Can studies of petroleum biodegradation help fossil fuel carbon management

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Recent studies of biodegrading oils from the organic geochemical and biological perspective (MADCOR process-Jones *et al*, 2008) have resulted in significant advances. We review these and also look at routes to use this knowledge to decarbonise fossil fuel based energy systems. Popular carbon management strategies focus on removal of CO_2 from flue gas streams or even from the atmosphere to subsurface storage. Here we present scoping studies for possible biogeochemical-engineering carbon management schemes suggested by observations from studies of biodegraded petroleum systems and fossil fuel energy recovery systems. We evaluate the feasibility of recovering hydrogen, instead of oil, directly from oilfields undergoing natural biodegradation processes and we also examine the feasibility of using a related process, biologically assisted carbon capture and conversion of CO_2 to methane, via $H_2 + CO_2$ methanogenesis in the hydrogen-rich environments of weathering subsurface ultrabasic rocks, as a route to recycle carbon dioxide in flue gases as methane. We examine potential uses of refractory water soluble carbon compounds, analogues of compounds found in severely biodegraded oils, as inert carbon sequestration materials. We review advances in oil biodegradation systematics and look at some of the engineering, energy and geochemical barriers to the feasibility of these possible technology routes.

Biomineralization of halotrichite on bauxite ores

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Yellow to gray-whitish bauxite ores of the Parnassos-Ghiona bauxite deposits, are located at the uppermost part of the deposit, underlying thin layers of coal and U. Cretaceous limestone. Such an ore is characterized by the presence of abundant pyrite and fossilized micro-organisms, resulted the Fe-bioleaching and Al-enrichment (up to 70 wt% Al_2O_3). Present study was focused on the whitish material grown up, after two weeks, on the surface of polished sections of grey bauxite, exposed to air oxidation, in the room conditions (20-25°C) and low air humidity.

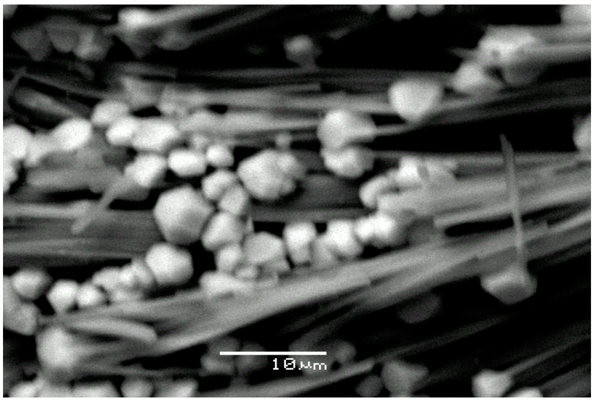

Figure 1: Back-scattered image from grey-yellow bauxite showing hydrous sulphates: needle-like halotrichite, [$FeSO_4.Al_2(SO_4)_3.22H_2O$], and granular $FeSO_4.H_2O$.

Enzymes of bacteria are powerful catalysts. The protein surfaces allow living bacteria to produce halotrichite and other sulphates on the thermodynamically unstable pyrite [1].

[1] Russell, M.J. Hall, A.J. Boyce, A.J. Fallick, A.E. (2005) *Economic Geology,* 100th Anniversary Special, 418–438.