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Field trip in the Nepal Himalayas

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Abstract: Short information about the geomorphological field trip in the Nepalese Himalayas. The field trip was conceived as a traverse across the entire High Himalayan system, travelling along the Kali Gandaki River up to the Thakkhola Graben, and passing between the Annapurna-Nilgiri Range and the Dhaulagiri. The field trip was largely focused of various aspects related to hazardous geomorphological processes associated with an extreme mountain environment: high local relief and rapid tectonic uplift, glaciated mountains, frequent large earthquakes, severe and contrasting monsoonal precipitation, and unregulated rivers.

Key words: Kali Gandaki River, Thakkhola Graben, Annapurna, Dhaulagiri, Nepal

After the 9th International Conference on Geomorphology in New Delhi (November 6–11, 2017), organised by the International Association of Geomorphologists and the Indian Institute of Geomorphologists, 28 geomorphologists from 12 nationalities (Australia, Brazil, France, Germany, Israel, Italy, Nepal, New Zealand, Poland, Russia, Spain, United Kingdom) had the great pleasure to participate in a wonderful field trip B9 in Nepal: *Geomorphology of the Nepal Himalayas: A transect across the Annapurna Range* (No-

Fig. 1. Participants of the Nepal Himalayas field trip

Fig. 2. The Annapurnas showing hogbacks developed on N-dipping strata

vember 12–19, 2017) (Fig. 1). The trip was magnificently organized and led by Prof. Monique Fort (Paris Diderot University, France), with the support of Dr. Basanta Raj Adhikari (Tribhuvan University, Nepal) and Prof. Narendra Raj Khanal (Tribhuvan University, Nepal). We also had the extremely kind assistance of the guide Babulal Lal Lama Tamang (Tribeni Trek, Nepal) and three helpers, as well as the skill of seven drivers that made possible the impossible.

Prof. Monique Fort started her investigations in Nepal in the 1970s, when the only way to get access to her study areas was by hiking with porters during

Fig. 3. Fine-grained sediments of the Marpha Lake at Marpha (behind the village), formed upstream of the natural dam created by the Dhampu-Choya rock avalanche

weeks. She transmitted to participants of field trip, not only her profound knowledge on the geomorphology of the Nepal Himalayas, but also her devotion to the Nepali people for their kindness, hospitality and loyalty.

The field trip was conceived as a traverse across the entire High Himalayan system, travelling from Kathmandu to Pokhara and then along the Kali Gandaki River up to the Thakkhola Graben, and passing between the Annapurna-Nilgiri Range (8 091 m a.s.l) and the Dhaulagiri (8 167 m a.s.l); a dream for every geomorphologists. The field trip was largely focused of various aspects related to hazardous geomorphological processes associated with an extreme mountain environment:

- local reliefs higher than 4 km and rapid tectonic uplift;
- glaciated mountains with peaks above 8 000 m a.s.l. (Fig. 2);
- frequent large earthquakes (e.g., 7.8 M_w 2015 Nepal earthquake);
- severe and contrasting monsoonal precipitation;
- unregulated rivers.

We traversed three major tectonic domains with distinctive geomorphological features, from south to north: Lesser Himalayan Zone, Higher Himalayan Zone and Tibetan Tethys Zone, bounded by the south-verging Main Central Thrust and the South Tibetan Detachment, respectively.

One of the main highlights of the field trip was the examination of giant pre-historic rock avalanches that created large landslide dams and long-standing lakes (e.g., Talbagar avalanche, Dhampu-Choya avalanche, Thini-Syang-Jomosom rock avalanche). These presumably earthquake-triggered catastrophic events, together with the drainage of the landslide-dam lakes, incorporated sharp changes in the longitudinal profile, sediment availability and behaviour of the fluvial systems. For instance, the Dhampu-Choya rock avalanche accumulated a pile 450 m thick of chaotic breccias in the valley floor damming the river and creating the 23 km long Marpha Lake, recorded by lacustrine sediments more than 200 m thick that penetrate into the tributary drainages (Fig. 3).

Participants of the field trip also had the chance to examine smaller historical rock avalanches that temporarily blocked major rivers and caused social and economic losses:

- the Baisari rock avalanche, triggered by the 2015 seismic series, which buried a small village, fortunately evacuated before the occurrence of the main slope failure; and
- the 1988 Tatopani rock avalanche, which caused flood damage at Tatopani village.

Fig. 4. Peculiar badlands developed on indurated gravel terrace deposits in Kagbeni area

Landslides in the steep mountain catchments may also induce debris flows by rapidly incorporating sediment to the torrents (e.g., Beg Khola), or flash floods by the burst of short-lasting landslide dams. For instance, the 5 May 2012 Seti River flood, which caused 32 known fatalities and 40 missing persons in Kharapani hotsprings area.

The program of the field trip included other interesting geomorphic features such as terraces underlain by floatbreccias more than 100 m thick (Kali Gandaki River at Kusma), water falls from hanging tributary valleys, the Thakkhola Mio-Pliocene Half-graben related to recent extension in the Tibetan Plateau, cave dwellings and impressive badlands in indurated terrace deposits (Kagbeni area) (Fig. 4), a large active earthflow at Khingar, horns (Macchapuchare Peak or Fish Tail) and perched glaciers, sequences of thick fill terraces (Seti Khola Riiver), a fracture-controlled cave developed in cemented calcareous Quaternary alluvium and a swallow hole (Gupteshwor Cave and Davi's Fall, Pokhara), knick points associated with a sharp change from broad alluvial rivers to incised bedrock channels with impressive potholes and flutes (Seti Kola River at Dhulegaunda).

At the end of the field trip there was a common "mantra": *we want to come back!*

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