Reconstruction of Asian dust source variability since 10 Ma based on grain size specific mineral composition at IODP Site U1425 in the Japan Sea

*李 梅花[1]、入野 智久[2]
*Mui Fa Alison Lee[1], Tomohisa Irino[2]

1. 北海道大学 大学院環境科学院、2. 北海道大学 地球環境科学研究院
1. Graduate School of Environmental Science, Hokkaido University, 2. Faculty of Environmental Earth Science, Hokkaido University

The Japan Sea is located in the downwind of the Asian dust source areas such as the Taklimakan and Gobi Deserts. Strong westerlies and the northwestern winter monsoon wind carry a significant amount of mineral dust materials from the sources to the Sea. Sediments recovered at IODP Site U1425 in the central Japan Sea (39°29.44′N, 134°26.55′E) could record aeolian dust deposition history from Miocene to the present. Mineral composition is related to parent rock composition and regional climate (Eve Arnold 1995). Therefore, the variations of mineral and chemical compositions of the sediments could enable us to reconstruct the changes in sediment source areas and the climatic history there since 10 million years ago (Ma). In this research, 180 samples obtained from IODP site U1425 Hole D (354m depth) were measured for mineral composition using X-ray diffraction analysis.

In principle, bulk mineralogy could highly depend on the grain size controlled by transport and deposition processes. The coarse fraction of terrigenous material is relatively concentrated in primary minerals such as quartz and plagioclase, whereas the clay minerals dominate the fine fraction (Eve Arnold 1995). According to the dust fall collected at Hokkaido, Japan in 2002 and 2010, the median size of aeolian dust is approximately 8 um. Aeolian dust researches at ODP Sites 797 in the Japan Sea and the Lake Suigetsu in the Japanese Islands also revealed that silt size sediments were mainly derived from Asian dust and finer sediments of clay are derived from riverine input from the Japanese island arc (Irino and Tada 2000, Nagashima et al. 2015). Therefore, in this research, we tried to control this to examine the mineral and chemical compositions of U1425 sediments in separate size classes such as silt (>4 μm) and clay (<4 μm) fractions separated by repeated pipette method. The mineral compositions in silt and clay fractions were determined to reconstruct the aeolian dust provenance changes over the last 10 million years. Major minerals and clay minerals were identified according to the position of basal reflections in the XRD diagram. Relative abundance of each detrital mineral was also evaluated by the peak height of the identical diffraction.

The mineral assemblages indicate that the provenance of silt and clay may be from different source areas. The mineral composition of Chinese Loess is generally characterized by higher quartz and plagioclase. Illite is the dominant clay mineral in the Chinese Loess (Donghuai Sun 2011). This suggests that higher ratio of quartz, plagioclase and illite indicate the Chinese Loess as a possible detrital origin. The temporal variability of mineral abundances shows that the highest intensities of quartz, plagioclase and illite are found for silt size fraction during Pleistocene, suggesting that the silt fraction in U1425 sediments

contained a lot of dust derived materials during this period. On the other hand, the feldspar composition in clay fractions show more orthoclase and less plagioclase than in silt fraction. Silt fraction contains more anorthite than clay fraction. Anorthite/Albite (An/Ab; 27.8/28°) in clay fraction ranges from 0.4 to 0.6, while that in silt fraction showed a wider range from 0.2 to 1. Meanwhile, the feldspar in silt fraction showed 3 characteristic compositions depending on ages. Miocene was characterized by the highest ratio of An/Ab, while the ratio during Pleistocene was lower. An/Ab during Pliocene stayed in between the values in Miocene and Pleistocene. It indicated a progressive changes of dust source areas or climatic (erosional) environments.

Temporal variations of some representative minerals show two abrupt change of the abundances at 7.7-7.9 Ma and 2.6-2.8 Ma, which suggests sudden changes of source areas or climate in the source region. The illite/Quartz (Qtz), chlorite/Qtz and Kaolinite/Qtz in silt and clay fractions show different results from bottom to top of the core. It is possible that the sources of these minerals were different between silt and clay. The difference was marked at 7.7 Ma where the two fractions show changing gradually. Then, the greatest difference between both fractions was found after 2.8Ma. The result suggests that silt and clay fractions have their own sources.

キーワード：IODP Exp. 346 Site U1425、mineral composition、dust provenance、clay minerals、quartz、feldspars
Keywords: IODP Exp. 346 Site U1425, mineral composition, dust provenance, clay minerals, quartz, feldspars