Geochemistry of minerals from Li-bearing granitic aplite-pegmatite veins of Segura area (Castelo Branco, Portugal)

I.M.H.R. ANTUNES[1], A.M.R. NEIVA[2] & M.M.V.G. SILVA[2]

[1]Polytechnic Institute of Castelo Branco, 6001-909 Castelo Branco, Portugal, imantunes@esa.ipcb.pt
[2] Department of Earth Sciences, University of Coimbra, 3000-272 Coimbra, Portugal, neiva@dct.uc.pt, mmvsilva@dct.uc.pt

ABSTRACT

Li-bearing granitic aplite-pegmatite veins containing muscovite, montebrasite, natromontebrasite, lepidolite, topaz, cassiterite and manganocolumbite crop out in Segura area. Primary lepidolite contains more F, Rb and less Al than primary muscovite. Primary natromontebrasite has more Na, F and less Li and OH than montebrasite. Cassiterite is zoned showing sequences of alternating parallel darker and lighter zones. The darker zones are strongly pleochroic, oscillatory zoned, show exsolved manganocolumbite and have more Nb and Ta than the lighter zones. Manganocolumbite is oscillatory zoned.

Keywords: *Li- bearing aplite-pegmatites, lepidolite, montebrasite, natromontebrasite, cassiterite, manganocolumbite.*

GEOLOGY

Segura area is located in Central Portugal, close to the Portuguese-Spanish border (Fig. 1). The syn-D3 Variscan pluton from Segura is dominated by a medium- to coarse-grained two-mica granite, but a medium- to fine-grained muscovite granite also intruded the Cambrian schist-metagraywacke complex (Fig. 1). Granitic NW-SE to NNW-SSE aplite veins intersect the schist-metagraywacke complex and granites.

FIGURE 1. Geological map of Segura area, central Portugal.
1. Schist-metagraywacke complex, contact metamorphic aureole; 2. medium- to coarse-grained two-mica granite; 3. medium- to fine-grained muscovite granite; 4. granodiorite porphyry veins; 5. granitic aplite veins; 6. Li-bearing granitic aplite-pegmatite veins with cassiterite; 7. Sn-W quartz veins; 8. Ba-Pb-Zn quartz veins; 9. arkoses; 10. faults.

Subhorizontal NE-SW Li-bearing granitic aplite-pegmatite veins containing cassiterite and lepidolite intersect this complex. These aplite-pegmatite veins are up to 15 cm thick and 300 m long (Antunes et al., 2002).
NW-SE to WNW-ESE quartz veins containing cassiterite and wolframite and ENE-WSW to NNE--SSW quartz veins containing barite, galena and sphalerite intersect the schist-metagraywacke complex and one of the latter veins cuts the muscovite granite (Fig. 1).

PETROGRAPHY OF GRANITIC APLITE-PEGMATITES VEINS

The Li-bearing granitic aplite-pegmatite veins have a subhedral granular texture and consist of quartz, microcline, albite, muscovite, montebrasite, natromontebrasite, topaz, lepidolite, cassiterite, columbite, apatite, zircon and rutile (Antunes et al., 2003). They are REL-Li aplite-pegmatites and can be included in the LCT family (Černý and Ercit, 2005).
Quartz is euhedral to subhedral, shows oscillatory extinction and presents several fractures. There are different generations of quartz. Microperthitic microcline with cross-hatch twinning and albite (An_o-An_3) are subhedral.
Muscovite and lepidolite are subhedral, occur associated and lepidolite partially replaces muscovite (Fig. 2a). Muscovite contains inclusions of zircon, apatite and quartz. Subhedral montebrasite and natromontebrasite, 3 x 2 mm in size, are replaced by muscovite. There are many crystals of topaz associated with quartz, feldspars and locally with cassiterite; they contain inclusions of albite. Euhedral crystals of cassiterite ranging between 6.2 x 2.1 mm and 18 x 5.6 mm, exhibit narrow parallel lighter and darker growth-zones (Fig. 2b). The darker zones are strongly pleochroic (ε – reddish brown to ω – colourless), whereas the lighter zone are translucent (Fig. 2b). However unzoned brownish crystals also occur.

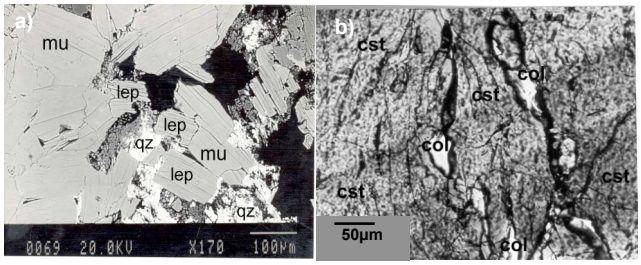

FIGURE 2. Microphotographies of Li-bearing granitic aplite-pegmatite veins from Segura. a) Lepidolite (lep) replacing muscovite (mu), quartz (qz); b) columbite exsolutions (col) from zoned cassiterite (cst).

Cassiterite has inclusions of muscovite and apatite and shows products of exsolution of manganocolumbite and mangano-ferrocolumbite (300 x 60 µm), which

commonly occur in the darker zones (Fig. 2b), but also in lighter zones, mainly in contact with darker zones.

GEOCHEMISTRY OF MINERALS

P_2O_5 is up 0.51 wt % in microcline and 0.62 wt % in albite.

Lepidolite is the principal mineral of the Li-bearing granitic aplite-pegmatite veins. Primary lepidolite is later and richer in F, Rb and poorer in Al than primary muscovite, but they are not related.

Primary montebrasite $[(Li_{0.81}Na_{0.19})_{\Sigma 1.0}Al_{0.95}(PO_4)(OH_{0.79}F_{0.21})_{\Sigma 1.0}]$ and natromontebrasite $[(Na_{0.52}Li_{0.48})_{\Sigma 1.0}Al_{0.97}(PO_4)(OH_{0.65}F_{0.35})_{\Sigma 1.0}]$ were also found and show some deficiency in Al attributed to slight alteration (Neiva et al., 2000). Natromontebrasite has more Na, F and less Li and OH than montebrasite. Natromontebrasite is a rare phosphate mineral that was only found at four different world places (Gaines et al., 1997).

Topaz has a homogeneous composition (Antunes, 1999). Cassiterite has Nb > Ta and Mn > Fe. The lighter zones are nearly pure SnO_2, whereas the darker zones have higher Nb and Ta contents. The darker zones are oscillatory zoned and their Nb and Ta contents increase, while Sn content decreases with increasing distance from exsolution products.

Exsolved manganocolumbite and manganoferrocolumbite (Figs. 3b, 4a) contain Nb > Ta, Mn > Fe, W > Sn and Ti > Sn. Some crystals are unzoned and others oscillatory zoned. The former have higher Nb, W, Mn and lower Ta, Ti, Fe and Fe+Mn contents than the latter (Fig. 4b).

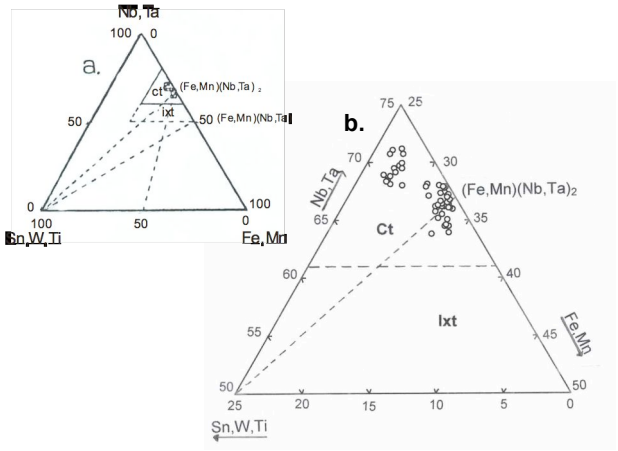

FIGURE 3. a. (Nb,Ta)-(Sn,Ti,W)-(Fe,Mn) diagram showing columbite-tantalite (ct) and ixiolite (ixt) fields (Neiva, 1996); b. compositions of columbite-tantalite exsolutions of Li-bearing granitic aplite-pegmatite veins from Segura.

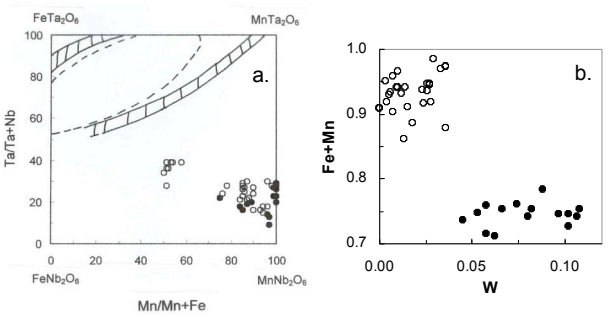

FIGURE 4. Compositions of columbite of Li-bearing granitic aplite-pegmatite veins from Segura: a. columbite quadrilateral (Černý et al., 1992); b. W versus Fe+Mn of unzoned and zoned columbite (• - unzoned crystals; O - zoned crystals).

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