Quarterly Newsletter
Wadia Institute of Himalayan Geology, Dehradun
(www.wihg.res.in)

Bhugarbh Vani

Volume-5, No. 2
April to June, 2015

RESEARCH ACTIVITIES

Tree ring evidence of late summer warming in Sikkim, northeast India:

The impact of climate change in high-elevation areas is acknowledged to have wide ranging implications on environment relevant to human society. However, our understanding of climate change in the high elevation eastern Himalayan region is hampered due to temporally and spatially limited weather records. Using ring-width chronology of larch (*Larix griffithiana*) from high-elevation North Sikkim, we developed mean late summer (July-August-September (JAS)) temperature reconstruction extending back to AD 1852. The reconstructed mean JAS temperature shows warming since the 1930s, with 1996-2005 being the warmest in context of the past ~150 years. We found that the warming trend reported here

Announcement

30th Himalaya-Karakoram-Tibet Workshop, October 6-8, 2015
http://www.hktwadia2015.org

Wadia Institute of Himalayan Geology, Dehra Dun, India, warmly invites you for the 30th Himalaya- Karakoram-Tibet Workshop and workshop field excursions.

Workshop Themes:

- **Evolution of Himalaya-Karakoram-Tibet: tracking mantle to mountain**
- **Fluid - rock interaction & its role in Himalaya-Karakoram-Tibet orogeny**
- **Records of climate change**
- **Linkages between tectonics, climate and surface processes**
- **Earthquake geology**
- **Recent advances in Geophysical studies towards understanding the HKT orogeny**
- **Biotic events and Sedimentary records**
- **Natural resources, natural hazards and societal implications**

Workshop field excursion:

- **One day pre-workshop field on October 5, 2015 and four days field trip during October 9 to 12, 2015 in Himalayan terrain.**
  Last date of Registration: July 30, 2015
  Last date of Abstract submission: August 20, 2015

Contact:

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Convener- 30th HKT 2015
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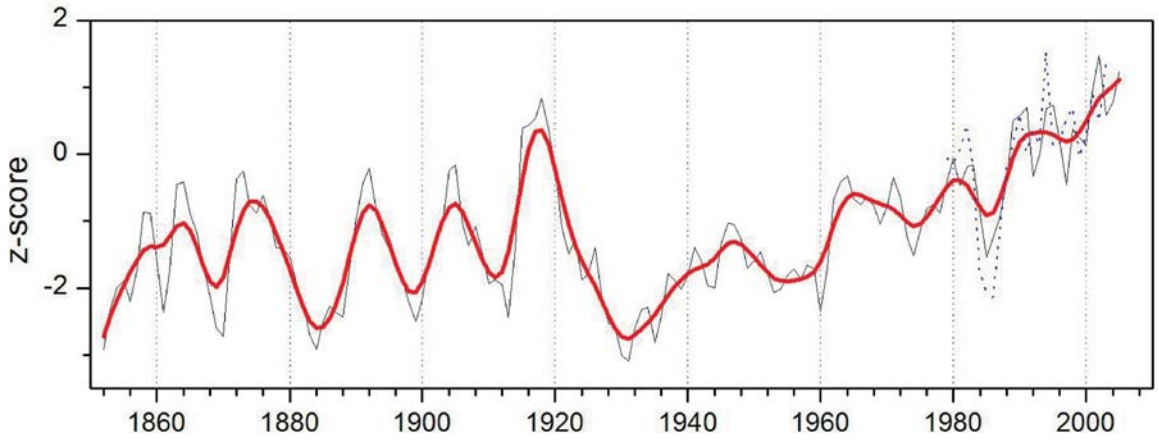
is consistent with other climate change indicators such as plant species migration to higher ranges and accelerated glacier retreats in Sikkim. Temporal and spatial extent of such annually resolved records need to be expanded for the data scarce eastern Himalayan region to understand regional variability and feedbacks in climate. (*Quaternary International, 371: 175-180*)



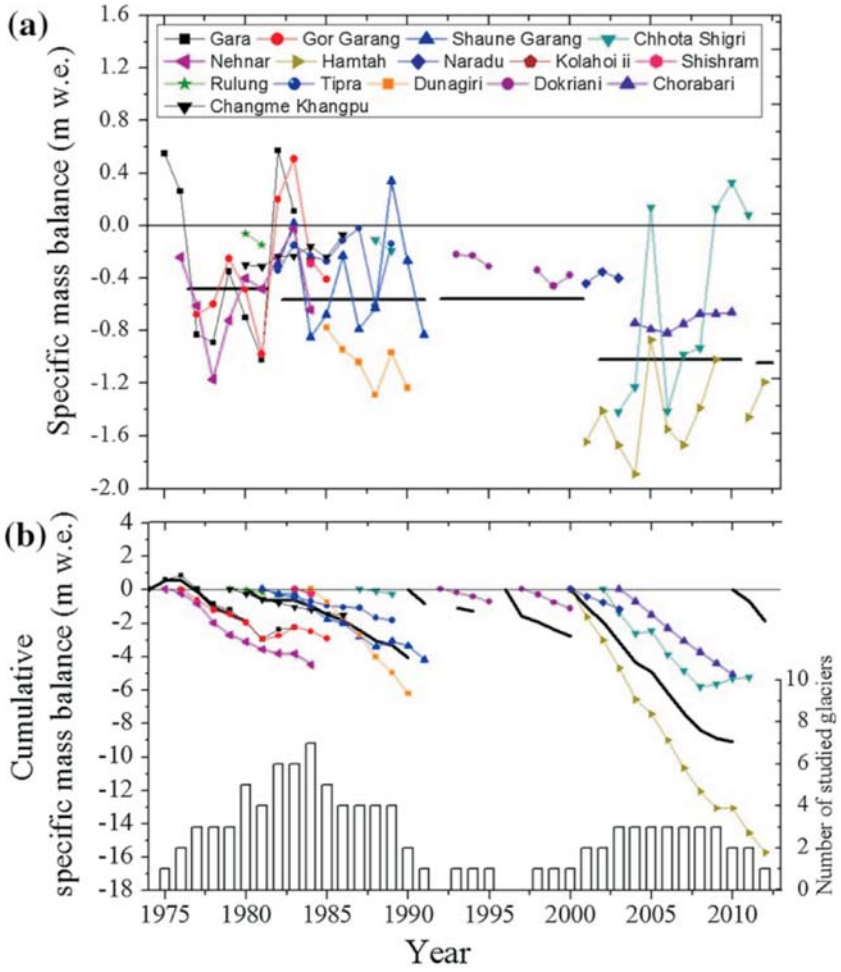
Mean late summer (July-August-September) temperature reconstruction extending back to AD 1852. Thick line is 10-year low pass filtered version.

Comparison of maximum likelihood and knowledge-based classifications of debris cover of glaciers using aster optical-thermal imagery:

Mapping of debris-covered glacier boundaries using remote sensing technique is restricted by the presence of supraglacial debris (debris over the glacier) since it has similar spectral properties than that of periglacial debris (debris outside glacial boundary). However, earlier studies have suggested that the temperature differences between the supraglacial and periglacial debris and/or geo-morphometric parameters can be used to separate these two classes. Several automated and semi-automated approaches have been developed for the mapping of debris-covered glacial boundaries utilizing thermal information and/or geo-morphometric parameters. Most of the techniques utilizing multisource datasets use semi-automated time consuming method of classification. In this article, a novel hybrid classification scheme utilizing both the maximum likelihood classification and knowledge based classification has been used which integrates inputs from ASTER optical, thermal and DEM remote sensing data for mapping debris-covered glacier boundary in a test area in the Chenab basin, Himalayas, India. The results of this new proposed classification scheme were compared with the classification results of maximum likelihood classification which has been used earlier by several researchers for a similar type of mapping. Further, cloud is also considered as one of the major hindrance in mapping of the glaciers due to its similar reflectance as that of snow. Additionally, the low radiometric resolution of most of the optical remote sensing data may sometimes cause serious problem in mapping glacial terrain classes due to saturation towards higher DN values due to higher reflectance of snow. A contrast enhancement using band transformation has been proposed in this remote sensing based study to resolve such problems. (*Remote Sensing of Environment DOI: 10.1016/j.rse.2014.10.026*)

Four decades of glacier mass balance observations in the Indian Himalaya:

Understanding the glacier mass balance is necessary to explain the rate of shrinkage and to infer the impact of climate change. An overview of the glacier mass balance records by glaciological, geodetic, hydrological and accumulation-area ratio (AAR) and specific mass balance relationship methods in the Indian Himalaya since 1970s was carried out. It suggests that the mass balance measurements by glaciological methods have been conducted for ten glaciers in the western Himalaya, four glaciers in the central Himalaya and one in the eastern Himalaya. Hydrological mass balance has been conducted only on Siachen Glacier from 1987 to 1991. Geodetic method has been attempted for the Lahaul–Spiti region for a short time span during 1999–2011 and Hindu Kush– Karakoram–Himalaya region from 2003 to 2008. A comparative study of *in-situ* specific balance data series with specific mass balance derived from AAR and specific mass balance relationship was done. The results derived from existing and newly presented regression model based on AAR and specific mass balance relationship induced unrealistic specific mass balance for several glaciers. A revision of AAR0 and ELA0 based on available *in-situ* AAR and specific mass balance data series of Indian Himalayan glaciers was also carried out. In general, *in-situ* specific and cumulative specific mass

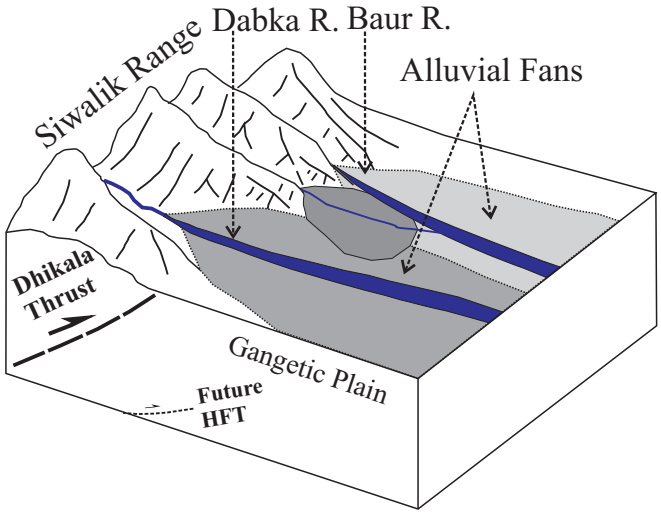


Glaciological annual specific mass balance of 15 Indian Himalayan glaciers for the period 1974–2012 (modified after Vincent et al. 2013). The black straight lines described mean cumulative composite record by decade. b Cumulative specific mass balance of individual glaciers. The black line shows mean annual cumulative specific mass balance which corresponds to the number of yearly studied glaciers.

balance observed over different regions of the Indian Himalayan glaciers shows mostly negative mass balance years with a few positive ones during 1974-2012. On a regional level, the geodetic studies suggest that on the whole western, the central, and the eastern Himalaya experienced vast thinning during the last decade (2000s). Conversely, Karakoram region showed slight mass gain during almost similar period. However, the glaciological, hydrological and geodetic mass balance data appears to exhibit short time series bias. Creation of benchmark glaciers network for future research to determine the impact of climate change on the Himalayan cryosphere was recommended. (*Regional Environmental Change*, 1-18. *DOI: 10.1007/s10113-015-0791-4*)

Drainage response to active tectonics and evolution of tectonic geomorphology across the Himalayan Frontal Thrust, Kumaun Himalaya:

Integrated studies of geomorphic indices of drainage networks and landforms developed across the mountain front along the Himalayan Frontal Thrust (HFT) between the Dabka and Baur rivers, Kumaun Himalaya shows that the HFT is a morphogenic structure in nature, creating a 100-m-high E–W trending escarpment that extends ~21 km. Geomorphological evidence indicates ~ 10.5 km westward migration of the Dabka River and ~5.2 km eastward migration of the Baur River. These migrations are a result of uplift of the hanging wall along the HFT. The HFT is offset by a transverse fault, which suggests that the latter postdates the reactivation of the HFT between 500 and 100 ka. Presence of different levels of strath terraces along the mountain front suggests the active nature of the HFT. To assess the relative tectonic activity, morphometric indices such as stream-gradient (*SL*) index, mountain front sinuosity (S_{mf}) index, and ratio of valley floor width to valley height (*Vf*) have been



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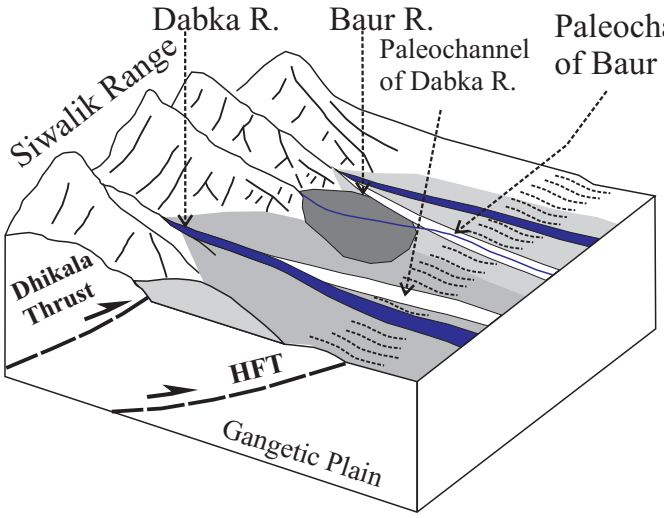

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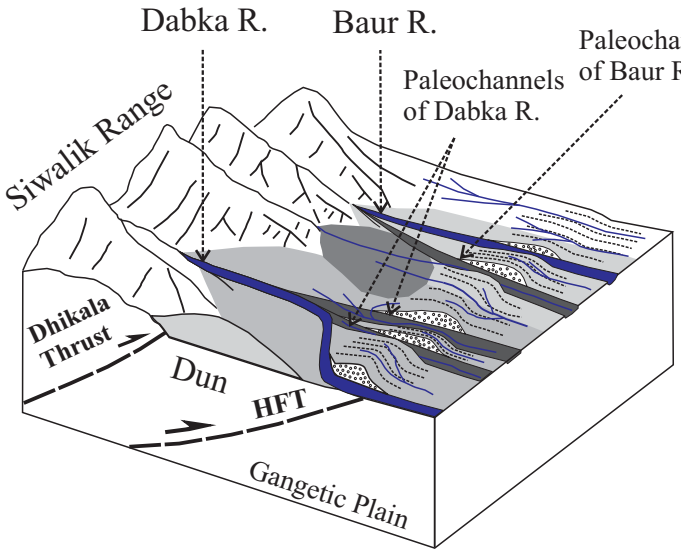

(III)

Conceptual model of migration of Dabka and Baur rivers.

analyzed. Results of the former two are consistent with the tectonic landforms developed in thrust zones. Paleochannels of the Dabka and Baur rivers are characterized by high *Vf* values while other valleys show low *Vf* values. Quaternary alluvial sediments have been deformed along the Pawalgarth Thrust, a splay of the HFT. Deformation has resulted in the formation of the Pawalgarh Anticline, a thrust-related asymmetric fold. (*Geomorphology, 239: 58-72*)

Estimation of strength characteristics of different Himalayan rocks from Schmidt hammer rebound, point load index and compressional wave velocity:

The transportation route between Chamoli and Badrinath in Uttarakhand is mainly a pilgrimage route to the famous Badrinath temple, at an elevation of about 3,100 m asl. It is estimated that some two to three million vehicles use this road annually, particularly between May and October. The Lesser and Higher Himalayan rocks exposed at 23 localities along the transportation corridor contain numerous joints. In view of their orientation, blocks of rock of varying sizes are susceptible to falling, endangering the vehicular traffic and the numerous village settlements along the route. The kinematic rockfall hazard analysis was carried out for all the 23 localities where *in situ* rocks were observed. The results of the analyses were evaluated and the areas classified as of low, moderate, or high hazard. (*Bulletin of Engineering Geology and Environment, 74 (2): 521-533*)

Kinematic Rockfall Hazard Assessment along a Transportation Corridor in the Upper Alaknanda valley, Garhwal Himalaya, India:

Various rock types including highly deformed to undeformed quartzites, granites, granitic gneisses, gneisses, metabasics (meta-amphibolites and meta-dolerite), and dolomites - collected from different formations of the Lesser and Higher Himalaya were tested to evaluate correlations between the uniaxial compressive strength (UCS) and the point load test (PLT), Schmidt hammer rebound (SHR) value, and compressional wave velocity (Vp). Various equations between UCS and PLT, SHR, and Vp were obtained using regression analysis. It was found that there is high scatter in the data when all lithologies are considered together, whereas this scatter is reduced when the lithologies are considered individually. This was attributed to wide variations in the mineralogical and textural characteristics of different rocks. Furthermore, it was also noted that quartzites exhibit high scatter in their data points, even though they are monomineralic. Thin section studies revealed that different microfabrics have been produced in the quartzites, due to the actions of different deformational phases during tectonic activity in the area. Therefore, it is necessary to treat deformed and undeformed rocks separately when deriving such equations. (*Bulletin of Engineering Geology and Environment*, *74(2): 315-326*)

Geothermal systems in the Northwest Himalaya:

Conventional energy resources are fast depleting and therefore alternative resources are required to sustain the fast progress and development of any nation. This situation is more pertinent to India where fast growing population and developmental activities are posing major challenges to the government as the country has limited resources of energy. Therefore, focused research should be intensified to explore the potential of geothermal energy resources in India. Realizing its importance, Wadia Institute of Himalayan Geology, Dehradun, has started a major research programme to study geothermal systems of the Himalaya covering Uttarakhand, Himachal Pradesh and Leh-Ladakh regions of India. (*Current Science*, *108: 1597-1599*)

RESEARCH PUBLICATIONS

In SCI Journals

Gupta, V. and Sharma Ruchika. 2015. Kinematic Rockfall Hazard Assessment along Transportation Corridor in the Upper Alaknanda valley, Garhwal Himalaya, India. Bulletin of Engineering Geology and Environment, 74 (2): 315-326.

Luirei, K. , Bhakuni S.S. and Kothyari G.S. 2015. Drainage response to active tectonics and evolution of tectonic geomorphology across the Himalayan Frontal Thrust, Kumaun Himalaya. Geomorphology, 239: 58-72.

Pratap, B., Dobhal, D.P., Bhambri, R., Mehta, M. and Tewari, V.C. 2015. Four decades of Glacier Mass balance Observations in the Indian Himalaya. Regional Environmental Change, 1-16.

Rai, S.K., Tiwari, S.K., Bartarya, S.K. and Gupta, A.K. 2015. Geothermal systems in the Northwest Himalaya. Current Science, 108: 1597-1599.

Tandon, R.S. and Gupta, V. 2015. Estimation of strength characteristics of different Himalayan rocks from Schmidt hammer rebound, point load index and compressional wave velocity. Bulletin of Engineering Geology and Environment, 74(2): 521-533.

Yadava, A.K., Yadav R.R., Misra K.G., Singh J. and Singh D. 2015. Tree ring evidence of Late summer warming in Sikkim, northeast India. Quaternary International, 371: 175-180.

In Non-SCI Journals

Olsson, R. Bhasin, R.K., Ragnarsson, A., Richter, B. Singh, B, Bartarya, S.K., Rai, S.K. and Rawat, G. 2015 Pilot Project study for Utilization of Geothermal Energy in North-Western Himalaya, Proceedings World Geothermal Congress, 2015 Melbourne, Australia, April 19-25, 1-8.

Soni S., Garg P.K., Singh A. & Maurya, A.K. 2015. Assessment of land use land cover change in Chakrar watershed using geospatial technique. Tropical Plant Research, 2(2), 101-107.

Reports

Dr Vikram Gupta along with other members of the Expert Team drawn from various organisations submitted a report on its Nepal visit to the National Disaster Mitigation Authority (NDMA), New Delhi.

PARTICIPATION IN CONFERENCES/SEMINARS/WORKSHOPS/MEETINGS

Conferences

Dr Kapesa Lokho and Ms Smita Gupta attended the National Conference on "Palaeogene of the Indian Subcontinent" at Lucknow during April 23-24, 2015 and presented the following papers:

Oral presentations

- Eocene foraminifera from the Naga-Manipur Hills of Indo-Myanmar Range, northeast India: fresh insights. (Kapesa Lokho)
- Signatures of Paleocene–Eocene Thermal Maximum in Subathu succession, NW sub-Himalaya, India. (Gupta, S. and Kumar K.)

Posters

- Chapattimyid rodents (Mammalia) from the Early Eocene beds of Subathu Formation, NW sub-Himalaya, India: palaeobiogeographic implications. (Gupta, S. and Kumar K.)

Dr Meera Tiwari attended "Akhil Bhartiya Rajbhasha Sammelan aur chintan Shivir" during June 17-19, 2015 at Ooti organized by 'Rajbhasha Seva Sansthan, New Delhi. The Hindi magazine "Ashmika" was selected as one of the best magazine for its high grade technical articles.

Seminars/Symposium

Dr Vikram Gupta attended the International symposium on "Tackling the challenge of slope stabilisation and Landslide Prevention" at Civil Service Institute, Dehra Dun during April 28-29, 2015 and delivered a lecture entitled:

"Towards establishing rainfall threshold for the Uttarakhand Himalaya."

Workshops

Dr Nilendu attended a workshop on 'Carbon/Water cycling research in the changing climate', organized by AsiaFlux, Gifu University, NIES, JaLTER and JSPS at National Institute for Environmental Studies (NIES), Tsukuba, Japan during April 23-25, 2015.

Meetings

Dr S.K. Bartarya attended a meeting of Hydrogeologists at Nainital regarding the Environmental Degradation of Sukha Tal, Naini Tal during April , 2015 organised by Centre for Ecology Development and Research (CEDAR).

Vikram Gupta attended kick-off meeting of the Indo-Norwegian hazard Project at NGF during April 24-25, 2015 and gave a talk entitled:

"Surabhi Landslide – revisited."

Dr D.P. Dobhal attended a meeting of the special committee to review the progress made by CFG under the Chairmanship of Secretary D.S.T. on May 23, 2015 and presented five years Progress Report of CFG.

Dr Ajay Paul attended meetings at National Disaster Management Authority (NDMA) at NDMA Bhawan, New Delhi on May 29 - June 2, 2015 and presented the following papers:

- Probability of landslides in Nepal.
- Probable predictions of earthquakes through animal behavior.

FOREIGN VISIT

Dr Nilendu visited the National Institute for Environmental Studies (NIES), Tsukuba, Japan during April 23-25, 2015 to attend Workshop on "the ecosystem carbon/water cycling research in the changing climate".

Dr Vikram Gupta visited Nepal as a member of the expert team constituted by the National Disaster Mitigation Authority (NDMA), New Delhi to assess landslide scenario and consequently discussing technical support to Nepal.

TRAINING ATTENDED

Ms Shubhra Sharma attended DST Summer School on "Mathematical Morphology in Geosciences' at the Systems Science and Informatics Unit (SSIU), Indian Statistical Institute, Bangalore Centre during March 24-April 08, 2015.

MEETING HELD IN THE INSTITUTE

Dr Vikram Gupta organised a kick-off meeting of the Indo-Norwegian Project at National Geotechnical Facility during April 24-25, 2015. Dr S.K. Mittal (CSIO, Chandigarh), Dr Y.P. Sundriyal (HNB Garhwal University, Srinagar), Dr Bhoop Singh (DST), Dr Rajesh Sharma & Dr Vikram Gupta (WIHG, Dehradun) and Dr R.K. Bhasin & Dr Frode Sanderson (Norwegian Geotechnical Institute, Oslo) along with the scientists working in the NGF participated in the meeting.

FIELD VISITS

Sh Anil Kumar participated in the International Ocean Discovery Program Expedition 355, Arabian Sea Monsoon during March 31 - May 31, 2015. Two sites (U1456 and U1457) were drilled in Laxmi Basin in the eastern Arabian Sea to record the mountain building, weathering & erosion, and climate over last ~11 Ma.

Sh Akshaya Verma and Sh Bhanu Pratap visited Dokriani Glacier, Uttarkashi District from May 06- May 20, 2015 for retrieval of data from three automatic weather stations, stake networking for mass balance, repair of hydrological observatory/ discharge site. Two snow pits (2.5 ft and 5.5 ft depth) were made for density measurements. Samples of snow and ice were also collected during the visit for isotopic and geochemical analysis.

Dr Amit Kumar and Dr Akshaya Verma (CFG) visited Dunagiri and Bangni Glaciers, Chamoli District during May 29 - June 4, 2015 for establishing meteorological and hydrological observatories near the snout of the Dunagiri Glacier in order to carry out observations for the ablation season (June to September) 2015. Apart from this a manual staff gauge was also installed on the melt stream from Bangni Glacier.

Dr Sameer Kumar Tiwari, Sh Tanuj Shukla and Ms Shipika Sundriyal have carried out field work at Gangotri and Dokriani glaciers of Central Himalaya during May 06-29, 2015. Samples were collected for hydrological, meteorological studies in snow/ice of glacier to attain their inter relationships. Moraine sediment samples were also collected for OSL dating to investigate the paleo-climatic conditions of the region.

Drs P.K. Mukherjee, S.S. Bhakuni, Gautam Rawat, Koushik Sen and S.S. Thakur took a geological traverse from Dehradun to Malari from June 8-14, 2015. This field-visit was aimed at selecting significant locations and stops with important features, tectonic boundaries, contacts, etc., to be shown to the delegates of the HKT field Workshop, to be organised by WIHG in Oct 2015 at WIHG, Dehradun.

Dr D.P. Dobhal, Dr M. Mehta, B. Pratap, T. Shukla, A. Misra and A.C. Gairola have carried out field work at Chorabari Glacier (Kedarnath) during June 22-30, 2015.

Dr Vikram Gupta and Sh Vipin Kumar have carried out reconnaissance survey in the Kinnaur district of Himachal Pradesh to study the spatial distribution of active landslides in the area during June 23-28, 2015.

Dr V. C. Thakur, Dr R. J. Perumal, Sh Aravind and Ms Shraddha Jagtap carried out field work along the Ravi, Chakki, Bhini and Ujh river systems of NW Himalaya in Punjab and J. & K. states in order to investigate active faults in the region and to constrain the long term deformation rates along the NW Himalayan front. Active faults mapped using satellite imageries were identified in the field and Total Station surveys were carried out along the river cut sections. Several OSL samples from Quaternary terraces were collected to quantify the long term vertical uplift rates across the Surin Mastgarh Anticline (SMA) in the NW Himalayan front. A back thrust can be inferred along the Bhini river valley (photograph below) which brings the Middle Siwalik rocks over the Upper Siwalik rocks.

INVITED/INTERACTIVE LECTURES

Dr Vikram Gupta delivered lectures in the National Geotechnical Facility (NGF) to the officers of the Geological Survey of India (GSI) in a trainee course organised by the GSI on June 18, 2015. The title of lectures are:

- The Landslides and various geotechnical issues in the Himalaya.
- Geotechnical issues for the landslide mitigation in the Himalaya.

Dr R.J. Perumal delivered lectures at College of Military Engineering, Pune and Deptt. of Geology, Pune University, Pune, on July 09-10, 2015. The title of lectures are:

- Active faults in Himalaya and neighbouring Countries: Implication to strategic developments.
- Introduction to Active faults and Paleoseismology.

Ph.D. DEGREE AWARDED

Ph.D. degree was awarded to Sh Mayank Joshi by HNB Garhwal University, Srinagar under the joint supervision of Dr V.C. Thakur (WIHG) and Prof Y.P. Sundriyal (HNB Garhwal University). The title of his Ph. D. thesis is: "Climate-tectonic interaction in the morphogenic evolution of Ravi river basin in Chamba region, Western Himachal Pradesh, NW Himalaya."

Ph.D. degree was awarded to Mrs Leena Kamra by HNB Garhwal University under the joint supervision of Dr V.M. Choubey (WIHG) and Prof R.C. Ramola (Badshahi Thaul Campus Tehri). The title of her Ph.D. thesis is "Studies of radon and allied parameters as earthquake precursors in Garhwal Himalaya."

Ph.D. degree was awarded to Sh Sameer Tiwari by UPES, Dehradun under the joint supervision of Dr S.K. Bartarya and Dr S.K. Rai of WIHG. The title of his Ph.D. thesis is "Isotopic and geochemical studies of geothermal springs of north west Himalaya, India: Implication for source and Degassing of Metamorphic CO_2".

Sh Bhanu Pratap has submitted his PhD thesis to theUniversity of Petroleum and Energy Studies (UPES), Dehradun under the joint supervision of Dr D.P. Dobhal and Dr V.C. Tewari of WIHG. The title of his thesis is "Mass Balance of Dokriani Glacier, Central Himalaya: A Model in Response to Climate Fluctuation and Debris Cover".

Sh P.K. Garg has registered for Ph.D. at P.G. Deptt. of Remote Sensing and GIS, University of Jammu under the joint supervision of Dr Aparna Shukla (WIHG) and Prof A.S. Jasrotia (Jammu University) . The title of his proposed Ph.D. thesis is "Assessment of variable response of Himalayan glaciers to climate change using geospatial techniques."

CELEBRATIONS

Technology Day:

The Technology Day was celebrated in the Institute on May 11, 2015. On this occasion a special lecture was delivered by Retd. Vice Admiral Raman Puri, PVSM, AVSM, VSM in the Anjaneya Auditorium of the Institute. The title of his lecture was "Technology in Make in India- The Defence Sector".

Foundation Day:

The 47th Foundation day was celebrated in the Institute on June 29, 2015. The Foundation Day Lecture was delivered by Professor V.K. Jain, Vice Chancellor, Doon University. The title of his lecture was "Climate Change: An overview". The Best Paper award was given to Drs. P.K. Mukherjee, P.P. Khanna and N.K. Saini for their paper "Rapid Determination of Trace and Ultra Trace Level Elements in Diverse Silicate Rocks in Pressed Powder Pellet Targets by LA-ICP-MS using a Matrix-Independent Protocol." published in Geostandards and Geoanalytical Research. The best workers awards were given to Sh Rakesh Kumar, Sh B.S. Rana, Sh S.K. Gupta, Sh Tirthraj Ram, Sh S.K. Thapaliyal, Sh Rajendra Prakash, Sh Rambir Kaushik, Sh Tajendra Ahuja, Sh Navneet Kumar, Sh Dinesh Singh, Sh Pritam Singh, Km Shalini Negi, Sh Deepak Tiwari, Sh Ramesh Chandra Rana, Sh Girish Chandra Singh, Smt Kamla Devi, Sh Santu Das, Sh Ravindra Singh, Sh R.S.Negi, Sh M.S. Rawat, Sh. Hari Singh Chauhan, Sh Kulvant Singh Manral, Sh Rahul Sharma, Sh Hari Kishan, Sh Pritam Singh Powar, Sh Chet Ram, Sh S.K. Gupta, Sh Shyam Singh, Sh Sohan Singh, Sh Vijay Singh and Sh Rajesh Yadav.

AWARDS/HONOURS

Dr Nilendu has been awarded DST Young Scientist Project for the year 2015-2018. The project is entitled "Micrometeorological measurements and modelling experiments in the Pindari glacier."

SUPERANNUATION

Dr Rafikul Islam joined Wadia Institute of Himalayan Geology initially as a research student and then as a Scientist 'B' in 1988 and superannuated as Scientist 'G' on 30th April, 2015. His specialization was in Geochemistry and Himalayan Tectonics. Dr Islam has travelled in various remote sectors of Himalaya for more than 30 years and worked extensively on various geochemical aspects of Himalayan rocks. His studies also included Pan–African magmatism in NW Himalaya, Subduction complex of India–Asia collision zone, Structure, Geochemistry, Geochronology of Tso-Morari and Zanskar Crystallines. The results of his studies were published in several National and International journals.

Dr Sumit Kumar Ghosh joined Wadia Institute as Scientist 'B' in 1984 and superannuated as Scientist 'G' on June 30, 2015. His main areas of interest were in marine and fluvial clastic sedimentology in Proterozoic basins of Peninsular Shield, Lesser Himalaya and Cenozoic Foreland Basin. Dr Ghosh has published two books and several papers in National and International journals. He was a recipient of the prestigious National Mineral Award for the year 2000-2002.

Shri Shekharanandan superannuated on May 31, 2015 after forty two years of dedicated service. He joined the Institute on August, 1973 as an attendant and retired as section cutter. He was known as a polite and sincere worker of the Institute.

Dr Keser Singh, Scientist 'G', superannuated on June 30, 2015. Dr Singh initially joined Wadia Institute in 1981as SRA and was selected as Scientist B in the year 1984. His research activities were concentrated mainly on the structure and tectonics of fold-thrust belt in the NW Himalaya. He studied the rock-deformation and determined the strain ratios in the rocks exposed along the major thrusts, including tectonic evolution of the Kishtwar Window.

Shri Bharat Bhushan Sharma, superannuated on June 30, 2015. Sh Sharma joined the Institute in the year 1984 as Laboratory attendant and retired as Senior Technical Assistant. He was a hardworking and sincere employee of the Institute.

WIHG family wishes a long, happy and prosperous life ahead to these members.

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