UNIVERSITY - NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

UNOLS
DEEP SUBMERGENCE SCIENCE COMMITTEE MEETING

SUMMARY REPORT

June 14-16, 1993

Carriage House
Woods Hole Oceanographic Institution
Woods Hole, MA

DEEP SUBMERGENCE SCIENCE COMMITTEE

Minutes of Meeting
Carriage House
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WELCOME AND INTRODUCTION

Jeff Fox, DEep Submergence Science Committee (DESSC) Chair, called the meeting to order at 8:30 a.m. on June 14, 1993. These minutes reflect the order in which agenda items were reported. Jeff began with an overview of DESSC events since last year's spring meeting. In 1992, the outlook for ALVIN operations was dismal with underutilization of the facility; however, since that time the community has been revitalized. The ALVIN Review Committee has been renamed the DEep Submergence Science Committee to reflect their broader scope of responsibilities. A workshop was held in the fall to assess the technology needs of the community and evaluate the interest in a global field program. Both this meeting and the ALVIN planning meeting held at the fall AGU were well attended by the user community.

This spring meeting will represent a major departure from previous Spring Review meetings. The funding agency's peer review process over the years has become very effective. As a result, the DESSC has modified their review to an examination of the proposals in regard to the logistics of scheduling the facility.

Attendance at all or part of the meeting included:

DEep Submergence Science Committee
Jeff Fox, GSO/URI, Chair
Dan Fornari, L-DEO/WHOI
Hugh Milburn, NOAA/PMEL
Casey Moore, UCSC
Mary Scranton, SUNY
Gary Taghon, Rutgers
Karen Von Damm, UNH
Marcus Langseth, L-DEO, FIC liaison, ex-officio member
Dick Pittenger, WHOI ex-officio member

Participants
Garry Brass, UNOLS Chair
Jack Bash, UNOLS
Annette DeSilva, UNOLS

Agency Representatives
LCDR George Billy, US Navy
Don Heinrichs, NSF
Keith Kaulum, ONR
Michael Ledbetter, NOAA

WHOI
Andy Bowen
Rick Chandler
Dudley Foster
Don Moller
Brian Tucholke
Barrie Walden

The ALVIN Review Committee Roster is included as Appendix II.

The minutes of the DEep Submergence Science Committee Planning Meeting, December 6, 1992, were accepted as written.

FLEET IMPROVEMENT COMMITTEE LIAISON. A representative from the Fleet Improvement Committee has been appointed as an ex-officio member of the DESSC. With the upcoming conversion of KNORR to a support ship for ALVIN, it was felt that the DESSC and FIC should be in close communication. Ken Johnson has agreed to serve in this position; however, was unable to attend this meeting. Marcus Langseth sat in for him.

DEEP SUBMERGENCE OPERATIONS AT WHOI:

ALVIN Upgrades - Dudley Foster reported on the upgrades planned for ALVIN in 1993, see Appendix III. To begin, there were a number of upgrades planned for 1992 that were not completed and are being carried over to 1993. These include an increased depth capability, new video monitors, gyro upgrade, and redesign of ALVIN's life support system. NAVSEA is still reviewing WHOI's request for an increased depth capability. The search for a replacement gyro is continuing, only one of the three Sperry gyros is still operating. Jeff Fox indicated that the community is very concerned with the Gyro situation and that science is not well served by a continued delay. The life support system on ALVIN is no longer being made, replacements are still under consideration.

New ALVIN upgrades planned for 1993 include improvement of the altimeter data and purchasing HMI lights for better video color. A number of improvements have already been implemented and are listed in Appendix III. Purchasing a new generation color video camera was dropped from the list due to budget cutbacks, it will be included in the imaging proposal discussed by Dan Fornari later in the meeting (see page 11).

Certification/Post-Certification - Barrie Walden reported that ALVIN's overhaul began in October and went reasonably well, see enclosure IV. The Navy has issued a new certification Instruction 9220, but WHOI has not been required to use it. Barrie noted that the paperwork volume increased substantially during this certification process. The preliminary survey by NAVSEA went well, but the timing of the final survey was a problem. NAVSEA requires that 90 percent of the certification items be complete prior to the certification. Consequently, this leaves very little time for WHOI to correct any deficiencies detected during the certification prior to beginning sea trials. The number of sea trial dives were restricted due to weather and contributed to the problems experienced when the scientific operations were resumed. Additionally, the engineering dives were eliminated from the schedule.

Barrie presented a few bar charts, Appendix IV, showing the planned certification and engineering dives along with a chart of those dives actually completed. Only one certification dive made it close to 4,000 meters and no engineering dives were made. DESSC was concerned with the cancellation of the engineering dives and recommended that in the future engineering dives should hold equal weight as the scientific dives. DESSC also indicated that ALVIN's schedule should be adjusted to provide adequate time for the complexity of an overhaul, time for engineering dives, and time to assure that the vehicle is up to par before resuming science dives. It was recommended to schedule the engineering dives throughout the operating year, rather than immediately after overhaul. Also, they recommended a week of padding between certifications and science operations, thereby creating flexibility in the schedule.

Barrie continued by discussing the motor controller problems experienced on Jeff Karson's Cruise. Prior to overhaul, WHOI had modified the motor controllers from hydraulic to brushless DC motors and also reduced the power to 120V DC. After modification, the controllers experienced four failures in their 18 months of operation. The original manufacturer wanted $5,500 to repair each controller, so WHOI went to an outside vendor for repair. Barrie explained that funding is not provided to WHOI for correction of problems. The Karson cruise began with no spare controllers on board. During the cruise, three controllers burned out requiring the cruise to be aborted. WHOI and the manufacturer were unable to detect the cause, but determined that the controllers were not being tested properly prior to installation. They are working to resolve the problem so that it will not recur in the future.

Other ALVIN equipment considerations include replacing the explosive release devises, the gyros, and the emergency breathing apparatus. WHOI has requested NAVSEA to allow them to perform the replacement of the explosive devises over time, so as to not interrupt operations. The sweep sonar system aboard ALVIN is very old and hard to maintain, but it has been difficult to find a new component that has the preferred set of characteristics. WHOI continues to search for a solution to the sonar problem. The Navy is sending WHOI one of their old ones to try out.

There have been a number of personnel changes in the ALVIN Group. Three people have left in the last six months. Roger Hughes, the expedition leader, resigned after the Karson cruise. Pat Hickey will become the expedition leader after the MAR work is complete. Larry Shumaker, one of the early ALVIN pilots and expedition leaders, has stepped in as acting leader during the interim. Additionally, two pilots have left the group, with one being temporarily replaced. As a result, the pool of pilots is not adequate. WHOI has hired two new people, one with a mechanical background and one with an electrical background.

The merge of WHOI ROV and towed-vehicle operations with the ALVIN group has been accomplished through the formation of the WHOI Deep Submergence Operations Group (DSOG). WHOI is trying to determine a way to physically merge the ALVIN shorebased technical group and the ROV group. The logistics and other considerations (including personnel) of future scheduling of ALVIN and ROVs when requested for use during the same time period is still being studied. WHOI DSOG is completing a technical description of the towed and ROV systems. The report will be available for distribution by UNOLS in late July, and can be used by scientists who are interested in developing ROV-based research field programs.

Barrie gave a report on the status of the request for ALVIN's depth increase. NAVSEA has indicated that they will require the testing of all variable ballast spheres prior to the depth increase. The cost for testing is estimated at $60K and would require the disassembly of the submersible to remove the spheres. WHOI has four spare ballast spheres at their lab and has recommended to NAVSEA the testing of these spares in place of those installed on ALVIN. NAVSEA has requested all supporting documentation on the spheres and will probably have a response in the near future. WHOI has no provisions for funding any testing associated with the depth increase.

Barrie discussed the new toxicity and flammability testing requirements for equipment being brought into ALVIN. Presently, science equipment to be brought into the sphere must be sent to NRL and be chamber tested at 100 degrees Fahrenheit prior to use in ALVIN. NAVSEA will not approve equipment that has been tested "in-kind." To reduce the number of items to be tested, Woods Hole is considering testing some common use equipment and then making them available to all users. A single test now costs $750.00. Keith Kaulum reported that this is probably the best deal we are going to get from the Navy. In fact, things may get worse if the nuclear submarine restrictions are applied.

Keith continued by reporting that some changes have been made in the way NAVSEA does business with ONR. Code 92Q is NAVSEA's certifying group and is responsible for reviewing records. Major technical reviews or modifications are the responsibility of NAVSEA Code 05. In the past, when WHOI requested technical modifications to ALVIN, ONR would submit a request to Code 92Q who would pass it along to Code 05 for review. Now, ONR will have to go directly to Code 05, then bring the results to 92Q. As a result, ONR will have to fund Code 05 for their efforts. ONR has proposed using someone other than Code 05 for technical reviews. In any case, things will get tougher, more time consuming, and more expensive. The only other option would be to drop ALVIN from the Navy's certification process.

1993/94 ROV Operations:

Brian Tucholke (WHOI) and Andy Bowen (WHOI-DSOG) reported on their recent ARSRP cruise to the Mid-Atlantic Ridge on KNORR. It was a Navy funded cruise to 26°-27° N, 49°-44° W using the 120 kHz side-looking sonar and the JASON/MEDEA systems (see Appendix V for system descriptions and cruise tracklines). Prior to the cruise, the Navy had granted permission for use of a classified GPS receiver on KNORR that would remove the dithering from GPS data. Brian reported that although problems were experienced with the CHIRP sonar on the 120 kHz vehicle, the PCode GPS navigation was outstanding. Positioning could be established within three to four meters RMS in approximately 4000 meters depth.

About 80% of the research goals of this complex and detailed ONR sponsored field program were achieved. Initial survey work was accomplished using the 120 kHz side-looking sonar vehicle (approximate swath width of imagery is about 1 km), towed at 150 meters above the seafloor. Brian noted that optimum 120 kHz tow speed is approximately 1 knot. A defective floatation sphere on the vehicle imploded at 3800 meters, causing damage to the system, but DSOG engineers, remarkably were able to repair the system within a few days so the survey work could continue. Brian presented pie-charts showing cruise time distribution among steaming, survey, and downtime. After the 120 kHz sonar surveys, JASON and MEDEA were used for sonar and visual imaging in local areas within the broader regions covered by 120 kHz surveys. During the sonar runs with JASON/MEDEA, the ROV was towed 20 meters above the seafloor at approximately 0.2 knots. During the visual surveys JASON was operated three to five meters above the bottom and vehicle speed was 0.1 knots.

Andy Bowen continued the presentation with an overview of the ROV operations performed in 1993 and those planned for the future, see Appendix VI. In 1993, the JASON project brought JASON/MEDEA to the Guaymas Basin, Gulf of California, for work at a hydrothermal vent site at 2100 meters depth. A scientific workshop was held on March 6 to premier the system's capabilities. The ROV made 15 dives with 13 different equipment/science sensor configurations, highlighting the versatility and adaptability of the system design. Presently, ten DSOG personnel, in addition to a full complement of science staff and watchstanders, are required to operate JASON/MEDEA while at sea. WHOI is dedicated to transitioning all the towed and ROV vehicles into standard turn-key operational systems that can be operated for deep sea research programs without the extensive need of research engineers at sea.

In 1992/93 the MEDEA/JASON was rebuilt, after the loss of many components during the Galapagos expedition the year before, and the ARGO-II overhaul began. Planned Activities for 1993 and 1994 include completing the ARGO-II overhaul, restoring the neutral tether, operational pressure testing of the new manipulator and fiber optic cabling system, completing JASON/MEDEA documentation, overhauling the 120 kHz and 200 kHz sonar systems and performing engineering dock trials. When asked what was required of a support ship for ROV operations, ANDY explained that the ship would need dynamic positioning, stability, and maneuverability. This would limit the acceptable platforms to KNORR, MELVILLE, and THOMPSON in the UNOLS fleet, however, it was noted that the system has been successfully operated from a number of commercial vessels normally used in the offshore oil and gas service industry.

DEEP SUBMERGENCE FACILITY ADMINISTRATIVE ISSUES:

Dick Pittenger reported on the administrative issues at Woods Hole, beginning with the organizational realignment of extra and intra-WHOI Groups, see Appendix VII. In extra-WHOI activities, the DESSC was formed to replace the ALVIN Review Committee. The new committee was key to addressing both near term and long term programmatic issues, ROV use, and technology improvements. The Federal agencies signed the new MOA which acknowledges ROVs, but falls short of providing block-funding. Activities of the intra-WHOI groups have included the merging to ALVIN and ROV operations. This process is coming along and is practically complete. Additionally, WHOI is in the process of hiring a deep submergence "Chief Scientist" to liaison between the science and operational groups. (Note: Since the meeting, Dan Fornari has been appointed to this position.)

Dick reported that ALVIN is recertified and back in service. The schedule prospects are bright (159 dives are already funded for next year). The WHOI ROVs are becoming hardened and now acknowledged as part of the deep submergence facility. WHOI is attempting to make it a "turn-key" operation. The Dynacon winch needed for ROV support is working very well on KNORR and WHOI is in the process of purchasing one for OCEANUS, Scripps is also buying one and AGOR 25 will also have a traction winch.

ATLANTIS II Sale and KNORR Conversion - Dick presented a timeline showing the planned sale of ATLANTIS II and conversion of KNORR, see Appendix VII. WHOI has advertised ATLANTIS II for sale with hopes of selling by 1995. A couple of countries have expressed an interest in the vessel. The Sea Beam is off the munitions list and is being advertised with the ship. If all goes as planned, KNORR's conversion is scheduled for the fourth quarter of 1995 and would run through the first quarter of 1996. ALVIN's Overhaul would be performed during this same period.

The proceeds from the sale of ATLANTIS II would be used to pay for the conversion of KNORR to a support ship for ALVIN and ROVs. Conversion items would need to be prioritized since funding is restrained. It is expected that the cost of essentially cross-decking equipment from AII to KNORR would be approximately $800 thousand. The cost of a new A-frame for KNORR would probably bring this cost up to $ 1.8 million. An external source of funding would be needed to cover costs. Selling AII earlier as opposed to later has some advantages since the ship's systems would be newer and would bring in more money. As an action item, the funding agencies, WHOI, DESSC and FIC need to determine the cost of KNORR's conversion and develop a prioritized list.

Functional Relationships - Dick Pittenger presented a chart (Appendix VII) showing the functional relationships for the deep submergence facility between the user community, DESSC and WHOI. The chart demonstrates that the facility cannot operate by committee alone. A great deal of advisory/coordination is required. The roles of each group continue to be defined as the transition progresses.

AGENCY REPORTS:

National Science Foundation - Don Heinrichs gave the report for NSF. They are trying to get more involvement between DESSC and the NSF program managers. There is a need to look at deeper diving vehicles, such as, SEA CLIFF, NAUTILLE, and SHINKAI. NSF is discouraging the use of the MIRs. Continued use of ALVIN is encouraged. NSF has some skepticism on the marriage of the WHOI ROV operation with ALVIN. They see the need for submersibles in the RIDGE and INTER-RIDGE programs.

NSF has looked into moving up the dates for ALVIN proposal submittals, but sees the change as problematic. There is some opposition to setting the February date as the fixed proposal submittal date. No changes in submittal dates are predicted for the near future.

Funding for ALVIN looks good in 1994; however, ALVIN/AII in the broader UNOLS Fleet picture is of NSF concern.

NSF has requested a 16 percent budget increase for the Ocean Sciences Division to Congress. This would compensate for the 10 percent President's stimulus project which was rejected plus an additional six percent. The chances of actually receiving an increase greater than ten percent is low.

Office of Naval Research - Keith Kaulum reported that ONR's reorganization has had little effect on science programs. Applied and Basic Research programs will be supported. For next year, no dramatic changes are anticipated in funding levels for Ocean Sciences and Facilities; however, it looks as if the Geophysics program will probably be cut from ONR. Keith noted that this year is a banner year for ONR ALVIN and ROV use.

Various personnel changes have been made at ONR. There is a new admiral, Admiral Marc Y. E. Pelaez, as well as two new program managers; Eric Shulenburger in Biology and Lou Goodman in Physical Oceanography.

There was a brief discussion by DESSC regarding JASON/MEDEA. Although in the next two years the JASON/MEDEA system will evolve to a more user friendly system, it presently needs ten WHOI DSOG personnel to operate. To be marketable and more cost effective the number of technician support must be reduced and DESSC urges the operator to move swiftly towards a user-friendly configuration.

NOAA/NURP - Michael Ledbetter provided the NOAA/NURP report stating that David Duane was unable to make the meeting due to prior engagements. Michael reported that Jim Baker, Jim Hall and Katherine Sullivan have been sworn in as the new NOAA senior leadership. Henry Frey is currently acting as Director of NURP. He is a physical oceanographer from NOS.

NOAA/NURP plans to continue their deep submergence activities with ALVIN use. Bob Embley's proposal for ALVIN use has been reviewed and will receive NOAA support if funds are made available. Peter Rona, NOAA's ALVIN user in the Atlantic will be leaving NOAA. For 1995, NOAA would like to entertain proposals for work in the Southern EPR region. NOAA is still interested in working with the Navy in coordinating the use of their Navy assets for research. They are also currently collaborating with JAMSTEC which allows US scientists to participate in dive programs involving Japanese deep submergence assets, and eight proposals are presently under review. NOAA hopes to get an opportunity to use JAMSTEC's full ocean depth ROV.

The President's Stimulus Program for NOAA was not funded. In FY94, NURP was included in the budget for funding of $2.035 million. (Note: Since the DESSC meeting, the Senate and House of Representatives have included funding for NURP in their proposed budgets.) At the present time, it is unclear how much funding will actually be allocated for support of ALVIN in 1994.

Michael reported that the vessel KAIMIKAI-O-KANOLA, being constructed under the supervision of the NURP center in Hawaii, will require additional funds to complete, however, it should be operational by 1994 for PISCES operations. The University of Hawaii will have title to the vessel and will operate it. Approximately $7.5 to $10 million has already been spent on construction costs. The ship will not have a NOAA crew. Don Heinrichs reported that NSF will not fund science on the vessel until after the ship has been UNOLS/ABS inspected, and then only after the UNOLS fleet is fully utilized.

<u>SEA CLIFF/TURTLE/NR-1</u> - LCDR George Billy reported on the status and plans for future scientific opportunities on the Navy's submersibles, see Appendix VIII. SEA CLIFF is presently on restricted availability until October, 1993. The manipulators appear to have a basic design flaw and they begin to leak at 12,000 feet. TURTLE is currently operational, but will start restricted availability in October of this year. In 1993, the Navy participated in the Guaymas Basin JASON IV project with LANEY CHOUEST and TURTLE. Fifteen Turtle dives were made and operations went very well. The Advanced Tethered Vehicle (ATV) and Tethered Unmanned Work Vehicle System (TUWVS) are operational but have some problems with motor controllers. NR-1 overhaul is complete and is operational. The February upgrades included a new reactor core, DS/OAS Sonar, CVL Sonar, ESC and Pan and Tilt Unit, and new bow. NR-1 performed science operations in the Gulf of Mexico. It is slated to have a new support ship in April, 1994. The vessel will be operated under contract to Edison

Chouest at $11 K a day based on a 365 day year. It is anticipated that this will be a long term contract. NR-1 has a depth capability of 2,300 feet and can stay submerged for 30 days. It must be in communication with its mother ship.

Future Navy operations include TURTLE operations in the Pacific Northwest in August of this year. SEA CLIFF and NR-1 operations are planned for the Spring/Summer 1994. It was suggested that perhaps the Navy's submersibles can pick up ALVIN's traditional work, if and when, ALVIN goes on a global field program. The Navy's vision for the future is to have level funding and improve reliability, but no new technology development is planned. They would like to improve scientific use by continuing the USN/NURP arrangement, exploring the possibility of permanent technicians, developing a users manual and using compatible equipment. They would like to work within the special "niche" defined by their facilities: SEA CLIFF's ability to work at depths greater than 4,000 meters, deep water ROVs, broad agency support for environmental surveys, technology demonstrations and underwater work tasks. The Navy would also like to expand their science support from 60 days to 120 days, with their facilities operating primarily in the Pacific. In the future, they will attempt to coordinate their operations with the DESSC.

In early 1994 there will be a demonstration cruise of SEA CLIFF at 20,000 feet to prove its operational capability. Operations will be in accordance with their reliability figures. The DESSC is committed to work with the Navy towards accomplishment of the admirable goals that have been established.

REVIEW DIVE REQUESTS

Review ALVIN Dive Requests for 1994 and make Scheduling Recommendations - For 1994, over 270 dives have been proposed for ALVIN work, with an additional 159 already specified as funded. Appendix IX includes a summary of all proposals and letters received for ALVIN and ROV work, along with a regional summary chart and maps. The DESSC examined the proposals for any logistical restraints that the operator should be made aware of. They recommended that since the great majority of the 159 dives already funded in 1994, as well as the majority of the work proposed, were located in the traditional Pacific areas, ALVIN should operate in this region in 1994. DESSC also emphasized the importance of incorporating engineering dives into each year's operation schedule. WHOI presented a preliminary schedule based on this recommendation, Appendix X. It must be emphasized that this schedule is preliminary, it does not include proposals which were received at the UNOLS Office after 4 June. Operations would begin in the East Pacific Rise, then continue in the Juan de Fuca, picking up work along the Pacific coast of Central America and the US, totalling over 200 dives.

ALVIN Operations into 1996 - Many of the proposals submitted this year requested dives for 1995, some of which are already funded. Additionally, John Delaney submitted a summary of ROBE activities, an integrated and interdisciplinary investigative program sponsored by the RIDGE program that is designed to create a seafloor observatory; the summary outlined extensive usage of the submersible in the North East Pacific thorough 1996, see Appendix XI.

Using proposal pressure as a guide, DESSC recommended three research locales for 1995, and offered two plans for accommodating this work. In Plan A, ALVIN would end 1994 in Panama, then transit through the canal for work in the Mid Atlantic Ridge to accommodate programs that are related to a variety of on-going programs, such as ODP objectives and the FARA investigation. In late spring, ALVIN would work its way back into the Pacific and northwards to the Juan de Fuca for a full season of operations. In the latter part of 1995, DESSC recommends an investigative foray to south of the equator in the eastern Pacific based on the level of interest and maturity of the science. Additionally, Don Heinrichs indicated the possibility of a cooperative submersible and ROV program with the Japanese for this area. The length of the program would be determined by proposal pressure and logistical concerns. After the Southern EPR work, ALVIN would begin a major overhaul period while KNORR is converted to support ship for ALVIN and ROVs.

There were a few concerns over this proposed Plan A. Work in the southern EPR would extend ALVIN operations into 1996; as a result, the overhaul of ALVIN would be performed only in 1996. It is normally the desire of the funding agencies to schedule the overhaul over two calendar years so that the cost can also be spread over two years. Additionally, ALVIN is scheduled for a hull inspection in 1995, WHOI would have to obtain permission from the Navy to extend the hull inspection until after completion of operations in1996. Finally, Plan A is built around two scheduling assumptions: ATLANTIS II, which is currently for sale, is not sold before the Spring of 1996; and KNORR remains funded through the end of 1995. If KNORR is not fully supported in 1995, there could be savings realized by advancing the date of KNORR's conversion to a support ship for ALVIN, as well as the overhaul date for the submersible, to fall 1995. To accommodate these concerns and conditions, DESSC recommends Plan B.

Plan B would begin the same as Plan A, but would put off the foray to the Southern EPR until after ALVIN's overhaul and KNORR conversion. The overhaul and conversion would begin in 1995. A tentative timeline which shows the Plan A and Plan B conversion schedules are included as Appendix XII.

DESSC will prepare an announcement to the community defining the recommendations of Plan A and Plan B, see Appendix XIII.

1996 and Beyond - Review Portfolios for Global Expeditions - Portfolios for research in the Western Pacific and the Tethyan Region were submitted by Patty Fryer and Kim Kastens, respectfully, See Appendix XIV. DESSC recommends a global program to the Western Pacific and perhaps the Tethyan Region, depending on continued maturation of letter proposals, once KNORR is on line as support ship and ALVIN has completed overhaul. The Western Pacific work would be a first priority because there are many sites that are mature and there is very strong proposal pressure (over 18 months of defined work). Some of this work off Hawaii may be able to be accomplished on PISCES.

Before beginning a global program, ALVIN and KNORR would undergo a rigorous shakedown and engineering dive program. After the shakedown, DESSC recommends

ALVIN operations begin with a modest number of programs in locations proximal to the U.S. A limited program in the Atlantic or eastern Pacific following the overhaul and conversion would help ensure that there were adequate support facilities at hand to solve post overhaul problems with the submersible, KNORR or the handling systems.

In the event of a global program, ALVIN may not return to traditional areas of work until 1998. DESSC recommends that the deep submersible community that have worked in the familiar natural laboratories to consider the implications of a program on time series investigations; in particular, how ROVs can be effectively used to carry out certain tasks and what we have to do now as a community to prepare for this situation. The community should also begin to work with the funding agencies in thinking of ways to exchange deep submergence assets internationally. LCDR Billy indicated that perhaps the Navy's assets could be used in the Northwest Pacific regions during ALVIN's expedition to remote areas.

ALVIN EQUIPMENT AND INSTRUMENTATION UPGRADES AND IMPROVEMENTS:

ALVIN Imaging Proposal - Dan Fornari showed a video comparing three imaging techniques currently used on ALVIN. The first example was taken during the recent Langmuir cruise to the Lucky Strike hydrothermal vents on the Mid-Atlantic Ridge and involved a Sony handycam used through ALVIN's viewport using the incandescent lighting on ALVIN's exterior. The second example was taken on an ALVIN cruise to the East Pacific Rise at 9°30-50'N using the Osprey 1-chip arm camera with data overlays. The last example was taken from JASON using a 3-chip camera with HMI 1200 watt lighting, plus lighting from the MIRS. The handycam image was of very good quality, the Osprey arm-camera somewhat less so, and the 3-chip imaging was of very high quality.

The current ALVIN 1-chip Osprey arm camera is maneuverable, being attached to the manipulator, and also has remote (in-ball controllable) zoom and focus capability. The images acquired using the Osprey had less visual quality than the handycam which is considered to be due to transmission loss through the cabling and connectors for the Osprey camera into the sub's video recorder and may be exacerbated by a video switcher problem that is currently being troubleshot. The Sony Hi-8 handycam is self-recording thereby avoiding any signal loss due to transmission through cables. It is estimated that approximately $10 - $15 K may be required to improve the cabling/switcher problems.

Dan reported on the status and recommendations for an ALVIN imaging upgrade. The full description of imaging items requiring improvements and their recommendations are included in Appendix XV. At the present time it would be more effective to improve lighting and maximize the capabilities of a 1-chip camera, then to purchase a 3-chip camera (given the expected advances in 3-chip technology and miniaturization expected in the next 12-18 months). The 1-chip camera does very well when focussed carefully and with proper lighting. The 3-chip is more expensive, cumbersome and would require modifications to use.

ALVIN users also felt the need for improvement to existing long-baseline navigation programs as they applied to imaging and locating image data within detailed surveys of seafloor field areas. Dan reported that principally labor costs are required for making the improvements to existing navigation programs and that these costs will be worked into the imaging proposal.

The overall cost of all improvements (lighting, cameras, navigation, and engineering/personnel time) was roughly estimated to be in the $200 to $300 thousand range. A two year proposal requesting funds to accomplish these critical upgrades will be prepared by WHOI. By the time of the publication of the minutes Dan will have received any further input from the DESSC and he and Barrie Walden will be writing the final proposal for submission to NSF (on behalf of all federal agencies who contributed to ALVIN operation) by late August, 1993.

DESSC recommended that the improvements be performed over two years with the purchase and installation of new HMI (metal halide) underwater lights, and a latest technology 1-chip camera in the first year. The purchase of the 3-chip camera could be put off until the second year. Other details of planned improvements to be included in the imaging upgrade proposal are included in Appendix XV.

Near and Long Term Technology Improvements - There was a discussion on the status of improvements for the rock (Stakes/Holloway) drill. Problems were encountered while using the drill during the recent Von Herzen cruise to the TAG area on the Mid-Atlantic Ridge. The drill was in its new vertical configuration, with multiple barrels. Unfortunately, the mechanism was not strong enough to hold the barrel, which slipped repeatedly preventing multiple coring operations. Von Herzen was, however, able to perform his science using the standard ALVIN temperature probe which was able to be stuck into the friable hydrothermal crust without difficulty. Leon Holloway has indicated that he can correct the problems and doesn't feel that they are major. It seems clear that the efficiency of the drill increases dramatically with rotations at higher speeds and it was noted that efforts have to be made to increase rotation speeds by improving aspects of ALVIN's hydraulic system, or, as pointed out by Dudley Foster to re-engineer the drill motor/mechanism to more effectively utilize available ALVIN hydraulic power.

Jeff and Dan will write a letter to Leon Holloway and Debra Stakes on behalf of DESSC encouraging them to submit a proposal for correction of the drill's problems and establish guidelines for science users to request the drill for their ALVIN programs. DESSC also recommended that WHOI develop procedures for gaining availability to tools owned by third parties that are compatible with ALVIN and ROVs, and for ensuring that all 3rd party tools are "operational" prior to being offered for use on ALVIN for science operations.

Sea Beam Operations on ATLANTIS II - Over the years the use of technician-assisted Sea Beam operations on AII has declined while "Cheap Beam" (no technician) use has been on the rise. The DESSC took into consideration the following observations/concerns:

- A multibeam capability aboard a support ship carrying out deep submergence science is a critical capability central to the effective operation of deep submergence science needs in many applications.

- For a variety of reasons (e.g., scientific emphasis and/or funding levels) multibeam use will vary from program to program making it difficult to fully support a single individual to solely handle Sea Beam responsibilities at sea.

- Although there were very cogent reasons in the past to support the Sea Beam operation as a separate function with respect to the rest of the ALVIN/AII operation, this position seems less and less tenable in terms of efficiency of operation and cost-effectiveness.

- The support staff at the GSO multibeam facility is now very small (i.e., Sheff Corey). In addition, the work generated by the AII Sea Beam operation is sufficient to keep Mr. Corey occupied for less than 6 months per year. It seems clear that it may be difficult for URI to provide support for Sea Beam aboard the AII because of reduced support levels for Mr. Corey.

- From developing patterns of Sea Beam usage aboard the AII, the vast majority of the multibeam usage will be in "cheap beam" mode. That is to say, investigators will bring their own Sea Beam expertise and/or investigators will only wish to use the system in a minimal way (i.e., dive site identification).

When taken together, the DESSC felt that the best and most efficient way to manage the Sea Beam operation at sea is to transfer the responsibility for management of shipboard operations over to Woods Hole Oceanographic. The DESSC recognized that at-sea Sea Beam responsibilities could be met in a variety of ways (e.g., include as part of a resident technician's responsibilities: fold into the responsibilities of the ALVIN operation), but left the solution up to the operator. A motion was made and accepted by DESSC (with two abstentions, Fox & Fornari) to work with the operator and funding agencies to transfer title and operation of Sea Beam to WHOI. Jeff will draft a letter to Bob Tyce requesting a transfer of the system.

ALVIN ARCHIVING:

Barrie Walden gave the committee an update on the archiving efforts for ALVIN. There has not been a procedure established to save the old footage. Technology continues to move forward at such a pace it does not seem appropriate to settle on a process that will change in short order. On the positive side, the cost of this technology continues to go down. In the mean time some sorting and searching of information continues with volunteer help in the interim while acceptable procedure is sought.

ASSESSMENT OF ALVIN COMMENTS:

One of the recommendations of the Spiess Committee's report to WHOI was that an ongoing survey of recent ALVIN users be conducted to assess the operational problems of the ALVIN operation and that this survey be made available to the WHOI operators and the DESSC. The procedure established was that the chair of DESSC personally contact each of the PIs and get a verbal assessment of cruises. Jeff gave the committee an initial synopsis of this effort for the 1992 operating year.

Jeff reported that the PIs were very pleased with the operations and the support they received aboard the ship and with the ALVIN Group. However, three areas were cited as being of concern by several of the users. These were:

1. The need for imaging and navigation capability improvements.

2. Limited bottom time when at the end of a battery cycle.

3. Concern was expressed regarding the morale and stress level of the ALVIN pilots and crew.

Each of these comments has been communicated to the ALVIN management and hopefully resolutions are at hand. This assessment of users will become a formal process each year.

TESTIMONY ON THE STATE OF DEEP SUBMERGENCE SCIENCE:

Jeff Fox testified before the Congressional Committee on Merchant Marine and Fisheries on the state of deep submergence science. The Committee was looking into NOAA/NURP's undersea program and invited Jeff, Sylvia Earle, Ned Ostenso, Tom Bright (Texas A&M, Sea Grant), and Robert Wickland (Univ. S.C, NURP Center Director) to testify. Jeff restricted his comments to the Nation's deep submergence science effort, his full testimony is enclosed as Appendix XVI. Both Sylvia and Jeff made the point that the program was not focused and that we have no true national agenda for deep ocean presence. Their comments were well received and stimulated thoughtful and interesting comments from both the Subcommittee Chair, Ortiz (D) TX and Vice Chair, Weldon (R) PA. Jeff received more detailed questions from both of these representatives to which he has replied. Their questions revolved around how the United States should proceed with a focused deep submergence policy and who should manage such a program. Subsequent to these exchanges Jeff, Garry Brass and Jack Bash met with Ned Ostenso and staff to seek a direction. One proposed idea was that Congress appropriate full block funding for a national Deep Submergence Program and that this program would be administered through the NOAA/NURP program. No further action has been taken. DESSC sees as a high priority, the need to create an enhanced and more stable funding mechanism for deep submergence science efforts, and hopes that by the time the present MOA expires a new and improved funding mechanism would be in place.

A NEW FUNDING PARADIGM:

This subject was a follow-on from the preceding agenda item. After considerable discussion it was concluded that the funding process should remain as is for the term of the current MOA and the community should work towards the creation of a new mechanism for a better funding paradigm with the NOAA/NURP option as one possibility.

DESSC TERMS OF REFERENCE:

A draft of the new DESSC Terms of Reference was discussed and accepted as written and is appended as Appendix XVII.

UNOLS CHARTER, ANNEX II.

Annex II of the UNOLS Charter addresses National Oceanographic Facilities and applies to DESSC. To comply with the Charter each annex is to be reviewed and readopted every three years. Minor changes were made to this annex and will be presented to the Council and general membership for readoption. A copy of the revised Annex II is included as Appendix XVIII.

ARCTIC SCIENCE 1993:

Garry Brass and Mark Langseth provided the Committee with a summary of events concerning the upcoming science opportunities aboard a U.S. Navy nuclear submarine. UNOLS has been coordinating the science planning for this cruise to the Central Arctic Ocean Basin in August. Nineteen days are allotted for survey and station work. Six or seven scientists will make the cruise. About 45 scientists will be contributors and potential participants. A committee of J. Morison, T. DeLaca, W.B. Tucker, W. Smethie and M. Langseth, Chair have coordinated and developed the science plan which is included as Appendix XIX. The Navy will provide the operating money ($3M) while the science money will come from a variety of sources. Future cruises are possible but could depend on the coordination and working relationships developed for this cruise.

DESSC WORKSHOP REPORT:

The remainder of the second day of this meeting was devoted to completing the report of the 1992 DESSC Fall Workshop that was held in Alexandria, VA. The report will consist of three parts: 1) A sampling of the range of fundamental scientific questions that can only be effectively addressed through the use of deep submergence assets; 2) An overview of the present deep submergence capabilities available in the U.S; and 3) A forward look as to where the community should be going.

ROV REVIEW:

It was reported that seven proposals were submitted for using WHOI ROV's in 1994. These include the use of, 120 kHz side-looking sonar, ARGO-II and MEDEA/JASON. All seven proposals are pending funding. Summaries for this work is included in Appendix IX.

RECOMMENDATIONS FOR NEW DESSC MEMBERS:

The terms of three members of the DESSC expire this year. These are: Casey Moore, Mary Scranton and Karen Von Damm. Both Casey and Mary were completing their second term and were not eligible for reappointment. Karen was completing her first term and agreed to stay on for a second term. In addition to filling the two vacated positions, DESSC members felt that it was necessary to now fill the additional engineering position that had been established at last year's organizational meeting of DESSC. The following candidate list was established:

Bob Collier, OSU, replacement for Mary Scranton
Dan Orange, MBARI, replacement for Casey Moore
Jim Bellingham, MIT, Engineering

Their names will be forwarded to the UNOLS Council for endorsement.

PLANNING FOR 1994 AND BEYOND:

The next DESSC meeting is scheduled for 5 December 1993 in San Francisco in conjunction with the fall AGU meeting. The entire deep submergence committee is encouraged to attend to provide an exchange of information and keep the community abreast of future planning. The meeting agenda will include the operations perspective; results of the 1993 deep submergence operating year; schedules for 1994; an update of the imaging proposal; agency presentations and long range planning for the out years.

UNOLS BOOTH AT AGU:

UNOLS is preparing to establish a booth at the fall AGU which is in the rudimentary stages of planning. DESSC is being asked to participate in the booth by providing posters, videos and other handouts as appropriate to inform the greater scientific community of the DESSC activities. DESSC is also asked to provide volunteers to help tend the booth. DESSC members were enthusiastic in their support for such an endeavor.

FAREWELLS:

The Committee thanked both Casey and Mary for their six years of diligent service and hard work as members of the DESSC. An ALVIN tee shirt was presented to both of the departing members.

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KNORR/AII CONVERSION PLANNING MEETING

An organizational meeting was held for establishing a subcommittee to provide oversight on the conversion of KNORR to a submersible handling ship. Present were: M. Langseth, J. Fox, D. Heinrichs, K. Von Damm, D. Fornari, R. Pittenger, B. Walden, R. Dinsmore, K. Kaulum, G. Brass, J. Bash and A. DeSilva. The committee is to provide a link between the scientific community and WHOI for design advice on the KNORR conversion. It was decided that the subcommittee should consist of two members of the FIC, two members of DESSC and two persons from the community at large plus the WHOI representation. Potential candidates for this subcommittee were discussed and will be contacted by M. Langseth to determine whether or not they will serve. Only one or two meetings are envisioned. The first meeting is tentatively scheduled on 8 September and will be held at WHOI while KNORR is in port. Issues to be discussed will include:

- A review of Glosten's drawings
- Multinarrow beam needs
- Space for ALVIN
- Space for ROVs
- Crew berthing accommodations
- Winch requirements
- Stern slamming
- Operations other than ALVIN/ROV
- A-frame decisions; and Cross decking plans.

Scheduling options for conversion are shown on the timeline in Appendix XII.

APPENDIX I

AGENDA

DEep Submergence Science Committee
8:30 a.m. June 14-16, 1993
Carriage House, Woods Hole Oceanographic Institution, Woods Hole, MA

8:30 a.m.- Monday, June 14, 1993 - Carriage House

Welcome and Introduction: Jeff Fox, DEep Submergence Science Committee Chair, will welcome attendees, describe meeting goals and set the agenda.

Accept Minutes of December, 1992 DESSC Planning Meeting.

Fleet Improvement Committee Liaison. A representative from FIC has been appointed as an ex-officio member of the DESSC.

Deep Submergence Operations at WHOI:

- **Report on ALVIN/ATLANTIS II Certification/Post-Certification, Status of 1993 Operations, Funding, and Preview of Factors for 1994.** Barrie Walden will report on 1992-93 ALVIN overhaul and certification. A review of upgrades installed during the overhaul along with proposed upgrades will be discussed. The controllers problem and fix will be addressed. 1993 operations status and funding will be reported along with factors pertinent to 1994 operations (e.g. status of 4500 m certification).
- **ALVIN/MEDEA/JASON Merge**- Barrie Walden will review the status of the ALVIN and ROV merge at WHOI.
- **1993/94 ROV Operations.** Brian Tucholke and Andy Bowen will report on their recent KNORR cruise to the Mid Atlantic Ridge using JASON. Andy Bowen will provide highlights on WHOI ROV operations for 1993 and plans for 1994.

Deep Submergence Facility Administrative Issues:

- **ATLANTIS II Sale.** Dick Pittenger will report on the status of the sale of ATLANTIS II.
- **KNORR Conversion.** Dick Pittenger will report on plans and schedule for the KNORR Conversion. A sub-committee will be formed of DESSC and FIC members to evaluate/oversee the design and conversion process.
- **Functional Relationships.** Dick Pittenger will present an organizational chart of the functional relationships between DESSC, WHOI's Deep Submergence Facility Groups, and the funding agencies.

Agency Reports on Program Funding for 1994 and beyond. Keith Kaulum, ONR; Michael Ledbetter, NOAA; and Don Heinrichs, NSF will report on program funding for deep submergence operations in 1994 and beyond.

SEA CLIFF/TURTLE/NR-1. LCDR Billy will report on the status and plans for future scientific opportunities on the Navy's submersibles.

12:00 noon to 13:00 - LUNCH

Review Dive Requests and Develop 1994 Schedule:

- **Review ALVIN and ROV Dive Requests for 1994.** NSF, ONR and NOAA representatives will provide best-available funding information for all dive requests. The DESSC will review all proposals for 1994 and beyond. The reviews will emphasize the appropriateness of the vehicle to perform the proposed science. The review and final schedule recommendations will be balanced against NSF, ONR and NOAA program/budget structure to assure that each agency's critical needs are met.

- **Review Portfolios for Global Expeditions** - DESSC will review portfolios submitted by the heros and heroines for research in remote global arenas. The Committee will discuss the maturity, level of interest, and timeliness of the proposed work.

- **Schedule Recommendations for 1994.** DESSC will work with the agency representatives and WHOI staff to develop a tentative schedule that most effectively utilizes the deep submergence assets. WHOI staff will assemble a candidate schedule for DESSC review based on those recommendations.

ALVIN Equipment and Instrumentation Upgrades and Improvements:

- **ALVIN Imaging Proposal.** Dan Fornari will review the ALVIN Imaging Proposal.

- **Near and Long Term Technology Improvements.** Discussion on how the DESSC should follow up on the community's recommendations made during the DESSC fall workshop and December planning meeting.

ALVIN Archiving. Update on the status of WHOI's proposal for preserving ALVIN's scientific film footage.

Assessment of ALVIN Comments. Jeff Fox will summarize the comments received from ALVIN users. DESSC will identify themes that warrant attention by the WHOI ALVIN group.

5:00 - 7:00 p.m. - Deep Submergence Science Committee Social - Fenno House

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8:30 a.m. - Tuesday, June 15, 1993- Carriage House

Testimony on the State of Deep Submergence Science. Jeff Fox will report on his testimony to the Committee on Merchant Marine and Fisheries addressing the state of deep submergence science. He will discuss follow-up responses to his testimony and other relevant meetings held in Washington DC with NOAA and NSF.

A New Funding Paradigm. Development of a strategy and a timetable for the establishment of a new funding paradigm for Deep Submergence Science.

DESSC Terms of Reference. Review/Accept draft Terms of Reference. Discuss strategies for implementing the new terms.

ARCTIC Science 1993. Garry Brass will report on the upcoming science opportunity for research aboard a U.S. Navy nuclear submarine.

12:00 noon to 13:00 - Lunch

DESSC Workshop Report. Finalization of working draft of DESSC Workshop Report.

8:30 a.m. - Wednesday, June 16, 1993 - Carriage House

Recommendations for New DESSC Members. Terms for Casey Moore, Mary Scranton, and Karen Von Damm expire. Karen will be eligible for re-appointment. Review and discuss recommendations/re-appointments for membership.

Planning for 1994 and beyond. Discussion of the next planning meeting in San Francisco (Sunday before AGU fall meeting?) Suggestions for agenda.

UNOLS Booth at AGU. UNOLS is considering having a booth at AGU. Discuss recommendations for a DESSC display at the booth.

Adjourn at Noon on June 16, 1993.

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A meeting of the KNORR/AII Conversion Subcommittee will be held at 1:00 pm at the Carriage House.

APPENDIX II

DEep Submergence Science Committee
(formerly the ALVIN Review Committee)

Rev. 3/93

(First Meeting 2/19/75)

1975

		Term Expires
A.F.	Richards, Chair, Lehigh	7/78
C.L.	Drake, Dartmouth	7/76
G.D.	Grice, WHOI	7/78
R.R.	Hessler, Scripps	7/77
G.H.	Keller, NOAA/AOML	7/77
S.	Murphy, U/Wash	7/76
C.	Rooth, RSMAS	7/76
K.K.	Turekian, Yale	7/78
T.J.	van Andel, Stanford	7/77
A.E.	Maxwell, WHOI, ex-officio	

1976

		Term Expires
A.F.	Richards, Chair, Lehigh	7/78
R.W.	Corell, UNH	7/79
M.C.	Gregg, U/Wash	7/79
G.D.	Grice, WHOI	7/78
D.E.	Hayes, L-DGO	7/79
R.R.	Hessler, Scripps	7/77
G.H.	Keller, OSU	7/77
K.K.	Turekian, Yale	7/78
T.J.	van Andel, Stanford	(resigned 9/76)
A.E.	Maxwell, WHOI, ex-officio	

1977

		Term
R.W.	Corell, Chair, UNH	7/76-6/79
J.B.	Corliss, OSU	7/77-6/80
M.C.	Gregg, U/Wash	7/76-6/79
G.D.	Grice, WHOI	2/75-6/78
D.E.	Hayes, L-DGO	7/76-6/79
A.F.	Richards, Lehigh	2/75-6/78
K.K.	Turekian, Yale	2/75-6/78
R.D.	Turner, Harvard	7/77-6/80
A.E.	Maxwell, WHOI, ex-officio	

1978

		Term
R.W.	Corell, Chair, UNH	7/76-6/79
J.B.	Corliss, OSU	7/77-6/80
J.M.	Edmond, MIT	7/78-6/81
M.C.	Gregg, U/Wash	7/76-6/79
D.E.	Hayes, L-DGO	7/76-6/79
K.C.	Macdonald, Scripps	7/78-6/81
D.C.	Rhoads, Yale	7/78-6/81
R.D.	Turner, Harvard	7/77-6/80
A.E.	Maxwell, WHOI, ex-officio	

1979

		Term
R.W.	Corell, Chair, UNH	7/76-6/82
R.N.	Anderson, L-DGO	7/79-6/82
J.B.	Corliss, OSU	7/77-6/80
J.M.	Edmond, MIT	7/78-6/81
K.C.	Macdonald, Scripps	7/78-6/81
D.C.	Rhoads, Yale	7/78-6/81
R.D.	Turner, Harvard	7/77-6/80
M.	Wimbush, URI	7/79-6/82
A.E.	Maxwell, WHOI, ex-officio	

1980

		Term
R.W.	Corell, Chair, UNH	7/76-6/82
R.N.	Anderson, L-DGO	7/79-6/82
J.M.	Edmond, MIT	7/78-6/81
D.E.	Karig, Cornell	7/80-6/83
K.C.	Macdonald, UCSB	7/78-6/81
D.C.	Rhoads, Yale	7/78-6/81
G.T.	Rowe, Brookhaven	7/80-6/83
M.	Wimbush, URI	7/79-6/82
A.E.	Maxwell, WHOI, ex-officio	

1981

		Term
R.W.	Corell, Chair, UNH	7/76-6/82
R.C.	Aller, U/Chicago	7/81-6/84
R.N.	Anderson, L-DGO	7/79-6/82
D.E.	Karig, Cornell	7/80-6/83
G.T.	Rowe, Brookhaven	7/80-6/83
F.L.	Sayles, WHOI	7/81-6/84
M.	Wimbush, URI	7/79-6/82
A.A.	Yayanos, Scripps	7/81-6/84
G.D.	Grice, WHOI, ex-officio	

1982

		Term
R.W.	Corell, Chair, UNH	7/82-6/85
R.C.	Aller, U/Chicago	7/81-6/84
J.K.	Weissel, L-DGO	7/82-6/85
D.E.	Karig, Cornell	7/80-6/83
G.T.	Rowe, Brookhaven	7/80-6/83
F.L.	Sayles, WHOI	7/81-6/84
M.	Wimbush, URI	7/82-6/85
A.A.	Yayanos, Scripps	7/81-6/84
G.D.	Grice, WHOI, ex-officio	

1983

		Term
R.W.	Corell, Chair, UNH	7/76-6/85
R.C.	Aller, U/Chicago	7/81-6/84
P.A.	Jumars, U/Wash	7/83-6/86
D.E.	Karig, Cornell	7/80-6/86
F.L.	Sayles, WHOI	7/81-6/84
J.K.	Weissel, L-DGO	7/82-6/85
M.	Wimbush, URI	7/79-6/85
A.A.	Yayanos, Scripps	7/81-6/84
G.D.	Grice, WHOI, ex-officio	

1984

		Term
R.W.	Corell, Chair, UNH	7/76-6/85
J.K.	Cochran, SUNY/Stony Brook	7/84-6/87
J.W.	Deming, Johns Hopkins	7/84-6/87
P.A.	Jumars, U/Wash	7/83-6/86
D.E.	Karig, Cornell	7/80-6/86
G.	Thompson, WHOI	7/84-6/87
J.K.	Weissel, L-DGO	7/82-6/85
M.	Wimbush, URI	7/79-6/85
G.D.	Grice, WHOI, ex-officio	

DEep Submergence Science Committee
(formerly the ALVIN Review Committee)

1985

		Term
R.W.	Corell, Chair, UNH	7/76-6/88
J.K.	Cochran, SUNY/Stony Brook	7/84-6/87
J.W.	Deming, Johns Hopkins	7/84-6/87
P.A.	Jumars, U/Wash.	7/83-6/86
D.E.	Karig, Cornell	7/80-6/86
W.	Ryan, L-DGO	7/85-6/88
G.	Thompson, WHOI	7/84-6/87
G.L.	Weatherly, FSU	7/85-6/88
G.D.	Grice, WHOI, ex-officio	

1986

		Term
R.W.	Corell, Chair, UNH	7/76-6/88
J.K.	Cochran, SUNY/Stony Brook	7/84-6/87
J.W.	Deming, Johns Hopkins	7/84-6/87
J.	Eckman, Skidaway	7/86-6/89
D.E.	Karig, Cornell	7/80-6/89
W.	Ryan, L-DGO	7/85-6/88
G.	Thompson, WHOI	7/84-6/87
G.L.	Weatherly, FSU	7/85-6/88
G.D.	Grice, WHOI, ex-officio	

1987

		Term
F.D.	Jennings, Chair, TAMU	7/87-6/90
J.K.	Cochran, SUNY/Stony Brook	7/84-6/87
J.W.	Deming, Johns Hopkins	7/84-6/87
J.	Eckman, Skidaway	7/86-6/89
D.E.	Karig, Cornell	7/80-6/89
W.	Ryan, L-DGO	7/85-6/88
G.	Thompson, WHOI	7/84-6/87
G.L.	Weatherly, FSU	7/85-6/88
G.D.	Grice, WHOI, ex-officio	

1988

		Term
F.D.	Jennings, Chair, TAMU	7/87-6/90
J.	Eckman, Skidaway	7/86-6/89
J.C.	Casey Moore, UCSC	7/87-6/90
D.C.	Nelson, UC/Davis	7/87-6/90
W.	Ryan, L-DGO	7/85-6/88
M.I.	Scranton, SUNY/Stony Brook	7/87-6/90
G.	Thompson, WHOI	7/84-6/90
G.L.	Weatherly, FSU	7/85-6/88
G.D.	Grice, WHOI, ex-officio	

1989

		Term
F.D.	Jennings, Chair, TAMU	7/87-6/90
D.A.	Cacchione, USGS	7/88-6/91
J.	Eckman, Skidaway	7/86-6/89
P.J.	Fox, URI	7/88-6/91
J.C.	Casey Moore, UCSC	7/87-6/90
D.C.	Nelson, UC/Davis	7/87-6/90
M.I.	Scranton, SUNY/Stony Brook	7/87-6/90
G.	Thompson, WHOI	7/84-6/90
G.D.	Grice, WHOI, ex-officio	

1990

		Term
F.D.	Jennings, Chair, TAMU	7/87-6/90
D.A.	Cacchione, USGS	7/88-6/91
P.J.	Fox, URI	7/88-6/91
J.C.	Casey Moore, UCSC	7/87-6/90
D.C.	Nelson, UC/Davis	7/87-6/90
M.I.	Scranton, SUNY/Stony Brook	7/87-6/90
G.	Taghon, OSU	7/89-6/92
G.	Thompson, WHOI	7/84-6/90
G.D.	Grice, WHOI, ex-officio	

1991

		Term
F.D.	Jennings, Chair, TAMU	7/87-6/92
D.A.	Cacchione, USGS	7/88-6/91
P.J.	Fox, URI	7/88-6/91
J.C.	Casy Moore, UCSC	7/87-6/93
D.C.	Nelson, UC/Davis	7/87-6/92
M.I.	Scranton, SUNY/Stony Brook	7/87-6/93
G.	Taghon, OSU	7/89-6/92
K.L.	Von Damm, ORNL	7/90-6/93
R.	Pittinger, WHOI, ex-officio	

1992

		Term
F.D.	Jennings, Chair, TAMU	7/87-6/92
D.A.	Cacchione, USGS	7/88-6/94
P.J.	Fox, URI	7/88-6/94
J.C.	Casy Moore, UCSC	7/87-6/93
D.C.	Nelson, UC/Davis	7/87-6/92
M.I.	Scranton, SUNY/Stony Brook	7/87-6/93
G.	Taghon, OSU	7/89-6/92
K.L.	Von Damm, ORNL	7/90-6/93
R.	Pittinger, WHOI, ex-officio	

1993

		Term
P.J.	Fox, URI	7/92-6/95
D.	Fornari, WHOI	7/92-6/95
H.	Milburn, NOAA	7/92-6/95
J.C.	Casy Moore, UCSC	7/87-6/93
M.I.	Scranton, SUNY/Stony Brook	7/87-6/93
G.	Taghon, Rutgers	7/89-6/95
K.L.	Von Damm, UNH	7/90-6/93
C.	Wirsen, WHOI	7/92-6/95
R.	Pittinger, WHOI, ex-officio	

APPENDIX III

CARRYOVER of PLANNED ALVIN UPGRADES - 1992

* **Increased depth capability to 15,000 feet**
  Still being evaluated by NAVSEA

* **Renovation of surface controller station**
  Racks on hand, install summer 1993

* **New video monitors in ALVIN**
  Still searching for suitable 5" color monitors

* **Gyro upgrade**
  One of three Sperry MK47 gyros is still operating. Development in laser ring gyros, fiber optic gyros, and hemispherical resonant gyros may make these a better heading reference replacement.

* **Redesign of ALVIN life support system**
  Replacement EBA's are still under consideration.

* **Extendable light deployment boom**
  Development deferred pending results of imaging proposal.

PLANNED ALVIN UPGRADES - 1993

* **Purchase HMI lights in 200-500 watt range**
  Will provide more lumens/watt, better video color temperature. No production units suitable for ALVIN exist. French prototypes for Cyana are best candidate.

* **Modify Osprey 1363 color video camera for Y/C output**
  COMPLETED. Improved video signal from the camera.

* **Rebuild (2) hull penetrators with coax conductors**
  COMPLETED. Maximizes signal quality from 1 or 3-chip CCD cameras to the recorder

* **Purchase newest generation color video camera**
  Higher resolution, more sensitivity, replace older Osprey 1361's. Removed as line item due to budget cutbacks.

* **Purchase two new 37 khz pingers**
  COMPLETED. Improved ease of locating bottom elevators and science equipment

* **Upgrade Trackpoint II video output, cabling and transducer**
  COMPLETED. Allows distribution of Trackpoint display to remote locations, redundant "stand alone" tracking capability, improved sensitivity and accuracy

* **Replace toplab navigation computers with 486/33 mhz machines**
  COMPLETED. Improved reliability, faster processing, expandable for future needs

* **Replace aluminum starboard (ISE) manipulator components with titanium**
  COMPLETED. Reduced maintenance, extend useful life of the manipulator

* **Improve altimeter data**
  Modify existing Benthos unit and experiment with modified consumer depth sounders. Our single Benthos unit is not working, presently evaluating Datasonics unit. Modification of consumer unit still an action item.

* **Move battery chargers and shore power supplies**
  COMPLETED. Reduced failure of battery chargers and shore power supplies due to equipment corrosion

APPENDIX IV

CERTIFICATION/POST-CERTIFICATION ISSUES

- New 9220 issued
- Paperwork volume increased -- previously requested manual reviews were completed and required editing; **25-50%** of the work accomplished was on paper
- Survey timing
- Sea trial weather and Navy operations constraints
- Present and pending problems:
  - Toxicity and flammability testing
  - Definition of Scope (e.g. release devices)
  - Manual reviews
  - Redefinition of ONR/92Q relationship

MOTOR CONTROLLERS

- Pressure tolerant vs. protected (housings, connectors and weight)
- History
- Prognosis and options

OTHER EQUIPMENT CONSIDERATIONS

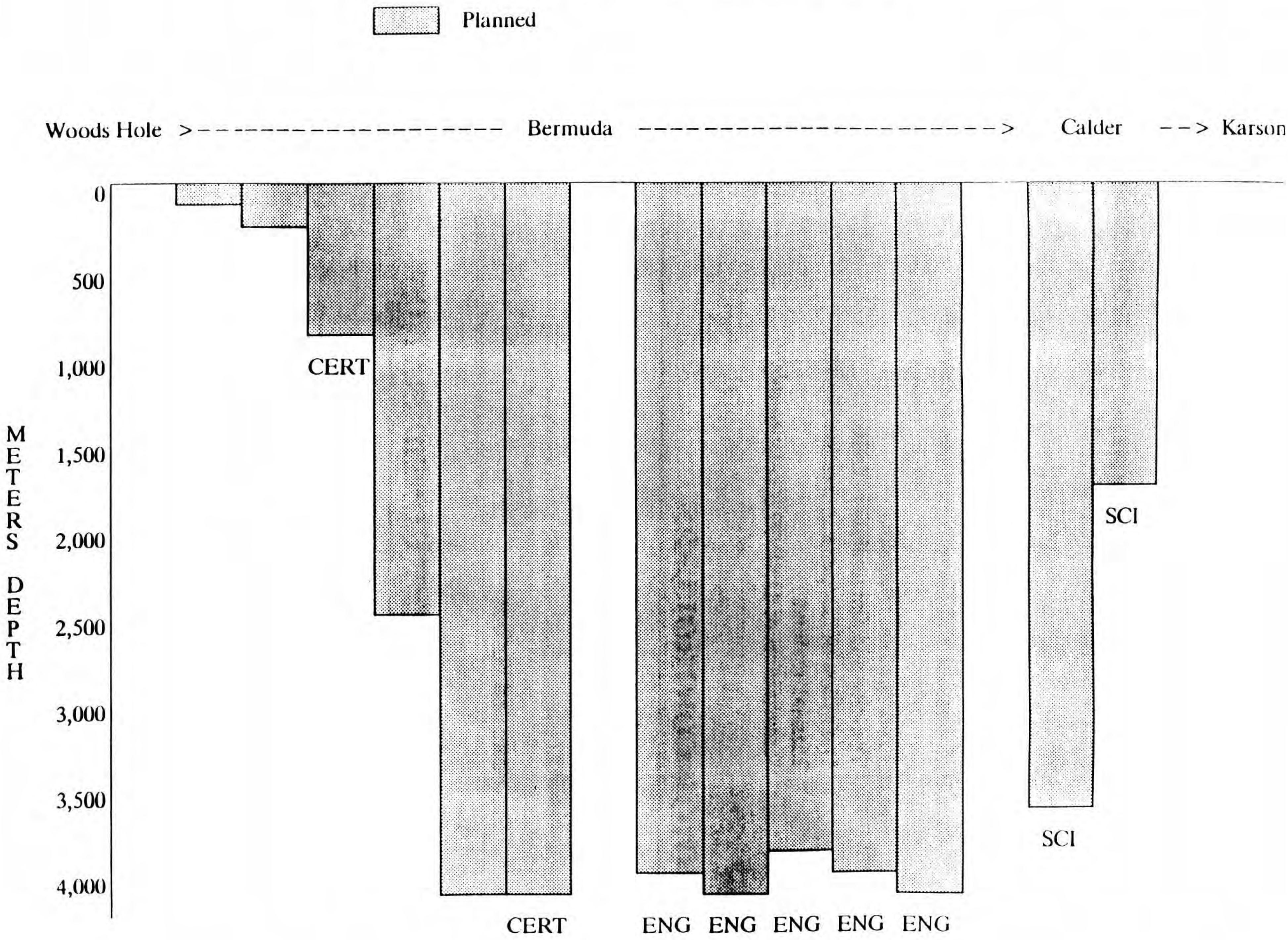
- Gyros
- Explosive release devices
- Emergency breathing apparatus
- Auxiliary battery charger

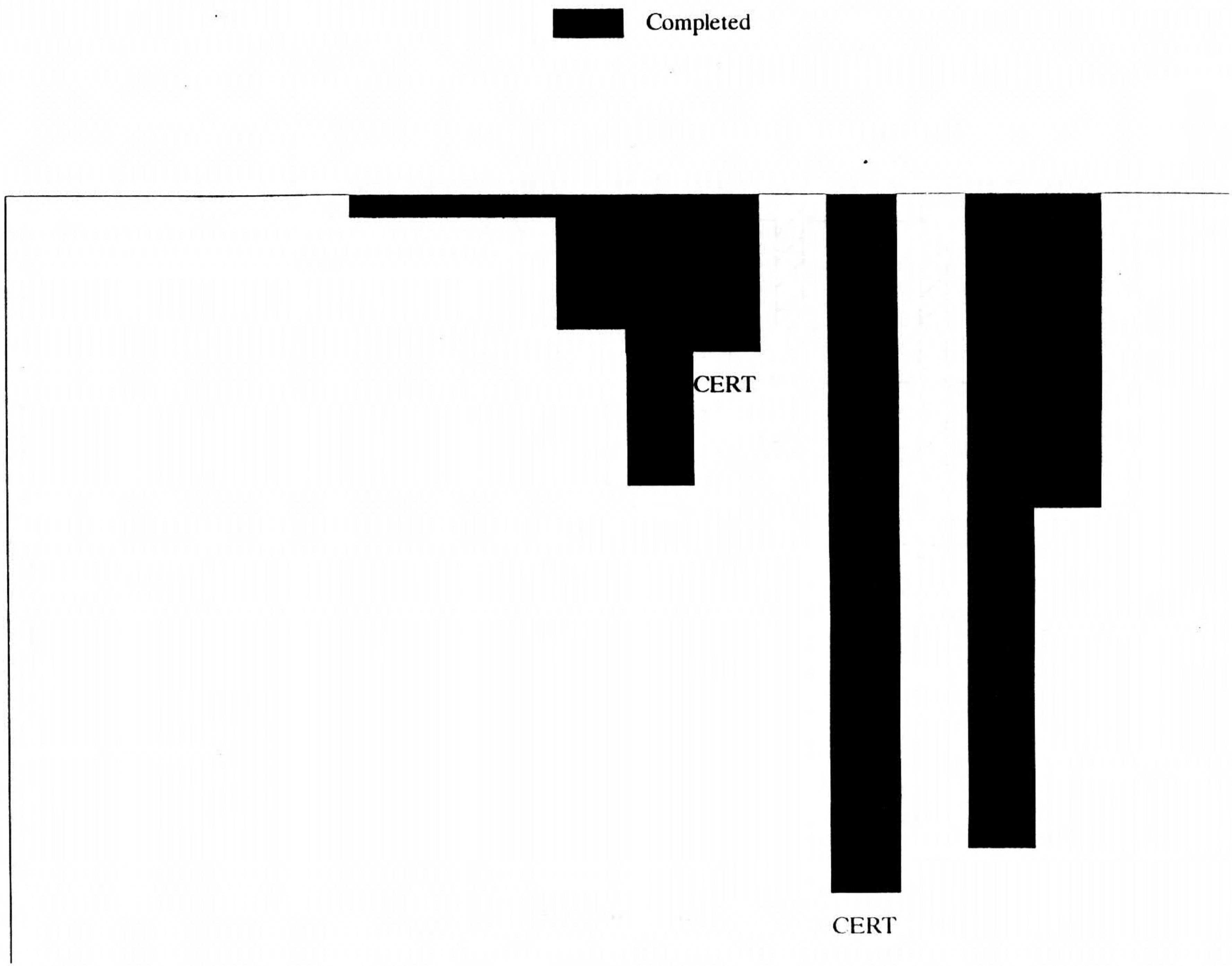
PERSONNEL

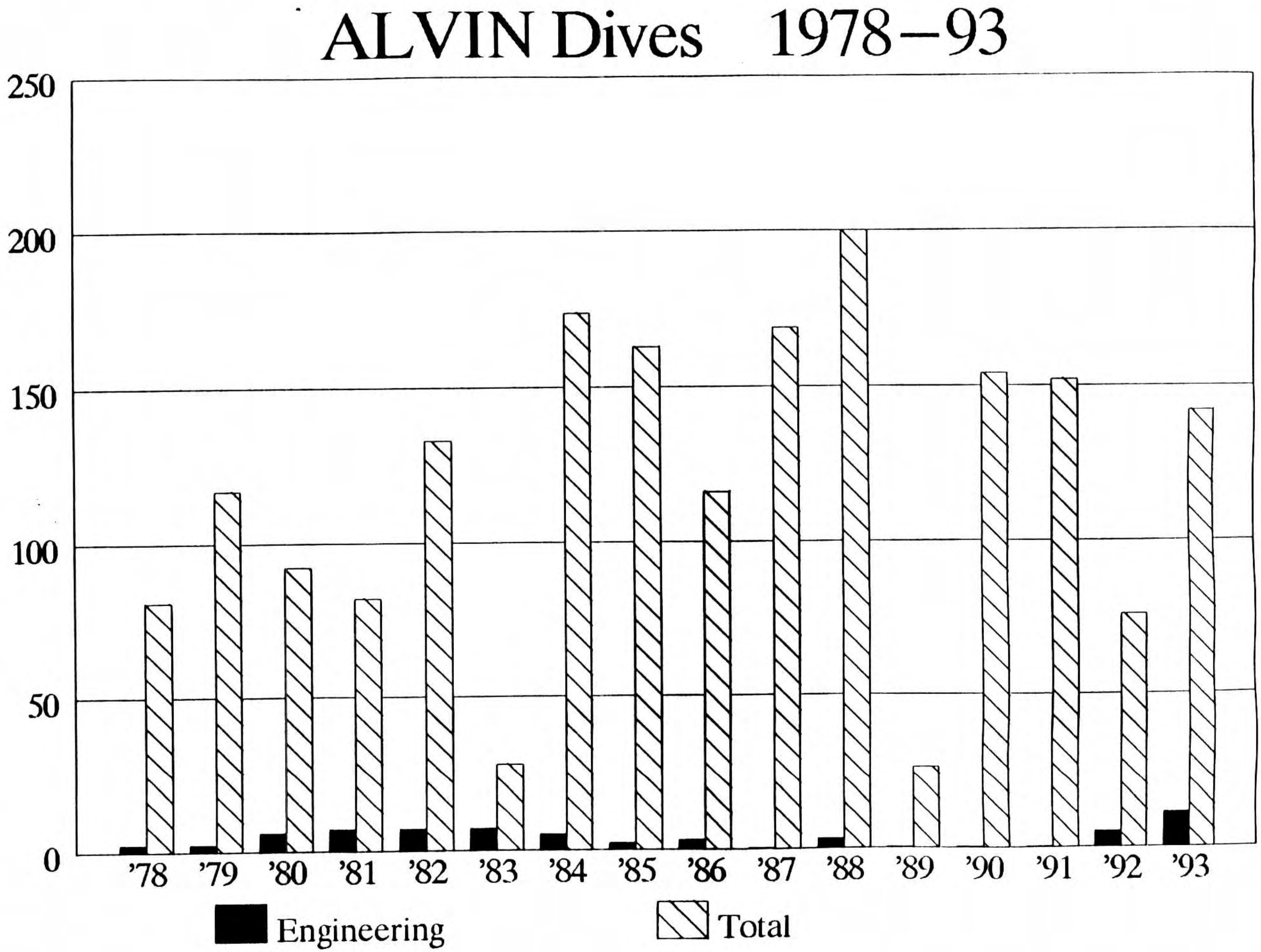
FUNDING

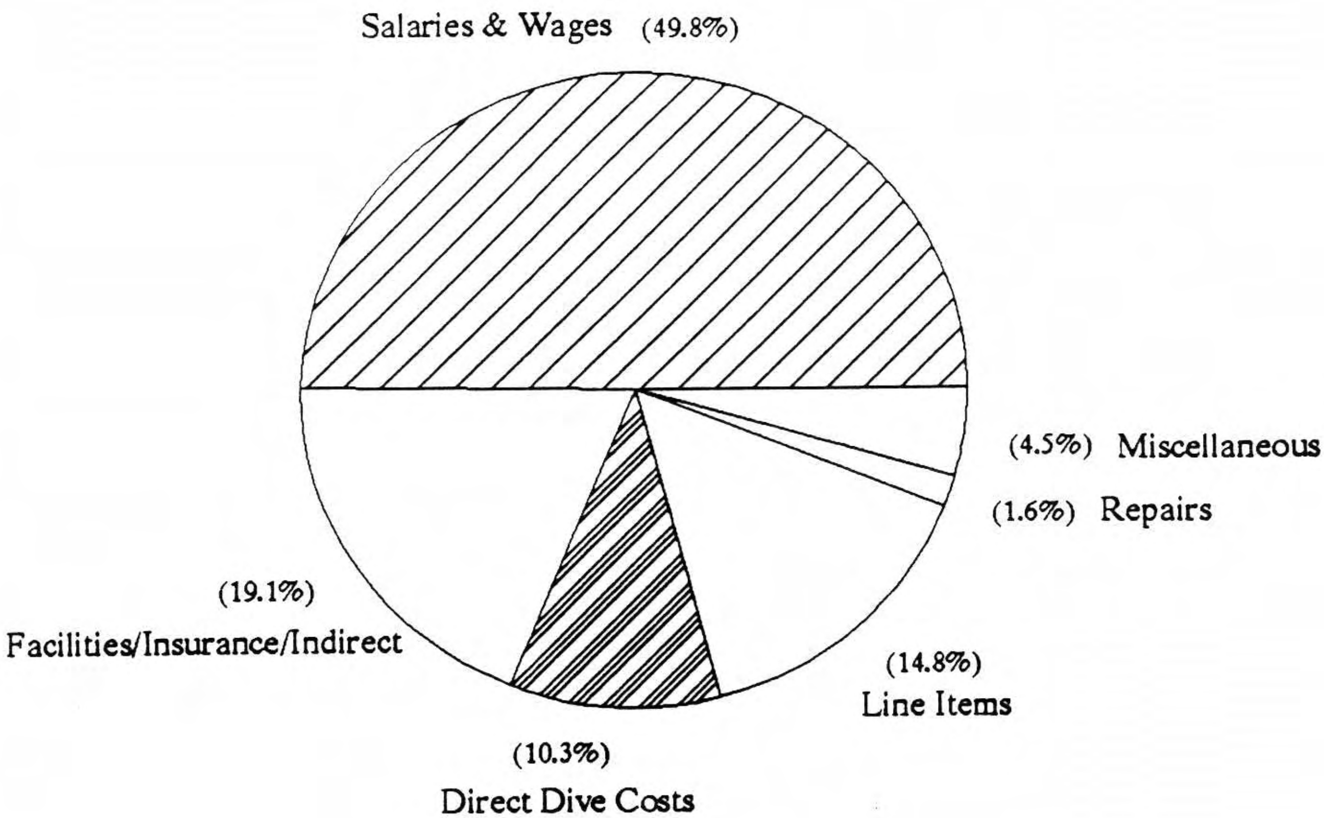
ROV/AUV OPERATIONS

ALVIN 1993 Post–Overhaul Dives




Completed
CERT
CERT


ALVIN Dives 1978–93
250
200
150
100
50
0
'78
'79
'80
'81
'82
'83
'84
'85
'86
'87
'88
'89
'90
'91
'92
'93
Engineering
Total



1993 ALVIN OPERATIONS

APPENDIX V

SURVEY SYSTEMS

KNORR 138-14 - TUCHOLKE

AMS 120 SYSTEM

120 KHZ SIDESCAN SONAR

MAGNETOMETER

CHIRP SONAR

ATTITUDE, HEADING, PRESSURE DEPTH, NAVIGATION (LBL)

JASON

IMAGING
- VIDEO
  - ONE-CHIP COLOR - FWD. LOOKING
  - THREE-CHIP COLOR - FWD. LOOKING
  - ONE-CHIP B/W - AFT LOOKING
- ELECTRONIC STILL CAMERA
- STILL, FILM

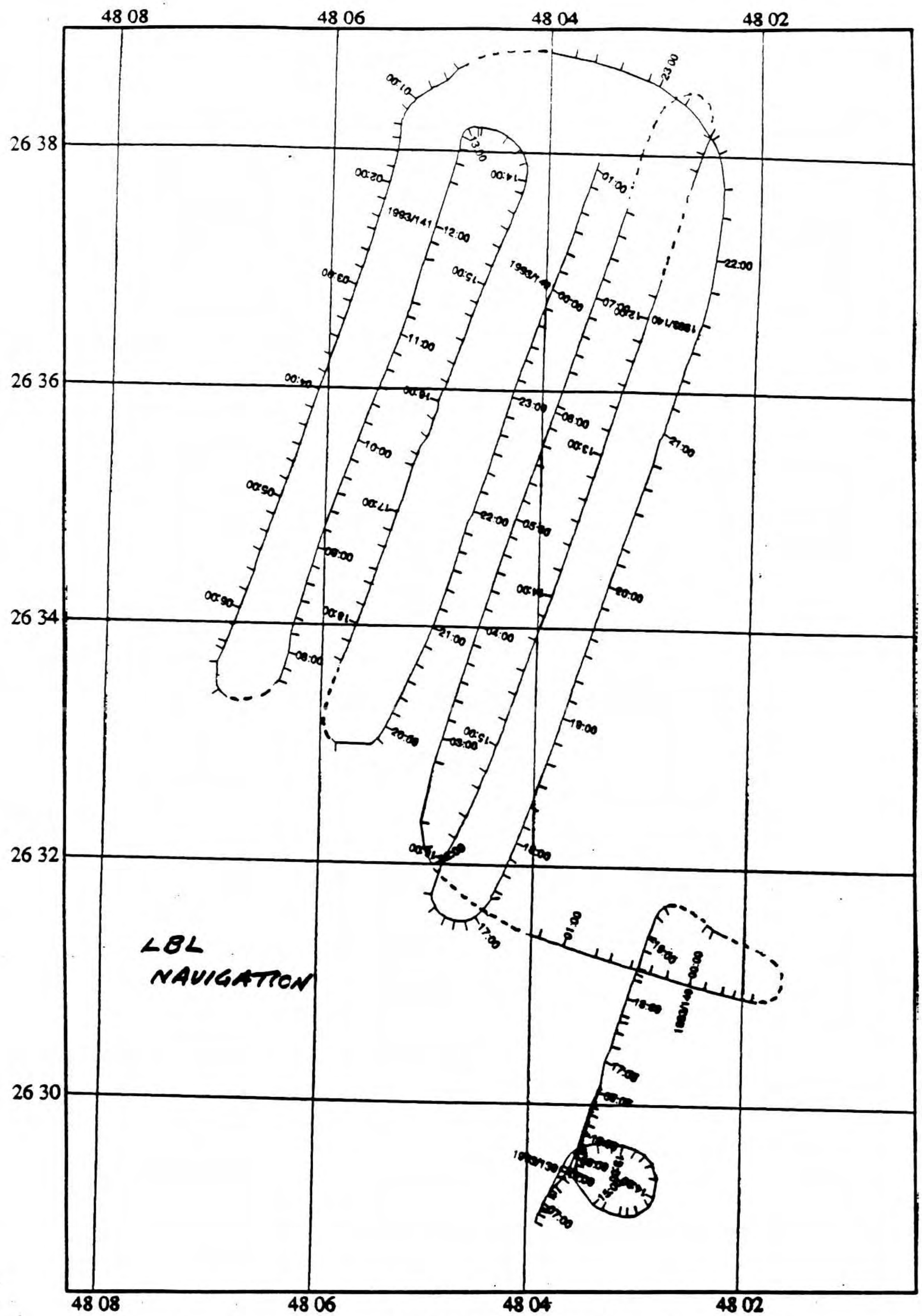
STANDARD SENSORS
- HEADING, PRESSURE DEPTH, NAVIGATION (LBL)

OTHER SENSORS
- DSL 200 SIDESCAN SONAR
- DSL 300 FORWARD-SCAN SONAR
- MESOTECH SCANNING SONAR
- DOPPLER SONAR
- MAGNETOMETER
- MANIPULATOR

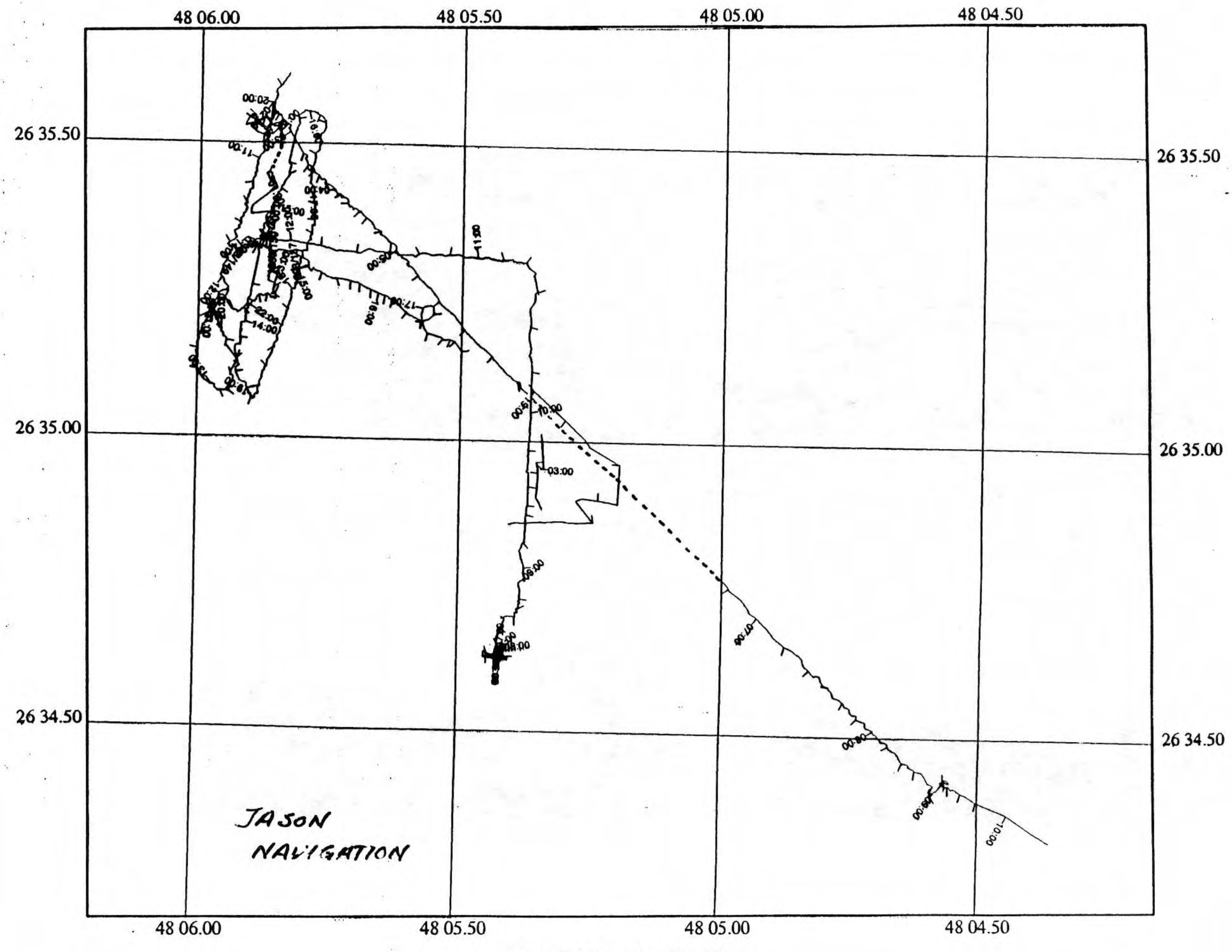
MEDEA

IMAGING
- ONE SIT CAMERA, B/W - DOWN-LOOKING

SENSORS
- PRESSURE DEPTH, NAVIGATION (LBL)

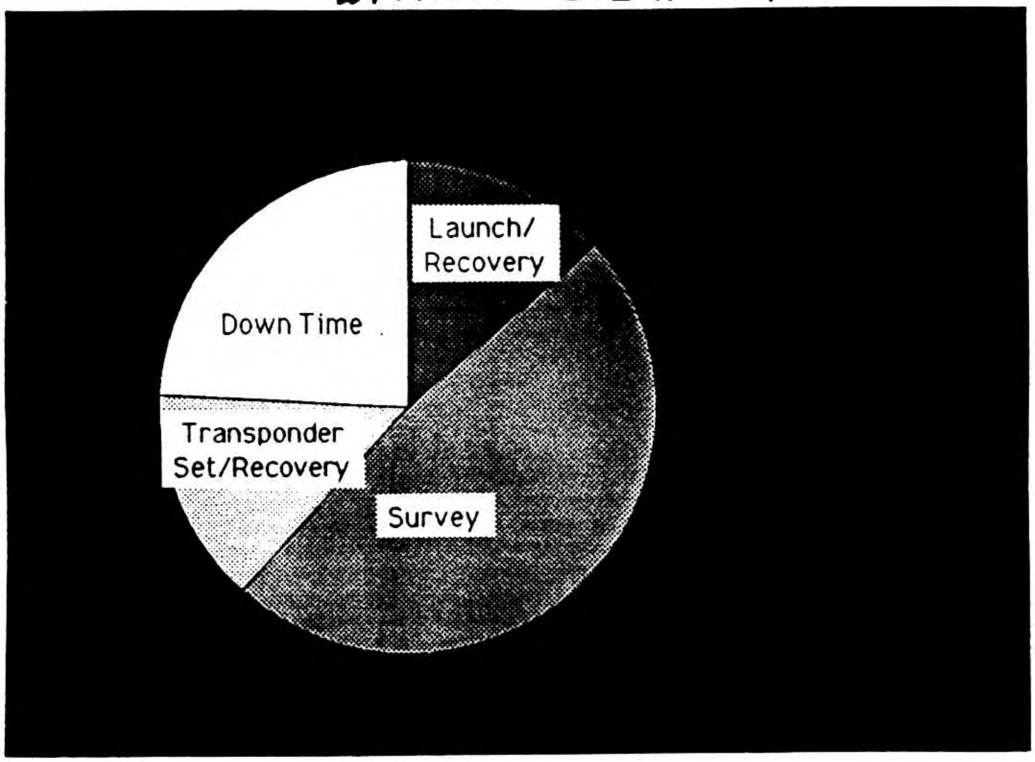


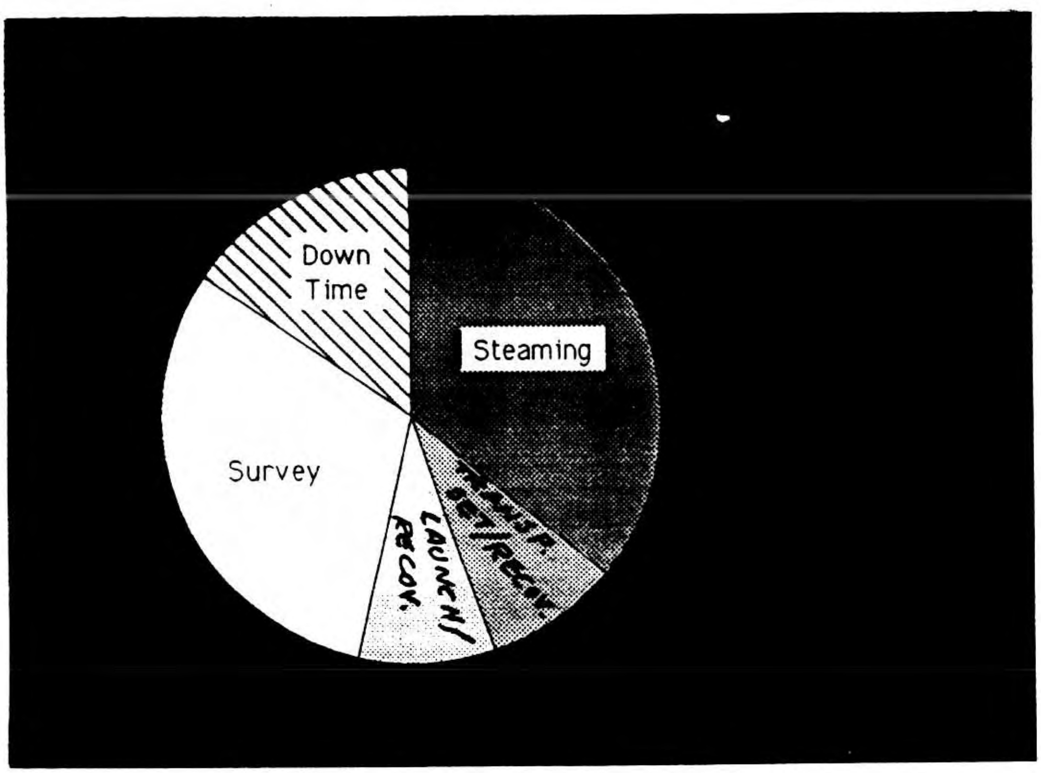
AMS 120 Trackline, Site B'



JASON Trackline, Site B'

WITHOUT STEAMING

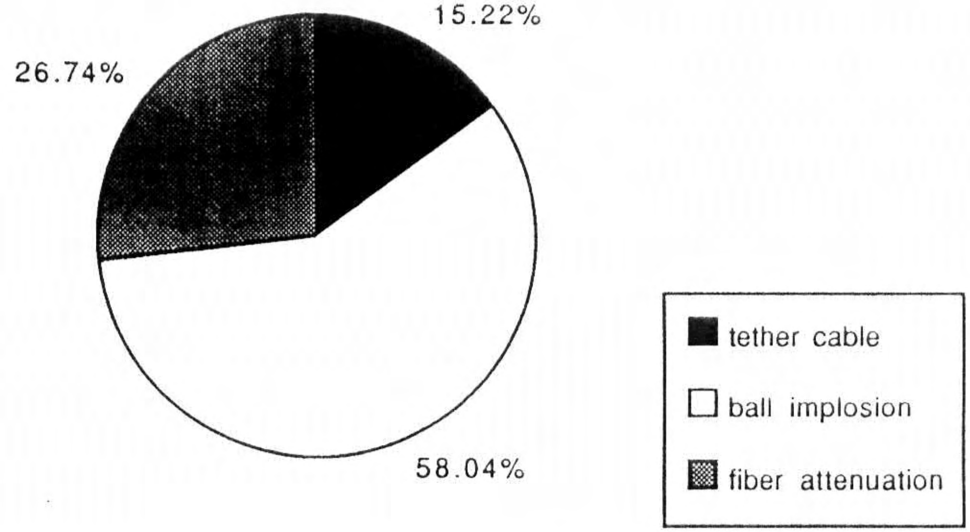




TOTAL CRUISE

KNORR 138-14
TUCHOLKE

AMS 120 & Jason Down Time



KNORR 138-14
TUCHOLKE

APPENDIX VI

<u>1993 ROV Operations</u>

-- Guaymas (Medea/Jason)

- Operations to 2,100 meters
- 13 different vehicle configurations
  - Manipulator
  - Suction sampler
  - Core tubes
  - Entrainment array
  - 200 kHz side scan sonar
  - 675 kHz sector scan sonar
  - Electronic still camera
  - Video plankton recorded
  - Temperature probes
  - Dissolution stakes
  - Exact tracking system

-- ARSRP Mid Atlantic Ridge (AMS 120, Medea/Jason)

- Operations to 3,900 meters with Medea/Jason and 4,400 meters with the AMS120
- Knorr dynamic positioning with P code GPS
- AMS 120 configured with:
  - 120 kHz split beam side scan sonar
  - Magnetometer
  - Doppler sonar
  - Chirp sonar
- Medea/Jason configured with:
  - Doppler sonar
  - Magnetometer
  - Electronic still camera
  - 200 kHz side scan sonar
  - 675 kHz sector scan sonar
  - 300 kHz sector scan sonar

6/14/93

Planned Activities 1993/94

-- Complete Argo II

-- Resolve neutral tether design

-- Operational pressure test of the new manipulator and fiber optic cabling systems

-- Complete Medea/Jason documentation

-- Engineering dock trials of Argo II and Medea/Jason

-- Overhaul of the basic AMS 120 vehicle

6/14/93

Unmanned Systems
Activities 1992/93

-- Completed Medea/Jason rebuild

- Replaced control vans
- Upgraded vehicle propulsion thrusters
- Replaced data logging system
- Replaced Jason surface/subsurface control computers
- Designed and fabricated a new manipulator
- Designed and tested a second generation neutrally buoyant tether cable

-- Argo II

- Preliminary design/specification completed
- Overhaul of specific Argo I components underway

6/14/93

APPENDIX VII

Deep Submergence Status

Organizational Realignment

Extra-WHOI

- DEep Submergence Science Committee (DESSC) replaced ALVIN Review Committee (ARC)
  - Advocacy: Expeditions, ROVs, Technology
- Federal Agencies sign new MOU
  - Acknowledges ROVs, falls short of block-funding

Intra-WHOI Groups

- ALVIN and ROV (ARGO - MEDEA - JASON) Ops

  Practically merged (single funding proposal)
- Deep Submergence "Chief Scientist" hiring underway

ATLANTIS II Sale

AGOR 25 Proposal Strategy

- **Sell ATLANTIS II**
  - **Use proceeds to pay for conversion of KNORR to support ALVIN and ARGO/MEDEA/JASON**
  - **Bring AGOR 25 ("ATLANTIS ") into service as ATLANTIS II numerical replacement**
- **No net increase in UNOLS large ship fleet**
- **ATLANTIS II advertisements/offers are on the street:**
  - **Independent**
  - **Through SeaBeam Instruments Inc.**

Deep Submergence Status
(Continued)

Systems

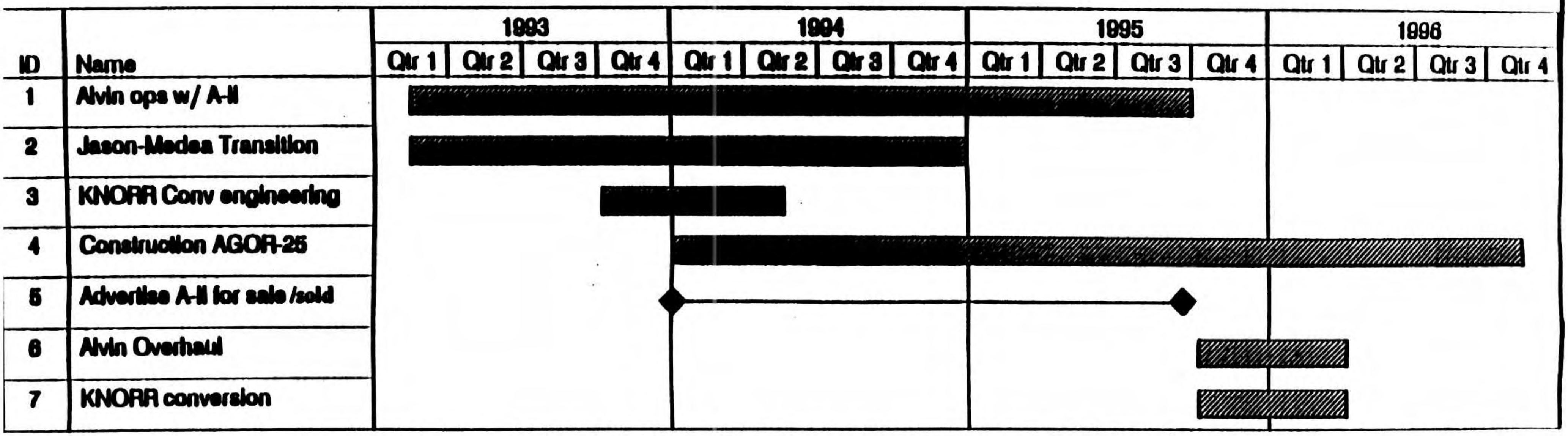
ALVIN	Overhauled - recertified - back in service Schedule prospects bright! Navy Certification Process - Ponderous(er)
JASON (et al) ROV's	"Hardened", acknowledged/funded as part of Deep Submergence Facility Successful Cruises - Guaymos, Mid-Atlantic Ridge - Proposals coming in - Power/flexibility of these tools being recognized/used

ATLANTIS II / KNORR Conversion

	93	94	95	96	97
Advertise ATLANTIS II for Sale	----------	----------			
ALVIN				<u>Overhaul</u>	
KNORR		<u>Design</u>		<u>Conversion</u>	
AGOR 25		-----	Construction	--------	

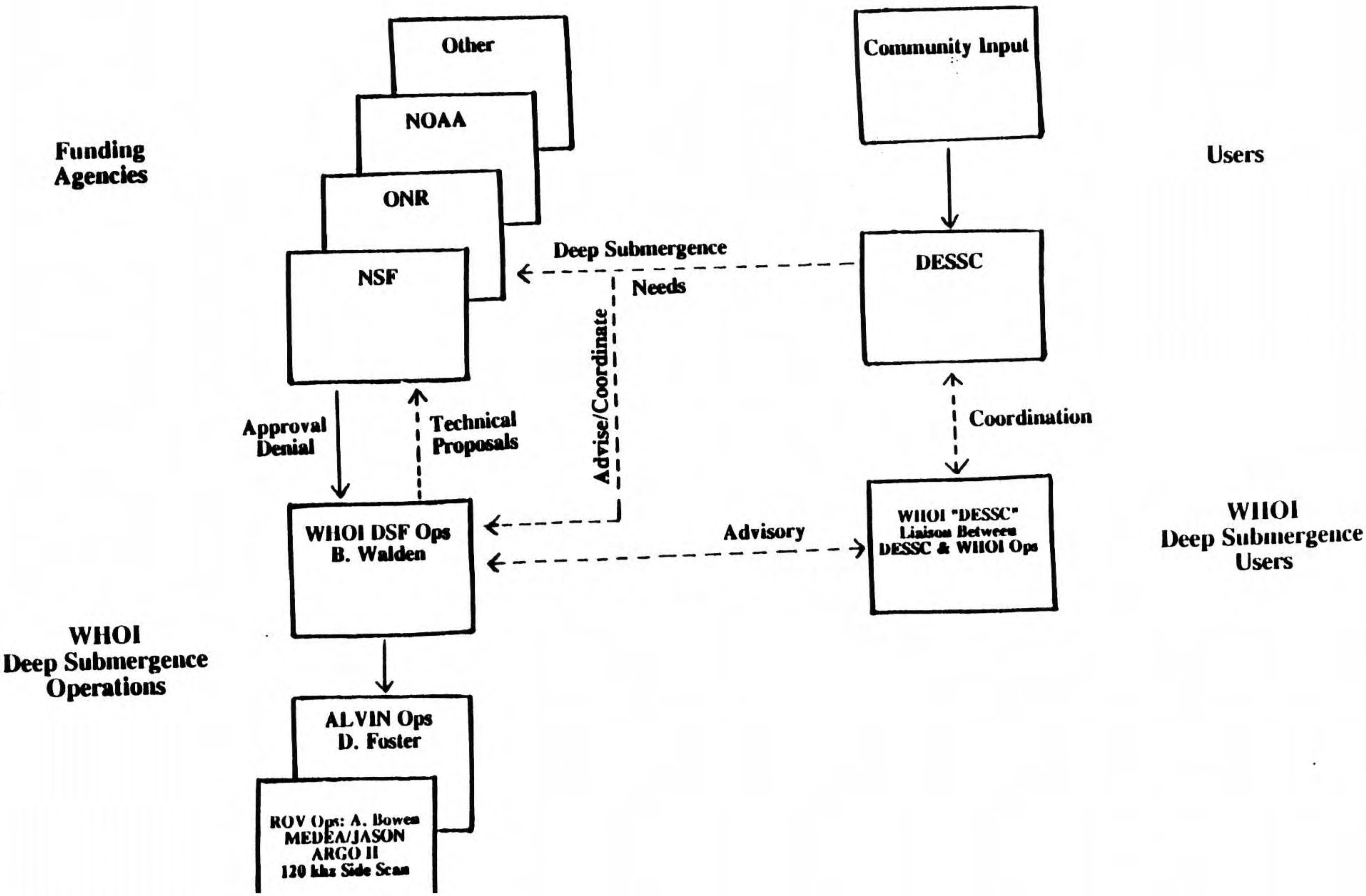
(Tentative)

SCHEDULE FOR TRANSITION OF WHOI DEEP SUBMERGENCE FACILITY



Deep Submergence Facility

Functional Relationships
Between DESSC, WHOI & Funding Agencies



APPENDIX VIII

DEEP SUBMERGENCE SCIENCE COMMITTEE

WOODS HOLE OCEANOGRAPHIC INSTITUTION

14 JUNE 1993

U.S. NAVY DEEP SUBMERGENCE

- CURRENT STATUS
- RECENT OPERATIONS
- FUTURE OPERATIONS
- VISION FOR FUTURE

U.S. NAVY DEEP SUBMERGENCE

CURRENT STATUS

- SEA CLIFF - RAV UNTIL OCT 93
- TURTLE - OPERATIONAL, START RAV IN OCT 93
- ATV AND TUWVS - OPERATIONAL
- NR-1 - OPERATIONAL
  - NEW SUPPORT SHIP (APR 94)

U.S. NAVY DEEP SUBMERGENCE

RECENT OPERATIONS

- GUAYMAS BASIN (FEB 20-MAR14)
  LANEY CHOUEST/TURTLE/JASON

- IN SUPPORT OF JASON IV PROJECT
  DR. ROBERT BALLARD - LEADER
  21 SCIENTISTS AFLOAT/ASHORE

- JASON/SATELLITE LINK

- 15 TURTLE DIVES

U.S. NAVY DEEP SUBMERGENCE

RECENT OPERATIONS

- NR-1 OVERHAUL COMPLETED FEB 93 UPGRADES INCLUDE:
  - NEW REACTOR CORE
  - DS/OAS SONAR
  - CVL SONAR
  - ESC AND PAN & TILT UNIT
  - NEW BOW

- GULF OF MEXICO SCIENCE OPS

U.S. NAVY DEEP SUBMERGENCE

FUTURE OPERATIONS

- TURTLE PACNORWEST (AUG 93)
- SEA CLIFF - SPRING/SUMMER 94
- NR-1 - SPRING/SUMMER 94

U.S. NAVY DEEP SUBMERGENCE

VISION FOR FUTURE

- LEVEL FUNDING
  - IMPROVE RELIABILITY
  - NO NEW TECHNOLOGY DEVELOPMENT

- IMPROVE SCIENTIFIC USE
  - USN/NURP ARRANGEMENT
  - EXPLORING POSSIBILITY OF PERMANENT TECHNICIANS
  - DEVELOP USERS MANUAL
  - COMPATIBLE EQUIPMENT

U.S. NAVY DEEP SUBMERGENCE

VISION FOR FUTURE

- USN "NICHE"
  - SEA CLIFF > 4,000 METERS
  - DEEP WATER ROVs
  - BROAD AGENCY SUPPORT
    - -- ENVIRONMENTAL SURVEYS
    - -- TECHNOLOGY DEMONSTRATION
    - -- UNDERWATER WORK TASKS
  - UNIQUE NR-1 CAPABILITIES

- EXPAND SCIENCE SUPPORT TO 120 DAYS

U.S. NAVY DEEP SUBMERGENCE

VISION FOR FUTURE

- OPERATIONS PRIMARILY IN THE PACIFIC

- COORDINATION WITH DESSC

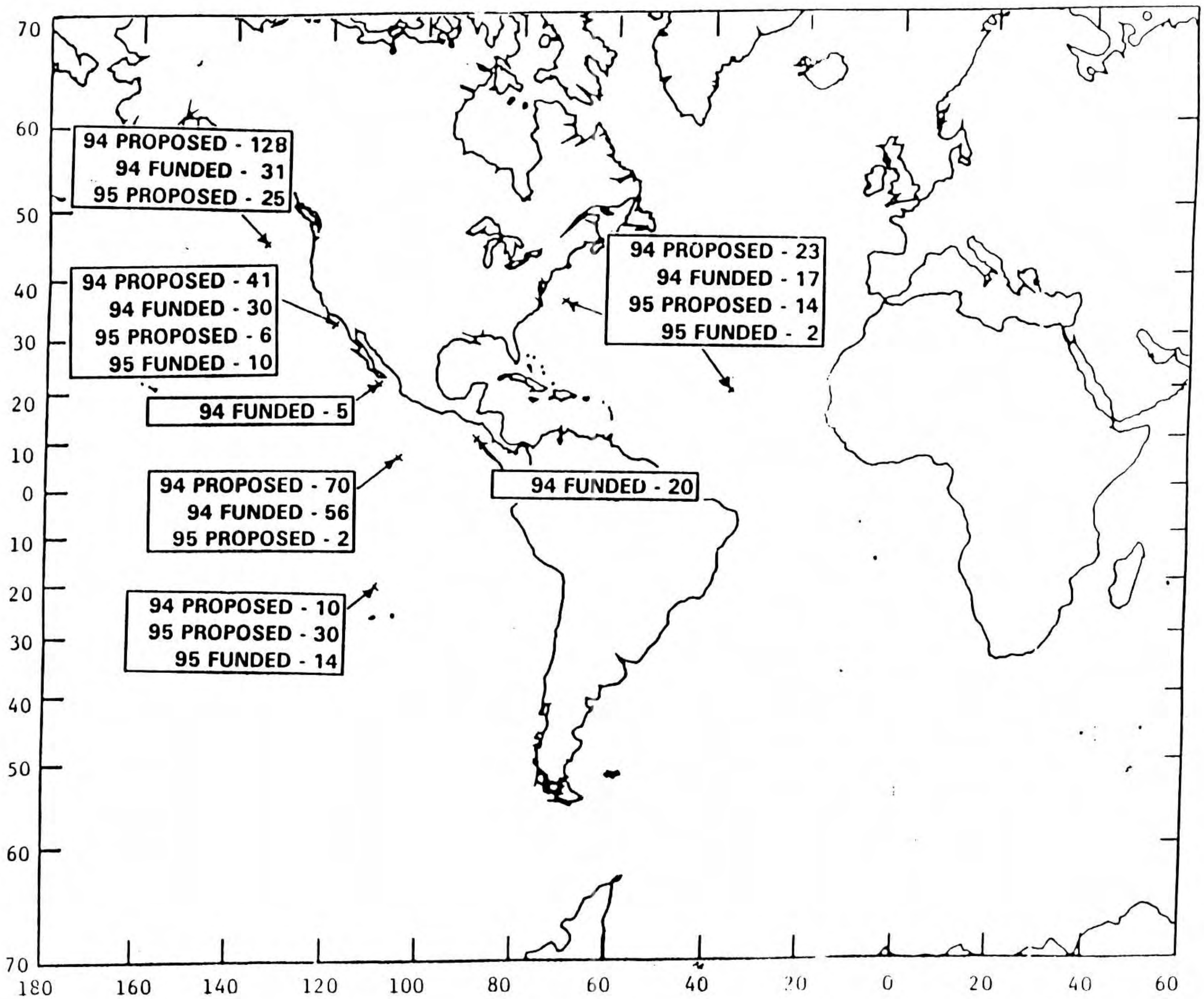
APPENDIX IX

ALVIN REGIONAL SUMMARY - 1994

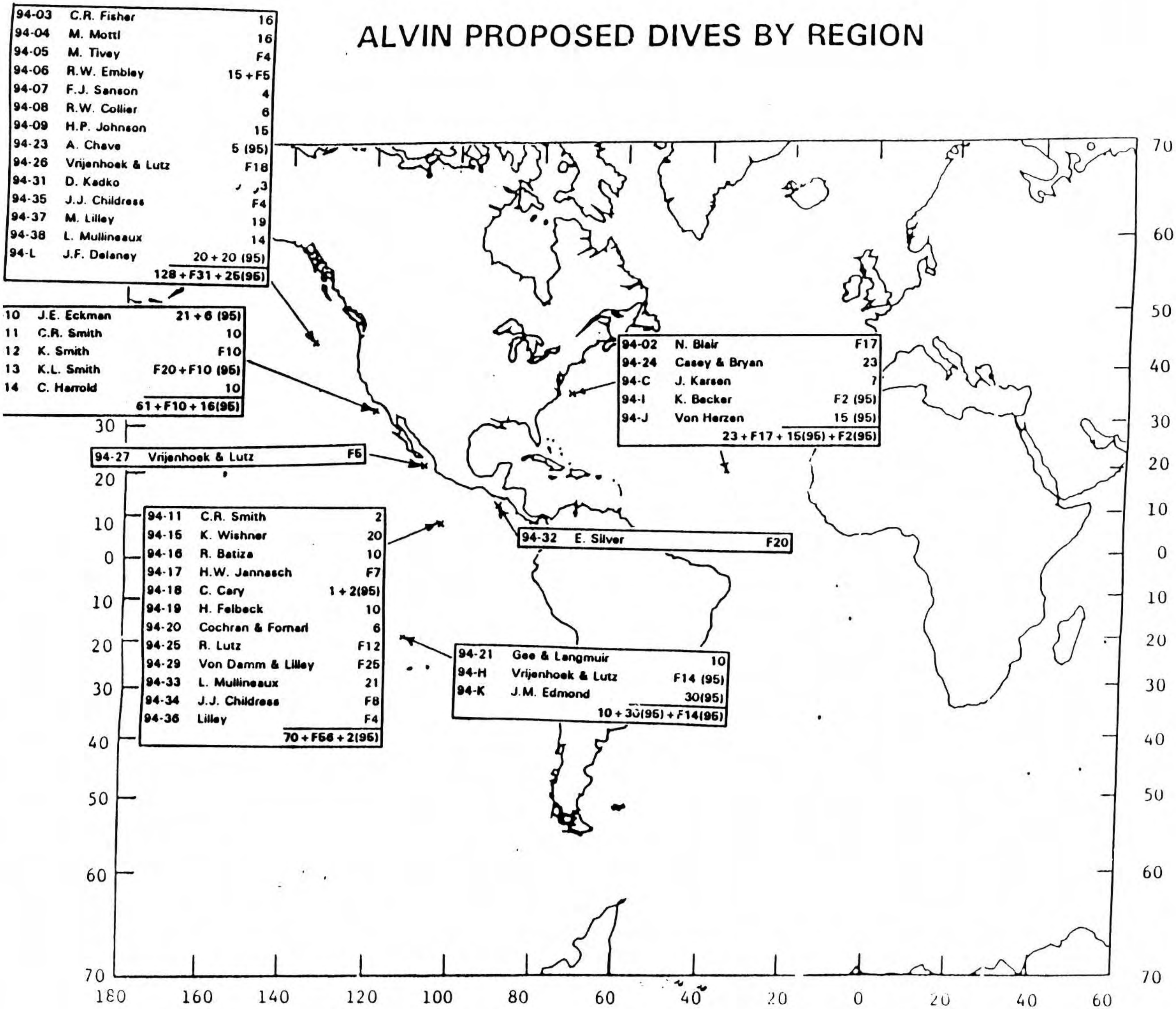
#	Investigator	Disc.	1994 Proposed Dives	1994 Funded Dives	1995 Proposed Dives	1995 Funded Dives
ATLANTIC:						
94-02	N. Blair	B & C		17		
94-24	Casey & Bryan	G&G	23			
94-C	J. Karsen		?	?		
94-I	K. Becker	G&G				2
94-J	R.P. Von Herzen	G&G			14	
	Total		23	17	14	2
JUAN DE FUCA:						
94-03	C.R. Fisher	Biol	16			
94-04	M. Mottl	B & C	16			
94-05	M. Tivey	G&G		4		
94-06	R.W. Embley	G&G	15	5		
94-07	F.J. Sanson	GChem	4			
94-08	R.W. Collier	G&G	6			
94-09	H.P. Johnson	G&G	15			
94-23	A. Chave	Biol			5	
94-26	Vrijenhoek & Lutz	Biol		18		
94-31	D. Kadko	G&G	3			
94-35	J.J. Childress	B & C		4		
94-37	M. Lilley	Multi	19			
94-38	L. Mullineaux	Biol.	14			
94-L	J.F. Delaney	G. & C	20		20	
	Total		128	31	25	0
MONTEREY/SAN DIEGO:						
94-10	J.E. Eckman	Biol	21		6	
94-11	C.R. Smith	Biol	10			
94-12	K. Smith	Biol		10		
94-13	K.L. Smith	Biol		20		10
94-14	C. Harrold	Biol	10			
	Total		41	30	6	10

#	Investigator	Disc.	1994 Proposed Dives	1994 Funded Dives	1995 Proposed Dives	1995 Funded Dives
GYAMAS BASIN:						
94-27	Vrijenhoek & Lutz	Biol		5		
	Total		0	5	0	0
OFF COSA RICA:						
94-3	E. Silver	G&G		20		
	Total		0	20	0	0
NORTHERN EAST PACIFIC RISE:						
94-11	C.R. Smith	Biol	2			
94-15	K. Wishner	Biol	20			
94-16	R. Batiza	G&G	10			
94-17	H.W. Jannasch	Biol		7		
94-18	C. Cary	Biol	1		2	
94-19	H. Felbeck	Biol	10			
94-20	Cochran & Fornari	G&G	6			
94-25	R. Lutz	GC & B		12		
94-29	Von Damm & Lilley	G&G		25		
94-33	L. Mullineaux	Biol	21			
94-34	J.J. Childress	B & C		8		
94-36	Lilley	B & C		4		
	Total		70	56	2	0
SOUTHERN EAST PACIFIC RISE:						
94-21	Gee & Langmuir	G&G	10			
94-H	Vrijenhoek & Lutz	Biol				14
94-K	J.M. Edmond	Chem			30	
	Total		10	0	30	14
	GRAND TOTAL:		272	159	77	26

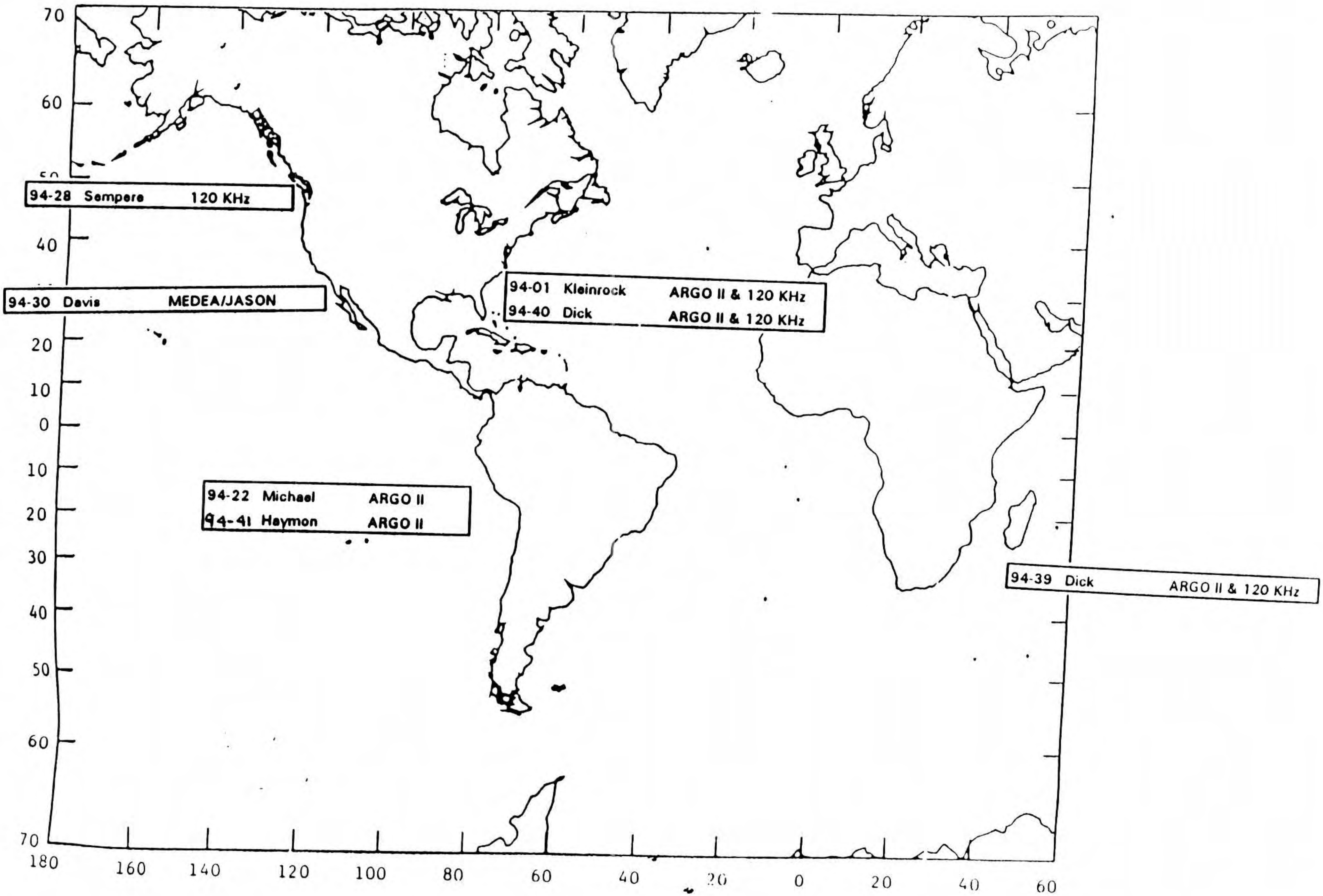
ALVIN PROPOSED DIVES BY REGION



ALVIN PROPOSED DIVES BY REGION



ROV PROPOSALS BY REGION



	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.

Investigator Associates Area Purpose Sponsor Date Alternate Dives Remarks Disc.

ALVIN PROPOSALS:

TLANTIC:

	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.
-02	N. Blair, NCSU	L. Levin, SIO D. DeMaster, NCSU	1) 32 52'N, 76 27'W 2) 35 23'N 74 50'W	The fate of algal carbon in continental slope sediments: A multi-tracer experiment.	NSF FUNDED	1) May 94 2) Aug 94	1) Jun 94 2) Sep 94	1) 11 2) 6		Biol & Chem
-24	J.F. Casey, U. Houston W. Bryan, WHOI	R. Hekinian H. Bideau P. Meyer	33 20' - 34 N, 38 40' - 38 30'W	Detailed mapping and sampling of Magma starved and Magma - productive second order Ridge Segments to the North and South of the Hayes Transform: A FARA ALVIN/NAUTILLE Joint submersible program.	NSF RIDGE MG&G	Jun-Jul 94-95	Jul-Aug 94-95	23		G&G

JAN DE FUCA RIDGE/GORDA RIDGE:

	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.
03	C.R. Fisher, Penn. State	K. Juniper, U. Montreal I. MacDonald, TAM V/ Tunnicleffe, U. of Victoria F. Williams, Penn S.	N. Cleft Segment of the Juan de Fuca Ridge 130 10' W x 45 N to	Modeling energy flow in a deep-sea autotrophic community." The project involoves detailed video mosaicking, determining rates of tubeworm growth, microbial productivitiy rates, chimney productivity, and integration of the above into a model of energy flow.	NSF	Jul-94	Aug-94	16		Biol.
04	M. Mottl, SOEST	C.G. Wheat, UH E. Baker, NOAA E. Davis, PGC R. Thomson, Canad V. Tunnicliff, U. Victoria M. Whiticar, U. Victoria	Eastern flank of Juan de Fuca Ridge Within 10 km of 47 47'N 127 44'W	Hydrothermal venting through outcrops on the eastern flank of the Juan de Fuca Ridge near 48 N: a manned-submersible study. Heat flow, coring for pore waters, temperature and flow velocity of springs to estimate fluxes. Sampling of rocks, deposits, organisms.	NSF 9314632	Jun - Sep 1994		16		Chem thermal Biol
05	M. Tivey, WHOI	A.M. Bradley, WHOI	Cleft Segment, Juan de Fuca Ridge 45 N, 130 W	Development of a versatile thermocouple/ thermistor array package for monitoring temperature at hydrothermal vent sites. Proposal to test the two instruments (deploy and recover them) using ALVIN in 1994.	NSF RIDGE/ MG&G FUNDED 94-014	July to early Sep-94	Jun-94	4	Would prefer dives to be added to C. Fisher's or R. Embley's	G&G

REVISED 6/10/93

ALVIN and ROV Proposals - 1994

	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.
5	R.W. Embley, NOAA	J. Lupton, NOAA R. Feely, NOAA E. Baker, NOAA B. Chadwick, OSU R. Koski, USGS G. Mossoth D. Butterfiled, JISAO V. Tunnicliffe M. Perfit J. Trefry D. Kadko M. Lilley	Cleft Segment, Juan de Fuca Ridge 44 50' - 45 10' N, 130 10'-130 16'W	Temporal and geologic studies at the North Cleft Segment: RIDGE Observatory Experiment (ROBE) Site.	NOAA & NSF funded 5 days for Trefry	July-Aug 1994	June or Sept 1994	15 +5		G&G, Chem
7	F.J. Sansone, UH	Other ROBE investigators	North Cleft, Juan de Fuca: 44 58' N, 130 13' W	In-Situ Hydrogen Measurements at Ridge Crest Hydrothermal Vents" - As part of the RIDGE Observatory Experiment (ROBE), we propose to deploy an in-situ sensor for continuous measurement of H2 emanating from diffuse vents.	NSF MGG	Summer 1994		4		Geo- Chem
3	R.W. Collier, OSU	G. Klinkhammer, OS M. Lilley, UW K. Von Damm, UNH	Northern Gorda Ridge: 42 45.3'N 126 42.47'W	Studies of Off-Axis Hydrothermal Venting on the Northern Gorda Ridge.	NSF MG&G 9314712	Jul-Sep 1994	Jun-Oct 1994	6	Require scheduling after NOAA dive to JDR to allow use of manifold sampler.	G&G
9	H.P. Johnson, UW	M.L. Holmes, USGS	Juan de Fuca/ Gorda Ridge 44 20'N, 130W 43 06'N, 127W 41 N,127 30'W	An Experimental Determination of the Density of Upper Oceanic Crust as a Function of Depth.	NSF MG&G 9314276	Jul,Aug 1994	Jun - Sep 1994	15		G&G
3	A. Chave, WHOI	C.L. Van Dover, WHOI J. A. Tyson, AT&T	Juan de Fuca: Endeavor Segment 47.8N, 129.2W	Ambient Light Imaging and Spectral System. Test/ initial science for ambient light imaging CCD camera system.	NSF	Jul-Aug 1995	Jun 95 or Sep-95	5		Biol
5	R.C. Vrijenhoek R. A. Lutz Rutgers		1) Juan de Fuca 2) Gorda Ridge 3) Oregon Subduction Zone	Gene Fow, Dispersal, and Systematics of Deep-Sea Hydrothermal Vent Organisms.	NSF FUNDED OCE 9302205	early 1994	mid 1994	1) 6 2) 6 3) 6	Requests that all 18 dives be combined as one cruise.	Biol.
1	D. Kadko		Juan de Fuca N. Cleft Segment 45 N, 130 10' W	Radioisotopic Studies of Temporal Variability of hydrothermal circulation on the North Cleft Segment, Juan de Fuca Ridge.	NSF MG&G 9314564	Summer 1994		3	This work is to be piggy-backed with other dives to this area. Trefry is a likely candidate.	G&G

	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.
35	J.J. Childress, UCSB	R. Lutz	Northeast Pac. same sites as Lutz	Studies on the Physiological Ecology of Hydrothermal Vent Chemoautotrphic Symbioses.	NSF FUNDED 9301374	Summer 1994		4	Dives to be combined with those of Lutz and Vrijenhoek.	Biol & Chem
37	M. Lilley, UW	C.G. Wheat, UH M. Mottl, UH R. Zierenberg, USGS J. Franklin, CGS J. Lupton, NOAA K. Juniper, U Quebec K. Becker, U. Miami E. Davis, PCG	Juan de Fuca, Middle Valley 48.5 N, 129 W	Chemical, Thermal, Geological and Biological Studies Using a Manned Submersible at the Middle Valley Vent Fields, Juan de Fuca Ridge.	NSF G&G 9314875	Jul-Sep 1994		19		Multi
38	L. Mullineaux, WHOI	P. Wiebe, WHOI	Juand de Fuca: 44 36' - 44 50'N 130 17' -26' W	Dispersal and Dynamics of Planktonic Organisms in Hydrothermal Vent Plumes. Program involves sampling plankton and conducting experiments in vent plumes.	NSF RIDGE 9019575	Aug-94	weather window	14		Biol.

ONTEREY/SAN DIEGO:

	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.
10	J.E. Eckman, Skidaway	D. Thistle, Florida State U.	San Diego Trough 32 51'N 117 46'W	Experimental investigation of the impact of predation by large, motile epifauna on microfauna and meiofauna in deep sea sediments. ALVIN will be used to deploy predator exclusion and inclusion cages on the floor of San Diego Trough, and to sample interiors (plus controls) over time.	NSF Biol. 9300908	Sep-94 Nov-94 Mar-95	9/94 - 12/94 2-4 mo.after (4-6 mo after (	15 6 6		Biol
11	C.R. Smith, UH	9 N: R. Vrijenhock R. Lutz L. Mulleneaux California: J. Deming S. Macko	EPR: 9 50' N, 104 17'W Calif: Site 1- 33 12'N,118 30'W Site 2 - 32 26'N, 118 9' W Site 3 -13 6'N, 117 43.5'W	Chemosynthetic communities on deep-sea whale falls: development, persistence and vent fuana colonization.	NSF Biol. 9314807	early 1994	first half 1994	2 on EPR Calif: (1) 4 (2) 4 (3) 2 12 total		Biol.
12	K. Smith, SIO	C.E. Reimers	(1) 33 14'N, 118 37'W (2) 34 50' N, 123 W	A bottom-transecting instrument for making long time-series measurements of sediment community oxygen consumption and other parameters to abyssal depths.	NSF FUNDED OCE 91- 15393	(1) Apr 94 (2) Jul 94		(1) 5 (2) 5		Biol.

	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.
13	K.L. Smith, SIO	A.F. Carlucci C.E. Reimers P.M. Williams E.R.M. Druffel J. Bauer, FSU	34 50'N, 123 W	Temporal variations in the deep-sea benthic boundary layer communites, long time series measurements.	NSF FUNDED OCE-9217334	Sept 1994 Nov 1994 Feb 1995		10 10 10		Biol.
14	C. Harrold, MBARI	B. Robison, MBARI G. Greene, USGS C. Baxter, Stanford J. Barry, MBARI G. Matsumoto, MB H. Jannasch, MBARI	Monterey Submarine Canyon 36 23' N 122 53' W	Investigations of Cold Seep Communities in the Monter Submarine Canyon System. Cold sulfide seep communities were discovered in Oct. 1988 but we know little or nothing about the geochemistry of their habitats, their biology, or ecology. Questions demanding attention include source of of the sulfides; migration of bivalves to and from the seeps; characterization of and variation in the communtities; nutrition of community members; genetics of CALYPTOGENA populations.	NSF	Sep-Oct 1993	Sep - Oct 1994	10		Biol

AYMAS BASIN

	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.
7	R.C. Vrijenhoek R. A. Lutz Rutgers		Gyamas Basin	Gene Fow, Dispersal, and Systematics of Deep-Sea Hydrothermal Vent Organisms.	NSF FUNDED OCE 9302206	early 1994	mid 1994	1) 5		Biol.

F COSTA RICA

	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.
12	E. Silver, UCSC	M. Langseth J. Gieskes D. Orange K. Brown L. Abbott L. Kahn J. Galewsky	Offshore Costa Rica 9.5 - 10 N, 85.8 - 86.2 W	Fluid Flow Paths in the Costa Rica Accretionary Wedge.	NSF FUNDED 9301554	Feb-Mar 1994	Any	20	9 dives are proposed for water depths of 4300 meters	G&G

RTHERN EAST PACIFIC RISE

	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.
5	K. Wishner, URI	R. Findlay M. Gowing, UCSC D. Hebert D. Kester, URI L. Levin, SIO C. Turley, PML (UK)	Volcano 7, 13 23' N 102 27' W	OMZI- Effects of the Oxygen Minimum Zone on the Fate of Particulate Organic Matter. Outline: A study of benthic and pelagic processes esp. at the lower OMZ boundary in the Eastern Pacific.	NSF Biol	Mar-May 1994	Feb-94	20		Biol

ALVIN and ROV Proposals - 1994

	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.
94-16	R. Batiza, U Hawaii	G.P.L. Walker, UH S. Self, UH L. Wilson, UH D. Bercovici, UH J.D.. White, U NZ G. Parker, U Minn.	Seamount 6 12 44'N 102 35'W 150 km east of EPR axis	Dynamics of Basalt Eruptions in the Deep Sea. A detailed study of eruptive hyaloclastite deposits with ALVIN.	NSF 9314288	late 1994	early 1995	10		G&G
94-17	H.W. Jannasch, WHOI	C. Wirsen, WHOI S. Molyneaux, WHO R. Huber, U. Regens J. Childress, UCSB R. Lutz, Rutgers K. Stetter, U. Regensburg D. Nelson, UCD	EPR 9 N, 104 W (11 & 13 N EPR also acceptable)	Microbial transformations at Deep-Sea Hydrothermal Vents. Studies on the high diversity of chemosynthetic microbial populations and processes. In 1994 at EPR focus on "young" vent sites and temporal changes.	NSF FUNDED OCE-9200458	Spring 1994	Summer 1994	7	Part of the RIDGE progra	Biol.
94-18	C. Cary, OSU	J. Stein, Agouron Inst.	EPR 13 N site: 12 48' N x 103 56' W	A molecular dissection of an epibiotic symbiosis in a highly thermotolerant metazoan - To determine the functional role of epibiotic bacterial microflora associated with the pompeii worm, Alvinella pompejana.	NSF	Apr-94 Apr-95	Open	1 2	The proposal is submitted as an ancillary project to the Lutz funded work.	Biol.
94-19	H. Felbeck, SIO	C. Fisher, Penn St. R. Lutz, Rutgers J.J. Childress, USC D. Desbruyeres, IFREMER	EPR: 9-10 N and/or 13 N	Carbon fixation and nitrate respiration in the Hydrothermal vent tubeworm Riftia pachyptila. Shipboard experiments and in situ measurements.	NSF RIDGE	fall 94	spring 94	10	support ship needed for lab setup & add. researchers.	Biol
94-20	J.R. Cochran & D.J. Fornari, LDEO	B.J. Coakley	Crest of EPR: 9-10 N, 104 15' W	Near-bottom gravity measurements and scanning sonar bathymetry from the submersible ALVIN: Keys to understanding MOR shallow crustal structure and distribution of dikes on the EPR crest at 9 31' N and 9 50' N.	NSF MGG	Feb - Jun 1994	any time	6		G&G
4-25	R. Lutz, Rutgers	R. Hessler, SIO D. Fornari, LDGO R. Haymon, UCSB D.M. Desbruyeres France P.A. Tyler, United Kingdom	EPR 9 45' to 9 52'N	Temporal changes in biological community structure and assoicated geological features at newly-formed hydrothermal vents along the East Pacific Rise Crest.	NSF- RIDGE FUNDED * OCE 9217026	Nov-94	May-94	12	Requests that the 4 funded Lilley/VonDamm dives be added to this cruise.	Geoche Biol
[illegible]	[illegible] L. Von Damm, UNH M.D. Lilley, UW	M.R. Perfit, UF R.M. Haymon, UW D.J. Fornari, LDGO K.C. MacDonald, UCSB	9 16' N - 10 5' N at 104 W EPR	Temporal evolution of hydrothermal, volcanic, and geologic properties of the EPR 9-10 N following the 1991 eruption.	NSF FUNDED OCE-9300508	Jan-94	later 1994	25	Avoid July-October as hurricane season 2800 m max depth	G&G

	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.
94-33	L. Mullineaux, WHOI	C.H. Peterson C. R. Risher	EPR: 9 50' N	Roles of Larval Settlement, Species Interactions and Physiological Adaptations During Colonization of Hydrothermal Vents. Program involves in-situ manipulation of recruitment plates in vent habitats.	NSF 9315554 RIDGE	winter & spring 1994		21 (2 Cruises)	second cruise should follow 1st by approx 4 months.	Biol
94-34	J.J. Childress, UCSB	D. Desbruyeres, IFREMER	EPR: 12 48-50' N x 103 56-58' W and 9 N site	Studies on the Physiological Ecology of Hydrothermal Vent Chemoautotrophic Symbioses.	NSF FUNDED 9301374	Spring or Fall 1994		8	Dives are to be coordinated with Lutz & Von Damm. Avoid hurricane season. Second ship requested.	Biol, & Chem
94-36	M.D. Lilley, UW	K.L. Von Damm	EPR: 9 50' N 104 17' W	Coupled Temporal Changes in Water Chemistry and Biological Community Structure at Newly-Formed Hydrothermal Vents on the EPR Crest.	NSF FUNDED 9302606	add to Lutz leg	3 + Lutz contigent	4	Dives to be added to Lutz cruise.	Biol & Chem

SOUTHERN EAST PACIFIC RISE:

	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.
94-21	J.S. Gee & C.H. Langmuir, L-DEO	S.P. Miller, UCSB	Southern EPR 19.5 S, 113.5 W	Alteration and the Central Anomaly Magnetic High: Implications for Ridge Crest Processes sampling, magnetic properties and geochemistry of samples form 19.5 d S on EPR.	NSF RIDGE 9314627	May-94	as schedule permits	10		G&G, Geo-chem

ROV PROPOSALS:

	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.
94-01	M.C. Kleinrock, WHOI	S.E. Humphris, WH G. Thompson, WHO	MAR- TAG Seg. 26 10' N, 44 50' W	Relations between Volcanism, Tectonism and Hydrothermalism along the TAG Segment of the Mid-Atlantic Ridge. (A nested survey using the DSL-120 and ARGO II as a site survey prior to TAG drilling.)	NSF ODP	prior to Sep-94		32 days on site	ARGO II and 120 Khz	G&G
94-22	P.J. Michael, U. Tulsa	D. Fornari, LDGO M.R. Perfit, U. Flori	Southern EPR: 8-9 S, 7-9 S, 107 30'-108 10'W	Petrologic and Morphologic Study of a Giant Lava Field at 8 S, EPR: A Snapshot of a Magma Chamber? Mapping, imaging and sampling of a 220km lava flow using ARGO II, rock coring & dredging: (transponders in place).	NSF MG&G RIDGE	Nov/Dec 1994	Oct 94 to Mar-95	14.5 days	ARGO II Proposal	G&G
94-28	J.C. Sempere, UW	J. Pariso K. Stewart D. Engebretson	Juan de Fuca: Cleft Segment 45 N, 130 W	A High-Resolution Optical and Acoustic Study of the RIDGE Seafloor Observatory, Southern Juan de Fuca Ridge.		May 94 to Oct-94			120 Khz	G&G
94-30	C. Davis, WHOI	S.M. Gallager, WHOI	Off San Diego 31-32 N, 118-120 W	In situ quatification of zooplankton aggregation mechanisms sound-scattering properties, and behavioral responses to sound.	NUWC	Apr-May 1994	Mar-Apr or Jun		MEDEA/JASON	Biol
94-39	H. Dick	H. Kleinrock, WHOI M. Tivey, WHOI G. Hirth, WHOI P. Robinson, J. Franklin, M. Salisbury, J. Malpas, Canada	SW Indian Ridge 57 10' - 57 20' E 32 35' - 32 55' S	"The Plutonic Foundation of A Very Slow-Spreading Ridge" ODP Site survey at the ATLANTIS II F.Z. using a sidescan (AMS 120) & Canadian ROV of a 30 km2 wavecut platform exposing plutonic basement around the location of Site 735 B. Program will include deep-towed magnetomenter.	NSF ODP				120 Khz	G&G
94-40	H. Dick	D. Fornari, WHOI J. Casey P. Kelameir S. Hall	MAR: 15 40' - 14 55' N 44 50' - 46 50' W	A SIDESCAN SONAR SURVEY of the MAR at 15 N. High resolution AMS 120, ARGO and magnetics survey of the MAR N & S of the 15 20' F.Z.	NSF MG&G RIDGE 9315702				120 Khz ARGO II	G&G
94-41	Haymon/ Macdonald		Southern EPR 17 - 18 S	Hydrothermal Vent Distribution Along the Axial Zone of the Ultrafast-Spreading EPR at 17-18 S: A Near-Bottom Fiber Optic Photo/Acoustic Survey using ARGO II.	NSF RIDGE	Fall 1994	Winter 1995	25 days	ARGO II	G&G

LETTERS OF INTENT AND/OR REQUESTS (WITHOUT PROPOSALS)

Mid Atlantic Ridge:

	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.
94-A	C.H. Langmuir LDEO	D. Fornari D. Colodner K. Von Damm S. Humphris M. Tivey C. Van Dover D. Desonie	MAR: Lucky Strike site	If 1993 dives to this new hydrothermal site are successful, a proposal for additional dives will most likely be submitted for the November 1, 1993 deadline.	NSF				Possible collaboration with French investigators.	G&G Biol
B	S. Humphris, WHOI	long list	MAR: TAG site 26 N	Variability in the structure, fluid chemistry, mineralogy and biology of the active TAG hydrothermal mound caused by drilling.	NSF	Mar - May 1995		20	Needs to be coordinated with drilling schedule.	G&G Chem Biol
94-C	J. Karsen		MAR	In 1994, Jeff Karsen's dive program was cut short because of ALVIN's mechanical problems. It is anticipated that additional dives will be needed in 1994						
94-I	K. Becker, U.Miami	E. Davis, PGC	TAG: 26 08'N, 44 49' W and Hole 395A 22 45'N, 46 05'W	Recovery of Data/Fluid Samples from Instumented ODP Bore Holes at TAG Hydrothermal field and Hole 395A	NSF FUNDED 9301995 ODP	Spring/ Summer 1995	Spring/ Summer 1996	2		G&G
94-J	R.P. Von Herzen, WHOI	A. Schultz, UW C. Van Dover, WHOI J. Edmond, MIT D. Kadko, U.Mia	TAG: 26 08'N, 44 49' W	The TAG Hydrothermal Site (Mid-Atlantic Ridge): Monitoring Temporal Variability and the Effect of Drilling.	NSF 9314542	Jan-Mar 1995	1995	14		G&G

Juan de Fuca:

	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.
94-D	M. Tivey, WHOI		Juan de Fuca: Cleft Segment	Monitoring Temperature at hydrothermal vent sites Deployment and Recovery of instruments.		1) May-Jul 1995 2) late 95		2		Biol Chem
[illegible]	F. Sansone		Juan de Fuca: Nothern Cleft Segment and Monolith	In-situ Hydrogen Measurements at Ridge Crest Hydrothermal Vents.				4		Chem

ALVIN and ROV Proposals - 1994

	Investigator	Associates	Area	Purpose	Sponsor	Date	Alternate	Dives	Remarks	Disc.
94-L	J.R. Delaney	R. McDuff M. Lilley D. Butterfield V. Robigou J. Deming R. Thomson M. Hannington K. Juniper A. Schultz J. Baross	Juan de Fuca Endeavour Seg 47 N, 129 W	Detailed mapping and Sampling of vent field to establish high-resolution spatial definition of co-variation in fluid chemistry and geological environment; testing and deployment of temperature salinity probes.	NSF	Jul & Aug 1994 1995	Jun & Sep 1994 1995	20 20	Will submit proposal	Geol Chem
North East Pacific Rise										
94-F	Lilley Von Damm R. Lutz Fornari Haymon Hessler		EPR: 9 50' N	Cruise Planning Memo: Science and Coordination for Lutz et al. and Lilley/Von Damm Programs - EPR 9 50'N for 1993&1994 ALVIN Diving Programs.	NSF	1993 & 1994		2 in 1993	Dives to be added onto Lutz 1993 dive program	multi
Southern East Pacific Rise										
94-G	M. Tivey, WHOI S. Humphris		EPR: 17 S and 22 S	Studies of the Mineralogy and Geochemistry of Hydrothermal deposits between 17 S and 22 S on the East Pacific Rise.		1995		15		Geo Chem
94-H	R.C. Vrijenhoek R. A. Lutz Rutgers		EPR: 17S and 22S	Gene Fow, Dispersal, and Systematics of Deep-Sea Hydrothermal Vent Organisms.	NSF FUNDED OCE 9302205			14	The request has not been submitted because it is believed that ALVIN will not be in region until 1995.	Biol.
94-K	J.M. Edmond, MIT	J.G. Schilling, URI R. Poreda, Perdue M. Lilley, UW H. Elderfield, UK	Southern EPR Easter Island and vicinity	Hydrothermal Studies on the Easter Microplate.	NSF 9312950	Austral Summer 1995		30		Chem

APPENDIX X

PRELIMINARY

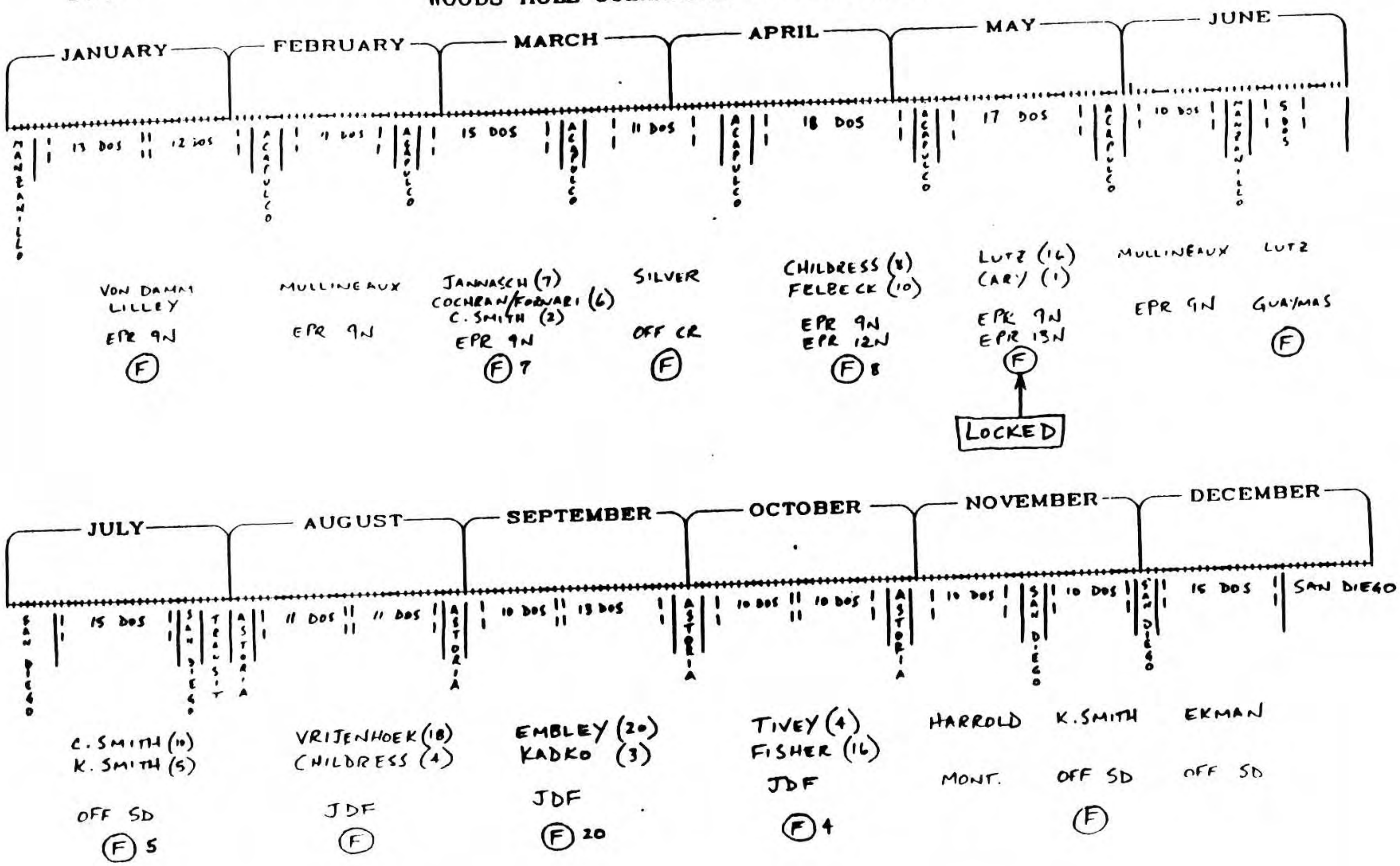
– DRAFT –

R/V ATLANTIS II & ALVIN OPERATIONS

1994

OPERATIONAL SCIENTIFIC SERVICES
WOODS HOLE OCEANOGRAPHIC INSTITUTION

107 DIVES AT EPR
5 DIVES AT GUAYMAS
40 DIVES OFF SD
10 DIVES OFF MONTEREY
65 DIVES AT JDF
227 TOTAL



APPENDIX XI

UNIVERSITY OF WASHINGTON
SEATTLE, WASHINGTON 98195

School of Oceanography, WB-10

June 10, 1993

Mr. Jack Bash, UNOLS Committee
Dr. Jeff Fox, Chair
DESSC
University of Rhode Island
Kingston, Rhode Island

Dear Jeff:

I have attached material related to the ROBE activities in the NE Pacific based on the meeting conducted here in Seattle last February. These timelines bear on the intended use of Alvin over the coming several years, although I suspect as with all workshop products the values listed below err on the enthusiastic side in terms of timing and amount of dive time requested. Not all of these projected needs will translate directly into formal dive requests on a precise time table, nevertheless it is clear that there will be a significant demand level for Alvin within the NE Pacific to work on the Cleft Segment as well as other sites, in the coming half decade.

For simplicity I summarize the projected usage of Alvin below by the three groups involved in the workshop:

	1994	1995	1996
Segment Scale	13 dives Sub or ROV	4 dives Sub or ROV	4 Sub 20 ROV
Vent/Hydroth	61 dives Alvin time	64 dives Alvin time	30 dives Alvin time
Water Column	20 dives Alvin time	20 dives Alvin time	no estimate

I have also included a brief description of the ROBE experiment which will give your committee a sense of what is involved in the program. I have not been able to establish precisely the requests actually submitted to NSF May 1, that are for the Observatory, but presumably Don Heinricks will bring that information to you at the WHOI meeting.

I will be in Seattle throughout the week of June 14, and will be happy to provide additional information if necessary.

John R. Delaney
(206) 543-4830

NSF DIVISION OF OCEAN SCIENCES
RIDGE PROGRAM -- TEMPORAL VARIABILITY
THE RIDGE OBSERVATORY EXPERIMENT

INTRODUCTION

The NSF RIDGE (Ridge Inter-Disciplinary Global Experiments) Initiative is a coordinated interdisciplinary program to understand geological, physical, chemical and biological processes occurring along the global mid-ocean ridge system. The goal of the RIDGE Observatory Experiment is to obtain time-series measurements on the ridge crest to understand the temporal variation and covariation of ridge-crest processes. This goal will require the development and long-term deployment of instruments for making time-series observations of magmatic, volcanic, hydrothermal, tectonic and biological processes. The basic approach of this effort will be experimental projects executed by individual investigators but coordinated with a larger community of investigators from a range of disciplines.

EXPERIMENT DESCRIPTION

The RIDGE Observatory Experiment is briefly described here to provide an overview of anticipated activities. A more detailed description is provided in the 1989 RIDGE Working Group Report on "Observing Temporal Variability of Ridge-Crest Processes" and in the RIDGE Science Plan published in 1992. The site selected for the initial RIDGE Observatory Experiment is the Cleft Segment of the Juan de Fuca Ridge. A compilation of work done to date on the Cleft Segment has been prepared, including basic maps, summaries of the types and sources of data available, and summaries of the instrumental systems in use, or planned, for the observatory effort. In addition, a digital database of information on the Cleft Segment will be maintained and this database and other documents can be accessed by contacting the RIDGE Office, Woods Hole Oceanographic Institution, Woods Hole, MA 02543 [(503) 457-2000 x2587, FAX (508) 457-2150].

The RIDGE Observatory Experiment will conduct a broad spectrum of measurements to study the covariation among related physical, chemical and biological processes at the Cleft Segment. The RIDGE Observatory will coordinate and integrate these research programs into a larger community, providing the benefits of covariation data from many simultaneous measurements. The RIDGE Observatory Experiment has organized its scientific goals and hypotheses into three broad categories: (1) volcanic and tectonic processes, (2) hydrothermal processes, and (3) water column processes. These groups represent collections of investigators with common scientific goals and methods, although, the RIDGE Observatory will facilitate interaction between these groups to exploit the inter-disciplinary nature of this experiment.

Volcanic and Tectonic Processes

The volcanic and tectonic processes group seeks to understand the present tectonic and magmatic development of the Cleft Segment, to monitor active volcanic/tectonic processes, and using constraints from time-series measurements of sea-floor and crustal processes, to develop integrated crustal accretion models at the segment scale. Examples of specific questions to be addressed with these experiments include:

-What is the spatial and temporal pattern of rifting events along the ridge segment?
-Over what time and spatial scales are rifting events episodic or continuous?
-How much seismic slip is observed on rift faults as a function of time?

-Is there a causal relationship between rifting events and hydrothermal flux?
-Is the segment behaving as one system or multiple systems?
-What are the depths, geometries, and dynamics of crustal heat sources?
-Do magma movements in the subsurface result in measurable deformation of the crust at the sea floor?
-When and where do eruptive events take place and what is the average volume of erupted material?
-How does movement of the crust evolve from the molten region to the solid plate?
-What is the relationship between petrologic variation in space and time, and magmatic/tectonic evolution?
-What are the sea floor manifestations of volcanic and tectonic events (areal extent of flows, fissures, etc)?
-What is the motion of the ridge relative to global geographic coordinates?

To investigate these questions, experiments are planned to measure seafloor deformation (horizontal strain, vertical displacement, tilt), seafloor seismicity (associated with volcanic activity and with regional tectonics), and seafloor crustal properties (location of faults, depth and extent of magma bodies, petrologic and chemical variations).

Hydrothermal Processes

The hydrothermal processes group seeks to quantify the seafloor hydrothermal mass and energy fluxes, the relative contribution of focused and diffuse hydrothermal venting, the variability in these sources and effects over time, and the interrelation of these sources with biological production and community structure. Examples of specific questions addressed are:
-What is the total instantaneous exchange of heat, fluid and chemical mass between the hydrothermal vents and the ocean?
-What is the pattern of circulation within the upper oceanic crust?
-What is the impact of entrained ambient benthic waters on the near-seafloor distribution and flow pattern of the effluent?
-What is the temporal variability of these processes?
-What is the interaction between hydrothermal systems and the biological systems dependent upon hydrothermal energy for survival?
-What is the interplay between magmatism and hydrothermal activity?

To address these issues continuous measurements are planned of temperature, effluent velocity, and fluid composition at numerous locations within an active vent field. Both diffuse venting and more focused higher temperature effluent will be monitored and sampled. Fluids will be analyzed for major, minor, and trace elements, and for gases (e.g., H_2, CH_4, CO_2). Estimates of the biological production supported by the hydrothermal fluxes will be determined (production by symbionts and free-living autotrophs). measurement of short-term production variability and determination of sources of variability, determination of the relation between productivity and the thermal/chemical energy flux of hydrothermal fluids, estimation of the biological fraction exported to the deep-sea, and determination of community response to production and flux changes.

Water Column Processes

The water column group seeks to understand the integrated thermochemical fluxes from vent system plumes, the temporal variability of plume structure, entrainment rates, vorticity dynamics, regional circulation patterns, and the chemical and biological processes transforming plume constituents. Core programs will focus on characterization of plume fluxes, long-term variability, detection of anomalous events and related process investigations. Specific questions addressed will include:
-What is the integrated heat flux from hydrothermal vent fields and its temporal variability?
-What are the plume chemical and biological constituents?

-What is the detailed physical expression of a typical plume in term of salinity, density temperature and particulates.
-What processes cause changes in the plume biological and chemical components?
-Is there a characterizable episodicity in plume behavior?
-What are the seasonal and episodic fluxes from the upper water column and how do they affect plume chemical biological processes?
-Does plume temporal variability form vortices and large scale circulation?
-Does plume dispersion influence biological patchiness and secondary productivity?
-Does deep mesoscale oceanic circulation influence dispersion and transport of plume components?

To resolve these questions a range of water column time-series observations will be conducted at the RIDGE Observatory site. Continuous measurements will include moored temperature recorders, current meters, sediment traps, and optical sensors as well as scintillation and video flow measurements. Specific chemical components measured will include: metals, inert and reduced gases, and nutrients. Repeated surveys will be conducted including tow-yo's of CTDT, dissolved and particulate tracers, bio-acoustic plume surveys, and AUV-deployed sensors on repeated survey tracks. Experiments to understand plume processes will include: ADCP profiling, buoyant plume studies, and Lagrangian drifters.

The above lists of questions and approaches are by no means complete and final. Additional suggestions for important ridge-crest temporal variability problems and approaches are solicited and may be incorporated into the RIDGE Observatory Experiment as it develops. A key component of this effort will be conducting studies which can inter-related a range of observations to provide insight on ridge crest processes. From this perspective, the highest priority measurements are those which have bearing on a broad range of questions and can best be related to other measurements conducted by the RIDGE Observatory Experiment.

EXPERIMENT TIME LINE

The RIDGE Observatory Experiment will be conducted during the period 1993-1999. During 1993 and 1994, experimental plans will be refined and instrumental systems will be developed and tested. During the period 1995-1999, an increasing number of measurements and experiments will be conducted within the RIDGE Observatory. Several long-term field studies of the Cleft Segment have already been initiated. The NOAA Vents Program is conducting several multiyear experiments to monitor ongoing activity on the ridge including: seafloor mapping, seafloor strain, vertical displacement, temperature and current meter moorings, hydrophone-array earthquake observations, and a deployment of seafloor seismic-spectra recorders. Also on the Cleft Segment, the USGS has deployed four acoustic transponders to measure seafloor strain, and in 1993, F. Spiess (SIO) will deploy an additional set of acoustic transponders for ridge-axis horizontal strain measurement.

SHIP, SUBMERSIBLE AND ROV REQUIREMENTS

During the period 1994-1999, the RIDGE Observatory Experiment will require significant use of surface vessel and deep submergence assets in the Northeast Pacific. Whenever possible, ship and submersible operations will be coordinated to provide the maximum benefit to the greatest number of investigators. It is likely that several shipboard and submersible operations may be conducted during a given cruise leg. Even assuming a sharing of seagoing platforms, however, it is anticipated that a minimum of three major surface-ship legs and three submersible legs will be required for the RIDGE Observatory Experiment each summer. In addition, NOAA and Canadian vessels may be present to conduct work at the RIDGE Observatory. Among the activities conducted on these expeditions will be detailed mapping and sampling activities, seafloor manipulation of equipment and natural objects, and deployment and servicing of a broad spectrum of seafloor instruments and experiments. We appreciate that deep submergence research may provide increasingly capable ROV's that can be employed for this work. These systems should be used as expeditiously as possible and the RIDGE Observatory Experiment is anxious to explore these technologies for the planned time-series experiments.

PROJECT COORDINATION

The RIDGE Observatory Experiment exists as a means to encourage and coordinate efforts for understanding long-term variability of the global ridge system. The most important role that the RIDGE Observatory will play is to focus monitoring efforts at a single ridge-crest segment and to encourage extensive communication between individual investigators participating in the project. To this end, an annual meeting, open to the entire scientific community, will be organized to discuss and coordinate current and future activities within the RIDGE Observatory Experiment and to disseminate scientific results. Contact the RIDGE Office for details of future RIDGE Observatory Experiment meetings and other information. For each year of the RIDGE Observatory Experiment, a pair of co-Chief Scientists will be appointed to coordinate the activities taking place during that field season [for 1993 the co-Chief Scientists are Fred Spiess (SIO) and Bob Embley (NOAA)]. In addition, a technical coordinating committee will be set up to handle issues such as instrument deployment and acoustic navigation. A document is available from the RIDGE Office giving locations and configurations of instruments currently deployed at the RIDGE Observatory site. Likewise, a database has be assembled for digital data of interest to a broad range of investigators within the RIDGE Observatory Experiment (e.g. fine-scale site bathymetry). This database is maintained at the RIDGE Office and can be accessed via the internet for ease of data transfer. The RIDGE Office actively encourages proposals, spanning a broad range of disciplinary interests, to conduct time-series observations within the Cleft Segment RIDGE Observatory Experiment.

SEGMENT SCALE GROUP

Petrologic sampling	cont.	cont.	cont. photogeologic mapping (ROV)
SOUTH CLEFT	tectonic studies		
horizontal deformation; intermediate baseline (acoustic) 3 inst.	8 instruments	cont.	cont.
horizontal deformation; long baseline (acoustic) 4 instruments	8 instruments	12 instruments	cont.
long baseline tilt meters (3 instruments)	cont.	cont.	cont.
	Absolute gravity	cont.	cont.
		3-axis tiltmeters (10 instruments)	cont.
short baseline tiltmeters (OBS) 3 months	longer deployment?	longer deployment?	
	OBS tectonic seismicity	cont.	cont.
NORTH CLEFT	Volcanic systems		
Volcanic systems monitors (seismometer, tilt, BPR, other sensors	cont.	cont.	cont.
short baseline extensometers (acoustic)	cont.	cont.	cont.
Moored temperature arrays and current meters	cont.	cont.	cont.
	Absolute gravity	cont.	cont.

IV. Specific Needs: (ship time, benchmarks, navigation, integration with vent scale and water column experiments)

INSERT OVERHEADS FROM FRED SPIESS ON NAVIGATION, MAPPING, ETC (GIVEN TO JOHN H.)

Ship time: approximate number of days per year

1994: 76

1995: 31

1996: 49

Special ship requirements:

1994: Of the total days, 14 require the Ewing; 13 require submersible or ROV.

1995: Of the total days, 4 require submersible or ROV

1996: Of the total days, 20 require ROV and 4 require submersible or ROV

V. Appendix:

Spreadsheet of individual experiments

Vent Time Line

Investigator	Experiment	1993	1994	1995	1996
Embley/Juniper/Butterfield	mapping, time-series vent fluid chemistry	ROPOS - 14 days	ROPOS - 14 days		
Embley/Butterfield	Vent fluid sampling, geologic mapping, chronology (drilling)		ALVIN - 12 days	ALVIN - 12 days	ALVIN - 12 days
Fisher	video mosaics and 2 video time-lapse		ALVIN - 15 days	ALVIN - 8 days	ALVIN - 3 days
Childress	T		ALVIN - 5 days	ALVIN - 15 days	
Felbeck	Tubeworm physiology, symbiont genetics		ALVIN - 2 days	ALVIN - 5 days	
Sempere/Pariso	High resolution side scan		scan		
Tivey	Temperature (other?) monitoring, high and low T		ALVIN - 4 days		
Kadko (w/Embley/ Butterfield/Feely)	Vent fluid sampling, chronology		ALVIN - 3 days	ALVIN - 1 day	
Sansone	Low temperature vent H2 sensor		ALVIN - 4 days	ALVIN - 4 days	ALVIN - 2 days
McMurtry	Low temperature chemical monitoring station			ALVIN - 3 days	ALVIN - 3 days
Lilley	Vent sampling, high temperature H2 sensor		ALVIN - 3 days	ALVIN - 3 days	ALVIN - 3 days
Schultz (w/Kadko?/ Juniper?/Baker?)	Heat flux density mapping, high res. thermal mapping, subsurface circ. mapping, biological groundtruth dye & tracer release & water sampling		ALVIN - 8 days (?) (March conflict?)	ALVIN - 8 days	ALVIN - 3 days
Rona (AOML-NOAA)/ Dworski (APL-UW)	Acoustic imaging (3-D) of black smokers; acoustic thermometry of diffuse heat source floor	TURTLE - 10 dives (18 days) (Aug-Sep)			
Malahoff	Vent scale geophysics	?	ALVIN - 2 days	ALVIN - 2 days	ALVIN - 2 days
McClain (Hildebrand)	Seismicity			Any surface ship - 15 days (not sole user)	Any surface ship - 10 days (not sole user)
Wheat	Short tem low temperature flow measurement; particle analysis		ALVIN - 3 days	ALVIN - 3 days	ALVIN - 2 days
	TOTAL		61 (11)	64 (11)	30 (8)

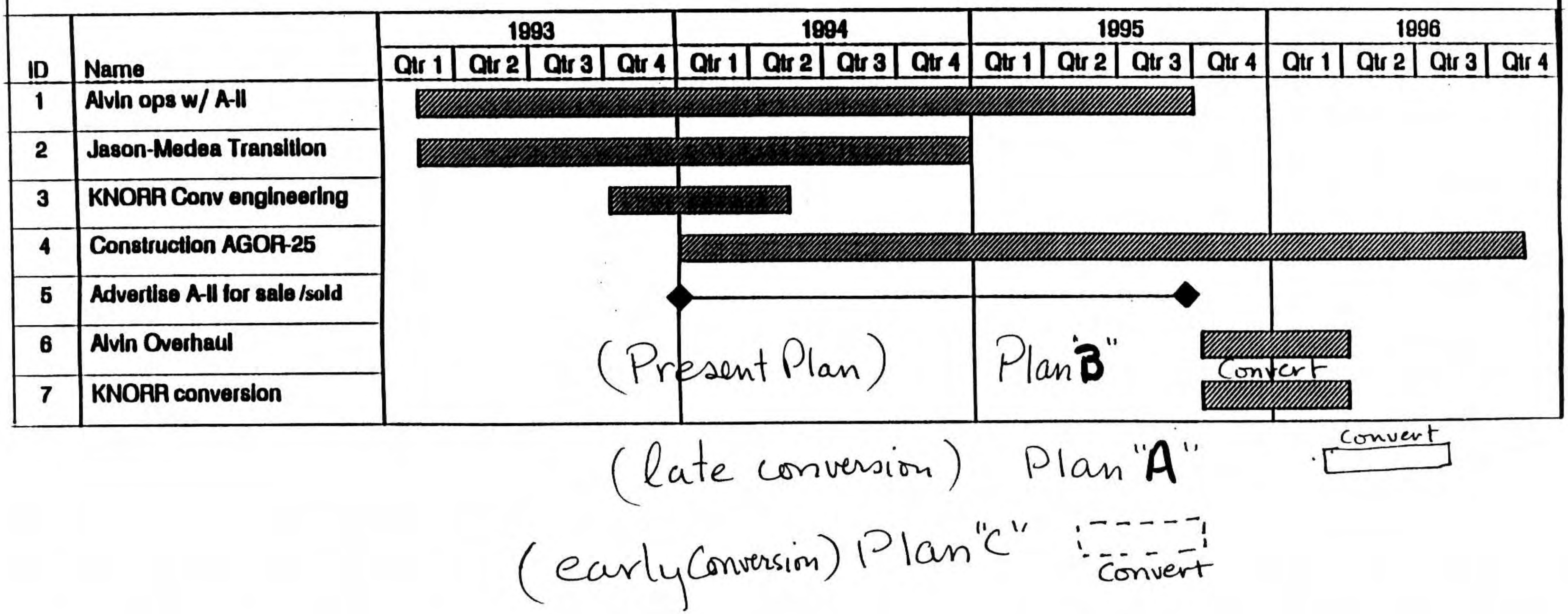
Water Column Time Line

Investigator	1993	1994	1995	1996
Joyce, Cannon, Baker, Hen (Funded)		Non-buoyant plume dynamics, ADCPs		Non-buoyant plume dynamics
NOAA_VENTS (Funded)	CM mooring; cross-ridge additional moorings	Sed. traps and additional moorings		
NOAA_VENTS (Funded)	MTR moorings			
NOAA_VENTS (Funded)	Tow-Yo and chem	Tow-Yo and chem	Tow-Yo and chem	Tow-Yo and chem
NOAA_VENTS (Funded)		Particle Exp.; ALVIN/ROV	ALVIN/ROV	ALVIN/ROV
WHOI		Bioacoustic disco.; bioacoustic ALVIN		
IOS (Funded)	Bioacoustic Tow-Yo	Bioacoustic Tow-Yo	Bioacoustic Tow-Yo	
U. Wash.		Plume video, ALVIN	Plume video, ALVIN	
U. Wash, IOS		Scintillation flow meter, ALVIN		
OSU		Sediment traps	Sediment traps	Sediment traps
Riser? RAFOS	Champion needed			
AUV	Scientific leader needed	Odessey	Odessey	
M. Lilley, U. Wash.		Microbial sampling	Microbial sampling	
B. Hickey, U. Wash (?)				
TOTAL	4 weeks NOAA	4 weeks NOAA	4 weeks NOAA	
	2 weeks IOS	2 weeks UNOLS	2 weeks UNOLS	
		2 weeks IOS	2 weeks IOS	
		20 days ALVIN	20 days ALVIN	

APPENDIX XII

(Tentative)

SCHEDULE FOR TRANSITION OF
WHOI DEEP SUBMERGENCE FACILITY



APPENDIX XIII

UNIVERSITY - NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

Date: July 20, 1993

To: Deep Submergence Science Community

From: The DEep Submergence Science Committee

SUBJECT: ALVIN Operations in 1994 and Beyond

On June 14-16, the DEep Submergence Science Committee (DESSC) met in Woods Hole to examine ALVIN and ROV proposals and formulate a plan for future operations. Proposal pressure for ALVIN was high which bodes well for full utilization in 1994. 159 dives for the 1994 field program have already been specified as funded and an additional 272 dive days are proposed. Most of the requests were for dives in the traditional work areas proximal to the U.S., and based on this response DESSC believes that in 1994 and 1995 ALVIN should largely be committed to work in these areas. The science to be carried out in those programs is very mature and the need for ALVIN is clear, with much of the work closely tied to exciting time series studies. At the meeting, the DESSC also evaluated investigative portfolios which represented a compilation of research programs proposed for three work areas: the Southern East Pacific, the Western Pacific, and the Tethyan Region, in order to assess the relative strengths of global work. The DESSC recognizes the large community of investigators who would like to use ALVIN in the global arena and, based on the letter proposals and portfolios presented, has factored in these interests starting in the fall of 1995. DESSC has recommended two long-range plan options for ALVIN operations in 1994 and beyond.

PLAN A:

For Plan A, DESSC recommends that ALVIN remain in the Pacific in 1994 and operate in the traditional Pacific regions. The vast majority of letter proposals submitted were for work in these areas. ALVIN would begin 1994 with operations along the Pacific coast of Central America and the Northern East Pacific Rise, then transit north along the coast picking up a number of funded and proposed projects along the way. There is strong proposal pressure to use ALVIN off of the Pacific Northwest coast, and it is anticipated that ALVIN will spend the summer to early fall season in this area before returning south ending the year in Panama. In 1995, Plan A calls for ALVIN to operate in three major research locals. ATLANTIS II would transit through the Panama Canal to the Mid Atlantic Ridge in the early part of the year to accommodate programs that are related to a variety of on-going projects, such as ODP objectives and the FARA investigation. In late spring, ALVIN would work its way back into the Pacific and northwards to the Juan de Fuca for a full season of projects, many related to the RIDGE ocean floor observatory. In the latter part of 1995, DESSC recommends an investigative foray south of the equator in the eastern Pacific. This work could carry over into early 1996 with the length of the program determined by proposal pressure and logistical concerns. DESSC believes that there are a number of proposed programs on the southern EPR that are ready for ALVIN-based work. Additionally, NSF has indicated the possibility of a cooperative submersible and ROV program with the Japanese in this area. Such a program could hopefully serve as a first step towards developing an effective way to share deep submergence assets in the global arena in the years to come.

After the Southern EPR work, ALVIN would return to WHOI, perhaps picking up one or two programs along the transit route, and begin an overhaul period in early 1996 while KNORR undergoes a conversion that will lead to its becoming the support ship for ALVIN and ROV operations. Immediately following the overhaul and conversion, KNORR and ALVIN would undergo a rigorous shakedown and engineering dive program. When science operations are resumed in the late Fall of 1996, the operator recommends a limited Atlantic or eastern Pacific program to ensure that there are no major problems either with the submersible, KNORR or the handling system. DESSC supports this recommendation in the hope that technical problems, if any, can be detected and corrected prior to operations in remote regions.

Following operations in an area proximal to the US, DESSC recommends an expedition to the Western Pacific in 1997 with perhaps operations in the Tethyan Region to follow. Proposal pressure and logistical constraints would dictate the actual scheduling. The DESSC recommends the Western Pacific as a first priority because there are many sites that are mature and there is very strong proposal pressure (over 18 months of work already defined). Work of opportunity along the way to these remote areas would be encouraged. Consequently under this plan, it is very likely that ALVIN will not return to the Juan de Fuca until after the 1997 field season. DESSC asks that investigators in the deep submergence community who have worked in the familiar natural laboratories (e.g. Juan de Fuca, EPR 9-10^{o} North) consider the implications of a global program on their time series investigations; in particular, how ROVs could be effectively used to carry out various time series investigative tasks and what has to be done now as a community to prepare for this logistical situation. The community should also begin to work with the funding agencies in thinking of ways to exchange deep submergence assets internationally so that programs, for which submersibles are essential, could have access to other manned vehicles.

The timing of Plan A is built around two scheduling assumptions: (1) ATLANTIS II, which is currently for sale, is not sold before the Spring of 1996; and (2) KNORR remains funded through the end of 1995. The market for a 30 year old research ship is not large but, if a reasonable offer is received for ATLANTIS II, ONR

TIMETABLES FOR PLANS A & B

	1994				1995				1996				1997			
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4
PLAN A																
Traditional East Pacific:	XXX	XXX		XXX		XXX						XX				
Northern EPR																
Pacific Coast of Central America																
Monterey/San Diego																
Juan de Fuca			XXX				XXX									
Mid Atlantic Ridge					XXX											
Southern East Pacific Rise								XXX	XXX							
ALVIN Overhaul & KNORR Conversion										000	000					
Shakedown Post Overhaul												O				
Engineering Dives	X		X			X		X						X		X
Global Field Program: W. Pac &/or Tethyan													XXX	XXX	XXX	XXX

	1994				1995				1996				1997			
	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4
PLAN B																
Traditional East Pacific:	XXX	XXX		XXX		XXX		X		X	XXX					
Northern EPR																
Pacific Coast of Central America																
Monterey/San Diego																
Juan de Fuca			XXX				XXX									
Mid Atlantic Ridge					XXX											
Southern East Pacific Rise												XXX	XXX			
ALVIN Overhaul & KNORR Conversion								000	000							
Shakedown Post Overhaul										O						
Engineering Dives	X		X			X				X			X			X
Global Field Program: W. Pac &/or Tethyan														XXX	XXX	XXX

FIGURE 1

and NSF will insist that the ship be sold. Or, if KNORR is not fully supported in 1995, there could be savings realized by advancing the date of KNORR's conversion to a support ship for ALVIN, as well as the overhaul date for the submersible, to fall 1995.

PLAN B:

Plan B, provides a scenario for how to accommodate, in the least disruptive way, for a scheduling change triggered by one of the conditions identified in the preceding paragraph. Obviously, if ATLANTIS II is sold in the very near future, then there will need to be a major adjustment in the scheduling of the ALVIN program. It is important to recognize that the national assets of the U.S. deep submergence science community are in a period of transition as we evolve from a support ship with somewhat limited space and technical capabilities to a support ship that can accommodate technically sophisticated and multidisciplinary deep submergence operations involving large science parties using submersibles and ROV's. The challenges of this transition are made more complicated by the realities of limited federal support. Independent of the challenges we face getting there, the deep submergence science community will be supported by a much more capable asset after the KNORR conversion has occurred.

Plan B begins operations in 1994 in the Northern EPR and is identical to Plan A's schedule through work in Juan de Fuca in Fall 1995. After completion of the Juan de Fuca work, ATLANTIS II would begin transiting back to Woods Hole. To avoid a long transit without science work, a limited eastern Pacific program can be incorporated into the schedule. Following these operations, ALVIN would return to Woods Hole in Fall 1995 for overhaul and KNORR would begin conversion. The work scheduled for the Southern East Pacific Rise would be put off until after the overhaul and conversion. ALVIN and KNORR would resume operations in Spring 1996 with a rigorous shakedown and engineering dive program. Before commencing an excursion to the Southern East Pacific, a limited dive program in the Atlantic or Eastern Pacific is recommended to ensure that there are no major problems with ALVIN, KNORR or the handling system. Following the Southern East Pacific work, a global field program is recommended for operations in the Western Pacific and/or Tethyan region, as proposal pressure and logistical constraints dictate. Any work of opportunity along the way will be encouraged.

Timetables summarizing Plans A and B are included as Figure 1.

APPENDIX XIV

University of Hawai'i at Mānoa

Planetary Geosciences Division
Department of Geology and Geophysics
School of Ocean and Earth Science and Technology
2525 Correa Road · Honolulu, Hawai'i 96822, USA
Telephone: (808) 956-6488 · Facsimile: (808) 956-6322

June 1, 1992

Dr. Jeff Fox
UNOLS office
University of Rhode Island
Fax: (401) 792-6486

Dear Jeff,

I am faxing the current table of information regarding the US investigators diving plans for the Central and Western Pacific regions. There are plans by various Australians to use Alvin in cooperation with US scientists in the Manus Basin, the Woodlark Basin, the Tabar-Lihir-Tanga-Fendi regions, the N. Fiji Basin, the Lau Basin, and the Andaman Sea, but I have as yet not heard any more than I had given you at the December meeting in San Francisco. Steve Scott, Canada, has proposed work also in the Woodlark and Manus Basins, but so far no additional info from him.

The relative maturity of the programs listed is given a numerical rating from 1 to 5 as described in the table. Two of the PI's Sager and Johnson are not ready at this time to write a proposal, but will be within a year or so. For this reason the Sager/Johnson project is given a "maturity" rating of 2. Stern's northern Mariana work also was given a 2 because it will require preliminary field work that has been proposed to NSF (for the current panel). If the field work does not get funded, an Alvin proposal would not be viable. The rest of the US PI's are all very serious about submitting proposals and all have very mature programs. The work proposed by Berkman for the Scotia Sea is included as a cooperative study on the second page of the table and is rated as a 2 because the preliminary work of organization seems to still be underway. This kind of work fits well within the scientific scope of many of the western and southwestern Pacific studies, but is not geographically related. Scheduling will be a problem. The total number of dives (336) given in the table does not include the dives Cavanaugh might get in cooperation with other PI's. Her work would have to piggy-back on other programs.

The table is arranged by region. The total number of days that would be required for the dives, including transit and port time (2 days per cruise), would probably be about 535, or about 18.5 months. If the Alvin is ready to go to the "remote" (although not to us Hawaiians) regions in mid-1996 it will be necessary to consider two factors in deciding scheduling. (1) The optimal time to perform cooperative work in the Mariana Region with the Japanese and with HURL is in 1996. (2) Weather windows for work in the western Pacific are a second critical factor. Hawaii and the central western Pacific will not be a problem with regard to weather. The best weather window for Mariana work is Jan. to Apr. Typhoon season starts in May and continues until Dec. The storms usually are generated south of Guam and take tracks progressively northward as the typhoon season progresses. Therefore the weather window for Mariana work can extend into or July or August. From the Manus Basin to the Lau Basin the typhoon season is Nov. to Mar. with the storm tracks moving progressively southward through this season. Therefore the more northerly targe: regions could be addressed toward the end of the season while the southerly ones should be done early. I offer the following suggestion for scheduling:

(Please let me know if you have trouble reading this material on the fax.)

Suggested schedule for Diving			
PI	#dives	Region	Month/Year
W. B. Bryan/J. B. Moore	24	Hawaiian Islands	Jun-Jan 96
M. O. Garcia	7	Loihi Seamount	Jun-Jan 96
W. Sager/P. Johnson	24	Emperor Seamounts	Jun-Jan 96
F. Sansone	13	Hawaiian Islands	Jun-Jan 96
E. L. Winterer	10	Western Pacific Seamounts	Jun-Jan 96
S. H. Bloomer	14	Southern Mariana Arc	Jan-Apr 96
			Jan-May 96
P. Fryer/ K. Fujioka	18	Mariana Forearc	Jan-May 96
P. Fryer	19	Mariana backarc basin	Jan-Apr 96
J. B. Gill/P. Fryer	16	Northern Mariana Arc	Jan-Aug 96
G. McMurtry	8	Northern Mariana Arc	Jan-Aug 96
R. J. Stern	15	Hiyoshi Seamounts	Jan-Aug 96
E. A. Silver	18	Huon Gulf, Solomon Sea	Apr-Oct 97
J. Hawkins	24	Lau Basin	Apr-Dec 97
J. Mahoney	24	Manahiki Plateau	Apr-Oct 97
Lutz/Vrijenhoek	8	?	
C. M. Cavanaugh	variable	Any seep/vent localities	
K. Fujioka/P. Fryer	15	Mariana Forearc	Jan-May 96
Arculus et al.	15	Eastern Manus	Apr-Oct 97
Arculus et al.	12	Western Woodlark	Apr-Oct 97
Arculus et al.	6	Tabar-Lihir-Tanga-Feni	Apr-Oct 97
Arculus et al.	10	Lau Basin	Apr-Dec 97
Arculus et al.	10	N. Fiji Basin	Apr-Nov 97
Arculus et al.	6	Andaman Sea	Apr-Oct 97
Scott	20	Woodlark & Manus Basins	Apr-Oct 97
Berkman/Dalziel/Hotta	?	Scotia Arc	MAY-AUG 97

Sincerely,

Patricia Fryer
Associate Planetary Scientist

1. Summary of Targets for Western Pacific Submersible Science.

US Studies:

	PI	#dives	Transit	Port	Region
1	W. B. Bryan/J. B. Moore	24	2 to 3	Honolulu	Hawaiian Islands
2	M. O. Garcia	7	1	Honolulu	Loihi Seamount
3	W. Sager/P. Johnson	24	4 to 5	Honolulu	Emperor Seamounts
4	F. Sansone	13	1 to 2	Honolulu	Hawaiian Islands
5	E. L. Winterer	10	6	Honolulu /Guam	Western Pacific Seamounts
	total # dives	78			HAWAII and CENTRAL PACIFIC
6	S. H. Bloomer	14	2	Guam	Southern Mariana Arc
7	P. Fryer/ K. Fujioka	18	4	Guam	Mariana Forearc
8	P. Fryer	19	1	Guam	Mariana backarc basin
9	J. B. Gill/P. Fryer	16	5	Guam	Northern Mariana Arc
10	G. McMurtry	8	4 to 5	Guam	Northern Mariana Arc
11	R. J. Stern	15	6	Guam	Hiyoshi Seamounts, N. Marianas
	total # dives	90			MARIANA REGION
12	E. A. Silver	18	1 to 2	Lae or Rabaul	Huon Gulf, Solomon Sea
13	J. Hawkins	24	4	Suva or Pago Pago	Lau Basin
14	J. Mahoney	24	4 to 5	Samoa or Tahiti	Manihiki Plateau
	total # dives	66			SOUTHWESTERN PACIFIC
15	Lutz/Vrijenhoek	8	?	?	?
16	C. M. Cavanaugh	variable	NA	variable	Any seep/vent localities
	TOTAL DIVES	242			ALL REGIONS

2. Summary of Targets for Western Pacific Submersible Science (cont.).

US Studies:

	PI	Objectives	Vehicle	Source	Rating*
1	W. B. Bryan/J. B. Moore	Mass movement, East rift, teconics, petrology	Alvin	NSF	3
2	M. O. Garcia	Petrogenesis, volcanology	Alvin	NSF	5
3	W. Sager/P. Johnson	Hot spot evolution, polar wander	Alvin	NSF	2
4	F. Sansone	?	Alvin	NSF	?
5	E. L. Winterer	Limestone caps, karst formation	Alvin	NSF	3
	total # dives				
6	S. H. Bloomer	Arc Volcanology, petrogenesis, hydrothermal systems	Alvin (&/or Pisces V)	NSF /NOAA	3
7	P. Fryer/ K. Fujioka	Serpentine seamount genesis, fluid flux accreted terranes (cooperative with Japanese)	Alvin & Shinkai 6500	NSF /JAMSTEC	4
8	P. Fryer	Spreading center, volcanology, tectonic activity, petrogenesis	Alvin (&/or Pisces V)	NSF /NOAA	4
9	J. B. Gill/P. Fryer	Arc volcanology/tectonic control over magma	Alvin (&/or PiscesV)	NSF /NOAA	4
10	G. McMurtry	Hydrothermal deposits & fluids	Alvin (&/or PiscesV)	NSF /NOAA	4
11	R. J. Stern	Arc volcanology, petrogenesis	Alvin (&/or PiscesV)	NSF /NOAA	2
	total # dives				
12	E. A. Silver	Drowned reefs, dynamic flecture of continental shelf/subduction	Alvin	NSF	3
13	J. Hawkins	Petrogenesis, tectonics, volcanology	Alvin	NSF	3
14	J. Mahoney	Exposures of basement for Oceanic plateau studies	Alvin	NSF	3
	total # dives				
15	Lutz/Vrijenhoek	Biological studies	Alvin	NSF	?
16	C. M. Cavanaugh	Symbiotic associations between invertebrates and bacteria at cold seeps and hot vents	Alvin	NSF	1

3. Summary of Targets for Western Pacific Submersible Science (cont.).

International Cooperative Studies:

	PI	#dives estimate	Transit	Possible Port	Region
17	K. Fujioka/P. Fryer	15	4	Guam	Mariana Forearc
18	Arculus et al.	15	2	Rabaul	Eastern Manus
19	(people from	12	2 to 3	Rabaul	Western Woodlark
20	Western Aus-	6	1 to 2	Rabaul	Tabar-Lihir-Tanga-Feni
21	tralia who want	10	2 to 3	Suva	Lau Basin
22	to do joint work with US people	10	2	Suva	N. Fiji Basin
23	and Alvin)	6	2?	Pinang or Port Blair?	Andaman Sea
24	Scott	20	3 to 4	Rabaul	Woodlark & Manus Basins
25	P.A. Berkman/ L Dalziel / H. Hotta	?	4 to 5	Falklands or Tierra Del Fuego	Scotia Arc
	TOTAL COOP DIVES	94			
	TOTAL COOP ROV	?			
	GRAND TOTAL #DIVES	336	77		ALL REGIONS

4. Summary of Targets for Western Pacific Submersible Science (cont.).

International Cooperative Studies:

	PI	Objectives	Vehicle	Source	Rating*
17	K. Fujioka/P. Fryer	Serpentine Seamounts, fluid seeps, structures	Alvin/ Shinkai 6500	NSF /JAMSTEC	4
18	Arculus et al.	Hydrothermal activity, petrogenesis	Alvin	NSF	3?
19	(people from	Hydrothermal activity, petrogenesis	Alvin	NSF	3?
20	Western Aus-	Major Au deposit on land=>submarine equivalent	Alvin	NSF	3?
21	tralia who want	Hydrothermal activity, petrogenesis	Alvin	NSF	3?
22	to do joint work with US people	Interaction of southern spreading center with Mathew-Hunter FZ	Alvin	NSF	3?
23	and Alvin)	spreading center and hydrothermal activity	Alvin	NSF	3?
24	Scott	Hydrothermal structures, volcanology possible cooperative work with Mir	Alvin	NSF	3
25	P.A. Berkman/ I. Dalziel / H. Hotta		ROV/Shinkai 6500	NSF /JAMSTEC	2
	TOTAL COOP DIVES				
	TOTAL COOP ROV				
	GRAND TOTAL #DIVES				

*Rating for Maturity Level:

5 = funded

4 = extremely mature - previous work in area includes seafloor mapping, bottom photography, published works on samples collected, previous diving or previous use of ROV in the area.

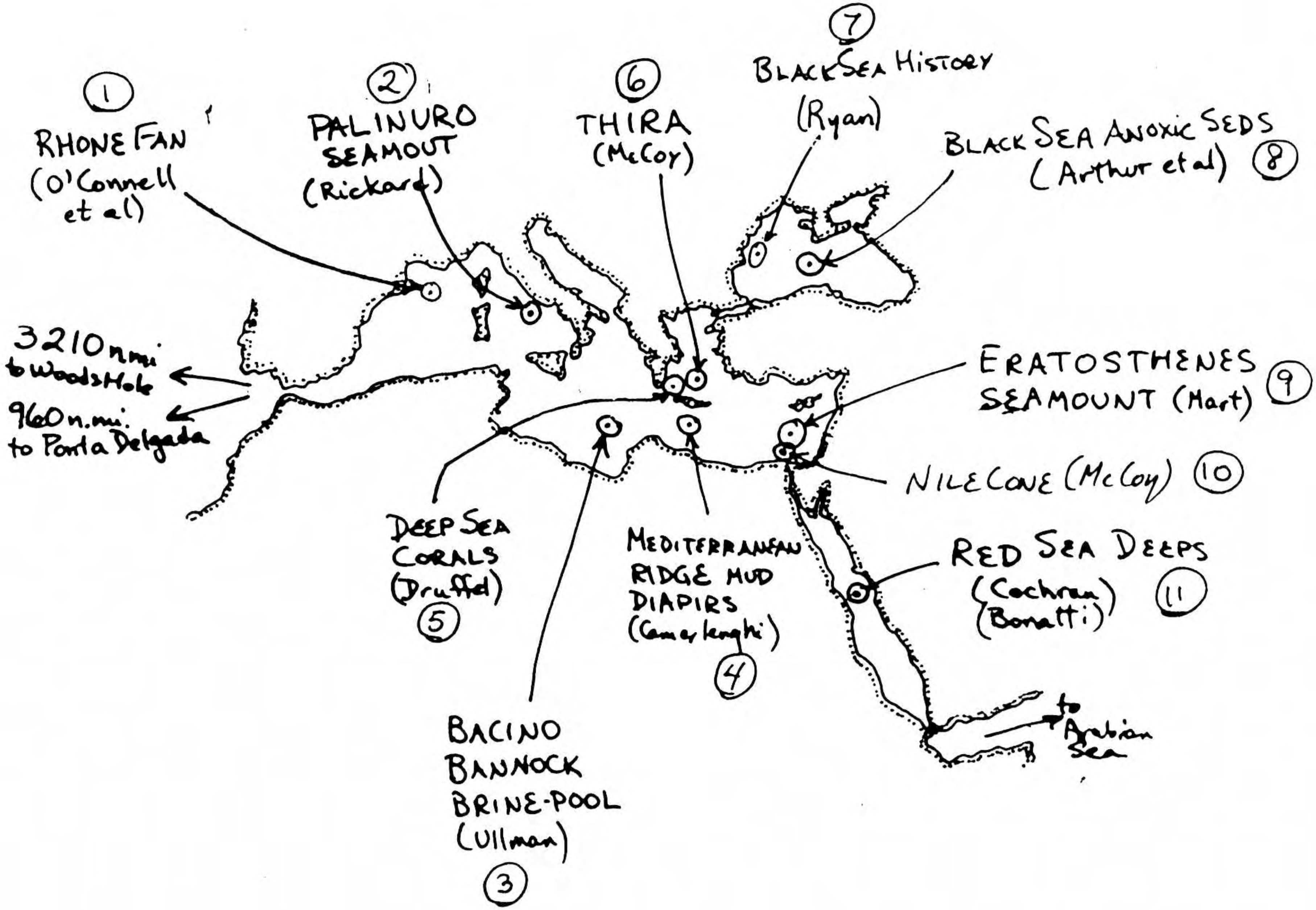
3 = mature - previous work in area includes seafloor mapping, bottom photography, published works on samples collected

2 = prelimninary - additional field work may be required before diving proposal is viable

1 = dependant - previous work of the type proposed has been published, but diving will augment other funded cruises as this work

Submitted by P. Fryer

Tethyan Region



Tethyan Region Expedition (west to east)
updated June 1993
Kim Kastens

Investigator Contact Info	Area	Program	Documentation in hand	Comments
S. O'Connell, C. McHugh, C. Pirmez and W.B.F.Ryan Lamont-Doherty Palisades, NY 10964 (914)359-2900 cecilia@lamont.ldgo.columbia.edu	Rhone Fan	8 dives on the channel walls and floor of deep sea fan valley; hydrophone pinger at night	letter proposal dated 5/14/1993	• experienced submersible users • well thought-out program • ambitious measurement and sampling program during dives: Stakes/Holloway drill, push-cores, auger cores, laser-scaled photography, piezometers, current meters, in situ p-wave velocity measurements, various devices left behind to "catch" a future turbidity current (8 dives may not be enough).
D. Rickard Dept. of Geology Univ. of Wales P.O.Box 914 Cardiff CF1 3YE Wales UK phone: 44-222-874326 fax: 44-222-874284 email: rickardD@uk.ac.cardiff	Palinuro Seamount, Tyrrhenian Sea	sample sulphide deposits and microbial mats (??6 dives??)	fax 11/30/92, fairly general	• good program. Palinuro sulphides have unique chemistry w/ high Hg, Ag & Au • good survey data available • small number of dives probably sufficient (my guess: ~6 dives) • German & British investigators
Ullman, Kastens et al College of Marine Studies Univ. of Delaware Lewes, Delaware 19958-1298 fax: 302-645-4007 tel: 302-645-4302 email: bill.ullman@mvs.udel.edu	Bacino Bannock, eastern Med.	eastbound: SeaBeam, Argo westbound: ALVIN ~12 dives	letter of intent 6/15/1990; reviewed by ARC 6/28/1990; email and personal communication still interested 11/92	• Kastens is experienced ALVIN and deep tow user • plan has been strengthened by addition of SLS/photo on eastbound leg since review by ARC • large international group of co-investigators • within swath of Mediterranean Ridge planned for intensive study by EC-funded MAST program
A. Camerlenghi, et al Osservatorio Geofisico Sperimentale P.O.Box 2011 (Opicina) I-34016 Trieste, Italy tel: 39-40-214-0255 fax: 39-40-327-307 acam@itsogs.bitnet	Mediterranean Ridge	map and sample mud diapirs (~10 dives)	letter of intent 11/26/90; fax from Mart saying still interested 10/9/90	• site of a highly-ranked ODP proposal (Mediterranean Ridge) • sufficient survey data in hand • my sense is that this probably will not mature into a competitive proposal; Camerlenghi was the motive force, and he has moved to another job.

E. Druffel WHOI Woods Hole, MA 02543 (508)548-1400 email: ermd@kopernik.whoi.edu	offshore Greece	sample giant long-lived black corals for isotopic studies .(4 dives minimum)	letter 11/8/90 email still interested 10/19/92	• experienced Alvin user for similar program in Florida Current area • well-focused small program with clear goals: look at time series of isotopes in giant black corals to infer temporal changes in water chemistry
F.W. McCoy Windward Community College U. of Hawaii 45-720 Keaahala Road Kaneohe, Hawaii 96744 (808)235-0077 fax: 808-247-5362	Thira Island, Aegean Sea	ALVIN sampling and photography in caldera (??6 dives??)	letter of intent 12/90; fax saying still interested 10/9/92	• slightly experienced ALVIN user • potential clearance problem for US ship to work in Aegean
W.B.F. Ryan Lamont-Doherty Palisades, NY 10964 (914)359-2900 billr@lamont.ldgo.columbia.edu	Black Sea	Piston coring and towed vehicle (SLS & video) (no diving)	personal communication with KAK 12/92	• very experienced ALVIN user • towed vehicle could be Argo/Medea or investigator-supplied vehicle • exiciting topic with potentially high PR value • some objectives may be met during summer '93 cruise aboard a Russian ship
M. Arthur et al Dept of Geosciences Penn. State Univ. University Park, PA 16802 (814)863-6054 fax: 814-863-7823 arthur@geosc.psu.edu	Black Sea	sampling anoxic sediments and overlying water column for geochemical and stratigraphic studies (~20 dives)	4-page proposal received by email, 12/92	• coinvestigators include G. Luther (Delaware), K. Neilson, W. Dean (USGS) • experienced submersible users • Knorr Black Sea expedition of several years ago provides sufficient background info for one or more competitive ALVIN proposals
Y. Mart & F.W. McCoy Israel Ocean & Limn Res. Ltd. Tel Shikmona, PO 8030 Haifa 31080 Israel fax: 972-4-511-911	Erastosthenes Seamount (SE Med)	sampling and mapping area of incipient continent-continent collision	letter of intent 12/90; fax from Mart still interested 6/14/92; fax from McCoy still interested 10/9/92	• also the site of a highly ranked ODP proposal (Mediterranean Ridge) • my sense is that there is not enough survey information to plan a competitive ALVIN-only program, but SLS on the eastbound transit followed by ALVIN on the westbound passage might fly
F. W. McCoy (see above)	lower Nile Cone	mapping and sampling diapirs, salt ridges and salt escarpments	letter of intent 1990; fax saying still interested 10/9/92	• slightly experienced ALVIN user • my sense is that there is not enough survey information to plan a competitive ALVIN-only program, but SLS going east plus ALVIN on going west might be OK
E. Bonatti Lamont-Doherty Palisades, NY 10964 (914)359-2900	Red Sea: (a) southern Red Sea 17-19°N; (b) Nereus deep; (c) Zabargad FZ	mapping and sampling Red Sea spreading centers, fracture zones and mantle protrusions (~25dives)	fax 12/92	• Bonatti experienced Alvin user • possible clearance problems

APPENDIX XV

ALVIN IMAGING UPGRADE
STATUS AND RECOMMENDATIONS
DESSC Meeting June 14-16, 1993

D. J. Fornari and B. Walden

Status

The imaging proposal has been revised but needs additional comments and response to the recommendations below by the DESSC before it is finalized.

WHOI plans to submit the proposal to the funding agencies by the middle of July for review so that hopefully a response could be received by early Fall. It will be proposed as a staged, 3 year effort as detailed below, in order to take best advantage of developing technologies and to permit adequate testing and engineering dives to ensure functionality and documentation of the new systems.

It is expected that WHOI will make some contribution towards the overall upgrade costs. This is presently being negotiated internally.

Recommendations

Based on suggestions and requests from a broad spectrum of the deep sea research community and discussions with the Alvin operations and technical group the following broad areas are suggested for improvement.

- Lighting (also on retractable hydraulic booms)
- Video cameras (pan-and-tilt) and recorders
- Solid-state scaling lasers for arm camera
- CCD digital still camera
- Mesotech swath sonar
- Navigation (including post-dive processing and display capability on support ship)
- Data archiving and database management

1. **Lighting**

It is unanimously agreed by users and outside experts that lighting for video imagery is not adequate on Alvin and is the one key element to taking high-quality video in the deep ocean. You can have the best camera with the highest resolution but without adequate lighting the rendered image will be poor.

The recommendation is to purchase HMI (metal halide) lighting. The number of lights to be purchased will depend on information received from IFREMER regarding the lights they are currently building for Cyana which are properly ballasted for 120 volts DC - Alvin standard power. At least 6 and possibly as many as 10 lights should be purchased (again depending on the wattage of the individual lamps) some of which would be for general lighting using retractable booms that would be located on the upper-forebody of Alvin, and some of which could be used for more specific lighting either associate with the arm camera or a pan-and-tilt.

An additional relay can is required for individual switching of the new lights as there is only one available (unused) relay on Alvin at this time.

2. Video Cameras and Recorders

Based on recent examples that compare 1-chip and 3-chip video imagery it is apparent that under the right lighting conditions the 3-chip images are of higher resolution and that this degree of resolution is required for some researchers, largely the biologists for close-up photography. The recommendation is to proceed, over the next year, to spec. out a camera and request bids for a 3-chip color video camera for Alvin.

In the meantime, we should immediately purchase an additional, current generation 1-chip camera to replace the one on the stbd. arm and place the arm camera on a pan-and-tilt for selectable, wider-area viewing. This would replace the forward looking SIT camera that should be retired (kept as a spare).

The zoom and focus knobs for the current 1-chip camera should be placed by the port-observer's viewport for easy access and manipulation. Future zoom and focus and pan-and-tilt controls should also be placed appropriately for observer control.

The currently configured down-looking SIT camera should be retained as it is very useful for high-altitude monitoring of the bottom and when going over steep scarps. Some additional lighting should be dedicated to that camera to help deflect the basket shadowing which currently mars the image.

It will be important to acquire some small solid state lasers for accurate scaling of subject material on the video images. R. Tusting of Harbor Branch is working on this and discussions are underway to possibly acquire a test set of lasers with ~10 cm spacing to install with the arm video camera.

Several (at least 4) new hi-8 recorders should be purchased immediately to permit the recording of 3 data from different cameras simultaneously. This capability is critical for repeat-observation experiments where many different perspectives of the seafloor are desired at the same time. All recorders should be capable of overlaying data bar on the image (or encoding it).

3. CCD digital still camera

A digital still camera (16 bit, 1024 x1024 image size) is currently being configured for Alvin as a result of the successful proposal by M. Edwards (HIG) and M. Smith (UW) which was funded by NSF (L. Rom). This system (includes 600 watt/sec strobe-2 remote heads) is being worked on now and will be ready for testing and installation on Alvin this fall. It is planned to be tested and placed in service on the Lutz et al. dives in mid-November.

It would be very useful to have 2-3 engineering dives this Fall, when the yard-work is completed in San Diego to test this and other imaging systems prior to the '93-'94 science schedule.

An additional video viewing station (1 hi-8 and 1 SVHS recorder and hi-resolution monitor) should be established on the support ship to provide more capability for scientists to review data from previous dives.

4. Mesotech scanning sonar

A number of proposals which are funded and scheduled for '93 and '94, as well as proposed for '94 and beyond are keenly interested in using the high-resolution, near-bottom swath capabilities of the Mesotech sonar. The system has worked reliably on the Jason ROV, however, it has never been fully integrated into the suite of Alvin imaging sensors. This sonar provides bathymetric data (when the pressure depth from the Paroscientific depth sensor is added) with a resolution of several tens of centimeters over a ~20-m-wide swath centered on the submersible track. The Mesotech sonar is a 675 kHz high-resolution, scanning (360° continuous rotation) bathymetric sonar that uses four preformed beams with 4° separation. Beam width is 1.7° horizontal and vertical beamwidth is 60°. The pulse length is selectable in 5-microsecond increments and receiver gain is selectable in 20 dB steps over a 40 dB range. The range scales are fully variable, and are determined by ping rate. The system may be used in either a forward or down-looking mode; for most Alvin applications it would be mounted in the down-looking mode to image the seafloor.

What is required to fully implement the Mesotech sonar on Alvin is an integrated attitude package (accurate pitch and roll sensors) and more rigorous time-basing of data, with the data recorded at high update rates (1/2 sec), to the datalogger. In addition acquisition software (similar to or the same as that currently used on Jason) needs to be integrated into the Alvin logging computer (or a separate one) and data recorded to a mass storage device (optical drive).

This effort should commence immediately so that it can be tested and made fully operational during upcoming cruises this summer and fall.

5. Navigation

Navigation programs and displays (both in the sub. and post-dive on the surface ship) need to be upgraded, better documentation must be written so that scientists can readily use the programs, and 3-transponder (simultaneous) fixes should be implemented. Also, a sub-transponder navigation survey program should be written and implemented to fine-tune transponder fixes for high-resolution detailed mapping and repeat-visit experiments. Several additional recoverable transponders should be added to the pool of aging Alvin transponders.

In addition, a computing facility (DOS and Macintosh-based) and hard-copy output device(s) need to be provided on the support ship for scientists to be able to easily reduce and plot Alvin navigation and data. This is view as an integral part of how the imaging data will be utilized and hence is included and given a high priority.

6. Data archiving and database management

This aspect of the imaging proposal is the least well-defined. Several interesting concepts have been floated and should be reviewed. They include work being carried out by W. Lange at WHOI that involves transferring 35 mm photo images to CD rom and data compression, archiving and display. This has the great potential to make the data more preservable and transportable, and could significantly improve the potential to more effectively utilize the imagery both video and 35mm still. It is recommended that some funds be allocated to exploring the potential for this technique by transferring some dive films to CD rom and experimenting with display and data management programs.

Other database management efforts are ongoing by J. Howland, K. Stewart and D. Yoerger at WHOI which have been successfully used with the Jason ROV. Those programs, as well as commercially available programs should be critically reviewed by a subset of the desk.

SUMMARY OF EQUIPMENT TO BE PROPOSED

1. 1-new 1-chip color video camera &
   1-new 3-chip color video camera
   solid state scaling lasers (2 or 4)
2. 4-new hi-8 recorders
3. 1-new SVHS recorder
4. 1-new high-resolution monitor
5. 3-new high-resolution monitors for in-sub
6. 1-new relay can
7. 6-10-new HMI lights
8. retractable light boom
9. pan-and-tilt for 1-chip camera
10. attitude package, software and mass storage for Mesotech
11. upgrade navigation programs and displays
12. 2-new Benthos TR6000 transponders
13. computers and printers for science navigation station on ship
14. evaluate data archiving technologies and database management programs

APPENDIX XVI

SOME THOUGHTS ON THE STATE OF DEEP [illegible] SUBMERGENCE SCIENCE

TESTIMONY OF
PROFESSOR PAUL J. FOX
(GRADUATE SCHOOL OF OCEANOGRAPHY, URI)
CHAIR, DEEP SUBMERGENCE SCIENCE COMMITTEE
OF THE
UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

BEFORE THE

SUBCOMMITTEE ON OCEANOGRAPHY, GULF OF MEXICO,
AND OUTER CONTINENTAL SHELF
OF THE
COMMITTEE ON MERCHANT MARINE AND FISHERIES
U.S. HOUSE OF REPRESENTATIVES

March 24, 1993

Mr. Chairman and Members of the Subcommittees:

I appreciate the opportunity to testify on behalf of the community of investigators interested in deep submergence science. Others here today are much better qualified to offer comments specific to NOAA's National Undersea Research Program (NURP). Instead, I will focus my comments on the deep water component of submergence science and address a range of relevant issues. In so doing, I will show how a component of NURP contributes in significant ways to deep submergence science.

RATIONALE: The vast interior of the global ocean and the underlying seabed is arguably this planet's last frontier. This inner space holds answers to fundamental questions in biology, chemistry and geology, and these questions can only be addressed through the effective use of deep submergence assets that provide the investigator with a cognitive presence and a capability to carry out controlled, manipulative and interactive tasks. Presently, submersibles and remotely operated vehicles (ROVs) provide this capability; autonomous unmanned vehicles (AUVs) are still largely developmental, but hold great potential for the future.

PRESENT STATE OF DEEP SUBMERGENCE SCIENCE:

- Scientific Objectives - Although deep submergence science is still characterized by unexpected discoveries and each experiment has an element of exploration, we know enough to identify a host of challenging questions the answers to which are critical to our understanding of how the earth works. For example, the largest biomass and the greatest diversity of animal communities on this planet reside within the interior of the ocean. In addition, the benthic organisms that inhabit the sediments of the deep sea represent another vast habitat of great apparent diversity. These communities are complex and exceedingly dynamic and represent the greatest gap in our understanding of this planet's biology. The answers to questions of direct societal interest such as the global carbon cycle and waste disposal will be incomplete until the ecological processes of the ocean's interior and underlying sediments are understood. Another example of a natural system that can only be adequately investigated with deep submergence assets is the Mid-Oceanic Ridge, the most striking single feature on our planet that encircles the earth. The ridge system is in excess of 50,000 km in length and is the locus of 20 km^3 of new oceanic crustal production every year. In this dynamic environment, there are a host of physical, chemical and biological processes involved in the interactions between circulating seawater and newly created crust that have important implications for our understanding of the composition of seawater, origin mineral deposits and early life on this planet.

- Community of Deep Submergence Investigators - The robust, challenging, fundamental and exciting nature of research in the global abyss has created a large community of scholars in the biological, chemical, geological/geophysical and engineering sciences. These investigators are largely distributed throughout the U.S. university community with the greatest concentration of investigators found at institutions with an emphasis in the oceanographic sciences. Important centers of innovative technological scientific expertise are located at private marine centers such as Harbor Branch, the Monterey Bay Aquarium Research Institute (MBARI), as well as in industry. The exciting nature of deep submergence science attracts many of the very best graduate students to a broad range of thesis topics in this field. It is probably fair to say that the growth in deep submergence science is not so much restrained, as it is hobbled, by a lack of resources (i.e. the number of deep submergence assets and access to these assets).

- Technological Assets: Gateways To The Abyss - For U.S. scientists, manned presence in the deep sea (>1000m) over the last twenty years has been provided by the submersible ALVIN (4000m limit), operated by Woods Hole Oceanographic Institution (WHOI) as a National Facility that is funded jointly by ONR, NOAA and NSF, and to a much lesser extent by the U.S. Navy submersibles SEA CLIFF (6000m limit) and TURTLE (3000m limit). Access to deep inner space has been very effective, providing a cognitive presence and an ability to carry out manipulative and interactive experiments. Indeed, our knowledge of the abyss is largely constrained by over two decades of successful submersible operations (e.g. ALVIN has made in excess of 2000 dives). In the past, the two submersibles of the U.S. Navy have been available to scientists for a limited time each year, but the unreliability of these assets has seriously compromised their usefulness. Recently, NURP has worked with the Navy to improve this situation, holding out the possibility that U.S. scientists can use SEA CLIFF effectively in the future and take advantage of its capability to reach 6000m. A 2000m increase in depth capability allows an investigator to reach approximately 98% of the abyss as opposed to 42% with a 4000m capability. Manned presence in the abyss, however, does have limitations imposed by creating the necessary life support systems (i.e. bulky sphere, limited bottom time, large time and labor commitment to safety). Recently, technological innovations of ROVs developed over the last two decades to serve industrial and scientific needs in shallow water have been hardened for use in the hostile environments of the deep abyss. ROV systems in different states of development exist at WHOI, MBARI and Scripps Institution of Oceanography. These systems are just coming on line and offer a tremendous new investigative methodology that nicely complements, and greatly enhances, our existing potential to carry out investigations in the abyss and on the abyssal floor. Given the geographic and intellectual scale of the scientific problems to be answered and the discoveries to be made in the ocean's inner space, it is clear that ROVs will play a pivotal role in the next chapter of investigation. In the academic community, AUVs are still very much in the developmental stages, but they have a great potential to augment and extend our ability to conduct research in the deep sea.

- Deep Submergence Facilities: A Key Component To Success - The successful and routine implementation of experiments in the hostile environment of inner space, whether it be manned submersibles or ROVs, is dependent on teams of experts, scientists and engineers that are responsible for equipment maintenance and development. These teams take time to develop and represent valuable resources that must be maintained in a coherent fashion if our ability to carry out state of the art investigations in the deep sea is to continue. In order to maintain a reliable deep submergence asset that meets the needs of the scientific questions being addressed, a robust infrastructure must be in place that insures continuity over the long term. This need was recognized almost two decades ago when ONR, NOAA and NSF entered into an interagency agreement to create a National Deep Submergence Facility at WHOI, assuring that the submersible ALVIN would be available for civilian scientific purposes. This interagency agreement has been remarkably successful and has remained in place to the present, although the language of the agreement has just been expanded to include the newly developed JASON-MEDEA ROV system. Outside of this framework, and supported in a variety of ways, there are a few other centers of deep submergence expertise - Scripps Institution of Oceanography, Deep Submergence Group, U.S. Navy, MBARI, and the NURP facility of the University of Hawaii - that are making, or hold a potential to make, contributions to deep submergence science.

PROBLEMS FACING DEEP SUBMERGENCE SCIENCE: I suggest that there is a short term problem facing our National Deep Submergence Facility located at WHOI, and a more general longer term problem facing the U.S. deep submergence effort as a whole.

- Short Term - The problem facing the community in the short term has two primary components. The nature of the tripartite interagency agreement that supports the National Deep Submergence Facility at WHOI is subject each year to vagaries of funding specific to each one of the three sponsoring agencies. For example, partitioning of the FY93 appropriation for NOAA/NURP resulted in a last minute reduction in the expected NOAA contribution to the ALVIN program, causing serious problems with the scheduling of the 1993 ALVIN program and allocation of resources. A last minute funding problem is not unique to 1993, nor is it restricted to NOAA's contributions; problems like this have been a recurrent theme for the last several years. The result is that it is all too common that this country's premier probe into the deep inner space of this planet has been seriously compromised . Such a recent history has not only effected usage of the vehicle by U.S. scientists, but also the ability of the Deep Submergence Group at WHOI to incorporate new and necessary technologies into the operational capability of the submersible. As a result, ALVIN does not offer to the U.S. community the benefits of advanced technology that have been incorporated into the deeper diving (6000-6500m) deep submergence systems operated by our foreign colleagues (France, Japan and Russia). ALVIN still is the premier system in toto because of its reliability, the nearly three decades of accumulated expertise that resides with the ALVIN team, and the innovative nature of the scientists using the submersible. Nevertheless, our manned presence in the deep sea is in jeopardy because we are loosing ground as other operators learn how to operate in the abyss. To compound matters, this precarious funding situation, which has characterized ALVIN for the last several years, is now made even more challenging because the new JASON-MEDEA ROV system has been added to capabilities/offerings of the National Deep Submergence Facility, but the bottom line has not significantly changed. On one hand, the community of deep submergence scientists is excited by the new and expanded research opportunities provided by this new ROV system, but on the other hand, it is not at all clear how these two systems can be supported in a way to maximize utilization. During this time of transition as the community grows into the new opportunities offered by ROVs and tries to upgrade the capabilities of our existing manned asset, ALVIN, the present funding mechanism does not constructively serve the needs of deep submergence science.

- Long Term - This country lacks a clear vision of how it wishes to go about probing the mysteries of this planet's inner space and a plan to carry it out. The creation of a National Deep Submergence Facility at WHOI approximately twenty years ago, and a tripartite agency agreement to make it happen, was an important step in giving this country a presence in the abyss. It is now time to develop a deep submergence strategy and implementation plan that will carry this country forward into the 21st century. This must be done if this country is to remain a leader in the exploration of the abyss.

CHALLENGE FOR THE FUTURE: I submit that, given the global scale of the ocean's inner space, the compelling nature of the scientific questions to be answered, and the societal gains to be harvested from deep submergence science, we need nothing short of a national commitment to this planet's last and best frontier. The scientific opportunities and the societal rewards are immense. Such a program should, however, be developed with care and thought involving representatives from industry, the research community, federal agencies and policy makers. To insure success, the emphasis would have to be on peer-reviewed science.

APPENDIX XVII

DRAFT - -DRAFT - - Terms of Reference - - DRAFT - - DRAFT

DEEP SUBMERGENCE SCIENCE COMMITTEE

Revised: July 13, 1993

INTRODUCTION:

The Terms of Reference for the DEep Submergence Science Committee (DESSC) are herein revised to reflect the expanding role of this committee. The name has been changed from the ALVIN Review Committee to the DEep Submergence Science Committee to indicate the Committee's broader scope of responsibility.

The Committee will retain its oversight responsibilities in the use of ALVIN. Incumbent in this is fulfilling an ombudsman role for the deep submergence community, insuring maximum participation in the use of ALVIN and championing the utilization of deep submergence assets globally. It is also the responsibility of the DESSC to promote new technology for ALVIN and to maintain cutting edge capability for this facility. In addition to ALVIN, it is the responsibility of the Committee to ensure that other deep submergence tools are made available to the community. This should include the integration of ROVs as well as other deep operating towed and autonomously operated instruments. The DESSC will assist NOAA and NAVY in the coordination and selection of civilian projects using the NAVY's submersibles, SEA CLIFF, TURTLE and NR-1.

The type of review needed for ALVIN proposals has changed over the past several years. Given the effectiveness of the peer review process used by funding agencies, it is clear that DESSC should emphasize, in its deliberations, the appropriateness and timeliness of the use of all deep submergence assets available to the community. The DESSC review would consider, for example, whether the proposed research might be best accomplished with other manned or unmanned submersibles, or enhanced by ROV's and undersea research tools, as well as the number of dives being requested to accomplish science diving objectives.

This revision to the terms of reference is intended also to promote the best utilization of deep submergence assets at a global scale. Past methods of planning had the effect of discouraging expeditions to remote geographic areas because it did not provide sufficient lead time for planning purposes, nor did it provide incentives for the scientific community to organize the needed critical mass of research projects. The DESSC will continue to work with the user community, federal sponsors and the operator of the deep submergence national facility to encourage deep submergence expeditions to remote geographic regions in a phased manner that meets the needs of a wide spectrum of deep sea research scientists. Additionally, DESSC will also encourage the advancement of cooperative international programs for the enhancement of multidisciplinary submersible science throughout the academic community.

SPECIFIC TASKS FOR THE DEEP SUBMERGENCE SCIENCE COMMITTEE ARE AS FOLLOWS:

1. **The UNOLS DEep Submergence Science Committee shall operate pursuant to appointment by UNOLS and in accordance with Annex II to the UNOLS Charter.** In addition, each funding agency will be invited to designate an official observer to the Committee.

2. **Review Proposals for Use of ALVIN, ROVs and Navy Submersibles:**

   A. The Committee shall consider all proposals for the use of ALVIN or ROVs. Information contained in the proposals will be used to plan an operational strategy for the deployment of ALVIN and ROVs. Reviews should consider whether the proposed research might be enhanced by the use of ROVs, AUVs and/or other undersea research tools, or be better accomplished using other manned or unmanned submersibles, perhaps those operated by other countries (e.g. France and Japan). The committee will use the proposal information to work with agency representatives and staff from the operating institution to develop schedules that will most effectively utilize deep submergence assets.

   B. Designated members of the DEep Submergence Science Committee will participate in the review of proposals for academic use of the Navy's deep submergence assets under the NOAA-Navy agreement. Review of proposals should consider the appropriateness of the use of the respective facility along with the scientific and technical merit of the proposed research.

3. **ALVIN Planning:**

   A. Annual Scheduling. The DESSC will sponsor with approval by UNOLS such meetings, study groups and workshops as required, including an annual scheduling meeting for the presentation and open discussion of proposed projects. The annual scheduling meeting should provide the user community with an opportunity to suggest, and at the same time get an indication for, the areas in which deep submergence assets could feasibly operate well in advance of proposal submission deadlines. The timing for this meeting should be such that the scheduling goals set out by the tripartite Memorandum of Agreement for support of the Deep Submergence Facility can be adhered to.

B. Global Expeditions: The DESSC will work with the academic scientists, federal sponsors and the operator to determine the feasibility of organizing deep submergence science expeditions to remote geographic regions. DESSC support for special workshops and review procedures may be required to address this task. This new procedure will need to be woven into the annual schedule planning process to ensure effective scheduling during periods when remote expeditions are not justified.

4. **Deep Submergence Science Tools:** The DESSC will, on a continuing basis, maintain awareness of new scientific tools and the needs of the users for new sensors and equipment to address important scientific questions. DESSC should encourage development and promote acquisition of these tools by the operator or interested scientists, and provide mechanisms whereby the supporting agencies can fund these technological developments which are essential to the maintenance of state-of-the-art capabilities for ALVIN and the ROVs. Workshops or special sessions during the Fall AGU meeting, as well as other National Scientific meetings may be required for this task. Technical capability of the deep submergence research assets will be formally reviewed by the DESSC, with the assistance of selected outside experts, at least once every two (2) years.

5. **User Concerns:** On a yearly basis, the committee will review and assess comments from scientific users of deep submergence assets and identify key areas that warrant attention by the operator and recommend remedial actions as appropriate.

6. **Undersea Technology:** With regard to undersea technology in the broader sense, the DESSC should monitor and promote the development and application of appropriate new submersible technologies, both manned and unmanned, shallow and deep, for use in undersea scientific research. The DESSC should coordinate their efforts with the science user community, technology developers and facility operators. The DESSC shall advise NSF, ONR, NOAA and other federal agencies on submersible technology, its evolution and applications. Additionally, the committee shall include a representative(s) with expertise in the areas of undersea engineering and technology.

   In carrying out this task the DESSC will need to coordinate its efforts with the Academy of Engineering Marine Board and may need to organize special workshops.

7. **Membership/Nomination of DESSC:** The DESSC membership shall be comprised of individuals who can represent the various oceanographic disciplines required to advise on the effective use of submersible assets.

The UNOLS Chair shall appoint the DESSC members from the nominations made by DESSC. Nominations for candidates to the committee shall be submitted to the DESSC for review. Nominations should include the candidate's vitae. Members of the DESSC will be appointed for three-year terms, staggered so that two or three terms begin each year. Individuals may serve not more than two consecutive terms. The operating institution may designate an ex-officio member(s) in addition to those members appointed by the UNOLS Chair. With the Council's concurrence, standing committees of UNOLS may also designate ex-officio members as appropriate to DESSC.

8. **Reports of activities shall be made to UNOLS.**

APPENDIX XVIII

ANNEX II
TO THE CHARTER

National Oceanographic Facilities

1. **In addition to regular institutional UNOLS facilities, there may be identified National Oceanographic Facilities,** defined as those facilities, specialized and otherwise, that are made available for the use of qualified scientists from any institution and the use of which shall be recommended by a UNOLS Review Committee.

2. **A research vessel or other research facility may be designated** a National Oceanographic Facility upon the approval of the UNOLS membership after review by the UNOLS Council, with the concurrence of the owner and operator of the facility and with reasonable assurance of support. National Oceanographic Facilities may be multi- or special-purpose facilities and may be designated for the entire annual operating period or any significant period thereof.

3. **The purpose of National Oceanographic Facilities is:**

   - To provide oceanographic vessel and other facility support to scientists who do not operate or have available the required facilities.

   - To provide for the support and use in academic research of specialized and unique facilities.

4. **An oversight committee** for each facility is established for the purpose of:

   a. Considering proposals for use of the asset,
   b. Recommending programs to be scheduled,
   c. Assessing the needs of the user community and
   d. Making appropriate recommendations for improvements of the facility.

   The Chair and members of the Committee are appointed by the UNOLS Chair, from nominations made by the Committee, and in consultation with the UNOLS Council. Members serve for terms of three years on a rotating basis, for no more than two consecutive terms. Each institution operating a National Oceanographic Facility may designate an ex-officio member(s) in addition to those members appointed by UNOLS. With the Council's concurrence, standing committees of UNOLS may also designate ex-officio members as appropriate to the oversight committee.

5. **In recommending the allocation of facility time,** the oversight committee act primarily on the logistical factors of the proposed research and its appropriate usage of the individual facility.

6. **Operational scheduling of the facility is the function of the operating institution.** The time frame for scheduling generally is in accordance with Annex I of the UNOLS Charter.

7. **Information and announcements** advertising the availability of a National Oceanographic Facility are a joint function of the operating institution and the UNOLS Office.

8. **Receipt, acknowledgment, collating and structuring of requests** for facility use will be the function of the operating institution in consultation with the UNOLS Office.

9. **An annual report** on the use of each National Oceanographic Facility is prepared by the appropriate institution in cooperation with the Review Committee and the UNOLS Office.

10. **Requests for funding** the operation of the facility are the responsibility of the operating institution.

11. **If a National Oceanographic Facility ceases to meet the criteria** above, especially with respect to being specialized or unique, recommendation may be made by the UNOLS Council to the funding agencies that such designation be discontinued. Each National Oceanographic Facility is reviewed by the UNOLS Council at least once each three years.

Approved and adopted:	May 5, 1972, College Station, TX
Readopted:	May 17, 1974, Washington, DC
Amended and readopted:	May 13, 1977, Washington, DC
Readopted	Oct 21, 1981, Washington, DC
Amended:	Oct 26, 1983, Washington, DC
Readopted:	May 25, 1984, Washington, DC
Readopted:	Oct 23, 1987, Washington, DC
Readopted:	Oct 28, 1988, Washington, DC
Readopted:	Sep 15, 1989, Washington, DC

APPENDIX XIX

Draft March 11, 1993

ARCTIC SCIENCE SUBMARINE CRUISE-93
SCIENCE PLAN

The science program will consist of 19 days of surveying and station work in the Central Arctic Ocean Basins. The submarine will acquire data for biological, physical, and chemical oceanography; ice dynamics, geology and atmospheric science. The cruise results will be relevant to studies of climate change, threats to the Arctic environment, movement and evolution of the ice cover and geological history of the Arctic Ocean basins. The equipment and instrumentation to do the planned research is currently installed on the submarine or available "off-the-shelf" from institutions in the United States.

1. THE STUDY AREA AND TRACK PLAN

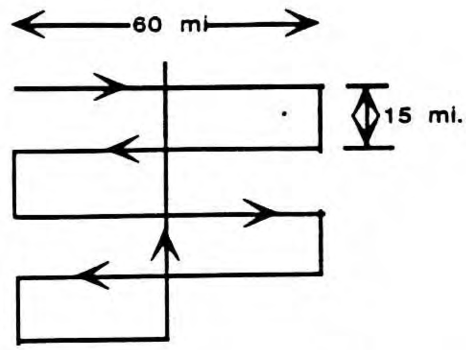
The cruise will be a combination of reconnaissance surveying, sampling traverses, and one detailed local survey. The proposed plan is for the submarine to make two long traverses that run from near the pole to the Alaskan margin. These will be complemented by two shorter traverses that extend across both the Lomonosov and Alpha/Mendeleyev Ridges. On the traverses, continuous measurements of depth, gravitational attraction, ice draft, sea-water salinity and temperature will be recorded. It is desirable for these parameters to be digitally recorded along with navigation on a central computer. Side-scan sonar images of the underside of the ice will be made along the traverses.

Recommended cruise track

Turning points:		Lat.(°N)	Long.	
Start at	"A"	87	15°W	
Proceed to	"B"	80	145°W	
to	"C"	75	145°W	
to	"D"	73	155°W	
to	"E"	80	180°W	
to	"F"	84	150°E	Candidate survey area
to	"G"	85	130°E	
to	"H"	86	130°E	
to	"I"	84.4	175°W	Candidate survey area
to	"J"	82.5	170°W	
to	"K"	82.5	155°W	
to	"L"	87	10°E	

An area approximately 100 km on a side will be surveyed in greater detail by track lines with a spacing on the order of 15 km. Approximate locations of turning points are attached.

Schematic of a detailed survey:



Total miles approximately 400

Two types of stations will be occupied at selected points along the traverses and in the areas of detailed surveying.

- Surfaced Sampling Stations will involve surfacing of the submarine in leads to make CTD casts, deploy expendable current profilers and take wireline water samples. Samples for biological, chemical and hydrological studies may also be taken during ascent and descent of the submarine.
- Buoy Deployment Stations will involve deploying Argos buoys to monitor ice motion, meteorological and hydrographic parameters. The submarine will surface and tie up to pack ice. Surfaced Sampling Station measurements will be made as above. More extensive bottle casts will be possible operating from the ice at these sites.

In what follows we describe by discipline the scientific objectives that will benefit from the this summer's cruise.

2. ICE DYNAMICS

2.1 Background and Objectives

The Arctic ice pack varies in thickness and age throughout its extent. The ice thickness distribution is essential to understanding the mass balance of sea ice. It is a product of the related processes of ice growth and decay, ice advection and ice deformation. The ice distribution is an important input to physical models designed to simulate the effects of global change.

2.2 Recommended Program

2.2.1 Ice Thickness: Since ice draft is a good approximation of its total thickness, ice draft data will be collected continuously along the entire cruise track with the Digital Ice Profiling System. This will provide essential information on summer ice thicknesses over much of the western Arctic basins, and will give a snapshot of regional variability. Coincident upward-looking side-scan sonar imagery will also be obtained. The side scan information is qualitative, but it can be used to determine ice type distribution, and the extent and orientation of leads and ridges. These can be compared to satellite derived parameters.

2.2.2 Ice Deformation and Evolution: An important component of the ice studies will be a grid survey of a 100 x 100 km area, which among other things will provide a test of how well single profiles represent two dimensional statistics. The areas will be circumscribed with an array of Argos buoys (to be deployed from aircraft). These buoys will monitor deformation of the ice cover through satellite telemetered positions updated daily. Ice draft surveys will provide a detailed definition of the initial ice thickness distribution within the areas to be monitored. One of the buoys, instrumented to measure salinity and temperature in the upper 300 m of water, will be deployed to estimate of heat flux, and melting and freezing at the base of the ice. It would be desirable to locate the buoy defined region with the window of a satellite borne Synthetic Aperture Radar (SAR), which means that it will likely be the grid positioned at point "J". Using the SAR data in conjunction with the buoys will provide more precise information on the advection and deformation of the area with time, and possibly information on the ice type distribution and roughness. It is hoped that the buoy-defined area can be resurveyed during future cruises to allow the quantitative determination of the ice thickness distribution with time.

3. METEOROLOGY

3.1 Background and Objective

An international program, in which the US is participating, is establishing and maintaining a network of drifting buoys in the Arctic Ocean to provide data for real-time operational requirements and for research in meteorology and oceanography. It supports the World Climate Research Program and the World Weather Watch Program. In support of the IABP, our objective during the Summer '93 cruise will be to:

3.2 Recommended Program

- Deploy 2 Meteorological (Met) buoys in the Central Arctic Basin

The deployment region will be in the neighborhood of 84°N, 150°W. The region currently is a gap in the buoy network. The buoys will measure atmospheric pressure and air temperature at standard 2 m height. The 2 m temperature measurement is far superior to the buoy hull temperature measurement of air-dropped buoys. That is why the opportunity to make a surface deployment in such an inaccessible region is so valuable.

4. GEOLOGY AND GEOPHYSICS

4.1 Background and Objectives

From the geological perspective the floor of the Arctic Ocean is largely uncharted. There are many important, unsolved problems related to the origin of deep basins in the Arctic Ocean especially in the western basins (the Amerasian Basin) and the ridges within them. The Arctic Submarine Cruise-93 will bring important new data to bear on the critical regions that are currently very sparsely sampled.

4.2 Recommended Program

The geology and geophysics program will consist of bathymetry and gravity measurements along the traverses described in the introduction. The recommended cruise track will provide 4 crossings of the Lomonosov and Alpha/Mendeleev Ridge. The traverse closest to the Asian side of the basin is designed to cross a group of rises of unknown origin that jut out from the Chukhotsk shelf. One of the long traverses will cross the heart of the Canada Basin and allow an important comparison of gravity profiles with existing magnetic anomaly data.

The 100 km by 100 km areas that will be surveyed for ice thickness will also provide bathymetry at the same level of detail. The detail survey will be located either over the Lomonosov or the Alpha Ridge-Mendeleev Ridge (points "F" or "J"). The spacing between tracks will yield the first bathymetric and gravity survey in the Arctic Ocean at a scale that will define the trends and continuity of smaller scale structural features of the ridges. In the detailed survey area it will be essential to make at least one crossline to provide tests of closure for the gravity profiles.

5. PHYSICAL OCEANOGRAPHY

5.1 Background and Objectives

5.1.1 Hydrography and Circulation:

The upper waters of the Arctic Ocean are composed of water entering from the Atlantic Ocean through Fram Strait, water from the Pacific Ocean entering through Bering Strait, and water over a wide density range entering from the extensive continental shelf regions. The water entering from the shelf regions consists of fresh water from river runoff and sea-ice melt in the seasonal ice covered areas, dense waters formed by brine rejection during sea ice formation, and mixtures of intermediate density.

The hydrography of the region of the Arctic Ocean between the eastern end of the Lomonosov Ridge and the Chuckchi Cap is virtually unknown. The region is very important because of its proximity to the broad East Siberian Shelf and its position between the Amundsen/Nansen Basins and the Canada Basin. The Atlantic water in the Eastern Basin is thought to move eastward from Fram Strait, along the Siberian continental slope to the Laptev Sea, losing heat and descending from 100 m to 300 m. There are two possible sources for the intermediate water, Atlantic Water that comes to the surface and is cooled and freshened, or it may be formed by salinization of shelf water by freezing during winter. In the Canada Basin the Atlantic Water tends to be deeper and capped by warm relatively fresh water of Pacific Ocean and Chukchi Sea origin. In the eastern portion of the region the transpolar surface current must separate from the Beaufort Sea anticyclonic gyre.

One objective is to examine the hydrography and circulation in the central Arctic Ocean. CTD and current profile measurements along a track through the basin will give us snapshot of oceanographic conditions. Although we have deployed hydrographic buoys in a number of regions of the Arctic, we have no data from the heart of the Makarov Basin. We propose to deploy hydrographic buoys from the submarine. These will give a time series of the upper ocean hydrography and tell us the effects of freeze up and melt on the upper ocean.

5.1.2 Mixing and Heat Flux:

Vertical shear measurements indicate mixing is very low over the deep water portions of the Nansen Basin. Significant vertical mixing is found only in shallow water around the Yermak Plateau and to a lesser extent over the Nansen-Gakkel Ridge. Extrapolation of the results to the entire Arctic Basin suggests that internal wave mixing can support only a small fraction of the heat flux required to cool the Atlantic water in the Arctic Ocean. However, data is scarce in the area covered by the cruise.

A second objective is to determine where enhanced mixing occurs, particularly whether enhanced mixing rates occur over other topographic features in the Arctic.

The Arctic Science Submarine cruise will provide an excellent opportunity to determine if the internal wave energy and dissipation are enhanced over other arctic topography such as the Lomonosov Ridge, Alpha Ridge, and Chukchi Cap. It will also indicate if the low energies found previously in the deep portion of the Nansen Basin are representative of the Canadian Basin.

5.1.3 Eddies and Mesoscale Structure:

In the central Arctic Basin eddies of anomalous water have been identified and tracked from observations taken at manned ice camps, in the Beaufort Sea It is hypothesized that these eddies originated in Barrow Canyon and migrated beneath the ice to the central Arctic. These eddies are 10 to 20 km in diameter and exist between 50 and 300 m depth. The eddies are scientifically important as they transport packets of water and vorticity around the basins. The frontal features of the Arctic Ocean are generally unresolved because of the difficulty in making hydrographic measurements with fine horizontal resolution. A submarine mounted CTD would provide an excellent opportunity to detect fronts in the basin.

The third physical oceanographic objective is a census of eddies, fronts and other mesoscale structures. The submarine mounted CTD record will be examined for indications of eddies and frontal boundaries. The submarine's set and drift may be suitable for detecting the larger velocity perturbations due to eddies by careful later analysis of navigation data. If a significant mesoscale feature is found and time permits, the submarine will make traverses across it on different courses to establish its size and characteristics. These tracks would be done at reduced speed to facilitate current estimation. Ideally, two detailed eddy studies should be conducted, one in the Beaufort Sea (young eddy) and one near the pole (old eddy).

5.2 Recommended Program

5.2.1 We recommend up to 15 Surfaced Sampling Stations, including buoy deployment stations. Each Surfaced Sampling Station should require about 6-8 hours including surfacing and diving.

At Surfaced Sampling Stations CTD data and water samples will be gathered over a range of space and time scales. A traditional CTD survey will be done using a lightweight Sea Bird Electronics SeaCat CTD and small portable winch with 600 m of cable. These CTD casts will require the submarine to surface but they will not necessarily require tying up to the ice.

Expendable Current Profilers (XCP) will be deployed to measure relative velocity and temperature from 5 to 1500 m with a resolution of 5-10 m and an accuracy of about 1 cm/s. The drops will be made at the Surfaced Sampling Stations in conjunction with the CTD casts. A number of drops will be concentrated in regions of changing bathymetry.

We anticipate that the ship will be equipped with the Arctic Submarine Laboratory (ASL) CTD installed in the sail, which will provide CTD data en route. It would be beneficial to supplement the ASL unit with a Sea Bird internally recording unit for purposes of intercalibration.

We recommned that up to 35 submarine-launched expendable CTD's (XCTD) be used deployed as time permits. These instruments allow CTD profiles to be obtained without surfacing the ship, but they are not, by themselves, accurate enough for our purposes. With simultaneous samples from the internally recording Sea Bird units, it may be possible to correct the XCTD profiles. Comparison with the standard CTD will allow us to evaluate the XCTD.

5.2.2 We recommend a hydrographic buoy installation one of two possible locations: one near 80°N, 180° and the other near 84°N, 150°E. The buoys are Polar Ocean Profile (POP) buoys that measure atmospheric pressure, air temperature, and temperature and salinity at 6 depths: 10, 40, 70, 120, 200, and 300 m. In the past the buoy deployments have required 6-8 hours, including surfacing the vessel, tying up to the ice, and doing a CTD cast. We are allowing 24 hours for the installations. This allows for contingencies, a Surfaced Sampling Station, and a complete 12 bottle cast from the ice.

For the most part the exact location of the Buoy Deployment Stations will not be critical. For this reason we recommend that most of them may develop from Surfaced Sampling Stations. That is when one of several, candidate Surfaced Sampling Stations is made, the ice can be examined to see if there is a suitable spot to pull the vessel up to the ice and install the buoy. If not, we move on to the next Surfaced Sampling Station and check ice conditions. With this flexibility, we hope to avoid possibly wasting time surfacing, only to find ice conditions were not suitable for "docking" and buoy installation.

6. CHEMICAL OCEANOGRAPHY

6.1 Background and Objectives

The various sources of water described above are tagged in different ways with various natural and anthropogenic substances. These substances can be used to identify the various source waters in the Central Arctic Ocean and estimate how long it has taken for the source waters to be transported to the interior.

The surface mixed layer contains fresh water derived from river input and sea ice melt. These two sources can be distinguished using a combination of salinity, tritium and oxygen-18 to oxygen-16 ratio measurements. certain trace elements can also be used to identify river water and possibly water from specific rivers. These trace elements include Rb, Cs, Ba, Sr, Li, B, F, I and the transition metals. The residence time on the shelf and the time required for the water to be transported from the shelf regions to the interior can be determined from tritium and helium-3 measurements. The mixed layer is underlain by the halocline which consists of upper and lower layers, and halocline is underlain by the Atlantic layer. The upper halocline is identified as a nutrient maximum and is of Pacific origin. The lower halocline water is Atlantic water and can be identified by its oxygen and nitrate characteristics. Both types of halocline water form over the continental shelf regions where extensive air-sea interaction occurs and become tagged with a number of anthropogenic substances. These substances include chlorofluorocarbons (CFCs), tritium, and helium-3. All of these can be used to estimate the time for the water to be transported to the interior.

It has recently been observed that the shelf waters over the Alaska shelf acquire large methane concentrations. These apparently come from dissociation of gas hydrates in the shelf sediments during winter when the shelf is ice covered. This could be an important source for the global atmospheric methane budget and may provide another means to trace the flow of shelf water into the interior. The Atlantic layer is identified as a temperature maximum. At its entrance to the Arctic Ocean in Fram Strait, the Atlantic layer has a high anthropogenic tracer content and CFCs and the tritium/helium-3 pair can be used to estimate transit times to the interior as for the shallower water masses. Atlantic water entering both the halocline and the lower Atlantic layer has another unique tag, cesium-137. This enters Atlantic water from the Sellafield nuclear fuel reprocessing plant located on the Irish Sea and is transported northward in the Norwegian Current. Cesium- 137 measurements can be used to both identify and estimate transit times of water of Atlantic origin in the Arctic Ocean.

The objectives are to determine the distribution of the various water types that comprise the upper 600 m of the Arctic Ocean and to estimate the transit times from their source regions from measurements of the substances discussed above. Another objective of the methane measurements will be to obtain a better assessment of the importance of methane production by gas hydrate dissociation in Arctic shelf sediments on the global atmospheric inventory of methane (which is increasing at about 1% per year).

6.2 Recommended Program

Water samples will be collected for tritium, helium-3, oxygen-18 to oxygen-16 ratio, CFCs, methane and trace elements. The samples will be returned to shore based labs for analysis. Cesium-137 will be extracted at sea onto a cartridge and the cartridge returned to a shore based lab for analysis. Oxygen and nutrient analysis will be carried out by the marine biology program

Water will be collected in two ways, from bottle casts and from the sea water line while the submarine is underway. Bottle casts will be performed at each surface CTD station using about a dozen 5-liter Niskin bottles to cover the upper 600 m. All sample types except cesium can be collected in this way. Cesium samples require at least 30 liters of water and preferably more. They will be collected from the sea water line through a cartridge and then back to the sea. Vertical profiles in the upper 130 m will be obtained by sampling when the submarine is at different depths.

7. BIOLOGICAL OCEANOGRAPHY

7.1 Background and Objectives

Biological studies will provide input into water mass identification, as well as, baseline data on sub ice and water column, community structure, diversity, biomass and dynamics in the Central Arctic Ocean.

7.2 Recommended Program

Water samples will be collected for chemical and biological analyses. The samples will be obtained at intervals, using the submarine's sea water system during traverses and during ascents to and descents from the surface. Discrete samples will be collected at Surfaced Sampling Stations using a wireline to depths of 600 m. Whereas most of the water samples will be preserved for later detailed analysis at U.S. institutions, opportunities may be available for on-site detailed sampling and experimentation during prolonged surfaced stations.

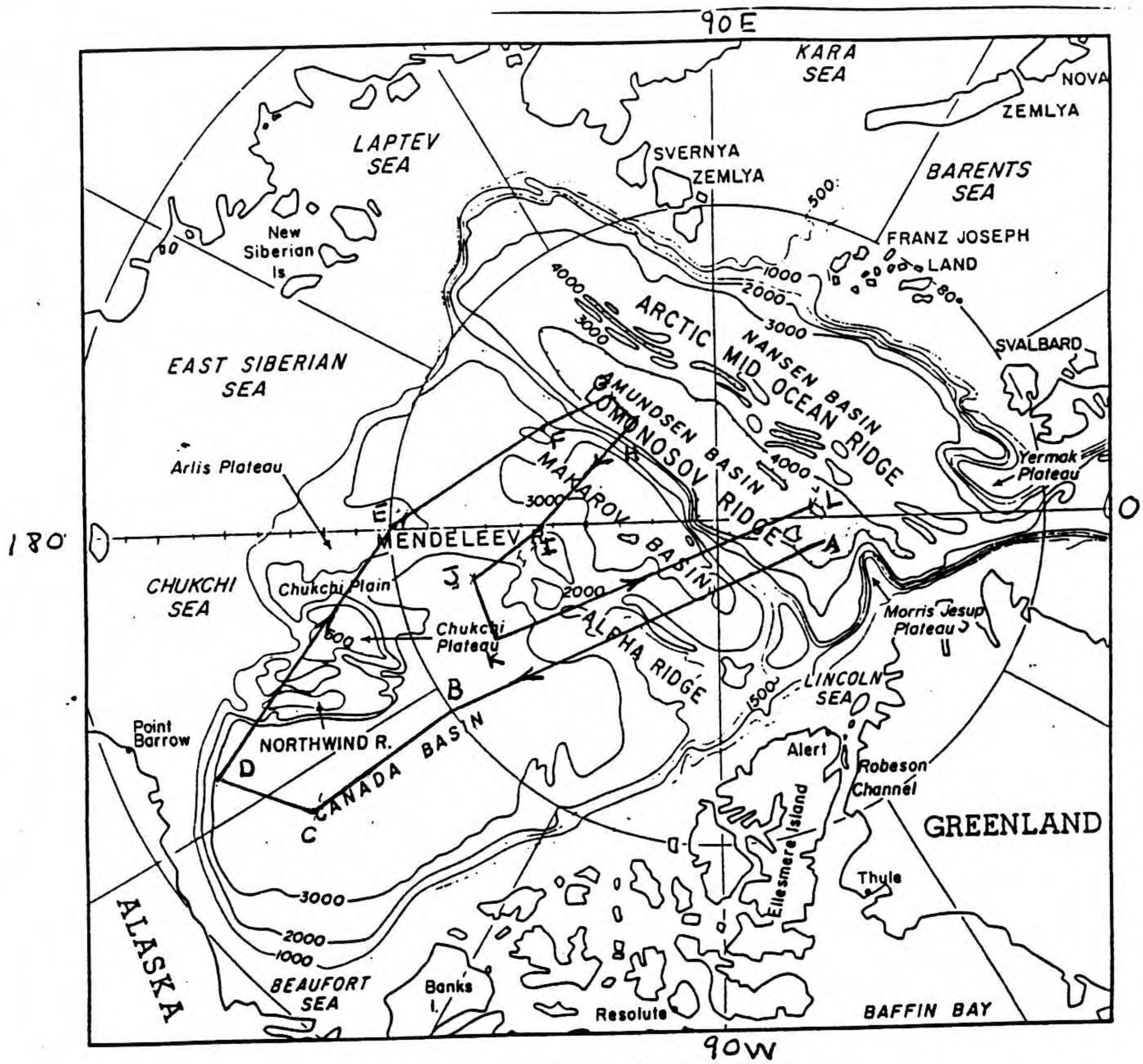


Figure 1. Overview map of the Arctic Ocean.

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