

Sediment fabrics, clay mineralogy, and element composition of mountainous lake sediment since the last interglacial period, Japan

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1. Introduction

We studied clay mineralogy, element composition and sediment fabrics using relict freshwater lacustrine sediment known as Takano Formation, which is located in southern Nagano City, central Japan. This sediment is mainly consisted of homogenous clayey silt with many tephra beds. This sediment covers 158 ka to 30 ka on the basis of four reliable wide-spread marker tephra such as Aso-2 (146 ka), Aso-3 (133 ka), Aso-4(99 ka) and BW1466 (38.5 ka). Here, we discuss interaction between East Asian summer monsoon strength and bottom-water redox status of ancient Takano Lake.

2. Materials and methods

The 53.88 m long core was drilled at Takano Formation. The samples were sliced at 1-cm interval, dried and then stored. Slab samples were collected using plastic cases and sealed for soft-X ray analysis.

For clay mineralogy and element composition, sliced samples were ground into powder. Clay minerals was identified using X-ray powder diffraction (XRD) method and element composition was analyzed by non-destructive X-ray fluorescence (XRF) core-imaging scanner, TATSCAN-F2 of Japan Agency for Marine-Earth Science and Technology.

For sediment fabrics, X-ray radiographs of slab samples were taken using a SOFTEX M-60 apparatus of Shinshu University and were scanned for image analysis.

3. Results and discussion

X-ray diffraction profiles suggest that quartz, cristobalite, siderite, anorthite, montmorillonite, muscovite, hornblende and chlorite are major components. In this study, we focused on manganese, iron and siderite profiles since the last interglacial period. Mn and Fe contents are in the range of 0-0.7 wt% and 8-20 wt%, respectively.

The Mn profile is similar to Fe profile in pattern, however, siderite content shows more similar fluctuation of Mn than that of Fe. This would be explained by the fact that Fe is present in many clay minerals as well as in siderite, whereas Mn is included in only siderite.

Sediment fabrics were classified into three classes based on the degree of preservation of lamination; well laminated, faintly laminated and no laminated. These sediment fabrics are closely linked to bioturbation intensity on the lake bottom. The sediment fabric can be used as a proxy for bottom-water conditions namely the dissolved oxygen concentrations. The laminations have a tendency to be well preserved in siderite-rich intervals. In general, siderite forms in anoxic environment.

According to pollen abundance of *Sciadopytis* and *Cryptomeria* which are adapted to wet conditions, East Asian summer monsoon was significantly strengthened from ca. 127 ka to 109 ka, ca. 99 ka to 90 ka, and ca. 88 ka to 69 ka. Precipitation amount in East Asia is mainly controlled by the summer monsoon. During these precipitation increased periods, biogenic opal and total organic carbon contents are also increased simultaneously. These similarity means that one of the controlling factors of primary production is precipitation.

Based on the above results, we can propose a depositional process of siderite in the ancient Takano lakes as follows; when precipitation increase, the nutrient supply is also increase as river inflow increases from the drainage area. Primary production in lake becomes high and subsequently the organic matter is decomposed by heterotrophic bacteria during settle down. Such bacteria produces carbonate ions during the decomposition process of organic matter. As a result, bottom-water becomes anoxic condition and Mn and Fe start to leach into the lake bottom. Siderite is formed by the combine chemically with Mn, Fe ions and carbonate ions.