# DEEP SEA DRILLING PROJECT
# TECHNICAL REPORT NO. 7
# OPERATIONS RESUMES – PART III

CONTRACT NSF C-482

## PRIME CONTRACTOR
## THE REGENTS
## UNIVERSITY OF CALIFORNIA


SCRIPPS INSTITUTION OF OCEANOGRAPHY

University of California at San Diego

# OPERATIONS RESUMES
## LEG 26 through LEG 33

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By

DEEP SEA DRILLING PROJECT
Scripps Institution of Oceanography
University of California at San Diego

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# INTRODUCTION

All the good things - and all the bad things - that happened aboard the D/V Glomar Challenger from an operational standpoint from Leg 26 through Leg 33 of the Deep Sea Drilling Project are told in Technical Report No. 7.

Technical Report No. 7 is the third publication about operational and engineering procedures aboard the drilling vessel, Glomar Challenger. TR No. 1 (Leg 1 through Leg 18) was published in October of 1971, while TR No. 5 (Leg 19 through Leg 25) came off the presses in October 1972.

Following procedures established for the first two technical reports on Operations Resumes, TR No. 7 gives technical achievements, drilling and coring results, drill bit performance and improvements, coring equipment modifications, tests of new procedures and equipment, improvements of drilling and coring procedures, plus problems encountered and anticipated and the steps taken or proposed to eliminate the trouble.

## ACKNOWLEDGEMENTS

The overall operational success of the Deep Sea Drilling Project, during the period represented by this report, can clearly be traced to the advice of the cruise operations managers loaned to the Project by major oil companies of the United States, the important engineering and management background brought to DSDP by Deputy Project Manager Frank C. MacTernan and the counsel of Operations Manager Valdemar F. Larson, Development Engineer Stanley T. Serocki and Resident Cruise Operations Manager Lamar P. Hayes.

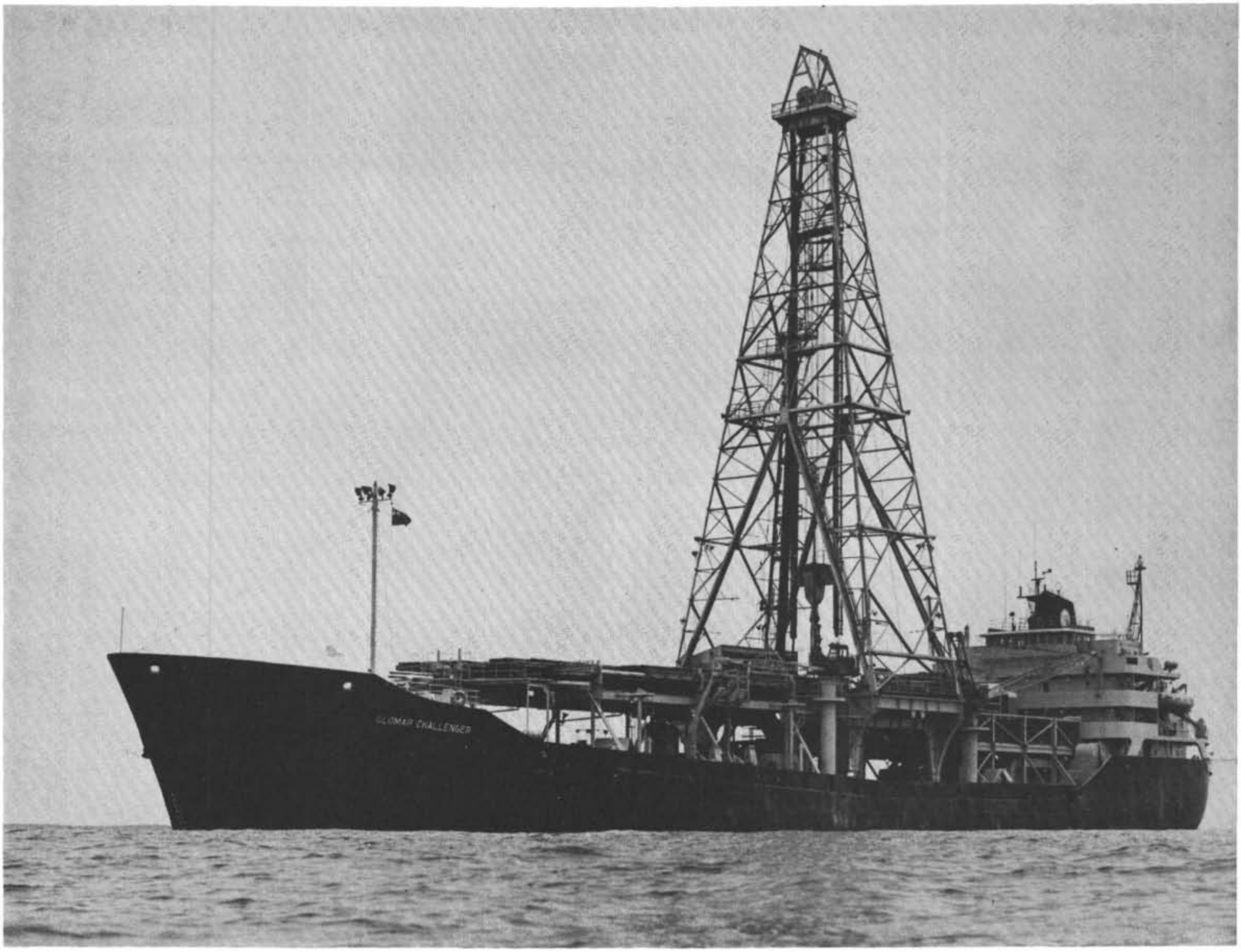
Mr. William T. Soderstrom, finance administrator; Mr. Ross E. Bates, senior buyer, and Mr. Robert E. Bower, contract officer contributed greatly to smooth business functions, while Mr. Robert Olivas, logistics officer, coordinated successfully all logistics functions necessary to achieve these operational successes.

An all-important contributor to the technical and scientific successes was Global Marine Inc., of Los Angeles, California, owners and operators of the D/V Glomar Challenger. The project expresses its deep appreciation to the continuing efforts of Global Marine Inc. in making the work of D/V Glomar Challenger into a success story of its own, within the overall project.

The continuing help of Mr. A R. McLerran, National Science Foundation Field Project Officer with DSDP and the support and funding of the Foundation are gratefully acknowledged.

Scientific advice provided by the Joint Institutions for Deep Earth Sampling (JOIDES) institutions and many JOIDES Advisory Panel members has been essential to the overall Project success.

M.N.A. Peterson
Principal Investigator & Project Manager
Deep Sea Drilling Project




DEEP SEA EXPLORER-This is a port side view of the Deep Sea Drilling Project drilling vessel, Glomar Challenger, which is drilling and coring for ocean sediment in all the oceans of the world. Scripps Institution of Oceanography, of the University of California at San Diego, is managing institution of DSDP under a $68.3 million contract with the National Science Foundation. The drilling vessel is owned and operated by Global Marine Inc., of Los Angeles, which holds a subcontract with Scripps to do actual drilling and coring work. The Glomar Challenger weighs 10,400 tons, is 400 feet long and the million-pound-hook-load capacity drilling derrick stands 194 feet above the waterline. She is the first of a new generation of heavy drilling ships capable of conducting drilling operations in open ocean, using dynamic positioning to maintain position over the bore-hole. A re-entry capability was established on June 14, 1970, which will enable the changing of drill bits and re-entering the same bore-hole in the deep ocean. Forward is the automatic pipe racker, designed by Global Marine Inc., which holds 24,000 feet of 5-inch drill pipe.

# OPERATION RESUMES

## Contents


| | | Page |
|---|---|---|
| Leg 26 - | Durban, South Africa, to Fremantle, Australia<br>August 22, 1972, to October 30, 1972<br>Cruise Co-Chief Scientists:<br>Dr. Thomas A. Davies, Deep Sea Drilling Project<br>Dr. Bruce Luyendyk, Woods Hole Oceanographic Institution<br>Cruise Operations Manager:<br>Mr. Lamar P. Hayes, Deep Sea Drilling Project | 1 |
| Leg 27 - | Fremantle to Fremantle<br>October 30, 1972, to December 20, 1972<br>Cruise Co-Chief Scientists:<br>Dr. James Heirtzler, Woods Hole Oceanographic Institution<br>Dr. John Veevers, School of Earth Sciences, Macquarie University, North Ryde, New South Wales, Australia<br>Cruise Operations Manager:<br>Mr. Carl M. Morris, Marathon Oil Co., Shreveport, La. | 20 |
| Leg 28 - | Fremantle to Christchurch, New Zealand<br>December 20, 1972, to February 27, 1973<br>Cruise Co-Chief Scientists:<br>Dr. Dennis Hayes, Lamont-Doherty Geological Observatory<br>Dr. Lawrence A. Frakes, Dept. of Geology, Florida State University, Tallahassee, Fla.<br>Cruise Operations Manager:<br>Mr. Lamar P. Hayes, Deep Sea Drilling Project | 35 |
| Leg 29 - | Christchurch to Wellington, New Zealand<br>February 27, 1973, to April 18, 1973<br>Cruise Co-Chief Scientists:<br>Dr. James P. Kennett, Narragansett Bay Campus, University of Rhode Island<br>Mr. Robert E. Houtz, Lamont-Doherty Geological Observatory<br>Cruise Operations Manager:<br>Mr. Carl M. Morris, Marathon Oil Co., Shreveport, La. | 56 |

Page

Leg 30 - Wellington to Apra, Guam 76
April 24, 1973, to June 13, 1973
Cruise Co-Chief Scientists:
Dr. James E. Andrews, Department of Oceanography, University of Hawaii
Dr. Gordon Packham, Dept. of Geophysics, The University of Sydney, Sydney, New South Wales, Australia
Cruise Operations Manager:
Mr. Valdemar F. Larson, Deep Sea Drilling Project

Leg 31 - Guam to Hakodate, Japan 95
June 13, 1973, to August 4, 1973
Cruise Co-Chief Scientists:
Dr. James C. Ingle, Dept. of Geology, Stanford University
Dr. Daniel E. Karig, Dept. of Geological Sciences, University of California at Santa Barbara
Cruise Operations Manager:
Mr. John R. Shore, Chevron Oil Field Research Co., LaHabra, California

Leg 32 - Hakodate to Honolulu, Hawaii 117
August 16, 1973, to October 10, 1973
Cruise Co-Chief Scientists:
Dr. Roger L. Larson, Lamont-Doherty Geological Observatory
Dr. Ralph Moberly, Institute of Geophysics, University of Hawaii
Cruise Operations Manager:
Mr. Lamar P. Hayes, Deep Sea Drilling Project

Leg 33 - Honolulu to Papeete, Tahiti 131
November 2, 1973, to December 17, 1973
Cruise Co-Chief Scientists:
Dr. E. Dale Jackson, USGS, Menlo Park, Calif.
Dr. Seymour O. Schlanger, University of California at Riverside
Cruise Operations Manager:
Mr. Stanley T. Serocki, Deep Sea Drilling Project

DEEP SEA DRILLING PROJECT
OPERATIONS RESUME
LEG 26

## SUMMARY

Leg 26 commenced in Durban, South Africa on August 22, 1972. After spending 14.9 days in port (of which nine days were in dry dock), the Glomar Challenger departed from Durban at 0645 September 6, 1972. The voyage proceeded south to the Mozambique Ridge, then west across the Indian Ocean and terminated in Fremantle, Australia at 0745 October 30, 1972.

During this interim period, the Challenger cruised 5695.9 nautical miles while investigating 9 sites. On these 9 sites, 12 holes were drilled. 2234 meters were cored on 246 coring attempts with recovery on 239 or 97%. In addition to the coring, 1695 meters were drilled for a total sub-bottom penetration of 3893 meters.

Many changes and modifications were made to the Glomar Challenger while in dry dock in Durban. All four thrusters were removed and overhauled; one gear box was changed out; a new generator was installed with assignments to provide more flexibility to the ship's power supply; a Vessel Motion Instrumentation System was installed and the Satellite Navigation System was moved from the Science Office to the Electronics Lab. Other modifications were made in preparation for cold weather operations planned for Legs 28 and 29 in the Antarctic Ocean.

Just beyond the sea buoy at Durban Harbor all systems were operationally checked. With the Glomar Challenger dead in the water, all thrusters were checked for maximum rpm's and both the bow and stern thrusters exceeded 540 rpm's. An ORE 13.5 kHz beacon was lowered on the sandline to 1000 feet to check out the hydrophones, the computer, and other related positioning equipment. All systems that had been changed or modified were tested and all systems were found in good order.

## DRILLING AND CORING

The configuration of the bottom hole assembly did not change throughout Leg 26. From the bottom up, the bottom hole assembly consisted of: the bit, float sub, core barrel, three 8-1/4" drill collars, two Baash Ross bumper subs, three 8-1/4" drill collars, two Baash Ross bumper subs, two 8-1/4" drill collars, one 7-1/4" drill collar and one joint of heavy weight drill pipe. This assembly is approximately 127 meters long and will provide about 30,000 pounds of weight in sea water.

The first three sites were south and southwest of Durban and on these sites our drilling and coring programs were planned around the expected weather condition. The scientific objectives were reached on the first two sites, however, on each site the weather was deteriorating as the sites were completed. On one occasion, the Weather Bureau in Durban was contacted directly to determine weather conditions for the next 24 hours in that area. Winds gusting up to 35 knots with 14 foot swells were common in this area. On many occasions the ship's roll actually exceeded 10 degrees and pitch, 7 degrees.

The third site, Site 252, was the first of two sites abandoned because of weather conditions. After 222 meters of penetration, it was necessary to abandon the hole. The winds were gusting over 40 knots, the seas were building quite rapidly and the barometer had dropped 19 millibars in a very short time. While clearing the mud line with the bottom hole assembly, a sudden change in the wind direction caused the ship to move off station 700 feet. No loss of equipment was experienced.

In addition, Site 258, located approximately 200 miles southwest of Perth, was abandoned because of adverse sea and wind conditions. After 525 meters of penetration, the mud line was cleared by the bottom hole assembly. As soon as this was completed, the ship lost its heading and was blown 800 feet off station before a correction could be made. During this gale, the winds peaked at 60 mph and the seas were 18 feet ±. The ship's roll was too severe to continue pulling drill pipe safely. Thirteen hours were lost riding out the gale with the drill string suspended below the ship.

Power failures during actual coring operations caused even more problems than the weather. At each of the first two sites a second hole was required when the first hole was lost because of loss of power to the bridge, computer and the drill rig floor. The first occurrence was on Site 250 when the temporary loss of power caused the computer to dump its program. While reprograming the computer, the ship was positioned manually. The relative position display on the bridge indicated that the ship was staying within 100 feet of the beacon. After the computer was reprogrammed, it was discovered that the relative positioning display had malfunctioned. The ship had actually drifted about 4,000 feet off station. Fortunately, the drill pipe had not broken off at the mud line. After proper positioning was established and the bit had been pulled clear of the mud line, the drill pipe would not rotate, although the weight indicator showed the drill string to be still intact. This indicated that the bottom hole assembly was bent. After the drill string was retrieved, two badly bent bumper subs, one 7-1/4" and two 8-1/4" drill collars were replaced. On Site 251, we had the same type of power failure. Power was quickly restored to the rig floor and the bit was pulled above the mud line. The relative positioning display had been repaired and was functioning normally and no losses were incurred. On Site 256, power was lost to the computer, drill motor and propulsion motor blowers. The ship, again, was positioned in manual. This problem was due to an overloaded circuit caused when all drilling power is being used while positioning with both shafts. The drilling motors and positioning motor blowers, computer, gyros are all on the same circuit. A thorough review of these electrical circuits is needed.

## HEAT FLOW MEASUREMENTS

Many heat flow measurements were taken. On the first 3 or 4 sites the measurements were good. Some bent and broken probes were experienced. On one occasion, heat flow was attempted while drilling in clay with limestone stringers. The flexible probe apparently bent on contact with bottom. A complete heat flow instrument was lost on Site 256. This loss was probably due to the probe bending and fouling in the bit. The inner core barrel was hard to unseat and an extra 4000 pounds of wireline pull was required to free it. Both core catchers were found to be completely stripped out when the inner barrel was recovered. On Site 257, a new bottom hole assembly was used. Probe damage was more of a problem than had been encountered on the first holes and the damage to the probes was apparently related to this new bottom hole assembly and not the formation. In addition, the float valve flapper spring was somewhat stronger than the proceeding valve had been. It is suspected that the flexible probe was slightly deflected on impact with the flapper which caused the point of the probe to strike a square surface on the bit. This would cause the probe to be bent before being implanted into the formation.

The new ball latch system worked very well and seems to be rugged enough to withstand the abuse that downhole tools are subjected to on floating drilling rigs. Core recovery and heat flow data has, however, been consistently poor when taking heat flow measurements with the combination tool. Heat flow measurements are normally taken in the soft clays or chalky sediments and the weight of the instrument probably acts to prevent the core from entering the inner core barrel. Operationally, the problems encountered appear to be mostly procedural. Only minor equipment modifications are required to conduct successful heat flow measurements.

To prevent probe damage and to obtain better measurements, the following steps are suggested:

1. Always check the bottom of the preceeding core to make sure the formation is suitable for implementation of the probe.

2. Make sure the formation is firm enough to hold 12,000 pounds of weight on the bit so the bottom bumper subs will remain in a half open, half closed position.

3. Lower the heat flow instrument on the sandline. Use 20 to 25 strokes on the pump so that the flapper valve will be open and the probe will not be deflected against the bit.

4. The heat probe extender needs to be stiffer. Presently, it is 3/4 inch O.D. We suggest that the O.D. be increased to one inch while maintaining the same cross sectional area.

5. Do not try to core and run heat flow at the same time. If the probe is bent, it will probable get fouled in the bit. This will cause instrument damage and/or loss of an instrument. In addition, it could easily cause the bit to become locked and/or result in the complete loss of the hole.

## CORING PROBLEMS

Core recovery was a continuous problem throughout the leg. The soft clays and chalks proved to be much more difficult to recover in the southern latitudes than previously experienced in the oozes and chalks of the fertile waters near the equator. Of the nine sites investigated, basalt was cored on six sites. Of the remaining three sites, one was abandoned because of stuck pipe, the other two were abandoned because of bad weather.

Site 255, located just east of the southern end of the Ninety East Ridge, was drilled in 1154 meters of water. The drill string became firmly stuck after a penetration of 108.5 meters below the mud line. The site was continuously cored but very little core was recovered. The first 70 meters was apparently sand. Then, hard limestone and chert stringers, setting at 16 degree angles, were encountered. After each core was recovered, the bottom was checked carefully to see if the hole was sloughing and had caused any fill on bottom. The drill string was being rotated with normal pump pressure when the sand apparently fell in and stalled the power sub. A drastic increase in pump pressure was observed. All bumper sub action was lost, which indicated that the sand had sloughed from the mud line and that the bottom hole assembly was stuck above the top bumper subs. The drill string was then severed at the mud line leaving the complete bottom hole assembly and three joints of drill pipe on bottom. The name that oceanographers have bestowed on this southern part of the Ninety East Ridge is "Broken Ridge" and that it appears to be.

## VESSEL MOTION INSTRUMENTATION SYSTEM

A Vessel Motion Instrumentation (VMI) System borrowed from Chevron Oilfield Research Co., was installed on board the Glomar Challenger while the ship was in Durban. Measurements were planned for Leg 26, however, only one measurement was made. This, on the very first site. Measurements to be recorded were; ship's roll, "X", "Y", heave, pitch, sway surge, drill string weight, wind, current, and ship's heading. The "X", "Y", and heading wires were disconnected while resolving a positioning problem (cross talk was experienced). Many attempts were made later to calibrate the various channels on the VMI recorder. These attempts were unsuccessful and plans were made to correct these problems in Fremantle.

## CORE BITS

Drilling bit improvement over the past two years has provided us the means of penetrating deeper into basalt. The first button bits introduced on the Project made it possible to penetrate the tough chert sections, but the bearings in these bits would go out long before the teeth (buttons) would. To extend the bearing life, the sealed bearing bit was tried and the bearing life was increased. For the last three legs a journal (or friction) bearing bit has been used and now the bearings are outlasting the buttons. The deepest penetration into basement has been made with the journal bearing bit. On Site 257, the journal bearing bit penetrated 63.5 meters into basalt. When this bit was retrieved, it was noticed that the bearings were as tight as a new bit. The outside buttons were in excellent condition, however, the inside buttons were either broken or missing. These buttons actually trim the core before it is pushed into the core barrel. Without these inside teeth, the penetration rate is greatly reduced. It is believed that by adding more buttons to the inside of these bits, we would extend our bit life even further and possibly increase the penetration rate.

## SIDEWALL CORER

A sidwall sampler was tested on Site 257. This tool, when fully perfected, will provide a means of obtaining a sample from a section or contact point that may have been missed because of poor core recovery or perhaps while drilling. The sampler is secured to the bottom of the inner core barrel by cable 5/8" x 10' in length. When the core barrel has seated, the sampler and carrier body drops through the bit. The catcher is hinge pinned to the carrier. As the catcher passes through the bit, it is kicked out against the well bore. As the drill pipe is raised, the catcher is forced into the formation. If the formation is too hard, a shear pin in the catcher arm should shear. The trial at Site 257, made after the hole was complete, demonstrated the workability of the inner barrel latch. Unfortunately, the tool apparently became lodged in the side of the hole while pulling drill pipe and was severely crushed by the core bit. Future runs will need to be run on the sandline.

## DYNAMIC POSITION EQUIPMENT

The positioning system performed well throughout Leg 26. The power failures caused the computer to dump its program on a few occasions, however, this problem can be attributed to power supply source and not the computer. However, a fail safe computer program should be developed. A surge or drop in the power supply to the computer will cause the loss of its program. To reprogram the computer, the ship must be positioned in manual for approximately 1-3/4 hours. The computer normally commands the engine room for a certain percent of power to be used on either the two bow and/or the two stern thrusters and/or to the main propulsion shafts to correct the ship's positioning error. Throughout Leg 26, these systems performed as they were designed. Without maximum efficiency from this equipment, at least three sites probably would have been abandoned because of weather.

ORE beacons were used on all sites. Six ORE 16 kHz beacons and four 13.5 kHz beacons were dropped. One ORE 16 kHz failed after 68.5 hours on bottom. The signal had weakened until the ship's hydrophones were losing acoustics (not hearing the beacon signal). This beacon had failed on a "presoak" test on a previous leg and had been repaired by the manufacturer. Apparently the batteries were too old to send a strong signal for an extended period of time. During the leg, one ORE 13.5 kHz beacon failed on a "presoak" test. This beacon will be returned to ORE for repairs and new batteries.

## CREW

Crew performance, again, was outstanding. A team effort of all aboard made Leg 26 a very successful voyage. The contractor's marine engineers in particular, are commended for their relentless efforts in solving the Challenger's power problems despite an unusually high workload occasioned by returning the engine room to a "ship-shape" condition following the many repairs/modifications made in dry dock at Durban.

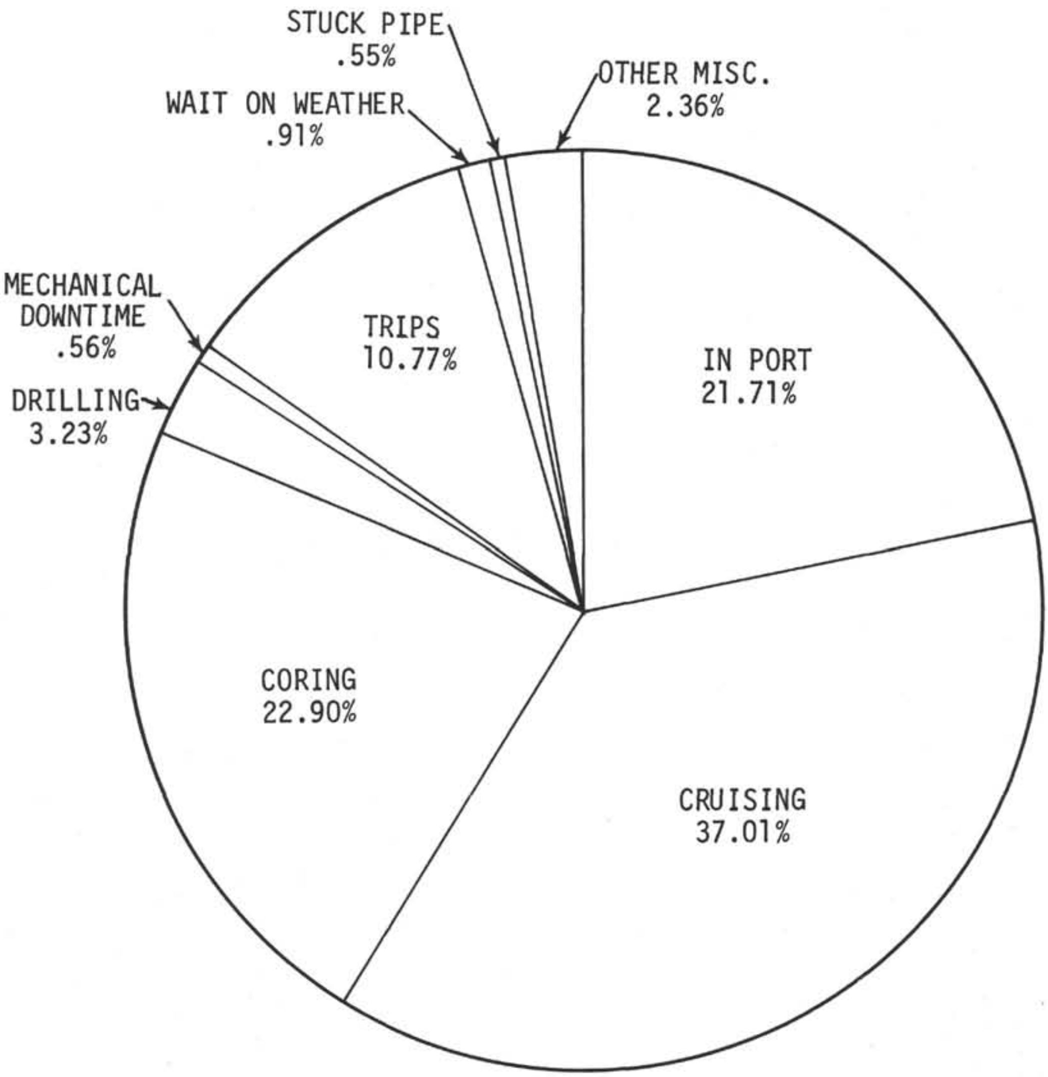
Lamar Hayes

Lamar Hayes
Cruise Operations Manager
Deep Sea Drilling Project

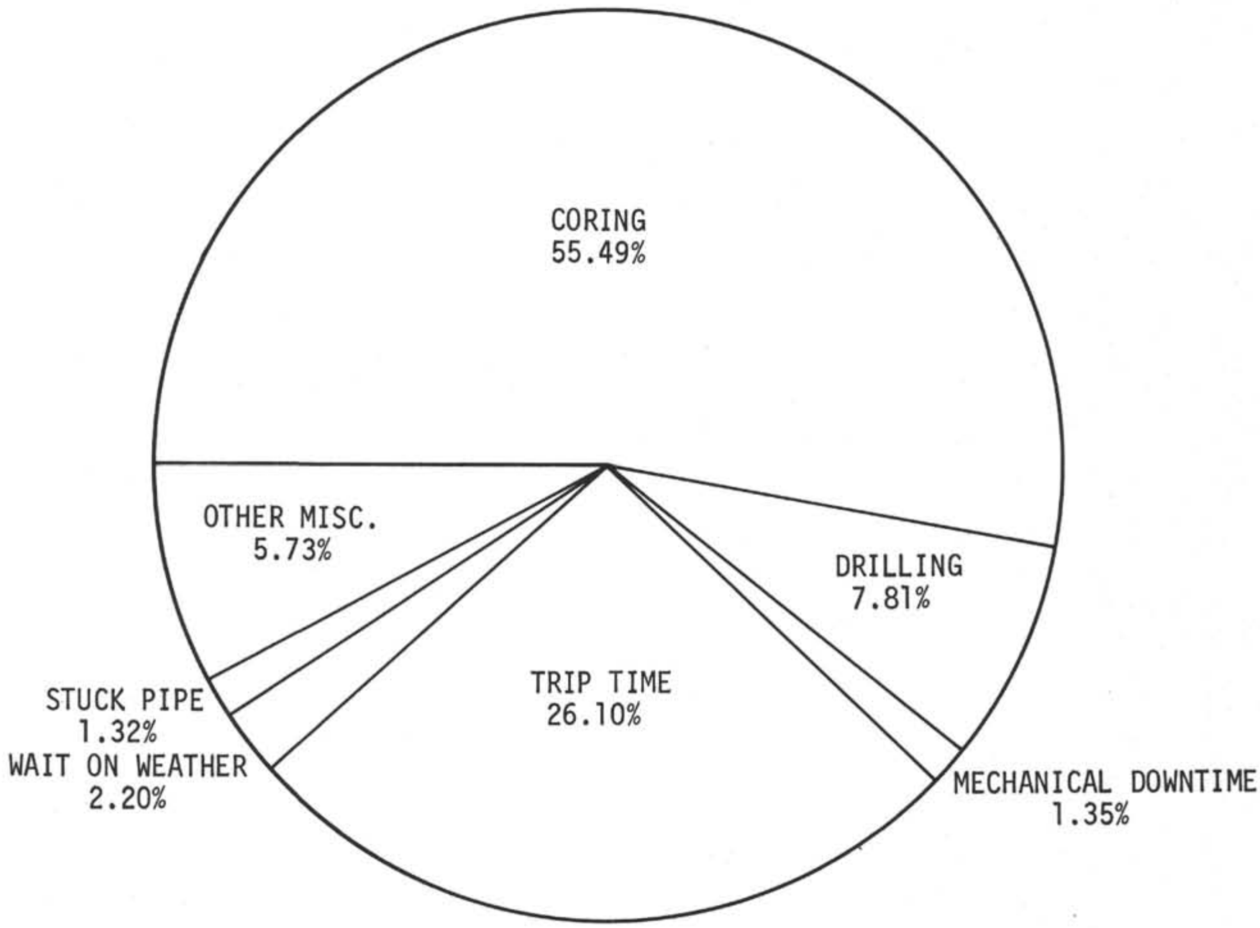
DEEP SEA DRILLING PROJECT
SUMMARY OF OPERATIONS
LEG 26

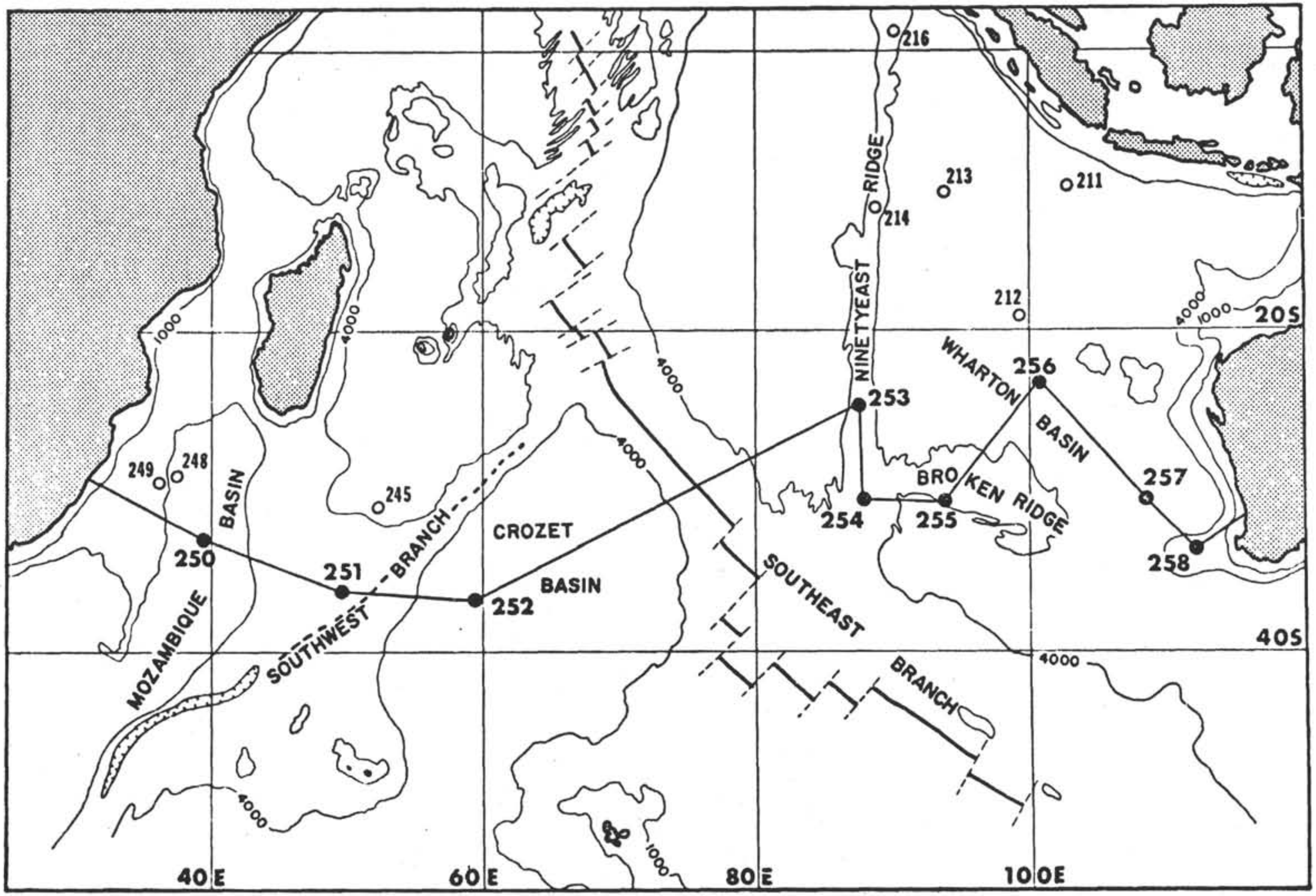
| | | |
|---|---|---|
| Total Days (August 22 - October 30, 1972) | | 68.76 |
| Total Days In Port | | 14.92 |
| Total Days Cruising | | 25.44 |
| Total Days On Site | | 28.38 |
| Coring Time | 15.75 | |
| Drilling Time | 2.22 | |
| Mechanical Downtime | .38 | |
| Trip Time | 7.41 | |
| Waiting On Weather | .62 | |
| Stuck Pipe | .38 | |
| Other | 1.62 | |
| Total Distance Traveled (Nautical Miles) | | 5695.9 |
| Average Speed (Nautical Miles) | | 9.26 |
| Sites Investigated | | 9 |
| Holes Drilled | | 12 |
| Number of Cores Attempted | | 246 |
| Number of Cores With Recovery | | 239 |
| Percent of Cores With Recovery | | 97 |
| Total Meters Drilled | | 1695 |
| Total Meters Cored | | 2234 |
| Total Meters Recovered | | 1184.85 |
| Percent of Core Recovered | | 51.4 |
| Total Meters Penetration | | 3893 |
| Maximum Penetration Per Hole (Meters) | | 738.5 |
| Maximum Water Depth (Meters) | | 5371 |

DEEP SEA DRILLING PROJECT
LEG XXVI
LEG TIME BREAKDOWN



DEEP SEA DRILLING PROJECT
LEG XXVI
ON-SITE TIME BREAKDOWN






DSDP LEG 26 Durban - Fremantle (Sept.- Oct. 1972)

# DEEP SEA DRILLING PROJECT
## SITE SUMMARY
## LEG 26

| Hole | Latitude | Longitude | Water Depth Meters | Number Of Cores | Cores With Recovery | Percent of Cores With Recovery | Meters Cored | Meters Recovered | Percent Recovered | Meters Drilled | Total Penet Meters | Avg. Rate Penet. | Time On Hole | Time On Site |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Foot of Mozambique Ridge** | | | | | | | | | | | | | | |
| 250 | 33° 27.67'S | 39° 22.20'E | 5129 | 3 | 3 | 100 | 28.0 | 21.3 | 76 | 37.0 | 65.0 | 130 | 37.50 | |
| 250A | 33° 27.74'S | 39° 22.15'E | 5129 | 26 | 25 | 96 | 240.5 | 124.5 | 51.7 | 498.0 | 738.5 | 30 | 113.50 | 151.00 |
| **Southwest Indian Ridge** | | | | | | | | | | | | | | |
| 251 | 36° 30.25'S | 49° 27.15'E | 3499 | 10 | 9 | 90 | 87.5 | 67.2 | 76.8 | | 87.5 | 116 | 27.25 | |
| 251A | 36° 30.26'S | 49° 29.08'E | 3499 | 31 | 29 | 93 | 276.5 | 158.3 | 57.2 | 222.5 | 499.0 | 33 | 59.00 | 86.25 |
| **Southwest Branch of the Mid Ocean Ridge** | | | | | | | | | | | | | | |
| 252 | 37° 02.44'S | 59° 14.33'E | 5042 | 7 | 7 | 100 | 57.0 | 41.5 | 72.8 | 190.0 | 247.0 | 247 | 38.50 | 38.50 |
| **Ninetyeast Ridge** | | | | | | | | | | | | | | |
| 253 | 24° 52.65'S | 87° 21.91'E | 1972 | 58 | 56 | 96 | 536.5 | 270.1 | 50.4 | 22.5 | 559.0 | 21 | 90.25 | 90.25 |
| **Western End of Broken Ridge** | | | | | | | | | | | | | | |
| 254 | 30° 58.15'S | 87° 53.72'E | 1263 | 38 | 38 | 100 | 329.0 | 150.5 | 45.7 | 14.5 | 343.5 | 21 | 51.25 | 51.25 |
| **Broken Ridge** | | | | | | | | | | | | | | |
| 255 | 31° 07.87'S | 93° 43.72'E | 1154 | 11 | 11 | 100 | 99.0 | 7.9 | 8 | 9.5 | 108.5 | 15 | 38.25 | 38.25 |
| **South Central Wharton Basin** | | | | | | | | | | | | | | |
| 256 | 23° 27.35'S | 100° 46.46'E | 5371 | 11 | 11 | 100 | 99.0 | 78.3 | 79.1 | 171.0 | 270.0 | 27 | 57.75 | 57.75 |
| **Southeast Wharton Basin** | | | | | | | | | | | | | | |
| 257 | 30° 59.16'S | 108° 20.99'E | 5288 | 17 | 17 | 100 | 155.5 | 76.7 | 49.3 | 171.0 | 326.5 | 12.5 | 80.50 | 80.50 |

Site Summary (Continued)
Leg 26

| Hole | Latitude | Longitude | Water Depth Meters | Number Of Cores | Cores With Recovery | Percent With Recovery | Meters Cored | Meters Recovered | Percent Recovered | Meters Drilled | Total Penet Meters | Avg. Rate Penet | Time On Hole | Time On Site |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Naturaliste Plateau | | | | | | | | | | | | | | |
| 258 | 33° 47.69'S | 112° 28.42'E | 2803 | 25 | 24 | 96 | 230.5 | 115.55 | 50.2 | 294.5 | 525.0 | 31.4 | 64.75 | |
| 258A | 33° 47.69'S | 112° 28.42'E | 2803 | 9 | 9 | 100 | 95.0 | 67.00 | 70.5 | 28.5 | 123.5 | 44 | 22.50 | 87.25 |
| | Totals | | | 246 | 239 | 97 | 2234.0 | 1148.85 | 51.4 | 1659.0 | 3893.0 | 26.3 | 681.25 | 681.25 |
| | Maximum | | 5371 | 58 | 56 | 100 | 536 | 270 | 79.1 | 498 | 738.5 | 247 | 113 | 151 |
| | Minimum | | 1154 | 3 | 3 | 8 | 28 | 7.9 | 8 | 9.5 | 65 | 15 | 22.5 | 38.2 |
| | Average | | 3502 | 20.5 | 19.9 | 97.5 | 186.1 | 95.7 | 51.4 | 138.2 | 324.4 | 26.3 | 51 | 75.7 |

## DEEP SEA DRILLING PROJECT
## BIT SUMMARY
## LEG 26

| Hole | Mfg. | Size | Type | Serial Number | Meters Cored | Meters Drilled | Meters Total Penet. | Hours On Bit | Condition | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 250 | Smith | 10-1/8 | F94C | KK998 | 28.0 | 37.0 | 65.0 | .5 | New | Bent bottom hole assembly. |
| 250A | Smith | 10-1/8 | F94C | KK998 | 240.5 | 498 | 738.5 | 24.6 | T-1, B-2, I | Cored 13 meters of basalt. |
| 251 | Smith | 10-1/8 | F94C | KK998 | 87.5 | | 87.5 | .7 | | Loss of power - pulled out of hole. |
| 251A | Smith | 10-1/8 | F94C | KK998 | 276.5 | 222.5 | 499 | 15.2 | T-4, B-3, I | Cored 10 meters of basalt. |
| | | | | | 632.5 | 757.5 | 1390 | 41 | | |
| 252 | Smith | 10-1/2 | F94C | KK989 | 57 | 190 | 247 | 1.0 | New | Abandoned site because of weather. |
| 253 | Smith | 10-1/8 | F94C | KN025 | 536.5 | 22.5 | 559 | 26.6 | T-1, B-2, I | Drilled one meter of basalt. Hole was abandoned when center bit hung in the support housing. |
| 254 | Smith | 10-1/8 | F94C | KN025 | 329.0 | 14.5 | 343.5 | 16.3 | T-2, B-2, I | Cored 18 meters of basalt. |
| 255 | Smith | 10-1/8 | F94C | KN025 | 99 | 9.5 | 108.5 | 6.9 | | Lost in hole. |
| | | | | | 964.5 | 46.5 | 1011 | 49.8 | | |
| 256 | Smith | 10-1/8 | 3 cone 94CJS | JZ238 | 99 | 171 | 270 | 10.1 | Lost 2 cones | Heat flow probe locked cones. 19 meters of basalt cored. |
| 257 | Smith | 10-1/8 | F94C | KN026 | 155.5 | 171 | 326.5 | 26.2 | T-5, B-2, I | Drilled 63.5 meters of basalt. Inside teeth gone off cones. |
| 258 | Smith | 10-1/8 | F94C | KN024 | 230.5 | 294.5 | 525 | 16.7 | | |
| 258A | Smith | 10-1/8 | F94C | KN924 | 95 | 38 | 123.5 | 2.8 | T-1, B-1, I | Drilled streaks of chert. |
| | | | | | 325.5 | 332.5 | 648.5 | 19.5 | | |

# DEEP SEA DRILLING PROJECT
## BEACON SUMMARY
## LEG 26

| Site No. | Make | Freq. kHz | Serial Number | Site Time Hours | Remarks |
|---|---|---|---|---|---|
| 250 | ORE | 16 | Unknown | 206.25 | Dropped at 4 knots - good signal. |
| 251 | ORE | 13.5 | 196 | 86.25 | Dropped at 4 knots - good signal. |
| 252 | ORE | 16 | 180 | 38.50 | Dropped at 7 knots - good signal. |
| 253 | ORE | 16 | 111-155 | 68.50 | Dropped dead in water - weak signal. Signal too weak after 68.50 hours. |
| 253 | ORE | 13.5 | 204 | 21.50 | Strong signal. |
| 254 | ORE | 16 | 177 | 52.00 | Dropped at 4 knots - good signal. |
| 255 | ORE | 13.5 | 202 | 38.25 | Dropped at 4 knots - good signal. |
| 256 | ORE | 16 | 181 | 57.75 | Dropped at 4 knots - good signal. |
| 257 | ORE | 16 | 176 | 80.50 | Dropped at 5 knots - good signal. |
| 248 | ORE | 13.5 | 201 | 87.25 | Dropped at 5 knots - good signal. |

# DEEP SEA DRILLING PROJECT
## TIME DISTRIBUTION
## LEG 26

| Date | Site Number | Cruise | Trips | Drill | Core | Stuck Pipe | Wait On Weather | Mechanical Downtime | In Port Time | Other | Total Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 08/22/72 | Durban | | | | | | | | 15.50 | | 15.50 |
| 08/23/72 | | | | | | | | | 24.00 | | 24.00 |
| 08/24/72 | | | | | | | | | 24.00 | | 24.00 |
| 08/25/72 | | | | | | | | | 24.00 | | 24.00 |
| 08/26/72 | | | | | | | | | 24.00 | | 24.00 |
| 08/27/72 | | | | | | | | | 24.00 | | 24.00 |
| 08/28/72 | | | | | | | | | 24.00 | | 24.00 |
| 08/29/72 | | | | | | | | | 24.00 | | 24.00 |
| 08/30/72 | | | | | | | | | 24.00 | | 24.00 |
| 08/31/72 | | | | | | | | | 24.00 | | 24.00 |
| 09/01/72 | | | | | | | | | 24.00 | | 24.00 |
| 09/02/72 | | | | | | | | | 24.00 | | 24.00 |
| 09/03/72 | | | | | | | | | 24.00 | | 24.00 |
| 09/04/72 | | | | | | | | | 24.00 | | 24.00 |
| 09/05/72 | | | | | | | | | 24.00 | | 24.00 |
| 09/06/72 | | | | | | | | | 6.75 | | 6.75 |
| | Total Port Time | | | | | | | | 358.25 | | 358.25 |
| 09/06/72 | 250 | 17.25 | | | | | | | | | 17.25 |
| 09/07/72 | 250 | 23.00 | | | | | | | | | 23.00 |
| 09/08/72 | 250 | 15.50 | 8.50 | | | | | | | | 24.00 |
| 09/09/72 | 250 | | 16.00 | .75 | 5.25 | | | | | 2.00 | 24.00 |
| 09/10/72 | 250 | | 5.00 | | | | | | | | 5.00 |
| | Total | 55.75 | 29.50 | .75 | 5.25 | | | | | 2.00 | |

Time Distribution (Continued)
Leg 26

| Date | Site Number | Cruise | Trips | Drill | Core | Stuck Pipe | Wait On Weather | Mechanical Downtime | In Port Time | Other | Total Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 09/10/72 | 250A | | 10.50 | 1.50 | | | | | | 7.00 | 19.00 |
| 09/11/72 | 250A | | | 9.00 | 15.00 | | | | | | 24.00 |
| 09/12/72 | 250A | | | 11.50 | 9.50 | | | 3.00 | | | 24.00 |
| 09/13/72 | 250A | | | | 24.00 | | | | | | 24.00 |
| 09/14/72 | 250A | | 13.50 | | 9.00 | | | | | | 22.50 |
| | Total | | 24.00 | 22.00 | 57.50 | | | 3.00 | | 7.00 | 113.50 |
| 09/14/72 | 251 | 1.50 | | | | | | | | | 1.50 |
| 09/15/72 | 251 | 24.00 | | | | | | | | | 24.00 |
| 09/16/72 | 251 | 24.00 | | | | | | | | | 24.00 |
| 09/17/72 | 251 | 12.50 | 8.50 | | 3.00 | | | | | | 24.00 |
| 09/18/72 | 251 | | | 1.00 | 9.00 | | | 5.75 | | | 15.75 |
| | Total | 62.00 | 8.50 | 1.00 | 12.00 | | | 5.75 | | | 89.25 |
| 09/18/72 | 251A | | | 1.50 | 6.76 | | | | | | 8.25 |
| 09/19/72 | 251A | | | 4.25 | 19.75 | | | | | | 24.00 |
| 09/20/72 | 251A | | 5.50 | | 18.50 | | | | | | 24.00 |
| 09/21/72 | 251A | | 2.75 | | | | | | | | 2.75 |
| | Total | | 8.25 | 5.75 | 45.00 | | | | | | 59.00 |
| 09/21/72 | 252 | 21.25 | | | | | | | | | 21.25 |
| 09/22/72 | 252 | 23.00 | | | | | | | | | 23.00 |
| 09/23/72 | 252 | 5.00 | 10.00 | 2.25 | 6.75 | | | | | | 24.00 |
| 09/24/72 | 252 | | 14.25 | .25 | 2.00 | 2.00 | | | | 1.00 | 19.50 |
| | Total | 49.25 | 24.25 | 2.50 | 8.75 | 2.00 | | | | 1.00 | 87.75 |

Time Distribution (Continued
Leg 26

| Date | Site Number | Cruise | Trips | Drill | Core | Stuck Pipe | Wait on Weather | Mechanical Downtime | In Port Time | Other | Toral Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 09/24/72 | 253 | 4.50 | | | | | | | | | 4.50 |
| 09/25/72 | 253 | 23.00 | | | | | | | | | 23.00 |
| 09/26/72 | 253 | 24.00 | | | | | | | | | 24.00 |
| 09/27/72 | 253 | 24.00 | | | | | | | | | 24.00 |
| 09/28/72 | 253 | 24.00 | | | | | | | | | 24.00 |
| 09/29/72 | 253 | 24.00 | | | | | | | | | 24.00 |
| 09/30/72 | 253 | 23.00 | | | | | | | | | 23.00 |
| 10/01/72 | 253 | 23.50 | .50 | | | | | | | | 24.00 |
| 10/02/72 | 253 | | 6.25 | | 17.75 | | | | | | 24.00 |
| 10/03/72 | 253 | | | | 24.00 | | | | | | 24.00 |
| 10/04/72 | 253 | | | | 24.00 | | | | | | 24.00 |
| 10/05/72 | 253 | | 4.25 | 2.75 | .50 | | | | | 10.25 | 17.75 |
| | Total | 170.00 | 11.00 | 2.75 | 66.25 | | | | | 10.25 | 260.25 |
| 10/05/72 | 254 | 6.25 | | | | | | | | | 6.25 |
| 10/06/72 | 254 | 24.00 | | | | | | | | | 24.00 |
| 10/07/72 | 254 | 11.50 | 4.25 | | 8.25 | | | | | | 24.00 |
| 10/08/72 | 254 | | | | 24.00 | | | | | | 14.75 |
| 10/09/72 | 254 | | 3.75 | | 11.00 | | | | | | |
| | Total | 41.75 | 8.00 | | 43.25 | | | | | | 93.00 |
| 10/09/72 | 255 | 9.25 | | | | | | | | | 9.25 |
| 10/10/72 | 255 | 24.00 | | | | | | | | | 24.00 |
| 10/11/72 | 255 | .75 | 4.50 | | 15.25 | 3.50 | | | | | 24.00 |
| 10/12/72 | 255 | | 2.00 | | | 5.50 | | | | 7.50 | 15.00 |
| | Total | 34.00 | 6.50 | | 15.25 | 9.00 | | | | 7.50 | 72.25 |

Time Distribution (Continued)'
Leg 26

| Date | Site Number | Cruise | Trips | Drill | Core | Stuck Pipe | Wait On Weather | Mechanical Downtime | In Port Time | Other | Total Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/12/72 | 256 | 9.00 | | | | | | | | | 9.00 |
| 10/13/72 | 256 | 24.00 | | | | | | | | | 24.00 |
| 10/14/72 | 256 | 24.00 | | | | | | | | | 24.00 |
| 10/15/72 | 256 | 10.50 | 12.00 | | | | | | | 1.50 | 24.00 |
| 10/16/72 | 256 | | | 4.50 | 14.75 | | | .50 | | 4.25 | 24.00 |
| 10/17/72 | 256 | | 10.00 | | 10.50 | | | | | | 20.50 |
| | Total | 67.50 | 22.00 | 4.50 | 25.25 | | | .50 | | 5.75 | 125.50 |
| 10/17/72 | 257 | 3.50 | | | | | | | | | 3.50 |
| 10/18/72 | 257 | 24.00 | | | | | | | | | 24.00 |
| 10/19/72 | 257 | 24.00 | | | | | | | | | 24.00 |
| 10/20/72 | 257 | 15.50 | 8.50 | | | | | | | | 24.00 |
| 10/21/72 | 257 | | 1.50 | 4.50 | 12.50 | | | | | 5.50 | 24.00 |
| 10/22/72 | 257 | | | | 24.00 | | | | | | 24.00 |
| 10/23/72 | 257 | | 11.50 | | 12.50 | | | | | | 24.00 |
| | Total | 67.00 | 21.50 | 4.50 | 49.00 | | | | | 5.50 | 147.50 |
| 10/24/72 | 258 | 23.00 | | | | | | | | | 23.00 |
| 10/25/72 | 258 | 14.25 | 7.75 | | 2.00 | | | | | | 24.00 |
| 10/26/72 | 258 | | | 6.25 | 17.75 | | | | | | 24.00 |
| 10/27/72 | 258 | | | 2.25 | 15.75 | | 6.00 | | | | 24.00 |
| 10/28/72 | 258 | | | | | | 7.00 | | | | 7.00 |
| | | 37.25 | 7.75 | 8.50 | 35.50 | | 13.00 | | | | 102.00 |

Time Distribution (Continued)
Leg 26

| Date | Site Number | Cruise | Trips | Drill | Core | Stuck Pipe | Wait On Weather | Mechanical Downtime | In Port Time | Other | Total Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10/28/72 | 258A | | 1.00 | 1.00 | 15.00 | | | | | | 17.00 |
| 10/29/72 | 258A | | 5.50 | | | | | | | | 5.50 |
| | Total | | 6.50 | 1.00 | 15.00 | | | | | | 22.50 |
| 10/29/72 | To Perth | 18.50 | | | | | | | | | 18.50 |
| 10/30/72 | | 7.75 | | | | | | | | | 7.75 |
| | Total | 26.25 | | | | | | | | | 26.25 |
| GRAND TOTAL | | 610.75 | 177.75 | 53.25 | 378.00 | 9.00 | 15.00 | 9.25 | 358.25 | 39.00 | 1650.25 |

DEEP SEA DRILLING PROJECT
OPERATIONS RESUME
LEG 27

## SUMMARY

Leg 27, of the Deep Sea Drilling Project, commenced on October 30, 1972 in Fremantle, W.A., Australia and terminated in Fremantle on December 20, 1972.

During this 51.01 day voyage, the Challenger cruised 3736 nautical miles, drilled five holes on five sites, with a total penetration of 2444.5 meters. Of the total penetration, 1570.5 meters or 64.3% was cored in 176 coring attempts with usable recovery realized on 173 (98.3%). Total core recovery was 960.3 meters for 61.1%. Water depths ranged from 2315 meters to 5709 meters and total depths ranged from 2757 meters to 6266.5 meters.

Major time distribution for the 51.01 day leg consisted of 13.55 days in port, 16.31 days cruising and 21.15 days on site. Of the 21.15 days on site, 13.92 days were spent coring, 1.48 days drilling, 3.98 days on trips and 1.77 days on mechanical down time and other miscellaneous time. The 13.55 days in port include 10.87 days involved in repairs.

The dynamic positioning system functioned very well throughout Leg 27 with the exception of Site 261, where the computer failed just prior to beacon launch. The ship was positioned over the beacon manually and the drill string was started in the hole. The computer was back in service and positioning in automatic before reaching bottom and spudding in.

Generally, the weather was excellent with clear skies and light winds. Some moderate, confused sea conditions were experienced on Site 259, but did not hamper operations.

On Site 263, the over-running clutch on the hydromatic brake failed and allowed the travelling blocks to free fall. The swivel and Bowen power sub were severely damaged, resulting in premature abandonment of the site. The Challenger proceeded to Fremantle, Australia for repairs. When the repairs were completed, there was not sufficient leg time remaining to drill an additional site, resulting in an abbreviated operational leg. A total of 10.87 days was lost in port effecting repairs.

## DRILLING AND CORING

The same bottom hole assembly was used for all holes on Leg 27 and consisted of the core bit, float sub, core barrel, three 8-1/4" drill collars, two bumper subs, three 8-1/4" drill collars, two bumper subs, two 8-1/4" drill collars, one 7-1/4" drill collar and one joint of 5-1/2" heavy weight drill pipe.

Core recoveries varied considerably from site to site, from a low of 33.5% on Site 260 to 82.7% on Site 262, with an overall average of 61.1%. The better recoveries generally occurred where the sediment was of fairly uniform density, while the poorer recoveries occurred when softer sediments were interbedded with hard streaks. On the sites with poorer recoveries, the water courses in the bits were firmly plugged with clay when pulled. With the water courses plugged, the fluid is forced around the inner barrel and jets directly on the core before it enters the core catcher. Any soft or unconsolidated material will be washed away and not recovered. Consideration should be given to redesigning the fluid passages in the bit and reducing the distance from the bit cones to the core catcher sub.

On Site 259, a new design core catcher to catch under gauge hard formation core was used in basalt and appeared to be effective with 64% recovery on core 1-7/8" to 2" in diameter. However, on Site 260, it was run after encountering basalt on the previous core. A core was cut and on the wire line trip, the core barrel was found stuck in the drill pipe at 170 meters below the rotary table. Apparently a piece of basalt had fallen from the previous core and lodged in a drill pipe tool joint. After jarring the core barrel free and retrieving it, all segments of the core catcher were missing. A center bit was run to check the drill pipe and appeared to seat properly on bottom. The center bit was retrieved and a core barrel was dropped which also appeared to seat properly. A core was cut and upon retrieving the core barrel, the core catcher was again found to have all twelve segments broken off. Eleven segments were recovered in the upper dog type catcher without any core recovery. It was evident that an obstruction was preventing the core barrel from latching in properly on bottom. The hole was abandoned and, when the pipe was pulled, 0.7 meters of basalt was found on top of the bit. The new catcher was tried one more time, on Site 261, and again, lost all twelve segments which were recovered on top of the core caught by the dog type catchers. The reason for these failures, after two successful runs, is not apparent.

On Site 262, methane gas, with a rotten swampy odor, was evident from 2320 meters (5 meters penetration) to approximately 2615 meters (300 meters penetration) in a soft, spongy ooze. The gas created a problem in containing the cores, since it caused them to expand rapidly when the catcher sub was unscrewed. On some runs, the cores were extruding through the catchers as the core barrel was brought to the surface. Below 2615 meters, the ooze was somewhat firmer and did not contain gas. At 2747.5 meters, the hole sloughed and stuck the bit on bottom. Circulation was established with mud and the pipe was worked free after ten minutes. At 2757 meters, the pipe was again stuck for a few minutes before it was circulated and worked free. Since most of the scientific objectives of the site had been realized, the hole was abandoned rather than risking loss of the bottom hole assembly.

All of the five inch drill pipe was inspected by Tuboscope while in port at Fremantle and 56 joints were questionable. These joints were removed from the string on Site 259. While underway from Site 259, they were thoroughly cleaned internally and inspected in detail with the borescope and ultra-sonic gauge. 22 joints were rejected and retired. The remaining 34 joints were marked and returned to the string on Site 260. The drill collars and subs were magnafluxed while coming out of the hole on Site 261. While underway to Site 263, the bumper subs were inspected and redressed. The bumper subs operated satisfactorily with only one of the old style partially sanding up during the leg.

There was no loss of down hole drilling equipment during Leg 27. On Site 263, while working the pipe as a core barrel was being pumped down at 5811 meters, the over-running clutch failed and effectively disengaged the hydromatic brake. The mechanical brakes quickly heated up under the 430,000 pound hook load and lost all effectiveness. The drill string and blocks free fell approximately 30 feet, jamming the Bowen power sub into the rotary table elevator bushings. The weight of the travelling blocks forced the outer case of the swivel down onto the top of the Bowen sub, stripping the bearings out of the swivel. The momentum of the free wheeling drum parted the 1-1/2" drilling line at the drum clamp. The free end of the drilling line came over the crown fast sheave and piled up on top of the travelling block. Also, the drilling line jumped the center sheave on the crown block. Fortunately, the travelling block remained in the guide rails and did not fall to the rig floor. With the Bowen sub on the bushings approximately 12 feet of additional pipe was in the hole, since a connection had not been made.

The drilling line was restrung over the crown and new drilling line pulled through to the drawworks drum. The debris was cleared up and the swivel partially reassembled to pick up the drill string. After eight hours, the string was picked up, found to be completely free, and was pulled out of the hole. The only apparent damage to the down hole equipment was one cracked cone on the bit.

Damage to the swivel and Bowen sub were too extensive for shipboard repair and the Challenger sailed to Fremantle for repairs. Inspection of the Bowen sub revealed considerable wear in addition to the damage from the accident and it was decided to completely overhaul the sub. Completion of these repairs used up the balance of the scheduled time for Leg 27.

The present braking system on the drawworks appears to be near maximum capacity when operating in the 20,000 foot depth range. Before planning to extend the depth capabilities of the Challenger, consideration should be given to improving the braking system.

## HEAT FLOW

Site 262 was the only site on Leg 27 where heat flow measurements had been proposed. The presence of gas in the upper sediments limited the heat flow runs, since the scientists felt that the core data would not be valid. Two runs were made as separate wire line runs with the instrument locked in the core barrel. Apparently, usable data was obtained on the first run at 2540 meters. However, on the second run at 2595.5 meters, the sediment was too firm and the extender was bent. The data recorded was of doubtful value.

## DYNAMIC POSITIONING

On Site 259 and 260, positioning was in automatic mode and stayed mostly within 40 feet. A minor problem of initial overthrusting in the "Y" axis on Site 259 was corrected by adjusting computer gains. On Site 261, the computer failed approximately 30 minutes prior to dropping the beacon. The ship returned to the beacon on manual and after one and one half hours to gain confidence in the ability to hold position on manual, the drill string was started in. The computer was returned to service and positioning in automatic before the bit reached bottom and the hole spudded. The failure was apparently caused by an overheated power supply. The computer failed again four hours later and operations continued without difficulty for eight and one half hours positioning manually.

Positioning on Site 262 was in automatic throughout, with a minor problem of rapid back and forth heading changes requested by the computer. A slight change of heading resolved the problem until a new heading encoder could be installed while enroute to Site 263.

On Site 263, positioning was on automatic except for 1.5 hours in manual while the computer was reprogrammed. The output portion of the program had been dumped by voltage fluctuations in the main computer power input.

## BEACONS

Six Burnett beacons and one ORE beacon were used on Leg 27. Two failures were experienced with both occurring on Site 259 before the beacons were dropped. The 16 kHz ORE beacon No. 184 stopped transmitting while hanging on the hook before launching. The standby Burnett 13.5 kHz beacon No. 1 was dropped and still had a good signal when the Challenger left the site. The second failure was a Burnett 16 kHz beacon Serial No. 1 which was dead on shipboard test. All the beacons were dropped while underway at approximately five knots. A Burnett 13.5 kHz beacon Serial No. 4 on Site 263 failed about 30 minutes prior to departure from the site. Operations were not affected since the pipe was on the rack and the Bowen sub and swivel were being separated.

## COMMUNICATIONS

Nearly all incoming and outgoing traffic, except for weather messages, was handled via the naval communication system, with NWC (North West Cape) as relay. This worked well despite some trouble working with a number of "green" operators at the Navy station. No serious delays were encountered. The average transit time per message was about six hours for "routine" traffic. Nearly all weather messages were handled via the Australian coastal radio network, with almost no delay. A small percentage of traffic was routed to the USA via the Australian stations in cases where time was critical and this the most expeditious method.

Voice communications with USA on radio telephone to Oakland (KMI) were uniformly successful. The best time was about two hours daily from 1000 to 1200 GMT on the 8 MHZ band, although communication could be established briefly around 2200-2300 on the 22 MHZ band. A very large number of commercial radio/telephone calls were made by crew and Scripps personnel. Amateur communications were almost non-existent. At the only time the "band" was open, the amateurs in the USA were asleep.

The RCA transmitter did not have crystals for either the Navy or Scripps frequencies, due to a recent modification. This will be corrected in Fremantle. The TMC suffered two casualties, however, it was possible to operate without reduced efficiency pending receipt of repair parts.

Radars worked satisfactorily, however, both radars require a modification to reduce brightness of "own ship's course" marker; similarly both radars require repair to the Automatic Tuning Board (although they operate satisfactorily with this board out of the circuit). These repairs to be made in Fremantle.

Generally, equipment performed satisfactorily.

## PERSONNEL

One lost time accident and several minor accidents occurred on Leg 27. A derrickman lost the ends of two fingers while moving pipe with the crane. In addition to treating these injuries, the ship's doctor also extracted three teeth and attended a seaman who suffered an apparent mild stroke the last day on Site 263. He was hospitalized upon arrival in Fremantle and is making rapid recovery.

All Global Marine personnel were extremely cooperative and their performance was outstanding. The scientific staff also are to be commended for their professional approach, cooperation and attitude throughout Leg 27. It was a pleasure to be associated with this group during the cruise.

Carl M. Morris
Cruise Operations Manager

# DEEP SEA DRILLING PROJECT
## SUMMARY OF OPERATIONS
## LEG 27

| | |
|---|---|
| Total Days On Leg | 51.01 |
| Total Days In Port | 13.55 |
| Total Days Cruising | 16.31 |
| Total Days On Site | 21.15 |
| Trip Time | 3.98 |
| Drilling Time | 1.48 |
| Coring Time | 13.92 |
| Mechanical Downtime | 0.69 |
| Other Miscellaneous Time | 1.08 |
| Total Distance Traveled (Nautical Miles | 3736 |
| Average Speed (Knots) | 9.54 |
| Sites Drilled | 5 |
| Holes Drilled | 5 |
| Number of Cores Attempted | 176 |
| Number of Cores With Recovery | 173 |
| Percent of Cores With Recovery | 98.3 |
| Total Meters Cores | 1570.5 |
| Total Meters Recovered | 960.3 |
| Percent Recovery | 61.1 |
| Meters Drilled | 874.0 |
| Total Penetration | 2444.5 |
| Percent of Penetration Cored | 64.3 |
| Maximum Penetration | 746 |
| Minimum Penetration | 331 |
| Average Penetration Per Hole | 488.9 |
| Maximum Water Depth | 5709 |
| Minimum Water Depth | 2315 |
| Average Water Depth | 4679.6 |

FIGURE 1
DEEP SEA DRILLING PROJECT
LEG XXVII
TOTAL TIME DISTRIBUTION

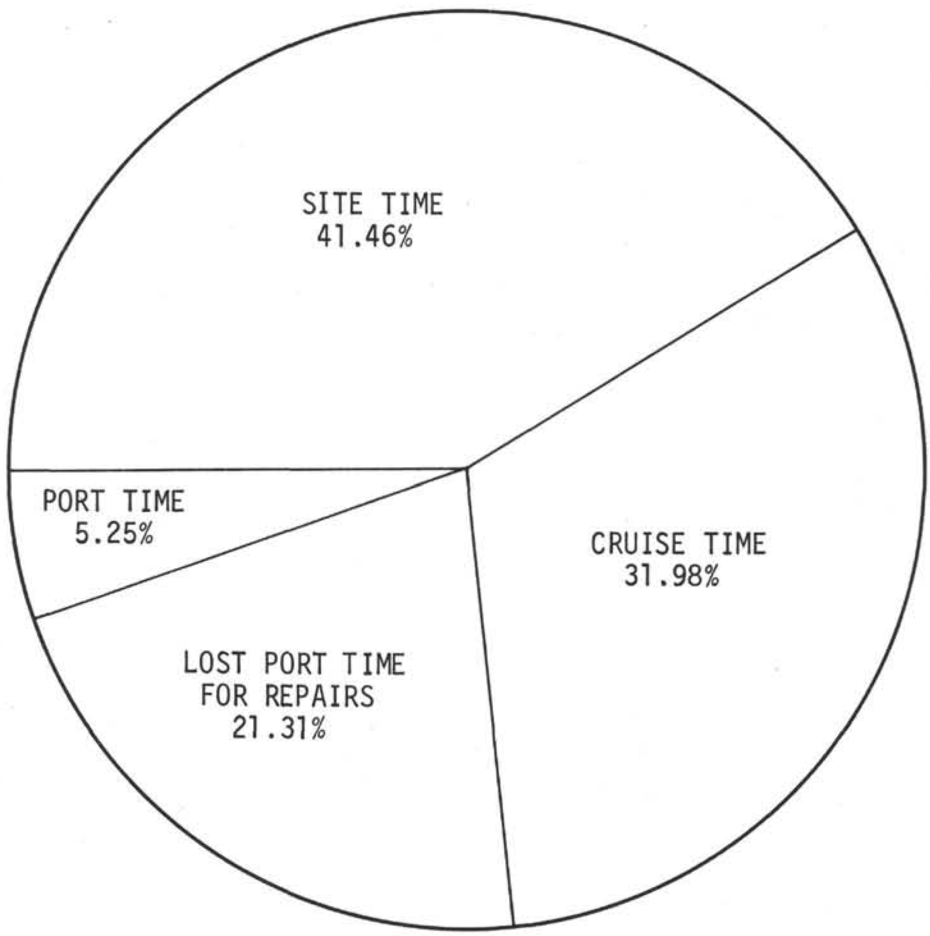
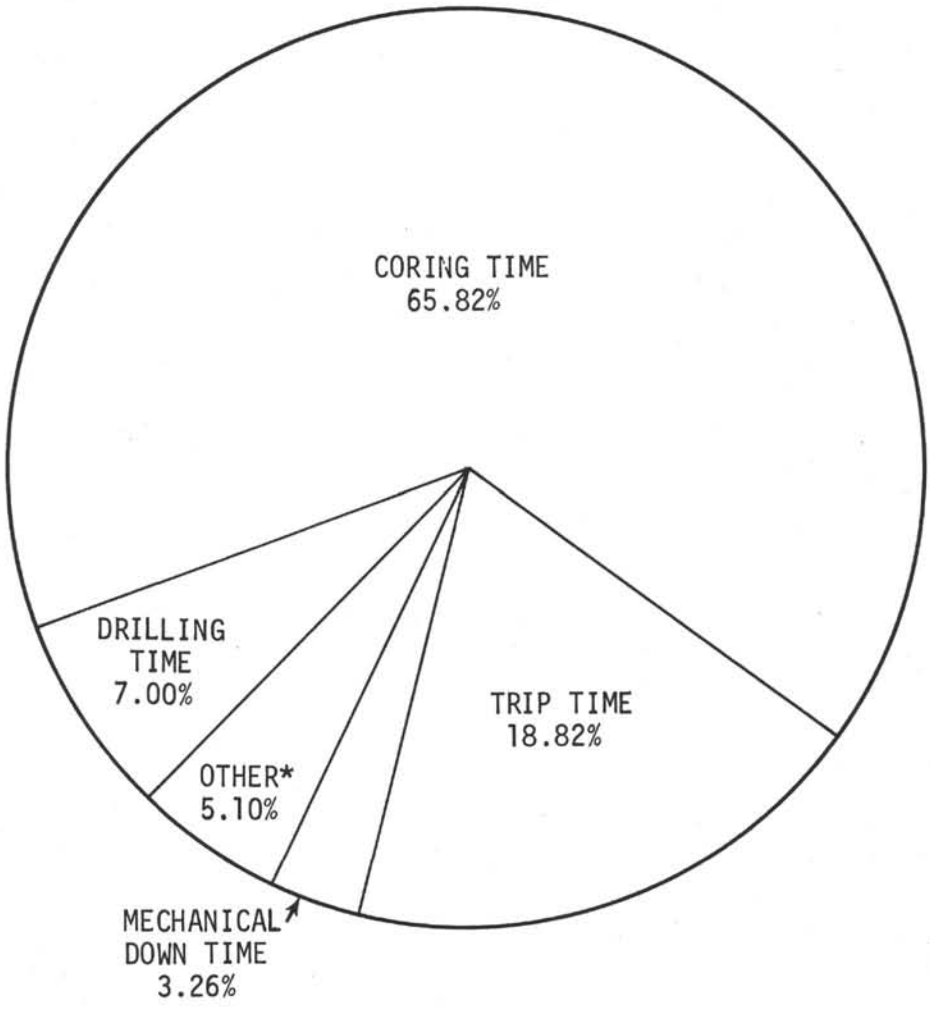
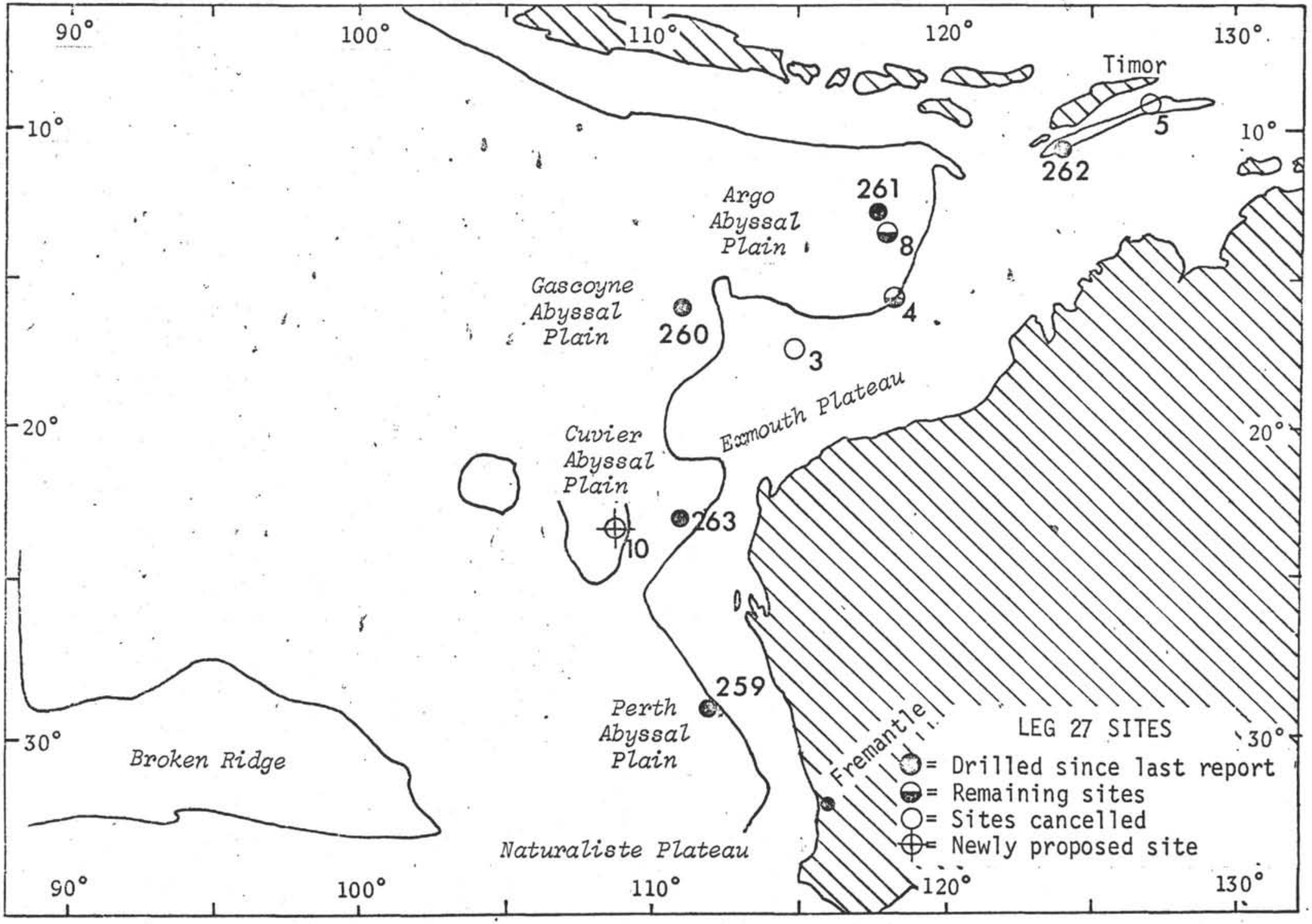


FIGURE 2
DEEP SEA DRILLING PROJECT
LEG XXVII
SITE TIME DISTRIBUTION




*Includes: Segregating pipe, Inspecting D.C.
Heat Flow, profiling, time lost positioning
and other miscellaneous lost time.



90°
100°
110°
120°
130°
10°
20°
30°
Timor
5
262
261
8
4
3
260
263
10
259
Argo Abyssal Plain
Gascoyne Abyssal Plain
Exmouth Plateau
Cuvier Abyssal Plain
Perth Abyssal Plain
Broken Ridge
Naturaliste Plateau
Fremantle
LEG 27 SITES
= Drilled since last report
= Remaining sites
= Sites cancelled
= Newly proposed site

# DEEP SEA DRILLING PROJECT
## BEACON SUMMARY
## LEG 27

| Site No. | Make | Freq. kHz | Serial Number | Site Time Hours | Remarks |
|---|---|---|---|---|---|
| 259 | ORE | 16.0 | 184 | 0 | Failed on board while approaching drop. |
| | Burnett | 16.0 | 1 | 0 | Dead on shipboard test. |
| | Burnett | 13.5 | 1 | 108 | Dropped at 5 knots. Good performance. Still had a good signal departing site. |
| 260 | Burnett | 16.0 | 2 | 82 | Dropped at 5 knots. Good performance. |
| 261 | Burnett | 13.5 | 3 | 129.5 | Dropped at 5 knots. Good performance. |
| 262 | Burnett | 16.0 | 4 | 54.5 | Dropped at 5 knots. Good performance. |
| 263 | Burnett | 13.5 | 4 | 128.0 | Dropped at 5 knots. Performance satisfactory. Failed approximately 1/2 hour before departing site. |

## DEEP SEA DRILLING PROJECT
## SITE SUMMARY
## LEG 27

| Hole | Latitude | Longitude | Water Depth Meters | Number Of Cores | Cores With Recovery | Percent Of Cores With Recovery | Meters Cored | Meters Recovered | Percent Recovered | Meters Drilled | Total Penet. Meters | Avg. Rate Penet. | Time On Hole | Time On Site |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Perth Abyssal Plain | | | | | | | | | | | | | | |
| 259 | 29° 37.05'S | 112° 41.78'E | 4712 | 41 | 40 | 97.6 | 346.0 | 248.8 | 71.9 | 0 | 346.0 | 17.39 | 108.0 | 108.0 |
| Gascoyne Abyssal Plain | | | | | | | | | | | | | | |
| 260 | 16° 8.67'S | 110° 17.92'E | 5709 | 20 | 19 | 95.0 | 169.5 | 56.7 | 33.5 | 161.5 | 331.0 | 22.18 | 82.0 | 82.0 |
| Argo Abyssal Plain | | | | | | | | | | | | | | |
| 261 | 12° 56.83'S | 117° 53.56'E | 5687 | 39 | 38 | 97.4 | 342.0 | 125.8 | 36.8 | 237.5 | 579.5 | 21.20 | 129.5 | 129.5 |
| Timor Trough | | | | | | | | | | | | | | |
| 262 | 10° 52.19'S | 123° 50.78'E | 2315 | 47 | 47 | 100 | 442.0 | 365.5 | 82.7 | 0 | 442.0 | 76.60 | 60.0 | 60.0 |
| Cuvier Abyssal Plain | | | | | | | | | | | | | | |
| 263 | 23° 19.43'S | 110° 57.81'E | 5065 | 29 | 29 | 100 | 271.0 | 163.5 | 60.3 | 475.0 | 746.0 | 20.48 | 128.0 | 128.0 |

DEEP SEA DRILLING PROJECT
BIT SUMMARY
LEG 27

| Hole | Mfg. | Size | Type | Serial Number | Meters Cored | Meters Drilled | Meters Total Penet. | Hours On Bit | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 259 | Smith | 10-1/8 | 3CTR 94CJS | JZ239 | 346 | 0 | 346 | 19.9 | T-2, B-8, G-7 | Cored 38.5m basalt. Shirttail wear. |
| 260 | Smith | 10-1/8 | 4CTR 94CJS | JZ246 | 169.5 | 161.5 | 331 | 14.9 | T-5, B-3, G-0 | Cored 8m basalt. |
| 261 | Smith | 10-1/8 | 4CTR F94C | KN037 | 342 | 237.5 | 579.5 | 27.3 | T-2, B-4, G-0 | Cored 47.5m basalt. |
| 262 | Smith | 10-1/8 | 3CTR 93CJS | JK194 | 442 | 0 | 442 | 5.8 | T-2, B-1, G-0 | For Rerun. |
| 263 | Smith | 10-1/8 | 4CTR F94C | KN072 | 271 | 475 | 746 | 36.4 | T-1, B-2, G-0 | One cone cracked. Drill pipe dropped when overrunning clutch failed. |

## DEEP SEA DRILLING PROJECT
## TIME DISTRIBUTION
## LEG 27

| Date | Site Number | Cruise | Trips | Drill | Core | Stuck Pipe | Mechanical Down Time | In Port Time | Other | Total Time |
|---|---|---|---|---|---|---|---|---|---|---|
| 10/30/72 | In Port Freemantle | | | | | | | 16.25 | | 16.25 |
| 10/31/72 | | | | | | | | 24.00 | | 24.00 |
| 11/1/72 | | | | | | | | 24.00 | | 24.00 |
| Total | | | | | | | | 64.25 | | 64.25 |
| 11/2/72 | 259 | 24.00 | | | | | | | | 24.00 |
| 11/3/72 | | 4.50 | 14.50 | | 5.00 | | | | | 24.00 |
| 11/4/72 | | | | | 24.00 | | | | | 24.00 |
| 11/5/72 | | | | | 24.00 | | | | | 24.00 |
| 11/6/72 | | | | | 24.00 | | | | | 24.00 |
| 11/7/72 | | | 10.50 | | 6.00 | | | | | 16.50 |
| Total | 259 | 28.50 | 25.00 | | 83.00 | | | | | 136.50 |
| 11/7/72 | 260 | 7.50 | | | | | | | | 7.50 |
| 11/8/72 | | 24.00 | | | | | | | | 24.00 |
| 11/9/72 | | 24.00 | | | | | | | | 24.00 |
| 11/10/72 | | 24.00 | | | | | | | | 24.00 |
| 11/11/72 | | 11.00 | 11.00 | | | | | | 2.00 | 24.00 |
| 11/12/72 | | | | 3.50 | 20.50 | | | | | 24.00 |
| 11/13/72 | | | | | 24.00 | | | | | 24.00 |
| 11/14/72 | | | 10.00 | | 6.00 | | | | 5.00 | 21.00 |
| Total | 260 | 90.50 | 21.00 | 3.50 | 50.50 | | | | 7.00 | 172.50 |
| 11/14/72 | 261 | 3.00 | | | | | | | | 3.00 |
| 11/15/72 | 261 | 24.00 | | | | | | | | 24.00 |
| 11/16/72 | | 24.00 | | | | | | | | 24.00 |

Time Distribution (Continued)
Leg 27

| Date | Site Number | Cruise | Trips | Drill | Core | Stuck Pipe | Mechanical Down Time | In Port Time | Other | Total Time |
|---|---|---|---|---|---|---|---|---|---|---|
| 11/17/72 | | | 10.50 | 2.00 | 7.50 | | 1.50 | | 2.50 | 24.00 |
| 11/18/72 | | | | | 24.00 | | | | | 24.00 |
| 11/19/72 | | | | 3.00 | 21.00 | | | | | 24.00 |
| 11/20/72 | | | | 2.00 | 22.00 | | | | | 24.00 |
| 11/21/72 | | | 4.50 | | 18.50 | | | | 1.00 | 24.00 |
| 11/22/72 | | | 4.50 | | | | | | 5.00 | 9.50 |
| Total | 261 | 51.00 | 19.50 | 7.00 | 93.00 | | 1.50 | | 8.50 | 180.50 |
| 11/22/72 | 262 | 14.50 | | | | | | | | 14.50 |
| 11/23/72 | | 24.00 | | | | | | | | 24.00 |
| 11/24/72 | | 2.00 | 5.50 | | 16.50 | | | | | 24.00 |
| 11/25/72 | | | | | 22.00 | | | | 2.00 | 24.00 |
| 11/26/72 | | | 6.50 | | 3.00 | 0.50 | | | 4.00 | 14.00 |
| Total | 262 | 40.50 | 12.00 | | 41.50 | 0.50 | | | 6.00 | 100.50 |
| 11/26/72 | 263 | 10.00 | | | | | | | | 10.00 |
| 11/27/72 | | 24.00 | | | | | | | | 24.00 |
| 11/28/72 | | 24.00 | | | | | | | | 24.00 |
| 11/29/72 | | 24.00 | | | | | | | | 24.00 |
| 11/30/72 | | 24.00 | | | | | | | | 24.00 |
| 12/1/72 | | 9.00 | 8.50 | | 2.00 | | 3.00 | | 1.50 | 24.00 |
| 12/2/72 | | | | 5.50 | 18.50 | | | | | 24.00 |
| 12/3/72 | | | | 6.50 | 17.50 | | | | | 24.00 |
| 12/4/72 | | | | 11.50 | 12.50 | | | | | 24.00 |
| 12/5/72 | | | | 1.50 | 15.50 | | 7.00 | | | 24.00 |
| 12/6/72 | | | 9.50 | | | | 5.00 | | 2.50 | 17.00 |
| Total | 263 | 115.00 | 18.00 | 25.00 | 66.00 | | 15.00 | | 4.00 | 243.00 |

Time Distribution (Continued)
Leg 27

| Date | Site Number | Cruise | Trips | Drill | Core | Stuck Pipe | Mechanical Down Time | In Port Time | Other | Total Time |
|---|---|---|---|---|---|---|---|---|---|---|
| 12/6/72 | Fremantle | 7.00 | | | | | | | | 7.00 |
| 12/7/72 | | 24.00 | | | | | | | | 24.00 |
| 12/8/72 | | 24.00 | | | | | | | | 24.00 |
| 12/9/72 | | 11.00 | | | | | | 13.00 | | 24.00 |
| 12/10/72 thru 12/20/72 | | | | | | | | 248.00 | | 248.00 |
| Total | | 66.00 | | | | | | 261.00 | | 327.00 |
| Grand Total | | 391.50 | 95.50 | 35.50 | 334.00 | 0.50 | 16.50 | 325.25 | 25.50 | 1224.25 |

# DEEP SEA DRILLING PROJECT
## OPERATIONS RESUME
## LEG 28

Leg 28 of the Deep Sea Drilling Project was the first trip for the Glomar Challenger into Antarctica. The Challenger departed Fremantle, Australia on December 20, 1972. The course initially was almost due south to Antarctica, then east along the coast of the Wilkes Land and then south into the Ross Sea. The voyage terminated in Christchurch, New Zealand on 0730 hours, February 27, 1973. While investigating the offshore area of the world's most southern continent, the Challenger drilled 16 holes on 11 sites and traveled 7400.5 nautical miles on this 68.8 day voyage. 5646.5 meters of sediment were penetrated of which 3014 meters were cored and 2632.5 meters were drilled. 329 cores were attempted and 1404.6 meters or 46.6 percent of the total interval cored was recovered.

Major time distribution for the 68.8 day leg consisted of 0.43 day in port, 32.13 days on site, 36.25 days cruising. Distribution of the 32.13 days on site were 19.55 days coring, 2.63 days drilling, 1.21 days mechanical downtime, 6.91 days trip time, 0.37 days lost waiting on icebergs and/or weather, and 1.46 days consumed with other miscellaneous tasks.

## VOYAGE SUMMARY

Our first site was approximately 250 miles southwest of Fremantle, Australia. This site had not been included in the final Leg 28 Prospectus and was selected close to port to check out all mechanical systems before our long journey south began. The drawworks auxiliary brake, power sub and swivel had just been repaired while in Fremantle. While drilling on Site 264, all systems were checked out thoroughly. Our trip to the Antarctica was ready to proceed. Site 264 was completed and the Challenger was underway on Christmas Eve, December 24, 1972.

The sea was very calm and the skies were overcast as we spent Christmas Day on board the Challenger. The following day the wind began building from the southwest. After all, we were now in the "roaring forties" and we could expect this and much more. As a result of the high winds blowing steadily 40 mph and gusting to 60 mph, the swells built up to 12-16 feet and caused the ship to roll from 10° to 20°.

On December 28, a fine rain turned to sleet and the wind continued to blow 40 to 60 mph. Many crew members began to dig out their arctic clothing. As we moved farther south, the temperature dropped accordingly and the days grew longer. The wind changed direction and was decreasing before we arrived on Site 265. By the time the site survey was completed, the seas were relatively calm. The site was completed without weather problems and very few mechanical problems. Site 266 was then drilled. The Challenger had no trouble positioning on any of these first three sites. The seas were calm, in fact, very calm for this part of the world. The wind was not a factor on any of these sites.

While enroute to Site 267, we saw our first iceberg at 58° 20'S latitude. Since the Challenger was not ice-strengthened, we passed the iceberg at a very safe distance. This was one of many we were to observe in the next month. Site 267 was near a field of icebergs. The site was selected not so much for the sediment thickness, but as an area with a minimum of icebergs. The final location was approximately 8 miles southwest of the original proposed site. When the beacon was dropped many icebergs, growlers and bergy bits were visible, however, the nearest iceberg was 6-1/2 miles away. The movement of all icebergs and large growlers within 10 miles were plotted from the radar display.

A current meter was lowered into the water and the indicated current of 0.47 knots was quickly observed to control the speed and direction of the icebergs. Therefore, although 20 plus icebergs were on the radar scope, the real concern was with those up-current. While icebergs are influenced more by current than other forces, their actual course proved to be more of a zigzag. Apparently, this was caused by the attitude, size and configuration of the iceberg relative to the current.

At Site 267, shortly after a redrill was spudded to pick up missing sections, it became necessary to abandon the hole because of an approaching iceberg. This was in keeping with our plan to suspend drilling if an iceberg moved within three miles of the Challenger. After moving the Challenger, the iceberg actually did move across the drill site.

Temperatures were well below freezing and water lines, air lines and air valves became frozen or clogged with ice. The electric rig floor heaters proved to be very inadequate; in fact, by the end of Site 267 two of the three electric heaters on the rig floor were inoperable. The remaining heater was then moved to the recreation room and diesel fired heaters were fabricated from steel pipe on board. They were quite adequate and were used for the remainder of the leg.

While departing Site 267, 49 icebergs were counted on the radar screen within a 10 mile radius of the Challenger. Due to the number of icebergs and a very dense fog that was encountered, we proceeded south to our next site at a greatly reduced speed. The fog further complicated navigational problems. At times, visibility was reduced to 50 yards and all available marine and drilling personnel were utilized as ice lookouts from various places on the ship. With these precautions, we were able to avoid serious problems and a safe transit was made.

Site 268 proved to be a most difficult drill site to locate. The Challenger's seismic records were nearly useless. Apparently thermal layers in the water caused the air gun signal to reflect before reaching bottom and in addition, these layers held the ship's noise at the surface. These noises were then picked up by seismic hydrophones. Icebergs were as numerous as on the previous site, however, after several hours, an area was found where the sediment thickness was acceptable and where the icebergs were not an immediate problem. Site 268, of all of the 11 sites investigated on Leg 28, gave us the feeling that the Challenger had arrived in another world. All forms of communications were very poor at this location which was approximately 120 miles north of the continent of Antarctica. The temperature would drop to the lower 20's during the one to two hours of darkness each day and during mid-day, would reach a high of only 28° to 30°. Air lines and water lines continued to freeze. Some fresh water lines froze with water circulating through them. At times, fog reduced visibility to almost zero, yet on the radar scope, there were usually 15 to 40 icebergs present. The radar proved to be invaluable even though we had discovered on the previous site that the radar would not always pick up the oval or rounded top icebergs. These were plotted visually and a close lookout was maintained at all times. Due to the short time exposed to the Antarctic weather, most of the personnel had not yet become accustomed to the cold weather. The temperatures, including the chill factor, was well below zero and it made de-icing of air lines, thawing out of water lines, and repairing hydraulic equipment a miserable job. The crew of the Challenger were happy when this site was completed and the vessel headed eastward to join up with the rest of the world.

After leaving Site 268, we cruised northeasterly up to 60° of latitude and then east along the coast of Wilkes Land north of the reported pack ice. Our speed was reduced to 5 knots on many occasions because of icebergs and/or thick fog. On this five day trip to Site 269, we saw several species of birds, including the Antarctic "petrel", a bird that feeds on pack ice, although no pack ice was seen. Several whales were seen and usually in the same area we would see "krill". These tiny, red-looking shrimp would be in schools of thousands and would cause red spots to appear in the water. Overall, the trip east was relatively uneventful. A west to east breeze assisted the Challenger in cruising up to 10 knots when the fog and icebergs would permit. At Site 269, the ship's computer failed and the mudline was cleared while making repairs. A second hole was required to reach our scientific objectives.

On January 26, 1973, a rendezvous was held with the USCG Icebreaker "North Wind" at 67° 38'S latitude 174° 54'E longitude. Captain Venzke of the "North Wind" boarded the Challenger at 2030 hours bringing with him some spare parts and our long awaited mail bag. The "North Wind" had cruised north from McMurdo Station to meet and escort the Challenger while entering, working in and leaving the Ross Sea. This had been considered necessary as the Challenger was not ice-strengthened. Captain Venzke informed us of the ice conditions to be expected and the proper techniques to employ while transiting the small amount of pack ice remaining. At 2300 hours, we headed south with our icebreaker escort leading the way. At 0400 hours, on January 27, we started seeing large patches of pack ice. Within an hour, it seemed that the horizons had turned white although the pack had no more than 1/8 to 3/8 coverage including many icebergs and bergy bits. On three occasions the Challenger, on advise from the icebreaker, stopped while the "North Wind" explored 5 ot 6 miles ahead to find the best route. The route chosen for the Challenger was not necessarily the most ice free, but was the route free of hard ice that could damage the hull of the "thin skinned" Challenger. Therefore, the Challenger went through the areas where the pack ice was either snow white or had brown markings along the water line. Blue or bluish green "hard" ice was avoided entirely. Of the approximately 20 miles of pack ice that was transited, the last 2 miles was the worst and "close escort" procedures were used. The Challenger stayed within 600 to 1000 yards of the "North Wind" and followed in a practically "ice free" path and only rotten ice was actually touched. Constant radio communication was maintained with the "North Wind" and Captain Venzke advised us on the hardness of each piece of ice that could possibly touch the Challenger. Some of the rotten ice had seals on them who seemed to enjoy having their environment intruded upon. Some of them put on quite a show for our many photographers. The "North Wind" and her crew did an excellent job of escorting the Challenger through this barrier to the Ross Sea. At no time was the Challenger in danger. Later a few bands of hard pack ice were observed on the radar screen but none were penetrated. This was the only pack ice to be penetrated on Leg 28 as the wind had moved the pack ice aside when the vessel returned from the Ross Sea.

As we cruised south, we headed into a strong, cold wind with blowing snow. The bow lookout house was utilized as a forward ice observation point. With the chill factor the temperature was a minus 15° and it was extremely difficult to see ice in the water from the wing of the bridge. The forward bow lookout installed during drydock turned out to be of real value.

Site 270, our first hole in the Ross Sea, was also the most southerly hole drilled on this leg. The water depth (although the deepest of the Ross Sea sites) was 644 meters and was, by far, the shallowest water the Challenger had positioned in since Leg 18, Site 176, which was only partially successful (the bottomhole assembly broke after 41 meters of penetration). Site 270 was cored to a depth of 422.5 meters below the ocean floor and 101.5 hours were spent on the site. Due to the firm bottom encountered at this site, 41 hours were used to penetrate the first 127 meters. Successfully drilling this, our most southerly site, was the most outstanding operational accomplishment of Leg 28.

The other Ross Sea sites, Nos. 271, 272 and 273, were located a short distance to the north of Site 270. All of these sites presented different operational problems such as shallow water, hard drilling from the mudline to total depth which made positioning critical, and silty sands with rocks and boulders which made core recovery poor. These three sites were all abandoned when traces of methane and ethane gas were detected. The sites were all plugged with cement.

While drilling the first three Ross Sea sites, we had many visitors from the USCG "North Wind" (approximately 180). A few of the Challenger's crew members visited the "North Wind". It was a pleasure for all of us to have these visitors on board. On February 9, while we were enroute to Site 273, the "North Wind" was relieved by the USCG

Icebreaker "Burton Island", at which time we again received some eagerly awaited mail. The "North Wind" had finished her assignment to the Challenger. The job they had done in escorting the Challenger was excellent. Before completing drilling in the Ross Sea, the "Burton Island" would also prove her worth.

When the beacon was dropped on Site 273, three icebergs were in view with the closest about 8 miles away. Positioning had to be near perfect as the water depth was only 505 meters. The maximum allowable excursion was 45 feet. After a penetration of 85 meters, positioning became unacceptable. The gyro had developed a 5° error which caused the Challenger to lose heading. The ship was then positioned in manual using an iceberg as a reference point to maintain heading while pulling the drilling assembly above the mudline. The gyro was quickly repaired and Hole 273A was spudded. Then, two of three icebergs which had been plotted from radar since our arrival on site, continued moving towards the Challenger as if pulled by a magnet. The first to arrive was a large bergy bit. When the bergy bit was within 3 miles of the site, the "Burton Island" started pushing it and moved it approximately 1/2 mile to our port side. Because of a change in current direction or other reason, the bergy bit once again headed straight for the Challenger. The hole was filled with heavy mud (traces of gas had been noticed in the last core) and the drill pipe was retrieved until the bit was within 20 meters of the mudline. The "Burton Island" again pushed the bergy bit away. The exposed ice was about half or less the size of the icebreaker, but 80% of the mass is below the water. When the bergy bit was pushed, it would twist and roll off the bow of the "Burton Island". Several attempts were required to move it away from the Challenger. The "Burton Island" sustained damage to her bow above the ice belt while pushing this troublesome bergy bit, but her actions saved the drill site. Now the second intruder was only 2 miles away and also on a collision course with the Challenger. The "Burton Island" pushed the larger iceberg completely out of the way with very little difficulty and drilling was resumed on Hole 273A.

The next planned site was on the Iselin Plateau which was to complete the Ross Sea program. Although ice reports indicated that this particular site was covered with ice and would remain so for the remainder of the year, the Challenger headed for the Iselin Plateau hoping, by some chance, that the ice reports were not correct or that a storm would move the ice away from the site. After 36 hours of cruising with winds gusting up to 60 mph and swells up to 26 feet, (the Challenger was rolling from 10° to 20°) the pack ice was found to be as reported. Our couse was reversed and an alternate site in the Belleny Trough was selected. Soon, our course was reversed again and we attempted to enter the Iselin Plateau from a different direction. Again, a solid belt of ice was found to be protecting the Iselin Plateau. No matter from which direction we attempted to enter, the results were the same, more pack ice. The Iselin Plateau would not be drilled this season. Our course was changed and once again, we were headed toward the Belleny Plateau to drill our last site. The wind was still at gale force. The "Burton Island" had rolls of 45° and reported she was taking some water through her damaged bow. As had been the case throughout Leg 28, the winds subsided as we arrived on the site and no time was lost here due to bad weather.

The 3326 meters of water on Site 273 was the deepest water we had worked in since entering the Ross Sea and positioning was not as critical. Nonetheless, some of our most anxious moments were experienced while trying to reach basement here. Approximately four hours before the site was finished we had momentary power failure to the bridge and the computer. The ship was then positioned in manual while the computer was reprogrammed and coring continued. To further complicate matters, the wind and seas began building. After the computer was reprogrammed, we were still unable to position in automatic because the 50 + mph wind and rough seas were causing an almost constant loss of acoustics. We were very fortunate to core 5 meters of basalt before abandoning the site. Manual positioning was, however, sufficient to keep the ship within 400 feet of the beacon. In the 3300 + meters of water, these excursions were well within the limits of acceptability. Positioning in manual and semi-automatic was continued until the drill pipe was retrieved.

Site 274 was the last site on this Antarctic leg. Sixteen holes had been drilled on 11 sites. Each site will be remembered by its own individual problems and challenges. We were fortunate to accomplish what we set out to do, namely, to explore the ocean sediments of the world's most southern continent. Eight of the 11 sites investigated were farther south than any previous offshore drilling.

Operational problems were caused by low temperatures and chill factors due to high winds which resulted in temperatures equivalent to a minus 20°F. This resulted in an ice covered deck and rig floor that made all outside movement hazardous. Frozen air and water lines were a constant problem. Literally, hundreds of icebergs, bergy bits, growlers, and pack ice created navigational and operational concerns but had little effect on our overall success. On January 19, 1973, at 1400 hours, the Challenger was underway to Christchurch, New Zealand. Since there was no pack ice reported north of us, the "Burton Island" was released from her escort duties. The pack ice, encountered while entering the Ross Sea, had been blown aside.

The various types of assistance and information that was made available to us was invaluable. Captain Peter Granholm, hired by GMI through the Lauritzen Lines of Denmark, acted as the shipboard ice advisor. He helped keep all the ice information up to date and assisted in evaluating current ice problems. The ice information, received three times a week from Suitland, Maryland, proved to be invaluable. The suggested courses for the Challenger were always free of pack ice.

The service of both icebreakers was equally outstanding. The USCG icebreakers "North Wind" and "Burton Island" assisted the Challenger both while enroute and while on-station.

As we left the Antarctic and the Ross Sea was only a memory, we considered ourselves fortunate and lucky to have spent approximately 50 days in these southern waters with only minor difficulties. We had the feeling that, perhaps, we slipped into Antarctica and recovered a few of her secrets and were well on our way to Christchurch before our presence had been discovered. Twenty four hours after the completion of our last site, a cloud cover picture from the ESSA satellite indicated that the entire Ross Sea was involved in a major storm lasting over 72 hours.

On our trip northward to Christchurch, we experienced some high winds and rough seas that caused the ship to pitch 8° and roll from 8° to 15°. On arrival in New Zealand all were ready to put their feet on solid ground. Leg 28 had been a long time at sea.

## DRILLING AND CORING

Before leaving Fremantle, many repairs had been made on the various drilling components. The overriding clutch to the auxiliary brake on the drawworks had failed on the previous leg and caused extensive damage to the swivel and power sub. All of this equipment had been repaired in Fremantle. Site 264, approximately 250 miles southwest of Fremantle, was drilled for scientific information and to prove out the repairs. All equipment was thoroughly checked while drilling this site. The drawworks auxiliary brake and the swivel functioned perfectly. The power sub gear selector caused some downtime, but this problem was not related to the repairs that had been made in Fremantle and did not necessitate returning to port.

The first three sites had soft clay at the mudline and recovery was average. On site 265, we cored 18 meters into basalt. Recovery was very poor. There were probably two reasons for this poor recovery. One was the high (90 rpm) rotary spread used. This high rpm was necessary because of a faulty gear selector on the power sub. First and second gear was inoperable and only third gear was available. Normally, basalt is cored in second gear at 40 rpm. The other reasons for the poor recovery in basalt can probably be attributed to the soft clay just above the basalt. Without a firm formation above the basalt, the bottom-hole assembly will not rotate around its own axis. The resultant "wobble" appears to cause the basalt to break into small pieces which wedge and jam the core barrel. While coring basalt, a new segment type core catcher was used. We doubt that poor recovery was caused by this catcher, as a hard formation finger type catcher that is normally run was used in conjunction with the experimental segment catcher. The segment type did prove to be durable and after use was in a "like new" condition. The major mechanical problems on the first three sites were the power sub gear selector and a hydraulic pump on the hydraulic power supply.

On Sites 267 and 268, located at 60° and 63° south, gray clay just below the mudline on these sites proved to be difficult to recover but otherwise hole conditions were good and basement was recovered on Site 267. On Site 268, recovery dropped to only 34.6% due to glacial erratics, pebbles and rocks embedded in the firm gray clay which changed to chert streaks and clay at depth. Below freezing temperatures were experienced along with winds of 30 to 40 mph. We discovered how unwinterized the ship really was. To name a few, the air lines to the pipe racker skate froze which was remedied by building an enclosure around the air motor; the man lift elevator would run at less than half speed; the electric heaters on the rig floor were ineffective. All of the fresh water lines on the drill rig floor froze. In Antarctica, our on-site time was limited because of high winds and possible interference by icebergs. Thawing water lines and de-icing air lines was lost time that we could ill afford.

Site 269 was the last site prior to entering into the Ross Sea. Water depth by drill pipe measurements was 4295 meters. The mudline was a firm gray clay and it was necessary to rotate the drill string and circulate with 20 strokes of pump in order to make penetration. During the last part of Site 269, positioning was very erratic. After drilling and coring to 4711 meters, the computer dumped its program. It was necessary to pull the bit clear of the mudline and make repairs to the computer. Hole 269A was then drilled to 4711 meters and intermittently cored to 5295. Formation was mostly mudstone and hole conditions were good, however, recovery was less than average. Before 269A was completed, it was necessary to change a hydraulic motor on the power sub and replace a pump on the main hydraulic power supply. Apparently these hydraulic failures were caused by drastic changes in oil temperatures which created condensation inside the hydraulic system. To alleviate this problem, the hydraulic system was purged on several occasions.

Site 270, the most southerly site, was located approximately 50 miles north of the Ross ice shelf. It was our first hole in the Ross Sea and in shallow water. Previous experience in shallow water drilling on Leg 18 had shown that the Challenger would over-position and its response was further influenced by the weight of the drill string. To improve our positioning capabilities, the following steps were taken.

1. Maximum ballast was taken on to get the Challenger as low in the water as possible. This helped prevent over-positioning and placed more area in contact with the current to give the ship a constant force to position against.

2. The computer gains were adjusted to minimize the angle of departure from the beacon before corrective action is taken.

3. While drilling in the bottomhole assembly, rotation was stopped when the ship moved away from the beacon as much as 2.8% of water depth. At 3.2%, the mudline was cleared.

4. After the bottomhole assembly was below the mudline, a 5° excursion was tolerated before rotation was stopped. The mudline was not cleared as long as no environmental elements threatened the ship. Our reason for this plan was that if positioning permitted the ship to move off the beacon 75 or 100 feet, we would be unable to pull the bottomhole assembly through the mudline without breaking off. The drill pipe was more flexible and we preferred that it be at the mudline.

On the first site in shallow water (Site 270), the water depth was established at 644 meters. The mudline was found to be a very sticky, firm clay that required rotation of the drill string and utilization of 10 spm of pump. At 17 meters, the formation turned to mudstone and the coring rate was reduced to approximately 3 to 4 meters/hr. Forty hours were spent drilling in the bottomhole assembly (127 meters). During this period, the ship's maximum excursion from the beacon was less than 40 feet and well within the established 2.8% of water depth. One hundred hours of on-site time was required to core to 422.5 meters (sub bottom). Recovery was good while coring the firm mudstone. The bottom 40 meters were a very abrasive angular conglomerate (breccia). Scientists surmised that the breccia probably was the accoustical basement. The four cone chisel tooth bit was severely worn and all cones had locked and skidded.

Sites 271 and 272 had similar operational difficulties. Water depths were actually less than at Site 270, namely 579 and 629 meters. The same positioning and coring plan was used as previously described. Both mudlines were a firm sticky clay and required rotating the drill pipe and using small amounts of pump. Core recovery was very poor on both holes, especially on Site 271. Pebbles and rocks were embedded in the clay and recovery was reduced to only samples from the core catchers. Coring operations were suspended on Site 271 when traces of methane, ethane and ethylene gases were detected. On the previous six coring attempts, only small pebbles had been recovered. All types of core catchers and coring tools had been used to try to improve the recovery without success. After 265 meters of penetration, the hole was suspended and the well bore was completely filled with 80 barrels of 13 ppg cement. At Site 271, the bit was completely worn out after drilling the 265 meters in 6.8 rotating hours. Apparently we had drilled a very abrasive sand in the areas of no core recovery. At Site 272, traces of methane and ethane gas were present in core number eleven and recovery was sufficient to constantly monitor the gas. At 384 meters (core number forty) the recovery, again, became very poor apparently due to drilling in loose sand. At 443 meters, the hole was abandoned when core recovery became too poor to properly monitor the gases. The well bore was filled with weighted drilling mud and then the bit was raised to 130 meters and a cement plug was placed from 130 meters to the mudline.

Site 273 proved to be our most difficult site in the Ross Sea. In choppy seas and a 30 knot wind, the Challenger had some difficulty in positioning over the beacon in 505 meters of water. After coring 76 meters, the hole had to be abandoned when the ship's gyro compass malfunctioned. The ship would not maintain heading. The ship was positioned in manual using an iceberg as a heading reference while pulling the drill pipe and making repairs to the gyro compass.

Hole 273A was then drilled to 80 meters and then continuously cored. A bergy bit and an iceberg threatened our drill site. The "Burton Island" was notified and pushed the bergy bit approximately 200 yards. After a penetration of 180 meters, the bergy bit and iceberg, again, threatened the site. The hole was filled with weighted drilling mud and the drill pipe pulled out of the hole until the bit was only 20 meters below the mudline. Traces of methane and ethane gas had been found on the last few cores and the weighted mud was intended as a good plug if the hole was abandoned. The bergy bit was then moved by the "Burton Island". It was about 1/3 size of the icebreaker and rolled while being pushed. This rolling damaged the bow of the "Burton Island". The iceberg also was moved away and coring was resumed in Hole 273A. The site was finally abandoned after 346.5 meters of penetration when a sinker bar could not be retrieved. While retrieving the overshot, the line wiper hung up on the sandline and then became free again and slid down the sandline. On impact with the lubricator valve, the line wiper cut the sandline, dropped the sinker bars and 20 feet of sandline down the drill pipe. Attempts to fish out the core barrel, sinker bars, and 20 feet of sandline with a wireline spear were unsuccessful. The hole was filled with heavy mud and a cement plug was placed in the hole from 130 meters to the mudline.

The last site, No. 274, was a deep water site located in the northwest part of the Ross Sea in 3326 meters of water. Drilling problems were minimal and recovery was excellent. Core recovery was 79% down to 325 meters. Near the end of drilling, the wind built up rapidly and the swells were 14 to 16 feet. After 390 meters of penetration, a momentary power failure to the bridge and computer caused the computer to dump its program. The ship was then positioned in manual while the computer was reprogrammed. High seas caused loss of acoustics and necessitated positioning in the manual mode. The hole was abandoned at 421 meters but five meters of basalt had been cored before the 55 mph wind and high seas caused the abandonment of the site.

## WEATHER

While operating at the first two sites south of Fremantle, weather facsimile were received from Canberra, Australia. They only put out four facsimile maps a day which reached below to 50°S latitude and only one of these was a surface map. On January 1, 1973 the Russian Station, Molodezdnaya, was received for the first time and we received many good facsimile maps from this station. Their maps were very helpful. While drilling on Site 168, we were unable to copy the Russian map and had to depend on Canberra for our only weather information.

On January 18, we received our first map from McMurdo Station, but reception was poor. Only ten good maps were actually received from McMurdo during the entire leg. Their surface analysis were, however, received at least twice daily while we were operating in the Ross Sea.

ESSA 8 reception was good the entire trip. We received four to nine pictures a day depending on the passes over our area. Unfortunately, the ESSA 8 picture only covered as far south as 69° or 70° south latitude and were not of much value on our Ross Sea sites. The Nimbus 4 satellite, which was on a north to south path, passed over our area and the Nimbus 4 pictures were used through Site 274. On its way north, Nimbus 4 shuts down transmitting at 50° south latitude.

Canberra was the station most used for our facsimile maps and ESSA 8 for our satellite pictures with Nimbus 4 assisting while working in the Ross Sea. The Russian facsimile maps and the surface analysis from McMurdo, all helped immensely and minimized loss time due to weather.

## COMMUNICATIONS

We were in contact with the Navy Station NWC at Northwest Cape, Australia which had been our usual method for the past several legs. As we approached the continent of Antarctica, communications with Northwest Cape became difficult.

We then established voice contact with NGD communications station at McMurdo and requested help in getting our traffic to and from WWD at SIO. They agreed and were very cooperative, especially when we were working in the Ross Sea.

Our teletype had been adjusted in Fremantle to copy 100 WPM so we were able to receive the many Antarctic broadcasts which are sent by teletype from McMurdo and contain the ice conditions report sent from Fleet Weather Facilities, Suitland, Maryland. By teletype, we received other information of general interest, including other activities that were in progress in Antarctica. The broadcast also included press news from AFRTS (Armed Force Radio and Television Service).

As we were in continuous contact, Scripps and other traffic were received expeditiously on request or call from McMurdo. We continued the teletype contact both ways until our all mode TMC transmitter failed on January 26. Thereafter, we used CW for sending messages and teletype for receiving messages from McMurdo. This continued until February 18 when McMurdo Station became short of radio men. From that date on, we were able to pass our traffic to the USCG "Burton Island" on CW or voice and they in turn passed it to McMurdo on their teletype circuits. The "Burton Island" was very cooperative and never far from the Challenger even while enroute to Christchurch.

## POSITIONING

Positioning can simply be described as excellent throughout Leg 28. To drill the shallow water site in the Ross Sea, the positioning system was near perfect. The bottomhole assemblies were drilled in five times on the four Ross Sea sites without a loss of bottomhole assemblies. The water depth on these sites ranged from 505 meters to 644 meters. The average depth of the four sites was 589 meters. Approximately 95 hours were required to drill in the bottomhole assembly on these Ross Sea sites. During this period, the maximum excursion was less than 50 feet. As in the past, it was noticed that the computer would build up a memory of the power requirements to position against a constant force for several hours and then, when a sudden change occurred in the direction of the wind or current, the computer was slow to accept this different or new force.

The only major problem with the positioning system occurred on Site 269 when the ship began over-thrusting in both the X and Y axis. The problem was not of sufficient magnitude to cause the hole to be abandoned while repairs were made. However, shortly thereafter, the computer dumped its problem and the hole was abandoned. It was later discovered that the two malfunctions were not related. The over-positioning was corrected by replacing two amplifiers in the X and Y data converters. This had caused erroneous positioning in both the X and Y axis in relative error and relative positioning. The computer lost its program because of overheating. To correct the problem of overheating, added venting of air into the computer cabinet should be considered. The present venting system is minimal. Failure due to overheating occurred also on Leg 27.

## CREW PERFORMANCE

All crew performance on this first Antarctic leg was excellent. The outstanding performance of all concerned made Leg 28 a major success. This success can be attributed to efforts of every individual on this historic leg.

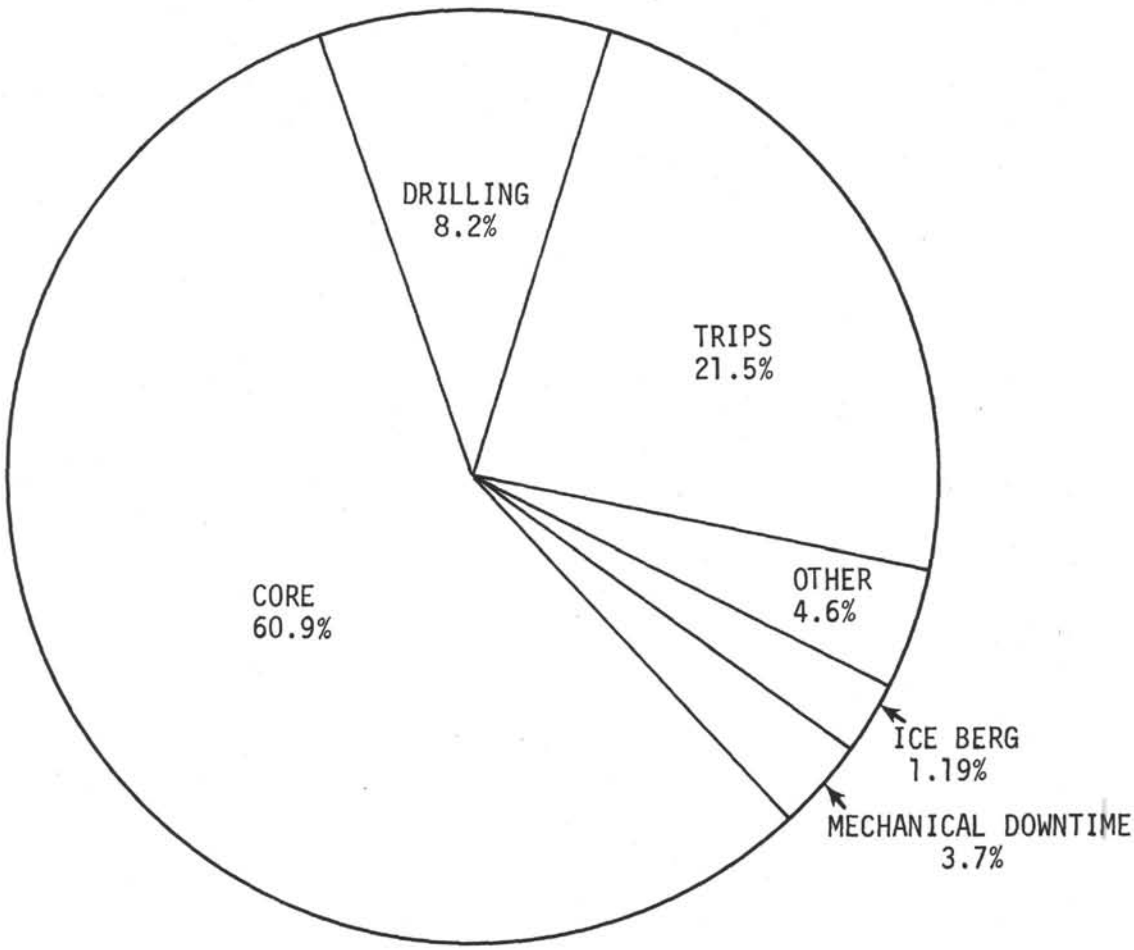
Lamar P. Hayes
Cruise Operations Manager
Deep Sea Drilling Project

March 28, 1973

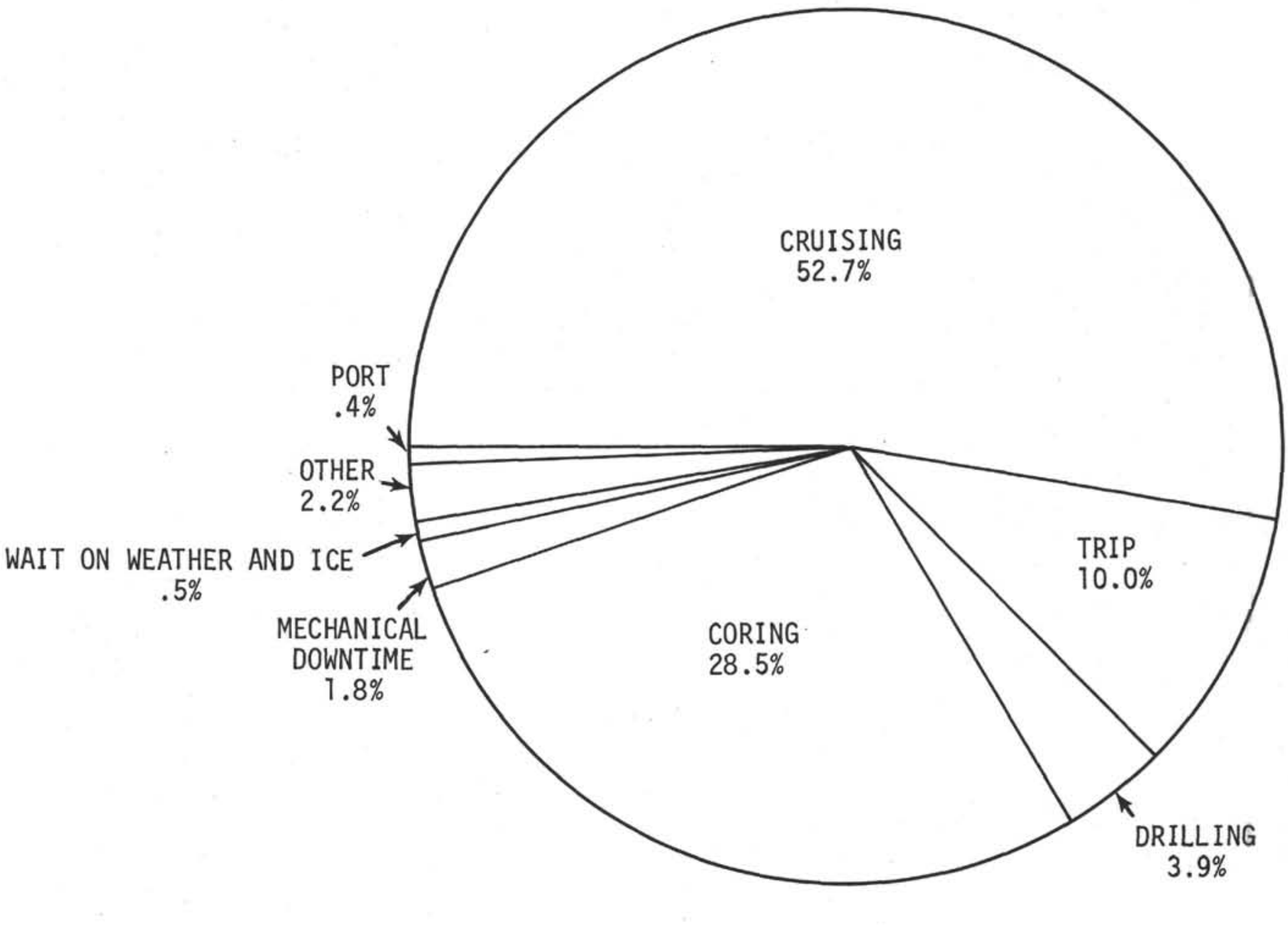
# DEEP SEA DRILLING PROJECT
## SUMMARY OF OPERATIONS
## LEG 28

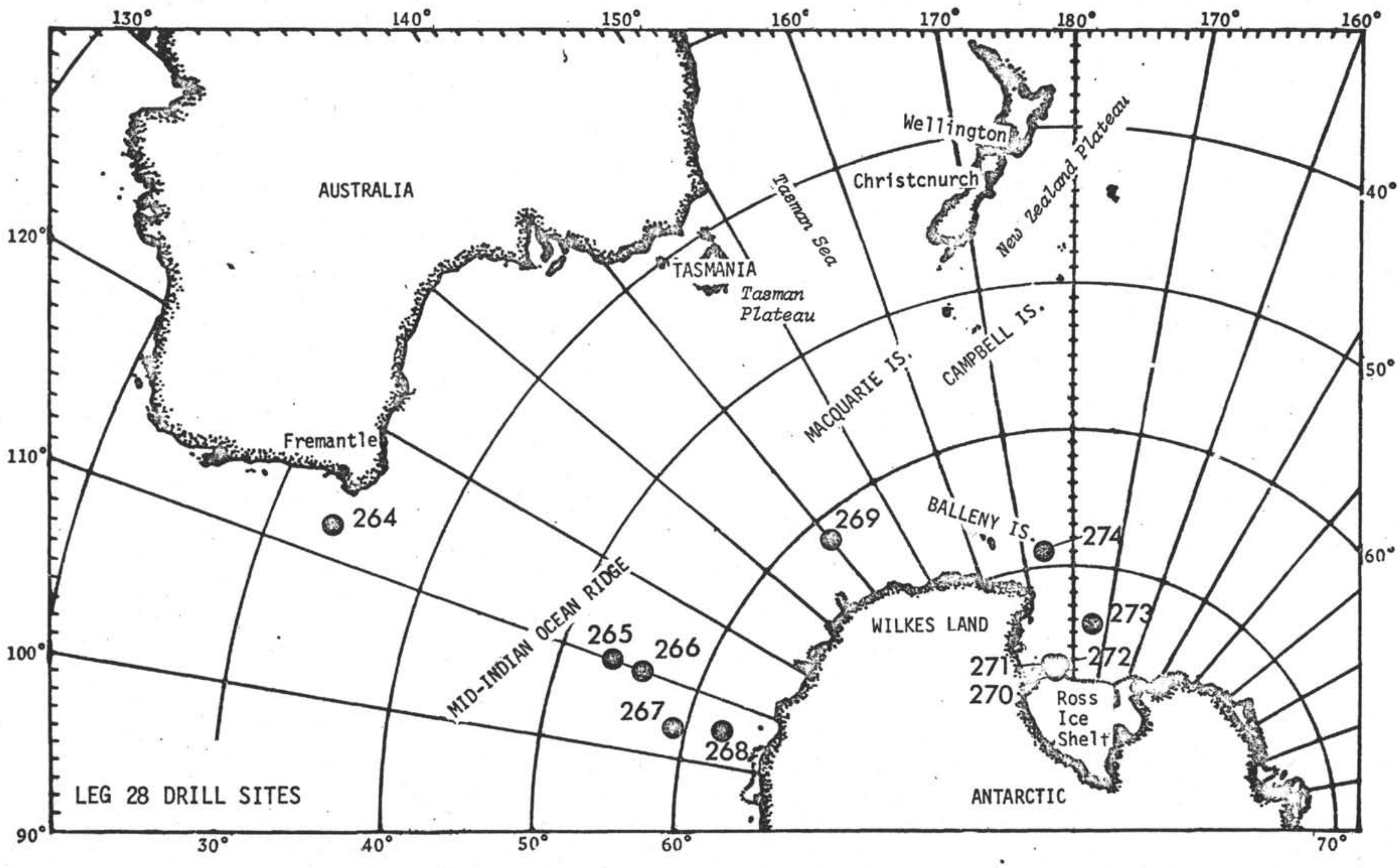
| | | |
|---|---|---|
| Total Days Leg 28 (December 20, 1972 - February 27, 1973) | | 68.8 |
| Total Days In Port | | .43 |
| Total Days Cruising | | 36.25 |
| Total Days On Site | | 32.13 |
| Trip Time | 6.91 | |
| Drilling Time | 2.63 | |
| Coring Time | 19.55 | |
| Mechanical Downtime | 1.21 | |
| Waiting On Weather & Icebergs | 0.37 | |
| Other Miscellaneous Time | 1.46 | |
| Total Distance Traveled (Nautical Miles) | | 7400.5 |
| Average Speed | | 8.9 |
| Sites Investigated | | 11 |
| Holes Drilled | | 16 |
| Number of Cores Attempted | | 329 |
| Percent of Cores With Recovery | | 89 |
| Total Penetration | | 5645.5 |
| Total Meters Drilled | | 2632.5 |
| Total Meters Cored | | 3014.0 |
| Total Meters Recovered | | 1404.6 |
| Percent of Core Recovered | | 46.6 |
| Percent of Total Penetration Cored | | 53.3 |
| Maximum Water Depth (Meters) | | 4574 |
| Minimum Water Depth (Meters) | | 505 |

DEEP SEA DRILLING PROJECT
LEG XXVIII
ON-SITE TIME DISTRIBUTION



DEEP SEA DRILLING PROJECT
LEG XXVIII
TOTAL TIME DISTRIBUTION




130°
140°
150°
160°
170°
180°
170°
160°
AUSTRALIA
Wellington
Christcnurch
New Zealand Plateau
Tasman Sea
TASMANIA
Tasman Plateau
MACQUARIE IS.
CAMPBELL IS.
Fremantle
BALLENY IS.
264
269
274
273
272
271
270
265
266
267
268
MID-INDIAN OCEAN RIDGE
WILKES LAND
Ross Ice Shelf
ANTARCTIC
LEG 28 DRILL SITES
120°
110°
100°
90°
40°
50°
60°
30°
40°
50°
60°
70°

DEEP SEA DRILLING PROJECT
SITE SUMMARY
LEG 28

| Hole | Latitude | Longitude | Water Depth Meters | Number Of Cores | Cores With Recovery | Percent With Recovery | Meters Cored | Meters Recovered | Percent Recovered | Meters Drilled | Total Penet. Meters | Avg. Rate Penet. | Time On Hole | Time On Site |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| The Southern Edge of the Naturaliste Plateau | | | | | | | | | | | | | | |
| 264 | 34° 58.13'S | 112° 02.68'E | 2883 | 15 | 11 | 73 | 142.5 | 65.0 | 45.7 | 73.0 | 215.5 | 52.9 | 33.25 | |
| 264A | 34° 58.13'S | 112° 02.68'E | 2883 | 4 | 4 | 100 | 38.0 | 33.2 | 87.4 | 120.5 | 158.5 | 99.0 | 14.25 | 47.5 |
| South Flank - S.E. Indian Ridge | | | | | | | | | | | | | | |
| 265 | 53° 32.45'S | 109° 56.74'E | 3592 | 18 | 17 | 94 | 169.0 | 107.7 | 63.7 | 293.0 | 462.0 | 90.0 | 56.25 | 56.25 |
| South Flank - S.E. Indian Ridge | | | | | | | | | | | | | | |
| 266 | 56° 24.13'S | 110° 06.70'E | 4183 | 24 | 24 | 100 | 219.5 | 145.2 | 66.1 | 164.5 | 384.0 | 52.6 | 56.75 | 56.75 |
| S.E. Indian Basin | | | | | | | | | | | | | | |
| 267 | 59° 15.74'S | 104° 29.30'E | 4574 | 7 | 6 | 85 | 58.0 | 25.9 | 44.6 | 161.5 | 219.5 | 52.0 | 27.25 | |
| 267A | 59° 15.74'S | 104° 29.30'E | 4574 | 3 | 2 | 66 | 28.5 | 11.6 | 40.7 | 42.0 | 70.5 | 56.0 | 3.75 | |
| 267B | 59° 14.55'S | 104° 29.94'E | 4559 | 10 | 10 | 100 | 95.0 | 53.5 | 56.3 | 218.5 | 313.5 | 98.0 | 36.50 | 67.50 |
| Wilkes Land Continental Rise | | | | | | | | | | | | | | |
| 268 | 63° 56.99'S | 105° 09.34'E | 3554 | 20 | 20 | 100 | 189.5 | 65.6 | 34.6 | 285.0 | 474.5 | 39.5 | 59.25 | 59.25 |
| South Magnetic Quite Zone | | | | | | | | | | | | | | |
| 269 | 61° 40.57'S | 104° 04.21'E | 4295 | 11 | 11 | 100 | 103.0 | 38.0 | 37.6 | 313.5 | 416.5 | 88.6 | 34.00 | |
| 269A | 61° 40.57'S | 104° 04.21'E | 4295 | 13 | 13 | 100 | 123.5 | 55.3 | 44.7 | 834.5 | 958.0 | 30.5 | 56.00 | 90.00 |
| S.E. Ross Shelf | | | | | | | | | | | | | | |
| 270 | 77° 26.48'S | 178° 30.19'W | 644 | 49 | 48 | 98 | 422.5 | 263.8 | 62.4 | | 422.5 | 61.0 | 101.50 | 101.50 |
| S.E. Ross Shelf | | | | | | | | | | | | | | |
| 271 | 76° 47.21'S | 175° 02.86'W | 579 | 24 | 11 | 45 | 223.0 | 15.3 | 6.8 | 42.0 | 265.0 | 44.0 | 57.25 | 57.25 |
| S.E. Ross Shelf | | | | | | | | | | | | | | |
| 272 | 77° 07.62'S | 176° 45.61'W | 629 | 48 | 39 | 82 | 439.0 | 162.0 | 36.9 | 4.0 | 443.0 | 13.0 | 74.25 | 74.25 |

Site Summary (Continued)
Leg 28

| Hole | Latitude | Longitude | Water Depth, Meters | Number of Cores | Cores With Recovery | Percent With Recovery | Meters Cored | Meters Recovered | Percent Recovered | Meters Drilled | Total Penet. Meters | Avg. Rate Penet. | Time On Hole | Time On Site |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West Central Ross Shelf | | | | | | | | | | | | | | |
| 273 | 74° 32.29'S | 174° 37.57'E | 505 | 9 | 9 | 100 | 76.0 | 27.9 | 36.7 | | 76.0 | 15 | 15.50 | |
| 273A | 74° 32.29'S | 174° 37.57'E | 505 | 29 | 24 | 82 | 266.0 | 55.5 | 20.8 | 80.5 | 346.5 | 16 | 83.50 | 99.00 |
| Belleny Trough | | | | | | | | | | | | | | |
| 274 | 68° 59.81'S | 173° 25.64'E | 3326 | 45 | 44 | 98 | 421.0 | 279.1 | 66.3 | | 421.0 | 27 | 84.75 | 84.75 |
| | | | | 329 | 293 | 89 | 3014.0 | 1404.6 | 46.6 | 2632.5 | 5646.5 | 38 | | |

## DEEP SEA DRILLING PROJECT
## BIT SUMMARY
## LEG 28

| Hole | Mfg. | Size | Type | Serial Number | Meters Cored | Meters Drilled | Meters Total Penet. | Hours On Bit | Condition | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 264 | Smith | 10-1/8 | F94C | KN104 | 142.5 | 73.0 | 215.5 | 4.7 | | Drilled 40 meters of conglomerate. |
| 264A | Smith | 10-1/8 | F94C | KN104 | 38.0 | 120.5 | 158.5 | 1.6 | T-1, B-6 | One cone locking? (3-cone bit) |
| | | | | | 180.5 | 193.5 | 374.0 | 6.3 | | |
| 265 | Smith | 10-1/8 | 94CJS | JZ247 | 169.0 | 293.0 | 463.0 | 5.1 | T-1, B-2 | Cored 18 meters of basalt. One tooth broken. |
| 266 | Smith | 10-1/8 | 94CJS | JZ247 | 219.5 | 164.5 | 384.0 | 7.3 | T-5, B-6, G-3/8 | Cored 13 meters of basalt. One cone was loose. Seven broken teeth. |
| | | | | | 388.5 | 457.5 | 847.0 | 12.4 | | |
| 267 | Smith | 10-1/8 | 94CJS | JZ249 | 58.0 | 161.5 | 219.5 | 4.2 | | Cored 16 meters of basalt. |
| 267A | Smith | 10-1/8 | 94CJS | JZ249 | 28.5 | 42.0 | 70.5 | 1.3 | | |
| 267B | Smith | 10-1/8 | 94CJS | JZ249 | 95.0 | 218.5 | 313.5 | 3.9 | T-7, B-7 | Cored 3 meters of basalt. All cones wove loose. 30% of teeth gone. |
| | | | | | 181.5 | 422.0 | 603.5 | 9.4 | | |
| 268 | Smith | 10-1/8 | F93C | KN151 | 189.5 | 285.0 | 474.5 | 12 | T-2, B-3 | 1 tooth missing in the core area. |
| 269 | Smith | 10-1/8 | F93C | KN145 | 103.0 | 313.5 | 416.5 | 4.7 | | |
| 269A | Smith | 10-1/8 | F93C | KN145 | 123.5 | 834.5 | 958.0 | 31.4 | T-2, B-5 | Drilled clay and mudstone. One loose cone and one tooth missing. |
| | | | | | 226.5 | 1148.0 | 1374.5 | 36.1 | | |
| 270 | Smith | 10-1/8 | 93CJS | JK242 | 422.5 | | 422.5 | 69 | All cones locked. | Drilled 380 meters of very hard mudstone and 40 meters of breccia. |
| 271 | Smith | 10-1/8 | F93C | KN221 | 223.0 | 42.0 | 265.0 | 6 | 1 cone almost off. | Drilled rocks and boulders. Clay and sand. Bit wear was a surprise. |
| 272 | Smith | 10-1/8 | F93C | KN150 | 439.0 | 4.0 | 443.0 | 32 | B-4, T-2 | Drilled clay and sand. Had shirttail wear. |
| 273 | Smith | 10-1/8 | F93C | KN261 | 76.0 | | 76.0 | 4.8 | | |
| 273A | Smith | 10-1/8 | F93C | KN261 | 266.0 | 80.5 | 346.5 | 20.8 | B-5, T-2 | Clay, sand and siltstone. |
| | | | | | 342.0 | 80.5 | 422.5 | 25.6 | | |
| 274 | Smith | 10-1/8 | 94C | HC758 | 421.0 | | 421.0 | 15.7 | B-7, T-4 | Cored some chert streaks in soft clay. Cored five meters of basalt. |

# DEEP SEA DRILLING PROJECT
## TIME DISTRIBUTION
## LEG 28

| Date | Site Number | Cruise | Trips | Drill | Core | Stuck Pipe | Wait On Weather | Mechanical Down Time | In Port Time | Other | Total Time |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 12/20-23 | In Port & 264 | 30.75 | 9.00 | 4.25 | 17.50 | | | 3.00 | 10.25 | | 74.75 |
| 12/23-24 | 264A | | 8.50 | 1.25 | 4.50 | | | | | | 14.25 |
| 12/24-1/1 | 265 | 142.75 | 19.25 | 2.00 | 28.00 | | | 7.00 | | | 199.00 |
| 1/1-1/4 | 266 | 23.00 | 18.25 | 5.50 | 31.75 | | | | | 1.25 | 79.75 |
| 1/4-1/6 | 267 | 28.25 | 12.25 | 2.00 | 11.50 | | | | | 1.75 | 55.75 |
| 1/6-1/7 | 267A | | 1.00 | .50 | 2.25 | | | | | | 3.75 |
| 1/7-1/8 | 267B | | 9.25 | 3.50 | 15.00 | | 7.25 | | | 1.50 | 36.50 |
| 1/8-1/12 | 268 | 43.00 | 18.00 | 13.00 | 25.00 | | | 3.25 | | | 102.25 |
| 1/12-18 | 269 | 111.00 | 9.25 | 3.00 | 18.25 | | | 3.50 | | | 145.00 |
| 1/18-21 | 269A | | 12.00 | 20.00 | 20.50 | | | 3.50 | | | 56.00 |
| 1/21-2/3 | 270 | 203.00 | 8.00 | | 92.50 | | | 1.50 | | | 305.00 |
| 2/3-5 | 271 | 7.50 | 8.00 | 4.00 | 36.25 | | | 2.00 | | 7.00 | 64.75 |
| 2/5-9 | 272 | 3.25 | 6.75 | | 60.25 | | | | | 7.25 | 77.50 |
| 2/9-10 | 273 | 27.00 | 2.75 | | 8.75 | | | | | 4.00 | 42.50 |
| 2/9-13 | 273A | | 4.25 | 4.25 | 37.25 | | 1.75 | 5.25 | | 6.75 | 59.50 |
| 2/13-19 | 274 | 65.00 | 19.25 | | 60.00 | | | | | 5.50 | 149.75 |
| 2/19-27 | Christchurch | 185.50 | | | | | | | | | 185.50 |
| | | 870.00 | 165.75 | 63.25 | 469.25 | | 9.00 | 29.00 | 10.25 | 35.00 | 1651.50 |

# DEEP SEA DRILLING PROJECT
## BEACON SUMMARY
## LEG 28

| Site No. | Make | Freq. kHz | Serial Number | Site Time Hours | Remarks |
|---|---|---|---|---|---|
| 264 | Burnett | 13.5 | 5 | 48 | Beacon dropped still in water - good signal. |
| 265 | Burnett | 16 | 05 | 56.25 | Beacon dropped still in water - good signal. |
| 266 | Burnett | 13.5 | 06 | 1.00 | Signal lost strength when beacon hit bottom. |
| 266 | Burnett | 16 | 06 | 55.75 | Good signal - dropped still in water. |
| 267 | Burnett | 13.5 | 07 | 31.25 | Good signal - dropped still in water. |
| 267B | Burnett | 16 | 07 | 36.50 | 8000' offset necessitated this beacon. Ship was moved because of on coming iceberg. |
| 268 | Burnett | 13.5 | 08 | 59.25 | Dropped still in water - good signal. |
| 269 | Burnett | 16 | 08 | 90.00 | Dropped still in water - good signal. |
| 270 | Burnett | 13.5 | 09 | 101.50 | Dropped at 4 knots in water - good signal. |
| 271 | Burnett | 16 | 09 | 56.50 | Dropped at 4 knots in water - good signal. |
| 272 | Burnett | 13.5 | 10 | 74.25 | Dropped at 4 knots in water - good signal. |
| 273 | Burnett | 16 | 10 | 99.00 | Dropped at 4 knots in water - good signal. |
| 274 | Burnett | 13.5 | 11 | 84.75 | Dropped still in the water - good signal. |

# DEEP SEA DRILLING PROJECT
# OPERATIONS RESUME
# LEG 29

## SUMMARY

Leg 29 commenced on February 27, 1973 from Port of Lyttleton at Christchurch, New Zealand, proceeded through the north Antarctic Ocean and south Tasman Sea and terminated in Wellington, New Zealand on April 18, 1973.

During this 50.23 day voyage, the Challenger cruised 4245 nautical miles, drilled 16 holes on 10 sites, with a total penetration of 3198.5 meters. Of the total penetration, 1908.5 meters or 59.7% was cored in 215 coring attempts with usable recovery realized on 206 (95.8%). Total core recovery was 1181.6 meters or 61.9%. The range of water depths was from 1078 meters to 4766 meters and total depths from 1286 meters to 5358 meters.

Major time distribution for the 50.23 day leg consisted of 3.49 days in port, 22.05 days cruising and 24.69 days on site. Of the 24.69 days on site, 11.16 days were spent coring, 2.55 days drilling, 7.98 days on trips, 1.27 days waiting on weather and 1.73 days on mechanical downtime and miscellaneous time.

The performance of the dynamic positioning system was erratic throughout Leg 29. On four sites, positioning was excellent operating in automatic even with adverse elements. On two sites, positioning was generally very good, operating in automatic mode the majority of the time on site with minor interruptions from loss of acoustics or program. On the other four sites, problems developed which necessitated operating in manual or semi-automatic modes during much of the time on site. The majority of the problems with the computer involved calibration of the PT-17 power supply. In addition, on three of these sites, there was evidence of strong bottom currents which caused the beacons to sway, resulting in fluctuating beacon signal and loss of acoustics. Also, at these sites, severe weather conditions contributed to the acoustic loss. It is apparent that the Challenger has the capability of holding position in adverse weather conditions when all systems are operational. However, some of the problems experienced on Leg 29 indicate the need to thoroughly check out the computer to improve the reliability of this equipment.

A variety of weather was experienced ranging from a few days of relatively calm seas and clear skies to 35 foot seas and wind gusting to 80 mph. The weather was responsible for 30.5 hours delay in operations while riding out storms on site. Some additional time was involved in traveling between sites in rough seas and gale force winds at reduced speed.

The major scientific objective was realized at all but the first two sites. At Site 275, limited data was obtained before terminating coring operations due to down-hole equipment failure. Because of equipment failure, Site 276 was terminated without core recovery because of lack of soft sediment cover.

## DRILLING AND CORING EQUIPMENT

The same bottomhole assembly configuration was used for all holes and consisted of the core bit, float sub, core barrel, three 8-1/4" drill collars, two Baash Ross bumper subs, three 8-1/4" drill collars, two Baash Ross bumper subs, two 8-1/4" drill collars, one 7-1/4" drill collar and one joint of 5-1/2" heavy weight drill pipe. This configuration resulted in an assembly approximately 127 meters long, weighting approximately 30,000 pounds in sea water.

All of the five-inch drill pipe was inspected by Tuboscope while in port at Lyttleton and eighty three joints were marked for further evaluation. These joints were removed from the string on the first two sites. Rough seas and adverse weather did not permit detailed inspection during the leg. This will be accomplished during port call at Wellington. The bumper subs were serviced and magnafluxed, except the top boxes of the drill collars, at Lyttleton. Three top boxes were magnafluxed while going in the hole on Site 275.

A total of five bits were used on the 10 sites of Leg 29. Four bits were the three cone configuration and one was the four cone configuration. All had sealed bearings and medium to long chisel tooth inserts. Two bits were lost, one after 4.23 hours and the other after 9.15 hours of rotation.

Two bits were run, which had additional water courses to minimize the washing of the core at the throat. The first was a three cone bit which was lost on Site 275 after coring 43 meters. The second was a modified four cone bit and it was used on four holes on three sites for a total of 42.7 hours rotating time. Even though the bit gave excellent service, core recoveries still varied with the nature of the sediment being cored.

Loss of seats in the float valve occurred on all but the last site. Loss of the seats destroys the effectiveness of the float valve. These seats are inserts and either fell out or were knocked out and lost through the bit.

A new designed core catcher for catching under gauge basalt cores was used on most basalt coring. This catcher has replaceable spring loaded segments in a tapered body. Since there was only limited penetration of basalt on each site, there was no opportunity to test the effectiveness of the under gauge design. However, two segments with tungsten carbide knives designed to scribe the core as it entered the core barrel were tested. The scribes were effective on the first few meters of core, but chipped or broke out, losing effectiveness on the balance of the core. The principle appears adequate, but a different material is needed for the scribe blades.

## DRILLING AND CORING

Core recovery varied from zero on Site 276 to 95.5% on Site 283A. The overall average for the leg was 61.9%. The recovery was more a function of the nature of the sediment than technique. Recoveries were affected by failure of the plastic liners. An estimated 7% of the liners used during the leg were split and/or collapsed upon recovery. On several occasions the entire core was lost in sections yet other cores had near 100% recovery. The reason for the liner failures is not evident and should be investigated.

Site 275 was spudded in 2837 meters of water and a mudline core cut. When the core barrel reached the surface, the swivel assembly shaft broke at the shoulder below the bearings and dropped the barrel back to bottom. A short catch overshot with the proper grapples was not on board so the drill string was pulled to retrieve the core barrel. The break appeared to be the result of fatigue. A program was established to magnaflux these assemblies on each leg.

On the same site after returning to bottom, coring and drilling continued at a very slow rate to 2899 meters. A new inner barrel was dropped and the bit was found to be plugged. The barrel had to be retrieved to unplug the bit.

The sediment was relatively hard and a center bit was dropped to drill ahead and bury the bottomhole assembly. After cleaning out 15 meters of hard fill and flushing with 50 barrels of mud, drilling continued but without penetration. The drill string was pulled and the spline on the second bumper sub from bottom was found to be broken off. The bit, core barrel, three drill collars, and two bumper subs were lost. The site was abandoned because of insufficient soft sediment coverage.

The first delay, because of weather, occurred on Site 276. The ship rode out the storm in 70 mph winds which gusted to 80 mph. Ten hours later the weather had moderated and we returned to the beacon previously dropped after drifting 12 miles during the gale. A firm bottom was encountered, but with 12,000 pounds weight on the bit, only one meter penetration was obtained. An attempt was made to bury the bottomhole assembly by washing down. However, only 23 meters of penetration in 2-1/2 hours was accomplished with a continually decreasing rate of penetration which discouraged further attempts and the site was abandoned for lack of soft sediment.

Site 277 was spudded in 1232 meters of water and cored and drilled to 1704.5 meters. Coring operations were routine with good recoveries in the softer oozes and poor recoveries after encountering intermittent hard cherty streaks.

Site 278 was spudded in 3708 meters of water while positioning in manual mode. After taking a mudline core, the hole was washed down to 101 meters to protect the bottomhole assembly and then continuously cored to 4146.5 meters. Basalt was encountered at 4136 meters with 4.6 meters of the 10.5 meters cored being recovered. The bit was pulled clear of the mudline and Hole 278A was spudded to core the interval which had been washed down on Site 278 while the computer was inoperative. Recovery of some sediment with pieces of basalt indicated that some basalt from Site 278 had fallen out of the core barrel and was lodged on the bit. An extended core barrel was dropped in an attempt to clear the bit. While retrieving the core barrel with the bit 32 meters below mudline, the computer failed with a complete loss of bridge display. Since the attempts to clear the bit were unsuccessful, the drill string was pulled and 0.6 meters of basalt recovered on top of the bit. Both lower bumper subs were bent from an apparent 1000' excursion, when the computer failed.

Firm sea floor was encountered in 3381 meters of water on Site 279 and one meter of core was cut with the maximum safe weight on the bit. Positioning capabilities were lost and the ship drifted off site. After repositioning, the sea floor was tagged at 3378 meters and Hole 279A spudded. Again, the upper 99 meters was washed down to protect the bottomhole assembly during the erratic positioning. Coring was continuous to a depth of 3580 in basalt with good recovery despite the adverse ship's motion resulting from 40 to 50 mph winds, 16 to 20 foot swells and strong currents coming from three different directions.

Site 280 was spudded in 4191 meters of water and one 6 meter mudline core recovered. As the second core was being punched at 4201 meters with 10,000 pound bit weight, the bit appeared to break into extremely soft sediment and dropped rapidly down to an apparent depth of 4206.5 meters. An attempt was made to recover the core barrel without success. Upon pulling the drill string, the core barrel, float sub and bit were missing. The pin of the bottom drill collar was deformed as if it had been wrenched out of the core barrel box. Hole 280A was spudded and routinely cored and drilled to 4715 meters, with the last 5 meters in basement. A sidewall coring attempt was made at 4214 meters in an interval which had been drilled. It was necessary to jar the core barrel loose to recover it. The hinge pins had backed out and the sample tube was lost in the hole. During the drilling and coring operations on Site 280, it was necessary to offset the beacon up to 500 feet to eliminate the severe drag of the pipe in the pipe guide.

Site 281 was spudded in 1601 meters of water and continuously cored to 1770 meters with a sample of schist recovered in core bottoming at 1760.5 meters. Two additional corings were attempted in hard formation but with no recovery. The second attempt gave indications that the barrel was not seating and latching. The drill string was pulled without finding any reason for the problem. Apparently, the obstruction fell out as the string was pulled. Hole 281A was spudded to recore several intervals with poor or no recovery in Site 280. While coring and drilling to 1646.5 meters, the weather deteriorated with 50-55 mph winds and 20-25 foot swells making positioning very difficult. The drill string was pulled clear of the mudline to ride out the storm which was expected to last 8-12 hours. After eight hours, the weather charts indicated another low had formed which would probably cause an additional delay of 24-36 hours. Since most of the objective had been accomplished, the scientists decided that the unrealized portion would not justify the additional time and the site was terminated.

Sites 282, 283 and 284, accomplished the scientific objectives routinely without significant problems. The weather was better and operations were satisfactory. On Site 282, the computer failed and the ship experienced a 1500 foot excursion while retrieving a core with the bit 18 meters below mudline, but no damage was incurred.

## DYNAMIC POSITIONING

Performance of the dynamic positioning system was erratic throughout the leg. Four Sites 275, 277, 283 and 284, were near perfect with positioning working well in the automatic mode the entire time on site. In particular, Site 277 was accomplished despite 40 mph winds and moderately rough seas.

On Site 276, a loss of acoustics and varying signal strength prevented positioning in any mode. A faulty 13.5 kHz beacon was suspected and a 16 kHz beacon was dropped without improvement in signal dependability. During the six hours involved in attempting to position, the weather continually deteriorated until the ship was secured and rode out a whole gale. After the weather moderated, the ship returned to the beacon and even though acoustics were intermittent, positioned in semi-automatic mode. The drill string was started in and before the bit reached bottom, positioning was in automatic. An extremely firm sea floor was encountered which suggested scouring of softer sediment and the possible presence of strong currents. These currents could possibly cause the beacons to oscillate on their tether, giving the erratic performance which was experienced.

Erratic acoustics were again evident on Site 278 with additional problems in the digital analog converter and PT-17 power supply. Positioning was accomplished in the manual mode on raw signals. The hole was spudded and washed down to bury the bottomhole assembly. The computer was repaired and positioning was in automatic before the initial hole was completed. However, the computer failed again while attempting to core the upper interval which had been washed down on the initial hole and two bumper subs were bent during an excursion estimated at 1000 feet.

An erratic signal, fluctuating from zero to 10 volts with the pulse width intermittently increasing to 5 milliseconds, was experienced with a 13.5 kHz beacon on

Site 279. A 16 kHz beacon was dropped and even though it had a normal pulse width of 4 milliseconds, erratic signals continued. After a 7.5 hour delay, positioning was sufficient to run in the drill string. A firm sea floor again indicated the probability of a strong current causing the fluctuating signals. Shortly after tagging the sea floor, a complete loss of acoustics and positioning capability allowed the ship to drift off station. After repositioning, a second hole was spudded and washed down to bury the bottomhole assembly. Failure of the PT-15 power supply, again, forced operation to the manual mode. After adjusting the power supply, the computer was reprogrammed and position maintained in semi-automatic. Automatic was not possible because of the severe weather.

On Site 280, positioning was in automatic throughout the time on site with the exception of 1.5 hours to reprogram the computer after an interruption in the power supply. The elements gave the positioning capabilities a test with heavy seas and near gale force winds which required heading changes as much as 180 degrees. The beacon was offset up to 500 feet to reduce the drag of the drill string in the pipe guide.

During most of the time on Site 281, positioning was satisfactory in automatic. However, deteriorating weather with 55 mph winds and 25 foot seas caused loss of acoustics. The site was abandoned because of an oncoming whole gale.

On Site 282, positioning was in automatic initially and holding well. Approximately four hours, after spudding in, the computer failed and the ship drifted off site approximately 1500 feet. Surprisingly, no damage was done to the bottomhole assembly. By changing the operation mode of the computer from "compute" to "idle" and back to "compute", it returned to operation. Operation in automatic was erratic due to 50 mph winds and 12' seas. The ship was positioned in semi-automatic during the remaining time on site.

## BEACONS

Twelve Burnett Electronics Laboratory (BEL) and one Ocean Research Equipment (ORE) beacons were used on the leg in occupying ten sites. One 13.5 kHz BEL beacon failed on shipboard test. With the exception of Site 284, all of the beacons dropped were released while underway at 4 to 5 knots. On Site 284, the ship was dead in the water when the beacon was dropped. The 13.5 kHz BEL beacon dropped on Site 276, was initially thought to be faulty because of erratic signal strength and loss of acoustics. However, the 16 kHz ORE beacon dropped as replacement, gave similar results. A firm sea floor indicated the possibility of bottom currents which would cause the beacon to swing on its tether and give a varying strength to the hydrophones. Another 13.5 kHz BEL beacon dropped on Site 279, gave a similar erratic signal strength. However, its pulse width intermittently increased to 5 milliseconds from the normal 4 milliseconds. In both cases, the problem appears to have been caused by bottom currents rather than faulty beacons.

On sites where bottom currents could be expected, a shorter tether, or connection between the beacon and anchor, seemed to reduce the oscillating of the beacon.

## WEATHER

As was anticipated, the overall weather was probably more severe than had been experienced on previous legs. Even though operations were slowed by the weather, the occasions when weather was so severe as to completely suspend operations was minimal.

Shortly after arriving on Site 276, a rapidly traveling weather front crossed the site and forced a delay in running in the drill string. Rough seas combined with strong bottom currents caused extremely erratic acoustics. With the winds building, the ship was secured and rode out the storm in winds which hit 70 mph with gusts to 80 mph and 18 to 20 foot seas. After 12 hours, the storm had moderated sufficiently to tack back to the site. The ship had been blown 12 miles from the beacon but rode out the storm very comfortably. A total of 20.5 hours delay, including the positioning, riding out the storm and returning to the site, resulted from this occurrence.

The only other suspension of operations occurred on Hole 281A while attempting to recore some intervals missed in Site 281. Winds of 50 mph and 25 foot seas were effecting acoustics to the extent that positioning could not be maintained for continued operations. Since the available weather charts indicated the storm should pass in 10 to 12 hours, the drill string was pulled well clear of the mudline and the ship secured. Winds increased to 60 mph with gusts to 70 mph. Later weather information indicated another low had developed on the heels of this storm and in all probability, would involve a further delay of 24 to 36 hours. Rather than lose this much additional time, as soon as was safe, the drill string was pulled and the site terminated. Shortly after departing, the most severe storm of the leg hit with sustained winds of 70 mph, gusting to 80 mph and seas varying from 35 to 40 feet.

While traveling from Site 278 to Site 279, the Challenger was bucking 50 to 60 mph northerly winds with 20 foot swells. Speed was reduced to 3.5 knots. Also, in traveling from Site 279 to Site 280, speed was reduced to 4 knots in 50 mph to 55 mph westerly winds with 20-25 foot seas. Cruising speed was slowed between Site 281 and Site 282. This was the most uncomfortable run of the leg with the Challenger rolling 18-20 degrees and pitching 8-10 degrees.

On the runs from Site 282 into Wellington, the average speed was improved considerably and the weather was favorable.

## COMMUNICATIONS

During Leg 29, considerable difficulty was experienced in communication with Navy stations. While it was usually possible to work NPN, Guam, or some other widely separated station such as NST Londonderry, it was not possible to establish solid communications with any single station. This made it easy to pass outgoing traffic, but difficult to obtain incoming traffic.

The incoming traffic problem was solved when direct communication with radio WWD was established after the first week or two. Unfortunately, WWD reduced its operating hours in early April and this was lost. However, by this time, it was possible to work NWC (Northest Cape, Navy) regularly for incoming and outgoing traffic. The volume of traffic was about normal and no unusual delays were encountered on outgoing traffic.

Radio receiving conditions were highly erratic, not only for purposes of radio telegraph, but also for radio telephone and radio facsimile. Without the high power of the TMC transmitter, communications would probably have been quite poor. It was possible to communicate with radio Oakland (KMI) on voice with good regularity and a large number of radio telephone calls were made by individuals. Amateur radio (HAM) communications were so spotty as to be unproductive.

The TMC transmitter had several failures, all of which were corrected. The power amplifier of the unit requires a number of replacement parts which are on order.

All KPH (radio San Francisco) traffic lists were copied and it was possible to work KPH by radio telegraph on nearly any day.

Radio ZLB Arawan (New Zealand) and Radio Sidney (VIS) handled all of the weather reports and both stations were in easy radio telegraph range at all times.

## PERSONNEL

Consideraing the adverse weather and general operating conditions, it is remarkable that only one minor injury occurred during the leg. This was a minor bruise and did not result in any lost time.

The performance and attitude of the Global Marine personnel were, again, outstanding during some of the reversals which occurred on this leg. It was enjoyable to associate with and be a part of this fine group during the cruise.

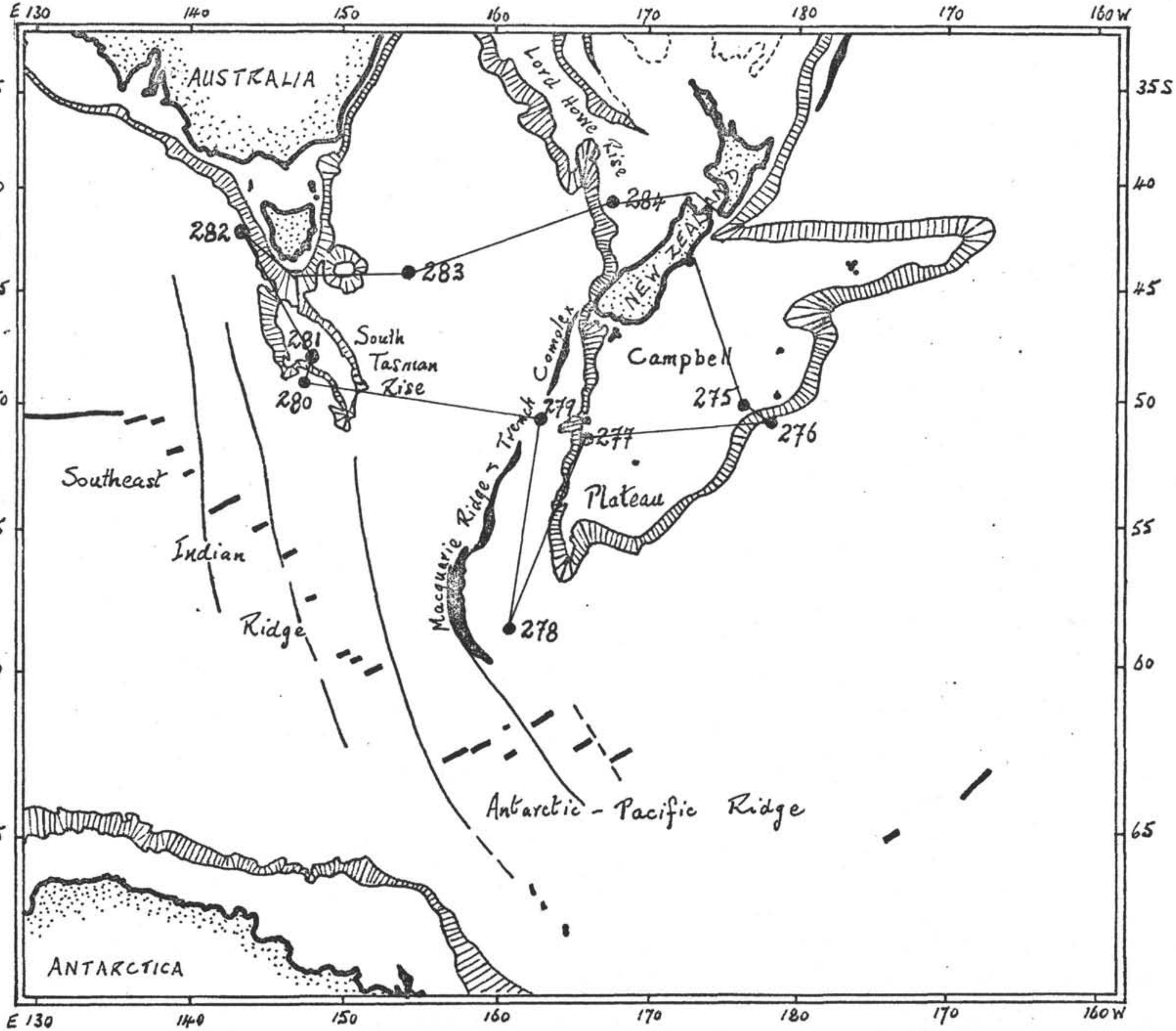


Carl M. Morris
Cruise Operations Manager
Deep Sea Drilling Project

April 30, 1973

# DEEP SEA DRILLING PROJECT
## SUMMARY OF OPERATIONS
## LEG 29

| | | |
|---|---|---|
| Total Days On Leg | | 50.23 |
| Total Days In Port | | 3.49 |
| Total Days Cruising | | 22.05 |
| Total Days On Site | | 24.69 |
| Trip Time | 7.98 | |
| Drilling Time | 2.55 | |
| Coring Time | 11.16 | |
| Mechanical Downtime | 0.08 | |
| Waiting On Weather | 1.27 | |
| Other Miscellaneous Time | 1.65 | |
| Total Distance Traveled (Nautical Miles) | | 4245 |
| Average Speed (Knots) | | 8.02 |
| Sites Drilled | | 10 |
| Holes Drilled | | 16 |
| Number of Cores Attempted | | 215 |
| Number of Cores With Recovery | | 206 |
| Percent of Cores With Recovery | | 95.8 |
| Total Meters Cored | | 1908.5 |
| Total Meters Recovered | | 1181.6 |
| Percent Recovery | | 61.9 |
| Total Meters Drilled | | 1290.0 |
| Total Meters Penetration | | 3198.5 |
| Percent of Penetration Cored | | 59.7 |
| Maximum Penetration Meters | | 592.0 |
| Minimum Penetration Meters | | 1.0 |
| Maximum Water Depth Meters | | 4766 |
| Minimum Water Depth Meters | | 1078 |




Sketch map Leg 29 sites.

FIGURE 1
DEEP SEA DRILLING PROJECT
LEG XXIX
TOTAL TIME DISTRIBUTION

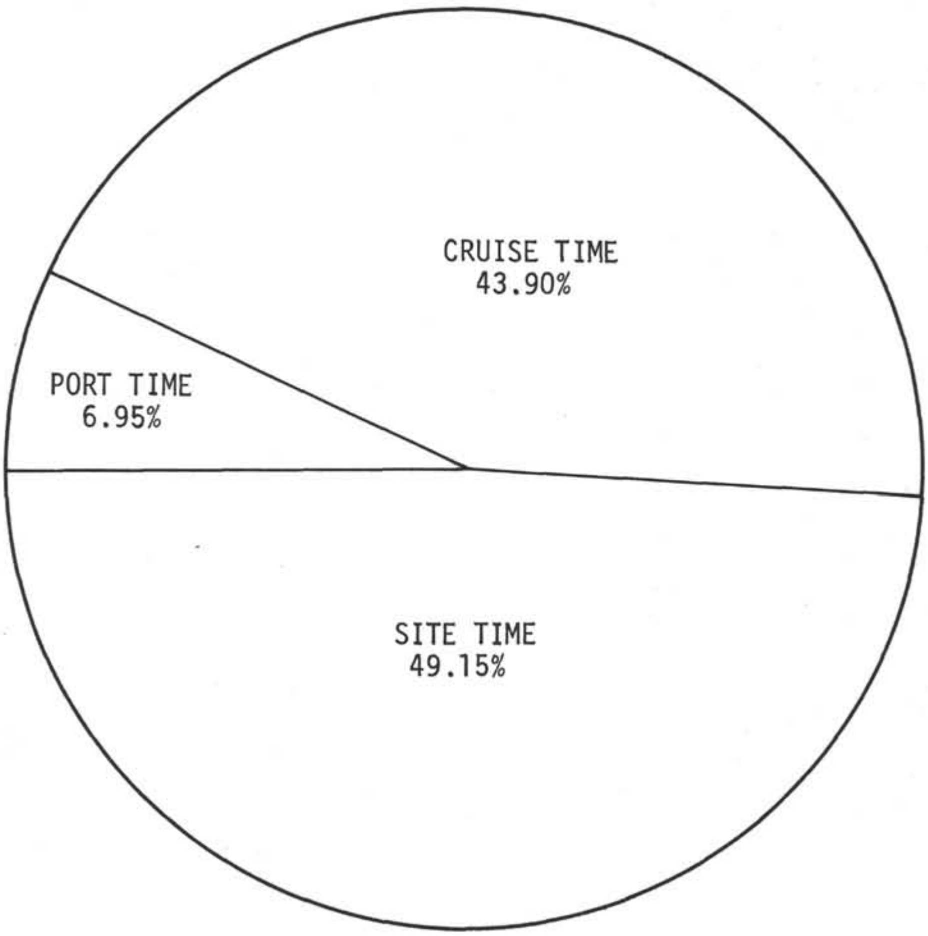
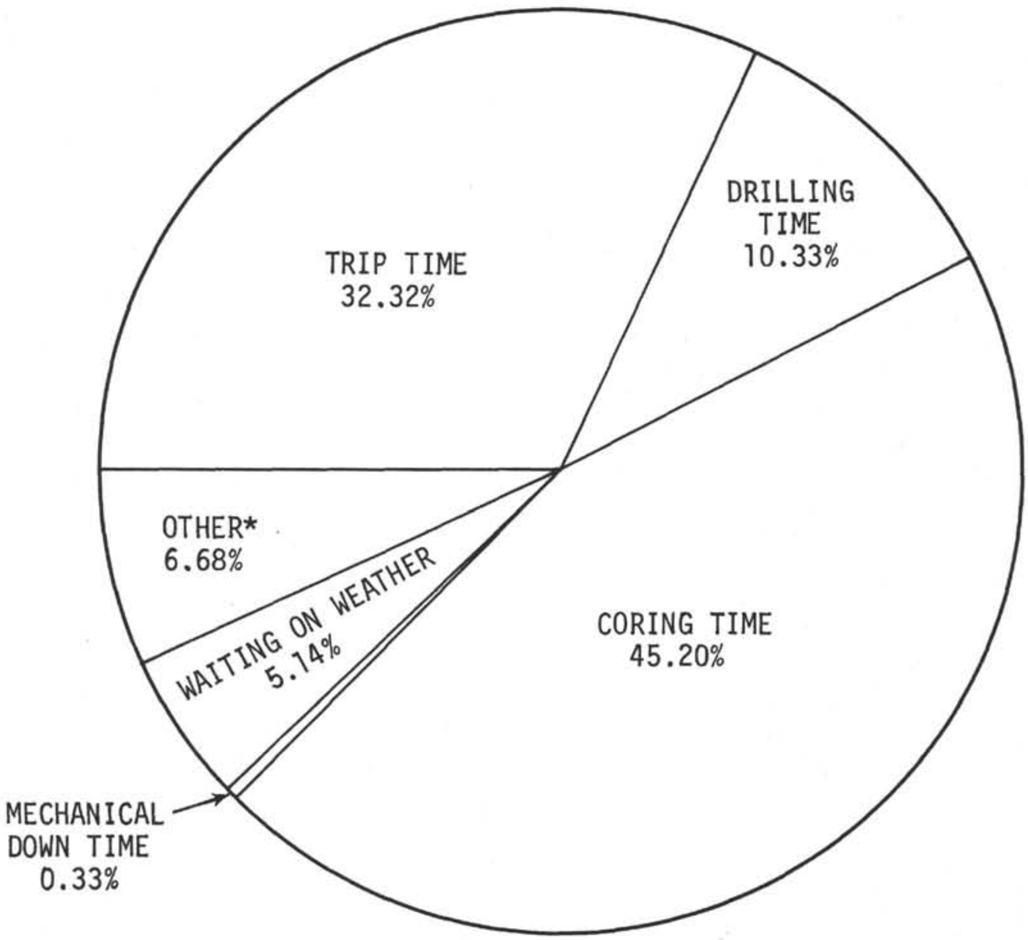


FIGURE 2
DEEP SEA DRILLING PROJECT
LEG XXIX
SITE TIME DISTRIBUTION




*Includes: Segregating pipe, Inspecting D.C.
Heat Flow, profiling, time lost positioning
and other miscellaneous lost time.

DEEP SEA DRILLING PROJECT

BEACON SUMMARY

LEG 29

| Site No. | Make | Freq. kHz | Serial Number | Site Time Hours | |
|---|---|---|---|---|---|
| 275 | Burnett | 16.0 | 11 | 51.50 | Good signal. Lost acoustics as departed site. |
| 276 | Burnett | 13.5 | 12 | 51.00 | Erratic acoustics. Dropped second beacon without improvement. |
| | ORE | 16.0 | 239 | 47.25 | Apparently, strong bottom current causing beacons to oscillate. |
| 277 | Burnett | 13.5 | 15 | 49.50 | Excellent signal. |
| 278 | Burnett | 16.0 | 13 | 74.00 | Good signal. |
| 279 | Burnett | 13.5 | 13 | 54.50 | Erratic signal with failing acoustics. |
| | Burnett | 16.0 | 14 | 52.75 | Adequate signal. |
| 280 | Burnett | 13.5 | 14 | | Failed on shipboard test. |
| | Burnett | 16.0 | 15 | 104.50 | Good performance. |
| 281 | Burnett | 13.5 | 16 | 55.00 | Some flucuation in signal width. |
| 282 | Burnett | 16.0 | 16 | 62.00 | Good performance. |
| 283 | Burnett | 16.0 | 17 | 68.50 | Excellent performance. |
| 284 | Burnett | 13.5 | 17 | 22.00 | Satisfactory performance. |

# DEEP SEA DRILLING PROJECT
## BIT SUMMARY
## LEG 29

| Hole | Mfg. | Size | Type | Serial Number | Meters Cored | Meters Drilled | Meters Total Penet. | Hours On Bit | Condition | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 275 | Smith | 10-1/8 3CTR | SS94C | HZ487 | 43.0 | 19.0 | 62.0 | 4.23 | Unknown | Lost in hole. |
| 276 | Smith | 10-1/8 3CTR | 94CJS | JZ237 | 1.0 | 23.0 | 24.0 | 2.50 | T-1, B-1 | Suitable for rerun. |
| 277 | Smith | 10-1/8 3CTR | 94CJS | JZ237 | 434.5 | 38.0 | 472.5 | 11.47 | T-1, B-2 | Suitable for rerun. |
| 278 | Smith | 10-1/8 3CTR | 94CJS | JZ237 | 324.5 | 114.0 | 438.5 | 7.84 | | |
| 278A | Smith | 10-1/8 3CTR | 94CJS | JZ237 | 19.0 | 25.0 | 44.0 | 0.15 | T-1, B-3 | Throat flared. Cored 10.5 meters basalt |
| | Total For Bit | | 94CJS | JZ237 | 779.0 | 200.0 | 979.0 | 21.96 | | |
| 279 | Smith | 10-1/8 3CTR | 94CJS | JZ563 | 1.0 | 0 | 1.0 | 0.07 | | |
| 279A | Smith | 10/1/8 3CTR | 94CJS | JZ563 | 110.0 | 92.0 | 202.0 | 8.67 | T-1, B-1 | Cored 5 meters basalt. For rerun. |
| 280 | Smith | 10-1/8 3CTR | 94CJS | JZ563 | 6.0 | 4.0 | 10.0 | 0.40 | Unknown | Lost in hole. |
| | Total For Bit | | 94CJS | JZ563 | 117.0 | 96.0 | 213.0 | 9.14 | | |
| 280A | Smith | 10-1/8 4CTR | F93C | KN146 | 201.0 | 323.0 | 524.0 | 21.18 | T-1, B-2 | Cored 5 meters basalt. For rerun. |
| 281 | Smith | 10-1/8 4CTR | F93C | KN146 | 169.0 | 0 | 169.0 | 6.28 | T-1, B-2 | |
| 281A | Smith | 10-1/8 4CTR | F93C | KN146 | 28.5 | 17.0 | 45.5 | 0.17 | T-1, B-2 | For rerun. |
| 282 | Smith | 10-1/8 4CTR | F93C | KN146 | 167.5 | 143.0 | 310.5 | 15.07 | T-2, B-4 | Cored 15.5 meters basalt. Shirttail wear. |
| | Total For Bit | | F93C | KN146 | 566.0 | 483.0 | 1049.0 | 42.70 | | |
| 283 | Smith | 10-1/8 3CTR | 93CJS | JK191 | 156.0 | 436.0 | 592.0 | 14.37 | | |
| 283A | Smith | 10-1/8 3CTR | 93CJS | JK191 | 11.0 | 9.5 | 20.5 | 0.10 | T-1, B-1 | Cored 3.5 meters basalt. For rerun. |
| 284 | Smith | 10-1/8 3CTR | 93CJS | JK191 | 208.0 | 0 | 208.0 | 1.07 | | |
| 284A | Smith | 10-1/8 3CTR | 93CJS | JK191 | 28.5 | 46.5 | 75.0 | 0.22 | T-1, B-1 | Suitable for rerun. |
| | Total For Bit | | 93CJS | JK191 | 403.5 | 492.0 | 895.5 | 15.76 | | |

DEEP SEA DRILLING PROJECT
SITE SUMMARY
LEG 29

| Hole | Latitude | Longitude | Water Depth | Number of Cores | Cores With Recovery | Percent With Recovery | Meters Cored | Meters Recovered | Percent Recovered | Meters Drilled | Total Penet. Meters | Avg. Rate Penet. | Time On Hole | Time On Site |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Campbell Slope | | | | | | | | | | | | | | |
| 275 | 50° 26.34'S | 176° 18.99'E | 2837 | 5 | 4 | 80 | 43.0 | 17.5 | 40.7 | 19.0 | 62.0 | 14.7 | 51.50 | 51.50 |
| Southwest Pacific Basin | | | | | | | | | | | | | | |
| 276 | 50° 48.11'S | 176° 48.40'E | 4677 | 1 | 0 | 0 | 1.0 | 0 | 0 | 23.0 | 24.0 | 9.2 | 51.00 | 51.00 |
| Cathedral Depression | | | | | | | | | | | | | | |
| 277 | 52° 13.43'S | 166° 11.48'E | 1232 | 46 | 46 | 100 | 434.5 | 258.5 | 59.5 | 38.0 | 472.5 | 41.2 | 49.50 | 49.50 |
| Emerald Basin | | | | | | | | | | | | | | |
| 278 | 56° 33.42'S | 160° 04.29'E | 3708 | 35 | 35 | 100 | 324.5 | 277.8 | 85.6 | 114.0 | 438.5 | 55.9 | 61.00 | |
| 278A | 56° 33.42'S | 160° 04.29'E | 3708 | 2 | 2 | 100 | 19.0 | 7.5 | 39.5 | 25.0 | 44.0 | 293.3 | 13.00 | 74.00 |
| Central Macquarie Rise | | | | | | | | | | | | | | |
| 279 | 51° 20.14'S | 162° 38.10'E | 3381 | 1 | 1 | 100 | 1.0 | 0.6 | 60.0 | 0 | 1 | 14.3 | 18.00 | |
| 279A | 51° 20.14'S | 162° 38.10'E | 3378 | 13 | 13 | 100 | 110.0 | 79.8 | 72.6 | 92.0 | 202.0 | 23.3 | 36.50 | 54.50 |
| South of South Tasman Rise | | | | | | | | | | | | | | |
| 280 | 48° 57.44'S | 147° 14.08'E | 4191 | 1 | 1 | 100 | 6.0 | 5.5 | 91.7 | 4.0 | 10.0 | 30.0 | 25.00 | |
| 280A | 48° 57.44'S | 147° 14.08'E | 4191 | 23 | 23 | 100 | 201.0 | 97.2 | 48.4 | 323.0 | 524.0 | 24.7 | 79.50 | 104.50 |
| South Tasman Rise | | | | | | | | | | | | | | |
| 281 | 47° 59.84'S | 147° 45.85'E | 1601 | 19 | 16 | 84.2 | 169.0 | 105.6 | 62.5 | 0 | 169.0 | 26.9 | 31.50 | |
| 281A | 47° 59.84'S | 147° 45.85'E | 1601 | 3 | 2 | 66.7 | 28.5 | 7.1 | 24.9 | 17.0 | 45.5 | 273.0 | 23.50 | 55.00 |
| North Magnetic Quiet Zone | | | | | | | | | | | | | | |
| 282 | 42° 14.76'S | 143° 29.18'E | 4217 | 20 | 18 | 90.0 | 167.5 | 63.7 | 38.0 | 143.0 | 310.5 | 20.6 | 62.00 | 62.00 |

| Hole | Latitude | Longitude | Water Depth | Number Of Cores | Cores With Recovery | Percent With Recovery | Meters Cored | Meters Recovered | Percent Recovered | Meters Drilled | Total Penet. Meters | Avg. Rate Penet. | Time On Hole | Time On Site |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South Central Tasman Sea | | | | | | | | | | | | | | |
| 283 | 43° 54.60'S | 154° 16.96'E | 4766 | 19 | 19 | 100.0 | 156.0 | 61.1 | 39.2 | 436.0 | 592.0 | 41.2 | 56.00 | |
| 283A | 43° 54.60'S | 154° 16.96'E | 4755.5 | 2 | 2 | 100.0 | 11.0 | 10.5 | 95.5 | 9.5 | 20.5 | 205.0 | 12.50 | 68.50 |
| Challenger Plateau | | | | | | | | | | | | | | |
| 284 | 40° 30.48'S | 167° 40.81'E | 1078 | 22 | 21 | 95.5 | 208.0 | 166.8 | 80.2 | 0 | 208.0 | 194.4 | 17.00 | |
| 284A | 40° 30.48'S | 167° 40.81'E | 1078 | 3 | 3 | 100.0 | 28.5 | 22.4 | 78.6 | 46.5 | 75.0 | 341.0 | 5.00 | 22.00 |

## DEEP SEA DRILLING PROJECT
## TIME DISTRIBUTION
## LEG 29

| Date | Site Number | Cruise | Trips | Drill | Core | Wait On Weather | Mechanical Downtime | In Port Time | Other | Total Time |
|---|---|---|---|---|---|---|---|---|---|---|
| 02/27/73 | Lyttleton, New Zealand | | | | | | | 16.50 | | 16.50 |
| 02/28/73 | | | | | | | | 24.00 | | 24.00 |
| 03/01/73 | | | | | | | | 24.00 | | 24.00 |
| 03/02/73 | | | | | | | | 19.25 | | 19.25 |
| Total | Port | | | | | | | 83.75 | | 83.75 |
| 03/02/73 | 275 | 4.75 | | | | | | | | 4.75 |
| 03/03/73 | | 24.00 | | | | | | | | 24.00 |
| 03/04/73 | | 19.00 | 5.00 | | | | | | | 24.00 |
| 03/05/73 | | | 21.00 | | 2.00 | | | | 1.00 | 24.00 |
| 03/06/73 | | | 5.50 | 3.00 | 6.50 | | | | 7.50 | 22.50 |
| Total | 275 | 47.75 | 31.50 | 3.00 | 8.50 | | | | 8.50 | 99.25 |
| 03/06/73 | 276 | 1.50 | | | | | | | | 1.50 |
| 03/07/73 | | 2.00 | 1.50 | | | 20.50 | | | | 24.00 |
| 03/08/73 | | | 17.50 | 3.00 | 2.50 | | | | 1.00 | 24.00 |
| 03/09/73 | | | 5.00 | | | | | | | 5.00 |
| Total | 276 | 3.50 | 24.00 | 3.00 | 2.50 | 20.50 | | | 1.00 | 54.50 |
| 03/09/73 | 277 | 19.00 | | | | | | | | 19.00 |
| 03/10/73 | | 24.00 | | | | | | | | 24.00 |
| 03/11/73 | | 5.50 | 4.50 | | 13.00 | | | | 1.00 | 24.00 |
| 03/12/73 | | | | 1.75 | 22.25 | | | | | 24.00 |
| 03/13/73 | | | 4.50 | | 2.50 | | | | | 7.00 |
| Total | 277 | 48.50 | 9.00 | 1.75 | 37.75 | | | | 1.00 | 98.00 |

Time Distribution(Continued)
Leg 29

| Date | Site Number | Cruise | Trips | Drill | Core | Wait On Weather | Mechanical Downtime | In Port Time | Other | Total Time |
|---|---|---|---|---|---|---|---|---|---|---|
| 03/13/73 | 278 | 17.00 | | | | | | | | 17.00 |
| 03/14/73 | | 19.00 | 3.50 | | | | | | 1.50 | 24.00 |
| 03/15/73 | | | 6.00 | 0.50 | 17.50 | | | | | 24.00 |
| 03/16/73 | | | | 1.00 | 23.00 | | | | | 24.00 |
| 03/17/73 | | | 2.00 | | 6.00 | | | | | 8.00 |
| Total | 278 | 36.00 | 11.50 | 1.50 | 46.50 | | | | 1.50 | 97.00 |
| 03/17/73 | 278A | | 8.00 | 2.00 | 3.00 | | | | | 13.00 |
| Total | 278A | | 8.00 | 2.00 | 3.00 | | | | | 13.00 |
| 03/17/73 | 279 | 3.00 | | | | | | | | 3.00 |
| 03/18/73 | | 24.00 | | | | | | | | 24.00 |
| 03/19/73 | 279 | 24.00 | | | | | | | | 24.00 |
| 03/20/73 | | 9.00 | 7.00 | | | | | | 8.00 | 24.00 |
| 03/21/73 | | | | | 3.00 | | | | | 3.00 |
| Total | 279 | 60.00 | 7.00 | | 3.00 | | | | 8.00 | 78.00 |
| 03/21/73 | 279A | | | 5.50 | 12.00 | | | | 3.50 | 21.00 |
| 03/22/73 | | | 6.50 | | 8.50 | | | | 0.50 | 15.50 |
| Total | 279A | | 6.50 | 5.50 | 20.50 | | | | 4.00 | 36.50 |
| 03/22/73 | 280 | 8.50 | | | | | | | | 8.50 |
| 03/23/73 | | 24.00 | | | | | | | | 24.00 |
| 03/24/73 | | 24.00 | | | | | | | | 24.00 |
| 03/25/73 | | 24.00 | | | | | | | | 24.00 |
| 03/26/73 | | 17.00 | 6.00 | | | | | | 1.00 | 24.00 |
| 03/27/73 | | | 10.50 | | 3.00 | | | | 4.50 | 18.00 |
| Total | 280 | 97.50 | 16.50 | | 3.00 | | | | 5.50 | 122.50 |

Time Distribution (Continued)
Leg 29

| Date | Site | Cruise | Trips | Drill | Core | Wait On Weather | Mechanical Downtime | In Port Time | Other | Total Time |
|---|---|---|---|---|---|---|---|---|---|---|
| 03/27/73 | 280A | | 6.00 | | | | | | | 6.00 |
| 03/28/73 | | | 3.50 | 5.50 | 15.00 | | | | | 24.00 |
| 03/29/73 | | | | 9.00 | 14.00 | | 1.00 | | | 24.00 |
| 03/30/73 | | | 8.00 | 5.00 | 9.00 | | | | 2.00 | 24.00 |
| 03/31/73 | | | 1.00 | | | | | | 0.50 | 1.50 |
| Total | 280A | | 18.50 | 19.50 | 38.00 | | 1.00 | | 2.50 | 79.50 |
| 03/31/73 | 281 | 8.50 | 4.50 | | 9.00 | | | | 0.50 | 22.50 |
| 04/01/73 | | | 4.50 | | 13.00 | | | | | 17.50 |
| Total | 281 | 8.50 | 9.00 | | 22.00 | | | | 0.50 | 40.00 |
| 04/01/73 | 281A | | 4.00 | | 2.50 | | | | | 6.50 |
| 04/02/73 | | | 4.50 | | 1.50 | 10.00 | 1.00 | | | 17.00 |
| Total | 281A | | 8.50 | | 4.00 | 10.00 | 1.00 | | | 23.50 |
| 04/02/73 | 282 | 7.00 | | | | | | | | 7.00 |
| 04/03/73 | | 24.00 | | | | | | | | 24.00 |
| 04/04/73 | | 24.00 | | | | | | | | 24.00 |
| 04/05/73 | | 14.50 | 8.00 | | 1.00 | | | | 0.50 | 24.00 |
| 04/06/73 | | | | 2.00 | 20.50 | | | | 1.50 | 24.00 |
| 04/07/73 | | | 3.50 | 7.00 | 13.50 | | | | | 24.00 |
| 04/08/73 | | | 4.50 | | | | | | | 4.50 |
| Total | 282 | 69.50 | 16.00 | 9.00 | 35.00 | | | | 2.00 | 131.50 |
| 04/08/73 | 383 | 19.50 | | | | | | | | 19.50 |
| 04/09/73 | | 24.00 | | | | | | | | 24.00 |
| 04/10/73 | | 9.00 | 8.00 | 0.50 | 3.50 | | | | 3.00 | 24.00 |
| 04/11/73 | | | | 10.00 | 14.00 | | | | | 24.00 |
| 04/12/73 | | | 1.50 | 5.00 | 10.50 | | | | | 17.00 |
| Total | 283 | 52.50 | 9.50 | 15.50 | 28.00 | | | | 3.00 | 108.50 |

Time Distribution (Continued)
Leg 29

| Date | Site | Cruise | Trips | Drill | Core | Wait On Weather | Mechanical Downtime | In Port Time | Other | Total Time |
|---|---|---|---|---|---|---|---|---|---|---|
| 04/12/73 | 283A | | 4.00 | | 3.00 | | | | | 7.00 |
| 04/13/73 | | | 4.50 | | | | | | 1.00 | 5.50 |
| Total | 283A | | 8.50 | | 3.00 | | | | 1.00 | 12.50 |
| 04/13/73 | 284 | 18.50 | | | | | | | | 18.50 |
| 04/14/73 | | 24.00 | | | | | | | | 24.00 |
| 04/15/73 | | 23.00 | | | | | | | 1.00 | 24.00 |
| 04/16/73 | | | 4.50 | | 11.50 | | | | | 16.00 |
| Total | 284 | 65.50 | 4.50 | | 11.50 | | | | 1.00 | 82.50 |
| 04/16/73 | 284A | | 3.00 | 0.50 | 1.50 | | | | | 5.00 |
| Total | 284A | | 3.00 | 0.50 | 1.50 | | | | | 5.00 |
| 04/16/73 | Wellington | 3.00 | | | | | | | | 3.00 |
| 04/17/73 | | 24.00 | | | | | | | | 24.00 |
| 04/18/73 | | 13.00 | | | | | | | | 13.00 |
| Total | Port | 40.00 | | | | | | | | 40.00 |
| Grand Total | | 529.25 | 191.50 | 61.25 | 267.75 | 30.50 | 2.00 | 83.75 | 39.50 | 1205.50 |

# DEEP SEA DRILLING PROJECT
## OPERATIONS RESUME
## LEG 30

### SUMMARY

Leg 30 was the third voyage of the Glomar Challenger to investigate the southwest and western equatorial Pacific region (see Figure 1). As such, it was in large part directed to pursuing questions raised by earlier drilling on Legs 7 and 21 and subsequent geophysical studies by others. In obtaining information bearing on these questions, most of the present operating capabilities of the vessel were utilized.

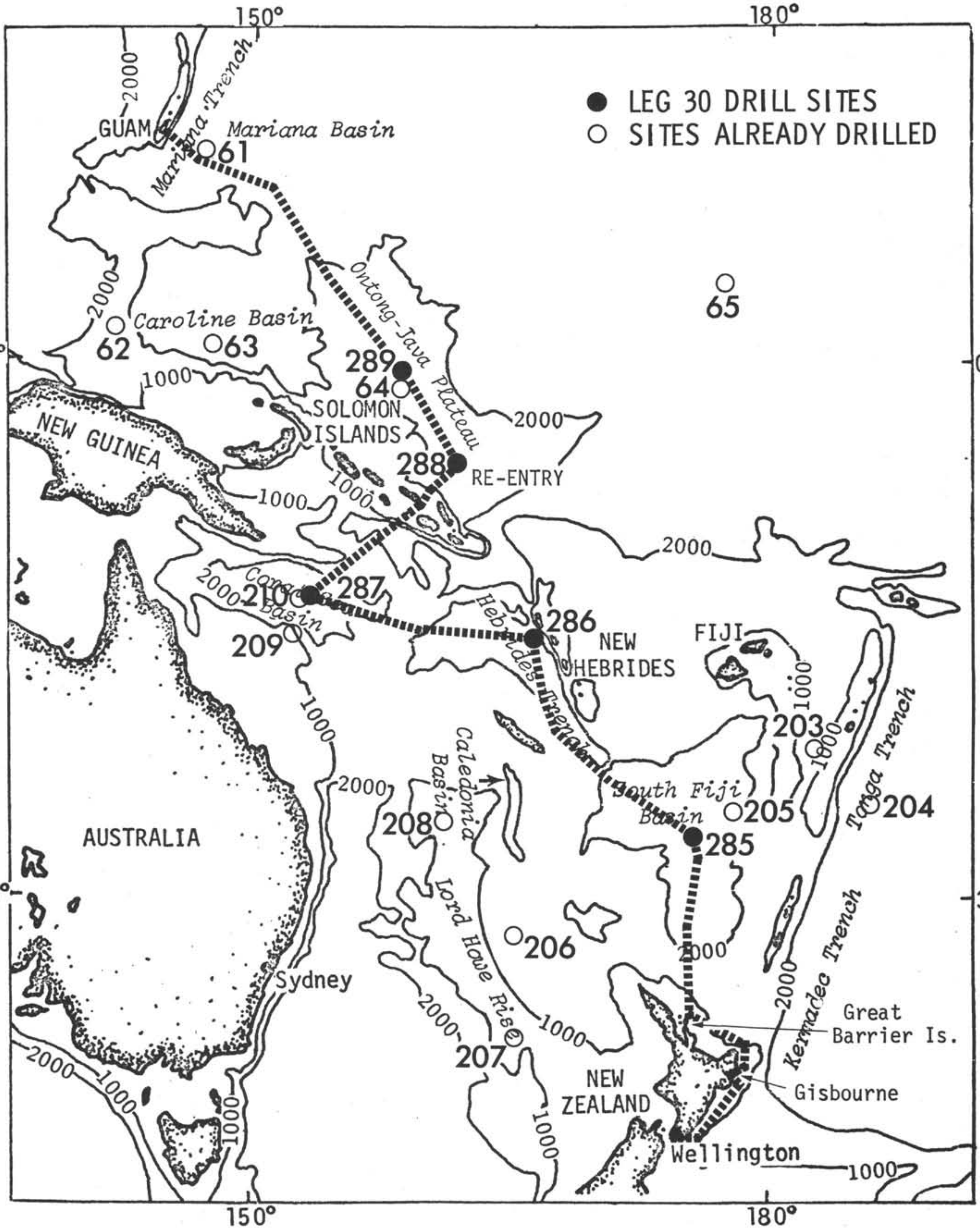
For the first time in over two years re-entry was used to successfully change a dull bit (Site 288). At another site, a penetration of 1271 meters was achieved and 133 cores were taken on a single entry (Site 289). Basalt was recovered on four of the five sites investigated with a penetration into the basalt of 57 meters on one hole (Site 286).

The voyage began at Wellington, New Zealand on April 24 after a six day port call and ended in Guam on June 13, 1973. A total of 250 cores were attempted with recovery on 249. A total of 2332 meters was cored and 1163.9 meters of core was recovered. Overall recovery was 49.9%.

The total length of the leg (including the Wellington port call) was 56.8 days of which 40.6% were spent cruising and 48.2% on site. Approximately one day was lost at the start of the voyage making repairs to the dynamic positioning computer.

The Deep Sea Drilling Project is managed by the Scripps Institution of Oceanography (University of California) under a contract with the National Science Foundation. The Glomar Challenger is owned and operated by Global Marine Inc., who perform the coring operations under a subcontract with the University of California. Planning for the voyages is coordinated with the scientific community through the Joint Oceanographic Institutions Deep Earth Sampling (JOIDES) organization.

Figure 1



LEG 30 DRILL SITES
SITES ALREADY DRILLED
150°
180°
0°
30°
Mariana Trench
GUAM
Mariana Basin
61
Ontong-Java Plateau
65
Caroline Basin
62
63
289
64
SOLOMON ISLANDS
NEW GUINEA
288
RE-ENTRY
2000
1000
Coral Basin
210
287
209
286
NEW HEBRIDES
FIJI
Hebrides Trench
203
Tonga Trench
South Fiji Basin
205
204
285
Caledonia Basin
208
AUSTRALIA
Lord Howe Rise
206
Sydney
207
Kermadec Trench
Great Barrier Is.
Gisbourne
NEW ZEALAND
Wellington

## RE-ENTRY

At Site 288, re-entry was used successfully to change dull bits. The site was on the Ontong-Java Plateau in relatively shallow water (3030 meters). Weather conditions were excellent.

An exploratory hole was drilled first to verify the location of bottom, determine the proper length of casing to use, and to take surface cores.

The cone and 13 3/8" casing were then run and "jetted-in" to 3086 meters. Top of the cone was 3026 meters. The casing was released and the hole drilled and cored to 3914.5 meters (20.3 rotating hours). Hard chert "stringers" were first encountered at 3490 meters in Miocene chalk and persisted to total depth (Early Cretaceous limestone). As a result of this chert, the bearings on the first core bit were quite loose when pulled and the casing running tool badly worn. Fortunately, the bit was to gauge. After running a new bit to 3020 meters and running a scanning sonar tool to locate the cone, the hole was re-entered on the first attempt. Approximately two hours of maneuvering in automatic were required; however, due to scanning sonar malfunctions, the total time spent to stab-in was twenty hours. The new bit went to bottom smoothly (approximately 4.5 meters of fill) and the hole was then cored to 4018.5 meters (16.4 rotating hours). When the bit torque increased, a second attempt to change bits was made.

On this second attempt, re-entry was made routinely, however, a bridge was found at 3103 meters and the hole was lost. Approximately seven hours were spent in an attempt to locate the original hole, but these were unsuccessful.

With experience, the present re-entry system should be satisfactory. Based on experience at Site 288, a maximum practical amount of casing should be "jetted-in" and a means devised to remove cuttings build-up in the cone.

## DRILLING AND CORING ASSEMBLIES

The normal bottomhole assembly used at all sites consisted of the bit, core barrel, three 8 1/4" drill collars, two 5' stroke bumper subs, three 8 1/4" drill collars, two 5' stroke bumper subs, two 8 1/4" drill collar, and one 7 1/4" drill collar.

This assembly was modified at Site 288 for running casing so that the bit would extend just below the casing shoe and two 5' stroke bumper subs would be directly above the casing running tool for releasing operations. This assembly consisted of the bit, core barrel, five 8 1/4" drill collars, casing running tool, two 5' stroke cumper subs, two 8 1/4" drill collars, and one 7 1/4" drill collars. For re-entry at Site 288, a second stand (3) of 8 1/4" drill collars was added to the normal bottomhole assembly between bumper subs. To provide the best string length for stabbing in for re-entry, one of the lower bumper subs was removed.

For the normal sediments encountered, the bottomhole assembly appeared to offer adequate weight. Normal practice was to use low circulation rates even on basalts to maintain good bumper sub action. On most sites, both an "old style" Baash-Ross 6SI bumper sub with mud slots and the "new style" Baash-Ross 6SI bumper sub with a solid body were run side by side. At Site 287, both of the "old style" bumper subs were completely "sanded-up" and required nearly thirty minutes to clean up. The "new style" subs were free.

At Site 285, a failure occurred in one of the top Baash-Ross bumper subs and a nearly complete bottomhole assembly was lost. Failure occurred in the last engaged thread of the service break connecting the splined mandrel to the lower sub. As operations at the time were still in soft sediments near the ocean floor, weather and positioning were excellent, and the recovered section showed evidence of an existing fracture; it was concluded that the sub had developed a fatigue crack during the severe weather conditions encountered in the Antarctic voyages. A recommendation has been made to Baash-Ross to modify the connection to overcome inherent design weaknesses.

The failed bumper sub was rebuilt following Site 285 from parts of subs that had failed previously. Following Site 289, this bumper sub was found not free. When broken down, the splined mandrel was found to be bent. It has been removed from service.

Drift shots were taken on nearly all sites near total depth prior to abandonment. The maximum deviation was recorded at Site 289 where a drift indication of 8 1/4° was found near bottom.

## CORING AND CORING EQUIPMENT

The standard non-rotating inner barrel was used at all sites. Recovery, as usual, was high (71.1%) in the oozes and soft clays near the ocean floor, dropped considerable once circulation was required (38.4%) and was poor when chert streaks were encountered (16.6%). Recovery of basalt was good (60.8%). The new slip type core catcher functioned well in basalt and demonstrated its ability to scribe cores. 59.6 meters of basalt were recovered.

Center bits were not used and all drilling between cores was done with the inner barrel in place. In the upper formations, experience has shown that the sediments are "washed" away when the pump is on. A common practice is therefore to "wash" several joints of drill pipe (i.e., core with the pump on) and then slow the pump down/off and obtain a core.

This practice, at times, is misleading. On Hole 288B, an inner barrel was dropped at 3177 meters and the core of 3177-3180 meters was foram zone N-13. In Hole 288, the inner barrel was dropped at 3154 meters and "washed" to 3173 meters. The reported core 3173-3182.5 meters was in foram zone N-12 and apparently from the "washed" interval. Recovery appears to be lower in soft clays and oozes when not continuously cored, probably due to high circulation rates between cores. "Coring" immediately after dropping the inner barrel and then "drilling" or "washing" ahead at lower pump rates to the next desired coring point should result in more reliable information and better recovery.

In an effort to improve recovery, an extended rotating spring-loaded inner barrel was used several times on Sites 285 and 289. Improved recoveries can be achieved with this technique, however, a smaller core (1 3/4" vs 2 3/8" diameter) is recovered.

TABLE ONE

| | Cores Taken Without Pump Or Rotations | | | Cores Taken Without Pump | | | Cores Taken With Pump On (Without Chert) | | |
|---|---|---|---|---|---|---|---|---|---|
| | No Of Cores | Meters Cored | Meters Rec | No Of Cores | Meters Cored | Meters Rec | No Of Cores | Meters Cored | Meters Rec |
| Extended Rotating Inner Barrel | 4 | 36.0 | 32.7 | 1 | 9.5 | 9.5 | 3 | 28.5 | 18.6 |
| % Recovery | | 90.8% | | | 100% | | | 65.3% | |
| Non-Rotating Inner Barrel | 20 | 190.0 | 150.3 | 92 | 867.5 | 584.3 | 65 | 609.5 | 226.1 |
| % Recovery | | 79.1% | | | 67.3% | | | 37.1% | |

In the soft clays, the cores recovered with the extended inner barrel were of a similar quality to those obtained with the non-rotating barrel. In firm chalks the cores recovered were badly crushed, however, it is difficult to say whether these chalks had even been recovered previously as recovery had been poor and probably consisted of only the more indurated sections. Coring times with the extended barrel are improved as the pump can be used.

TABLE TWO

PARTIAL CORING RECORD - SITE 289

| Core No | Meters Cored | Meters Recovered | SPM Pump | Time Interval | Type Of Core Barrel |
|---|---|---|---|---|---|
| 87 | 9.5 | 1.8 | 0 | 20 | Non-Rotating |
| 88 | 9.5 | 3.3 | 0 | 22 | Non-Rotating |
| 89 | 9.5 | 6.2 | 10 | 12 | Extended |
| 90 | 9.5 | 3.7 | 0 | 20 | Non-Rotating |
| 91 | 9.5 | 7.0 | 8 | 15 | Extended |
| 92 | 9.5 | 1.2 | 6 | 12 | Non Rotating |
| 93 | 9.5 | 5.4 | 8 | 12 | Extended |
| 94 | 9.5 | 4.8 | 0 | 14 | Non-Rotating |
| 95 | 9.5 | 1.8 | 0 | 20 | Non-Rotating |

The small diameter cores obtained by the extended inner barrel do not fit established core handling procedures. The double latch and spring loaded drive assembly performed well. The shoe of extended inner barrel was internally built up with Servcoloy which appeared to minimize plugging experienced previously. This did, however, give an unfavorable core liner (2 1/4" I.D.) to core size ( 1 3/4" O.D.) ratio which frustrated many established sampling techniques. A "floating" 2" I.D. inner - inner barrel would minimize many of the problems noted above.

On Site 287, "O" rings were run on the core catcher sub in an attempt to improve recovery by packing off the inner barrel in the throat of the core bit. This prevents circulation from impinging directly on the core. Results were encouraging, however, they must be judged inconclusive as the proper "O" rings were not available after a few runs and no systematic evaluation was made.

## TABLE THREE

## PARTIAL CORING RECORD - SITE 287

| Core No | Meters Cored | Meters Recovered | SPM Pump | Time Interval | "O" Rings |
|---|---|---|---|---|---|
| 6 | 9.5 | 4.9 | 0 | 8 | No |
| 7 | 9.5 | 0.4 | 5 | 8 | No |
| 8 | 9.5 | 4.5 | 5 | 9 | Yes |
| 9 | 9.5 | 2.7 | 5 | 8 | Yes |
| 10 | 9.5 | 4.8 | 5 | 8 | Yes |

No major coring equipment failures occurred. The core barrel float valve seats were found to be loose and were glued in place. They had been machined slightly out of tolerance. New valves were ordered. No collapsed liners occurred. It appears that collapsed liners occur when the outside temperatures are low. Possibly, this low temperature sets up stresses in the core liner.

Some recovery was achieved on all but one coring attempt. The recovery, although at times low, was usually sufficient to date the age of the formations being cored. Greater recovery could probably be achieved with the extended inner barrel system, however, the size of core would be reduced and in the chert intervals, there would be the risk of damage to the coring equipment until the system is fully proven. The technique appears sound and can be made stronger, if needed.

### CORE BITS

All core bits were of the special roller insert design developed by the Project in conjunction with the Smith Tool Co. With one exception, all were totally destroyed or lost in meeting the scientific objectives of the sites.

At Site 285, a 2 3/4" x 10 1/2" 4 cutter Type 94 core bit was run. This bit was lost after a few cores were cut when a failure occurred in the bottomhole assembly. This larger diameter core bit is designed for the extended inner barrel system and allows a 2 1/8" core to be cut in soft formations. In hard formations, a 2 3/4" core is cut and the normal plastic liner must be removed. No further runs were made with this bit design due to the concern of the scientists aboard regarding handling of cores without butyrate liners.

On the second hole at Site 285, a 3 cutter Type 94 core bits was used. After fifteen rotating hours (4.2 hours on basalt), the bit locked up. When pulled, a complete shank and cone were found to be missing. It appeared that a weld failure had occurred where the shank was attached to the body.

On Site 286, another 3 cutter Type 94 core bit was used. After twenty rotating hours (including 11.3 hours and 57 meters in basalt) the hole was terminated after recovering a full nine meter core of basalt. When the bit was pulled, seals were found to be gone in two of the cones and one of these cones was being held on only by the core guide. The bit had lost gauge.

At Site 288 (re-entry) chalk and limestone with extensive chert strings were anticipated. A gauge hole was required if a successful bit change was to be made and it was hoped that the chert cuttings could be ground up small enough for the sea water to carry them out of the hole. On this basis, a Type 9C (round insert) 4 cutter core bit was selected.

The first bit was pulled after 20.3 rotating hours when the bit torque increased significantly. The bearings on all four cones were extremely loose, however, the bit was to gauge. On the second bit, additional weight (70%) was used and the bit was pulled after 16.1 hours when the torque first began to increase. Two seals had failed. On both bits, many broken teeth were found due to the many hard chert stringers encountered.

At Site 289, a 4 cutter Type 94 core bit was successful in penetrating 1271 meters in 53.7 rotating hours through a thick chalk/limestone section with numerous chert stringers. When the bit was recovered, two of the bearings were found to be gone and center inserts were completely gone. This had allowed an oversized core to be cut which had finally plugged the throat of the bit and stopped further penetration.

## POSITIONING

All systems worked well while on site. No major excursions occurred. No major loss of acoustics were experienced except at Site 289. At this site, loss of acoustics was experienced on the after hydrophones (stationary) when backing down. Switching to the forward hydrophones restored acoustics. A total of five beacons were used on the five sites. At Sites 286 and 287, the new Marine Resources, Inc. beacons were evaluated (one 13.5 kHz and one 16 kHz). They proved satisfactory, however, the pulse width of the 16 kHz beacon was short (3.6 milliseconds vs 4.0 milliseconds specified). At Sites 288 and 289, Ocean Research Equipment, Inc. twelve day beacons were used for 213 and 187 hours respectively.

The forward hydrophones were both worked up and down until a downward travel of over ten feet was obtained. They had become fouled with rust. It is hoped that lowering of the hydrophones to ± ten feet would be effective in minimizing lost acoustics due to prop wash in areas with severe weather conditions. Evaluation will now have to wait until these types of conditions are encountered.

Much of the work during the previous Leg 29 had been hampered by the lack of an automatic positioning capability. This was related to the adjustments of one of the power supply units of the Xerox Data System's Sigma II computer. When a new properly adjusted unit was installed during the port call at Wellington, a second power supply unit promptly burned out. A new unit was obtained in the United States and brought to the ship by the oncoming crew. When installation of these two new power supply units failed to make the computer operable, phone communication was established with XDS in Los Angeles (XDS does not have service representation in New Zealand nor were weekend telephone numbers available in the United States). When it became apparent that assistance was needed from the United States, arrangements were made for a XDS service representative to meet the ship in Gisborne, New Zealand enroute to the first site.

The XDS representative met the Glomar Challenger upon arrival in Gisborne and when after nine hours progress was reported (the program could be loaded), the ship set sail towards Auckland. A rendezvous point was selected near Great Barrier Island in case additional parts were needed and if not, to disembark the XDS representative. Diagnostic tapes at both high and low voltages were run and one marginal card was replaced.

A rendezvous was then made by helicopter to disembark the XDS representative. A total of nineteen hours were lost by the stop at Gisborne and by the added mileage to Great Barrier Island.

When the ship was approaching the second site, the air conditioning chiller unit was off for approximately thirty minutes and when the temperature in the computer room reached 74°F, a circuit breaker in the memory section of the computer opened. The chiller was returned to service and the computer reprogrammed normally. This experience points out the need for a back-up temperature control to the computer room. Plans to install a spare refrigeration unit from one of the core vans was deferred when it as learned that Global Marine Inc. had plans for a separate system in the near future.

# LEG 30

## DYNAMIC POSITIONING SUMMARY

LEGEND

CHALLENGER HEADING-AVERAGE

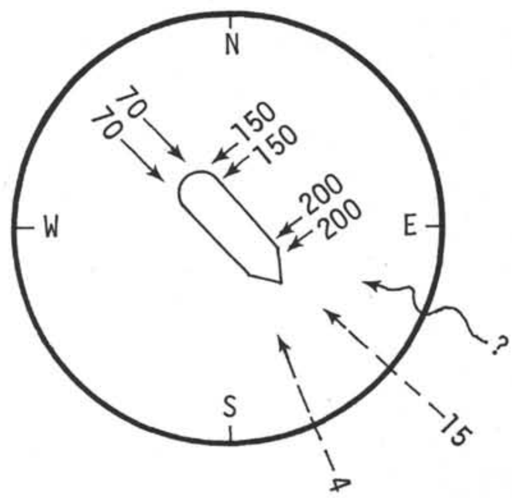
15 WIND: DIRECTION AND SPEED (MPH)-AVERAGE

4 SWELL: DIRECTION AND HEIGHT (FEET)-AVERAGE

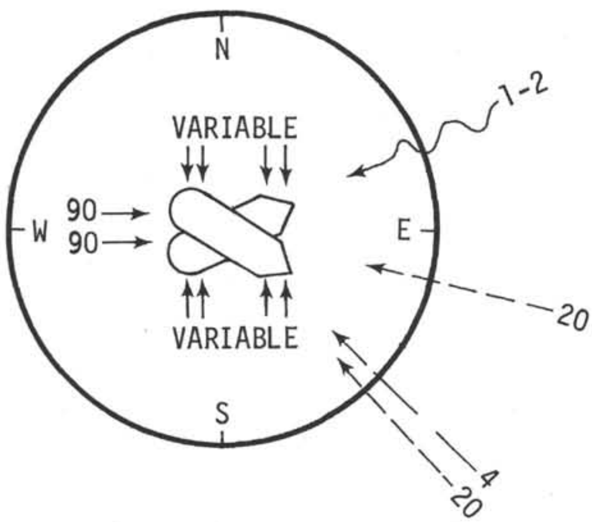
2 CURRENT: DIRECTION AND SPEED (KTS.)

THRUSTER AND MAIN PROPULSION ARROWS INDICATE AVERAGE RPM.

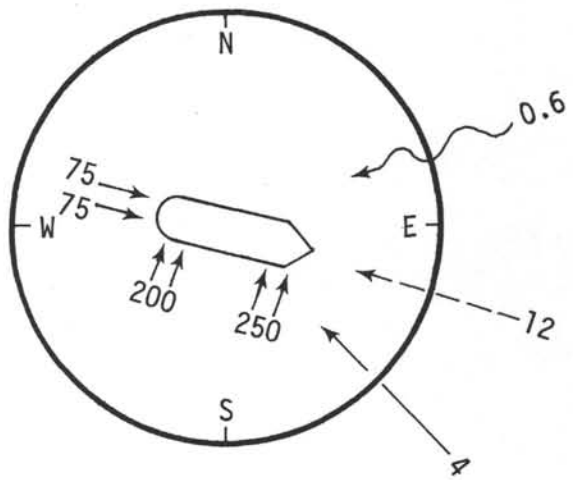
SITE 285



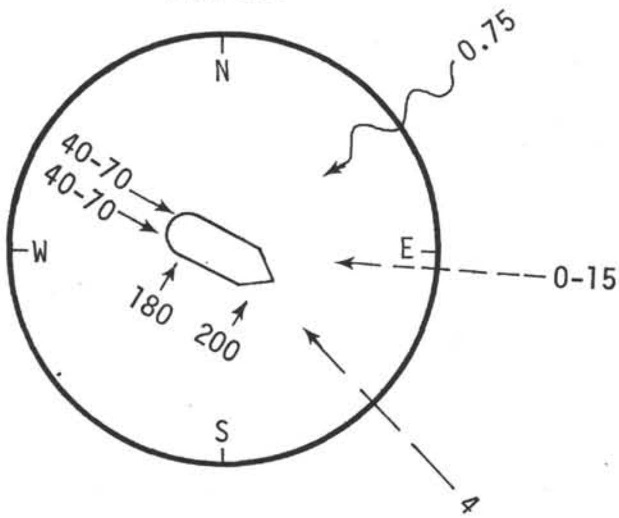

SITE 286



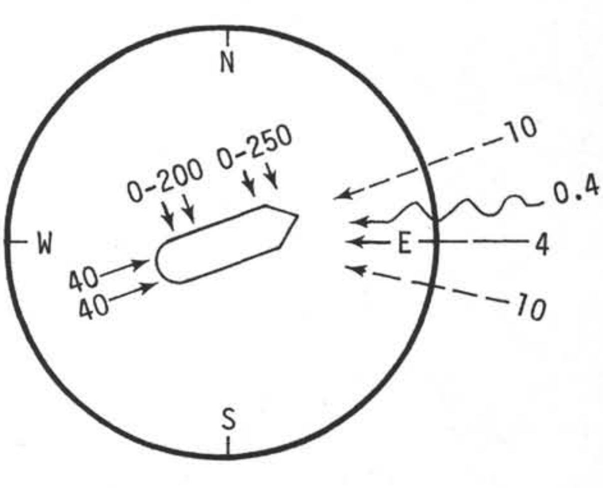

SITE 287




SITE 288




SITE 289



## UNDERWAY

Between sites, profiling was done at full speed (210 turns). Enroute to the second site, one of the main propulsion engines was down for approximately 17 hours due to an exhaust valve failure. Approximately 1 1/4 hours was lost due to the resultant reduced speed.

### TABLE FOUR

| | | Distance Nautical Miles | Total Time | Average Speed Knots |
|---|---|---|---|---|
| Wellington | Site 285 | 1162.0 | 4 days 22 hr 21 min | 9.82 |
| Site 285 | Site 286 | 851.6 | 3 days 14 hr 43 min | 9.82 |
| Site 286 | Site 287 | 851.0 | 3 days 4 hr 0 min | 10.19 |
| Site 287 | Site 388 | 769.5 | 3 days 11 hr 19 min | 9.18 |
| Site 288 | Site 289 | 405.4 | 1 day 14 hr 21 min | 10.57 |
| Site 289 | Guam | 1233.0 | 4 days 0 hr 48 min | 10.20 |
| Voyage Total | | 5272.5 | 21 days 19 hr 32 min | 10.07 |

Average fuel consumption was approximately 4800 gal/day while underway and 3200 gal/day while on site.

## COMMUNICATIONS

Communications direct with WWD at Scripps Institution of Oceanography were difficult as the best hours for transmission were during their off hours. During present working hours, 0600 to 1800 La Jolla local time, there was considerable interference from other worldwide coastal stations. Despite this, all incoming traffic was handled direct with WWD by CW.

While at the first two sites outgoing traffic was passed to WWD through the New Zealand Navy Station ZLO by radioteletype. During the remainder of the voyage, outgoing traffic was passed to WWD through the U.S Navy Station NPN at Guam by CW. On a few occasions messages were handled direct with WWD by CW.

Many phone patches were made for "morale" purposes through the amateur radio set with the cooperation of many "ham" operators in the United States.

## PORT CALL

Leg 30 began at 1248 hours Wednesday, April 18, 1973 when the Glomar Challenger arrived in Wellington, New Zealand. The controlling item during the port call time wise, was the scheduled major overhaul of two Caterpillar D-398 engines (1 and 3). This work was begun shortly after arrival and continued around the clock until finished. The overhaul was completed in five days after which the engines were given a short test run. The engines had over 35,000 hours of service each and have performed well since overhaul. Oil consumption has been reduced considerably. Two engines were previously overhauled in Durban (9 and 12) and four are scheduled for Japan (2, 4, 5, 6,).

The port call was during Easter and from Thursday evening until Tuesday morning outside services were difficult to obtain. Arrangements were made to load most supplies on Wednesday and Thursday and the ship was moved to a bunkering berth Sunday evening. Fueling, however, could not be arranged for until Monday morning. The ship was "topped-off" ($\pm$ 400,000 gallons) by Tuesday morning and the ship sailed at 1215 hours April 24.

The Vessel Motion Instrumentation System was removed and the EDO Western scanning sonar system needed for re-entry was reinstalled. The entire working string of 5" drill pipe was inspected with the Tuboscope internal sonde. Thirty four joints were marked for additional inspection and were removed from the string at the first site.

The Global Marine crew change was complicated. The oncoming crew, which was flying on an affinity plan with Air New Zealand, was delayed nearly 24 hours by airline mechanical problems. Supervisors on the off going crew were held over and most of the off going personnel departed as scheduled. They also were flying on an affinity plan and in addition, reservations as a whole were tight during the Easter holidays.

Repair of the XDS Sigma II Computer used in the Dynamic Positioning System was attempted. When it became apparent that a service representative from the United States would be required, the ship was ready to sail. Arrangements were made for a rendezvous with the serviceman at Gisborne, New Zealand enroute to the first site. For details see section under Positioning.

Neville Mott from Global Marine's Maintenance and Repair Section attended the port call to ship check the proposed heave compensation installation scheduled for Japan. Several modifications of equipment for re-entry were made at a local engineering works whose owner arranged for the New Zealand Antarctic Society to visit the ship and hear a presentation by Dr. Kennett, Chief Scientist of Leg 29, on the results of the Glomar Challenger's work during the last austral summer in the Antarctic.

## PERSONNEL

No major accidents occurred and there was no lost time due to injury. All personnel, including drilling, marine and scientific party, were quite safety conscious and contributed to the fine record during the eight week period.

Global Marine's personnel performed well and are to be commended for the handling of the re-entry operations. There was a great deal of enthusiasm and pride of accomplishment shown by all.

The scientific party, including the SIO technician staff, were a professional group, conscientious and enthusiastic and displayed an understanding nature when operational problems arose.

Overtime for DSDP personnel in excess of 70 hrs/wk was associated with work performed by the electronics technician, chemist and laboratory officer. Concerted efforts are continuously made to control such overtime, however, the workload of these classifications are dictated by breakdown, demands of scientists and supervision of DSDP shipboard personnel.

V.F. Larson

V. F. Larson
Cruise Operations Manager
Deep Sea Drilling Project

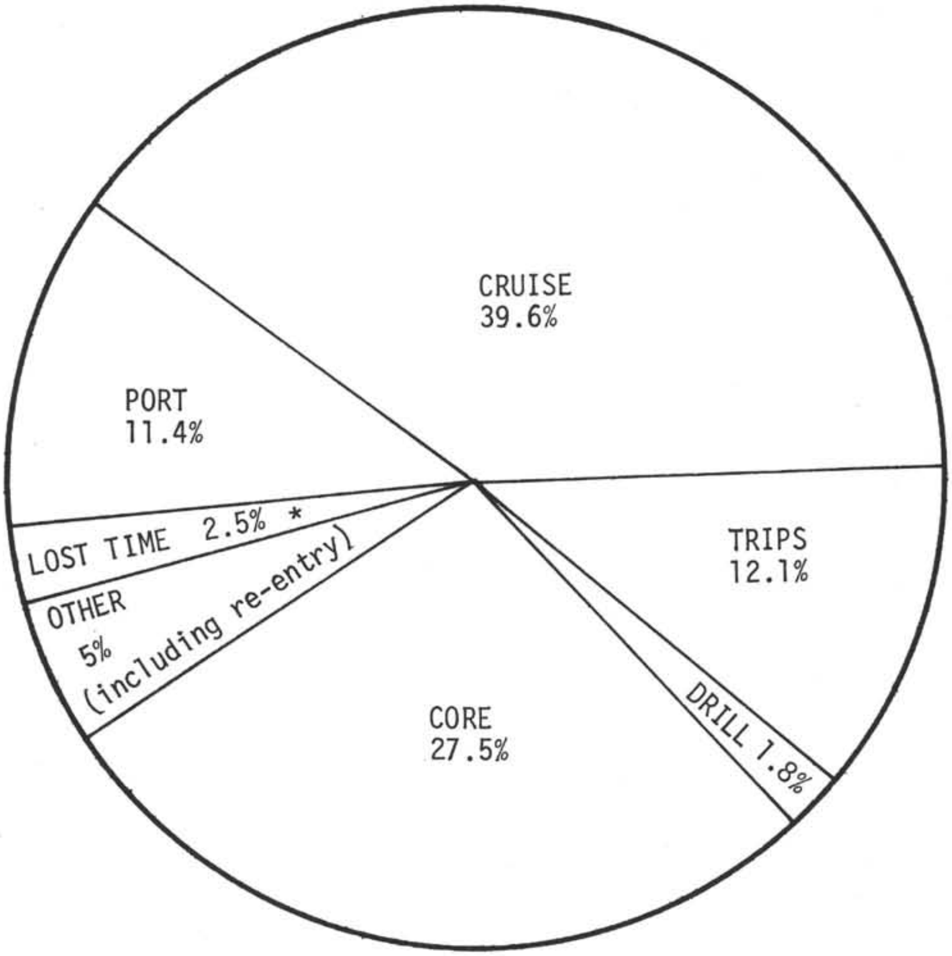
July 2, 1973

# DEEP SEA DRILLING PROJECT
## SUMMARY OF OPERATIONS
## LEG 30

| | | |
|---|---|---|
| Total Days Leg 30 | 56.0 | |
| Total Days In Port | 6.4 | |
| Total Days Cruising (Including Site Survey) | 22.2 | |
| Total Days On Site | 27.4 | |
| Trip Time | 6.8 | |
| Drilling Time | 1.0 | |
| Coring Time | 15.4 | |
| Lost Time - Mechanical Downtime | 0.2 | |
| Other (Failed Bottomhole Assembly) | 1.2 | |
| Other (Includes Re-entry) | 2.8 | |
| Total Distance Traveled (Nautical Miles | 5272.5 | |
| Average Speed (Knots) | 10.1 | |
| Sites Investigated | 5 | |
| Holes Drilled | 9 | |
| Number Of Cores Attempted | 250 | |
| Number Of Cores With Recovery | 249 | |
| Percent Of Cores With Recovery | 99.6 | |
| Total Meters Cored | 2332.0 | 7,649' |
| Total Meters Recovered | 1163.9 | 3,818' |
| Percent Of Cored Interval Recovered | 49.9 | |
| Total Meters Drilled | 1808.0 | 5,930' |
| Total Penetration | 4140.0 | 13,579' |
| Percent Of Penetration Cored | 56.3 | |
| Maximum Penetration At Single Hole | 1272.0 | 4,172' |
| Maximum Water Depth | 4674.0 | 15,331' |
| Minimum Water Depth | 2224.0 | 7,295' |
| Average Water Depth | 3813.1 | 12,506' |

FIGURE I

DEEP SEA DRILLING PROJECT
TOTAL TIME DISTRIBUTION
LEG XXX

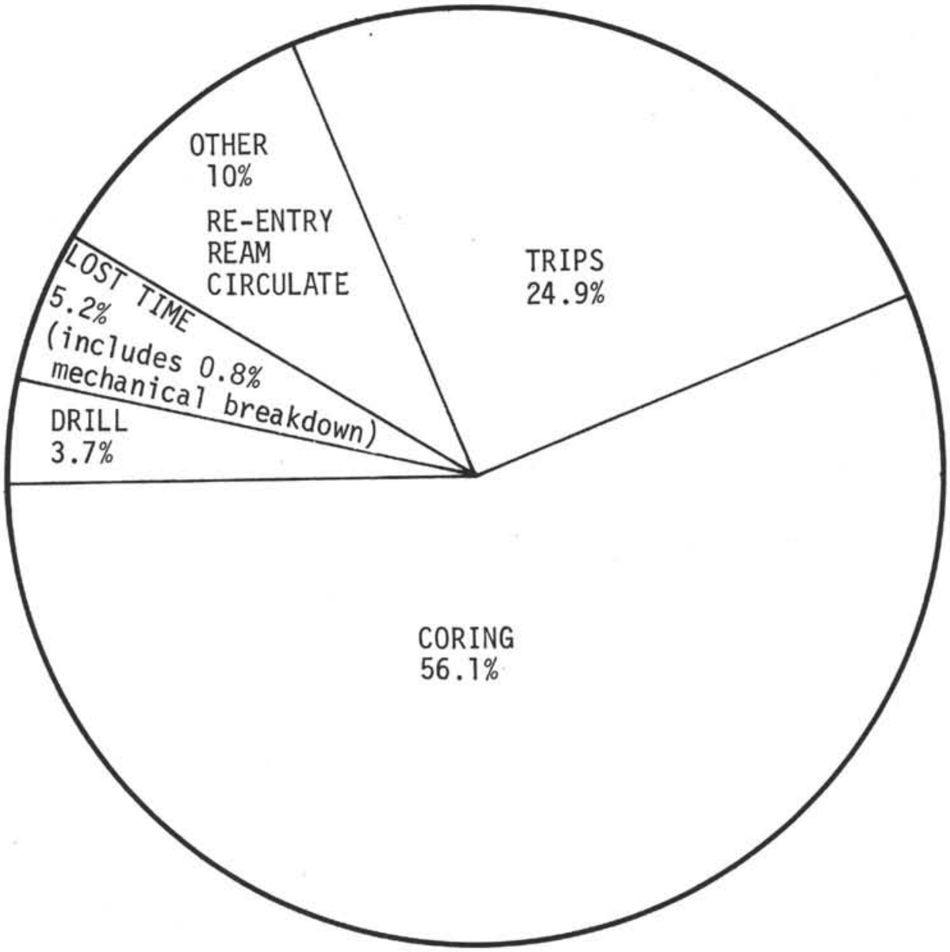



START LEG: APRIL 18, 1973
FINISH LEG: JUNE 13, 1973
TOTAL TIME: 56.8 DAYS

*(includes 0.4% mechanical breakdown)

FIGURE II

DEEP SEA DRILLING PROJECT
ON-SITE TIME DISTRIBUTION
LEG XXX




TOTAL TIME ON SITE: 27.4 DAYS
TOTAL SITES: 5
TOTAL HOLES: 9

# DEEP SEA DRILLING PROJECT
## SITE SUMMARY
## LEG 30

| Hole | Latitude | Longitude | Water Depth Meters | Number Of Cores | Cores With Recovery | Percent With Recovery | Meters Cored | Meters Recovered | Percent Recovered | Meters Drilled | Total Penet Meters | Avg Rate Penet M/Hr | Time On Hole Hrs | Time On Site |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| South Fiji Basin | | | | | | | | | | | | | | |
| 285 | 26° 49.16'S | 175° 48.24'E | 4674 | 5 | 5 | 100 | 45.5 | 42.2 | 92.7 | 47.5 | 93.0 | 81.0 | 37.0 | |
| 285A | 26° 49.16'S | 175° 48.24'E | 4674 | 10 | 10 | 100 | 85.5 | 47.3 | 55.3 | 498.5 | 584.0 | 39.9 | 64.5 | |
| | Site Totals | | | 15 | 15 | 100 | 131.0 | 89.5 | 68.3 | 546.0 | 677.0 | 42.9 | | 101.5 |
| New Hebrides | | | | | | | | | | | | | | |
| 286 | 16° 31.92'S | 166° 22.18'E | 4484 | 41 | 41 | 100 | 383.0 | 170.4 | 44.5 | 323.0 | 706.0 | 34.8 | 98.0 | 98.0 |
| Coral Sea | | | | | | | | | | | | | | |
| 287 | 13° 54.67'S | 153° 15.93'E | 4653.5 | 18 | 18 | 100 | 157.0 | 72.2 | 46.0 | 95.0 | 252.0 | 31.1 | 57.0 | 57.0 |
| Ontong-Java Plateau | | | | | | | | | | | | | | |
| 288 | 5° 58.3'S | 161° 49.57'E | 3030 | 11 | 11 | 100 | 98.0 | 50.4 | 51.4 | 140.0 | 238.0 | 64.3 | 29.3 | |
| 288A | 5° 58.3'S | 161° 49.57'E | 3030 | 30 | 29 | 96.7 | 284.5 | 61.3 | 21.5 | 704.0 | 988.5 | 27.2 | 173.2 | |
| 288B | 5° 58.3'S | 161° 49.57'E | 3030 | 1 | 1 | 100 | 3.0 | 2.9 | 97.0 | 0 | 3.0 | 17.7 | 1.0 | |
| 288C | 5° 58.3'S | 161° 49.57'E | 3030 | 1 | 1 | 100 | 4.5 | 4.5 | 100.0 | 0 | 4.5 | 90.0 | 9.7 | |
| | Site Totals | | | 43 | 42 | 97.7 | 390.0 | 119.1 | 30.5 | 844.0 | 1234.0 | 30.6 | | 213.2 |
| Ontong-Java Plateau | | | | | | | | | | | | | | |
| 289 | 00° 29.92'S | 158° 30.69'E | 2224 | 133 | 133 | 100 | 1271.0 | 712.7 | 56.1 | 0 | 1271.0 | 23.7 | 187.0 | 187.0 |
| | Leg Totals | | 3813 | 250 | 249 | 99.6 | 2332.0 | 1163.9 | 49.9 | 1808.0 | 4140.0 | 30.0 | | 656.7 |

DEEP SEA DRILLING PROJECT
BIT SUMMARY
LEG 30

| Hole | Mg. | Size | Type | Serial Number | Meters Cored | Meters Drilled | Meters Total Penet | Hours On Bit | Condition | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 285 | Smith (RR) | 10 1/2 4 Ctr | F94C | KK989 | 45.5 | 47.5 | 93.0 | 1.15 | Lost In Hole | Rerun Leg 26, Site 252. Little or no rotation. |
| 285A | Smith | 10 1/8 3 Ctr | F94C | KN103 | 85.5 | 498.5 | 584.0 | 14.62 | Lost One Cone | Remaining two cones were tight. Many inserts broken. |
| 286 | Smith | 10 1/8 3 Ctr | F94C | KN102 | 383.0 | 323.0 | 706.0 | 20.3 | T-1 B-8 10 BT | 1/2" OG seal gone on two cones. Balls nearly gone on one cone. |
| 287 | Smith | 10 1/8 3 Ctr | 94CJS | JZ244 | 157.0 | 95.0 | 252.0 | 8.1 | T-1 B-4 | 1/8" OG seal gone on one cone. No broken teeth |
| 288 | Smith (RR) | 10 1/8 3 Ctr | 94CJS | JZ244 | 140.0 | 98.0 | 238.0 | 3.7 | T-1 B-4 | 1/8" OG seal gone on one cone. No broken teeth Rerun from Site 287. |
| 288A | Smith (#1) | 10 1/8 4 Ctr | FS9C | JS521 | 218.5 | 666.0 | 884.5 | 20.3 | T-2 B-8 16 BT | 1/16" OG. All bearings gone. One cone had skidded. |
| 288A | Smith (#2 | 10 1/8 4 Ctr | FS9C | JS522 | 66.0 | 38.0 | 104.0 | 16.1 | T-2 B-4 13 BT | 1/16" OG. Two seals gone. |
| 288B & C | Smith | 10 1/8 4 Ctr | 9C | KC071 | 7.5 | 0 | 7.5 | 0.2 | As New | Side tracked hole in soft ooze. |
| 289 | Smith | 10 1/8 4 Ctr | 94CJS | JZ248 | 1271.0 | 0 | 1271.0 | 53.7 | T-4 B-8 IG | Many broken teeth. Two cones had begun skidding |

# DEEP SEA DRILLING PROJECT
## BEACON SUMMARY
## LEG 30

| Site No. | Make | Freq kHz | Serial Number | Site Time Hours | Remarks |
|---|---|---|---|---|---|
| 285 | Burnett | 13.5 | 17 | 101.5 | Appeared weak from start. Did not fade. |
| 285A | Burnett | 13.5 | 17 | | |
| 286 | MRI | 13.5 | 273001 | 98 | Appeared weak from start. Did not fade. |
| 287 | MRI | 16.0 | 273002 | 57 | Strong. Pulse width 3.5 m sec. Not to specs |
| 288 | ORE | 16.0 | 234 | 213.2 | Double Life |
| 288A-B-C | ORE | 16.0 | 234 | | |
| 289 | ORE | 13.5 | 223 | | Double Life |

# DEEP SEA DRILLING PROJECT
## OPERATIONS RESUME
## LEG 31

## SUMMARY

Leg 31 of the Deep Sea Drilling Project started on June 13, 1973 at Apra, Guam and ended 52.3 days later at Hakodate, Japan on August 4, 1973. The Challenger traveled 4111 nautical miles and drilled a total of 17 holes at 13 sites in the Philippine Sea and the Sea of Japan. Water depths averaged 4453 meters (14,606') and varied between 2399 meters and 6057 meters. Hole depths averaged 365 meters (1,210') and ranged between 98 and 1087 meters.

Weather was good during the leg. Typhoon Billie was in the embryonic stage while in the general area of the Challenger and had no effect on operations. Typhoon Ellen, more capricious than most and traveling in several different directions, including north, northwest, southwest, and west, deteriorated to a tropical storm and resulted in 12 hours downtime as a precautionary measure prior to spudding at Site 298.

Distribution for the 52.3 days total leg time was 61.4% site time, 34.8% cruise time, and 3.8% port time (Figure 1). Total site time of 32.1 days was divided into 52.7% coring, 7.8% drilling, 30.8% trips, and 8.7% other (Figure 2).

A total of 6272.5 meters of ocean sediments were penetrated, of which 42% were cored. The average hole program consisted of taking 4.5 cores per 100 meters, with usable recovery obtained on 93% of the 285 cores attempted and total recovery of 47%.

Of the 17 holes drilled, 12 were abandoned earlier than anticipated; two due to increasing gas shows; seven from deteriorating hole conditions; one for sanded bumper subs; one from failure of the Bowen sub hydraulic system; and one due to a medical emergency which resulted in Leg 31 being terminated 2-1/2 days early. Equipment losses were limited to a bit and two drill collars at Site 298A and damaged equipment totaled three drill collars and four bumper subs at Sites 290A and 298A. Mechanical downtime of 10 hours accrued from problems with the Bowen sub hydraulic system. Dynamic positioning worked well during the leg, but trouble with computer interfacing required the semi-automatic mode of operation during the last two sites. No problems resulted, however.

Several other memorable events occurred during the leg, including sailing the Challenger under the Shimonoseki Straits bridge with clearance being adequate but appearing minuscule when viewed from the deck; the filming operations by NHK as a portion of a Japanese documentary on earthquakes; and being under surveillance while in the Sea of Japan, first by a Soviet-built frigate and then by a Russian oceanographic vessel, plus occasional military aircraft from both Japan and Russia.

## DRILLING AND CORING ASSEMBLY

The bottomhole assembly used on Leg 31 was the same for all holes and consisted of the following: core bit, float sub, 8-1/4" core barrel, three 8-1/4" drill collars, two Baash-Ross bumper subs, three 8-1/4" drill collars, two Baash-Ross bumper subs, two 8-1/4" drill collars, one 7-1/4" drill collar, and a joint of 5-1/2" 26 lb/ft drill pipe. Bumper subs were of the newer design without drain holes in the outer body.

Drilling progress at 35% of the holes was effectively halted by stall torques on the drill pipe (range 8,000 to 12,000 ft/lbs) and caving hole conditions. Mud was ineffective in attempting to correct problems. Six holes experienced high torques, not only while drilling, but also when off-bottom reaming the hole and conditions appeared similar to those encountered in land drilling when penetrating formations containing boulders. Formations being drilled at the time were volcanic conglomerate (290, 290A), basalt (291, 291A, 294), and brown clay (295). All holes but one were successfully abandoned without incident. While pulling the last core at Hole 290A, the pipe stuck and the bit plugged. Unfortunately, the long length of the drill string (6211 meters or 20,372 feet) limited the maximum (prudent) pull on the drill pipe to 550,000 lbs, which was ineffective in freeing the bottomhole assembly. Three runs were then made with the severing tool. On the first, there was a misfire due to a faulty cap. The second run obtained a successful firing at a bumper sub joint, but the string still remained stuck. On the third run, just prior to firing, the pipe came loose due to continual vessel heave and bumper sub action and the charge was pulled unfired. After pulling out of the hole, the bumper sub was found to be badly bulged but still intact. One problem noted during operations at this depth was that the hoist odometer and the collar locator did not provide the desirable confidence of preciseness for depth or tool joint location.

At two sites it became necessary to abandon the holes for reasons of potential pollution. Site 299, continuously cored during the initial 247 meters, began showing a relatively steady methane background at about 133 meters. A more or less steady background of ethane, ranging from 0.5 to 1.5 units on the chromatograph, started at 142 meters and continued until a depth of 418 meters. At this point, ethane readings began to increase without a corresponding increase in methane. Between 494 and 532 meters, ethane reached a maximum of 10 units, and the methane-ethane ratio changed from $23.3 \times 10^3$ at 360 meters to $3.0 \times 10^3$ at 532 meters, where the hole was abandoned. Bubbling of hydrocarbon gasses from cores was quite evident, but no obvious oil staining was found. Similar conditions were experienced at Site 301, where initial traces of ethane were recorded at 117 meters, and the hole was abandoned at 497 meters. Since abandonment decisions such as these are partially subjective rather than objective, and are important from both an antipollution and scientific objective viewpoint, it appears that greater efforts to better define critical gas values and ratios would be quite rewarding. As DSDP drilling becomes progressively deeper, more precise yardsticks would seem to be even more important. A valuable contribution towards this end would be a compilation of data from all legs, indicating conditions under which similar abandonment decisions have been made.

Total core recovery of 47% during Leg 31 was below that which has been experienced on many legs. Various combinations of weight on bit, rotary speed, and pump SPM were tried to improve recovery, but no winning combination was found. Formations most difficult to core were those which have been troublesome in other areas, namely clayey materials interspersed with sand, turbidites, and fractured basalt or volcanic conglomerates.

Plastic sock and core tube failures were at a minimum and not a major factor in the poorer recovery. The extended core barrel was used but once and, therefore, no valid comparison could be made on its potential. Greater usage might result if handling procedures and techniques were more adaptable to the smaller dimeter core.

The Larson core catcher with both spring-loaded and slip-type dogs was used when coring harder sediments at Sites 291A through 296, and recovery averaged 35%. A comparison between the Larson catcher and normally used hard dogs was made at Site 296. Here, seven cores in volcanic conglomerates, using the hard dogs, averaged 14% while nine cores using the Larson catcher averaged 42%. However, cracks developed in the Larson catchers and they were taken out of service. A design modification to strengthen the dog areas and relieve abrupt changes in cross-section may be advisable for future catchers of this type.

At Site 293, a core catcher with two external O-rings for sealing in the bit bore was also used in an attempt to improve core recovery and bit tooth cleaning. Comparison of results with the regular core catcher was made while cutting 13 cores in turbidites. The first ten of these were taken with the O-ring catcher and recovery averaged 45%. The next three were with the regular core catcher and averaged 41%. Each time the O-ring catcher returned to the surface, the O-rings were missing. It is not known if they were lost during coring operations or as the catcher passed through the bottom bearing assembly during installation. Further enlargement of this bottom bearing assembly should probably be made prior to any further evaluation. Greater success in maintaining a seal might also be realized if a different packing were used, chevron type, for example. The O-ring type catcher was taken out of service as the sediments at Hole 293 became harder and the possibility of failure in the reduced O-ring groove cross-section existed.

Hard type dogs with tungsten carbide facing were also tested during the leg. Although some of the facing chipped off while in service, it was the consensus that their performance was superior to that of the older style.

Sanded bumper subs occurred only once and were not the operational problem they have been on some legs. At Site 297, it was suspected that some of the subs began to sand-up at a sub depth of 553 meters. As drilling progressed, the ability to maintain a constant, reasonable weight on the bit became almost impossible. A combination of sanded subs, an 11', ten-second swell, and a vessel roll of 5 dgreees (half angle) resulted in bit loads in excess of 40,000 lbs. Consequently, a decision was made to pull out of the hole, correct the problem, and respud at 297A. On pulling out, it was found that the bumper subs were unsanded. Therefore, 297A was spudded as soon as the string could be returned to bottom.

Penetration below 200 meters was made at 297A, at which time the Bowen sub became inoperative due to problems with the hydraulic system. After 10 hours of troubleshooting, a decision was made to abandon 297A so that adequate time would be available for evaluating the next hole, 298, and still meet an established deadline for transfer of personnel in the Shimonoseki Straits. By the time Hole 298 was ready to spud, several components of the hydraulic system had been changed and it was operational once again. Contaminant fouling of various valves was suspected as being the source of the problem. When the same situation reappeared at Site 302, it was quickly solved with a minimum of delay. Although this problem is apparently uncommon, further work is required to pinpoint the contaminant source and minimize its reoccurrence.

Bit life during Leg 31 was relatively low. Three cutter sealed bearing bits, medium tooth, were primarily used. The average life of those taken out of service with ratings of less than T-1, B-1, was 12.5 hours (maximum 20.8 hours). No particular reason for reduced life was apparent. Some improvement for the three cutter bits was noted after the core throat had been shortened (approximately one inch) and the tendency of the cutters to lock on bent core throats eliminated.

Loss and/or damage to the bottomhole assembly occurred at Hole 290A (stuck pipe, previously mentioned) and at Hole 298A, mostly at the latter. Here, as the hole was being abandoned during inclement weather and in the early morning hours, a power failure occurred to the computer and other facilities. Although power was restored within eleven minutes, the vessel drifted off the hole approximately 250 feet (16.5% of the water depth). The bit and two drill collars were lost, three bumper subs were bent, and two drill collars damaged.

It was hoped that on Leg 31 an evaluation of the drill pipe pinger would help solve the problem of determining precise spud depths and eliminate reliance on PDR measurement, especially in the softer sediments. Briefly, the pinger consists of: a special inner core barrel with ball latch at the top; a series of inner (hollow) sinker bars, a shear-pinned inside the inner barrel; a transducer on the bottom of the sinker bars, connected by an electric cable to an electronic package at the top of the bars; and a fishing neck on top of the electronics package for retrieval of the entire unit. After a bottom depth determination has been made, a punch core can be taken. Unfortunately, a series of delays and bad luck seemed to plague the instrument from the start. Initially, it was found that a sub needed to be recut before a complete assembly could be made. Also, the equipment was somewhat at variance with the drawing and a few length modifications were necessary.

On assembling the unit, the pressure case containing the battery pack and electronics package suddenly became very warm and, on disassembly, a short was discovered. The defective unit was replaced by an available spare. The final blow came when the transducer shorted and no spares were available. Hopefully, future legs will be more successful in their test efforts, as the pinger appears to be a worthwhile addition to operational tools.

Other equipment evaluations included a new style inner barrel swivel and a modified float valve. Swivels performed without incident, but require magnafluxing before it can be assumed former problems have been solved. Float valves on past legs have failed by breaking of the hinge on the flapper, with evidence pointing to washed-out seals as part of the problem. To correct this, a large snap ring was installed below the seal ring. No failures were experienced on Leg 31. Records were kept on the first 8 holes drilled and results are as follows:

(1) After a total of 65 cores: spring replaced, seal ring replaced, flapper redressed.

(2) After a total of 88 cores: spring replaced, seal ring replaced, flapper replaced.

(3) After a total of 98 cores: no additional replacements. Records terminated.

## VESSEL OPERATION

Weather and dynamic positioning during the leg were generally good, with normal vessel excursion about 0.3% of water depth. Four of 11 sites required the use of only one bow and one stern thruster. At two sites, positioning was made somewhat more difficult by the current changing 180 degrees over a 24-hour period (295, 296). The maximum excursion during the leg occurred at shallow water Site 292 (2,943 meters) when a sudden squall arose and pushed the vessel 250' off the hole, or 2.6%, prior to recovery.

A computer malfunction required the manual mode of operation during half of Site 294 and all of Site 295. However, weather was calm, water was deep (5,784 and 5,802 meters), and maximum excursion was less than 1%. During Site 298A, Typhoon Ellen with 65 mph gusts, 8' seas, and 12' swells caused short periods of acoustic losses, and resulted in a 200' positioning error (1.3%). It was at this same time that a circuit breaker in the emergency lighting circuit tripped, shutting off power to the computer, gyro, radar, and emergency lighting buss, and indicating a similar loss to the wheelhouse, rig floor, and engine room. Even with power restored within 11 minutes after failure, the vessel was pulled 2500' off the hole and the bottomhole assembly suffered subsequent loss and damage. During the last two sites, semi-automatic operation was used without incident, due to a failure of the interface between the vertical reference gyro and the computer, which caused erroneous roll and pitch input to the computer.

Two interesting tests were performed by the Challenger while in the Sea of Japan. The first was the distance-time required from Full Ahead to Stop; the second, the time for a full circle without thrusters. From a speed of 10 knots the Challenger was dead-in-the-water within 1000 feet or 2 minutes 28 seconds. A full circle was accomplished in 4 minutes 34 seconds.

## BEACONS

Beacon performance during the leg was erratic at times, with 35% either unsatisfactory or marginal. Unsatisfactory beacons were almost immediately either low in power or transmitted unacceptable signals to the computer. A total of 17 were required, with results indicated in the table below:

| Mfg. | Freq. (kHz) | Satisfactory | Unsatisfactory | Marginal | Total |
|---|---|---|---|---|---|
| Burnett | 13.5 | 1 | 0 | 1 | 2 |
| Burnett | 16.0 | 2 | 0 | 1 | 3 |
| ORE | 13.5 | 4 | 2 | 0 | 6 |
| ORE | 16.0 | 4 | 2 | 0 | 6 |
| | | 11 | 4 | 2 | 17 |

Most beacons were dropped while cruising at 5 knots. At three sites, offsets from the beacon of from 2000' to 2500' were used satisfactorily (290A, 291A, 293).

## HEAT FLOW AND INCLINOMETER TESTS

A total of seven heat flow tests were conducted during the leg; two in the Shikoku Basin (297), two in the Shikoku Trench (298A), and three in the Japan Basin (301). Standard procedures were used, with 10 minutes on bottom and 5,000 to 10,000 lbs. weight on the bit. Tests were satisfactory with the exception of each final run at 298A, terminated after 4 minutes due to excessively high bit loads, and 301, where the instrument leaked.

Inclinometer measurements were made at only two sites because the holes were either fairly shallow or unstable conditions precluded conducting such tests. At Hole 292, a deviation of 2 to 3 degrees was obtained after coring through 76 meters of basalt and reaching a total depth of 443.5 meters. At Hole 296, the deviation was 0 degrees after reaching a total depth of 1087 meters and bottoming in ash and volcanic conglomerate.

## COMMUNICATIONS

Volume of traffic was about normal. For the portion of the voyage from Apra, Guam to Shimonoseki Straits, a nightly schedule (0100Z) was held with Radio WWD and nearly all incoming traffic was cleared, plus some outgoing traffic.

However, after entering the Sea of Japan, it was no longer possible to communicate with Radio WWD on any frequency; it was difficult most of the time to communicate with powerful commercial Radio Station KPH (San Francisco) except on 8 MHZ band at about 1000 GMT.

As a result of the above, some rather large delays were incurred on several messages. Separate recommendations have been made to avoid repetition of such delays.

## PERSONNEL

Continual observance of the necessary rules and regulations resulted in a fine safety record for both the scientific party and Global Marine personnel during the 7-1/2 week cruise.

Leg 31 ended, however, on a somber note when one of the GMI personnel suffered a slight stroke and the Challenger arrived 2-1/2 days early at Hakodate, Japan, for hospitablization of the patient. Fortunately, the medical emergency had a happy ending in that, at last report, the GMI employee was recovering nicely and was to rejoin his shipmates on the flight back to the U.S.

Global Marine is to be commended not only for the skill of their personnel and the pride they have in their job and equipment, but also for their unfailing efforts toward making a successful cruise for everyone.

Additionally, the scientific party, whose professionalism and expertise were continually in evidence, suffered many disappointments in being unable to reach all scientific objectives. They were a real pleasure, however, in that their dedication to the job and sense of humor did not allow their enthusiasm to be dampened by negativism.

J. R. Shore
Cruise Operations Manager
Deep Sea Drilling Project

## DEEP SEA DRILLING PROJECT
## SUMMARY OF OPERATIONS
## LEG 31

| | | |
|---|---|---|
| Total Days (June 13 - August 4, 1973) | | 52.3 |
| Total Days in Port | | 2.0 |
| Total Days Cruising | | 18.2 |
| Total Days on Site | | 32.1 |
| Coring Time | 16.9 | |
| Drilling Time | 2.5 | |
| Trip Time | 9.9 | |
| Mechanical Downtime | 0.5 | |
| Other Misc. Items | 2.3 | |
| Total Distance Traveled (Nautical Miles) | | 4111.5 |
| Average Speed (Knots) | | 9.9 |
| Sites Investigated | | 13 |
| Holes Drilled | | 17 |
| Number of Cores Attempted | | 285 |
| Number of Cores With Recovery | | 266 |
| Percent of Cores With Recovery | | 93.3 |
| Total Meters Cored | | 2611.5 |
| Total Meters Recovered | | 1233.5 |
| Percent of Core Recovered | | 47.2 |
| Total Meters Penetrated | | 6272.5 |
| Percent of Penetration Cored | | 41.6 |
| Total Meters Drilled | | 3661.0 |
| Maximum Penetration per Hole (Meters) | | 1087.0 |
| Minimum Penetration per Hole (Meters) | | 98.0 |
| Average Penetration per Hole (Meters) | | 369.0 |
| Maximum Water Depth (Meters) | | 6057 |
| Minimum Water Depth (Meters) | | 2399 |
| Average Water Depth (Meters) | | 4453 |

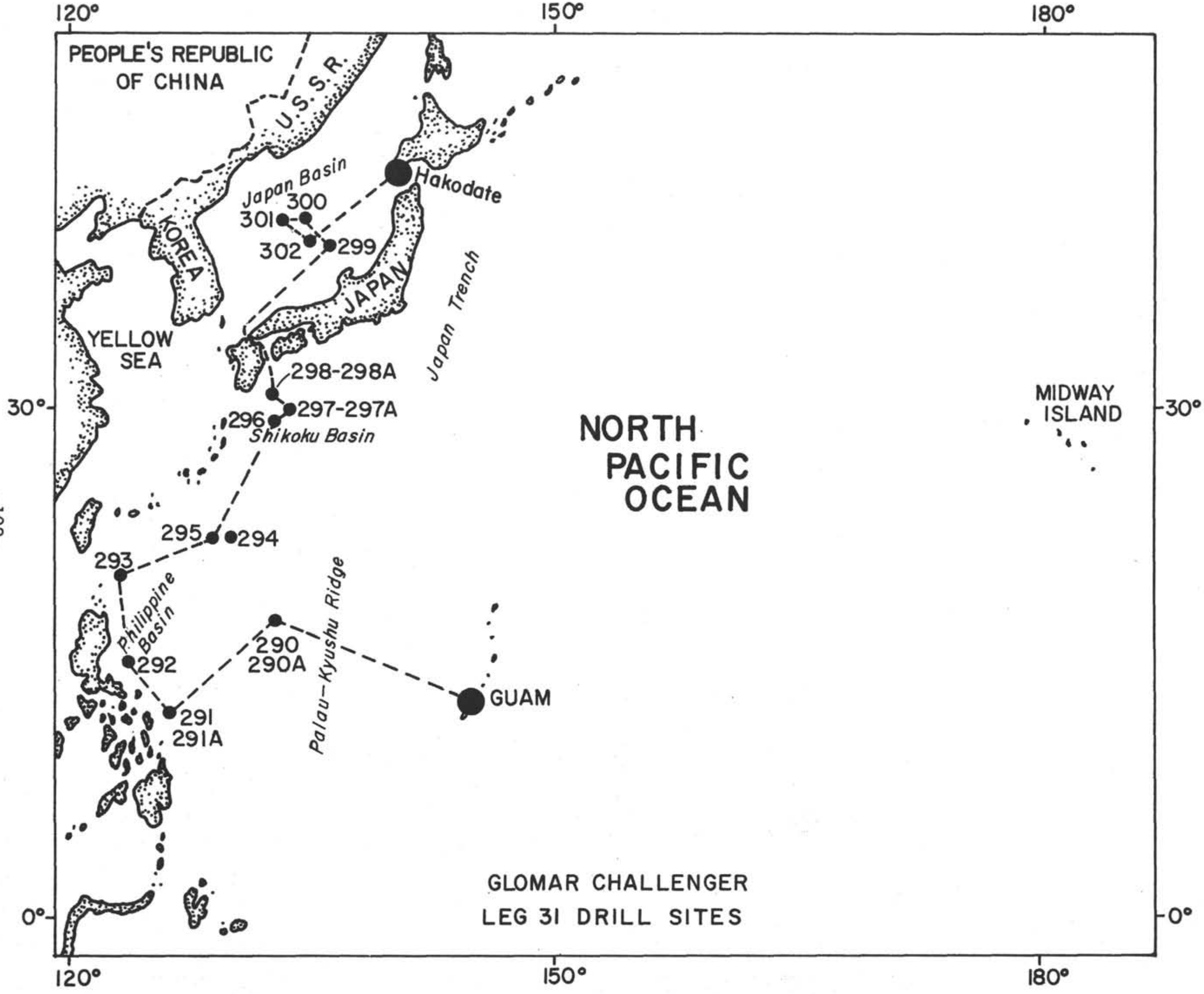
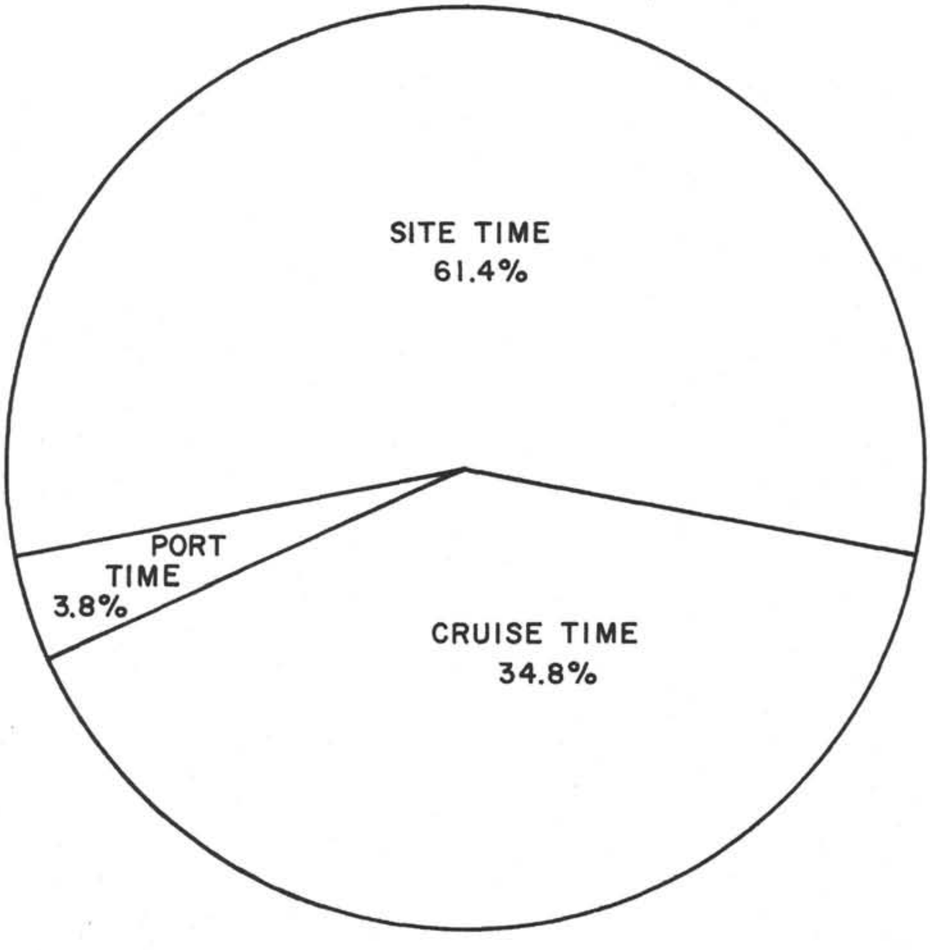
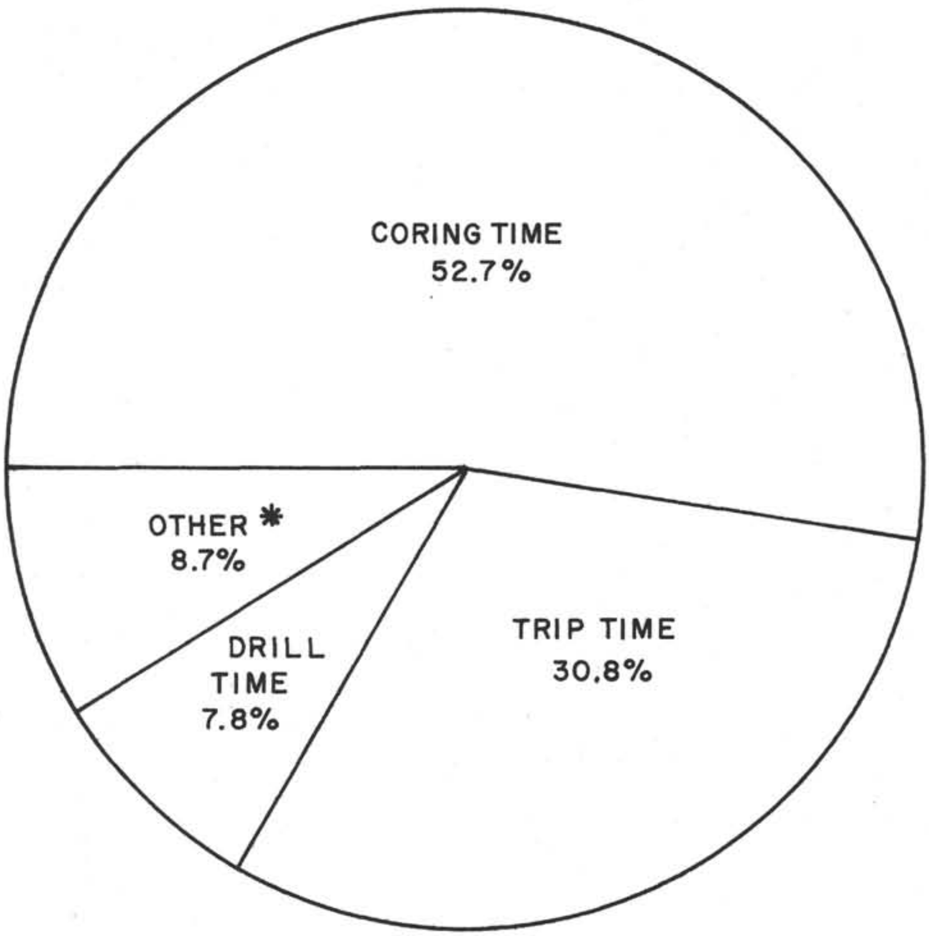

120°
150°
180°
PEOPLE'S REPUBLIC
OF CHINA
U.S.S.R.
KOREA
JAPAN
YELLOW
SEA
Japan Basin
Hakodate
300
301
302
299
Japan Trench
298-298A
297-297A
296
Shikoku Basin
NORTH
PACIFIC
OCEAN
MIDWAY
ISLAND
295
294
293
Philippine
Basin
292
290
290A
Palau-Kyushu Ridge
291
291A
GUAM
GLOMAR CHALLENGER
LEG 31 DRILL SITES
30°
0°

FIGURE 1
DEEP SEA DRILLING PROJECT
TIME DISTRIBUTION
LEG XXXI
TOTAL TIME




START LEG: 0300 GMT, 13 JUNE 1973, APRA, GUAM.
COMPLETE LEG: 0900 GMT, 4 AUGUST 1973, HAKODATE, JAPAN.
TOTAL TIME: 52.3 DAYS.
TOTAL SITES: 13.
TOTAL HOLES: 17.

FIGURE 2
DEEP SEA DRILLING PROJECT
TIME DISTRIBUTION
LEG XXXI
ON-SITE TIME




TOTAL LEG TIME: 52.3 DAYS.
TOTAL TIME ON SITE: 32.1 DAYS.
TOTAL SITES: 13.
TOTAL HOLES: 17.

* INCLUDES: WAITING ON WEATHER
HEAT FLOW & INCLINOMETER SURVEYS
SPECIAL HOLE ABANDONMENT OR CONDITIONING
MISC. OTHER ITEMS

# DYNAMIC POSITIONING DATA

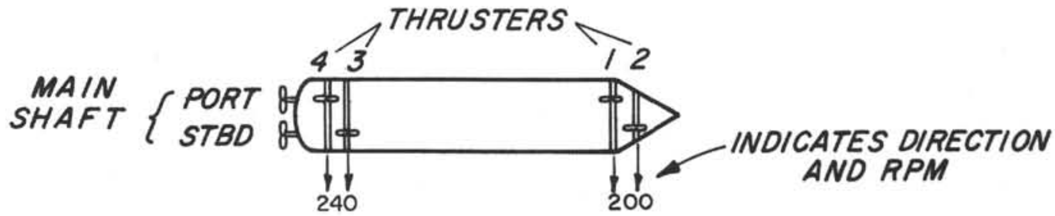
## LEGEND

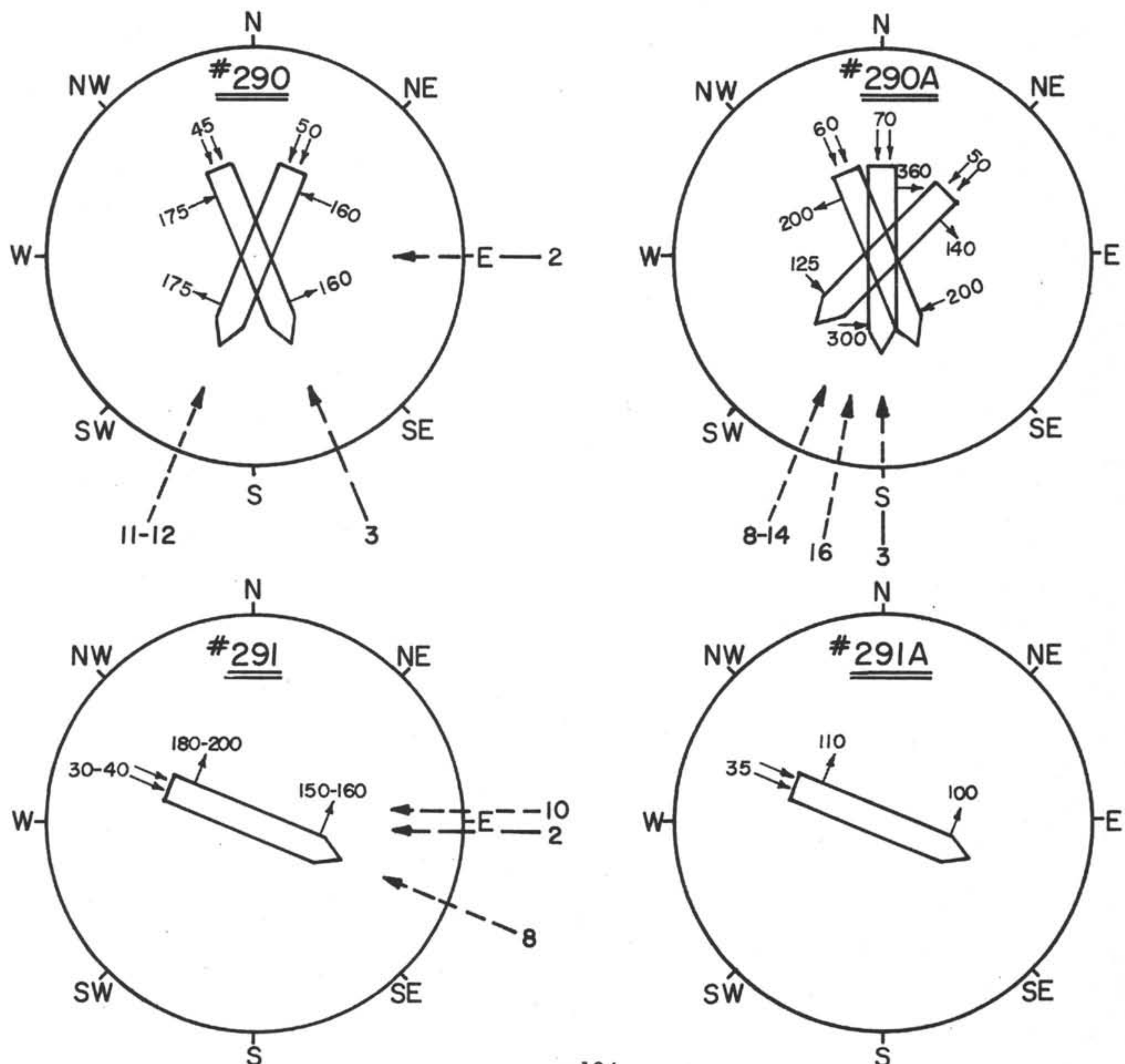
CHALLENGER HEADING

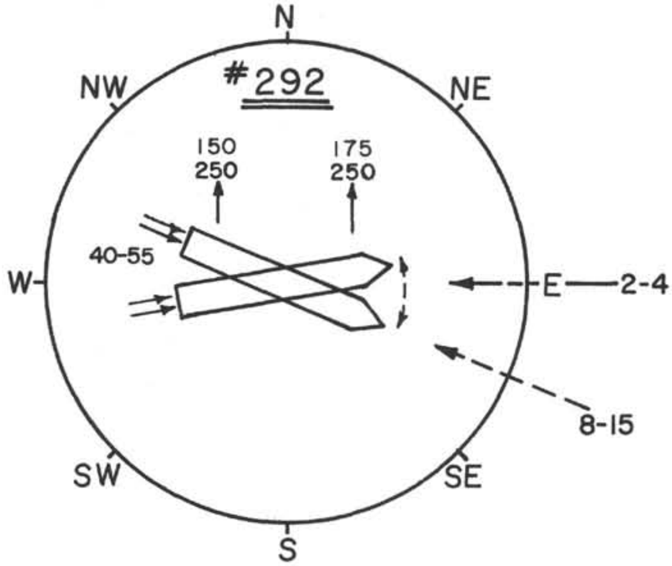
15 WIND: DIRECTION & SPEED (MPH)

6 SWELL: DIRECTION & HEIGHT (FT.)

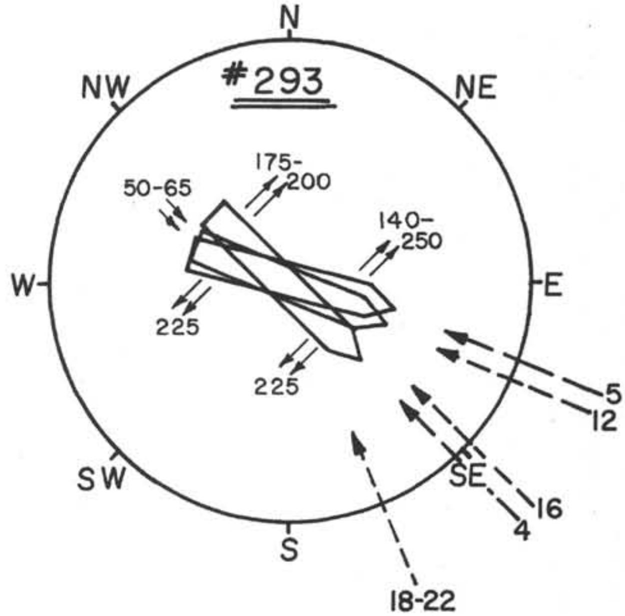
2 CURRENT: DIRECTION & SPEED (KTS.)



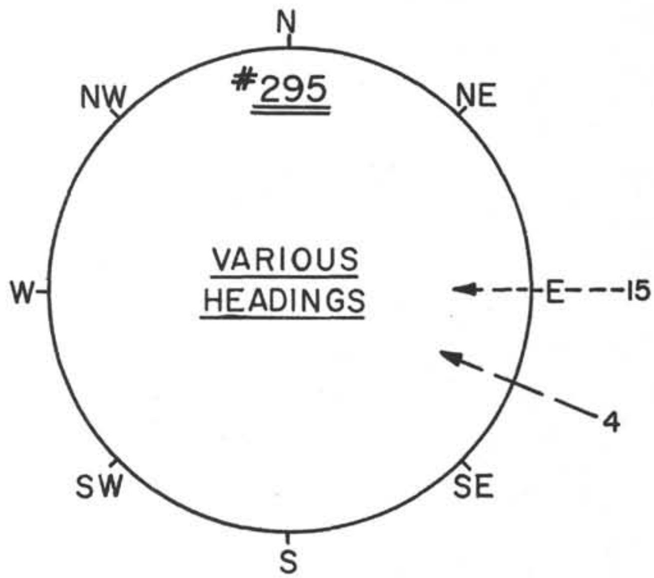


N
NW
NE
W
E
SW
SE
S
#292
150
250
175
250
40-55
2-4
8-15

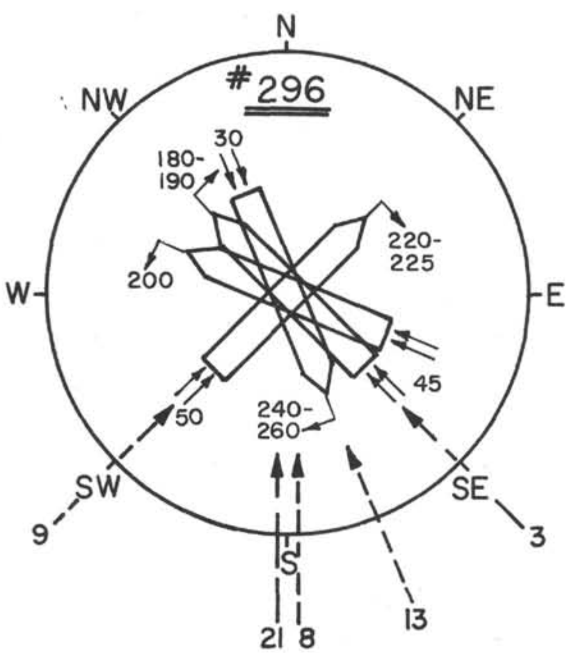



N
NW
NE
W
E
SW
SE
S
#293
175-
200
50-65
140-
250
225
225
5
12
16
4
18-22

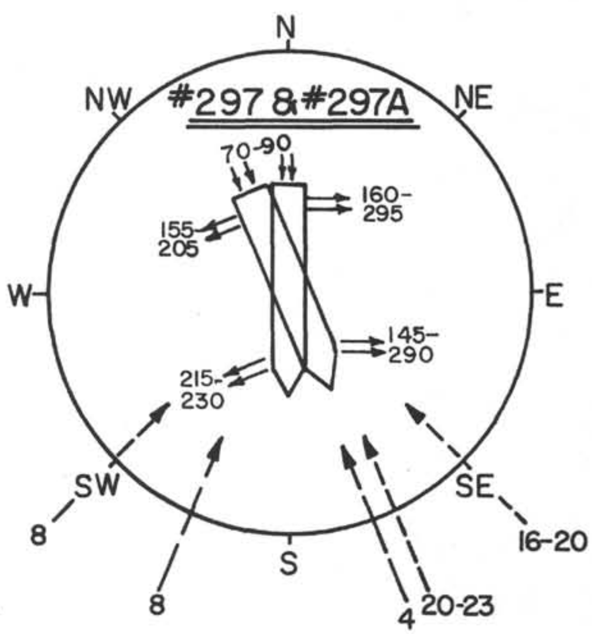

N
NW
NE
W
E
SW
SE
S
#294
30
240
200
10
3

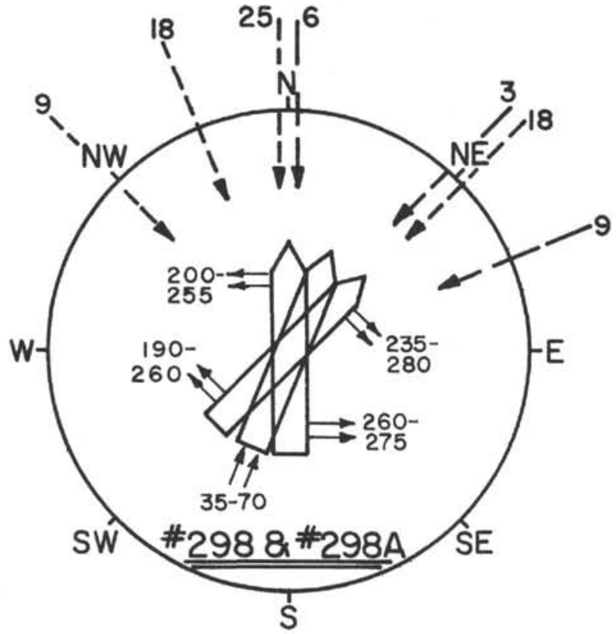
N
NW
NE
W
E
SW
SE
S
#295
VARIOUS
HEADINGS
15
4

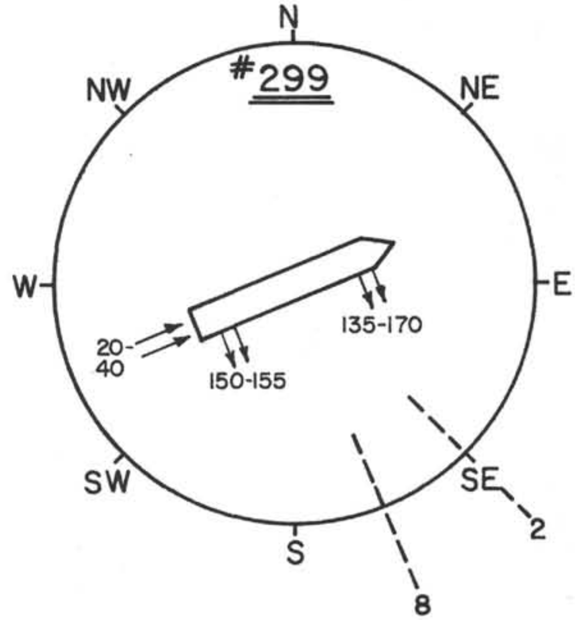



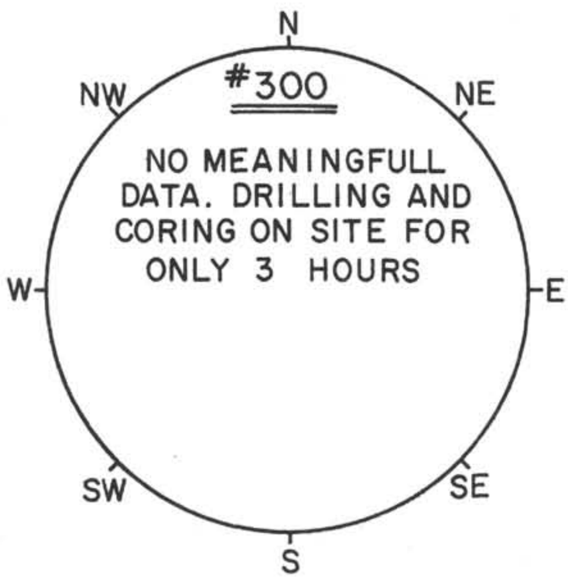
N
NW
NE
W
E
SW
SE
S
#296
180-
190
30
200
220-
225
45
50
240-
260
9
3
21
8
13

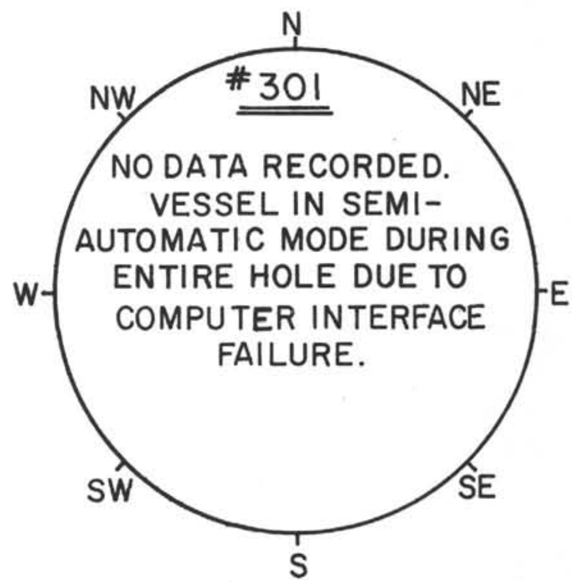



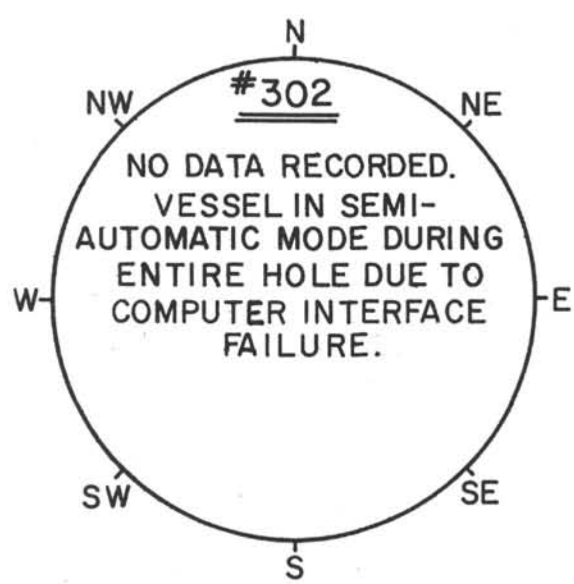
N
NW
NE
W
E
SW
SE
S
#297 & #297A
70-90
160-
295
155-
205
145-
290
215-
230
8
8
4
20-23
16-20


18
25
6
9
3
18
9
N
NW
NE
W
E
SW
SE
S
200-
255
190-
260
235-
280
260-
275
35-70
#298 & #298A


N
NW
NE
W
E
SW
SE
S
#299
20-
40
150-155
135-170
2
8


N
NW
NE
W
E
SW
SE
S
#300
NO MEANINGFULL
DATA. DRILLING AND
CORING ON SITE FOR
ONLY 3 HOURS


N
NW
NE
W
E
SW
SE
S
#301
NO DATA RECORDED.
VESSEL IN SEMI-
AUTOMATIC MODE DURING
ENTIRE HOLE DUE TO
COMPUTER INTERFACE
FAILURE.


N
NW
NE
W
E
SW
SE
S
#302
NO DATA RECORDED.
VESSEL IN SEMI-
AUTOMATIC MODE DURING
ENTIRE HOLE DUE TO
COMPUTER INTERFACE
FAILURE.

# DEEP SEA DRILLING PROJECT
## BEACON SUMMARY
## LEG 31

| Site No. | Make | Freq. kHz | Serial Number | Site Time Hours | Remarks |
|---|---|---|---|---|---|
| 290 | Burnett | 16 | 12 | 39 | Generally satisfactory. Dropped at 5 knots. Water depth 6057 M. Seas calm. Signal did deteriorate after 3 days while pulling out of hole at 290A but caused no problem. |
| 290A | Burnett | 16 | 12 | 38 | |
| | | | | 77 | |
| 291 | Burnett | 16 | 19 | 23.5 | Operation satisfactory. Strong signal throughout. Dropped at 5 knots. Water depth 5217 M. Seas calm. |
| 291A | Burnett | 16 | 19 | 16.5 | |
| | | | | 40.0 | |
| 292 | Burnett | 13.5 | 19 | 80.5 | Generally satisfactory. Beacon deteriorated during last part of hole; req'd manual positioning. Dropped at 5 knots. Water depth 2943 M. Inclement weather at times. |
| 293 | ORE | 13.5 | 151 | 0 | Unsatisfactory. Dropped at 5 knots. Water depth 5601 meters. Poor signal; req'd another beacon within 2 hrs. Later returned to normal but only 10% of power. |
| | Burnett | 16 | 20 | 82.5 | Operation satisfactory. Strong signal throughout. |
| 294 | ORE | 16 | 240 | 24.5 | Operation satisfactory. Good signal. Dropped at 5 knots. Water depth 5784 M. Seas calm. Partially operated in Manual due to computer failure. |
| 295 | Burnett | 13.5 | 20 | 21.0 | Operation satisfactory. Good signal. Dropped while vessel stopped. Water depth 5802 M. Seas calm. Operated 100% Manual due to computer failure. |
| 296 | ORE | 16 | 249 | 0 | Unsatisfactory. Dropped at 5 knots. Water depth 2920 M. Poor signal, similar to Site 293; req'd another beacon immediately. |
| | ORE | 13.5 | 212 | 101.0 | Operation satisfactory. Seas calm. |

<u>DEEP SEA DRILLING PROJECT</u>
<u>BEACON SUMMARY</u>
<u>LEG 31</u>
(Continued)

| Site No. | Make | Freq. kHz | Serial Number | Site Time Hours | Remarks |
|---|---|---|---|---|---|
| 297 | ORE | 16 | 235 | 67.5 | Operation satisfactory. Good signal. Dropped at 5 knots. Water depth 4458 M. Seas moderate. |
| 297A | ORE | 16 | 235 | 28.0 | |
| | | | | 95.5 | |
| 298 | ORE | 13.5 | 211 | 72.0 | Operation satisfactory. Good signal. Dropped at 5 knots. Water depth 4628 M. Seas moderate to |
| 298A | ORE | 13.5 | 211 | 18.5 | heavy. Acoustic losses for short periods during |
| | | | | 90.5 | passage of typhoon Ellen. (6-day beacon) |
| 299 | ORE | 13.5 | 221 | 0 | Unsatisfactory. Dropped at 5 knots. Water depth 2637 M. Weather calm. 7.0 ms signal originally; then 4.0 ms but 30 db reduced power. Req'd replacement in 15 min. |
| | ORE | 16 | 231 | 52.0 | Operation satisfactory. Seas calm. |
| 300 | ORE | 13.5 | 218 | 17.5 | Operation satisfactory. Good signal. Dropped at 5 knots. Water depth 3427 M. Seas light. |
| 301 | ORE | 16 | 238 | 0 | Unsatisfactory. Dropped at 5 knots. Water depth 3520 M. Seas light. Signal power 30 db low and unacceptable. |
| | ORE | 13.5 | 224 | 54.0 | Operation satisfactory. Seas calm - light. |
| 302 | ORE | 16 | 239 | 35.0 | Operation satisfactory. Good signal. Dropped at 5 knots. Water depth 2399 meters. Seas light. |

# DEEP SEA DRILLING PROJECT
## TIME DISTRIBUTION
## LEG 31

| Date | Site Number | Cruise Hours | Trips Hours | Drill Hours | Core Hours | Stuck Pipe Hours | Mechanical Downtime Hours | In Port Time Hours | Other Hours | Total Time Hours |
|---|---|---|---|---|---|---|---|---|---|---|
| 6/13-6/15 | | | | | | | | 47.3 | | 47.3 |
| 6/15-6/18 | | 73.2 | | | | | | | | 73.2 |
| 6/18-6/20 | 290 | | 14.5 | 4.0 | 20.5 | 0 | 0 | -- | 0 | 39.0 |
| 6/20-6/21 | 290A | | 13.0 | 2.5 | 5.0 | 17.5 | 0 | -- | 0 | 38.0 |
| | | | 27.5 | 6.5 | 25.5 | 17.5 | 0 | | 0 | 77.0 |
| 6/21-6/23 | | 47.5 | | | | | | | | 47.5 |
| 6/23-6/24 | 291 | | 10.5 | 1.0 | 9.5 | 0 | 0 | -- | 2.5 | 23.5 |
| 6/24-6/25 | 291A | | 10.5 | 1.0 | 4.0 | 0 | 0 | -- | 1.0 | 16.5 |
| | | | 21.0 | 2.0 | 13.5 | 0 | 0 | | 3.5 | 40.0 |
| 6/25-6/26 | | 30.5 | | | | | | | | 30.5 |
| 6/26-6/30 | 292 | | 13.5 | 0 | 65.5 | 0 | 0 | -- | 1.5 | 80.5 |
| 6/30-7/1 | | 31.5 | | | | | | | | 31.5 |
| 7/1-7/4 | 293 | | 24.5 | 6.0 | 51.5 | 0 | 0 | -- | 0.5 | 82.5 |
| 7/4-7/6 | | 46.0 | | | | | | | | 46.0 |
| 7/6-7/7 | 294 | | 10.0 | 0.5 | 14.0 | 0 | 0 | -- | 0 | 24.5 |
| 7/7 | | 3.0 | | | | | | | | 3.0 |

## DEEP SEA DRILLING PROJECT
## TIME DISTRIBUTION
## LEG 31
(Continued)

| Date | Site Number | Cruise Hours | Trips Hours | Drill Hours | Core Hours | Stuck Pipe Hours | Mechanical Downtime Hours | In Port Time Hours | Other Hours | Total Time Hours |
|---|---|---|---|---|---|---|---|---|---|---|
| 7/7-7/8 | 295 | | 13.0 | 1.0 | 7.0 | 0 | 0 | -- | 0 | 21.0 |
| 7/8-7/10 | | 45.5 | | | | | | | | 45.5 |
| 7/10-7/14 | 296 | | 18.5 | 13.0 | 69.0 | 0 | 0 | -- | 0.5 | 101.0 |
| 7/14-7/15 | | 11.0 | | | | | | | | 11.0 |
| 7/15-7/18 | 297 | | 16.5 | 5.5 | 42.5 | 0 | 0 | -- | 3.0 | 67.5 |
| 7/18-7/19 | 297A | | 16.0 | 2.0 | 0 | 0 | 10.0 | -- | 0 | 28.0 |
| | | | 32.5 | 7.5 | 42.5 | 0 | 10.0 | | 3.0 | 95.5 |
| 7/19 | | 13.0 | | | | | | | | 13.0 |
| 7/19-7/22 | 298 | | 14.5 | 12.0 | 33.5 | 0 | 0 | -- | 12.0 | 72.0 |
| 7/22-7/23 | 298A | | 11.0 | 1.5 | 1.5 | 0 | 1.5 | -- | 3.0 | 18.5 |
| | | | 25.5 | 13.5 | 35.0 | | 1.5 | | 15.0 | 90.5 |
| 7/23-7/26 | | 76.5 | | | | | | | | 76.5 |
| 7/26-7/28 | 299 | | 11.5 | 2.0 | 35.5 | 0 | 0 | -- | 3.0 | 52.0 |
| 7/28-7/29 | | 12.5 | | | | | | | | 12.5 |
| 7/29-7/30 | 300 | | 13.5 | 0.5 | 2.5 | 1.0 | 0 | -- | 0 | 17.5 |
| 7/30 | | 11.0 | | | | | | | | 11.0 |

DEEP SEA DRILLING PROJECT
TIME DISTRIBUTION
LEG 31
(Continued)

| Date | Site Number | Cruise Hours | Trips Hours | Drill Hours | Core Hours | Stuck Pipe Hours | Mechanical Downtime Hours | In Port Time Hours | Other Hours | Total Time Hours |
|---|---|---|---|---|---|---|---|---|---|---|
| 7/30-8/1 | 301 | | 14.5 | 3.5 | 26.5 | 0 | 0 | -- | 9.5 | 54.0 |
| 8/1-8/2 | | 14.5 | | | | | | | | 14.5 |
| 8/2-8/3 | 302 | | 11.5 | 4.0 | 18.5 | 0 | 0 | -- | 1.0 | 35.0 |
| 8/3-8/4 | | 20.0 | | | | | | | | 20.0 |
| Totals | | 435.7 | 237.0 | 60.0 | 406.5 | 18.5 | 11.5 | 47.3 | 37.5 | 1254.0 |

# DEEP SEA DRILLING PROJECT
## BIT SUMMARY
## LEG 31

| Hole | Mfg. | Size | Type | Serial Number | Meters Cored | Meters Drilled | Meters Total Penet. | Hours On Bit | Condition | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 290 | Smith | 10-1/8 | 3 CTR F93C Sealed Brg. | KN304 | 80.0 | 175.0 | 255.0 | 4.8 | | Core throat bent. Evidence of tooth interference. Six teeth missing. Several cracked or chipped. Ports plugged. Stabilizer hard facing worn. |
| 290A | Smith | 10-1/8 | 3 CTR F93C Sealed Brg. | KN304 | 19.0 | 121.0 | 140.0 | 1.7 | T-3, B-8 | |
| | | | | | 99.0 | 296.0 | 395.0 | 6.5 | | |
| 291 | Smith | 10-1/8 | 4 CTR 94 CJS Sealed Brg. | JZ 253 | 41.0 | 85.5 | 126.5 | 3.4 | | Much scarring on body & stabilizers. Evidence of cones locking on bent core throat. Ports open. |
| 291A | Smith | 10-1/8 | 4 CTR 94 CJS Sealed Brg. | JZ 253 | 16.5 | 98.0 | 114.5 | 1.4 | T-2, B-4 In gage. | |
| | | | | | 57.5 | 183.5 | 241.0 | 4.8 | | |
| 292 | Smith | 10-1/8 | 3 CTR F94C Sealed Brg. | KN081 | 443.5 | 0 | 443.5 | 20.8 | T-1, B-2 In gage. | Suitable for rerun in shallow hole. Core throat O.K. Ports open. |
| 293 | Smith | 10-1/8 | 3 CTR F94C Sealed Brg. | KN107 | 202.5 | 361.0 | 563.5 | 13.3 | T-8, B-8 Out of gage. | Many teeth missing. Core throat bent. Shank cracked. 2 ports plugged. Stabilizers worn. |
| 294 | Smith | 10-1/8 | 3 CTR 94 CJS Sealed Brg. | JZ 241 | 51.5 | 66.5 | 118.0 | 0.83 | T-1, B-1 In gage. | One tooth chipped. Bearing & core throat in good condition. Ports open. Good for rerun. (Core throat shortened prior to running.) |
| 295 | Smith | 10-1/8 | 3 CTR 94 CJS Sealed Brg. | JZ 241 | 28.5 | 129.5 | 158.0 | 0.73 | | |
| | | | | | 80.0 | 196.0 | 276.0 | 1.56 | | |
| 296 | Smith | 10-1/8 | 3 CTR 94 CJS Sealed Brg. | JZ 240 | 612.0 | 475.0 | 1087.0 | 18.8 | T-4, B-4 In gage. | Core throat modified. Core throat good condition. Several inside teeth missing. One port plugged. |
| 297 | Smith | 10-1/8 | 3 CTR F940 Sealed Brg. | KN084 | 242.5 | 437.0 | 679.5 | 9.7 | T-1, B-1 In gage. | Core throat modified. Apparently in good shape in spite of occ. high bit loads due to sanded b. subs. Core throat & ports O.K. One cone has 14 cracks between T.C. inserts. |
| 297A | Smith | 10-1/8 | 3 CTR F940 Sealed Brg. | KN084 | 0 | 200.5 | 200.5 | 0.8 | T-2, B-6 In gage. | |
| | | | | | 242.5 | 637.5 | 880.0 | 10.5 | | |
| 298 | Smith | 10-1/8 | 3 CTR 94 CJS Sealed Brg. | JZ 242 | 145.5 | 465.5 | 611.0 | 16.9 | Unknown | Core throat modified. Bit lost in hole. |
| 298A | Smith | 10-1/8 | 3 CTR 94 CJS Sealed Brg. | JZ 242 | 9.5 | 88.5 | 98.0 | 0.8 | | |
| | | | | | 155.0 | 554.0 | 709.0 | 17.7 | | |

DEEP SEA DRILLING PROJECT
BIT SUMMARY
LEG 31
(Continued)

| Hole | Mfg. | Size | Type | Serial Number | Meters Cored | Meters Drilled | Meters Total Penet. | Hours On Bit | Condition | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 299 | Smith | 10-1/8 | 3 CTR F94C Sealed Brg. | KN106 | 361.0 | 171.0 | 532.0 | 5.3 | T-1, B-1 In gage. | Core throat modified. Suitable for rerun. Everything in good condition. |
| 300 | Smith | 10-1/8 | 3 CTR F94C Sealed Brg. | KN106 | 10.5 | 106.5 | 117.0 | 0.5 | T-1, B-1 In gage. | Core throat modified. Suitable for rerun. Everything in good condition. |
| 301 | Smith | 10-1/8 | 3 CTR F94C Sealed Brg. | KN106 | 183.5 | 313.5 | 497.0 | 4.7 | T-1, B-1 In gage. | Good for rerun in hole of shallow basement penetration. |
| | | | | Total | 555.0 | 591.0 | 1146.0 | 10.5 | | |
| 302 | Smith | 10-1/8 | 3 CTR F943 Sealed Brg. | KN085 | 164.5 | 367.0 | 531.5 | 6.1 | T-1, B-1 In gage. | Core throat modified. Everything in good condition. Suitable for rerun. |

# DEEP SEA DRILLING PROJECT
## SITE SUMMARY
## LEG 31

| Hole | Latitude | Longitude | Water Depth Meters | No. Of Cores | Cores With Recovery | % of Cores W/ Rec. | Meters Cored | Meters Recovered | Percent Recovered | Meters Drilled | Total Penet. Meters | Avg. Rate Penet. | Time On Hole | Time On Site |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Palau-Kyushu Apron, Philippine Sea | | | | | | | | | | | | | | |
| 290 | 17°44.85'N | 133°28.08'E | 6057 | 9 | 8 | 89.0 | 80.0 | 38.9 | 48.6 | 175.0 | 255. | 51.0 | 39.0 | 39.0 |
| 290A | 17°45.05'N | 133°28.44'E | 6057 | 2 | 1 | 50.0 | 19.0 | 1.9 | 10.0 | 121.0 | 140. | 73.7 | 38.0 | 77.0 |
| West Philippine Basin | | | | | | | | | | | | | | |
| 291 | 12°48.43'N | 127°49.85'E | 5217 | 5 | 5 | 100.0 | 41.0 | 10.0 | 24.4 | 85.5 | 126.5 | 90.5 | 23.5 | 23.5 |
| 291A | 12°48.45'N | 127°49.98'E | 5217 | 2 | 1 | 50.0 | 16.5 | 1.4 | 8.5 | 98.0 | 114.5 | 81.9 | 16.5 | 40.0 |
| Benham Rise | | | | | | | | | | | | | | |
| 292 | 15°49.11'N | 124°39.05'E | 2943 | 47 | 46 | 98.0 | 443.5 | 242.8 | 54.7 | 0 | 443.5 | 21.3 | 80.5 | 80.5 |
| Luzon Slope | | | | | | | | | | | | | | |
| 293 | 20°21.25'N | 124°05.65'E | 5601 | 23 | 20 | 87.0 | 202.5 | 78.8 | 38.9 | 361.0 | 563.5 | 42.4 | 82.5 | 82.5 |
| West Philippine Basin | | | | | | | | | | | | | | |
| 294 | 22°34.74'N | 131°23.13'E | 5784 | 7 | 6 | 86.0 | 51.5 | 23.2 | 45.0 | 66.5 | 118.0 | 142.0 | 24.5 | 24.5 |
| 295 | 22°33.76'N | 131°22.04'E | 5802 | 3 | 3 | 100.0 | 28.5 | 19.8 | 69.4 | 129.5 | 158.0 | 216.0 | 21.0 | 21.0 |
| Palau-Kyushu Ridge | | | | | | | | | | | | | | |
| 296 | 29°20.41'N | 133°31.52'E | 2920 | 65 | 64 | 98.5 | 612.0 | 312.1 | 51.0 | 475.0 | 1087.0 | 58.7 | 101.0 | 101.0 |
| Shikoku Basin | | | | | | | | | | | | | | |
| 297 | 30°52.36'N | 134°09.89'E | 4458 | 27 | 26 | 96.5 | 242.5 | 124.2 | 51.2 | 437.0 | 679.5 | 70.0 | 67.5 | 67.5 |
| 297A | 30°52.36'N | 134°09.89'E | 4458 | 0 | 0 | 0 | 0 | 0 | 0 | 200.5 | 200.5 | 250.0 | 28.0 | 95.5 |
| Shikoku Trench | | | | | | | | | | | | | | |
| 298 | 31°42.93'N | 133°36.22'E | 4628 | 16 | 16 | 100.0 | 145.5 | 66.8 | 45.9 | 465.5 | 611.0 | 36.2 | 72.0 | 72.0 |
| 298A | 31°42.93'N | 133°36.22'E | 4628 | 1 | 1 | 100.0 | 9.5 | 0.4 | 4.2 | 88.5 | 98.0 | 122.5 | 18.5 | 90.5 |
| Yamato Basin | | | | | | | | | | | | | | |
| 299 | 39°29.69'N | 137°39.72'E | 2583 | 38 | 36 | 94.7 | 361.0 | 172.3 | 47.7 | 171.0 | 532.0 | 100.4 | 52.0 | 52.0 |
| Japan Basin | | | | | | | | | | | | | | |
| 300 | 41°02.96'N | 136°06.30'E | 3427 | 2 | 0 | 0 | 10.5 | 0 | 0 | 106.5 | 117.0 | 234.0 | 17.5 | 17.5 |
| 301 | 41°03.75'N | 134°02.86'E | 3520 | 20 | 17 | 85.0 | 183.5 | 49.9 | 27.2 | 313.5 | 497.0 | 105.7 | 54.0 | 54.0 |
| Yamato Ridge | | | | | | | | | | | | | | |
| 302 | 40°20.13'N | 136°54.01'E | 2399 | 18 | 16 | 88.9 | 164.5 | 91.0 | 55.3 | 367.0 | 531.5 | 87.1 | 35.0 | 35.0 |
| Summary | | | | 285 | 266 | 93.3 | 2611.5 | 1233.5 | 47.2 | 3661.0 | 6272.5 | 56.7 | | |

# DEEP SEA DRILLING PROJECT
# OPERATIONS RESUME
# LEG 32

After spending 11.5 days in port, the Challenger departed Hakodate, Japan at 06:30 hours on August 16, 1973 and terminated the voyage in Honolulu, Hawaii at 14:15 hours on October 10, 1973.

During this 67.6 day leg, the Glomar Challenger cruised 4712 nautical miles, and drilled 12 holes, while investigating 11 sites; cored 2210.5 meters in 241 coring attempts. A total of 738.8 meters of core were recovered for an average of 33.4%. In addition to the coring, 1369 meters were drilled for a total penetration of 3579.5 meters.

Major time distribution for the 67.6 days consisted of 11.5 days in port, 21.3 days cruising, 34.77 days on site, 1.72 days drilling, 18.25 days coring, 9.87 days making trips with the drill string, 2.06 days waiting on weather, .29 days working stuck drill pipe, .32 days rig repair and 2.26 days includes servicing equipment, locating the mudline, picking up new drill collars and other miscellaneous operations.

The lithological sequence on the first three sites consisted of soft nanno ooze overlaying thick sections of chert embedded in soft clay as chalky ooze. These sites had over 100 meters of soft sediment before encountering the chert layers which caused considerable trouble with hole conditions and core recovery. One of these sites was continuously cored, the others were drilled to the first reflector and then continuously cored to bottom. Recovery in the soft oozes was very good, however, recovery in the chert stringers was poor.

Previous legs in the Western Pacific had experienced many operational problems, such as the loss of bottomhole assemblies due to thin sediment cover, stuck drill pipe, plugged bits, deep water, inoperative bumper subs, rough seas and below average core recovery. These problems had led to several tool modifications. Bumper subs without mud slots in the outer body had been tested for the past year and were successful in eliminating the tools from "sanding up" and becoming inoperative. Journal bearing bits were available to extend bit life. The near bit float valve eliminated the back flow through the drill pipe that usually caused the bit to plug. The chert, however, continued to frustrate core recovery and the weather accounted for two days of lost time.

## DRILLING AND CORING

To drill and core several hundred meters of chert, soft clay and chalk ooze, the basic bottomhole assembly was used on all sites and consisted of: one 8-1/4 inch core barrel, three 8-1/4 inch drill collars, two bumper subs (new type), three 8-1/4 inch drill collars, two bumper subs (new type) two 8-1/4 inch drill collars, one 7-1/4 inch drill collar and one joint of heavy wall drill pipe. This assembly is 127 meters long and will provide 30,000 pounds of weight that can be applied to the bit. The float valve is located just above the bit. While retrieving the core barrel, the float valve closes and prevents swabbing of the drill pipe and the back flow of cuttings and slough.

Weather was the biggest problem on the first site (#303) and hole conditions were poor on the second site (#304). On site #304 core recovery was very poor regardless of how much pump pressure, bit weight or rotary spped was applied. Dry drilling of the soft clays and chalk oozes between the chert stringer did, however, provide the scientists with sufficient core to date these sediments. A spring tensioned extended core barrel was tried one time. It was successful in 0.75 meters of core recovery of soft chalky ooze. In making this coring run, the extended core barrel became flared out and was temporarily stuck in the throat of the bit. After this, the scientists preferred not to run the extended barrel again due to the risk of losing the hole due to a stuck inner barrel.

There are a number of reasons why core recovery is difficult while coring cherts embedded in the soft oozes and clay:

1. In some instances the bit will break through a thin chert layer and a section of the chert is pushed ahead of the bit. This blocks off or "jams" the core barrel and will not permit additional sediment to enter the core barrel.

2. A minimum of 10 strokes of pump per minute (gpm) is required to maintain circulation while drilling chert. This much fluid washes away the oozes and clay from between the chert layers.

3. On many coring attempts, a piece of round chert will be wedged in the core catchers and prevents additional entry of sediment into the core barrel.

4. Apparently some of the soft sediments are water sensitive. Many cores recovered consist of a piece of chert with milky water trapped in the core barrel.

5. The "chert gravel" accumulates in the bottom of the hole and get progressively worse with depth while coring chert. Apparently there is no way of disposing of these cuttings. They are too heavy to circulate out and too hard to grind into smaller pieces. At times, cores consist of 2 or 3 meters of this chert gravel.

Stuck pipe, plugged bits and stuck core barrels were a common problem throughout most of the leg. On Site #305, the core barrel was stuck and the bit was plugged at 410 meters subbottom. A second core barrel, equipped with a sand catcher, then was dropped on top of the stuck barrel. When retrieved, the second core barrel had chalk ooze trapped in the bottom. This indicated that the hole had caved and the back flow had washed cuttings up inside the drill pipe and caused the bit to plug and the core barrel to stick. After pulling out a few stands of pipe, circulation was established and the core barrel was retrieved. Nine meters of chert cuttings were recovered.

Site #307, located southwest of Shatsky Rise, was one of the more difficult sites to drill. Hard chert was encountered at 32 meters subbottom and three hours were required to core nine meters. Chert was recovered on every core until contact with basalt at 312 meters. The drill string became stuck on three different occasions. A total of 215 barrels of mud were used to stabilize hole conditions and to free the stuck drill pipe. The pipe stuck on bottom once while drilling; apparently the drill string was stuck at the bit because all the bumper subs were working. After torquing and pulling on the drill string, the pipe came free. The hole was flushed with mud and drilling was resumed.

The problem of getting through the multiple chert layer and to the basalts has been basically solved. With the bits that are presently in use, we have the capability of penetrating several hundred meters of chert string and still penetrating basalt. The major remaining problem that plagues operations when penetrating cherts is drill string sticking. Chert cuttings that accumulate on bottom are a part of this problem. Button bits appear more effective at grinding these chert cuttings into smaller pieces than the longer chisel tooth bits and this helps prevent the drill pipe from sticking. Bumper subs that completely sand up with fine chert cuttings become inoperative and will not remove the vessel motion from the drill string. This causes the drill string to be forced laterally against the well bore and breaks off the exposed chert stringer. The pieces then fall around the bit or sand up in the bumper subs. In either case, the drill string usually becomes stuck. Without full bumper sub action, the chances of releasing the drill string are greatly reduced. Using the new type bumper subs that have no mud slots, there was no accumulation of chert cuttings in the bumper subs on any of the 12 holes that were drilled. The drill pipe did stick on several occasions but each time the string was jarred loose by the hammer effect of the four free working bumper subs.

Four sites had less than the required 100 meters of sediment needed to support a bottom-hole assembly. Two of the sites were drilled without any major difficulties, but on each of the other two sites the bottomhole assembly broke at the bottom of the lower bumper sub. On each of these sites, a core barrel, three 8-1/4 inch drill collars and one bumper sub were lost. A third bumper sub was bent and damaged beyond repair. Data is conclusive that we can spud in with less than 100 meters of sediment but tool losses will increase as the sediment gets thinner, however, these risks are at times warranted by the scientific objectives.

A drill pipe spinner wrench was installed on the rig floor after completion of the first drill site. The main purpose of the spinner wrench was rig floor safety. It replaced the spinning rope that had been used to screw the stands of pipe together when tripping in. A safer operation was achieved and, in addition, the time for "tripping in" of the drill pipe was reduced by two hours on a 18,000 foot hole.

## BITS

All bits were the journal bearing type except a Smith 9C (4-cone seal bearing) button bit that was used on Shatsky Rise, Site #306. On Site #303 and #303A, a 3-cone bit was used. On all subsequent sites, a 4-cone bit was used. On Sites #305 and #306 the bits were run until the cones and legs were worn from the bit body.

Site #312 was abandoned after waiting on weather for 19.25 hours. A beacon was dropped but the hole was never spudded.

One - 3-cone, journal bearing, shaped insert
One - 4-cone, sealed bearing, button insert
Seven - 4-cone, journal bearing, shapped inserts

Included in the seven 4-cone bits, were two experimental bits. These bits have a 1-3/4 inch deeper throat than the other five bits. This modification was made to improve core recovery by having the core catcher closer to the bottom of the hole. Recovery with this bit was good on Site #313 while coring cherts, chalk, limestone and hard sand, but on several occasions, the core barrel stuck in the bit and required an extra wireline run to retrieve it. It is possible this was caused by the nature of the sediment that was cored, or was caused by the added depth to the throat of the bit where cuttings or sand can be trapped between the core barrel and bit.

On Site #312, "tripping-in" operation was suspended after the bottomhole assembly had been assembled. Due to the wind and swell conditions, the ship was unable to maintain a heading into the swell. The core barrel was dropped to keep the float valve open while waiting on weather with the bottomhole assembly suspended. When the weather had subsided, the bottomhole assembly was removed to inspect all connections and bumper subs. We discovered that the bit throat had cracked into four pieces. The core barrel is designed to impact on the support bearing but apparently the spacing was too long and the core barrel landed on the throat of the bit. This spacing problem has been corrected and the bit has been returned to the manufacturer for repair and evaluation.

The bits that are presently being used on the Project are capable of penetrating 400 to 500 meters into chert, but to sample basement on the Shatsky Rise with a single bit is highly improbable and re-entry will be required to penetrate the estimated 800 to 900 meters of chert above basement.

## ORIENTED CORING

Oriented coring was scheduled for Leg 32 to study the magnetic anomalies of the Western Pacific. A specialist from the Sperry Sun Well Survey Company was on board to supervise this oriented coring and to interpret the oriented cores.

Site #304 was selected for the first attempt at oriented coring from the Glomar Challenger. A gammaloy (non-magnetic) core barrel was used with the rest of the standard bottomhole assembly. The hole was drilled in 5640 meters of water. After recovering basalt from 5975 meters to 5983 meters, the non-magnetic inner core barrel was assembled with a 3 point scriber and segment core catcher. The orientation survey instrument was spaced to the proper distance inside the inner barrel. The assembly was dropped into its coring position. Four meters were cored in 3-1/2 hours and during this time, the rotation of the drill string and mud pumps were stopped on eight occasions for pictures to be taken on half meter intervals. The core barrel was retrieved with the sandline but only half the core barrel was recovered. The inner core barrel had unscrewed at the middle connection and the half of the inner core barrel with the core was left in the hole. The site was then terminated and the drill pipe tripped out of the hole. The bottom section of the inner barrel was undamaged and a half meter of basalt core was recovered. The core that was recovered had three scribe marks along the sides of the core. The latch sleeve at the top of the core barrel was found to be unscrewed and had dropped around the inner barrel.

The multishot film was of no value since the inner barrel had unscrewed and lost its orientation. The film was developed but was of no scientific value. Many of the pictures were stacked on top of each other and the direction was a fllp flop from one direction to another. The hole angle was fairly constant at 2-1/2° to 3°.

There is some concern that the sensitive downhole instrument compass may have been influenced by the magnetic field of the basalt and on board tests indicated that the basalt did influence the compass to a small degree. More experience with oriented cores in basalt will be required. Leg 34 is now scheduled for additional oriented coring.

Basalt was reached on two other sites but oriented cores were not attempted because of very poor, unstable hole conditions. Oriented coring requires that the drill string remain motionless, on bottom, without pump for several minutes which is hazardous in these areas.

## SHIPS POSITIONING

Only on two occasions were there any problems with the positioning computer and neither of these failures interferred with operations. The computer dumped its program after Site #303 was finished. The other failure occurred while underway between sites.

The ship's hydrophones were lowered four feet to attempt to stop acoustic losses while waiting on weather at Site #303A. A noticeable improvement was found and the hydrophones were then lowered to ten feet and stopped 90% of the acoustic losses previously experienced. On the remaining eight sites, the hydrophones were lowered ten feet just after the beacon drop. Some loss of acoustics were experienced at Site #310A when winds were gusting over 70 mph. The current would push the forward thruster wake water under the keel and cause air to get into the hydrophones even when lowered.

## WEATHER

Weather was involved in the drilling of all sites with the exception of Site #305 and #313, which was our last site. A total of 49.5 hours were lost while waiting on weather. Winds were 25 to 40 mph on nearly all drill sites. Full gales were experienced on Sites #303 and #310 with maximum winds of 75 mph with 18 to 20 foot seas. The ship's positioning was made difficult by the two or three different swells that were running in different directions. On Site #312, the seas were only about 8 feet but the wind and current were from the same direction and 90° from the swell. This site was never drilled, only a beacon was dropped. After waiting on weather for 19-3/4 hours, plans to drill this site were abandoned.

Sites that were directly involved with weather and where lost time was recorded are as follows:

1. Site 303A

   Lost eight hours, prior to spud, due to gale force winds and heavy seas. The drill string was suspended with the bit above the mudline, while riding out the storms.

2. Site 308

   Only 1/2 hour was lost to bad weather. The site was abandoned because of a current/swell condition that was causing the ship to pitch 4° and roll 13°. Pulled the drill pipe out of the hole to inspect the bottomhole assembly. The site was not redrilled due to bad weather and thin sediment.

3. Site 310

   This site was abandoned after it had been drilled approximately 185 meters below the mudline. Winds up to 60 mph were too strong for the ship to maintain a proper heading into the swell. Pulled the bit above the mudline and wait on weather for 11-1/4 hours.

4. Site 310A

   Wait on weather for a total of ten hours before the site was spudded. The weather conditions were the same as Site #310.

5. <u>Site 312</u>

This site was never spudded. Only the beacon was dropped and the bottomhole assembly was assembled then left suspended for 19-3/4 hours because of confused swells with the wind and current form 90°. Ship didn't have the thrust power to keep a heading into the swell and thrust against the wind and current.

## CREWS PERFORMANCE

As would be expected of the Challenger's crews, the seaman and drilling crews did an outstanding job. Without professional seamanship, we probably would have broken the bottomhole assembly at least on two occasions. The drilling crews worked under adverse conditions of a rolling ship on most of the drill sites. Through their determination and skills, many objectives were reached and with a minimal loss of equipment.

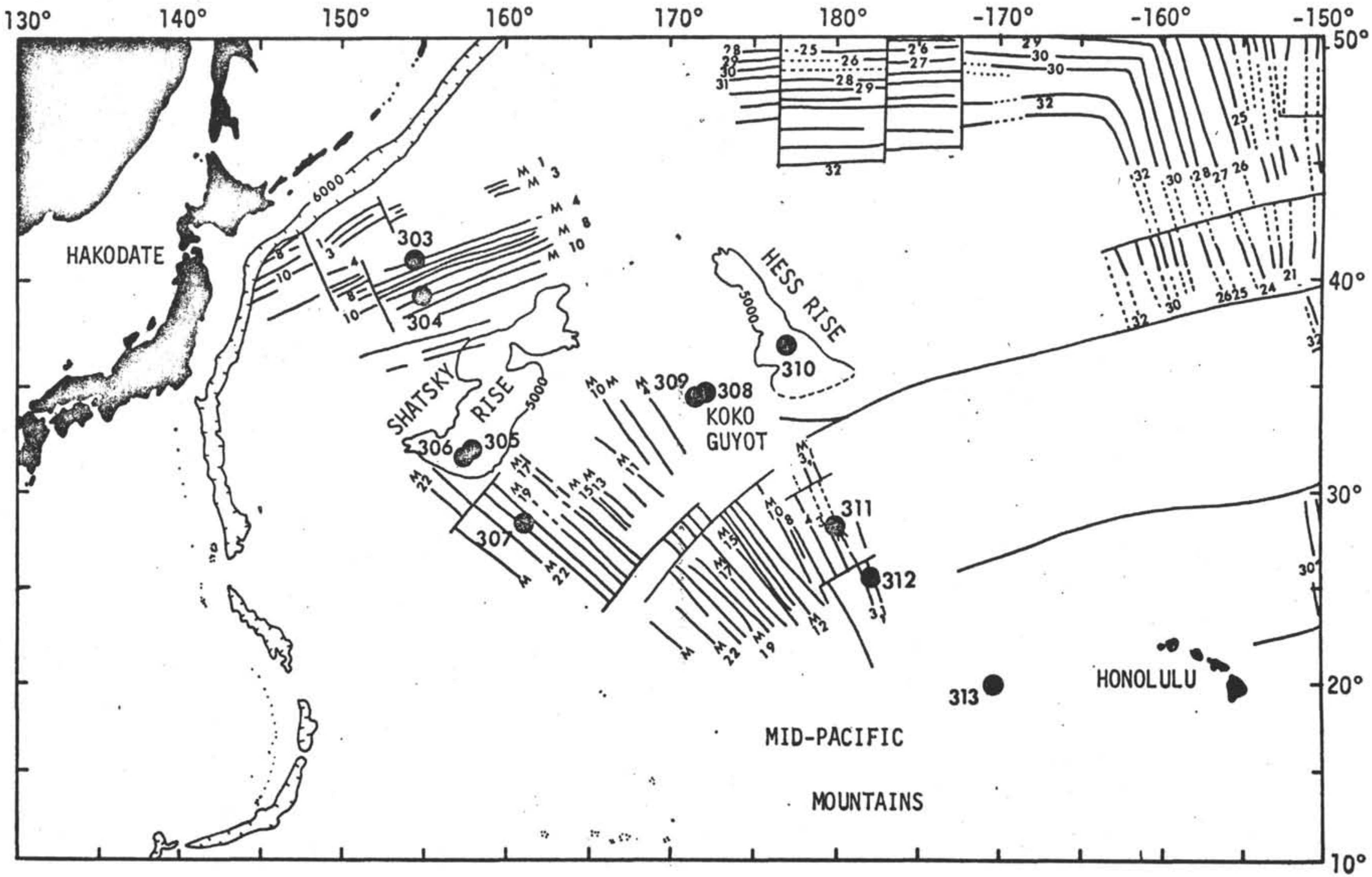
Lamar Hayes

Lamar P. Hayes
Cruise Operations Manager
Deep Sea Drilling Project

October 1973

# DEEP SEA DRILLING PROJECT
## SUMMARY OF OPERATIONS
## LEG 32

| | | |
|---|---|---|
| Total Days Leg (August 4 - October 10, 1973 | | 67.6 |
| Total Days In Port | | 11.52 |
| Total Days Cruising | | 21.30 |
| Total Days On Site | | 34.77 |
| Trip Time | 9.87 | |
| Drilling Time | 1.72 | |
| Coring Time | 18.25 | |
| Mechanical Downtime | .32 | |
| Stuck Pipe | .29 | |
| Wait On Weather | 2.06 | |
| Other | 2.26 | |
| Total Distance Traveled (Nautical Miles) | | 4712 |
| Average Speed (Knots) | | 8.7 |
| Sites Investigated | | 11 |
| Holes Drilled | | 12 |
| Number of Cores Attempted | | 241 |
| Number of Cores With Recovery | | 220 |
| Total Meters Cored | | 2210.5 |
| Total Meters Recovered | | 738.8 |
| Percent of Core Recovered | | 33.4 |
| Total Meters Drilled | | 1369 |
| Total Meters of Penetration | | 3579.5 |
| Maximum Water Depth | | 5708 |
| Maximum Penetration | | 640.5 |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SHATSKY RISE
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HESS RISE
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KOKO GUYOT
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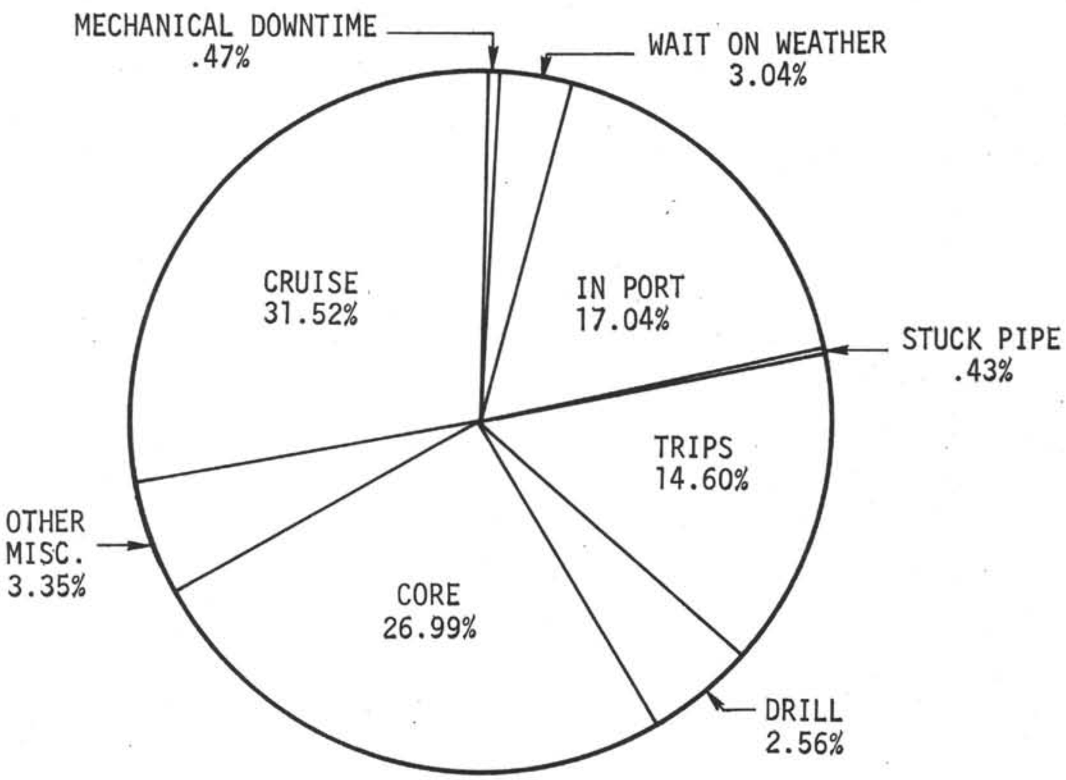
313
HONOLULU
MID-PACIFIC
MOUNTAINS

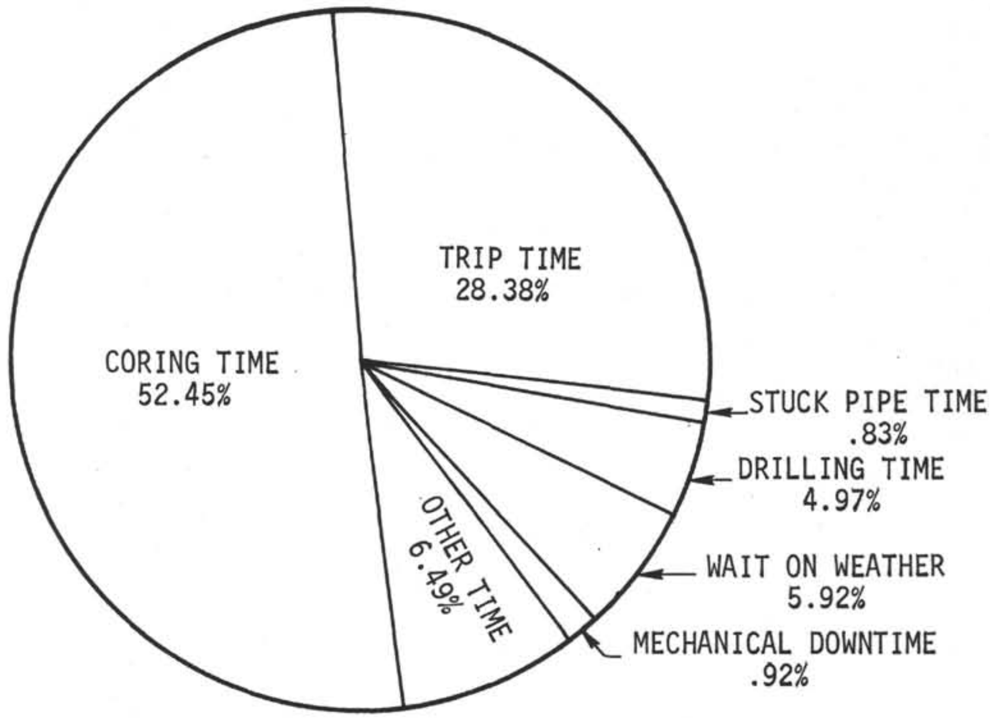
LEG 32

TOTAL TIME DISTRIBUTION



LEG 32

SITE TIME DISTRIBUTION




Included in Others:
- Magnaflux BHA
- Service rig and drilling line
- Position ship over beacon
- Fishing for core barrel, etc.
- Run side wall sampler

DEEP SEA DRILLING PROJECT
BEACON SUMMARY
LEG 32

| Site No. | Make | Freq. kHz | Serial Number | Site Time Hours | Remarks |
|---|---|---|---|---|---|
| 303 | ORE | 13.5 | 229 | 11.25 | Signal dropped off 30 d.b. Could not position ship. |
| | | 16.0 | 249 | 116.50 | Good signal. |
| 304 | ORE | 13.5 | 220 | 72.25 | Dropped at 4 knots. Good signal. |
| 305 | ORE | 16.0 | 245 | 119.00 | (12 day beacon) Strong signal. |
| 306 | ORE | 13.5 | 226 | 105.75 | Dropped at 4 knots. Good signal. |
| 307 | ORE | 16.0 | 233 | 97.25 | Dropped at 4 knots. Good signal. |
| 308 | ORE | 13.5 | 228 | 21.75 | Dropped at 4 knots. Good signal. |
| 309 | ORE | 16.0 | 244 | 17.00 | Dropped at 5 knots. Good signal. |
| 310 | ORE | 13.5 | 213 | 93.75 | Dropped at 5 knots. Good signal. |
| 311 | ORE | 16.0 | 237 | 43.25 | Dropped at 5 knots. Good signal. |
| 312 | ORE | 13.5 | 210 | 29.25 | Signal weak. Positioning was OK. |
| 313 | ORE | 13.5 | 219 | 89.75 | Good signal. |

## DEEP SEA DRILLING PROJECT
## BIT SUMMARY
## LEG 32

| Hole | Mfg. | Size | Type | Serial Number | Meters Cored | Meters Drilled | Meters Total Penet. | Hours On Bit | Condition | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 303 | Smith | 10-1/8 | F94C 3CTR | KN105 | 54.0 | 175.0 | 229.0 | 3.0 | B1, T1 | Stuck core barrel in drill pipe. |
| 303A | Smith | 10-1/8 | F94C 3CTR | KN105 | 82.0 | 211.0 | 293.0 | 8.2 | B8, T2 | 7.5m of chert and 8m of basalt. |
| | | | | | 136.0 | 386.0 | 522.0 | 11.2 | | |
| 304 | Smith | 10-1/8 | F94C 4CTR | PC188 | 131.0 | 216.0 | 347.0 | 16.4 | B8, T5 | Cored 12m of basalt. Two cones were locked. |
| 305 | Smith | 10-1/8 | F94C 4CTR | PC186 | 631.0 | 9.5 | 640.5 | 25.5 | B8, T8 | Penetrated 450m of chert. Left two cones and one shank in hole. |
| 306 | Smith | (Rerun from Site 288C) | | | 380.5 | 94.5 | 475.0 | 40.2 | B8, T8 | Drilled 470m of chert streaks. Left all 4 cones in hole. |
| 307 | Smith | 10-1/8 | F94C 4CTR | PC203 | 111.0 | 205.5 | 316.5 | 24.0 | B4, T7 | 275m of chert and 7m of basalt. Inside teeth broken. |
| 308 | Smith | 10-1/8 | F94C 4CTR | PC189 | 30.5 | 38.0 | 68.5 | 3.4 | B1, T1 | Same as new. |
| 309 | Smith | 10-1/8 | F94C 4CTR | PC189 | 2.0 | 10.0 | 12.0 | 2.4 | | Broke bottomhole assembly. Bit lost in hole. |
| 310 | Smith | 10-1/8 | F94C 4CTR | PC192 | 193.5 | 0 | 193.5 | 2.6 | | Clear mudline. Wait on weather. |
| 310A | Smith | 10-1/8 | F94C 4CTR | PC192 | 163.5 | 189.0 | 352.5 | 8.8 | B6, T6 | |
| 311 | Smith | 10-1/8 | F94C 4CTR | PC191 | 37.0 | 9.0 | 46.0 | 7.5 | | Lost in Hole. |
| 312 | Smith | 10-1/8 | F94C 4CTR | PC187 | 0 | 0 | 0 | 0 | | Bad weather. Hole was not drilled. |
| 313 | Smith | 10-1/8 | F94C 4CTR | PC187 | 394.5 | 211.5 | 606.0 | 22.1 | B3, T3 | Drilled 400m of chalk, limestone and chert and 12m of basalt. |

# DEEP SEA DRILLING PROJECT
## SITE SUMMARY
## LEG 32

| Hole | Latitude | Longitude | Water Depth Meters | Number Of Cores | Cores With Recovery | Percent With Recovery | Meters Cored | Meters Recovered | Percent Recovered | Meters Drilled | Total Penet. Meters | Avg. Rate Penet. | Time On Hole | Time On Site |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 303 | 40° 48.50'N | 154° 27.08'E | 5625 | 6 | 4 | 66 | 54.0 | 25.8 | 47.7 | 175.0 | 229.0 | 76 | 72.00 | |
| | | | 5625 | 10 | 8 | 80 | 82.0 | 5.8 | 7.0 | 211.0 | 293.0 | 35 | 55.75 | 127.75 |
| 304 | 39° 20.27'N | 155° 04.19'E | 5640 | 17 | 14 | 82 | 131.0 | 30.1 | 23.0 | 216.0 | 347.0 | 19 | 72.25 | 72.25 |
| 305 | 32° 00.13'N | 157° 51.00'E | 2921 | 58 | 48 | 82 | 631.0 | 210.6 | 33.4 | 9.5 | 640.5 | 25 | 119.00 | 119.00 |
| 306 | 31° 52.02'N | 158° 28.71'E | 3416 | 43 | 39 | 90 | 380.5 | 27.3 | 7.2 | 94.5 | 475.0 | 12 | 105.75 | 105.75 |
| 307 | 28° 35.26'N | 161° 00.28'E | 5708 | 13 | 13 | 100 | 111.0 | 19.4 | 17.5 | 205.5 | 316.5 | 13 | 97.25 | 97.25 |
| 308 | 34° 58.94'N | 172° 08.98'E | 1346 | 5 | 4 | 80 | 30.5 | 7.3 | 23.9 | 38.0 | 68.5 | 20 | 21.75 | 21.75 |
| 309 | 34° 54.32'N | 171° 33.67'E | 1470 | 1 | 0 | 0 | 2.0 | 0 | 0 | 10.0 | 12.0 | 2.4 | 17.00 | 17.00 |
| 310 | 36° 52.15'N | 176° 54.06'E | 3524 | 21 | 21 | 100 | 193.5 | 145.6 | 75.2 | 0 | 193.5 | 74 | 34.25 | 93.75 |
| 310A | 36° 52.15'N | 176° 54.06'E | 3524 | 18 | 20 | 95 | 163.5 | 27.5 | 16.8 | 189.0 | 352.5 | 40 | 59.50 | |
| 311 | 28° 07.46'N | 179° 44.25'E | 5280 | 5 | 5 | 100 | 37.0 | 19.0 | 51.3 | 9.0 | 46.0 | 6.1 | 43.26 | 43.25 |
| 312 | 25° 34.70'N | 178° 08.00'W | 5355 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 29.25 | 29.25 |
| 313 | 20° 10.52'N | 170° 57.15'W | 3492 | 44 | 44 | 100 | 394.5 | 220.4 | 55.9 | 211.5 | 606.0 | 28.3 | 89.75 | 89.75 |
| | | TOTALS | | 241 | 220 | | 2210.5 | 738.8 | | 1369.0 | 3579.5 | | 816.75 | 816.75 |
| | | MINIMUM | 1346 | 1 | 0 | 0 | 2.0 | 0 | 0 | 0 | 0 | 6.1 | | |
| | | AVERAGE | 4148 | 18 | 17 | 91 | 170.0 | 56.8 | 33.4 | 105.0 | 275.3 | 23.0 | | |
| | | MAXIMUM | 5708 | 58 | 48 | 100 | 631.0 | 22.0 | 75.2 | 216.0 | 640.5 | 76.0 | | |

# DEEP SEA DRILLING PROJECT
# OPERATIONS RESUME
# LEG 33

## SUMMARY

The purpose of Leg 33 was to investigate the geologic history of the Line Island, the Tuamoto Island Chain, and the Manihiki Plateau of the equatorial Pacific. Core samples for the investigation were obtained from the drilling of eight holes at five sites. Emphasis was placed on moderately deep penetration and the target zones were reached at all but the initial and last site. Basalt was reached at two of the sites and volcanic sediments, at two. Maximum basalt penetration was 38.5 meters at Site 315, which reached a depth of 1034 meters.

Project capability was increased by the installation and use of a heave compensation system which is expected to increase bit life as well as core recovery and quality. At Site 318, the compensator was used for the first time to continuously drill and core through hard rock. After 29 rotating hours and 745 meters of penetration, the bit was pulled. The core bit inserts were in good condition and all cones were tight on the journal bearings. This bit condition indicates a potential for increased penetration which will be furthered evaluated on Leg 34. A downhole pinger for acoustic location of the sea bottom also received its initial test and proved its ability to find bottom with a resolution on the order of ± 5 meters.

After a port call of 23 days, required for installation and preliminary testing of the heave compensator at Honolulu, the Challenger left port on November 2 and terminated at Papeete, Tahiti on December 17. Length of the leg, including the Honolulu port call, was 67.7 days of which 30.4% were spent cruising and 35.4% on site.

A total of 184 cores were attempted with recovery on 172. Overall recovery was 51.5% with 884 meters of core recovered out of a total cored interval of 1718 meters.

The Deep Sea Drilling Project is managed by the Scripps Institution of Oceanography (University of California, San Diego) under a contract with the National Science Foundation. The Glomar Challenger is owned and operated by Global Marine Inc. who perform the coring operations under a subcontract with the University of California. Planning for the voyages is coordinated with the scientific community through the Joint Oceanographic Institutions Deep Earth Sampling (JOIDES) organization.

## DRILLING AND CORING BOTTOMHOLE ASSEMBLIES

The bottomhole assembly normally used is made up with a bit, float sub, core barrel, three 8-1/4" drill collars, two bumper subs, three 8-1/4" drill collars, two bumper subs, two 8-1/4" drill collars, one 7-1/4" drill collar and one joint of 5-1/2" heavy weight drill pipe. On Sites 317 and 318, where the heave compensator was used, the bottomhole assembly was modified by removing one of the lower two bumper subs. The upper two bumper subs remained in the assembly. With this assembly, drilling could continue to the objective even if the heave compensator should fail. In the event of a malfunction, the heave compensator could be locked up and removed from the drill string. When experience demonstrates the reliability of the compensator, the only bumper subs needed in the drill string will be those providing jarring/bumping action in the case of stuck pipe. At present, with the heave compensator in the string (assuming drilling in hard formations which requires the working of both sets of bumper subs), there is insufficient clearance between the water table and the connector block to pull the bit off bottom when making a connection. However, with one bumper sub out of the assembly when using the compensator in hard formation, it is possible to be five feet off bottom during a connection. This still maintains five feet between the water table and the block with the compensator fully extended.

## BITS

All bits were of the journal bearing, four cone, medium tooth insert type. Bit performance was excellent and no drilling was prematurely terminated because of bit failures. Typically, the bits were pulled with one loose cone after penetrating some 250 meters of hard strata requiring 20,000 lbs or more of bit weight to drill.

Usually, bearing failure was further advanced than cutting structure failure. Sediment sequences varied at different sites but in general the lithologic sequence was composed of an upper 500 meters of ooze and chalk drilled with up to 10,000 pounds of weight, 150 meters of chalk and chert requiring 10 to 20,000 pounds of weight and a hard limestone, siltstone and basalt interval of some 200 meters requiring 20 to 22,000 of weight. As might be expected, sound velocity in the hard strata correlated well with drilling time. Correlations between lithology, sonic velocity, rate of penetration and bit weight were used to evaluate bit performance.

The bit at Site 318, where the heave compensator was used, was in exceptionally good condition. Graded at T-3, B-3, the bearings were still tight and inserts in excellent condition after a penetration of 745 meters. Hard rock, including silicified limestone, was drilled. Of the 745 meters penetration, 158 meters required bit weights of 15 to 22,000 pounds to penetrate.

## CORING ASSEMBLIES

The "hard formation" slip type core catcher with hard facing proved effective and is recommended for use in hard rock sections. On eight cores, plastic socks had torn and patches of plastic had plugged the check valve in the core. Recovery in these instances varied from zero to about 50%. Consideration should be given to a stronger sock material. Two swivel assemblies were retired because of normal wear and tear. One of the swivels was bent below the bearing assembly, probably during repeated joint breakout and was replaced. The second swivel had a failure of grease seals.

Sinker bars were shortened up by ten feet to allow head room for running into the connector block. To improve action, the jars were moved to a point below the sinker bar.

## SITE SUMMARY

Site 314 - A hard bottom was encountered which could not be penetrated. An attempt to punch core with up to 6,000 pounds weight resulted in no recovery. A flared nose on the extended core barrel used indicated set down on a hard layer. An attempt was then made to use a conventional core barrel and assembly using 12-16,000 pounds weight, 1,000 psi pump and 9,000 feet pounds torque. The pipe could not be rotated and it was decided to move a second hole with the drill pipe suspended. The core barrel from the original hole was found jammed. On pulling the pipe, the core barrel was found in a bent bumper sub. Both lower bumper subs were bent a maximum 15° in an extended condition. The drill string had not parted but the inner core barrel was damaged beyond use. No further attempt was made to drill the site.

A downhole pinger was successfully used at this site to indicate bottom and is discussed below.

Site 315 - Two holes were drilled at Site 315. The original hole was lost when the vessel took an excursion of some 1,000 feet due to positioning failure while at a subbottom penetration of 88 meters. Four bumper subs were bent in the excursion and the bottomhole assembly broke and was lost below the lowest bumper sub.

The second hole was successfully drilled to a penetration of 1034.5 meters including 38.5 meters of basalt. The pipe stuck briefly four times requiring overpulls of up to 150,000 pounds to free.

Site 316 - This site was routinely drilled to the objective depth of 837 meters penetration into sandstones and claystones of volcanic origin. Massive chert beds were drilled and chert cylinders to about six inches long were recovered.

Site 317 - To improve the prospect of reaching basement, a first hole was planned through the chert section with only spot coring. Thereafter, continuously coring to basement was scheduled. A follow up hole was planned for continuous coring of the section missed in the initial hole. While making a connection at 2976 meters, after 351 meters penetration, a bolt rattled free from the pipe stabber and jammed the core barrel. The pipe was pulled and 317A was spudded.

Hole 317A was then routinely drilled to an objective subbottom depth of 943 meters including 38 meters of basalt. As planned, the upper section was only spot cored.

Hole 317B was then spudded to core shallow sections previously missed. After continuously coring 45 cores to a penetration of 424.5 meters, the core barrel was again found jammed. Attempts to fish out possible junk were unsuccessful and the string was pulled. A rubber and metal valve sealing section had parted from a mud valve and had been pumped through the line and lodged against the core barrel. The damaged valve was repaired and sealing sections on two other mud valves refurbished.

The drill bit was in excellent condition when recovered from Site 317A (B-2, T-2, no loose cone). Performance here was a function of relatively soft rock. Whereas, the previous sites had a lower hard rock interval of 210-300 meters with sonic transit time of 3 km/sec. Site 317 penetrated a 300 meters "hard" rock layer of 2 km/sec except for a 25 meter layer of 3 km/sec strata average.

Site 318 - The heave compensator was placed in the drill string and used to total depth. In soft sediments, alternate cores were taken with the unit compensating. Starting at a penetration of 606 meters, hard rock requiring bit weights of 18 to 22,000 pounds were encountered and the heave compensator was used continuously to minimize bit wear. Silicified limestones and hard dense siltstones slowed drilling to as low as 16 minutes a meter. The compensator kept variation in bit weight to $\pm$ 1,000 pounds in the mild seas. (Details on heave compensation are in a succeeding section). The bit was in excellent condition considering the drilling conditions. Cones were tight, only one insert was broken and the teeth were graded at T-3.

Mud was used at all locations and proved effective in flushing cuttings. Hole conditions were good at all sites when the holes were abandoned and would have supported additional drilling.

## HEAVE COMPENSATOR

The heave compensation system was installed and partially tested at dockside during the Honolulu port call. Installation was complete except for the stabilizer arms which were fabricated by the drill crew while underway. Installation time was underestimated by the contractor and 23 days were required for installation. Welding and installation of high pressure piping remained on the critical path during installation. Except for minor leaks, which were readily repaired, the system passed Coast Guard Certification tests.

Following crew orientation and system checkout, the compensator was tested at dockside. Test loads of 415,000 pounds and 600,000 pounds were pulled against substructure beams and the compensator was stroked using the drawworks to simulate heaves to 12 feet. Data was incomplete because test time was reduced to permit ship departure for Leg 33 on November 2. The data obtained, however, showed good correlation with predicted performance and indicated the system had the potential to meet design specifications of $\pm$ .625% load variation at 400,000 pound drill string load.

A GMI and Brown Brothers engineer were aboard for Leg 33 to provide service and analyze system performance. The GMI engineer disembarked at Fanning Island. Testing, troubleshooting and field modifications were made while underway with a minimum interference with normal drilling operations. The fabrication of stabilizer arms proved time consuming and delayed operational testing of the system until Site 316.

After field modifications of the raise lower circuit and locking latches and troubleshooting of the Olmstead safety valve, the crew received familiarization training at Site 317. At Sites 317B and 318, the system was tested and monitored for performance. Performance data was obtained by recording instrumentation from remote transducers and visually recording drill data from the drillers console. For example with a total hook load of 285,000 pounds, bit weight of 20,000 pounds and heaves to 6.5 feet, the system compensated with an average weight fluctuation $\pm$ 1500 to $\pm$ 3200 pounds. For analytical and test purposes, a partial air bank using only 28% of the available air volume was used and performance is expected to improve with full bank operation and minor system adjustments. Performance data is being analyzed for conformance to specifications and for contractural acceptance of the system.

## DRILL PIPE PINGER

Sea floor depths for coring are routinely found by PDR and drill pipe measurement when actual cores are recovered. In very soft sediments, accuracy decreases and coring attempts may begin several tens of meters above or below the mudline. To improve this accuracy, the Project has been developing a drill pipe pinger which was successfully used to locate bottom at Site 314. In 5225 meters of water, the pinger found bottom with a resolution of $\pm$ 5 meters. Water depth was 5221 meters of PDR and 5225 meters by drill pipe.

The pinger incorporates a 12 kHz transducer and self contained electronics package made up to a special piston core barrel which can retrieve a 7.5 meter core. In use, the self contained pinger was placed and locked in the outer core barrel with the transducer protruding one foot below the core catcher. As the assembly was lowered, direct and reflected waves were traced on a Gifft recorder. Convergence of the two waves fixes the location of the sea floor. The direct wave clearly shows each time a stand of pipe is made up to the drill string and lowered. Pulse rate of the pinger is two seconds and the recorder is operated on a one second sweep.

The piston corer assembly is actuated by latching onto the pinger fishing neck and shearing a releasing pin. This action releases the pinger assembly from the outer core barrel. By maintaining a tension on the pinger and simultaneously lowering the drill string, a piston core can be taken. At Site 314, sea bottom sediments were too indurated for piston coring and no recovery was obtained on one attempt.

## POSITIONING

Performance of the dynamic positioning system was satisfactory except on Site 315 where failure of the digital to analog converter resulted in the loss of the bottomhole assembly.

Weather was not a major factor on this leg although some acoustic interference was anticipated due to choppy seas generated by 25-35 mph trade winds. The hydrophones were lowered 10 feet on Sites 315, 316, 317 and completely eliminated acoustic losses. Thruster noise levels became quite high at times. Despite this, good acoustics were maintained at all times.

At Site 314, automatic positioning was used for the duration except for two instances about 12 hours apart when the display, main shafts and thruster commands became slightly erratic. Each time this happened, switching modes from auto to semi-auto and back to auto cured the problem. This did not interrupt drilling as the erratic behavior was not overly pronounced and was of less than five minutes duration each time.

At Site 315, positioning was initially good in automatic. Failure of several cards in the digital to analog converter caused loss of the bottomhole assembly due to erroneous display signals after about 14 hours on site. Maximum excursion was about 1,000 feet.

At Site 315A on November 16, erratic loss of acoustics with drastic changes in thrust direction and magnitude occurred. The ship moved about 400 feet off the hole before the positioning system could recover. High sustained thrust requirements necessitated going to semi-auto as thrusters were overloading the generators. At daylight, it was discovered that the convergence of the equatorial current and counter-current had passed under the ship with a great deal of turbulent water and opposite current flow on either side of the line of convergence. After the current stabilized, positioning was returned to auto with no further problems on this site.

Positioning on Site 317 was in auto with the exception of about 15 minutes in semi-auto when failure of the pitch gyro amplifier caused the main shafts to be commanded full astern from 100 rpm ahead. The amplifier was replaced and the system returned to auto for the duration. Positioning was excellent for the remainder of the leg with no further problems of any kind.

## COMMUNICATIONS

The majority of traffic was handled via WWD, with no traffic being handled via the Navy, either incoming or outgoing. In general, the WWD traffic was handled expeditiously, receiving on 12 MHZ band and usually transmitting on the 17 MHZ band.

Considerable technical difficulty was experienced with the TMC transmitter, mainly due to burned out contacts on a high voltage switch, but also a major breakdown lasting two days which destroyed five condensers, two RF coils, the power amplifier tube, and at the end, it was discovered that a ground had appeared on the primary of the main power transformer. The reason for this failure, which was repaired, has not been determined. It was barely possible to raise WWD or San Francisco using the 500 watt RCA transmitter. To some degree, this was due to our being on a heading of about 050 for many days, which pointed the ship directly at the California stations, thus interposing the drill tower between them and the transmitting antennas.

Volume of traffic handled was larger than usual and no significant delays in handling were encountered.

The radars both performed well, having been given a thorough overhaul at Honolulu by representatives of Decca, at the request of Decca, who also exchanged (without charge) a complete transceiver of one radar.

The FCC safety of life at sea inspection was passed and a certificate issued on October 19, 1973 by FCC, Honolulu, Hawaii.

Voice radiotelephone communications via radio KMI (Oakland, California) were excellent and consistent on the 17 and 12 MHZ bands and were used to a large degree for technical consultations concerning the heave compensator, as well as for a large number of private telephone calls.

## CREW PERFORMANCE

Crews on Leg 33 continued with the high level of efficiency and performance displayed on previous legs. In addition to normal duties, the crews made modifications to the heave compensator, conducted its sea trials and helped develop handling methods for its most effective use. Hard work and the ability to innovate were important contributions which allowed the Project to develop the heave compensation capability with minimal impact on the scientific objectives of the leg.

S. T. Serocki
S. T. Serocki
Cruise Operations Manager
Deep Sea Drilling Project



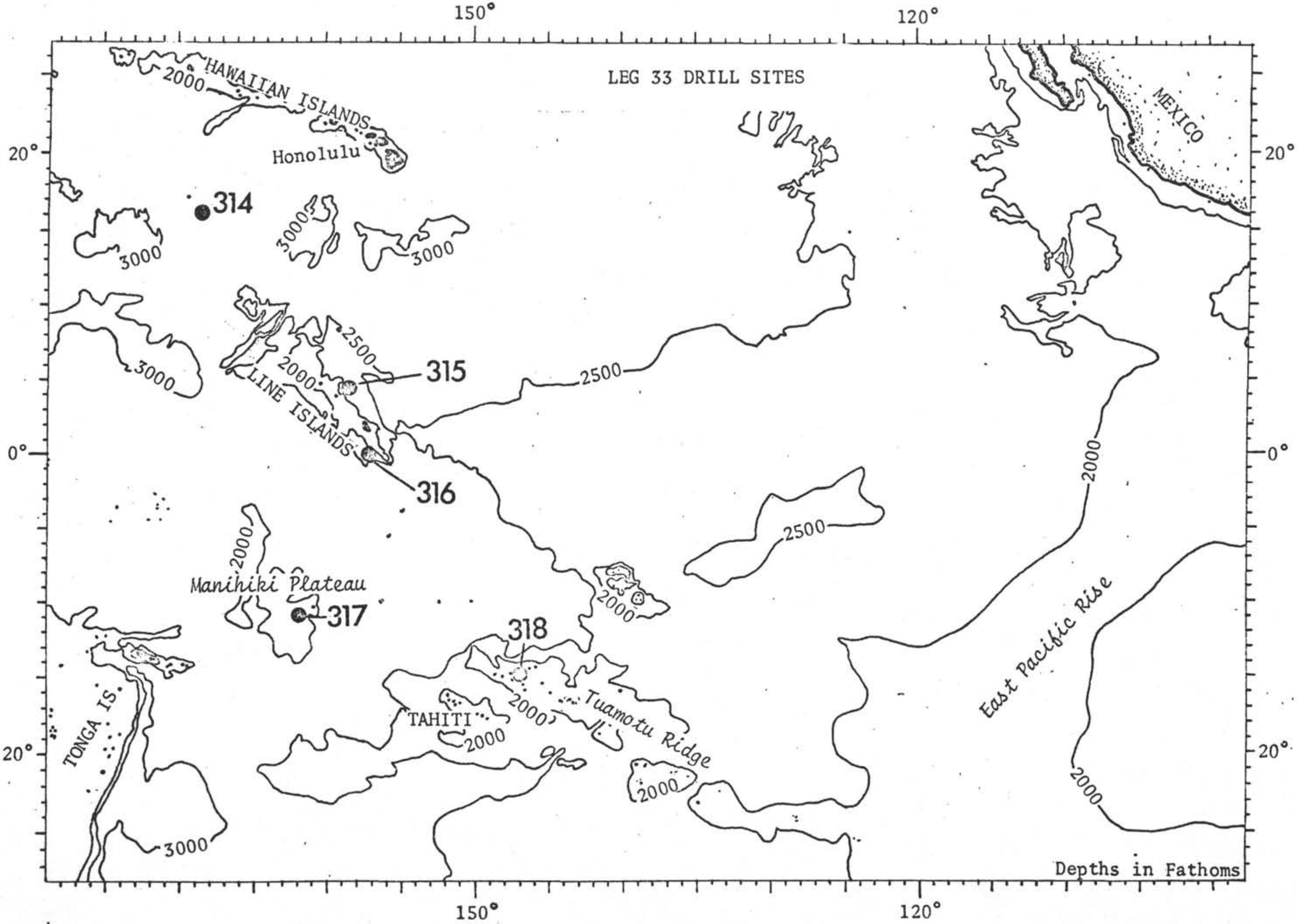
January 1974

DEEP SEA DRILLING PROJECT
SUMMARY OF OPERATIONS
LEG 33

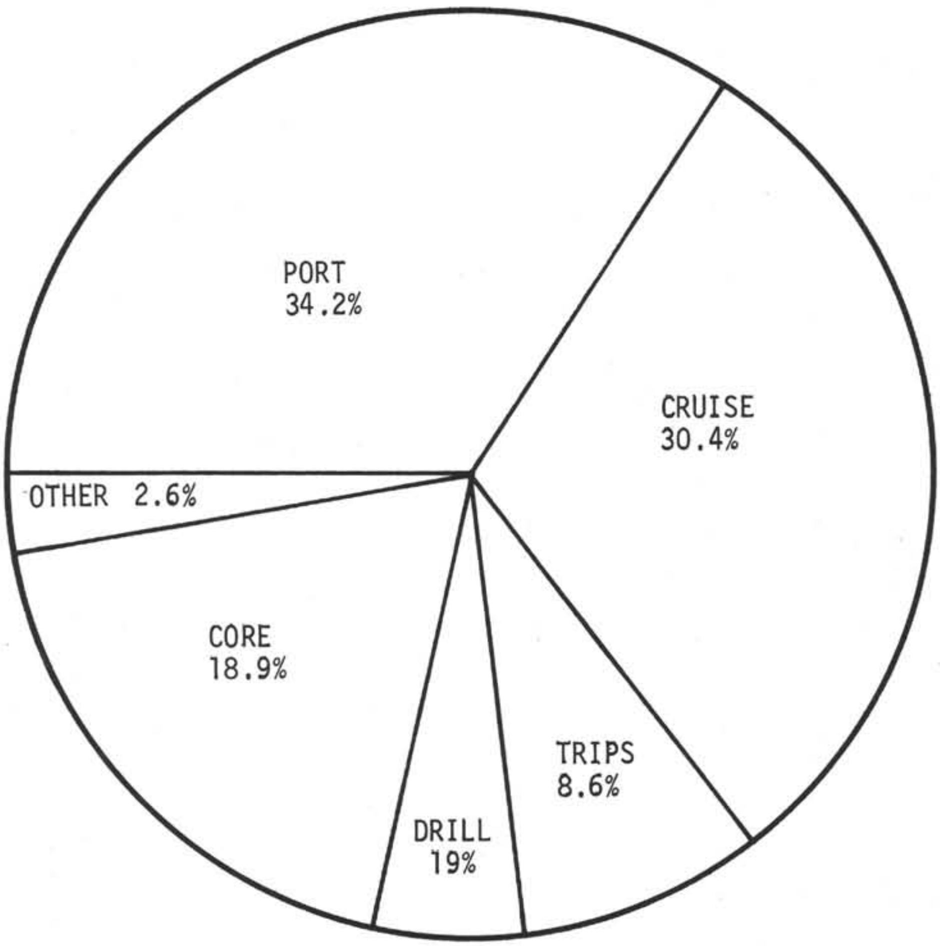
| | |
|---|---|
| Total Days Leg 33 (October 10 - December 17, 1973) | 67.7 |
| Total Days In Port | 23.7 |
| Total Days Cruising | 20.5 |
| Total Days On Site | 24.1 |

| | |
|---|---|
| Trip Time | 5.8 |
| Drilling Time | 3.6 |
| Coring Time | 12.8 |
| Mechanical Downtime | 0 |
| Waiting On Weather | 0 |
| Other Miscellaneous Time | 1.9 |

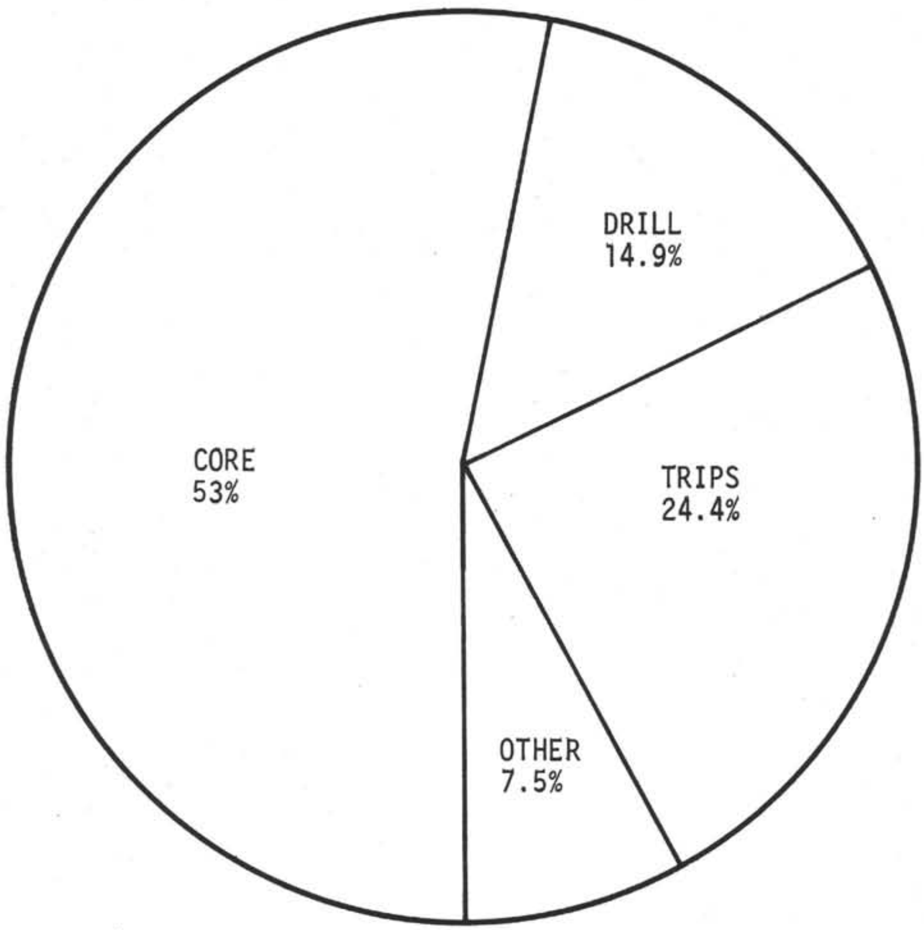
| | |
|---|---|
| Total Distance Traveled (Nautical Miles | 4004.0 |
| Average Speed | 8.3 |
| Sites Investigated | 5 |
| Holes Drilled | 8 |
| Number of Cores Attempted | 184 |
| Percent of Cores With Recovery | 172 |
| Total Penetration | 4465.0 |
| Total Meters Drilled | 2747.5 |
| Total Meters Cored | 1718.0 |
| Total Meters Recovered | 883.9 |
| Percent of Core Recovered | 51.5 |
| Percent of Total Penetration Cored | 38.5 |
| Maximum Water Depth (Meters) | 5225 |
| Minimum Water Depth (Meters) | 2622 |


LEG 33 DRILL SITES
150°
120°
20°
0°
20°
HAWAIIAN ISLANDS
Honolulu
MEXICO
2000
3000
2500
314
315
316
317
318
LINE ISLANDS
Manihiki Plateau
TONGA IS.
TAHITI
Tuamotu Ridge
East Pacific Rise
Depths in Fathoms

DEEP SEA DRILLING PROJECT
LEG 33
TOTAL TIME DISTRIBUTION



DEEP SEA DRILLING PROJECT
LEG 33
ON SITE TIME DISTRIBUTION



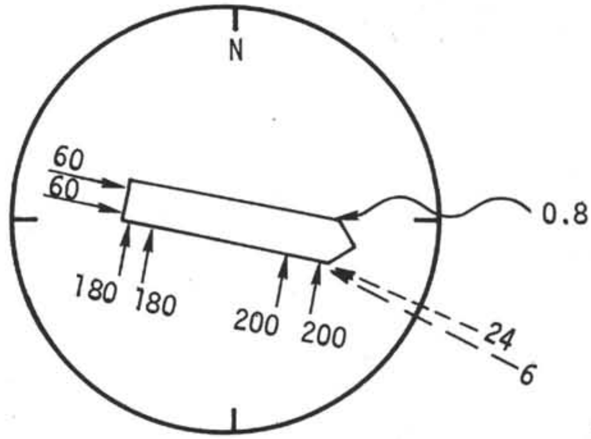
## LEG 33

## DYNAMIC POSITIONING SUMMARY

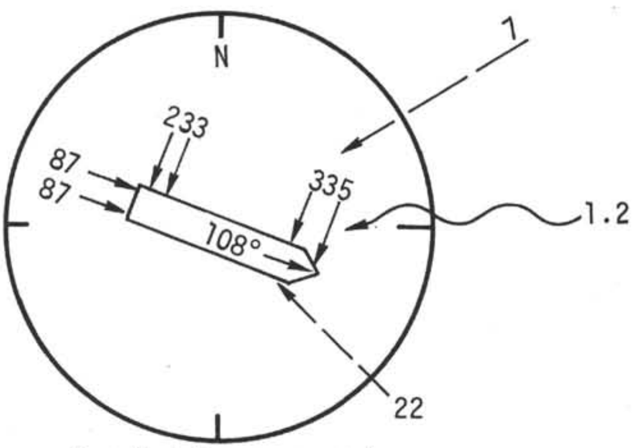
LEGEND

- HEADING AVERAGE
- WIND: DIRECTION AND SPEED (MPH) - AVERAGE
- SWELL: DIRECTION AND HEIGHT (FEET) - AVERAGE
- CURRENT: DIRECTION AND SPEED (KTS.)
- THRUSTER AVERAGE RPM

#314

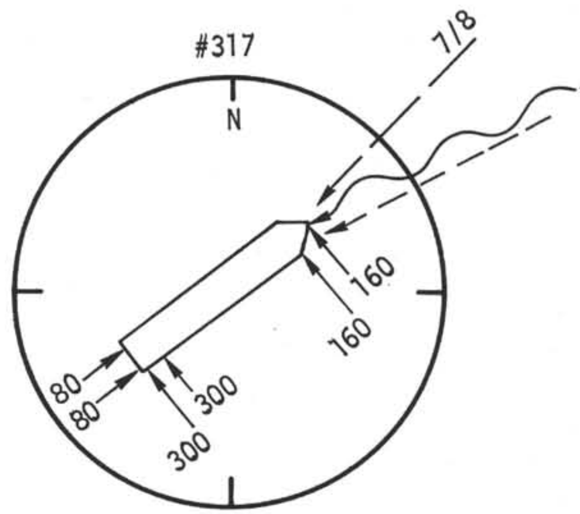



#315

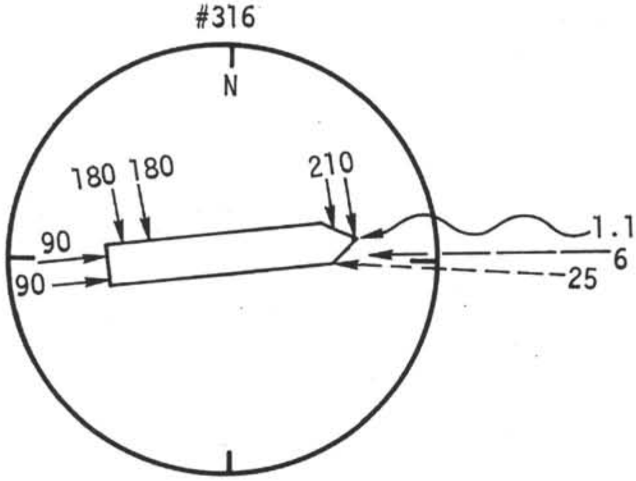



Completely averaged positioning variable

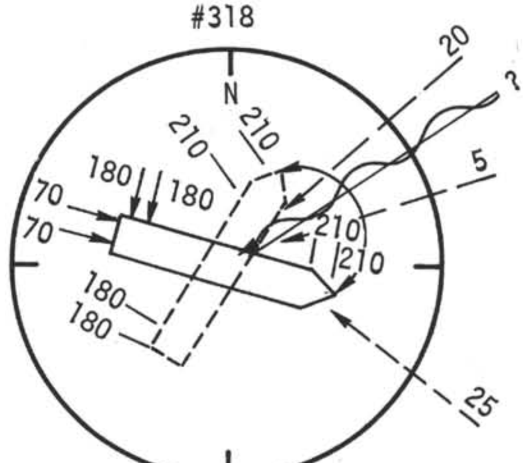
#317




#316




#318




Wind changed from 130° to 040° during hole, heading from 100° to 028°, current assumed only no charted current.

DEEP SEA DRILLING PROJECT
BEACON SUMMARY
LEG 33

| Site No. | Make | Freq. kHz | Serial Number | Site Time Hours | Remarks |
|---|---|---|---|---|---|
| 314 | ORE | 16.0 | 242 | 42.5 | Very strong signal. |
| 315 | ORE | 16.0 | 260 | 32.0 | Very strong signal - long life. |
| 315A | ORE | 16.0 | 260 | 124.5 | Very strong signal - long life. |
| 316 | ORE | 13.5 | 209 | 9.5 | Signal dropped by 25 db - dropped replacement. |
| 316 | ORE | 16.0 | 248 | 105.5 | Very good signal. |
| 317 | ORE | 16.0 | 257 | 26.5 | Very good signal. |
| 317A | ORE | 16.0 | 257 | 89.5 | Very good signal. |
| 317B | ORE | 16.0 | 257 | 67.0 | Very good signal. |
| 318 | ORE | 13.5 | 286 | 77.0 | Good signal. |

## DEEP SEA DRILLING PROJECT
## SITE SUMMARY
## LEG 33

| Hole | Latitude | Longitude | Water Depth | Number of Cores | Cores With Recovery | Percent With Recovery | Meters Cored | Meters Recovered | Percent Recovered | Meters Drilled | Total Penet. Meters | Avg. Rate Penet. | Time On Hole | Time On Site |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Johnston Island Trough | | | | | | | | | | | | | | |
| 314 | 15° 54.75'N | 168° 28.09'W | 5225 | 2 | 0 | 0 | 17.0 | 0 | 0 | 27.5 | 44.5 | 165.0 | 42.5 | 42.5 |
| Fanning Island Fan East | | | | | | | | | | | | | | |
| 315 | 4° 10.26'N | 158° 31.54'W | 4164 | 4 | 2 | 50 | 28.0 | 16.7 | 59.6 | 57.0 | 85.0 | 98.0 | 32.0 | |
| 315A | 4° 10.26'N | 158° 31.54'W | 4164 | 34 | 31 | 91 | 323.0 | 130.8 | 40.5 | 711.5 | 1034.5 | 26.0 | 124.5 | 156.5 |
| Line Islands South | | | | | | | | | | | | | | |
| 316 | 0° 05.21'N | 157° 07.74'W | 4464 | 30 | 29 | 97 | 285.0 | 103.8 | 36.4 | 552.0 | 837.0 | 21.0 | 115.0 | 115.0 |
| Manihiki Plateau | | | | | | | | | | | | | | |
| 317 | 11° 00.09'S | 162° 15.78'W | 2625 | 3 | 3 | 100 | 28.5 | 19.2 | 67.7 | 323.0 | 351.5 | 13.0 | 26.5 | |
| 317A | 11° 00.09'S | 162° 15.78'W | 2622 | 34 | 33 | 97 | 313.5 | 162.1 | 51.7 | 630.0 | 943.5 | 10.5 | 89.5 | |
| 317B | 11° 00.09'S | 162° 15.78'W | 2622 | 45 | 42 | 93 | 424.5 | 304.2 | 71.6 | 0 | 424.5 | 6.3 | 67.0 | 183.0 |
| Tuamotu Ridge | | | | | | | | | | | | | | |
| 318 | 14° 49.63'S | 146° 51.51'W | 2659 | 32 | 32 | 100 | 298.5 | 147.1 | 49.2 | 446.5 | 745.0 | 25.7 | 77.0 | 77.0 |
| | | Totals | | 184 | 172 | 93 | 1718.0 | 883.9 | 51.5 | 2747.5 | 4465.0 | 29.0 | 574.0 | 574.0 |
| | | Maximum | 5225 | 45 | 42 | 100 | 424.5 | 304.2 | 71.6 | 711.5 | 1034.5 | 165.0 | 124.5 | 183.0 |
| | | Minimum | 2622 | 2 | 0 | 0 | 17.0 | 0 | 0 | 0 | 44.5 | 6.3 | 32.0 | 42.5 |

DEEP SEA DRILLING PROJECT
BIT SUMMARY
LEG 33

| Hole | Mfg. | Size | Type | Serial Number | Meters Cored | Meters Drilled | Meters Total Penet | Hours On Bit | Condition | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| 314 | Smith | 10-1/8 | F94C 4-CTR | PC204 | 17.0 | 27.5 | 44.5 | .5 | T-1, B-1 | Suitable for rerun - excellent condition. |
| 315 | Smith | 10-1/8 | F94C 4-CTR | NW800 | 28.0 | 57.0 | 85.0 | .4 | | Broke bottomhole assembly - lost. |
| 315A | Smith | 10-1/8 | F94C 4-CTR | PC205 | 323.0 | 711.5 | 1034.5 | 39.8 | T-8, B-8 | One cone loose- 3 medium tight - few inserts broken. |
| 316 | Smith | 10-1/8 | F94C 4-CTR | NW801 | 285.0 | 552.0 | 837.0 | 39.9 | T-5, B-5 | One cone loose. |
| 317 | Smith | 10-1/8 | F940 4-CTR | NW802 | 28.5 | 323.0 | 351.5 | 1.5 | No Wear | |
| 317A | Smith | 10-1/8 | F94C 4-CTR | NW802 | 313.5 | 630.0 | 943.5 | 31.0 | T-2, B-2 | In gage - no loose cones. |
| 317B | Smith | 10-1/8 | F94C 4-CTR | PC204 | 424.5 | 0 | 424.5 | 6.3 | T-3, B-4 | Suitable for rerun - cones medium tight - in gage. |
| 318 | Smith | 10-1/8 | F94C 4-CTR | PC206 | 298.5 | 446.5 | 745.0 | 28.9 | T-3, B-3 | Used compensator - no loose cones - center inserts good condition. |