**Insight into the metabolisms of phototrophic alphaproteobacteria associated to the stromatolites of Dziani Dzaha, Mayotte**

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Lake Dziani Dzaha is a tropical thalassohaline crater lake located on the Petite Terre Island of Mayotte (Comoros archipelago, western Indian Ocean). Stromatolites are actively growing in the shallow waters of the lake. These stromatolites are mainly composed of aragonite with lesser proportions of hydromagnesite, calcite, dolomite and phyllosilicates. They are morphologically and texturally diverse, ranging from tabular structure covered with a cauliflower-like crust to columns with a smooth surface. The cauliflower-like crust is mainly associated with phototrophic alphaproteobacteria that are related to aragonite and cyanobacteria belonging to the Pleurocapsales order. Cyanobacteria accumulate magnesium silicate in their sheaths, stabilizing the structure of the cauliflower-like crust. We jointly used fluorescent *in situ* hybridization (FISH)-guided laser microdissection, whole genome amplification, and metagenomic analysis to shed light on the metabolic capabilities of the observed alphaproteobacteria. These analyses show that the microdissected alphaproteobacteria belong to the Rhodospirillales and Rhodobacterales orders. Rhodospirillales possess (i) the *cbbL* gene encoding the large subunit of ribulose-1,5-bisphosphate carboxylase-oxygenase (RuBisCO), which drives CO2 fixation, (ii) the *pufM* gene encoding the M subunit of the photosynthetic reaction centre and (iii) the *nifH* gene encoding the nitrogenase iron protein involved in nitrogen fixation. Conversely, the *sox* genes involved in sulfide oxidation and sulfur globules formation are absent. We were not able to amplify the whole genome of the microdissected Rhodobacterales but metagenomic data show that they generally possess *pufM*, *nifH* and *soxYZ* genes but no genes related to carbon fixation except for one partial metagenome-assembled genome out of 26 that possesses both *cbbL* and *cbbM* genes encoding the large subunit of RubisCO. The Rhodobacterales being dominant, the formation of aragonite is thus mainly associated with the activity of the photoheterotrophic Rhodobacterales. To make a step further, we have developed laser microdissection coupled with (i) scanning electron microscopy and (ii) SNOM (scattering scanning near field optical microscopy) to have a better knowledge about the mineral phases specifically associated with cyanobacteria and alphaproteobacteria.