



Early Triassic stromatolites in a siliciclastic nearshore setting in northern Perth Basin, Western Australia: Geobiologic features and implications for post-extinction microbial proliferation



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ABSTRACT

An Early Triassic stromatolite deposit in Gondwana is documented from the Smithian succession of the Lower Triassic Kockatea Shale Formation in the Northampton area, northern Geraldton, Western Australia. Abundant tube-like sheaths of filaments and tiny circular microspherule balls are well preserved in laminae of the Northampton stromatolites, which are characterized by finely laminated domes and digitate high-relief columns. These filament sheaths are superficially analogous to their counterparts of modern stromatolites, and thus are interpreted as putative fossilized filamentous cyanobacteria. Elemental mapping of EDS analysis shows very high contents of both Fe and Si elements as well as common presence of both S and Al elements along the laminae of the stromatolites, suggesting that the stromatolites may have been ferritized or silicified. Both ferritization and silicification may have played a crucial role in the exceptional preservation of the micro-structures in the Northampton stromatolites. The high content of Al along the laminae indicates that the stromatolites may have been influenced by terrigenous fine-grained clastics during their growth. The Northampton stromatolites show several growth modes, initiating on either pebbles/conglomerates or sandy seafloor and building laminar domes and digitate, high-relief columns during an initial transgression period. Steady increase in sea level facilitated the growth of stromatolites. The Early Triassic stromatolites ceased growth due to either rapid rise in sea level or increased clay influx probably sourced from increased weathering on land at that time, or both. The occurrence of the Northampton stromatolites in the siliciclastic succession, in comparison with published records of Early Triassic microbialites, reveals that post-extinction microbialites were widespread in the Smithian. Stromatolites show a broad geographic distribution from low-latitude to southern high-latitude regions of Gondwana and inhabited not only carbonate settings, but also siliciclastic nearshore settings. All features of these Early Triassic stromatolites indicate a microbial bloom in the aftermath of the P–Tr mass extinction.

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1. Introduction

As consequence of the severe biocrisis at the end of the Permian Period, marine ecosystems underwent the most devastating global degradation of Phanerozoic history (Erwin, 2006). Microbe-dominated ecosystems were the most widely spread during the Early Triassic than during any other periods of the Phanerozoic (Chen and Benton, 2012). Microbialites deposited after the end-Permian event have been generally considered as ecologically and biogenically special sediments,

characteristic of stressful environments in the aftermath of the most devastated ecologic crisis of Earth history (Schubert and Bottjer, 1992; Garzanti et al., 1998; Kershaw et al., 1999; Lehrmann, 1999; Paul and Peryt, 2000; Kershaw et al., 2002; Wignall and Twitchett, 2002; Ezaki et al., 2003; Baud et al., 2005; Wang et al., 2005; Hips and Haas, 2006; Baud et al., 2007; Farabegoli et al., 2007; Kershaw et al., 2007; Sano and Nakashima, 2007; Ezaki et al., 2008; Mary and Woods, 2008; Yang et al., 2008; Kershaw et al., 2011; Mata and Bottjer, 2011; Yang et al., 2011; Ezaki et al., 2012; Kershaw et al., 2012; Mata and Bottjer, 2012). Of these, most Lower Triassic microbialites are thrombolites, while stromatolites are less common (Mata and Bottjer, 2012). The resurgence of microbial communities occurred through the entire Early Triassic recovery interval, with four episodes of high abundance of microbialites in

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the early Griesbachian, late Griesbachian–early Dienerian, Smithian, and late Spathian (Pruss et al., 2006; Baud et al., 2007; Mata and Bottjer, 2012). Pruss et al. (2006) and Baud et al. (2007) documented the third episode in the Smithian in Oman, south Turkey and both

north and central Iran; inorganic sea-floor precipitates found in the western USA occur during this episode (Woods et al., 1999; Baud et al., 2007). This paper documents a new discovery of Smithian stromatolites in Western Australia, then part of Gondwana, demonstrating

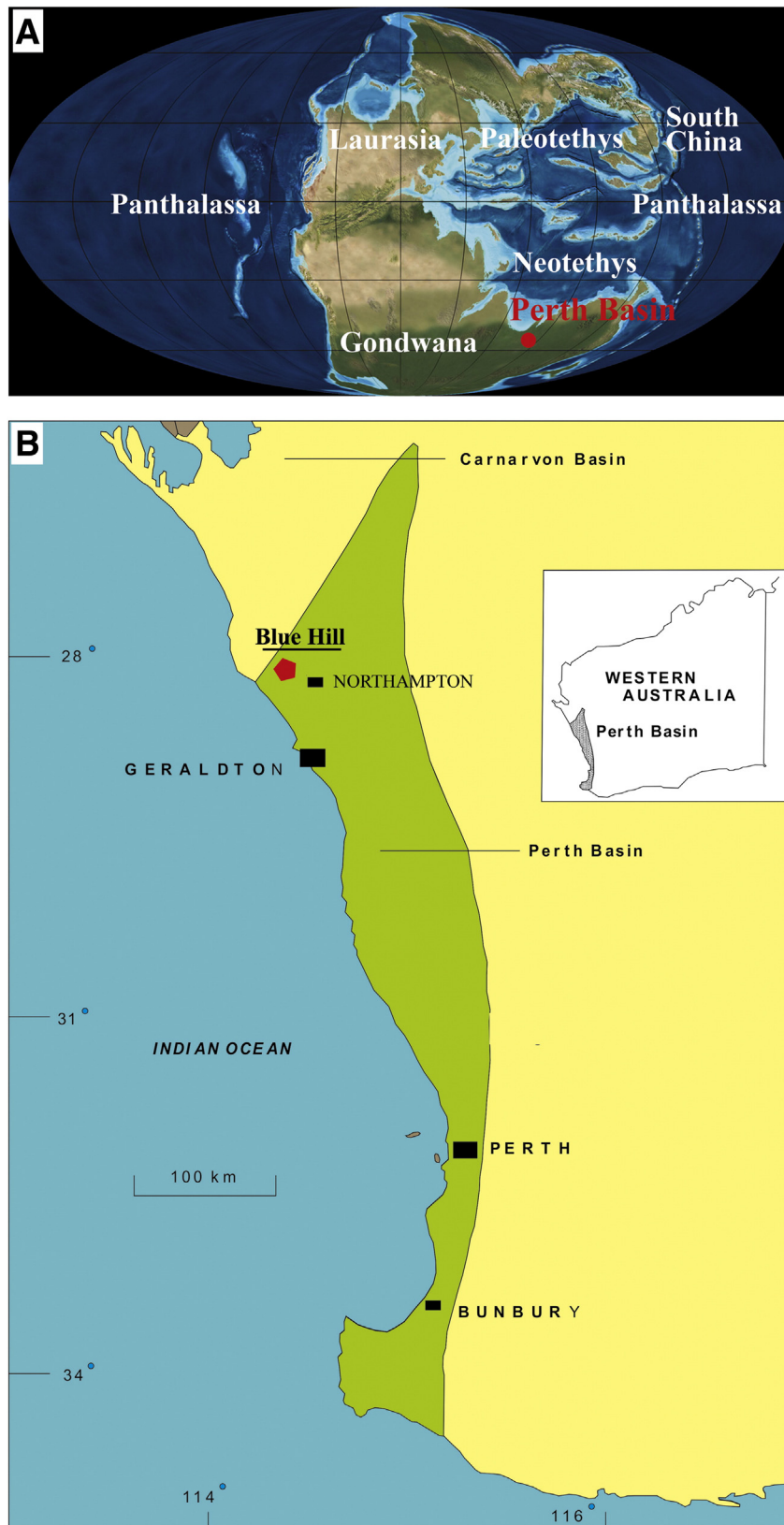


Fig. 1. (A) Palaeogeographic map showing the position of the Perth Basin during the Early Triassic (after Scotese, 1994). (B) Location of the Blue Hill section (GPS: 253275°E, 6860450 N) of the Northampton area, northern Geraldton, Western Australia.

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