Geochemical investigations of the oldest (≥3800 Ma) abyssal peridotites: Implications for early Earth processes

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Peridotites from southern West Greenland are currently the best characterised "sample" of the early Archean upper mantle. As such they are the focus of integrated geochemical, geochronological, field investigations and are providing unique insights into early earth processes including the role of impacts, mantle evolution and mechanisms of crust formation.

These rocks are located in the northern part of the early Archean Itsaq Gneiss Complex and occur as ≤500m long enclaves of variably altered ultramafics containing rare relics of unaltered dunite-harzburgite. The ultramafic enclaves are associated with mafic supracrustal and plutonic rocks, and siliceous metasediments. SHRIMP U/Pb geochronology on igneous zircons from components of the surrounding and intruding orthogneisses, indicate an age for the ultramafic rocks of >3800 Ma (1). The diverse ultramafic and mafic rocks are interpreted as first being tectonically intercalated, and then enclosed in much more voluminous tonalitic rocks during the development of a 3790-3810 Ma composite magmatic arc early in the evolution of the Itsaq Gneiss Complex. Although these samples represent early Archean lithospheric mantle that was trapped within ancient sialic crust during its formation, their chemical affinities (e.g. Si-Al-Mg proportions, ol/opx ratio and mineral compositions) are much closer to modern abyssal peridotites than to cratonic Archean lithospheric mantle as sampled by peridotite xenoliths from southern Africa and Siberia.

The antiquity and chemical integrity of some of these samples is demonstrated by preservation of extremely unradiogenic $^{187}Os/^{188}Os$ isotopic compositions (2). The age of the peridotites overlaps with estimates for the timing of the lunar terminal cataclysm (3.8-4.0 Ga). The similarity of the highly siderophile element characteristics of these c.3800 Ma samples to modern mantle peridotites, argues for a limited contribution from late impacts, such as those that formed the major lunar basins, to the siderophile element inventory of the Earth's upper mantle.

References

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The *in situ* molecular characterisation of a biomineralization process: a synchrotron infrared study

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Biomineralization is an important geomicrobiological process that can control mineral formation, mass transport, and microbial fossilization. However, the rates and mechanisms of bacteria-surface mediated precipitation reactions remain poorly understood. Our current understanding of the effects of bacteria on mineral precipitation and whether or not they can mediate or induce precipitation relies usually on indirect evidence (i.e., bulk measurements or fixated samples). Only a few techniques can provide direct and *in vivo* data on the changes in chemical or physical characteristics occurring at the bacteria-mineral interface during biomineralization. Synchrotron-based Fourier transform infrared (SR-FTIR) micro-spectroscopy has emerged recently as a new and powerful non-destructive tool, that can provide both qualitative and quantitative information about the biochemical structure of single bacterial cells (i.e., proteins, lipids, nucleic acids, carbohydrates) and about how these components interact with their chemical environment (i.e, the effects of pH, temperature, ionic strength).

Here we present data from an *in situ* SR-FTIR spectroscopic study that has been carried out with the goal (a) to quantify silica precipitation on single cyanobacterial cells and (b) to monitor the effect of silica precipitation on the bacterial organic functional groups. Our results show that SR-FTIR spectroscopy can provide *in situ*, and *in vivo* molecular-scale information that can be used to elucidate silica binding characteristics and kinetic rates. In addition, the effect of silica precipitation on specific cellular components was monitored. The derived kinetic and bio-geochemical results will be discusses in the light of the possibilities this new molecular level tool offers to geomicrobiological studies.