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An integrative study of biomarkers with crystal morphology from Ladakh hot spring travertines, India: Implications for astrobiological investigations

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Biomarkers have been widely studied from hot spring silica sinters to understand the preservation potential of organic traces of life. Although hot spring travertines also serve as potential candidates for astrobiological explorations, they are yet to be extensively explored. Chumathang in Ladakh hosts a high altitude (> 3,000 m) hot spring system with extreme water temperature (70°-85°C) and near neutral to alkaline pH, serving as a potential Martian analog. In this study, we have qualitatively assessed the preservation potential of biomarkers in the morphologically different travertine deposits. In addition, we have also tried to understand the causes leading to variations in the crystal habit in the different layers of the deposits. Our results show that all the stromatolitic travertine deposits contain calcite varying in crystal habit in the different layers while yielding some biomarkers that are suggestive of cyanobacterial origins. Alkanes, their branched homologues, and fatty acid esters show similar compounds in the morphologically different deposit samples. Preservation of mineralized microbial mats supports the active role of microbes in the formation of the deposits. Thus, although post-burial diagenetic impact has a strong influence in the preservation potential of biomarkers in carbonate travertines, an approach incorporating biomarkers with the varying crystal habit of the deposits would provide a better understanding to develop tools for the search for life in Martian terrain.