

Geochemical analysis of the pigments and affinity of the Jurassic calcareous algae *Solenopora jurassica*

HOLLY E. BARDEN¹ PHILIP WITHERS² JULIA BEHNSEN²
UWE BERGMANN³ PHILLIP L. MANNING^{1,4}
ROY A. WOGELIUS¹ AND BART E. VAN DONGEN¹

¹Williamson Research Centre for Molecular Environmental Science, School of Earth Atmospheric and Environmental Sciences, University of Manchester, Williamson building, Oxford Rd, M13 9PL
(holly.barden@postgrad.manchester.ac.uk)

²Manchester X ray Imaging Facility, The School of Materials, The University of Manchester, Oxford Road, Manchester, M13 9PL

³SLAC, National Accelerator Laboratory, Linac Coherent Light Source, Menlo Park, CA 94025, USA

⁴Department of Earth and Environmental Sciences, University of Pennsylvania, Philadelphia, PA 19104, USA

The enigmatic fossil calcareous algae *Solenopora jurassica* is known for its distinctive pink and white banding. Though widely accepted as an algae, there has been some debate over its taxonomic affinity, as well as the derivation of its visible banding pattern which thought to be seasonal. Despite these hypotheses little geochemical work has been carried out to test them. This study represents the first in depth geochemical analysis of this fossil in order to study its affinity and the possible seasonal origin of its banding pattern. Seasonal growth is shown by differences in calcite density, and increased Mg/Ca molar ratios and chlorine levels indicate higher temperatures during the time that white bands were deposited when compared to the pink bands. Pyrolysis gas chromatography mass spectrometry and infrared spectroscopy show the presence of tetramethyl pyrrole, protein moieties and carboxylic acid groups, indicative of the red algal pigment phycoerythrin. This supports the identification of *S. jurassica* as an algae, given that the pigment is only known to occur in cyanobacteria and algae. There is no evidence that the fossil is bacterial and no other taxonomically indicative biomarkers were identified.

Serpentinites as catalysts for vapor conversion of methane in the Earth crust

VICTOR BARELKO¹, OLEG SAFONOV², NATALIA BYKOVA¹, VICTOR DOROKHOV¹ AND LEONID BYKOV¹

¹Institute of Problems of Chemical Physics, Russian Academy of Science, Chernogolovka, Russia (barelko@icp.ac.ru)

²Institute of Experimental Mineralogy, Russian Academy of Science, Chernogolovka, Russia (oleg@iem.ac.ru)

Serpentinites of the oceanic lithosphere are an active source of reduced gases, such as H₂, CH₄, as well as an abiogenic source of complex hydrocarbons. Appearance of H₂ is related to the serpentinization of ultrabasic rocks of the oceanic floor. However, production of H₂ in the CH₄ and H₂O-bearing fluids is possible according to the catalytical reaction known as «vapor conversion of methane», since serpentinite composition and structure can serve as close analogy of the artificial catalysts. We performed an experimental study of the reaction of the methane conversion by vapor using massive lizardite-antigorite serpentinite, which in addition to serpentine contains chromite, magnetite and few chlorite. The sample has not crushed to the fraction 0.5-0.71 mm before experiment. The volume ratio H₂O/CH₄ in the reaction zone was 8-10/1, filtration rate through the rock 1 cm-thick layer was 0.5-0.6 cm/s, while the time of the contact of the vapor-methane mixture with serpentinite was 1.5-2 s. During interaction with the vapor-methane mixture, serpentinite was partially dehydrated with presumable formation of olivine and silica-rich aqueous solution. Chromatography shows that the conversion of CH₄ to H₂ increases with temperature and reaches 14 % at 825°C. The conversion of CH₄ to CO and CO₂ at 825°C is 3 % for both components. Along with H₂, CO and CO₂ the reaction products include ethanol and methanol, which do not form on standard catalysts. The present experimental results support the conclusion on the high catalytical effectiveness of serpentinite: at short time of contacts of the vapor-methane flux with this rock resulted in relatively high degree of conversion. Experiments inspire testing of the catalytical properties of other crustal rocks.