Research program 1976-1977 in the S.E. Atlantic Ocean

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Intern verslag

Inhoud:

NEDERLANDS INSTITUUT VOOR ONDERZOEK DER ZEE

VERSLAGEN

nummer 1976 - 16

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Netherlands Institute for Sea Research

Texel

The research program of the Netherlands Institute for Sea Research, Texel, for 1976-1977 in the S.E. Atlantic Ocean includes four subjects:

1. mixing of Niger water, Zaïre water and ocean water in the area between the Gulf of Guinee and the Zaïre.
2. mixing and chemical processes in the Zaïre estuary and in the adjacent ocean.
3. sediment transport and sedimentation in the Angola basin, with the emphasis on deposition of material derived from the Zaïre estuary through the Zaïre canyon.
4. nutrient (silicate) content of the Antarctic Bottom Water in this area.

This program will be carried out by the departments of Geology/Geochemistry, Chemical Oceanography and Physical Oceanography with assistance of the Biology department and the Vening Meinesz Laboratory of Utrecht State University. Subsequent analysis of samples collected in this program, will be done in cooperation with the Isotope Laboratory of Groningen State University and the Chemistry department of the Reactor Centrum at Petten.

Mixing of Niger water, Zaïre water and ocean water in the Gulf of Guinee - Zaïre area

In the Gulf of Guinee during the entire year a more brackish surface layer of 20-50 m is present. This layer is formed by admixture of river water of the Niger and other, smaller rivers, and of rainwater, as precipitation is much larger than evaporation in this area. More to the south there is also an admixture of Zaïre river water whereas towards the southwest the brackish surface layer passes into the ocean surface water. The boundaries between ocean water, Guinee (Niger) water and Zaïre water vary strongly with the seasons. Sharp fronts are present in June/July between Annabon and Cape Lopez, which move southward during

the autumn. Optical tracers and the relation between salinity and silicate content offer the possibility to distinguish between the freshwater fractions of Niger and Zaïre. Also the content of dissolved nutrients will be determined in the surface layers, and the loss of dissolved N and P will tentatively be correlated with simultaneously measured primary production. Earlier research in this area (mainly carried out during the EQUALANT program) failed to give attention to the influence of the Niger and Zaïre rivers on the primary production.

Mixing and chemical processes in the Zaïre estuary and the adjacent ocean

Although the Zaïre river is the second largest river in the world after the Amazon river, very little work has been done on mixing in the estuary whereas on chemical processes nothing is known. Research in other estuaries has shown that mobilisation and removal processes can be expected which determine how much of the material brought seaward by the river will eventually reach the ocean. In order to study these processes and to get more knowledge on adsorption and desorption processes in the estuary water samples will be collected for determination of salinity, pH, temperature, content of nutrients, suspended matter, trace elements and particle size. Also primary production during the period of sampling will be determined.

Mixing continues outside the estuary in the adjacent ocean where a plume of outflowing brackish water is formed. It can be expected that fosfates and nitrogen compounds coming from the river have been consumed by plankton already at low salinities but that some silicate will remain. Therefore emphasis will be given to the determination of nutrients, chlorophyl and primary production in this area. Additional data will be collected to complete the results obtained in the estuary.

Sediment transport and sedimentation in the Angola Basin

The main feature in this area, determining as far as known, a large part of the sedimentation in the Angola Basin, is the Zaïre canyon. It

originates in the estuary so that there is a direct connection between the estuary and the deep sea floor. This is at present a unique feature, although a similar situation has occurred in the past during the Pleistocene at the mouths of the Mississippi and the Niger. In the Zaïre estuary much fine sediment is deposited in the canyon head, where weak bottom currents have been measured. Regularly however large amounts of sediment flow downward through the canyon, breaking telephone cables, which happened 30 times between 1887 and 1938. The mechanism is not clear: bottom cores and box samples, to be collected in the head of the canyon, will give more information on sedimentation and subsequent transport. This may also clarify why the Zaïre canyon has not been silted up as has happened with the canyons at the Mississippi and the Niger.

On the continuation of the Zaïre canyon and the associated submarine fan there is only limited knowledge, mainly collected by the Lamont Geological Observatory and Woods Hole Oceanographic Institution. These data will be extended by airgun and 3,5 KC echosounder registrations and by collecting 10 m piston cores for studying the extent, structure and age of the deep sea fan.

On the continental rise and slope an area with anaerobic bottom-sediment has been found previously. The sediment is dark-coloured, containing pyrite grains and gasbubbles. The conditions which have led to this anaerobic condition will be studied and cores will be stored at $-18^{o}C$ for further analysis at Texel. It is probable that decomposition of organic material from the Zaïre estuary deposited along the slope, has led to anaerobic conditions. There are also indications that this accumulation of organic matter has led to relatively dense populations of bottom organisms (detritus feeders). Therefore biomass will be determined in box samples.

A second source of sediment in the Angola Basin is probably the Antarctic Bottom Water. Some of this water is known to flow northward over the Walvis Ridge and thick bottom deposits in the Angola Basin have been associated with this flow. It is not known how far north this flow extents into the Angola Basin and to what extent Antarctic Bottom Water flows in from the north. Therefore bottom water in the Angola

Basin will be sampled and turbidity will be measured with a nephelometer. The nephelometer data will be related to particle size data, to total particle content and to the type of particles.

Nutrients (silicate) in the Antarctic Bottom Water

Antarctic Bottom Water, flowing northward, mixes with North Atlantic Deep Water but probably also changes in composition by exchange and solution processes affecting the sediment on the sea floor. The influence of Antarctic Bottom Water on carbonate solution is relatively well known but probably also silicate content changes during the long contact with the bottom. Therefore water samples will be collected in the water near to the bottom (also at 0,5 m and 1,0 m above the bottom), in combination with short (25 cm) cores which will be used for collecting interstitial water. In all samples salinity and nutrient (silicate) content will be determined. Samples will be collected in the Angola Basin and further north at 10^{o} intervals.

Concept-program for 1976

For the part of the program to be realised in 1976 the following schedule has been made. The program will be carried out with a chartered merchant-vessel where laboratories have been installed in containers. The whole program will take two or three cruises, to be made in 1976, 1977 and 1978/79, depending on the amount of ship time available and the results obtained after two cruises.

1976

October	4	Departure Rotterdam. Testing equipment; two deep stations (water samples)
	12	Arrival Madeira
	14	Departure Madeira. Two deep water stations (water samples)
	18	Arrival Dakar
	19	Departure Dakar. Mixing Gulf of Guinee - Zaïre. In this period one visit to a harbour for oil and water

November 9 Arrival Boma. Zaïre estuary and canyon head.

23 Departure Boma. Zaïre river plume, Zaïre canyon and fan, bottom water Angola Basin. In this period one visit to a harbour for oil and water.

December 14 Arrival Dakar

15 Departure Dakar

27 Arrival Rotterdam

NB. This schedule may be subject to changes when the definite schedule is made, but will be maintained as much as possible.

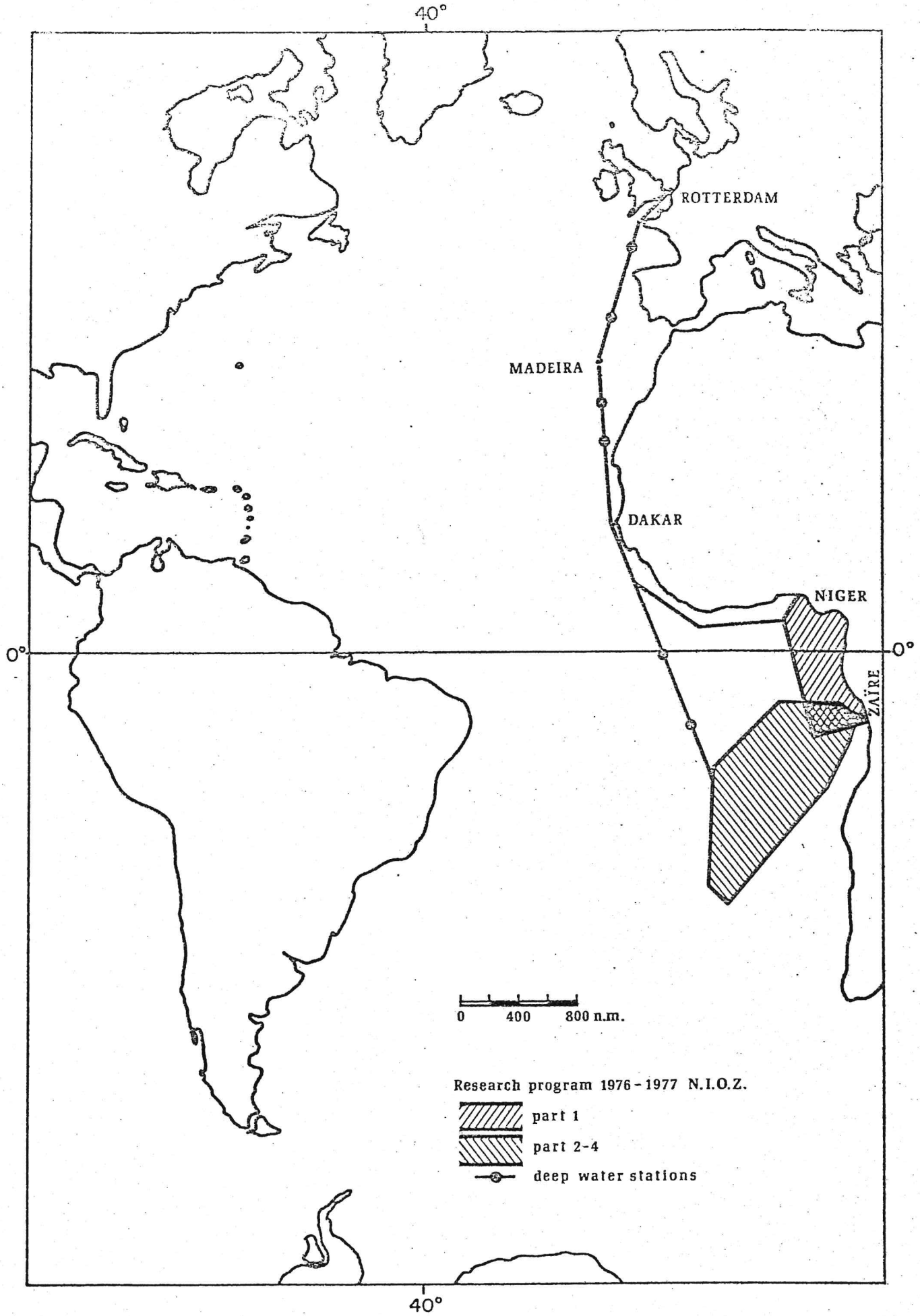
40°
ROTTERDAM
MADEIRA
DAKAR
NIGER
0°
0°
ZAÏRE
0 400 800 n.m.
Research program 1976 - 1977 N.I.O.Z.
part 1
part 2-4
deep water stations
40°

Fig. 1

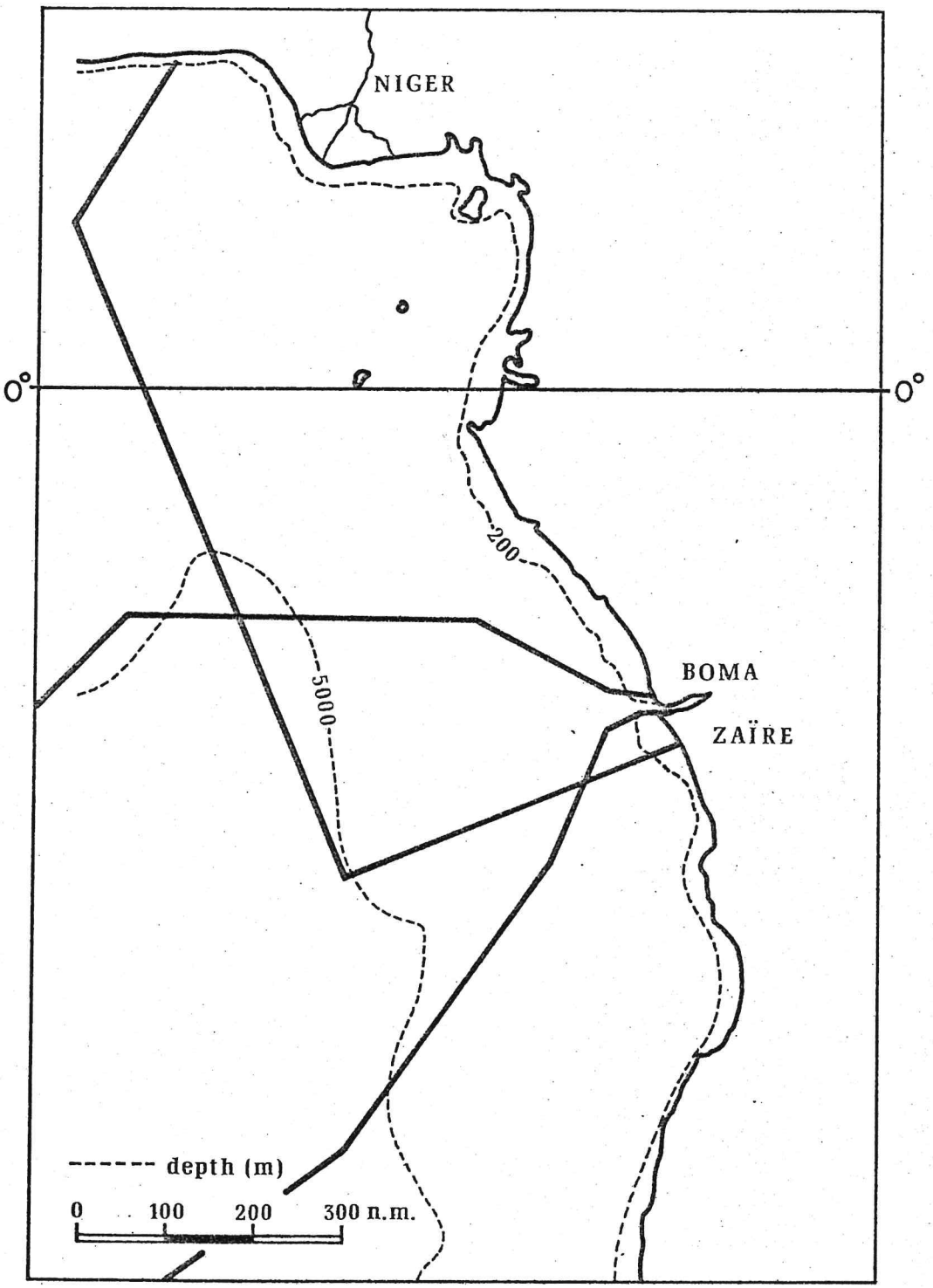

Fig. 2

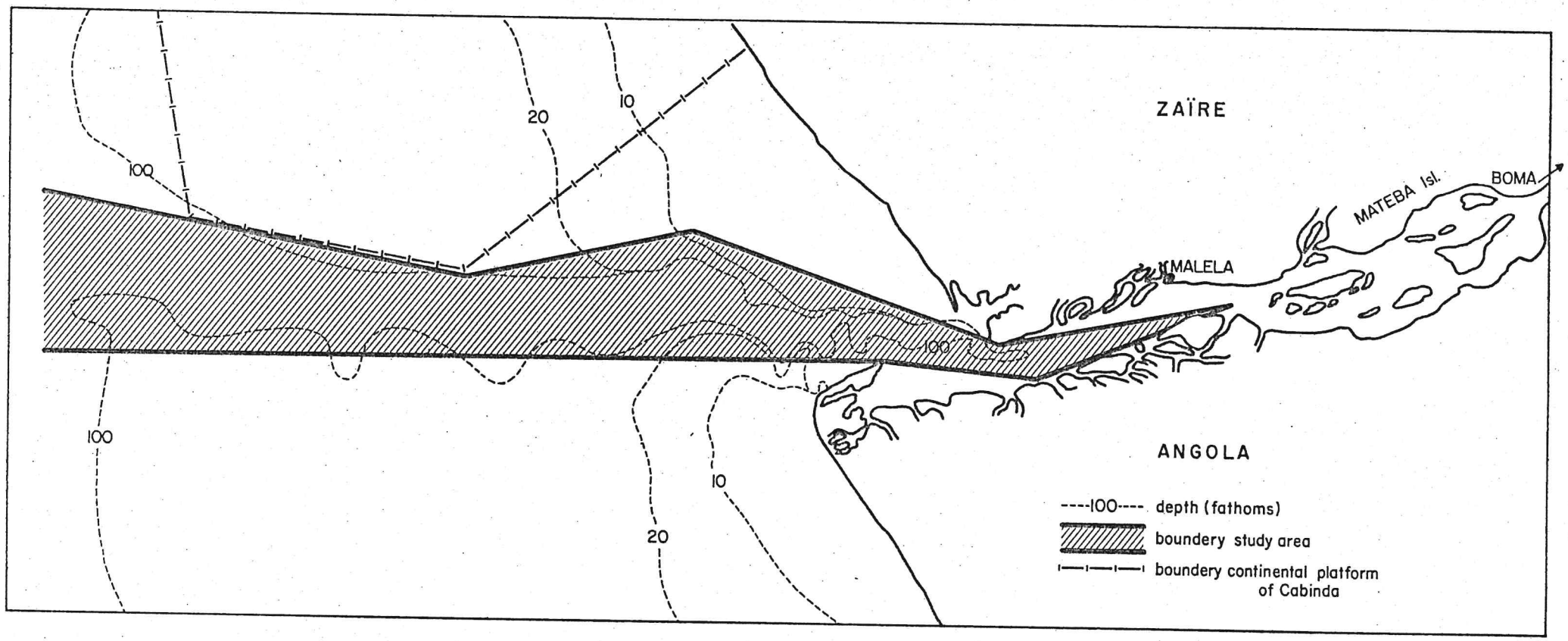
ZAÏRE
ANGOLA
MATEBA Isl.
BOMA
M'MALELA
100
20
10
100
100
10
20
----100---- depth (fathoms)
boundery study area
boundery continental platform of Cabinda

Fig. 3