NEW VIEWS OF THE COMPLEX EUKARYOTE *TAPPANIA PLANA* FROM THE 1.4 GA BELT SUPERGROUP, UNITED STATES. Zachary R. Adam[1,2], [1]Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA, [2]Blue Marble Space Institute of Science, Seattle, WA, USA.

Introduction: The appearance of crown-group eukaryotes was one of the defining transitions in evolutionary history, ultimately giving rise to complex multicellular life and a recognizably modern biosphere. The fossil record provides the only direct account of this transition, but is challenged by a dearth of diagnostically eukaryotic morphology in many basal/unicellular groups, and the progressive loss of sampling potential with time [1,2]. Recognition of eukaryotic microfossils in >1.6 billion-year-old rocks [3-6] demonstrates their early Proterozoic presence, but it remains to be seen whether these are fully constituted members of the crown-group, or intermediate stem-group forms sharing 'some but not all' of the features present in the Last Eukaryotic Common Ancestor. Microfossils recovered from the early Mesoproterozoic Greyson Formation (lower Belt Supergroup) of Montana include diagnostically eukaryotic *Dictyosphaera*, *Valeria* and *Tappania*, substantially extending the early record of eukaryotes on Laurentia [7]. Exceptionally well preserved populations of *Tappania* also yield a uniquely resolved view of this taxon's underlying biology. Novel anatomical features include vesicles bearing multiple branching processes, compound branching processes, and a bi-layered wall structure in which the inner and outer walls exhibit independent differentiation. Examples of paired and fused *Tappania* in the Greyson biota recall similar associations in populations from India and Siberia [4,5]. Modern analogues for *Tappania*'s characteristic 'neck-like extensions' can be found in the conjugation papillae/tubes of sexually reproducing zygnematalean algae [8,9], as well as 'shmoo' formation in ascomycetous yeasts [10]. The presence of such developmental complexity in *Tappania* substantially expands its documented range of derived eukaryotic features [11], bolstering its recognition as a crown-group eukaryote, arguably the oldest on record. These new views on Earth's oldest unambiguously eukaryotic organism carry important phylogenetic and paleobiological implications for constraining the early evolution of eukaryotes, and by extension, for estimating the possible distribution of complex life on planets beyond our solar system.

References:

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