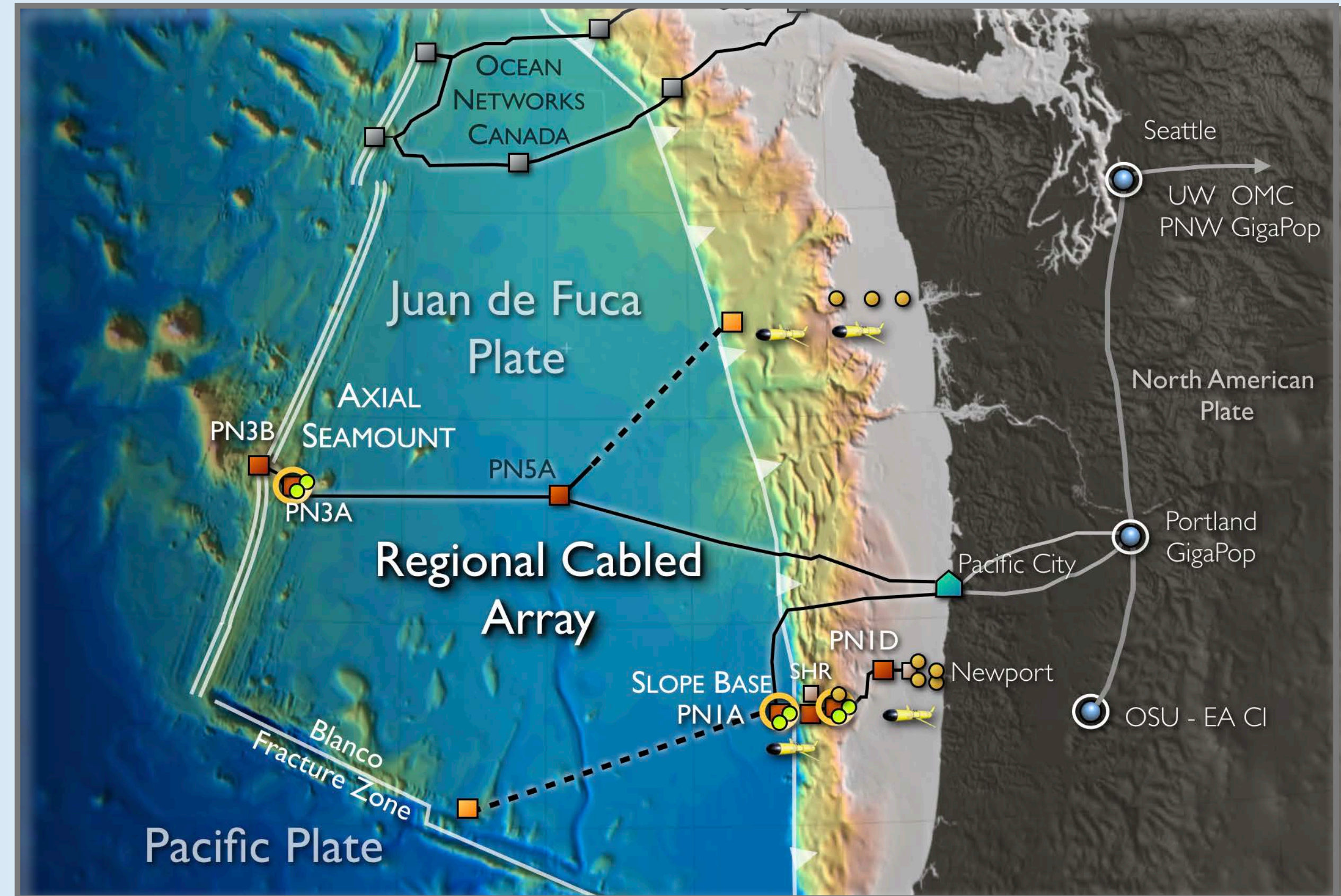


Regional Cabled Array Update OOIFB Meeting

Deb Kelley & RCA Team
October 12, 2023



Regional Cabled Array VISIONS'23 Operations and Maintenance Cruise TN422

August 11 - September 20, 2023

- ▶ Four Legs, 144 Berths, 25 students, 22 48 ft trailers transported 306,000 lbs of gear to-from Newport
- ▶ ROV *Jason* 51 dives over 31 at-sea days
- ▶ Katie Bigham, soon to be Ph.D (U. Wellington) Chief Sci. Leg 4 🎉

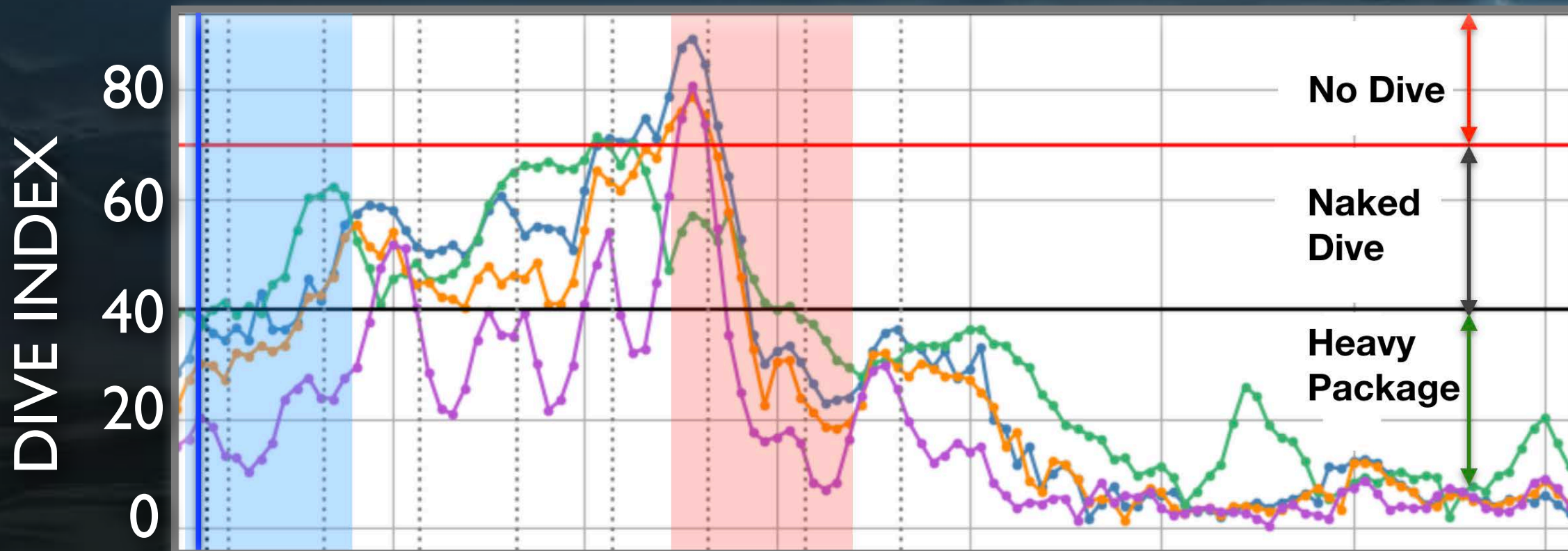
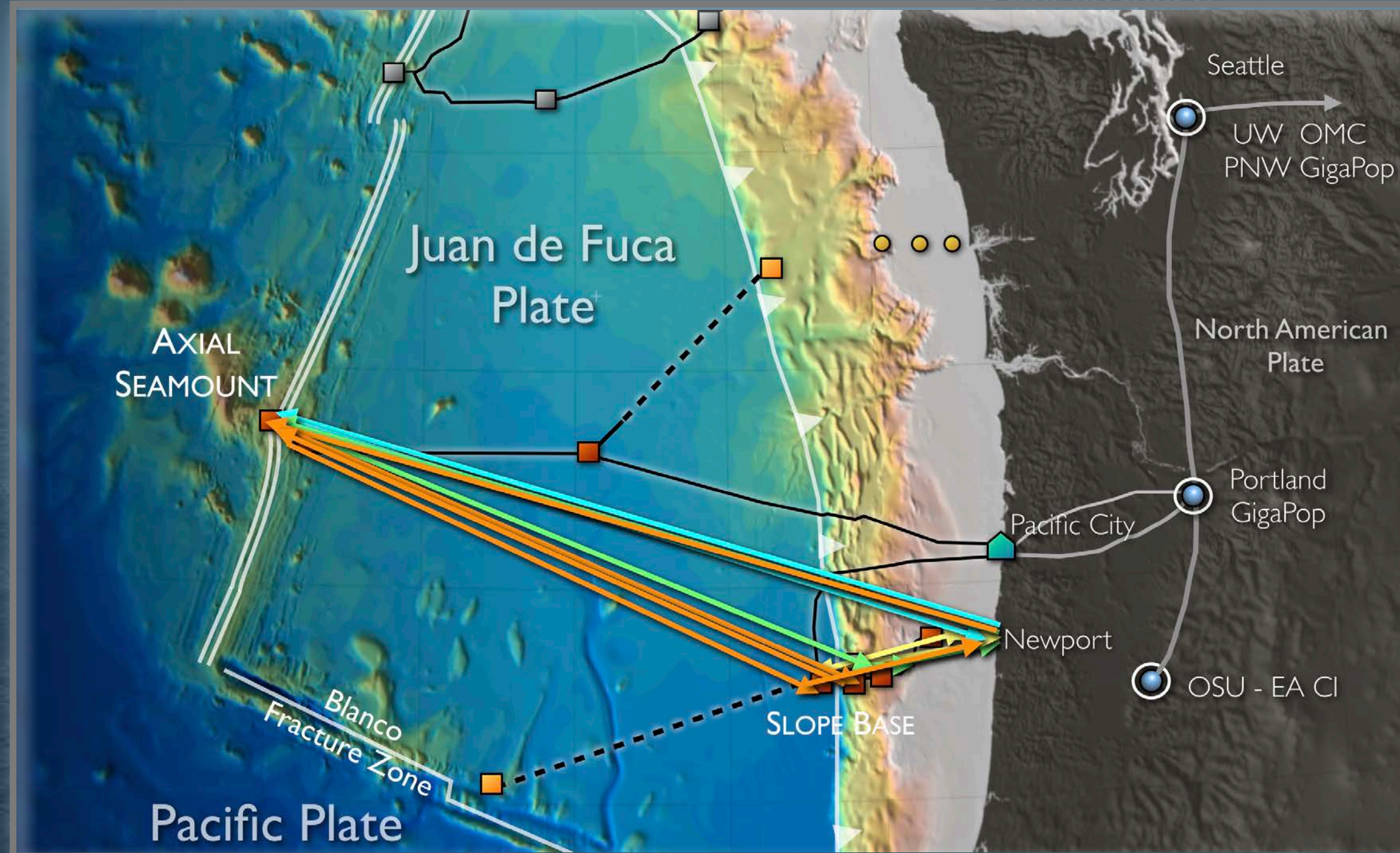


R/V Thompson



ROV Jason

Regional Cabled Array VISIONS'22 Operations and Maintenance Cruise



- 7-8 days lost to weather; *Jason* winch and ROV controller issues, 3 dives lost power, 2 cable terminations, failure of Jetway (ROV power system)
- 2248 Nautical Miles (2587 Miles) transited
- 220 OOI Core instruments recovered and reinstalled
- 3 Instrumented Platform Interface Assemblies and 3 instrumented winched Science Pods turned
- 3 Secondary Nodes, 2 Benthic Experiment Platforms
- 4 PI Instruments turned, 6 PI instruments recovered, 4 PI instruments installed



PI Days and Other Efforts

- ▶ R. Anderson, Carleton College (OCE2045697-Bio) “CAREER: Temporal dynamics of microbial and viral function and adaptation in hydrothermal vents” 5 years. 2 Days*

Rich time-series of microbial and viral metagenomics every 10-20 days for 3 years (RCA cabled in situ microbial DNA sampler)

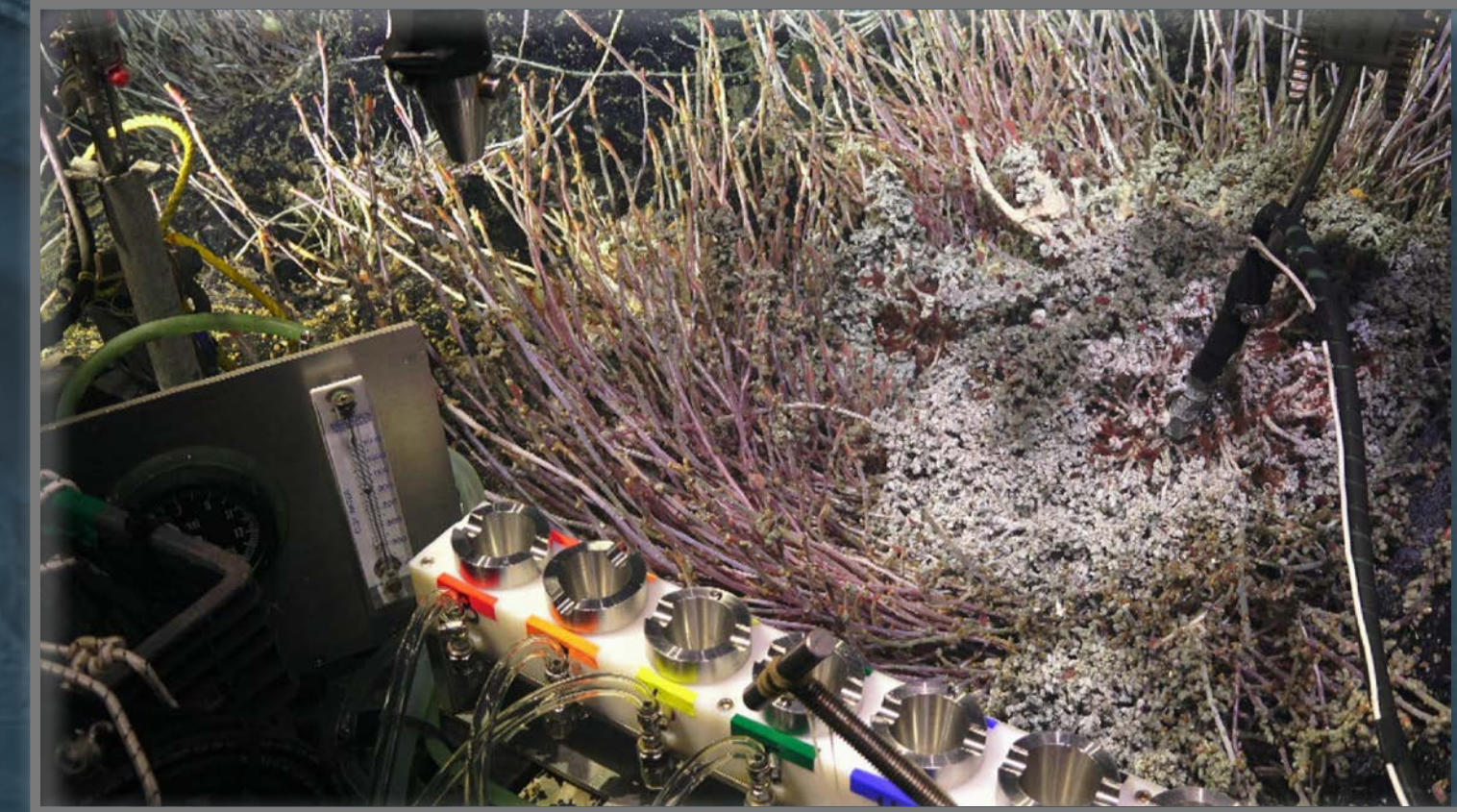
New insights into marine viral ecology in habitats outside commonly studied surface oceans (Universal Fluid Obtainer)

- ▶ K. Bemis, Rutgers University (OCE 1736702) “Collaborative research: Heat flow mapping and quantification at ASHES hydrothermal vent field using an observatory imaging sonar.” 1 Day**

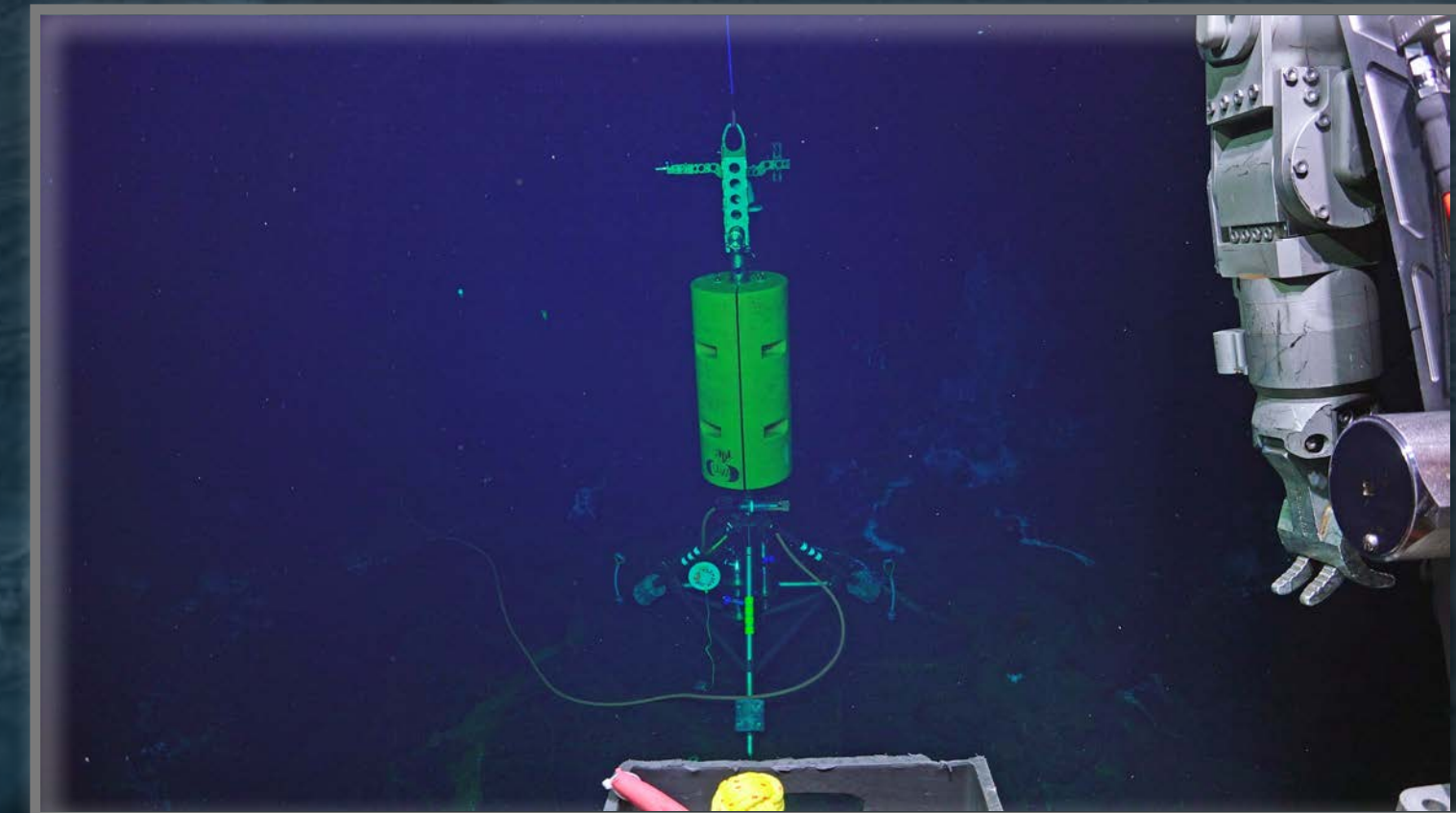
Multibeam sonar operational on the cable since 2018. End of award so required recovery of sonar, sonar reflectors and 50 m of cable

- * Due to weather loss, only 1 day of Andersons work was done - pursued to Leg 4 from leg 1. However, important samples were recovered and processed by the RCA team (A. Paley and J. Nelson - 18 hrs of work)

- ** Due to weather loss 50 m of cable and reflectors are still in ASHES. Will require process development re how to deal with lost PI days - first time



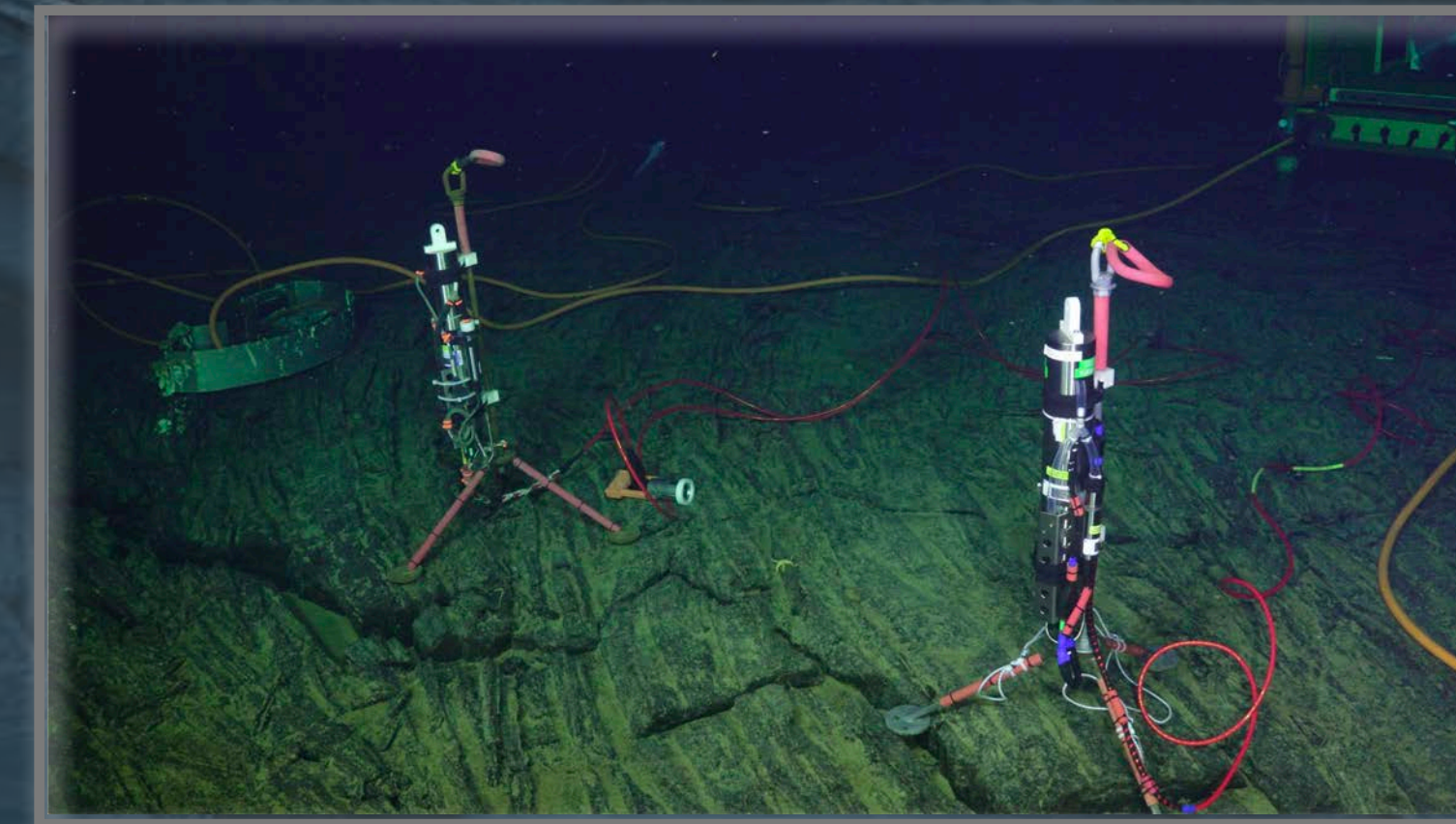
UFO Sampler



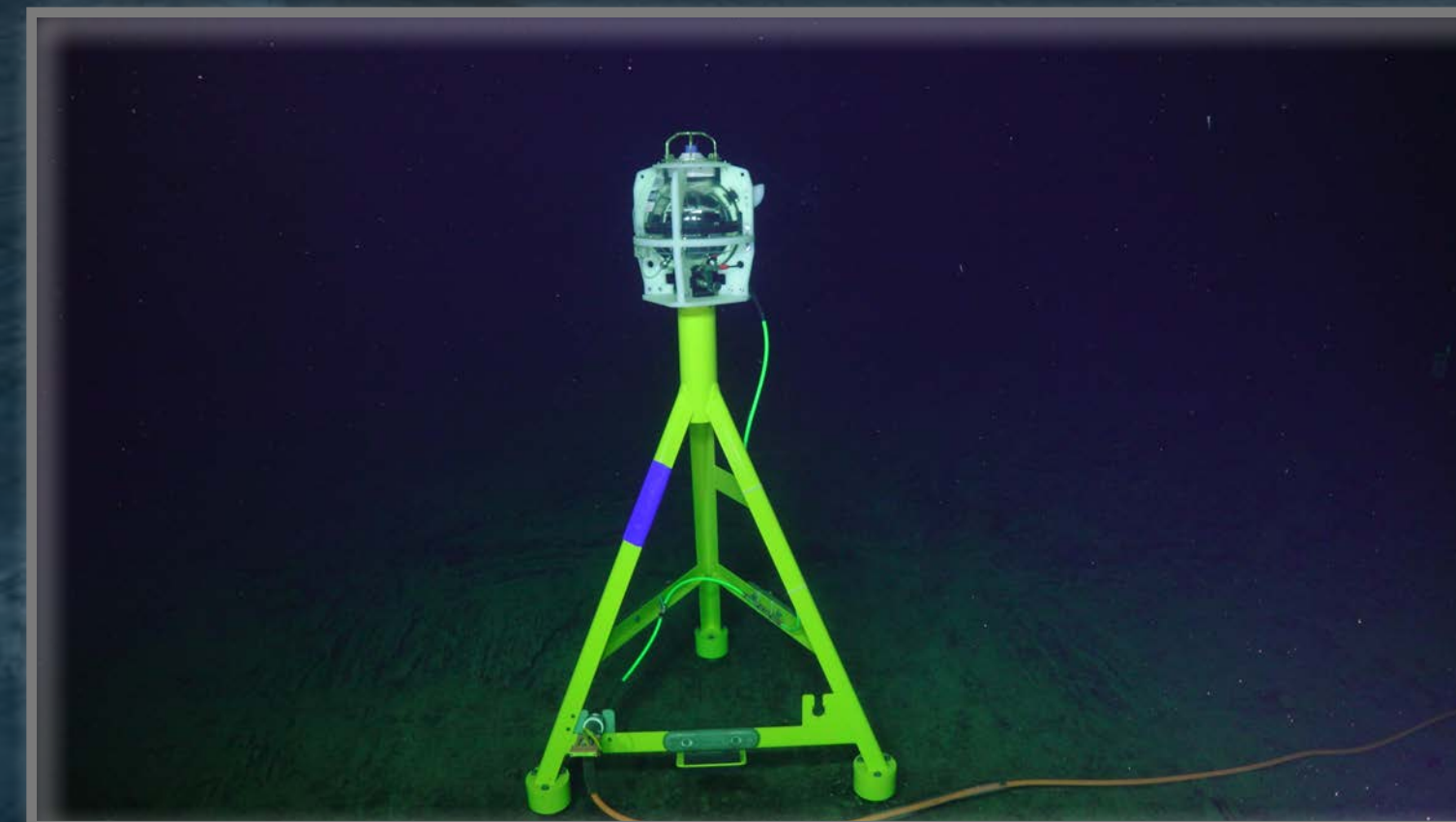
COVIS Sampler

PI Days and Other Efforts

Central Caldera



2022 and 2023 CTDs



Cabled FETCH



- ▶ W. Chadwick (OSU) “Phase 2 of Enhancements to the OOI Cabled Array at Axial Seamount” (OCE-1928282) 2019-2024 1 day

Testing hypothesis subsurface warm brines are released into the caldera following an eruption.

CTD's deployed in 2022 in ASHES Hydrothermal Field, and in Central and Eastern Caldera were turned.

- ▶ W. Wilcock (UW) “An Acoustic Array At Axial Seamount for Geodesy and Autonomous Vehicle Support” (OCE-2130060) 2022-2026 1 day

Utilizing sound waves traveling between stations to measure changes in the horizontal distance between stations - caldera deformation pre, during, post an eruption

Acoustic ranging includes cabled Sonardyne transponder and 3 other transponders. Cabled FETCH was to be recovered, but vendor could not meet delivery. However, all data from the uncabled transponders were downloaded by interrogation from the ship. VISIONS'23 Ph.D student now working on these data.

PI Days and Other Efforts

L. Lapham (U of Maryland) “Collaborative Research: Investigating the source and flux of dissolved organic carbon released from methane seeps to the deep-ocean” (OCE-2049517) 2021-2024

Can you help us - Alvin weathered out at Southern Hydrate Ridge. Would it be possible to install 4 osmotic fluid samplers (has 2 NSF-funded days with RCA in 2024 to recover) Leg 2

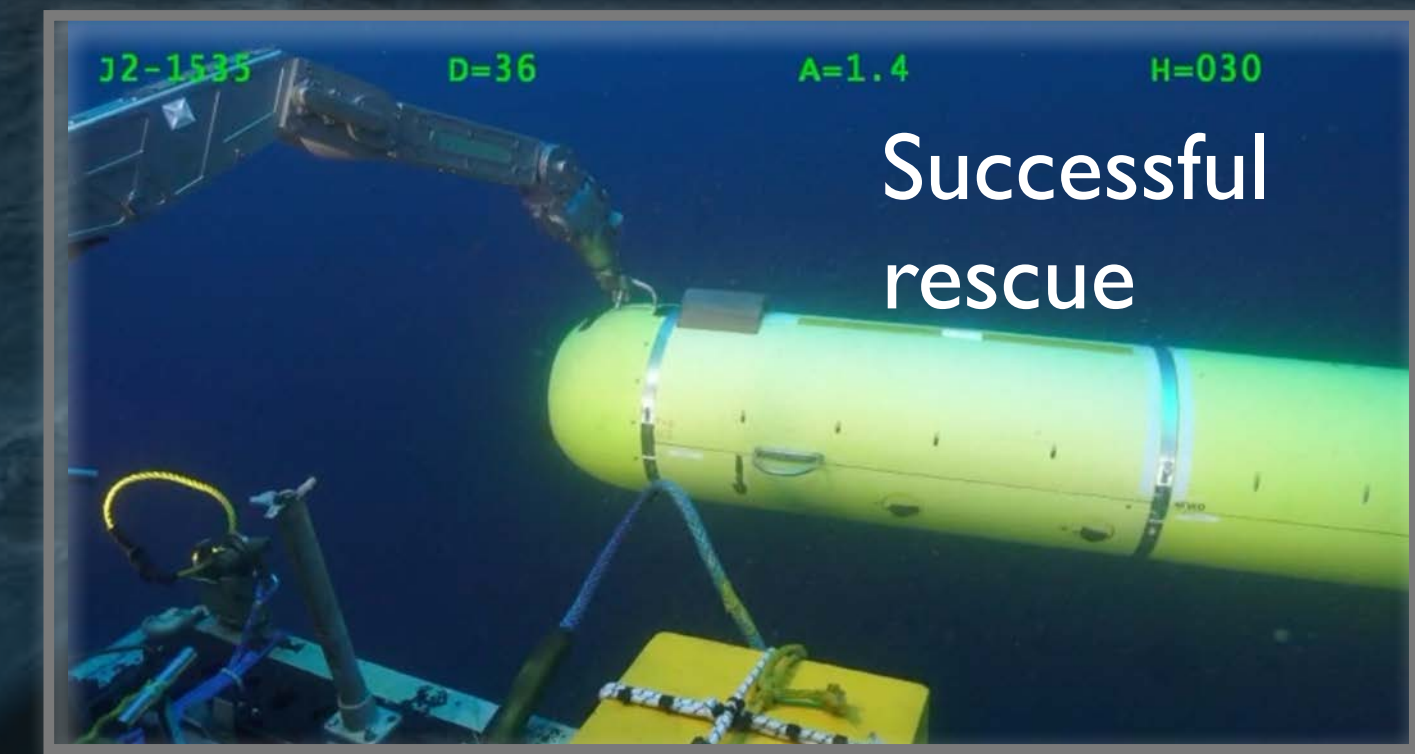
“Sincere thank-you....I am not being overly dramatic when I say that what you all did out there **saved our project**”

W. Chadwick (OSU), S. Nooner (UNC), D. Caress (MBARI), D. Kelley (UW) “Collaborative Research: Multi-scale Geodetic Monitoring at Axial Seamount” (OCE-2226488) 2023-2028

Ship to ship call from D. Caress, R/V Rachel Carson Axial Caldera- Can you rescue our Dorado class AUV (50 m deep) with *Jason* Leg 3

“Thanks to all for the willingness to take the time and risk to save our AUV.

Apologies for inflicting this drama on you on what is otherwise a spectacular day out here.”



VISIONS'23 at Sea Experiential Learning Program

- ▶ 21 Undergraduate students and 4 graduate students participated on the cruise spanning oceanography, engineering, neuroscience, informatics, geology etc.
- ▶ 1 VISIONS'22 undergrad returned as a student "ambassador" to mentor the V23 students
- ▶ 1 VISIONS'22 student returned to work all year in our lab and 2 VISIONS 21 students became RCA technicians, sailing on V23



Andrew Paley

'Gap year' before grad school



Han Weinrich

Microbiology position at NOAA

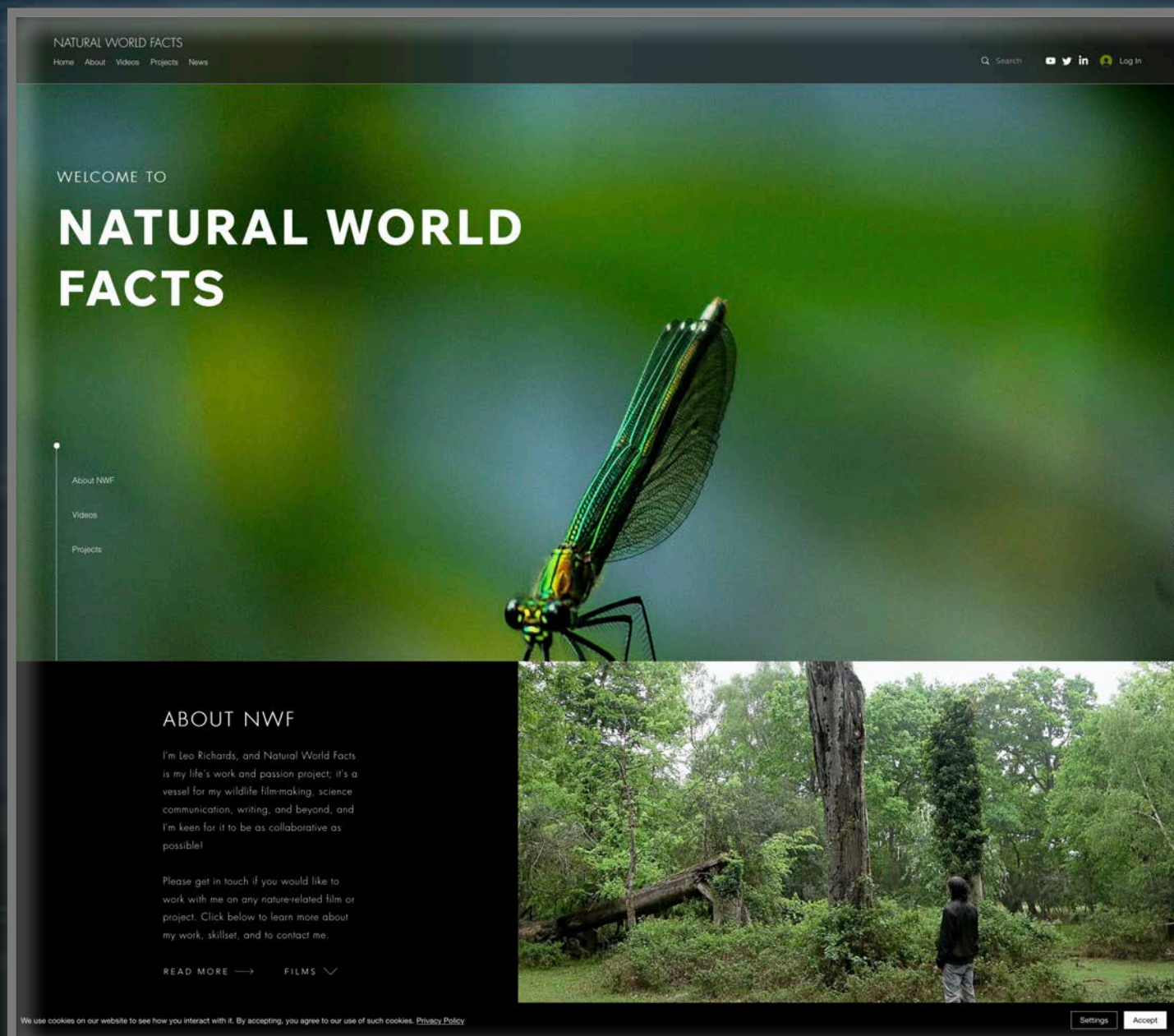
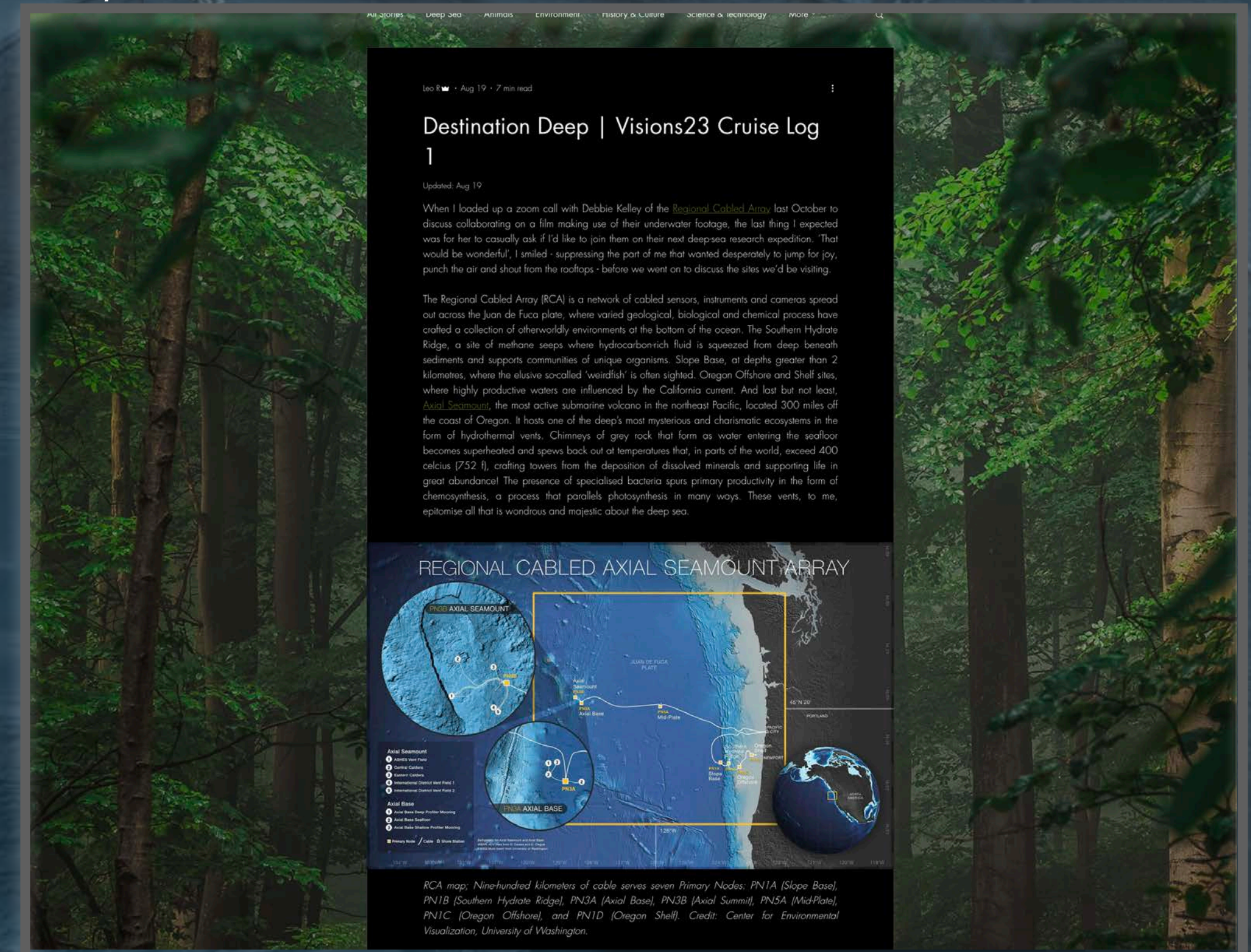
Projects: Machine Learning; 11,000 biological images downloaded/catalogued SHR



Long Term Engagement: Natural World Facts

Leo Richards: Southhampton

<https://www.naturalworldfacts.com/>



- ▶ Sailed on VISIONS Legs 1-3
- ▶ ~800,000 Subscribers, films viewed >74 million times
- ▶ Will produce numerous documentaries on the RCA, environments (e.g, Axial Seamount, Hydrate Ridge), life



Long Term Impacts



Deb Glickson

National Academies
Board Director
Earth Sciences and
Resources

VISIONS'05, 2004
TN175 Chief Sci



Brendan Philip

Deputy Director For
Water Infrastructure
White House Council
on Environmental
Quality

VISIONS'11, 2020
TN382 V'20 Chief Sci



Kris Ludwig

Assistant Director for
Resilience Science &
Technology

White House Office of
Science and Technology
Policy

Lost City 2003



Katie Bigham

2023 Awarded NSF
OCE 2 year Postdoc
(Kelley & Vardaro)

VISIONS'14, RCA staff
2017 - 2019

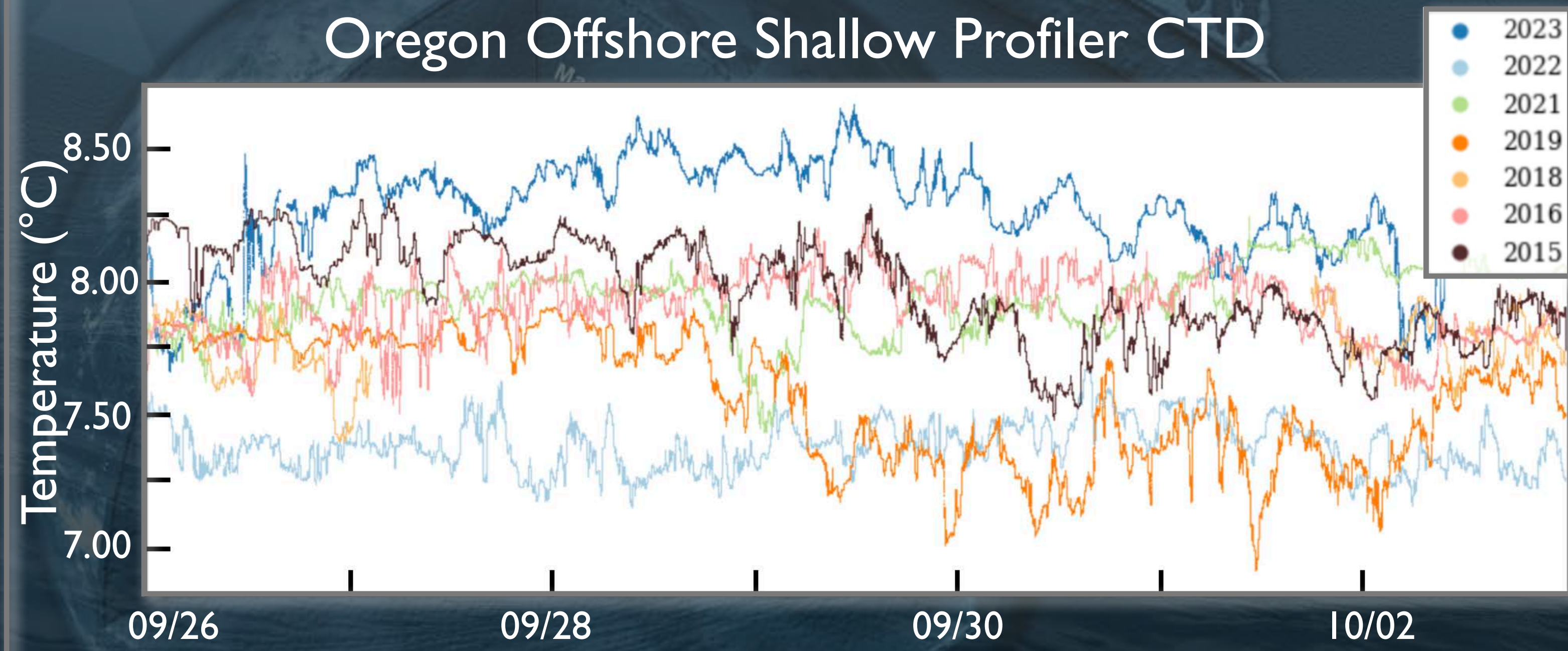
2023 TN422 V'23 Chief
Sci



Quality Control: Human-in-the-Loop Dashboard and Implementation of AWS Cloud Services for QA/QC and



Oregon Offshore Shallow Profiler CTD



- ▶ RCA array and EA data harvested from OOI into UW cloud-based zarr files to allow for fast access and interactivity of multiple large datasets
- ▶ Overlay climatology, nearest neighbors, previous data, QC flags
- ▶ Rotate between set timespans (day, week, month, year)

September 25, 2023



National Science Foundation

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NSF News

NSF announces 4 Mid-scale Research Infrastructure-1 awards to bolster cybersecurity, windstorms science, ocean observatory, and lasers research infrastructure

September 25, 2023

The U.S. National Science Foundation is pleased to announce four Mid-Scale Research Infrastructure-1 (Mid-scale RI-1) awards for Fiscal Year 2023-2024 that will continue the agency's support of cutting-edge science and engineering research. The four awardees chosen exemplify the best of American science and engineering. Their design and construction of research infrastructure will deliver results that bolster national security, shed new light on fascinating discoveries and lead to innovations that will benefit the American public.

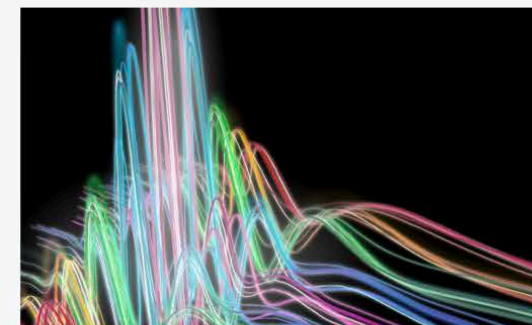
The Mid-scale RI-1 awards support the design and implementation of research infrastructure — including testbeds, equipment, cyberinfrastructure, large-scale data sets and personnel — whose total project costs exceed NSF's Major Research Instrumentation Program but are under \$20 million. By supporting cutting-edge research, NSF and the awarded research facilities will allow scientists and engineers to test new theories and questions in a novel setting, pushing science forward.

"The four awardees NSF has selected — the University of Rochester, Iowa State University, the University of Washington, and the University of Southern California — exemplify the most novel, innovative infrastructure being designed and built in our country to advance the best ideas and train the highly skilled talent in science and engineering for our future," said NSF Director Sethuraman Panchanathan. "By investing in the most innovative infrastructure, NSF aims to strengthen opportunities for all Americans and advance the frontiers of science and technology."

Share



Related stories



NSF congratulates laureates of the 2023 Nobel Prize in physics



This week with NSF Director Panchanathan

Creating an Offshore Subduction Zone Observatory in Cascadia with the Ocean Observatories Initiative Regional Scale Array (COSZO)

Mid-scale Research Infrastructure-1 NSF OCE 2329819

PI: William Wilcock

\$10,652,162

Duration: 48 months

University of Washington and
University of California San Diego

- ▶ Preproposal: Submitted January 5, 2023
- ▶ Full Proposal: Submitted May 2, 2023*
- ▶ Reverse NSF Site Visit: July 11, 2023
- ▶ Recommended for Funding : August 3, 2023

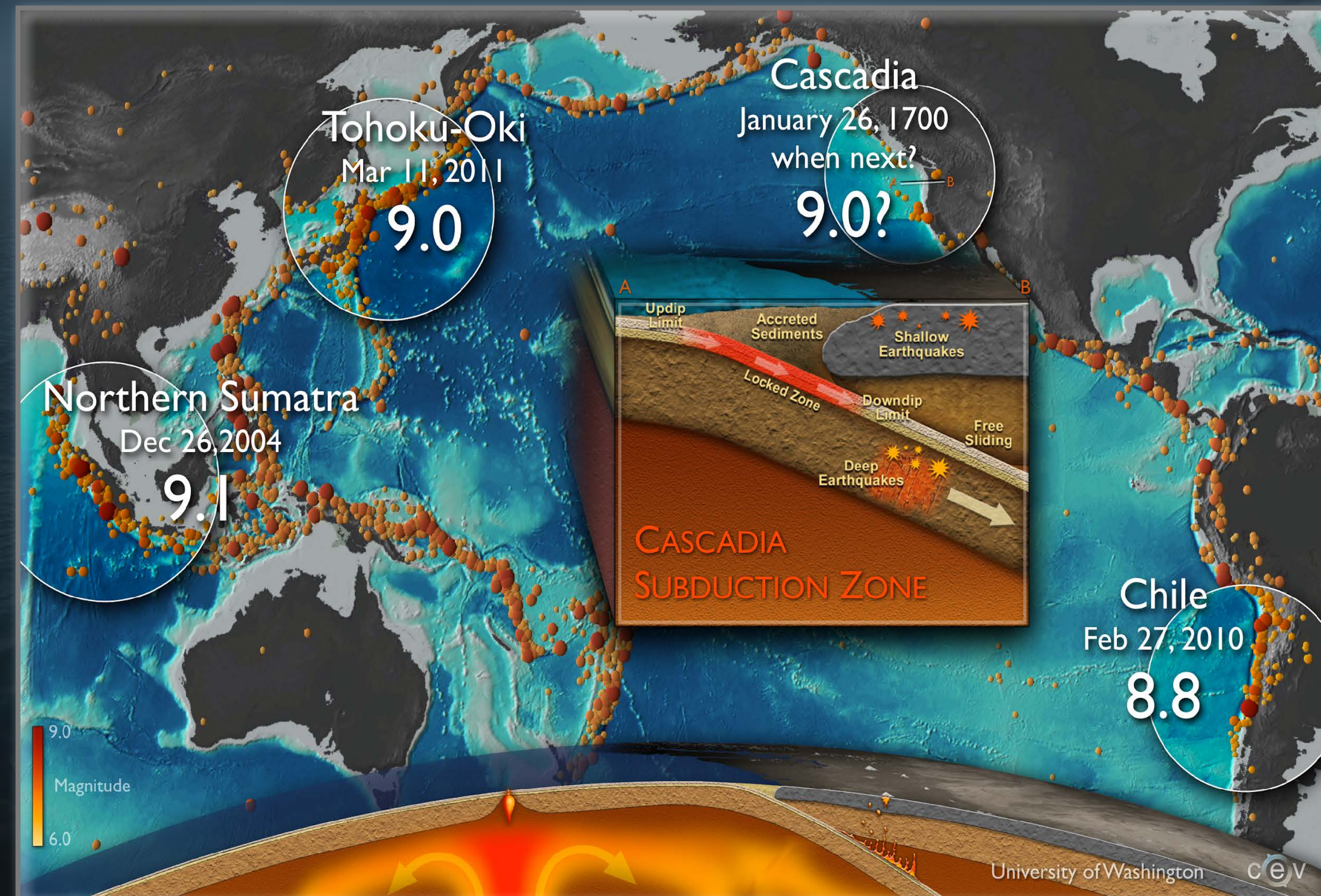
*Including 108 page project execution plan



OCEAN OBSERVATORIES INITIATIVE

Why Important

- ▶ Subduction zones produce the largest earthquakes on the planet that launch the most devastating tsunamis.
- ▶ Understanding the physical process governing earthquakes is the greatest geophysical Grand Challenge
- ▶ The losses to the USA from an earthquake and tsunami in the Cascadia subduction zone are the highest of any natural hazard we face.
- ▶ Because the fault lies almost entirely offshore, land-based observations alone are inadequate to capture its behavior. Required offshore instrumentation is very sparse.



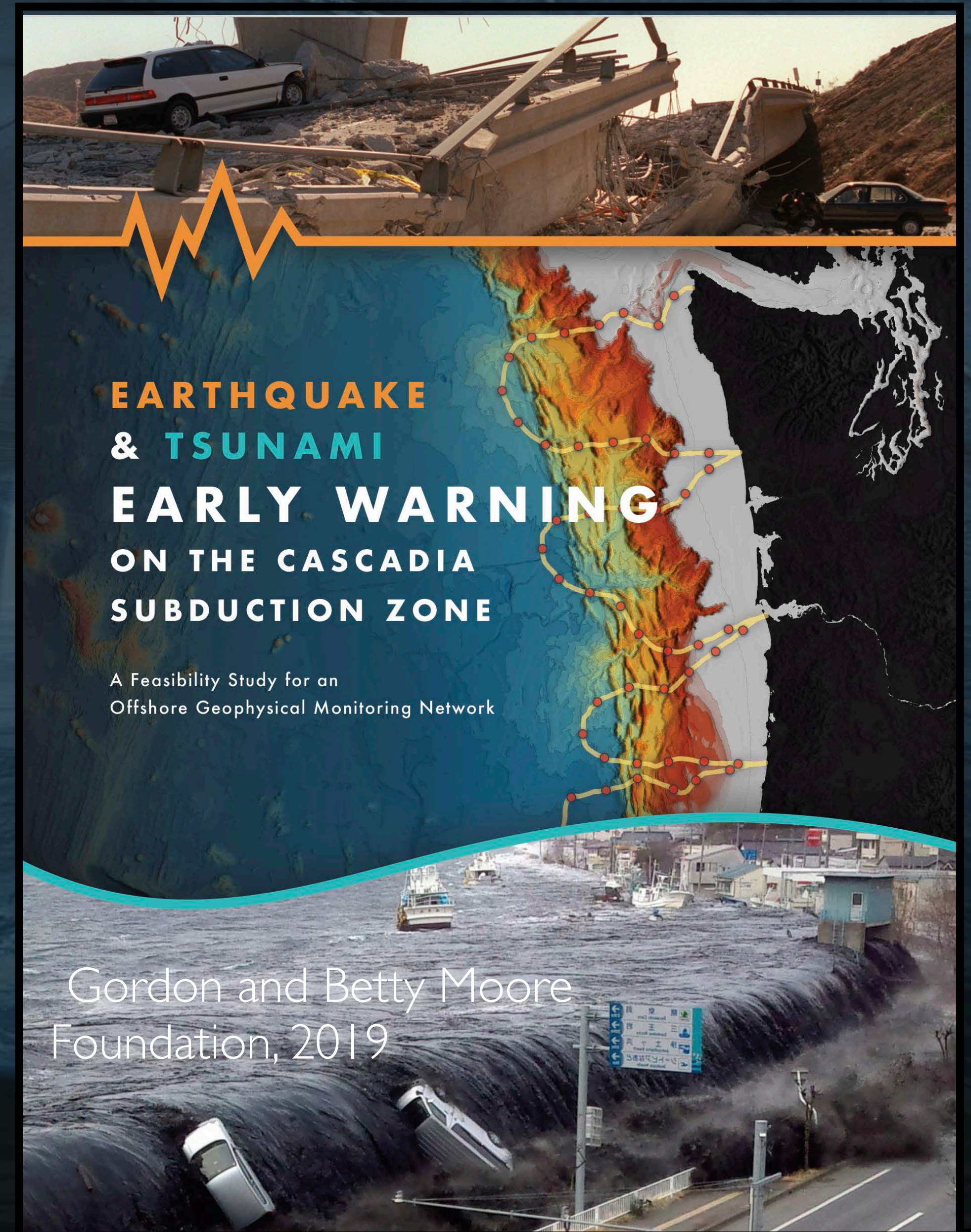
Scientific Need is Exceptionally Well-Supported

- ▶ “The frontier of earthquake and tsunami observation is offshore, where the slip in great earthquakes actually happens, but is almost never recorded. [...] Thus, **there is a critical need for continuous seafloor observation to capture the evolving state of the megathrust in 4D.**” -From The SZ4D Initiative: Understanding the Processes that Underlie Subduction Zone Hazards (McGuire, Plank et al. 2017).
- ▶ “Knowledge of the temporal and spatial variability in interface behavior requires that such instrumentation be deployed permanently and record continuously. **Offshore sensors must transmit data from the seafloor in real-time to be useful for detection of activity that may be precursory to a major earthquake and tsunami,** and to improve warnings of earthquake shaking and tsunami waves.” – From Reducing Risk Where Tectonic Plates Collide—U.S. Geological Survey Subduction Zone Science Plan (Gomberg et al., 2017).

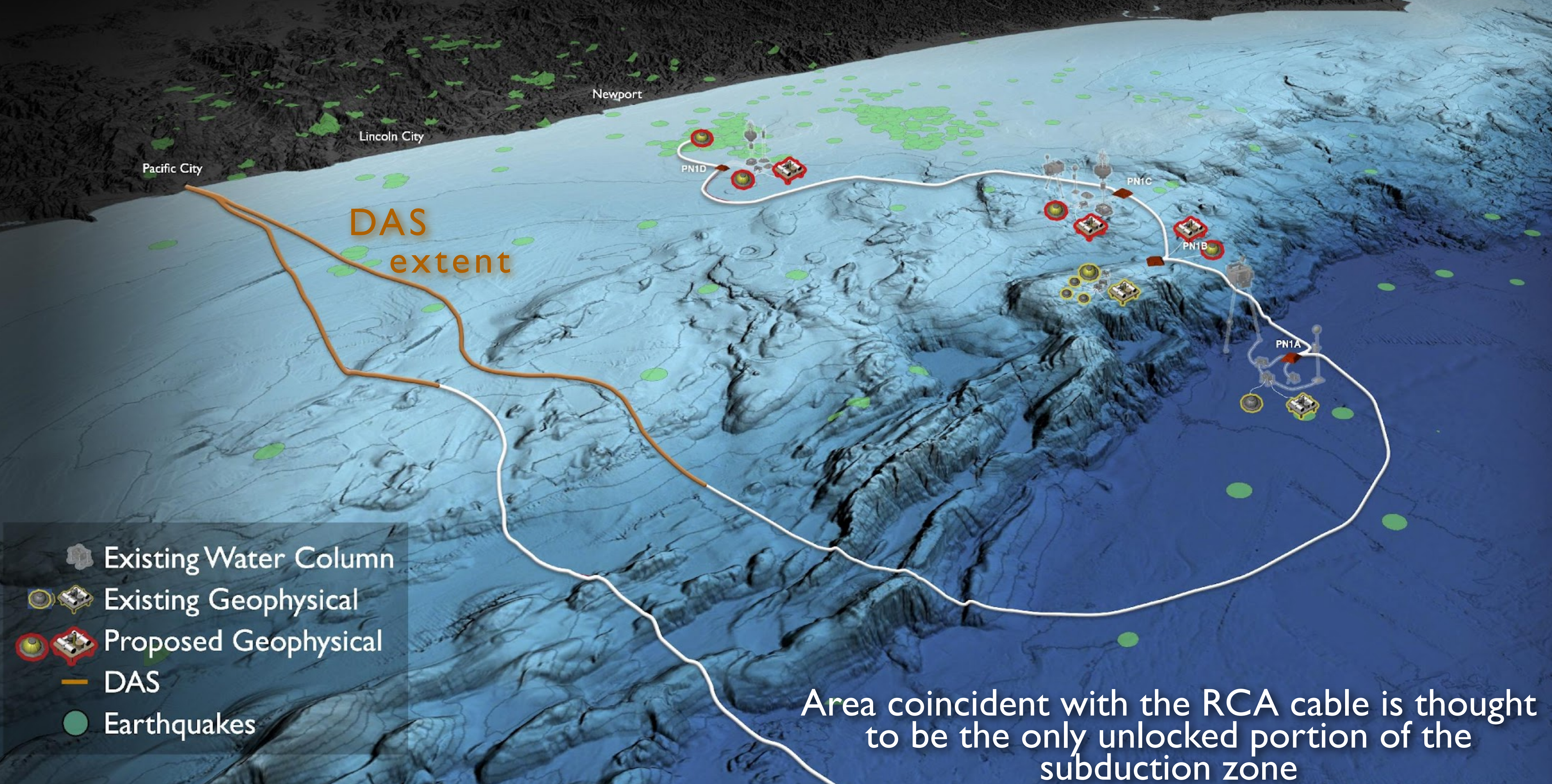


Scientific Need is Exceptionally Well-Supported

- ▶ Offshore monitoring can contribute substantially to the timeliness, reliability, and accuracy of earthquake and tsunami early warnings and has the potential to save many lives.
- ▶ The 2011 tsunami from the M 9.1 subduction earthquake off Japan took 19,000 lives and was the costliest natural disaster in history. This tragedy occurred despite the known risk of such events in that region, in part because the quake struck without warning, the size of the quake (and therefore the tsunami) was initially underestimated, and authorities had not envisioned such a large tsunami in their planning. In hindsight, it became clear that the tsunamigenic earthquake was preceded by substantial slow slip and precursory foreshocks detected by onshore and offshore instruments which could have been detected in real time with offshore instrumentation.

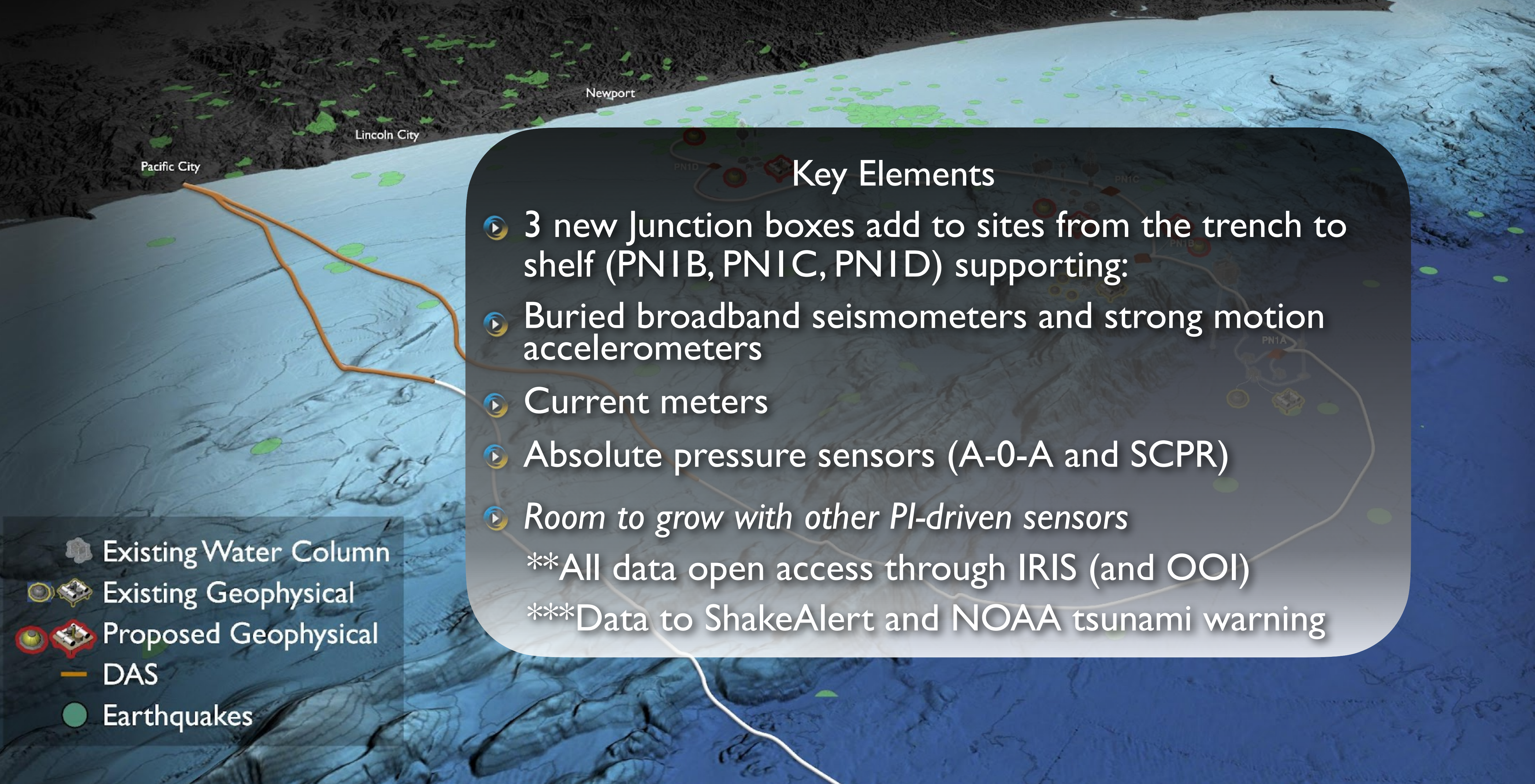


Cascade Offshore Subduction Zone Observatory



Area coincident with the RCA cable is thought to be the only unlocked portion of the subduction zone

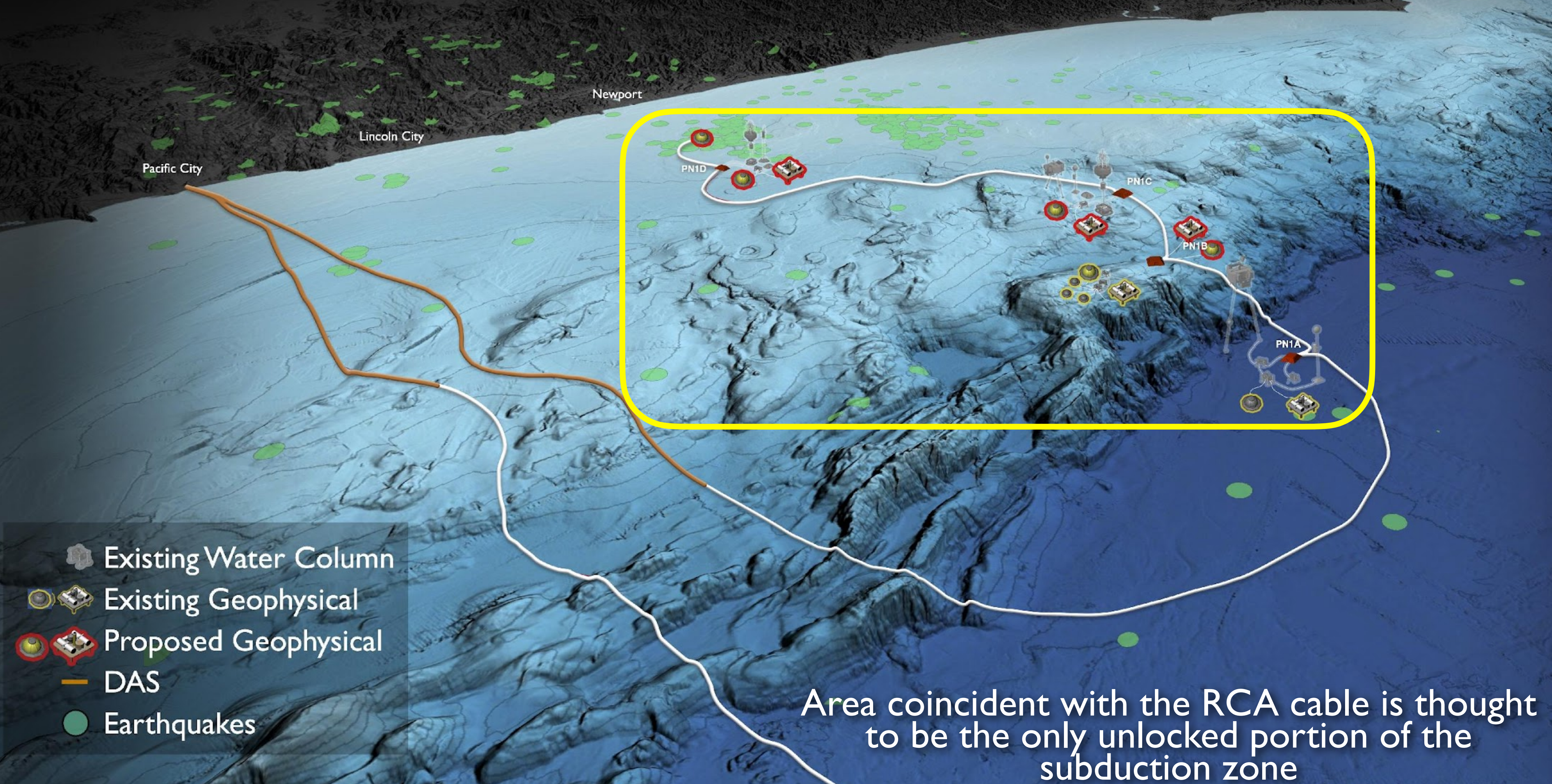
Cascade Offshore Subduction Zone Observatory



Key Elements

- ▶ 3 new Junction boxes add to sites from the trench to shelf (PNIB, PNIC, PNID) supporting:
 - ▶ Buried broadband seismometers and strong motion accelerometers
 - ▶ Current meters
 - ▶ Absolute pressure sensors (A-0-A and SCPR)
 - ▶ *Room to grow with other PI-driven sensors*
- **All data open access through IRIS (and OOI)
- ***Data to ShakeAlert and NOAA tsunami warning

Cascade Offshore Subduction Zone Observatory

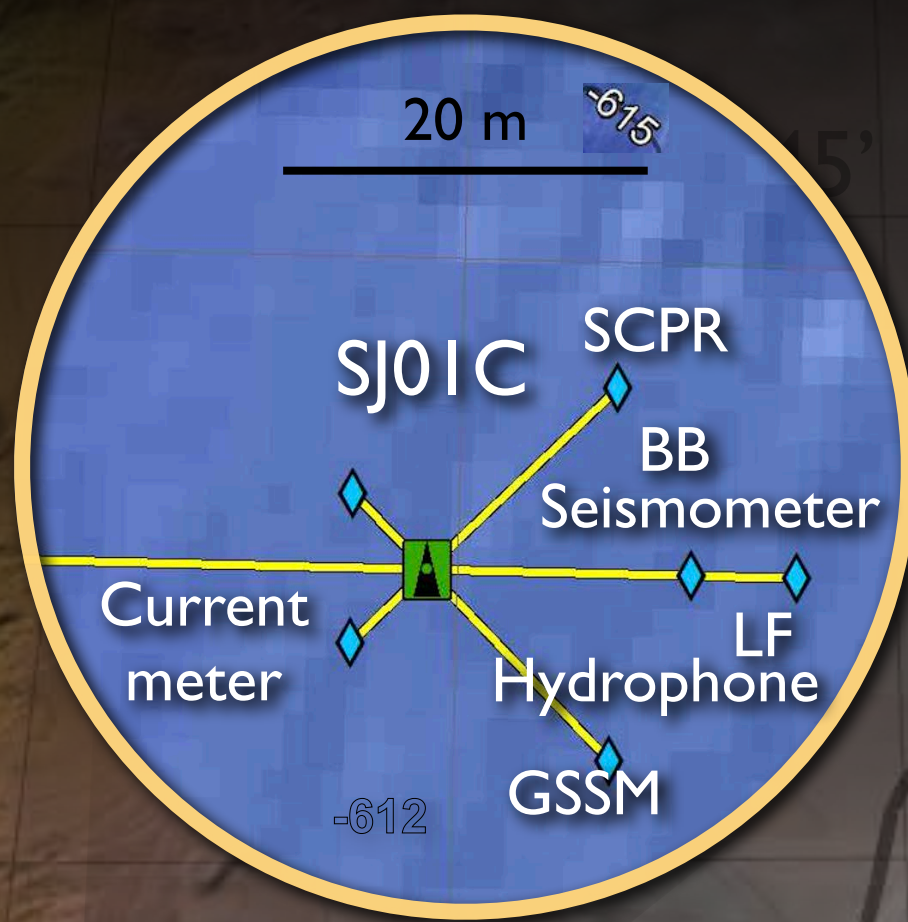


- Existing Water Column
- Existing Geophysical
- Proposed Geophysical
- DAS
- Earthquakes

Area coincident with the RCA cable is thought to be the only unlocked portion of the subduction zone

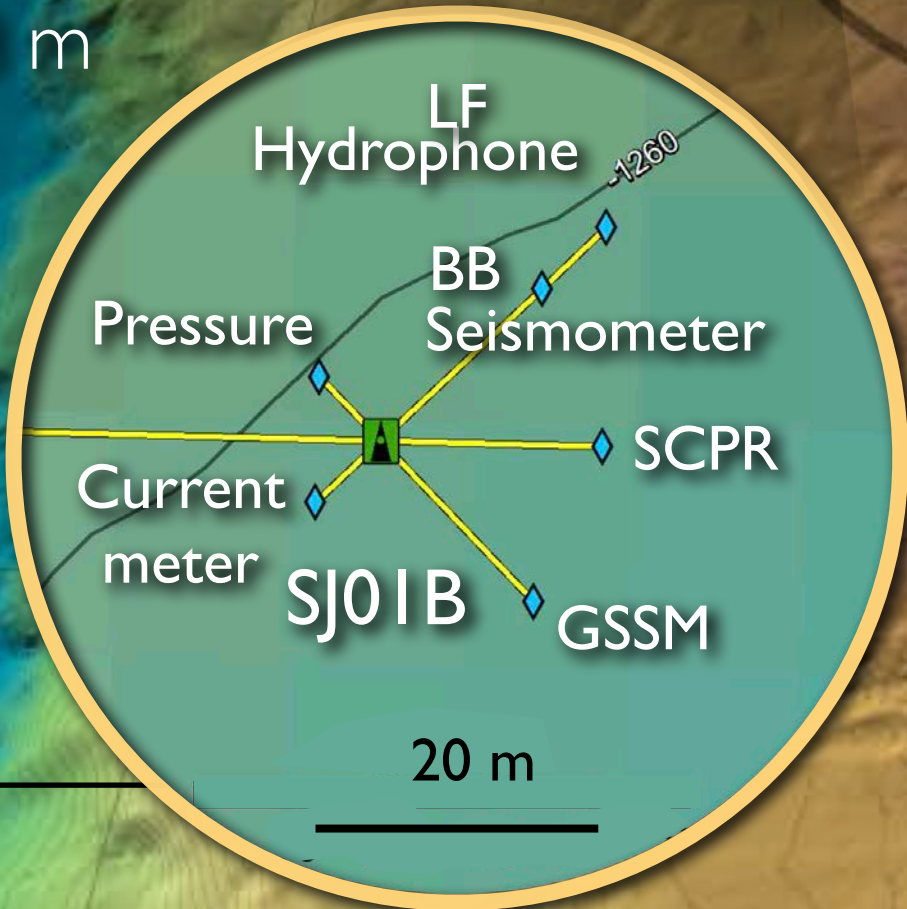


Southern Hydrate Ridge 800 m

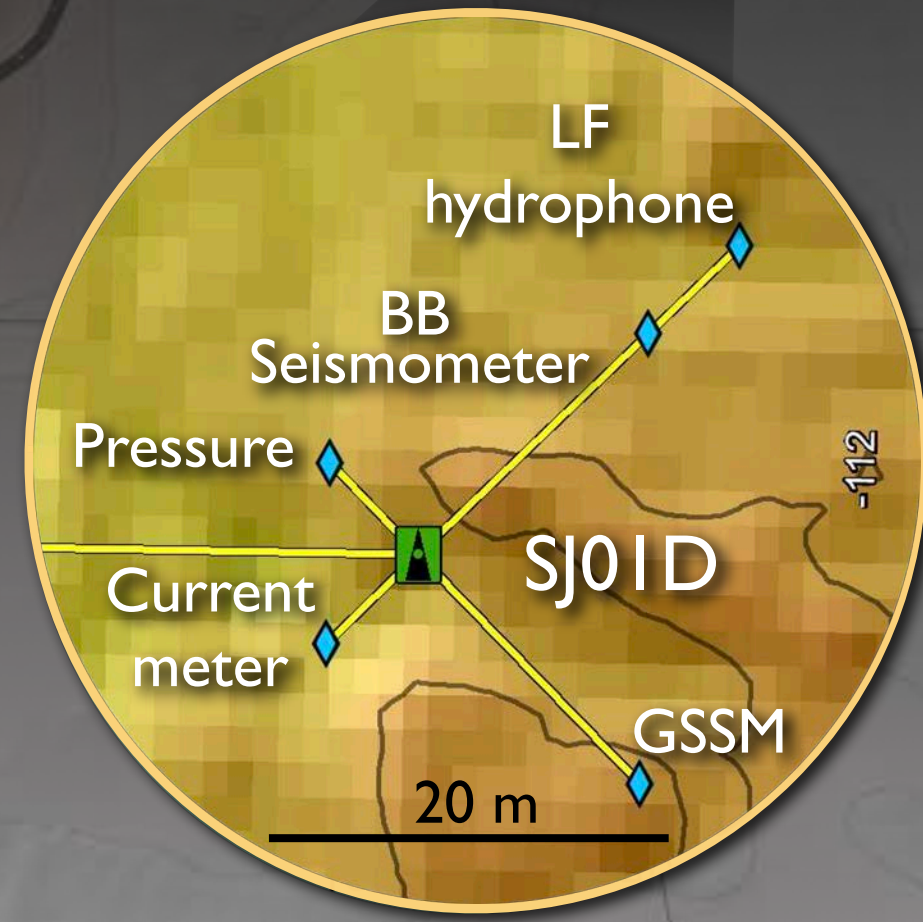


PNIA Slope Base 2908 m

PNIB 1237 m 50 m



PNIC Oregon Offshore 620 m 50 m



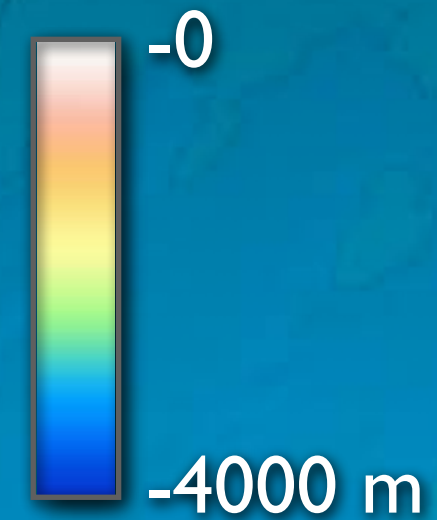
PNID

Oregon Shelf

BB Seismometer 80 m

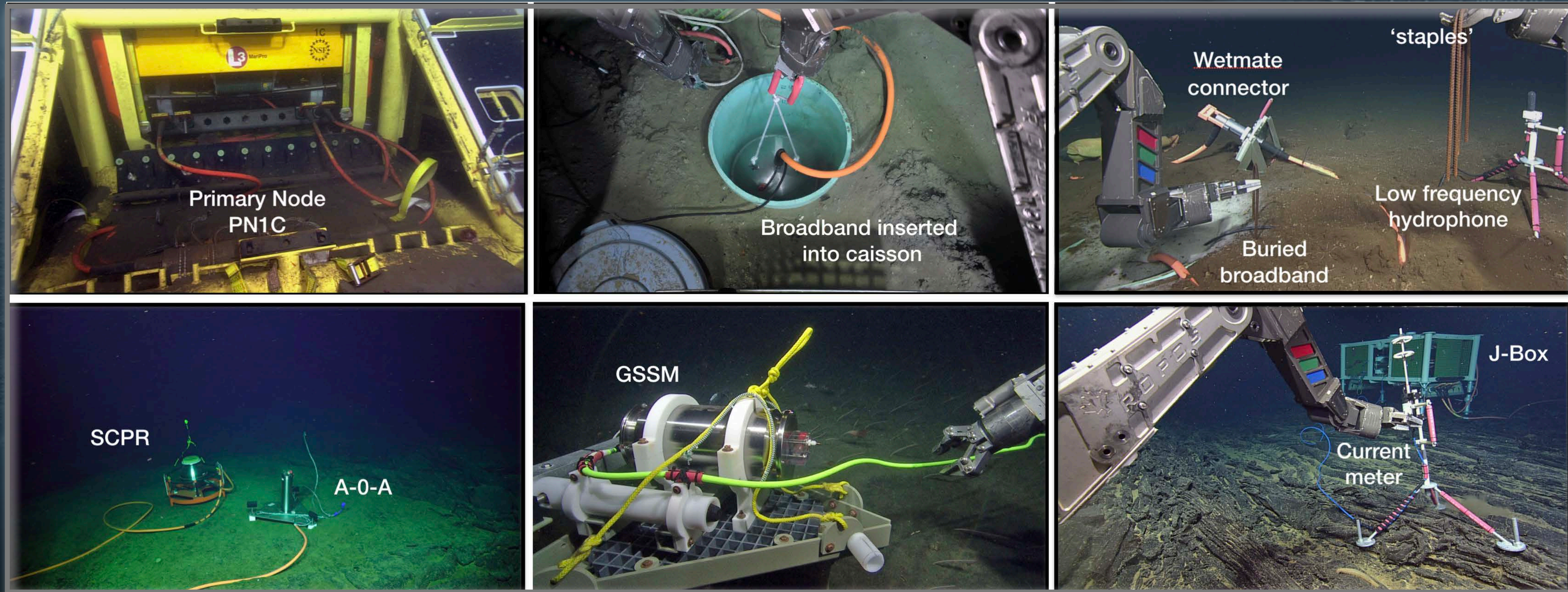
MJ01C

50 m contours



Installation 2026 13 add-on days to the annual RCA cruise
 SCPR: Self calibrating pressure sensor (Sasagawa UCSD)
 GSSM: Geodetic and Seismic Sensor Module (Wilcock UW)

COSZO Instrumentation: Low Risk and technology transfer from prior NSF-funded awards



- ▶ 18 Junction boxes built by APL extremely robust - no failures since 2014 when installed
- ▶ Broadband seismometer, Low frequency hydrophone and Current meter, RCA core instrumentation
- ▶ Self calibrating pressure sensor (SCPR) and Geodetic and Seismic Sensor Module (GSSM) employs A-0-A and includes a low-noise three-component quartz crystal accelerometer: All already installed on Axial Seamount

COSZO Student/Early Career Training

▶ 16 REU Students

Projects integrated into science and engineering (APL) 2024 - 2026, subset will participate in VISIONS APL Summer Program Diverse + Inclusive Naval Oceanographic Summer Internship Program

▶ 3 Graduate Students

Participate in development and deployments (2026) Involved in QA/QC

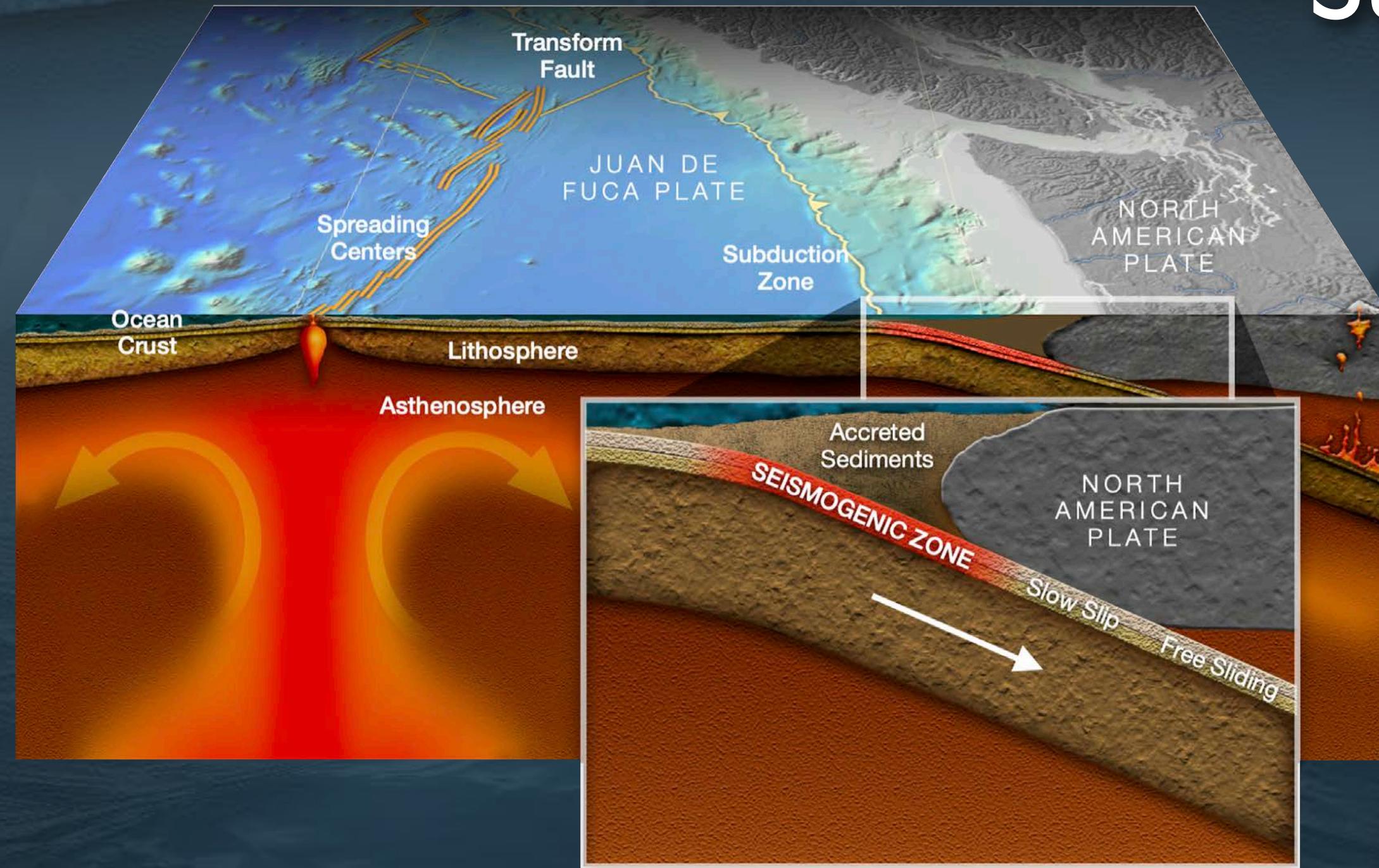
▶ 3 Early Career Workshop

COSZO can & will engage local stakeholders through linkages to other programs

- NSF CRESCENT (Cascadia Region Earthquake Science Center - OSU) Funding in FY25 for a workshop focused on offshore observations
- Pacific Northwest Seismic Network
- NSF Cascadia Coastlines and Peoples (CoPe) Hazards Research Hub



Summary



The Cascadia subduction zone, spanning the offshore coasts from Northern California to British Columbia, hosts earthquakes up to magnitude 9 every few hundred years, the last of which was in 1700.

Now, thanks to COSZ, the Regional Cabled Observatory will produce real-time data that will help answer fundamental questions about how the subduction zone faults work and will enhance the existing systems for earthquake and tsunami warning.

“Beyond the clear geophysical and geologic value of this [OOI RCA] array, a compelling case was made that the power and bandwidth supplied by the seafloor cable could enable a wide variety of additional multidisciplinary sensors.” – From Sea Change: 2015-2025 Decadal Survey of Ocean Sciences