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Unearthing Ottawa's ancient microbial past: biomarkers in Ordovician aged stromatolites from the Ottawa River

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Stromatolites are laminated rock formations produced by mat-forming microorganisms that offer important insight into ancient microbial ecosystems. Organic compounds, e.g. lipids, that become trapped and preserved during stromatolite formation may be used as biomarkers of extant or extinct life. However, interpretation of these preserved signals relies on the ability to distinguish between modern contributions and biomarkers hypothesized to have been captured during the period of stromatolite formation. Here, Ordovician period stromatolites collected from the Ottawa River over a 2-year period were used to investigate putative organic contributions from the modern-day ecosystem and the preservation potential of endemic biomarkers. Stromatolites were cut using a diamond saw to distinguish between outer, modern impact material and pristine cores, and compared to river sediment, microbial mats, and river water. Organic solvent extraction and gas chromatography-mass spectroscopy showed that fatty acids and n-alkanes ranging from C12 to C27 were the most abundant compounds in pristine stromatolite cores. Within the pristine cores, alkanes represented ~30-75% of the overall proportion of identified compounds. A comparison of stromatolite exteriors and pristine interiors showed increased biomarker abundance and variability in the exteriors. The exterior samples showed more heterogeneity between samples and years than the cores that contained fewer, but more consistent organics. Average total organic carbon of the interiors was 0.5% Results suggest that organics identified in the pristine interiors are more representative of the organics deposited during formation while exteriors reflect modern contributions influenced by the location of the stromatolites within a dynamic river environment. Overall, these findings advance our understanding of how to distinguish between modern contributions, reflective of the current depositional environment, from the original stromatolite forming microbial ecosystem biomarkers. Additionally, it aids in understanding the preservation potential of biomarkers over geologic time scales helping to identify more robust biosignatures.