DEep Submergence Science Committee

Woods Hole Oceanographic Institution
Carriage House
Woods Hole, MA
June 16-17, 1998
Meeting Summary Report

Appendices

I. Introductory Remarks

The DEep Submergence Science Committee met in the Carriage House of Woods Hole Oceanographic Institution on June 16-17, 1998. The meeting was called to order by Mike Perfit, DESSC Chair, at 9:00 am. After introduction of participants, the agenda was reviewed. The items of the agenda, ***Appendix I***, were addressed in the order as reported below. The participants of the meeting are listed in ***Appendix II***.

Accept Minutes - The DESSC meeting minutes of December 1997 were accepted as written.

II. National Facility Operator's Report

Dick Pittenger began by first reporting on the NSF Academic Research Fleet Review process. The Review Committee is Chaired by Dr. Roland Schmitt, retired RPI President. Their first meeting was held on June 8-10 at NSF. A variety of presentations were made by members of the UNOLS

community. Dick and Karen Von Damm made a presentation on deep submergence research facilities. They reviewed the management and administration of the facilities as well as the science drivers. Copies of their presentation can be obtained from the UNOLS Office.

Dick continued by introducing Bob Brown, a new member of the Deep Submergence Group at WHOI. He was previously an ALVIN pilot and an ex Navy submariner.

National Facility Vehicles Operations Summary - Rick Chandler provided a summary of the 1998 ALVIN and ROV operations, see ***Appendix III***. It was noted that this year the average bottom time for ALVIN has been 5.2 hours and the average bottom time for the ROVs has been 35 hours per lowering. Rick provided a list of ALVIN/ROV highlights from this year's operations. The highlights included 25 hours of data collection with the ESC camera sled. The DSL-120 sonar has been used to survey 357 NM of ridge. The tube core carousel was successfully used and the Simrad SM2000 multibeam sonar was tested. The full list of 1998 NDSF highlights is included in ***Appendix III***.

Andy Bowen continued with a report on the engineering development achieved during Guaymas Jason operations, see ***Appendix IV***. These included replacement and testing of the ring laser gyro. The Simrad SM2000 was evaluated. Simrad provided an engineer for the evaluation. The system is rated to 2500 meters and performed impressively. The Doppler/Long Baseline system was evaluated. It appears to be an appealing alternative to EXACT which requires a transducer for use. A site map was developed for a subsequent ALVIN dive, which was very useful and optimized the use of ALVIN.

ATLANTIS Post Shakedown Availability (PSA) - Joe Coburn reviewed the improvements accomplished on ATLANTIS while in its PSA. Improvements to the SHIP DURING THE PSA cost $2.8 M and included $1M in WHOI cost sharing funds. There were improvements for bow thruster noise abatement which resulted in 7 to 10 dB reduction in noise in staterooms at 100% thruster RPM. Improvements were made to reduce anchor slamming, but it still slams under some conditions. It was noted that the slamming is a problem that plagues all of the new AGORs and should be addressed by the Navy. Improvements were made to the HVAC system on the 01 Level. A mission announcing system was installed. Overall, the improvements will help to make the ship more livable. The full list of PSA improvements are included in ***Appendix V***.

There is still a backlog of pending improvements and upgrades for ATLANTIS. This list of backlog items is contained in ***Appendix V*** and still needs prioritization. Funding for these items has not been identified. The list includes among other things completing propulsion control upgrades, additional HVAC improvements, and increasing the fresh water storage capacity. Efforts are continuing to bring SeaBeam performance up to specification. There are still some problems, however, WHOI feels that the system is working almost to spec.

The DESSC discussed ways to address the prioritization of the outstanding list of improvements. One suggestion was to have a check off list attached to the PI cruise assessment report. The PI could indicated the improvements that he/she felt were most needed. The list would include the back-log

items.

DESSC inquired into the status of obtaining additional berthing for ATLANTIS. Joe Coburn explained that WHOI is not pursuing this at this time. The estimated costs to add berthing were very high (in excess of $500K). Additionally, there would be major tradeoffs. WHOI had a naval architect evaluate 2 alternatives: Option 1 took up the forward end of the main lab (reducing lab space by 600 sq. feet). Option 2 added deck house structure forward and lost two van spaces forward. It would also add much more high weight to the ship.

Science Liaison and Operator/User Communication/Updating the WEB and planning manuals for science - Don Moller reported these topics. His viewgraphs are included as ***Appendix VI***. He began by explaining that WHOI is now conducting pre-cruise planning meetings. The meetings are attended by the PIs, Don, Barrie Walden, Dudley Foster and sometimes Rick Chandler. The meetings have been useful largely because it makes all parties involved think about the cruise well in advance.

Don provided an organization chart showing the operator's roles and relationship to the agencies, PIs and other operators. In the proposed new office composition, there will be a Coordinator/Science Liaison/Scheduler, an Assistant Coordinator, and a Staff Assistant. One position (the Coordinator) would serve as a replacement for Don Moller. The other position would be an assistant to this person. Joe Coburn, Barrie Walden, Peter Wiebe, Dan Fornari, Don Moller and Barbara Martineau will review the applicants. Dick Pittenger will make the final decision. [In late summer, Jon Alberts was selected as the replacement for Don Moller.]

In the pre-proposal phase, Barbara Martineau will most likely get more involved. WHOI will provide assistance to PIs regarding vehicle capabilities, costs, weather windows, instrumentation, and logistical issues. The WHOI National Facility web site is a good resource for pre-proposal planning; however, WHOI and DESSC need to inform the community that the site is there for their use.

In the scheduling phase, there would be close coordination with the WHOI Port Office, ships, Deep Submergence Operations Group marine technicians and community. Scheduling will be necessary for the ships, deep submergence vehicles and the future WHOI SWATH. The coastal SWATH vessel is planned to come on-line in early 2000. Twenty local labs and institutions are interested in having access to the vessel. In the cruise preparation phase, the cruise plan/prospectus will be developed using the information from the pre-cruise meeting and electronic scheduling tools. In the execution phase, WHOI will monitor and provide assistance as needed during each cruise mobilization and demobilization. This phase will include post-cruise feedback, billing, data disposition, archiving, post-cruise reports and science feedback.

III. Upgrades to National Facility Vehicles and Science Sensors:

Status Report on current upgrades proposal - Dudley Foster reviewed the various deep submergence

facility upgrades completed or in progress, see ***Appendix VII***. Datalogger hardware and software upgrades have been implemented. WinFrog is being used as a back-up to navigation. The DESSC discussed WinFrog. WHOI explained that the WinFrog package is so complicated and encompassing that they are trying to convince the vendor to simplify the system and make it easier to use. It still remains to be seen if WinFrog will be the tool of choice in two years. Video upgrades and image acquisition infrastructure includes hardware and software, flat panel displays and ROV monitors. WHOI is evaluating flat panel displays. Monitors for the ROVs still need to be purchased.

Syntactic foam for additional science payload has been purchased for ALVIN. The added foam will provide approximately 180 lbs of buoyancy. Fabrication and installation of the foam is complete. There will be some adverse trim implications. Extra steel will also be needed for ballast. Syntactic foam was also purchased for Jason and will add approximately 90 lbs of buoyancy. Fabrication and installation of the foam is complete.

The virtual ALVIN model is under development. It will serve as a power management tool. The conceptual design has been completed and software development is 70% complete.

Scanning sonar has been procured and the system is under evaluation. SIMRAD SM2000 demonstrations were planned on Jason and ALVIN in May 1998; Straza 1510 in June 98; and Tritech possible in July 1998. In the original upgrade proposal there were funds for Imagenix. However, the industry has been changing so WHOI is investigating to find the best system for the cost. Simrad does not provide the depth (400m), but they are willing to investigate. ALVIN search mode requires 1000 meters. WHOI's planned approach is to upgrade Imagenix, keep Simrad/Mesotech in operation and pursue the SM2000 system.

The Ring Laser Gyro purchase will be cost shared 50% by WHOI. The prototype system design is complete. Hardware and software procurement for the development system is complete. The prototype system as used on Jason in Guaymas. Integration and final design on ALVIN and ABE is to be done.

Four Slurp pumps have been purchased and the sample chamber has been successfully used. Progress is being made on the digital snapshot cameras. Installation and testing is planned for the beginning of 1999. "Steerable" elevators for ALVIN and Jason were funded by WHOI. Model testing will be done over the 1998 summer. WHOI will purchase and evaluate commercial inductive modules for wireless data transmission link. The LEDs might have more range.

Annual request for upgrades to science sensors and operational capabilities of NDSF vehicles - Barrie Walden reviewed the future process for handling upgrades. Sandy Shor has indicated that a more routine process of upgrade proposing is desired. The model used for the "instrument proposals" is appealing. NSF would rather see yearly proposals rather than the major upgrade proposals which have been periodically submitted . Since WHOI is still working on the present proposal through 1999, it is expected that there will be no proposal submitted this year. September 1 is the deadline for upgrade proposals. The next upgrade proposal is slated for 9/1/99. [Note: Since the meeting, Barrie Walden

submitted an equipment request for a Simrad bathy system for the vehicles.]

The DESSC discussed the memo from Maurice Tivey requesting the addition of magnetometers to all DSF vehicles. These cost approximately $10K each. The DESSC noted that a policy is needed on how to deal with annual upgrade proposals. Barrie also raised the question of who will maintain these types of equipment that are requested by the user community.

Bob Gagosian's Welcoming Remarks:

Bob Gagosian welcomed DESSC to WHOI and gave a brief summary of the National Oceans Conference held in Monterey, CA. Speakers at the conference noted that observatories will be important in the future as will ROVs, AUVs, and HOVs. Rita Colwell the new NSF Director understands the value of ocean science. Bob was involved with Presidential meetings involving issues of fisheries, national security, the environment and the oceans. Bob briefed the President on the group's activities in deep submergence science and exploring the ocean. There is a lot of interest and focus in this area at high levels of the government. We need to get the observatories in place for the future. Bob noted that there is no new funding and that any spending must have economic value. Most of the Deep Sea Observatory discussion at the National level was tied to exploration and unusual vent activities. It must be keyed into the economy, such as, biomedical values.

IV. Operational Summary of Other Deep Submergence Activities:

1. MBARI - Mike Perfit reported that MBARI funded 60 days for mapping the West Coast using EM300 Simrad, 30 kHz. The data is spectacular. Information can be found on MBARI's webpage. VENTANA work is planned for the Santa Barbara Channel. TIBURON has been used at 2000 meters. MBARI is very pleased with the video system on WESTERN FLYER and TIBURON. WESTERN FLYER will be in the shipyard for repair until May 1999. Debra Stakes of MBARI recently successfully used the diamond drill core on ROPOS in preparation for Indian Ocean operations.

2. MPL - Fred Spiess provided a report on MPL activities, see ***Appendix VIII***. He reviewed the Deep Tow Group's seagoing operations for 1997-1998. A side scan survey and bottom photography using Deep Tow was conducted on the Cortes Tanner Banks in June 1997. The operations were conducted from REVELLE. Fred provided photographs of the vehicles. Near-bottom magnetics and sidescan surveys were conducted at 19 S and 17 S using Deep Tow. These operations were from MELVILLE in April-May 1998.

SINKEX sediment sampling was conducted in August 1997 using the control vehicle. The Control Vehicle can be used on 0.688 cable. The Control Vehicle was originally used to place instruments on the sea floor and is now also used to put objects in drill holes. OSN-1 instrumentation deployment was conducted in Jan-Feb 1998 and recovery along with down-hole logging was planned for June 1998. A seismometer was installed in the drill hole and hooked up for 24 hours before disconnecting. Three packages were left on the bottom for recording. At the time of the meeting, the packages were retrieved

and the recorders and seismometers were intact.

Navy Operations - Andy Silver, ONR, reported on 1997 and 1998 Navy deep submergence science operations. TURTLE had no science dives in 1997 and was decommissioned in October, 1997. SEA CLIFF had six dives of MPL science work. Scorpio was used in 16 dives to recover a sunken tower off Hawaii. SEACLIFF was decommissioned in April 1998 (see report below). ATV has been used for operations to locate YORKTOWN. SCORPIO may also be used in 1998. ATV had in incident this year in which a 17-inch glass imploded. It has been repaired and is back in operation.

NURP - Cindy Van Dover gave the report and began by stating that this is her last year as Director of the NURP West Coast center. The West Coast and PR Undersea Research Center 1998 field programs were described, see ***Appendix IX***. All of the 1998 programs were funded out of the NURP Center and used ROPOS, ALVIN, VENTANA, DELTA, and low cost ROVs. The total estimated cost (science plus operations) is $1,958,801. Some of this work also has NASA involvement.

In 1999, the NURP West Coast Center has decided to pursue the Gulf of Alaska initiative. In addition to the National Funding, the West Coast center will add funding from their own center funds. Additionally, there is some follow-up work planned for Juan de Fuca, 9°N and off Southern California.

ROPOS - Mike Perfit gave the report on operations using ROPOS. Shallow water tests using the drill in preparation for operations in the Indian Ocean have been conducted. Trials for a hydraulic chain saw will also be conducted. The saw will be used during operations for the EDIFIC REX program in June/ July 1998. As part of the field program, a three to four meter hydrothermal chimney will be removed from the Juan de Fuca area and brought to shore. THOMPSON will be the support ship for this program. The chimney will be put on display in the American Museum of Natural History in NY. ROPOS will also be used from RON BROWN for two cruises in 1998; one in the Oregon Margin and one at Axial Seamount at the Juan de Fuca Ridge. Lastly, ROPOS will be used for annual survey of seabed dumpsite near Vancouver Island. The support ship will be CCGS VECTOR. Long term upgrades and improvements include a new 5200 meter cable and a new winch. Additional information on ROPOS can be found at the website, http://www.ropos.com.

UNOLS Report

Ken Johnson provided a report on UNOLS activities. The big item that UNOLS has been involved with this year has been the NSF Academic Fleet Review process. A review committee, chaired by Dr. Roland Schmidt, retired RPI President, has been tasked to examine the mix of ships, their location, the number of ships, and the UNOLS mode of operation. The first meeting was held on June 8-10 at NSF. UNOLS provided a series of presentations which were intended to give a description of UNOLS, the academic research fleet, and the types of research supported by these platforms. Karen Von Damm and Dick Pittenger made a presentation on the National Deep Submergence Facility Operations and future science needs. They presented the need for a 6000 meter science vehicle capability. The second meeting scheduled for 1-3 September at SIO will look at the economics of the fleet operations as well as

alternative modes of operations. The Spring OCE letter requested community input regarding the academic fleet.

In other UNOLS issues, the original gloomy ship utilization outlook for 1998 improved as the year progressed. Originally, EWING and ENDEAVOR were scheduled to be laid up during the year. However, EWING was able to accommodate a private charter for geological work off of Canada. ENDEAVOR was able to schedule a NOAA fisheries program off the Pacific coast of Mexico.

Ken reported that UNOLS held a Town Hall Meeting at the OSLO conference in San Diego. Attendance was low and might be attributed to a variety of reasons; such as conflicts with other planned activities or the lack of major problems to raise.

Ken concluded by noting that his term will be up in September. A new Chair is needed and must come from an operator institution.

Agency Reports:

National Science Foundation (NSF) - Dolly gave the report for NSF. She began by remarking on the Academic Fleet review. Basically, the committee is charged to look at the overall management of the fleet operations as well as the funding of operations. Roland Schmidt was vice president at General Electric, retired president of RPI and has served on the National Academy. It appears that the facilities cannot go on as in the past. They may need to be recompeted every five years.

Dolly reported on the results of the May NSF panel. It looks as if 1999 will be a busy year for Deep Submergence science. Much of the work was already funded prior to the panel. Some of the funded work will flow into 2000. The deep submergence facility is the most healthy in the fleet.

Office of Naval Research - Andy Silver gave the report for ONR. TURTLE, which was decommissioned in October, 1997, will most likely go to a museum. It has been stripped of its major equipment. SEA CLIFF was decommissioned in April. NAVSEA drafted a letter to PMS325, overseer of SEACLIFF, requesting that it be sent to WHOI. The letter is close to being signed. Once signed, the vehicle will be shipped to WHOI. The vehicle will most likely come with two vans plus spare parts. ATV is doing surveys this year. It is scheduled to become inactive in April 1999. [note: Since the DESSC meeting, SEA CLIFF was delivered to WHOI and the Navy has decide to retain ATV indefinitely.]

The Navy funding for deep submergence science work included 12 days using Jason in Guaymas in 1998. In 1999, no days are planned. The ONR facilities budget is approximately $5M. The facilities program supports ship time on a 80/20 percent with ONR's 6.1 science programs. ONR has also decided to fund 6.2 ship time programs. This includes applied research programs such as those conducted by the Navy Labs. This could add $6M to $8M to the budget. In 1999, ONR facilities will fund aircraft science time; however, no new money will be added to the budget for this support. In recent years,

ONR facilities has been not spending its entire budget on ship time.

In other Navy ship activities, the AGOR 26 SWATH vessel is in the design phase. The entire budget for the design and construction of the vessel is $45M. University of Hawaii was selected to be the operator. Lockheed/Martin is the designer. It was noted that a center well is not planned for the vessel. There was a lively discussion on the UNOLS/community lack of involvement in the design process of this ship. To date, UNOLS has not been provided much feedback on the design process. There is a fear among the community that the design will progress so far along that any changes would no longer be feasible because of cost. Sujata reported that Lockheed has established a virtual design which can be accessed via an electronic vault with the proper authorization. Sujata reported that UNOLS/FIC can be provided access to the vault. Additionally, a full report on the ship's design and status can be provided at the UNOLS Council meeting. The design process is progressing very rapidly and a better picture of what the ship will look like will be available soon.

V. DESSC White Paper Discussion

Deep Submergence Science Initiatives - Beyond 2000 - Mike Perfit introduced this topic. In 1994, the DESSC Global Abyss was published and recommended the use for ROVs. In 1997, a review of SEA CLIFF was performed by members of the community and the need for a deep operating ROV was recommended. At the December 1997 DESSC meeting, the community discussion indicated that a deep, robust ROV is needed to support future deep submergence needs. In March 1998, Mike and Dan Fornari met with agency representatives of NOAA and NSF (ONR was not available) at NSF to discuss this need for a new ROV and to obtain advice on ways in which to obtain it. It was suggested that a community meeting may be useful in defining the future deep submergence needs. Community involvement in this meeting must be broad and not just include DESSC. The meeting should ask the question, "What are the tools that we will need in the next ten years?" Mike suggested that an early 1999 meeting be planned to identify the science needs. The organizers could include RIDGE, MARGINS, UNOLS/DESSC, ODP, the Federal agencies, and members of the biological and chemical oceanography fields. Mike has contacted the chairs of these various groups to discuss the meeting plans. It is hoped that by late 1999, the community should be able to identify the tools needed. To begin this process, Mike suggested that we take the initiative with a white paper.

Patty Fryer continued with a discussion on the MARGINS initiative. She discussed the Subduction Factory Workshop held in La Jolla, CA on 6-9 June. The meeting discussions included the following general areas:

- Science objectives
- Criteria for focus on geographic areas best suited for study.
- General discussions regarding implementation:
    - Staging over decadal period
    - multidisciplinary approach
    - international cooperation.

Special topics of interest to DESSC include bottom observations/time series experiments and access to depths greater that 4,500 meters. A follow-up session is planned at AGU and the science needs will be discussed.

Review written contributions from DESSC members - Next the white paper was discussed. Prior to the meeting, Mike had asked the DESSC to provide written responses (***Appendix X***) to a series of three questions:

1. What are the current important deep submergence science research interests in your field of research?
2. What do you see as your important future deep submergence research directions in the next five to ten years?
3. What deep submergence vehicles will be needed to accomplish your research objectives?

Each DESSC member provided a short summary of their respective written responses.

Cindy Van Dover began and reported that she looked at this from two perspectives; one from and NURP view, and the other from her own research view. She indicated that future research directions include fisheries habitat research, pollution assessment and remediation, and clathrate deposits, tectonic hazards, and sub-ice processes. To view tectonic hazards, there is a need to go deeper. There is also a need for diversity. From Cindy's own research, ridge crest biology, she saw a need to support time series studies, reproductive biology, diversity, physiology, phototrophs and NASA interests. We also need to address shallow water interests.

Hugh Milburn reported on NOAA's vents interest, primarily in the Juan de Fuca area. There will continue to be a need to monitor vents. We must have a suite of vehicles able to fly-away. For the Neptune program, a team of air-dropped AUVs for monitoring event plumes is envisioned. There will also be a need for a dedicated ROV for servicing the cable to the Neptune program.

Dan Orange reported that there will be science research needs in the areas of geodetics and gas hydrates. There will be a need for long-term monitoring of fluid flow/physical properties at the seafloor as well as at drillholes.

Patty Fryer reported that her research will be in non-accretionary convergent margins. Four factors should be taken into account when considering the facility needs for this type of research:

1. Bottom characterization,
2. Long-term monitoring,
3. deeper capability tools, and
4. international cooperation.

In order to study mass transport in these environments, there will be a need to be able to monitor changes in geochemical conditions in situ via the use of ocean-floor observatories. Both ODP borehole and ancillary monitoring stations on the seafloor will be needed in the future. These will have to be serviced with a new generation of deep submergence assets.

Mike Perfit reported on research on the submarine portions of island arcs and in back arcs. Not much is known about the geologic and tectonic history of these features. Also, very little is known about vent fluids in arc environments and the biologic communities that exist in these locales. Multidisciplinary studies are needed in these areas.

Dan Fornari reported that mid-ocean ridges and hydrothermal vents will continue to be of interest. There is a need for event monitoring and response. Embedded in this is observatory type systems. He suggested using observatories for education and public outreach programs.

Marv Lilley reported on his research in temporal studies of hydrothermal systems and the need to know what is going on with respect to long-term processes in these systems. There is still a lot to learn about hydrothermal systems. There is also a need to be able to access several places at the same time, and to perform multidisciplinary studies. The margins areas include Cost Rico (west), Nicaragua, the Aleutians, Izu-Bonins, Marianas and Tonga.

Bob Collier reported on his research area in chemical interactions. Hydrothermal systems continue to be of high interest and margins research is a growth area. In the environmental realm, the deep ocean environment needs to be looked at as a way to entrain CO2, remove it from the atmosphere and entrap it. A vehicle may be needed to explore this area. Also noted was that the community has had a difficult time to get funding for rapid response and monitoring programs.

Carl Wirsen reported that his research in microbiology will continue to be an important area in the next five to ten years. LEXEN will continue to look at the stability of microorganisms. A sample-oriented group of vehicles is needed for this work as opposed to survey tools.

Jim Bellingham discussed vehicle technology. He began by reporting that ABE worked well and has undergone a significant amount of maturation. Many vehicles will be needed to meet future needs. Jim noted that it was a shame that ABE doesn't have core funding. Past funding has come from ONR and NSF. Dana Yoerger reported that an ABE II proposal has been funded by Larry Clark at NSF. If the AUVs continue to be supported properly, they have a chance of becoming a useful tool. AUVs will allow you to use the right tool for the right job.

Next, Dan Orange addressed the question of what deep submergence vehicles will be needed in the future, see Appendix X. From Dan’s perspective, bigger, faster, cheaper and reliable vehicles are need to support science. From an industry perspective, ROVs (and AUVs) are built for the customer and are not all are alike. HOVs are still needed to maintain a cognitive presence. AUVs are needed for interrogation and survey work. An ROV with torque, strong manipulators, payload, tool chest, and

horse power is needed. One option to pursue would be to buy a commercial core ROV.

Day 2 - June 17, 1998

SEA CLIFF Proposal - Dick Pittenger introduced this topic. Plans call for SEA CLIFF to be delivered to WHOI (note, SEACLIFF was delivered to WHOI on August 5, 1998). WHOI plans to take a close look at the vehicle, keeping in mind that the present capabilities of ALVIN must be preserved. WHOI has submitted a proposal to ONR to perform an engineering study of the vehicle. Barrie Walden reported on what is contained in the proposal, see ***Appendix XI***. The proposal calls for an engineering study for a replacement U.S. 6,000 m manned research submersible. The cost of the proposal is $200k. With the decommissioning of SEA CLIFF, the US lost it manned presence to 6000 meters, as a result, the proposed study is to determine the best method for obtaining 6,000 meter manned submersible with improved capability and reliability. The goal will be develop a design, capability and cost matrix. They would like to determine the best utilization for the system. To do this, WHOI plans to evaluate other 6,000 meter submersibles (MIR, NAUTILE, and SHINKAI), and study the options. Utilizing SEA CLIFF to upgrade ALVIN offers a 6,000 m Titanium sphere, syntactic foam, advanced VB system and CTFM sonar. The proposal calls for reviewing the importance of the viewport location both from a science and engineering standpoint. Changing the location could improve the comfort level, but it would need to be determined if this would be worth the effort. It was noted that we need to hear from the community. What do they need? The agencies will need more justification of why we need newly positioned viewports.

WHOI's DSF Perspective - Dick Pittenger provided WHOI's perspective on deep submergence facilities. Presently there are ten traction winches available on the U.S. ships, see ***Appendix XII***. WHOI owns three (ATLANTIS, OCEANUS and one portable). Scripps has two traction winches, one each on REVELLE and NEW HORIZON. The others are at L-DEO, OSU, NAVO (2) and NOAA. Rochester .680 fiber optic cable has proven reliable, rugged and robust. It is available at WHOI, SIO and NAVO. Jason is proven and accepted. Dick provide a time line for bringing a new ROV into the system. As the new ROV is developed, new technologies will be incorporated into Jason as appropriate. If we go beyond 6000 meter, we will need to look at new, or revised, cable. Jason would be kept aboard ATLANTIS with the new ROV operating in a fly-away mode.

There was a discussion on AUVs. There are more and more coming on-line. There is the Remus-like vehicle for shallow water work. Odyssey operates in the shallow mid-water as well as in deep regions (3000 to 6000 m). ABE I is a long duration, deep ocean vehicle while ABE II will be designed to operate in deep water with improved launch, recovery and data collection capabilities.

Mike Perfit requested that WHOI make a presentation at the winter workshop reviewing their approach for design of the new ROV and explain why they are taking the approach they are taking. WHOI reported that the next-generation ROV proposal is already in progress and WHOI is polling commercial manufacturers. DESSC pointed out that the community could use a powerful, robust ROV. Jim Bellingham noted that AUVs could be used to extend the depth capability. From an engineering

perspective there should be a dialog between the people who want to do research at great depths and the people who build vehicles/instruments that go deep. The Margins group might be interested in the deep AUVs. It was suggested that for the December meeting the community be asked the questions: 1) does the community want a heavy duty ROV for work up to 6,000 m, and/or 2) do they want an upgraded ALVIN?

NASA's Deep Submergence Activities - John Rommel from NASA gave a presentation on NASA's interactions and interest in deep submergence activities. Their interests include work in Antarctica, Europa exploration and the "light at the vents" program. NASA has a compelling interest in placing scientists remotely in deep ocean - how to maintain a virtual environment. They would like to understand the instrumentation needed to study these processes. Europa has shown evidence of ice on its surface. There may be an ocean under the ice. In the year 2003 there will be a Europa mapping vehicle. By the year 2008, a Europa landing is planned and they will attempt to send an ROV or AUV under the ice. It is unknown how thick the ice may be. The question they are facing is how do you get a vehicle on Europa and how do you get it to work? There will be a Europa test program. Other issues include planetary protection - how do we keep earth contamination off the planet. NASA is looking for a partnership between the oceanographic community and engineering groups. Funding of $1m is expected for next year.

DESSC Membership Replacements:

DESSC Chair Replacement - Mike Perfit has decided not to stay on for a second term as DESSC Chair. Nominations were solicited from the community prior to the meeting. Patty Fryer left the meeting during the discussion on membership replacements. The DESSC members recommended the nomination of Patty Fryer for DESSC Chair based on her vision for deep submergence science, leadership qualities, DESSC experience, and experience using deep submergence vehicles. The nomination will be forwarded to the UNOLS Chair for approval. [Patty was approved during the September UNOLS Council meeting].

DESSC Members - Patty returned to the meeting and joined in the discussion on recommendations for new DESSC members. There are three openings on the committee. Carl Wirsen and Hugh Milburn have rotated off of the committee. With Patty becoming the DESSC Chair, her seat will also need to be filled. Suggestions to fill these positions were made. It was noted that Bob Embley (NOAA/PMEL) had been nominated and has expressed a willingness to serve on the committee. His background is in G&G. The committee agreed to recommend his nomination to the UNOLS Chair. [Bob was approved this Fall].

Memorandum of Understanding (MOU) - Dolly Dieter reported that the NSF, ONR and NOAA are working on the MOU. They are considering changing the agreement so that it applies for five years instead of three. Also, they plan to change the wording so that it says "vehicles" instead of only ALVIN.

1999-2000 Deep Submergence Scheduling:

Review of Planning Letters - Don Moller reported that the 1998 schedule for the submersibles is very tight. He provided the 1998 timeline, see ***Appendix XIII***. For 1999, the facility proposal pressure is high with 383 funded ALVIN and ROV days/dives which would require approximately 575 operating days. Don showed the list of funded programs by region. The traditional areas still have a lot of pressure. There is also high demand for time series work. Don showed a list of proposed/pending programs for 1999 and beyond. He provided a map of the names and funded programs by area.

For 1999, ATLANTIS has 381 operating days with 220 dive days. Don showed a potential cruise track for the funded programs. The proposed ship schedule is compressed as much as possible. The ship must stand down in June. The work should carefully be reviewed to determine which Juan de Fuca ALVIN programs can be accomplished by ROV.

ALVIN's overhaul is currently planned for winter 2000/2001. In 2000, ATLANTIS is scheduled to start the year in San Diego and is open for work in January through April. In the May/June time frame work is funded at 9N, East Pacific Rise for work. In July/August there are programs funded for work at Juan de Fuca.

Additional Long Range Planning - The committee discussed the potential of global expeditions after ALVIN's overhaul in 2001. Michael Garcia has been funded for work in the mid-Pacific. This could help in gaining support for other programs in the mid and Western Pacific. The DESSC suggested advertising in EOS to let people know that there is an opportunity to go to the Western Pacific. Additionally, Cindy Van Dover has been funded for work in the Indian Ocean. We should let the community know that the vehicles will be there and there is an opportunity for additional work. Mike Perfit recommended that Cindy and Mike send him a description of the type of work that they will conduct as well as the vehicles that they plan to use. An announcement can be sent to the RIDGE and MARGINS community.

International Collaboration Initiatives - Mike Perfit reported that the DESSC Chair has been invited to the MOMAR conference in Lisbon in October 1998 to explain the capabilities of the deep submergence vehicles. The conference will focus on long-term monitoring at the Mid-Atlantic Ridge. The meeting is being co-chaired by Maya Tolstoy and has a web page. [Patty Fryer attended the meeting].

Discussion of Traditional Operating Areas vs. Expeditionary Science - The DESSC discussed ways of promoting expeditionary science and how to use ROVs for the global programs.

WHOI Deep Submergence Data Archiving Policy - Brian Tolchoke, WHOI, reviewed the latest revision to the WHOI Archive policy. The driving motivation for the policy is to insure that data is always available to the science community. There was considerable discussion on the policy. There was concern on the commercial use of the data and how much income is being generated by WHOI from

the commercial use. A variety of changes were suggested and forward to Brian by the committee. Brian agreed to incorporate the changes and recirculate the policy for review. (The policy was finalized and forwarded to the funding agencies for final approval. A copy will be available at the December DESSC meeting.)

DESSC Terms of Reference and UNOLS Charter, Annex II - The DESSC reviewed the current terms of reference and Annex II and agreed that an update is needed to better reflect the role of the committee. They agreed that their role was to serve as the voice of the community. A subcommittee would be needed to rewrite the terms. It was generally agreed that the word "advisory" should replace "oversight" as this better defines the role. The DESSC also recognized that they review schedules instead of proposals as in the past. Dick Pittenger provided an organizational chart which showed DESSC's relationship to the operator and agencies. There was a general comment to replace references to "ALVIN" with "Deep Submergence National Facility." Mike Perfit will forward to Annex II changes to Clare Reimers, UNOLS Charter Review Committee Chair.

DESSC Discussion of Integrated Facilities, Nested Survey Strategy:

How to better educate the User Community on Conducting Field Programs with ALVIN, Jason, Argo-II and DSL-120 sonar - A User's Perspective - Dana Yoerger discussed his recent results from a field program at the Guaymus Basin using Jason. The program was ONR funded and exercised the SeaNet Capabilities. He reviewed some of the results and Simrad data collected. Dana reported that the cruise was very successful due to pre-cruise planning and test runs. In his opinion, the DESSC and operator need to do a better job of telling the community what Jason can and cannot do.

AGU Fall Special Session - Mike reported that he and Dan might try to have a session at the Fall AGU meeting to explain what deep submergence tools are available for deep submergence science and how these tools can be best utilized. [Dan Fornari and Dan Scheirer are co-chairing two sessions (oral and poster) at the fall AGU titled, "New Methods in High Resolution, Near-Bottom Seafloor Mapping and Imaging. The oral session is scheduled for Sunday afternoon on 6 December and the poster session is planned for Monday morning on 7 December.]

Public Outreach - Jim Bellingham spoke about DESSC's role in enhancing public outreach and education. Patty suggested that at the December meeting we set aside time to discuss methods for performing public outreach. It was suggested that more things could be posted on the UNOLS web site. Newspaper articles could be included on the website.

Meeting Wrap-Up

The DESSC briefly discussed what they would like to see in the next upgrade proposal. Additional Homer probes along with a sonar upgrade was recommended.

Mike expressed the committee's appreciation to Hugh Milburn and Carl Wirsen for their service with

the DESSC.

The meeting was adjourned at 3:30 pm.

Revised 6/15/98

DEep Submergence Science Committee

Carriage House, Woods Hole Oceanographic Institution
June 16-17, 1998

MEETING AGENDA

MEETING BEGINS AT 9:00 AM

Tuesday, June 16, 1998 (0900)

I. Introductory Remarks - (Perfit)

1. Meeting Logistics, Agenda items
2. Accept minutes

II. National Facility Operators Report (Pittenger/WHOI Personnel)

1. National Facility Vehicles Operations Summary (Chandler)
2. ATLANTIS PSA (Coburn, Moniz)
3. Science Liaison and Operator/User Communication/Updating the WEB and planning manuals for science (Moller, Martineau)

III. Upgrades to National Facility Vehicles and Science Sensors (WHOI-DSF Personnel)

1. Status Report on current upgrades proposal (Walden, Brown, Foster)
2. Annual request for upgrades to science sensors and operational capabilities of NDSF vehicles - joint WHOI/DESSC (Walden)

IV. Operational Summary of Other Deep Submergence Activities

1. MBARI (M. Perfit)
2. MPL (F. Spiess)
3. Navy (A. Silver)
4. NURP (C.L. Van Dover)
5. ROPOS (M. Perfit)

V. DESSC White Paper Discussion (Perfit)

1. Deep Submergence Science Initiatives - Beyond 2000 (Perfit)
   New Science ROV- planning and funding
2. Review written contributions from DESSC members (Perfit)

3. WHOI DSF Perspective (WHOI-DSF Personnel)

VI. Agency Reports

1. NSF - (E. Dieter)
   Results from May panel - updating DESSC/UNOLS deep submergence funded programs listing
   Impact of UNOLS review on DESSC
2. ONR - (A. Silver)
   Funded science programs
   Navy deep submergence vehicle decommissioning
3. NOAA
   Funded programs

Wednesday, June 17, 1998 (0900)

VII. DESSC Membership Replacements (Perfit)

1. DESSC Chair Replacement
2. DESSC Members - Summary of Current Membership Status and Suggestions for Replacements

VIII. 1999-2000 Deep Submergence Scheduling

1. Review of Planning Letters and Website postings and Identification of funded programs, science/logistical constraints, different vehicle requests - (Chandler/Moller/DeSilva)
2. Additional Long Range Planning (Perfit)
   Future global deep submergence initiatives: Western Pacific, Indian Ocean, S.EPR, Mediterranean,
   Polar Regions (DESSC members/area champions)
   International collaboration initiatives (Perfit)
3. Discussion of traditional operating areas vs. expedition science.

IX. WHOI Deep Submergence Data Archiving Policy (Perfit/DeSilva, w/WHOI personnel as needed)

1. Discussion - DESSC and Agency Comments

X. Review/Revise DESSC Terms of Reference and UNOLS Charter, Annex II (Perfit/DeSilva)

1. Status of inter-agency MOU (Agency Reps.)

XI. DESSC Discussion of Integrated Facilities, Nested Survey Strategy (Perfit and WHOI Personnel)

1. How to Better Educate the User Community on Conducting Field Programs
   with ALVIN, Jason, Argo-II and DSL-120 sonar - A User's Perspective (D. Yoerger)
2. AGU Fall Special Session (Fornari)
3. Public Outreach - revisited (Perfit)

DEep Submergence Science Committee Dinner
Tuesday, 16 July 1998
6:30 p.m.
Coonamesset Inn
311 Gifford St.
(corner of Jones Rd. & Gifford St.)

Dinner is planned at the Coonamesset Inn on Tuesday, 16 June 1998 at 6:30 p.m. It will be pay-your-own and order from the menu.

Appendix II

Participant List

DESSC Meeting - June 16-17, 1998

NAME	Affiliation	Phone #	Fax#	E-mail
John Bash	UNOLS	(401) 874-6825	(401) 874-6167	unols@gso.uri.edu
Jim Bellingham	MIT	(617) 253-7136	(617) 258-5730	belling@mit.edu
Andy Bowen	WHOI	(508) 289-2643	(508) 457-2191	abowen@whoi.edu
Robert Brown	WHOI	(508) 289-2786	(508) 457-2107	rbrown@whoi.edu
Rick Chandler	WHOI	(508) 289-2272	(508) 457-2107	rchandler@whoi.edu
Joe Coburn	WHOI	(508) 289-2624	(508) 540-8675	jcoburn@whoi.edu
Robert Collier	OSU	(541) 737-4367	(541) 737-2064	collier@oce.orst.edu
Annette DeSilva	UNOLS	(401) 874-6825	(401) 874-6167	unols@gso.uri.edu
Dolly Dieter	NSF	(703) 306-1577 x7233	(703) 306-0390	edieter@nsf.gov
Dan Fornari	WHOI	(508) 289-2857	(508) 457-2187	fornari@tone.whoi.edu
Dudley Foster	WHOI	(508) 289-2273	(508) 457-2107	dfoster@whoi.edu
Patty Fryer	U of Hawaii	(808) 956-3146	(808) 956-6322	pfryer@soest.hawaii.edu
Ken Johnson	MLML	(408) 755-9657	(408) 753-2826	johnson@mlml.calstate.edu
Marv Lilley	U Washington	(206) 543-0859	(206) 543-0275	lilley@ocean.washington.edu
Barbara Martineau	WHOI	(508) 289-2450	(508)457-2185	bmartineau@whoi.edu

Hugh Milburn	NOAA	(206) 526-6169	(206) 526-6744	milburn@noaapmel.gov
Sujata Millick	ONR	(703) 696-4530	(703) 696-2007	millics@onr.navy.mil
Don Moller	WHOI	(508) 289-2277	(508) 457-2185	dmoller@whoi.edu
Theo Moniz	WHOI	(508) 289-3489	(508) 540-8675	tmoniz@whoi.edu
Dan Orange	MBARI	(408) 775-1761	(408) 775-1645	dano@mbari.org
Mike Perfit	U of Florida	(352) 392-2128	(352) 392-9294	perf@geology.ufl.edu
Dick Pittenger	WHOI	(508) 289-2597	(508) 457-2185	rpittenger@whoi.edu
Andy Silver	ONR	(703) 696-6999	(703) 696-2007	silver@onr.navy.mil
Fred Spiess	UCSD	(619) 534-1621	(619) 534-6849	fns@mpl.ucsd.edu
Phil Taylor	NSF	(703) 306-1587	(703) 306-0390	prtaylor@nsf.gov
Cindy Van Dover	NURP/U of Alaska	(907) 474-5870	(907) 474-5804	vandover@ims.alaska.edu
Barry Walden	WHOI	(508) 289-2407	(508) 457-2107	bwalden@whoi.edu
Carl Wirsen	WHOI	(508) 289-2307	(508) 457-2169	cwirsen@whoi.edu
Dana Yoerger	WHOI	(508) 289-2608	(508) 457-2191	dyoerger@whoi.edu

Appendix III

Deep Submergence Facility Operations Summary

1998 NDSF Operations

(to date)

	ALVIN	ROVs
• **Days at Sea:**	56	58
• **Assigned Operating Days:**	78	65
• **Dives/Lowerings Completed:**	37	9
• **Average Duration (hrs):**	7.6	41
• **Average Bottom Time (hrs):**	5.2	35

- **Highlights:**
  - *Continued cross-training of ALVIN personnel during Jason ops in Guaymas Basin*
    - *revised hydro boom, new fiber optic cable and Markey traction winch tested*
  - *357 NM of ridge survyed with DSL-120 sonar*
  - *25 hours of data collected wih ESC camera sled*
  - *Tube core carousel successfully used*
  - *Diffuse flow mapped with Doppler sonar*
  - *Simrad SM 2000 multibeam sonar tested:*
    - *1.25 sq KM area mapped +/- 3 meters*
    - *.025 sq KM area mapped +/- .5 meters in 2 hours*

hours

- *6 hydrothermal fluid samples taken*
- *Flange characterization (diffuse flow visualization/sampling)*

Appendix IV

Jason Engineering Improvements

Engineering Development Achieved during Guaymas Jason OPS

- Ring Laser Gyro tested
- Simrad SM 200 evaluated
- Doppler/LBL developed and compared to EXACT
- Doppler closed loop control
- Coring carousel used
- Diffuse flow mapped with doppler and CTD
- Atlantis traction winch and F.O cable
- Large area ESC and color video mosaics
- Rapid development of site map passed for subsequent ALVIN use

Appendix V

ATLANTIS Post Shakedown Availability

R/V Atlantis Upgrades

Joe Coburn
Woods Hole Oceanographic Institution

Accomplished @ PSA-1

PSA -$2.8 M

- Incl. $1 M WHOI cost sharing

- **Bow thruster noise abatement**
  - Hydrodynamic and acoustic treatment
    - resulted in 7to 10 db reduction in noise (to 75 dBA) in staterooms at 1 00% thruster RPM
  - Air injection (variation of USN Prairie/Masker)
    - engineering development continues
- **Fwd science hold and access**
- **Upgraded DPS**

Accomplished @ PSA - 2

- Anchor clanging noise abatement
  - Improved, but problem still exists under some circumstances
- Aft weather door to main lab
- Wet lab weather door
- Installed mission announcing system
- HVAC improvements on 01 Level
- Additional thermal insulation on 01, 02, and 03 decks
- Expanded telephone system
  - Service to all staterooms

Accomplished @ PSA - 3

- 2 additional fume hoods and isolation of fume hood exhausts
- 2 additional transducer hull fittings
- Transducer void air lock
- Upgraded Port (ROV) Hydroboom
- Upgraded propulsion control & monitoring system
- Much more, directed towards engineering and operations

Backlog or pending projects

Funding for these has not been identif ied
Priorities have not been established- the order is random

- Complete propulsion control upgrade
- Further HVAC improvements
- Rationalize lab power
    - More extensive UPS & clean power distribution

Backlog or pending projects - 2

- Correct anchor handling deficiency
    - chain-wildcat problem
- Improve lab drains
- Add'l deck drains
- Workboat launch & storage system
- Renew several weather doors rusted out from within
- Increase & improve lab LP air

Backlog or pending projects - 3

- Increase space for gymnasium - workout
- 2nd phase of crane upgrade (whip speed)
- Improve trawl wire leads and arrangements
- Improve STBD Hydroboom fairlead
- Complete installation of 2nd fuel oil purifier
- Install add'l drinking fountains

Backlog or pending projects -4

- Make another attempt to fix anchor clanging

- Complete next phase of bow thruster noise abatement
    - Increase air flow
- Increase fresh water storage capacity
    - had to buy water in foreign ports
- Correct Alvin battery charging power
    - Soft start for cranes may rectify problem
- Improve Alvin dehumidifier system

Backlog or pending projects - 5

- Procure 2 critical circuit breaker spares
- Improve mooring chocks
    - improper installation, damaged again
- Reorient bulwark door to open outward
- Design & install accommodation ladders
- Modify (fix) AFFF system

Backlog or pending projects - 6

- Bring SeaBeam performance up to specs
    - SBI is working on this
- Improve darkroom
    - deficiencies remain from Halter
- Install shower grab bars
- Replace engine coolers
    - jacket water coolers have temp. fix
    - fuel oil coolers need replacing

R/ V Atlantis - Post Shakedown Availability

PSA - $2.8 M
- Incl. $1 M WHOI cost sharing

- Bow thruster noise abatement
    - Hydrodynamic and acoustic treatment
        - resulted in 7to 10 db reduction in noise (to 75 dBA) in staterooms at 100% thruster RPM
    - Air injection (variation of USN Prairie/Masker)
        - engineering development continues
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- Upgraded DPS
- Anchor clanging noise abatement

    - Improved, but problem still exists under some circumstances
- Aft weather door to main lab
- Wet lab weather door
- Installed mission announcing system
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- Transducer void air lock
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- Upgraded propulsion control & monitoring system
- Much more, directed towards engineering and operations

R/V Atlantis - Backlog or pending projects
Funding for these has not been identified
Priorities have not been established

- Complete propulsion control upgrade
- Further HVAC improvements
    - Rationalize lab power
- More extensive UPS & clean power distribution
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    - SBI is working on this
- Improve darkroom
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    - jacket water coolers have temp. fix
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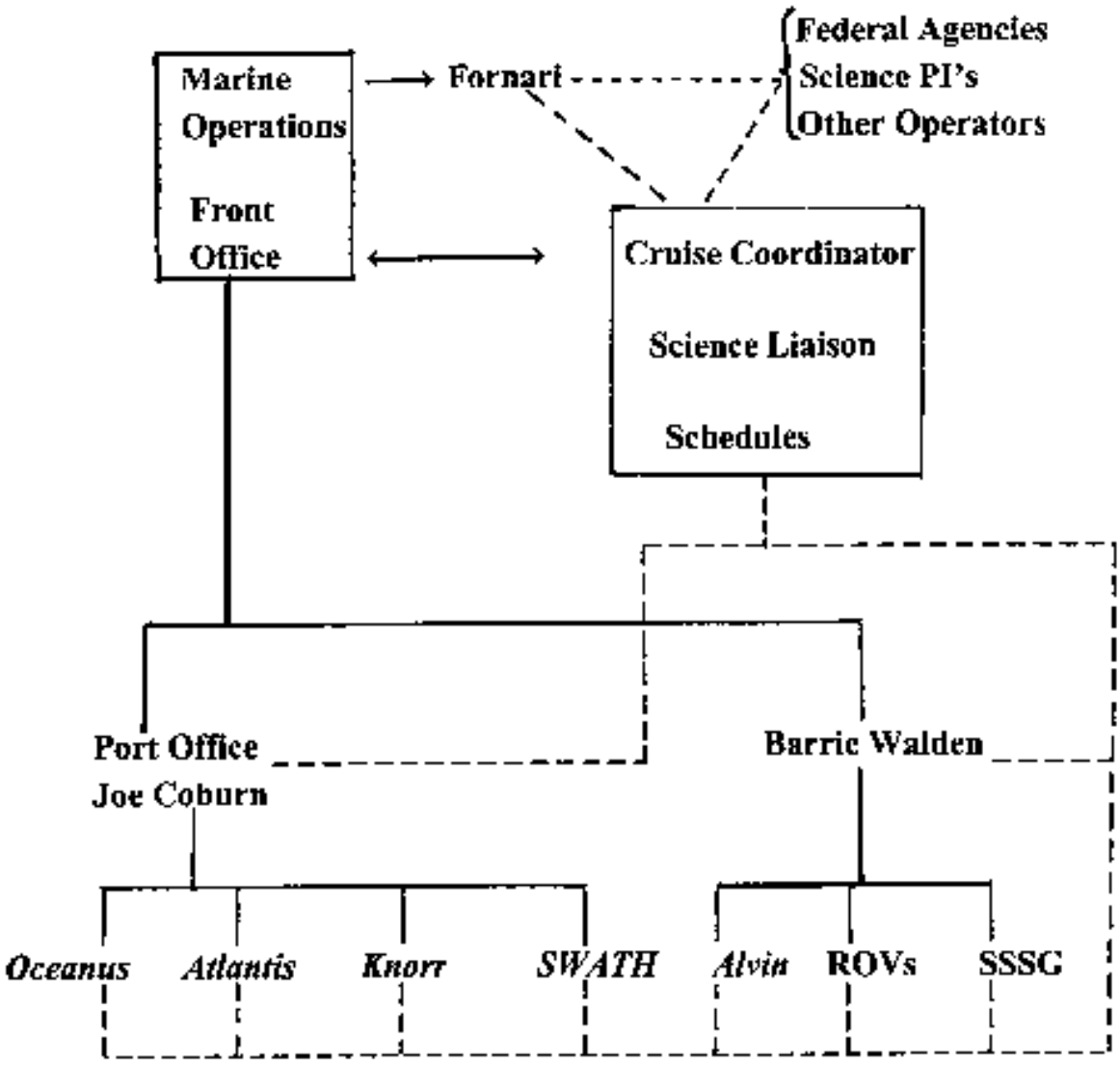
Appendix VI

Science Liaison Functions



Office Composition

Present

- Don Moller (with a lot of involvement & assistance from Ruth & Barbara)

Proposed

- Coordinator/Science
- Liaison/Scheduler
- Assistant Coordinator
- Staff Assistant II

Pre-Proposal Phase

- Providing assistance to PI's regarding:
  - Capabilities
  - Costs
  - Weather windows
  - Instrumentation
  - EEZ issues and diplomatic clearances
  - Connecting PI's with similar geographic and or scientific interests, etc.
- Advertising and salesmanship

Scheduling Phase

In close coordination with the Port Office, Ships, Deep Submergence Operations Group ship technicians and community input, put together proposed schedules of:

- Three large ships
- Coastal SWATH
- Submersibles

Cruise Preparation Phase

- Prepare cruise plan/prospectus using:
  - Pre-cruise meetings

    - Electronic planning tools

- These will include:
    - WHOI (and science-provided) instrumentation
    - Financial arrangements
    - Logistics planning
    - Foreign clearances
    - Special manning

Execution Phase

- Monitoring and assisting as needed each cruise mobilization and demobilization
- Post-cruise feedback
- Billing
- Data disposition
- Archiving
- Post-cruise reports
- Science feedback/lessons-learned

Appendix VII

National Faciility Upgrades

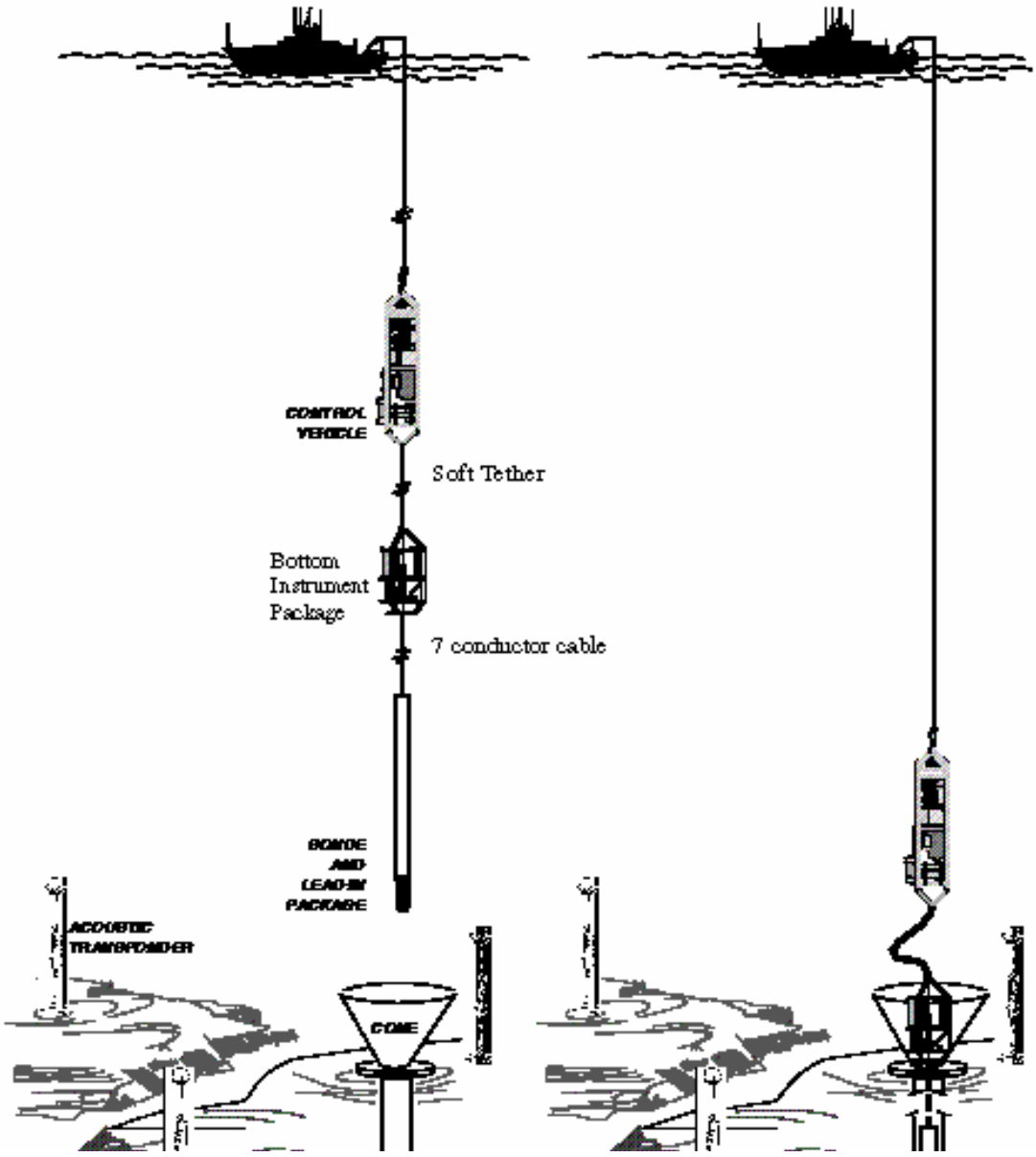
This presentation can be requested from the UNOLS Office (office@unols.org).

Appendix VIII

MPL Report

DEEP TOW GROUP
SEAGOING OPERATIONS 1997-1998

- SIDESCAN SURVEY AND BOTTOM PHOTOGRAPHY OF CORTES-TANNER BANKS (June 1997)
- SINKEX SEDIMENT SAMPLING AROUND A SHIP WRECK (August 1997)
- OSN-1 INSTRUMENTATION DEPLOYMENT (January - February 1998)
- NEAR-BOTTOM MAGNETICS AND SIDESCAN SURVEYS (April - May 1998)
- OSN-1 INSTRUMENT RECOVERY AND DOWN HOLE LOGGING (June 1998)
- DEEP TOWED GRAVITY METER (May 1998)



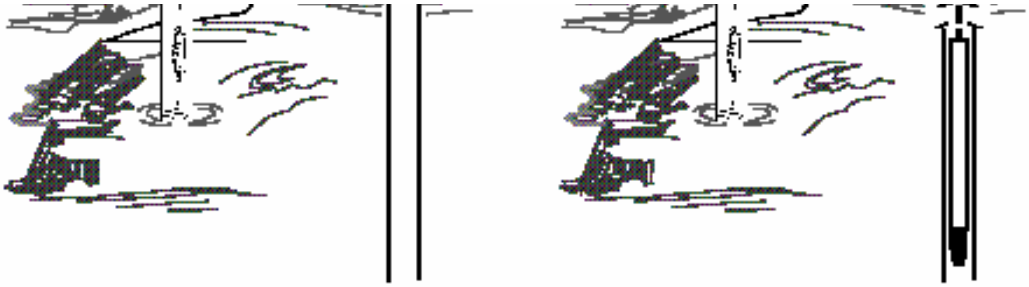


Figure 1-3: This schematic diagram shows the configuration of equipment used in a wireline deployed borehole seismic system (left). On B3S2 the borehole package is a single sonde consisting of the lead-in package, with a navigation transponder, lights and camera for re-entry, as well as the three component broadband seismometer. Telemetry, control, data acquisition and data recording electronics and batteries are housed on the Bottom Instrument Package (BIP). The Control Vehicle (or thruster) is used to maneuver the sonde into the borehole. One advantage of this system over other ocean bottom seismometers is that the the ship remains tethered to the seafloor system after deployment and data can be acquired on board ship prior to releasing the tether (right). After release of the tether the acquisition system on the BIP records continuous seismic data for over three months.

Plate 4a: The Control Vehicle (CV) contains thrusters, up and downlooking sonar, a navigation transponder, and telemetry electronics.

Plate 4b: The logging probe contains a camera, lights, navigation transponder, two calipers, and pressure and temperature transducers.

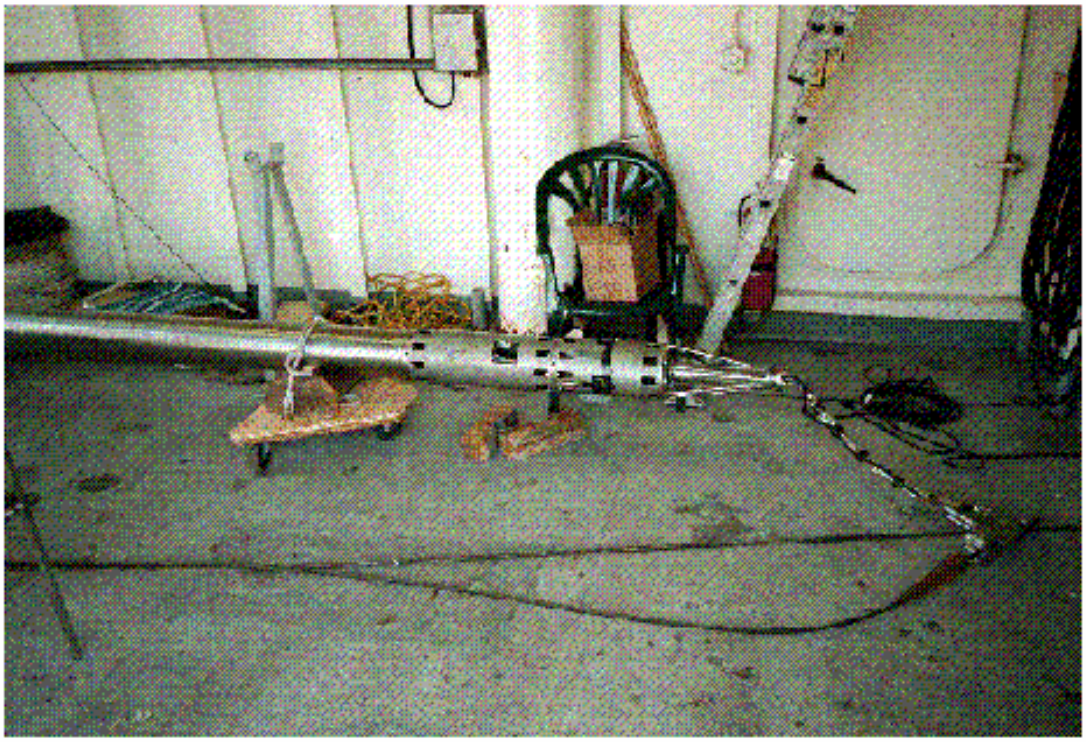


Plate 2a: Above (to the right) of the upper hole lock of the borehole seismometer is a cable slackening device to minimize vibrations in the logging cable from affecting the seismometer.

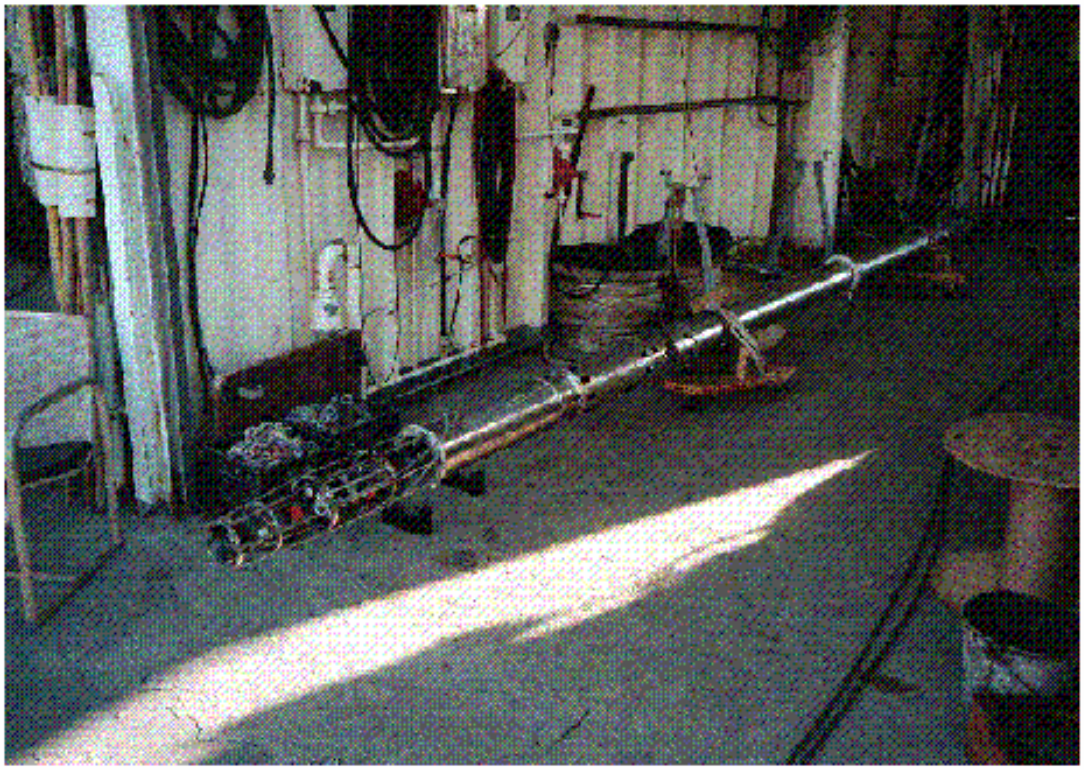
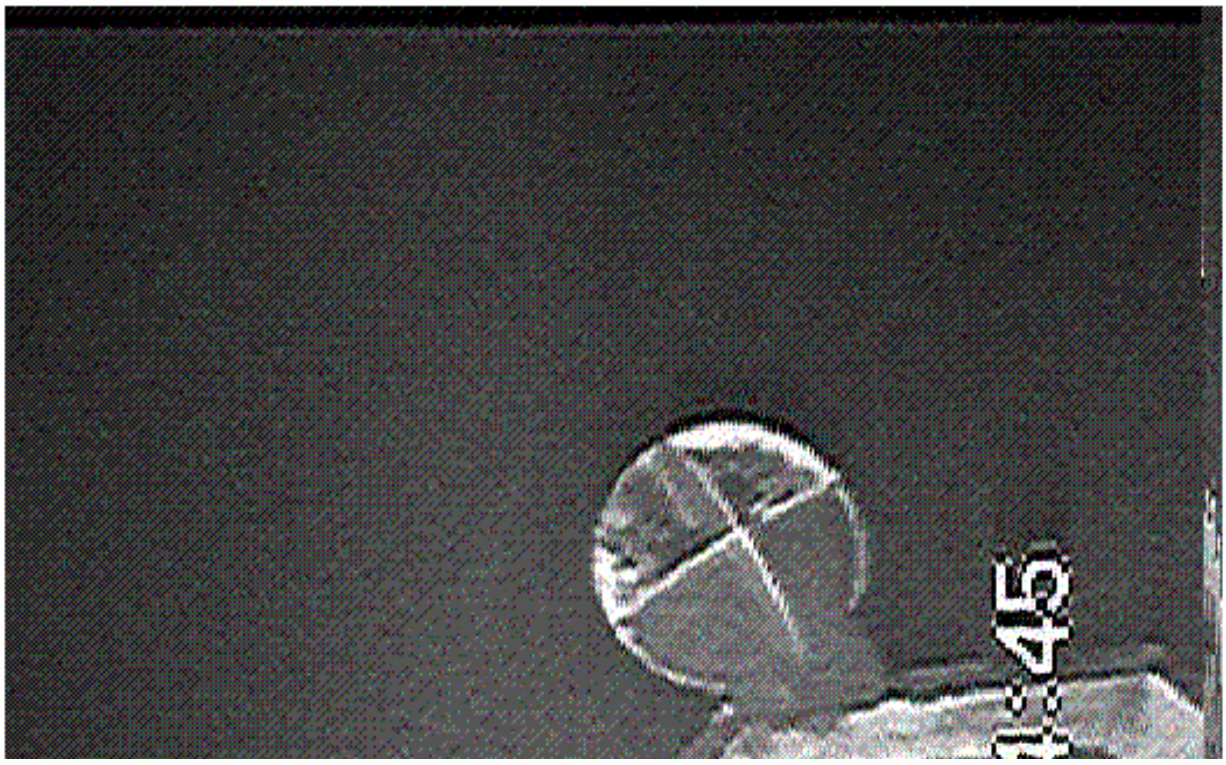


Plate 2b: The lead-in package (LIP) is attached below the lower hole-lock of the borehole seismometer.



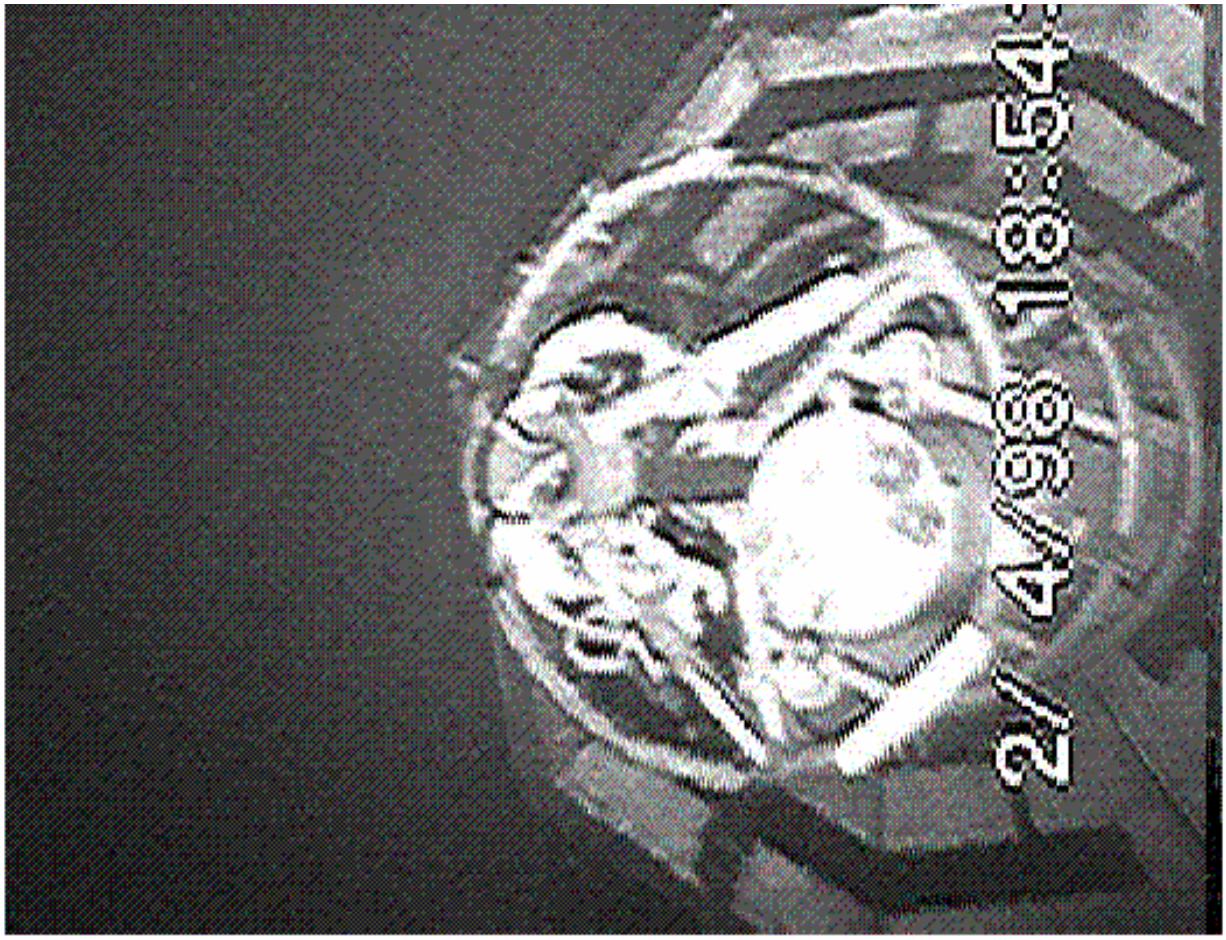


Plate 13: The SEABASS-II Bottom Instrument Package is shown in the re-entry cone at Hole 843B prior to leaving the site for the four month autonomous recording period.

Appendix IX

NURP West Coast Center Activities

WC & PR Undersea Research Center
1998 Field Programs

Asset	*Location*	*PI/Topic*	*Days*
ROPOS	JdF	Embley – ridge crest	9
	Cascadia	Torres – seeps	4
ALVIN	S. California	Smith – whales	5
	S. California	Torres – seeps	1
	JdF	Cavanaugh – vents	3
VENTANA	Monterey	Martin – seeps	6
	Monterey	Starr – fish	2
DELTA	various	various	52
LCROV	various	various	44

Total Estimated Cost (Science plus OPs): $1,958,801

WC & PR Undersea Research Center
1999 Alvin Request

Location	*PI/Topic*	*Dives*
Gulf of Alaska		
Kodiak Seamount	Lonsdale – tectonics	4
Edge Seeps	Levin – seep biology	6
	Brown – seep flux	3
Patton Seamount	Stevens – crabs	5
	Duncan – tectonics	1
Juan de Fuca	Cavanaugh – vents	3
EPR, 9N	Cavanaugh – vents	3
S. California	Smith – whales	7
	Torres – seeps	8

Appendix X

DESSC Input to Future Deep Submergence Science Issues

DESSC White Paper
6/15/98

Request from Mike Perfit:

In preparation for the meeting, I would like all of us to think about the future of deep submergence science in order to produce a DESSC White Paper that addresses future deep submergence science facility needs. In my recent discussions with the Federal agency reps., it has become clear that they want the deep submergence community to join together to "decide" what the important aspects of deep submergence science will be in the next decade and what tools we will need to accomplish our research. These "decisions" will have to be made by meetings open to the general science community in the next year or so. The first meeting will probably be held at the beginning of 1999 and may be run by some combination of RIDGE, UNOLS and/or NOAA. I believe it is important for DESSC to present our view of the future of deep submergence science in order to guide the community and facilitate the planning. Consequently, I would like each committee member to prepare two to three pages of material addressing the following questions with regard to your own specialties and general beliefs.

1. What are the current important deep submergence science research interests in your field of research?
2. What do you see as your important future deep submergence research directions in the next five to ten years?
3. What deep submergence vehicles will be needed to accomplish your research objectives?

Please submit your response to these three questions no later than 10 June to the UNOLS Office <unols@gso.uri.edu>. We will compile the responses for review at the DESSC meeting.

1) WHAT ARE THE CURRENT IMPORTANT DEEP SUBMERGENCE SCIENCE RESEARCH INTERESTS IN YOUR FIELD OF RESEARCH?

(P.F.) I and several colleagues are currently work in nonaccretionary convergent margins. Our interests encompass geologic processes active in three principal tectonic environments: forearcs (between the trench axis and the volcanic arc), the volcanic arc, and backarc basins.

The deep submergence aspects of the forearc studies include exploration of processes active on the inner slope of the trench. The inner trench slope processes under investigation are tectonic erosion, transport of sediments across the deeper parts of the forearc toe, seismic activity associated with faulting on the inner slope of the trench and processes of mud volcanism and fluid venting on the seafloor along the deep inner slope. Understanding these processes benefit from various types of surveys that require submersible tools and from in situ experimentation and deployment of long-term monitoring systems. The use of ROVs is preferred for these environments because of the lengthy descent and ascent times that would be required to accomplish work at depths in excess of 6500 m. The outer forearc, in depths between the break in slope at the edge of the inner

trench slope and the forearc basin regions, includes fault-bounded horst blocks and grabens, mud volcanism and sites of fluid venting. These sites are of interest for detailed studies and will require deep-towed surveying tools of several types (see below) and geologic sampling (with HOVs or ROVs) that includes collecting rocks, coring sediments, drilling into deposits, slurping up biota, sampling vent fluids, taking vent temperature, taking heatflow measurements in vent sites and surrounding regions, and deploying various short- and long-term monitoring devices.

Arc and backarc basin volcanism and tectonic deformation are associated with extension in the backarc regime. I am interested in the tectonic control over distribution of volcanic centers, in the interrelationship between stresses and faulting, and in variations in the composition of the lavas. Studies will include surveying faults and volcanic features with both shallow and deep-towed systems for imagery, magnetics and detailed bottom photography and sampling.

(HM) VENTS/RIDGE related research - primarily in the JDFR: Vent chemistry, geology, geophysics, etc.

(DO)

- fluid flow
- geodetics
- seafloor mapping
- long term monitoring of ODP drillholes
- gas hydrates

(CW) Following are some comments requested regarding my own area of research in relation to present and future deep submergence needs. I am keeping it brief. I do not think things have changed too much from what went into the Global Abyss Report of 1994. I should say that while "our area" is microbiology I will mention as best as I can the needs of large organism biology , based on my knowledge of the work of others.

There exists for our field of research the need to image, place and retrieve experiments and in particular sample (both generally and on fine scale) in the following areas accessible by deep submergence vehicles:

1. mid and deep water column
2. soft bottom - deep sea benthos and petroleum seep sites (also Guaymas Basin)
3. hard bottom - cold and hot vent sites

The current research interests, for a majority of involved scientists in the area of microbiology (and to a large part also biologists), center around hydrothermal vent areas followed by cold or petroleum seep sites. These microbiological interests ask questions of "who's there", "how many are there", and "what are they doing". The path taken of late seems to be a marriage between classical cultural microbiology and newer molecular biology approaches. Aspects of sulfur and nitrogen metabolism involved in both free living organisms as well as in symbiotic associations receives a lot of attention. The whole field of high temperature microbiology, concentrating on the hyperthermophilic archaea, is of great interest from both ecological as well as biotechnological directions. Research into energy fluxes as well as spatial and temporal variation are ongoing or new ones envisioned.

2) WHAT DO YOU SEE AS YOUR IMPORTANT FUTURE DEEP SUBMERGENCE RESEARCH DIRECTIONS IN THE NEXT FIVE TO TEN YEARS?

(P.F.) The focus of my marine research and that of my collaborators will be on developing a comprehensive view of the processes involved in recycling of lithospheric constituents within subduction regimes. This will require detailed investigation of the geology of mud volcanoes and fault-controlled fluid venting in forearc regions and the study of variability of arc and backarc basin volcanism. The study of the mud volcanism phenomenon will entail instrumentation of the edifices including reentry drill holes, CORKed and instrumented in order to monitor long-term changes in fluid flux, chemistry, heat flow, seismicity and stress regime. Also I am in the process of developing coring techniques from standard research vessels that will permit deployment of ancillary monitoring devices near drill holes or as arrays around mud volcanoes and fault systems in the forearc environment. These cores will produce shallow cased holes that will be appropriate for instrumentation. The instruments will need to be deployed and data recovered from them by submersible tools, ROVs or HOVs would be appropriate. It may even be possible to deploy AUVs to so the data collection. The study of arc and backarc volcanism and tectonics.

(HM) Continued effort on the JDFR with additional work on the EPR with similar science goals. However, we envision an increasing interest in microbiology, rapid response, and long term observatories driving the field effort.

(CW) With respect to important directions in the future I think what I just referred to (energy flux determinations and more detailed spatial and temporal variation studies) will be directions for major work in the future. Sampling requirements, more so than imaging and mapping, will continue to be paramount in our areas of research. More fine scale sampling, combined with physical parameter measurements, will be important in vent research and to some degree in the other oceanic areas employing deep submergence vehicles. Instrumentation development, apart from submersible improvements, will proceed as funding allows and will depend on the skill and capacity of deep submergence assets for accurate deployment and recovery. It would be my hope that more involvement of soft bottom and water column researchers would take place over the next decade, especially if opportunities to visit new areas heretofore uninvestigated by submersible operations happen.

(CVD) Current and future important deep submergence science research interests:

General:

Fisheries/habitat research for stock assessment and management and basic fisheries research. This work begins in shallow water (100 m and greater) but extend into deeper waters (>1000 m) where developing fisheries are becoming important. There is increasing interest in a variety of aspects of fish biology in populations that exploit seamount hydrographies and habitat.

Pollution assessment and remediation. This work again is often, but not always, in relatively shallow waters (100-1000 m), below SCUBA depths and "out-of-sight, out-of-mind". Military disposal of chemical and other wastes is often to blame. Other pollution hazards include sunken ships with full fuel tanks or cargoes of toxic material.

Clathrate deposits. As our appreciation for the size of clathrate deposits in the oceans grows, there is gathering interest in understanding the global flux of methane from the seabed into the ocean. These deposits also can support biota (both microbial and macrobiota) of interest for their existence in an extreme environment.

Tectonic hazards. Active plate margins on coasts are targets for efforts to determine mechanisms and dates of activity and their seabed and coastal consequences. These also include a component related to flux of porewater fluids expelled along fault lines and the biota that exploit these fluxes.

Sub-ice processes. Primary production beneath ice and coupling of this production to the benthos are dynamic processes that are high priorities for Arctic and Antarctic research.

Arctic ecosystems, climate oscillations and global warming. Productive coastal waters of the Arctic are targets of increasing study due to the perception that these will be among the most sensitive systems to changes in surface ocean temperatures.

Diversity: Diversity in the deep sea can be extremely high. There is a push to understand patterns of diversity at much greater resolution and with more systematic sampling than ever before. This does kind of sampling does not usually require submersibles or other deep-water assets.

RIDGE CREST BIOLOGY

Biogeography: Priorities include Arctic Ocean Ridges, Bransfield Straits, Scotia Ridge, Cayman Trough, Andaman Ridge, Southern Atlantic and any active deep-water seamounts. Other targets for comparative studies include seep sites in remote locations and whale skeletons wherever encountered.

Time-series studies: Wherever eruptions take place to study succession rates, patterns, especially the microbiology immediately post-eruption and greater emphasis on larval and recruitment studies at appropriate temporal and spatial scales (especially weekly, bimonthly sampling or instrumentation maintenance or maybe even daily). This is probably also true of other aspects of time-series processes following eruptions, especially in the critical first 6 months or so.

Reproductive Biology: Replicated short-term experiments needed to study settlement cues and frequent sample intervals to study gametogenesis especially in species shown to be synchronous. Reproductive synchrony implies the presence of an exogenous cue. Right now this is guessed to be tidal but no one has been able to demonstrate this link.

Diversity: Quantitative replicated sampling of microhabitats to study relationship between, for example, diversity and species composition vs age of a vent, areal extent of a vent, spreading rate and/or geographic location, distance between vent sites, depth etc.

Physiology: Continuing interest in physiological adaptations of a variety of vent species.

Phototrophs/Extremophiles/Suburface Biosphere: Search for...

NASA interests: NASA is developing plans to focus on remote, sub-ice ocean hydrothermal systems (and

perhaps other systems) to assist in developing operational capabilities for exploration of Lake Vostok in Antarctica and the Europan Ocean. For obvious reasons, they are likely to be especially interested in autonomous vehicles with sophisticated sensor and navigational packages. They are also interested in sampling extreme environments in their continuing studies of the origin of life on earth.

(RC) Deep Submergence Science Research - Chemical Oceanography (CO)

Much of the emphasis in CO research over the past decade has been on upper ocean/atmosphere chemical cycles - especially the biogeochemistry related to the carbon cycle. The recent "FOCUS" workshop products reinforce that this is likely to continue. This community has not been very active in using deep submergence assets.

However, Marine Geochemistry (sitting between Chem and Geol) deals with the inventories and processes controling elements in the oceans and particularly identifying the "Oceanic Sources and Sinks" responsible for net fluxes. These studies explicitly focus on the interfaces. In this domain rest the most powerful applications of deep submergence technology. There are probably at least three classes of natural environments that will require insitu manipulative capabilities and, most likely, human presence on the seafloor. These include: seafloor hydrothermal systems (low and high temp.), ocean margin subduction zones, and the benthic environments under highly productive upper ocean environments. This list is not unique to chemistry - in fact MG&G, through the RIDGE initiative and core programs, has been the primary funder of these efforts.

Seafloor Hydrothermal Systems were first sampled by ALVIN over a decade ago. Continued effort on these system will expand to include more low temp focus, work on a variety of time series experiments and observatories, and continued work on the unique biochemistry the vent system community.

The Margins Initiative reflects a new interdisciplinary focus on active continental margins environments. Large-scale fluid circulation is the most important chemical transport mechanism through margins. Geochemical processes such as diagenesis and metamorphism, and deformation processes such as stick-slip faulting versus creep, are strongly controlled by the rate of fluid flow, fluid composition and the rate of rock-fluid interactions. Fluid flow and diagenetic processes represent important contributions to the global geochemical inventory.

The study of Paleoenvironments and Sedimentary Process will continue to be a major focus of the marine geochemical community. In particular, submergence assets will support insitu studies of modern biogeochemical processes so that they can be used to interpret the sediment record.

(DO)

- determining the role of gas in fluid expulsion, seafloor geomorphology, reflectivity, and shallow hazards
- long term monitoring of fluid flow/physical properties at the seafloor as well as at drillholes
- examining the relationship between physical properties, fluid flow and seismicity

3) WHAT DEEP SUBMERGENCE VEHICLES WILL BE NEEDED TO ACCOMPLISH YOUR RESEARCH OBJECTIVES?

(P.F.) The forearc studies I envision will require surveys with side-scan sonar (both regional initially and then followed by deep-towed high-resolution systems - e.g., DSL120). I expect that some surveys will require

bottom photography (digital systems would be preferable). The break-away coring system and mini-CORKs that I am developing will produce shallow, cased, holes with appropriately-sized CORKs for instrumentation of various sorts. Emplacement of these shallow, cased holes will require precision coring of a type only attainable if the corer is instrumented with real-time video and may require some level of propulsion. These mini-CORKed holes will have to be serviced by HOVs, ROVs, or possibly AUVs in order to function as long-term monitoring sites.

The sorts of features I have been working with require very detailed and precise sampling. We may need to develop rock drilling capability for HOVs in order to do some of the work. Bottom drilling with a tethered drilling device that has some maneuverability would be useful, but for detailed, precision sampling, for instance, sampling within crevices or into the sides of vent structures, a rock drill mounted on an HOV or dedicated ROV may be required.

Our particular need will be to attain a deep presence (deeper than 6500 m) and I will be very interested in development of deep ROVs or development of collaborative programs with facilities that have them.

(HM) An ROV with larger payload capacity that JASON (something closer to ROPOS) but with good mapping, manipulative, and sampling tools would best serve the deep submergence needs of this Laboratory. A vehicle that could be used on any of the new AGOR class vessels would give the scheduling flexibility needed, and with the increased bottom time and other attributes, the sampling and monitoring programs would grow. There should be little need for a manned submersible for these tasks. Additionally, AUVs should be used for event response, as proposed for ABE and others.

(CW) The answer to the third question regarding what vehicle needs is a simple one. Both are needed, but will depend on the specific mission of the research. For our area, microbiology and biology, sampling needs on a daily basis is most often the case. Sometimes these needs can be accomplished by a JASON type ROV if they are not too great. Other times the need for a much heavier lift capability is required, and this can be served by the vehicle itself or possibly by an elevator system. In any case, the vehicles needed to accomplish the goals of our research include both manned and unmanned vehicles, perhaps with an emphasis on the manned submersible.

(CVD) Deep-Submergence Vehicle Requirement for Vent Biology Research:

ROV Specs:

- 6000 m or greater depth capability
- precision sampling capability for biota
- system for returning macrobiota at ambient pressures and temperatures
- system for drilling sulfides for study of microbial/geochemical gradients
- > 150 lb payload routinely (either associated with the vehicle itself or
- through a sophisticated elevator system)
- precision navigation
- high def, reliable, flexible imaging platforms
- maneuverability (100 m scope on the seafloor without moving the ship;
- stability during sampling)
- endurance (48 hour deployments or longer)
- standard and flexible plug-ins for ancillary instruments/sensors

- data management

Probably the greatest limitations to my research right now are NOT the quality of the vehicles per se, but science funding and vehicle availability, especially for time-series studies or replicated sampling.

(RC) Both margins and ridgecrest research communities have identified insitu laboratories and observatories as critical new tools to establish time-series studies of chemical processes. On going efforts to develop/improve insitu sensors will broaden the need and uses of deep submergence assets.

If we are going to "entrain" new users onto the submergence platforms, we need to bring in some "new customers" - people that have been using other tools but may be ready for the vehicles. The midwater range between 200m depth and 1000m depth represents a habitat that is chemically important yet difficult to sample for important particulate matter processes.

(DO)

- ROVs, preferably heavy duty, hydraulic equipped.
- AUVs for retrieving data?
- seafloor observatories.

VEHICLE TECHNOLOGY - Jim Bellingham

Q: What is the state of AUV technology?

A: AUVs are operated fairly routinely by a number of groups. In particular, in the US there is a large focus on small, high performance AUVs. These systems are presently limited by available sensors and by ranges/ endurances well below those theoretically achievable. The research focus is no longer on getting the systems working, rather it is on more advanced issues like developing docking capabilities and/or extending range. Navigation remains a problem, although the limitations here are conceptually not much different from those with which ROVs and crewed vehicles have to deal.

Q: Are AUVs going to make it into the field?

A: There are a number of AUV efforts emerging which support significant field programs. In the US those are: the MIT/WHOI/other ODYSSEY (Bellingham et al.), WHOI ABE (Yoerger, Bradley), WHOI REMUS effort (von Alt), and FAU Ocean Explorer/Voyager (Smith). There are other groups working on AUV technology, but the central players are listed above. The ODYSSEY effort has fielded 18 cruises/ice camps over the last several years, and the balance of operations is steadily moving from engineering proof of concept to science driven data gathering. ABE had what I would call an extremely successful science cruise last summer.

Most of the AUV operations to date have been one-time events, demonstrating some new sensor or operational capability. However, as feasibility is proven by ground breaking efforts, other more focused teams are being to coalesce to design systems for specific projects and applications.

My experience is that there has been an enormous amount of excitement over AUV operations. I get far more calls for field operations than I can support with my present infrastructure. Many of these requests are from scientists who have been involved with previous AUV operations.

I would not be surprised if in five-ten years, most of the large ship time is consumed with AUV operations of one type or another.

Q: Who is funding this work?

A: With the exception of ABE, which was developed with NSF $ and does not have core funding, virtually all the money in this arena comes from ONR.

Q: Are these deepwater science vehicles?

A: In terms of user communities, the deep science community is very conservative re technology adoption, heavily committed to existing assets, and weak from a technology development funding perspective. Despite the fact that the strongest economic arguments for use of AUVs are for deepwater applications, it seems likely that deep submergence science will lag behind other AUVs users in adopting the technology. Most of the AUV activity addresses shallow water applications (< 200 m). Both ODYSSEY and ABE are deepwater systems, although most Odyssey operations have been <500 m.

Q: What is a likely model for adoption of deep AUVs by the scientific community as operational assets?

A: I thought about this a great deal, and don't have a firm grasp on all the dimensions of the problem. Maybe a well outfitted deep sonar platform might be 400-800 K a few years down the road (the present shallow Hugin is a 2.5 M system). Most of the cost, or at least a large portion, is the sensor. These vehicles will be out of reach of the typical laboratory, but probably not so expensive as to be limited to a single national facility. It is worth noting that there are much greater costs associated with the support equipment and personnel for operations. One option I looked at a while ago was to view AUVs as part of a ship's compliment of equipment. One could imagine mature systems being supported by one expert and the ship's SSG. In any case, the data processing capability will become an extremely important part of any such capability - sending the scientist home with raw data will not work!

One interesting question is the role AUVs will play in deep sea observatories. This is an area in which a national facility could play an important role.

Q: What is going on in industry?

A: The oil industry is moving into deep water (3000 m) and is finding it does not have the tools to work there. There is great interest in AUVs, and indeed one of the most successful AUV programs around is the Norwegian

Hugin effort, which is entirely focused on oil/gas commercial applications. One of my lab members has spent several weeks in the last year visiting oil companies and has found a great deal of (active) interest in AUVs. The threshold to entry here is very high, but one commercial system already exists (Hugin). In my discussion with industry, I've noticed a very different change in attitude with respect to AUVs. It used to be that the question was whether AUVs were useful for anything, now the question is what is the successful business model. The economic arguments are clear, and the technology required appears very achievable. It is interesting to note that virtually all the commercial focused activity is overseas - most US activities are focusing on the military sector, as usual. An exception is the Bluefin spinoff from my lab.

Q: What is the international scene?

A: There are some very active programs in Europe. The Autosub project in the UK has been revitalized in recent years, and is racking up a reasonable number of successful field deployments. While the present Autosub is not full ocean rated, the objective of this effort is to develop deep vehicles, and they seems to be making good progress. The Danish Martin program is developing AUVs for commercial applications, and seems to be well funded from private coffers. The Norwegian Hugin program (mentioned above) is a consortium of government, oil company, equipment/sonar company and operations company. It has taken a very focused approach to developing AUVs for deep surveys (their present vehicle is shallow, but their next vehicle will be 2000 m rated and with and endurance of multiple days). I am not that familiar with the Japanese efforts - they have achieved very little return for their large AUV investment in the last decade - however I hear 2nd hand that they might be refocusing their efforts. The Russians developed a very credible operational AUV capability in the last days of the cold war, and over the last several years apparently have built vehicles for the Chinese and the Koreans (deep rated systems) if I understand correctly. Other countries, such as Australia and Singapore have both been making the rounds building up critical mass to launch significant AUV projects, primarily focused on Navy applications. The Singapore effort has been particularly high level.

Q: What about ROVs in industry?

A: There have been a number of changes in ROV manufacturer/user communities. First, commercially available ROVs with deep ratings are becoming more common as many companies anticipated the oil industry shift to deep water (there have been extremely capable deep systems for a while). Second, ROV operators have started building their own vehicles, to the dismay of the commercial manufacturers. Indeed, most of the deep ROV manufactured are built inside the large operators (Oceaneering, Racal, etc.). These vehicles tend to be work vehicles, not mapping vehicles. For mapping, industry is still using towed systems, and is beginning to look to AUVs.

Q: What about manned vehicles in industry?

A: Very minimal role.

DESSC 6/16/98

Deep Submergence Tasks

- Image
- Survey — HOV
- Sample — ROV
- Manipulate — AUV
- Sensor

Science Feedback

Bigger, Faster, More, Cheaper, Reliable

Industry perspective

ROVs (and AUVs)

built for customers - and not all alike!

[ROV = vehicle with propulsion and manipulation]

DO Favors (next 5 years)

HOV for cognitive presence

AUVs for data interrogation

survey

(esp. Mid-water)(observatory)

ROVs → torque (hydraulic-electric)

(wish list?)

strong manipulators

payload

hydraulic tool chest

↑ HP (min. power limitations)

on the fly course, sample flexibility

lights, video, bandwith

Appendix XI

ALVIN / SEA CLIFF Proposal

Introduction

- Decommissioning SEA CLIFF - loss of US manned 6000 m science capability
- Strong support for continued manned presence to 6000 m
- SEA CLIFF too large, heavy, expensive for science community
- Important to retain resident capabilities of ALVIN

Engineering Study for a Replacement U.S. 6000-meter Manned Research Submersible
WHOI/DSG- June 1998

Background

- Design of MIRs and NAUTILE indicate 18,000 lb savings compared to SEA CLIFF
- Transfer of SEA CLIFF offers:
    - 6000 m Ti sphere
    - valuable 6000 m syntatic
    - advanced VB system
    - updated CTFM sonar system
- Review importance of viewport location from both science and engineering perspectives

Study

- GOAL
    - Best method for obtaining 6000 m manned submersible with improved capability and reliability
    - Develop design, capability, and cost matrix
    - Determine best utilization of SEA CLIFF assets

- METHODS
    - Evalutate other 6000m submersibles
    - Study options with regard to spheres/viewport locations
    - Literature search/ industry dialog concerning new technology
    - Consider design review and certification issues

- REPORT

- Cost and engineering analysis to facilitate evaluation of feasible options
- Recommendation for optimum path to effective, reliable, and affordable 6000m manned submersible

Appendix XII

Available Traction Winches

Traction Winches in U.S. Ships:

WHOI (ATLANTIS, OCEANUS, portable)	3
OSU (WECOMA)	1
SIO (REVELLE, NEW HORIZON)	2
LDEO (EWING)	1
	7
NAVO	2
NOAA (BROWN)	1
TOTAL	10

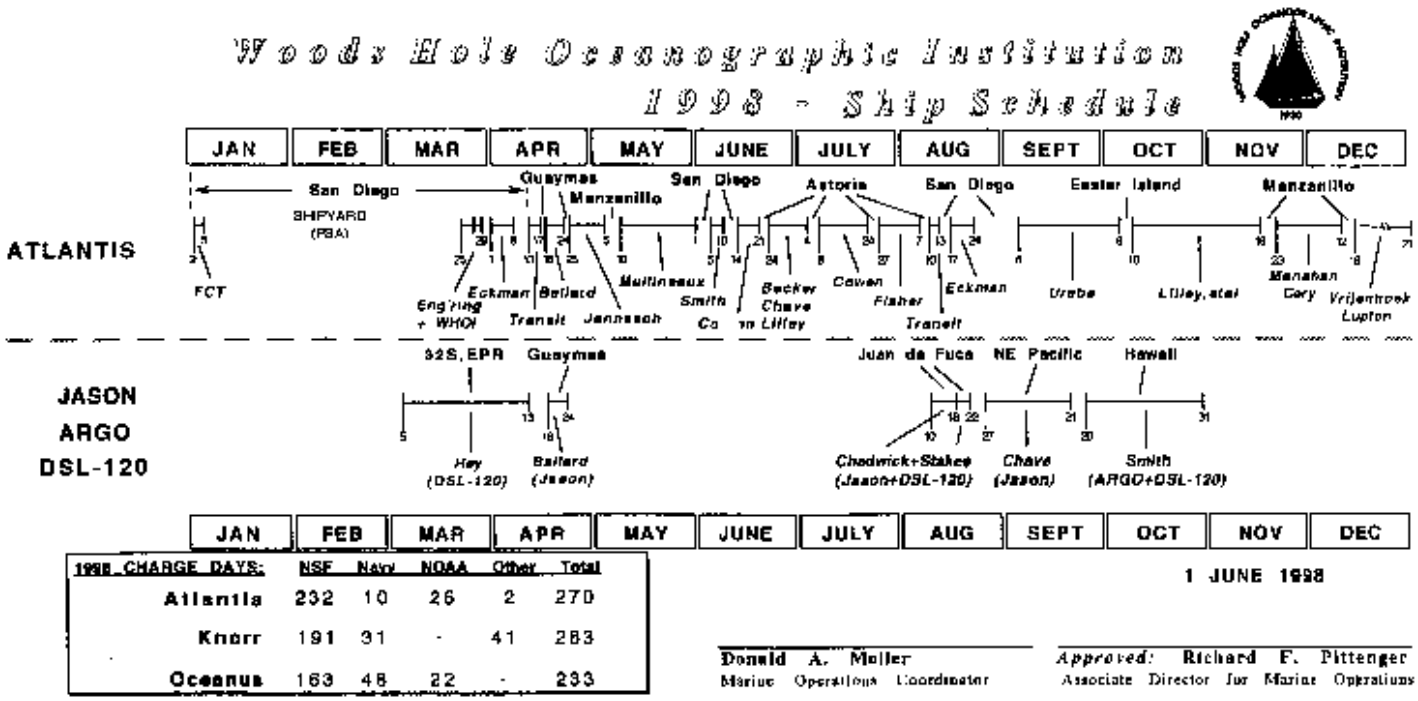
Rochester 0.680 Fiber Optic Cable

- proven, reliable, rugged, robust
  - WHOI 2 long, 2 short
  - SIO 1
  - NAVO 2

Jason - proven, accepted

Appendix XIII

Deep Submergence Vehicle Requests - Summary



1998 CHARGE DAYS:	NSF	Navy	NOAA	Other	Total
Atlantis	232	10	26	2	270
Knorr	191	31	-	41	263
Oceanus	163	48	22	-	233

1 JUNE 1998

Donald A. Moller
Marine Operations Coordinator

Approved: Richard F. Pittenger
Associate Director for Marine Operations

Deep Submergence Group
Proposal Pressure
(Days on Station & Number of Dives)

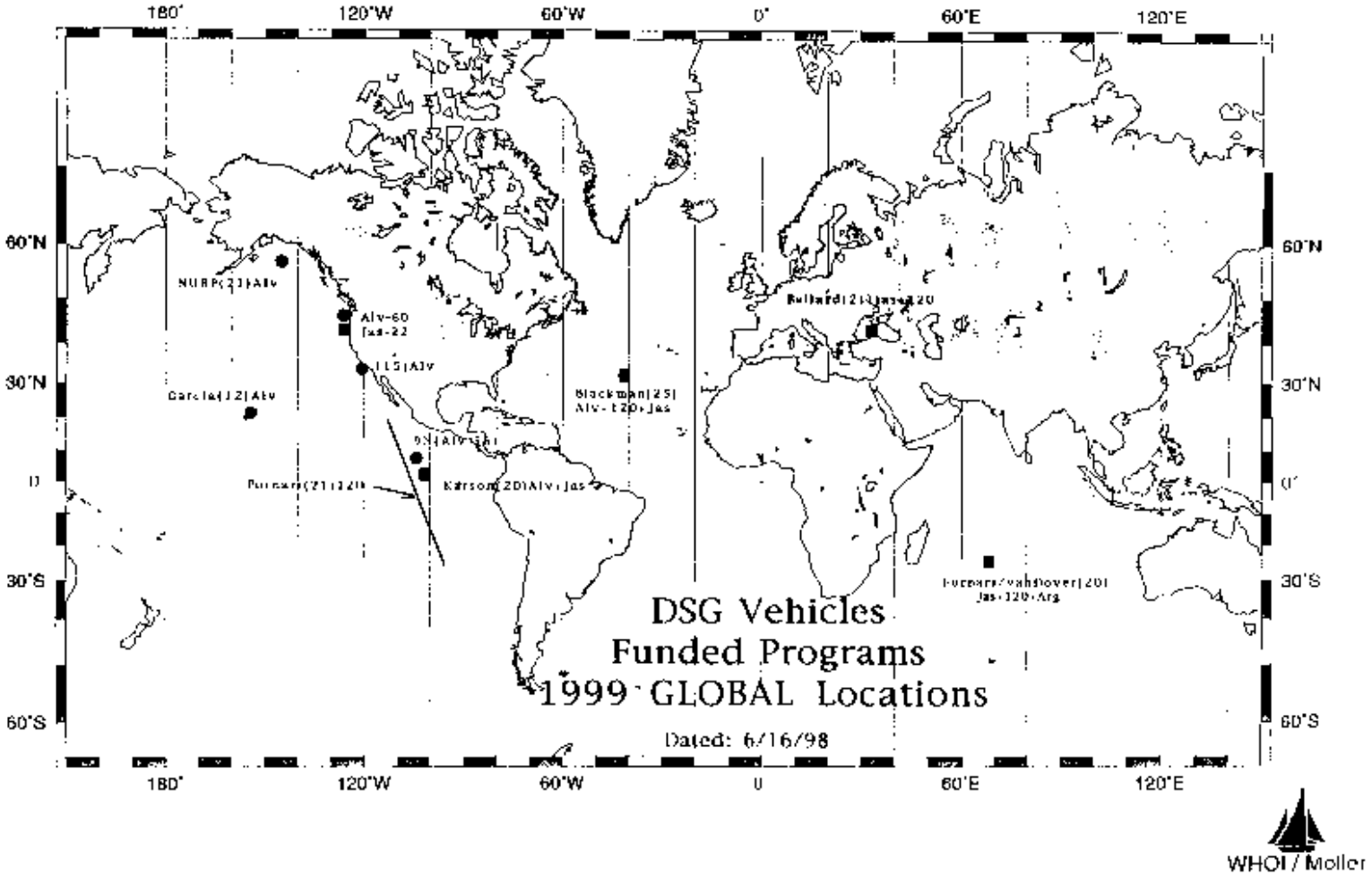
	Proposed	Funded	% Success
Alvin only	386	205	50
Alvin with ROVs	234	116	50
ROVs only	183	62	34
Totals	803	383	48
Calender Days Needed		575 days	

1999 and BEYOND

proposed *Alvin* & ROV DIVE PROGRAMS

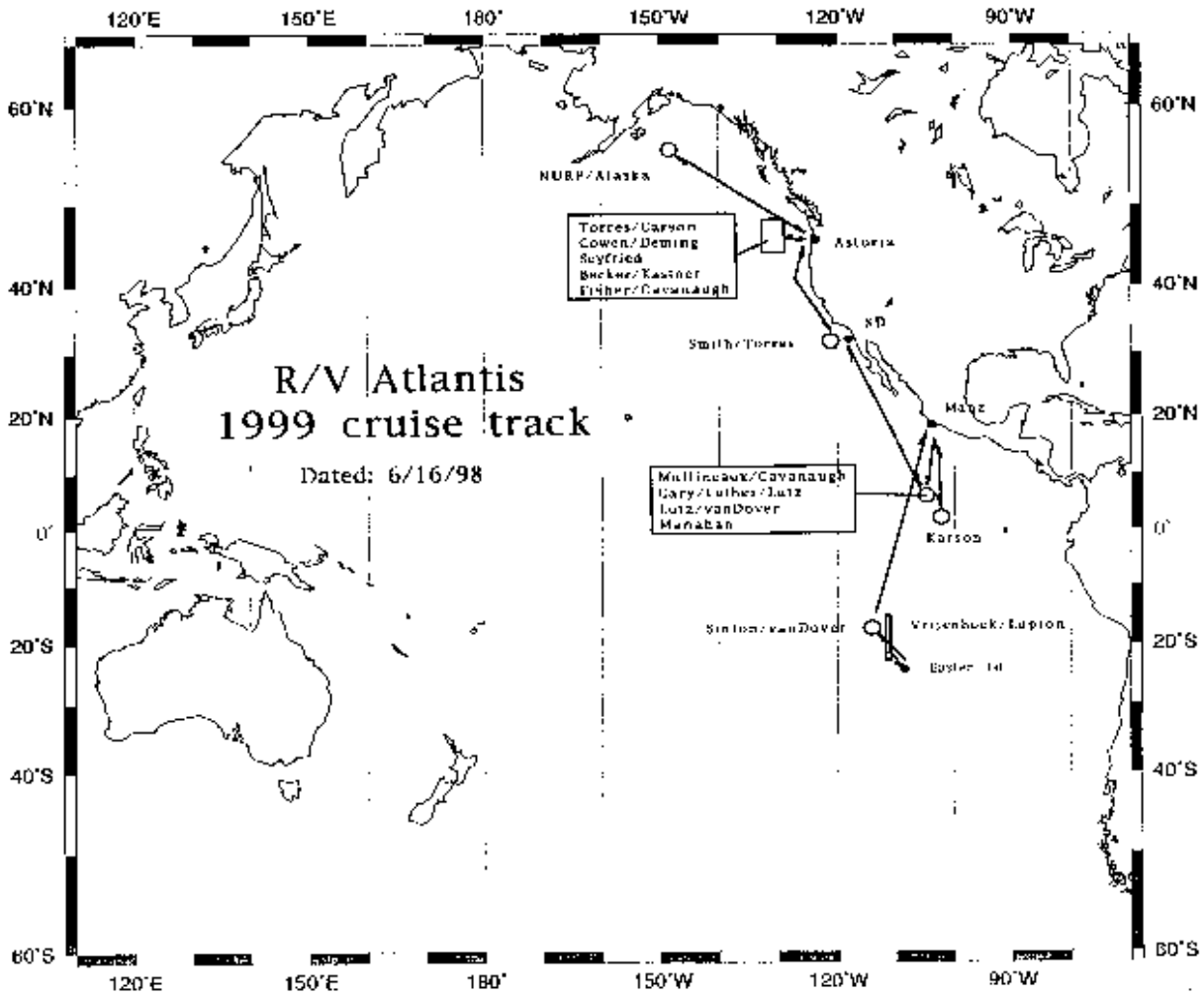
(Sorted by Dive Site)

Year	Program	Agency	Vehicle(s)	Days on Sta.	
			Southern EPR		
1999	Naar	NSF	*Alvin* & DSL-120	21	
2000	vanDover	NSF	*Alvin*	8	
			9 North, EPR		
1999	Gary	NSF	*Alvin*	8	
1999	Cochran	NSF	*Alvin*	30	
1999	Gregg	NSF	*Alvin*	3	
1999	Schouten	NSF	DSL-120 & Jason	25	
1998	Tolstoy	NSF	*Alvin*	5	
2000	Tolstoy	NSF	Jason	4	
			California Coast		
1999	Levin	NSF	*Alvin*	26	
1998	Rathburn	NSF	*Alvin*	13	
			Juan de Fuca		
1999	Delaney	NSF	*Alvin* & Jason	30	
1999	Johnson	NSF	*Alvin*	29	(ROBE)
1999	Johnson	NSF	*Alvin*	7	
1999	Lilley	NSF	*Alvin*	6	
1999	Rona	NSF	Jason	12	
1999	Schaeffer	NSF	*Alvin*	2	
			Other Regions		
1999	Ballard	ONR	Jason DSL-120, ARGO	21	(Black Sea)
1999	Cliff	NSF	*Alvin*	36	(Marianas)
1999	Davis/Gallagher	NSF	Jason	14	(GLOBEC)
1999	Fryer	NSF	DSL-120	?	(Marianas)
1999	Rona	NSF	*Alvin* & Jason	21	(MAR-15N)
1999	Smith, D.	NSF	DSL-120	25	(Hess Deep)
1999	Staudigel	NSF	*Alvin*	5	(any vent)
1999	Tucholke	NSF	*Alvin* DSL-120, ARGO	21	(MAR-23N)


180°
120°W
60°W
0°
60°E
120°E
60°N
30°N
0°
30°S
60°S
NURP(23)Alv
Alv-60
Jas-22
Garcia(12)Alv
Blackman(25)
Alv-120-Jas
Kerson(20)Alv-Jas
Ballard(21)Jas-120
Purcare/Yahdover(20)
Jas-120-Arg
DSG Vehicles
Funded Programs
1999 GLOBAL Locations
Dated: 6/16/98
WHOI / Moller

1999
Operating Days Proposed

	ATLANTIS			ALVIN & JASON DIVES
	TOTAL	FUND.	PEND.	TOTAL
NSF	283	283	0	175
ONR	0	0	0	0
NURP	0	0	0	3
NURP/Alaska	70	70	0	42
OTHER	0	0	0	0
MAINTENANCE	28	-	-	
TOTAL	381	353	0	220


120°E
150°E
180°
150°W
120°W
90°W
60°N
40°N
20°N
0°
20°S
40°S
60°S
NUBP/Alaska
Torres/Larson
Cowen/Deming
Seyfried
Buckner/Kastner
Fisher/Cavanaugh
Astoria
Smith/Torres
R/V Atlantis
1999 cruise track
Dated: 6/16/98
Mullineaux/Cavanaugh
Gary/Luther/Lutz
Lutz/vanDover
Manahan
Manz
Karson
Sinton/vanDover
Vrijenhoek/Lupton
Foster Id

WHOI / Moller

1999 R/V ATLANTIS 1999

Proposed Ship Schedule