

First record of cryptospores in post-Hirnantian (latest Ordovician-early Silurian) sediments from Ethiopia

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Recently discovered outcrops of post-glacial Early Palaeozoic mudstones in northern Ethiopia have yielded a well-preserved assemblage of cryptospores (e.g., *Rugosphaera rugosa*, *Segestrespora laevigata*, *Tetraedraletes medinensis*, *Velatitetras laevigata* and *V. retimembrana*). These palynomorphs represent the first biostratigraphic evidence of Early Palaeozoic sediments in NE Africa and have the potential to shed light on the post-Hirnantian plant colonization of Gondwana.

The mudstones overlay glaciogenic sediments of the end Ordovician (Hirnantian) glaciation in form of channel fills up to 20 m thick and several hundred meters wide. Laterally the mudstones thin-out or are completely absent. The basal part of the succession consists of glacially influenced sand-, and mudstones that are overlain by grey to yellow sand-bearing mudstones of probably Silurian age. The succession is truncated by cross-bedded sandstones with marine trace fossils, e.g. *Arthropycus*, and locally by a basal layer of quartz pebbles and overlaid by intensely bioturbated sandstones.

The palynomorph assemblage is dominated by the enigmatic land-derived cryptospores and colonial algae of possibly freshwater origin. Typical marine elements such as acritarchs and scolecodonts are extremely rare, chitinozoans are missing so far. In addition, microscopically pyritized objects of unknown affinity but of probably primary organic origin occur. They obviously reflect metabolic products during very early mineralization processes in anaerobic habitats or at oxic-anoxic interfaces.

We interpret the mudstones as the early post-glacial filling of a relic glacial topography, either of underfilled glacial troughs or sub-glacial channels in a terrestrial or marginal marine environment. The sharp contact to the overlying shallow marine sandstones formed as a transgressive ravinement surface and marks the start of fully marine conditions of an inner shelf environment.

The mudstones are the first indication of sediments in NE Africa east of NW Sudan, likely correlative to Early Palaeozoic post-glacial shales in North Africa and Arabia. Those are locally enriched in organic matter and form major regional hydrocarbon source rocks. The overlying Silurian shelf sandstones document the flooding of far interior regions of Gondwana during a post-glacial transgression coming from the Palaeotethys caused by the melting of the Hirnantian Gondwana ice sheet.