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Macro- and megafauna communities in three deep basins of the South-East Atlantic

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ABSTRACT

During 'Meteor' expedition 'DIVA 2' in 2005 the abyssal macro- and megafauna communities were studied in the northern Cape Basin, in the northern Angola Basin and in the eastern and western Guinea Basin. Water depths varied between 5040 and 5670 m.

Surface deposit feeding or predatory ophiuroids dominated the megafaunal community in the northern Cape Basin, sponges, sipunculids and fish in the northern Angola Basin, and asteroids, crustaceans and fish in the eastern Guinea Basin, while in the western Guinea Basin sipunculids dominated.

In the northern Cape Basin, peracarid crustaceans were the dominant macrofaunal group, followed by polychaetes and bivalves. In the Guinea Basin, polychaetes, peracarid crustaceans and bivalves dominated, although omnivorous or predatory free-living nematodes of macrofaunal size (> 0.5 mm) made up 40–60% of the total abundance, with maxima in the western basin.

The chlorophyll *a* content of sediments was lower in the northern Cape and Angola Basins than in the Guinea Basin, which was consistent with the differences in water masses, primary production and flux rate of organic matter in the three basins of the South-East Atlantic. The differences in structure and function of the macro- and megafauna communities in the three basins correlated with the differences in the amount of food reaching the seafloor in tropical and subtropical settings.

1. Introduction

The topography of the South-East Atlantic is characterised by three deep basins, which reach water depths > 5000 m (Fig. 1). The Cape Basin is located south of the Walvis Ridge. The Angola Basin covers the area off the Namibian and Angolan coasts north of the Walvis Ridge. The Guinea Rise separates it from the Guinea Basin, which is located off the coast of Ivory Coast in tropical waters.

Several studies revealed that the diversity of benthic communities at extreme depths depends on the flux of organic matter produced in the upper water column (Sibuet et al., 1989; Boetius et al., 1996; Rowe and Pariente, 1992; Levin et al., 2001; Lambshead et al., 2002; Smith et al., 2008). Also, the results of the DIVA 1 expedition in the eastern deep Angola Basin documented the effect of different food availability on the diversity of benthic communities along a gradient of increasing surface primary production (Kröncke and Türkay, 2003). This gradient crossed water masses of the warm South Equatorial Counter Current and the cold Benguela Oceanic Current, which meet in the Angola–Benguela front (Peterson and Stramma, 1991; Jansen et al., 1996; Bernard et al., 1999). High primary production in the Angola Basin due to warm water masses and nutrient supply from the Zaire (Congo) River and the Benguela upwelling system (von Bodungen et al., 2008) led to higher sedimentation rates and food supply for the benthos at the northern part of the DIVA 1 gradient.

Antoine et al. (1996) and Seiter et al. (2005) provided data on primary production and flux rates of particulate organic matter in the South-East Atlantic. The highest production and flux rates were calculated for the Benguela upwelling system along the Namibian and Angolan coasts. Production and flux rates were also high in West African equatorial waters, low to moderate in the Angola and Guinea Basins and low in the offshore Cape Basin. Thus, the aims of the "Meteor"-Expedition Me 63/2 – DIVA 2 (February 25th to March 30th, 2005) (Türkay and Pätzold, 2009) were to study the relationship between primary production, flux rates and the biodiversity and biomass of the macrofaunal and megafaunal communities of these three deep-sea basins in the South-East Atlantic, since there is only little information available on the biodiversity of the macro- and megafauna in this region.

Macro- and megafauna were studied at three stations in the offshore south-western Angola Basin by Vinogradova et al. (1990) and in six areas in the eastern Angola Basin during the DIVA1 Expedition (Kröncke and Türkay, 2003; Cristobo et al., 2005; Brandt et al., 2005; Bohn, 2006; Fiege et al., 2010), where also meiofauna was studied (Martínez Arbizu and Schminke, 2005; Martínez Arbizu and

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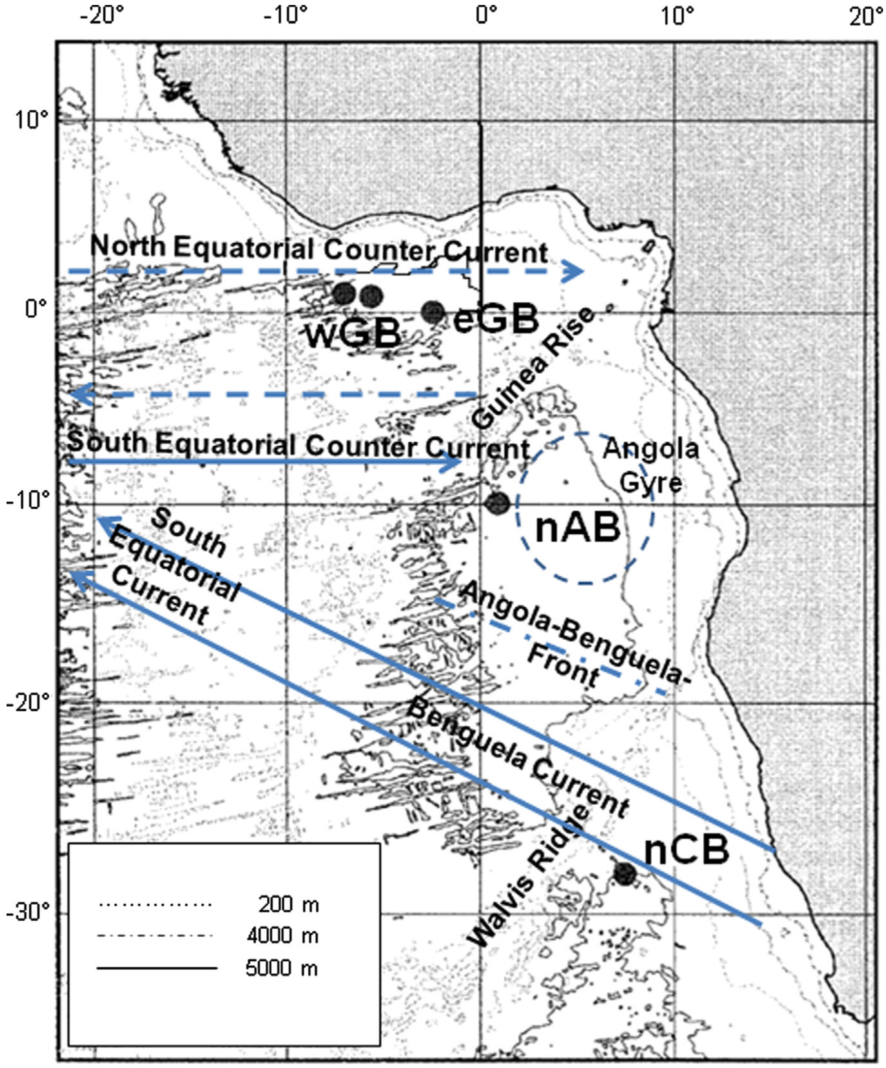

Fig. 1. Location of study sites in the northern Cape Basin (nCB), in the northern Angola Basin (nAB) and in the eastern and western Guinea Basin (eGW, wGB) and major current systems according to Peterson and Stramma (1991).

Brix, 2008; Brökeland and George, 2009). Galéron et al. (2009) investigated the spatial and temporal variability in macrofauna communities in the vicinity of the Zaire River along the deep continental margin of the Gulf of Guinea partly associated with a giant pockmark, which was also studied by Olu-Le Roy et al. (2007) and Menot et al. (2010). Studies on meio- and megafauna at the Walvis Ridge were carried out by Dinet (1973), Monniot and Monniot (1976), Fedorov and Karamyshev (1991), while Schmiedl and Mackensen (1997) studied modern foraminifera in this region.

During the DIVA 2 expedition we studied the benthic communities in the northern Cape Basin, the northern Angola Basin and the Guinea Basin in order (a) to compare the diversity of the benthic communities in the different basins and (b) to assess the relationship between different flux rates of organic matter in the three basins and deep-sea benthic diversity.

2. Material and methods

2.1. Study areas

The study areas in the Cape Basin were located in depths of 5039 m, in the Angola Basin of 5672 m and in the Guinea Basin of 5174 m (Fig. 1). Study areas at a similar depth were chosen within each basin to sample benthic fauna. A single study area was sampled in the northern Angola and the northern Cape Basins respectively. Three study areas were sampled in the eastern and western parts of the Guinea Basin.

The circulation in the eastern South Atlantic Ocean is dominated by the Benguela Current system (Fig. 1). At about 30°S the Benguela Current separates into the Benguela Oceanic Current and the Benguela Coastal Current that is influenced by the coastal upwelling regime. With flow velocities of 10–20 cm/s the cold Benguela Oceanic Current crosses the Walvis Ridge and feeds the South Equatorial Current, while the Benguela Coastal Current meets the warm Angola Current at about 16°S forming the Angola–Benguela Front in coastal regions (von Bodungen et al., 2008). The South Equatorial Counter Current results in a cyclonic gyre in the surface waters of the Angola Basin, which meets the cold Benguela Oceanic Current and extends the Angola–Benguela Front towards the open Angola Basin. The Equatorial Counter Current feeds the water masses of the tropical part of the South-East Atlantic (Reid, 1989; Petersen and Stramma, 1991; Speer et al., 1995; Jansen et al., 1996; Berger and Wefer, 1996; Larqué et al., 1997).

The Cape Basin >4000 m is filled with water masses called Lower Circumpolar Deep Water in Schmiedl and Mackensen (1997) or Antarctic Bottom Water in Scholten et al. (2008) (Fig. 2A). North Atlantic Deep Water can enter the northern Cape Basin via deeper parts of the Walvis Ridge (Schmiedl and Mackensen (1997);