Quartz nanoparticles in 2461-2495 million years old banded iron formation from Dales Gorge, Hamersley, Western Australia

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The 2461-2495 million year old banded iron formation (BIF) from Dales Gorge Formation, Hamersley, Western Australia contains hematite, magnetite, Fe (II)-silicate, quartz, carbonates and apatite [1]. Massive hematite were observed to contain quartz nanoparticles with size ranged from <100 nm to 400 nm. Electron dispersive spectroscopic (EDS) measurements indicated their chemical compositions are close to quartz. Fourier infrared probe also showed a Si-O composition. Some quartz crystals were observed on the surface of massive aggregates of hematite (Figure 1), more quartz nanoparticles could be found inside the etching cavities bigger than quartz in hematite aggregates with a few etching cavities contain two quartz nanoparticles. All those quartz nanoparticles have euhedral faces. Those quartz nanoparticles are common in the anhedral hematite aggregates, but different from quartz crystals in the BIF assemblage which were bigger. Quartz nanoparticles are the only mineral that can be observed in the etching cavities, and they were the only mineral observed in hematite. This implied their formation was short after the precipitation of hematite, but earlier than magnetite, iron-silicates and carbonates. Those particles on the surface of hematite appeared tightly fixed in the etching cavities indicated undisturbed hydrological condition, while the crystals in bigger etching cavities implied a poppling hydrodynamic condition. We suggest that those quartz nanoparticles fell on the just precipitated hematite iron-gel in the shallow oxidized sea environment with an exogenesis. It implied that hematite was the only chemical phase at the early stage of banded iron deposition.

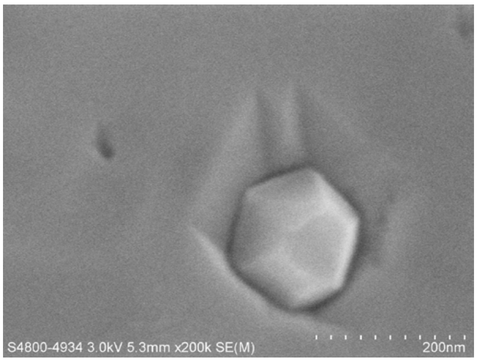

Figure 1: Quartz nanoparticle fell on the just precipitated hematite iron-gel and made a pit.

[1] Pecoits *et al*. (2009) *Precambrian Res*. **172**, 163-187

Copper isotope fractionation by higher plants

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Transition metals such as Fe, Cu and Zn are present as trace elements in organisms, but are essential for life. Thus variations in transition metal isotope composition may be important in tracing the interaction between geosphere and biosphere, to trace the pathways of these elements into and within biological system. A prerequisite for these applications is an adequate understanding of the mass fractionation of these isotopes during steps of biological uptake and translocation. Here we report the result of a case study for Cu isotope fractionation by higher plant using a Cu accumulator *Elsholtzia splendens*.

Elsholtzia splendens growth-experiments were carried out in green house and in soils with different chemical properties, namely: copper contaminated soil collected from natural environment (denoted as CK), CK with addition of sulphur powder, CK with addition of EDDS, and CK with addition of both EDDS and sulphur. Soils, roots, stems and leaves were measured for Cu isotope ratios using Nu Plasma HR MC-ICPMS after digestion and chemical purification. The results display some prominent features: 1) relative to soils, the plants show overall lighter isotope enrichment, implying significant isotope fractionation occurred during Cu uptake of the root from the soil and light Cu isotope were taking preferentially; 2) from soil to root to stem, Cu isotope composition become progressively lighter, indicating stepwise mass fractionation during Cu uptake and translocation; 3) relative to stems, leaves enrich heavy Cu isotope by *ca*.0.3‰, suggesting a change in Cu transport mechanism from stems to leaves, and showing that heavy Cu isotope can be preferentially taken at some stage during biological processes; 4) the extent of light isotope enrichment of the plant relative to soil varies with the chemical property of the soil, and the light Cu isotope enrichment is enhanced by the addition of EDDS.

The results presented above enhance our knowledge about mass fractionation processes of transition metal isotopes in higher plants significantly.