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ORIGINAL PAPER

Sepiolite Dissolution by Different Silicate Solubilizing Bacteria

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Abstract

Since limited research has been conducted on the effect of soil bacteria on the weathering of sepiolite, the present study aimed to investigate the efficiency of silicate solubilizing bacteria in the release of Mg, Fe, and Si from sepiolite. The experimental treatments consisted of 12 bacterial isolates in two culture media (rich and poor) with three incubation time points (5, 10, and 15 days). The greatest pH reduction and release of elements were observed in the poor medium. After 5 days of growth, the release of Mg and Si was 24% and 68% higher in the poor medium than those of the rich medium, respectively. After 10 and 15 days of growth, the release of these elements from the sepiolite decreased in both culture media types; however, it was higher in the poor medium compared with the rich medium. *Serratia marcescens* had the highest ability to release Mg and Si in both rich and poor media. Despite the release of significant amounts of elements from the sepiolite, the bacterial isolates were not able to change the mineral structure over this time-course (15 days). It appears that a longer time is needed for the mineral-bacteria interactions in order to change the mineral structure of the sepiolite. The results demonstrated the potential of the silicate solubilizing bacterial isolates for the release of nutrients (e.g., Mg and Fe) from sepiolite, suggesting their possible implications to improve nutrient cycling and crop nutrition, particularly in soils that are rich in sepiolite.

Keyword X-ray diffraction · Silicate solubilization · Mineral-bacteria interaction · Bioweathering · *Bacillus* · *Serratia marcescens*

Highlights

1. The dissolution of sepiolite in the presence of 12 different bacterial isolates was investigated under different culture media composition and incubation time points.
2. *Pseudomonas* sp., *Bacillus anthracis*, *Bacillus cereus*, and *Serratia marcescens* were identified as the superior isolates with high sepiolite solubilization activity.
3. The composition of the culture medium played an important role in the release of structural elements (e.g., Mg, Fe, and Si) from the sepiolite.
4. The duration of 15 days of bacteria-mineral interaction was not sufficient to transform the sepiolite.

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1 Introduction

Clay minerals are the most abundant silicates in the Earth's crust, which are considered as one of the main nutrient sources for microorganisms (Uroz et al. 2011; Wang et al. 2019). Numerous studies have shown that microorganisms can accelerate the release of elements from silicates under aerobic conditions (e.g., Dai et al. 2014; Parmar et al. 2016; Ren et al. 2016; Balland-Bolou-Bi et al. 2019). It is essential to understand how bacteria, as one of the most important

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