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Role of Biofilms in Geological Carbon Sequestration

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Geologic sequestration of CO_2 involves injection into underground formations including oil beds, deep un-minable coal seams, and deep saline aquifers with temperature and pressure conditions such that CO_2 will likely be in the supercritical state. Supercritical CO_2 ($scCO_2$) is only slightly soluble in water (approximately 4%) and it is therefore likely that two fluid phases will develop in the subsurface, an aqueous and a supercritical phase. Supercritical CO_2 is less dense and much less viscous than water therefore creating the potential for upward leakage of CO_2 through fractures, disturbed rock, or cement lining near injection wells. Our research focuses on microbially-based strategies for controlling leakage of CO_2 during geologic sequestration and enhancing the process of CO_2 trapping.

We have demonstrated that engineered microbial biofilms are capable of enhancing formation, mineral, and solubility trapping in carbon sequestration-relevant formation materials.

Batch and flow experiments at atmospheric and high pressures ($>$ 74 bar) have shown the ability of microbial biofilms to decrease the permeability of natural and artificial porous media, survive the exposure to $scCO_2$, and facilitate the conversion of gaseous and supercritical CO_2 into long-term stable carbonate phases as well as increase the solubility of CO_2 in brines.

Successful development of these biologically-based concepts could result in microbially enhanced carbon sequestration strategies as well as CO_2 leakage mitigation technologies which can be applied either before CO_2 injection or as a remedial measure.

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