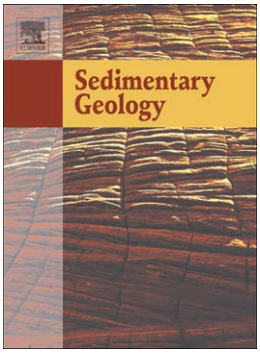

Microbial pathways and palaeoenvironmental conditions involved in the formation of phosphorite grains, Safaga District, Egypt

Walid Salama, Ahmed El Kammar, Martin Saunders, Rania Morsy, Charlie Kong

PII: S0037-0738(15)00127-X
DOI: doi: 10.1016/j.sedgeo.2015.05.004
Reference: SEDGEO 4861

To appear in: *Sedimentary Geology*

Received date: 1 January 2015
Revised date: 22 May 2015
Accepted date: 24 May 2015

Please cite this article as: Salama, Walid, El Kammar, Ahmed, Saunders, Martin, Morsy, Rania, Kong, Charlie, Microbial pathways and palaeoenvironmental conditions involved in the formation of phosphorite grains, Safaga District, Egypt, *Sedimentary Geology* (2015), doi: 10.1016/j.sedgeo.2015.05.004

Microbial pathways and palaeoenvironmental conditions involved in the formation of phosphorite grains, Safaga District, Egypt

Walid Salama*[1,2], Ahmed El Kammar[2], Martin Saunders[3], Rania Morsy[2], Charlie Kong[4]

*[1]CSIRO Mineral Resources Flagship, ARRC, PO Box 1130, Bentley, WA, 6102, Australia
[2]Geology Department, Faculty of Science, Cairo University, Giza 12613, Egypt
[3] CMCA, University of Western Australia, Crawley, WA 6009, Australia.
[4]Electron Microscope Unit, University of New South Wales, NSW 2052, Australia

Abstract

Phosphatic grains of the shallow marine phosphorite deposits of Egypt are classified as either phosphatic bioclasts preserving biological structure (e.g. skeletal fragments such as fish bones and teeth) or phosphatic peloids and intraclasts. This study describes the destructive and constructive microbial pathways represented by bioerosion of bones by endolithic cyanobacteria and accretion of phosphatic peloids by bacteria. The palaeoenvironmental conditions and post-depositional/diagenetic history of these grains have also been considered. Scanning and transmission electron microscopy showed that the phosphatic peloids under transmitted light microscopy are composed mainly of microspheres (0.5 to 2.5 µm) similar in shape and size to coccoid-like bacteria. Chemical mapping showed that these microspheres are composed of carbonate-fluorapatite (CFA) and surrounded by degraded carbonaceous matrix. These grains are suggested to be reworked from pre-existing microbial mats during transgressive-regressive cycles affecting the southern Tethyan Campanian-Maastrichtian shallow continental shelf. The bioerosion of phosphatic bones is characterized by a network of meandering microborings that penetrated inward from the bone surface by endolithic cyanobacteria. The bioerosion of bones resulted in a gradual centripetal digestion and conversion of bones into micritic phosphate peloids. The bioerosion mechanism is probably started in the acidic sheath surrounding cyanobacteria followed by supersaturation of PO_4 and reprecipitation of crystalline CFA as electron dense remineralized rims. Electron microprobe microanalyses showed that the remineralized microbored areas are higher in CaO, P_2O_5, and F and depleted in Cl, relative to unaltered bones. A gradual demineralization of remineralized