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MORPHOLOGY OF BARKLEY CANYON, CASCADIA MARGIN

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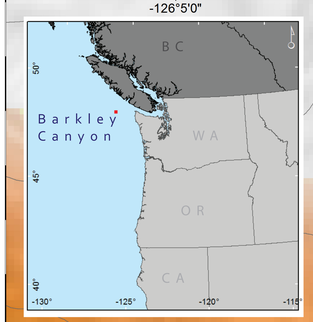


Summary

This AUV survey provides detailed bathymetry of a section of Barkley Canyon floor and sidewalls that ranges between 960 and 1020 m water depth. AUV and ROV surveys indicate Barkley Canyon is an inactive canyon. The seafloor immediately surrounding the Canyon-Axis node (985 m) is smooth, with boulder shaped mounds attributable to local debris flows, rather than organized down canyon processes. Distinct morphologies that are associated with gas hydrate were mapped and observed at two sites on a headland on the canyon's north western flank. Features found at both the Hydrate node (870 m) (A and B) and on the eastern side of the headland (C) are associated with chemosynthetic biological communities and presumably hydrate deposits. Similar mounds, indicating possible seepage sites, are seen elsewhere on the canyon walls, but were not surveyed with the ROV. The seafloor around the Mid-Canyon node (890 m) is smooth. The Absence of sediment drape in chirp profiles, coupled with the firm sediment observed in vibracores from Hydrate Node, suggest these nodes are situated on older, presumably pre-Quaternery strata.

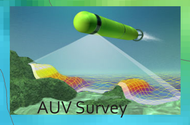
Objective:

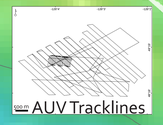
Ocean Networks Canada (ONC) operates the NEPTUNE cabled observatory offshore British Columbia. An 812 km long loop of fiber optic cable to which scientific instruments can be connected enables continuous long-term studies of sea floor environments. A primary node on this cable is on the north flank of Barkley Canyon and secondary cables run to three satellite nodes placed within Barkley Canyon at 870 m, 890 m, and 985 m. The Hydrate node (870 m) is located where oil seeps and gas hydrate exposures are known to occur.

The seafloor mapping survey was conducted to (1) provide context for the seafloor observatory infrastructure; (2) to determine if distinctive morphologies can be identified which may indicate the existence of other fluid seepage sites elsewhere on the flanks of Barkley Canyon; and (3) to evaluate whether Barkley Canyon is an active sediment transport conduit.

AUV mapping survey:

The fine-scale morphology and shallow seafloor structure on the flanks and floor of Barkley Canyon on the Cascadia Continental Margin was mapped in detail using an Autonomous Underwater Vehicle (AUV). The AUV was programmed to fly ~50 m off the seafloor with either 150 m or 10 m line spacing carrying a 200 kHz multibeam sonar (vertical precision of 0.15 m and horizontal resolution of 1.0 m) and a 2-10 kHz chirp seismic reflection profiler, which provide resolutions unattainable using standard shipboard survey techniques.





Hydrate Node

The seafloor surrounding the Hydrate node is marked by 10 circular mounds up to 2 m high and 10 m in diameter (B).

Vibracores

ROV collected vibracores (red crosses) 17, 18, and 19 encountered firm sediment assumed to be pre-Quaternary near the Hydrate Node. Core 20, taken from the sediment drape on the canyon sidewall and 21 from the canyon floor, are indistinguishable. Scale bar shows 10 m intervals.

Canyon Walls

Lineations in the bathymetry mark the exposed edges of truncated beds. Rough, apparently fresh textures, within slide scarps highlight the importance of erosion on the development of the canyon flanks.

The lack of reflectors in the chirp profiles indicates most of the canyon's sidewalls are largely sediment-bare. Although wedges of sediment drape occur in places on the canyon sides, the chirp profiles show no detectable sediment drape at either node site .

Seismic Lines

Chirp profile X-X' and Y-Y' show the nearly flat canyon floor is underlain by an acoustically uniform unit that is up to 24 m thick. Underlying this acoustically uniform unit is a single strong reflector (Y-Y') which suggests that a better defined channel existed on the canyon floor at an earlier time.

Distinctive Morphology (B, C)

ROV dives confirmed the small mounds mapped on the eastern and western flank of this headland are gas hydrate mounds (indicated with red arrows).

Canyon Floor (D)

The bathymetry shows meter-scale blocks sticking-up through the canyon floor fill (D). Block positions and scour patterns suggest these are associated with debris flow deposits. The canyon floor lacks channeling and contains ≥ 24 m of acoustically uniform sediment fill, which is ponded between the canyon's steep sidewalls.

The background surface ship bathymetery shown was collected by the Schmidt Ocean Institute courtesy of Karen Douglas.