Iron rich amphiboles: a study on correlated structural and electrical properties

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In metamorphic rocks, Fe-bearing amphiboles carry important information on the crystallization conditions (G. Della Ventura et al., 2005); their HT processes are in addition strongly connected to the increasing electrical conductivity of subducting slabs at convergent plate margins (Wang et al., 2012). Amphiboles species like riebeckite (crocidolite) and grunerite (amosite) are also interesting technological materials, previously used in several technological applications due to invaluable thermal resistance characteristics. After the late '80s, however, due the discovery of their carcinogenesis effects these materials have been banned in many countries and their toxicity has been deeply studied (e.g., Turci et al., 2017).

The chemical/physical properties of the amphiboles and their behavior at high temperatures are associated to their loss of structural hydrogen. This process involves the oxidation of the iron atoms and the consequent release of protons at the crystal surface in the form of molecular water (Della Ventura et al., 2017). Although many studies have been devoted to characterize the oxidation behavior (e.g., Oberti et al., 2018, Della Ventura et al., 2018) and the associated structural adjustments (e.g., Welch et al., 2007), the dynamics of this process are still poorly constrained.

Here, we will describe a novel approach for the investigation of the oxidation process in amphiboles specifically tailored for these minerals (Della Ventura et al, 2018, Galdenzi et al, 2018). The method employs the X-ray Absorption Spectroscopy to monitor, with a high reliability, the Fe\textsuperscript{3+}/Fe\textsubscript{tot} ratio in the sample during the heating experiment. We will also show new results on the conductivity anomalies in amphiboles, based on the analysis of data collected using in situ XAS experiments, performed while heating the sample and simultaneously measuring its conductivity. In addition to important understanding of the role of these minerals in geology and geophysics, this study reveals unexpected properties of the amphiboles that suggest the possibility to design new materials with outstanding properties.


F. Galdenzi, G. Della Ventura, G. Cubin, S. Macis e A. Marcelli, «Accurate Fe\textsuperscript{3+}/Fe\textsubscript{tot} ratio from XAS spectra at the Fe K-edge,» Radiation Physics and Chemistry, 2018.