Geophysical Research Abstracts, Vol. 7, 09120, 2005
SRef-ID: 1607-7962/gra/EGU05-A-09120

Biological formation of ethane and propane in the deep marine subsurface

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Deeply buried marine sediments from the Equatorial Pacific and the Peru Margin recovered during ODP Leg were analyzed for concentrations and carbon-isotopic compositions of ethane and propane. Ethane and propane were detected at all depths studied, 0 to 380 meters below the sea floor, and the major fraction of these gases was principally sorbed rather than dissolved. Multiple lines of evidence indicate that these gases are formed in situ and are biologically synthesized rather than the products of thermal degradation of fossil organic material or abiotic synthesis. These lines of evidence include: 1) All sites are isolated from reservoirs of fossil hydrocarbons, 2) Ethane and in particular propane are enriched in ^{13}C relative to ethane and propane produced by thermolysis of fossil carbon or by abiogenic synthesis, 3) Temperatures ranged from 2 to 25˚C, much too low for abiotic synthesis, 4) Ethanogenesis and propanogenesis from acetate are exergonic under in situ conditions, 5) Intact prokaryotic cells are present in all sediments studied and chemical compositions of pore fluids indicate microbial activity at all depths, and 6) Their uniform vertical distribution in each borehole implies production *in situ* rather than transport from greater depths. Acetate is probably the electron acceptor that is reduced to ethane. Isotopic evidence suggests that propane is formed by reduction of a product derived from acetate and bicarbonate. This geomicrobiological process provides a sink for acetate and hydrogen and may have an important role in subsurface microbial communities.