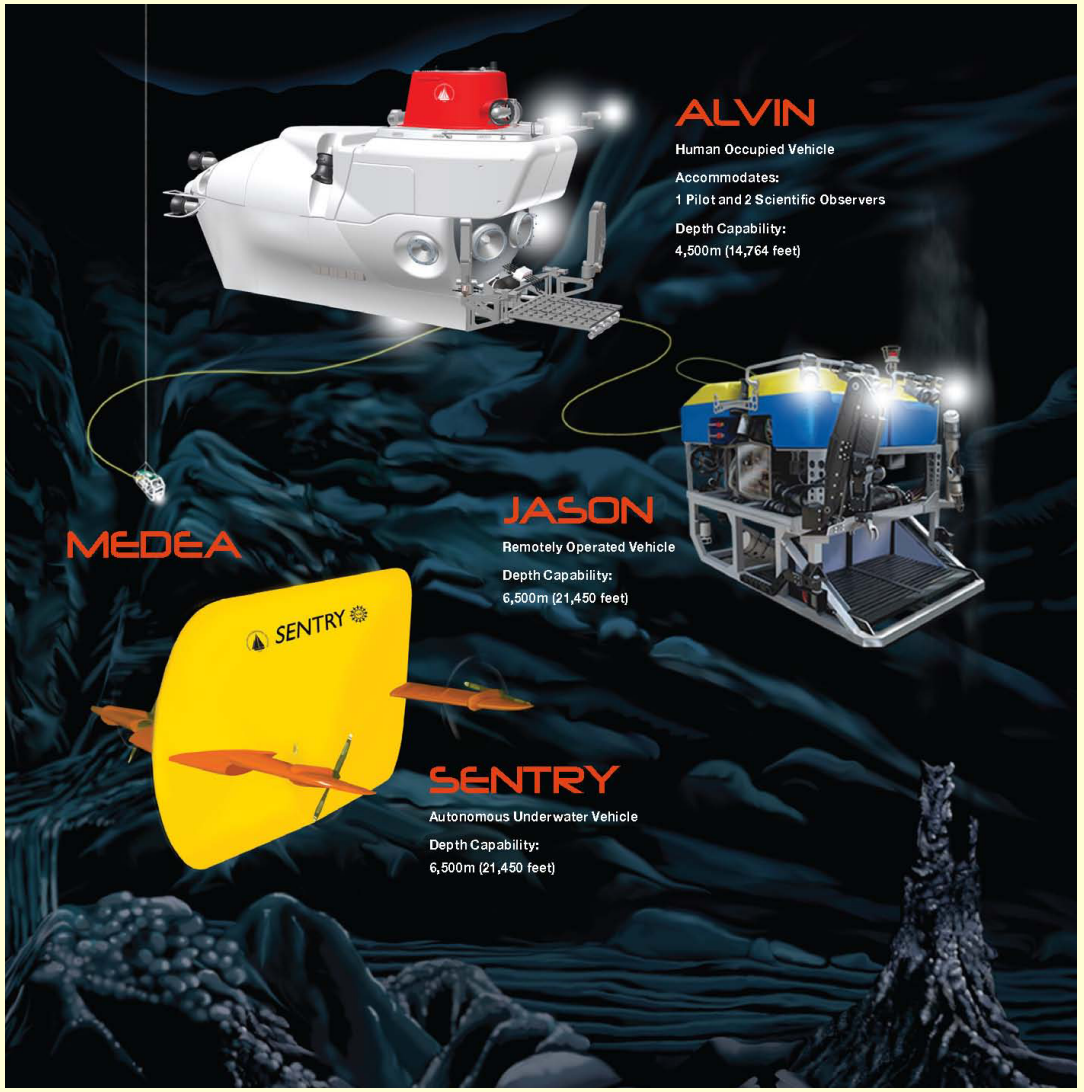
National Deep Submergence Facility:
Alvin, Jason & Sentry

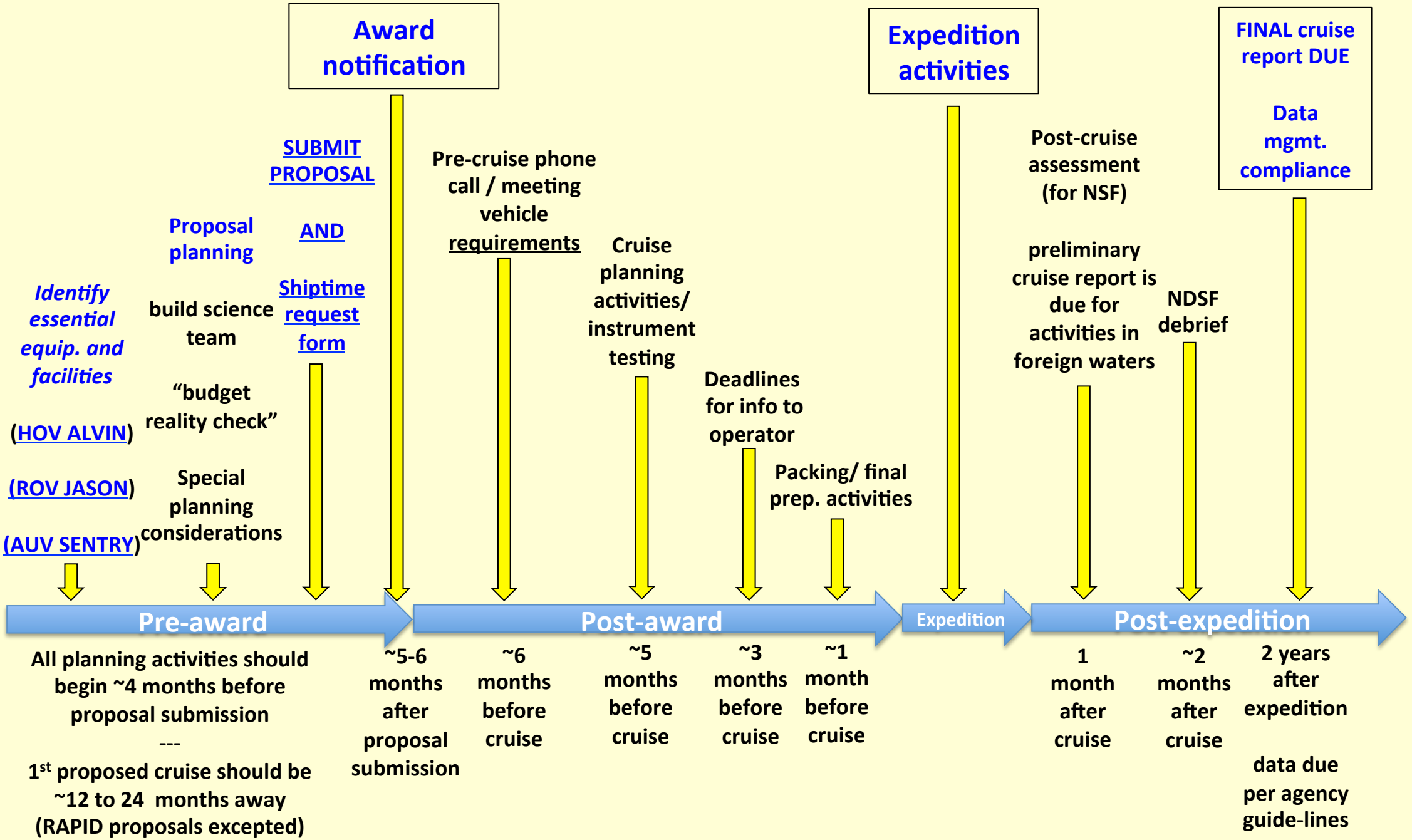


Background

The National Deep Submergence Facility (or NDSF) manages and operates the U.S. submersible *Alvin*, the remotely operated vehicle *Jason/Medea*, and the autonomous underwater vehicle *Sentry*. All are capable of reaching 6000 meters (DSV *Alvin* cannot yet until battery technology improves).

These deep submergence vehicles are renowned for advancing deep sea research, e.g. the discovery of hydrothermal vents.

However, the NDSF and its vehicles also play a major role in interdisciplinary oceanography, from studying the relationship between nearshore and deeper water processes to assessing the impact of anthropogenic activities (such as mapping the fate of oil released after the *Deepwater Horizon* accident). History has shown that NDSF vehicles have frequently played a major role in advancing oceanographic research.


Award notification
Expedition activities
FINAL cruise report DUE
Data mgmt. compliance
SUBMIT PROPOSAL
AND
Shiptime request form
Proposal planning
build science team
"budget reality check"
Special planning considerations
Identify essential equip. and facilities
(HOV ALVIN)
(ROV JASON)
(AUV SENTRY)
Pre-cruise phone call / meeting vehicle requirements
Cruise planning activities/ instrument testing
Deadlines for info to operator
Packing/ final prep. activities
Post-cruise assessment (for NSF)
preliminary cruise report is due for activities in foreign waters
NDSF debrief
Pre-award
Post-award
Expedition
Post-expedition
All planning activities should begin ~4 months before proposal submission
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1st proposed cruise should be ~12 to 24 months away (RAPID proposals excepted)
~5-6 months after proposal submission
~6 months before cruise
~5 months before cruise
~3 months before cruise
~1 month before cruise
1 month after cruise
~2 months after cruise
2 years after expedition
data due per agency guide-lines

DeSSC new user Program (Grant Writing)

Proposal contains many items. We will discuss the major items for the actual science.

Project summary (1 page) contains 3 items: Overview, Intellectual Merit and Broader Impacts
Proposal (15 page limit) - Self-contained general plan of work including broader impacts
References
Biosketch (2 page limit per PI)
Budget (per year and total) / Justification (3 page limit)
Current and pending support
Facilities (PI's University; used to assess adequacy of resources available)
Supplementary Documentation – ship time request form is here

New NSF budget requirements were initiated in January, 2015

Project Summary
Intellectual Merit of proposed research should indicate Hypothesis Driven Research
Example: **title "Pyrite nanoparticles are a kinetically stable iron source to the ocean"**
1) To demonstrate that hot waters, with varying Fe and H_2S concentrations from hydrothermal vents around the world, contain significant quantities of nanoparticulate pyrite (FeS_2), which incorporates other metals, and of other nanoparticulate metal sulfide phases (e.g.; $CuFeS_2$,CuS, Cu_2S).
2) To document that nanoparticulate FeS_2 is resistant to oxidation and thus able to be transported long distances from the vent source.

Broader Impacts resulting from proposed activity:
Enhancing the field through transformative science, and benefits to education and outreach.

Example:

Research on the existence and stability of metal sulfide nanoparticles from hydrothermal vents is lacking and is a necessary first step to understand the importance of vent-derived Fe and other materials for ocean biogeochemistry. **The persistence of nanoparticles in the deep ocean beyond plumes and to remote areas of the ocean likely has major impact on the chemical budgets of Fe and other metals (Cu, Zn, Ni, Co), which are potential limiting micronutrients and are used in enzyme systems by biological organisms. FeS_2 nanoparticle stability, mobility and eventual decomposition will have important implications for primary and bacterial production in the oceans as well as the oceanic budgets of these and other non essential metals, which form sulfides (e.g.; Pb, Cd, Hg).**

The PI will train one Ph.D. graduate student. The PI is committed to active involvement in numerous educational and public outreach activities and will have K-12 teachers involved with the project including one participating on the cruise as in past work. Outreach activities include a 15 minute highlights HD video of the field program, a web site that will discuss the work and a study program in local Delaware environments with local high school students using their own school built ROV.

DeSSC new user Program (Grant Writing)

The idea for the proposal is key!

When developing the proposal. Will it be?

- **Individual PI (you alone which is rare) or**
- **Collaborative (Good to work with someone with experience if you have no prior experience)**

Need to know what data (real time) and samples are required to be successful in attaining objectives.

What assets are necessary from NDSF to obtain them?

- **More than one asset needed? (e.g., *Alvin / Sentry* are autonomous) (*Jason* – tethered to a ship)**
- **How do you determine the asset?**
- **E.g., water depth working range [6000 meters; less than 4500 meters *(Alvin's* present rating)]**
- **hours on bottom needed (*Alvin* – 6 hours per day; *JasonII* – days; *Sentry* –1 to 2 days)**
- **type of work [multi-beam, biological sampling, (geo)chemical sampling, etc. and combinations]**

How many dive days are needed to accomplish the work?

Figure weather days; technical issues! You may not get the asset at the time of the year you desire.

Ship time request form is submitted as SD in the proposal.

If NDSF does not have the ancillary equipment (sampling gear, sensors, etc.)? What to do? User supplied!

- **Find someone who has the equipment, sensors and collaborate.**
- **Borrow.**
- **Develop it yourself (OTIC?).**

Telepresence enabled research

In recent years high bandwidth telecommunications have been used, particularly in ocean exploration, to bring the immediacy of discovery to the widest possible community.

The oceanographic fleet is being downsized and the new Ocean class ships (Sally Ride and Neil Armstrong) will have less berths for scientists (24 instead of 32). Up to 10 berths are required for ROV Jason II leaving 14 berths for scientists. Thus, not all people involved with a project may be able to be aboard ship.

Two-way telecommunication requires more funds to insure that the proper high bandwidth telecommunication system is available for HD video and communication so scientists in the research team back at the lab can see the research and discoveries in real time, and then actively participate in decision making regarding field research priorities. This will enhance the intellectual capacity to achieve the desired end-products for the project.

Costs for Telepresence can be substantial and have to be added to the cost of the research grant. Discuss with NSF program Director and Brian Midson before submission.

Ocean Sciences Meeting 2016 session **ED001: "Accessing the Deep Ocean From Higher Ground: New Advances in Telepresence-Enabled Research"**

Budget (per year and total) / Justification (3 page limit)

For preparation, need start/end dates of project

Who will do the work (when and where)? – give specifics for each team member

Faculty salary – no more than 2 months summer salary allowed per year under GPG basic guidelines with the exception of certain specific program solicitations.

Grad Assistants – high or low tuition, percentage of effort and length of time

Professionals/Technicians – names if known, percentage of effort

Undergraduates/wage payroll – need hourly rate and number of hours

Equipment needed to do the research that the PI does not have at present.

Supplies & Expenses: laboratory, shipboard, also some NDSF assets charge for steel weights (*Alvin*).

Shipping Costs! Agent costs!

Outreach costs!

Travel: domestic & foreign to meet the ship, conferences, etc.

Justification – no more than 3 pages allowed

1. Breakout of large expenses in categories, ie: materials/supplies, travel, equipment, etc.

2. Include budget notes for fringe benefits, tuition (if applicable), and F&A rates

Ship time request form I

Project Title: Pyrite nanoparticles are a kinetically stable iron source to the ocean

Project Short Title: Pyrite nanoparticles
Project Status: Submitted
UNOLS Project ID #: 102864
Version #: 1
Last Modified: 2/13/2011 3:02:00 PM
Date Submitted: 2/13/2011
Project Created By: George W. Luther

P.I. Name: George W. Luther
Institution: UDEL_CEOE
Phone: (302) 645-4208
Fax:
Email: luther@udel.edu

Institution: UDEL_CEOE - University of Delaware, College of Earth, Ocean and Environment
Address: School of Marine Science and Policy
700 Pilottown Rd.
Lewes, DE 19958 USA

Co P.I. Name	Institution	Phone	Email
No Associated Co-PI			

Science Discipline: Marine Geophysics
Large Program Abbr:
If Other Science Discipline, specify:
Large Program Comments:

Project Status: New Proposal

Agency/Division/Program	Grant/Project Number	Agency Funding Status
NSF/OCE/MGG		To Be Submitted

Agency Description:
Institutional Proposal #:
Proposal Deadline submitted for: 2/15/2011
Project Start Date: 8/01/2011
End Date: 7/31/2014
Project Budget:

Year	Ship(s) Requested (Name Or Size)	Total Days Req.	Start Date	Repeat/Multi-ship/ Clearance Req./Est. Cost	Status
2012	Atlantis	10	5/04/2012	N/N/N/423000	Submitted
2013	Hugh R. Sharp	2	7/10/2013	N/N/N/26932	Submitted

Project Webpage:
Summary of Field Work: hydrothermal vent work at the Mid-Atlantic Ridge

Obtain surface seawater for laboratory studies

Summary of Facility Requirements: Jason or Alvin
Summary of Other Requirements or Comments:

Chief Scientist: George W. Luther
 # in Science Party: 8 **# of Science Teams:** 1 **# of Marine Techs:** 1
Science Party Explanation: We will need the Jason or Alvin group to do the proposed work including outreach activities.

I understand that there may be another request for work in this area at this time.

Instrumentation that affects scheduling

Instrumentation Explanation:

Major Ancillary Facilities

Alvin
Jason

Ancillary Facilities Explanation: The project will study the hot hydrothermal vents so these vehicles are needed to sample the vents.

Ship time request form II

Project Short Title: Pyrite nanoparticles
UNOLS Project ID #: 102864
PI Name: George W. Luther
Version #: 1
Last Modified: 2/13/2011 3:02:00 PM
Date Submitted: 2/13/2011
Institution: UDEL_CEOE - University of Delaware, College of Earth, Ocean and Environment
Funding Agencies: NSF/OCE/MGG

UNOLS Request ID #: 1004422
Last Modified: 2/13/2011
Request Type: Primary
Date Submitted: 2/13/2011
Submitted By: George W. Luther

Year	Ship/Facility	Optimum Start	Earliest Start	Latest Start
2012	Atlantis	5/04/2012		

Dates To Avoid:

	Science Days	Mob Days	DeMob Days	Transit Days (Est)	Total
Op Days Needed	10	0	0	0	10

Multi-Ship OP? No **Description:**
Repeating Cruise? No **# of Cruises:** 0 **Interval:**
Repeating Description:
Schedule Justification: need a global vessel to support Jason. If Alvin is available only the Atlantis can be used.

	Lat/Long	Marsden Grid	Navy Op Area
Beginning	17.85° N/10.077° W	38	NA10
Ending	17.85° N/10.077° W	38	NA10

Op Area Summary:
Op Area Size:
Op Area Details: we propose to do 10 dives or days of work at Rainbow, TAG and Snake Pit on the Mid Atlantic Ridge

Foreign Clearance Required: No
Coastal States:
Foreign Clearance Comments:

Start Port: Horta, Azores (Acores), Portugal
Intermediate Ports: None
End Port: Horta, Azores (Acores), Portugal
Port Explanation: UNOLS and the ship operator know better which port should be used.

NDSF assets normally need 4 days for MOB and 4 days for DEMOB.

Good idea to add these in anyway. MUST do it for use of ships without NDSF assets.

Post Cruise Assessment Form (PCAR)

Post Cruise Assessment Report Information

PCAR ID: 100405

Date Created: 11/19/2012 2:40:00 PM **Date Modified:** 11/19/2012 3:06:00 PM

Cruise Information

Ship: Knorr **Area of Operations:** NA10

Cruise Dates: 10/16/2012 - 11/9/2012 **Chief Scientist:**

Cruise Number: KN209-02

PIs and Funding Agencies:

PI: George W. Luther, UDEL_CEOE **Funding Agency:** NSF/OCE/MGG

Type of Work: Pyrite nanoparticles **Grant #:** 1131109

PI: Andrew D. Bowen, WHOI **Funding Agency:** NSF/OCE/IPS

Type of Work: Jason Engineering Dv **Grant #:**

PI: Ruth Curry, WHOI **Funding Agency:** NSF/OCE/PO

Type of Work: DynAMITE **Grant #:** 0926848

PI: **Funding Agency:** OTHER

Type of Work: ROV JASON **Grant #:**

Ship Personnel

Master: Kent Sheasley **Marine Technician:** Amy Simoneau and Anton Zafereo

Completer's Information:

Person's Name: Dr. George W. Luther III. **Position on this cruise:** PI/Chief Scientist

Institution: University of Delaware, College of Earth, Ocean and Environment

Assessment:

1. To what extent were the planned science objectives of this cruise met?

rating: 81%-90%

comment:

Our goal was to collect focused flow water samples from 3 known hot hydrothermal vent locations on the MAR, a slow spreading center. We were able to get samples at all 3 locations. We had hoped to have one more dive day at each of the locations, but that was not possible due to weather problems and malfunctions related to Jason II on dives J2-666 and J2-668. The extra dives or hours on a given dive would have provided more statistical relevance for our work.

At the northern Rainbow site, we obtained the lowest number of samples (8 total). These samples provide us with some statistical relevance, but we had hoped for more to achieve better statistical data on iron and sulfur chemistry speciation and nanoparticles at the vent.

A CTD was performed at each site to track the rising plume.

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2. Rate how well the science party contributed to achieving the scientific objectives of this cruise (pre-cruise planning, communication, adequate personnel, equipment, attention to safety, organization, etc.).

rating: Excellent

comment:

A planning meeting occurred in Woods Hole on June 13 with the head of NDSF, the Jason group and others from WHOI.

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3. Rate how well ship operator pre-cruise activities (planning, coordination, and logistics) and shore support contributed to achieving the scientific objectives of this cruise.

rating: Excellent

comment:

The discussion was excellent as WHOI made sure that all materials requested were ready for the cruise. Their suggestions were implemented by the Science party as well.

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4. Rate how well the ship operator supplied scientific equipment and marine technicians supported this cruise (appropriate equipment, equipment operational and ready for cruise, calibrations, documentation, technicians trained and familiar with equipment).

rating: Excellent

comment:

Amy Simoneau and Anton Zafereo provided great service for CTD operations including data reduction from the CTD. Anton gave tutorials to several people including the students. A USBL system was placed on the CTD in order to provide location of the CTD relative to plumes and we were able to get great plume water samples. We were able to track the plume water at all 3 sites well above the vents; at TAG 500 meters above the site.
This aspect of our work was done very efficiently.

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5. Rate how well the scheduling of this cruise supported achieving the scientific objectives of this cruise (appropriate ship, year, season & dates, communications regarding schedules, online systems and scheduling process).

rating: Good

ship requested: Atlantic Explorer, Atlantis

comment:

We requested the cruise to occur in May but we were pushed back to October, and the weather was not good as we lost 4 dive days of the ROV Jason to weather.

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6. Rate the level of safety in shipboard and science operations (safety briefing and instructions, procedures & equipment).

rating: Excellent

comment:

Ship board safety was excellent. The crew did an excellent job in training us on shipboard procedures. Dee Emrich, chief mate, did an excellent job in boat/fire drill training and Peter Liarikos, bosun, insured that all science personnel used proper safety procedures when handling shipboard gear.

Lab safety seemed excellent. Chemicals were stored and used properly.

Post Cruise Assessment Form (PCAR) II

7. Rate how well the officers and crew and the manner in which the research vessel was operated contributed to achieving the scientific objectives of this cruise (communications, ship handling, deck procedures, attitude towards the science objectives, training, adequate number of crew, shipboard routine, etc.).

rating: Excellent

comment:

I have the highest regard for Captain Kent Sheasley. His handling of all situations from weather decisions and Jason malfunctions was done in a calm and professional manner and contributed to his crew working optimally. We communicated well and often about situations so decisions could be made in a timely and efficient manner.

Every member of the crew was very supportive of helping us achieve our science objectives. They displayed much interest in our work and there were many engaging discussions between crew and science party. We are very grateful for their interest and provided each of them with a 15 minute highlight video of our vent research. Again, I wish to express the science party's thanks to Peter Liarikos, bosun. He and all of his crew worked 24/7 to accomplish our goals as they retrieved elevators with samples for us, and reset the pole through the hull with CASSIUS USBL transponders for Jason navigation at each site and then placed the pole on deck so we could move quickly to the next site. They always operated in a very safe manner and impressed upon all that safety really matters on the R/V Knorr. They helped insure that the science party worked safely and efficiently on deck. As safety officer at my own institution, I can admire their work.

I recommend that for the newer ships a USBL system be installed during construction so that it can be used for best placement location of CTDs, corers and other science gear. This would be safer and have significant positive impact for doing science.

All of the mates did a great job in handling the vessel and providing timely information on weather and time to locations so we could plan our bottom time as efficiently as possible. This was essential with the weather windows we had. For two dives, J2-666 and J2-668 there were significant recovery problems due to the tether and thruster problems. In fact these were dead vehicle recoveries and required the mates (Dee Emrich and Derrick Bergeron for those dives) to hold position or move the ship at the appropriate time to ensure a safe recovery of Jason.

Tito Collasius, our expedition leader, did a top-notch job as well. We discussed that the ROV Jason is the major asset for the NDSF now that the HOV Alvin is not fully ready for use. We also communicated well and often about situations so decisions could be made in a timely and efficient manner.

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8. Rate how well the research vessel and its installed equipment contributed to achieving the scientific objectives of this cruise (material condition, readiness, living conditions and habitability, condition of lab spaces, design, layout, deck equipment, winches, cranes, frames, propulsion, power, etc.).

rating: Excellent

comment:

The steward, Bobbie Bixler, and cook, Erskine Goddard, did an outstanding job. They were ably assisted by Tony Reveira.

The engineering department led by Steve Walsh aided us in a repair of a titanium major sample bottle by providing us with a titanium tap to rethread a hole that science messed up. Amy Simoneau endured that the bottle was repaired.

Jerry Beard, Comm/ET, helped with our outreach phone call to Cape Henlopen High School. He was able to provide a speaker phone for six of us to answer students' questions. Also, he was able to audio tape the call for our future use.

I can easily say that the science party would love to sail with this group of professionals again.
The Knorr crew is the best in the fleet as they are always ready to work and provide service to science.

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9. Number of science days lost:

due to weather: 4.00

due to ship equipment: 1.00

due to ship science equipment:

due to user science equipment:

comment:

The RV Knorr did NOT cost us any loss of days due to weather and ship gear. The R/V Knorr worked well for us on all fronts and in II weather conditions.

Loss of dive days was due to operational procedures for the ROV Jason, which is not as robust as the RV Knorr. Even in modest seas of 3 meters, it is difficult to launch and recover Jason, and 3.5 weather days lost were due to Jason not the Knorr. In our case, we even experienced swells from Hurricane Sandy of about 3 meters, which were on top of a 1-2 meter sea state in 15-16 knot winds.

Because of poor weather, we only performed one dive at Rainbow and decided to save dive days by steaming 3 days to TAG. We performed one dive at TAG and then went to Snake pit as poor weather followed us to TAG. This move cost another 0.6 dive days due to weather as we had not originally planned to return to TAG after Snake pit, and this extra steaming time was not in the original cruise plan.
WEATHER SUMMARY: Loss of 3.5 weather days from October 29 to November 1 plus the extra half day of travel to TAG from Snakepit. From my experience and that of Anton Zafereo (a former Alvin PIT and Knorr SSSG), Alvin could have been launched on October 29-30.

One more day was lost to a combination of factors. The CASSIUS USBL calibration for ROV Jason work did not provide a good calibration on the first dive at Rainbow, and it had to be recalibrated at TAG. This took an extra 5-6 hours at TAG. Two other malfunctions occurred to Jason. First, on the third dive at Snake pit (J2-666), Jason II experienced a malfunction as the fiber portion of the tether was compromised making it impossible to control Jason so the dive was aborted. The tether and the port horizontal thruster were replaced in a remarkable 16 hours.
Second, on dive 5 at TAG, Jason's port horizontal thruster had a hard ground, which was then disabled. Two more samples were taken and the dive was aborted. The thruster was replaced a second time and the next dive #6 occurred about 12 hours later. However, this dive only lasted 11 hours due to a small weather window.

Despite these mechanical malfunctions, we applaud the Jason group for turning these potential disasters into smaller dive time losses. It is unfortunate that these problems occurred during good weather windows. The combination of all these items resulted in only 1 dive day lost. It surely could have been more, but the reaction of the Jason group to these problems shows that the Jason group is as much or more of an asset to the NDSF as the Jason vehicle itself. We thank the expedition leader, Tito Collasius, for his leadership during our cruise. He was understanding of our needs and did his best to get us samples so we could succeed.

Despite our bad luck, we did accomplish much. We thank the RV Knorr crew and the ROV Jason group for all of their efforts on our behalf. They are professionals who do their best regardless of the situation. We know that they wanted to provide us with more service and samples.
We hope to sail with both groups again soon.

I should like to recommend that DeSSC, the NDSF and WHOI research for better ways to launch and recover Jason so dive days losses due to weather be minimized.

NSF Reports

Annual Reports on nsf.gov discuss many topics

- **accomplishments**
- **goals met**
- **problems**
- **outreach**
- **personnel**
- **etc.**

Final “Annual” Report

Final Outcomes report for public dissemination