Tin isotope analysis for an archaeological application

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Sn isotopes was proposed to verify recycling of bronze products[1]. In order to evaluate recycling by Sn isotopes, we need an assumption that raw materials of tin ore (cassiterite) have uniform Sn isotopic composition independent of regional differences. Recently, Haustein *et al.*[2] reported a series of Sn isotopic data for cassiterite samples and observed the largest significant variation of the isotopic composition (about 0.6 ‰ per mass). In this study, we investigated the variation of Sn isotopic compositions for cassiterite samples mainly in Japan. Prior to this challenge, we developed a new method to decompose cassiterite samples[3] and analyze their Sn isotopic compositions.

We analyzed 7 cassiterite samples from Japanese deposits and one cassiterite from Peru. And we found a linear correlation that follow a mass dependent fractionation in the cassiterite samples. Sn isotopic variation in Japanese cassiterites was limited to be within ±0.16‰ per mass. Such an isotopic fractionation presumably reflect differences in mineralization environment of cassiterite, such as precipitation processes and redox reactions. However, the classification of deposit types and Sn isotopic ratio seem to have no correlation. Therefore, more information is required to explain the observed Sn isotopic fractionation in cassiterite. On the other hand, in our preliminary experiments, bronze artifact from China shows fractionation of ±0.7‰ per mass [3], which exceeds the range of mass fractionation observed in the cassiterite samples. Therefore, Sn isotopes might be useful in detecting recycling. We are also planning to analyze these bronze artifacts again and to verify isotopic fractionation.

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Paleoenvironmental reconstructions of the Yangtze Sea, South China, through the Ordivician and Silurian transition

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The Yangtze Sea covering the Yangtze Craton in the South China received deposits mainly of black shale, with some shell limestone interlayers during the Late Ordovician and Earily Silurian periods [1]. Sedimentary facies and isopach data indicate that several highlands, either emerging or submerging, developed in the Yangtze Sea. Both Chemical Index of Alteration (CIA) and Chemical Index of Weathering (CIW) changes indicated a moderate chemistry weathering in the Late Ordovician under cold and dry climate, and suggested a peri-glacial period [2]. Before and after the peri-glacial period, climate of the Yangtze Sea was characterized by warm and humid condition [3, 4].

A series of geochemical data implied that deep water mass above the submerging highland differed from shallow water mass in redox. The deep water mass, represented by samples from the Wangjiawan section located in Yichang, was characterized by reduction with DOP > 0.45 and FeHR/FeT > 0.38 in most time of the Late Ordovician to Early Silurian, excepting in the peri-glacial period that showed an oxidation with DOP <0.45 and FeHR/FeT < 0.38. On the other hand, the shallow water mass, represented by samples from the Sanjiaguan section located in Yichang, was characterized by oxidation with DOP <0.45 and FeHR/FeT < 0.38, quite similar to that of the deep water in the peri-glacial period.

The $\delta^{13}C$ of sedimentary organic carbon data showed positive excursion in the peri-glaical period in both deep and shallow water sections [5]. It might reflect the “high-low-high” changes in organic productivity. It is the high organic productivity and reduction of the deep water that have promoted deposition of hydrocarbon source rocks in the Yangtze Sea, South China.

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