course the world does not run out of indium. That, however, is a story for another day.

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Field training in glaciology: a way to touch, feel and understand

Glaciers and ice sheets cover approximately 10% of the Earth's surface, out of which 3% is in Asia (IAHS (ICSI)/ UNEP/UNESCO 1989). A study of mountain glaciers of the Himalaya has serious implications to understanding climate change and the future of water resources in India. Glaciologists have developed sophisticated techniques to monitor our glaciers. Although there are 9575 glaciers in the Indian part of the Himalaya, only a few have been monitored on a long-term basis. The monitoring is distributed variably and controlled by altitude, orientation and differential precipitation patterns of the Indian summer monsoon and western disturbances[1]. Many questions remain about the current status and future impact of these glaciers. Work in extreme climate and high-altitude conditions requires training. Very few organizations in India are conducting training programmes on glacial studies. The Geological Survey of India (GSI) is one of them. GSI initiated snow, ice and glacier studies in 1974, by establishing the Glaciology Division. Since then it has been monitoring the Indian Himalayan glaciers using state-of-the-art techniques[1]. During the last few decades, technological advancements have changed the methods of observation and modern high-speed computers and satellite-based approaches are being used for monitoring the glaciers in real time. From time to time, the Glaciology Division of the GSI has been developing and implementing new concepts and theories intended to develop expertise in the field of glaciology. GSI has been conducting a field training course in glaciology since 1993; till date seven courses have been successfully conducted and 95 students, research scholars and scientists have been trained. In continuation of this series, the 8th training course (4 August–7 September 2014) funded by DST, New Delhi was designed to educate the trainees in various facets of glaciological studies, both theory and practice. An overwhelming response was received and 19 trainees from different universities, academic and research institutions and faculty members of the GSI, participated in the course.

The course was inaugurated on 5 September 2014 by V. K. Raina (formerly at GSI), Deepak Srivastava (formerly at GSI), Subodh Kumar Sharma (Northern Region, GSI), Jogindar Singh (GSI, Chandigarh), Ashwagosh Ganju (SASE), Alok Chitranshi (GSI), S. P. Shukla (GSI) and some other faculty members of GSI and SASE were present. The objective of this training programme was to develop manpower for initiating systematic studies of glaciated region of the Himalaya, which is necessary to understand the glacio-hydrology, meteorology, glacial dynamics, glacial micro-meteorology and suspended sediment loads in head-water regions. An understanding of the complete glacial environment is necessary, including physical and chemical changes and therefore, a multidisciplinary approach is needed for glaciological studies.

Overall, 44 lectures and 10 practical sessions, including field demonstration for collecting the samples and installation of automatic weather stations, were conducted at the GSI office in Chandigarh, SASE Chandigarh/Manali and Hamtah Glacier base camp. This was followed, under the supervision of GSI officers, by a traverse along the Chandra valley and a ~7 km trek along Hamtah Glacial valley to reach the accumulation zone of the glacier. Interactive sessions, including high-altitude trekking and fitness conducted at Hamtah Glacier, helped the students to discuss various problems associated with high-altitude terrain. Hands-on training in the use of various instruments like total station survey equipment, and ground penetrating radar (GPR) was given; data processing was taught in the field. The total station equipment used in modern surveying enabled measurement of angle, distance as well as coordinates and helped record absolute location of the object. GPR is a potentially powerful, non-destructive technique which is widely used to estimate ice thickness, bedrock topography,

hidden crevasses, study of glacial channels, mapping internal structure of ice sheets and glaciers. Besides this, glacial hydrology, mass balance measurements, stake networking and snout monitoring were also taught on the Hamtah Glacier. All measurements were made by the participants under the guidance of the experts. Positive feedback from the trainees indicates that this field training course in glaciology was beneficial and meaningful to all of them.

Training courses aim at imparting progressive ideas and expertise in different fields and are useful for people working in different organizations. They help in the process of acquiring the essential skills required to do work in a particular field. The present training course not only targeted a specific field, but touched upon every aspect of glaciology leading to understanding the processes and factors operating in glacial environments. The training has motivated the participants to focus on the 'how to work' and 'where to work' on various aspects of glaciers. The field demonstrations and practical exercises helped the participants to develop a clear understanding of glaciers and their own path for research.

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