

Fe and Mn speciation in multicoloured tourmalines

M. R. Cicconi (1), G. Giuli (1), A. Trapananti (2), and E. Paris (1)

(1) School of Science and Technology - Geology Division, University of Camerino, Italy (mariarita.cicconi@unicam.it), (2) CNR-IOM-OGG Grenoble, c/o ESRF, BP 220, F-38043 Grenoble, France

Four multicoloured tourmalines, where the variation of colours occurs in concentric bands, have been analysed by X-ray Absorption Spectroscopy (XAS) at the Fe and Mn K-edge, in order to investigate the oxidation state and the site location of Fe and Mn, with the final purpose of understanding the physico-chemical factors affecting their colour. The natural multicoloured crystals present only Fe and Mn as chromophore elements, but despite the quite simple chemistry, they show a variety of colours including hues of blue, pink, red and green. In zones where Mn is predominant, a pink colour is observed, whereas Fe predominance induces green or blue colours. Interestingly, the presence of Fe and Mn has been recognized also in the colourless areas.

XAS measurements have been collected at beamline GILDA-BM08 of the ESRF. The beam size at the sample was 0.15 mm x 1 mm in order to be able to selectively measure the different coloured zones of the crystals. A 13-elements high-purity Ge detector allowed to collect the fluorescence spectra through a cross section of each of the samples. Detection of the Mn K α and Fe K β X-ray emission lines allowed to selectively collect profiles of Mn and Fe abundances across the studied crystals. Pre-edge peak (PE) analysis shows that Mn and Fe are dominantly divalent in all the measured samples. PE integrated intensities are compatible with the location of Mn and Fe in the octahedral sites. Preliminary theoretical XANES calculations also agree with the octahedral coordination of Mn and Fe.

For these samples, the change in colour appears related to the variation in the relative abundance of Mn and Fe rather than to variations of their oxidation states.