Environmental reconstruction in the Bering Strait region using Sr and Nd isotopes in the continental shelf sediments

Yoshihiro Asahara[1]; Fumi Takeuchi[1]; Kana Nagashima[2]; Naomi Harada[3]; Kazumasa Oguri[4]; Osamu Tadai[5]; Koshi Yamamoto[6]

[1] Earth Planet. Sci., Nagoya Univ.; [2] JAMSTEC; [3] JAMSTEC, IORGC; [4] IFREE, JAMSTEC; [5] MWJ; [6] Earth and Planetary Sci., Nagoya Univ

Arctic environmental changes both in the sea and on land have been recently observed, such as a decrease of the sea ice, the change of ecosystem in the Bering Sea, and unusual melting of permafrost layers and continental glaciers in Alaska, northern Canada, and Siberia, and the relationship of global warming to the changes has been keenly discussed. To discover factors controlling the Arctic environmental changes, it is important to reveal the present and the past environment over the past few decades to few hundred years. This study focuses on environmental changes of the Bering and Chukchi Seas and the surrounding continents. Strontium and Nd isotope analyses of the detrital fractions in the sediments are applied to grasp changes of terrigenous supply to the Bering and Chukchi Seas.

Sediment samples were collected from the continental shelf of the Bering and Chukchi Seas during the research cruise MR06-04 Leg.2 by R/V Mirai. Multiple cores (MC) from 7 sites in the Chukchi Sea and 14 sites in the eastern Bearing Sea were used in this study. Sedimentation rate by ^{210}Pb and ^{137}Cs counting is 0.13-0.24 cm/yr. In this study, Sr and Nd isotopes in the uppermost layers (0-1cmbsf) of the 21 points were analyzed to clarify the present distribution of terrigenous detritus. In addition, 4 to 7 points along core depth for 6 MC samples in the eastern Bering Sea were analyzed to examine depth profile, namely, temporal changes. The sequential extraction method was performed to remove carbonate, Fe-Mn precipitate, the biogenic silica, and the organics from the sediment, and the residue was defined as silicate detritus. Strontium and Nd isotope analyses for all the detrital fractions, and quantitative analyses of Rb, Sr, and REEs for a part of them were performed.

Regional distributions of the Sr and Nd isotopes of the surface sediments show higher Sr isotope ratios and lower Nd isotope ratios in the Chukchi Sea (^{87}Sr/^{86}Sr = 0.7106 to 0.7150; epsilon Nd = -10.1 to -8.3), and lower Sr isotope ratios and higher Nd isotope ratios in the eastern Bering Sea (0.7045 to 0.7091; -7.5 to +0.9). In addition, Rb and Sr contents and REE patterns (La/Lu, Eu/Eu$*$etc.) change noticeably across the Bering Strait. These mean that the sediments in the Bering and Chukchi Seas have clearly distinct sources. The terrigenous detritus in the Chukchi Sea are mainly derived from the Mackenzie River basin including the Canadian Shield (^{87}Sr/^{86}Sr = 0.719; epsilon Nd = -14). Meanwhile, the detritus in the eastern Bering Sea mainly consists of two components: one is the continental material from the Yukon River basin mainly underlain by Mesozoic rocks in Alaska (0.708; -7: estimated values), and the other is the Aleutian-arc volcanics (0.703; +6 to +9: e.g. McCulloch and Perfit, 1981; Westgate et al., 2007) transported by the Alaska Current.

The eastern Bering sediments over the past 100 years show slight variations of the Sr isotope ratio and relatively wide variation of the Nd isotope ratio. The variation and trend of the time-series sediments in the Sr-Nd isotope diagram are fairly similar to those of the grain-size fractions from one of the sediment, and thus are possibly controlled by change of grain size of the detritus from the Yukon River basin. In addition, some of the Nd isotope time-series show periodic fluctuations correlating with annual mean SAT (surface air temperature) for the Arctic (e.g. Polyakov et al., 2003): epsilon Nd value is low in the high SAT period, and high in the low SAT period. When northern parts of the Eurasian and North American continents was relatively cold, continental glaciers possibly increased the supply of the larger grain-size material with higher epsilon Nd value. More detailed analyses with high time resolution will be performed to characterize effects which the SAT and/or global warming have on the Arctic continental environment.