Microbial diversity at the rise of atmospheric oxygen: Two distinct microfossil communities from the Turee Creek Group, Western Australia

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The c. 2.4 Ga Turee Creek Group (TCG) from the Hamersley Ranges in Western Australia preserves a snapshot of a whole ecosystem from a shallow water stromatolite-thrombolite reef, to deeper water microfossiliferous black chert units[1]. That this sequence occurs across one continuous outcrop provides a unique opportunity to study a range of life from multiple different habitats within the same system, allowing insight into the diversity of life present during the rise of atmospheric oxygen (Great Oxidation Event: GOE).

The recently discovered suite of microfossils[2,3,4] is preserved in deep water nodular and bedded black chert units, and now encompasses at least 18 different morphotypes including two forms new to the geobiological record[5]. The two types of black chert contain communities of microfossils from different environments: a primarily benthic, *in situ*, deep water assemblage from the nodular chert, and a transported, originally shallow-water (likely phototrophic) community in the bedded black chert (Fig. 1)[5].

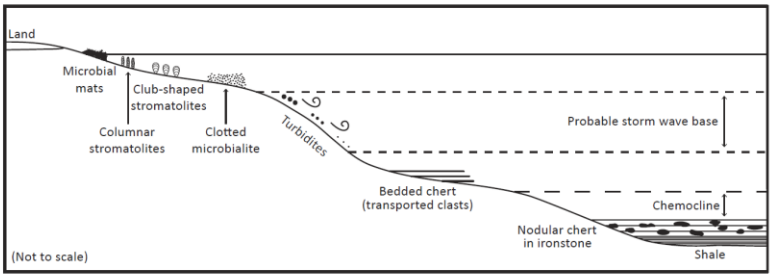

Figure 1: Model of the TCG environment, showing the relative position of the inter-tidal microbialites and the deeper-water microfossiliferous bedded and nodular black cherts[5].

The deep water bedded black chert consists of rounded organic clasts transported from the shallower water. Numerous microfossil forms within these clasts bear similarity to the well-known microfossil assemblage of the c. 1.8 Ga Gunflint Iron Formation, Canada[6]. Gunflint-type microbiota are preserved in multiple localities worldwide, ranging from c. 1.6-2.1 Ga, and examples are representative of similar shallow-water environments rather than one common stratigraphic horizon[7]. Thus, the assemblage of Gunflint-type microfossils presented here from the TCG further highlights the persistence of silica-rich, subtidal microbial environments throughout the Paleoproterozoic, and forms the oldest known examples of the Gunflint microbiota worldwide.

The two communities of microfossils from the nodular and bedded black cherts of the TCG, when combined with the wide array of stromatolitic microbialites preserved in the intertidal zone[1], provides a snapshot of a c. 2.4 Ga ecosystem (Fig. 1). The TCG microfossil assemblage also creates a substantial reference point in the sparse fossil record of the earliest Paleoproterozoic, and illustrates that microbial life diversified quite rapidly from the simple forms preserved in the Archean.

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