COLUMBIA UNIVERSITY
INTERDEPARTMENT MEMORANDUM

Date Nov. 11, 1983

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Subject

RESEARCH CRUISE REPORT

R/V ROBERT D. CONRAD - Leg. RC 24-11 & 12

Attached is a copy of the final cruise report for the above cruises. Two legs are combined in one report.

The areas of investigation were the Norwegian margin and the margin of East Greenland. The ship's ports were Bergen, Norway; Sandnessjoen, Norway; Reykjavik, Iceland from August 18 to September 24, 1983.

The Chief Scientist was John Mutter.

Ann Burns
MARSCICO Office

Enc.

CRUISE REPORT RC 24-11 AND RC 24-12

Preface

The reports for these two legs are combined here because the investigations carried out on the two legs represent two parts of a single project.

Itinerary

Bergen, Norway; Sandnessjoen, Norway; Reykjavik, Iceland

August 18 - September 24, 1983.

Work Completed

Twenty three two-ship Expanded Spread Profiles; 1,414 km two-ship Wide Aperture CDP profiling, and about 80 km single ship CDP profiling.

John C. Mutter	Chief Scientist	L-DGO
*Joseph D. Philips	Co-Chief Scientist	Univ. of Texas
*Peter Buhl	Co-Chief Scientist	L-DGO
James Smith	Science Officer	"
Joseph Stennett	Electronic Technician	"
Carlos Gutierrez	" "	"
Kevin Little	"	"
**Sterling Gillfillan	" "	Univ. of Texas
Joyce Alsop	Watchstander	L-DGO
Laura Kong	"	"
Hilary Heron	"	"
Carolyn Zehnder	"	"
**Jenny E. Glasser	" (student)	"
*Jakob Skogskid	" "	Univ. of Oslo
**Ingi Olaffson	" "	Univ. of Bergen
*Heinrich Meyer	Observer	B.G.R.
Martin Iltzsche	Airgun Technician	L-DGO
John DiBernardo	" "	"

* RC 24-11 only
** RC 24-12 only
N.B. Peter Buhl participated aboard S/V PROSPEKTA.

Objectives

The basic objective of the two legs was to obtain a set of two-ship multichannel seismic measurements at conjugate locations on the Norwegian margin and the margin of East Greenland. The data will be used to determine

the structure of the crust and distribution of deep sedimentary horizons on these margins to investigate the history of continental rifting and the early history of seafloor spreading. We were particularly interested to learn if the oldest oceanic crust adjacent to the margin of East Greenland exhibited unusual thickness and internal structure like that of the oldest crust adjacent to the Norwegian margin.

Two types of two-ship data were collected :

1) Expanded Spread profiles in which the two ships steam apart from a common midpoint - one firing an airgun array - the other receiving arrivals on its multichannel streamer. These experiments acquire high resolution reflection/refraction data at a point to use in deriving deep crustal structure.

2) Wide Aperture CDP profiles in which the two ships steam in line at a fixed separation to obtain CDP profile with a large synthetic receiving array length in a high CDP fold.

Narrative: RC 24-11

The two research vessels - R/V ROBERT D. CONRAD of Lamont-Doherty and S/V PROSPEKTA of Prakla-Seismos, working for B.G.R. (Germany) - left Bergen in the evening of August 18, 1983 (CONRAD at 1800, PROSPEKTA at 2000), and steamed north to a location off Alesund where both ships commenced streamer deployment. On CONRAD we replaced three active and one stretch section with refurbished sections because the original sections had hardened with age, and we anticipated that this might lead to embrittling and cracking in the cold waters off East Greenland. Andy Montez (Seismic Engineering) was on board to supervise this work. We also removed an average of two pounds of lead from each section. The streamer was employed with a tailbuoy supplied by Prakla-Seismos which was equipped with an active transmitter to measure

streamer bearings. Streamer work was completed about 2200 on August 19, after which Peter Buhl and Andy Montez transferred to PROSPEKTA. Andy Montez was later taken to shore with some Prakla technicians.

Work commenced with ESP 5. The two ships started from initial positions at the ESP end points - CONRAD to the northeast - PROSPEKTA to the southwest. PROSPEKTA fired its guns on a 60-second cycle, recorded its own shots, and CONRAD also recorded PROSPEKTA's shots. Both ships steamed to the opposite end points at about 5 knots, crossing at the midpoint at a separation of about 1000 m. This method of shooting obtains two ESPs in one experiment; one at closing ranges and one at expanding ranges, and simultaneously collects a vertical incidence profile because the shooting ship records its own shots. ESPs shot to 70 km can be obtained in about 12 hours by this method.

At the end of the ESP run the ships steamed to the opposite ends of the next ESP and repeated the procedure. PROSPEKTA obtained normal CDP profiles on these traverses while CONRAD made no recording as it was thought that with both ships firing airguns some interference might result, despite the large ship-to-ship separation.

ESP's 5, 4, 3 and 2 were collected in this way, starting at 2330 on the 20th, and finishing at about 1330 on the 23rd. From there we made a Wide Aperture CDP transect through the ESP midpoints. Before starting this line PROSPEKTA brought its streamer on board to check the condition of the tailbuoy, then steamed at full speed to meet CONRAD and transfer a chronolog clock and frequency standard via ZODIAC because they had discovered problems with one of their oscillators. The Wide Aperture line began at 2315 on the 23rd and was completed at 2015 on the 24th. Sonobuoys were deployed by PROSPEKTA and recorded on both ships along this line.

After passing through the midpoint of ESP 5 we made a Wide Aperture CDP

profile to the midpoint of ESP 6 - then collected ESP 6 by shooting the expanding ranges first, then returning along the track at closing ranges before reforming to work a Wide Aperture profile to ESP 7. ESP 7 was then collected in the same manner as ESP 6.

During the Wide Aperture profiling we experienced consistent problems with the pressure fitting which connects the air hose to the large chamber airguns. It was subject to cracking and needed repair and/or replacement frequently. The average life of the fitting was less than 24 hours. However, since CONRAD was shooting only during Wide Aperture profiling and not for the ESPs, there was usually time for maintenance. At the end of the Wide Aperture profile connecting ESP's 6 and 7 the guns fired at a lower pressure - about 1400 psi - to extend the life of the fitting to complete the line.

Soon after commencing the Wide Aperture profiles from ESP 7 to ESP 8 the weather, which had been particularly good until then, deteriorated rapidly. The streamers on both ships became very noisy and both were brought on board. We began retrieving the gear at 1000 on the 27th and had it on board at 1800, working with difficulty in heavy weather. By the late evening winds were at 40 knots and seas were running 30'-40'. The tailbuoy was not brought on board because of the difficult sea conditions and was towed on a polyethylene rope. Unfortunately, the rope broke during the storm, possibly sheared by the prop and the tailbuoy was lost.

The weather continued to prevent work until the 31st. We deployed the streamer at 0245, removing another pound of lead off each of the three end sections and adding 20 lbs to the head section to improve the trim. We began work again at 0720 on the 31st; a total time lost for bad weather of nearly four days.

Shortly after starting the Wide Aperture profile, PROSPEKTA's streamer

snagged on a fishing net towed by a trawling fisherman and at 1600 on the 31st had to break off the line to untangle the net from the streamer. No major damage was caused and work began again at 1935.

ESP's 8, 9 and 10 were then collected with Wide Aperture profiling between their midpoints. No major problems affected this part of the program.

Because of the time lost to bad weather it was clear that we could not complete our objectives on Jan Mayen Ridge, so we decided to shoot ESP's 11, 12 and 13 in the style in which ESP's 5 through 2 were collected - then run a Wide Aperture profile through the midpoints of ESP's 13 through 10, and make for a port on the Norwegian coast rather than the intended port of Akureyri (Iceland).

The final ESPs were collected with no problems. After ESP 13 was collected we retrieved the streamer to check and recalibrate DT #2 because it had been giving unusually shallow readings. We found that it was miscalibrated by about 10' (too shallow). After redeployment the streamer towed at a constant depth of 40'-45' throughout.

The Wide Aperture profile connecting ESP's 13 through 10 was completed at 0220 on September 6 and we headed for Bodo at 0630. At about 1600 we were advised by PROSPEKTA that they had been denied entry to Bodo by the Norwegian Foreign Affairs Department and we were asked to seek at port to the south. We altered course for Sandnessjoen and docked at 0600 on September 7.

Narrative RC 24-12

CONRAD and PROSPEKTA departed Sandnessjoen at 1100 on September 8 to begin a three day transit across the Mohn's Ridge to about 76 degrees North on the margin of East Greenland. During this transit we recorded gravity and magnetic measurements only, and steamed at about 9.5 knots. We deployed the streamer beginning at 1145 on September 11th and started work at the

northeastern end point of ESP 14 at 1900. At the midpoint crossing we transferred a Loran-C antenna to PROSPEKTA via ZODIAC as they had reported problems with Loran reception which they had traced to an antenna coupler.

We initially planned a transect of four Expanded Spread profiles at 76 degrees North across the feature which Talwani and Eldholm had identified as the Greenland Escarpment; a feature which may be the conjugate of the Voring Plateau Escarpment on the Norwegian margin and, therefore, related to the continent-ocean boundary. Of the four planned we completed three, ESP's 14, 15 and 16 before the ice edge was encountered. We then proceeded along the ice edge in a northeast direction to find a point at which to commence a Wide Aperture CDP profile through the midpoints of the ESPs. We were able to reach the shelf edge at 76 degrees 22' N, the highest latitude at which CONRAD has worked, and began the Wide Aperture profile from there, starting at 0945 September 13 and completing it at 2400 on September 13. From there we steamed southwest collecting a Wide Aperture profile along a trend parallel to magnetic lineation No. 24. Sonobuoys were deployed continuously along this line and recorded on both ships.

On reaching about 75 degrees N we steamed to the northwest to attempt a transect onto the continental shelf again. The ice edge was encountered before we were at the shelf break, and we opted to collect an ESP at the highest position on the slope that the ice edge would allow us to occupy. After a period of maneuvering ESP 18 was begun with both ships in a water depth of around 900 fm. Both ships had encountered considerable brash ice and some broken floe in seeking suitable end point locations for the ESP. No major damage to equipment was incurred.

This ESP was completed at 1750 on September 15. A Wide Aperture CDP line was begun from the southwest end point of the ESP toward the west in the hope

of gaining the continental shelf. Once again the ice edge prevented penetration onto the shelf so we turned onto a southwest course to follow the ice edge in the hopes of finding a location where the shelf was exposed. It was necessary to make continuous maneuvers along this track in order to skirt the ice edge. On reaching 74 degrees N a Wide Aperture CDP profile was shot perpendicular to the margin to establish a structure transect at this latitutde similar to that at 76 degrees N. Three ESPs (19,20, 21) were located with midpoints along this Wide Aperture profile. These were located in positions which appeared to be equivalent to ESP's 14, 15 and 16 on the northern part of the margin.

After completing ESP 21 CONRAD worked from the northeast end along the ice edge to the southwest collecting CDP data as it progressed. PROSPEKTA also acquired CDP data moving to the south to seek a position on the continental shelf on which to locate an ESP. At 2100 on September 18 we were able to begin shooting ESP 22 with both ships just landward of the shelf edge; CONRAD working from north to south toward a midpoint at about 73 degrees N.

At the completion of ESP 22 both ships attempted to steam farther west to collect ESPs on the inner shelf. However, CONRAD experienced electrical problems with its streamer and had to retrieve and repair it. As the streamer was being laid out again, working north, the weather deteriorated and a dense field of large ice fragments was encountered. After the streamer was completely deployed we were forced to turn east out of the ice field but weather conditions were such that it became necessary to bring the equipment in again and heave to. Four depth control birds had been damaged by contact with large ice fragments. The storm was intense and lasted throughout the nights of September 19 and 20, but by the morning of the 20th it had cleared considerably - as had the ice - apparently broken up and driven south

by the storm. We were able to move well west on the shelf and with the southeast headland of Hold with Hope in sight we obtained ESP 23, then moved east to obtain ESP 24 on the midslope and ESP 25 on the lower slope. After ESP 25 was begun the weather closed in again. With following seas causing CONRAD's streamer to be extremely noisy and difficult to trim, we abandoned our work, brought the streamer on board, and at 04430 on September 22, headed for Iceland.

PROSPEKTA stayed in the area, waited out the storm, then collected CDP data along a transect connecting the midpoints of ESP's 25, 24, 22 and 23. They then worked to the south along the shelf before ending at about 72 degrees N.

Recommendations

1. Improvement in lighting of the back deck area where streamer work is conducted is essential. Streamer work at night is presently difficult and sometimes hazardous.

2. A system for obtaining direct readout of streamer depths on the bridge or chartroom so that the ship's officers can be directly aware of the state of trim of the sreamer. Either a TV monitor of the gauges in the MCS lab or repeat gauges would be satisfactory.

3. A TV monitor of the back deck work area to be mounted in chartroom or bridge both for personnel safety and so that the streamer can be observed during turns. Presently, the streamer is often dragged against the uprights of the goalpost frames during turns and this should be avoided.

4. An improved system for filling streamer sections with oil is required. Some means of pumping oil directly to the back deck work area is most desirable.

5. Direct access between MCS and dry labs is highly desirable.

NORWEGIAN-GREENLAND CONJUGATE MARGINS STUDY