Modular Seafloor and Water Column Systems for the Ocean Observatories Initiative Cabled Array

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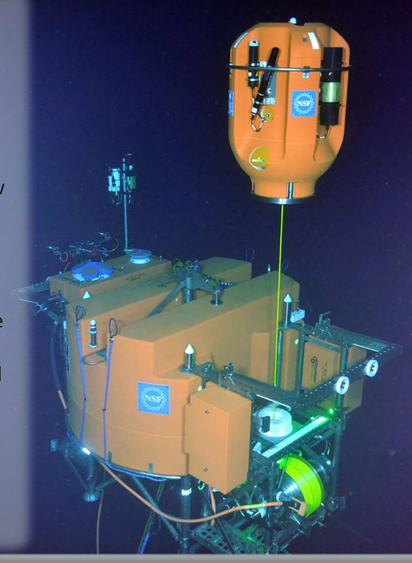
Full Water Column Coverage

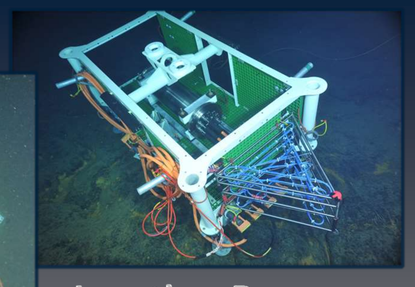
Each of three two-legged moorings incorporates two anchors with tethers that meet at a large floating platform stationed 200m below the surface. One tether is an electro-optical-mechanical cable for power and communications. The mooring platform supports the winched profiler, capable of hosting 15 science instruments, and a dedicated mooring controller.



Winched Profiler & Mooring Platform

Wire-Following Profiler

The deep profiler, operating between the seafloor and 150m water depth, drives up and down a fixed mooring line that doubles as an inductive modem interface for continuous real-time communications. The battery-powered vehicle recharges after several profiles at a custom-built cabled docking station located near the seafloor, where a WiFi link provides higher bandwidth communications for full data retrieval and mission downloads.

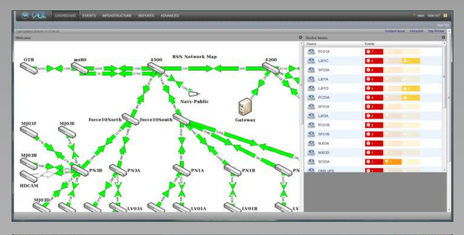


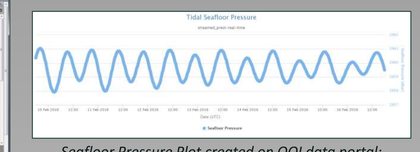
Junction Box

Seafloor junction boxes each support up to 8 instruments, providing isolated power, customized communications and accurate IEEE-1588 timing. Junction boxes can be daisy-chained for added capacity. *Left*) Junction Box mounted in a trawl-resistant frame by Oregon State University, *Right*) Junction Box with mounted thermistor frame, ready for final installation.

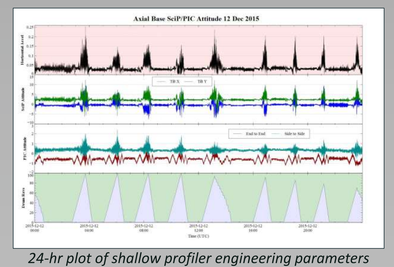
Over the past decade, cabled ocean observatories have become an increasingly important way to collect continuous real-time data at remote subsea locations. This has led to the development of a class of subsea systems designed and built specifically to distribute power and bandwidth among sensing instrumentation on the seafloor and throughout the water column. The Ocean Observatories Initiative (OOI) Cabled Array, funded by the US National Science Foundation, consists of a core infrastructure that includes 900 km of fiber optic/electrical cables, 7 primary nodes, 18 seafloor junction boxes, three mooring-mounted winched profiling systems, and three wire-crawling profiler systems. In aggregate, the installed infrastructure has 200 dedicated scientific instrument ports (of which 120 are currently assigned), and is capable of further expansion. The Cabled Array is powered by shore-based infrastructure and uses networks of fiber optic and electrical cabling that provide real-time data access and control of remotely deployed instrumentation. Seafloor junction boxes, winched profilers, wire-following profilers, and flexible management software applications were developed and/or adapted for cabled use by the University of Washington's Applied Physics Lab in order to complete the installation of the largest North American scientific cabled observatory in Oct, 2014. These represent truly modular and configurable "plug-and-play" observatory-class systems.

Real-Time Management & Data





Seafloor Pressure Plot created on OOI data portal: https://ooinet.oceanobservatories.org/



24-hr plot of shallow profiler engineering parameters

Management software runs on shore, with real-time connections to deployed equipment. The custom-built Element Management System (bottom left) provides status and control of all instrument ports. The Observatory Management System (upper left) displays system-wide status and propagates detected events to operators. All science data is passed directly to the OOI Cyberinfrastructure for public access (upper right). Engineering parameters are collected and evaluated by operators for overall system health monitoring (lower right).

Nearing 2 Years Operational, Ready for Expansion

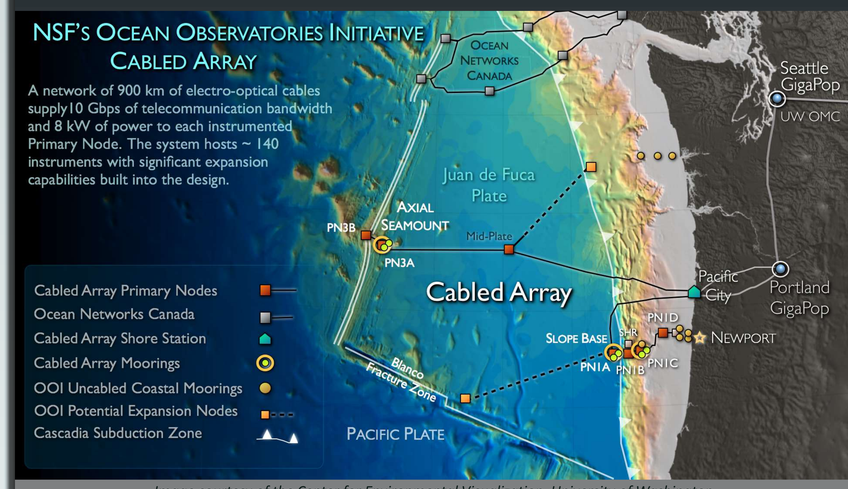
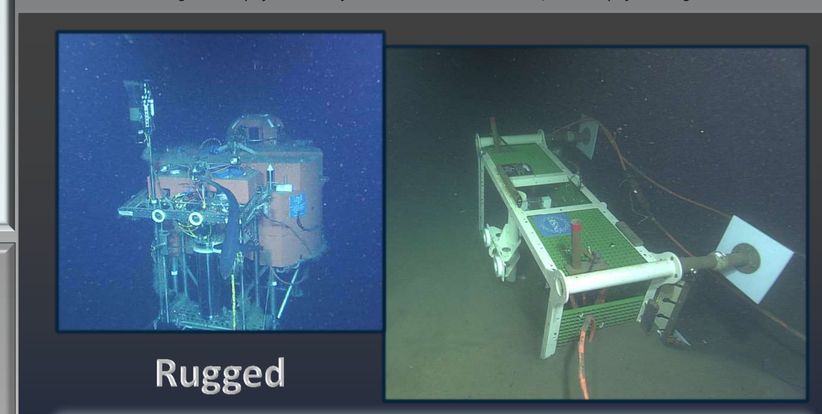


Image courtesy of the Center for Environmental Visualization, University of Washington



Rugged

Deployed junction box and profiler systems have experienced "external aggression" but remain functional. The first annual maintenance was performed in summer 2015. All systems are work-class ROV-serviceable. *Left*) Shark checks out mooring platform at 200m, *Right*) Seafloor junction box pulled onto its side (operators detected change via on-board attitude sensor)

Using only a fraction of its available power and bandwidth, the OOI cabled array has spare instrument and expansion ports and is ready for integration with new systems!

Ready for Expansion

Acknowledgments

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