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Can morphology of stromatolites reflect biogenicity ? Lessons from the living stromatolite of Lake Salda, SW Turkey ?

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The stromatolite considered as the oldest fossil forms in Earth are scarce in modern days in contrast to their widespread occurrences in Archean. The formation of stromatolite has been largely attributed to metabolic activity of photosynthetic microorganisms, their sediment trapping and binding capacities in addition to in-situ precipitation. However, recent findings suggest more diverse microbial community involvement in stromatolite formation processes. A controversy regarding of origin of stromatolites (biotic vs abiotic) still exists today. Morphology of stromatolites, showing various shape (e.g domes, cauliflower, columnar) and size, is usually attributed to biological activity. To fully understand relationship between morphology and biological activities often considered as biogenic indicator, we conducted a series of experiments to reveal the grain trapping and binding capabilities of microbial mats vs. in situ precipitation during morphology formation of stromatolite. The mat samples with identified microbial community profile and obtained from the living stromatolite of Lake Salda were used in laboratory experiments carried out under various environmental conditions. Water chemistry, mineralogy and morphology of precipitation (hydromagnesite) occurred on sand grains were monitored in weekly bases to monitor binding and trapping capacity of the mat. In contrast to the sterile-abiotic conditions, cauliflower morphology with a hydromagnesite mineralogy developed in the biotic experiments by binding and trapping of the precipitated particles in the vials. SEM images of the structure showed the filaments and EPS as a binding and major trapping agency of the precipitates, respectively. Chemical precipitation with magnesium hydroxides in composition and lack of cauliflower morphology observed in the abiotic experiments demonstrated that microbial community may cause the development of unique morphology via their metabolic functions as well as binding and trapping capacity in Lake Salda. Overall, preliminary experimental results presented here suggest that morphology of stromatolite may hold keys for understanding microbial community on early Earth as well as researching extraterrestrial life beyond the Earth.