Pleistocene monsoonal environmental changes reconstructed by fossil diatom analyses of the Paleo-Kathmandu Lake sediments

Tatsuya Hayashi[1]; Harutaka Sakai[2]; Yoshihiro Tanimura[3]; Masao Uchida[4]

[1] Earth Sci.,Kyushu Univ; [2] Earth Sci., Kyushu Univ; [3] Geology, Natn. Sci. Mus.; [4] JAMSTEC

During the last two decades, history of the Indian monsoon has been reconstructed mainly based on the investigation of deep-sea sediments in the Arabian Sea and the Bay of Bengal. On the other hand, its continuous terrestrial records during the Pleistocene are extremely limited, though those of the East Asian monsoon have been intensively studied, especially in the Loess Plateau, China. In this respect, lacustrine sediments of the Kathmandu Basin on the southern slope of the Nepal Himalaya are ideal archives. Recently, a 218-m-long core mainly composed of continuous muddy sediments was drilled in the basin under the Paleo-Kathmandu Lake project, and multi-proxy analyses of the drill-core have been carrying out in order to reconstruct continuous records of paleoenvironmental changes.

In this study, I analyzed fossil diatom assemblages and biogenic silica content of the drill-core samples. Principal objectives of this study are to reveal changes in diatom assemblages (productivity, composition and diversity) and the water-level of the Paleo-Kathmandu Lake, and to compare them with changes in the Indian monsoon and environments in other regions during the middle to late Pleistocene.

In order to construct an age model of the drill-core for the past 600 kyr, I tuned records of wet-dry condition in the Kathmandu Valley obtained from palynological studies to the SPECMAP stack, a standard record of global climatic changes. The time series record of biogenic silica content demonstrates dominant periodicities in all orbital bands (100, 41, 23 and 19 kyr), and they show statistically significant coherence with those of the Indian monsoon index (Leuschner & Sirocko, 2003). These results indicate high reliability of the constructed age model in orbital time scale.

The record of the lake-level changes was reconstructed based on diatom environmental indicators as follows. The water-level gradually rose from ca. 690 to 584 ka (Zone 1) and maintained very high from 584 to 310 ka (Zone 2-4). During 310 to 17 ka, the water-level became shallower than before 310 ka, and periodically fluctuated. After 17 ka, the water-level significantly fell, and almost all of the lake-water drained by 15 ka. The record of changes in the lake-level generally agrees with that of wet-dry condition in the Kathmandu Valley. This indicates that changes in Indian monsoonal rainfall controlled the lake-level changes.

The diatom productivity indicated by the valve concentration and the biogenic silica content increased during the interglacial periods. In addition, it shows dominant periodicities in the 100-kyr eccentricity, the 23-kyr and the 19-kyr precession bands. Changes in the diatom productivity were synchronized with those in the amount of terrestrial organic matter and rare-earth elements derived from heavy minerals in granitic rocks, which flowed into the lake. These indicate that the monsoonal rainfall controlled supply of terrestrial nutrients, and this may have controlled the diatom productivity.

Both the composition and the diversity of diatoms were controlled by lake-level changes. During 690-584 ka (Zone 1), the composition gradually became stable and the diversity decreased, accompanied by gradual rise of the water-level. During 584-310 ka (Zone 2-4), very high water-level caused presence of monodominant planktonic taxa, Cyclotella kathmanduensis and Puncticulata versiformis. During 310-13 ka (Zone 5-9), fluctuation of the water-level between relatively high and low condition brought about frequent changes in the composition, and the diversity became higher than before 310 ka.