Influence of Substrates and Biological Activity on Microbialite Formation: A Case Study of Lake Kournas, Greece

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1.Introduction

Microbialites are organo-sedimentary rocks formed by the trapping and binding of detrital sediments and/or the precipitation of authigenic minerals by benthic microbial communities (Burne & Moore, 1987). Their development is influenced by **environmental variability** and **substrate characteristics**, but the role of substrate type is still poorly understood. (Roche et al., 2019). Lake Kournas provides a rare temperate freshwater setting where karst hydrology, variable chemistry, and diverse biota interact to form microbialites. This study investigates how substrates and biological communities collectively influence microbialite formation and variability in Lake Kournas.

Fig 1 : Panoramic view of the study lake: Kournas, Crete, Greece

2. Methods

- A **multi-proxy** approach was used to study microbialite structure, formation, and distribution.
- Microbialites, country rocks, water samples, and surface sediments were systematically collected around Lake Kournas.
- Water samples and sediments were taken **adjacent** to living or fossil microbialites to link water chemistry with microbialite occurrence (mineralogy and chemistry)

3. Results

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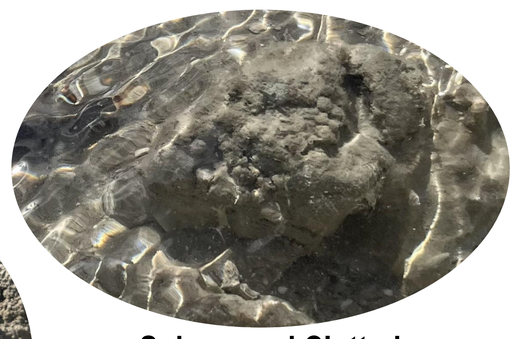
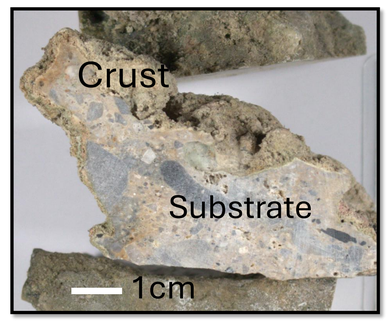


Submerged Clotted

Submerged Columnar

Submerged Clotted

Columnar



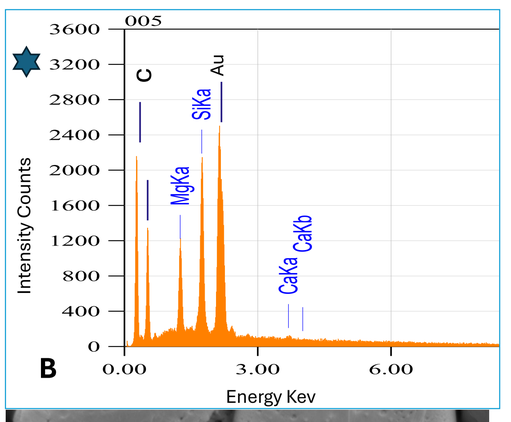
Cross-section of a columnar microbialite sample

Cerebroid

Lithified Columnar

Cross-section of a lithified columnar microbialite sample

Fig 2 : Satellite view of sampling locations, along with the types of microbialite observed around Lake Kournas, Crete, Greece



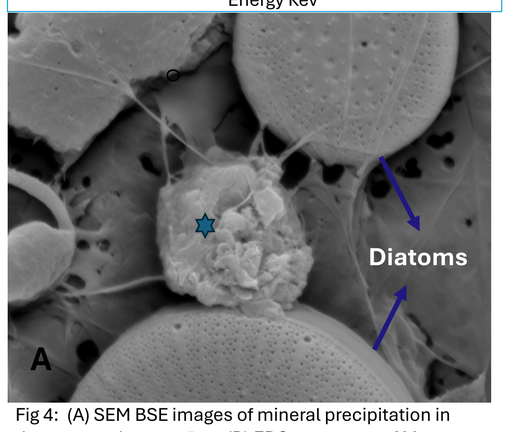


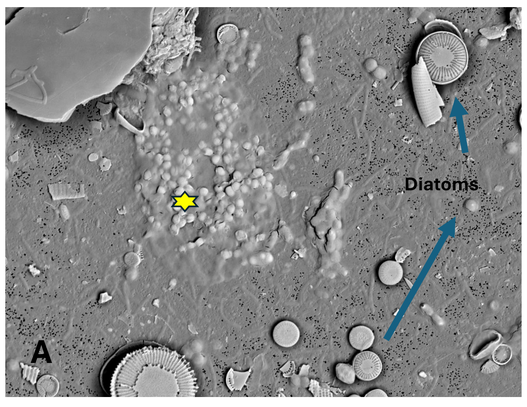
Fig 4: (A) SEM BSE images of mineral precipitation in the water column at 5 m, (B) EDS spectrum of Mg-silicate in water column

Observed physicochemical parameters

The **pH** values of lake surface (8.23–8.27) were consistently alkaline. For water column pH decreased gradually from the surface down to ~8.05, and then **dropped sharply** at the deeper levels (7.39 ⟶ 7.15).

Conductivity values ranged from 2.121 to 2.269 mS/cm, suggesting ionic strength characteristic of mineral-rich waters.

Alkalinity on the surface was observed to be in the range of 2.169 to 2.228 mmol/l . However, it was observed to be much higher at the bottom of the lake (19 m) at 3.425 mmol/l



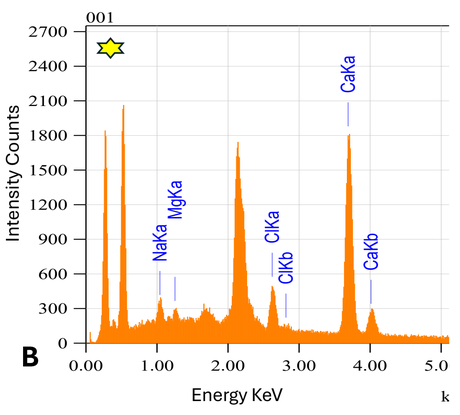


Fig 3: (A)SEM BSE images of an organism with nodules. (B) EDS Spectrum of Calcium inside the organism

4. Summary and Future Work

Microbialites of various morphologies were observed around the lake. The water chemistry suggests that the bottom of the lake is stratified and mineral-rich. Further X-ray diffraction (XRD) together with Fourier-Transform Infrared (FTIR) spectroscopy analysis will be carried out to identify mineral phases in microbialite. Water chemistry and chemical profile data will be examined to assess vertical and spatial variability across the lake. Saturation indices of solutions with respect to different minerals will be calculated.

Reference

Burne, R. V., & Moore, L. S. (1987). Microbialites: organosedimentary deposits of benthic microbial communities. Palaios, 241-254.

Roche, A., Vennin, E., Bundeleva, I., Bouton, A., Payandi-Rolland, D., Amiotte-Suchet, P., ... & Visscher, P. T. (2019). The role of the substrate on the mineralization potential of microbial mats in a modern freshwater river (Paris Basin, France). Minerals, 9(6), 359.

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