New insights on the biogenicity of South Africa’s oldest stromatolites

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Stromatolites represent the most ancient macroscopic evidence for life on Earth. While the biogenicity of Paleoproterozoic (>3.2 Ga) stromatolites from Australia is well established (e.g., Allwood et al., 2006), reported stromatolitic structures of comparable age from the Barberton Greenstone Belt in South Africa (Byerly et al., 1986) have received little attention in the last decades, and thus deserve a fresh look (Homann, 2019).

In order to unravel the origin of these enigmatic deposits, we analyzed putative stromatolites of the ~3.3 Ga Mendon Fm. for their sedimentological context and three-dimensional morphology. We also performed μXRF elemental mapping, Raman spectroscopy of preserved carbonaceous matter, and analyzed major and trace element as well as organic carbon isotope compositions. In the field, the stromatolites display domal to pseudocolumnar growth morphologies and occur in distinct carbonaceous chert horizons. They form layers of < 1 to 20 cm thickness and have been identified in several outcrops spread over a lateral distance of ~10 km (Byerly et al., 1986). Internally, the stromatolites are characterized by crinkly, tourmaline-rich laminations that form sideward-inclined columns of several centimeters height. Deposition likely occurred during periods of volcanic quiescence in hydrothermally-influenced shallow-water paleoenvironments, which were perhaps severely affected by distant asteroid impacts (Lowe and Byerly, 2015). A syndepositional origin of the structures is supported by draping of underlying deposits and the occurrence of eroded stromatolite crust chips. Lowe and Byerly (2018) compared these slightly curved chips with evaporitic silica crust precipitates that commonly form around hot spring deposits. This paleoenvironmental interpretation is supported by the newly acquired REE data. Organic carbon isotope analysis of the 3.3 Ga stromatolites yield δ¹³Corg values between ~34.5‰ and ~22.1‰ with mean TOC values of 0.2‰. Collectively, this new data set further strengthens the bio- and syngenicity of South Africa’s oldest known stromatolites.