Nitrogen and Carbon nuclear reaction analysis on minerals from an Archean silicified rhyolitic pyroclastite

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Nitrogen and carbon are biophilic elements that can originate from the degradation of organic matter and be incorporated into minerals. Therefore, these elements can be a useful biomarker if fractionation processes are fully understood. Early Archean rocks (3.5 Ga old), contain in general low C and N leading to N and C mineral contents of several hundreds of ppm N and C. Our study focussed on an Archean chert from the Coppin Cap belt, Warrawoona Complex, Pilbara, Australia. This chert hosts evidences of early life (biofilms and kerogen clusters, carbonaceous compositions, negative C13 isotopes). We performed NRA analysis to localise and quantify N and C in the mineral phases and organic matter. This method has the advantage of being able to perform non-destructive point analyses and scans of different sizes. The chert is mostly composed of quartz and hydromuscovite, minor Ti-oxides and phosphates, and rarely sulfides and sulfates. They were formed by ingruent dissolution of K-feldspars during chert formation and occur either as K-feldspar pseudomorphs or inclusions in protobiotites or in the cryptoquartz matrix. Hydromuscovite contains 500 to 1250 ppm N, and up to 9000 ppm C. Quartz, Ti-oxide and phosphates contain both elements below the detection limit of the nuclear microprobe.

We hypothesise that N replaces K as ammonium in hydromuscovites. No particular correlation for C and N was observed. This can be due to different N and C sources, such as organic matter decay and /or metasomatic input, or to a fractionation process of these elements and a selective uptake by the phyllosilicate structure.