Advanced Tethered Vehicle (ATV) Meeting

SUMMARY REPORT

Tuesday, 16 September 1997
1:00 - 5:30 PM

National Science Foundation
Boardroom
4201 Wilson Blvd.
Arlington, VA

Advanced Tethered Vehicle (ATV) Meeting
Boardroom, National Science Foundation
4201 Wilson Blvd., Arlington, VA
Tuesday, 16 September 1997
1:00 - 5:30 PM

Appendices

I. Meeting Agenda
II. Meeting Participant List
III. DESSC Memo to Agency Reps dated July 21, 1997
IV. West Coast and Polar Regions Undersea Research Center - Navy Asset Summary
V. Hypsometry of all Ocean Basins and Trench Depths
VI. ATV Hardware Status and SIO Cost Considerations
VII. WHOI ATV Discussion

1. Welcome & Background - Bob Knox, Scripps Institution of Oceanography (SIO), opened the meeting by welcoming the participants and reviewing the background and purpose of the meeting. The meeting was initiated by SIO, with cooperation, consultation and assistance from UNOLS/DEep Submergence Science Committee (DESSC), UNOLS Office, federal agencies and meeting participants. The agenda is included as ***Appendix I*** and the list of meeting participants is included as ***Appendix II***. The purposes of the meeting were to:

a) Learn the latest information on the Navy's plans to decommission ATV and to dispose of the vehicle, and its spare parts and associated equipment inventory. Further, under the assumption that the vehicle may be made available to the academic community:
b) To hear discussion by various interested parties as to what the future of the vehicle should be, and to discuss future science potential, deep submergence community needs, operational and funding possibilities, and facilities impacts;
c) To hear particular plans/projections from SIO/MPL as to how they could constitute a new ATV operating entity, and of the science they envision under this new management straw plan;
d) To hear from other participants regarding points in (c) and alternative views thereof;
e) To develop consensus plans and recommendations to agencies, insofar as possible, and/or to lay groundwork for further meeting(s) to formulate or refine such plans and recommendations for use of ATV.

2. DESSC involvement to date, response to ONR question about ATV future, results of survey - an initial deep submergence science community perspective - Mike Perfit, UNOLS/DESSC Chair, reported that DESSC supported Bob's initiation of

the meeting. Mike provided a brief overview of DESSC's involvement in the ATV discussion to date. In March 1997, the DESSC and the SEA CLIFF Working Group were informed that the Navy was considering plans to retire ATV. At the June UNOLS Council Meeting, DESSC was requested by the agency representatives to investigate the community's interest in using ATV for science. DESSC was also asked by the agencies to apply the results of their SEA CLIFF survey to provide an initial response regarding ATV. The survey had indicated that there was significant community interest in using ROVs for their deep submergence work. The survey also indicated that it was important to maintain ALVIN and to not jeopardize its capabilities. The DESSC deliberated on the subject of ATV briefly at their July DESSC meeting. Following the meeting, a memorandum dated July 21 (see ***Appendix III***) was sent to the agencies by DESSC indicating that they believed that ATV, its equipment and components should be available for academic use and that they should be given the opportunity to evaluate the system.

3. Office of Naval Research (ONR) Update on ATV Status, Condition, Decommissioning Plans/Options from Navy Viewpoint, Navy experience of ATV capabilities, Strengths and Weaknesses - Sujata Millick (ONR) provided a review of the Navy's plans for retirement of their deep submergence vehicles. TURTLE will be retired by the end of September, 1997; SEA CLIFF is scheduled to be retired in September 1998 and ATV is slated for retirement in October 1998. The Navy has determined that they will not need the manned vehicles for the search and rescue operations.

Sujata reported that in July, ATV had been damaged in a collision with its support ship. The Navy made a decision to repair the vehicle and return it to service.

ONR would like the community's input on the following:

- Evaluate the value of ATV and its usefulness for deep submergence research.
- How do the science needs play into this factor?
- How does agency funding factor into it?

The agencies have been tasked to project their deep submergence needs/mission for the future.

A discussion followed and it was noted that the community would need to know how ATV has been used in the past. Sujata indicated that San Diego's ATV maintenance team can provide the pros and cons of ATV. She also indicated that ATV will come with all parts, spares and documentations.

Sujata then reviewed the process of disposal. Any decision to use the ATV as a science ROV would be an interagency decision. If all agree that the vehicle would be best used for science, ATV would most likely be transferred to ONR (it is doubtful that the Navy

would be interested in operating it themselves). An operating arrangement similar to that used for ALVIN would most likely be the model. A user fee would be charged. The vehicle would be available for Navy search missions, although these operations can be expected to be rare.

4. NURP-NOAA experience, present use and future hopes/plans re ATV. Possible Future Link with USCG - Ray Highsmith, West Coast & Polar Regions Undersea Research Center/University of Alaska-Fairbanks, gave a summary of NURP's experiences using the Navy's assets. His view graphs are provided as ***Appendix IV***.

He began by reporting that ATV recently received a new tether system and that the support ship's A-Frame will come with the vehicle. Ray provided a map of the West Coast showing the research operational sites for the Navy DSVs from 1994 to 1997. The Navy vehicles were used 29 days in 1994, 57 days in 1995, 74 days in 1996 and 63 days in 1997 (Note: Actual 1997 use will be substantially less than 63 days due to weather and priority Navy requirements for the vehicle). These yearly totals include transit time plus days on station. The charter rate for these days was approximately $5,500 per day which covered consumables. There are 55 days scheduled for 1998 work. Next, Ray provided a breakdown of the number of dives per vehicle (ATV, TURTLE, SEA CLIFF) by year along with the bottom time totals in hours. In these operations, ATV was taken to approximately 4,000 meters depth. Strides were made each year by the Navy in improving the vehicles and their associated components. Scheduling for this year's operations has been difficult. Many of the problems have been a function of rotating crews. There has been little development of long term personnel experience.

Ray Highsmith concluded by pointing out that it is unlikely that NURP will be able to use ATV if they have to pay the full daily costs for the vehicle and its support ship.

Possible future Link with USCG - CDR George Dupree, USCG, reported that the Coast Guard has no interest in acquiring ATV. However, they would be happy to bring the vehicle aboard one of their ships during "Science of Opportunity" cruises. The Coast Guard's new ice breaker, HEALY, currently under construction would be a good platform. In 1999, HEALY will operate in the ARCTIC in a Science of Opportunity mode.

5. ATV science opportunities, plans, projections, likely participants - a SIO/MPL perspective - Peter Lonsdale provided SIO/MPL's perspective on ATV. He began by stating that ATV as a science platform can perform better than SEA CLIFF and TURTLE. ATV can reach 6,000 meters which covers 98% of the ocean bottom. Researchers have indicated that they need to go to the deeper depths. In the SEA CLIFF survey, one third of those responding indicated that they were content to go to 4,500 meters. The survey also showed however, that there is an additional third that

would like to go to 6,000 meters. The report also indicates that the community is not sure whether SEA CLIFF is the right vehicle to take them to 6,000 meters.

Peter gave examples of areas where greater depth capability is needed, see ***Appendix V.*** For work in the trenches, only the young crust, thick sediment trenches of Cascadia and Columbia are accessible using ALVIN. With ATV the old crust, thick sediment trenches of Nankai, Barbados, and East Aleutian would also be accessible. It was pointed out that even with a 6,000 meter vehicle, the trenches of Japan, West Aleutian, Kurile, Tonga and the Mariannas would still be out of vehicle range. In Peter's opinion, deep submersible research geologists would prefer to use ROVs as opposed to human occupied vehicles. ROVs can go down to depth and stay down without the power limitations of HOVs.

ROVs are a great tool for deep sea observatories. They are more versatile in that they are not dedicated to a single platform. ROVs can be supported by numerous vessels allowing them to serve as quick response tools for geological events.

Lastly, Peter provided a list of reasons why ATV should operate at Scripps:

- The vehicle should operate in the Pacific.
- Much of the deep water is in the Pacific.
- Many of the deep trenches are in the Pacific.
- The Pacific is best monitored for geologic events.
- There are established observatories.
- NURP has an eager group of scientists that have used ATV and would like to continue using the vehicle.
- NOAA's Vents Program in the Pacific can be supported by ATV. ATV can use RON BROWN as a platform.

Mike Perfit added that there are other critical research areas other than trenches. There are transform faults and back arc areas.

6. ATV Operational Practicalities - technical requirements, costs, existing expertise and capability: a SIO/MPL perspective - Christian deMoustier (SIO/MPL) lead this discussion by asking three questions: (1) Can we use such a vehicle? (2) Can we afford it? and (3) How do we make it happen? Chris gave a brief description of the components associated with ATV, see ***Appendix VI.*** These include a lift winch, new cable (7000m), a Dynacon winch, floats, hydraulic power unit, four vans, a handling system, and an A-Frame. The system is portable, requires 12,000 square feet of deck space, and weighs 110,000 lbs installed. It can be supported by all of the new AGORs. It can also be supported by NEW HORIZON. The ATV's tether is heavier than the one used with Jason and is used with floats for buoyancy on the 100 m of cable adjacent to the vehicle. ATV is an evolving system and a number of things have been upgraded. In 1997, the upgrades included improvements to the Dynacon winch and

hydraulic power unit, turning sheave, and telemetry. Various additional upgrades are under consideration.

Chris continued by reviewing the various cost considerations associated with ATV, see ***Appendix VI.*** The costs were broken down by maintenance, mobilization/ demobilization, expendables, and personnel salaries at sea. Maintenance was estimated at $60K per year. Mobilization, putting the system on and off the ship and storage, is estimated at $21.3K. Expendables, which includes items such as disk drives, batteries, etc., is estimated at $12.5 k per trip. Personnel salaries at sea for four MPL and two OTEC personnel was estimated at $2.9k during transit and $3.6k per day during operations. On average, the daily rate for the system would be approximately $5k per day in and out of San Diego. The cost figures and staffing levels were based on SIO experience with two separate Deep Tow operations involving different vehicles, carried out in the summer of 1997. When the system is in storage, there would be no cost. Costs for shipping the systems to other ports was not included in the fees. There would be no amortization. Proposals to the agencies could be expected in the out years for upgrade and replacement of ATV's components. Chris noted that under SIO operation it would be effective to partner with OTEC, the local technical support company that has long experience of ATV operations and maintenance support to the Navy, and also to tap into the San Diego area pool of experienced ROV pilots.

7. Viewpoints of WHOI/National Deep Submergence Facility re ATV - Dick Pittenger began the WHOI discussion with a brief overview of ATV and its support systems. His viewgraphs are included as ***Appendix VII.*** A series of diagrams showing ATV and its components were provided. A table of the components, their weights and COG were also provided. Although the A-Frame is large, it can be palleted. The total weight of the palleted system i.e., the shipping weight, is approximately 172,000 lbs.

Next Dick provided the pros and cons of ATV. The pros included ATV's topside handling system, tether, user friendly manipulators, vans, mission electronics (cameras, sonars, lights) and large basket space. The cons list categorized the ATV as a large, bulky system which was not optimized for science. The control electronics and software are 1970's vintage and probably no longer made. It uses only one of its three fibers for telemetry. With rotating Navy personnel, the corporate memory may not accompany the vehicle. The pressure housings are large, the hydraulic system noisy and complicated and the navigation system would require improvements. Additionally, there has been a history of tether breaks.

There is also a number of unknowns associated with ATV. Dick mentioned that it is unknown what if any documentation and spares would accompany the vehicle. (Note: that in the ONR report (Item #3), Sujata indicated that the vehicle would come with spares and documentation.) Other unknowns include details on ATV's electrical power system, power propulsion, hydraulic system, and navigation and closed loop control.

Dick provided WHOI's views on priority areas for ATV's modernization and upgrade. These included telemetry, control electronics, navigation, hydraulics, power supplies and science capabilities. He then reviewed the future potentials of ATV. Without hardware and software changes, ATV could serve as a heavy lift, 6000m ROV with ALVIN-like capability. Its reliability and functionality are unknown. With major upgrades, ATV could be a pathway to a new science ROV. It would need to be enhanced for added reliability and reconfigured for a full science capability. Before any investment, it would be useful to investigate the market for new ROVs with respect to cost and capabilities.

Next, Dick reviewed the history of ALVIN and ROV use since 1986. ALVIN use averages at 150 days a year with light use years during overhaul periods. He then presented a viewgraph showing the use of various other deep submergence vehicles since 1990 by year. Dick raised the questions: Is this a reasonable representation of use demand? How many days are being left on the shore? He showed the cruise tracks for ATLANTIS II for 1990 through 1996. Operations have been in the traditional North ATLANTIC and North Pacific regions.

Dick highlighted some of the advantages of WHOI serving as the operator of ATV. The WHOI National Deep Submergence Facility (NDSF) is already part of the Navy's SUBMISS/SUBSUNK SAR system. All ALVIN dive operations are coordinated with Navy and they are on call in times of emergency. If ATV is added to the NDSF, it would add to and sustain this national responsibility. It would keep the critical core of highly trained/skilled people at WHOI. WHOI would be able to operate ATV at several levels, such as: a minimum/demo level; a supplement to NDSF using the same people for all vehicles; or ATV could fill-in during ALVIN's overhaul periods. ATV at WHOI sustains SUBMISS/SUBSUNK SAR capability. WHOI would commit to aid progressive modernization and upgrade of ATV leading to the "next-generation ROV."

WHOI provided their operational and cost strategies for ATV. Personnel support would include one FTE on shore and eight people at sea. The expertise and experience of the ALVIN group would be used for ATV operations.

Karen Von Damm, who was attending the meeting as RIDGE chair, stated that demand for a science ROV is there. However, there is the question of funding. We need to determine what the community needs and wants.

8. Break - after a brief break, the meeting resumed.

9. DESSC views on ATV's fate; working toward a coherent plan for the deep submergence community - Mike Perfit reported on DESSC's views on ATV's future as a science tool. The community has indicated a need for a 6000 m ROV for science. Research in observatories competes with expeditionary science. The community needs to be able to research the Southern Oceans, Southern EPR and the Western Pacific. It

is proving to be impossible to do expeditionary science without the availability of another facility.

Mike warned that we still need to know more about the science capabilities of ATV. There has been very few papers published on the science conducted with ATV. He requested that information on the science capabilities of ATV be available to the community prior to the December DESSC Meeting. Chris indicated that he had a booklet of the vehicle's capabilities. However the booklet does not include some of the upgrades that have recently been incorporated into the system. It was suggested that perhaps representatives from DESSC, WHOI, and SIO should visit the ATV facility in San Diego to become more familiar with the system. Mike asked the questions of whether or not there are other ROVs available that might serve as a better science tool. He also expressed concern that ATV might dilute the funding for the NDSF?

There was a brief discussion on ALVIN versus ATV as a science tool. There is concern that while trying to bring ATV on-line, both systems will be compromises. However, the community would probably agree that it is worth a try to add a 6,000 m capable ROV.

10. Further comments by agencies, and Q&A opportunity - ONR: Pat Dennis commented that this meeting was very positive. The heads of agencies through FOFCC will look at the facilities. The agencies will request that the Navy provide ATV's spare parts with the system. This is an opportunity to take a chance. The community needs to look ahead.

NOAA/NURP: Barbara Moore cautioned the group that in adding ATV to the suite of science tools available there may be a financial strain on the system. For NURP, the more money put towards facilities, the less available for science.

NSF: Don Heinrichs commented that NSF does not put funds into facilities unless there is a need to. He suggested that the community should accept the asset and mothball it until a plan to proceed can be developed.

11. General Discussions and meeting outcome: Identification of additional information needed by DESSC, agencies, or science community; any specific recommendations emerging from this meeting; next steps and future meeting(s) - To conclude the meeting the group made suggestions on how to proceed. They agreed that a day trip to San Diego to visit ATV would be worthwhile. A preliminary package for a DESSC forum in San Francisco should be collected and distributed. The future plans for ATV could be previewed at the December DESSC meeting. This would be a major agenda item at the meeting.

Fred Speiss indicated that the community should agree to take ATV. Bob Knox confirmed that if SIO were given operation of ATV it would put up to $200,000 in

non-federal funds into the initial operation/demonstration of the vehicle and its deployment on a SIO ship.

There was a general discussion on the steps ONR will take in acquiring ATV. Sujata indicated that it would need to be an interagency discussion to acquire ATV. If the asset is offered to ONR, then by the MOU, they will be required to communicate with the other agency representatives.

FOFCC plans to meet in October and the ATV will be addressed. It was requested that the agencies keep DESSC, WHOI and SIO informed about the process. This is a data collection phase. The UNOLS Office was requested to create an ATV Website describing its capabilities. An ATV discussion at the fall DESSC Meeting is also planned.

The meeting was adjourned at 5:30 p.m.

POST-MEETING ACTIVITIES

Since the meeting, the Navy has been reconsidering whether to decommission the ATV. As a result, follow-up actions such as establishment of a web page and discussion at the December DESSC meeting are being held in abeyance pending an official statement from the Navy as to ATV's availability.

ADVANCED TETHERED VEHICLE (ATV) MEETING

Boardroom, National Science Foundation
4201 Wilson Blvd.
Arlington, VA
Tuesday, 16 September, 1997
1:00 - 5:30 PM

MEETING TO CONSIDER THE POTENTIAL ROLE OF THE NAVY'S ADVANCED TETHERED VEHICLE (ATV) FOR DEEP SUBMERGENCE SCIENCE WITHIN THE ACADEMIC COMMUNITY

Initiated/organized by Scripps Institution of Oceanography, with cooperation, consultation and assistance from UNOLS/DESSC, UNOLS Office, federal agencies and meeting participants.

PURPOSES OF MEETING:

a) To learn the latest information on the Navy's plans to decommission ATV and to dispose of the vehicle, and its spare parts and associated equipment inventory. Further, under the assumption that the vehicle may be made available to the academic community:

b) To hear discussion by various interested parties as to what the future of the vehicle should be, and to discuss future science potential, deep submergence community needs, operational and funding possibilities, and facilities impacts;

c) To hear particular plans/projections from SIO/MPL as to how they could constitute a new ATV operating entity, and of the science they envision under this new management straw plan;

d) To hear from other participants regarding points in (c) and alternative views thereof;

e) To develop consensus plans and recommendations to agencies, insofar as possible, and/or to lay groundwork for further meeting(s) to formulate or refine such plans and recommendations for use of ATV.

AGENDA

1. **Welcome. Background; SIO initiation of this meeting.**
   R. Knox, SIO and UNOLS Council
   (1:00 - 1:10)

2. **DESSC involvement to date, response to ONR question about ATV future, results of survey - an initial deep submergence science community perspective.**
   M. Perfit, University of Florida and DESSC Chair
   (1:10 - 1:20)

3. **ONR update on ATV status, condition, decommissioning plans/options from Navy viewpoint. Navy experience of ATV capabilities, strengths and weaknesses.**
   S. Millick, ONR and LCDR J. Newton, N87, plus possible other Navy participant(s)
   (1:20 - 1:40)
   Discussion (1:40 - 1:45)

4. **NURP-NOAA experience, present use and future hopes/plans re ATV. Possible future link with USCG.**
   R. Highsmith, West Coast & Polar Regions Undersea Research Center/University of Alaska - Fairbanks and CDR G. Dupree, USCG (tentative)
   (1:45 - 2:05)
   Discussion (2:05 - 2:10)

5. **ATV science opportunities, plans, projections, likely participants - a SIO/MPL perspective.**
   P. Lonsdale, SIO/MPL
   (2:10 - 2:30)
   Discussion (2:30 - 2:35)

6. **ATV operational practicalities - technical requirements, costs, existing expertise and capability: a SIO/MPL perspective.**
   C. de Moustier, SIO/MPL
   (2:35 - 2:55)
   Discussion (2:55 - 3:00)

7. **Viewpoints of WHOI/National Deep Submergence Facility re ATV.**
   R. Pittenger, WHOI and UNOLS Council; other WHOI attendees
   (3:00 - 3:20)
   Discussion (3:20 - 3:25)

8. **BREAK** (3:25 - 3:40)

9. **DESSC views on ATV fate; working toward a coherent plan for the deep submergence community.**
   M. Perfit, University of Florida and DESSC Chair
   (3:40 - 4:00)
   Discussion (4:00 - 4:05)

10. **Further comments by agencies, and Q&A opportunity: ONR, NSF, NOAA, USCG (tentative).**
    S. Millick, ONR; D. Heinrichs and E. Dieter, NSF; NOAA representatives; USCG representatives
    (4:05 - 4:30)

11. **General discussion and meeting outcomes: identification of additional information needed by DESSC, agencies, or science community; any specific recommendations emerging from this meeting; next steps and future meeting(s).**
    (4:30 - 5:30)

Adjournment

ATV Meeting - September 16, 1997

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UNIVERSITY-NATIONAL OCEANOGRAPHIC LABORATORY SYSTEM

An association of institutions for the coordination and support of university oceanographic facilities.

MEMORANDUM

Date: July 21, 1997

To: E. Dieter, NSF
S. Millick, ONR
G. Smith, NOAA

From: The DEep Submergence Science Committee
(M. Perfit- Chair, J. Bellingham, R. Collier, P. Fryer, M. Lilley, H. Milburn, D. Orange, C. Van Dover, C. Wirsen)

Cc: DESSC
R. Knox, SIO
WHOI - DSOG

Subject: **Preliminary Response From DESSC Regarding Community Interest In Obtaining The U.S. Navy's Advanced Tethered Vehicle (ATV) For Use In Academic Research Programs**

In response to a request by representatives of U.S. Federal Agencies that support deep submergence science, the DEep Submergence Science Committee (DESSC), at its recent meeting (July 16-18, 1997) deliberated on how the academic research community could utilize ATV after it is decommissioned by the Navy in 1998. DESSC is well aware of the needs of academic science and the projected requirements for deep submergence vehicle systems and facilities to meet those needs. A recent DESSC survey and Working Group report have documented the important science to be done at depths to 6000m, and the critical need to acquire routine access to these depths using a human occupied vehicle (HOV) and a remotely operated vehicle (ROV). *In line with these findings, DESSC believes that ATV and its components, spare parts and documentation should be provided to the academic community for routine use.*

The important decisions regarding how best to utilize ATV for science, and how to operate it most cost effectively require that the funding agencies and the science community gather information regarding all operational aspects of the vehicle so that its past history, science capabilities, present and projected cost of operation, and facility/support requirements can be documented and evaluated.

In accordance with the DESSC's overall plan to include the perspectives and requirements of the deep submergence research community in the decision making process, the DESSC supports the idea that a meeting, to discuss the availability and use of

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ATV, should take place prior to the UNOLS Council Meeting in September, 1997. In the interim, the DESSC suggests that NOAA representatives assist Scripps scientists with an interest in using ATV in compiling the information on ATV and distributing it to the parties attending the September meeting. Ideally, that information should include the following:

1. Detailed technical characteristics and capabilities of ATV.
2. Operational and facility requirements.
3. Summary of all systems intended to be decommissioned.
4. Short statements of recent experience from science users of ATV indicating pros and cons of the system for their field programs.
5. Rough estimates of operational costs.

West Coast & Polar Regions Undersea Research Center

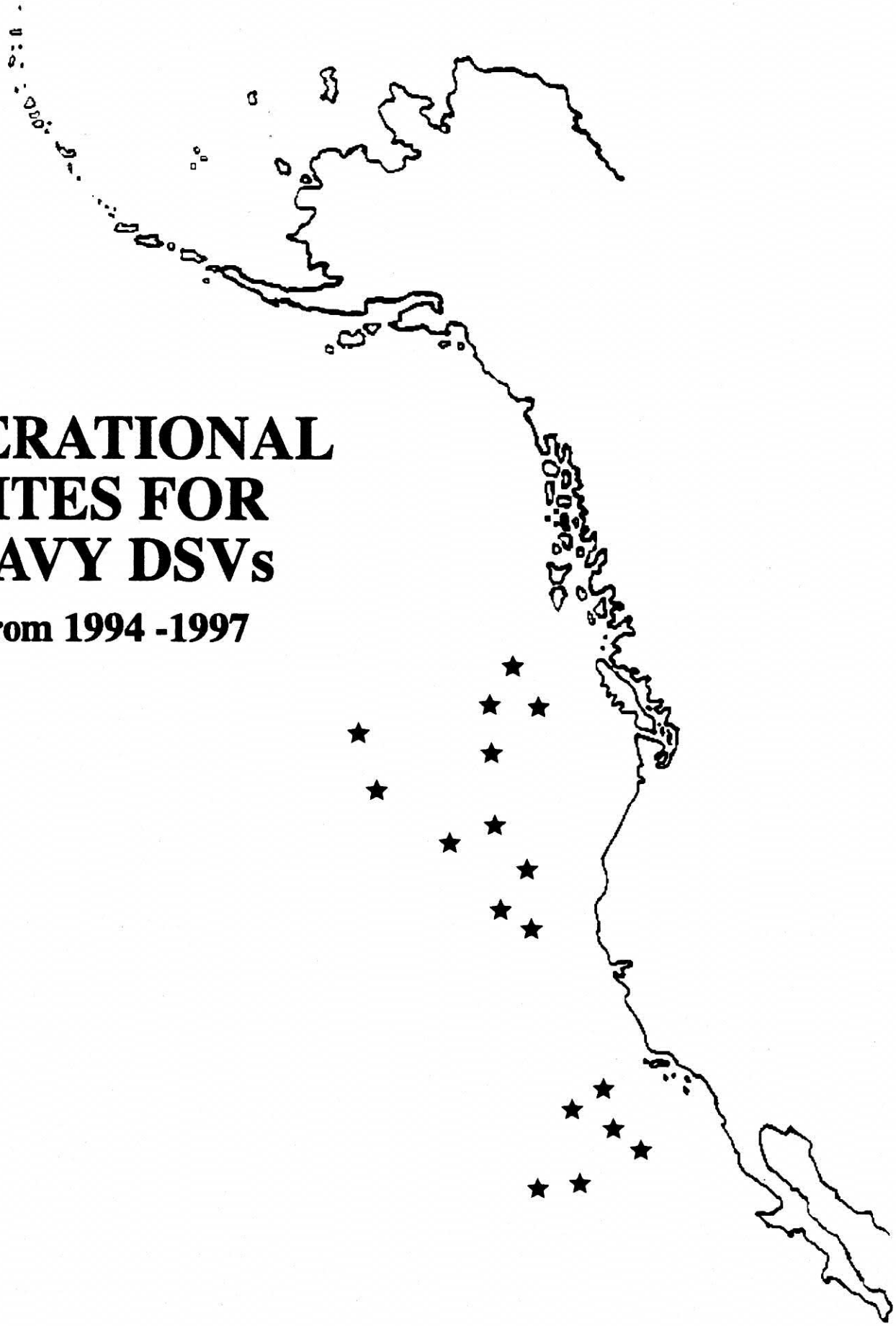
School of Fisheries and Ocean Sciences

UNIVERSITY OF ALASKA FAIRBANKS

Established 1990

OPERATIONAL SITES FOR NAVY DSVs

from 1994 -1997

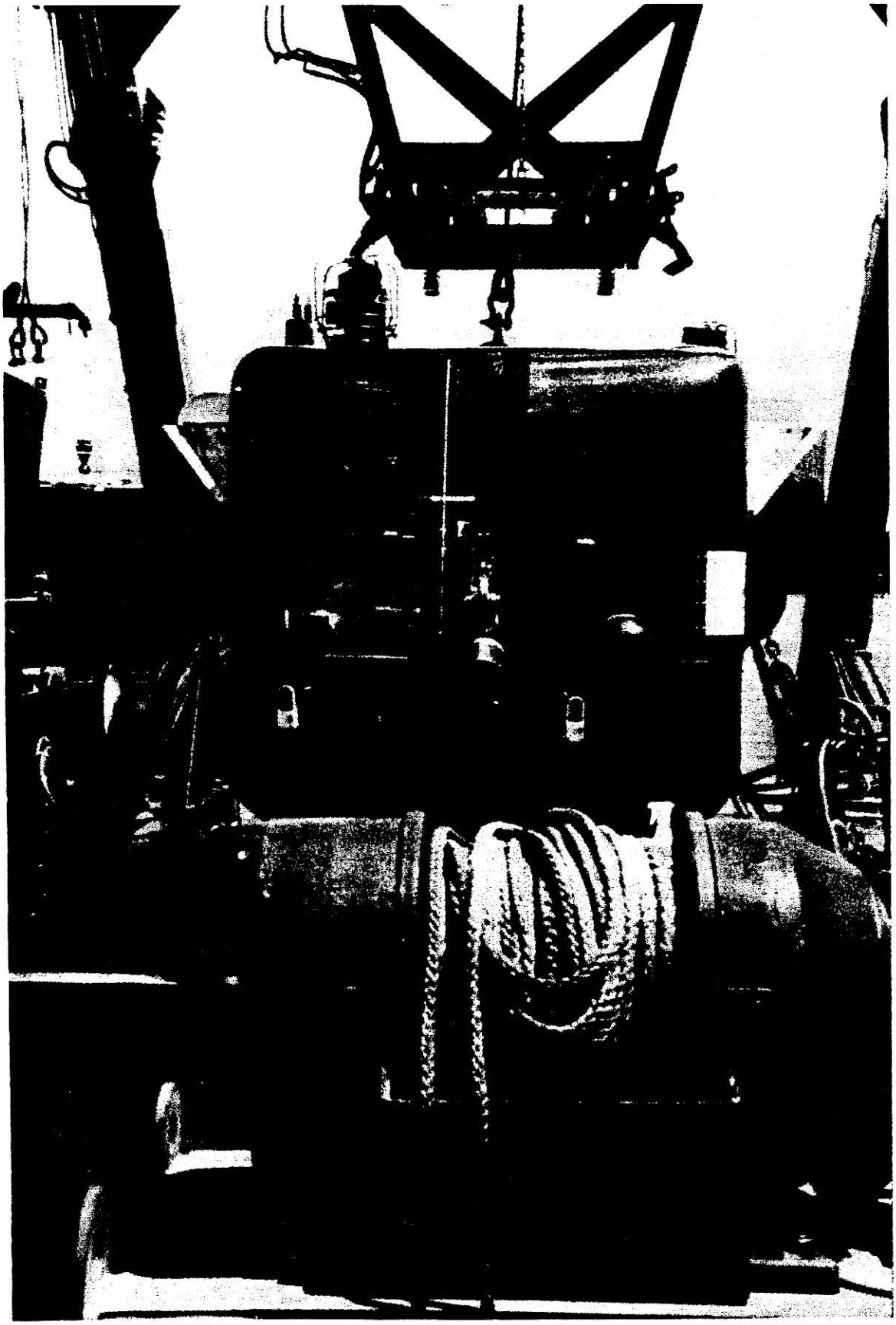


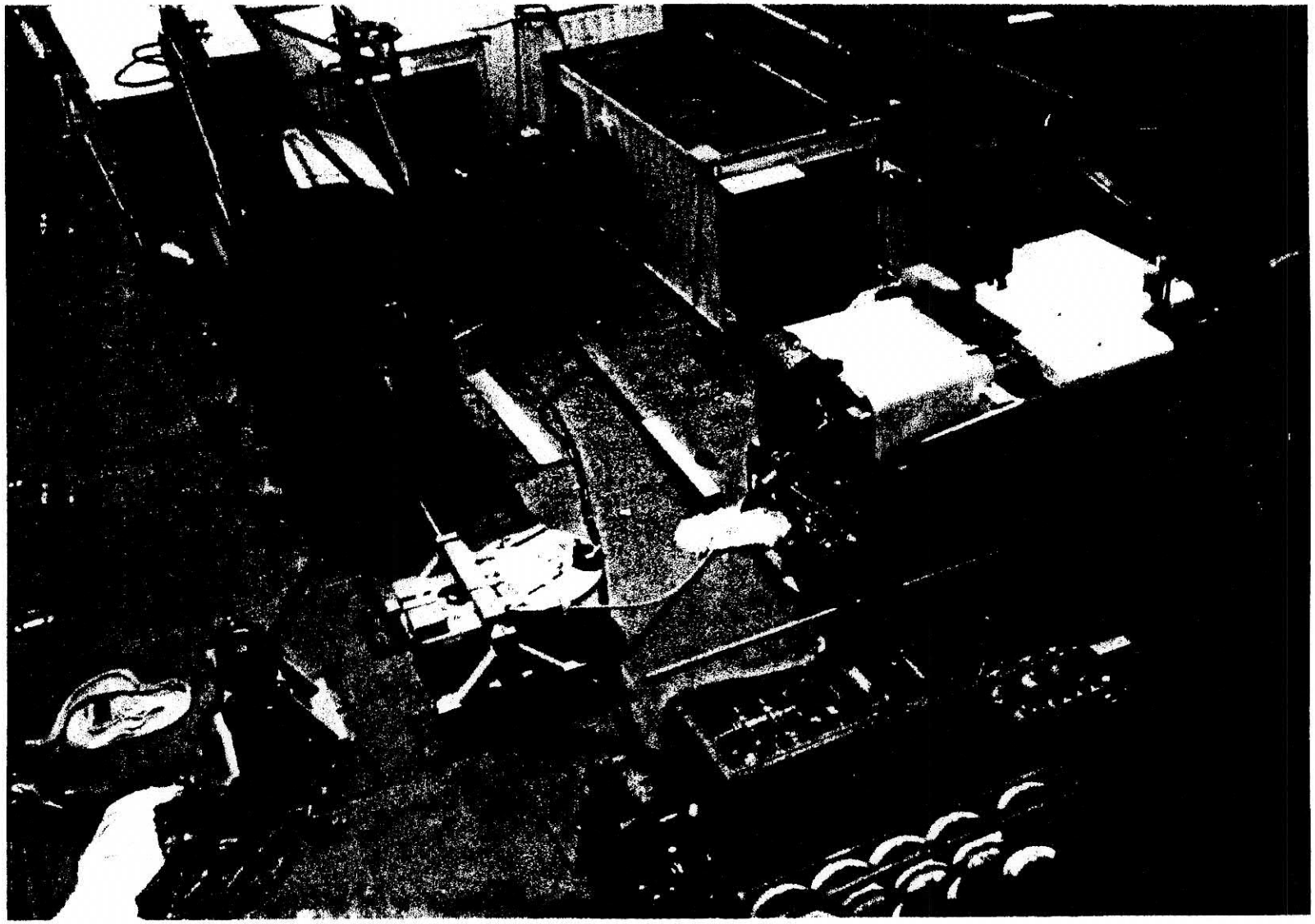
NAVY CHARTER DAYS

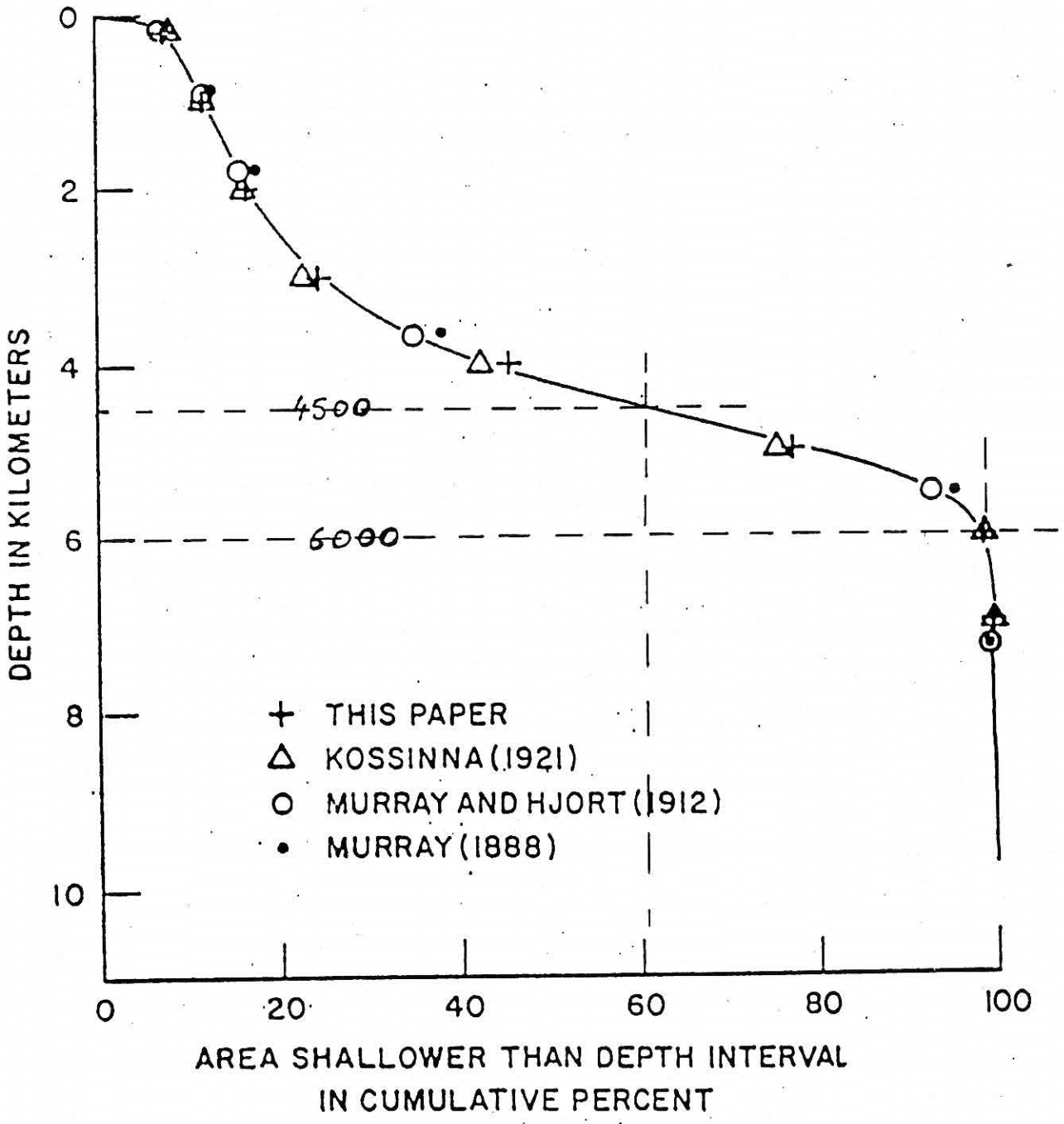
Year	Days
1994	29
1995	57
1996	74
1997	63

NURP DIVES

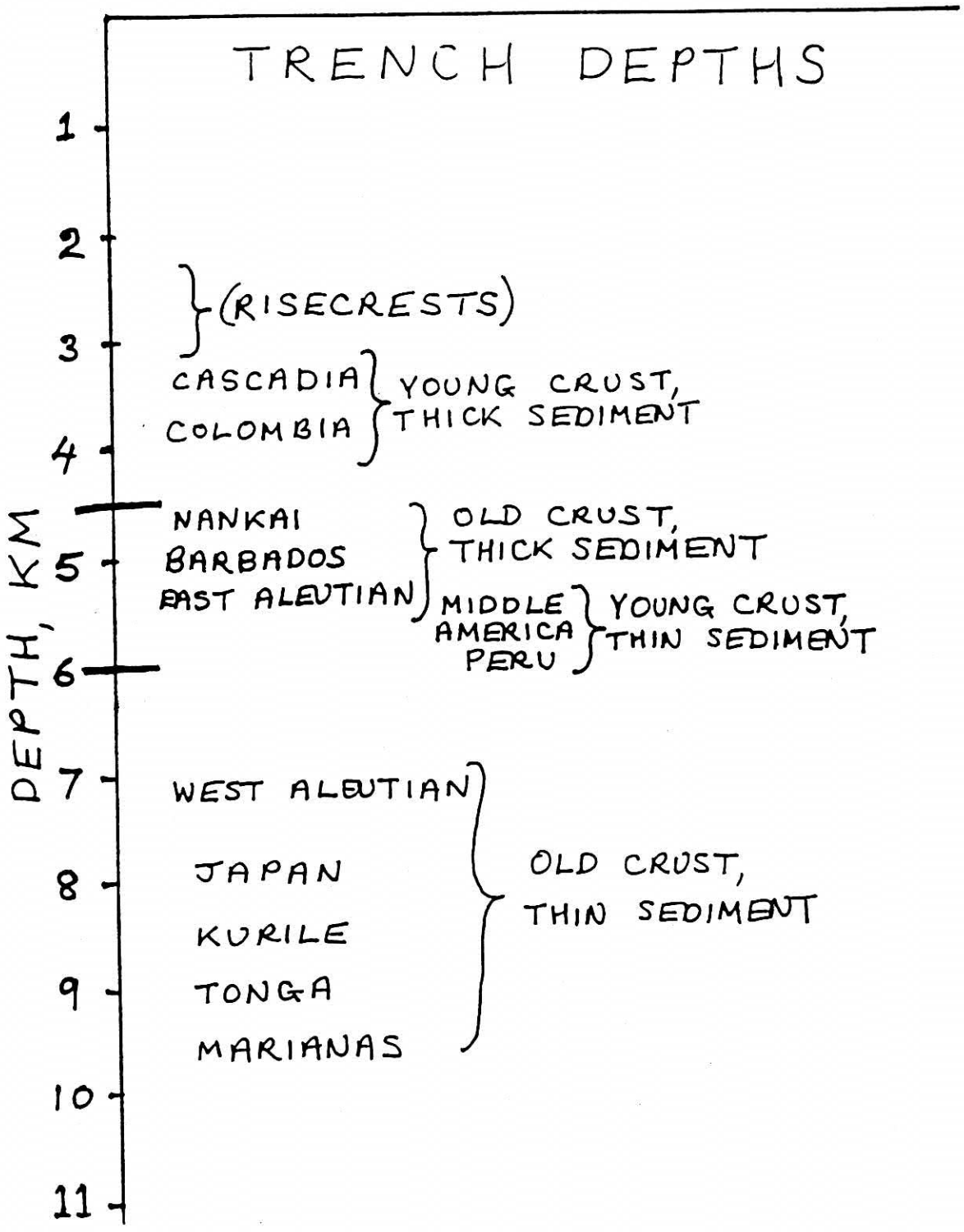
1994	#Dives	Bottom Time (hrs)
ATV	21	308
TURTLE	9	50
SEA CLIFF	4	24
1995		
ATV	33	294
TURTLE	7	48
SEA CLIFF	20	123
1996		
ATV	14	208
Super Scorpio	8	124
SEA CLIFF	12	125







Hypsometry of all ocean basins according to various studies.


TRENCH DEPTHS
DEPTH, KM
1
2
3
4
5
6
7
8
9
10
11
(RISECRESTS)
CASCADIA
COLOMBIA
YOUNG CRUST, THICK SEDIMENT
NANKAI
BARBADOS
EAST ALEUTIAN
OLD CRUST, THICK SEDIMENT
MIDDLE AMERICA
PERU
YOUNG CRUST, THIN SEDIMENT
WEST ALEUTIAN
JAPAN
KURILE
TONGA
MARIANAS
OLD CRUST, THIN SEDIMENT

ATV HARDWARE STATUS

- Upgraded in 1997:

  Dynacon Winch + hydraulic power unit

  Tether (7000 m)

  Turning sheave

  Telemetry

- Upgrades to be considered:

  Ram tensioner (use Dynacon slack tensioner)

  Lift winch

  Launch and recovery station

  Custom hydraulics valves

  Custom electronics PCBs

COST CONSIDERATIONS

- Maintenance (60% parts, 40% labor) $60k/y
- Mobilization/demobilization $21.3k
- Expendables $12.5k/trip
- Personnel salaries at sea(4 MPL, 2 OTEC) $2.9k-$3.6k /day

Days/year	Mob/demob	Trips	Daily rate @8H/12H
60	1	2	$4.6k/$5.3k
60	2	2	$5k/$5.7k
120	4	4	$4.5k/5.2k

Woods Hole Oceanographic Institution

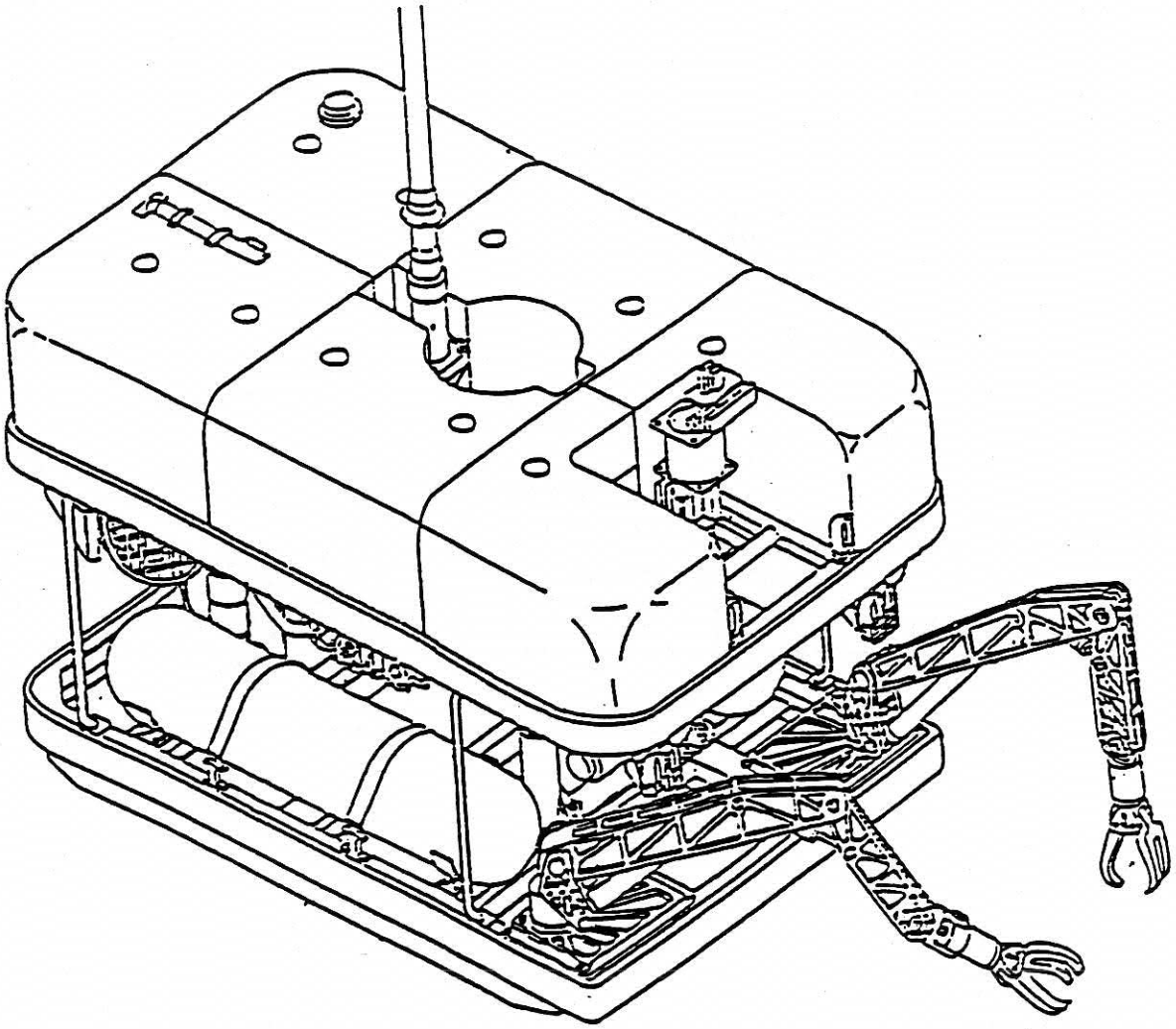
National Deep Submergence Facility

ATV Discussion

by
Richard F. Pittenger
Associate Director for Marine Operations

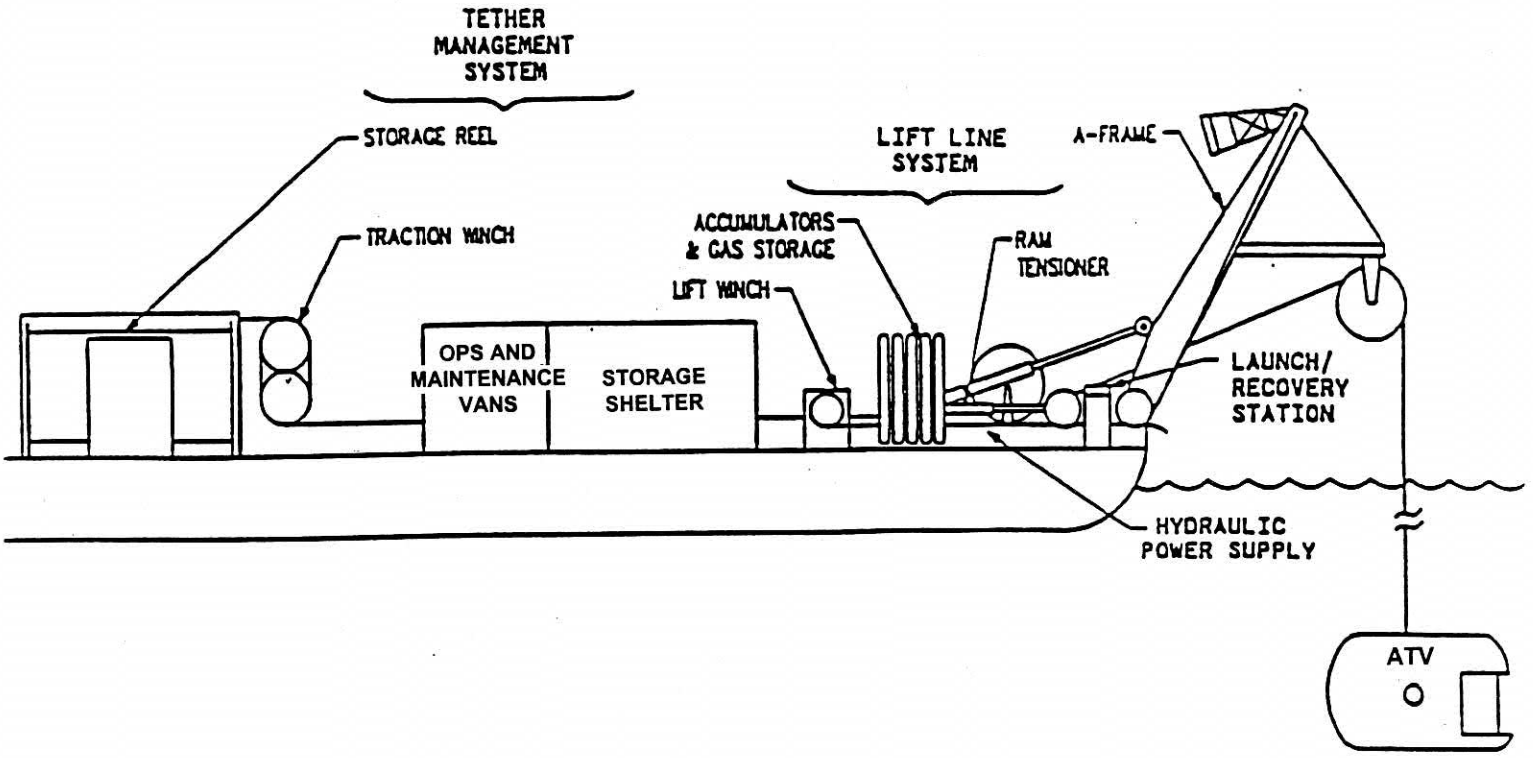
16 September 1997

ATV Discussion



WHOI/DSF
ATV Meeting 9/16/97

The Navy ATV and Support System



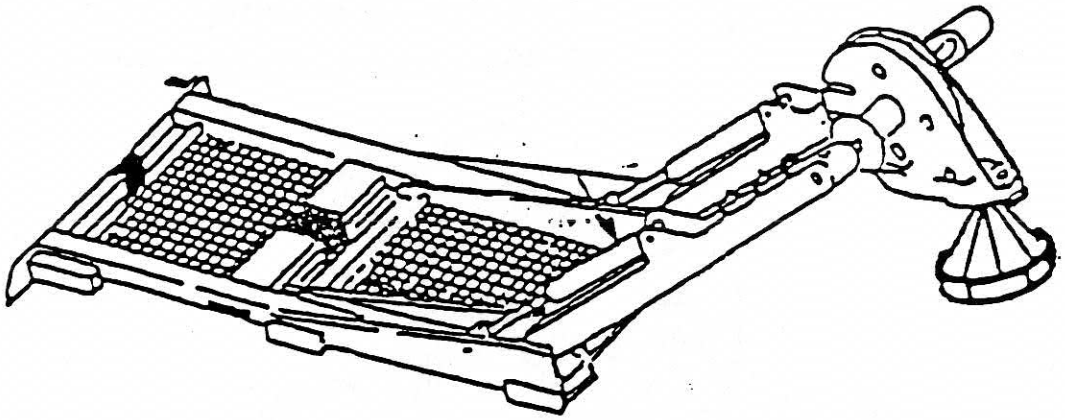
Total Footprint **600 sq. ft.**
Weight **110,500 lbs.**

A-Frame

The A-frame is a structural steel weldment which consists of a skid, crossbeam, booms, two hydraulic cylinders, a 50" head sheave, a vehicle rotation device, and a latching mechanism (LLA):

Specifications:

Max Height:	**24.5 feet**
Max Reach:	**14.5 feet**
Length:	**20 feet**
Width:	**10 feet (operating)**
	8 feet (transport)
Weight:	**27,000 pounds**
Capacity:	**130,000 pounds (rated)**

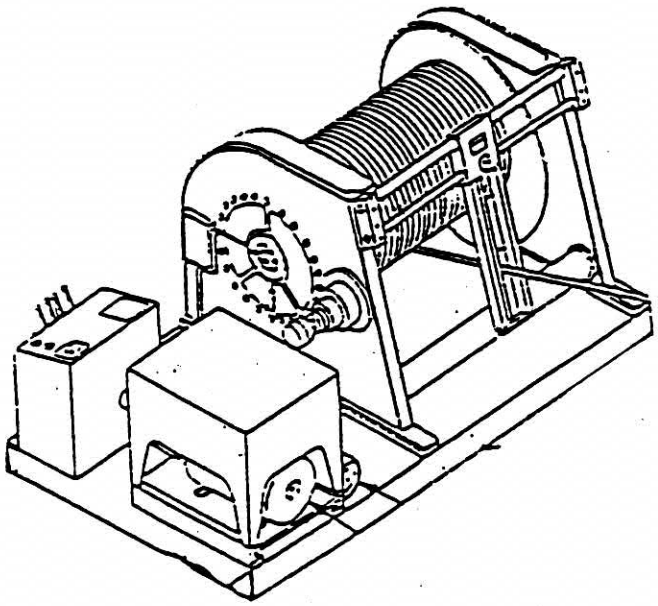


Winch/Skid Assembly

The winch/skid is a structural steel weldment which consists of a platform to support the winch drum, an umbilical level-wind, a control console, an hydraulic oil cooler, and an hydraulic power unit.

Specifications:

Max Height:	**7.75 feet (without level-wind)**
Length:	**16 feet**
Width:	**8 feet**
Weight:	**38,000 pounds (with umbilical)**
Power Reqd:	**480 VAC 3 phase, 60 cycle (main)**
	120 VAC 1 phase, 60 cycle (control)
Hyd. Press:	**3,000 psi (nominal) at 50 GPM**
Line Capacity:	**Approx. 7,000 feet of tether**
Pull Capacity:	**12,000 pounds (outer wrap)**
	30,000 pounds (inner wrap)



Operations Van

The Operations Van is essentially a weather-proof enclosure to protect electronic equipment and controls used to operate the Super Scorpio vehicle. It is 8' x 8' x 20', air-conditioned and sealed against the elements. The van contains numerous pieces of equipment including:

Pilot Control Console
Co-Pilot Control Console
Ground Fault Interrupt System
Intercom Unit
Uninterruptable Power Supply (UPS)
Auxiliary Navigation System (Hydrostar)
Equipment Racks to mount auxiliary equipment
Video Monitoring and Editing Units

ATV and Support Equipment
Palletized Load Descriptions

LOAD	PRI	ITEMS	DIMENSIONS	WEIGHT/ COG
1	3	Lift Winch Lift Winch Subbase Power Cables (Pallet)	1 463L Pallet 88 x 108 x 50h	6,425 44
2	4	Storage Reel	3 463L Pallet Train 268 x 108 x 100h	32,000 134
3	15	ATV Vehicle & Dolly actual length 184 in	2 463L Pallet Train 178 x 108 x 83h	13,800 90
4	6	Traction Winch	3 463L Pallet Train 268 x 108 x 94h	17,263 104
5	12	Generator # 1	2 463L Pallet Train 178 x 108 x 100h	8,738 89
6	13	Generator # 2	2 463L Pallet Train 178 x 108 x 100h	8,861 89
7	7	Hydraulic Power Unit	1 463L Pallet 88 x 108 x 78h	5,900 51
8	11	Hanging Sheave (pallet) Stern Fairlead (pallet)	1 463L Pallet 88 x 108 x 42h	1,865 44
9	1	Ram Cage Ram Cage Subbase TMS Base Main Beams Level Wind Frame & Shaft	3 463L Pallet Train 268 x 108 x 48h	11,315 153
10	2	Topple Sheave Topple Sheave Subbase Upturn Sheave Upturn Sheave Subbase ATV Fairlead Hanging Sheave Stand TMS Subbase section	1 463L Pallet 88 x 108 x 65h	2,790 44
11	8	Vehicle Pedestal (Pallet) Nitrogen Module (Pallet) Float Rack	1 463L Pallet 88 x 108 x 74h	2,500 44
12	5	A-Frame in Trans Pack Navigation Pole	3 463L Pallet Train 268 x 108 x 91h	17,000 125

ATV and Support Equipment
Palletized Load Descriptions
(Continued)

LOAD	PRI	ITEMS	DIMENSIONS	WEIGHT/ COG
13	17	LRS Station	1 463L Pallet 88 x 108 x 108h	1,400 44
14	9	Thruster Pods (4 each) Nitrogen Rack	1 463L Pallet 88 x 108 x 24h	1,200 44
15	14	Control Station Van	258 x 96 x 96h over double 463L pallets	15,000 129
16	16	Maintenance Van	265 x 96 x 96h over double 463L pallets	17,000 133
17	10	Miscellaneous Cables & Hoses	1 463L Pallet 88 x 108 x 96h	3,500 44
18	18	Auxiliary Equipment Deck Cameras Heat Exchanger Transponders (DOT) ATV Support Box ADF Antenna Power Switcher (Pallet)	1 463L Pallet 88 x 108 x 96	3,500 44
19	19	Personnel Baggage (If Needed)	1 L Pallet 88 x 108 x 50	2,000 44

TOTAL WEIGHT/COG 172,057/1493

NOTE: COG is measured from the left end of the pallet or pallet train

All loads are assumed to be balanced at the center of the pallet or pallet train along the width axis.

CONDITION OF ATV

Pros

- Topside Handling System - Dynacon winch, A-frame, heave compensation
- Tether/Cable - light weight, Kevlar, 3 fiber, 10 k meter
- Manipulators
- Vans - Control and Maintenance
- Mission Electronics - Sonars, cameras, lights
- Large basket space

Cons

- Large, bulky system / not optimized for science
- Control electronics and software 1970's vintage
- Uses only one fiber of three / poorer science telemetry
- Corporate memory may not accompany vehicle
- Pressure housings larger than necessary
- Hydraulic noise
- Tether termination / frequent breaks
- Navigation(LBL, USBL) poor

Unknowns

- Spares and documentation
- Power (electrical) system
- Power propulsion (under-powered?)
- Hydraulics system
- Navigation and closed loop control

Priority Areas for ATV Modernization/Upgrade

- Telemetry
- Control Electronics
- Navigation, Guidance and Control
- Hydraulics (?)
- Power Supplies (?)
- Science Capabilities
  - ◊ Tool sleds

FUTURE POTENTIAL OF ATV

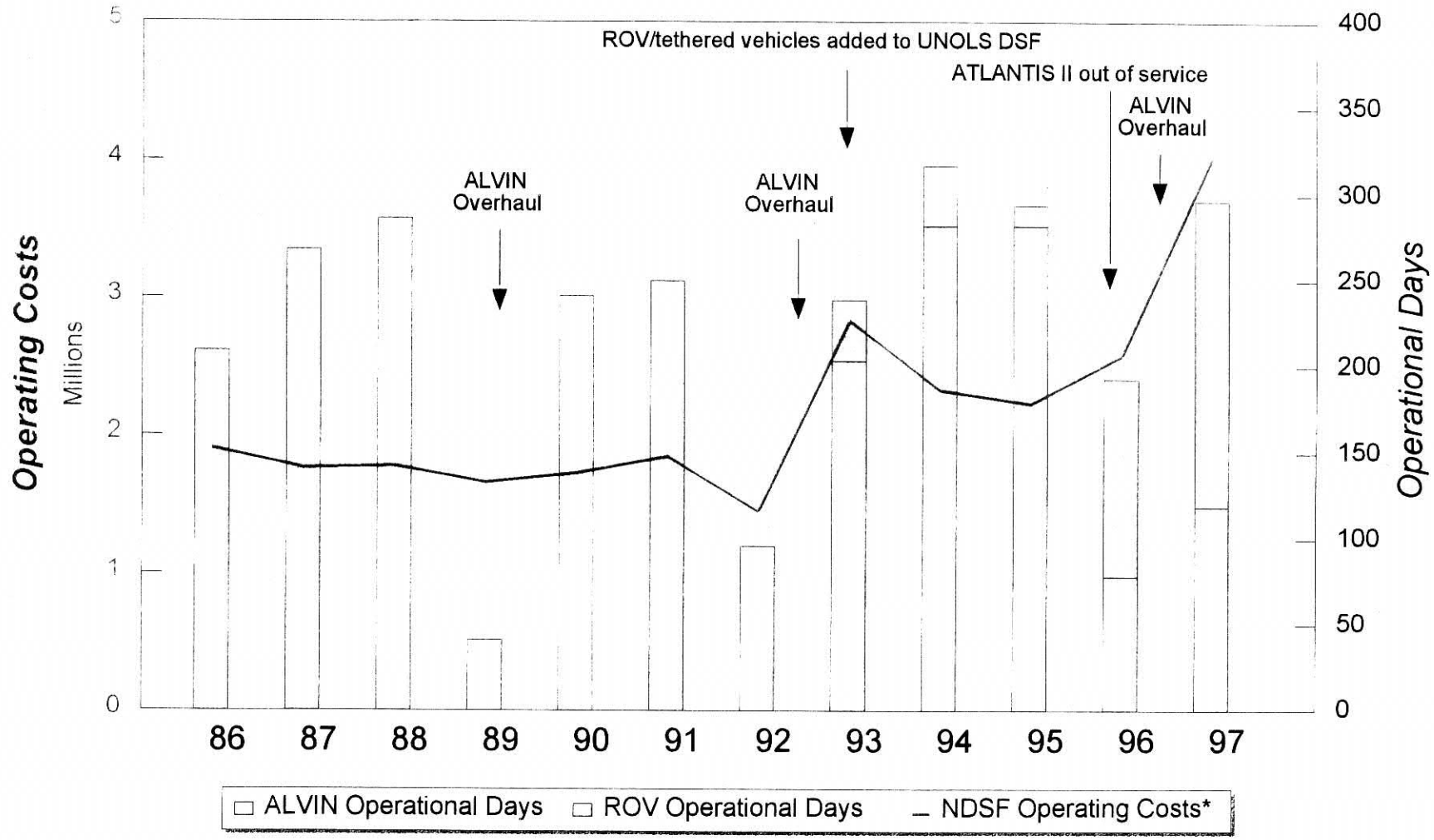
- **Without major hardware and software changes.**
  - ◊ **Heavy lift, 6000m, ROV**
  - ◊ ***Alvin*-like capability**
  - ◊ **Reliability & functionality unknown**

- **With major upgrades/modernization pathway to new science ROV.**
  - ◊ **Handling system, tether, and mission electronics are a good starting position.**
  - ◊ **Need to build in reliability and reconfigure for full science capability.**

Deep Submergence Use History

WHOI/DSF
ATV Meeting 9/16/97

National Deep Submergence Facility



*Not including ship costs

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Deep Submergence Vehicles: Science Use Summary 1990-1997

Dives/Days in Water

	1990	1991	1992	1993	1994	1995	1996	1997
Alvin	154	152	76	136	181	172	49	89
SeaCliff					4	20	12	44*
Turtle					9	7		
Jason		21		38		6	26	59
Argo-II					7		28	27
DSL-120		8		14	11		17	3
ATV					21	33	14	
Super Scorpio							8	*
TOTAL	154	181	76	188	233	238	154	222

***Statistics for the Navy vehicles were provided by LTJG Kassman for 1994 through 1997. In 1997 they estimate that they will have 44 days on-station - the number of dives and division of work between vehicles is still being determined. *Super Scorpio* and *Sea Cliff* are to be used.**

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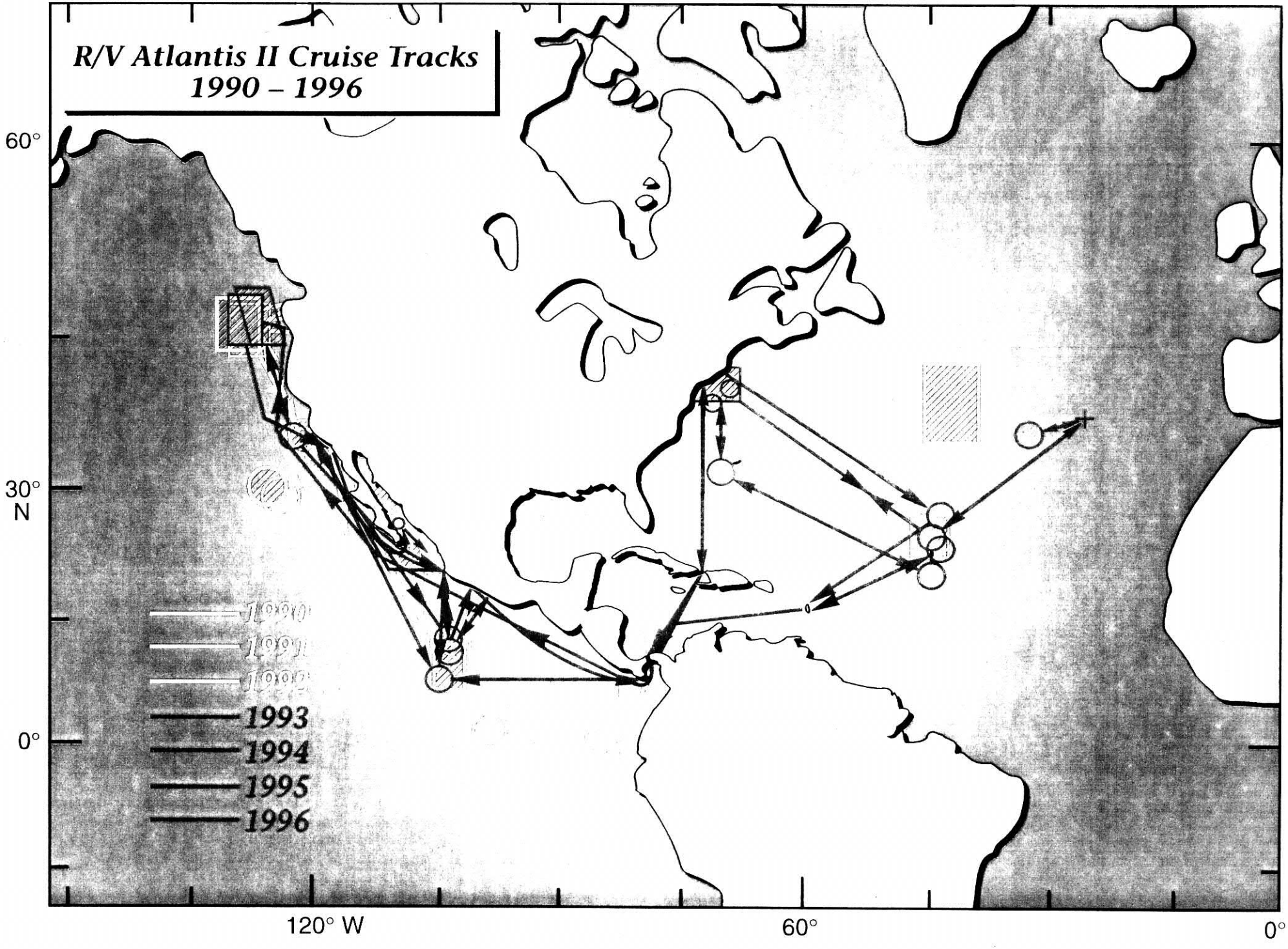

R/V Atlantis II Cruise Tracks
1990 – 1996
60°
30°
N
0°
120° W
60°
0°
1993
1994
1995
1996

National Responsibility (Beyond Science)

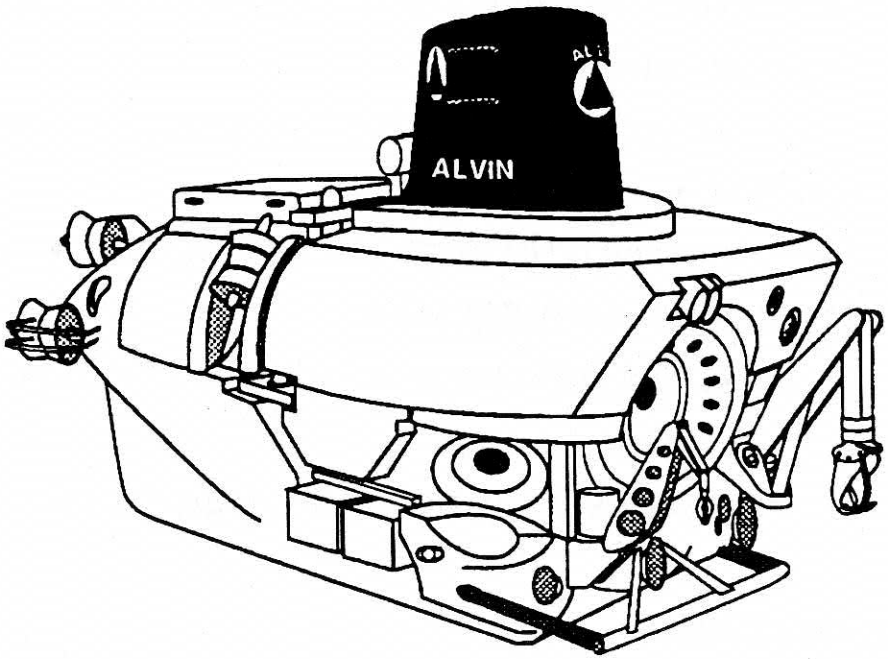
- **The WHOI-NDSF is already part of the Navy's SUBMISS/SUBSUNK SAR system.**
  - ◊ **All dive operations are coordinated with Navy.**
  - ◊ **On call in times of emergencies.**

- **If ATV is added to NDSF, it would add to and sustain this national (non-science) responsibility.**

WHOI-NDSF Operates ATV

- **Keeps critical core of highly trained/skilled people at WHOI.**
  - ◊ **Maintains *Alvin*/ROV/tethered vehicle team (Integrated NDSF).**
- **WHOI able to operate ATV at several levels.**
  - ◊ **Minimum/demo level.**
  - ◊ **Supplement to NDSF using same people for all vehicles (requires schedule control).**
  - ◊ **ATV could fill *Alvin* overhaul slot.**
  - ◊ **ATV as fly away on other ships (*Thompson, Revelle, Melville, Knorr*).**
- **Sustains SUBMISS/SUBSUNK SAR capability.**
- **WHOI would commit to aid progressive modernization and upgrade of ATV leading to the "next-generation ROV."**

HUMAN OCCUPIED VEHICLES



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HUMAN OCCUPIED VEHICLES

Strengths

- **Human cognitive presence on the bottom.**
- **Known quantity, proven performance.**
- **Day after day operations, cruise after cruise.**
- **Flexible, responsive.**
- **Cost effective, effective community oversight (DESSC).**
- **Kept current through technological/operational improvements/upgrades.**
- ***Atlantis* has full range of other services for:**
  - ◊ **Night-time ops.**
  - ◊ **Nested survey ops (like *Argo-II, DSL-120*).**

Weaknesses

- **4-6 hour bottom time.**
- **Some safety risk (no major safety incidents).**

HOV'S HISTORY

- *Alvin* has long, successful track record.

- Community has repeatedly expressed its support for keeping *Alvin* and HOVs:
  - ◊ Global Abyss
  - ◊ National Academy Report - Undersea Vehicles and National Needs
  - ◊ DESSC *Sea Cliff* Working Group Report and Community Poll

HOV is critical: ***A US platform with a proven performance record is needed.**** **It is essential as a nation that we not lose the 6km capability. Because much of scientifically interesting seafloor falls between 4500 and 6000m, this direct observation function is critical. While ROVs and AUVs can replace many of the functions of manned submersibles, direct observation of the seafloor is critical for many biological and chemical studies of soft-sediment habitats. Work in the Western Pacific is >4500m deep and work on mid ocean ridges have axial depths in the 4000-5000m range. Tectonics/petrology studies of transforms and ridge-transform intersections will also require submersible depth capabilities in this range.** ***Extensive fine-scale manipulations, to date, can best be carried out only by manned submersible;**** **without this capability, work at 4500-6000m depths is limited.**

"*Sea Cliff* Working Group Report", p. 5
UNOLS DESSC, July 1997

***Emphasis added**

SEA CLIFF should NOT replace ALVIN:

- **ALVIN is a much more supportable, effective, mature vehicle than SEA CLIFF. If ALVIN can be readily modified for 6000 meter operation by cannibalizing SEA CLIFF, great, but replacing ALVIN with SEA CLIFF would be a disaster for the community! *ALVIN has a much higher productivity (dives/year) and has been outfitted specifically for science research****
- **SEA CLIFF has suffered extensively from reliability problems (poor track record), while *ALVIN continues to be an incredibly productive workhorse.** SEA CLIFF is much less capable than ALVIN for seafloor sampling and observing. SEA CLIFF (aside from depth advantage) would require major modification to be as capable as ALVIN. It is too expensive to operate. The sphere is the only useful thing on SEA CLIFF.**
- **Although there is certain value in diving beyond ALVIN's limits, the problem is on of ALVIN availability, not diving capability or depth limits. Simple replacement of ALVIN with SEA CLIFF is very risky, and does not solve the growing problem if insufficient submersible access to US scientists. Two vehicles would add versatility.**

"*Sea Cliff* Working Group Report", p. 7
UNOLS DESSC, July 1997

***Emphasis added**

KEY COMPONENTS OF *ALVIN* OPERATION

- **Safe, reliable, Navy-certified, cost-effective/cost-constrained.**
  - ◊ **People are the key.**
  - ◊ **Continuity, experience, expertise (Walden, Foster, Hickey, Pilots, Techs)**
  - ◊ **Team work, team spirit.**

- **Minimum safe funding/operating levels for HOV operations.**
  - ◊ **100 dives per year.**
  - ◊ **Funding for HOV core personnel.**
  - ◊ **Experienced/trained ship-submarine team for launch/recovery operation and maintain Navy certification.**

SUMMARY

- **HOVs continue to perform an essential science mission.**
- **ROVs have important capabilities for science and are gaining acceptance and use.**
- **At present and for the foreseeable future, HOVs and ROVs will perform complimentary roles.**