Palaeogeography, Palaeoclimatology, Palaeoecology xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Palaeogeography, Palaeoclimatology, Palaeoecology

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

Preface

Biosedimentary records of China from the Precambrian to present

1. Introduction

Growing evidence shows that biotic activities are involved in most, if not all, sedimentation processes from the ancient geological past to the present day. As reflected in recent major international conferences (i.e., ISC, GSA meetings, and so on), organism-induced sedimentation (also termed Biosedimentology) has attracted increasing interest from global paleontologists and sedimentologists. The theme of this special issue in *Palaeo-3* is organism (including microbial) involvement in sedimentation throughout Earth's history from the Proterozoic to the present-day with an emphasis on well-preserved examples from China. Emphasized in particular are organism-environment interactions during critical periods for the evolution of Earth's life.

The overall goal of this thematic issue is to provide a better understanding of biological processes in physical sedimentation throughout the geological past to the present day and their possible consequences and controls. Papers included in this special issue provide sedimentological, geobiological, paleoecologic, and geochemical studies from diverse locations in China throughout the Paleoproterozoic to present-day. This thematic issue assembles studies emphasizing three aspects: (1) microbially mediated and microbially induced sedimentary structures (MISSs), microbialites, giant ooids, oncoids, vermicular limestone, and beach rocks, (2) metazoan build-ups such as reefs, bioherms, and carbonate platforms, and (3) (bio)geochemical signals of extreme environment and climate changes. They include 2 papers addressing Precambrian records, 2 papers on Cambrian metazoans and microbialites, 4 papers on Ordovician metazoan reefs, 1 paper on early Silurian microbialite, 1 paper on Late Devonian microbialite, 1 paper on Permo-Carboniferous chemostratigraphy and paleoclimate imprints, 1 paper on Middle Permian cyclostratigraphy, 6 papers on Permian–Triassic (P–Tr) extreme environments, climates, and microbial blooms in marine and terrestrial ecosystems, 1 paper on Middle Triassic food web reflected from coprolites, 1 paper on the mid-Carnian Pluvial Event (CPE, Preto et al., 2010; Ogg, 2015), 1 paper on modern beach rocks near coral reefs in the South China Sea, and 1 paper on a bacterial community from a Tibetan lake (Fig. 1). We hope that these contributions advance global biosedimentological knowledge.

2. Biosedimentary records from China and responses to global events

Biosedimentary records (mainly stromatolites and MISSs) come from two major intervals: Paleo- to Mesoproterozoic and Late Neoproterozoic of the Precambrian in China. Microbial participation is crucial in the preservation of late Ediacaran animal embryos. Since the Cambrian explosion, the Cambrian–Devonian metazoan and microbial reefs are exceptional, and their alternate occurrences indicate several metazoan-microbe transitions (MMT) during that interval. Microbial development linked with the end-Permian mass extinction is also remarkable in South China. The post-Triassic Mesozoic and Cenozoic sediments in China are mainly terrestrial facies, from which biosedimentary records are rarely reported. Modern-day sedimentary processes are well recorded in both the South China Sea and the Tibet-Qinghai Plateau of western China, providing unique opportunities to observe biological processes of sedimentation in the present-day ocean and glacial lakes. These Chinese biosedimentary records are more fully summarized below.

2.1. Paleoproterozoic to Mesoproterozoic

In China, Paleo- to Mesoproterozoic successions are exposed in the Jixian area of Tianjin City (Fig. 1), and the entire succession, up to 10 km thick, is the most intact record of this period in China. Stromatolites are extremely abundant, exceptionally preserved, and concentrated mainly in two units, the Wumishan and Tieling formations, separated by nearly 1000 m from one another in the lower and upper parts of the Proterozoic succession (Zhu et al., 1994). The Wumishan stromatolites comprise small structures that have digitate, low relief columns, while the Tieling stromatolite assemblage by comparison shows massive, branching, high-relief columnar or domal forms (Zhu et al., 1994). These North China records strengthen the idea of a global proliferation of stromatolites (Awramik and Sprinkle, 1999) after the first rise of oxygenation (Great Oxidation Event I) in the Paleoproterozoic (Knoll, 2011).

MISSs are commonly present in Paleo- to Mesoproterozoic siliciclastic successions in North China (Shi et al., 2008; Mei et al., 2009; Tang et al., 2013; Lan et al., 2013; Lan, 2015). Yang et al. (2017, this volume) document abundant exceptionally preserved wrinkle structures and sand veins from the 1.64 Ga Chuanlinggou Formation in the Jixian area, North China Craton (Fig. 1). The former is characterized by two-dimensional microbial mats, while the sand veins show a vertical or oblique biostructure. Filamentous extracellular polymeric substances (EPS) and biofilms are detected in a clay matrix of wrinkled layers, and abundant nano-particles of various EPSs (isolated nanoglobules, paired nanoglobules, dumbbell-shaped nanoglobules, and polyhedron aggregates) in clay matrix close to sand veins, providing strong evidence of microbial activities during the formation of the MISSs. Wide spatial distribution, broadened environmental inhabitation, and extremely high abundance of the MISSs indicate proliferation of benthic microbial communities in siliciclastic shallow seas during Paleo- to Mesoproterozoic times.

http://dx.doi.org/10.1016/j.palaeo.2017.03.002

Please cite this article as: Chen, Z.-Q., et al., Biosedimentary records of China from the Precambrian to present, Palaeogeogr. Palaeoclimatol. Palaeoecol. (2017), http://dx.doi.org/10.1016/j.palaeo.2017.03.002

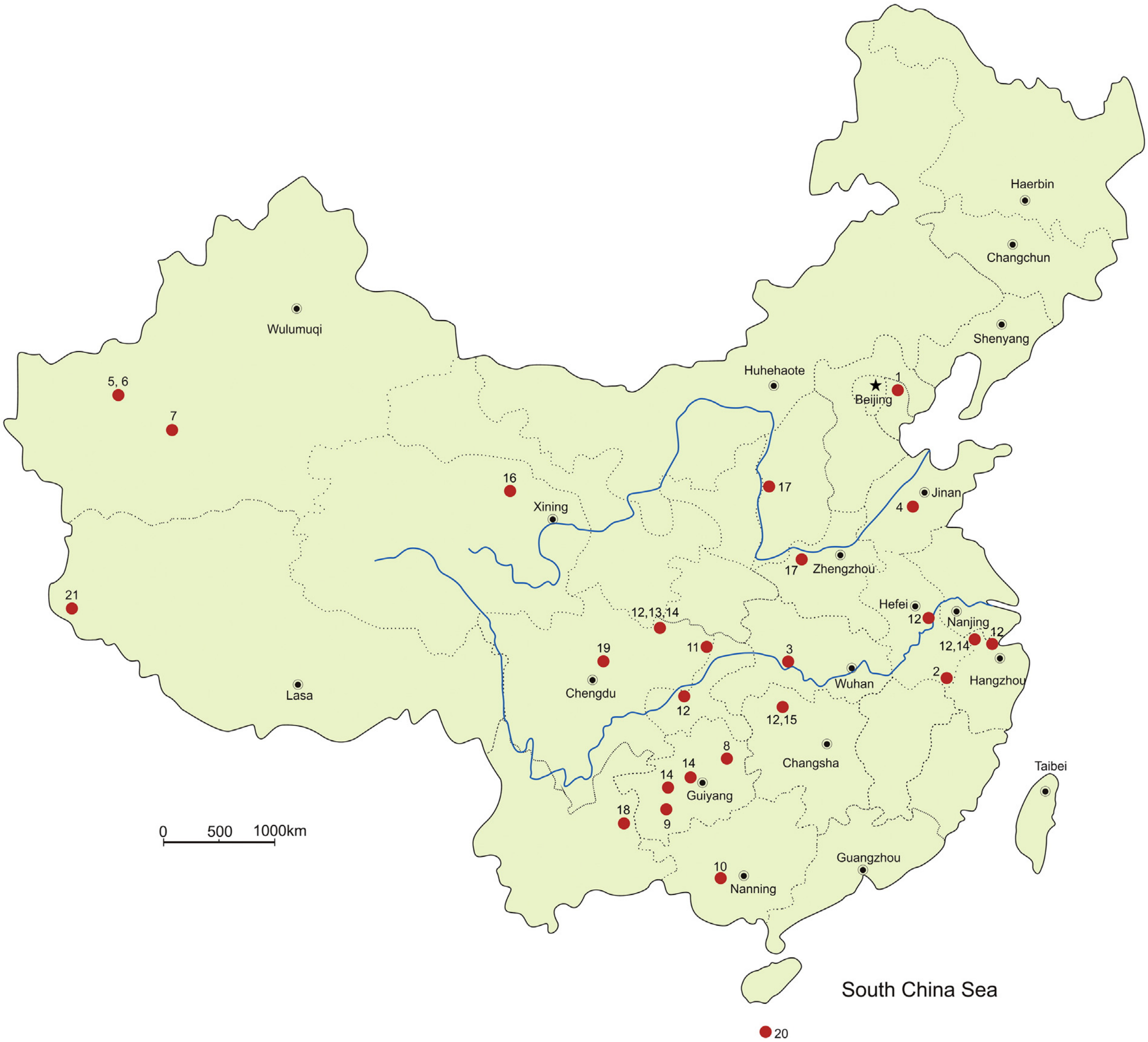

Fig. 1. Spatio-temporary distributions of biosedimentary records from China. 1, Yang et al. (2017): Paleo- to Mesoproterozoic MISSs, Jixian, Tianjin, North China; 2, Guan et al. (2017): late Ediacaran biota, Lantian area, Anhui Province, South China; 3, Chang et al. (2017): early Cambrian sponges, Yichang area, western Hubei Province, South China; 4, Yan et al. (2017): Middle Cambrian thrombolites, Taian area, Shandong Province, North China; 5, Li et al. (2017a): Middle Ordovician *Calathium* reefs, Tarim Basin, NW China; 6, Wang et al. (2017): Middle Ordovician *Calathium*-microbial reefs, Tarim Basin, NW China; 7, Zhang et al. (2017): Late Ordovician carbonate platform-reef complex, central Tarim Basin, NW China; 8, Li et al. (2017b): early Silurian microbialites, Shiqian area, Guizhou, SW China; 9, Shen et al. (2017a): Late Devonian metazoan and microbial reefs, Ziyuan, Guizhou Province, SW China; 10, Liu et al. (2017a): Late Carboniferous to Middle Permian chemostratigraphy and glacial imprints, Gongchun area, Guizhou Province, SW China; 11, Fang et al. (2017a): Middle Permian astronomic cycles, Dukou area, Sichuan Province, SW China; 12, Zhou et al. (2017): P–Tr biomarkers, Meishan and Huangzhishan (Zhejiang Province), Chaohu (Anhui Province), Cili (Hunan Province), Laolongdong and Shangsi (Sichuan Province), Chaohu (Anhui Province), and five sections outside China; 13, Xu et al. (2017a): P–Tr claystone, Shangsi area, Sichuan Province, SW China; 14, Fang et al. (2017b): P–Tr ash clay beds and microbes, Anshun and Guiyang (Guizhou Province), Shangsi (Sichuan Province), and Meishan (Zhejiang Province); 15, Deng et al. (2017): early Triassic anachronistic facies, Cili area, western Hunan Province, South China; 16, Xu et al. (2017b): earliest Triassic marine MISSs, Tianjun area, Qinghai Province, western China; 17, Chu et al. (2017): earliest Triassic terrestrial MISSs, Luoyang (Henan Province) and Liulin (Shanxi Province), North China; 18, Luo et al. (2017): Middle Triassic coprolites, Luoping area, Yunnan Province, SW China; 19, Shi et al. (2017): Carnian sponge mound, Mianzhu area, Sichuan Province, SW China; 20, Shen et al. (2017b): bench rocks, Xisha Islands, South China Sea; 21, Liu et al. (2017b): methanogenic bacteria, Bangong Co Lak, Tibet, western China.

2.2. Late Neoproterozoic

One of the most fantastic discoveries of early life is the exceptionally preserved animal embryos from the late Ediacaran Doushantou Formation, Guizhou Province, (Xiao et al., 1998). These tiny eggs demonstrate the reproduction pattern and process of animal cells, marking the emergence of the first animals on Earth (Xiao et al., 1998). Another important find bearing on the origin of early animal life is the early Ediacaran Lantian biota from Anhui Province (Fig. 1), representing probably the earliest known assemblage of macroscopic and morphologically differentiated eukaryotes, including diverse algal and putative animal fossils (Yuan et al., 2011). Guan et al. (2017, this volume) present geochemical and biosedimentary evidence to indicate microbially involved pyritization that promoted exceptional preservation, particularly soft tissues, of the Lantian biota with special reference to the macroscopic fossil *Chuaria*. Two taphonomic states of *Chuaria* fossils are observed: pervasively pyritized globose and non-pervasively pyritized subglobose forms. The pyritized *Chuaria*-bearing strata yield greater total organic carbon (TOC) contents than the fossil-barren interval, and similar total sulfur (TS) contents to the latter. The TOC-TS crossplots suggest that completely and non-pervasively pyritized fossils were preserved in suboxic and euxinic conditions, respectively. The organic-poor, reactive iron- and sulfate-rich environments in combination with slow sedimentation rates may have facilitated fossil pyritization in the Precambrian.

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