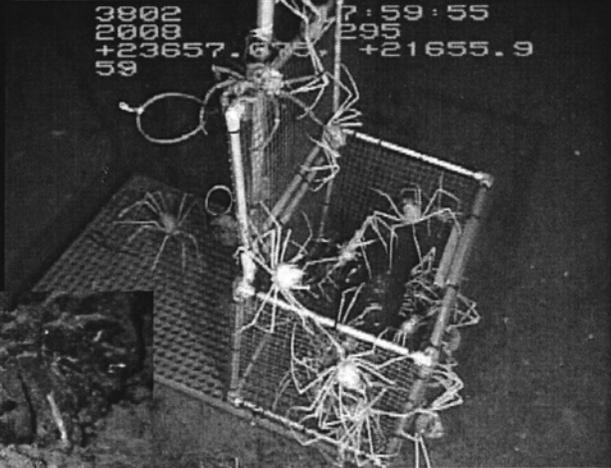
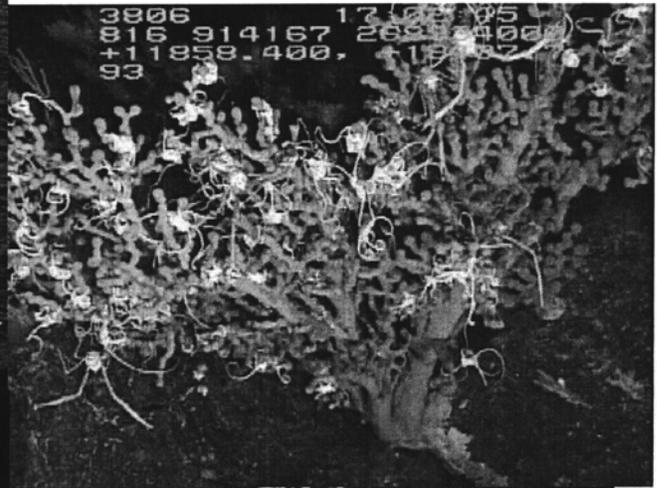


AT7-15 & 7-16

# Cruise Report

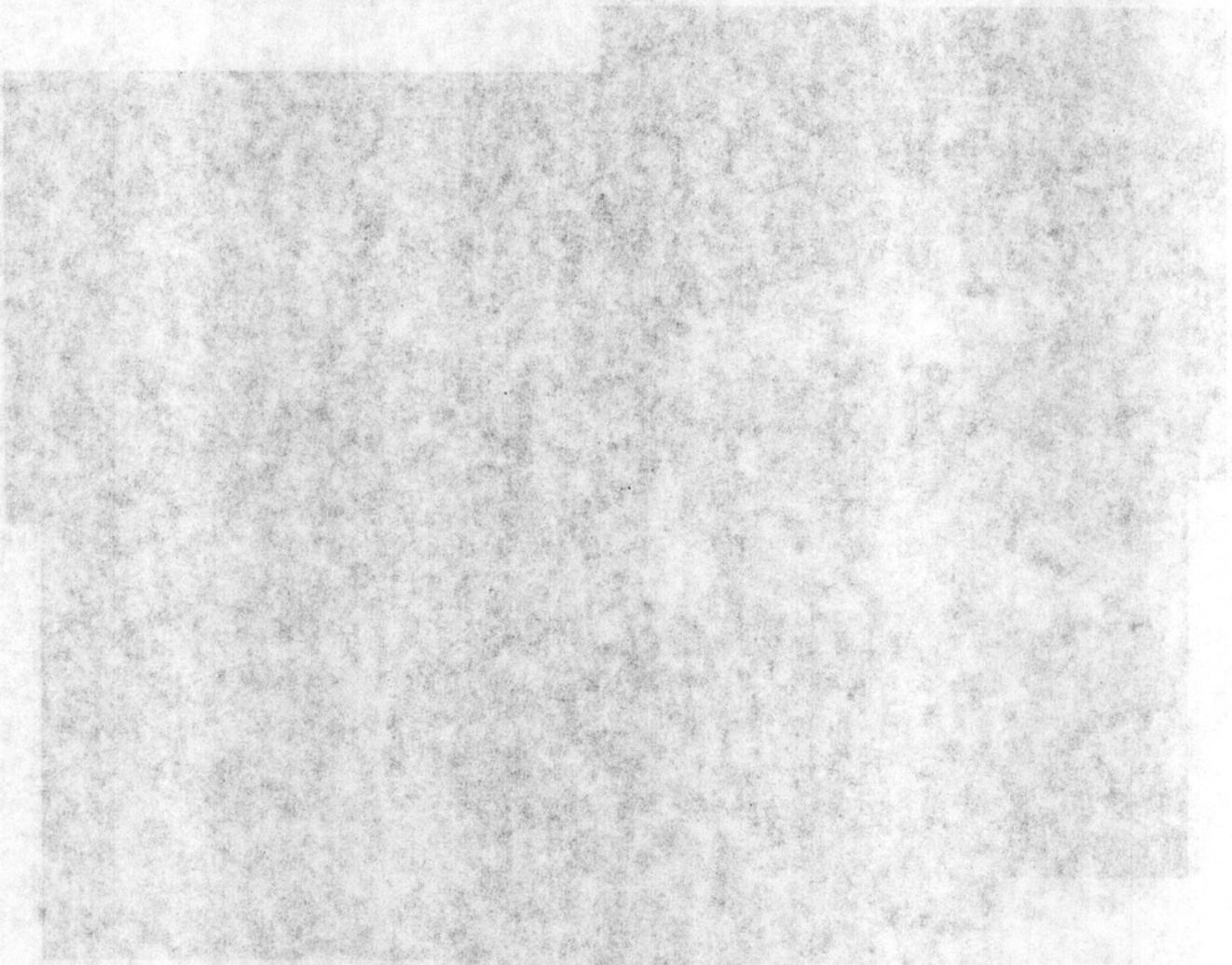
Gulf of Alaska Seamount Exploration (GOASEX)  
June 22<sup>nd</sup> – July 15<sup>th</sup>, 2002  
Astoria – Kodiak – Astoria



Cruise Report

1177/10/2  
11/10/10

Gulf of Alaska Seamount Exploration (GOASEX)  
June 22nd - July 15th, 2002  
Astoria - Kodiak - Astoria



**Cruise report for *R/V Atlantis* Cruises AT-7-15 & AT-7-16  
GULF OF ALASKA SEAMOUNTS EXPLORATION (GOASEX)**

June 22<sup>nd</sup> – July 15<sup>th</sup>, 2002  
Astoria, Oregon – Kodiak, Alaska – Astoria, Oregon

**PRINCIPAL INVESTIGATORS**

Thomas Guilderson, Lawrence Livermore National Laboratory & UC Santa Cruz  
Randall Keller, Oregon State University (Chief Scientist, Leg 2)  
Thomas Shirley, University of Alaska, Fairbanks  
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**TABLE OF CONTENTS**

**INTRODUCTION**

Goals of the Expedition  
Anticipated Benefits  
Education and Outreach

**GOALS AND OBJECTIVES OF EACH RESEARCH TEAM**

Geology and Microbiology  
Crabs and Associated Invertebrates  
Carbon Cycle and Climate Change

**RESULTS**

Navigation  
Acoustic Surveys  
*Alvin* Dives  
Geology and Microbiology  
Crabs and Associated Invertebrates  
Carbon Cycle and Climate Change  
Education and Outreach

**SUMMARY**

**CRUISE PARTICIPANTS**

**APPENDIX A. DIVE DATA**

**APPENDIX B. SEABEAM MAPS**

## INTRODUCTION

### Goals of the Expedition

The goals of this Ocean Exploration expedition were to explore five previously unexplored volcanic seamounts in the Gulf of Alaska (GOA) to characterize their unique biota and habitats, and to determine how these undersea mountains formed. The deep-sea submersible *Alvin* was used at each seamount to collect samples and to develop a photographic inventory of benthic macrofauna during each dive. Comparisons were made between seamounts, and depth transects were conducted with the *Alvin* to examine depth distribution, habitat utilization and community structure of seamount organisms. A full-coverage swath bathymetry map of each seamount was produced, and various rock exposures were sampled for age, duration, composition, and distribution of volcanic phases, as well as for microbiological studies. Reef-building deep-sea corals and sclerosponges were collected to determine their potential for providing information about climate-ecosystem variability in the GOA, and to determine the distribution and reproductive biology of deep-sea corals. The genetic structure of deep-sea gorgonian corals will be studied to determine whether seamount populations are genetically isolated units. Species distribution and habitat utilization of deep-sea crabs were examined and live samples were collected to determine biological characteristics such as species, sex, and reproductive condition. A 'gentler' manipulator claw was developed and tested on the *Alvin* to aid in the collection of live crabs. Observations were made at various depth ranges where particular crab species were most abundant, to document reproductive or aggregative behaviors, as well as biological interactions with other species.

### Anticipated benefits

Most seamounts in the Gulf of Alaska have never been explored, so there was great potential for new discoveries during this expedition. Because of their isolation, seamounts are known for high levels of endemism. Not surprisingly, a large percentage of seamount fauna has been found to be endemic in other regions of the world's oceans. We anticipated that the GOA seamounts will prove to be as biologically rich as others, and so ultimately the results of this expedition would have profound implications to aid in the protection of seamount fauna in the GOA. Other benefits of this expedition included gaining a more complete understanding of the geologic history of the GOA, and potentially adding to our current knowledge of historic climate and oceanic conditions of this dynamic region. Through our work we will also determine the importance of seamounts as essential habitats for unique and likely endemic species.

### Education and Outreach

This expedition provided a wonderful educational opportunity to inform and excite the general public, as well as the scientific community, about unique and unexplored regions of the deep ocean environment. Outreach and education products included detailed lesson plans that targeted grades 5–12. These lesson plans can be accessed via the Oceanexplorer web site (<http://oceanexplorer.noaa.gov>), and this site was updated every few days from the field so that the general public could follow the expedition. A 5<sup>th</sup> grade teacher from Illinois joined the science crew for the duration of the expedition, and an undergraduate student from the University of Alaska's Institute of Marine Sciences Alaska Native and Minority Student Internship/Mentoring Program, participated in the second leg of the cruise. A producer and a videographer from the National Geographic Channel were present on the first leg of the cruise, and their goal is to produce several segments on the expedition for their program. This cruise also provided an educational platform for the North Pacific Fisheries Observer Training Center, as one of their observer trainers joined the first leg of the cruise, and their new Director joined the cruise for the second leg. An outreach opportunity between OE and an alternative middle school in Providence, Rhode Island was developed through the OE expedition coordinator for the Gulf of Alaska cruise, and this initiative will wrap up in the fall with a presentation on the research cruise findings.

A scheduled port stop in Kodiak, Alaska, provided an opportunity for invited students, teachers, fishing and conservation representatives, elected officials, and other invited guests to come aboard the *RV Atlantis* and view *Alvin* and the science made possible by this expedition.

#### GOALS AND OBJECTIVES OF EACH RESEARCH TEAM

##### Geology and Microbiology

Our goal is to understand the volcanic and tectonic histories of seamounts in the Gulf of Alaska, and thus expand our knowledge of the geologic history of the Gulf. In order to understand how the Gulf of Alaska seamounts formed and for how long they were volcanically active, we planned to visit five previously unexplored seamounts (Figure 1), create full-coverage swath bathymetry maps of them and their surroundings, and collect rock samples to determine their volcanic histories. In addition to the importance of these seamounts as geologic records of volcanic activity in the Gulf of Alaska and the dynamics and kinematics of the Northeast Pacific Basin, they are significant for their influence on oceanographic circulation, and also serve as centers of biological activity. Our explorations also included a search for new microorganisms living in the rocks. The frontiers of microbial research are expanding rapidly, largely as a result of the search for microorganisms with medical and industrial applications.

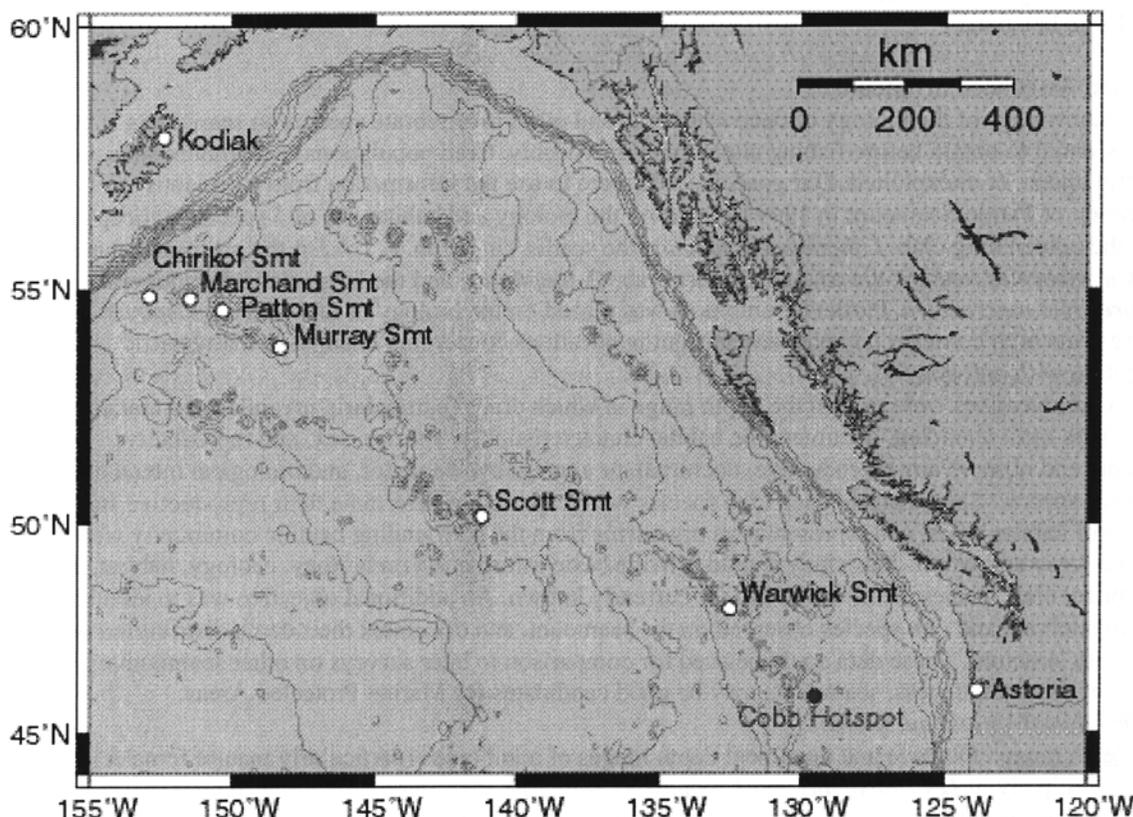


Figure 1. Map of the Gulf of Alaska showing the locations of the six seamounts visited on this expedition. Scott Seamount was mapped, but not sampled. The current location of the Cobb hotspot under Axial Seamount on the Juan de Fuca Ridge is also shown because all of the labeled seamounts (except for Scott) probably formed at the Cobb hotspot.

Our approach was to create a full-coverage swath bathymetry map of each seamount and collect rock samples along vertical transects through the maximum possible depth intervals, with the objectives to establish the:

- Volcanic history of Murray Seamount. Are there undiscovered rift zones or summit cones on Murray that are the source of the anomalously young basalts known to exist nearby?
- Volcanic history of Warwick Seamount. This seamount formed above a hotspot, but close to a spreading center. How does its volcanic history reflect the interplay of the hotspot and the ridge, especially in comparison to the younger and older seamounts in the same hotspot trail?
- Age and plate tectonic setting of Chirikof and Marchand seamounts. What are the ages and origins of these two seamounts? Are they the oldest remaining products of the Cobb hotspot, or do they have some other origin?
- Microbiology of progressively older seamounts in the Cobb hotspot trail. How quickly does microbial alteration of basalts progress, and under what conditions?

Each of these seamounts could stand alone as an exploration target, but the synergy of studying them all together provides comparisons between seamounts formed over the same hotspot but at different times and distances from a seafloor spreading center. In addition, we can extend our comparison to the substantial body of published data from Axial Seamount on the Juan de Fuca Ridge, the current location of the Cobb hotspot.

#### Crabs and Associated Invertebrates

Knowledge of the biology of deepwater crab and other invertebrate species on seamounts is poor, but is essential to obtain before fishing alters them irrevocably. Crab populations at seamount sites are presently under- or unexploited. Our goals in 2002 were to use the information from a previous exploration of Patton Seamount in 1999 to focus on the biology and habitat use of 5 species of deepwater crabs: the golden king crab, *Lithodes aequispinus*; the scarlet king crab, *L. couesi*; the grooved Tanner crab, *Chionoecetes tanneri*; the triangle Tanner crab, *C. angulatus*; and the large-clawed spider crab, *Macroregonia macrochira*. Particular emphasis was placed on the biology of *Lithodes aequispinus* because of its high commercial value and intriguing questions concerning changes in bathymetric distribution with ontogeny.

Our objectives were to visit the depth range in which crabs (particularly juveniles and mature females) are most abundant, document the habitat characteristics by species, sex, and reproductive condition, and observe any reproductive, nocturnal, or aggregative behavior, and biological interactions with other species. Specimens of each crab species were captured to determine their reproductive status. Samples of habitat types, and representative organisms from the surrounding benthic community were collected for examination. This study should provide basic information on biology, ecology, habitat, and behavior for crab species about which little is currently known. An additional objective was to identify other invertebrate and fish species observed on the seamount, and document their depth distribution and community structure. These data could be used for comparison to later surveys on other seamounts; because of their uniqueness, seamounts may be good candidates for Marine Protected Areas.

#### *Specific Objectives and questions:*

Adult depth range: Observe and document depth ranges of adult crabs (particularly mature females) principally of *L. aequispinus* and *L. couesi*, *C. tanneri* and *C. angulatus*. Determine if males and females occur at similar depth, and if they are segregated by sex.

Habitats and species interactions: Examine and describe the habitats where each species occurs.

Determine which species are sympatric and whether they occupy the same habitat.

Juvenile depth range and habitats: Locate juvenile crabs and describe their depth range and habitats/substrates. Collect and examine potential habitats for juveniles, such as: hydroid colonies, coral colonies, and other sessile colonial invertebrates.

Study reproductive condition of female crabs. Capture and examine females in order to determine their stage of larval and ovarian development. Females of some species may be asynchronous spawners, so different crabs may be in different reproductive phases.

Capture and Holding Conditions: Use a “kinder, gentler” manipulator for capturing crabs with less damage. Maintain collected crabs in chilled sea water tanks aboard the *Atlantis*.

Diversity and community structure other species. We hope to compare the invertebrate communities between the seamounts we visit on this cruise and begin to assemble a picture of the biogeography of GOA Seamounts.

### Carbon Cycle and Climate Change

To study changes in ocean circulation and water mass distribution involved in the genesis and evolution decadal climate variability, it is necessary to have records of climate variables several decades in length. Instrumental records are limited because technology for continuous monitoring of ocean currents (*e.g.* satellites and moored arrays) has only recently been available. The historical record of key physical (*eg.* SST, SLP, salinity) and corresponding environmental (*eg.* nutrients, phyto-zooplankton standing stocks, fish-catch/recruitment) variables is of insufficient length and contains spatial and temporal gaps such that we have an incomplete picture of the nature of decadal scale variability. Long time-series data is required to test the various hypotheses regarding the ultimate cause of decadal scale variability and increase the reliability of our prognostication of future climate. The close correspondence between ecosystems and climate or ocean conditions in the Gulf of Alaska provides a natural laboratory to explore biogeochemical archives in deep-sea corals and sclerosponges in the context of extending our observations back beyond the instrumental record.

Our objectives for this cruise follow this theme with three primary themes: determine the amount of anthropogenic (fossil fuel) CO<sub>2</sub> in the region utilizing Suess effect driven changes in δ<sup>13</sup>C and bomb-radiocarbon. Reconstruct the decadal – centennial scale oceanic variability in the Alaskan Gyre via biogeochemical proxy records in deep-sea corals (scleractinian) and gorgonians. Reconstruct the longer or millennial scale (glacial-interglacial) variability as recorded in sediment geochemistry and biological archives (*eg.* planktonic and benthic foraminifera).

In addition we will assess the longevity of deep-sea corals. Deep-sea macro fauna are not only interesting in their own right but provide habitat for an uncountable number of individuals/species including commercially important species (*eg.* rockfish, cod, halibut, king crabs). These mini-reefs are threatened by human activities such as trawling and long-lining. There is also a mitigation strategy being developed as part of the national energy policy whereby anthropogenic CO<sub>2</sub> will be directly injected into the deep-ocean (termed ocean carbon sequestration). It is unclear what effect this activity may have on deep-sea ecosystems via alteration of interior water carbon chemistry.

#### *Sampling strategy:*

1. Anthropogenic CO<sub>2</sub> in the North Pacific
  - a. Underway and CTD stations where we will measure
    - i. ΣCO<sub>2</sub>
    - ii. δ<sup>13</sup>C, Δ<sup>14</sup>C of dissolved inorganic carbon
2. Nutrient cycling and oceanic biogeochemistry
  - a. Underway and CTD stations where we will measure
    - i. δ<sup>13</sup>C and δ<sup>15</sup>N of particulate organic carbon
  - b. Collection of push cores with sediment/water interface intact.
3. Collection of deep-sea corals: stony (scleractinian) and gorgonians
  - a. Distribution of deep-sea corals and relation to depth, T, S, [O<sub>2</sub>]
  - b. Distribution of deep-sea corals in the North Pacific

#### 4. Gravity coring

- a. Bathymetric mapping and sub-bottom profiling of a number of potential targets in the time available.
- b. Collection of giant gravity cores from suitable locations.

### RESULTS

#### Navigation

*Atlantis* cruise 7-15 departed Astoria, Oregon at 0800 on June 22<sup>nd</sup>, 2002, and ended in Kodiak, Alaska at 0900 on July 3<sup>rd</sup>. *Atlantis* cruise 7-16 departed Kodiak, Alaska at 0930 on July 4<sup>th</sup>, and ended in Astoria, Oregon at 1300 on July 15<sup>th</sup>. The first 4 days of the northbound leg were spent in transit to Murray Seamount. We arrived on site in the early hours of June 26<sup>th</sup>, and conducted a short SeaBeam survey before the first dive on the morning of the 26<sup>th</sup>. The work pattern thereafter consisted of *Alvin* dives during the day (Table 1 and Appendix A) and SeaBeam surveys, CTDs, and gravity coring at night. Six additional dives were conducted on Murray, Patton, and Chirikof seamounts, before departing the study area at 1700 on July 2<sup>nd</sup> for the transit to Kodiak. Cruise 7-16 began with an overnight transit from Kodiak to Marchand Seamount, where we conducted the first dive of the southbound leg, followed by an overnight transit to and dive on Murray Seamount. We then departed Murray on July 6<sup>th</sup> for the 30 hour transit to Campbell and Scott seamounts. After passing over Campbell and Scott and determining that the top of Scott was shallower, we prepared to dive on Scott, but 20 knot winds and a building swell caused the dive to be postponed and then canceled. We decided to abandon Scott because the top was about 1000m deep and spend the last four dives on Warwick Seamount, whose top rises up to about 500m. After another 30 hour transit, we arrived at Warwick and commenced SeaBeaming, *Alvin* diving, CTDing, and gravity coring until we departed for Astoria at 2300 on July 13<sup>th</sup>.

#### Acoustic Surveys

We conducted complete SeaBeam surveys of each seamount and its surroundings to select dive and gravity core locations and to search for structural and tectonic lineations that could provide clues to how these mountains formed. We created full-coverage bathymetry maps (Appendix B) of all of the seamounts visited except for Patton, where a map already existed from the 1999 *Atlantis* cruise. We did fill in a small data gap on the 1999 Patton map, so the updated map is included Appendix B. Technical support for creating printable maps was not available on board the *Atlantis*, but the all-night efforts of Chris Moy and Peter Etnoyer produced maps for all of the seamounts except Chirikof (see Appendix B).

#### Dives

On the northbound leg (AT-7-15), seven dives were completed (Table 1), with no dives lost to weather. After the first three dives on Murray Seamount, we determined that the top was too deep to meet our goals of observing Golden king crabs, so the next three dives were made on Patton Seamount. This caused incomplete sampling of geology and coral on Murray seamount, but another dive was scheduled there for the second leg. The final dive of the first leg was on Chirikof Seamount.

On the southbound leg (AT-7-16), six dives on three seamounts included a dive on Marchand Seamount, followed by our fourth dive on Murray Seamount. A dive scheduled for Scott Seamount was canceled due to weather. The final four dives were on Warwick Seamount.

#### Geology and Microbiology

Geologists participated in 8 of the dives, and at least one good rock samples was recovered on all 13 of the dives except for the 3 on Patton (Table 2), where there is already a good collection of rocks from the 1999 *Alvin* dives there. Glacial erratics and manganese crusts were a problem on all of the seamounts except Warwick.

Rocks were collected on five dives for microbiological studies (Table 3). The *Alvin* manipulator placed the rocks in an isolation box which is designed to minimize contamination of the rocks with surface water and to hold the rocks in their ambient sea water until they are transferred to sterile containers on deck. Microorganisms were filtered from the water in the isolation box to collect microorganisms for a control.

**Table 1. Dive Summary**

| Date    | Dive | Location       | Latitude (N) | Longitude (W) | Dive Time | Bottom Time | Start Depth | Objectives                      | Port Scientist | Starboard Scientist |
|---------|------|----------------|--------------|---------------|-----------|-------------|-------------|---------------------------------|----------------|---------------------|
| 6/22/02 |      | Depart Astoria |              |               |           |             |             | Safety drill, science mtg       |                |                     |
| 6/23/02 |      | In transit     |              |               |           |             |             | <i>Alvin</i> briefings          |                |                     |
| 6/24/02 |      | In transit     |              |               |           |             |             |                                 |                |                     |
| 6/25/02 |      | In transit     |              |               |           |             |             |                                 |                |                     |
| 6/26/02 | 3797 | Murray Smt     | 53° 53.47'   | 148° 30.66'   | 8:29      | 4:19        | 2763        | rocks & crabs                   | Keller         | Stevens             |
| 6/27/02 | 3798 | Murray Smt     | 53° 53.56'   | 148° 31.93'   | 6:44      | 5:45        | 1089        | crabs & rocks                   | Shirley        | Rowe                |
| 6/28/02 | 3799 | Murray Smt     | 53° 59.54'   | 148° 30.23'   | 5:56      | 4:48        | 1358        | coral & crabs                   | Guilderson     | Nielsen             |
| 6/29/02 | 3800 | Patton Smt     | 54° 36.0'    | 150° 26.54'   | 5:42      | 5:17        | 485         | crabs & coral                   | Shirley        | Roark               |
| 6/30/02 | 3801 | Patton Smt     | 54° 33.94'   | 150° 23.03'   | 7:17      | 6:25        | 1035        | crabs & PR                      | Stevens        | Cohen               |
| 7/1/02  | 3802 | Patton Smt     | 54° 31.83'   | 150° 18.21'   | 5:51      | 3:51        | 2052        | crabs & PIT                     | Heyl           | Berry (PIT)         |
| 7/2/02  | 3803 | Chirikof Smt   | 54° 49.51'   | 152° 55.73'   | 8:38      | 5:23        | 3222        | rocks & coral                   | Keller         | Baco                |
| 7/3/02  |      | Arrive Kodiak  |              |               |           |             |             | Port Call and PR/Outreach       |                |                     |
| 7/4/02  |      | Depart Kodiak  |              |               |           |             |             | Transit to Marchand Smt         |                |                     |
| 7/5/02  | 3804 | Marchand Smt   | 54° 56.83'   | 151° 19.19'   | 8:38      | 5:29        | 3038        | rocks & coral                   | Rowe           | Flood Page          |
| 7/6/02  | 3805 | Murray Smt     | 57° 1.19'    | 148° 31.05'   | 6:28      | 4:27        | 1993        | coral & rocks                   | Moy            | Fisk                |
| 7/7/02  |      | Transit        |              |               |           |             |             |                                 |                |                     |
| 7/8/02  |      | Scott Smt      |              |               |           |             |             | Dive canceled due to rough seas |                |                     |
| 7/9/02  |      | Transit        |              |               |           |             |             |                                 |                |                     |
| 7/10/02 | 3806 | Warwick Smt    | 48° 5.35'    | 132° 50.63'   | 5:58      | 4:52        | 842         | coral & crabs                   | Dunbar         | Hoyt                |
| 7/11/02 | 3807 | Warwick Smt    | 48° 4.89'    | 132° 39.46'   | 6:54      | 4:24        | 2573        | rocks & PIT                     | Fisk           | Leach (PIT)         |
| 7/12/02 | 3808 | Warwick Smt    | 48° 3.32'    | 132° 44.62'   | 6:37      | 5:52        | 758         | coral & rocks                   | Guilderson     | Russo               |
| 7/13/02 | 3809 | Warwick Smt    | 48° 5.47'    | 132° 44.78'   | 5:12      | 4:02        | 1191        | coral & rocks                   | Roark          | Russo               |
| 7/14/02 |      | Transit        |              |               |           |             |             |                                 |                |                     |
| 7/15/02 |      | Arrive Astoria |              |               |           |             |             |                                 |                |                     |

**Table 2. Rock Recovery**

| Dive | Seamount | Rocks | Mass (kg) | Lithologies                                  |
|------|----------|-------|-----------|--|
| 3797 | Murray   | 8     | 45        | 4 basalts, 1 breccia, 1 Mn crust, 2 erratics |
| 3798 | Murray   | 3     | 14        | all breccias                                 |
| 3799 | Murray   | 4     | 3         | 1 breccia, 3 erratics                        |
| 3800 | Patton   | 0     |           |  |
| 3801 | Patton   | 1     | 4         | Mn crust                                     |
| 3802 | Patton   | 0     |           |  |
| 3803 | Chirikof | 9     | 18        | 7 basalts, 1 hyaloclastite, 1 erratic        |
| 3804 | Marchand | 7     | 21        | 5 basalts, 1 breccia, 1 Mn crust             |
| 3805 | Murray   | 7     | 16        | 6 basalts, 1 erratic                         |
| 3806 | Warwick  | 1     | 7         | basalt                                       |
| 3807 | Warwick  | 10    | 44        | 8 basalts, 2 hyaloclastites                  |
| 3808 | Warwick  | 5     | 30        | all basalts                                  |
| 3809 | Warwick  | 4     | 40        | all basalts                                  |

All samples are curated at COAS, Oregon State University

Rocks were subsampled and processed in a clean hood in the *Atlantis* Biology Lab. Subsamples were frozen at -80°C for later extraction of DNA. Whole rock subsamples were preserved for examination by scanning electron microscope (SEM) and for attached prokaryotic abundance (APA). Crushed subsamples were used to inoculate cultures that contained sterile basalt glass, and crushed material was

also preserved to determine detached prokaryotic abundance (DPA). These analyses will be completed at laboratories at Oregon State University. Analyses of phospholipid fatty acids (PFLA) will be conducted at a lab in Denmark.

These future analyses will tell us the amount and kinds of bacteria that live within deep sea volcanic rocks. Microbes in these deep sea rocky environments may be some of the most primitive on Earth because of their potential ability to survive on a diet of rocks and water. Microbes with this ability could have lived before the appearance of plants about 3,800 million years ago.

**Table 3. Rock Samples for Microbiology Studies**

| Sample | Description   | Depth (m) | Latitude (N) | Longitude (W) | Samples prepared |     |     |     |     | Other                         |
|--------|---------------|-----------|--------------|---------------|------------------|-----|-----|-----|-----|-------------------------------|
|        |               |           |              |               | Cultures         | SEM | DNA | APA | DPA |                               |
| 3803-3 | hyaloclastite | 3170      | 54° 49.48'   | 152° 55.67'   |                  |     |     |     |     | Frozen for later study        |
| 3804-5 | basalt        | 2459      | 54° 56.34'   | 151° 19.48'   | yes              | yes | yes | yes | yes | DNA of bottom water           |
| 3805-1 | water         | 1985      | 54° 1.18'    | 148° 30.15'   | yes              |     |     |     | yes | DNA of bottom water           |
| 3806-1 | basalt        | 815       | 48° 5.41'    | 132° 50.42'   | yes              | yes | yes | yes | yes | DNA of bottom water           |
| 3807-1 | hyaloclastite | 2468      | 48° 4.90'    | 132° 39.58'   | no               | yes | yes | yes | yes | DNA of bottom water           |
| 3807-2 | hyaloclastite | 2288      | 48° 4.81'    | 132° 39.87'   | yes              |     |     | yes | yes | DNA of bottom water           |
| 3807-5 | basalt        | 2028      | 48° 4.67'    | 132° 40.24'   | yes              | yes | yes | yes | yes | refrigerated samples for PFLA |
| 3809-3 | basalt        | 1148      | 48° 5.25'    | 132° 44.86'   | yes              | yes | yes | yes | yes | DNA of bottom water           |

#### Crabs and Associated Invertebrates

Crab biologists participated in seven of the 13 dives; an eighth dive was cancelled due to inclement weather. A total of 68 crab specimens belonging to 8 species were collected from five seamounts (Table 4), however additional species (e.g., *Oregonia bifurca*, *Munidopsis sp.*) were observed and recorded on video tapes, but not collected. Morphological measurements, carapace condition, and correlates of reproductive status were recorded for all specimens collected. Gonads and embryos were collected when available from female specimens; photo documentation of gonad color and development was made. Many crabs were returned alive to the Kodiak NMFS laboratory at the end of leg AT-7-15 for culturing and studies of their biology. Additional specimens were returned frozen or preserved from cruise leg AT-7-16. For all specimens not retained alive, tissue samples for genetic analyses were collected for Drs. Amy Baco and Tim Shank (WHOI). Additional tissue samples were collected for determination of nutritional sources by means of carbon isotope analyses, to be conducted by Dr. Sathy Nadiu, University of Alaska Fairbanks.

**Table 4. Crab species captured on each dive.**

| Dive        | Species |    |    |    |    |    |    |    | Grand Total |
|-------------|---------|----|----|----|----|----|----|----|-------------|
|             | Ca      | Ct | Ch | La | Lc | Mm | Pm | Pv |             |
| 3798        |         |    | 2  |    | 3  | 1  |    |    | 6           |
| 3799        |         |    |    |    | 3  | 1  | 1  | 1  | 6           |
| 3800        |         |    |    | 11 | 2  |    |    |    | 13          |
| 3801        |         |    |    | 2  | 1  |    |    |    | 3           |
| 3802        | 3       |    |    |    |    | 19 |    | 2  | 24          |
| 3803        |         |    |    |    |    | 1  |    |    | 1           |
| 3805        |         |    |    |    |    | 1  |    |    | 1           |
| 3806        |         | 2  | 2  |    |    |    |    |    | 4           |
| 3807        |         |    |    |    |    | 4  |    |    | 4           |
| 3809        |         | 2  |    |    | 2  | 1  | 1  |    | 5           |
| Grand Total | 3       | 4  | 4  | 13 | 11 | 28 | 2  | 3  | 68          |

Abbreviations are: Ca, *C. angulatu*; Ct, *C. tanneri*; Ch, *Chirostylus sp.*; La, *Lithodes aequispinus*; Lc, *Lithodes couesi*; Mm, *M. macrochira*; Pm, *P. multispina*; Pv, *Paralomis verillii*.

Determinations of depth distributions and habitat associations of adult crabs (principally of *Macroregonia macrochira*, *Lithodes aequispinus* and *Lithodes couesi*, *Chionoecetes tanneri* and *Chionoecetes angulatus*) will be made from video tapes collected from the 13 *Alvin* dives. Most species had heterogeneous distributions, either bathymetrically or spatially. Habitats and faunal assemblages may help explain the distributional patterns of crab species.

One of our major goals was to locate and describe the habitat of juveniles of *Lithodes aequispinus* and *Lithodes couesi*. Our preliminary observations suggest that juveniles of *L. aequispinus* and *L. couesi* were confined to a narrow bathymetric range at depths deeper than those in which the adults are normally encountered. The juvenile distribution of the species became apparent on dive 3801 on Patton Seamount. On that dive, we observed that juveniles of *L. couesi* occurred from 550 to 900 m, but *L. aequispinus* only occurred in a narrow band from 583 to 623 m. Virtually all juvenile lithodids occurred either on solid rock or on cobble and boulders and were rarely observed on sand/gravel bottom. Yellow crinoids were abundant from 583 m to the top of Patton Seamount (<300 m), and no juvenile *L. aequispinus* were observed among them in those depth zones.

The pattern of zonation observed was that the largest specimens of *L. aequispinus* occurred on rock pinnacles from 250-400 m. Juveniles apparently settle in the deeper water below 600 m. The presence of dense fields of crinoids between 400 and 600 m may prevent successful settlement of juvenile king crabs in their depth zone. Crabs probably have to grow to a size at which they are no longer vulnerable to brittlestar and crinoid predation before they move upslope to shallower depths. *Lithodes couesi* remain at deeper depths as adults, perhaps due to competition from the much larger *L. aequispinus*.

Of particular interest to us were the spider crabs, *Macroregonia macrochira*. Their biology is poorly known even though the species is common below 1000 m, and the only brachyuran we observed at those depths. We captured 28 specimens either with *Alvin*'s manipulators, or using a baited trap placed on the elevator. Most crabs did not survive the trip to the surface, despite being placed in a tank of chilled seawater. Many females were dissected for examination of ovaries. Ovary conditions varied from undeveloped and unspawned, to partly developed and ovigerous, to well developed, perhaps an indication of asynchronous reproduction by the species. A significant portion of *M. macrochira* specimens observed *in situ* were missing appendages, suggesting evidence of predation or agonistic interactions. The lack of regenerating appendages among specimens suggested molting of adults did not occur or was infrequent. Mating or fighting scars were present on the appendages of adult male specimens. One large male was recorded eating an adult female, confirming cannibalism. Feeding or attempting feeding activities of many specimens was recorded on video. This crab species is widespread throughout the North Pacific deep water, and may prove to be an excellent candidate for genetic research. Commensal amphipods were collected from two specimens, at depths deeper than previously recorded; the amphipods may also be candidates for genetic studies.

We brought two new tools for use in our crab studies. A large basket with plastic fingers worked well for holding large crabs on *Alvin*'s science tray, although smaller specimens sometimes escaped or washed out, particularly at the surface. A finer mesh and more complete hinged top may remedy the deficiencies. The "crabulator", a set of metal fingers for the starboard manipulator, did not work as well as hoped, but provided experience for future design modifications. We also built a second "trap" that was placed on the elevator and used successfully to capture several species of crabs. This study provided experience which will permit improvement and new designs of devices for the collection of more and smaller decapod crustaceans to be deployed by *Alvin* or other submersibles.

A summary of samples taken for genetic studies by Amy Baco-Taylor is given in Table 5.

#### Carbon Cycle and Climate Change

Underway sampling was performed on the outbound leg (Astoria – Kodiak) at approximately every half degree of latitude. CTD stations were determined to provide baseline hydrographic information

**Table 5. Summary of samples for genetic studies.**

|                                     | Murray | Patton | Chirikof | Marchand | Warwick |
|-------------------------------------|--------|--------|----------|----------|---------|
| Bamboo spp.                         | 5      | 11     | 3        |          | 8       |
| Primnoid sp. 1 "white pipe cleaner" | 3      | 3      | 1        |          |         |
| Primnoid sp. 2                      | 3      |        | 1        | 6        | 4       |
| Antipatharian spp.                  | 6      | 1      | 1        |          |         |
| Paragorgia                          | 2+1?   |        |          |          | 1       |
| Rubbery Pink                        | 3      |        |          |          | 1       |
| Other Corals                        | 2      | 2      | 1        | 1        | 2       |
| Ophiuroid spp.                      | 48+    | 76+    |          |          | 30+     |
| Polychaetes                         | 2      |        |          |          |         |
| Lithodes couesi                     | 1      | 1      |          |          | 2       |
| Macroregonia macrochira             | 2      | 4      | 1        |          | 5       |
| Chionocetes tanneri                 |        |        |          |          | 3       |

for relation to the distribution of deep-sea macrofauna, and carbon-chemistry. Particulate organic carbon was collected for all underway samples and a sub-set of Niskin bottles from the CTDs.

In the course of this research cruise we participated in 13 *Alvin* dives. On the first leg, we collected a small number of individuals. A complete listing of the coral collection can be found in the individual dive plan reports. Key samples include: one small living and two sub-fossil bamboo corals, and a large *Paragorgia* from Murray Seamount. On the second leg, we collected a number of living bamboo corals, and a single large *Paragorgia* from Warwick Seamount. Other small living specimens were collected to understand feeding behavior.

Night operations included swath-mapping (sea-beam) bathymetric surveys. These surveys were used to select a small sub-set of saddles, channels, and perched basins for subsequent sub-bottom profiling and assessment of coring. On the first leg, we obtained one short GGC (giant gravity core) at Murray Seamount. No other suitable sites were found, although a more intensive and detailed survey could prove fruitful. A similar strategy was employed on the second leg and six GGCs were taken at depth on the flanks of Warwick Seamount including two cores in excess of fourteen feet in length.

#### Education and Outreach

Outreach and education products included detailed lesson plans for grades 5–12 that can be accessed via the Oceanexplorer web site. Material such as logs, essays, images, and short video clips were collected throughout the duration of the cruise and were posted on the Oceanexplorer web site, so that the general public could follow the expedition. An 'ask the scientist' link was also included on the web site, and all questions and answers were posted as they came in. An undergraduate student from the University of Alaska's Institute of Marine Sciences Alaska Native and Minority Student Internship/Mentoring Program, Benjamin Warlick, participated in the second leg of the cruise. Scientists on board assisted Benjamin with collection of tissue samples from deep-sea crabs so that he could complete a summer research project with his Internship Program. Sue Doenges, a 5<sup>th</sup> grade teacher from Naperville, IL, participated in both legs of the cruise, and helped provide tours of the *Atlantis* during the one-day port call in Kodiak, Alaska. Sue presented her experiences from the cruise at OE's South Atlantic Bight Professional Development Teacher's Institute in Charleston, South Carolina on August 1. Chad Cohen, a producer for the National Geographic Channel, and Norris Brock, a videographer for National Geographic were present on the first leg of the cruise, and they will produce several pieces on the Expedition for their program. This cruise also provided an educational platform for the North Pacific Fisheries Observer Training Center, as Greg Morgan, an observer trainer, joined the first leg of the cruise, and their new Director, Peter Risse, joined the cruise for the second leg.

Tours of the *Atlantis* and the *Alvin* sub were provided to approximately 200 people through invitation during the one-day port stop in Kodiak, Alaska. All tour groups had the opportunity to experience the science made possible by the expedition through interactions with the scientists and graduate students who displayed samples of corals, rocks, and live deep-sea crabs that had been collected on the four seamounts explored on the first leg of the cruise. Lesson plans developed for the expedition were handed out to all educators who toured the ship. Tour groups included members of the fishing industry, several departments from the University of Alaska, several K-12 school groups, the US Coast Guard, the Kodiak Chamber of Commerce, the Kodiak School Board, the Kodiak National Wildlife Refuge, the Kodiak Audubon Society, several summer camp groups, Kodiak NMFS, the Kodiak City Mayor, Carolyn Floyd, as well as the Kodiak Island Borough Mayor, Gabrielle Ledoux.

Students from an alternative middle school in Providence, Rhode Island called UCAP (Urban Collaborative Accelerated Program) decorated Styrofoam cups during a summer program and shipped them to Kodiak, Alaska for OE expedition coordinator, Catalina Martinez, to pick up during the one-day port stop. These cups were sent down on the *Alvin* and were compressed at depth as part of a demonstration project between OE and the students of UCAP. The compressed cups will be given back to the UCAP students when Catalina visits the school to present the research cruise findings in the fall. Lesson plans that were developed for the cruise were also sent to UCAP science teachers for use during their summer biology course.

#### **SUMMARY**

Cruises 7-15 and 7-16 of the *RV Atlantis* visited six seamounts, five of them previously unexplored. We created new, full-coverage bathymetric maps of the five unexplored seamounts (a multibeam map of Patton already existed), and dove on four of the unexplored seamounts, plus Patton, using the *Alvin* submersible (our dive to the fifth unexplored seamount, Scott, was canceled due to poor weather). The 13 *Alvin* dives were approximately evenly split between the coral, crab, and rock groups, with most dives shared by two groups. This allowed each group to participate in more dives and obtain samples from a larger area, but put severe strains on the use of bottom time in the submersible. Nevertheless, exploration inevitably leads to discovery, and this expedition revealed the spectacular volcanic geology of these seamounts and resulted in the collection of precious samples of long-lived deep-sea corals, crabs in various reproductive stages, and rock samples for geological studies. These exciting results will improve our understanding of the unique biology, geology, and oceanography of the Gulf of Alaska, and will provide tantalizing data for future proposals to revisit this poorly-known region of the oceans.

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**APPENDIX A. DIVE DATA**

|                   |   |                  |         |         |                |         |
|-------------------|---|------------------|---------|---------|----------------|---------|
| Dive plan for     | <i>Alvin</i> Dive #   | <b>3797</b>      |         |         |                |         |
| Date              | 6/26/02   | Wednesday        |         |         |                |         |
| Time              | Start Dive  | 8:00             |         |         |                |         |
|                   | End Dive  | 17:00            |         |         |                |         |
| Location          | Murray Seamount   |                  |         |         |                |         |
|                   |   | Depth (m)        | Lat deg | Lat min | Lon deg        | Lon min |
| Start Position    |   | 2700 m           | 53      | 53.63   | 148            | 30.38   |
| End Position      |   | 2190 m           | 53      | 54.38   | 148            | 30.71   |
| Distance          | naut. Mi.   | 0.785            |         |         |                |         |
|                   | Heading (true)  | 346              |         |         |                |         |
| Personnel         | Pilot   | Bruce Strickrott |         |         |                |         |
|                   | Port Observer   | Randy Keller     |         |         | Lead Scientist |         |
|                   | Stbd Observer   | Brad Stevens     |         |         | Scientist      |         |
| Objectives        | Exploration, bottom to top if possible<br>Collect rocks in sample basket<br>Look for crab species present<br>Look for coral; collect if possible<br>Other inverts<br>Push cores at deepest point<br>Water sample at deepest point |                  |         |         |                |         |
| Special Equipment | Rock Basket<br>wood Biobox<br>Push cores<br>Niskin bottle (1)   |                  |         |         |                |         |
| Samples collected | 8 rocks (5 volcanic, 2 erratics, 1 Mn crust)<br>3 sediment cores<br>1 sponge<br>several corals  |                  |         |         |                |         |
| Sample data       |   | Zulu             | m       |         |                |         |
|                   |   | Time             | Depth   | X       | Y              |         |
| Sediment core 1   | left outside  | 19:15            | 2727    | 5064    | 6750           |         |
| Coral 1           | white, branched, 2 pieces   | 19:45            | 2680    |         |                |         |
| Sediment core 2,3 | left inside, right inside   | 21:17            | 2388    | 5004    | 7522           |         |
| coral 2           | "pipe cleaner", large   | 22:24            | 2254    | 4776    | 7957           |         |
| coral skeleton    |   | 23:06            | 2188    | 4705    | 8118           |         |

Dive plan for *Alvin* Dive # **3798**

Date 6/27/02 Thursday

Time Start Dive 8:00  
End Dive 1440 on bottom 1530 on deck

Location Murray Seamount

|                | Depth (m) | Lat deg | Lat min | Lon deg | Lon min |
|----------------|-----------|---------|---------|---------|---------|
| Start Position | 1094      | 53      | 56.00   | 148     | 32.50   |
| End Position   | 670       | 53      | 57.10   | 148     | 33.00   |

Distance naut. Mi.

|           |               |             |                |
|-----------|---------------|-------------|----------------|
| Personnel | Pilot         | Phil Forte  |                |
|           | Port Observer | Tom Shirley | Lead Scientist |
|           | Stbd Observer | Mike Rowe   | Scientist      |

Objectives

- Collect crabs in basket
- Collect rocks in basket
- Collect corals
- Push cores at deepest point
- Water samples at deepest point

Special Equipment

- Crab basket
- "Crabulator fingers"
- Small rock basket
- Coral box
- Push cores
- Niskin bottles (5)

| Samples collected      |                                | Number | Zulu time | Depth | X    | Y     |
|------------------------|--------------------------------|--------|-----------|-------|------|-------|
| Scarlet king crab      | <i>Lithodes couesi</i>         | 3      |           |       |      |       |
| red pinchbug           | <i>Chirostylus</i> sp.         | 2      |           | 760   |      |       |
| spider crabs           | <i>Macroregonia macrochira</i> | 1      |           |       |      |       |
| Sediment cores         |                                | 3      | 2035      | 936   | 2656 | 12308 |
| Niskin water samples   |                                | 5      | 2156      | 718   |      |       |
| 3 rocks (all volcanic) |                                |        |           |       |      |       |

Dive plan for *Alvin* Dive # **3799**  
 Date 6/28/02 Friday  
 Time Start Dive 8:17  
 End Dive 13:47 on bottom  
 Location Murray Seamount

|                | Depth (m) | Lat deg | Lat min | Lon deg | Lon min |
|----------------|-----------|---------|---------|---------|---------|
| Start Position | 1407      | 53      | 59.58   | 148     | 30.48   |
| End Position   | 649       | 53      | 58.83   | 148     | 30.48   |

Personnel Pilot Pat Hickey  
 Port Observer Tom Guilderson  
 Stbd Observer Julie Nielsen

Objectives Main coral collection dive on Murray  
 video archive factors determining crab distribution:  
 substrate, depth, coral cover, etc  
 niskins and pushcores where possible  
 collect crabs

Special Equipment Coral/Rock box  
 Push cores  
 Niskin bottles (5)

Samples collected

|                     |                                  |         |
|---------------------|----------------------------------|---------|
|                     | 4 rocks (1 volcanic, 3 erratics) |         |
| Scarlet king crab   | Lithodes couesi                  | 3       |
|                     | Paralomis verillii               | 1       |
|                     | Paralomis multispina             | 1       |
| spider crabs        | Macroregonia macrochira          | 1       |
| Kamchatka coral     | Paragorgia arborea               | 1       |
| Bamboo coral        |                                  | 3       |
| Antipatharian coral |                                  | several |
| basket stars        | Gorgonocephalus sp               | dozens  |

**OBSERVER NOTES:**

On bottom 1709h, 1404 m water Z

Large spider crab dead ahead -

Brittle stars everywhere

Large branching coral to port that we overshot as we came in for landing.

In hindsight possibly a bamboo coral and one that we would have loved to have.

2 niskins fired #1 and #2 for N.W.

Spider crab volunteered for pot.

Spotted in X: 4920, Y 18067 - 300 m from orig projected dive location, but flew to approp contour.

|  |                             |
|--|-----------------------------|
| First coral specimen in Baco bin #1: 4920 18050 2.4°C<br>1400m   |                             |
| Rock sample 1404m X: 4916, Y: 18048  | turned out to be an erratic |
| Second specimen for AB bin #4: X: 4931, Y: 17954 2.4°C   |                             |
| Third specimen for AB bin#5: X 4956 17857, 2.4°C 1376m   | Time stamp:<br>18:08:29     |
| Two large corals in crab basket: 4964 17731, 2.4°C 1337m<br>bamboo coral attached to rock, and yellow branching coral  |                             |
| Fourth specimen for AB bin#6 X 4954 Y 17652 1308m  | Time stamp:<br>18:31:28     |
| Rocky outcrop/ledge @ 1230m  | Time stamp:<br>18:51:32     |
| nominal: 4956, 17491 (18:56 - 19:11)   |                             |
| Sampled coral @ this ledge -<br>one live coral -black coral (sea fan/fern) into crab basket: additional specimens into Baco bins 7, 8, 9<br>fired niskins 3&4 for NW |                             |
| Sub-fossil bamboo - can see where it broke off: 4975 17065 932m  | Time stamp:<br>19:52        |
| other small bamboos - polyps fully extended, not worth taking - too small.   |                             |
| Another fossil bamboo into crab pot: 4991 16946 838m   | Time stamp:<br>20:21        |
| This one was in situ - standing upright and attached<br>coral sample: 4988 16887 800m,   | Time stamp:<br>20:27        |
| Paragorgia spp all over the place 720 - 680m   |                             |
| Paragorgia "felled" 5015 16774, 722m   | Time stamp:<br>20:37        |
| Last niskin 4989 16505 664m  | Time stamp:<br>21:35h       |

|                   |  |                  |         |         |         |         |
|-------------------|--|------------------|---------|---------|---------|---------|
| Dive plan for     | <i>Alvin</i> Dive #  | <b>3800</b>      |         |         |         |         |
| Date              | 6/29/02  | Saturday         |         |         |         |         |
| Time              | Start Dive   | 7:55             |         |         |         |         |
|                   | End Dive   | 13:22            |         |         |         |         |
| Location          | Patton Seamount  |                  |         |         |         |         |
|                   |  | Depth (m)        | Lat deg | Lat min | Lon deg | Lon min |
| Start Position    |  | 484              | 54      | 36.00   | 150     | 27.00   |
| End Position      |  | 274              | 54      | 35.00   | 150     | 27.00   |
| Distance          | naut. Mi.  |                  | 1       |         |         |         |
| Personnel         | Pilot  | Bruce Strickrott |         |         |         |         |
|                   | Port Observer  | Tom Shirley      |         |         |         |         |
|                   | Stbd Observer  | Brendan Roark    |         |         |         |         |
| Objectives        | Golden king crabs + juvenile<br>Collect corals<br>niskins and pushcores where possible   |                  |         |         |         |         |
| Special Equipment | Crab basket<br>Coral/Rock box<br>Push cores<br>Niskin bottles (5)<br>Crabulator  |                  |         |         |         |         |
| Samples collected | 1 mating pair of <i>Lithodes couesi</i><br>1 mating pair of <i>Lithodes aequispinus</i><br>9 additional male <i>Lithodes aequispinus</i><br>6 samples of soft coral for Amy Baco<br>5 Niskin bottles<br>1 bamboo coral<br>1 Brisingid starfish |                  |         |         |         |         |

|                   |   |              |         |         |         |  |
|-------------------|---|--------------|---------|---------|---------|--|
| Dive plan for     | <i>Alvin</i> Dive #   | <b>3801</b>  |         |         |         |  |
| Date              | 6/30/02   | Sunday       |         |         |         |  |
| Time              | Start Dive  | 8:00         |         |         |         |  |
|                   | End Dive  | 16:00        |         |         |         |  |
| Location          | Patton Seamount   |              |         |         |         |  |
|                   | Depth (m)   | Lat deg      | Lat min | Lon deg | Lon min |  |
| Start Position    | 1023  | 54           | 33.85   | 150     | 23.10   |  |
| End Position      | 325   | 54           | 33.90   | 150     | 25.60   |  |
| Distance          | Range   | 0.85 n. mi.  |         |         |         |  |
|                   | Bearing   | 270 TRUE     |         |         |         |  |
| Personnel         | Pilot   | Phil         |         |         |         |  |
|                   | Port Observer   | Brad Stevens |         |         |         |  |
|                   | Stbd Observer   | Chad Cohen   |         |         |         |  |
| Objectives        | Golden king crabs and juveniles<br>Collect corals<br>niskins and pushcores where possible<br>Live broadcast from the bottom |              |         |         |         |  |
| Special Equipment | Crab basket<br>Coral/Rock box<br>Push cores<br>Niskin bottles (5)<br>Crabulator   |              |         |         |         |  |
| Samples collected | L. aequispina   | 2, grasping  |         |         |         |  |
|                   | L. couesi   | 1            |         |         |         |  |
|                   | Coral samples   | 5            |         |         |         |  |
|                   | Water samples   | 3            |         |         |         |  |
|                   | 1 rock (Mn crust)   |              |         |         |         |  |

|                   |   |                     |         |         |         |             |
|-------------------|---|---------------------|---------|---------|---------|-------------|
| Dive plan for     | <i>Alvin</i> Dive #   |                     |         |         |         |             |
|                   |   |                     |         |         |         | <b>3802</b> |
| Date              | 7/1/02  | Monday              |         |         |         |             |
| Time              | Start Dive  |                     |         |         |         | 8:00        |
|                   | End Dive  |                     |         |         |         | 0:00        |
| Location          | Patton Seamount   |                     |         |         |         |             |
|                   |   | Depth (m)           | Lat deg | Lat min | Lon deg | Lon min     |
| Start Position    |   | 2052                | 54      | 31.69   | 150     | 18.17       |
| End Position      |   | 1615                |         |         |         |             |
| Distance          | Range   |                     |         |         |         | 0.85 n. mi. |
|                   | Bearing   |                     |         |         |         | 270 TRUE    |
| Personnel         | Pilot   | Pat Hickey          |         |         |         |             |
|                   | Port Observer   | Taylor Heyl         |         |         |         |             |
|                   | Stbd Observer   | PIT - Anthony Berry |         |         |         |             |
| Objectives        | Locate crab elevator  |                     |         |         |         |             |
|                   | Golden king crabs + juveniles                               |                     |         |         |         |             |
|                   | Collect mature females if possible                          |                     |         |         |         |             |
|                   | Collect corals  |                     |         |         |         |             |
|                   | niskins and pushcores where possible                        |                     |         |         |         |             |
|                   | Go deep or go home  |                     |         |         |         |             |
| Special Equipment | Crab basket   |                     |         |         |         |             |
|                   | Coral/Rock box  |                     |         |         |         |             |
|                   | Push cores  |                     |         |         |         |             |
|                   | Niskin bottles (5)  |                     |         |         |         |             |
|                   | Crabulator  |                     |         |         |         |             |
| Collections       | Located crab elevator and released to surface with 14 crabs |                     |         |         |         |             |
|                   | 2 push core samples   |                     |         |         |         |             |
|                   | 2 niskin water samples                                      |                     |         |         |         |             |
|                   | 6 coral samples   |                     |         |         |         |             |
|                   | 2 <i>Paralomis verillii</i>                                 |                     |         |         |         |             |
|                   | 22 <i>C ang macroregonia</i>                                |                     |         |         |         |             |

Dive plan for *Alvin* Dive # **3803**

Date 7/2/02 Tuesday  
Time Start Dive 8:00  
End Dive 17:00

Location Chirikof Seamount

|                | Depth (m) | Lat deg | Lat min | Lon deg | Lon min |
|----------------|-----------|---------|---------|---------|---------|
| Start Position | 3300      | 54      | 49.48   | 152     | 55.67   |
| End Position   | 2660      | 54      | 50.44   | 152     | 55.84   |
| Distance       | 1.5 km    |         |         |         |         |

Personnel Pilot Bruce Strickrott  
Port Observer Randy Keller  
Stbd Observer Amy Baco

Objectives Collect rocks  
Collect corals  
niskins and pushcores where possible  
crabs if seen

Special Equipment 1 extra long milk crate for corals  
2 long milk crates for rocks  
2 small milk crates for rocks  
Niskin bottles (5)  
Push cores

Samples collected 9 rocks (all volcanic)

|                   |   |                  |         |         |         |         |
|-------------------|---|------------------|---------|---------|---------|---------|
| Dive plan for     | <i>Alvin</i> Dive #   | <b>3804</b>      |         |         |         |         |
| Date              | 7/5/02  | Friday           |         |         |         |         |
| Time              | Start Dive  | 8:00             |         |         |         |         |
|                   | End Dive  | 5:00             |         |         |         |         |
| Location          | Marchand Seamount   |                  |         |         |         |         |
|                   |   | Depth (m)        | Lat deg | Lat min | Lon deg | Lon min |
| Start Position    |   | 3038             |         |         |         |         |
| End Position      |   | 2163             |         |         |         |         |
| Distance          | Range   | 2.9 km           |         |         |         |         |
| Personnel         | Pilot   | Phil Forte       |         |         |         |         |
|                   | Port Observer   | Michael Rowe     |         |         |         |         |
|                   | Stbd Observer   | Sarah Flood Page |         |         |         |         |
| Objectives        | Collect frocs from many depths for geology<br>Collect 7-8 rocks (preferably pillow basalt margin) from a single location and put in microbiobox<br>Collect corals (large for Tom, small for Amy)<br>Niskins (1 each on landing and takeoff, and 1 at large coral or pushcore location)<br>Collect crabs and pinchbugs if seen |                  |         |         |         |         |
| Special Equipment | 1 extra long milk crate for corals (and crabs)<br>2 long milk crates for rocks<br>Microbiobox (trigger tracer syringe after box is closed)<br>Bacobox<br>Push cores (3)<br>Niskin bottles(5)  |                  |         |         |         |         |
| Collections       | 7 rocks (6 volcanic, 1 Mn crust)<br>5 small corals of same species<br>2 niskin water samples<br>2 large coral samples (same species)<br>1 Stalk containing barnacles<br>~6 samples of basalt for microbiobox  |                  |         |         |         |         |

Dive plan for *Alvin* Dive # **3805**

Date 7/6/02 Saturday

Time Start Dive 8:00

End Dive 17:00

Location Murray Seamount

|                | Depth (m) | Lat deg | Lat min | Lon deg | Lon min |
|----------------|-----------|---------|---------|---------|---------|
| Start Position | ~1950     | 54      | 1.17    | 148     | 30.86   |
| End Position   | ~1100     | 53      | 59.64   | 148     | 30.86   |

Distance 2.85km

Near vertical climb with one small saddle towards the end of the dive.

Would like to move horizontally along contours when samples look promising.

|           |               |             |
|-----------|---------------|-------------|
| Personnel | Pilot         | Pat Hickey  |
|           | Port Observer | Chris Moy   |
|           | Stbd Observer | Martin Fisk |

Objectives Collect corals (multiple individuals, the bigger the better, bamboo & corallium, living & dead, see photos in sub)

Collect rocks from many depths for geology (avoid rocks lying loose on surface)

Collect 7-8 rocks from a pillow basalt margin at a single location as deep as possible and put in microbiobox

Pushcores (1 at each sedimented location)

Niskins (1 each on landing and takeoff, and 1 at large coral or pushcore locations)

Collect crabs and pinchbugs if seen

Special Eqpt Large crate for corals (and crabs)

1 large milk crate for rocks

Microbiobox (open, fill with rocks, close, trigger tracer syringe)

Push cores (3)

Niskin bottles (5)

Samples collected

7 rocks (5 volcanic, 2 erratic)

Dive plan for *Alvin* Dive # **3806**

Date 7/10/02 Wednesday Bottom time  
 Time Start Dive 8:00 8:32:00  
 End Dive 17:00 1:23 PM

Location Warwick Seamount  
 expected depth range: <1000 meters

|                | Depth (m) | Lat deg                       | Lat min | Lon deg  | Lon min |
|----------------|-----------|-------------------------------|---------|----------|---------|
| Start Position | 871       | 47.00889                      |         | 131.1596 |         |
| End Position   | 803       | 48.09013                      |         | 131.1596 |         |
| Distance       | ~1 km     | mostly in east-west direction |         |          |         |

Navigation problems; very little distance vertically covered; conclusion: we were going around in circles  
 Started steep and became flat; position was in question

Personnel Pilot Bruce Strickrott  
 Port Observer Rob Dunbar  
 Stbd Observer Zachary Hoyt

Objectives Collect corals (multiple individuals, the bigger the better, bamboo & corallium, living & dead, see photos in sub)  
 Visual stratigraphy of crab depth zonation, relation to substrate, habitat, etc.  
 Collect assorted crabs - tasty ones are preferred  
 Collect 7-8 rocks from a pillow basalt margin at a single location as deep as possible and put in microbiobox  
 Collect a few rocks if possible  
 Collect a small (6-inch) piece of many individuals of the same species of coral  
 Pushcores (1 at each sedimented location)  
 Niskins (1 each on landing and takeoff, and 1 at large coral or pushcore locations) - if we come across a thicket of corals multiple bottles at once to get enough POC for analyses

Special Eqpt Crab basket  
 Bacobox  
 Microbiobox (open, fill with rocks, close, trigger tracer syringe)  
 Small milk crate for rocks  
 Push cores (3)  
 Niskin bottles (5)

Samples collected Crabs: 2 *Chionocetes tanneri*  
 2 Galatheids  
 Rocks: 1 for microbiology

Corals: 4 bamboos (1 sub-fossil)  
2 Paragorgia  
4 Gorgonian fan corals  
Water: 4 Niskins  
Other: 1 transparent cucumber

Observations: Area of dive was dominated by communities of large sponges >1 m in size, large Paragorgia and bamboo corals. Many Galatheids were common on corals both Paragorgia and bamboo. Common smaller white sea-fans (? primnoid?) were observed as well as large sea anemones (up to 15 cm). Substrate consisted exclusively of basaltic flow material, mostly weathered pillows.

Dive plan for *Alvin* Dive # 3807

Date 7/11/02 Thursday

Time Start Dive 8:00

End Dive 17:00

Location Warwick Seamount

|                | Depth (m) | Lat deg | Lat min | Lon deg | Lon min |
|----------------|-----------|---------|---------|---------|---------|
| Start Position | 2609      | 48      | 5.00    | 132     | 39.20   |
| End Position   | 1390      | 48      | 4.39    | 132     | 41.03   |
| Distance       | 2.55 km   |         |         |         |         |
| Bearing        | 244°      |         |         |         |         |

Personnel  
Pilot Pat Hickey  
Port Observer Martin Fisk  
PIT Brian Leach

Objectives  
Locate elevator, close lid, trigger release  
Collect 7-8 rocks from a pillow basalt margin at a single location as deep as possible and put in microbiobox  
Collect rocks from many depths for geology  
Collect corals (multiple individuals, the bigger the better, bamboo & corallium, living & dead, see photos in sub)  
Visual stratigraphy of crab depth zonation, relation to substrate, habitat, etc.  
Collect assorted crabs - tasty ones are preferred  
Collect a small (6-inch) piece of many individuals of the same species of coral  
Pushcores (1 at each sedimented location)  
Niskins (1 each on landing and takeoff, and 1 at large coral or pushcore locations) - if we come across a thicket of corals, multiple bottles at once to get enough POC for analyses

Special Eqpt  
1 extra long milk crate for corals (and crabs)  
Microbiobox (open, fill with rocks, close, trigger tracer syringe)  
2 large and 2 small milk crates for rocks  
Push cores (3)  
Niskin bottles (5)

Samples collected  
Released crab trap.

Rock samples

|            | Time stamp | X       | Y     | Zm   | Bin#   |
|------------|------------|---------|-------|------|--------|
| Sample #1  | 17:34      | 25437   | 18347 | 2467 | 6      |
| Sample #2  | 18:00      | 25074 ? |       | 2288 | 5      |
| Sample #3  | 18:43      | 24707   | 17958 | 2091 | 4      |
| Sample #4  | 18:53      | 24649   | 17927 | 2055 | 1      |
| Sample #5  | 19:00      | 24612   | 17912 | 2027 | Biobox |
| Sample #6  | 19:02      | 24612   | 17912 | 2027 | 2      |
| Sample #7  | 19:40      | 24495   | 17855 | 1919 | 3      |
| Sample #8  | 20:02      | 24464   | 17844 |      | 10     |
| Sample #9  | 20:24      | 24352   | 17822 | 1706 | 7      |
| Sample #10 | 20:31      | 24282   | 17787 | 1653 | 12     |

Portside Niskin: btl #5 16:44

Second Niskin: btl #4 17:04

Btls 3,2, &1 20:35

Push cores 16:45 2575  
 same nominal 17:10 2581  
 location

Dive plan for Alvin Dive # 3808

Date 7/12/02 Friday  
Time Start Dive 8:00  
End Dive 17:00  
Location Warwick Seamount

|                | Depth (m) | Lat deg | Lat min | Lon deg | Lon min |
|----------------|-----------|---------|---------|---------|---------|
| Start Position | ~775m     | 48      | 3.44    | 132     | 44.37   |
| End Position   | ~550m     | 48      | 3.44    | 132     | 45.86   |
| Distance       | 2km       |         |         |         |         |
| Bearing        | Due West  |         |         |         |         |

A shallow climb up from a flat ledge off Warwick. Can zig-zag along contours to find critters/rocks. Approx. end position - not a race to get to the end position. Can go further if so choose as well.

Personnel Pilot Phil Forte  
Port Observer Tom Guilderson  
PIT Chris Russo

Objectives Collect 7-8 rocks from a pillow basalt margin at a single location as deep as possible and put in microbiobox  
Collect rocks from many depths for geology  
Collect corals (multiple individuals, the bigger the better, bamboo & corallium, living & dead, see photos in sub)  
Visual stratigraphy of crab depth zonation, relation to substrate, habitat, etc.  
Collect assorted crabs - tasty ones are preferred  
Pushcores (1 at each sedimented location)  
Niskins (1 each on landing and takeoff, and 1 at large coral or pushcore locations) - if we come across a thicket of corals, multiple bottles at once to get enough POC for analyses

Special Eqpt Crab/coral pot  
Microbiobox (open, fill with rocks, close, trigger tracer syringe)  
2 milk crates for rocks (large and small)  
Push cores (3)  
Niskin bottles (5)

Samples collected 5 rocks (all volcanic)

**OBSERVER NOTES:**

|                             |       |      |      |
|-----------------------------|-------|------|------|
| Released to bottom ~1500GMT | 200m  | 1510 | 6.4C |
|                             | 630m  | 1524 | 4.2C |
| bottom                      | 15:30 | 760  |      |

sm bamboo, pipe cleaners, anenomes, sm rubbery pink coral, one smallish rattail and Sebastes (red), several small crabs and pinch bugs

bottom consists of a solid MnO crust with a dusting of sediment

will spl small to mid bamboo just to port - few fronds for ABT and rest into crab-pot  
**Niskin - first from port (#5)**

19471 15576 (via Bruce)  
 19059 15169 overlay

**Sm bamboo #1** 16:02 758m 3.8C ABT #9

Nav computer acting stupid.... Why the heck would anybody want to run software on a windows box??

reset 2XX, overlay updated 16:23h

We are 60m due south of target

Climbing ~16:25 slight current from south

sm. Black corals 753m 16:27h to port (where are the brittle stars?)

scattered biology, larger sponges

~743m Tanner crab to portside - saw it too late to stop, also some small scarlets(?)

Current picked up like crazy - or did we loose a weight?

back to bottom ~768m 16:52h

**Bamboo #2** 17:03 19388 15681 larger, good solid  
 think coming out

**sm reddish coral in crab pot (w/o rock)** 19388 15681

Nice wall w/ lots of bio to 726m

Dike below us 17:30

**2-rocks spls into bins # 1&2 forward @ 17:42** 19226 15640 725 samples 1 & 2

3-chip pan and zoom

Changed DV-CAM tape ~17:57

**Bamboo #3** ~17:57 19210 15689 720

**2nd niskin port (#4)** ~17:57 19210 15689 720

**red sea whippy thing on rock**

rubble field 715-690m & current much less (finally!!)

**Bamboo #4** 19155 15581 705 (1 x 1 m) ABT #10 (aft jar)

It is painful to watch Phil prune this to fit in the crab pot.

Scarlet kings - off to port, medium sized but multiples of them. 18:49h 695m

**Rock sample #3** 19:09 19038 15573 658 bin #3 (port aft of 4-  
 bin box)

taken from a large outcrop of a highly fractured but massive (~2 m wide) lava flow

less MnO crust and more sediment present at depths above the rubble field (~670 m)

**Biogeo box - lava tube- rock sample #4** 19020 15573 646

samples aquired from both the interior and margin area of a large lava tube in hopes of biological mediated glass margin

Space check - 2 more rocks, 3 niskins, more coral (19:50 hr, ~1 hr bottom time)

Interesting - no gold coral only small black corals - nothing worth grabbing

**Bamboo #5** 18979 15577 634 (4C) pieces into ABT bins on  
 starboard, both bins

**Last 3-niskins fired here before sampling (3-2-1)**

This bamboo is incredible !!! 1.5m x 1.5m superstructure (at least) and 40 cm up from stalk. Lots of p/t and 3-chip

octopus to port 2 foot arm-length (via Phil) 18877 15566 617

All three push cores from this small enclave - nice foram sand !!!!

**Final rock sample #5** 21:00 18884 15569 617

sample acquired near the margin of another massive lava flow, the interior of the flow is characterized by large columnar jointed basalt (columns ~1m in length and well defined

Dive plan for *Alvin* Dive # **3809**

Date 7/13/02 Saturday  
Time Start Dive 8:00  
End Dive 17:00  
Location Warwick Seamount

|                | Depth (m) | Lat deg | Lat min | Lon deg | Lon min |
|----------------|-----------|---------|---------|---------|---------|
| Start Position | ~1300     | 48      | 5.51    | 132     | 44.81   |
| End Position   |           | 48      | 4.43    | 132     | 45.41   |
| Distance       | 2.1 km    |         |         |         |         |
| Bearing        | S S/W     |         |         |         |         |

A steep climb from a small ledge at mid-depth.  
Release crab-trap elevator  
Can go further if so choose as well.

|           |               |                  |
|-----------|---------------|------------------|
| Personnel | Pilot         | Bruce Strickrott |
|           | Port Observer | Brendan Roark    |
|           | PIT           | Chris Russo      |

Objectives Collect 7-8 rocks from a pillow basalt margin at a single location as deep as possible and put in microbiobox  
Collect rocks from many depths for geology  
Collect corals (multiple individuals, the bigger the better, bamboo & corallium, living & dead, see photos in sub)  
Visual stratigraphy of crab depth zonation, relation to substrate, habitat, etc.  
Pushcores (1 at each sedimented location)  
Niskins (1 each on landing and takeoff, and 1 at large coral or pushcore locations) - if we come across a thicket of corals, multiple bottles at once to get enough POC for analyses

Special Eqpt Crab/coral pot  
Microbiobox (open, fill with rocks, close, trigger tracer syringe)  
2 milk crates for rocks (large and small)  
Push cores (3)  
Niskin bottles (5)

#### OBSERVER NOTES:

|                                 |       |       |       |       |
|---------------------------------|-------|-------|-------|-------|
| Samples collected               | time  | x     | y     | depth |
| released to bottom @ ~15:00 GMT |       |       |       |       |
| on bottom                       | 15:49 | 19056 | 19276 | 1200  |

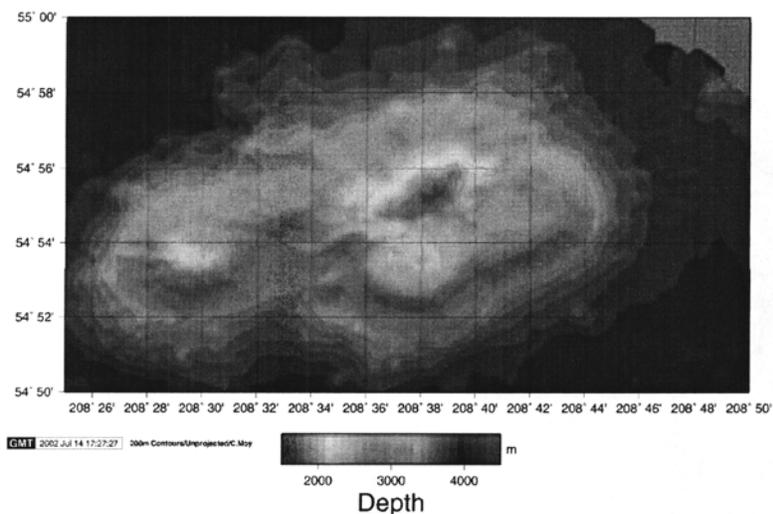
visible at bottom are a few scattered small black and "pipe cleaner" corals, some red "spine back" fish  
and rattail fish, and a couple of shrimp swimming in the water column  
bottom is very flat and covered with a few inches of sediment  
began looking for crab trap 16:07

|   |       |       |       |      |
|---|-------|-------|-------|------|
| crab trap found   | 16:19 | 18950 | 19404 | 1210 |
| upon arrival two crabs were spotted in the trap and a couple more were on the ground in the near vicinity of the trap.                                    |       |       |       |      |
| crab trap released acoustically   | 16:35 |       |       |      |
| 1 crab in the trap  |       |       |       |      |
| computer crash and rebooted   | 16:41 |       |       |      |
| sediment core taken near trap locale  | 16:45 | 18950 | 19404 |      |
| niskin bottle #1 fired  |       |       |       |      |
| sedimented area around crab trap has lots of rattail fish spread out a few meters apart   |       |       |       |      |
| terrane change  | 17:02 | 18853 | 19104 | 1194 |
| sediment covered ground ends abruptly at the base of a large outcrop of pillow basalt   |       |       |       |      |
| <b>Rock sample #1</b>   | 17:06 | 18854 | 19096 | 1191 |
| sample taken from a large pillow basalt in the outcrop placed into bin position #1  |       |       |       |      |
| close-up video of sampling also acquired.   |       |       |       |      |
| <b>Rock sample #2</b>   | 17:14 | 18865 | 19099 | 1184 |
| sample collected from the margin of a weathered out pillow basalt and placed into the crab box  |       |       |       |      |
| climbing up from the pillow outcrop we came across some MnO oxide plates before returning to flat sedimented terrane                                      |       |       |       |      |
|   |       | 18860 | 19051 | 1169 |
| moving along this sedimented area we reached a second outcropping of pillow basalt  |       |       |       |      |
| terrane change  |       | 18846 | 18981 | 1155 |
| <b>Rock sample #3 (biobox)</b>  | 17:30 | 18865 | 18985 | 1148 |
| two pieces from a large pillow basalt were collected one placed in the biobox and the other into bin#4  |       |       |       |      |
| terrane flattened out again   | 18:05 |       |       | 1130 |
| more "life" present lots of pinch bugs and sponges along with anemones  |       |       |       |      |
| terrane change  |       |       |       | 1100 |
| flat area ended at the base of another massive pillow basalt outcrop. This outcrop also has a lot of flow toes draped over and in between pillow basalts. |       |       |       |      |
| <b>Crab sampled</b>   | 18:07 | 18882 | 18916 | 1093 |
| terrane change  | 18:17 | 18901 | 18710 |      |
| flat area covered with rubble and lightly sedimented  |       |       |       |      |
| computer crash  | 18:20 |       |       |      |
| computers reset by Bruce  |       |       |       |      |
| terrane change  | 18:24 | 18895 | 18641 | 1088 |
| another pillow basalt outcrop   |       |       |       |      |
| terrane change  | 18:27 | 18873 | 18611 | 1084 |
| "pavement" like terrane with a moderate slope   |       |       |       |      |
| terrane change  | 18:35 | 18834 | 18505 | 1040 |
| back to pillow basalts  |       |       |       |      |
| attempted to sample pillow basalt   | 18:40 | 18831 | 18489 | 1020 |
| sample could not be obtained on account of strong currents  |       |       |       |      |
| terrane change  |       |       |       | 1012 |
| pillow basalts overlain by more massive flows   |       |       |       |      |
| terrane change  | 18:49 | 18820 | 18479 | 995  |
| back to more pillow basalt currents still strong  |       |       |       |      |

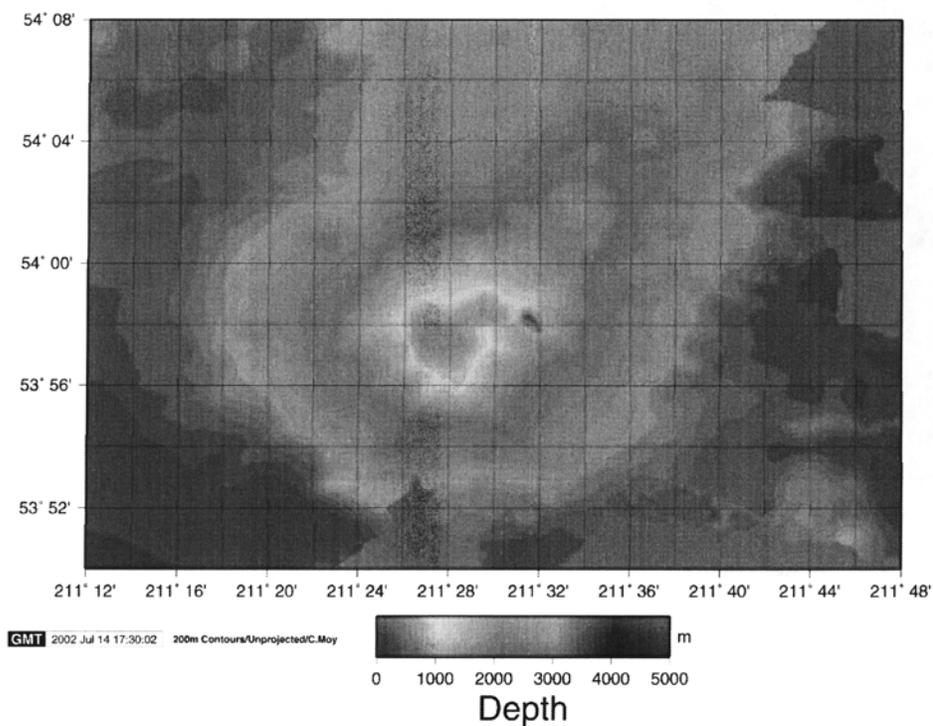
|  |       |       |       |     |
|--|-------|-------|-------|-----|
| terrane change, back to more massive basalt flows  |       |       |       | 980 |
| <b>Rock sample #4</b>  | 18:55 | 18818 | 18475 | 977 |
| large basalt piece removed from near the margin of a basalt flow   |       |       |       |     |
| terrane change   |       | 18812 | 18445 | 973 |
| top of the outcrop was reached and terrane flattened out became "pavement" like and was slightly sedimented. |       |       |       |     |
| terrane change   | 19:13 | 18786 | 18383 | 963 |
| pavement like terrane becam covered by rubble  |       |       |       |     |
| bus tye fuse failure   | 19:30 | 18787 | 18217 | 935 |
| failure leads to end of dive   |       |       |       |     |
| final 4 niskin bottles fired   | 19:34 | 18790 | 18220 | 935 |

APPENDIX B. SEABEAM MAPS

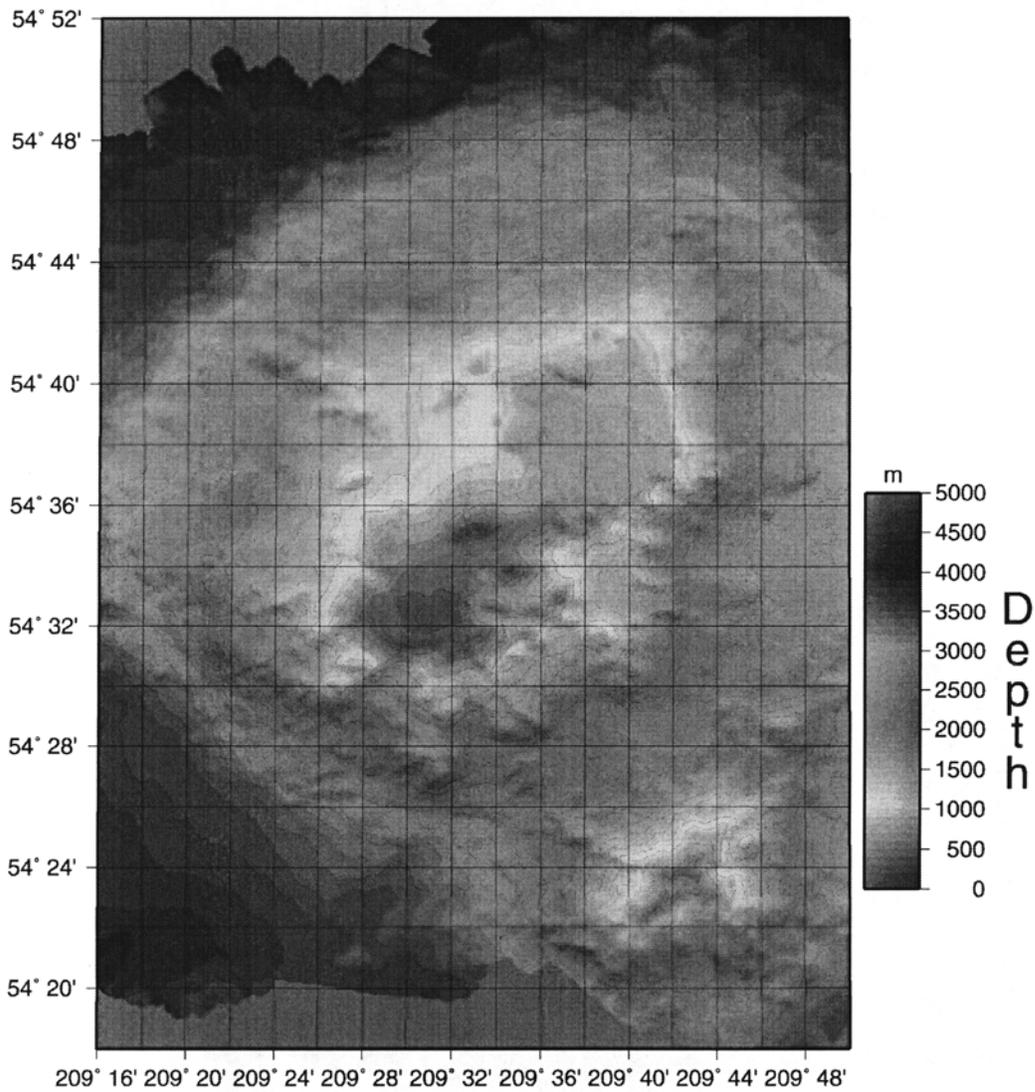
MARCHAND SEAMOUNT



MURRAY SEAMOUNT

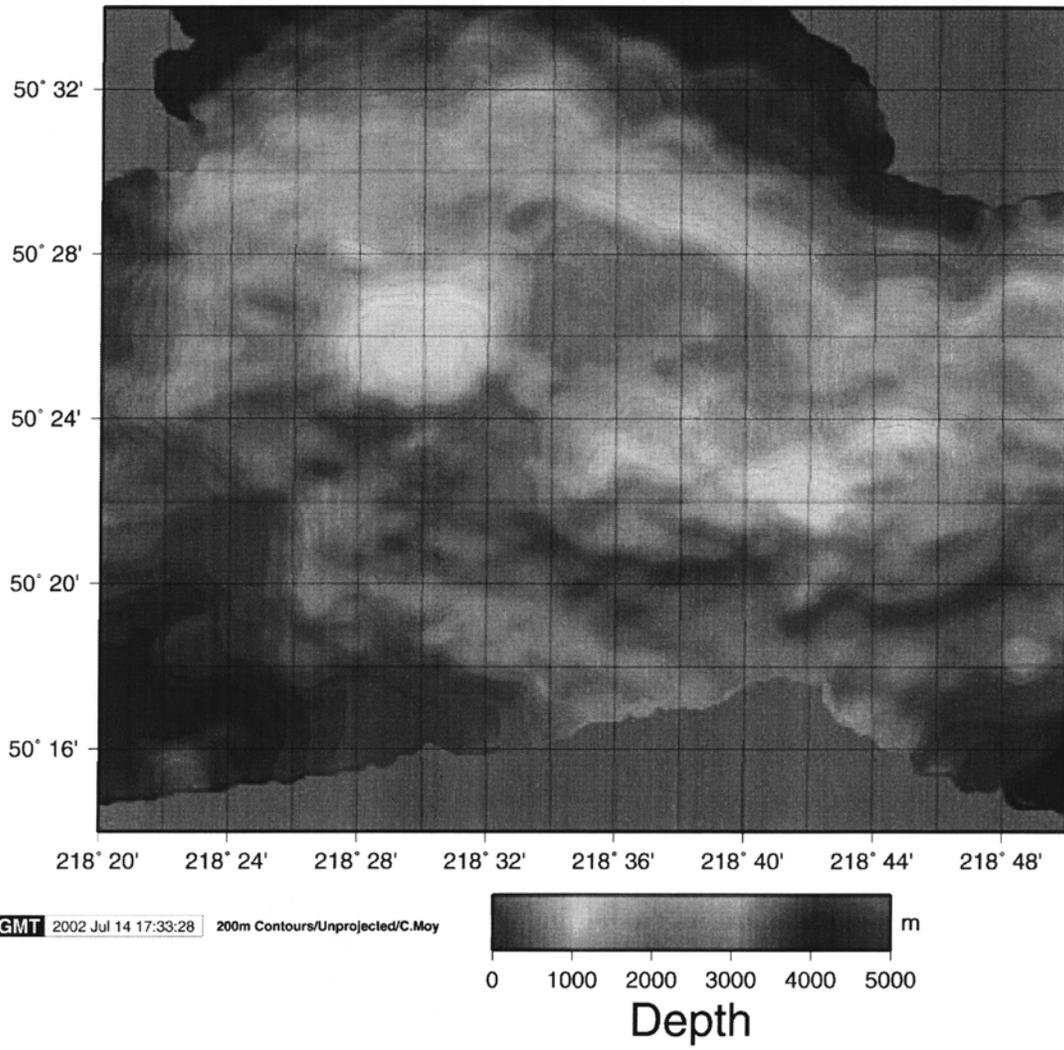


# PATTON SEAMOUNT

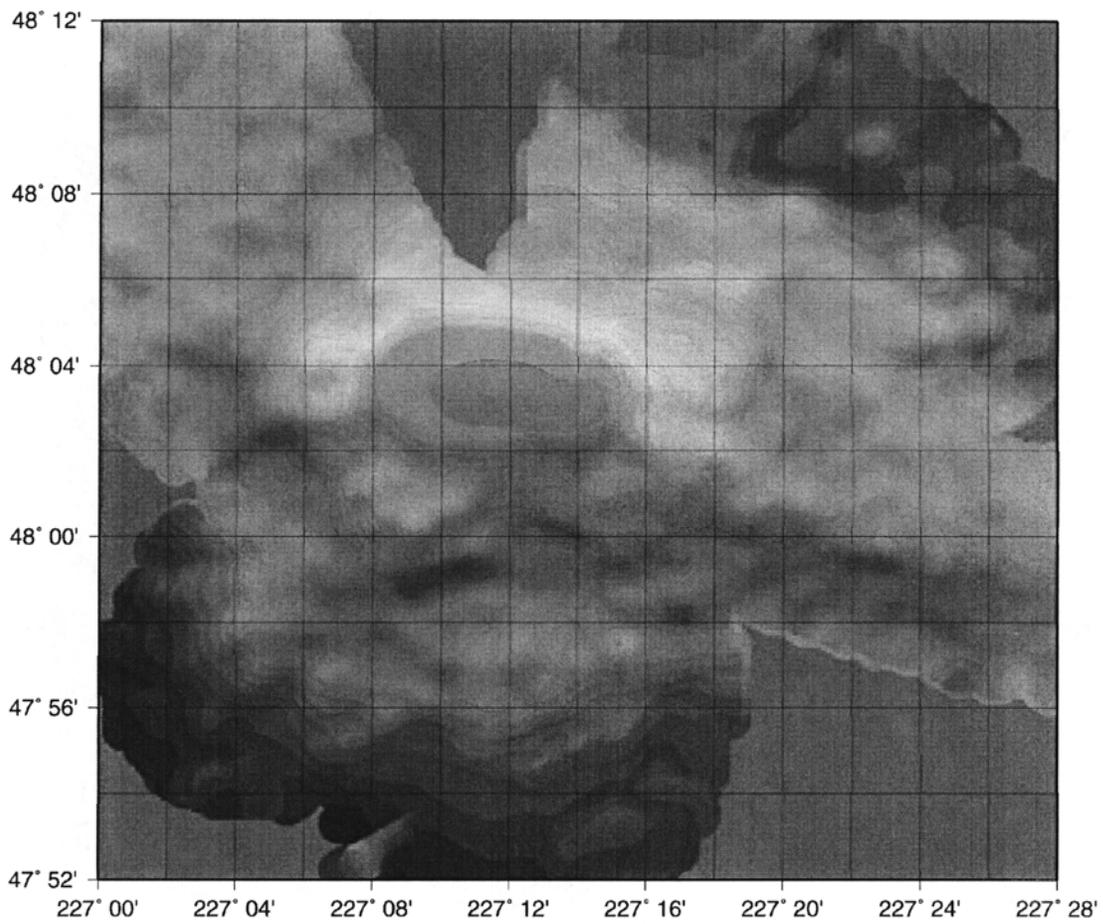


GMT 2002 Jul 14 17:31:20 200m Contours/Unprojected/C.Moy

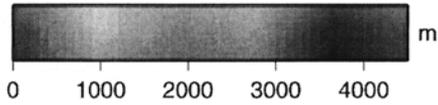
# SCOTT SEAMOUNT



# WARWICK SEAMOUNT



GMT 2002 Jul 14 17:35:12 200m Contours/Unprojected/C.Moy



Depth