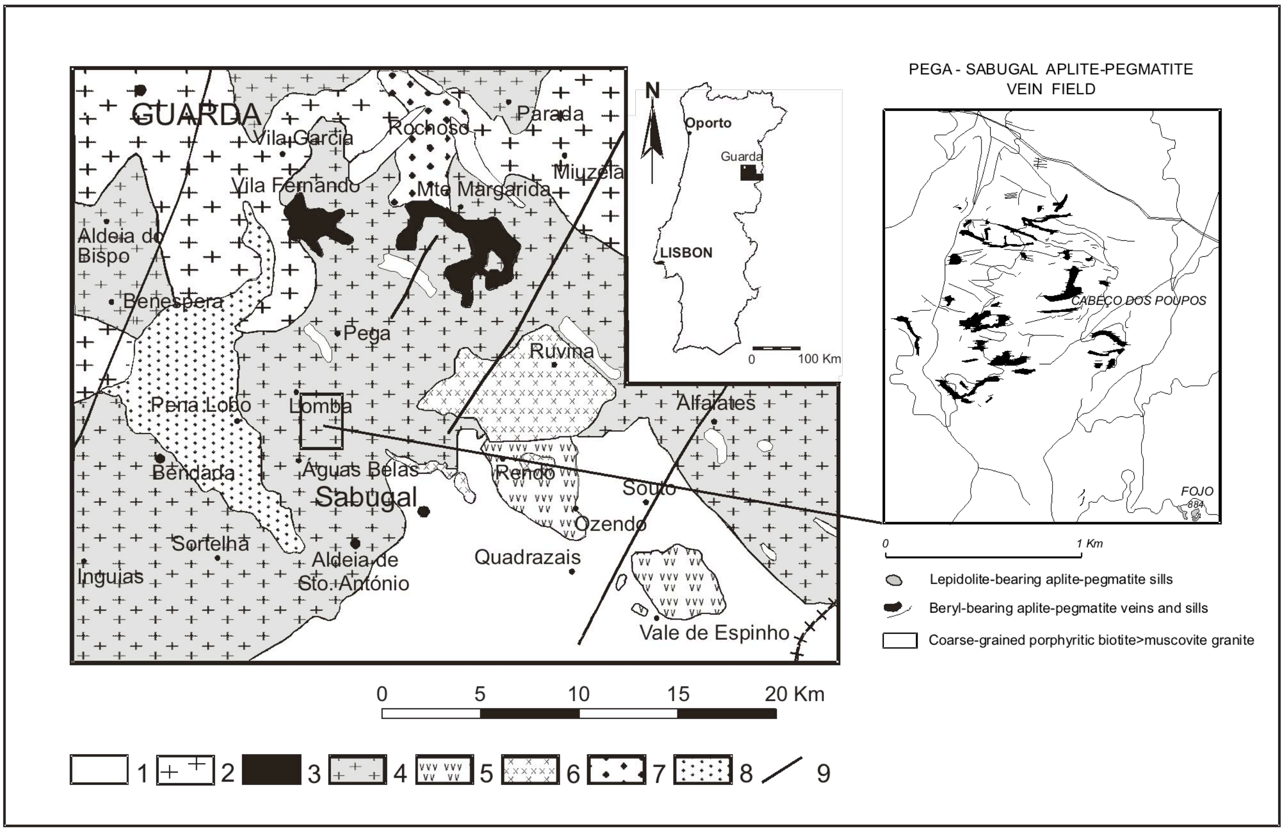

FIGURE 1. Simplified geological map of Guarda – Sabugal area and detailed mapping of Pega (Sabugal) aplite-pegmatite vein field. 1 - Cambrian schist-metagraywacke complex; 2 - very coarse-grained porphyritic biotite>muscovite granite (G1); 3 - fine- to medium-grained porphyritic biotite>muscovite granite (G2); 4 - coarse-grained porphyritic biotite>muscovite granite (G3); 5 - medium-grained porphyritic biotite>muscovite granite (G4); 6 - medium-grained slightly porphyritic two-mica (biotite=muscovite) granite (G5); 7 - medium-grained muscovite>biotite granite (G6); 8 - medium- to coarse-grained muscovite>biotite granite (G7); 9 - faults.

-pegmatite veins and sills trending E-W to ENE-WSW, from 10 cm to 15 m thick and up to 700 m long predominate. Some subhorizontal beryl-bearing aplite-pegmatite sills trending N10ºE, 20ºSE were also found in this area (Fig. 1). These aplite-pegmatite veins and sills contain quartz, perthitic orthoclase and microcline, albite, muscovite, beryl, ferrocolumbite, ferrotantalite, Fe-Mn phosphate minerals and rare siderophyllite, zinnwaldite, tourmaline and cassiterite. In general, these veins and sills produced, on the host granite G3, a metasomatic zone, 15 cm thick, containing zinnwaldite. Rare lepidolite-bearing aplite-pegmatite sills from 10 to 30 cm thick and up to 20 m long also intruded granite G3 and crop out to the south of the vein field at higher topographic levels than beryl-bearing aplite-pegmatite veins and sills. They contain quartz, albite, potash feldspar (mainly orthoclase), lepidolite, topaz, manganocolumbite, manganotantalite, cassiterite, montebrasite and Sr-phosphate mineral. These sills produced, on the host granite G3, a thin metasomatic zone of 10 cm thickness, containing more zinnwaldite and Li than the metasomatic zone due to beryl-bearing aplite-pegmatite veins and sills.

GEOCHEMISTRY

The granites G2 and G3 and aplite-pegmatite veins and sills from Pega are peraluminous, with A/CNK ratio of 1.13-1.35 in granites and 1.07-1.65 in veins and sills. The beryl-bearing aplite-pegmatite veins and sills have higher SiO_2, Rb, F, Sn, Li contents and lower TiO_2, total FeO, MgO, CaO, Sr, Zr, Y, Th and Ba contents than the host granite G3. Granites G2 and G3 and beryl-bearing aplite-pegmatite veins and sills define fractionation trends for major and trace elements (Fig. 2).

The lepidolite-bearing aplite-pegmatite sills have higher Al_2O_3, MnO, P_2O_5, F, Li, Sn, Rb, Sr and Nb contents and lower SiO_2, CaO, FeO and MgO contents than beryl-bearing aplite-pegmatite veins and sills. $\delta^{18}O$ increases from granite G2 to granite G3 and is similar or higher in veins and sills than in the host granite G3.

GEOCHEMISTRY OF MINERALS

Albite ($An_{0\text{-}2}$) from aplite-pegmatite veins and sills has lower Ca content than the phenocryst and matrix albite-oligoclase of host granite G3. The Ba content of potash feldspar from aplites and pegmatites is extremely low. The average P_2O_5 content of potash-feldspar increases from host granite to aplite-pegmatite veins and sills, which can be explained by fractionation (Neiva, 1998).

Siderophyllite from beryl-bearing aplite-pegmatite veins and sills has higher Si, Al, Mn, F, $Fe^{2+}/(Fe^{2+}+Mg)$ contents and lower Mg and Ti contents than Fe^{2+}-biotite from host granite G3. Primary muscovite from beryl-bearing aplite-pegmatite veins and sills has higher Fe and F and lower Ti and Mg contents than primary muscovite from host granite G3. Columbite-tantalite crystals from beryl-bearing aplite- pegmatite veins and sills show a fractionation trend from ferrocolumbite to ferrotantalite. In lepidolite-bearing sills, there is a fractionation trend from manganocolumbite to manganotantalite, both with Mn/(Mn+Fe)>0.9.

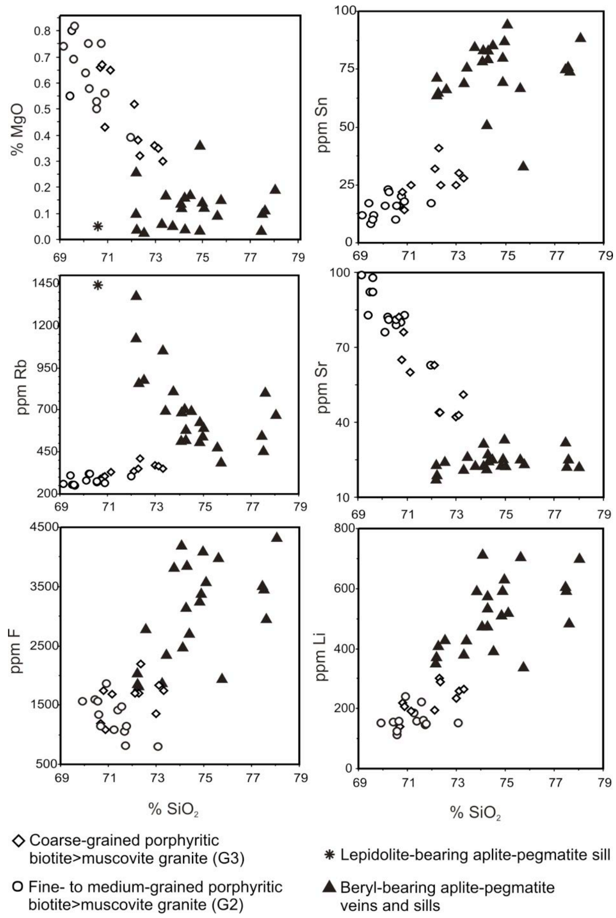

FIGURE 2. Variation diagrams of major and trace elements of granites G2 and G3 and aplite-pegmatite veins and sills from Pega (Sabugal). In some variation diagrams, the lepidolite-bearing aplite-pegmatite sill is not plotted because it contains 17450 ppm F, 1081 ppm Sn, 202 ppm Sr and 4147 ppm Li.

CONCLUSIONS

Beryl-bearing aplite-pegmatite veins and sills from Pega correspond to the beryl-columbite-phosphate subtype of beryl type, while lepidolite-bearing aplite-pegmatite sills correspond to the lepidolite subtype of complex type, all belonging to the REL-Li subclass of rare-element pegmatites (Černý & Ercit, 2005). Variation diagrams of major and trace elements of granitic rocks and compositions of feldspars and micas and whole-rock $\delta^{18}O$ values suggest that the host granite G3 is the parental granite for the Pega aplite-pegmatite vein field.

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