

Sandstone petrography and areal comparison of the Lower Siwalik Group(Miocene), west-central Nepal

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Metamorphism and exhumation of high-grade metamorphic rocks that consists of the Higher Himalaya took place during Miocene time (Sakai, 2005). The Himalayan orogen is a result of ongoing collision between Indian and Asian continents. A number of studies carried out about this example of continental collision progressed from Paleogene to present time (Honda and Sakai, 1988; Najman, 2006). Metamorphism and uplift process is related to formation of the Himalayan orogeny. In this study, sandstone petrography is studied in the Lower Siwalik Group in four areas; Karnali River, Dang Valley, Surai Khola and Tinau Khola in west-central Nepal. The comparison with each petrographical result reveals the timing of exhumation of the high-grade metamorphic rocks in central Himalaya.

Siwalik Group is interpreted as a foreland basin deposit of Himalayan orogen from Miocene to Pliocene time, especially the deposition of the Lower Siwalik Group is contemporaneous to the exhumation of Higher Himalaya. Thus this study aims to clarify the historical change of the hinterland constitution using modal composition of sandstones, heavy mineral assemblage and chemistry of detrital garnet grains by EDS. Paleomagnetic stratigraphy is used to determine the depositional age in each area (Gautam and Fujiwara, 2000; Rosler et al., 1997; Gautam et al., 2012). Result of modal analysis of sandstone in each area shows the recycled orogenic provenance, which indicates the Himalayan origin. Furthermore most quartz grains are classified into middle and upper rank metamorphic field in triangular diagram proposed by Basu et al. (1975), which is suggestive of middle and upper rank metamorphic rock source. Some sandstones, which were deposited in 13-8Ma, contain high-temperature minerals, such as kyanite, sillimanite, and staurolite. These minerals imply the exhumation of high-grade metamorphic rocks in hinterland, though definite timing of unroofing in these crystalline rocks is obscure due to scarcity of the minerals. Then the chemical composition of detrital garnet grains, which are included in all of sandstone samples, is used to chase the transition of hinterland. As a result, the chemical composition of detrital garnet grains had been changed in the Lower Siwalik deposited during 13~8Ma. Because this duration is likely to be close to an appearance of kyanite and staurolite, the compositional change of detrital garnets suggests the exhumation of Higher Himalaya in Late Miocene time. Timing of exhumation in each area are estimated as follows; 13.2~12Ma in Karnali River area, 13~10.9Ma in Dang Valley area and 10.9~9.5Ma in Srail Khola area. It is suggested that the unroofing in western area is probably prior to that in eastern area. This tendency indicates the unroofing of Higher Himalaya propagated from the west to the east. Previous works in Pakistan and north-western India showed that the unroofing of high-grade metamorphic rock progressed from the west toward the east in north-western margin of Indian sub-continent (Najman et al., 2003a,b; White et al., 2002).

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