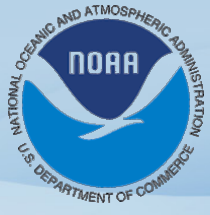


PMEL

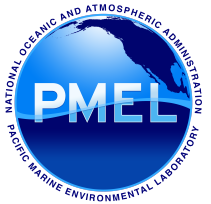
Pacific Marine Environmental Laboratory

Marine Ecosystem Research

Earth-Ocean Interactions Program

Bill Chadwick

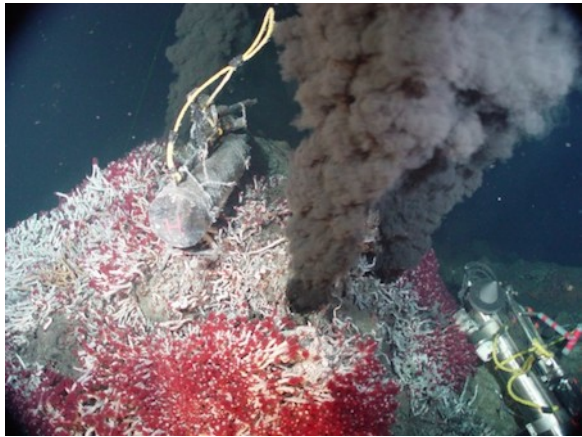
Ed Baker, Dave Butterfield, Bob Embley,
Steve Hammond, Bill Lavelle, John Lupton, Joe Resing



Earth-Ocean Interactions

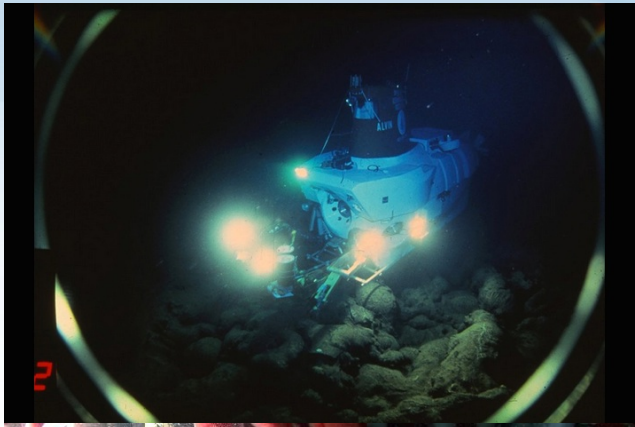
- Mission: *Discovering, measuring, understanding, and predicting ecological impacts of natural chemical, biological, and geological processes between the solid earth and ocean*

- One of two EOI talks
- EOI Ecosystem Research is accomplished with national and international collaborators



Background

- Discovery of hydrothermal vent ecosystems was revolutionary
  - National Research Council Report "50 Years of Ocean Discovery": Landmark Achievement #1 in Biological Oceanography
- Continues to fuel innovative transformative research

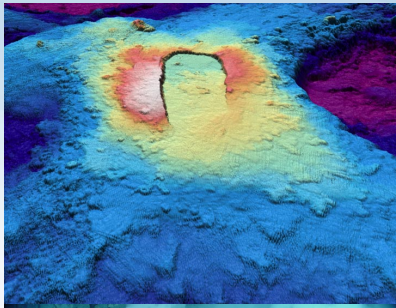


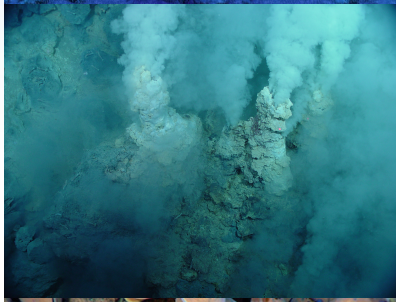
EOI Research Themes

1) Time-Series Studies

2) Global Exploration and Research

3) Acidification Natural Laboratories



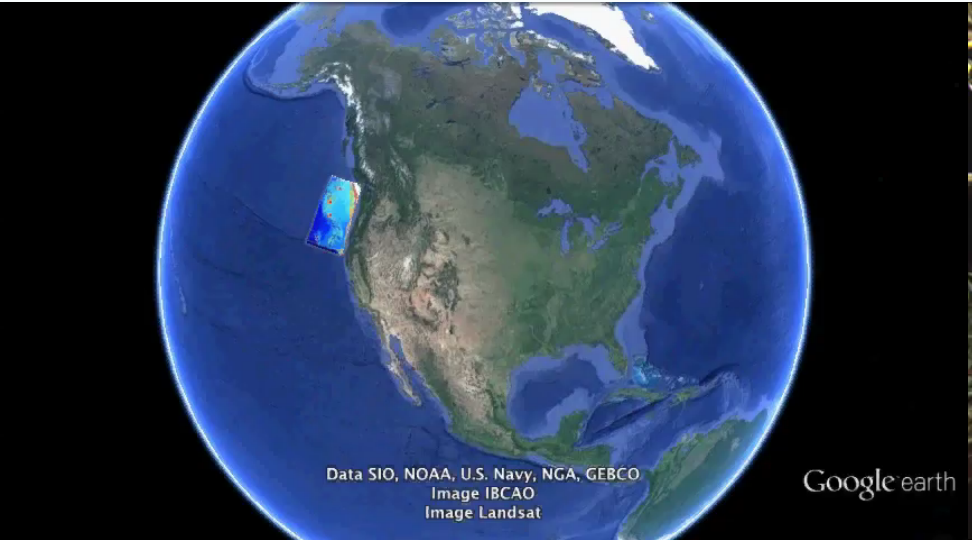


EOI Research Themes

1) Time-Series Studies: Axial Seamount (NeMO)

– Dynamic interactions of Geology/Chemistry/Biology

Partners: National Science Foundation, Univ. of Washington, Univ. of NC Wilmington, Scripps Inst. Oc., MBARI

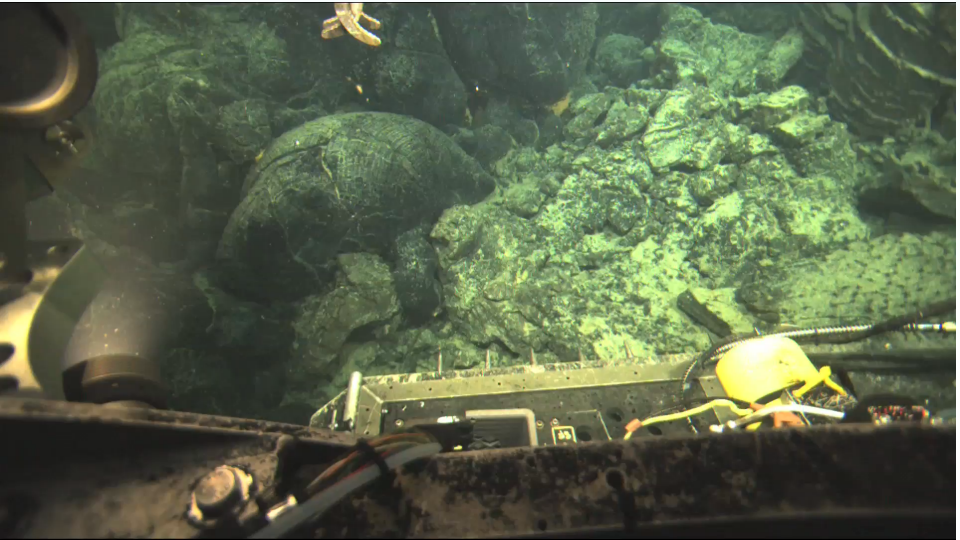


EOI Research Themes

1) Time-Series Studies: Axial Seamount (NeMO)

– Eruption impacts on chemistry & ecosystems

Partners: Marine Biological Laboratory, Moore Foundation, Schmidt Ocean Inst., UMass Amherst, Craig Venter Inst.

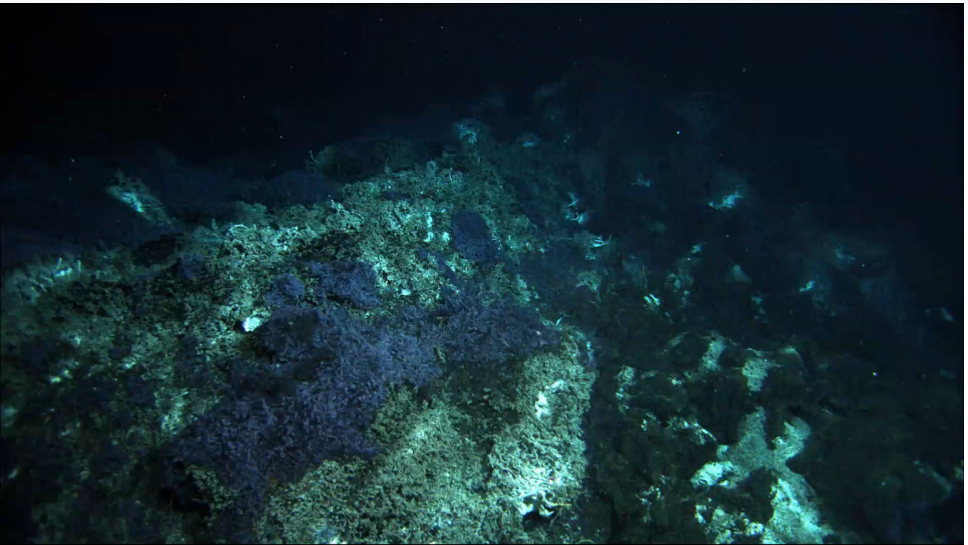


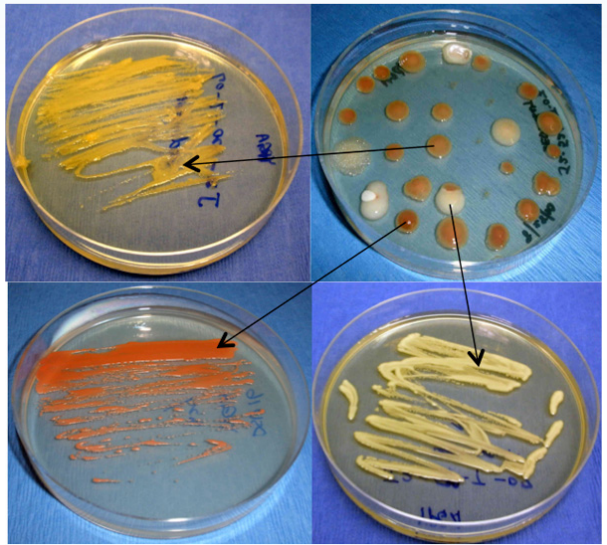
EOI Research Themes

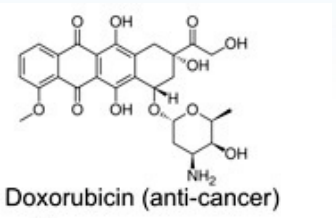
1) Time-Series Studies: Axial Seamount (NeMO)

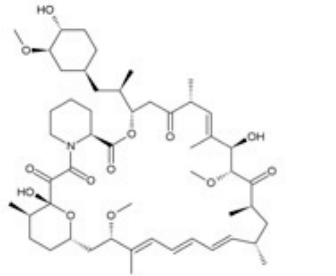
– OSU Pharmacology collaboration for drug discovery

Partners: Oregon State University College of Pharmacy, Univ. of Victoria, Western Washington Univ.







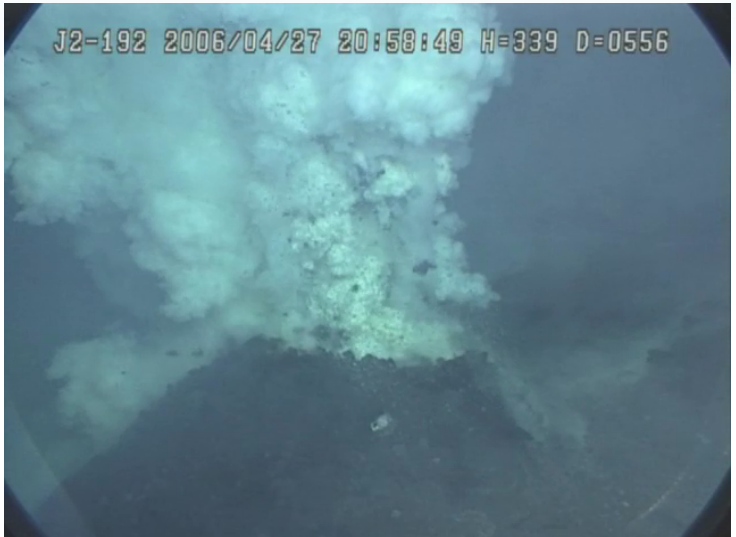


EOI Research Themes

2) Global Exploration and Research:

- Mariana Arc: high diversity of vent environments

Partners: NOAA Ocean Exploration, NSF, U Victoria, Univ. of Oregon, Woods Hole Oceanographic Inst., GNS Science

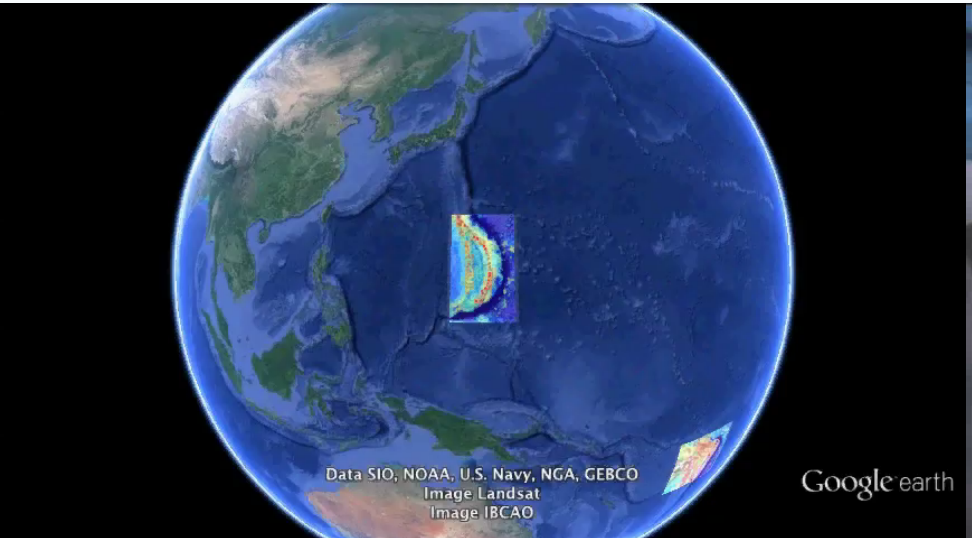


EOI Research Themes

2) Global Exploration and Research:

- Lau Basin: one of most active parts of planet

Partners: NOAA Ocean Exploration, NSF, Australia National Univ., GNS Science, WHOI, UH, Nautilus, MARUM

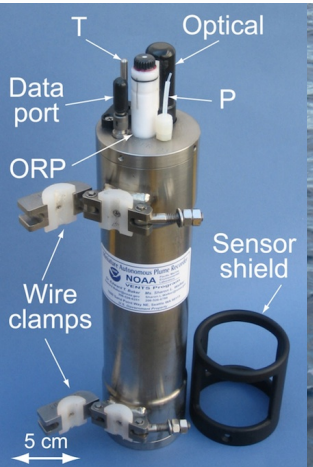


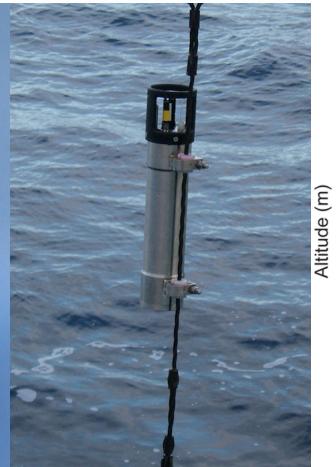
EOI Research Themes

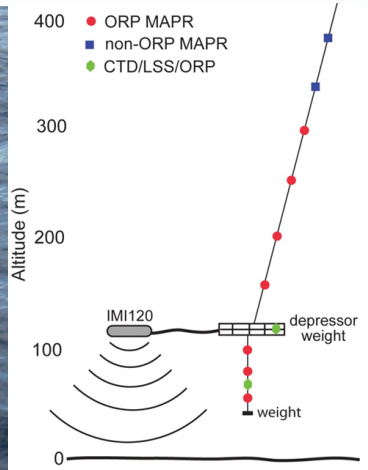
2) Global Exploration and Research:

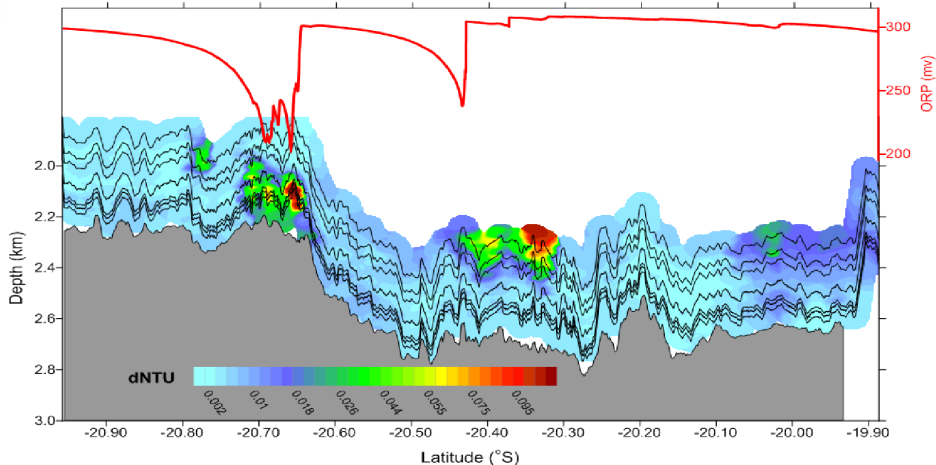
– Extending reach through innovative technology: MAPRs (Miniature Autonomous Plume Recorders)

Partners: In last 5 years, collaborations with 8 domestic and 16 foreign universities and institutes







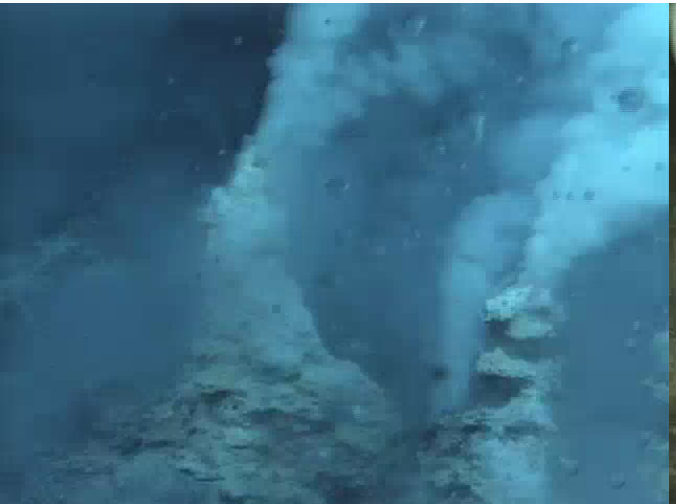


EOI Research Themes

3) Acidification Natural Laboratories:

– NW Eifuku seamount, Mariana Arc

Partners: NOAA Ocean Exploration, Univ. of Victoria, Western Washington Univ.

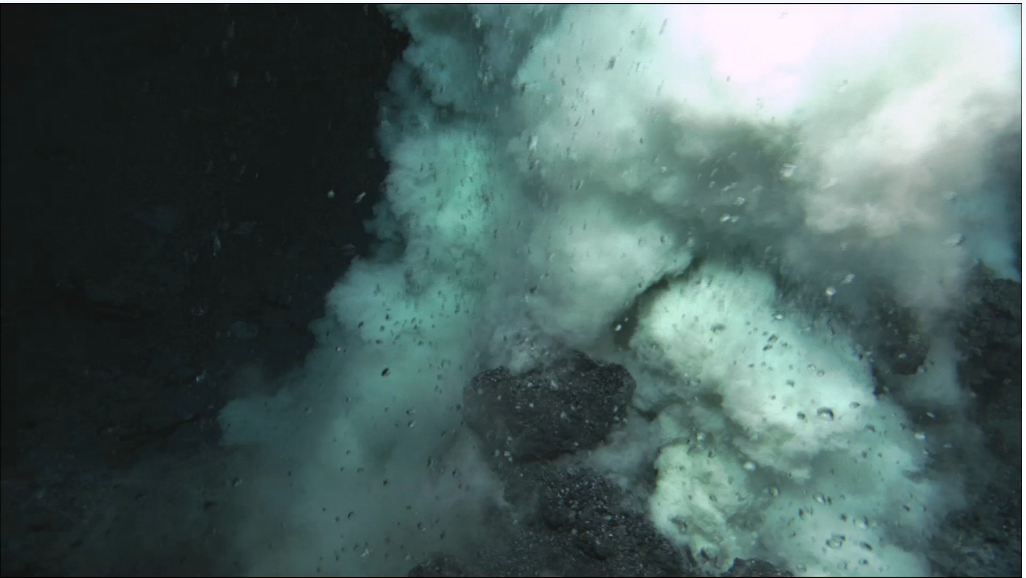


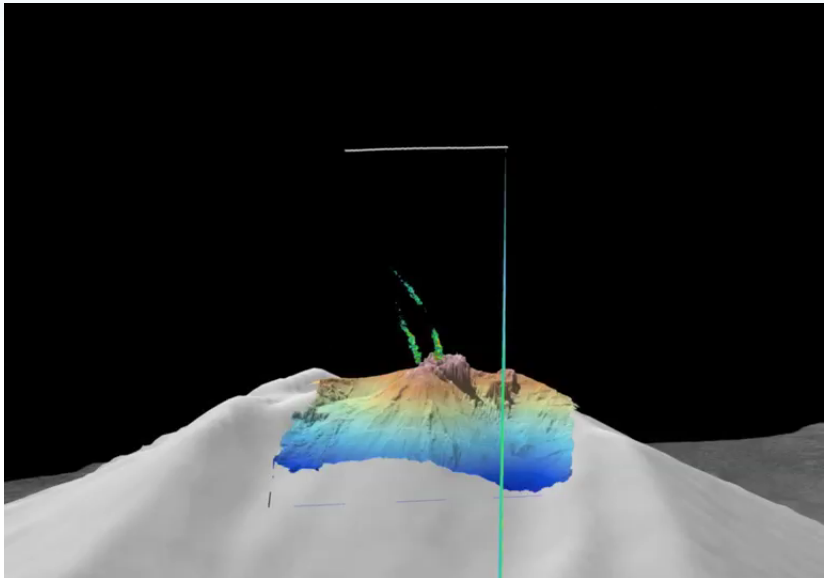
EOI Research Themes

3) Acidification Natural Laboratories:

– NW Rota seamount, Mariana Arc

Partners: NOAA Ocean Exploration, National Science Foundation, Oregon State Univ./CIMRS, Univ. of Washington/JISAO



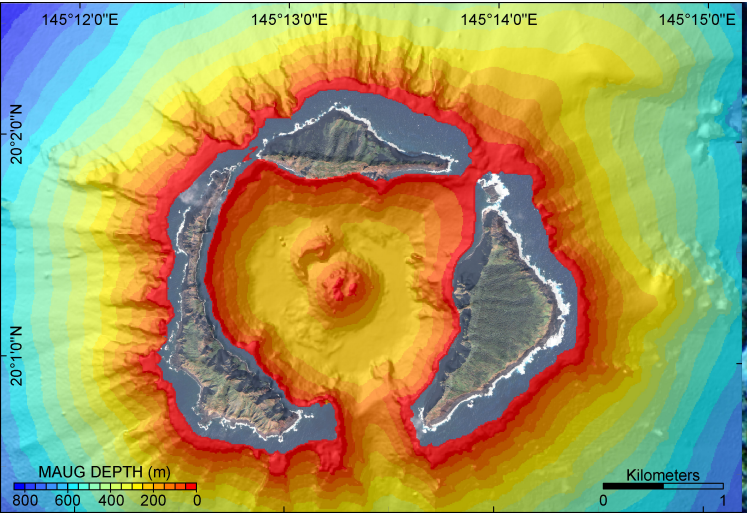


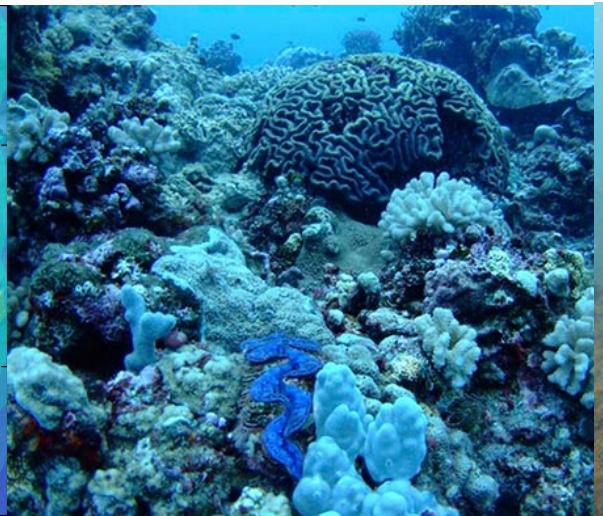
EOI Research Themes

3) Acidification Natural Laboratories:

– Maug Island, Mariana Arc

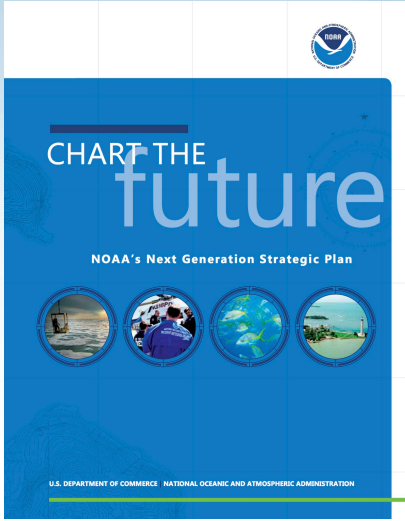
Partners: NOAA Ocean Exploration, NOAA Coral Reef Ecosystem Division (PIFSC), NIST, NOAA Ocean Acidification Program





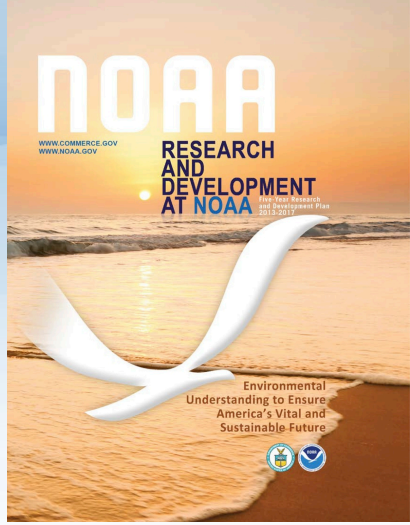
Relevance

- NOAA Healthy Ocean Goal of sustaining marine habitats and biodiversity within healthy and productive ecosystems.
- NOAA goal of gaining a holistic understanding and making useful predictions of future states of the Earth-Ocean system.



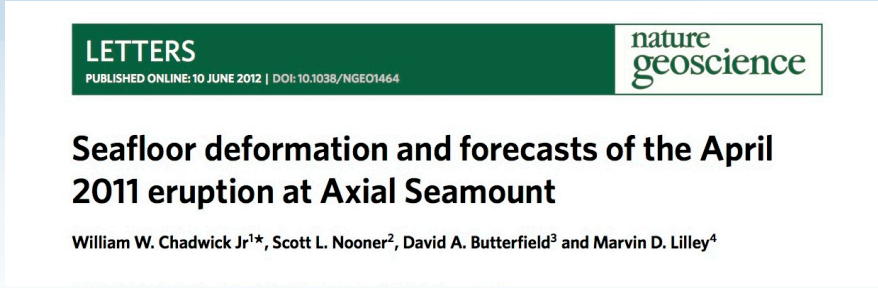
Relevance

- NOAA's 5-year Research and Development Plan:
  - *Discover and characterize new ocean resources*
  - *Map and characterize ocean basin boundaries*
  - *Understand the processes of ocean acidification and its consequences for marine organisms and ecosystems*
  - Question: "*What exists in the unexplored areas of our oceans?*"
  - *Expand knowledge and understanding of marine biodiversity, biogeochemical processes, ecosystems, and living and non-living marine resources*



Performance

1) Time-Series Studies:
   - First successful eruption forecast at a submarine volcano
2) Global Exploration and Research:
   - First observations of an active deep-sea eruption



LETTERS
PUBLISHED ONLINE: 10 JUNE 2012 | DOI: 10.1038/NGEO1464

nature geoscience

Seafloor deformation and forecasts of the April 2011 eruption at Axial Seamount

William W. Chadwick Jr[1]*, Scott L. Nooner[2], David A. Butterfield[3] and Marvin D. Lilley[4]

nature

Vol 441|25 May 2006|doi:10.1038/nature04762

LETTERS

Long-term eruptive activity at a submarine arc volcano

Robert W. Embley[1], William W. Chadwick, Jr[1,2], Edward T. Baker[3], David A. Butterfield[3,4], Joseph A. Resing[3,4], Cornel E.J. de Ronde[5], Verena Tunnicliffe[6], John E. Lupton[1], S. Kim Juniper[7], Kenneth H. Rubin[8], Robert J. Stern[9], Geoffrey T. Lebon[3,4], Ko-ichi Nakamura[10], Susan G. Merle[1,2], James R. Hein[11], Douglas A. Wiens[12] & Yoshihiko Tamura[13]

Performance

2) Global Exploration and Research:
   - Deepest eruption found; unusual lava composition

3) Acidification Natural Laboratories:
   - First study of effects of volcanic acidification on ecosystem with mussels

nature geoscience

ARTICLES

PUBLISHED ONLINE: 9 OCTOBER 2011 | DOI: 10.1038/NGEO1275

Active submarine eruption of boninite in the northeastern Lau Basin

Joseph A. Resing[1]*, Kenneth H. Rubin[2], Robert W. Embley[3], John E. Lupton[3], Edward T. Baker[4], Robert P. Dziak[5], Tamara Baumberger[6], Marvin D. Lilley[7], Julie A. Huber[8], Timothy M. Shank[9], David A. Butterfield[1], David A. Clague[10], Nicole S. Keller[11]†, Susan G. Merle[5], Nathaniel J. Buck[1], Peter J. Michael[12], Adam Soule[11], David W. Caress[10], Sharon L. Walker[4], Richard Davis[13], James P. Cowen[2], Anna-Louise Reysenbach[14] and Hans Thomas[10]

LETTERS

PUBLISHED ONLINE: 12 APRIL 2009 | DOI: 10.1038/NGEO500

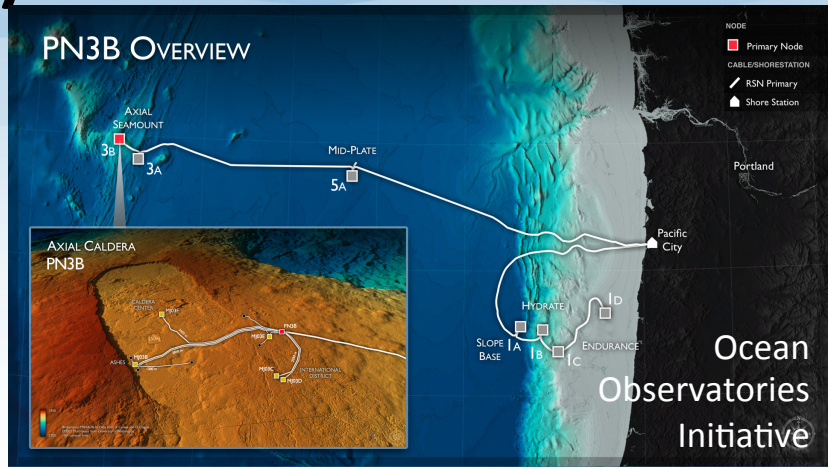
nature geoscience

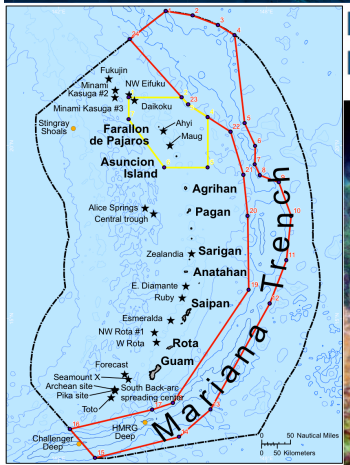
Survival of mussels in extremely acidic waters on a submarine volcano

Verena Tunnicliffe[1,2]*, Kimberley T. A. Davies[1]†, David A. Butterfield[3], Robert W. Embley[4], Jonathan M. Rose[1] and William W. Chadwick Jr[5]

Quality

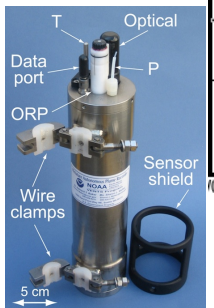
- Time-Series Studies:
  - NSF/OOI cabled observatory node at Axial Seamount
- Global Exploration and Research:
  - Mariana Trench Marine National Monument

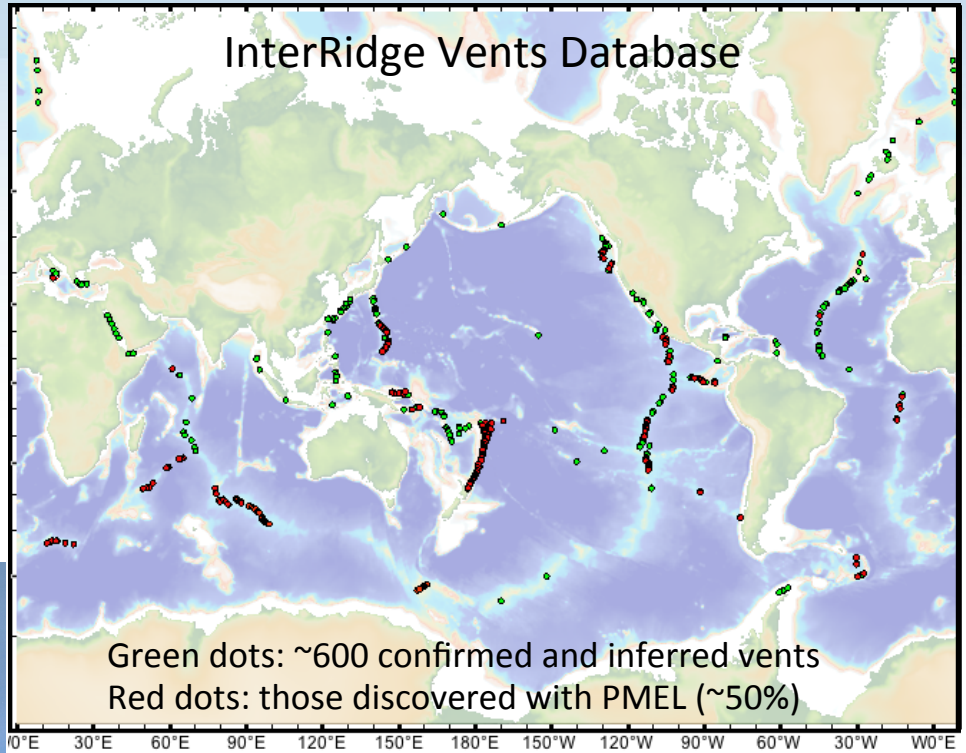




Quality

- Global Exploration and Research:
  - Of known or inferred vent sites globally, ~50% have been discovered with PMEL involvement
  - ~25% discovered using MAPRs





Future Directions

- Time-Series Studies:
  - OOI and Neptune Canada cabled observatories
- Global Exploration and Research
  - Exploration of Mariana back-arc, characterization of MTMNM & Lau
- Acidification Natural Laboratories
  - Ecological impacts of volcanic CO_2