Mineralogy and geochemistry of Rhodolith from Wu do, Jeju, S. Korea

SERKU KANG[1], SANGTAE KIM[2] AND YUL ROH[1]

[1]Chonnam National University, Gwangju, Korea
rohy@jnu.ac.kr
[2]McMaster University, Hamilton, Canada
sangtae@mcmaster.ca

The formation of carbonate minerals by biological processes may play an important role in carbon and metal geochemistry in natural environments. This study focused on investigation of mineralogical and biogeochemical characteristics of rhodoliths and examination of rhodolith formation whether they were formed by chemical or biological processes.

The rhodoliths and seawater were sampled at Seogwang-ri beach in the western part of Wu do, Jeju, Korea. The chemical compositions and pHs of seawater were measured by ICP-AES and pH meter. Microorganisms, Wu Do-1, enriched from rhodoliths were aerobically cultured at 25°C in D-1 media and Wu Do-1 were analyzed by 16S rRNA gene DGGE analysis to confirm microbial diversity. Mineralogical characteristics of rhodoliths and precipitates formed by Wu Do-1 were determined by XRF, XRD, and SEM-EDS analyses. The stable isotope analysis was conducted to infer forming conditions of the rodoliths.

The seawater had a range of pH 6 to 7, and consisted of approximately 400 mg/L of Ca^{2+} and 1,200 mg/L of Mg^{2+} which are low saturation index to form carbonate minerals by chemical process. XRF and XRD analyses showed the rhodoliths mainly consisted of 46% CaO and 5 % MgO and mineralogy is Mg-rich calcite ($M_xCa_{1-x}CO_3$). A 16S rRNA sequence analysis showed Wu Do-1 contained a carbonate forming microorganisms, *Proteus mirabilis*. Wu Do-1 precipitated carbonate minerals using D-1 media containing Ca- and Mg-acetate and mineralogy of the precipitated carbonate mineral was Mg-rich calcite. SEM-EDS analyses showed that the Mg-rich calcite formed by Wu Do-1 had a rhombohedron shape. And the Mg-rich calcite consisted of Ca, Si and Mg with EPS. The stable isotope analysis indicated that rhodoliths were composed of lighter ^{13}C and heavier ^{18}O which may strongly suggest initiative microbial roles for formation of carbonate minerals.

These results indicate that the rhodoliths at Seogwang-ri beach could be formed biologically and Wu Do-1 induce precipitation of Mg-rich calcite on the cell walls and EPS via the accumulation of Ca and/or Mg ions on the cells. This study indicates that microbial precipitation of carbonate minerals may play one of important roles in metal and carbon biogeochemistry as well as carbon sequestration in natural environments.