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The importance of gas/solution exchange for CO_2 biomineralization into carbonates in the subsurface

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Geological storage of CO_2 in the subsurface is an important option envisaged to mitigate enhanced CO_2 atmospheric greenhouse effect in the coming decades. The potentialities of certain subsurface microorganisms to induce CO_2 mineralization into carbonates could strongly enhance the stability of the CO_2 containment by cementing the borders or even stabilizing significant amounts of injected CO_2 into solid carbonates. Little is known, however, about the actual biochemical processes involved. CO_2 mineralization experiments have been conducted using *Bacillus pasteurii*, an ureolytic model strain, which was inoculated in an artificial ground water and submitted to different conditions including variations in inoculum size, substrate amounts and CO_2 partial pressures. Complex pH/cell quantity/ureolytic activity evolutions were measured, evidencing strong interplays between enzymatic activity, calcite precipitation and CO_2 transfer at the gas/solution interface. Alkalinization due to the enzymatic hydrolysis of urea, part of which is shown to occur by extracellular processes, is regulated by the acidifying effect of CO_2 diffusion into the aqueous solution. The effect of strong cellular mortalities induced by calcite precipitation are investigated and quantified. Implications for constructing appropriate numerical and analogical models of CO_2 biomineralization in subsurface environments are finally discussed.