Preliminary results from a new ELA-ICPMS: U-Pb geochronology and elemental analysis

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We report the performance of a newly installed ELA-ICPMS supplied by Resonetics Inc. and based on the configuration of Eggins & Shelley [1]. The system consists of a Lambda-Physik LPX 220 ArF excimer laser (λ=193 nm) which produces a "flat-top" ion-beam on the X-axis, and nearly "flat-top" on the Y axis, adapted to a micromachining workstation. A N_2 flushed beam delivery unit masks and demagnifies the beam, and focus onto target using a low numerical aperture lens that provides a long working distance (25 cm), and a depth of focus ranging from 50 to 200 µm, depending on the demagnification.

Ablation takes place in a two-volume cell [2] which allows analysis of large samples (5 cm) and fast washout times (<5 s). The laser system is coupled with a Thermo X series II quadrupole ICPMS, and A sensitivity of > 5,000 cps/ppm for ^{238}U is typically obtained for analysis of NIST 612 (50 µm spot size, 5 hz, 4.5 J/cm^2).

Our system is capable of producing ^{206}Pb/^{238}U ages with < 1.5 % 1σ errors. Preliminary results indicate that the ages of widely used zircons such as Temora, R33, and 91500 can be perfectly matched, within age errors < 1% from the reported U/Pb age.

The low uncertainty in the signal (typically < 2% for most elements) and rapid washout allows the detection of compositional changes in banded formations closely matching the sample texture, thus allowing the analysis of these materials for high-resolution paleoenvironmental reconstruction.

[1] Eggins S. & Shelley J.M.G. (2002) *Geostandards Newsletter* **26**(3), 269-286. [2] Arrowsmith P. & Hughes S. K. (1988) *Applied. Spectroscopy* **42**, 1231-1239.

Scanning fransmission X-ray microscopy analysis of metamorphic biogenic carbon

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Identifying traces of life in the rock record can be challenging. In fact, fossilized biogenic organic matter (OM) drastically evolves during diagenetic and metamorphic processes and may completely lose its original biochemical structure. This constitutes a major limitation to the search for life in the geological record, as many rocks have experienced high temperatures and/or pressures. SEM, TEM and Raman microspectroscopy have been particularly useful to provide both structural and chemical information at a submicrometer scale. Nevertheless, such necessary information remains insufficient to unambiguously determine the biological origin of fossilized OM. Scanning Transmission X-ray Microscopy (STXM) now offers valuable capabilities for *in situ* imaging fossilized OM with a chemical-based contrast at a 25-nm spatial resolution. Additionally, high spatial (~25 nm) and energy (~0.1 eV) resolution near-edge x-ray absorption fine structure (NEXAFS) spectroscopy provide information on carbon speciation, allowing performing organic geochemistry at the submicrometer scale. Here we report STXM observations at the nm-scale of fossil fern spores and vascular tissues found in Triassic metasedimentary rocks from the French Alps[1]. The morphology of these micron-scaled vegetal debris is perfectly preserved although they have been submitted to high-pressure metamorphism (~360°C, ~14 kbars). Ultrathin sections were extracted from the samples by Focused Ion Beam milling for structural and chemical characterization by STXM. By combining microscopy and spectroscopy at the C K-edge, chemical and mineralogical heterogeneities have been systematically evidenced within these metamorphic OM and interpreted as inherited from original biogeochemical heterogeneities. This study illustrates the capability of STXM to detect and characterize carbonaceous remains in the rocks at the 20-nm scale and to provide *in situ* observations indicative of biogenicity even for high-grade metamorphic OM.

[1] Bernard S. *et al.* (2007) *EPSL* **262**, 257-272.