

## Late Quaternary Environmental Changes in the Himalayan Front, Deduced from Geomorphology, Soil and Pollen Analysis

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We surveyed a sub-Himalayan intermontane basin, the Hetauda Dun, which is located in Central Nepal. The present environment of the basin is humid subtropic covered with Shore Forest. Annual precipitation in Hetauda is over 2000 mm/yr that is almost twice in Kathmandu Valley. This very humid climate is caused its geographic location. The Hetauda Dun lies just the foot of the Mahabharat Range that is also known as the Lesser Himalaya. The mountain range is the most effective barrier to the summer monsoon from the Indian Ocean. Its orographic rainfall in summer makes the Hetauda Dun humid.

The basin fills are composed of terraced alluvium. Age of terraces, Nayabasti 1 and 2 (33 - 18 ka), Pashupatinagar 1 and 2 terraces (11 - 4.5 ka), have been determined by radiocarbon dating. Therefore, these deposits are expected to record palaeoenvironmental changes from the Last Glacial Stage to the present. They may provide keys to clarify the relation between the monsoon fluctuation and the orographic effect of the Himalayas.

The Nayabasti-1 terrace is covered with reddish brown soil. Top soil on the Nayabasti-2 terrace is slightly oxidised and its colour is yellowish brown. The Pashupatinagar terraces and younger alluviums are covered with gray or brown soils. Red-yellow soils are generally considered to be products of long-term weathering under tropic or subtropic environment. The gap of soil development between the Nayabasti-1 terrace and younger alluviums suggests that the former experienced a prior subtropic environment in the Stage 3. By contrast, immature soils on the younger alluviums indicate that the Himalayan front was not subtropic environment in the Last Glacial Maximum (Stage 2).

Pollen fossil samples from the lower part of the Pashupatinagar-1 terrace deposits, which were formed from the LGM, are dominated by Pinus, Picea and Gramineae. The result shows that the palaeoclimate in the Hetauda Dun was dry and cold. The temperature was about 7-8 degrees colder than the present. In the LGM, the Mahabharat Range already existed as high as in the present. Therefore, the summer monsoon in the LGM was not strong enough to produce the orographic rainfall. From the upper part of the Pashupatinagar-1 terrace deposit, Ferns are detected intermittently. This may show that the basin was getting humid in the late glacial time. We find flood sediments, which include a stack of Shorea, from the Pashupatinagar-2 terrace deposits. In this stage, the physical environment of the Hetauda Dun was similar to that of the present. Precise ages from the upper Nayabasti Stage to the Pashupati Stage are now dating, and we will report them in our presentation.