Calcification of the eucaryotic microalga Oocardium stratum NAEGELI 1849 (Zygnematophyceae): Exploring the niche of a highly effective biocalcifyer

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Aside of physical processes (e.g., CO_2 degassing due to turbulence) the formation of spring-associated limestones (SAL) is generally ascribed to the biological activity of cyanobacteria, mosses and diatoms. The eucaryotic micro-alga Oocardium stratum is a highly effective biocalcifyer that is increasingly identified in limestone-precipitating springs (LPS) worldwide. Inspection of numerous LPS of the Eastern Alps, however, shows that this micro-alga is not found at every spring; if present, it typically dominates the benthic calcifying assemblage. This calls to better understand the ecological requirements of O. stratum.

Based on observation of a selected spring over more than a year, and integrating results of previous works, we indicate that O. stratum is adapted to: (Ultra-)Oligotrophic, shallow, highly turbulent, ambient-temperature (4.7-20°C) spring streams with Ca-(Mg)-HCO_3-(SO_4) waters that achieve significant oversaturation for low-magnesian calcite. Oocardium persists over a wide range of concentrations – over two or three orders of magnitude – of CO_2 (uptaken for photosynthesis) as well as of Ca^{2+}, sulfate and nitrate. To date, no uncalcified sheet-like biofilm of O. stratum cells has been observed by us or is described in literature. O. stratum can calcify so rapidly as to outpace potential competitors (mosses, cyanobacteria). Only diatoms gain from being associated with O. stratum in finding highly differentiated microhabitats on Oocardium calcite. Whether O. stratum, in turn, profits from diatoms via community metabolism is not clarified. For O. stratum, calcification is not facultative (as for cyanobacteria) but essential to its life strategy. In lack of specialized tissues or symbionts that would support the branching mucus stalks in upward growth, precipitation of a calcite tube can be seen as a solution to the problem of being held against gravity, to stay competitive in keeping substrate occupied. Zygnematalean algae date back at least to Cambro-Ordovician times, and photosynthetic eucaryotes and spring habitats exist since the Proterozoic. Fossil spring limestones previously thought to be of cyanobacterial origin only thus may comprise a hitherto unidentified "eucaryotic component", or may even have been largely produced by calcifyers similar to O. stratum.