Quantitative fluid inclusion analysis using synchrotron X-ray microfluorescence

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Synchrotron Radiation-induced X-Ray Fluorescence (SR-XRF) and X-Ray Absorption Near Edge Structure (XANES) experiments were used to characterize the composition and speciation of solutes trapped in individual fluid inclusions. We have developed a fully automated fluorescence-based quantification procedure including the use of a He chamber for reducing detection limits of low Z elements (S, Cl), a combination of on-line fluorescence and transmission measurements for direct estimates of the fluid inclusion thickness and depth [1] and the development of a standardless quantification procedure [2]. Quantification of complex fluid inclusion containing liquid, vapour and solid phases at room temperature using 2D fluorescence mapping and of homogenized inclusions at high temperature using punctual analysis provided consistent results, hence indicating that quantification of heterogeneous systems is reliable [3].

The experimental set-up, the acquisition protocol and treament procedures installed on ESRF beamline ID22 has been applied succesfully to a variety of studies of geological relevance. These include: 1) characterizing the sulfate and halogen contents of Archaean seawater and hydrothermal fluids from the 3.525 Ga Dresser Formation Chert-Barite deposit (Western Australia; [4]), 2) characterizing the composition and origin of the different generation of fluids associated with the formation lode gold deposits in the Warrawoona Syncline (Pilbara Craton, Western Australia; [5]) and 3) constraining the speciation and local environment of Cu in coexisiting liquid and vapour inclusions from the Yankee Lode deposit, Mole Granite, Australia [3]. This later study involved in situ XANES analysis and SR-XRF mapping of homogenized fluid inclusions at high temperature.

References

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