Stromatolites

What are stromatolites?

Stromatolite fossils are micro-laminated accretionary structures most commonly formed in carbonate-rich, warm shallow water by the cementation of fine sedimentary material by biofilms of cyanobacteria These structures can take the form of globular mats, rounded mushroom-like domes on a narrow base, and even columnar or conical shapes. Their thinly layered cross-sections roughly resemble that of an onion.

Cross-section through a stromatolite showing the thinly laminated structure.

How they grew…

Stromatolites often began as a thin, filmy, mat of cyanobacteria growing on the bottom of warm, shallow, clear lagoons where they could easily photosynthesize. This photosynthesis depleted carbon dioxide in the surrounding water, initiating the precipitation of calcium carbonate. These calcium carbonate particles, along with fine grains of sediment carried by the water, were trapped within a sticky layer of mucus surrounding the bacterial colonies. The bacteria proceeded to send tiny filaments upwards through the sediment to reach the sunlight and establish a new layer on top of the old. The mineralized layers of stromatolites were accreted through repetitions of this process, resulting in the various forms observed.

What's cool about stromatolites?

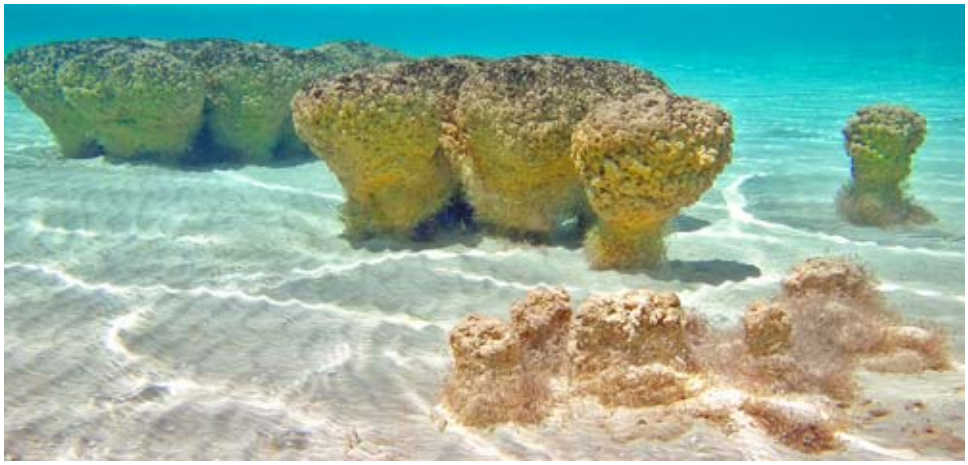
Stromatolites are some of the oldest fossil structures found on earth, some dating back 3.5 billion years! For the first 2.5 billion years, they were the predominant form of life on earth and the first reef builders. Among the earliest life forms to utilize photosynthesis, stromatolites quietly spent those billions of years gradually increasing oxygen levels in the seas and primeval atmosphere. This process resulted in a filtering out of many harmful rays from the sun, which would change the course of evolution and lead to the colonization of land by primitive plants. These pioneer plants were then able to simultaneously reduce the levels of atmospheric carbon dioxide and contribute more oxygen to the atmosphere, ultimately producing conditions suitable for terrestrial animal life. If it were not for the early actions of stromatolites, humans and other oxygen-dependent life forms may never have been able to evolve.

What happened to end their reign?

Ironically, stromatolites played a major role in their own demise. Increased levels of dissolved oxygen in the water led to the evolution of new, more complex, and predaceous life forms that began to graze on the stromatolites about 1.25 billion years ago. We have little fossil evidence of these early predators as they were apparently soft-bodied, but their emergence is inferred by the gradual decrease in stromatolites starting about that time. By about 500 million years ago, however, the fossil record shows a marked decrease in stromatolites due to grazing by a multitude of predators (typically marine snails) that now had shells to leave in the fossil record. The connection between grazer evolution and radiation and stromatolite decline is well documented. Only following the mass extinction of most marine life forms at the end of the Ordovician and Permian do stromatolite populations make a temporary comeback, only to decrease again as populations of grazers rebounded. The stromatolites of the Lykins formation at Heil Ranch date from shortly before the great Permian extinction.

Living fossils

With the ever-growing number of grazers in the seas, it was long believed that stromatolites had become extinct millions of years ago. Then, in 1956, a team of petroleum geologists exploring along the western coast of Australia stumbled upon living stromatolites in Shark Bay. The level of excitement was akin to that generated when a living coelacanth, a primitive lobe-finned fish believed to have gone extinct about 70 million years ago, was caught off the coast of Africa in 1938. It appears that the extreme salinity of Shark Bay (about twice normal) is intolerable to most grazers and other creatures and offers protection to the stromatolites. Since 1956, several other isolated stromatolite colonies have been discovered around the world, in both hyper-saline lakes and isolated marine lagoons, where they are similarly protected from grazing organisms.



Living stromatolites in Shark Bay, Australia.