DIVERSIFICATION OF EARLY LIFE: MICROFOSSILS FROM THE c. 2.45-2.21 Ga TUREE CREEK GROUP, WESTERN AUSTRALIA

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The Great Oxidation Event (GOE), ~2.45-2.3 Ga, saw a worldwide increase in atmospheric oxygen (Farquhar et al., 2000; Holland, 2002; Bekker et al., 2004; Philippot et al., 2018). The effect that this extreme change in climate had on life at the time, however, is unknown, primarily due to a lack of well-preserved fossiliferous rocks from this period.

A diverse range of stromatolites, thrombolites and microfossils have recently been documented from the c. 2.45-2.21 Ga Turee Creek Group (TCG) in Western Australia (Barlow et al., 2016; Barlow and Van Kranendonk, 2018). The age of the TCG, as well as its low metamorphic grade (which has enabled good fossil preservation), makes it perfectly placed to provide insight into the type and diversity of life present during the GOE. Specifically, the TCG contains a diverse array of fossils from a variety of habitats: a shallow-water portion of the stratigraphy preserves a range of dolomitic stromatolites and thrombolites, while deeper-water nodular and bedded black chert units preserve at least nineteen microfossil morphotypes, within four distinct microfossil communities. These communities consist of:

1) Tangled masses of filamentous and unicellular microfossils (Figure 1A), interpreted as a benthic, sea-floor-inhabiting community that may have cycled sulfur, or possibly iron.

2) Long filamentous microfossils that are associated with abundant, small clusters of subhedral pyrite (Figure 1B). This is also considered a benthic assemblage, with in situ, sulfur isotope data that suggests pyrite mineralisation via bacterial sulfate reduction.

3) Large spheroidal microfossils and thick filamentous microfossils, which are interpreted as in-fallen, likely planktonic forms (Figure 1C).

4) A variety of unicellular microfossils, filamentous forms, and star-shaped filament rosettes that are preserved in rounded, organic-rich clasts from within bedded black chert (Figure 1D). These clasts were transported from shallow-water, into the deeper-water setting, and the contained microfossils are interpreted as the remains of likely phototrophic microorganisms.

Combined, these newly-described fossils from the TCG span both shallow to deeper water environments, and planktonic to benthic habitats, creating an unprecedented snapshot of what a marine ecosystem looked like during the rise of atmospheric oxygen. The TCG fossil assemblage provides a substantial new reference point in the sparse fossil record of the earliest Paleoproterozoic, and highlights that life at this time was more diverse than previously thought.

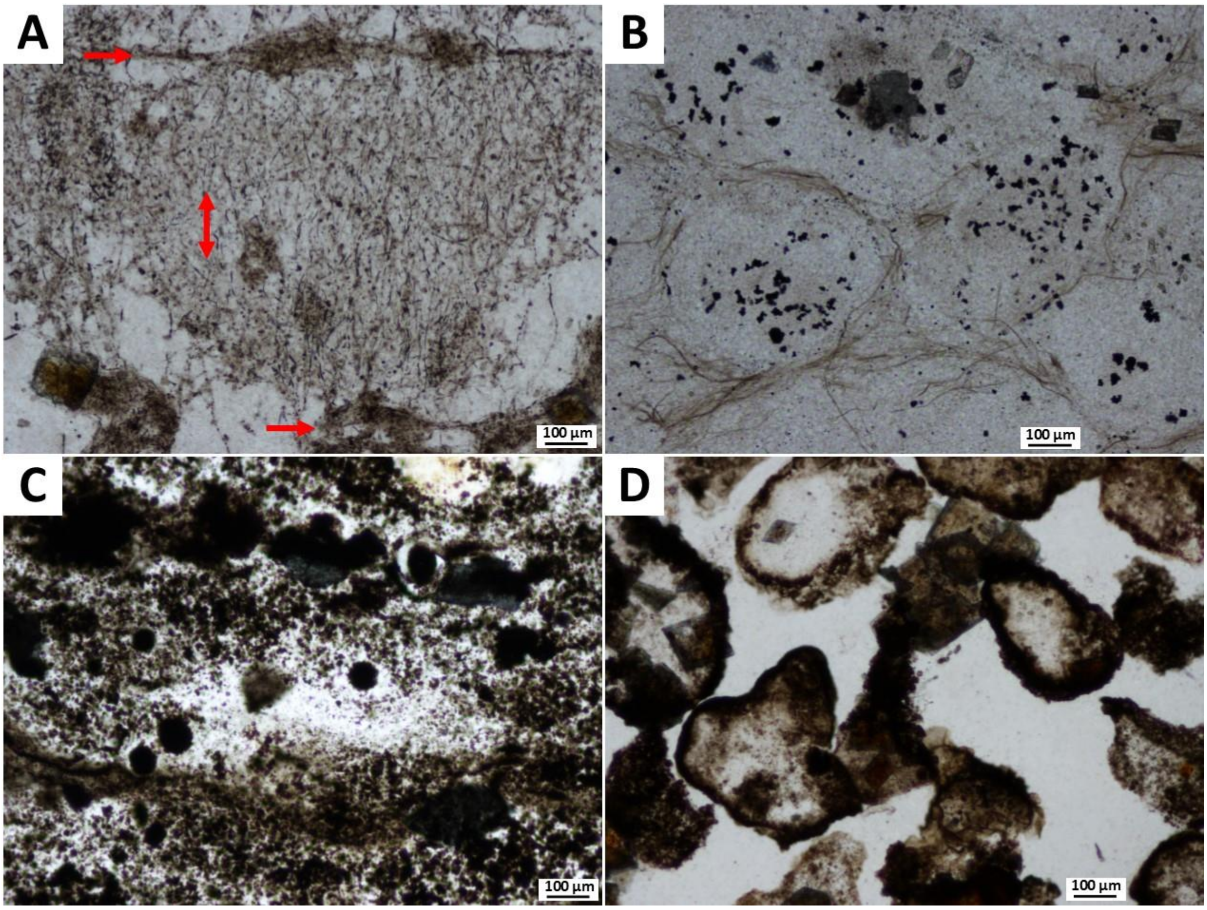

Figure 1. Examples of the four texturally and morphologically distinct microfossil communities from the TCG. A) Benthic, deep-water assemblage of filamentous and unicellular forms, preserved (in cross section) in original growth position, with alternating vertically- and horizontally-aligned filaments (arrows). B) Benthic, deep-water assemblage of long (~575 µm) filamentous microfossils, encircling clusters of pyrite (central black grains). C) In-fallen, likely planktonic assemblage of large spheroidal microfossils and thick filamentous microfossils, within abundant, fluffy organic matter. D) Grainstone clasts, from bedded black chert, which contain a shallow-water assemblage of likely phototrophic microfossils.

References

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