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Effect of organic acids on the dissolution of spodumene and preliminary study on microbial lithium extraction

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Lithium is a key metal element for the development of green energy, and spodumene isolated from hard rock type lithium ores is the main raw material for extracting lithium. Conventional methods of lithium extraction require treatment by using high concentrations of acid and/or base at very high temperatures, which causes a large environmental impact. In contrast, microbiological degradation is an effective and environment-friendly method to extract lithium. Considering organic acids secreted by microbe promote silicate mineral dissolution, we designed and performed experiments to reveal the effect of organic acid (oxalic acid and citric acid) as well as inorganic acid (HCl) on spodumene dissolution. The 20-day dissolution demonstrated oxalic acid shows higher performance than citric acid and inorganic acids with similar pH. Filtrates collected from the experimental groups with the addition of 40 mM oxalic acid yield Li, Al, and Si concentrations as high as 15.8mg/L, 128.7mg/L, and 113.4mg/L respectively. Several secondary products like smectite, calcium oxalate, and amorphous phases could be observed in the groups that reacted with organic acids. Strains of *Pseudomonas rhizosphaerae*, *Acinetobacter lwoffii*, and *Bacillus mycoides* have been separated from the weathered spodumene sampled from mine environments. Among the three strains, *Bacillus mycoides* shows high lithium extraction, which is 30% higher than that of abiotic groups with high concentrations of organic acids. On the reacted spodumene surface, a large number of smectite flakes and halloysite nanotubes appeared, which could adsorb Li^+ ions. These findings suggest that *Bacillus mycoides* shows a high potential to dissolve spodumene and extract lithium at ambient temperature and pressure conditions.