# Are Stromatolites the Most Ancient Skeletal Organisms?

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Stromatolites have an ancient and contradictory research history. Initially, they were classified as non-organic fossils and either concretions or layered limestones. Over time, their organic nature was established, but details regarding the stromatolite-forming organisms were not known. Walcott (1914) proposed that stromatolites are produced by blue-green algae (cyanobacteria) and this was confirmed by the present-day observation of stromatolite-forming microbiota. Since that time stromatolite-forming organisms were considered as colonies of microorganisms with the stromatolite being the result of the interaction between the colonies and trapping sediment. This description of the nature of stromatolites was successfully used for the Precambrian. However, the stromatolite-forming microorganisms were never considered as an organism. Thus the following controversy arose: the cyanobacterial accumulation is not able to undergo morphogenesis, but is capable of forming a large morphogenically shaped mineral bodies, the stromatolites, which are stable in space and time (Fig. 1). To resolve this controversy, laboratory modelling was performed on the stromatolite forming biota (Орлеанский and Раабен 1997). To continue this experiment, separate research project on the morphogenetic reaction society (here "society" refers to a compact settlement of independent elements- filamentous cyanobacteria" with a non-determined degree of integrity) of contemporary filamentous cyanobacteria as a whole community was performed.

Ten types of structures (Fig. 2) were detected for filamentous cyanobacteria creation as a result of their regrouping (Sumina 2002). The forms of the structures are specific and grow as a behaviour response to various influences, sometimes growing up to 10 cm. So the community appears to possess differentiation and

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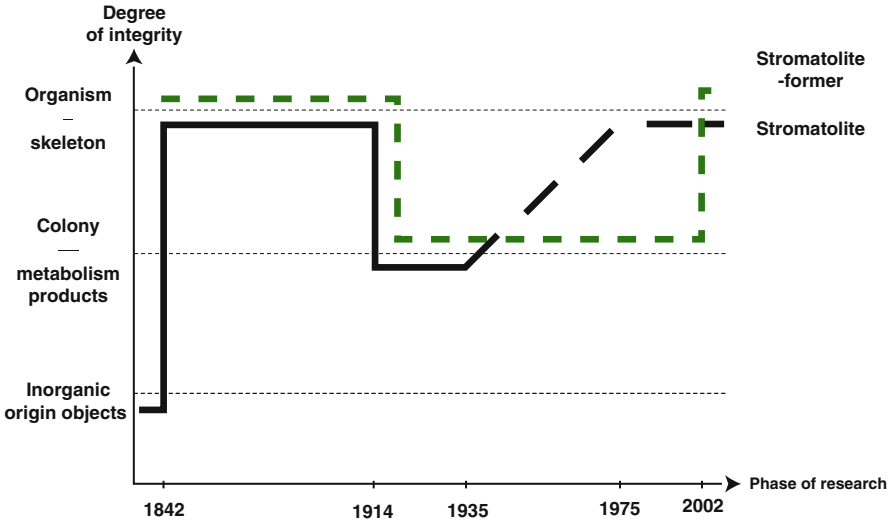


**Fig. 1** Scheme illustrating changes in interpreting stromatolites and stromatolite-forming organisms

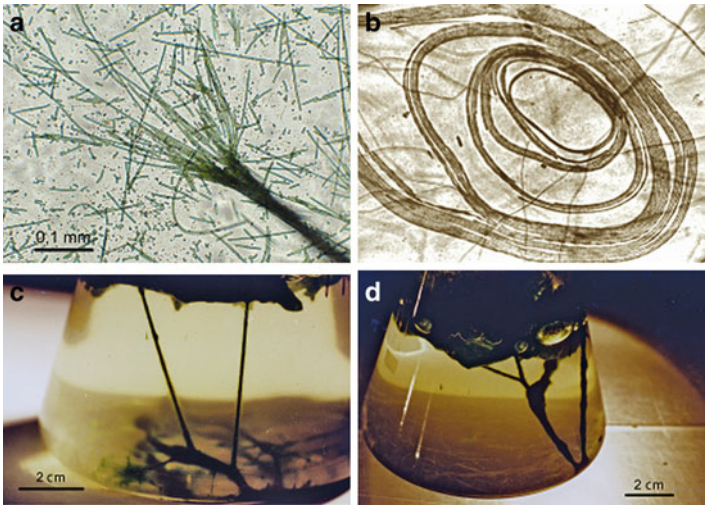


**Fig. 2** The structures formed by filaments: (**a**) bundle; (**b**) rings; (**c**) and (**d**) contraction of bundles

morphogenesis abilities, not as a number of separated filaments, but as an entire unity structure. A stromatolite may be also regarded as community morphogenesis evidence under conditions of mineral sediment. So far as the stromatolite form and its evolution correspond to the needs of the stromatolite-former as a photosynthesising organism. We may consider a stromatolite to be a supporting mineral formation, which appears as a result of morphogenesis. The morphogenesis ability

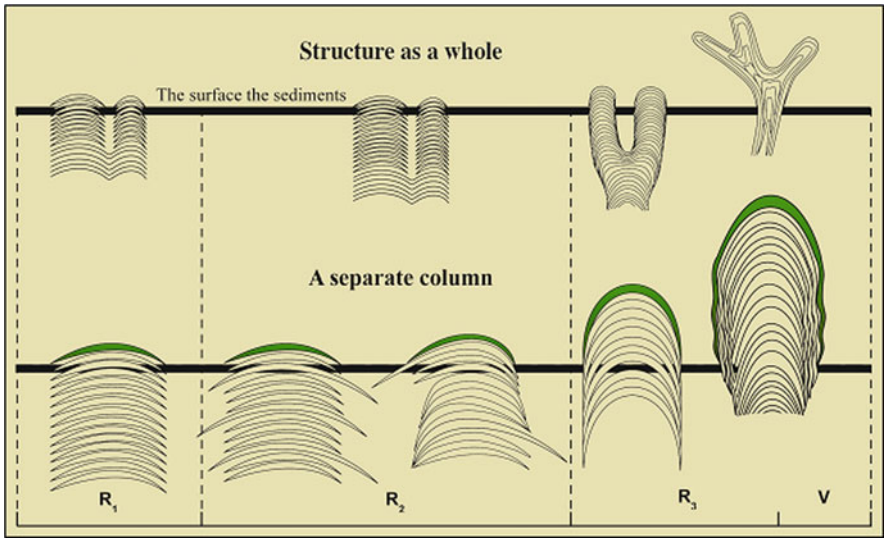


**Fig. 3** Scheme of morphogenetic transformations of Upper Precambrian stromatolites

is inherent both to the stromatolite-former as a cyanobacterial community and also to the stromatolite itself. The latter ability occurs in the adaptive features of single parts and also for the building as a whole. The comparison of experimental results and evolutionary variations in fossil stromatolites allow us to consider the stromatolites as a peculiar analogue to the skeleton of eukaryotic organisms. The coordination, agreement and dependence of the variations in the evolution of morphological features up to Upper Precambrian is evident (Fig. 3). The comparison of stromatolite and eukaryote skeletons shows the following features of skeletons: morphological definition, hierarchical organization, definition and evolutionary stasis. However, the direct comparison of stromatolites and eukaryotic skeletons is not possible because of the prokaryotic nature of the producers. The term "skeleton" is currently utilized only for eukaryotic organisms. It is evident that the "skeleton" assumes a comparison between the supporting prokaryotes and eukaryotes mineral formations from the most general point of view.

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