A Comparative Study Of Helium Isotope For Manganese Nodules and Their Surrounding Sediments

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Deep-ocean sediments have among the highest $^3He/^4He$ ratios measured on Earth. Their $^3He/^4He$ ratios can be as high as 2_10^{-4}. Merrihue (1964) first attributed it to input of extraterrestrial material. Ozima et al. (1984) studied the helium isotope compositions of ocean sediments in detail. Judging from the common occurrence of high $^3He/^4He$ ratios and the negative correlation of ^3He contents with the sedimentation ratio, they concluded that the extraterrestrial He is carried by interplanetary dust particles (IDPs).

Although quite a number of results of helium isotope in deep sea marine sediments have been reported, but little is known about $^3He/^4He$ ratios on manganese nodules which are considered to be an important type of mineral resources and a part of marine sediments. In order to understand the origin of $^3He/^4He$ ratios abnormity of marine manganese nodules, we measured the helium isotope compositions for nodules and their surrounding sediments, their magnetic fractions and bulk, from C-C zone of the East Pacific Basin.

The $^3He/^4He$ ratios of nodules vary from 3.50 to 5.38×10^{-5} and sediments from 2.17 to 3.88×10^{-5}. The $^3He/^4He$ ratios of manganese nodules are similar to those of their surrounding sediments, and the changes of both ratios are synchronous. The $^3He/^4He$ ratios and ^4He concentration of magnetic fractions in nodules and sediments are apparently higher than those in bulk. All data points of nodules and sediments sit in or close to the mixing curve between the IDPs and the terrigenous sediments in the chart of ^3He - $^3He/^4He$. It shows that the high $^3He/^4He$ ratios in nodules may also result from IDPs. If flux of extraterrestrial ^3He into the nodules was constant, so the growth rate of manganese nodules also can be independently calculated on the concentration of extraterrestrial ^3He in nodules.

Dissolution of iron-rich clay and sulfur sequestration by a sulfate-reducing bacterium

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Industrial emission of SO_2 into atmosphere causes acid rains, which severely degrade soil. We hypothesize that sulfate-reducing bacteria are able to remediate acid-rain contaminated soils through reductive dissolution of iron in clays and precipitation of iron sulfides from sulfate reduction. Experiments were performed to test this hypothesis using a *Desulfovibrio* sp. strain G-11 and an iron-rich nontronite (NAu-2).

Cells were grown in cultures containing lactate (50 mM) and NAu-2 (total iron 30 mM) with or without sulfate. Cell abundance, reduced iron, and pH were measured during incubation. Final solids were characterized by XRD and SEM/EDS. Cations in solution were determined by ICP.

In the absence of sulfate, cell numbers increased by three-fold during incubation and the reduced iron accounted for <10% of total iron in Nau-2. In the presence of sulfate, however, cell numbers increased by 19-fold and the reduced iron accounted for 23% of total iron in NAu-2. Results suggest that reduction and dissolution of structural iron in NAu-2 were significantly enhanced through bacterial sulfate reduction.

EDS analysis of final solids shows that calcium and iron were removed from NAu-2 during bacterial sulfate reduction, perhaps as a result of the collapse of the clay structure as shown by XRD. On the other hand, decreased iron and calcium and increased pH in solution during bacterial sulfate reduction imply that iron and calcium might have precipitated as iron sulfides and calcium carbonates, respectively. This study demonstrates that sulfate-reducing bacteria may play an important role in maintaining soil quality against acid-rain degradation.

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