# Effects of femtosecond laser ablation on monazite micro- and nano-structure.

A.M. SEYDOUX-GUILLAUME[1], R. FREYDIER[1], F. POITRASSON[1] AND R. WIRTH[2]

[1] LMTG, CNRS, UPS, 14 avenue Edouard Belin, 31400 Toulouse, France; seydoux@lmtg.obs-mip.fr

[2] GFZ, Telegrafenberg, PB 4.1, 14473 Potsdam, Germany e-mail address

Laser ablation inductively coupled plasma mass spectrometry (LA-ICPMS) has been widely used for the past 15 years. Nevertheless, this analytical technique implies very complex chemical and physical effects on the structure of ablated minerals that are not fully understood. Following previous reports suggesting that femtosecond laser ablation of solids may be simpler than with the widespread nanosecond lasers, we investigated the effects of an IR femtosecond laser ablation on micro- and nano-structure of a monazite. Scanning Electron Microscope (SEM) was used to investigate the particles deposited on the sample surface, the form and the size of the crater, and the microstructure of the inner walls. Transmission Electron Microscope (TEM) associated with Focused Ion Beam (FIB) preparation was used first to characterize the nanostructure of deposited particles on the sample surface. For that, FIB/TEM foils were prepared both perpendicularly to the surface of the samples and to the edge of the crater. In order to investigate the bottom of the crater, and evolution of crater deepness with time, various craters were produced, from only one pulse to 300 pulses (with 85µJ/pulse). One FIB/TEM foil was obtained across a crater produced by a single pulse.

First TEM results on a crater produced by one pulse show that it is ~3.5 µm deep. The upper part of the monazite foil, just under the crater bottom, is composed of a ~3 µm layer of nano-crystalline monazite. "Glass bubbles" (50 nm to 1 µm), are included in this nano-crystalline monazite in the first micrometer zone. Under this ~3 µm zone, monazite is not affected anymore by the laser. In the case of "normal analytical condition"[1], only particles deposited on the sample surface were studied. They consisted of nano-crystalline monazite (5-30 nm) too, however within amorphous monazite that seems to be an agglomeration of "glass bubbles". The entire deposited layer is approximately 2µm deep, for a crater that is ~550 µm deep; however the nano-crystalline particles are localized only on the upper half of the layer and in very small amount. The rest of the layer consists of amorphous agglomeration of a monazite glass.

[1] Poitrasson F., Mao X., Mao S.S., Freydier R. and Russo R.E. (2003), *Anal. Chem.*, **75**, 6184-6190.