EGU21-7169
https://doi.org/10.5194/egusphere-egu21-7169
EGU General Assembly 2021

SEM-based mineralogical mapping at the submicrometer-scale of modern Sardinian stromatolites

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Stromatolites, i.e. macroscopically laminated carbonate rocks formed by diverse microbial communities, are particularly emblematic geobiological materials since they are the oldest evidence of life-mineral interactions, dated up to 3.5 Gyrs ago. They are found throughout the history of the Earth and have received strong attention because they provide precious information about microbial paleobiodiversity and paleoenvironments. However, while this information is interpreted based on our knowledge about modern analogs, the latter remains very incomplete. Here, we studied recently discovered modern stromatolites from Mari Ermi[1], a coastal pond in Western Sardinia, that seasonally experience severe evaporation and broad salinity variations. For this purpose, we explored the mineralogical composition of these unique sedimentary archives and its spatial variations in order to gain better insight into how mineral phases record the conditions and processes of their formation. We investigated the heterogeneous distribution of minerals using quantitative X-ray chemical maps provided by energy dispersive x-ray spectrometry analyses coupled with scanning electron microscopy (SEM-EDXS). Hyperspectral maps were analyzed using an innovative data treatment method [2] allowing phase recognition within the complex mineral mixtures and solid solutions encountered. This method provided quantitative data on spatial distribution, modal content and associated calculated unit formulas for each identified mineral and phase with a hundred nanometer resolution. Based on these results, we will discuss the origin of the laminations in the stromatolites.

Reference:

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