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QUANTITATIVE ANALYSIS WITH THE CAMECA SXFIVE FE AT HIGH LATERAL RESOLUTION AND HIGH REPRODUCIBILITY. APPLICATIONS TO GEOCHRONOLOGY AND MINERALOGY.

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The development of the Schottky emitter and its implementation as electron source in Electron Microprobe has significantly improved the characterization of materials in earth sciences and in metallurgy.

The strength of an Electron Probe Microanalysis (EPMA) is the ability to accurately measure and quantify element in traces at few 10's ppm level. The Field Emission (FE) Source allows trace element analysis with high beam currents thanks to the high brightness of the source and the excellent stability of the beam current, trading off spatial resolution. Of course, accuracy of major element quantification is maintained with a FE source.

As X-rays are generated from a much larger diameter than the diameter of the incident electron beam, it is advised to work at low voltage and low beam current in order to take full advantage of the small spot sizes achievable with a Field Emission Source. Thus, the analytical resolution is not limited anymore by the beam diameter but only by the diameter of the X-ray emission volume.

One of the advantages of the FE Source is to obtain fine focused electron beam at low beam voltage ($\leq$10 keV) while maintaining high and stable beam current. In these experimental conditions, the penetration depth of the primary electrons and thus the interaction volume- in which electrons are scattered and generate X-rays- decreases to sub-μm scale (compared to micron scale of the traditional Electron Microprobe at 15 or 20 keV).

Thanks to WDS spectrometers with sub 10eV energy resolution, accurate quantitative analysis can be achieved even on sub micron phases at low beam energy and high lateral resolution using L- and M-Lines for heavy elements.

This will be illustrated, in a first example, by measuring different areas in a Monazite grain. U, Pb and Th are quantitatively analyzed with high precision in order to characterize age domains.

In the above example, several generations of monazite growth are represented in the quantified high-resolution X-ray maps. Of foremost interest is the high Y rim and fracture filling monazite (ca. ~1800 Ma) which has penetrated much older monazite (ca. ~2400 Ma). (Monazite from Boothia Peninsula, Nunavut, Canadian Artic)

In a second example, quantification of small refractory phases (hibonite, grossite, perovskite, . . .) formed by gas condensation in the solar nebula will be presented.

Paris Meteorite is a stone classified by the Muséum National d'Histoire Naturelle as a CM chondrite.

It contains chondrules and Calcium-aluminum-rich inclusions (CAI). These latter are materials formed at nearly the same time as the solar system i.e. 4.56 billion years ago.