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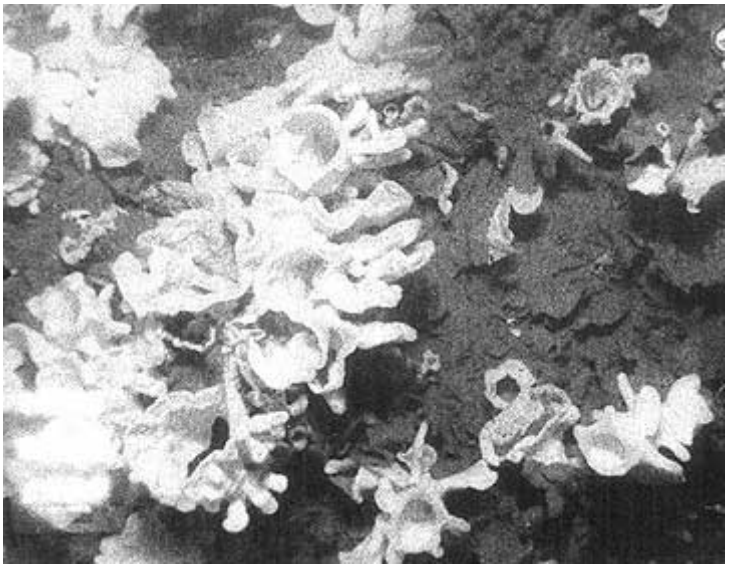

STRANGE BEINGS

by Lynn Lee

Discover. To be the first to find or find out about.

The first hint of something strange surfaced in 1984 during a sea-floor mapping exercise in Hecate Strait. Geological Survey of Canada (GSC) scientists observed through sonar imaging, unexpected permeable bumps over huge areas of the sea floor. Similar acoustic anomalies, described as an "amorphous, irregular seismic signature having no coherent internal reflectors," were observed again in 1986, this time during a survey in Queen Charlotte Sound. In 1987, GSC scientists Kim Conway and Vaughn Barrie discovered the sponge reef. It was "something that succeeded even our expectations," says Conway.

Unique. Being the only one of a particular type.

It's unique and it's big. It is the only living bioconstruction of its kind known in the world. And it lives in our backyard - four sponge reefs, around 9,000 years of age, 700 kilometres squared in combined surface area and up to 18 metres high, all under 150 to 250 metres of water.

The posts and beams of the sponge reef are siliceous sponges of the Order Hexactinosa, providing the rigid framework necessary for reef formation. Like the building of coral reefs, young sponges attach and grow upon the older generation, laterally and vertically extending the reef. The reef complexes exist in three continental shelf troughs from Hecate Strait south to Queen Charlotte Sound. The northernmost reef sits 10 nautical miles offshore from Banks Island; the southernmost is 50 nautical miles north of Vancouver Island.

Extinct. Of an animal or plant species having no living representative.

Siliceous sponge reefs were thought extinct. Prehistoric sponge reefs stretched in a discontinuous belt 7000 kilometres - three and a half times longer than the Great Barrier Reef off northeast Australia - across the northern Tethys to the margin of the Atlantic Ocean at a time when part of modern Europe, as we know it, was under the sea. Today, fossilized outcrops extend across Romania, Poland, Germany, Switzerland, France, Spain, Portugal, off Newfoundland and Oklahoma. The sponge reef on our coast is a living organism ecosystem that will provide insight into the Jurassic paleoenvironment which supported the vast Tethys sponge reef.

The first recorded hexactinellid sponges shared oceans with coelacanth fish (thought extinct until discovered off the coast of South Africa in 1938) during the Devonian Period 400 million years ago. Sponge reef distribution climaxed in the late Jurassic Period 140 million years ago, with the formation of the northern Tethys reef. This fossilized sponge reef from the Age of Dinosaurs is the largest bioconstruction ever known to exist. Following the Jurassic Period, sponge reef distribution dramatically declined to apparent extinction during the Cretaceous Period 65 million years ago.

Science. The systematic study of the nature and behaviour of the material and physical universe, based on observation, experiment, and measurement, and the formulation of laws to describe these facts in general terms.

Up until 1987, sponge reef science was limited to description and study of the fossilized northern Tethys sponge reefs and similar areas. Paleontologist Manfred Krautter, at the University of Stuttgart in Germany, spent years studying the fossil sponge reefs of Spain, Germany and Portugal. But, in 1987, the dinosaurs came to life.

Underwater photography in Hecate Strait captured live irregularly-shaped sponges, with random fingerlike projections and a large central cavity. Over two years, GSC scientists map-ped the location and extent of the sponge reefs; mollusc shells embedded in core samples allowed the reef to be aged by carbon-dating.

In 1999, Canadian and German scientists, including Conway and Krautter, embarked on a joint research program to unlock to secrets of the sponge. Funded by the Geological Survey of Canada and the University of Stuttgart, the Canadian Coast Guard vessel John P. Tully cruised over the reefs. Aboard were a team of scientists and sophisticated geophysical surveying equipment. A Delta submersible (equipped with underwater still and video cameras and a mechanical maneuvering arm with a grab sampler and super sucker slurp gun) provided images, picked up specimen rocks and sponges, and excavated sediment. At one point during the survey, it took five hours, traveling at speeds of 1 to 2 nautical miles per hour, for the submersible to cross the reef.

Forty hours of videotapes and nearly two thousand 35mm slides later, the scientists fastidiously identified species and their abundance through the sampled sites. Marine organisms noted to date include annelid worms, bryozoans, bivalves, gastropods, spider crabs, box crabs, shrimps, prawn, sea stars, urchins, brittle stars and rockfishes. Initial observations suggest that the sponge reef provides benthic habitat for a wide variety of organisms and that the local ecology of the reef is different than that outside the reef area. For the first time anywhere, hexactinellid reefs were studied by direct observation.

How did these sponge reefs form?

First, a special set of environmental circumstances provided good attachment sites, allowing the sponge to grow. About 15 to 13 thousand years ago, when glaciers covering much of Hecate Strait and Queen Charlotte Sound began to melt, sea levels were about 150m lower than they are today. Icebergs scoured the continental shelf, leaving marks at modern depths over 250m. During the Holocene Period 9,000 years ago, sponge reef construction started on iceberg-ploughed berms of coarse gravel.
Second, the hexactinosan sponges that form the reef construction are a special type of hexactinellid sponge; the interwoven fabric of spicules is fused by an overcoat of silicon dioxide, allowing the sponge skeleton to remain intact after death, thus providing the building blocks for reef formation.

Third, there was a balance between sediment coming into the area and sponge survival and growth, allowing the reef to persist and develop over geologic time. In a process similar to sand and silt dropping out of river water in lower velocity backeddies and off-channel areas, sediment deposits out of sea water as it travels into lower velocity eddies created by the rough surface of the reef.

The Building Blocks

Sponges of all kaleidoscopic shapes, sizes and colours belong to the Phylum Porifera. Over 10,000 species are known worldwide, from the equator to the poles, from shallow tidepools to deep ocean trenches. Largely unchanged in basic form since the Devonian Period, hexactinellid (glass) sponges are characterized by their siliceous spicules (inanimate crystals of silica or calcium carbonate) which consist of six rays intersecting at right angles (similar to a toy jack). The spicules (hexactines) are interwoven throughout the sponge body. Although numerous sponge species exist on the reef, three form the framework of the reef: Aphrocallistes vastus, Chonelasma calyx and Farrea occa.

Sponges are distinct, having the most simple body structure of all multi-cellular animals. A sponge is typically composed of an outer layer (cortex) and an inner layer filled with spicules and organic fibres. Water, the lifeblood of the sponge, is drawn into the organism through innumerable small openings (ostia) which perforate the outer surface, acting as gateways to a labyrinth of internal canals and chambers. Lining the walls of the labyrinth, millions of flagellated cells beat vigorously to sweep water through the sponge body, simultaneously trapping food particles for energy. Much like blood in our circulatory system, water also transports oxygen to internal cells while removing cellular waste products. In the reef sponges, filtered water is expelled through a central cavity (osculum).

Incredibly efficient filter feeders with a predilection for bacteria and other organic debris, a typical sponge can filter four to five times its body volume every minute. At this rate, a basketball-sized sponge would process several thousand litres of water each day. A sponge reef complex covering an area of 700km2 two and a half times the size of Louise Island - with a presumed average height of 0.5m, would therefore filter 1.75 trillion litres of sea water per day - roughly equivalent to 6 times the volume of Yakoun Lake or 500 times the daily discharge volume of the Yakoun River watershed!

Construction

Individual sponge mounds, which initially look symmetrical and circular, develop irregular shapes as suspended sediment settles on the mounds through slowing of tidally-driven currents. As sediment accumulates, individual and coalescing mounds develop and tend to elongate in the direction of prevailing seabed currents. These reefs represent the only significant post-glacial deposits throughout much of the continental shelf since negligible amounts of sediment settle outside of the sponge reefs. Interestingly, the marine sediments trapped in the reef contain up to 3% organic carbon as high as values found in the sediments of productive estuaries.

Today, the reef occurs both as mounds (bioherms) and as sheets (biostromes). The bioherms are steep-sided formations up to 18m six stories high; The more extensive biostromes are several metres thick and cover many square kilometres one square kilometre encompasses 75 typical city blocks. Any given reef complex is composed of bioherms and biostromes of varying shapes, sizes and densities.

Unlike many sponges which are reduced to a mat of loose spicules once their organic matrix has decomposed, dead hexactinosan sponges retain their shape as they are buried by clay-rich sediment. This burial process protects the siliceous skeletons from dissolving in sea water. Building on the skeletons of previous generations, live sponges can be over a metre high. With an estimated maximum growth rate of 1 cm per year, these sponges are over 100 years old!

The Building

The "living dinosaurs" are known no where else in the world. These sponge reefs are a key to the past, to unlocking the secrets of the life and times of the largest bioconstructed organism ever to live on earth. And we know very little about them. Do more sponge reefs exist? Are the reefs limited to their present habitat? What are the environmental conditions that allow the sponge reef to persist? What is the role of the sponge reef in the continental shelf ecosystem? What are the ecological effects of all that water filtering? How do the sponge reefs reproduce? Countless questions remain to be answered. As Conway concludes, "It's all new to science, no one knows these things." No one knows what extraordinary secrets remain hidden in the heart of the ocean.

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