



NOVAE - Networked Observations and Visualizations of the Axial Environment

Draft AGENDA v.10.3

AXIAL VOLCANO - WIRED AND RESTLESS! A GATHERING TO EXPLORE TWO DECADES OF SCIENTIFIC POTENTIAL April 20–22, 2015, Talaris Center, Seattle WA

<http://novae.ocean.washington.edu>

Goals of the first NOVAE Workshop:

- 1) Introduce new scientific & technological developments re: Mid-Ocean Ridge (MOR) Systems;
- 2) Review and update the driving scientific questions and hypotheses specifically related to Axial and generally related to the global impacts of subsea volcanism and hydrothermal systems;
- 3) Explore evolving and novel technologies that can be entrained in Axial Studies;
- 4) Identify compelling research paths forward over 5, 10, and 20 years; and,
- 5) Capture workshop discussions & conclusions as draft science plan for community review.

Background Material - Science

- NOAA Long-term Studies - Axial Seamount http://www.pmel.noaa.gov/eoi/axial_site.html
- RIDGE Research - <http://tos.org/oceanography/archive/25-1.html> (2012 pub)
- International RIDGE Research Archive: <http://www.interridge.org/IRnewsletter>
- Axial Workshop Report from the 2011 Meeting
(<https://sites.google.com/site/axialrsnscienceworkshop/background>);
- Five videoed talks from Axial Meeting in 2011:
(http://www.interactiveoceans.washington.edu/story/Axial_Science_Workshop_Talks)
- See also Resources (<http://novae.ocean.washington.edu/story/Resources>), NOVAE website

Background material - Locations

- Talaris location: <http://www.talarisconferencecenter.com/maps-directions.php>
- UW-Ocean Sciences: <http://www.ocean.washington.edu/story/Directions+%26+Address>
- UW-Applied Physics Lab: http://www.apl.washington.edu/campus_map/campus_map.php

Background Material - Technical or Programmatic

- NSF's Ocean Observatories Initiative: <http://oceanobservatories.org/>
- OOI Infrastructure: <http://oceanobservatories.org/infrastructure/>
- OOI Data Policy: <http://oceanobservatories.org/data/>
- Cabled Technology: <http://oceanobservatories.org/design/technology/cabled-technology/>

NOVAE WORKSHOP - DAY ONE – MONDAY, APRIL 20

Morning Plenary, Science and Technology John Delaney & Kendra Daly

Review of Axial Scientific investigations. Presenter focus should be on synthesizing major issues and identifying major challenges. Each presentation must be no more than 20 minutes, then 10 minutes of Q & A. Rapporteurs for each session.

0730 Coffee and Continental Breakfast - Talaris Center

0830 WELCOMING REMARKS - OVERVIEW OF WORKSHOP (15 m)

0845 Axial Inflation: Past, Present & Future - *Chadwick & Nooner* (20 talk/10 Q&A)

0915 Axial Volcano Multichannel Seismic Structure - *Arnulf, Kent, Harding* (20/10)

0945 Real-time Seismicity/Mechanics of Diking - *Wilcock & Tolstoy* (20/10)

1015 **Break for Coffee** (20 min)

1035 Hydrothermal Discharge: Chemistry-Volatiles-Heat-*Butterfield & Lilley* (20/10)

1105 Cabled Array - Primary & Secondary Infrastructure - *Mike Harrington* (20 m)

1125 History and Scientific Setting of Sensor Network Now in Place - *Deb Kelley* (20 m)

1145 Morning Session Q & A (20 min)

1210 Lunch in Dining Facility at Talaris (1 hr, 15 min)

Afternoon Plenary, Science & Technology *Dana Manalang & Giora Proskurowski*

1325 Microbial and Viral Research at Axial - *Huber, Holden, & Juniper* (20/10)

1355 2011 & Future Eruptions - Quantitative Mapping - *Clague & Caress* (20/10)

1425 Megaplume Formation, Impacts, Dispersal - *Baker, Lupton & Luther* (20/10)

1455 Hydrography near Axial: Ecosystem Displacement - *Thomson & Daly* (20/10)

1525 **Coffee Break** (20 min)

1545 Modeling Axial System: Observations to Understanding - *T.Crone* (20/10)

1615 **New Technology Ideas** (to be continued morning of Day 2):

High Speed Optical Comms thru Seawater - Norm Farr (10/10)

Eco-Genomic Analyses w/ and w/o Human Control - Jim Birch (10/10)

Resident Unmanned Underwater Vehicles: AUVs, ROVs and Hybrid AUV/ROV systems
as mobile instrument platforms on Axial - Vincent Auger (10/10)

Next Footprint of Deformation Sensor Arrays? - Scott Nooner(10/10)

1735 Comment/Question/Answer Period related to Afternoon Session (30 min)

1750 Anticipation of Day 2.

1800 Reception - Cash Bar

1930 **Hosted Dinner - Talaris Restaurant** - Speaker: **Dr. Rick Murray**, New
Director NSF Division of Ocean Sciences.

2100 End of Day One.

NOVAE WORKSHOP - DAY TWO – TUESDAY, APRIL 21

Morning Plenary Followed by Breakouts

0830 Reflection on First Day; Sketch of the Second Day

0845 **New Technology Ideas** - (Continued from previous evening) *Manalang and Proskurowski*

We invite participants to propose terse “elevator talks” - 5 min to 10 min each. Suggested presentations should be received before April 17 in the form of a paragraph plus 2 to 5 slides per idea. We will publish all on the website, and allot presentation time to as many ideas as possible in this session.

Speaking Order and Time TBD

- Sentry AUV - New Capabilities - *Carl Kaiser* ()
- Telepresence - *Fredrik Ryden* ()
- Going Wireless - *Dana Manalang* ()
- SeaFlow: Continuous observations of the structure and dynamics of microbial populations in the oceans - *Jarred Swalwell*
- Vent-Submersible Incubation Device - *Stefan Sievert* ()
- Optical Chemical Sensors - *Giora Proskurowski* ()
- Electric field detection - *Zoltan Szuts* ()
- Acoustic Scintillation - monitoring hydrothermal plumes - *Daniela Di Iorio* ()
- Video processing and large data sets - *Andy Stewart* ()
- Automated underwater sensing of nucleic acids - *Rhett Martineau* ()
- A New Sonar: Cabled Observatory Vent Imaging Sonar (COVIS) - *Karen Bemis et al.* ()

1015 - Discussion of ideas presented.

1025 **Coffee Break w/** (20 min)

1045 **Begin Major Breakout Sessions**

Key Discussion Themes to be Addressed by Each Breakout Group:

- 1) What are the priority science questions? (Review provided list; add new ones if needed)
- 2) Near-term: What science questions can be addressed with resources now available?
- 3) What measurements can characterize sub-systems *before, during and after* eruptions?
- 4) What time and space measurement scales are needed to address science questions?
- 5) What can be measured using *in situ* sensors or shipboard measurements?
- 6) What **could** be measured with additional approaches?
- 7) Transformative? Check NSF Web site for definition.

(https://www.nsf.gov/about/transformative_research/definition.jsp)

- 8) Intermediate term: What additions could better address priority science questions?

Breakout #1 - Processes Below the Seafloor - Magmatic and Seismic Geometry

Organizers: M. Zumberge, S. Nooner, M. Tolstoy

Processes:

- Magma chamber geometry and inflation;
- Deformation and changes in brittle-ductile zone;
- Magmatic heat and volatile output to overlying, adjacent hydrothermal system;
- Fracturing of crust above magma chamber;
- Phase separation and heat transfer mechanisms.

Approaches:

- Measurement of deformation and of heat transfer;
- Expansion of seismic and geodetic sensor footprints;
- Repeated multichannel seismic “snapshots” of subsurface structure;
- Improve computational resolution for seismic data reduction;
- Gravity surveys.

Breakout #2 - Processes Near the Seafloor-Volcanism, Venting-Microbes & Fluid.

Organizers: M. Lilley, J. Holden, D. Clague

Processes:

- Eruption and formation of lava flows;
- Establishment and evolution of vent fields; thermal output;
- Temporal variation and chemical evolution of each established vent;
- Changes in microbial populations and viral communities near seafloor;
- Distribution and changes in ecology of macro-faunal communities.

Approaches:

- Best use of ships for long-term studies;
- What can be done remotely? Reasons pro and con for remote analysis?
- Arrays of remote eco-genomic and volatile/nutrient analyses;
- Novel seafloor robotic laboratories - human in the loop?
- Remote sampling - transport to shore-based laboratories;
- Mobile, Remote Laboratories.

Breakout #3 - Processes in Water Column: Before, During & After Megaplume

Organizers: R. Thomson, E. Baker, K. Daly, & D. Caress

Processes:

- Formation of Megaplume--Water-column products of eruptions:
 - Environmental requirements, e.g., if cross-flows, turbulence or variable currents (tides, inertial waves) are strong, do effluents simply become well-mixed quickly and waft away before establishing megaplume boluses?
- Ejection of particles, microbes, heat, chemical mass in megaplume;
- Concurrent changes in normal venting during an eruption;
- Megaplume displacement of ambient water column structure - how extreme?
- Megaplume evolution: consolidation, migration, dissipation?
 - impact in dispersing effluents? e.g., is uniform advection-diffusion from a distributed set of sources more important than episodic dispersal via migrating megaplume boluses in creating distributions of silica, helium, iron, etc. in the North Pacific?
 - diffusion rates of active and passive tracers, before and after water-column alteration by massive venting; alteration of vertical distribution by mixing;
- Microbial distribution;
- Zooplankton biomass distribution;
- Organic particle composition and distribution.

Approaches:

- What measurements/sensors are needed for each process?
- Controlled-release gliders, floats, tracers
 - best sensors to deploy on mobile assets?
 - what's available?
 - what will be available soon?
- Permanent, interactive AUV's on cabled docking stations;
- Expanded use of profiling moorings;
- High-bandwidth optical comms through seawater;
- Seafloor crawlers.

1215 Lunch in Dining Facility at Talaris (1 hr)

Afternoon Breakout Sessions Continue

1330 - 15:30 Breakout sessions from the morning continue with additional #4

Breakout 1 - continue

Breakout 2 - continue

Breakout 3 - continue

Breakout 4 - Modeling - begin

Breakout #4 - Modeling the Axial System -

Organizers: Ben Larson, Tim Crone, Doug Luther

- What questions can modeling help answer?
- Can magma dynamics be constrained using seafloor observations?
- Biogeochemical ecosystem responses to volcano-hydrothermal change?

1530 - 1550 Break for Coffee (20 min)

1550 - 1700 – **Breakout Groups Begin to Focus on:**

- 1) Integrating element linkages (e.g., earthquakes to vent fluids & microbes, volume of lava vs size of megaplume created), rate of inflation linked to seismic activity;
- 2) Settle on major issues/ideas/approaches for coming years/decades:
 - a) Near-term issues - What can be done in five years? How react to an eruption?
 - b) Mid-term issues - Next ten years - Transformational, How do we prepare for next eruption? Define routine behavior, constrain deformation patterns;
 - c) Long-term challenges, next twenty years? Transformational? Innovative?
Can next eruption be predicted? Can processes be quantified?
 - d) Model development needed to serve experimental design? Data assimilation?

1700 **Plenary Reports of Breakout groups - 15 min each:**

1800 Late Afternoon: Define writing assignments and timelines for producing Workshop Report as a science plan, published articles, other...
Continued dialogue, arguments, disagreements (?) about definition of best ideas.

ADJOURN AT 1830 Free-Range Dining - University District

NOVAE WORKSHOP - DAY THREE – WEDNESDAY, APRIL 22

0900 Morning: Plenary Discussions

Discussion of paths forward:

- Best ideas presented as judged by attendees;
- Funding strategies for overall program and components of the program;
- Identification those willing to lead portions of this program - A Steering Comm?;
- How do we build community/public engagement for the overall program?
- Educational elements & citizen science involving real-time science inquiry;
- Short, focused breakout sessions as needed to complete elements of Workshop

1030 Breakouts as needed,

11:30 **Plenary** - Summary of major ideas and of plan for decades of science/technology/education/public outreach needed for a viable near-, intermediate-, and

long-term program focused on real-time, interactive remote investigations of Mid-Ocean Ridge phenomena.

1200 Lunch in Dining Facility at Talaris (1 hr)

Adjourn after lunch. Organizers continue to write, argue, weed, and refine until end of day with agreement on timeline for written report.

Report to be finished in early July, circulated widely for comment, and results made broadly available.