Palaeogeography, Palaeoclimatology, Palaeoecology 369 (2013) 58–66

Contents lists available at SciVerse ScienceDirect

Palaeogeography, Palaeoclimatology, Palaeoecology

journal homepage: www.elsevier.com/locate/palaeo

Bathymetric distribution of ichnocoenoses from recent subtropical algal nodules off Fraser Island, eastern Australia

Davide Bassi [a,*], Yasufumi Iryu [b,1], Juan C. Braga [c], Hideko Takayanagi [b], Yoshihiro Tsuji [d]

[a] *Dipartimento di Fisica e Scienze della Terra, Università degli Studi di Ferrara, via Saragat 1, I-44122 Ferrara, Italy*
[b] *Department of Earth and Planetary Sciences, Graduate School of Environmental Studies, Nagoya University, Nagoya 464–8601, Japan*
[c] *Departamento de Estratigrafía y Paleontología, Universidad de Granada, Campus Fuentenueva s/n, 18002 Granada, Spain*
[d] *Exploration Department, Japan Oil, Gas and Metals National Corporation, Toranomon Twin Building, 2-10-1 Toranomon, Minato-ku, Tokyo 105–0001, Japan*

ARTICLE INFO

Article history:
Received 21 March 2012
Received in revised form 1 October 2012
Accepted 4 October 2012
Available online 11 October 2012

Keywords:
Ichnocoenosis
Coralline red algae
Subtropical carbonates
Bioeroder distribution
Recent
Australia

ABSTRACT

Coralline algal nodules living on the subtropical shelf off Fraser Island, eastern Australia, from the inner to the uppermost outer-shelf, from 28 to 117 m water depth are pervasively bioeroded. Five ichnogenera have been identifed as nodule borers, comprising one ichnotaxon attributed to bivalves (*Gastrochaenolites*), one to sponges (*Entobia*) and three to polychaetes and barnacles (*Trypanites*, *Maeandropolydora*, *Rogerella*). Microtraces comparable to those produced by fungi, algae, bacteria and/or sponges are also present. Two ichnocoenoses have been recognised. The 'shallow' water ichnocoenosis (*EGTM)* occurs at 60 m and shallower depths and includes all identified ichnogenera. The 'deep' water ichnocoenosis (from 68 to 117 m) is characterised by *Trypanites* and the *Trypanites*/*Maeandropolydora* network (*TM* ichnocoenosis) with a generally higher boring density than in shallower nodules. Decreasing size of algal nodules and reduced thickness of the coralline thalli probably explain the decrease in diversity of ichnogenera with depth, as the larger bioeroders are excluded from the ichnoassemblages. Lower growth rates favour higher density of bioerosion in deeper algal nodules.

© 2012 Elsevier B.V. All rights reserved.

1. Introduction

Ichnological data such as tiering, ichnotaxonomic composition, and trace density can be used to reconstruct a wide range of paleoenvironmental parameters (Taylor et al., 2003). In particular, spatial patterns of macroborings and microborings can be applied as proxies of water paleodepth if they can be attributed to the action of specific borers, particularly those associated with photosynthetic algae (Bromley and Asgaard, 1993; Bromley, 1994; Perry, 1998; Blanchon and Perry, 2004). For example, *Gnathichnus*, the structure produced by algal-grazing echinoids, and *Entobia gonoides*, the work of the sponge *Cliona virides* (with algal symbionts) have been considered restricted to depths of a few metres (Taylor et al., 2003). Perry and Hepburn (2008, fig. 7) broadly characterised different reef sub-environments by the types and relative abundance of key boring species, which can potentially be applied to interpret ancient examples. Using a uniformitarian approach, paleodepths can be inferred for Neogene and younger sediments, if borings can be attributed to extant taxa. For example, *Gastrochaenolites* formed by *Lithophaga* is believed to reflect very shallow water depth (Goldring, 1995; Taylor et al., 2003).

There is, however, a sampling bias of living ichnoassemblages toward very shallow-water settings (<10 m; Crimes and Harper, 1970; May et al., 1982; Gibert de et al., 1998; Greenstein and Pandolfi, 2003; Bromley and Heinberg, 2006; Santos et al., 2010) that can potentially lead to misinterpretation of present-day depth zonations and facies models, and affect subsequent palaeobathymetric reconstructions of fossil analogues. Nonetheless, off shore boring ichnocoenoses are common in present-day shelf carbonates (Bassi et al., 2012; Nunes Leal et al., 2012) and their study might provide new insights on the distribution of ichnoassemblages and their application to interpret ancient environments. In fact, an ichnocoenosis so far identified only in shallow-marine rockgrounds and hardgrounds and in firm, compacted, but unlithified substrates, occurs in living macroid assemblages from deep fore-reef to shelf settings in Central Ryukyu Islands (south-western Japan), ranging in water depth from 61 to 105 m (Bassi et al., 2011).

This study reports ichnocoenoses constituted by macroborers such as bivalves, sponges, sipunculid and polychaete worms, and barnacles in living algal nodules from the shelf off Fraser Island in southern Queensland, eastern Australia (Fig. 1). Comparable ichnocoenoses were previously considered to be absent in relatively deep-water shelf environments. This contribution demonstrates that variation in ichnodiversity in algal nodules is mainly related to algal-nodule size and thickness of coralline algal plants. Thus, a secondary goal is to provide examples of ichnodiversity grades in present-day subtropical

---

* Corresponding author.
E-mail addresses: bsd@unife.it (D. Bassi), iryu@m.tohoku.ac.jp (Y. Iryu), jbraga@ugr.es (J.C. Braga), takayanagi.hideko@c.mbox.nagoya-u.ac.jp (H. Takayanagi), tsuji-yoshihiro@jogmec.go.jp (Y. Tsuji).

[1] Present address: Institute of Geology and Paleontology, Graduate School of Science, Tohoku University, Aobayama, Sendai 980–8578, Japan.

0031-0182/$ – see front matter © 2012 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.palaeo.2012.10.003

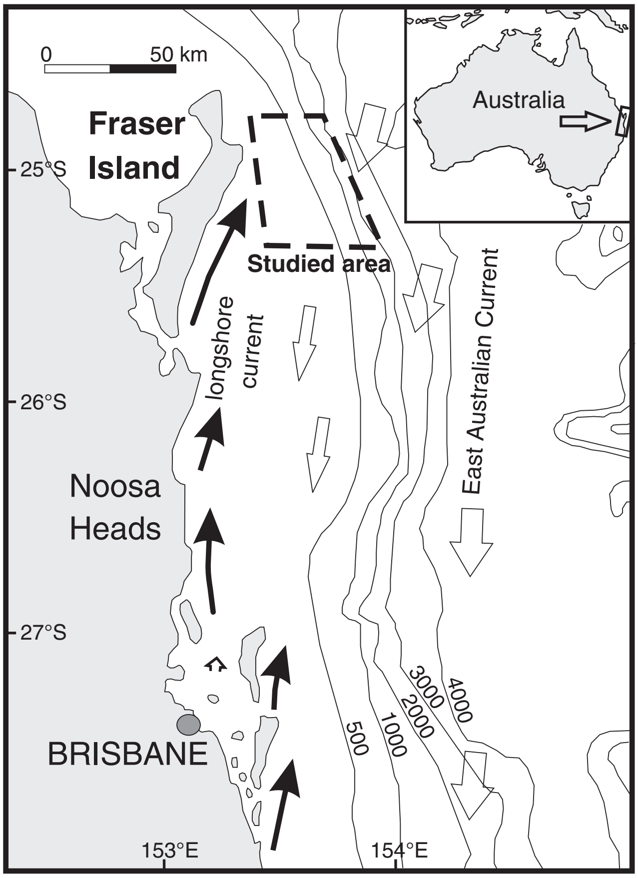

Fig. 1. Geographical map of Fraser Island and location of the studied area. The south flowing East Australian Current provides warm water along the outer shelf and upper slope and support carbonate production along the southeastern Australian margin (Marshall et al., 1998; Schröder-Adams et al., 2008).

rhodolith deposits for evaluation of palaeoenvironmental reconstruction in sedimentary successions bearing conspicuous rhodolith content, regardless of geologic age. Ichnocoenosis distribution studied from Recent deposits provides a useful means for comparison with fossil deposits of all ages.

2. Geographical setting and sedimentary facies

The study area is located offshore from Fraser Island, roughly between 24°50′ S and 25°20′ S, at the southern limit of deposition of tropical carbonates in the eastern Australian continental margin (Fig. 2). The area is subjected to occasional high nutrient supply (e.g. upwelling off Fraser Island; Australian Dept. of Sustainability, 2011) and to seasonal low water temperatures, having the greatest impact during late spring/summer (Malcolm et al., 2011). A flat inner shelf extending to 45 m depth, is followed by a gently sloping middle shelf from 45 to 100–110 m, with several banks rising to shallower depths. A nearly continuous terrace at about 105 m marks the boundary with the outer shelf, which descends to 210–450 m (Marshall et al., 1998). Five facies have been distinguished in the shelf surface sediments. Fine-grained quartz sand covers the inner platform, whereas coarse-grained carbonate sand occurs from 40 to 80 m. Coral boundstones appear on the banks and rhodolith-coral gravels extend from the banks to the lower limit of the middle shelf (Harris et al., 1996; Marshall et al., 1998). Carbonate fine sand facies predominate below 110 m water depth (Tsuji et al., 1994a,b; Marshall et al., 1998). Algal nodules occur in all facies but they are most common in the middle-shelf bioclastic gravels.

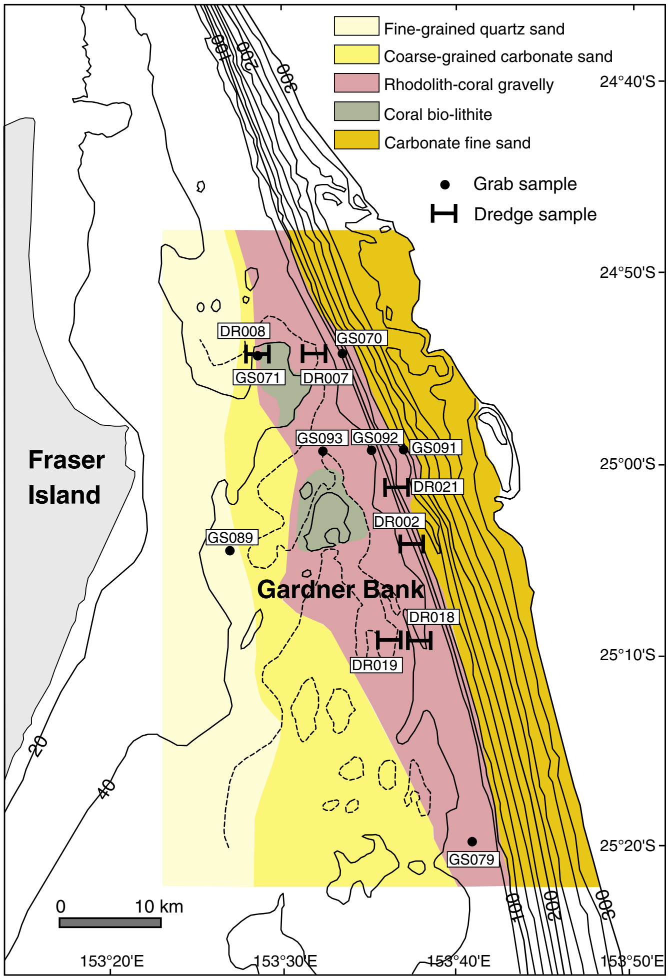

Fig. 2. Facies distribution on the shelf and upper slope off Fraser Island and sample location (from Marshall et al., 1998). Grab and dredged samples were collected during a scientific survey cruise carried out in 1991 jointly by the Australian Geological Survey Organization (AGSO) and Japanese National Oil Corporation (JNOC) (Tsuji et al., 1994a,b). Bathymetry in meters. Dredged-sample segment not to scale.

3. Materials and methods

The studied algal nodules were collected as dredged and grabbed samples (31) from surficial sediments along seven transects (Marshall et al., 1998), from the sea floor off Fraser Island during a scientific survey cruise carried out in 1991 jointly by the Australian Geological Survey Organization (AGSO) and Japanese National Oil Corporation (JNOC). According to Steneck (1986), the term “algal nodule” includes both coated pebbles/cobbles (<50% coralline red algae) and rhodoliths (>50% corallines) (Bosellini and Ginsburg, 1971; Bosence, 1983; Peryt, 1983).

The nodules were actively growing when collected, as shown by their reddish colours characteristic of living coralline algae. The pigments responsible for the red colour rapidly decay after algal death, resulting in whitish coralline skeletons typical of fossil rhodoliths. The polarity of the last growth phase can be recognised by the location of coloured living corallines on the algal nodule surface. Although rhodoliths can be moved by currents affecting the shelf, algal nodules are considered to be essentially in situ growths (Marshall et al., 1998) and re-deposition of shallow-water rhodoliths in deeper settings can be discarded.

The nodule internal structure, their taxonomic composition and borings affecting the algal nodules have been observed in 280 ultra-thin sections (about 10 μm in thickness). The outer surface and sectioned

Download English Version:

https://daneshyari.com/en/article/4466683

Download Persian Version:

https://daneshyari.com/article/4466683

Daneshyari.com