Swimming with the Stromatolites at Shark Bay

After leaving the luxuries of Carbla Station behind, it was time to get back into some stromatolite science at Shark Bay.

(Above) Overnight accommodation at Carbla Point, in the left background is the food preparation area and dining hall.

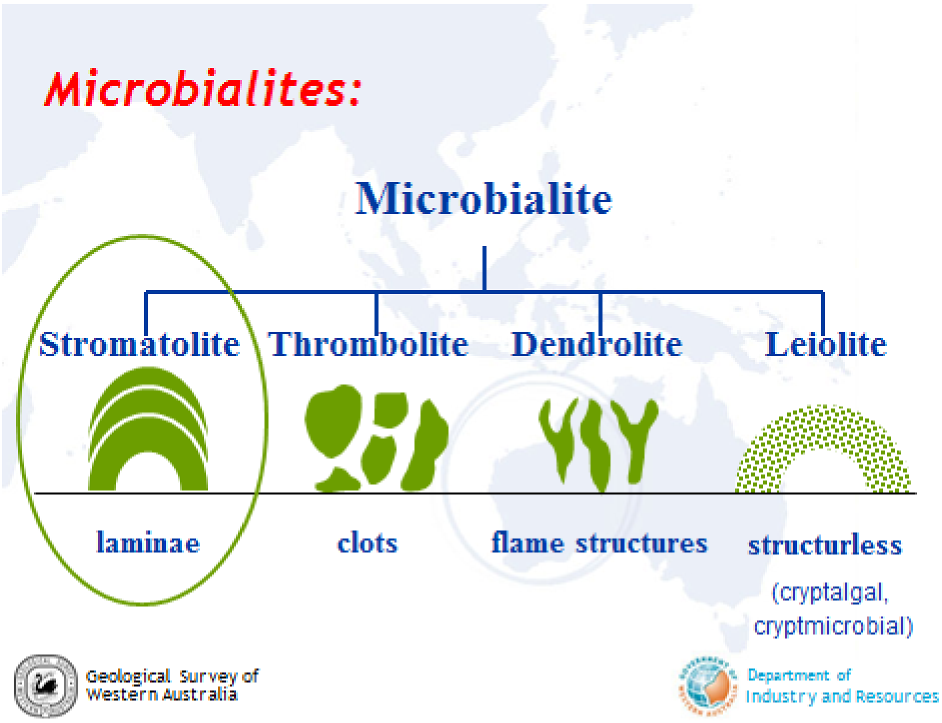
(Above) Traditional style Shearer's quarters-a home away from home at Carbla Station

Shark Bay is a UNESCO World Heritage Site located around 800 km North of Perth. The region has a well-documented history, with the area first identified by Dutch explorer Dirk Hartog in 1616. In fact he landed on an island just off Shark Bay (now called Dirk Hartog Island) and left a pewter plate with an inscription marking the occasion. The actual Hartog plate isn't located there anymore, it can be viewed at the Rijksmuseum in Amsterdam. This has caused some controversy, since the plate isn't in Australia anymore, but shows the earliest written evidence for Australia's European history from around 400 years ago (which isn't bad when you consider that WA was only settled by the British in 1829), some feel that it should be returned-well I guess it is also an important part to European history as well.

Shark Bay is world famous for many attractions-dolphins, dugongs, whales, loggerhead turtles, a range of endemic reptiles and crustaceans and of course the stromatolites. The expedition didn't get to view the traditional stromatolites at Hamelin Pool, but were fortunate enough under the guidance of the landowners and ranger to view the excellent examples at Carbla Point.

So what's the big deal about stromatolites?
Stromatolites are structures that are formed by biological material, especially cyanobacteria (blue-green algae), forming a symbiotic relationship with the abiotic environment by joining with sediment, such as sand to form layered structures.

Stromatolites are in fact a sub-set of a broader category of biological structures called microbialites.



(Above) Image courtesy of Dr Kath Grey, Chief Palaeontologist of Western Australia, from a presentation made to St Joseph's School on 17th October, 2008.

The microbialite examples being looked at in Carbla Point fall do into the stromatolite group. It is proposed that stromatolites initially form in unique conditions from an accumulation of bacterial material, which forms a microbial mat.

The living mat is usually green or dark in appearance and when examined closely shows interconnecting bacterial fibres, these mats can often feel quite mushy and soft, with force may break easily.

Over a period of time, a long time (a geological type of long time), sand gets trapped in between the fibres and to maximise energy production efficiency, some strands begin to grow vertically allowing the greatest possible amount of photosynthesis. The vertical growth also permits a greater level of sediment trapping, which means that in-between biological layers are fragments and grains of sand. Once a point of stability is reached, a mat capping forms and materials trapped below this and the level of sediment die off, showing the darker material as cement-like dead material, which often gets confused for a rock. So what we see much later is the process of biological material interwoven with abiotic substances that forms a dome structure, which could be centimetres or even metres tall.

So how do these relate to the Pilbara structures?

What can be viewed at Shark Bay (as well as some other locations around WA and the world) are living examples of the fossils from the Pilbara. By examining the shape and structure (morphology) and how growth develops and under what conditions, comparisons can be made to geological sites and being able to identify the characteristic curves to classify these fossilised structures. Through examination of the living world we hope to understand our ancient past and unravel the history of the Earth.

(Above) On the left fossilised stromatolite patterns in the Pilbara with their living cousins from Shark Bay and (Below) living examples beneath the water line at Carbla Point.

So why is the understanding of stromatolites so important?

Planetary scientists, such as the group that we have on this expedition are keen to understand the processes that combine to form stromatolites. It is clear to everyone that stromatolites do not form everywhere, so why in certain locations such as Shark Bay?

Is it the salinity levels, the temperature, the lack of predators, currents and wave action? We just don't know, this is why Spaceward Bound is here-to answer these types of questions. Some may find it daunting that the world experts don't appear to be able to put the whole stromatolite jigsaw together, I think it is quite exciting to see scientists discuss the processes, the factors and hypothesize and that we are all helping to research exactly what is this final piece of the illusive puzzle.

As well as participating in science in action, being able to re-enforce to students how research is conducted and the importance of field work is a tremendous experience in itself.

So why are stromatolites so important to planetary scientists?
What we see when we look at stromatolites are the earliest examples of what we understand as life. It was the first time that organic chemicals came together and created something that digested, excreted, reproduced, respired, responded, etc, so cyanobacteria is quite special-especially when for survival, with safety in numbers accumulated together and formed networks that used its surroundings to establish a permanent foothold.

When we consider these living examples (perhaps 3,000 years old) mere infants compared to the 3.5 billion year old grand-daddy examples from the Pilbara, they still represent the same type of processes. So if we go back in time to visit the early Earth, it was quite different to now. Far more landmass, less soil (not enough time yet for weathering and erosion processes), more impacts from space (as the solar system was yet to be stable and there was a lot more debris about) and the atmosphere was different. If we consider the early Achaean, it is believed that the Earth's atmosphere was almost 'alien-like' with significant amounts of gases such as methane and ammonia (From volcanoes from the early turbulent Earth), quite toxic substances. Through chemical processes, via lightning the methane reacted and Carbon dioxide was produced over a few hundred million years.

This was important as it is the CO_2 that was being used the earliest bacteria and as a by-product of photosynthesis created the Oxygen that we all know, love and cherish today. In addition, as these stromatolites are found at the water's edge, the O_2 was released in the water. With the large amount of Iron in the water, it freely reacted to form Iron Oxide, which eventually settled at the bottom of the Earth's oceans and were subsequently covered and are now uncovered around the world, including the Pilbara as the Banded Iron Formations.
As the Iron levels in the ocean were depleted, this free Oxygen eventually made its way up into our atmosphere, helping to make it is what we see now and hospitable for life. So studying and understanding stromatolites is very useful, they are our earliest cousins, the spawn for all life on Earth and they gave us Iron Ore!

So why is NASA looking at stromatolites?
It is believed that the early conditions of the Earth and Mars were similar. In fact, 3 to 4 billion years ago, Mars may have actually been a better, more stable (less plate tectonic/volcanic activity and as Earth is closer to the Sun, more susceptible to bombardment from all the objects floating about) location for life to start.

So it is proposed that if conditions were similar between the two planets, then there could have been an opportunity for life to start on Mars. There could be a second place in our solar system where life may have started. This means that scientists need to understand how and where these objects form and engineers need to understand how to build devices that are able to traverse the terrain and be able to identify these structures on future Mars missions. Enter Spaceward Bound, teachers need to be able to teach students about these types of structures and how we all fit together in this solar system and we all need to be in the field in Shark Bay to experience this.

(Above) Doing field science can be tough sometimes, Jon Rask studying submerged stromatolites-perhaps a little distracted by the underwater photo shoot.

(Above) A real highlight for the day was to swim with the stromatolites, to get up, close and personal with these objects (even though it was only 16^{O}C-planetary scientists are a tough bunch!) and then to discuss the scientific possibilities and probabilities.

(Above) One of first (and last) views of the stromatolites at the beach at Carbla Point.

(Above) As we discovered, it wasn't all stromatolites. Ken 'Steve Irwin' Silburn getting up close with a sea-snake (Crickey!) found in shallow water.