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Microbial Effects of Iron Elution from Hematite into Seawater Mediated via Dissolved Organic Matter

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Abstract : The restoration of seaweed beds recovery has been developed using a fertilization technique for supplying dissolved iron to barren coastal areas. The fertilizer is composed of iron oxides as a source of iron and compost as humic substance (HS) source, which can serve as chelator of iron to stabilize the dissolved species under oxic seawater condition. However, elution mechanisms of iron from iron oxide surfaces have not sufficiently elucidated. In particular, roles of microbial activities in the elution of iron from the fertilizer are not sufficiently understood. In the present study, a fertilizer (iron oxide/compost = 1/1, v/v) was incubated in a water tank at Mashike coast, Hokkaido Japan. Microorganisms in the 6-month fertilizer were isolated and identified as Exiguobacterium oxidotolerans sp. (T-2-2). The identified bacteria were inoculated to perform iron elution test in a postgate B medium, prepared in artificial seawater. Hematite was used as a model iron oxide and anthraquinone-2,7-disolfonate (AQDS) as a model for HSs. The elution test performed in presence and absence of bacteria inoculation. ICP-AES was used to analyze total iron and a colorimetric technique using ferrozine employed for the determination of ferrous ion. During the incubation period, sample contained hematite and T-2-2 in both presence and absence of AQDS continuously showed the iron elution and reached at the highest concentration after 9 days of incubation and then slightly decrease to stabilize within 20 days. Comparison to the sample without T-2-2, trace amount of iron was observed, suggesting that iron elution to seawater can be attributed to bacterial activities. The levels of total organic carbon (TOC) in the culture solution with hematite decreased. This may be to the adsorption of organic compound, AQDS, to hematite surfaces. The decrease in UV-vis absorption of AQDS in the culture solution also support the results of TOC that AQDS was adsorbed to hematite surfaces. AQDS can enhance the iron elution, while the adsorption of organic matter suppresses the iron elution from hematite.

Keywords : anthraquinone-2, 7-disolfonate, barren ground, E.oxidotolerans sp., hematite, humic substances, iron elution
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