First molecular identification of fungal microfossils in 715-810 millions years-old shale rock

S. BONNEVILLE[1], F. DELPOMDOR[2], A. PREAT[1], C. CHEVALIER[3], T. ARAKI[4], M. ABYANEH[4], A. STEELE[5], A. SCHREIBER[6], R. WIRTH[6], L. G. BENNING[6,7]

[1] *BGéosys, Université Libre de Bruxelles, 50 av. F. D. Roosevelt, 1050 Brussels, Belgium (steeve.bonneville@ulb.ac.be)*

[2] *Illinois State Geological Survey, University of Illinois at Urbana-Champaign, 615 E. Peabody dr., 61820 Champaign, Illinois, USA*

[3] *CMMI,Université Libre de Bruxelles, 12 rue des professeurs Jeener et Brachet, Charleroi, 6041, Belgium*

[4] *Diamond Light Source, Harwell Science and Innovation Campus, Didcot, Oxfordshire OX11 0DE, UK*

[5] *Geophysical Laboratory, Carnegie Institution of Washington, 1530 P St NW, Washington DC 20005, USA.*

[6] *German Research Center for Geosciences, GFZ, Telegrafenberg, 14473 Potsdam, Germany*

[7] *Department of Earth Sciences, Free University of Berlin, 12249 Berlin, Germany*

Precambrian fossils of fungi are sparse and thus the knowledge of their early evolution as well as the roles they play in the global carbon cycle and climate are limited. By forming symbiotic associations with the first phototrophs that colonized land surfaces, fungi were crucial partner in one of the most transformative evolution of life. Molecular clock studies place the divergence of the main groups of Fungi within the Meso-Neoproterozoic. Yet, documented putative fungal fossils from Precambrian are controversial.

Here, we report the discovery of fungi fossils in a shale rock from the 810-715 Myr old Mbuji-Mayi Supergroup (MMS), Democratic Republic of Congo (DRC). Syngenetically preserved in a transitional, aerially-exposed paleoenvironment, these carbonaceous filaments of ~5 µm in width exhibit septa, anastomosis and high-angle branching that can form dense interconnected mycelium-like structures. Using an array of microscopic (SEM, TEM and confocal laser scanning fluorescence microscopy) and spectroscopic techniques (µRaman, µFTIR and C- and N-XANES), we demonstrated the presence of vestigial chitin in these fossil filaments and document the eukaryotic nature of their precursor. Based on those combined evidences, these fossil filaments and mycelium-like structures are identified as remnants of fungal networks and represent the oldest, documented remains of Fungi to date.