Uplift tectonics of the Kathmandu Nappe, central Nepal: an approach based on fission-track dating

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The Himalaya is a fold-and-thrust belt which formed in the northern margin of the Indian continent after the India-Eurasia collision in the Eocene time (Schelling and Arita, 1991:Zhao et al., 1993). It is characterized by a series of foreland-propagating thrust system, with an out-of-sequence thrust (OST), which are splays off of a major mid-crustal subhorizontal decollement (Main Himalayan Thrust). Among these thrusts the Main Central Thrust (zone), along which the Higher Himalayan crystallines in the north are thrust over the Lesser Himalayan sediments in the south, is the dominant structural element of the Himalayan orogen.

A large amount of geological and geomorphological evidence have suggested that the Himalayan upheaval started in the northern part and has shifted southward with time and that it has been accelerated in the Higher Himalaya since the Late Pliocene. Such a recent rapid upheaval of the Higher Himalayan zone is supposed to be caused by the out-of-sequence thrusting (Arita and Ganzawa, 1997).

In the Kathmandu area, the high-grade crystalline rocks of the Higher Himalayan zone in the north extends southwards for the distance of more than 50 km covering the meta-sediments of the Lesser Himalayan zone and form the Kathmandu Nappe in the reverse omega-shape. The Nappe is cut by an out-of-sequence fault at the narrow part (north of the Sheopuri injection zone) to the north of Kathmandu basin.

We carried out fission-track dating on the high-grade pelitic and granitic gneisses in the Sheopur zone of the northern part of the Kathmandu nappe (8 samples) and the root zone of the nappe (Gosainkund Lekh) to investigate recent uplift rate of the root zone of nappe and effect of the out-of-sequence thrust to recent uplift in its northern part. Nine zircon FT ages in the Gosainkund Lekh area range from 1.5 Ma (1,525 m in elevation) to 2.8 Ma (5,045 m) showing almost similar ages to those from the Annpurana area (1.2 Ma to 2.3 Ma: Arita and Ganzawa, 1997). The ages of samples from the northern side of the Gosainkunde Lekh increase linearly with increasing in the elevation of sample sites showing an average exhumation rate of 2.4 mm/y. This rate is significantly higher than that in the Annapurna area (0.9 mm/y). On the other hand, those form the southern side yields almost the same ages between 2.5 Ma and 2.8 Ma regardless of the sample elevation. The zircon ages of the Gosainkunde Lekh suggest that the rocks on the southern side of the Gasainkunde Lekh passed evenly the depth of closure temperature of zircon around 2.6 Ma, and then the northern part of the southern side (the highest part of the Gosainkund Lekh) and the northern side uplifted more rapidly than the southern part.

FT ages of zircon (eight) and apatite (seven) from rocks around the Sheopur Lekh range from 6.9 Ma to 4.4 Ma and 5.5 Ma to 4.3 Ma, respectively. These ages appear to be irrespective of their sample elevations (1,200m-2,400m). Furthermore, zircons and apatites collected both sides of the possible OST (Trisuli-Likh Fault) yield almost the same FT ages of 7 to 5 Ma. This shows that the OST has been inactive since the latest Miocene. It is noteworthy that the zircon FT ages from the altitudes between 1,500m and 2,000m in the present area together with the zircon FT ages of ca. 9 Ma from the early Paleozoic granites in the southern part of the Kathmandu basin (Arita and Ganzawa, 1997) suggest a general trend that these ages are younging northwards from 9 Ma to 1.5 Ma, indicating the rapid exhumation (upheaval) of the Higher Himalayan zone since the late Miocene. This should be considered in relation to the Himalayan climatic change in the period (Konomatsu, 1997).

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