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Methanogenic growth at high partial pressures of CO2: Implications for the injection of CO2 into biogenic gas reservoirs

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The in situ chemical environment of deep microorganisms is not reproducible with traditional in vitro methods.

To explore hypotheses related to microbial activity at high pressure, we have adapted the flexible-gold reaction-cell technology used in hydrothermal experiments for the aseptic inoculation, growth, and sterilization of microbial cultures at pressures up to several hundred bars. This experimental capability allows for serial sub-sampling of microbial culture fluids and the coexistence of separate CO2, hydrocarbon, and aqueous fluids. We demonstrated a proof of concept with 1) yeast cultures and 2) obligately anaerobic aceticlastic methanogens. We present the results of a set of experiments related to the dependence of methanogenic growth on the partial pressure of CO2 at total pressures greater than 100 bars. Preliminary results indicate that in nature, CO2 concentrations may reach a critical threshold whereby a separate CO2 rich fluid phase becomes an effective sterilizing agent. In addition, we present a theoretical model consistent with high partial pressures of CO2 as a general limitation of microbial activity at depth.