Detrital heavy mineral record and Nd-Sr isotopic signature in Bengal Fan

*Kohki Yoshida[1], Cruz Jarrett[2], Manoj M.C.[3], Nozomi Hatano[5], Christian France-Lanord[4], Takeshi Kuritani[6]

1. Department of Geology, Faculty of Science, Shinshu University, 2. Florida State University, 3. Birbal Sahni Institute of Palaeosciences, 4. CNRS- Universite de Lorraine, 5. Graduate School of Science and Technology, Shinshu University, 6. Hokkaido University

The Bengal fan was formed by detritus shed by the Ganges and Brahmaputra rivers, reflecting India-Asia plate collision. The “IODP Expedition 354: Bengal Fan” recovered sediments recording the tectonic and climatic history related to the Himalayan orogeny (Fance-Lanord et al., 2016). We examined the heavy mineral assemblage, chemical composition of specific minerals and Nd-Sr isotope in the sediments deposited from the Miocene to present in the deepest hole (U1451A and B) in this expedition to clarify the detailed denudation history of the Himalayas. In addition, the heavy minerals in modern river sediments, taken from the Ganges and the Brahmaputra River in eastern India, are examined to compare with the Bengal Fan sediments.

The basal horizon of the Bengal Fan sediments, which consists of the latest Oligocene to earliest Miocene, was supplied by high-grade metamorphic terrene, correlatable to the High Himalaya Crystalline (HHC). Also, mafic metamorphic detritus, such as blue-green amphibole, were supplied suddenly from 14-13 Ma. Rare chromian spinels and Na-amphiboles were found in several horizons. These mafic detritus were actively provided after 7 Ma. These detritus were probably provided from the Yarlung-Tsangpo Suture Zone (YTSZ). After 6 Ma, olivine-pyroxene rich horizons are frequently intercalated in the Quaternary series. Tentative dominance of specific metamorphic minerals suggests episodic sediment production around HHC and YTSZ. The predominance of mafic minerals after 6 Ma indicates the contribution of the Brahmaputra River was increased. It is reported that the bed load sediments in the upper stream of the Brahmaputra River are characterized by the predominance of olivine, pyroxene, and ilmenite with a minor amount of spinels (Garzanti et al., 2004).

The depth profile of Sr-Nd isotopic signatures in the Bengal Fan sediments shows significant temporal variations. The range in 87Sr/86Sr and εNd indicate the dominance of Himalayan source. These signatures are bracketed by sediments from the Ganges, Brahmaputra River sands overlap with a data of the Lower Meghna (Pierson-Wickmann et al., 2001) indicating that the sediments in Bengal Fan are mixed products supplied from these two big rivers. Also, the Sr-Nd isotope depth profiles show a change in isotopic compositions around the lower part of the Middle Miocene.

These mineralogical and isotopic signatures indicate a relatively reduced supply of sediments from Brahmaputra river during the early Miocene time. The Sr-Nd isotopic signatures, the occurrence of mafic minerals and rare chromite grains also show significant variations indicating changes in the relative proportion of sediments originated from two big rivers. Especially in Pliocene and Quaternary sequences, the heavy mineral assemblage and Sr-Nd isotope signatures display a rapid and frequent change in the relative portion of sediments from both revivers. This is possibly related to the historical change of Brahmaputra river discharge refracting river capturing in eastern Himalayan syntaxis.

References

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