Investigating the effects of early diagenetic processes on freshwater ooid formation using organic proxies

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A wide variety of chemical reactions governed by microorganisms are involved in early diagenetic processes in carbonate sediments. These reactions include the degradation of organic matter under aerobic and anaerobic conditions, and can favor and/or prevent carbonate precipitation. Among anaerobic bacterially-mediated reactions, sulfate-reduction and the anaerobic oxidation of methane are considered as the most important processes leading to carbonate precipitation. A sandy bank located in the shallow water sediments of western Lake Geneva, Switzerland, is composed of more than 90% of ooidal sands. It is widely accepted that ooids require the presence of a nucleus and physicochemical factors that trigger carbonate precipitation, i.e., (1) water that is supersaturated with respect to calcium carbonate that is regularly refreshed and frequently degassing CO_2, and (2) an agitated environment allowing for CO_2 degassing (Simone 1981). Previous studies have shown that, contrary to expectation, photosynthetic microbes contribute to the formation of the entire cortex of these ooids present at the water-sediment interface (Plée et al., 2008, 2010; Pacton et al., 2012). However, little is known about early diagenetic processes, occurring deeper in these sediments, which could impact the fate (e.g., a further development) of the ooid cortices. The aim of this study is thus to determine the textural and biogeochemical changes in these freshwater ooids occurring downcore between the time of their formation and early stages of lithification. Selected ooid intervals have been examined for their lipid biomarker composition along with petrographic and microscopic investigations and in-situ $d^{13}C$ measurements in ooid cortices.

Preliminary results show abundant framboidal pyrite at the oxic-anoxic sediment interface pointing towards the presence of sulfate-reducing bacteria. The development of calcareous meniscus of micritic composition between ooids and a progressive enrichment in ^{13}C towards the outer part of ooid cortices are also observed downcore. However, the hydrocarbons and fatty acids distributions appear similar throughout depth, and are consistent with mixed inputs from bacteria, terrestrial plants and algae. The latter suggest that in Lake Geneva anaerobic microbial communities do not play a significant role in the formation of ooids even in the anoxic section of the sediments. These data confirm previous experimental results and observations in the most recent sediments, opening new perspectives for the formation of ooids in other lacustrine environments.

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