



Factors controlling growth and morphology of early Miocene stromatolites from Montaigu-le-Blin, France

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A large variety of stromatolite morphotypes are present in the early Miocene sedimentary sequence that outcrops in the region of Montaigu-le-Blin, France. Thanks to its good degree of preservation, this formation is an ideal place to evaluate the key factors controlling the occurrence and morphology of the stromatolites, as well as to study the diagenetic processes that transform a soft, slimy lithifying microbialite into a solid, laminated sedimentary rock. Facies analysis suggests that the Montaigu-le-Blin stromatolites formed in shallow waters, in a restricted, laterally heterogeneous basin. Various evidence suggests a biological origin for the stromatolites, whose formation cannot be explained through abiotic background precipitation driven by evaporation, temperature changes, or migration of metamorphic fluids. Microscopic observations revealed that the Montaigu-le-Blin stromatolites are mainly comprised of authigenic calcite that precipitated directly from the basin waters (no evidence for trapping and binding) in close association with algae, microbial cells, and exopolymeric substances. Well-preserved microfossils of photosynthetic organisms are widespread within the thin sections. The calcite constituting the stromatolites is characterized by positive $\delta^{13}\text{C}$ values (1.7 to 4.4 ‰), suggesting that microbial mediation of calcite was mainly related to the metabolic activity of photosynthetic organisms or anoxygenic phototrophs, and not to metabolisms in which organic material is degraded (e.g. sulfate reduction). The laminated habit of the stromatolites results from alternating layers of porous, digit-like sparite and more compacted organic-rich micrite. No correlation was identified, through isotopic analysis, between these two types of laminae and external environmental factors (i.e. temperature, salinity, eutrophication state). Rather, we hypothesize that periodic fluctuations in the dominant microbial/algal species within the mat influenced the morphology and the porosity of the different laminae. The results of this study provide insights for interpreting stromatolites that are morphologically and petrographically similar to that of Montaigu-le-Blin, but are included in older and less well-preserved rocks, which makes it difficult to evaluate their biogenicity and differentiate primary features from late stage metamorphic textures.