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A filamentous cyanobacterium showing structured colonial growth from the Early Devonian Rhynie chert

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Abstract

This paper describes a new aquatic filamentous-colonial fossil cyanobacterium from the Early Devonian Rhynie chert that grows on sediment and submerged plant parts. It is associated with the formation of microbial mats, and occurs in structured colonies, in which the individual filaments are aligned more or less parallel into flat, irregular stands, or united radially into hemispherical aggregates; it may also form elongate, fan-shaped tufts. Individual filaments are ~3 μm in diameter, and consist of uniseriate trichomes composed of barrel-shaped cells enveloped in a thin but distinct sheath. Heterocysts and akinetes have not been observed, which suggests that the cyanobacterium belongs to the cyanobacterial subsection III (Oscillatoriales). This is the first account for sessile, structured colonial growth in cyanobacteria from the Rhynie chert.

Keywords: colonial growth; *Croftalania venusta* nov. gen. et sp; cyanobacteria; filament; microbial mat; Rhynie chert; subsection III (Oscillatoriales)

1. Introduction

Cyanobacteria are critical constituents of many marine, brackish and freshwater ecosystems, not only in producing oxygen, but also in serving as one of the primary producers of organic matter at the base of the food chain (e.g., Whitton and Potts, 2000a). They also may play an important role in the nitrogen cycle by converting inert atmospheric N_2 into a metabolically accessible form such as nitrate or ammonia (Newton and Orme-Johnson, 1980). Cyanobacteria are regarded as one of the most successful groups of prokaryotic organisms in Earth history based on a fossil record that is among the oldest for any group of organisms (Golubic and Seong-Joo, 1999). Geochemical evidence from the Precambrian indicates that cyanobacteria were responsible for the transition in the Earth's atmosphere from its primordial, anaerobic state to its current, aerobic condition (Giovannoni et al., 1988; Tomitani et al., 2006).

Despite the extensive fossil record of cyanobacteria, documentation of these organisms from non-marine paleoenvironments is rare. The earliest putative fossils believed to represent cyanobacteria from a strictly continental biota come from the Early Silurian Passage Creek in Virginia, U.S.A. (Tomescu et al., 2006). Although such reports may be important in tracing the earliest

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appearance of various cyanobacterial lineages in non-marine environments, and support the hypothesis that cyanobacteria were among the earliest colonizers of continents (cf. Knoll, 1985), they do not provide an accurate account of the diversity of cyanobacterial life in early non-marine ecosystems.