



Anais da Academia Brasileira de Ciências

ISSN: 0001-3765

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Academia Brasileira de Ciências

Brasil

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Anais da Academia Brasileira de Ciências, vol. 74, núm. 4, december, 2002, pp. 727-735

Academia Brasileira de Ciências

Rio de Janeiro, Brasil

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A note on the occurrence of the encrusting foraminifera *Homotrema rubrum* in reef sediments from two distinctive hydrodynamic settings

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Manuscript received on October 16, 2001; accepted for publication on August 8, 2002;
presented by DIOGENES A. CAMPOS

ABSTRACT

Sediment samples from two different reef environments were analyzed for their foraminiferal content: the Sioba/Rio do Fogo reefs, located in a broad shallow shelf dominated by strong currents (Rio Grande do Norte State), and the Praia do Forte reefs, located in a narrow shelf under the influence of wind-induced waves (Bahia State). The recorded foraminiferal fauna, from forty-six samples, is represented by 113 species, being the encrusting species *Homotrema rubrum* present in nine samples from the Sioba/Rio do Fogo reefs and in 11 samples from Praia do Forte reefs. *Homotrema* fragments recovered from Sioba/Rio do Fogo are mostly polished with rounded edges (51.59%) and some have a whitish color, whereas the specimens from Praia do Forte reefs are predominantly composed of reddish fragments (82.41%) with sharpened points (63.88%). The high wave energy on the reef environment of Praia do Forte is responsible for the fragmentation of living *Homotrema* tests (red color), which are deposited near to their source area. The effects of the strong current system operating in the broad continental shelf of Sioba/Rio do Fogo is the major cause of sediment reworking, producing polished grains accumulated in its reef surroundings.

Key words: *Homotrema rubrum*, reefs, coralline algae, coral.

INTRODUCTION

Homotrema is a calcareous encrusting foraminifera genus, with a large test (usually more than 8 mm in diameter), with varied shape (globular, hemispheric) and presenting different types of encrustation: irregular, conic, truncated. The first chamber is branched and/or spiraled, and the last ones are distributed in layers. Irregular openings between lateral walls occur when new chambers are added. These unilocular animals have, when alive, a common reddish color, caused by the pigment decomposition of hosted en-

dossimbionts (Loeblich and Tappan 1964, 1988), but become light-pink to whitish after death (Emiliani 1951). The distribution and growth form of *Homotrema* tests may be controlled by environmental conditions, particularly the local hydrodynamic energy.

The purpose of this work is to compare the *Homotrema* specimens collected from two different reef sites which are dominated by distinctive hydrodynamic settings: the Sioba and Rio do Fogo reefs, in northeast Brazil, which are in a broad shallow shelf, dominated by strong currents (Testa 1996), and the Praia do Forte coastal reefs, which are located in a narrow part of the eastern coast of Brazil,

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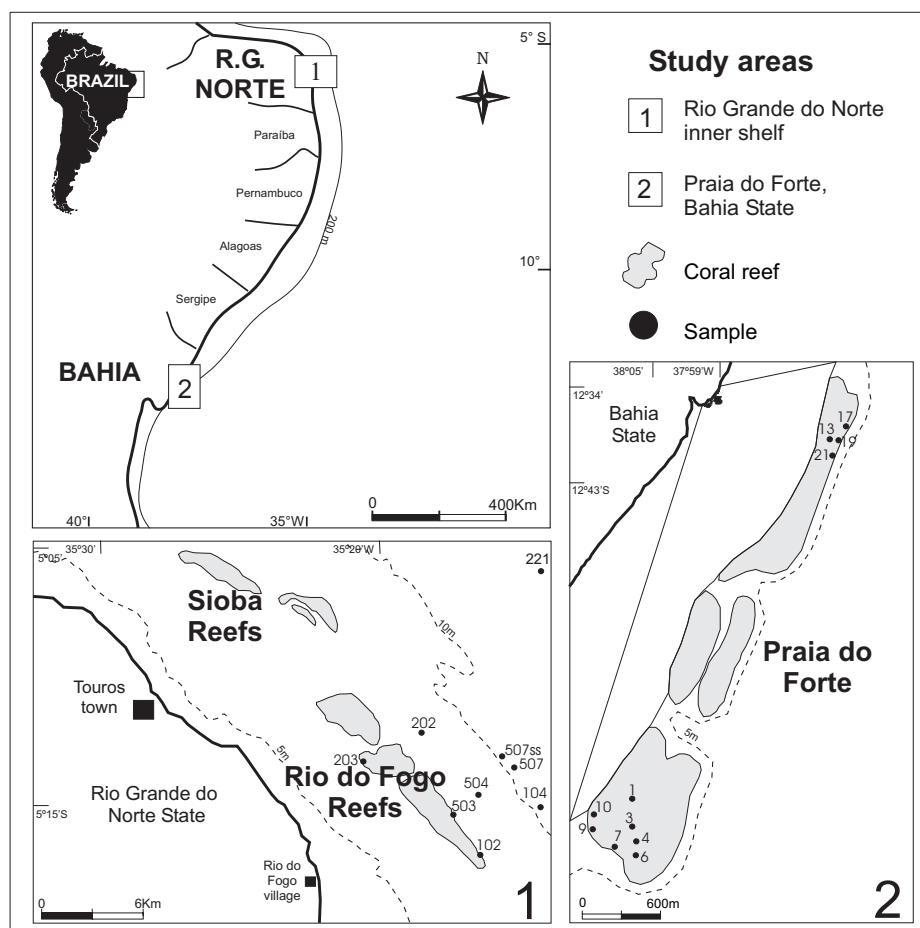


Fig. 1 – Map of the studied reefs with location of the samples containing *Homotrema rubrum* fragments.

under the influence of wind-induced waves (Dominguez et al. 1992, Bittencourt et al. 2000).

The Sioba and Rio do Fogo reefs are located in the inner continental shelf of the of Rio Grande do Norte State, in northeastern Brazil ($5^{\circ}15'S$ - $35^{\circ}20'W$) (Fig. 1). Climate along the whole coast of the state is semi-arid, with average rainfall varying from 600 to 1500 mm/year (Schultz et al. 1992, Rao et al. 1993). Summer is the dry season, extending from September to February, whilst winter, the wet season, extends from March to August. Temperature of surface waters varies from $26.5^{\circ}C$ (winter) to $28.5^{\circ}C$ (summer) (Servain et al. 1990). Salinity values range between 36 and 37‰ (Testa 1996).

The reefs of Praia do Forte are located in the northernmost part of the coast of the Bahia State, in eastern Brazil ($12^{\circ}30'S$ - $38^{\circ}00'W$) (Fig. 1), a region dominated by a tropical humid climate, where rainfall ranges between 1300 to 1900 mm/year, and air temperature varies from $23^{\circ}C$ (winter) to $28^{\circ}C$ (summer) (Nimer 1989). Dominant easterly winds occur in January and September, northeasterly winds are frequent from October to December and from February to March, whereas strong southeasterly winds occur during wintertime (April to August) (DHN 1993). Temperature of surface waters ranges from $25^{\circ}C$ in summer, to $28^{\circ}C$, in wintertime, and salinity varies from 35 to 37‰ (DHN 1993).

MATERIALS AND METHODS

Samples of reefal sediments were collected in both studied areas during SCUBA diving, using plastic containers. In the Sioba and Rio do Fogo area twenty-four samples were collected from sand accumulations and rodoliths relict deposits, surrounding the reefs. In the Praia do Forte area, twenty-two samples were collected, twelve from the bottom around the reefs and ten from the tidal pools on the partially exposed reef tops.

In the laboratory all samples were washed in fresh water using a 62-mesh sieve, for elimination of salts, dried and stored in plastic bags. From each sample, two hundred specimens of foraminifera were randomly picked and stored in appropriate microfossil slides, for identification under a stereomicroscope. Only the samples having *Homotrema* specimens were selected for study, e. g., twenty samples – nine from the Sioba/Rio do Fogo area and eleven from Praia do Forte. From the Sioba/Rio do Fogo reefs the selected samples were 102, 104, 202, 203, 221, 503, 504, 507ss and 507, and from Praia do Forte reefs, the samples with the presence of *Homotrema* were 01, 03, 04, 06, 07, 09, 10, 13, 17, 19 and 21 (see Figure 1).

RESULTS

One hundred and thirteen foraminifera species were identified in the studied sediment samples, being ninety-one from the Sioba/Rio do Fogo area, and eighty from the samples collected in the Praia do Forte reef sediments. Fifty-eight species were common from both studied areas, thirty-three of them occur only in samples from the Sioba/Rio do Fogo reefs, and twenty-two are registered in the samples from the Praia do Forte reefs area (see Table I).

From the twenty four samples collected from the Sioba/Rio do Fogo reefs, only nine of them have *Homotrema* fragments, summing a total number of one hundred fifty seven fragments (see Table II). A major part of these fragments (51.59%) are polished, and 32.12sharpened points. Well-preserved forms (15.29%) occur only in three samples (Table II) (Fig. 2).

One hundred and eight specimens of *Homotrema* were registered in eleven samples from the Praia do Forte reefs (from twenty-two collected) (see Table II); and most of these specimens (63.88%) have sharpened points. Polished fragments and well-preserved forms represent 18.53% and 17.59% respectively, of the identified fragments (Table II, Fig. 2).

Red colored tests predominate both in the Sioba/Rio do Fogo reefs (68.15%), as well as in the Praia do Forte area (82.41%), where they are the dominant colored tests found in the identified specimens (Table II, Fig. 3). Tests with pink color occur only in two samples from Praia do Forte, where both together reach 11.11% of the analyzed specimens. Whitish fragments are more common in the samples from the Sioba/Rio do Fogo reefs, reaching 31.85% of all identified specimens.

DISCUSSION AND CONCLUSIONS

The Sioba/Rio do Fogo studied samples are spreaded in a broader area than the Praia do Forte samples. They represent different reef zones, such as the fore reef (samples 102, 503, 202, 504) and the back reef zone (sample 203), and are also located in more varied depths (from about 5 m to more than 10 m). Most of the Praia do Forte samples were collected in the shallow reef flat zone, in depths less than 5 m. The more diverse types of reef habitats present in the Sioba/Rio do Fogo area are probably the reason for the higher number of foraminifera species found in the Rio Grande do Norte reefs (91) than in the Bahia reefs (80).

Well-preserved reddish *Homotrema* fragments indicate proximity of their source areas, and polished fragments are evidence of sediment transport and/or effect of high-energy conditions. In both areas, living and/or recent dead *Homotrema* specimens (red colored) dominate, which is an indication that most samples were collected at or near the original habitats.

In the Sioba/Rio do Fogo reefs polished fragments dominate (51.59%). The effects of the strong current system operating in the broad continental

TABLE I

Foraminifera species identified in the studied areas.

Species	Sioba/ Rio do Fogo	Forte Beach	Species	Sioba/ Rio do Fogo	Forte Beach
<i>Homotrema rubrum</i>	X	X	<i>Quinqueloculina bicornis</i>	X	X
<i>Ammonia beccarii</i>	X	X	<i>Quinqueloculina candeiana</i>		X
<i>Archaias angulatus</i>	X	X	<i>Quinqueloculina contorta</i>	X	X
<i>Amphistegina gibbosa</i>		X	<i>Quinqueloculina costata</i>	X	X
<i>Amphistegina lessonii</i>	X		<i>Quinqueloculina crassa</i>	X	X
<i>Articulina mucronata</i>	X	X	<i>Quinqueloculina cuvierina</i>	X	X
<i>Articulina multilocularis</i>	X		<i>Quinqueloculina fusca</i>	X	X
<i>Bigenerina textularoidea</i>	X		<i>Quinqueloculina horrida</i>	X	X
<i>Bolivina compacta</i>		X	<i>Quinqueloculina implexa</i>		X
<i>Bolivina translucens</i>	X		<i>Quinqueloculina lamarckiana</i>	X	X
<i>Borelis pulchra</i>	X		<i>Quinqueloculina microcostata</i>	X	X
<i>Cancris sagra</i>		X	<i>Quinqueloculina moyensis</i>		X
<i>Cibicides aknerianus</i>	X	X	<i>Quinqueloculina reticulata</i>	X	X
<i>Cibicides pseudogerianus</i>	X	X	<i>Quinqueloculina seminulum</i>	X	X
<i>Clavulina tricarinata</i>	X		<i>Quinqueloculina sulcata</i>	X	X
<i>Cornuspira involvens</i>		X	<i>Quinqueloculina parkeri</i>	X	X
<i>Dentostomina enoplostoma</i>	X		<i>Quinqueloculina planciana</i>	X	
<i>Discorbis candeina</i>		X	<i>Quinqueloculina polygona</i>	X	
<i>Discorbis mira</i>	X	X	<i>Quinqueloculina pricei</i>	X	X
<i>Discorbis obtusa</i>	X	X	<i>Quinqueloculina reticulata</i>	X	X
<i>Discorbis orbicularis</i>	X	X	<i>Quinqueloculina venusta</i>	X	X
<i>Elphidium articulatum</i>	X		<i>Quinqueloculina vulgaris</i>	X	X
<i>Elphidium crispum</i>	X		<i>Reusella spinulosa</i>		X
<i>Elphidium discoidale</i>	X	X	<i>Schlumbergerina alveoliniformis</i>		X
<i>Elphidium galvestonense</i>	X	X	<i>Sigmoilina poeyana</i>		X
<i>Elphidium poeyanum</i>	X	X	<i>Sigmoilina subpoeyana</i>		X
<i>Elphidium sagrum</i>		X	<i>Siphonina pulchra</i>	X	X
<i>Globigerinoides ruber</i>	X	X	<i>Sorites marginalis</i>	X	X
<i>Hanzawaia bertheloti</i>		X	<i>Spiroloculina antillarum</i>	X	X
<i>Hauerina occidentalis</i>	X		<i>Spiroloculina caduca</i>	X	X
<i>Heterostegina depressa</i>	X		<i>Spiroloculina depressa</i>	X	
<i>Heterostegina suborbicularis</i>	X	X	<i>Spiroloculina estebeni</i>	X	
<i>Massilina pernambucensis</i>	X		<i>Spiroloculina profunda</i>	X	
<i>Miliolinella australis</i>	X		<i>Spiroloculina moesi</i>	X	X
<i>Miliolinella labiosa</i>	X	X	<i>Textularia agglutinans</i>	X	X
<i>Miliolinella suborbicularis</i>	X	X	<i>Textularia candeiana</i>		X
<i>Miliolinella subrotunda</i>		X	<i>Textularia earlandi</i>		X
<i>Nonion grateloupi</i>	X	X	<i>Textularia gramen</i>	X	X
<i>Nonionella atlantica</i>	X	X	<i>Textularia kerimbaensis</i>	X	
<i>Oolina hexagona</i>	X		<i>Tretomphalus atlanticus</i>	X	

TABLE I (continuation)

Species	Sioba/ Rio do Fogo	Forte Beach	Species	Sioba/ Rio do Fogo	Forte Beach
<i>Peneroplis bradyi</i>	X	X	<i>Tretomphalus bulloides</i>	X	X
<i>Peneroplis carinatus</i>	X	X	<i>Triloculina bicarinata</i>	X	
<i>Peneroplis pertusus</i>	X	X	<i>Triloculina carinata</i>	X	
<i>Peneroplis proteus</i>	X		<i>Triloculina gracilis</i>		X
<i>Planorbulina acervalis</i>	X		<i>Triloculina laevigata</i>		X
<i>Planorbulina mediterraneensis</i>	X	X	<i>Triloculina linnaeana</i>	X	X
<i>Poroeponides lateralis</i>	X	X	<i>Triloculina lutea</i>		X
<i>Pyrgo alata</i>	X		<i>Triloculina oblonga</i>	X	X
<i>Pyrgo bulloides</i>	X	X	<i>Triloculina planciana</i>		X
<i>Pyrgo denticulata</i>	X		<i>Triloculina rosea</i>		X
<i>Pyrgo elongata</i>	X		<i>Triloculina sommeri</i>	X	X
<i>Pyrgo patagonica</i>	X	X	<i>Triloculina subrotunda</i>	X	X
<i>Pyrgo subsphaerica</i>	X	X	<i>Triloculina typica</i>	X	
<i>Pyrgo tainanensis</i>	X		<i>Triloculina tricarinata</i>	X	X
<i>Quinqueloculina agglutinata</i>	X		<i>Triloculina trigonula</i>	X	X
<i>Quinqueloculina angulata</i>	X	X	<i>Wiesnerella auriculata</i>	X	
<i>Quinqueloculina australis</i>	X				

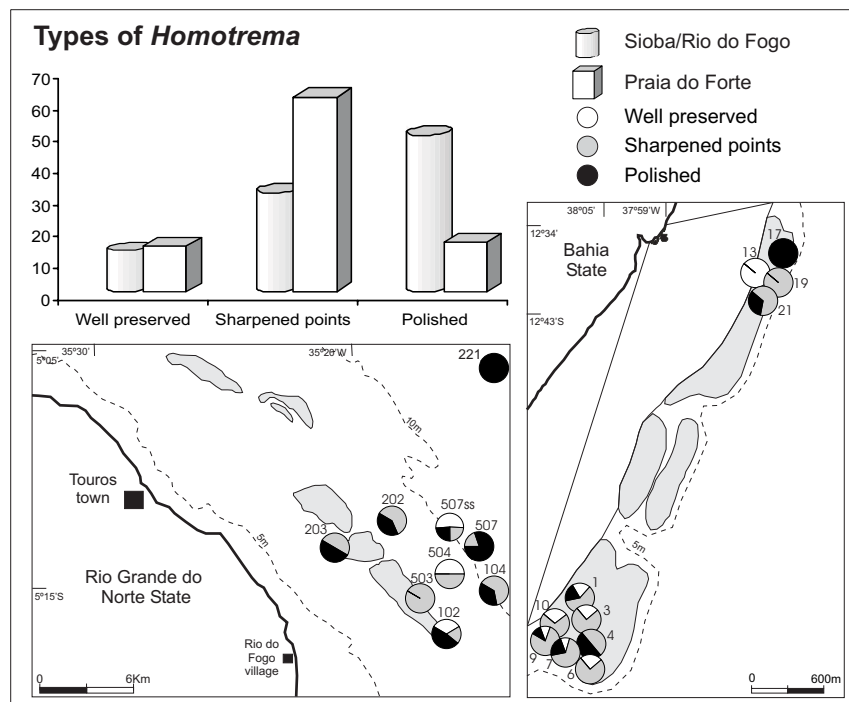
Fig. 2 – Distribution of the major types of *Homotrema* fragments found in the studied reef areas.

TABLE II

Number of specimens of *Homotrema* (fragments) and percentage of their major types and colors found in the samples from Sioba/ Rio do Fogo and Praia do Forte reefs.

	Samples	Number of specimens	Well preserved fragments (%)	Sharpen points (%)	Polished (%)	Red (%)	Pink (%)	White (%)
Sioba / Rio do Fogo	102	21	33.33	19.05	47.62	–	–	100.00
	104	22	–	63.64	36.36	36.36	–	63.64
	202	10	–	60.00	40.00	100.00	–	–
	203	06	–	50.00	50.00	100.00	–	–
	221	08	–	–	100.00	25.00	–	75.00
	503	06	–	100.00	–	83.33	–	16.67
	504	04	50.00	50.00	–	50.00	–	50.00
	507ss	29	51.72	24.17	24.14	100.00	–	–
	507	51	–	19.61	80.39	88.24	–	11.76
	Total	157	15.29	33.12	51.59	68.15	–	31.85
Praia do Forte	01	12	25.00	75.00	25.00	100.00	–	–
	03	4	25.00	75.00	–	100.00	–	–
	04	4	–	50.00	50.00	50.00	50.00	–
	06	15	25.00	75.00	–	66.67	–	33.33
	07	40	10.00	67.50	22.50	75.00	25.00	–
	09	9	11.11	77.78	11.11	100.00	–	–
	10	14	28.57	71.43	–	100.00	–	–
	13	1	100.00	–	–	100.00	–	–
	17	4	–	–	100.00	80.00	–	20.00
	19	2	–	100.00	–	100.00	–	–
	21	3	–	66.67	33.33	80.00	–	20.00
	Total	108	17.59	63.88	18.53	82.41	11.11	6.48

shelf off Rio Grande do Norte State, is the major cause of reworking of the sediment that accumulate on the surrounding reefs, producing polished grains, among them the *Homotrema* fragments.

In the Praia do Forte area most *Homotrema* fragments have a reddish color (82.41%) and are broken with sharpen points (63.88%). The high wave energy on this reef environment is responsible for the fragmentation of the reef structure, which is composed by corals, coralline algae and several encrusting organisms, e. g. *Homotrema* and vermetid (Nolasco and Leão 1986), producing fragments that are deposited near to their source area.

Figure 4 illustrates the major surface features

of *Homotrema rubrum* fragments described in this work.

ACKNOWLEDGMENTS

The authors thank Dra. Viviane Testa (UFBA) for the samples from Rio Grande do Norte reefs, and CNPq for fellowship provided to A. J. Machado (Process no. 520577/95-7) and CAPES for fellowship provided to S. S. Moraes.

RESUMO

Amostras de sedimento, coletadas em dois diferentes ambientes recifais, foram analisadas sob o ponto de vista do seu conteúdo de foraminíferos: os recifes de Sioba/Rio do

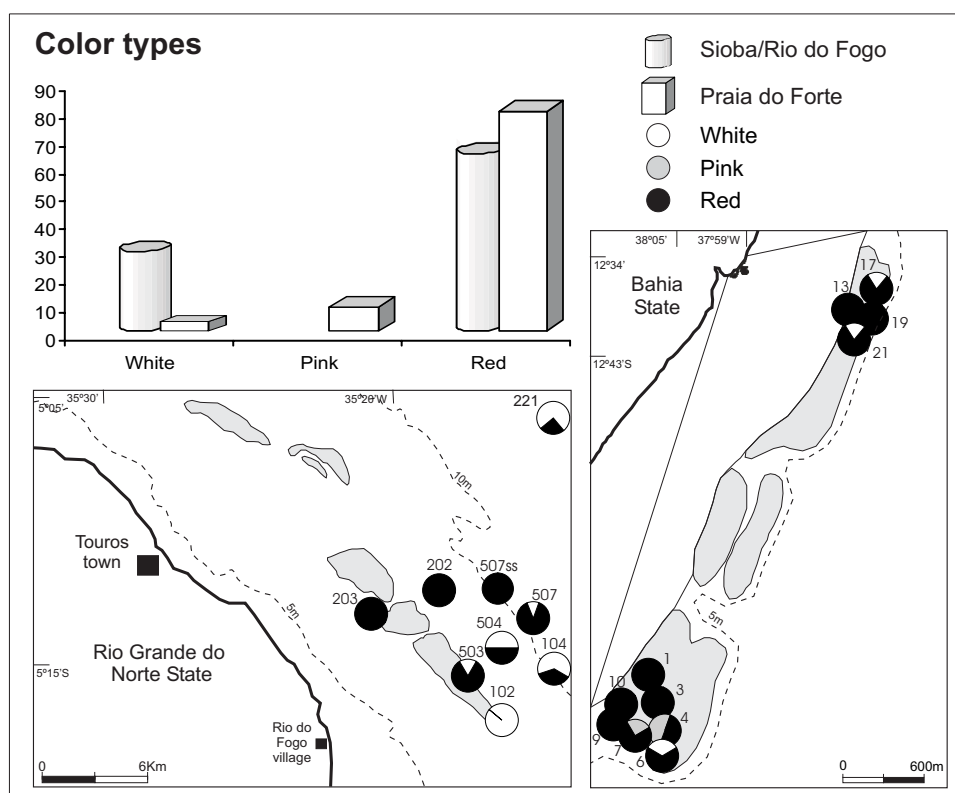


Fig. 3 – Distribution of the *Homotrema* colored tests found in the studied reef areas.

Fogo, localizados em uma plataforma continental larga e rasa dominada por fortes correntes (Estado do Rio Grande do Norte), e os recifes de Praia do Forte, localizados em uma plataforma continental estreita sob a influência de ondas induzidas pelo vento (Estado da Bahia). A fauna identificada, em quarenta e seis amostras, é representada em cento e treze espécies de foraminíferos, sendo que o foraminífero incrustante *Homotrema rubrum* ocorre em nove amostras provenientes dos recifes de Sioba/Rio do Fogo e em onze amostras coletadas nos recifes de Praia do Forte. Os fragmentos de *Homotrema* presentes nas amostras dos recifes de Sioba/Rio do Fogo apresentam-se na sua maioria polidos (51,59%) e alguns deles com coloração esbranquiçada, enquanto que os espécimes dos recifes de Praia do Forte apresentam-se, na sua maioria, ainda coloridos de vermelho (82,41%) e pontiagudos (63,88%). A energia das ondas no ambiente recifal de

Praia do Forte é responsável pela fragmentação das testas, ainda vivas (vermelhas), de *Homotrema*, as quais são depositadas próximo de suas áreas fonte. Os efeitos da ação da energia das correntes no ambiente recifal da ampla plataforma continental de Sioba/Rio do Fogo é a maior causa do retrabalhamento do sedimento, produzindo grãos polidos acumulados nas áreas circunvizinhas dos recifes.

Palavras-chave: *Homotrema rubrum*, recifes, alga coralina, coral.

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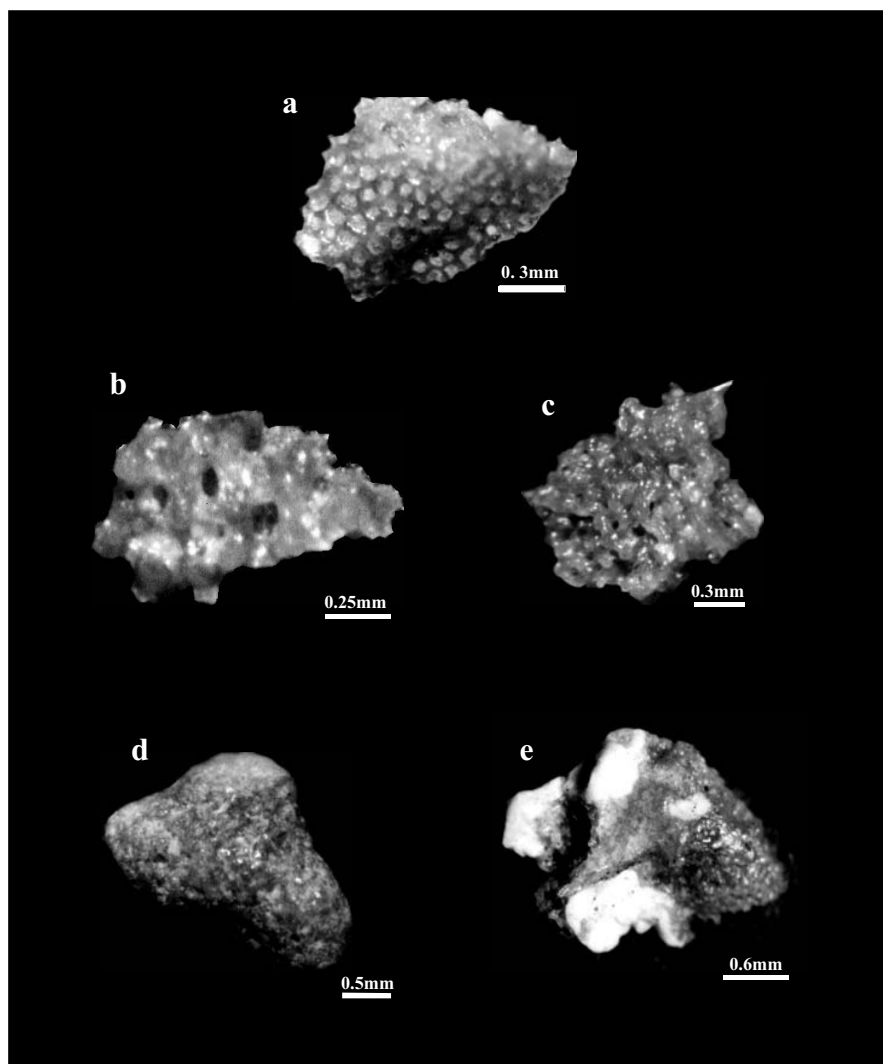


Fig. 4 – Surface features of *Homotrema rubrum* fragments: a. well preserved chambers, scale 1 cm = 0.3 mm; b. sharp pointed grain, scale 1 cm = 0.25 mm; c. hollowed chambers, scale 1 cm = 0.3 mm; d. polished grain, scale 1 cm = 0.5 mm; e. *Homotrema* encrusting in coralline algae fragment, scale 1 cm = 0.6 mm.

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