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Robert Conrad Cruise 25-02
Abyssal Morphology and Quaternary Growth of Hudson Submarine Fan
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OCE82-08868
Piermont, NY to Norfolk, VA
2 February to 23 February 1984

Robert Conrad cruise 25-02 was the first scientific use of the new NECOR SeaBeam system. The scientific program combined multibeam bathymetric surveying with single-channel watergun seismic reflection profiling to define the Recent and Neogene growth processes of Hudson Submarine Fan. Operations extended from the head of Hudson Submarine Canyon (72°30'W, 39°40'N) to the Sohm Abyssal Plain near 35° N, 68° W where the fan channel merges imperceptibally with the basin sediments. Multibeam bathymetry was used to trace the entire length of the canyon/channel system, and grid surveys were carried out at critical points along the channel to define tributary and distributary patterns. A network of seismic reflection profiles was run over much of the fan to examine the Pliocene and Pleistocene history of fan development, and to tie the surveyed region into the regional network of existing seismic data.

Operations are summarized as follows:

The cruise began at 1000 hrs on 2 February in Piermont, NY, with final software modifications to the data logger (Buhl), gravity system testing (Cochran, Bitte) and GPS installation (LaBrecque) taking place while hove to off Staten Island during the afternoon. Following transit to the shelf break at the head of Hudson Canyon, the following operations were conducted during the cruise.

1. Canyon/channel transect. 3-4 February. Single long line, following Hudson Canyon and Hudson Submarine Channel from the shelf break to the 4000 meter contour on the landward edge of the Lower Continental Rise Terrace (LCRT).

2. Seismic sections, Hudson Channel termination. 4-5 February. Three seismic lines to tie important gaps in seismic data and to examine buried channel distribution. Strong flow of Gulf Stream towards the NE prevented good seismics on SW lines, and seismics were suspended until weather conditions improved and appropriate NE lines could be run. Seismics also severely limited by malfunctioning Nova computer.

3. Hatteras Outer Ridge Erosional Zone grid survey. 5-7 February. SeaBeam grid survey of coalescing channels at seaward edge of the Lower Continental Rise Terrace (Hatteras

Outer Ridge). Down due to weather and damage to Eclipse computer during survey. SeaBeam was run without merged navigation/contours while software was being completed. No seismics due to weather.

4. Distributary channel transect and LCRT seismic lines. 7-11 February. SeaBeam transect up westernmost of coalescing channels mapped in HOREZ, followed by seismic grid pattern across central LCRT.

5. Lower Canyon Survey, Part 1. 11-13 February. SeaBeam and seismic reflection grid survey of the landward edge of the LCRT, where the Hudson channel branches to form multiple distributary channels.

6. Seismic tie: Lower Canyon Survey to DSDP Sites 106, 388. 13-14 February.

7. Lower Continental Rise Hills Grid Survey and channel termination search transect. 14-16 February. Survey of section of LCRH in which channels have pirated troughs of the sediment waves, forming a constrained tributary system. Surveys show pathways of flow cutting across the wave trend, gradually shifting flow paths towards the abyssal plain across the "washboard terrain" of the wave field.

8. Seismic tie: DSDP Sites 388, 603 to the Lower Canyon Survey. 16-17 February.

9. Lower Canyon Survey, Part 2. 18 February. Completion of grid survey at base of Hudson Channel (landward edge of LCRT). Predominantly SeaBeam, with limited seismics.

10. Seismic tie: Lower Canyon Survey to Base of Canyon Survey. 18-19 February. Upslope along western flank of canyon, tied to a grid of USGS multichannel seismic lines.

11. Grid Survey: Base of Hudson Canyon. 19-20 February. SeaBeam and seismic reflection survey of upper continental rise immediately seaward of Hudson Canyon exit from the continental slope.

12. Seismic tie: Base of Hudson Canyon to DSDP Sites 612, 613. 20-21 February. Seismic line completing full seismic tie between drill sites and all RC25-02 lines.

On completion of the final seismic line at the shelf/slope break, seismics and SeaBeam were secured, and we transited to Lewes, Delaware where we were met by a launch at the pilot station. Buhl, Watts and Bitte came aboard to carry out a gravity survey of the Wallops Island test range on the shelf between Delaware and Chesapeake Bays. This operation took 36 hours, including transit, and ended early on 23 February. The cruise ended in Newport News

(Norfolk), VA at 0800 hrs on 23 February.

Cruise 25-02 was generally quite successful, and most of the cruise objectives were met. Although data quality suffered somewhat due to the poor weather during the first half of the cruise, and we lost some time, we were extremely pleased to learn that SeaBeam does continue to function, even in seas up to 15 feet and winds in excess of 50 knots. However, we do not recommend working in these conditions routinely, particularly until the gravity table on CONRAD is replaced by the new Bell system for SeaBeam vertical reference.

Watergun seismic profiles from the present cruise will add significantly to our understanding of both the fan stratigraphy and the flow pathways of turbidity currents over the fan during the Pleistocene. SeaBeam is, of course, unable to identify buried channels, and we identified a tributary system lying to the west of the main channel system on the LCRT which is buried over the middle rise, but which is exposed on the lower rise. Seismic reflection profiles should enable us to resolve questions involving the extent of this system and the nature of the processes which caused the channel jump. In terms of operation, the waterguns were superb, and the only problems were in the data logging system. A test of the feasability of synchronizing two waterguns proved very successful. We found that firing characteristics were similar and repeatable, and the resulting profiles were of superb quality. A similar test of one watergun and one airgun was less encouraging. Airguns apparently fire too erratically (plus or minus 2 msec between shots) to allow simultaneous firing with waterguns. At the end of the trip, some pitting was noted on the pistons of the waterguns, and this may be a problem later. However, it did not affect operations on RC25-02, which immediately followed overhaul and component replacement in both guns.

SeaBeam data from Hudson Fan are the first multibeam data from a channelized large fan, and will be important in defining the morphologic characteristics of this class of fan. We have already learned that channels on this fan meander significantly, are primarily erosional, have pirated pre-existing morphology in the lower fan, and debouch onto the abyssal plain via a "transverse channel" flowing parallel to the margin. We identified gullying along the upper slope section of Hudson Canyon, and observed complex mass-wasting features along the margin of the channels deeper on the rise. While post-cruise processing will be necessary on the first week's data, due to continued software development during this first SeaBeam cruise, we expect to demonstrate convincingly that we have identified all of the branches of surface channels between the shelf/slope break and the crest of Hatteras Outer Ridge, as well as the principal pathways seaward of this sediment ridge of flow through the Lower Continental Rise Hills.

Overall, we were very pleased with the cruise results, and anticipate that they will be a useful and important step in understanding the depositional processes of submarine fans. We are particularly grateful to the ship's officers and crew, who made a cruise in unpleasant conditions successful, and whose morale could not help but rub off on even those suffering lingering mal-de-mer after 10 days. Thank you all.

PROBLEMS

The following items caused problems during the cruise, ranging in severity from irritation to loss of data and/or ship time:

1. Ship's gyro malfunction. The gyro was not working properly on our departure from Piermont, where an offset of 8° was noted. This rapidly became an erratic error, varying by more than 20° from true. Precise determination of gyro error is not possible, since the variation of the magnetic compass has not been updated since major changes in ship configuration in the yard, and we were not regularly blessed with clear weather for celestial checks. Since the change in gyro error was apparently not constant, it will not be possible to accurately reconstruct the history of error, and hence heading data will be inaccurate. This will affect the quality of SeaBeam data in that contour adjustment will not be possible, and it will affect the quality of all navigation using satellites, since dead reckoning uses the ship heading. It may explain some of the problems noted in satellite positioning with the new SatNav receiver.

2. Communications with Lamont. This was perhaps the most irritating, if not the most important, problem during the cruise. For much of the cruise, it was not possible to send any hard copy communication from the ship, as the Telex did not function properly, the Osborne link on Marisat did not function well, and Telemail was impossible because of pre-amp problems in the ATS system. In addition, during the first week of the cruise we were often unable to communicate via voice on ATS due to antenna problems which could not be repaired in bad weather. This left us with Marisat as our only method of communication. We found that verbal communication was not effective for insuring prompt reply to questions regarding impending plans and changes, and it is, of course, very poor for transmitting lists of needed supplies. Attention to improving communications between the ship and Lamont should be given the highest priority by the Marine Office.

3. Air conditioning. Persistent problems with the three air conditioning units in laboratory spaces should be looked into (Dry Lab, MCS Lab, New Gravity Lab). While no computer failures resulted from air conditioning failure

during the present cruise, it is almost certain that they will occur when working in other than the North Atlantic in winter. We had one day in which the temperature was above 90° in the Gravity Lab, and another on which both the A/C units in the Dry Lab/MCS Lab failed simultaneously. The new A/C unit in the MCS Lab is a particular disappointment, since it is extremely noisy, and it suffered badly during installation. We can predict continuing complaints about both operation and noise.

4. Exhaust ventilation. Installation of a fan for venting dust (particularly carbon soot from the 6 graphic recorders) from the dry lab was not completed during the yard period. This will be a big problem very shortly. Filters on the SeaBeam computers are already quite dirty, and dust is pervasive, even though filters were put over the exhaust fans on the Edo recorders.

5. Shipboard communications. Major improvements are warranted in shipboard communications. The meager squawk box system provides no option for "private" communication, but instead addresses all 7 working boxes*. For our cruise, we borrowed a communication set from the SeaMARC group to provide direct conversation between the bridge and lab. However, there is no way at all to communicate with the Gravity Lab or the Lounge, and it should not be necessary to wake the Captain and Chief Scientist when calling half-hourly pit log readings from the bridge to the lab. When the main communication system is used for regular conversation between lab and bridge, particularly at night, it means that the other stations get turned very low or off, and are of no use in emergency situations. The fantail squawk box, a must for safe and convenient work deploying and retrieving off the stern, does not work at all, and should be repaired or replaced.

* Bridge, dry lab, MCS lab, wet lab, Captain's SR, Chief Scientist's SR, galley.

6. Pass-through seals. Permanent seals need to be applied to cable pass-throughs from the dry lab to the deck, both on the waist deck and on the 01 level by the stack. Both of these leaked during the sea trials. While no problems were encountered during the present leg, the temporary seals should be replaced before they become a problem again.

7. Pit log/Speed log readouts in lab. Some method needs to be devised to provide a direct reading of miles travelled to the dry lab. In addition, the various speed readouts presently in the lab should be properly labelled as to from whence derived (Furuno, Loran C, Magnavox) so that they may be properly logged. During the present cruise, we had these data called down from the bridge every half hour. This is not a proper long-term solution.

8. Data logger. Several problems were encountered. System lockups occurred regularly early in the cruise, apparently due to both a faulty disk controller board and to a program problem related to the Furuno input. Significant seismic data was lost (plus navigation) before a board from the Gravity Lab Nova4 was swapped into the Dry Lab Nova4. This made it impossible to use the Gravity Room computer for program ONLINE, which provides a readout on the bridge displaying distance from pre-plotted track, and which is imperative for running closely spaced lines. It also meant that we were unable to provide navigation to the new Bell gravimeter, and hence could not fully test the system prior to the last day. This was made possible when Peter Buhl arrived on board with the backup tape needed to run the data logger without the disk controller board. This board was then removed fromthe data logger, returned to the Gravity Lab Nova4 computer and used during the gravity system test.

9. Graphic recorders. Profiler A failed because of a bad 120 kHz frequency board for which we had no spare. No backup recorder (other than B and C, which were in use) was on board. The UGR used for 3.5 kHz profiling had intermittent transmit jumps in program mode, and the second (unused) echosounder recorder does not have program capability. Either more complete spares should be provided, or the promised new recorders should be installed promptly to insure against catastrophic failure on upcoming legs. Legs which include SeaBeam will require continuous use of programmed echosounding to prevent system interference, and appropriate spares and boards must be aboard.

10. System interference: SeaBeam, 3.5 kHz, waterguns. The 3.5 kHz echosounder and the watergun system interfere with each other, and both the 3.5 kHz and waterguns interfere with SeaBeam. All must be monitored to prevent collection of bogus data. The following interference combinations occurred regularly: 3.5 transmit onto both watergun and SeaBeam receive; watergun transmit and receive onto SeaBeam receive; watergun transmit and receive onto 3.5 receive. The former is the most serious problem, because it contaminates both digital seismic and SeaBeam data, and cannot be removed in processing. Appropriate automated time delay mechanisms for all three systems should be installed.

11. Seismic rack wiring. Exposed data logger and recorder signal wires were accidentally knocked loose twice during the cruise, each time causing data loss during the search for the problem. They should be better protected.

12. Speed log output to data logger. The Furuno speed log output caused problems while collecting seismic data, as too much time for transmission of speed information caused

lock-ups, preventing seismic logging. Peter Buhl brought aboard a revised data logging program on 22 February, and it is anticipated that this will solve the problems.

13. Weather forecasts. As anticipated, we lost time and suffered poor data quality due to weather problems. This is a fact of life off Cape Hatteras in February. However, we would have benefitted from improved quality weather facsimiles, and from up to date information on when various stations transmit forecasts.

14. GPS navigation. The Magnavox GPS provided by John LaBrecque was a major disappointment. Very little useful data was produced, due to hardware problems and operator illness. It was not possible to fully train shipboard personnel in system operation, although Dan Chayes (URI SeaBeam engineer) spent more time than anyone else aboard in system operation, and succeeded in gathering some data. Of 21 days at sea, one good "day" (5 hours) and 5 or 6 more days of moderately good data were collected. We recommend that it be removed from the ship before departure from Norfolk, since after this time the ship will be away from the U.S. for 8 months, and shipping will be prohibitively expensive.

15. Work space. In general, workspace for navigating and planning is better than it was before the yard period. However, the dry lab lacks a good place to lay out charts. A minimum solution would be a board on the bulkhead for hanging working charts. While the new table and light table in the Gravity Lab are very spacious, there is no communication to that area, and hence it cannot be used properly. Some chart area in the dry lab is important. The small "office" in the old darkroom was used with minor success on our leg, but it is extremely small, and with a computer set up by the Ch. Sci., there was little room for laying out charts.

16. SeaBeam startup problems. Some time and data were lost due to SeaBeam data acquisition/processing problems. Data logged on tape has gaps during the first week due to software problems. This was even worse on sea trials, as disk file backups were not saved, and only ~50% of sea trials digital data were stored on tape. 4.5 hours of ship time were lost when the SeaBeam Eclipse computer fell out of the rack during a storm, landing on deck (miraculously without significant damage). Except for the data logging problem, however, no serious problems were encountered, and the only additional problems with SeaBeam acquisition were related to weather (time lost in 50+ kt winds during first week) and interference from other sonar systems.

17. XBT launcher. The hand-held launcher should be replaced by a permanently mounted launcher. We were unable to launch at night during the first week due to weather conditions --

some of this could have been prevented had we not had to stand at the rail for 90+ seconds while the XBT recorded. Also, if access to the main deck were not limited to the starboard waist deck, night launches would be more convenient in bad weather. Some thought should be given to this problem, as sound velocity profiling is necessary for accurate SeaBeam mapping, and is particularly important in oceanic frontal regions which are commonly poor weather areas.

18. Vertical reference for SeaBeam. Substantial improvement in SeaBeam data quality on turns and in bad weather is expected when the vertical reference is moved from the old to the new gravimeter.

19. Watergun corrosion. On the whole, the DC electric compressor and the two waterguns performed flawlessly due to Martin Iltzsche's professional work. However, after 64 hours of operation, the starboard gun (#1) showed excessive corrosion on the piston. This was not due to improper maintenance, as the gun was dismantled less than 24 hours after final use, and it was refurbished completely before the cruise. The manufacturer should be notified, and the quality of steel in the pistons brought into question.

PERSONNEL

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