Nano-carbonate clustering in organic globules supports a biogenic origin of 2.7 Gyr old stomatolites

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The macroscale morphology of Archean stromatolites has been used as evidence of early microbial ecosystems. But as Archean stromatolites only rarely contain fossil microbes, their biogenicity is tacitly assumed on the basis of macroscopic morphological comparisons with modern structures. Biogenetic definitions, however, require microscopic examination of suspected stromatolites.

We obtained an unique collection of pristine samples from a diamond drillhole that intersected the 2.7Ga Tumbiana Formation, Australia (Pilbara Drilling Project, Van Kranendonk *et al*., 2006). We report the occurrence of micron-sized globules of organic carbon intimately associated with the host micritic carbonate. Scanning Transmission X-ray Microscopy (STXM) analysis revealed that these organic globules are composed of organic carbon with aromatic, aliphatic and carboxyl functional groups. High Resolution Transmission Electron Microscopy (HRTEM) analysis revealed that the organic material occurs in intimate association with clustered, 50-200nm rounded bodies of aragonite. These nano-aragonite aggregates show striking similarities with nano-carbonate spheroids associated with microbial cells and polymers in modern microbialites.

Our results indicate that Tumbiana stromatolites were likely formed via in-situ microbial lithification. They also extend the geologic record of aragonite back more than 2,300 million years, with profound implications on the environmental conditions prevailing on Early Earth.

Reference

Van Kranendong M. J., Philippot P., and Lepot K. (2006), *Western Australia Geological Survey*, Record **2006/14**, 25p.

^{7}Be, excess ^{210}Pb and artificial radionuclides as tracers of orographic deposition of aerosols

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Aerosols play a significant role in global biogeochemical cycles and climate system. In mountainous sites, atmospheric deposition of pollutants and nutriments is enhanced by different mechanisms including feeder-seeder effect or cloud-interception. Understanding these mechanisms is necessary to improve deposition models and evaluate the sensitivity of these fragile ecosystems.

We use inventories of ^{210}Pb, ^{7}Be, both natural aerosol-bound radionuclides and artificial radionuclides (^{137}Cs and Pu) in undisturbed soils to quantify mechanisms influencing aerosol deposition along the different slopes of the Puy de Dôme (1465m asl), an unactive volcanoe in Massif Central. We combine these results with 2-years measurements of aerosols and atmospheric deposition at the top and the base of Puy de Dôme.

The figure 1 shows that ^{210}Pb inventories are increasing with altitude. Using also ^{7}Be and ^{137}Cs inventories, we are able to demonstrate that this increase of ^{210}Pb and therefore aerosol deposition is due to orographic effects. It seems that NO and NE slopes are more affected by orographic deposition Other mechanisms increasing the deposition of "surface air" enriched in ^{210}Pb like the feeder-seeder mechanism can also explain these results. ^{7}Be gives us insights of aerosol origin from the free troposphere and the stratosphere. Despite shorter representativity of ^{7}Be values ($^{1/2}$life: 50d), measured flux ratios of ^{210}Pb/^{7}Be (0.04-0.016) in soils are in good agreement with ^{210}Pb/^{7}Be ratio measured in aerosol and precipitations (0.1-0.16).

It will be discussed how the use of both radionuclides can offer a way to quantify wet deposition mechanisms and validate 3-D conceptual models of atmospheric deposition.

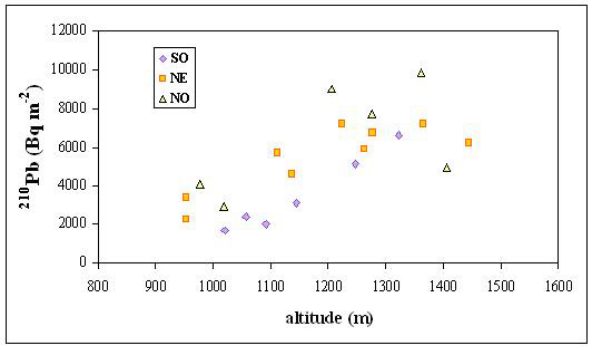

Figure 1: ^{210}Pb inventories in soils vs. altitude along different slopes of the Puy de Dôme