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Recent benthic foraminifera from the Caribbean continental slope and shelf off west of Colombia

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ABSTRACT

A quantitative benthic foraminiferal analysis was conducted on 30 sea-floor sediment samples distributed along the continental slope and shelf in Fuerte Area (Colombian Caribbean), between 39 and 2469 m water depth.

The aims of the research were to provide data on the distribution of southwestern Caribbean Recent benthic foraminifera, to estimate changes in the foraminiferal distribution related to the bathymetry and the characteristics of the substrate, to define a data-bank on distribution of recent tropical benthic foraminifera from the southwestern Caribbean, to provide reference on foraminiferal distribution that can be used in bathymetric reconstructions of ancient environments.

Three different assemblages corresponding to three different environments were identified by cluster analysis. Assemblage A, characterized by variable percentages of porcellaneous, hyaline and agglutinated benthic foraminifera indicative of shelf environments. Assemblage B, dominated by calcareous hyaline foraminifera mainly composed of infaunal foraminifera corresponding to upper bathyal, marine conditions. Assemblage C, composed by agglutinated and calcareous hyaline foraminifera characteristic of normal deep-water marine environments.

1. Introduction

It is commonly accepted that benthic foraminiferal distribution pattern are controlled by a complex set of, often related, parameters including water depth, substratum type, food availability, oxygen concentration, water currents, turbulence, light, salinity, pH and temperature. There are several studies that show that the distribution of benthic foraminifera is determined by an interaction of physical, chemical and ecological variables (Boltowskoy et al., 1991; Murray, 1991, 1995; Brasier, 1995; Bernhard and Sen Gupta, 1999; Jorissen, 1999; Loubere and Fariduddin, 1999: Sen Gupta, 1999; Scott et al., 2001). Benthic foraminifera are a powerful tool for reconstructing paleoenvironments, paleo-bathymetry and paleo-oxygenation (Murray, 1991, 2006; Kaiho, 1994; Schumaker et al., 2007).

Benthic foraminiferal assemblages of Colombian Caribbean, particularly in deep water environments, are still poorly known. There have been many studies on Recent Benthic foraminiferal distribution patterns in the Caribbean Sea mainly dealing with continental shelf and upper slope foraminifera (Crouch and Poag, 1979; Buzas et al.1989; Havach and Collins, 1997; Peebles et al., 1997; Collins, 1993, 1999; Javaux and Scott, 2003; Schumaker et al., 2007; Wilson and Ramsook, 2007). Available works on Caribbean recent foraminifera generally deals with other geographical areas within the Caribbean Sea, but there are not published data on Colombian Caribbean recent foraminifera.

This study presents a survey of the geographic and bathymetric distribution of Recent benthic foraminifera in the Fuerte Area (Colombian Caribbean) within the depth range of 39–2469 m.

The distribution of benthic foraminifera together with the environmental data such as bathymetry and kind of substrate are used to understand which factors may be the responsible for producing the observed pattern of distribution.

The aims of the research are: 1) to acquire a better knowledge of some parameters governing Recent benthic foraminiferal distributional patterns; 2) to improve the use of benthic forams as paleobathymetric indicators; 3) to estimate changes in foraminiferal distribution related to the bathymetry and the kind of substrate; 4) to provide data on Caribbean recent benthic foraminiferal associations; 5) to put together a taxonomical data-bank of recent

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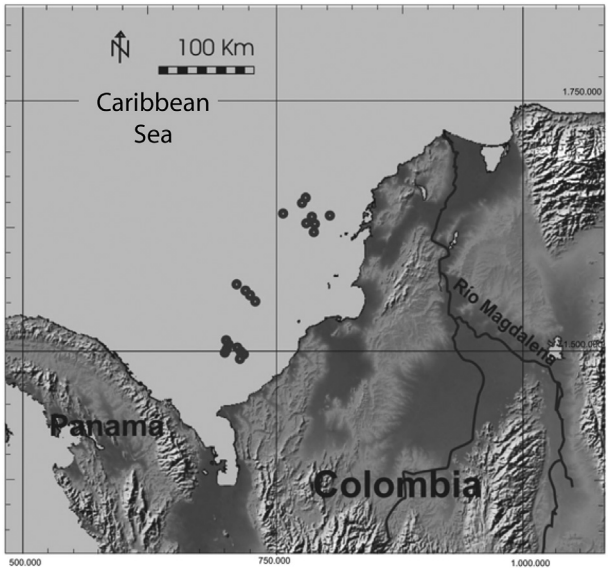

Fig. 1. Location of the studied samples along the continental slope and shelf of Fuerte area.

tropical benthic foraminifera; 6) to provide reference on foraminiferal associations distribution that can be used in paleoenvironmental and paleobathimetric reconstructions of Neogene sequences in the area.

2. Environmental setting

The Caribbean is a semi-enclosed sea adjacent to the landmasses of Central and South America. It is characterized by warm water between 0 and 180 m water depth, particularly the surface water 0–80 m water depth are underlain by high salinity water (Subtropical Under Water, or SUW between 80 and 180 m water depth). The SUW corresponds to the upper part of the thermocline (180–550 m) and its upper boundary corresponds to the thermocline (nutricline) level in the Caribbean Sea (Wüst, 1964). Due to its density, the SUW prevents nutrients in deep waters from reaching the surface water. The Caribbean Sea is generally occupied by nutrient-depleted surface water (apart from some nutrient-rich waters in the southern Caribbean linked to upwelling or river discharges) because the SUW is a permanent thermocline (Kameo et al., 2004).

Below the SUW a mixture of the SUW and the cold and nutrient-rich Antarctic Intermediate Water is present (Wüst, 1964). This layer from 180 to 550 m presents low oxygen content (<0.3 ml/l). The Antarctic Intermediate Water and the North Atlantic Deep Water are cold waters that occupy the water column between 550 and 3000 m water depth.

The Fuerte Area (Fig. 1) is located in the south-western part of the Colombian Caribbean between latitudes 10 33 00 N and 08 47 00 N. The continental slope extends from the shelf-break at about 200 m to the 2500 m isobath.

3. Material and methods

Thirty piston core samples were collected during a sampling campaign conducted in 2007 by BHP Billiton along the continental slope and shelf of Fuerte Area (Colombian Caribbean) Fig. 1. Eight samples have been collected along the middle and outer continental shelf between 39 and 220 m, two of them on the shelf break. Four samples have been collected on the upper slope between 290 and 588 m, six on the middle (623–999 m) and twelve along the lower continental slope between 1038 and 2469 m. Bathymetric ranges subdivision used in this work are the ones reported by van Morkhoven et al. (1986). The samples, together with the coordinate

Table 1
List of the samples together with water depth, coordinates of the sampling points and sediment description.

Sample	Water depth (meters)	USBL E	USBL N	General description of sediment
G 38	39	346645	1006372	claey sand
G82	58	362430	1048516	clay with a sand fractiom
G83	70	367375	1062398	sand
G1	72	317666	982297	claey sand
G3	96	315599	984663	clay
B215	135	389022	1116441	clay with coral fragments
G29	204	333399	1010584	clay
G216	220	398027	1123665	clay with gastropods fragments and abundant ostracods
G100	290	38756	1124107	clay
G45	389	339251	1036053	clay with shell fragments
G110	425	401981	1140852	clay
G13	588	316794	1004233	clay with gastropod fragments
G15	623	316163	1005827	clay–fine sand
G 10	626	313991	1000956	clay
G 16	778	314439	1006705	clay
G103	940	387288	1132463	clay
G19	950	310241	1009291	clay -pyrite
G67	999	328064	1055756	clay
B208	1038	325479	1061343	clay
G21	1195	301460	1010717	clay
B202	1233	299393	1005351	clay
G104	1320	378541	1134068	clay
G22	1321	302503	1013574	clay
B209	1338	318932	1066424	clay
G106	1350	384222	1140175	clay
B221	1390	375272	1155095	clay
B203	1643	300387	1017733	clay
B218	1930	355341	1143438	clay
G112	2180	378717	1159315	clay
B210	2469	310624	1072868	clay