

Microbially Induced Calcite Precipitation by *Bacillus subtilis* 168 for Underground Gas Stagnation, Soil Compaction, and Ion Sequestration

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Microbially Induced Calcite Precipitation (MICP) is a biochemical reaction that certain urease positive bacteria can perform. Through MICP, said bacteria can precipitate microscopic limestone crystals that act as particle adhesives in sand, soil, and concrete. This study was conducted to examine if MICP crystallization by *Bacillus subtilis* 168 could be used to compact soil and impede the proliferation of underground CO₂ into the atmosphere. *Bacillus subtilis* 168 was grown with Media 415, transferred into urea-CaCl₂-dextrose liquid media, and administered into soil plots. Through MICP, the *Bacillus* excreted carbonate ions that reacted with calcium in the media to generate limestone crystals that solidified the soil. The soil was modulated by introducing P₂O₅ and Lime (MgCO₃, CaO, MgO) fertilizers, which decreased and increased pH respectively. Following treatment with bacteria and fertilizers, the soil was inserted into a chamber with NaHCO₃ deposited beneath it. When H₂O₂ was administered, NaHCO₃ released CO₂ that rose through the soil and was detected by a UV gas-probe. After collecting CO₂ effluxes in ppm from the soil plots, it was determined that soil treated with only MICP stagnated CO₂ efflux to the highest extent. Soils treated with MICP and lime produced similar results, suggesting that lime played a minimal role in particle consolidation, likely because lime fertilizer was too large to be used by the bacteria. P₂O₅-treated soils had the highest effluxes, possibly because protons emitted by P₂O₅ reacted with limestone to produce additional CO₂. Statistical analysis suggested data significance. MICP used for grouting and ion detoxification is discussed.