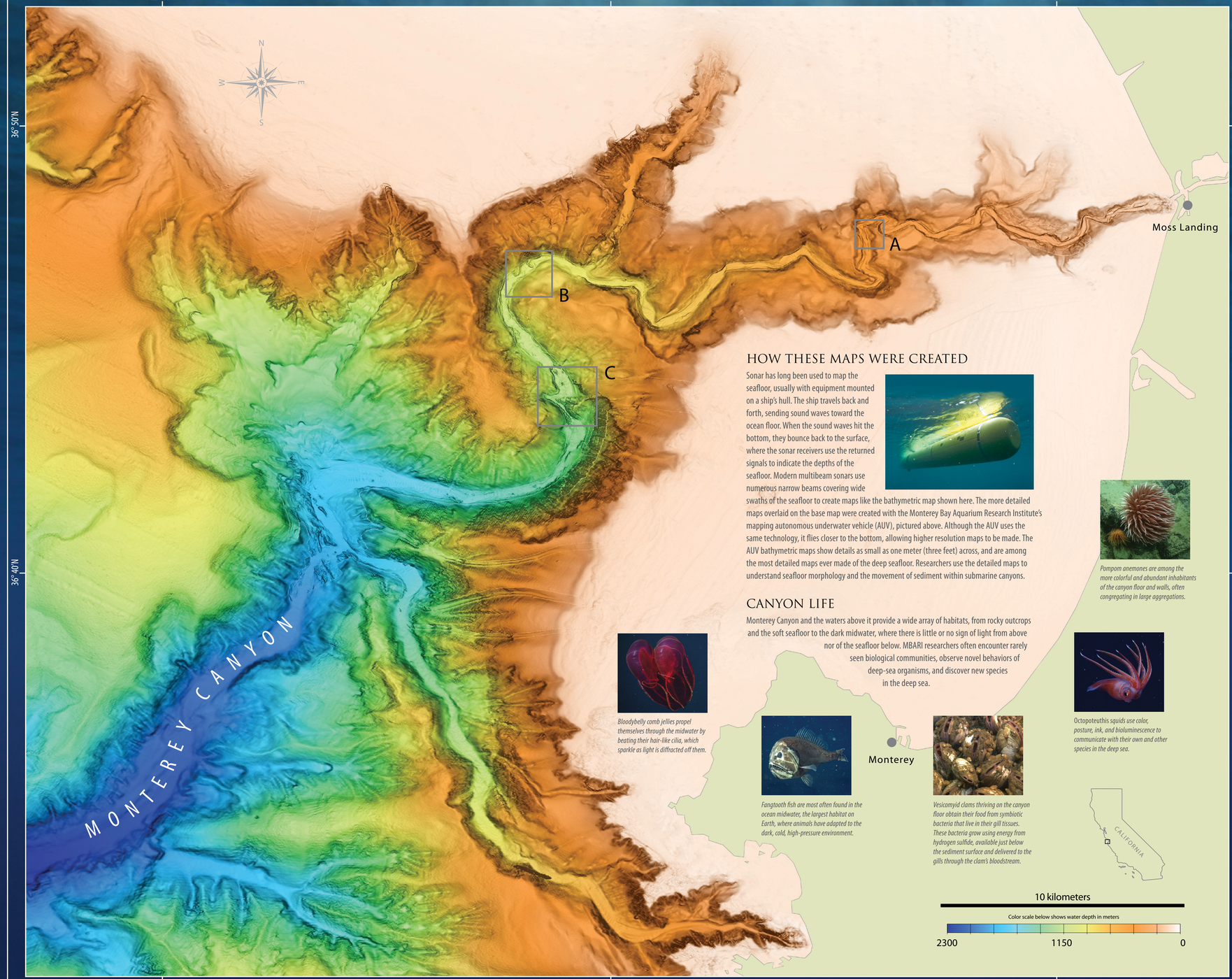
MONTEREY CANYON

Stunning deep-sea topography revealed

MBARI



HOW THESE MAPS WERE CREATED

Sonar has long been used to map the seafloor, usually with equipment mounted on a ship's hull. The ship travels back and forth, sending sound waves toward the ocean floor. When the sound waves hit the bottom, they bounce back to the surface, where the sonar receivers use the returned signals to indicate the depths of the seafloor. Modern multibeam sonars use numerous narrow beams covering wide swaths of the seafloor to create maps like the bathymetric map shown here. The more detailed maps overlaid on the base map were created with the Monterey Bay Aquarium Research Institute's mapping autonomous underwater vehicle (AUV), pictured above. Although the AUV uses the same technology, it flies closer to the bottom, allowing higher resolution maps to be made. The AUV bathymetric maps show details as small as one meter (three feet) across, and are among the most detailed maps ever made of the deep seafloor. Researchers use the detailed maps to understand seafloor morphology and the movement of sediment within submarine canyons.

CANYON LIFE

Monterey Canyon and the waters above it provide a wide array of habitats, from rocky outcrops and the soft seafloor to the dark midwater, where there is little or no sign of light from above nor of the seafloor below. MBARI researchers often encounter rarely seen biological communities, observe novel behaviors of deep-sea organisms, and discover new species in the deep sea.

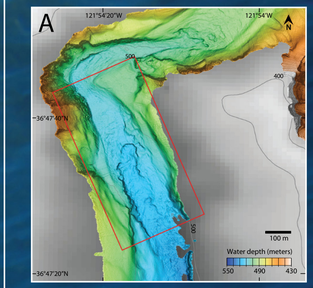
Pompom anemones are among the more colorful and abundant inhabitants of the canyon floor and walls, often congregating in large aggregations.

Bloodybelly comb jellies propel themselves through the midwater by beating their hair-like cilia, which sparkle as light is diffracted off them.

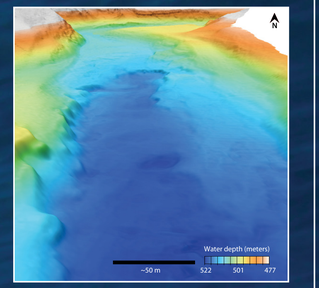
Fangtooth fish are most often found in the ocean midwater, the largest habitat on Earth, where animals have adapted to the dark, cold, high-pressure environment.

Vesicomyid clams thriving on the canyon floor obtain their food from symbiotic bacteria that live in their gill tissues. These bacteria grow using energy from hydrogen sulfide, available just below the sediment surface and delivered to the gills through the clam's bloodstream.

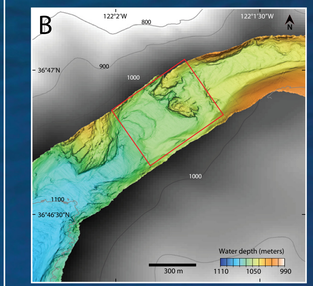
Octopoteuthis squids use color, posture, ink, and bioluminescence to communicate with their own and other species in the deep sea.



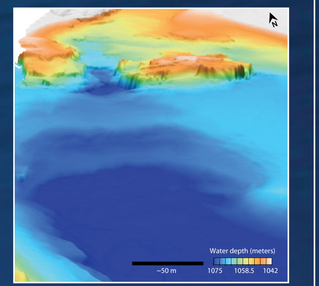
The Monterey Canyon floor near 500 meters water depth, where a nearly right-angle bend in the axial channel occurs. The resolution of the AUV multibeam data reveals features on the canyon floor that have never been seen before. Red box shows area covered in perspective view to the right.



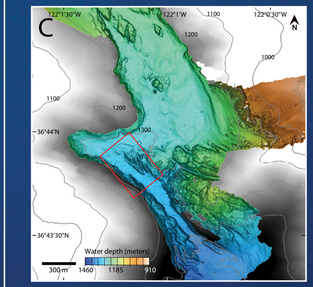
Perspective view shows scarps within the canyon floor.



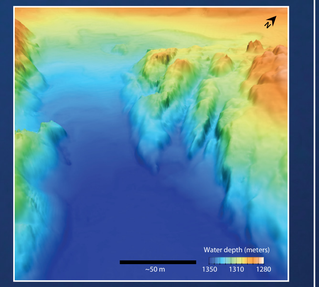
The Monterey Canyon floor at 1,060 meters water depth, where the channel is constricted by bedrock that juts out of the seafloor. Downstream of the outcrops are two scarps on the canyon floor. Red box shows area covered in perspective view to the right.



Perspective view looking up-canyon at the two scarps and narrow constriction illustrating the complexity of the canyon floor morphology.



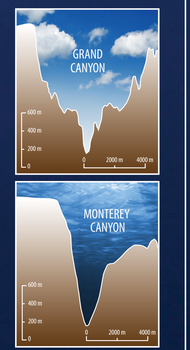
The Monterey Canyon floor near 1,300 meters water depth, where the axial channel takes a sharp turn around a distinct rocky outcrop. Upstream of the turn the channel is more than 500 meters wide; after making the turn, it narrows to a trough with nearly parallel sidewalls and is as little as 38 meters wide. Red box shows area covered in perspective view to the right.



Perspective view of isolated slabs of rock which rise as much as 50 meters above the canyon floor on the flanks of the narrow channel. Such detail can only be visualized with these state-of-the-art tools.

ABOUT THE CANYON

Monterey Canyon is one of the deepest submarine canyons on the west coast of the United States. The canyon head lies just offshore of Moss Landing on the Central California coast, from where the main channel meanders over 400 kilometers seaward to a depth of more than 4,000 meters on the abyssal plain. Repeated mapping in certain areas of the canyon have shown that the terrain changes substantially every few months due to large sediment-transport events involving both debris flows and turbidity currents. If the water drained from Monterey Bay, the newly revealed terrain would be stunning, with cliffs, gorges, valleys, and spires matching the scenery found in some of our most beautiful national parks.



Right: Cross-sections of the Grand Canyon (top) and Monterey Canyon (bottom) shown at the same scale demonstrate that these features are similar in size and shape. Both canyons are conduits through which massive volumes of sediment move. While water flowing in the Colorado River carved the Grand Canyon, a directly analogous process is not known to have occurred within Monterey Canyon.

Reference: Paull, C.K., D.W. Caress, W. Ussler III, E. Lundsten, and M. Meiner-Johnson (2011). High-resolution bathymetry of the axial channels within Monterey and Soquel submarine canyons, offshore Central California. *Geosphere*, **7**: 1077-1101, doi: 10.1130/GES00636.1. • www.mbari.org •