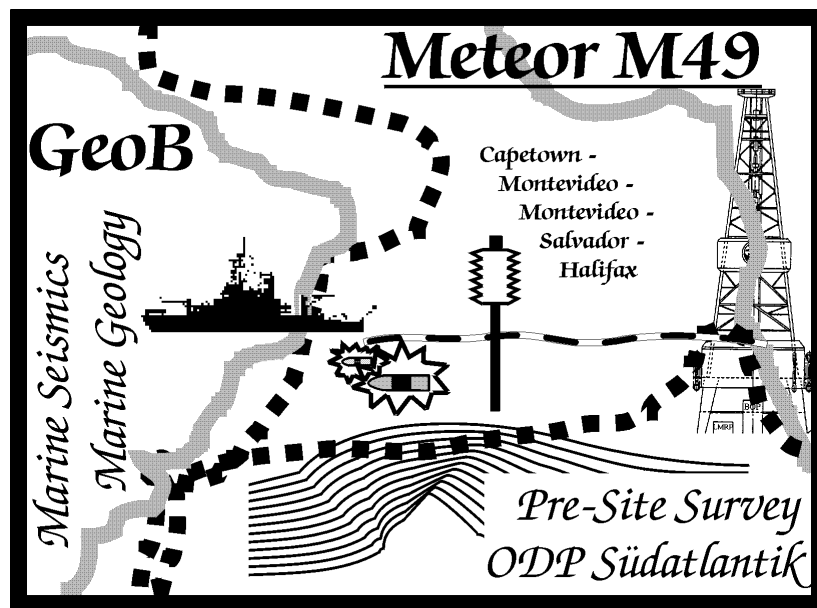


METEOR-Berichte 02-1
ODP Südatlantik 2001

Cruise No. 49
4 January – 5 May 2001



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Abstract

METEOR Cruise 49 combined four legs to the Walvis Ridge, in the southwestern South Atlantic off Argentine, Uruguay and southern Brasil and in the equatorial Atlantic. All cruises were related to pre-site survey for active proposals in the Ocean Drilling Program, which included marine multichannel seismics and geologic sampling.

The **first** leg M49/1 (Capetown-Montevideo) was devoted to reflection seismics, sediment echosounder and bathymetric measurements to investigate Paleogene sedimentary sequences on the outer Walvis Ridge. Extreme climatic conditions in the Paleogene, dating utilizing astronomical cycles and the reconstruction of paleoceanographic development are main objectives of the ODP proposal (J. Zachos), which could be supported with new survey data.

The **second** leg M49/2 concentrated with reflection seismic, bathymetric and sediment echosounder surveying as well as geologic sampling on the southern part of the South American continental margin off Argentine and Uruguay. A drilling proposal of Wefer et al. could be supported by identifying new drill sites, which are aimed to the reconstruction of Neogene paleoceanography.

The working program of the **third** leg M49/3 was directly related to Leg 2 and the ODP drilling proposal of Wefer et al. During this cruise the northern part of the South American continental margin in the Argentine Basin was studied with seismic, echosounder and swath sounder surveying and geologic sampling to identify undisturbed and continuous Neogene sedimentary sequences.

During the **forth** Leg of the METEOR cruise 49 particle sedimentation in the western equatorial Atlantic and in the Brazil Basin was investigated. A geological transect across the North Brazil Current off Surinam can be used to reconstruct the transport of warmer water masses from the equatorial Atlantic into the Caribbean and the North Atlantic during the Quaternary. The third topic were seismic, echographic, bathymetric and geological investigations at the Demerara Rise off Surinam (ODP proposal of J. Erbacher, BGR). During the entire cruise, plankton material and surface water was continuously collected by means of the ship's pumping systems to test specific proxies.

Zusammenfassung

Die vier Expeditionen der METEOR Reise 49 führten auf den Walfisch Rücken, in den westlichen Südatlantik vor Argentinien, Uruguay und das südliche Brasilien und in den äquatorialen Atlantik. Sie verbanden marin-seismische Messungen zur Festlegung von Bohrlokalationen für verschiedene Bohrvorschläge des Ocean Drilling Programms mit meeresgeologischen Arbeiten.

Während des **ersten** Fahrtabschnittes M49/1 (Capetown-Montevideo) wurden ausschließlich reflexionsseismische, sedimentechographische und bathymetrische Daten gesammelt, um paläogene Abfolgen auf dem äußeren Walfisch zu untersuchen. Extreme Klimazustände im Paläogen, die Datierung mit astronomischen Zyklen und die Rekonstruktion der paläozanographischen Entwicklung sind Zielsetzung eines ODP Bohrvorschlages (J. Zachos), der mit neuen Daten vorbereitet und unterstützt wurde.

Der **zweite** Abschnitt M49/2 konzentrierte sich mit reflexionsseismischen, bathymetrischen und sedimentechographischen Messungen auf den südlichen Abschnitt des südamerikanischen Kontinentalrandes vor Argentinien und Uruguay. Mit den Ergebnissen wurde ein Bohrvorschlag

von Wefer et al. zur paläozeanographischen Entwicklung im Neogen unterstützt und mit gezielten geologischen Beprobungsarbeiten ergänzt.

Das Arbeitsprogramm des **dritten** Abschnitts M49/3 stand in unmittelbarem Zusammenhang mit Abschnitt 2 und dem ODP Bohrvorschlag von Wefer et al. Während dieses Fahrtabschnitts wurde der nördliche Teil des südamerikanischen Kontinentalrandes im Argentinien Becken seismisch, echographisch, bathymetrisch und geologisch untersucht, um ungestörte neogene Sedimentabfolgen zu finden.

Auf dem **vierten** Fahrtabschnitt der METEOR-Reise 49 wurden zunächst Untersuchungen zur Partikelsedimentation im westlichen äquatorialen Atlantik und im Brazil-Becken durchgeführt. Anschließend wurde ein geologisches Profil quer zum Nordbrazilstrom vor Surinam abgearbeitet, um den Transport warmer Wassermassen aus dem äquatorialen Atlantik in die Karibik und den Nordatlantik während des Quartärs zu rekonstruieren. Dritter Schwerpunkt waren seismische, echographische, bathymetrische und geologisch / sedimentologische Untersuchungen am Demerara Plateau vor Surinam (ODP-Bohrvorschlag von J. Erbacher, BGR). Während der gesamten Reise wurde zudem Planktonmaterial und Oberflächenwasser mit den Schiffspumpen entnommen, um verschiedene Proxies zu testen.

Research Objectives

METEOR cruise M 49 combined four legs in the South Atlantic Ocean (Fig. 1 and table 1). During the **first leg** high resolution multichannel reflection seismic measurements were done to support the proposal 'Early Cenozoic Extreme Climates - The Walvis Ridge Transect' by J. Zachos (Univ. Sta. Cruz, USA) for scientific drilling carried out by the Ocean Drilling Program. The measurements improved the available data and knowledge from seismic surveys of the 70's and from previous drilling of the Deep Sea Drilling Project Leg 74 about sedimentary sequences and sedimentary structures.

The Walvis Ridge separates the Eastern Atlantic into the Angola Basin and the Cape Basin (Fig. 1). Since the opening of the South Atlantic this volcanic structure acts as a barrier for the circulation of deep and surface currents. It also defines a depositional environment, which is in contrast to the neighboring basins dominated by continuous biogenic sedimentation.

In this respect the Walvis Ridge represents one of the few locations in the South Atlantic Ocean, where paleoceanographic investigations can be carried out without the dominance of terrigenous material or the influence of local upwelling processes. Sedimentation rates are on the order of a few centimeters per 1000 years only and allow studies of Paleogene and late Mesozoic sequences, avoiding diagenetic overprints or coring disturbances due to lithification.

The drilling project, which was supported by our seismic measurements, aims to the investigation of extreme climatic conditions of the Paleocene. For precise dating, sediments shall be drilled with multiple parallel holes, which will be correlated through the use of astronomically controlled variations in lithology and sediment physical properties.

The study area on the outer Walvis Ridge includes a depth transect from the crest of the ridge towards the Angola Basin as well as several locations on the Walvis Ridge crest at different distances from the African continent. Multichannel seismic data can be used to identify new drilling locations and to develop a seismostratigraphic concept.

The **second leg** focused on the Neogene paleoceanography of the southwestern Atlantic which is important for the understanding of global circulation and its link to the geologic record. A drilling proposal by Wefer et al. with the title 'Brazil-Falkland (Malvinas) Confluence: Paleoceanography of a Mixing Region' is aiming to carry out for the first time scientific drilling in this key region. Due to the complexity of depositional regimes at the South American continental margin, two METEOR cruises applying geophysical methods of reflection seismics, bathymetry and sediment echosounding combined with geologic sampling were dedicated to the task of the identification of suitable drilling locations.

During R/V METEOR Cruise M 49/2 pre-site surveys were carried out in three different regions off Argentina and Uruguay. The subsequent **third leg** of M49 operated in Brazilian waters.

The Cenozoic evolution of the working areas off Argentina, Uruguay and Brazil has not been studied in detail previously. This was mainly due to the complexity of topography, sedimentary structures and the strong influence of bottom currents, which limits the lateral continuity and extent of reflectors and sedimentary units. Knowledge about the near-surface sedimentation was improved during several METEOR cruises (M 29/1, M 29/2, M 46/2, M 46/3) of the SFB 261. R/V METEOR Cruise M 49/2 primary aimed to the upper 200 m to 600 m of the sediment cover, which cannot be reached with sediment echosounding. Whereas the structural and stratigraphic

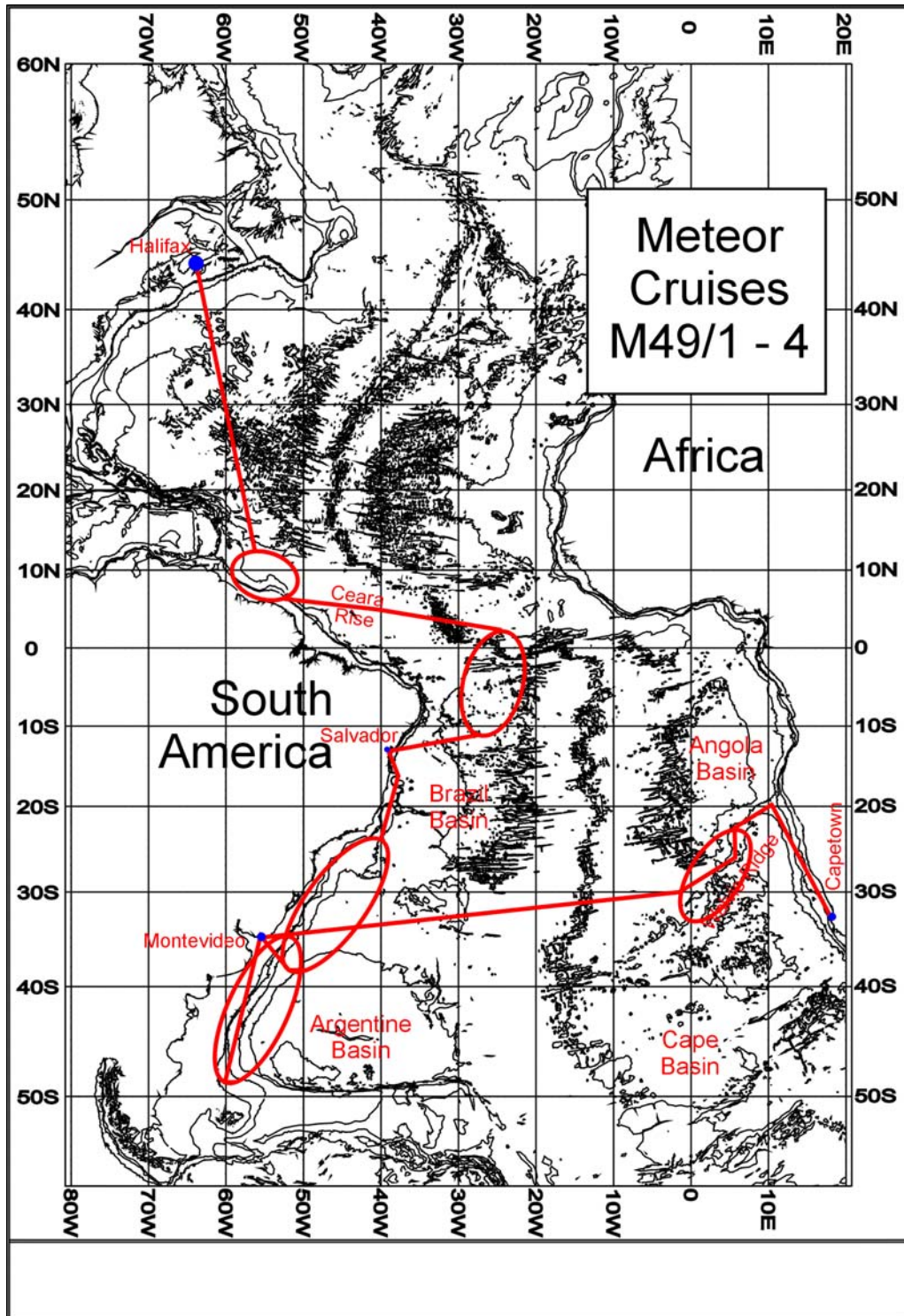


Fig. 1: Cruise tracks and working areas of METEOR cruise No. 49

resolution of conventional seismics is on the order of 10 meters, the Bremen system provides more detailed insight.

The geological program of the **fourth leg** of METEOR cruise M 49 was the extension of investigations of pelagic sediments in the tropical-subtropical Atlantic in the frame of the special research project SFB 261. Additionally particle sedimentation in the western equatorial Atlantic and in the Brazil Basin was investigated.

The best examples in the geologic record of rapid extinctions linked to massive perturbation of the global carbon cycle and extreme changes in Earth's climate come from the Cretaceous to Paleogene (e.g. mid-Cretaceous Oceanic Anoxic Events, OAEs, late Palaeocene Thermal Maximum, LPTM). The Demerara Rise (DR) represents an ideal drilling target for paleoceanographic research of Paleogene to mid-Cretaceous sediments because target sediments: (1) crop out on the sea-floor, (2) exist with good stratigraphic control in expanded unlithified sections, (3) contain spectacularly well-preserved microfossils and (4) were deposited within the core of the tropics in a proximal location to the equatorial Atlantic gateway.

Ocean Drilling Program (ODP) proposal 577 suggests 10 drillsites on a depth transect between 1735 and 3320 m present water-depth at the northern margin of DR. Investigations during METEOR cruise M 49/4 (1) contribute new high resolution multi channel seismic data to complete the existing grid of industry seismic lines and (2) help to identify localities of outcrops of Paleogene to Cretaceous sediments which partly were sampled.

Table 1 : Legs and chief scientists of METEOR cruise M 49.

Leg	Period	Ports	Chief scientist
M 49/1	4.1.01 – 10.2.01	Capetown (South Africa) – Montevideo (Uruguay)	Prof. Dr. V. Spieß
M 49/2	13.2.01 – 7.3.01	Montevideo (Uruguay) – Montevideo (Uruguay)	Prof. Dr. V. Spieß
M 49/3	9.3.01 – 1.4.01	Montevideo (Uruguay) – Salvador (Brazil)	Prof. Dr. U. Bleil
M 49/4	4.4.01 – 5.5.01	Salvador (Brazil) – Halifax (Canada)	Dr. G. Fischer

Masters: S. Bülow (M 49/1, M 49/2), M. Kull (M 49/3, M 49/4)

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