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#### Purpose of the Dive

Explore the biology and geomorphology of this minor canyon

#### Description of the Dive:

**Setting:** Dive 4 took place in an unnamed minor canyon to the east of Veatch Canyon; upon reaching the bottom we christened the area "Okeanos Canyon" in honor of the vessel and her crew. The canyon is a small slope-sourced feature with steep, sharp sides. It is quite narrow relative to other nearby canyons, measuring only about 100 meters wide at its narrowest point. The dive consisted of a transect over a small mid-canyon cliff (30 m relief) of geologic interest and then up the main canyon walls.

**Exploration:** The ROV D2 was deployed at 1217 UTC to a depth of 1517 m and reached the bottom at about 1330 UTC. The ROV began its transit of the heavily-sedimented canyon floor at the base of a small cliff spanning the width of the canyon. The sediment was characterized by a light color, perhaps due to a higher concentration of carbonate-rich material (hemipelagic sediment). There was little evidence of major current activity, suggesting that the canyon has been quiet and inactive in geologically recent times. Large (1-3 m) debris boulders led the way to a chalk cliff with the same burrowed and scraped appearance as the chalk unit observed in the other canyons. The sedimented bottom had a high density of xenophyophores (*Syringamina* sp.) and many *Ophiomusium*-like ophiuroids; there was a surprising diversity of corals on the debris boulders, including *Anthomastus*, *Paramuricea*, *Swiftia* and cup corals. Fish at the landing site included synphobranchid eels, grenadiers, a cusk eel, skate and chimaera (*Hydrolagus*).

The cliff was characterized by differential erosion, several deep overhangs and several scoured caves at the base of an intermediate terrace, all indicating significant erosion. Several fish species were seen at the base of

the small cliff wall, including Longfin Hake (*Urophycis chesteri*), Oreo/False Boarfish (*Neocyttus helgae*) and Black Dogfish (*Centroscyllium*). Cup corals, *Solenosmilla* corals, black corals (?*Bathypathes*), bamboo coral (*Keratoisis*), sponges and octopus (*Graneledone verrucosa*) were seen on the wall. The dive provided insufficient evidence to explain the origin of the mid-canyon cliff, but two possibilities are 1) the headwall scarp of a landslide initiated at this depth or 2) currents reacting to a regional change in slope and eroding away the chalk layer.

Following a pause in the dive due to technical problems with the ship's stern thrusters, the ROV returned to the heavily-sedimented canyon floor just above the mid-canyon cliff. During the transit across the sediment, several reddish debris blocks similar to the upper siltstone layer of Hendrickson canyon were found up to 30 m from the canyon wall; xenophyophores (*Syringamina* sp.) were particularly abundant. Shortly before the wall we came across the carcass of a fish, tentatively identified as a redfish (*Sebastes fasciatus* or *S. mentella*) by Peter Auster and based on the close-up imaging of the jaw bones. Although it appeared there was still some flesh on the skeleton, there were no characteristic "bone fauna" observed, only several amphipods. We were surprised to see a pycnogonid sea spider swimming above bottom. Several participating scientists noted they had never observed this behavior, but later research showed a few reports of this behavior in shallow water have been published.

The ROV then proceeded to climb the canyon wall (still traversing the chalk unit) to a depth of 1395 m where we encountered a very interesting feature later termed the "Octopus Grotto." This was an extensive series of deeply-eroded caves holed out above a more resistant chalk layer, with many caves inhabited by octopi (both *Graneledone verucossa* and *Muusoctopus* sp.). The caves seemed wider at the base than at the top and were reminiscent of sea caves, although the great age (Eocene) and depth of the chalk unit likely rule out the possibility of near-shore wave-eroded features. More likely some sort of fluid (possible spring water from the shelf) flowed downward through the rocks and was forced out at the top of the more resistant layer. On the wall there were many patches of cup corals (*Desmophyllum*) and much higher density of *Solenosmilla* colonies than seen in the 3 previous canyon dives on this leg; *Parantipathes*, *Clavularia*, and *Acanthogorgia* colonies were also present as were limid bivalves (?*Acesta*). A Rockling (?*Gaidropsarus*) was seen in one cave seeming to hide among the corals hanging from above. Directly above the octopus caves, at a depth of 1385 m, the ROV encountered a contact between the chalk layer and a red-brown siltstone. Platey fracture marks and tabular debris revealed layering in the siltstone. We observed bamboo coral (*Keratoisis*) and *Paragorgia ?johnsoni* colonies and a corallimorpharian on the rock here. At 1374 m the ROV reached the gently sloping canyon top and moved back into a soft-sediment environment. On the sediments was a Fathead (*Cottunculous ?thomsoni*), sea pens, and many xenophyophores. A second trial of the sediment probe indicated > 80 cm of sediment on the cliff top. This trial marked the end of the dive.

#### **Other species observations:**

This was the most diverse of the first four canyon dives in terms of number of fish species observed (n=15); species list of fish observations was provided by shore-based scientist Peter Auster: Cutthroat eel (*Synphobranchus* sp.), Skate (Rajid), Cusk eel (sp 1), Cusk eel (*Dicrolene*), Cusk eel (?*Brotulotaenia*), Grenadier (sp 1), Marlinspike Grenadier (*Nezumia*), Chimaera (*Hydrolagus*), Halosaur (*Aldrovandia*), Blue hake (*Antimora rostrata*). Oreo (*Neocyttus helgae*), Longfinned hake (*Urophycis chesteri*), Black dogfish (*Centroscyllium*), Rockling (?*Gaidropsarus*), Fathead (*Cottunculous*)

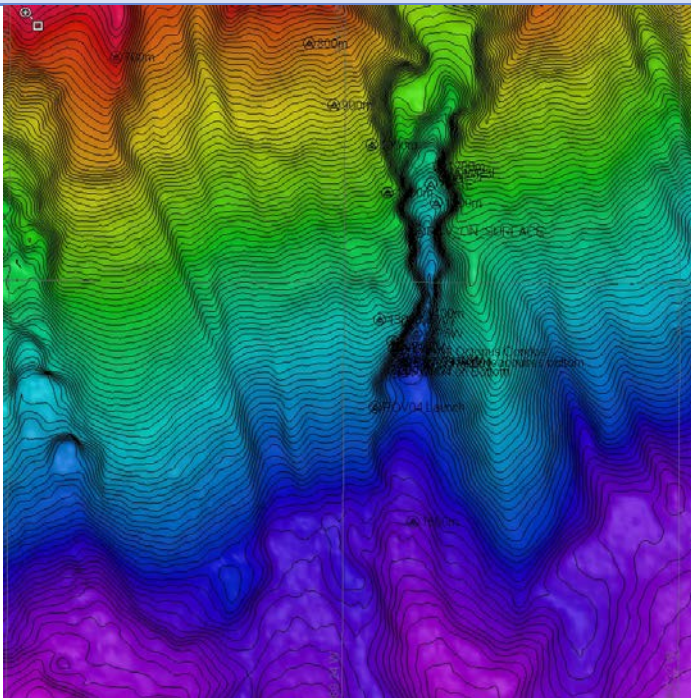
Cnidaria: seapens (?*Distichoptilum*); black corals (*Bathypathes*, *Telopathes*), Edwardsiidae, Hormathiidae, *Actinernus* sp., ?*Bolocera* and venus fly trap (?*Actinoscyphia* or *Paraphelliactis*) anemones; cerianthid tube anemones; hydromedusae (? *Probosciodactyla stellata*)

Crustacea: red crab (*Chaceon*), king crab (*Neolithodes*), lophogastrid shrimp, Nematocarinidae,

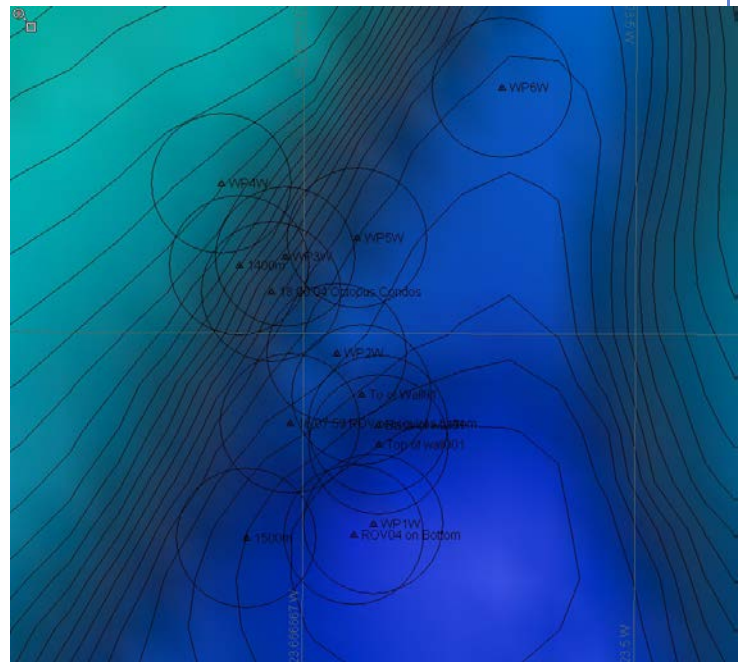
**Interesting highlights:** Laterally-continuous zone of large, deeply-eroded caves holed out of a less resistant chalk layer and home to numerous octopi ("Octopus Grotto"), contact between lower chalk unit and upper red-brown siltstone unit at 1385 m (vs. 1465 m in Hendrickson canyon).

The ROV left the bottom at about 1930 UTC from 1195 m.

**Overall Map of ROV Dive Area**

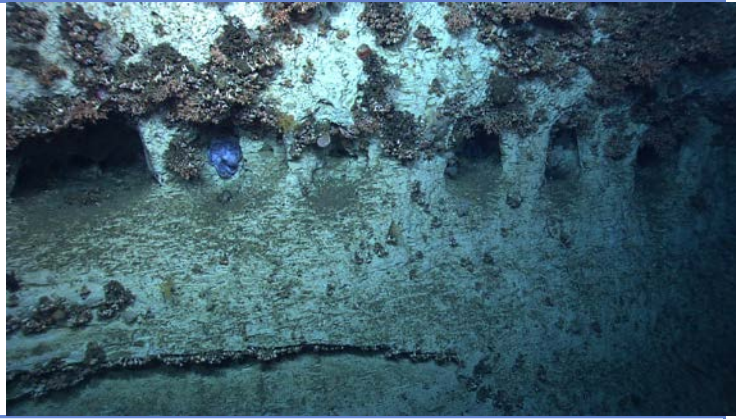
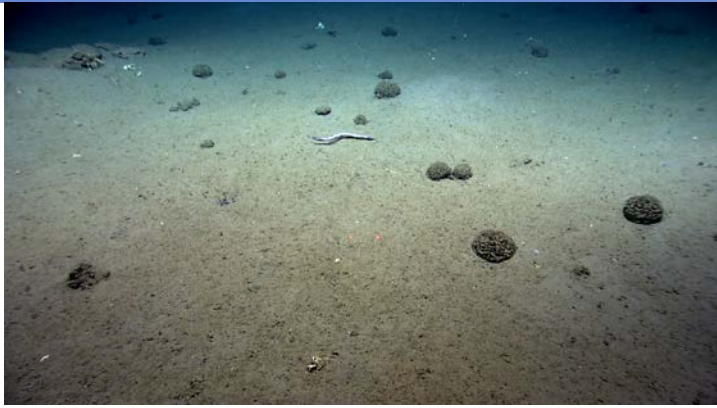


**Close-up Map of Main Dive Site**



**Representative Photos of the Dive**





**Please direct inquiries to:**

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