Trace-element behaviour in tourmalines from Minas Gerais, Brazil

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In the last century, Brazil became an important producer of high-quality tourmalines in the world. Most of these minerals formed within the granitic pegmatites of the Eastern Brazilian Pegmatite Province, in the mining State of Minas Gerais, located in the south-eastern part of the country. Minerals of the tourmaline supergroup are constituted by rhombohedral borosilicates with a R3m space group, and a general formula $XY_3Z_6[T_6O_{18}](BO_3)_3V_3W$ (Hawthorne and Henry, 1999).

Seventeen tourmaline crystals from eight pegmatite deposits spread across the province have been analysed by electron-microprobe and LA-ICP-TOF-MS, in order to provide accurate data about the major and trace elements concentrations in each crystal. Compositions usually vary along the elbaite-schorl solid solution, with sometimes compositional and optical zonings between both end-members. Some elbaite-schorl samples from different deposits show similar trace element concentrations, thus implying that some deposits certainly formed under the same geological conditions. One sample from the Lavra do Urucum pegmatite (KF-081) shows a rossmanite composition, with the Y group of sites occupied by two Al and one Li cations. Another sample from the same pegmatite (WR-045) is significantly enriched in REE and Ca, with values reaching 30 ppm La, 56 ppm Ce, 6 ppm Pr, 18 ppm Nd, and 1.90 wt. % CaO. Such a composition shows an evolution towards liddicoatite, which has also been observed in a Mozambican sample from the Mavuco pegmatite. The similar geochemical signature of these two crystals is currently under investigation.

In order to constrain the cation distributions on the different crystallographic sites of these samples, the tourmalines were investigated by single-crystal X-ray diffraction methods. Measured unit-cell parameters, between 15.82 Å ≤ a ≤ 15.93 Å and 7.09 Å ≤ c ≤ 7.13 Å, are consistent with elbaite-to-schorl compositions. Refined site populations have been calculated from the structural data and are similar to the assigned site populations given by the electron-microprobe analyses. Mean bond lengths determined through the structure refinement are also consistent with the calculated bond lengths, and bond-valence sums obtained for the different sites are close to the ideal theoretical values. A detailed examination of polyhedral distortion coefficients indicates an inverse correlation between the distortions of the Y and Z sites. Concerning the Z site, the highest distortion values are observed for schorl-rich compositions.

These preliminary data, coupled with those obtained on similar samples from Mozambique, will certainly allow to better understand the crystal-chemical control on trace-element distribution in these complex pegmatite minerals.

Reference:

Hawthorne FC, Henry DJ (1999) Classification of the minerals of the tourmaline group. European Journal of Mineralogy, 11(2): 201-215.