

Exploration of the Pacific Remote Islands Marine National Monument

Kingman Reef, Palmyra Atoll, and Seamounts of the Surrounding US EEZ

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For the first time since 2019, *E/V Nautilus* returned to the northern Line Islands region of Kingman Reef and Palmyra Atoll within the Pacific Remote Islands Marine National Monument (PRIMNM). Using ROVs *Hercules* and *Argus*, the expedition completed a total of eight dives to seafloor depths ranging between 659 m and 3,771 m, targeting previously unexplored seamounts and ridges. The original expedition plan focused on exploring sites external to the PRIMNM within the US exclusive economic zone (EEZ), but poor sea state conditions associated with strong trade winds forced operations into southern portions of the Monument. Six ROV dives occurred within the boundaries of the PRIMNM, and two dives targeted newly mapped seamounts northwest of Kingman Reef (Figure 1). The deepest ROV dive to date (to 3,771 m) in the Kingman and Palmyra Unit of the PRIMNM was H1908 on an unnamed seamount south of Palmyra Atoll. Seafloor mapping operations were

conducted throughout the expedition, typically during transits between ROV dive sites, but also to fill mapping gaps when weather conditions did not permit ROV operations. In all, 19,507 km² of seafloor were mapped, including never-before-mapped seamounts, and 11,453 km² of the total were within US EEZ boundaries.

Across 95 hours of ROV bottom time, 80 biological, 37 geological, and 24 water samples for environmental DNA (eDNA) were recovered. Biological samples primarily consisted of deep-water corals, sponges, and other invertebrate megafauna, along with associated commensal organisms. Collections of corals and sponges revealed unknown but characteristic species of a site, potential range extensions of known taxa, and species unknown to science. At least one candidate new species of coral in the genus *Calyptrophora* has since been identified from a specimen collected near Kingman Reef at 1,375 m depth.

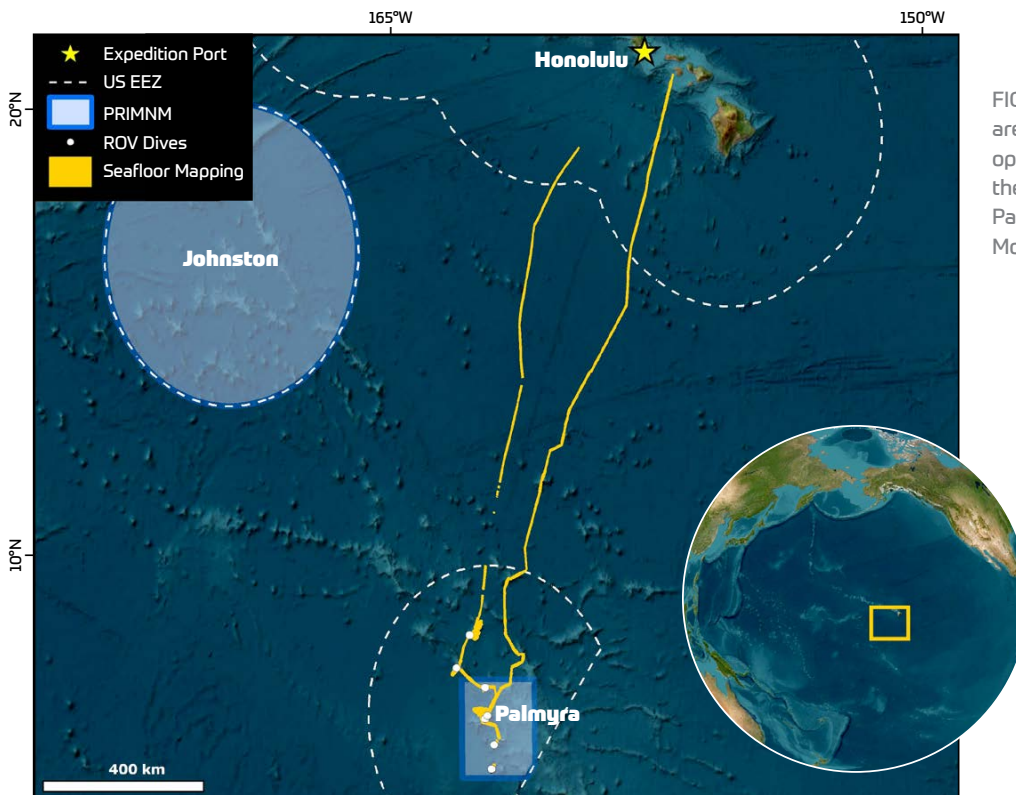


FIGURE 1. Map showing the locations of areas mapped by *E/V Nautilus* and ROV operations during expedition NA137 to the Kingman and Palmyra Unit of the Pacific Remote Islands Marine National Monument (PRIMNM).



FIGURE 2. Enigmatic geological stratification across a steep rocky face observed at dive site H1912. These observed layers may indicate turbidites deposited after a slump or slope failure.

Geological sampling targeted rocks that can provide insights into the geological context for the Northern Line Islands region and information about ferromanganese crust geochemistry. With the exception of a shallower dive site at Kingman Reef, the seafloor environment was dominated by ferromanganese-coated pillow lavas, sheet flows, and occasional enigmatic rock formations (Figure 2). Of the 37 geological samples collected, 11 contained abundant clinopyroxene, plagioclase, and amphibole phenocrysts. They are currently being processed for age determinations using $^{40}\text{Ar}/^{39}\text{Ar}$ geochronology and whole rock geochemistry.

Interesting findings included a conglomerate from an unnamed guyot (dive H1911) that contained sub-rounded basalt clasts and fresh amphibole in the matrix. Amphibole was also found in a volcanic sample collected during dive H1913 on an unnamed guyot. This mineral has rarely been identified in *Nautilus* cruise samples from the Kingman/Palmyra area.

Analyses of biological and geological collections from this expedition support various regional research projects. Geochemistry work is ongoing, using samples to compare crust accumulation and composition to others previously collected from the Pacific Islands Region. Six rocky crust fragments were sampled to enable DNA sequencing of microbial communities living within them. DNA from bamboo coral specimens are being sequenced to explore the biodiversity of this taxonomic group across the Central Pacific. Finally, eDNA obtained from filtered seawater captured adjacent to high-density deep-water coral communities, as well as collected coral tissues, are being sequenced to support the development of eDNA characterization tools and a genetic reference library for the Central Pacific.

High-density coral and sponge communities were observed to be patchy across the seafloor landscapes, but were encountered at each ROV dive site, including at Kingman Reef and off the southwest of Palmyra

FIGURE 3. An image taken by ROV *Hercules* shows a dense and diverse coral and sponge community often associated with vertical surfaces at an unnamed seamount north of Kingman Reef in the PRIMNM.



Atoll. Bamboo corals (Keratoisidae), several primnoid coral genera (primarily *Calyptrophora* spp., *Narella* spp., *Paracalyptrophora* spp.), golden corals (Chrysogorgiidae), and black corals (multiple families) dominated high-density coral communities. Glass sponges (*Atlantisella* sp., *Poliopogon* sp., *Farrea* spp.) dominated deeper depths, and *Sericolophus* sp. was observed where soft sediment covered the seafloor. A noteworthy observation of the expedition was a high-density and high-diversity community documented on steep vertical slopes and overhangs at an unnamed seamount north of Kingman Reef (Figure 3).

In addition to the science objectives, the expedition focused on education and outreach activities. Educators and scientists conducted 69 ship-to-shore interactions from the *Nautilus* studio broadcast in both Hawaiian language and in English, reaching more than 2,700 students.