Glacial fjord environment and ecosystem reconstructed from sediments deposited in Bowdoin Fjord, northwestern Greenland.

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Marine-terminating glaciers widely distributed along the Greenlandic coast are particularly important for glacial fjord ecosystem. Meltwater discharge from a glacier generates freshwater plumes near the ice front, which enhance primary production by transporting nutrient-rich deep water to the fjord surface. Meltwater discharge is important also because it distributes glacial sediments into fjords near the glacier termini. Reconstruction of past depositional environments near glacier front is necessary for accurate future prediction of change in glacial ecosystem. In July-August 2018 and 2019, we collected sediments at Bowdoin Fjord in front of Bowdoin Glacier, a marine terminating outlet glacier in northwestern Greenland. In this presentation, we show results of analyses of minerals and organic matters, and discuss sedimentary process in Bowdoin Fjord. This research was partly funded by MEXT (Japanese Ministry of Education, Culture, Sports, Science and Technology) through Arctic Challenge for Sustainability (ArCS) the Arctic region research project.

Surface sediments and sediment cores were collected from the sea floor at the depth from 175 to 570 m, using Ekman-Birge grab and gravity corers, respectively. Suspended matters are collected near the glacier front. Distance from the sampling sites to the glacier was 0.6-18 km. 2-4 cm scale alternations of brown and gray sediments are observed from the upper unit of the sediment cores (BFE and BFW) collected nearby the glacier front (~ 1km). However, there is no alternation in the sediment core (BFS) located at 10 kilometers away from glacier front. The brown sedimentswere derived from Proterozoic weathered sandstones and transported by meltwater from Qaanaaq Ice Cap. In contrast, the gray sediments with sand fragments are originated from Archean metamorphic rocks and transported by subglacial discharge and glacial streams from Bowdoin and Tugto Glaciers. Sand (>63 μm) contents of the surface sediments are higher (32%) near the glacier (BF9, ~600 m). Mineral and elemental composition data by XRD and SEM-EDS show that the abundances of albite (Na-rich feldspar) and Fe/Mg-rich sand fragments are higher in the sediments deposited nearby the glacial front. In addition, amphibole contents are higher in the surface sediments deposited near the lateral moraine of Bowdoin Glacier. These characteristics of the sediment cores are useful for revealing changes in depositional process in Bowdoin Fjord. In the sediment cores collected from the eastern side of fjord (BFE), sand contents significantly increase at 40 cm below the sediment surface. This change is possibly due to rapid retreat of Bowdoin Glacier since 2008.

From biomarker analysis, concentrations of diatom biomarkers such as highly branched isoprenoids including IP_{25} are higher than those of dinosteroid and long-chain alkenones originated from other producers. Moreover, BF9 sample is characterized by higher concentration of IP_{25} and no detection of long-chain n-alkanes originated from higher plant wax, which shows terrigenous organic matter deposition are lower nearby the glacier front. This result suggests that organic matter deposited in the fjord are mainly originated from diatom. On the other hand, the relative abundance of dinosteroid (dinoflagellate biomarker) is higher in the sediments from lower unit of BFE. This data suggests that the higher dinoflagellate production was maintained before 2008 when the glacier front was closer (< 300m) to the sampling site. Ciliate cysts are observed as main marine palynomorphs from the surface sediments. Ciliate production is possibly activated by organic-matter-rich deep water transported into the fjord by freshwater plumes. Dinoflagellate cysts are more abundant in the sediments from lower unit of BFE, which is consistent with biomarker data. We conclude that these peculiar organic matters and mineral compositions are useful for developing the proxies of environment and ecosystem in glacial fjords..