IS CYST FORMATION IN EARLY EUKARYOTES A REQUIREMENT FOR THEIR PRESERVATION IN THE FOSSIL RECORD? H. Agić[1] and M. Moczydłowska[1], [1]Department of Earth Sciences, Uppsala University, Villavägen 16, 752 36 Uppsala, Sweden, heda.agic@geo.uu.se

Most of the Archaean-Proterozoic fossil record consists of non-biomineralizing microorganisms or their signatures. Body fossils of bacteria and early eukaryotes are preserved in siliciclastics, shales and carbonates, and are usually studied by preparation of thin sections or extraction from the rock matrix via acid maceration.

The first eukaryotic organic-walled microfossils (OWM) appear at least by 1.8 Ga and undergo morphological diversification and evolutionary radiation in the Mesoproterozoic. There are no preserved eukaryotic-grade microfossils except OWM until the onset of biomineralization much later in the Neoproterozoic, evident in the record of testate amoebae (VSM) and microfossils with scaly elements.

OWM are a less conspicuous component of the fossil record than taxa with skeletal or shelly elements. Organic matter decays quickly upon death of the organism, due to autolytic enzymes or degradation via heterotrophy. However, species producing vegetative cells, resting cysts, zygotes, or spores, show considerable resistance to autolysis.

Case studies on extractable carbonaceous OWM indicate they are preserved due to complex refractory molecules in the structure of their sturdy vesicle walls. Living analogues across protistan clades utilise such sporopollenin-like compounds for the cyst wall construction during reproductive phase.

Algaenan-containing trilaminar sheath structure (TLS) is secreted during aplanospore formation in extant chlorophyte alga *Haematococcus*. TLS has also been documented in *Leiosphaeridia* acritarchs from the Cambrian Lükati Formation in Estonia. *Leiosphaeridia* is a long ranging morphotype, dating as far back as 1.8 Ga. Presence of TLS in these fossils suggests their function as reproductive cyst.

Dictyosphaera-Shuiyousphaeridium plexus from the Mesoproterozoic Ruyang Group, China, also exhibits cyst-like morphology and unique elements of wall reinforcement: internally secreted organic platelets.

In addition to these early OWM, many Meso-Neoproterozoic taxa such as *Tappania*, *Trachyhystrychosphaera* and *Kildinella* contain cyst-like characters: 1) reproductive openings, 2) ornamentation, 3) occasionally preserved internal bodies and 4) acetolysis-resistant vesicle walls – properties observed among extant encysting protists.

Ornamented (process-bearing) microfossils in particular bear strong similarities with zygotes of living unicellular algae. Property of acetolysis-resistant vesicle is a result of sporopollenin-like macromolecules in the wall, synthesized most commonly by the autotrophic eukaryotes. Presence of such recalcitrant organic walls requires significant metabolic investment by the microorganism, which suggests a protective and/or reproductive function. This also allows for easier, and more detailed preservation in the rock record.

One of the concerns arising from the studies on the early eukaryotic fossils is the bias towards encysting organisms. The eventual search for the fossil record on other planetary bodies could face the same challenges as the Precambrian palaeobiology: fossilisation and eventual detection might be problematic for any unicellular eukaryotic-grade organisms if they have not evolved reproduction via encystment, or cyst formation as means of coping with adverse environmental conditions.