The link between Sr isotope record, weathering and glaciations during Neogene

HIROHIKO KASHIWAGI[1] AND NAOTATU SHIKAOZNO[2]

[1] Fac. Appl. Chem., Dept. Sci. Tech., Keio Univ.
(hirohiko.kashiwagi@mmm-keio.net)
[2] Fac. Appl. Chem., Dept. Sci. Tech., Keio Univ.
(sikazono@applc.keio.ac.jp)

The rapid increase of marine ^{87}Sr/^{86}Sr in late Cenozoic has been disputed associated with the elevation of the Himalayan and Tibetan Plateau (HTP) and development of glaciations and deglaciations. We used a model which differentiates the effect of the uplift from that of glaciations and deglaciations during Neogene, and investigated the link among Sr isotope variations, HTP weathering, and glaciations numerically.

The calculated off-axis hydrothermal flux at present is more important than axial flux, but this ridge flux could be estimated still larger than that by previous models because groundwater flux which is difficult to estimate but potentially has large flux is ignored in the previous and our models. If we consider groundwater flux based on the data available in the model, the hydrothermal flux increases by half. Rather, in this case, the resultant flux is consistent with the estimate of off-axis flux based on the chemical composition of the ridges.

We compare the obtained temporal Sr isotope values of silicate rocks in the region excluding the HTP (R_S), which might reflect development of glaciations with weathering fluxes and δ^{18}O variation. The resultant R_S unidirectionally increases during early Miocene. It could be reconciled with frequent glaciations and deglaciations in this interval. This explanation might be reinforced by the correlation between glacial Mi events and observed marine ^{87}Sr/^{86}Sr variation in shorter time scale. From Pliocene to present, we find the correspondence between the variation of R_S and glacial events. Also, in this interval, the HTP weathering flux increases, which suggests that the increase of marine ^{87}Sr/^{86}Sr is partly due to the accelerated weathering with high ^{87}Sr/^{86}Sr in glacial-interglacial cycle, and the remainder might be explained by the enhanced HTP weathering. However, there are no prominent fluctuations in R_S and weathering flux in the period of extensive glaciation and cooling event in middle Miocene. This might indicate that the cycle of the glaciations and deglaciations rather than glaciations themselves is significant for the variation of ^{87}Sr/^{86}Sr. Moreover, from this cooling event to late Miocene, R_S does not increase, although the ice cap continuously developed in this interval. This might be due to the relatively weak impact of glacial-interglacial conditions, climatic condition in the Antarctica, uncertainty of atmospheric CO_2 estimate, and development of permanent ice cap which does not largely affect the amount of weathering.

Isotopic analyses based on mineral separation of carbonate chimney induced by cold seepage at the Conical Seamount, Mariana Forearc

K. KATO[1], H. WADA[2] AND K. FUJIOKA[3]

[1] Graduate School of Science and Engineering, Shizuoka Univ., 836 Oya, Shizuoka 422-8529, Japan
(k_kato@se-geomail.sci.shizuoka.ac.jp)
[2] Faculty of Science, Shizuoka Univ., 836 Oya, Shizuoka 422-8529, Japan (sehwada@ipc.shizuoka.ac.jp)
[3] Research and Technology Department, Global Ocean Development Inc., 1-13-8 Kamiookanishi, Konan-ku, Yokohama 233-0002, Japan (fujioka@godi.co.jp)

The sample is a carbonate chimney collected from the Conical Seamount at Mariana Forearc, composed of fine-grained calcite, aragonite, and an amorphous grain. Isotopic analyses of individual carbonate minerals of the carbonate deposits are key for understanding their formation. Calcite and aragonite were distinguished by staining by Meigen's solution, and isotopic analyses were carried out in each mineral. Remarkably contrasting isotope value in calcite and aragonite was revealed.

The ^{14}C activity (Δ^{14}C) shows low in calcite (av. –976‰) and little active in aragonite (av. –831‰). These data suggest a different mixing ratio of the seawater and the venting fluid at each mineral precipitation. Aragonite was precipitated from the mixing of 60% of the seawater (Δ^{14}C = –240‰) and 40% of the venting fluid (Δ^{14}C = –1000‰) and calcite was 10% of the seawater and 90% of the venting fluid. This result indicates a different precipitation stage of calcite and aragonite in the chimney.

^{87}Sr/^{86}Sr ratio in each mineral shows another view of carbonate precipitation in comparison with the result of Δ^{14}C. ^{87}Sr/^{86}Sr ratio of aragonite was 0.70914 (av.) and calcite was 0.70674 (av.). The mixing ratio of the seawater (^{87}Sr/^{86}Sr = 0.7092) and the venting fluid (estimated at ^{87}Sr/^{86}Sr = 0.7052) calculated from ^{87}Sr/^{86}Sr ratio in calcite (about 10% of the seawater, about 90% of the venting fluid) agree with the result of ^{14}C activity. Whereas the mixing ratio for aragonite precipitation calculated from ^{87}Sr/^{86}Sr ratio shows about 94% for the seawater and about 6% for the venting fluid. The variation of calculated mixing ratio between Δ^{14}C and ^{87}Sr/^{86}Sr ratio at calcite precipitation is interpreted as a result of selective interpolation of seawater Sr during aragonite precipitation because strontium concentration of aragonite is about one order higher than that of calcite.

The staining method is highly potential for isotopic analysis of carbonate deposits precipitated at the cold seepage area, and isotopic analysis for separated mineral from the mixture give us adequate data for understanding of each mineral formation processes.