Evidence of biogeochemical processes in iron duricrust formation

ALAN LEVETT[1], EMMA GAGEN[1], JEREMIAH SHUSTER[1], GORDON SOUTHAM[1]

[1]School of Earth Sciences, University of Queensland, Brisbane, Queensland 4072, Australia

Canga, an iron-rich duricrust, typically caps iron ore mines in Brazil and possesses macroscopic 'organic' features that extend to the sub-millimetre scale. Examination of polished canga using secondary and backscattered electron field emmision scanning electron microscopy revealed goethite cements that were formed in association with microorganisms. Biological cycling of iron within canga has resulted in two distinct forms of microbial fossilisation: goethite permineralisation of biofilms and mineralisation of cell envelopes. Fossilised filamentous, cocci and rod-shaped cell morphologies were identified in goethite permineralised biofilms that formed in close proximity to kaolinite-rich grains. In contrast, the cell envelopes immobilised by authigenic iron oxides were primarily of rod-shaped microorganisms, were not permineralised and occurred in pore spaces of canga. Mineralised cell envelopes of intact, rod-shaped moulds that lacked permineralisation were interpreted to represent fossilised iron-oxidising bacteria in canga ecosystems. As a comparison, present-day microbial communities from iron seeps and water bodies in close proximity to canga were examined using transmission electron microscopy. This analysis revealed that microorganisms were encrusted with various iron oxides. Microorganisms entombed in iron oxides putatively represent iron-oxidising bacteria. Precipitation of iron oxides on microbial membranes indicates active microbial processes are in part responsible for the cycling of iron within canga ecosystems. Active biogeochemical oxidation of iron in present-day canga ecosystems and evidence of fossilised microogranisms in canga indicates a role for iron-oxidising bacteria in the evolution of iron duricrusts in Brazil.