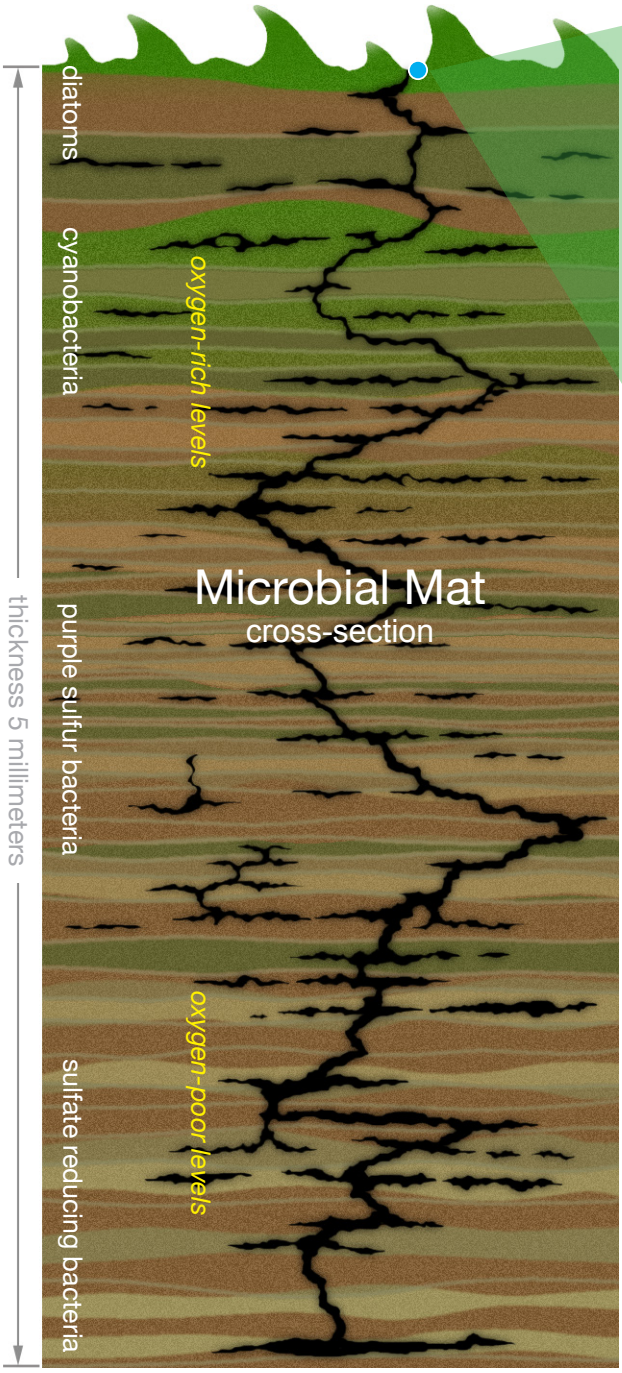
Accompanies Episode 13 of the 13-part video series

— *Stromatolite Explorer* —

Written by Eric R Russell



Marine Ecology: Microbial Mat

The Log of Captain Alda Adler

Day 1: 09:00 hours... My first mission! My first log entry... Grandpa Jon would know exactly what to say. He would know the perfect words... something inspiring and courageous. But, my crew and I are diving into a microcosm that he didn't even dream of exploring – **the extreme environment of a shallow salty sea**.

Our mission is to survey and discover the chemical conditions to a depth of 5 millimeters – of **a living microbial mat.**

We want to learn as much as possible about this extreme Earth micro habitat. **Exobiologists** believe that this is the kind of harsh environment where life on other planets might be found. What we find here is the kind of life that human explorers to other planets will most likely encounter.

The mat's spiky surface is caused by filaments of **oxygen-producing bacteria** pushing upward from below, creating a mountainous landscape. Our vessel, *Stromatolite Explorer*, will enter a microbial mat through a fissure on the surface. We intend to follow gaps and pockets in the living mat until we reach our destination.

Stromatolite Explorer

Extreme Micro Enviro Reconnaisance

Vehicle Dimensions

LENGTH	.1 mm
BEAM	.08 mm

Vehicle Mission

Maximum speed	1.5 mm per minute
Mission duration	2 days

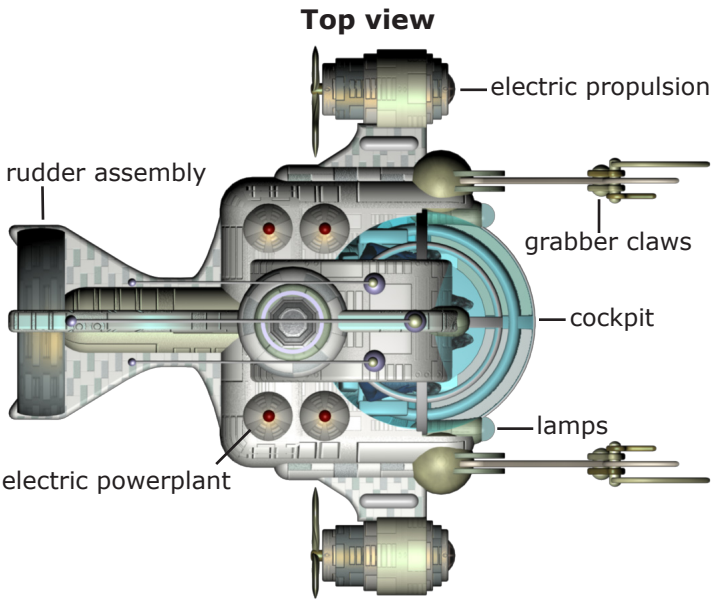
The *Stromatolite Explorer* is a sub-microscopic exploration vehicle designed to withstand the extreme conditions of Earth's harshest environments.

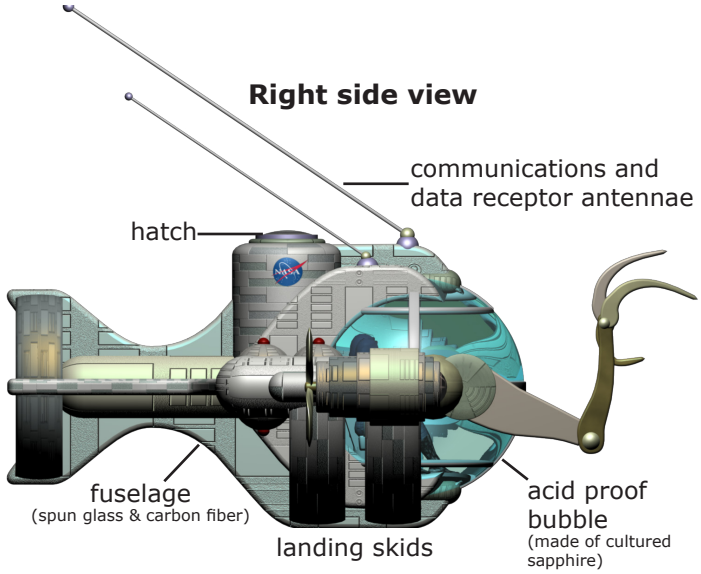
The *Explorer's* mission is to carry an investigative team of exobiologists to record environmental data in primitive-earth conditions – conditions similar to those that might be found on other planets.

Such challenging harsh environments are the ideal place to search for simple, primitive life – the kind thought to inhabit Earth approximately 3.5 billion years ago.

Launched in 2035, the vehicle is built from spun glass plating with carbon fiber reinforced exoskeleton. Power is an electrical cell, with photo-sensitive recharge. Twin outrigger motors allow maximum maneuverability. Articulated grabber claws allow handling of samples for close examination.

Requiring a single pilot, the *Stromatolite Explorer* can carry a second microscopic mission specialist for the full mission duration.





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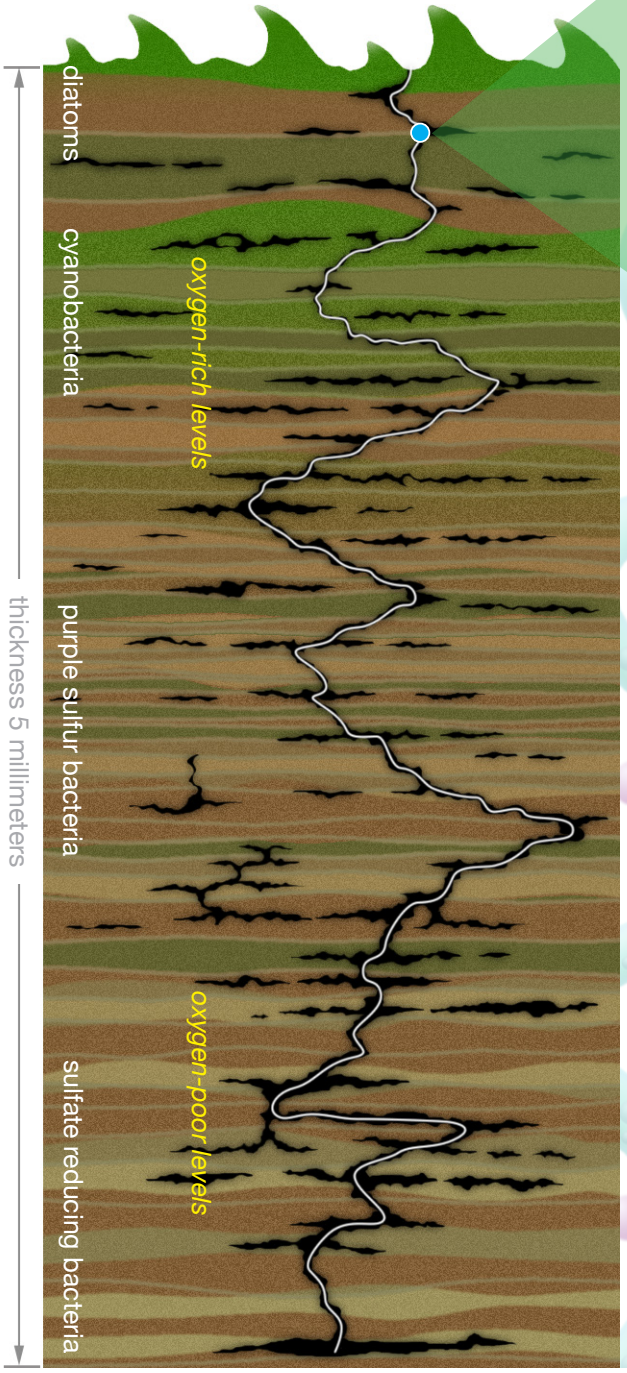
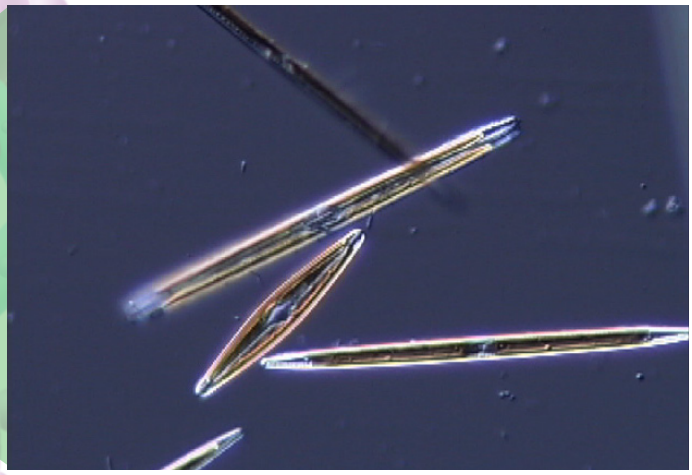
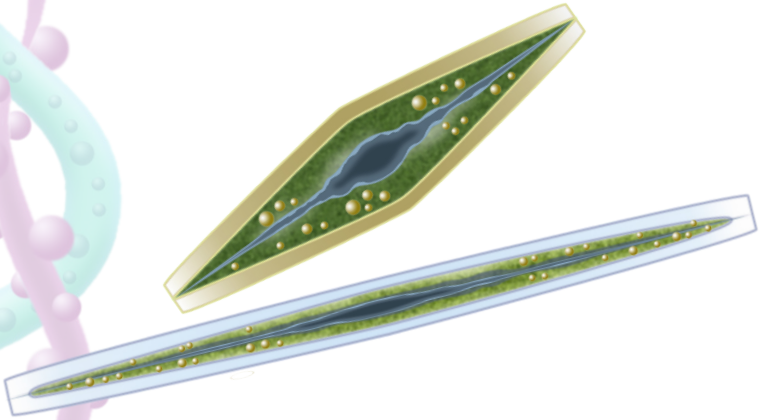


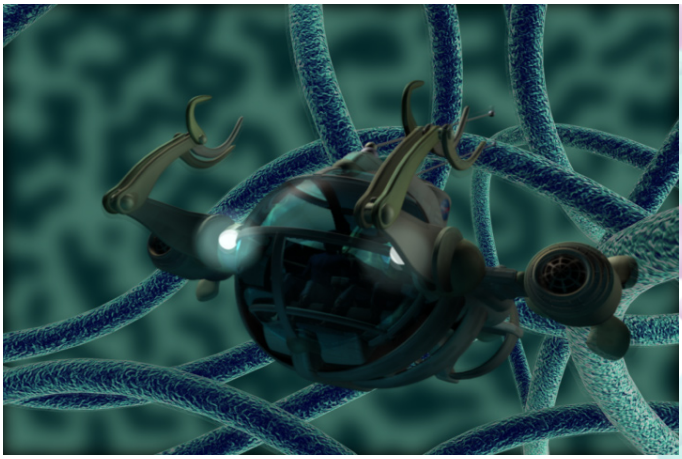


The Log of Captain Alda Adler

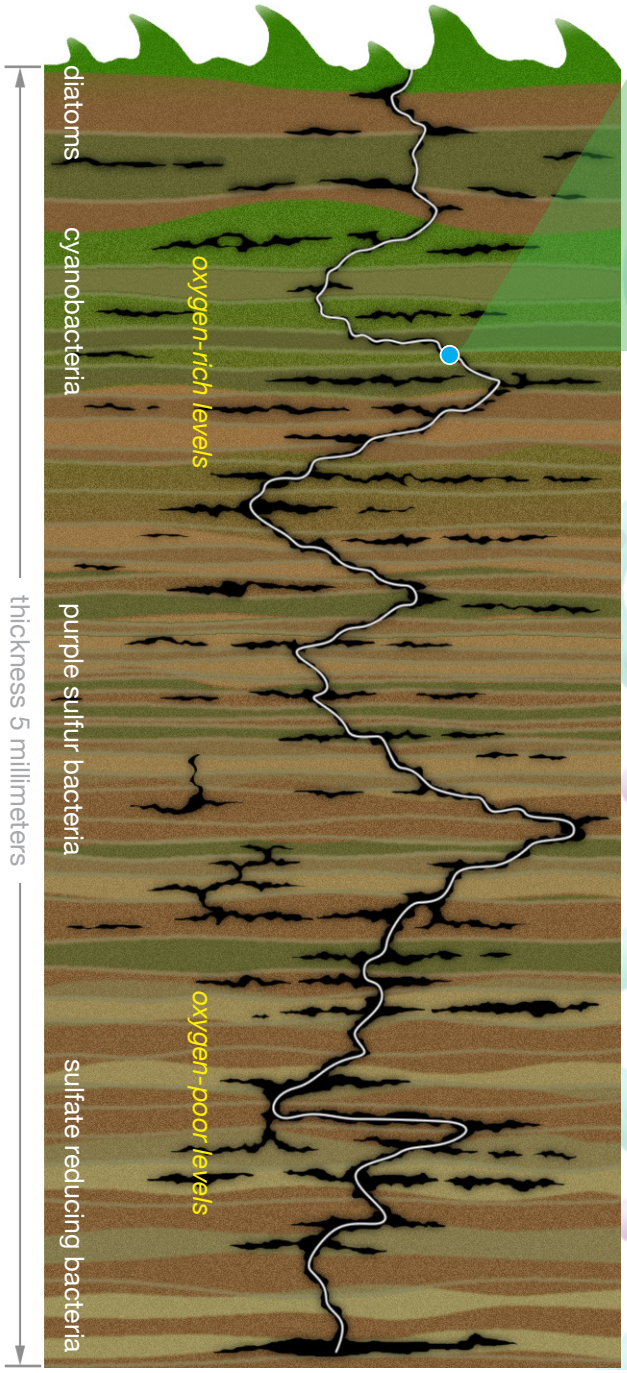
Day 1: 10:20 hours... Diatoms! *Stromatolite Explorer*, in the upper half millimeter of the mat, enters swarms of free-drifting diatoms. These **single-celled algae** are encased in glass, and made buoyant by **oil droplets** inside their silica houses.

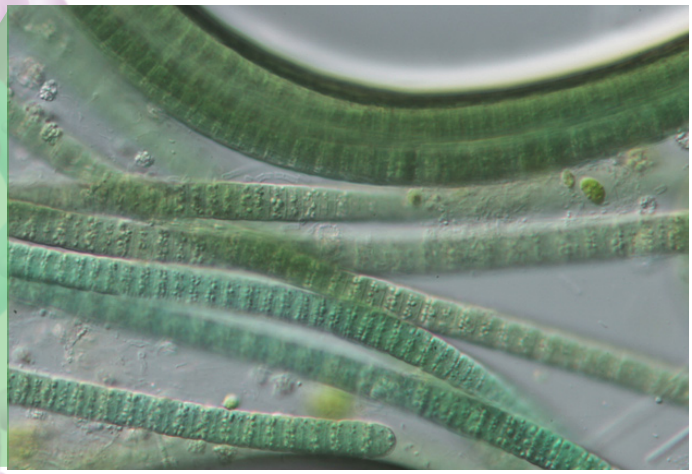


Diatoms are active **photosynthesizers**, receiving plenty of sunlight for making this upper most region of the mat very oxygen-rich! Because there is so much oxygen available, this level is home to micro animals such as nematodes. We wonder if we will find these light-dependent organisms deeper in the mat as we descend.



Depth: 1.2 millimeters



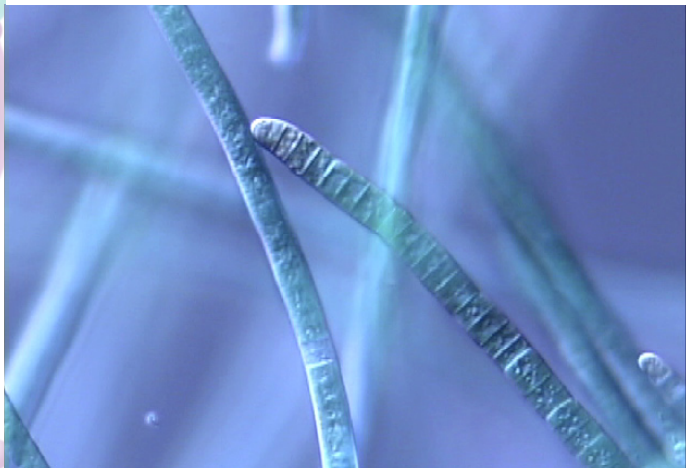


The Log of Captain Alda Adler

Day 1: 11:00 hours... At the 1-millimeter depth we enter the world of ***cyanobacteria***. The strands are interconnected cells, but none contain a nucleus. They form long chains that bend and stretch.

Cyanobacteria, also called **blue-green algae**, produces oxygen when sunlight is present. Oxygen bubbles many times the size of our ship are visible forming within the dense strands.

We deploy the *Explorer's* grabber claws to assist with navigating through this increasingly dense living maze. The path grows darker as we descend, and oxygen levels begin to dip slightly as less and less sunlight penetrates the mat.



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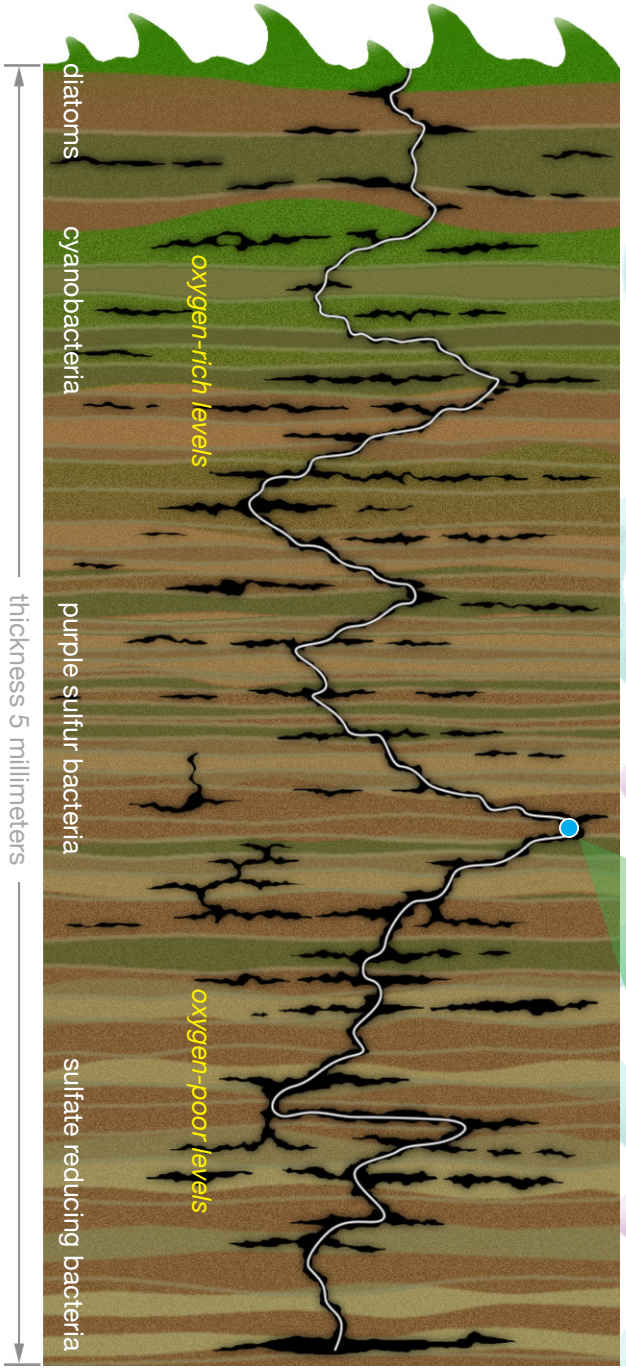
DEPTH	O2	H2S	pH
0.5 mm	600	0	9.2
1 mm	1000	0	8.75
2 mm	0	20	7.5
3 mm	0	100	7
4 mm	0	140	6.8
5 mm	0	150	6.6

Diatoms
Cyanobacteria
Purple Sulfur Bacteria
Sulfate Reducing Bacteria

Depth: 3 millimeters

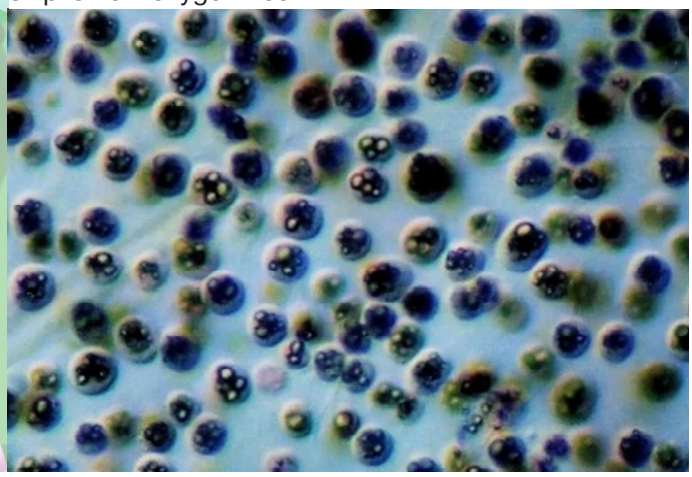


The Log of Captain Alda Adler

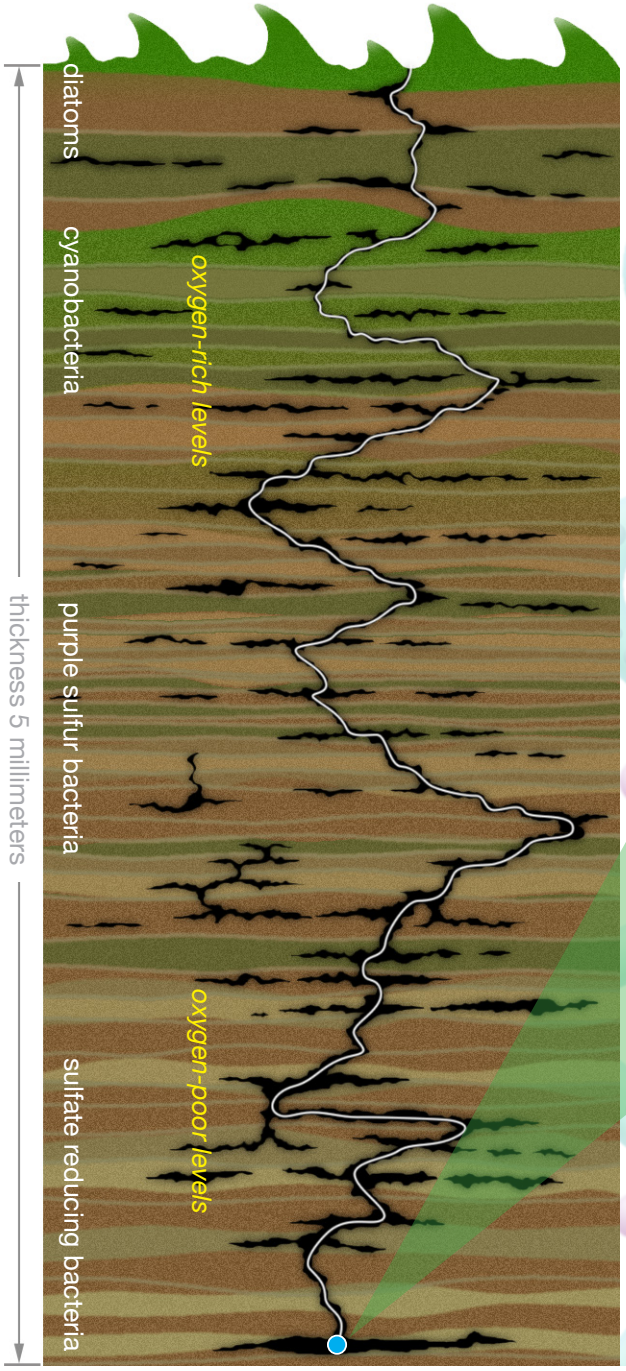
Day 1: 11:40 hours... Three millimeters into the mat now. Sunlight is dimmer here, and the nature of the mat population has changed. We have entered the realm of **purple sulfer bacteria**.

These small spherical cells use the existing dim light to power themselves, but they do it in a different way. This is not the photosynthesis of green organisms like cyanobacteria and algae. Purple sulfur bacteria use **hydrogen sulfide** instead of water to capture photons and make energy molecules.

These strange simple cells do not produce oxygen, and our instruments confirm that the environment outside the ship is now oxygen free!



Depth: 5 millimeters



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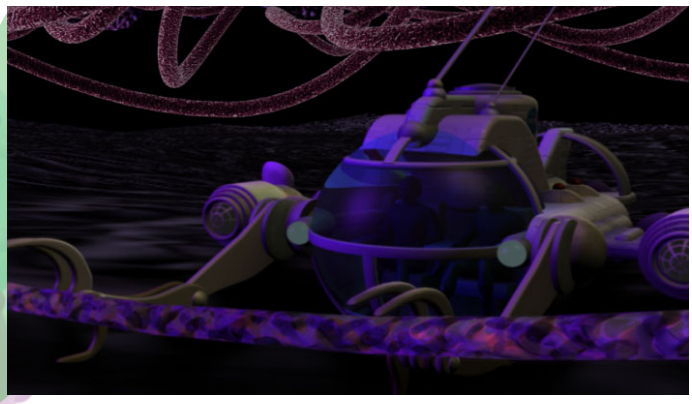
The Log of Captain Alda Adler

Day 1: 18:00 hours... We arrived at the bottom of the mat 8 hours ago. This region is utterly dark. No sunlight penetrates this deeply into the mat.

For 8 hours we have been collecting data at the darkest level of the microbial mat community. To our amazement there is still life, but very different than the kind of life found near the sunlit surface. Strands of **sulfate reducing bacteria** thrive down here. These strands appear to migrate up and down through the layers of the mat as night falls.

We hear an alarm, and are alerted by our computer that we are out of power! To make matters worse we cannot recharge our batteries, because there is not enough sunlight. We are stranded down here at the bottom of a microbial mat! Unless...

Our onboard clock tells us that up in the surface world the sun has set. Maybe this is our chance to escape! If we time it right, perhaps we can grab onto one of those migrating strands of sulfate reducing bacteria and catch a free ride back to the surface!



The plan works! During our return trip we gather more data and learn just how active the mat is at night!

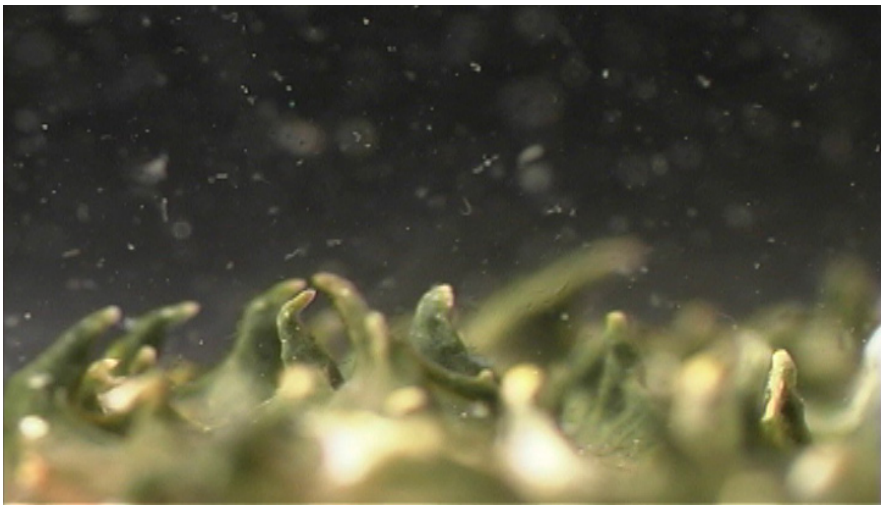
Our journey through a microbial mat has revealed how quickly life can change in just a few tiny millimeters – from photosynthetic algae at the surface, to sulfur munching bacteria just a hair away. These very simple forms of life are what exobiologists will be looking for when robot explorers are sent to Mars and other planets.

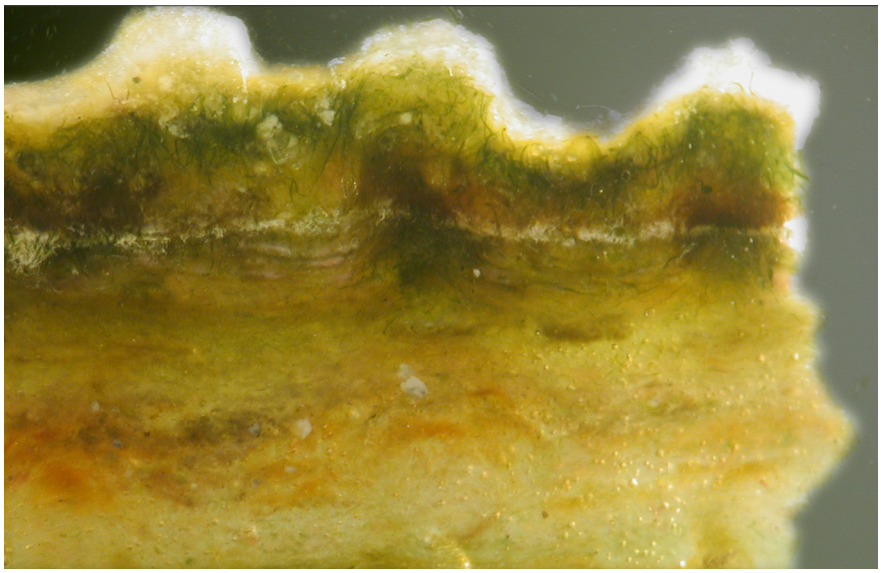
Stromatolites on Mars?

Mineral Layers that were Once Living Organisms

When probes seeking signs of life are sent to planets such as Mars, they are looking for simple living organisms like those found in a microbial mat community. If probes discover layered minerals, it would be powerful evidence that microbial life once thrived there.

As seen in this adventure microbial mat communities are made up of very thin layers of different microorganisms. The entire community is only 5 millimeters thick. The layered microbes produce various chemicals, which when trapped beneath new mats produce petrified mineral layers. Over vast stretches of time these stacks of layered minerals become fossilized and are known as **stromatolites**.





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