Preservation of hydrogenated organic moieites in Archean cherts

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Molecular evidence for biologic origin of Archean organic matter (OM) must be searched in the least thermally altered samples. Determining the extent to which OM is preserved in Archean rocks is therefore crucial to select the best candidates in the search of organic biosignatures. As most of the Archean rocks hosting microfossils are cherts, we have investigated the maturity of the OM from a series of cherts spanning the geological record (0.05 to 3.5 Gyr). Several approaches are commonly used to assess the maturity of kerogens, such as elemental analysis, Rock Eval pyrolysis and Raman spectroscopy, but each of them is associated with some limitations. To avoid any bias in the interpretation, it is crucial to compare the data derived from the different techniques, especially when dealing with Archean samples.

The H/C atomic ratio derived from elemental analysis may be affected by the presence of hydrogenated minerals. To overcome this limitation, nanoscale secondary ion mass sepctrometry was used as it allows selecting organic regions of interest for the measurement of $^{12}CH^-/^{12}C^{13}C^-$ ionic ratios. However, the latter must be properly calibrated towards H/C. Rock-Eval hydrogen index was also proposed as a proxy for H/C but this does not hold for the most aromatic kerogens, like those from Archean cherts. However, the shape of the S2 curve as a function of temperature gives clues about the OM thermal stability. As for Raman spectra, the relative intensity of the main bands and their width were shown to provide information on the stage of carbonization undergone by the OM as well as its metamorphic temperature.

This combination of techniques led us to provide an approach to determine the aliphaticity of the investigated Archean cherts and to propose that silicification promoted the preservation of some hydrogenated organic moieties in Archean cherts.