The comparison of heavy mineral assemblage and chemical composition of detrital garnets between Bengal Fan and Himalayan foreland basin sediments

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The submarine Bengal Fan is the largest submarine fan system on Earth. The changes in the mineral assemblages of fan sediments record the uplift history of the Himalayan orogenic system.
IODP Expedition 354 drilled seven sites in an E–W transect along the 8˚N latitude in the Bengal Fan (France-Lanord et al., 2015). The deepest site U1451 A and B recovered a complete sequence of fan deposits. The sediments drilled at this site consisted of mica and quartz-rich sand, silt, and clay, with the exception of the lower Oligocene-Eocene section. In this study, we examined the chemistry of detrital garnets in the sediments in Bengal Fan and Siwalik Group in Nepal in order to compare both provenance characteristics. The garnet compositions plotted are shown on the Py-Sp+Alm-Gro-And triangular diagram with discriminant fields by Mange and Morton (2007). The data of mineral assemblage in the Siwalik Group is after Yoshida et al. (2016).
It is already reported that the heavy mineral assemblage of the Late Oligocene silt-sands mainly consists of tourmaline and rutile assemblage with rare garnet and amphibole by Yoshida et al. (2016). At the early part of the Middle Miocene sequence, amphibole and garnets increase rapidly, and there are frequent occurrences of aluminosilicate and staurolite. In the Middle Miocene sediments, the assemblage of heavy minerals becomes diverse, and metamorphic minerals, such as staurolite, chloritoid, aluminosilicate, amphibole, and garnet, are normally included in the sediments. The detrital garnets show the derivation from crystalline schist and amphibolite facies metamorphic rocks in the Early Miocene period and granulite facies metamorphic rocks in the Middle Miocene period.
In the lower Siwalik Group, foreland basin deposits, the mineral assemblage is characterized by the predominance of zircon and tourmaline. The heavy mineral assemblage was changed in the middle part of the lower Siwalik Group. The sediments include a large amount of blue-green amphibole and aluminosilicates (kyanite and sillimanite) with staurolite and chloritoid. In the end of Early Miocene, the detrital garnets were shed mainly from amphibolite facies metamorphic rocks. The detrital garnets were derived from granulate and amphibolite facies metamorphic rocks in the Middle Miocene time. These changes seem to have been occurred around 13-10 Ma in western Nepal and 9-7 Ma in central Nepal (Yoshida et al., 2016).
These measurements of heavy minerals demonstrate wide exposure and sediment production from a metamorphic terrane in the Himalayas during the Middle Miocene period, though these high-grade metamorphic minerals are occasionally included in Early Miocene sands. Also the above mentioned metamorphic mineral grains of Early Miocene and Late Oligocene sands may record exposure history of a metamorphic terrane, consists of amphibolite facies, prior to the period of high sediment production during the Middle Miocene. The chemistry of detrital garnet, records the gradual change of source terranes, from low-grade metamorphic facies and amphibolite facies to high-grade metamorphic facies. This change is similar to the provenance transition recorded in foreland basin deposits.

References

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