ORAL PRESENTATION

ENVIRONMENTAL CHANGE AND THE DEVELOPMENT OF BIOLOGICAL COMPLEXITY ON THE EARLY EARTH

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Two of the major transitions in the evolution of life on Earth are the development of eukaryotic cells and the subsequent development of multicellular, macroscopic life. Evidence of these transitions is preserved in the Precambrian fossil record, with fossil eukaryotes known from at least ~1,600 million years ago (Ma) and multicellular, macroscopic fossils from around ~600 Ma. The appearance of the latter during the Neoproterozoic coincides with a period of great environmental change, including global glaciations and major shifts in atmospheric composition. It has been suggested that these environmental changes actually triggered evolutionary processes that resulted in the transition to more complex, macroscopic life. The oldest confirmed fossil eukaryotes, however, are preserved within Earth's 'boring billion' – a period of relative environmental stasis and tectonic stability during the mid-Proterozoic. It is considered likely that eukaryotes originated much earlier on in Earth's history, but exactly when they evolved is currently unclear. An earlier period of great environmental change, including global glaciations and significant shifts in atmospheric composition, occurred in the Paleoproterozoic (~2,400 Ma). Some have hypothesised that this could have also resulted in the development of biological complexity; possibly providing impetus for the origin of the eukaryotic cell. However, this hypothesis remains largely untested, due to a lack of fossil-bearing rocks from this critical time period. During my PhD, I identified a new type of fossil from the early Paleoproterozoic (~2,400 Ma) that provides direct support for this theory. This fossil has no known counterparts in the geological record, yet bears resemblance to modern-day eukaryotic algae. Combined morphological, depositional and isotopic analyses provide a strong case for the classification of this new microfossil as eukaryotic, pushing back the record of eukaryotic microfossils by ~800 Ma. This research refines our understanding of the evolution of complex life on Earth, and has important implications in knowing what to look for when searching for life elsewhere.