Provenance analysis of aluminosilicate detritus in marine environment by Sr-Nd isotopes: terrigenous input from the Amur River to the Sea of Okhotsk and the western subarctic Pacific

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Provenance analysis of terrigenous material in marine sediment and suspended matter provides information about a paleo- and modern environment such as atmospheric and ocean circulations and climate change on continent. It also figures out a relationship between terrigenous input and biological productivity in ocean. Radiogenic isotopes such as strontium ($^{87}Sr/^{86}Sr$) and neodymium ($^{143}Nd/^{144}Nd$) in detrital (aluminosilicate) fraction of marine sediments and suspended particles are valuable indicators for identifying the geographical provenance of the terrigenous material (e.g. Dasch, 1969; Grousset et al., 1988; Asahara et al., 1999; Asahara et al., 2012). Because the isotope ratios in detritus, especially Nd isotope, are not significantly altered by the process of weathering, transportation and deposition.

Primary productivity is high in the Sea of Okhotsk (OS), most likely because of terrigenous input from the Amur River that includes dissolved matter and suspended matter. And the western subarctic Pacific (WSP) is one of High Nutrient Low Chlorophyll (HNLC) regions, and the most important source of iron in the WSP has been thought to be terrigenous matter from the Amur River together with the Asian dust (e.g. Nishioka et al., 2007). To reveal the transport and deposition processes of the fluvial materials in the OS, the Sr and Nd isotopes of the detritus in the surface sediments and suspended matter were investigated.

The regional variations of the isotopes indicate that the detritus has three main sources: Amur River detritus, with a high $^{87}Sr/^{86}Sr$ ratio (0.711–0.715) and relatively low ε_{Nd} value (−8 to −7); volcanic detritus derived from the Okhotsk-Chukotka volcanic belt to the north of the OS, with a low $^{87}Sr/^{86}Sr$ ratio (0.703) and high ε_{Nd} value (+7 to +8); and detritus from the sedimentary rocks north of Sakhalin Island, with a high $^{87}Sr/^{86}Sr$ ratio (0.709–0.710) and low ε_{Nd} value (−10 to −9). The results indicate that the Amur River detritus is dispersed across the northwestern continental shelf and further transported southward along the east coast of Sakhalin while flowing out of the shelf. The Amur River detritus flowing out of the shelf is mixed with the Okhotsk-Chukotoka volcanic material transported from the northern area of the OS by the Okhotsk Sea intermediate water (OSIW). The transport processes of the Amur River detritus in this area are supported by previous studies of turbidity that indicated that the dense shelf water (DSW) entrains resuspended sedimentary particles on the northwestern continental shelf and transports them to the OSIW. It is possible that the OSIW entrains the Amur River material, which then circulates in the OS and partly flows out to the WSP.

[Reference]

Yasuda, T., Asahara, Y., Ichikawa, R., Nakatsuka, T., Minami, H., Nagao, S. (2014) Distribution and transport processes of lithogenic material fromthe Amur River revealed by the Sr and Nd isotope ratios of sediments from the Sea of Okhotsk. Progress in Oceanography 126, 155-167.

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