

Lead, carbon and nitrogen isotope geochemistry of apatite-bearing metasediments from ~3.8 Ga Isua supracrustal belt, West Greenland

YUJI SANO¹, MANABU NISHIZAWA¹,
NAOTO TAKAHATA¹, KENTARO TERADA²,
TSUYOSHI KOMIYA³ AND YUICHIRO UENO⁴

¹Ocean Research Institute, The University of Tokyo, Tokyo, Japan (ysano@ori.u-tokyo.ac.jp)

²Department of Earth and Planetary Sciences, Hiroshima University, Higashi-Hiroshima, Japan

³Department of Earth and Planetary Sciences, Tokyo Institute of Technology, Tokyo, Japan

⁴Department of Earth Science and Astronomy, The University of Tokyo, Tokyo, Japan.

We performed U-Pb geochronology and REE geochemistry of apatite in metasediments from >3.7 Ga Isua supracrustal belt (ISB), West Greenland, together with stepwise combustion isotopic investigation of carbon and nitrogen for the apatite-bearing quartz-magnetite BIF of uncontested sedimentary origin from northeastern ISB. Ion microprobe analyses reveal that apatites in psammitic schist from ISB show an isochron of 1.5 ± 0.3 Ga, suggesting the latest (~1.5 Ga) metamorphic event (>400°C), while apatites in the quartz-magnetite BIF are U-poor, and have various Pb isotopic ratios, which are scattered between two age components (~1.5 Ga and ~3.8 Ga). Chondrite-normalized REE pattern of the apatite in the BIF shows a flat pattern with significant positive Eu anomaly. Carbon isotopic analyses for the quartz-magnetite BIF by stepwise combustion suggest that two components of reduced carbon are present in the BIF. One is released below 1000°C (mainly 200 ~ 400°C; LTC), and the other above 1000°C (HTC). The $\delta^{13}\text{C}$ values of the LTC are about -24‰. The LTC is clearly contaminant incorporated after metamorphism, because such low temperature component should not have survived the >400°C metamorphic event. On the other hand, the $\delta^{13}\text{C}$ values of the HTC are -30‰ for one aliquot and -19‰ for another. The HTC is possibly within magnetite in the quartz-magnetite BIF, because decrepitation temperature of magnetite is ~1200°C. Since the magnetite is concordant with bedding surface, it is likely that the HTC is incorporated in the BIF during diagenesis. Thus, the HTC is the most important candidate for the primary reduced carbon preserved in the BIF. Note that the very low $\delta^{13}\text{C}$ value (-30‰), negative $\delta^{15}\text{N}$ value (-3‰), and low C/N atomic ratio (86) for >1000°C fraction of one aliquot are comparable to those of kerogen in Archean metasediments. In addition, such significant ^{13}C -depletion can not be explained by siderite decomposition, which may have produced graphite during metasomatism. Thus, this study shows that further analysis on magnetite from Isua BIF is one of the key subject to test for the presence of early life

Temporal variation of atmospheric trace components over the northwestern North Pacific during a Kosa event

M. SASAKAWA¹, A. OOKI², T. UI¹ AND M. UEMATSU^{1,3}

¹Ocean Research Institute, The University of Tokyo, Tokyo, Japan (mochoki@ori.u-tokyo.ac.jp)

²Graduate School of Environmental Earth Science, Hokkaido University

³Japan Science and Technology Corporation, Saitama, Japan

Introduction

It is known that nitric acid gas is absorbed into sea salt particles in the marine boundary layer (MBL). This suggests that reactive gases are removed easily to the sea surface by sea salt particles. Recently, several researchers have studied the reaction processes that occur between mineral particles and acidic gases (e.g., HNO_3 and SO_2). In the MBL, mineral particles may also play an important role in the removal mechanisms of atmospheric trace components just like sea salt particles. As such, there will be a corresponding change in aerosol chemistry with an increase of mineral particles. It is then necessary to clarify the behaviors of atmospheric trace components during Kosa events for better understanding of the geochemical cycle between the atmosphere and the ocean.

Results and discussion

Kosa events are observed frequently during spring over the North Pacific. We conducted two research cruises (KT01-1: 1-7 March, KT01-2: 10-16 March) last March 2001 over the vicinity of the Japanese main islands in the northwestern North Pacific, where we caught a large Kosa event on 6 March. Aerosol samples were collected for a 4-hour duration during this dense Kosa event to investigate high temporal variations of trace components. The concentrations of mineral-originated components (nss- Ca^{2+} , Al, Fe, nss-Ca) in the coarse mode (diameter > 2.5 μm) increased sharply during the Kosa event. The concentrations of total- NO_3^- (= particulate- NO_3^- + gaseous- NO_3^-) and particulate- NO_3^- also increased simultaneously. On the contrary, the ratio of gaseous- NO_3^- /total- NO_3^- decreased to less than 0.4, when it was >0.5 under normal conditions. The concentration of sea salt (Na^+ concentration) increased due to the strong wind speeds during the Kosa event. Considering high sea salt concentration, this decrease of the ratio is explained by the scavenging of gaseous- NO_3^- to mineral and sea salt particles. It is concluded that mineral and sea salt particles enhanced the deposition of NO_3^- to the sea surface during Kosa events.