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Chemistry and genetic implications of tourmaline and Li-F-Cs micas from the Valdeflores area (Cáceres, Spain)

Alfonso Pesquera,[1,*] Jose Torres-Ruiz,[2] Pedro P. Gil-Crespo,[1] and Nicolas Velilla[2]

[1]Departamento de Mineralogía y Petrología, Universidad del país Vasco 644, 48080 Bilbao, Spain
[2]Departamento de Mineralogía y Petrología, Universidad de Granada, E-18002 Granada, Spain

Abstract

Pervasive metasomatism that involved the formation of tourmaline-rich rocks and influx of Li, F, and Cs into Ordovician psammo-pelitic metasediments occurred in the Valdeflores area (Cáceres, Spain). Numerous Li- and Sn-bearing, mineralized, greisen-type veins also can be observed here, in the vicinity of geochemically specialized granites. Tourmaline-rich rocks appear as: (1) massive, fine-grained, dark green to black rocks; and (2) fine-scale tourmaline-rich laminae, which alternate with quartz-rich layers parallel to the bedding.

Electron microprobe analyses indicate that the tourmaline lies mostly within the space defined by the exchange vectors from dravite: $FeMg_{-1}$ (schorl), $\square AlNa_{-1}Mg_{-1}$ (foitite), $AlOMg_{-1}(OH)_{-1}$ (olenite), and $CaMgNa_{-1}Al_{-1}$ (uvite). The Fe/(Fe+Mg) ratio ranges mainly from 0.87 to 0.54 and increases with Al in the Y-site. Analytical results and substitutional relations show an insignificant elbaite component. Mica in the tourmalinized rocks is very fine-grained (mostly <50 μm). White mica ranges from lithian muscovite-phengite to lepidolite/zinnwaldite, containing up to 8.40 wt% F, 6.0 wt% Li_2O, and 10.73 wt% FeO. Dark mica shows a variable color and has compositions characterized by relatively high contents of Cs_2O (1.14–2.78 wt%) and F (1.94–8.08 wt%), with a deficit in K_2O (5.75–9.04 wt%). Log (f_{H_2O}/f_{HF}) of fluids in equilibrium with biotite in the tourmaline-rich rocks was 4.02–4.17 at $T \approx 400$ °C. Log (f_{H_2O}/f_{HF}) values of fluids in equilibrium with topaz ($X_F \approx 0.8$) in country rock adjacent to contacts with veins, and in equilibrium with amblygonite-montebrasite ($X_{amb} = 0.2$) in the veins were about 4.30–4.60 and 6.4–6.7, respectively. These variations denote the existence of gradients in relative a_{HF} more than differences of temperature during metasomatism. The lack of tourmaline in the veins is interpreted to reflect the alkalinity and low Fe-Mg contents in the fluids, which precluded the formation of tourmaline. Consequently, most of the boron was expelled into metasediments where tourmaline was produced as a result.