N/C ratio and carbon and nitrogen speciation of fossilized organics: *in situ* investigations using STXM

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Assessing the biogenicity of organics preserved in old rocks is challenging notably because of (1) the possible contamination by recent organic matter and (2) the inevitable degradation of organics during burial [1]. While the first issue requires high resolution techniques to demonstrate the syngenicity of organics with the host rock, the second one requires extensive experimental constraints to eventually reconstruct the original chemistry of fossilized organics [1,2].

Scanning Transmission X-ray Microscopy (STXM) is a synchrotron-based spectromicroscopy technique which allows microscopic observations with chemical sensitivity, i.e., *in situ* mapping of organics within rocks at a 15-nm spatial resolution [2], and spectroscopic measurements that offer a precise estimation of the nitrogen-to-carbon (N/C) atomic ratio of organics [3] as well as key information about carbon and nitrogen speciation at the submicrometer scale [4].

Here, we report STXM-based XANES data collected on experimentally fossilized microorganisms and abiotic organic aerosols. Results indicate that despite having experienced 250°C - 250 bars up to 100 days, fossilized microorganims and fossilized aerosols still exhibit different molecular signatures, i.e., they remain different in terms of N/C ratio and carbon and nitrogen speciation.

Although experimental simulations may not perfectly mimic natural diagenesis, these observations suggest that burial processes may not completely degrade the chemical and molecular signatures of organics, either biogenic or abiotic. This study illustrates the capabilities of STXM to bring key chemical and molecular information possibly indicative of biogenicity, even for ancient carbonaceous microstructures.

[1] Bernard and Papineau (2014) *Elements* 10, 435–440. [2] Gueriau *et al*., (2016) *Elements* 12, 45–50. [3] Alleon *et al*., (2015), *Carbon*, 84:290–298. [4] Bertrand *et al*., (2016), *Topics in Curent Chemistry* 374, n°7.