Mesoproterozoic eukaryotes diversification or the miscalled "Boring Billion"

EMMANUELLE J JAVAUX[1], B.K. BALUDIKAY[1], J. BEGHIN[1], Y. CORNET[1], C. FRANÇOIS[1], C. LORON[1], M-C. SFORNA[1]

[1]PPP lab, UR GEOLOGY, ULiege, B18, 14 allée du 6 Août, 4000 Liege Belgium ; ej.javaux@ulg.ac.be

Well-preserved Mesoproterozoic microfossil assemblages occur worldwide: in the 1.1-0.9 Ga Mbuyi-Mayi Supergroup, DRCongo (Baludikay et al, 2016); in the 1.1 Ga Atar/El Mreiti Gp, Mauritania (Beghin et al 2017); in the 1.5-1.4 Ga Roper Gp, Australia (Javaux & Knoll, 2016); in the 1.5 Ga Belt Gp, USA (Adam et al, 2017); in the ~1.3 Ga Kamo Gp (Nagovitsin et al, 2009), the 1.05 Ga Lakhanda Fm (Hermann, 1990), the 1.4–1.45 Ga Kaltasy Fm, the ~1.5Ga Kotuikan Fm (Vorob'eva et al, 2015), Russia; in the Sarda Fm, India (Prasad and Asher, 2001); in Arctic Canada (Butterfield et al, 2000; Loron et al, 2017); and in the 1.56 Ga Jixian Gp, China (Zhu et al, 2016). However, the unambiguous eukaryotic record starts in the late Paleoproterozoic of China (Lamb et al 2009; Xiao et al, 1997; Yin, 1997), India (Sharma et al, 2014), and Australia (Javaux et al, 2004). These assemblages show that mesoproterozoic oceans supported diverse prokaryotic and eukaryotic microbial communities. Taxonomic richness is highest in inshore facies, and populations interpreted as unambiguous or probable eukaryotes occur most abundantly in coastal and proximal shelf shales. Available paleoredox data indicate that these basins had oxic surface waters, and anoxic and ferruginous or euxinic (rarely oxic) subsurface waters.

Phylogenetic placement within the Eukarya is difficult, although combining morphology and wall ultrastructure and chemistry may provide constraints on biological affinities (e.g. Javaux and Marshall, 2006; Cornet et al, in prep). Molecular clock estimates suggest that preserved microfossils may belong to stem group eukaryotes or stem lineages within major clades of the eukaryotic crown group. Regardless of taxonomy, mesoproterozoic fossils provide direct or inferential evidence for many fundamental features of the eukaryotic cellular toolkit, including a dynamic cytoskeleton and endomembrane system, life cycles that include vegetative cells and resting cysts coated by decay-resistant biopolymers, reproduction by budding and binary division, heterotrophy, osmotrophy, simple multicellularity, photosynthesis and macroscopic size. Despite these biological innovations, the diversity and ecological importance of unambiguous fossil eukaryotes (however, a minimum estimation of the real eukaryotic diversity), could have been limited by ecological and environmental constraints.