Journal of Nepal Geological Society, 2001, Vol. 25 (Sp. Issue), pp. 89–92

Danuwargaun Fault as a trigger for draining of the Palaeo-Kathmandu Lake, central Nepal

Harutaka Sakai
Department of Earth Sciences, Kyushu University, Ropponmatsu, Fukuoka, 810-8560, Japan
(E-mail: hsake@rc.kyushu-u.ac.jp)

ABSTRACT

A normal fault named as the Danuwargaun Fault was discovered in the southern margin of the Kathmandu Valley. The fault is trending NE-SW and dipping 80 to 90° at NW. The secondary minor faults run along the fault, and a sand dyke intrudes into fluvial beds, trending N 54° E with dip of 80° toward NW. As the northeastern extension of the fault seems to cut the Lukundol Formation and terrace gravel of the Chapagaun Formation (Shrestha et al. 1998), the fault might be active. A change of flow direction of the Bagmati River from N-S to NE-SW near the fault exposure suggests that the draining of the Palaeo-Kathmandu Lake was possibly caused by faulting in the southern margin of the valley.

INTRODUCTION

It is well known that the Kathmandu Valley was once occupied by a lake, which was named the Palaeo-Kathmandu Lake (Sakai et al. 2000, 2002). According to the legend in Nepal, the Bodhisattva Manjusri from Tibet cleft the mountains at Chobar with one blow of his sword, and the lake-water was drained. In fact, there is an active fault at Chobar (Saijo et al. 1995), and the Chobar Fault seems to have played an important role for the basin development of the Kathmandu Valley (Sakai 2001). However, it is difficult to consider that these faults were responsible for draining of the Palaeo-Kathmandu Lake, because the final draining of the lake water must have been taken place at a site further to the south near Danuwargaun (gaun means village in Nepalese). The continuation of the lake further towards south is evidenced by thick lacustrine sediments in the area between Chobar and Danuwargaun.

The cause of draining out of the Palaeo-Kathmandu Lake has hitherto never been discussed from a geological view point. During the course of field investigation for the Paleo-Kathmandu Lake Project, I paid attention to the faults which cut the basin-fill sediments, and I discovered a fault which cuts the Tarebhir and Lukundol formations in the southern part of the valley. In this paper, I report the occurrence of the fault and discuss on the origin of drainage of the Palaeo-Kathmandu Lake.

DANUWARGAUN FAULT

A normal fault cutting the boulder beds and fluvial sandy beds was discovered at the cliff on the eastern river bank of the Bagmati River, 3.5 km to the south of Bunmati village (Fig. 1). The fault is running along NE-SW directions and dipping towards the NW at 80 to 90°. Vertical displacement along the fault is 77 cm and the eastern block has moved downward relatively (Fig. 2-1). Along the master fault, several minor step faults occur in the cross-stratified sand beds (Fig. 2-2), and some of them show dip towards SE. Each fault plane is very sharp and disturbance in sand layers is minima, though the beds are unconsolidated at all (Fig. 2-2). We named this fault the Danuwargaun Fault (Fig. 1).

A sand dyke intrudes into the fluvial beds at a distance of 1.5 m to the west, and parallel to the fault. The width of the dyke is 1 to 3 cm, and the central part is composed of fine silty sand and the outer part comprises of grey clay (Fig. 2-3). The strike of dyke is N 54° E and dip shows 80° to the east.

The fluvial beds and the overlying boulder beds cut by the fault are the uppermost part of the Tarebhir Formation of Sakai (2001) and the Member I and II of the Lukundol Formation by Yoshida and Gautam (1988). According to the magnetic polarity zonation by Yoshida and Gautam (1988), the age of the sediments is about 2.7 Ma belonging to the upper part of the Gauss Chron.

A possible extension of the fault is shown on the engineering and environmental geological map by Shrestha et al. (1998). The fault extends from a place 1 km to the northeast of the fault at Danuwargaun to Sunakothi bazar (Fig. 1). It indicates that the fault cuts not only the Lukundol Formation but also terrace-forming gravel bed of the Chapagaon Formation. It proves that the Danuwargaon Fault was active during the Pleistocene. Shrestha et al. (1998) also mapped a parallel fault lying 3 km to the east of the exposure of the Danuwargaun Fault (Fig. 1).

DISCUSSION

Numerous NE-SW trending faults are running in the Lesser Himalayas and Siwalik Hills as shown on the geological map by Stöcklin and Bhattarai (1981). They cut

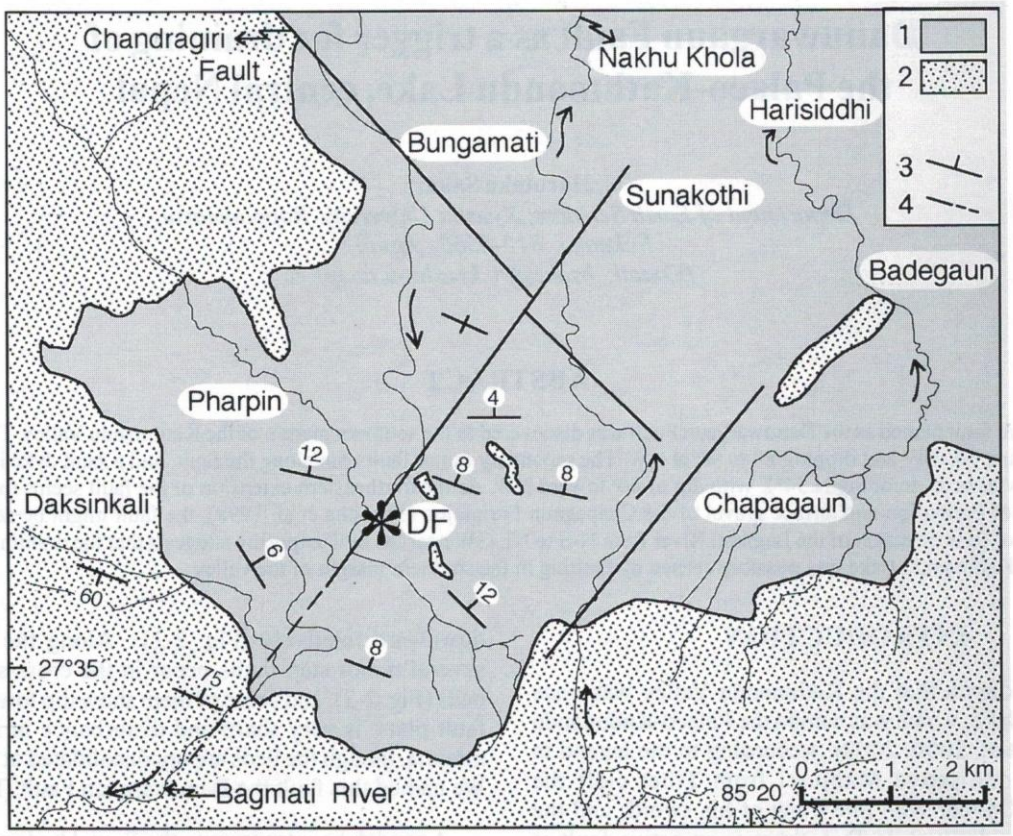

Fig. 1: Map showing basement rocks and basin-fill sediments in the southern part of the Kathmandu Valley. DF: Outcrop of the Danuwargaun Fault.
1: Kathmandu Basin Group, 2: basement rocks, 3: dip and strike of beds, and 4: fault and inferred fault

the longitudinal faults running parallel to the strike of the Himalayan Range. One of them seems to have formed a NE-SW trending narrow ridge of basement rocks surrounded by the basin-fill sediments at Chapagaun (Fig. 1).

On the geological map by Stöcklin and Bhattarai (1981), the Main Boundary Thrust (MBT) is shown to have displaced by faults trending NE-SW. In eastern Nepal, Nakata (1982) reported the active conjugate faults trending NE-SW and NW-SE. This type of active faults is thought to have been formed as shear fractures caused by subducting Indian plate. The Danuwargaun Fault seems to have the same origin.

In the Kathmandu Valley, all tributaries flow inward to the valley and join the trunk river Bagmati, which finally cuts the Mahabharat Lekh in the south and drains the water to the Gangetic plain (fig. 1 of Sakai 2001). The Bagmati river flows southward quite straight for nearly 10 km from the confluence with the Bishnumati River, and then changes its direction towards SW at 1 km to the north of southern margin of the valley (Fig. 1). The exposure of the Danuwargaun Fault is located at this sharp bend of the river. From the exit of the valley, the Bagmati River flows toward SW for about 7 km up to the confluence of the Kulikani Khola. I guess that when the Bagmati River changes its flow direction around Danuwargaun, then it flows along the weak depression zone of the faults, running parallel to the Danuwargaun Fault. The valley head erosion in the Mahabharat Lekh must have been progressed by the Proto-Bagmati River. Thus, the active faulting along the Danuwargaun Fault might have produced the drainageway. As the Danuwargaun Fault itself is too small to produce the drainage outlet, there must be a master fault along the stream of the Bagmati River. However, the Danuwargaun Fault may have played as a trigger to drain the Palaeo-Kathmandu Lake.

ACKNOWLEDGEMENTS

The field investigation was carried out in 1999 as a part of the Palaeo-Kathmandu Lake project. I acknowledge the help and cooperation received from Dr. Bishal Nath Upreti and Dr. Prakash Chandra Adhikary, Department of Geology, Tribhuvan University and thankful for fruitful discussions. The fieldwork was financially supported by a Grant-in-Aid for Scientific Research (A)(2)(No.11304030) from Japan Society for the Promotion of Science.

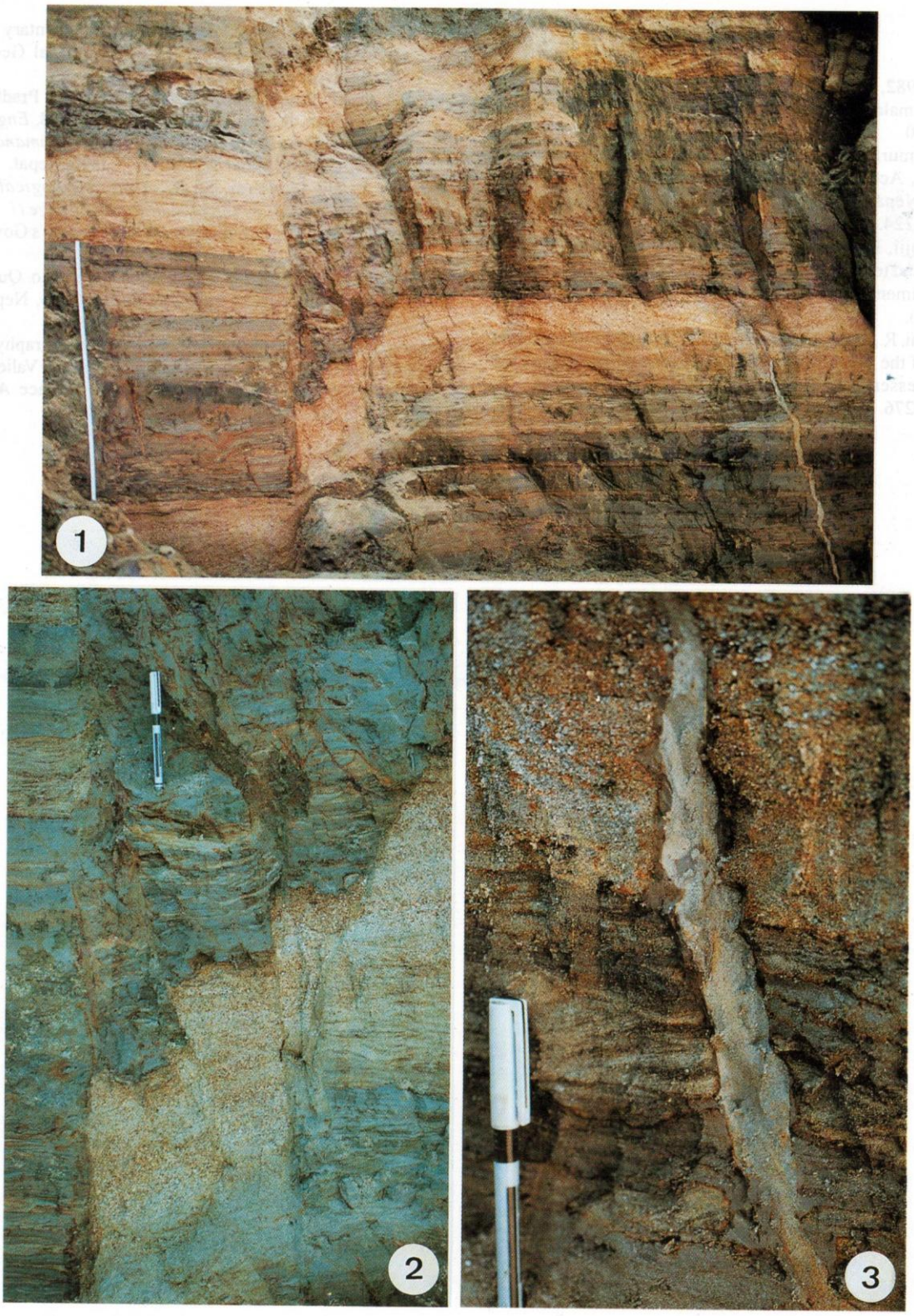

Fig. 2: Photograph of an outcrop of the Danuwargaun fault, cutting fluvial sediments of the Tarebhir Formation, in the eastern bank of the Bagmati River.
2-1: Overview of the outcrop. Vertical displacement is 77 cm and scale bar is 1 m. Note a sand dyke on the right hand side. 2-2: Close-up view of main fault and associated minor step faults. Length of pen is 13.5 cm. 2-3: Close-up view of a sand dyke comprising of fine silty sand and marginal grey clay.

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