Lamont - Doherty Geological Observatory | *Palisades, N.Y. 10964*
of Columbia University

Cable: LAMONT, Palisades, New York State

Telephone: Code 914, Elmwood 9-2900
Twx: 710-576-2653

CRUISE REPORT

Ship Name:

Cruise No: 3406

Departure: 1 Aug. 77 (Date) from Colombo (Port)

Arrival: 27 Aug. 77 (Date) at Mahé, Seychelles (Port)

Days at Sea: 26

Days Foreign Port: 4 (No. of days in arrival port)

Area of Operation: Western Indian Ocean; Amirante Passage, northernmost Mascarene Basin and southernmost Somali Basin.

Program Description: Near-bottom sedimentation processes in the Amirante Passage: Paleoclimatic and sedimentation history of Antarctic Bottom Water flow through the passage. 3.5 kHz echo character mapping and acoustic stratigraphic mapping of sediment deposits. Piston coring, bottom photography, and nephelometry. Bulk physical property measurements on piston cores.

Participants: (All L-DGO unless otherwise specified)

Damuth, John E., ...Chief Scientist
Holland, Michael, ...Camera and Nephelometer
Mossman, Brian ..................................E.T.
O'Neill, Owen ...................................E.T.
Paisley-Smith, Van, ...Gravity
Petersen, Robert, ...E.T.
Quali, Ropate ....Core Bosun
Smith, Hector ....Air Gun
Sundvik, Michael ....Core Describer
Johnson, David A., ...Visiting Scientist, (W.H.O.I.)
Prell, Warren L., ...Visiting Scientist (CLIMAP, Brown Univ.)

All inquiries regarding cruise should be made to the chief scientist.

The R/V VEMA departed Colombo, Sri Lanka on August 1, 1977 and arrived in Mahé, Seychelles on August 27, 1977. Approximately 4,400 miles were steamed during the 26-day transit. The primary area of operation was the Amirante Passage in the western Indian Ocean between the Seychelles Islands and Madagascar. The cruise was an ONR-supported leg to study near-bottom processes in the western Indian Ocean. The Amirante Passage was chosen as the primary study area because a previous Woods Hole cruise had revealed the presence of a variety of acoustic reflectivity provinces and current-controlled sedimentary deposits in and around the passage which are apparently related to the northward flow of Antarctic Bottom Water (AABW) from the Mascarene Basin through the passage into the Somali Basin. The major objectives and operations of the cruise were as follows:

1) Determine the present-day morphology, acoustic structure, and nature of sediments of the Amirante Passage and adjacent portions of the northernmost Mascarene and southernmost Somali Basins in order to discover the pattern of flow and the dynamic effects on sedimentation of the AABW as it passes through this region. This objective was accomplished by conducting a detailed bathymetric (using 3.5 and 12 kHz PDRs) and seismic reflection survey of the passage and by taking piston cores, bottom photographs and nephelometer profiles at strategic locations in the passage. Because the Amirante Passage consists of several deep ($>$4500 m) north-south trending valleys separated by steep ridges, our survey consisted primarily of east-west geophysical profiles across the region in order to map the bathymetry and trends of the ridges and the locations of the principal channels and sills within the region.

We took cores, bottom photographs, and nephelometer profiles on the floors of several of the deep valleys in order to determine the presence and intensity of flow of the AABW from west to east across the passage. This will enable us to determine whether the AABW has a strong flow through all the channels or whether the flow is mainly confined to the westernmost channels as previously suspected. Preliminary results (e.g. bottom photographs) suggest that the AABW has a fairly strong flow through the eastern channels as well.

We mapped erosional/depositional features formed by the AABW using 3.5 kHz echograms and seismic reflection profiles. In particular, the previous Woods Hole cruise had discovered that north-south zones of large sediment waves occur along each side of the westernmost channel in the passage; whereas in the center of the channel erosion apparently was prevalent. We mapped the distribution of the sediment waves in more detail and took cores, bottom photographs, and nephelometer profiles on both the sediment waves and in the channel axis. The photographs revealed intense ripples and erosion in the channel axis but relatively tranquil bottom with only minor current activity in the zone of sediment waves. We also cored a zone of prominent reflectors which outcrop in the channel floor and which appear to be exposed by erosion. We hope that the dating of this core will enable us to determine the time of initiation of bottom-water flow through the passage.

2) As part of our overall survey of the region we took cores, bottom photographs, and nephelometer profiles along a profile at 12°20'S in the northern Mascarene Basin. The locations of these stations correspond to the locations of hydrographic profiles previously taken by B. Warren. We wanted to establish if possible, a correspondence between hydrographic and geologic evidence for the location and relative intensity of the AABW in the northern Mascarene Basin.

3) Another objective of the cruise was to study the acoustic and bulk physical properties of sea-floor sediments in relation to acoustic reflectivity provinces as observed on 3.5 kHz echograms. We had intended to measure sediment velocities at close interval ($\leq$20 cm) down piston cores raised from various,

unique acoustic provinces. In addition, we would sample the cores at the same interval and the samples would be sent back to Lamont where the bulk physical properties (e.g. bulk density, porosity, grain density, etc.) would be determined and correlated with the velocity measurements and acoustic records. Unfortunately the oscilloscope used to measure the velocities arrived at the ship inoperative and thus we could not conduct the velocity measurements. We did, however, sample several long cores at close interval for bulk physical property analysis.

4) Another major objective was to study the paleoclimatic history of AABW flow through the passage during the late Quaternary in order to determine how the volume and strength of the AABW flucturated in response to glacial/interglacial climatic oscillations. This is to be accomplished by biostratigraphic and paleo-climatological studies of a series of piston cores raised at approximately 200 m intervals between 4000 and 2500 m from the floor and walls of the passage. Woods Hole had previously taken a series of such cores up the side of a ridge in the passage from depths greater than 3500 m. On V3406 we attempted to locate and core ridges which extended above 3500 m and thus extend the profile of cores up to 2500 m. Although most of the ridges in the passage turned out to be too steep to be suitable coring sites for unreworked pelagic sediments, we did obtain some cores from depths of 2500 to 3500 which should supplement the previous suite of cores. Detailed study of these cores should reveal the properties and flow characteristics of the AABW in Recent sediments (as reflected by the planktonic floral and faunal relationships observed in the sediments). Once the present-day influences of the AABW have been recognized and defined in the sediments, it will then be possible to work backward in time down the cores to determine how the intensity and volume of the AABW has fluctuated within the passage in response to glacial/interglacial oscillations.

5) A secondary objective of the cruise was to supplement existing core coverage of the western Indian Ocean to aid in ongoing investigations in paleo-oceanography and paleo-climatology (e.g. CLIMAP). During our 12 day transit from Colombo to the Amirante Passage we took several cores from depths less than 4000 m in an attempt to obtain continuous late Quaternary sediment sequences to aid these ongoing studies. The shallower cores (< 3500 m) from the Amirante Passage region should also be helpful in these paleo-climatological studies.

6) We also ran several geophysical lines across the Amirante Trench, a deep (~5000 m) flat-floored trench-like feature which borders the western edge of the Amirante and Seychelles Islands. We obtained several good seismic and gravity profiles across the trench as well as a core, bottom photos, and a nephelometer profile from the trench floor.

The weather proved to be a major problem during the entire period of our work in the Amirante Passage region. The southwest monsoon caused continuous heavy seas (sea states 5, 6, and 7) which greatly reduced the amount of station work that could be accomplished. We were at no time able to conduct two-wire operations and heavy seas greatly slowed setting-up, extrusion etc. of the corer. We probably could have taken twice as many stations had the sea not been so rough. The heavy seas also prevented any sonobuoys from being shot. It is apparent that this time of year (August) is not the time to conduct shipboard operations in this part of the western Indian Ocean.

Several minor and major mechanical problems occurred with the equipment during the leg. The profiler worked very poorly the first few days. Finally it was discovered that one profiler was cross-talking to the other. The profiler was taken apart and reassembled and from then on we got pretty good records although the heavy seas introduced a lot of noise into the records when sailing with the

wind. The airgun also experienced a multitude of minor
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hoses are old and worn out. They should be replaced as
VV3 valve also gave problems.

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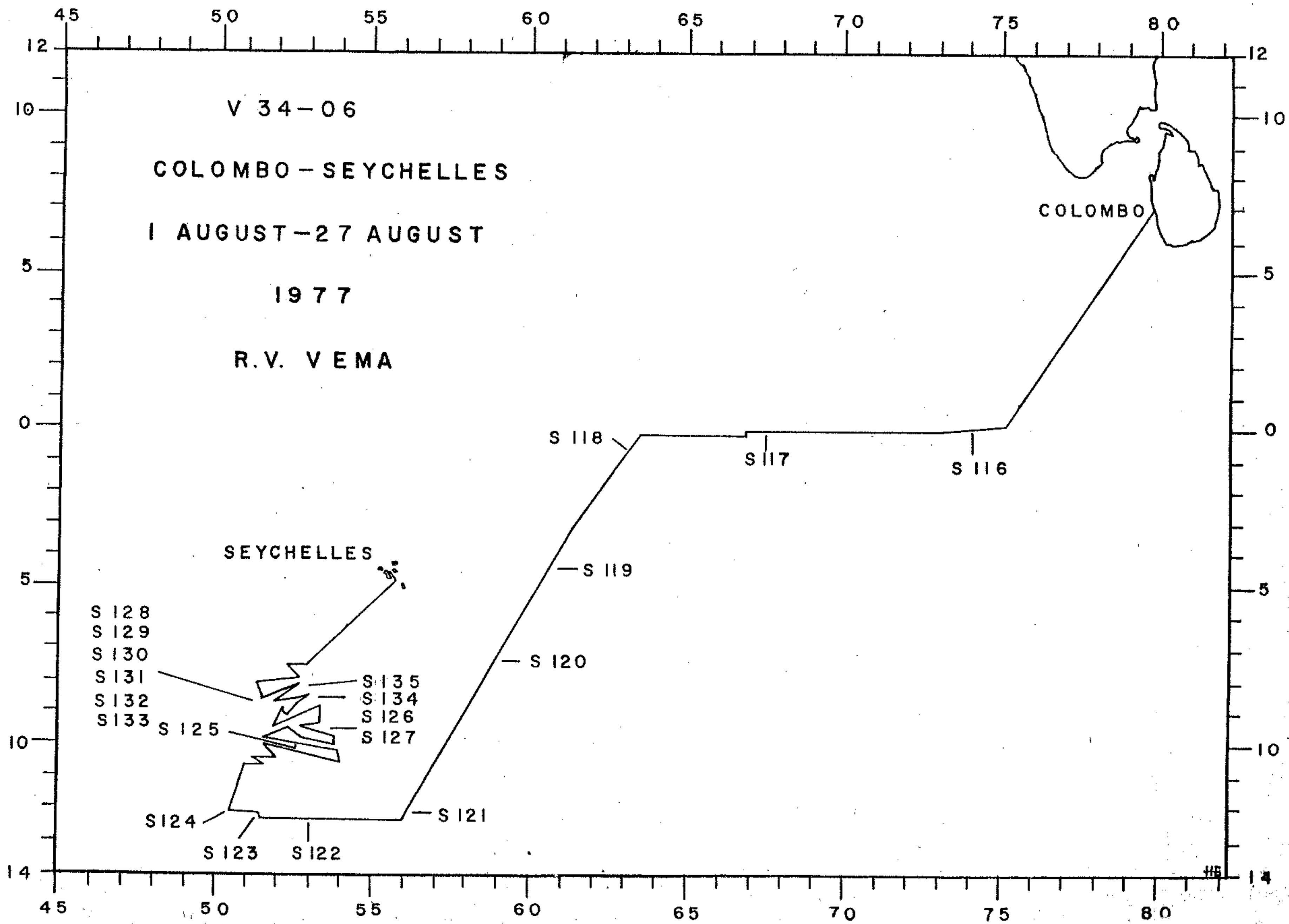
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