178-2 - EARLY EUKARYOGENESIS AND EUKARYOTIC DIVERSIFICATION

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Eukaryogenesis, the sequence of evolutionary events occurring between FECA and LECA (respectively the First and Last Eukaryotic Common Ancestors), is one of the most radical transition in life evolution. FECA was probably born from a syntrophic association of one Asgard archaeon, one alpha-proteobacterium, and gene transfers from other bacteria in an oxic-anoxic transition zone, possibly in the Archean. However, the timing and relative order of evolution of cellular features characterizing LECA, such as the nucleus, endomembranes, cytoskeleton, and mitochondria, remain debated. Estimations for the age of LECA range from 1.9 Ga to 0.7 Ga, depending on molecular clocks and interpretation of the fossil record.

New microfossil assemblages from the Paleoproterozoic McArthur basin of Australia reveal an ecosystem with cyanobacterial mats, diverse unidentified vegetative cells and cysts, and ornamented protists. The morphological complexity of some of these fossils implies cytological sophistication for the synthesis of organic plates, external equatorial outgrowth, internal concentric ridges, and diverse protrusions on large recalcitrant organic walls, which indirectly evidence the evolution of a complex cytoskeleton and endomembrane system before 1.75 Ga, and pushes back the minimum age of eukaryotic fossils previously reported at 1.65 Ga. These early protists thrived in anoxic-suboxic near-shore marine water, probably close to benthic cyanobacterial mats providing low oxygen concentration undetectable by most geochemical proxies but sufficient for steroid synthesis and aerobe metabolism. They provide a minimum age for LECA, consistent with several molecular clocks.

Crown-group eukaryotes emerged well before 1 Ga based on the minimum age of multicellular red and green algae (Archaeplastida and 1ary endosymbiosis of the plast), and fungi and younger amoebae (Amorphea), as well as new evidence for possible Vaucheriale algae (TSAR supergroup and 2ary endosymbiosis of the plast). High resolution analyzes of the morphology, ultrastructure and biochemistry of enigmatic microfossils and experimental taphonomy, combined with micro- and macro-paleoeocology, reveal the paleobiology and evolution of early eukaryotes in terrestrial and marine habitats and their links to ecological and environmental causes, as inspired by the brilliant pioneer work of A H Knoll.

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