

Dating of stromatolite, the oldest traces of life on Earth

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Context

Stromatolites are organic laminated sedimentary structures that are considered to form by microbial activities and are among the oldest traces of life on Earth (1,2). The age of stromatolites is often determined indirectly by zircon dating of volcanic deposits below and above the sediments. Recently, new avenues for precise dating of carbonates have been developed (3) that could be applied to stromatolite structures with potential accuracy and precision that will allow for the reconstruction of their growth history. In this project, we propose to date stromatolites of two important suites of Archean deposits, the Tumbiana (South Africa) and Malmani (Australia; Figure 1). The Campbellrand-Malmani carbonate platform in South Africa was deposited between 2.58 and 2.5 Ga and consists mostly of carbonates and mudrocks. The abundance and variety of carbonated stromatolite domes, with sizes varying from centimeters to several meters, are associated with well-preserved sedimentary structures such as ripples. These stromatolites were deposited concomitantly of the Great Oxygenation Event. The Tumbiana stromatolite (Australia) records a unique ecosystem dated at 2.7 Ga and has been extensively studied over the past 20 years (4). Samples obtained from drillcore outcrops offer a unique opportunity to investigate the processes of carbonate precipitation and diagenesis.

Using state-of-the-art techniques, outcomes of these project will provide a unique mineralogical, geochemical, and geochronological records of stromatolite growth history during this important geological time period.

Objectives and Methods

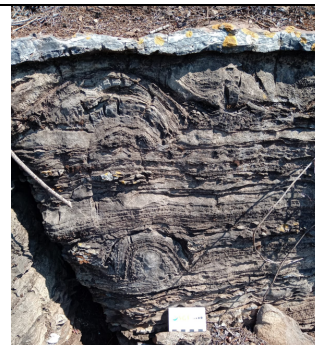
Mineralogical characterization of carbonate (optical microscope, SEM-EDS, and cathodoluminescence).
Microtomography of the stromatolite structures
Geochemical composition of stromatolite growth structures (e.g., stable isotope profile)
Geochronological U-Pb dating of carbonate laminae
Reconstruction of stromatolites growth history, in terms of timing and environment
Comparison of the different samples and with literature data

Literature

- (1) Summer and Grotzinger (2004) Implications for Neoproterozoic ocean chemistry from primary carbonate mineralogy of the Campbellrand-Malmani Platform, South Africa, *Sedimentology* 51,
- (2) Riding The Nature of Stromatolites : 3,500 Million Years of History of Research (2011)
- (3) Nuriel et al. "The use of ASH-15 flowstone as a matrix-matched reference material for laser-ablation U-Pb geochronology of calcite." *Geochronology* 3-35-47 (2021).
- (4) Decraene, Marie-Noëlle, et al. "Intense biogeochemical iron cycling revealed in Neoproterozoic micropyrates from stromatolites." *Geochimica et Cosmochimica Acta* 312 (2021): 299-320.



Malmani Stromatolite, large dome



Malmani Stromatolite

Choice of orientation :

- 1) Sedimentary, Environmental and Reservoir Geology / 2) Geochemistry, Alpine tectonics, Ore Deposits