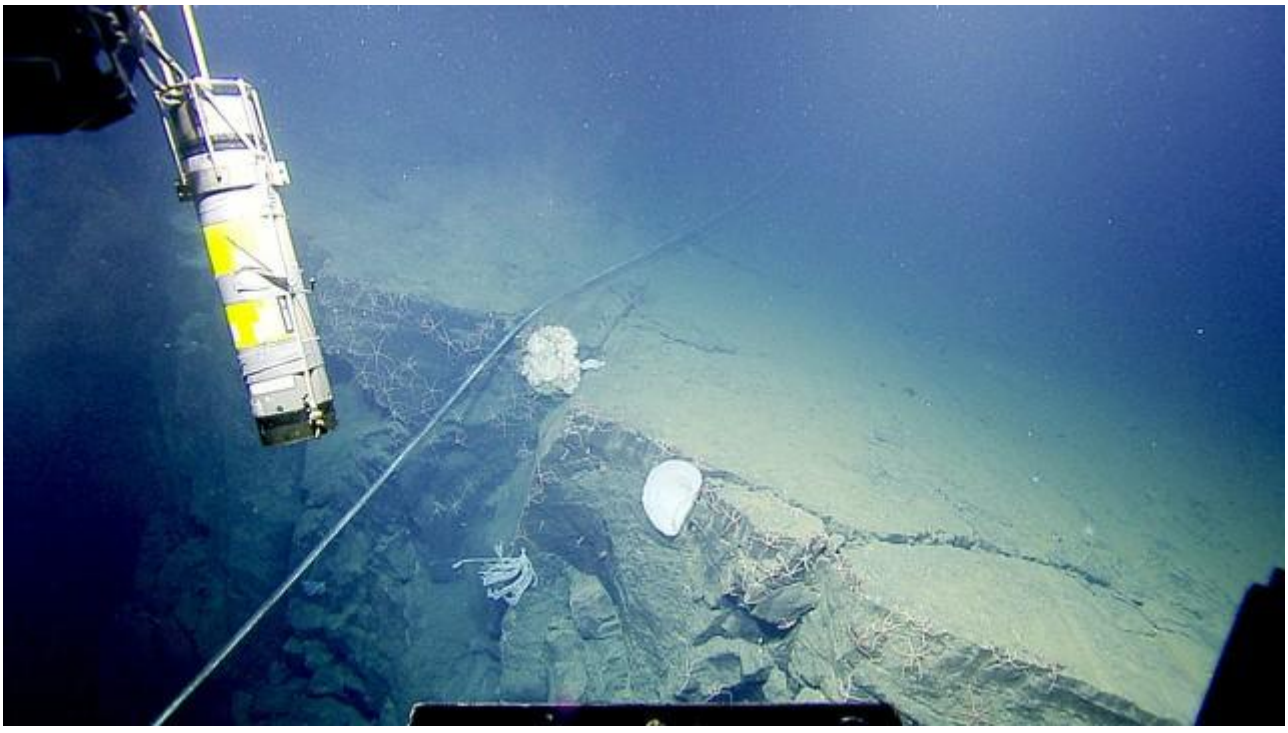
Expedition 2016 Wrap: Bigger Footprint Enables Better Science

Submitted by Max Kasprzik Fri, 2016-07-08 09:08

Ocean Networks Canada?s (ONC) Expedition 2016: Wiring the Abyss returned to port on June 25 after 40 days at sea off the west coast of Canada. This ambitious undertaking involved 149 people aboard three ships, and included three remotely operated vehicles (ROV) making 44 dives to deploy, maintain and recover 180 instruments and lay 18 km of fibre-optic cable. The dynamic 24/7 operations engaged viewers across the world via live stream and featured regular Q&A with scientists, educators and engineers.



All in a day's work: laying cables on the Juan de Fuca spreading ridge.

This successful expedition expanded the footprint of ONC?s cabled NEPTUNE observatory in the northeast Pacific, which will deepen our scientific understanding of the planet.

ONC deployed and connected four seismometers and four regional circulation moorings at the Endeavour segment of the Juan de Fuca ridge, a deep-sea volcanic rift that separates the Pacific and Juan de Fuca tectonic plates. The seismometer on the west flank of the Juan de Fuca Ridge is ONC?s first on the Pacific Plate. The sensors enable a better understanding of this dynamic environment that includes hot vents and a vibrant fauna in Canada?s first marine protected area. In particular, the new seismometer array yields locations and magnitudes of local spreading earthquakes.

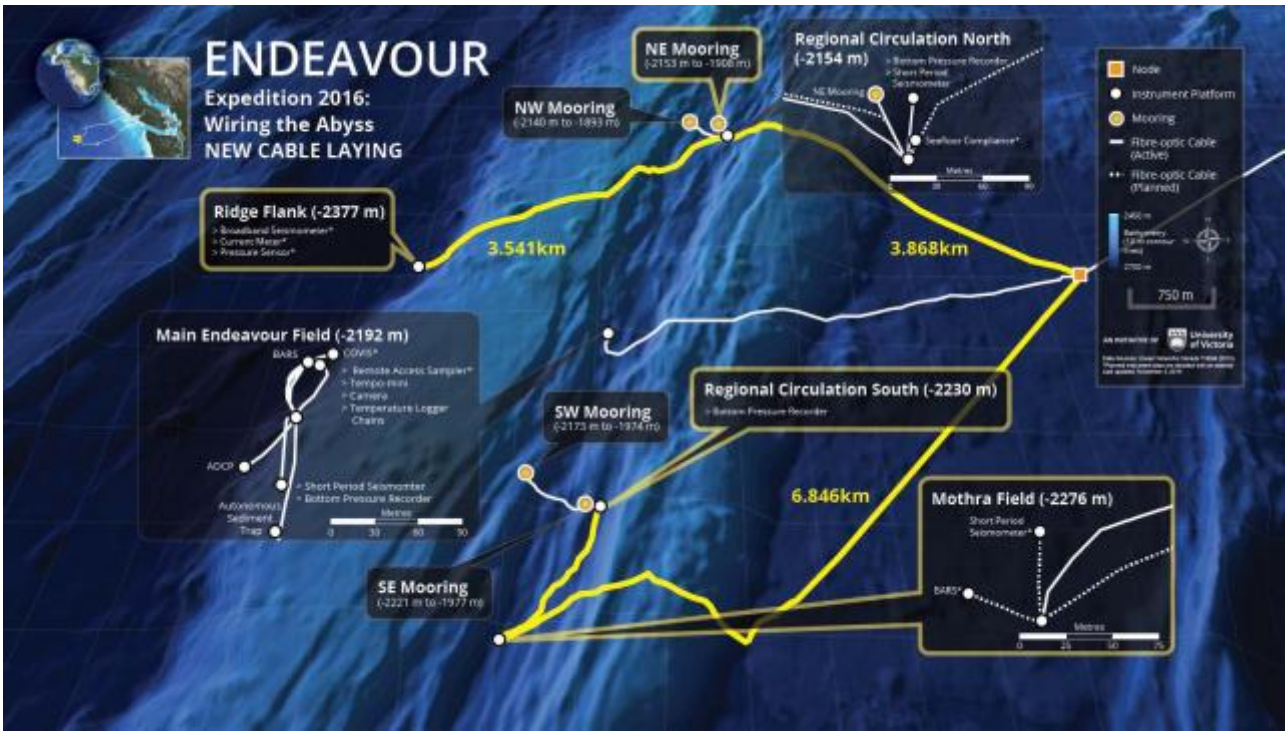
?Congratulations on expanding the seismometer array on the Juan de Fuca ridge to four seismometers. This is an important step in completing the ridge seismometer array, which will allow us to better understand ocean ridge earthquake activity,? says Garry Rogers, Ph.D. Emeritus Research Scientist, Geological Survey of Canada / NRCan / Government of Canada, Adjunct Professor, School of Earth and Ocean Sciences, University of Victoria.

Views of the Endeavour hydrothermal vents from the E/V *Nautilus* control room.

With the help of C/S *Wave Venture*, a total of 18 km of steel-armoured, fibre-optic cable was laid on the ocean floor to connect instruments primarily at Endeavour (15 km) and at Clayoquot Slope (3 km).

?The new cables at the Endeavour mid-ocean ridge will hugely increase our understanding of tectonic or volcanic events along mid-ocean ridges,? comments University of Victoria marine geologist Laurence Coogan, who is ONC's theme leader for "Interconnections Among the Seafloor, Ocean and Atmosphere." The data fed back in real-time will tell us when the ocean floor is cracking, which affects black smoker vent fluid circulation in the deep biosphere. The interconnected nature of these systems with the overlying ocean can even affect the

zooplankton associated with the hydrothermal vent plume at 300 m above the ocean bottom.?



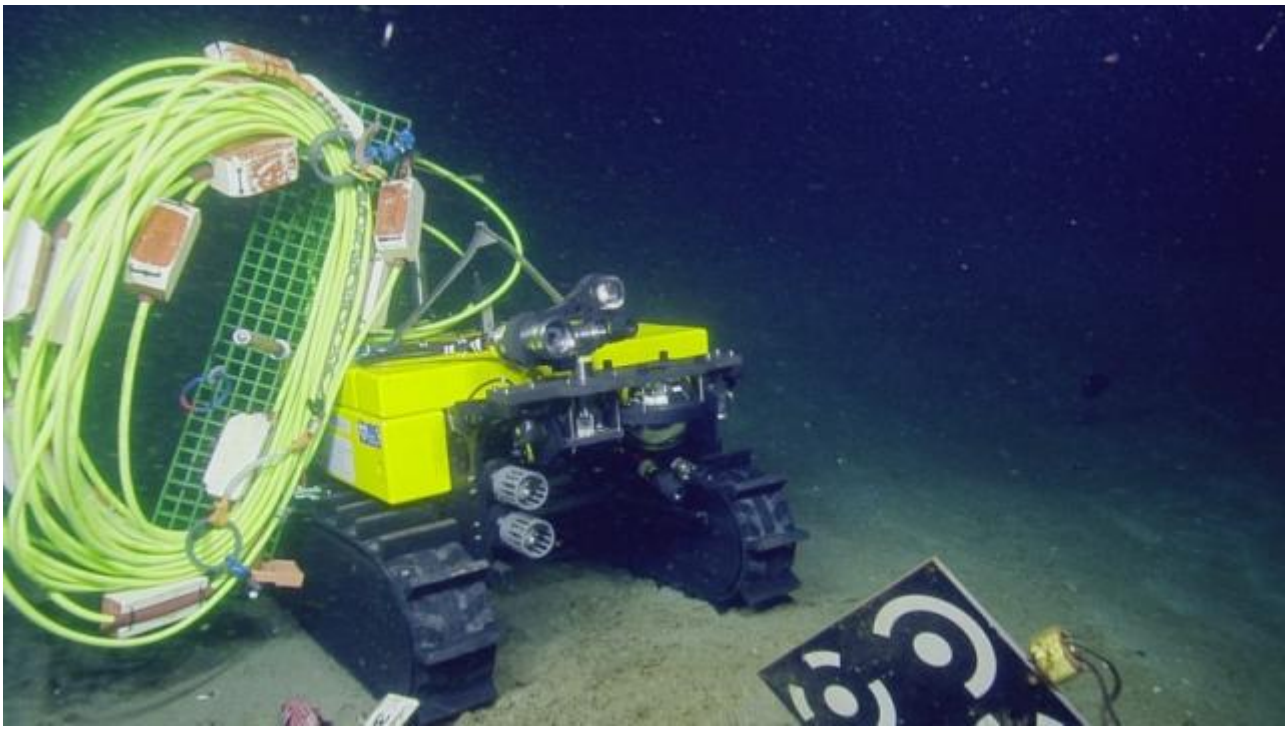
Endeavour now has 15 km of new fibre-optic cables (outlined in yellow).

?We have now realized the challenging vision of a comprehensive suite of observation arrays at sites across Endeavour, one of the most challenging ocean environments on Earth,? comments Richard Dewey, ONC?s Associate Director, Science Services.

A tsunami array that was previously deployed at Cascadia?and suffered from breaks in the fibre optic communication paths?was brought back to life using an innovative new communications solution. Originally proposed by Woods Hole Marine Systems, ONC is now successfully transmitting data to the data management system Oceans 2.0 through copper power conductors. Three bottom pressure recorders are also now transmitting data in real-time.

Round the clock operations on the E/V *Nautilus* with ROV *Hercules*.

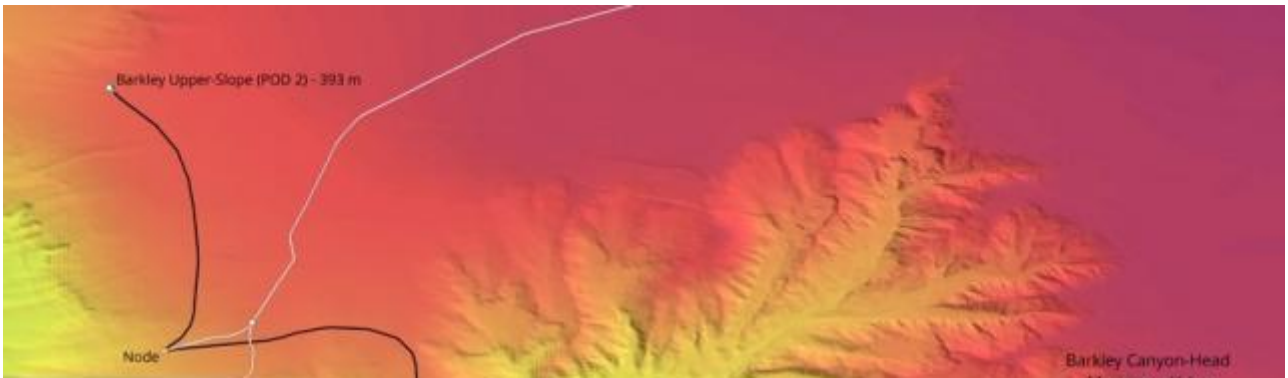
The success of Wiring the Abyss 2016 granted ONC?s science users increased access to the most vibrant marine ecosystem in our cabled observatories. At Barkley Canyon, a redesigned, trawl-resistant node was redeployed and connected, along with an upgraded Wally the Crawler and an autonomous sediment transport mooring at the canyon head, which will allow scientists to better understand the dynamics of shelf-to-canyon exchange processes.



An upgraded Wally has an innovative 3-D imaging system that can detect changes in the seafloor down to a 1 mm resolution.

"Submarine canyons are geographic features on the seafloor, like underwater river valleys that steer deep-water circulation and concentrate biomass and particulate matter,? comments Pere Puig, Institute of Marine Sciences oceanographic geologist who is the ONC theme leader for "Seafloor and Sediment in Motion."

?The existing ONC Barkley Canyon site is located in a water depth of 1000 m, far away from the canyon's shallower rims incising the continental shelf edge. The addition of an autonomous site at one of the canyon head branches will be of great interest for my area of research, which focuses on the ways that sediment moves from the continental shelf down to the deep sea. Other scientists are interested in using the data from this new site to understand the up-welling movement of water from the deepest parts of the canyon up onto the shelf."



The new Barkley Canyon-head mooring will help scientists better understand the shelf-to-canyon exchange process.

ONC?s tenth anniversary expedition also laid the groundwork for an earthquake early warning system, thanks to a $5 million investment from the Government of British Columbia earlier in the year. A new Titan accelerometer at Barkley Canyon was the first of several seismic sensors that will be deployed on the Cascadia subduction zone over the next five years. These sensors will improve the accuracy of primary wave detections that can provide up to 90 seconds of advance warning to British Columbia residents of damaging ground shaking from the secondary wave.

Titan accelerometers are the work-horses of ONC's earthquake early warning system.

This coordinated effort was made possible with the support of new and longtime collaborators who provided ships, ROVs, engineering and expertise. During Leg One, cable solutions were provided by TE SubCom while cable installation was supported by Global Marine?s cable ship C/S *Wave Venture*, which was ?critical to the success of an extremely challenging deployment operation?, according to ONC?s Adrian Round.

The C/S *Wave Venture* working closely alongside E/V *Nautilus*.

In a delicate dance involving two ships maneuvering less than 80 metres apart, the C/S *Wave Venture* achieved a first for ONC by successfully laying 18 km of steel-armoured, fibre-optic extension cable in the deep ocean. The exploration vessel E/V *Nautilus*, along with ROVs *Hercules* and *Argus*, played an important supporting role by monitoring the cable lays while conducting scientific research and providing state-of-the-art telepresence capabilities.

During Leg Two, the University of Alaska?s research vessel R/V *Sikuliaq* paired up with Woods Hole Oceanographic Institute?s newly refurbished ROV *Jason* to deploy the large instrument platforms and sensor packages, and also conducted scientific research.

?As the operator of the R/V *Sikuliaq*, the University of Alaska School of Fisheries and Ocean Sciences is honored and proud to work with ONC, and is particularly pleased to have the opportunity to strengthen this international effort,? says Dr. Bradley Moran, Dean of the University of Alaska School of Fisheries and Ocean Sciences.

The University of Alaska's ice-class R/V *Sikuliaq*

Additional Expedition highlights:

- Sampled and surveyed ocean environments at Endeavour in support of future planned expansions and ONC?s continuing partnership with Fisheries and Oceans Canada, which manages the Endeavour marine protected area.
- Redeployed a mooring in the Juan de Fuca Strait that supports data collection for the Capital Region District of Victoria.
- Recovered and downloaded data from autonomous CTDs (measuring conductivity, temperature and depth, as well as salinity, density and pressure of water) at Barkley Canyon hydrates and the autonomous tsunami metre bottom pressure recorders at Cascadia Basin that included records from the 2015 Chile tsunami.
- Deployed a larval colonization experiment for France?s Ifremer at Endeavour and recovered a larval colonization experiment for the International Network for Scientific Investigation of Deep-sea Ecosystems.
- Gathered deep sea sediment samples as part of the Global Freezer Survey, an initiative led by INDEEP and Oregon State University to collect samples around the globe to map the genetic diversity of deep sea microbes on a worldwide scale.
- Adapted to bad weather by conducting additional multi-beam, echo-sounder surveys which provided critical time series ocean floor mapping at the continental margin, and CTD surveys across Endeavour to track vent plumes.
- Conducted sampling at all sites including water, tubeworms, hagfish, sediment push cores, water column and bottom video surveys.
- Deployed scavenger bait traps for crabs and amphipods to collect grooved tanner crabs to investigate the role of methanotroph bacteria in their diet.
- Conducted methane bubble surveys at Clayoquot Slope.
- Deployed a low-frequency acoustic Doppler current profiler (ADCP) in the Barkley Canyon axis for a full 1 km water current profile.
- Recovered a vertical profiler system, enabling the necessary refurbishment for ONC?s offshore full water column profiling system.
- Recovered shell experiments from Barkley Canyon hydrates.
- Partially recovered the whalebone experiment.

Tags:

- expedition 2016
- R/V Sikuliaq
- C/S Wave Venture
- E/V Nautilus
- NEPTUNE
- Wiring the Abyss
- earthquake early warning
- endeavour
- barkley canyon
- wally

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