

Hexactinellid sponge reefs on the British Columbia continental shelf: geological and biological structure



Siliceous sponges (Hexactinellids) form dense clusters on a sponge reef in Hecate Strait. The sponges are about 1 metre in height.

Background

Siliceous sponge reefs were discovered on the western Canadian continental shelf in 1987-1988 by the Geological Survey of Canada. Recent surveys using a manned submersible (*Delta*) have provided new information. The sponges form mounds to 18 m in height and beds kilometres in width on the seafloor in the deep troughs of Hecate Strait and Queen Charlotte Sound. Found nowhere else in the world, the sponge reefs are unique to the western Canadian shelf. Siliceous sponge reefs were a common reef type during the Age of Dinosaurs so the newly discovered reefs are like a "living fossil". The reefs grow through the attachment of young sponges onto the skeletons of the previous generation and trap fine sediment that moves with bottom currents through the troughs. This sediment forms the matrix material of the reef. The sponge reefs have existed in the troughs of the shelf for an estimated 8500-9000 years.

The sponges on the surface of the reefs grow to more than 1 metre in height. The age of sponges of this height is thought to be on the order of 100 years. The dense coverage of sponges provides habitat for invertebrate and fish species. Bottom trawling and dredging gear and fisheries that use other types of mobile fishing equipment will damage the reefs and break and remove sponges from the reef surface. The framework of the sponge skeletons is very fragile and is readily broken

up with minor physical impacts. The reefs may serve as a nursery area for fish and invertebrates – more research is required to determine the ecological and economic importance of these reefs to invertebrate and fish species.

This document was written to provide information to promote awareness of the sponge reefs to those that access or utilize continental shelf seafloor areas. Specifically, sectors of the fishing industry which use mobile fishing gear, and potential industrial users of the seabed such as cable and pipeline installers are intended as an audience. Information concerning the nature of the seafloor will better facilitate continued, sustainable use of the seabed of the continental shelf in areas where the sponge reefs are found. For more detailed information regarding recent seafloor research outlining the nature of sponge reefs on the western Canadian continental shelf please refer to Conway (1999).

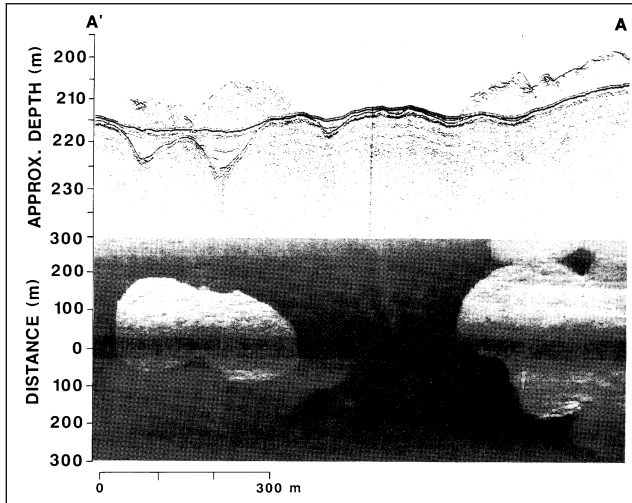


Location of sponge reefs on the British Columbia continental shelf.

Summary

- This document provides information on the location, biological and geological characteristics and, to the extent known, the significance of sponge reefs that exist on the continental shelf of northwestern Canada in Hecate Strait and Queen Charlotte Sound. The intention here is to provide an overview of these features for those who utilize, harvest or otherwise interact with the seafloor in areas where the sponge reefs occur.
- The focus of the report is the presentation of information regarding the unique nature of the sponge reefs found in the troughs which cross the continental shelf. Worldwide, the sponge reefs have only been found off the west coast of Canada. In the geologic past this type of reef was very common and formed some of the largest reefs ever built on earth.

- The sponges that form the reefs are siliceous Hexactinellid sponges that have a rigid framework skeleton. The skeleton provides a surface for attachment of more sponges of subsequent generations. The sponges thus form a framework of skeletons, which traps sediment and builds extensive mounds to 18 m in height and beds kilometres in width. Submersible observations suggest that the fauna found on the sponge reefs is different from adjacent areas.
- A relationship between surficial geology, water depth and occurrence of sponge reefs has been established. The sponge reefs are abundant where iceberg furrowed glacial till is exposed at the seafloor and do not seem to occur rooted in other types of unconsolidated deposits or on bedrock surfaces. The reefs occur between 165 and 230 m water depth.
- The sponge reefs are readily mapped using remote acoustic methods such as sidescan sonar and high-resolution seismic (see below). The Geological Survey of Canada employed these methods simultaneously to map their distribution. The reefs are also apparent as semi-transparent surficial sediment bodies on most echo sounder or profilers at frequencies at or below 12 kilohertz.
- Three main species form the framework of sponge skeletons of the reef; they include the hexactinellid Hexactinosan species *Chonelasma calyx*, *Aphrocallistes vastus* and *Farrea occa*. Sponges that were often abundant on but are not considered the main reef forming species included the hexactinellid Rossellid species *Rhabdocalyptus dawsoni*, *Acanthascus platei* and *Staurocalyptus dowlingi*. In some areas the reef surface has a dense coverage of one or two of the Hexactinosan species over many square metres. *Chonelasma calyx*, with very prominent tubes, form large mono-specific clusters.



Seismic profile view (above) and sidescan sonar plan view (below) of sponge reefs in southern Queen Charlotte Sound. The reefs appear as white zones on black on the sonogram due to the clayey, non-reflective nature of the matrix sediment of the reefs and the reflective aspects of the sandy glaciomarine sediments which the reefs sit on. The sponge reefs in this image can be seen to be about 10 m thick.

Issue

The sponge reefs in certain areas are being impacted by mobile fishing gear. The paired tracks of otter trawl fishing net doors or otter boards can be seen on sidescan sonar records in some areas where the sponge reefs occur. It is probable given the fragile nature of the sponges that they would not survive being dragged over with this type of equipment. In Hecate Strait submersible dive observations indicate areas of sponge skeletons broken off, removed or piled in linear mounds on the seafloor. In northern and southern Hecate Strait, areas of sponges lying broken off at the seafloor were observed. In some areas, broken projections of sponges (“stumps”) and sponges with abraded distal edges were seen during dives. In undisturbed settings, the sponge skeletons remain in place after death. The timeframe of recovery of a destroyed sponge reef, based on what we know about the growth rates of hexactinellid sponges, is suspected to be on the order of 100 - 200 years.



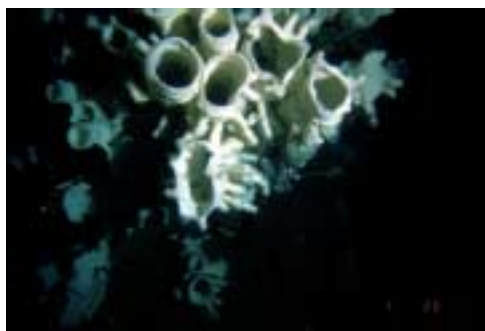
Sidescan sonogram of the seafloor in southern Queen Charlotte Sound at the periphery of a sponge reef complex in 210 m water depth. The sponge reefs are the white zones on the lower center portion of the sonogram; the trawl marks are the paired diagonal lines which run from upper left to lower right.

Conclusions

Globally unique hexactinellid sponge reefs occur in the iceberg scoured troughs of the continental shelf in both Hecate Strait and Queen Charlotte Sound in water depths between 165 and 230 metres. The sponge reefs form mounds to 18 m in height and are extensive, forming reef complexes up to 300 km². The surface of the reefs in some of these areas is estimated to be 100 -150 years old, based on sponge growth rates and longevity. The sponge reefs have continuously occupied the oldest sites since the shortly after the end of the last glaciation. Sponge reef formation occurs through a fine balance between sediment input and sponge growth. The sponges, especially members of the Order Hexactinosa, form a framework of sponge skeletons that trap sediments entrained in currents.

The sponge reef complexes on the continental shelf of western Canada represent unique bioconstructions that have not been found elsewhere in the world. They are most like fossil reefs that date from the Age of Dinosaurs so are like a “living fossil”. The reefs have occupied the troughs on the continental shelf for about 8500-9000 years.

The sponge reefs are being impacted by mobile fishing gear. The opportunity for study of the sponge reefs, both in terms of their modern ecology, and the linkages that these reefs have with extinct Mesozoic reefs, may not exist in the future without protection. Further biological study of these reefs will be required to determine relationships between invertebrate and fish species and the sponge taxa and the relative importance of the sponge reefs to the shelf ecosystem.



Surface of healthy sponge reef – southern Queen Charlotte Sound.

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