Geophysical Research Abstracts
Vol. 13, EGU2011-3213, 2011
EGU General Assembly 2011

Prokaryotes Stimulate Mineral-H2 Formation for the Deep-Biosphere and Subsequent Thermogenic Activity.

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The deep sub-seafloor biosphere contains two thirds of Earth's prokaryotic biomassand is present down to kilometre depths, which may indicate the presence of novel mechanisms of energy generation as temperatures increase in the subsurface. In sediment slurry experiments (0 – 100 °C) with a range of common minerals (including basalt rock and quartz) there is significant H2 formation at elevated temperatures, but only in the presence of prokaryotes. This stimulates further prokaryotic activity, typical of deep sediments (sulfate reduction, acetogenesis and CO2 production, plus continuing methanogenesis), and Bacteria and Archaea representative of many deep sediment types develop. H2 and acetate formation is particularly stimulated above 70 °C, as in Nankai Trough deep, hot sediments. Surprisingly, prokaryotic activity even enhances reactions when temperatures were subsequently raised to thermogenic levels (∼125–155 °C), including hydrocarbon generation. Mechanochemistry may be responsible for this mineral-H2 formation and is enhanced by prokaryotes (bio-mechanochemistry), and stress and fracturing in the subsurface, which is widespread on Earth and any tectonically active planet.