

Ninth field training course in glaciology, 2016

Glaciers are important for many reasons, e.g. their high sensitivity to even slight climate changes; vast reservoirs of fresh water resources; agents of landscape sculpturing; habitat for some rare species; working as sink for palaeoclimatic signals; life source for many big rivers; and contributor to sea level change. Governments of different countries want to have first-hand data about various aspects of glaciers, particularly how fast glacier mass is changing. India has major portion of the Himalayan mountain ranges which are abode to great mountain glaciers. Despite 9575 glaciers in Indian territorial boundary^{1,2}, we have very scarce field data of about 50 glaciers only. As far as the government's interest in Himalayan glaciers is concerned, it wants to know how fast are glaciers receding (or advancing), both vertically and horizontally and why.

In India, there are very few people engaged in glaciology research because of harsh climatic conditions, difficult terrain, very high cost of field work and data collection, and high-risk of danger to life. With the aim to train more youngsters to create passionate workforce for glaciological research, the Science and Engineering Research Board (SERB), a statutory body established in 2008, under the Department of Science and Technology, sponsored a total of 9 training programmes since 1993 up to 2016. Looking at the success rate of generating glaciologists with the help of this strenuous training programme, another Field Training Course in Glaciology is scheduled to be conducted in 2017. And, it should be continued as long as possible.

The 2016 course was organized in three steps keeping in mind the fact that most of the trainees would need acclima-

tization for high altitude environment (HAE). Extensive lecture classes related to various aspects of snow and ice properties, glacier geomorphology, dating methods and their application to glaciology, snow and avalanche studies, glacier hydrology, modern surveying techniques, etc. were held at the Geological Survey of India, Regional Office, Chandigarh. Afterwards, the trainees halted at Manali (2050 m amsl) for three days. Here, the participants were taken to Cold Lab and Model Room in Snow and Avalanche Study Establishment, Manali and showed how meteorological parameters are collected at Automatic Weather Station. The participants then halted at Chhatru Base Camp (3352.80 m amsl) for acclimatization and then were taken to Hamtah Base Camp nearby Hamtah Glacier Snout.

The training covered almost every aspect of field practices of glaciology studies. Starting from what criteria should be taken into consideration for choosing a glacier for study, to estimating mass balance of glacier using stake method in the ablation zone and density pitting in the accumulation zone, glacier depth measurement using Ground Penetrating Radar, snout monitoring using Total Station survey with submeter accuracy were taught. There were field demonstrations on how to collect water samples for determining the suspended sediment load. Water flow velocity and discharge measurement using float method of glacier/snow melt stream was also taught. The main objective of geomorphological traversing, both upstream and downstream of Chhatru Base Camp, was to enable and initiate a thought process among trainees to identify glaciated landforms like different types of moraines and infer about sequential

processes sculpturing those landforms. Geomorphological traversing was aimed at enabling the trainees to reconstruct palaeoglacial environment of the area. Participants were also trained to collect samples for OSL dating and how to look for a suitable site for sample collection, what precautions need to be taken during collection of a sample. There was also an excellent lecture and field demonstration of lichenometry, one of the methods of relative dating of glaciated and glacierized areas. Geomorphological mapping was demonstrated with Total Station survey by the GSI faculty. Lastly, the participants were shown how to prepare samples for hydrogeochemical analyses, particularly for major ion chemistry, trace element analysis, total organic carbon and Hg pollution.

1. Raina, V. K., Snehani and Sangewar, C. V., *Glacier Snout Monitoring in the Himalayas*, Geological Society of India, Bengaluru, 2015, 1st edn, p. 377.
2. Raina, V. K. and Srivastava Deepak, *Glacier Atlas of India*, Geological Society of India, Bengaluru, 2008, p. 315.

ACKNOWLEDGEMENTS. We thank Science and Engineering Research Board, New Delhi for funds. We also thank all the faculty members of GSI, especially Dr S. P. Shukla, Glaciology Division, GSI, Lucknow for conducting the course.

Manish Pandey* and **Sarvagya Vatsal**, School of Environmental Sciences, Jawaharlal Nehru University, New Delhi 110 067, India; **Aditya Mishra**, Department of Geology, H.N.B. Garhwal University, Srinagar 249 161, India.

*e-mail: manish07sep@gmail.com