When most people think of “coral reefs,” they tend to envision beautiful blue water, warm temperatures and a tropical environment.

But did you know hundreds to thousands of meters below the sea surface, where temperatures can drop to 4 degrees Celsius and sunlight no longer reaches, we still find corals – as well as a host of marine species. From sea stars to octopus to fishes, the deep sea is home to a diversity of marine life that have adapted to survive despite cold temperatures, extreme pressure, and no sunlight.

Deep-sea corals can be as colorful and diverse as their shallow-water counterparts, however, because of the lack of sunlight, deepwater corals obtain energy by using their tentacles to capture prey rather than through photosynthesis. Just like shallow water coral reefs, deepwater reefs provide habitat and shelter for many marine organisms, including sea stars, crabs, and fishes.

Our benthic ecology lab at the U.S. Geological Survey’s Wetland and Aquatic Research Center, studies organisms at the bottom of the ocean, also known as benthos. We are especially interested in the microscopic critters that live in the seafloor mud, also known as sediment, around important deepwater habitats like coral reefs. However, conducting research in these hard-to-reach sites at the bottom of the ocean requires coordination between a team of scientists, engineers, and a ship’s crew.

We work with partners to organize multi-week research expeditions aboard scientific research vessels, like the R/V Atlantis, operated by the Woods Hole Oceanographic Institution.

Once we load all of our gear and science supplies onto the ship, we head out to sea where most of our study sites are found.

Humans can’t withstand the pressure or temperatures in the deep sea, so we rely on a lot of different tools and technologically advanced machines to help us observe and collect samples from the seafloor.

A CTD or conductivity temperature depth sensor is deployed over the side of the ship and is used to collect water samples and data throughout the water column…

We also use underwater robots to access these environments. Remotely operated vehicles or ROVs - like the Jason, which is operated by the Woods Hole Oceanographic Institution - are piloted by someone at the surface and typically carry cameras and lights, as well as other tools that help collect information – like water conditions and temperature - and samples – like rocks and coral fragments - from the seafloor.

Sometimes, we can make the dive down to the deep in a submersible, like the Alvin, operated by Woods Hole Oceanographic Institution and owned by the U.S. Navy. Using the Alvin, three people, usually one pilot and two scientists, can dive up to 4,500 meters deep for up to 10 hours. ROVs and submersibles usually have a manipulator arm that can be used to pick up rocks and animals and collect deep-sea sediment using push cores. These push cores are about a foot tall.
and provide a vertical profile of the deep-sea sediment. The manipulator arm places the core into the sediment in a spot of interest to the team of scientists, for example, near deep-sea coral or deep-sea mussel beds as seen here. The pilot then uses the manipulator arm to gently remove the core and place it into a secure carrying container so it can return safely to the surface.

Once a sediment push core arrives on the deck of a ship, scientists look it over, recording various features, like the height of the sediment in the core, changes in color, and any noticeable cracks or disturbances in the sediment. After observations are recorded, the sediment core is sliced and diced. Most of the animals are found in the first 10 cm of the core, so we separate the core into 3 sub-sections: 0-2 cm, 2-5 cm, and 5-10 cm.

These sediment fractions are stored in Nalgene bottles and preserved until they can be worked up. A chemical called Rose Bengal is a stain that when added to the sample, turns the animals (and preservative) pink, making them easier to see under the microscope.

At the lab, we sieve the sediment under gentle running water to help remove extra sediment and animals that are far too small to observe even under a microscope.

We then sort the remaining material underneath a microscope, and count and identify all of the tiny critters we find.

Animals we commonly find include worms; crustaceans like tanaids, isopods, copepods, and amphipods; gastropods like snails; bivalves like mussels and clams.

These animals might be tiny, but they play an important role in the ocean. They help with nutrient cycling and are part of the oceanic food web because a lot of larger animals, including economically important species, use them for food. Deep-sea benthos can also act as environmental indicators, giving us an idea of how deep-sea ecosystems respond and potentially recover following a disturbance event, like an oil spill.

As part of our deep-sea research program, we are also studying deep-sea coral specimens to see if we can mimic the conditions they need to survive in our lab. The more we know about these corals and the animals that rely on them, the better we can inform the management and conservation of these deep-sea resources.

Our ocean is so important. It provides half of the oxygen on our planet, helps regulate temperature and weather, and supports a diversity of organisms, including those that humans rely on for food. Yet, more than 80 percent of our ocean, including the deep sea, remains unexplored. Our team of USGS scientists, experts in fields like chemistry, ecology, geology, microbiology, genetics, and paleobiology, continue to explore this unknown world, a world that has rarely – if ever – been seen by the human eye. Each field expedition brings our scientists face-to-face with something new, and we continue to work with our partners to learn as much as possible about these important yet understudied deep-sea ecosystems and organisms.
For more information on USGS deep-sea research, please visit [USGS DISCOVRE](https://www.usgs.gov/centers/wetland-and-aquatic-research-center-warc/science/discover-diversity-systematics-and?qt-science_center_objects=0#qt-science_center_objects).