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# दृष्टिकोण

वाडिया हिमालय भू-विज्ञान संस्थान

भारत सरकार के विज्ञान एवं प्रौद्योगिकी विभाग के अधीन
एक स्वायत्तशासी संस्थान

# Drishtikon

A half yearly newsletter of research scholars
Wadia Institute of Himalayan Geology

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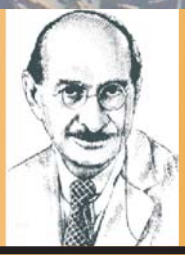


इस अंक में



*We want to hear from you*

*To inspire our readers and recognize your accomplishments we would like to feature your scientific/general article in our upcoming volume. Please send your articlesto: drishtikon@wihg.res.in*

## सम्पादकीय

परिवर्तन एवं गुणवत्ता के पायदानों पर चलते हुए, संस्थान के शोध छात्रों का छमाही पत्रक 'दृष्टिकोण', अपने चौथे अंक के रूप में आपके सामने है। आजादी के बाद निरन्तर अग्रसर भारत में स्वतंत्रता के अधिकार एवं प्रजातांत्रिक व्यवस्था के बीच विकास व्यक्तित्व भी हुये है तथा आधुनिक मापदण्डों के अनुसार विकासक्रम भी जारी है। विकास व्यक्तित्व जहाँ, आज की युवा पीढ़ी के लिये नायक रूप में स्थापित है, वहीं विकास क्रम पर विचार की आवश्यकता रहती है। सामान्य से नीचे स्तर से आरम्भ जीवन में, इन नायकों का अत्यन्त विकट परिस्थितियों से संघर्ष एवं उन पर विजय प्राप्त कर अति शीर्ष पर पहुंचना न केवल मानवीय जीवटता की कहानी है बल्कि लाखों करोडों के प्रेरणास्रोत भी हैं। भारत एवं भारतीयता पर गर्व के हमारे पास कई कारण हो सकते हैं, परन्तु सर्वोपरि कारण है "वसुधैव कुटुम्बकम" की हमारी भावना एवं विचार। यह विचार न केवल हमारे सद्भाव को प्रकट करता है बल्कि हमारे सहअस्तित्व की मान्यता भी प्रदर्शित करता है। फोकस में खोगेन के लेख के माध्यम से हम सभी अपनी श्रद्धांजलि अर्पित कर रहे है हमारे ही काल के हमारे नायक, भुतपुर्व राष्ट्रपति एवं महान वैज्ञानिक 'डा. अब्दुल कलाम' को। जिनका जीवन न केवल हमारे लिये अनुकरणीय है बल्कि जो स्वयं आज भारतीयता के स्तम्भ एवं भारतीयता पर गर्व का कारण बन चुके है।

दूसरी ओर, आधुनिकता का लिबास ओढ़े, विकासक्रम की प्रगति, प्राकृतिक संसाधनों के अंधाधुंध शोषण पर टिकी है। जिसके कारण विनाश के कगार पर बढ़ते विश्व में, विकास की परिभाषा पर मंथन की आवश्यकता महसूस होती है। विकास की इस दौड़ में हमें समझना होगा कि प्रकृति से सामंजस्य के बिना, विभिन्न आपदायें हमेशा मुँह बायें खड़ी रहेंगी। अभिव्यक्तियाँ में इस बार प्राकृतिक संसाधनों की विशिष्टताओं, उनके उचित दोहन तथा प्रकृति से सामंजस्य की आवश्यकता को प्रकट करती है 'जूली', 'तनुज' और 'श्रद्धा' की कलम अपने – अपने आलेखों में।

उचित शोध के बाद ही तकनीकी ज्ञान उपलब्ध होता है तथा भविष्य के शोध में उपलब्ध तकनीकी ज्ञान का प्रयोग, शोध की विशिष्टता अथवा उपयोगिता बढ़ा सकता है। कुछ ऐसा ही कहने की कोशिश करता है 'संजय' का लेख 'विज्ञान में संगणन का युग'। शोध विज्ञान में 'विपिन' के भू–स्खलन अध्ययन हेतु क्षेत्र भ्रमण के अनुभव एवं अरूण की कूट–टेकीलाइट पर जानकारी के अलावा अन्तर्दृष्टि में 'इमलीरेनला जमीर' ने अत्यन्त खुबसुरती से जीवन के सार को भू–गर्भीय शब्दावली में संजोया है। इन सबके साथ, आपकी टिप्पणीयों की प्रतीक्षा में यह अंक आपके सम्मुख प्रस्तुत है।

**This page is a tribute to late Dr. A.P.J. Abdul Kalam**

**A portait of Dr. APJ Abdul Kalam**
**Aravind A. (**JRF)

Dr. A.P.J. Abdul Kalam, the 11th President of India from 2002 to 2007 was one of the greatest personalities of India. He was a pioneer scientist, a leader and moreover an inspirer who had turned and directed many lives in India. He was a guide to millions of young hearts. he taught that dreams can always be full filled and that hard work is never left unrewarded.

## HOMAGE TO KALAM SAHAB

Kalam Sahab loved India for many reasons, but the most he liked about India and it's people with gratitude was that Indians never conquered anybody's land in the history like British and other empires did on us. Neither had we looted anybody's wealth like we were looted for eons of years. This is what that made him proud of being an Indian; not to be greedy like the rest of the world. He often said we did not conquer any land because we always respect freedom of others and believe to live with harmony. So much of positivity in mind and patriotism at heart is what Kalam Sahab was. He grew up as a child who refused to be defeated by circumstances and was brave enough to ride against the tide of poverty by earning money as a newspaper vendor to support his studies. Later, he became a top-notch scientist and the most proclaimed president of India who was always loved by all. His persistent hard work, courage, dedication and devotion to his duty became the fertilizer for his success as a leader of the Indian Missile mission. With his team, he ultimately proved that India is not less than any other countries in terms of intelligence, power and capabilities.

He was also a man of simplicity and truthfulness. During his presidency, he disliked those people the most who always say "Yes sir" to him. He was rather very happy when somebody honestly disagreed with him and if the reason is 99% logical, Kalam Sahab would change his mind and accept the opinion of the person. He always welcomed new ideas and innovations coming from people around him and often used to say "This is not Rashtrapati Bhavan but People's Bhavan." One day on a long official journey, he noticed a commando with his gun standing all day long on a vehicle that was going ahead of his car for protection. When they reached their stop, Kalam Sahab went straight to the soldier and shook his hand with thanking words. He believed that no one on earth is above or below to anybody. Any form of service or duty deserves respect. Such a modest person was our ex-president. He felt quite comfortable sitting beside a cobbler or a barber and have a warm conversation, like a good friend talking to his friends. Humanism always comes first to him while professionalism takes a back seat. How can a person enjoy his life by donating all his earnings to the less privilege kids and spend his post-retired life without any savings? How can a person satisfy himself by keeping only three pairs of suits and about 2000 books as personal property? Yes, that was what Kalam Sahab did without any regret and took his last breathe while giving a scientific lecture to a group of students at Shillong.

Today, the Missile man has gone for a long voyage without a return ticket, leaving behind thick piles of inspiration and courage to the minds of Indian people. The life that had begun as a poor kid became an epitome of success and his story has entered into the archives of GREAT INDIAN STORIES. He proved that being humble is the most royal attitude, hard work is the best habit, knowledge is the real power, confidence and smile are the two most beautiful things to wear everyday.

*Kalam Sahab, I was not blessed to meet you in flesh and blood, but was always inspired by your vision and personality. You came on earth like a rain which quenches the thirst of dry earth.*

Adieu, Dr. Kalam, Rest in peace

**S. Khogen Singh** (SRF)

## शोध विज्ञान

**The Era of computing in Science**

*"Computing is not about computers any more. It is about living" says Nicholas Negroponte.*

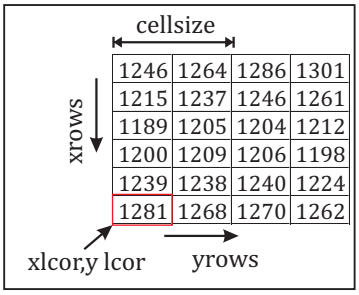
Computing can be defined as a systematic study of algorithmic processes that describe and transform information. It is simply "What can be (efficiently) automated?" Because society needs people to do computing well, we must think of it not only as a profession but also as a discipline.

At present in Earth Science community majority aims to generate the data. The dependency now lies on some processing software to further process the data. However, holding an eye only upon the outputs will not resolve the problem of getting deviated results,

whence we adjust or apply tricks to get the desired output. The problem could be resolved only if we question "How the processing happened?" Going down to the number system one could understand the reality of complex and non-linear natural systems.

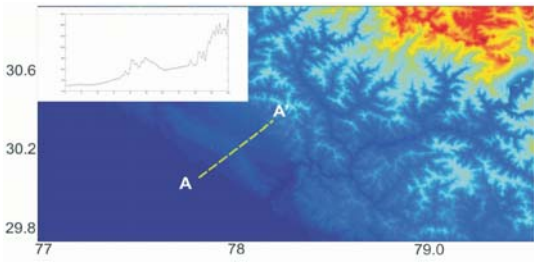
The improvement of output lies in the error. Therefore, one should understand these errors. It is possible by computing the data with your own base of mathematics either by developing algorithms or use the predefined algorithms. It is the key to access your data at each and every step of processing and to view its transformation which takes you to the target. To discuss practical means of computing rather than just a theory I would like to submit an easy algorithm to make you understand what the Shuttle Radar Topographic mission imagery data looks like and how you can on your own further process the things.

The "srtm.arc" is provided with header information as shown below.
ncols = 3103; %%% number of columns
nrows = 1434; %%% number of rows
xlcor = 76.96308505; %%% corner longitude
ylcor = 29.72869006; %%% corner latitude
celsiz = 0.00083333333333333; %%% cell size in arc degrees.




The research could face definite end due to limited approach of available software. But once you know computing you can process the data as per your requirement. As per your comfort in any coding platform you can built your own code. A demo code has been developed in the MATLAB which will guide you to load and plot SRTM data. The output plot also shows a 2D topography profile AA' (inset) which can be plotted using another code and is out of approach of the provided code.

```
%%% A Program to load and %%% plot SRTM ASCII DATA
clc; clear all; close all
%%%% Define Header and load %%%% file
ncols  = 3103; nrows  = 1434;
xlcor  = 76.96308505; ylcor  = 29.72869006;
celsiz  = 0.00083333333333333;
 A=load('srtm_data.txt');
%%%  Parameterization of data
format long
xucor=xlcor+celsiz*ncols;
yucor=ylcor+celsiz*nrows;
xrange=xucor-xlcor;
yrange=yucor-ylcor;
l=xlcor:celsiz:xucor-celsiz;
m=ylcor:celsiz:yucor-celsiz;
[L,M]=meshgrid(l,m);
M=flipud(M);
%%%% Plotting the data %%%%%%
el=A(:,:);
[mz pad]=vec2mat(el,ncols);
surf(L,M,mz)
shadinginterp
view(0,90)
xlim([77 79.5])
ylim([29.8 30.8])
set(gca,'XTick',[77:1.0:79.5]);
set(gca,'YTick',[29.8:0.4:30.8]);
%%%%%%%% end %%%%%%%%
```




by **Sanjay Negi** (SRF)

## Fossil earthquakes: Overview of Pseudotachylytes and its Paleo-seismic signatures?

Pseudotachylytes as first termed by Shand (1916), are similar in appearance with the glassy basaltic rock Tachylyte. These are rare fault rocks, formed only during high-velocity seismic events or through extraterrestrial impacts. Hence, these rocks are often called as fossil earthquakes (Lin, 1994; Chu et al, 2012; Austrheim & Andersen, 2004; Lin, 2007). They typically possesses black, glassy or more commonly a fine to medium grained groundmass (matrix), aphanitic to glassy veins, of varying width, interpreted to have formed from the frictional melt. The matrix encloses clasts of minerals and rock fragments, mainly derived from the immediate wall rocks (John et al, 2009). It indicates that the Pseudotachylyte formation involves melting and not solely by cataclastic (Magloushin and Spray, 1992). However, cataclastic margins and clasts of cataclastic indicate that the early stages of their formation involves communition (the reduction of solid materials from one average particle size to a smaller average particle size, by crushing, grinding, and other processes during faulting at upper crust of the Earth). Melt-origin pseudotachylyte generally contains numerous minute crystals known as microlites, which are also found in volcanic rocks. The presence of microlites of various shapes is considered to be a distinct characteristic of pseudotachylyte derived from a melt (Shand 1916; Park 1961; Sibson 1975; John et al, 2009). While the processes of pseudotachylyte generation are frequently disputed, it is agreed that seismogenic pseudotachylyte is unique being the only known rock that forms exclusively at seismic slip rates. As such, seismogenic pseudotachylytes are able to preserve many dynamic processes of paleoearthquakes and can itself be considered as a fossil earthquake. In the following paragraphs I hint about the presence of pseudotachlytes and the importance to study them for paleo-seimic activity in the Himalayan collision zone as well in the mid crustal regions of India

## In Himalayan collision zone:

The Almora Crystalline Zone (ACZ) in the Kumaun Lesser Himalaya is characterized by the typical occurrence of a variety of mylonite types along its southern boundary (SAT) and is marked by a high degree of shearing, pulverization and recrystallization of rocks (Bhattacharya and Agarwal, 1985). Within this mylonite zone, thin-dark-coloured veins of pseudotachylytes are reported by Agarwal et al (2011). Folded veins of irregular thickness are also observed. It indicates that the intense deformation and friction-related heating is generated during the seismic slip along thrust sheet, which is responsible for producing the melts. Rapid frictional sliding during the thrust sheet movement would have generated heat at the base, resulting into the formation of melts locally. Rapid crystallization of this melt has resulted in thin veins of pseudotachylytes (Sibson, 1975; Lin, 1994). Fault veins are interpreted to decorate the generation surfaces where frictional melt is produced during seismic slip and from where most of the melt is extruded to form injection veins (Sibson, 1975; Swanson, 1992). The detailed studies of these Himalayan pseudotachylyte veins will provide the better

relationship with the seismic activity along the Himalayan thrust sheets.

### In Peninsular regions:

Pseudotachylytes are also common in mid-crustal conditions particularly along the shear zones. Gangavalli shear zone in Salem, Tamilnadu, is one of the shear zones of the Southern Granulite Terrain (SGT) (Ghosh et al, 2004). The shear zone rocks have been mylonitised to varying degrees. Brecciation and retrograde metamorphism have taken place along the shear zone. From the bulk chemistry determined by XRF, the Pseudotachylytes are inferred to have been formed as a result of nearly complete melting of former quartz, feldspar, pyroxene and mica dominated rock i.e., charnockite. It is inferred that the Gangavalli shear zone developed subsequent to the upliftment of the charnockites to the upper part of the crust (Biswal et al, 2010). The clast matrix study of these pseudotachylytes thin sections have been analyzed using GIS based Image processing techniques. The results show that the thermal gradient developed during the faulting process was more in the central portions of the shear zone (Prasath, and Thirukumran, 2010, Unpublished work). The more studies like geothermometric mapping of the entire fault zone which will enlighten the intensity of earthquake related process that cause the formation of Pseudotachylytes.

Even though, the laboratory experiments of pseudotachylyte formations suggested to reconsider the use of Pseudotachylytes as indicators for paleoseismic events (Pec et al, 2012), pseudotachylytes are proposed to be a perfect rock record for the paleo-seimic signatures in natural mode of formations. On the basis of pseudotachylyte volumes and energy balance calculations Sibson (1975) estimated dynamic shear stress resistance during co-seismic slip and Wenk et al (2000) compared past earthquakes in exhumed paleo-faults with actual micro-earthquakes at parkfield along the San Andres fault. Also, the pseudotachlytes can also be studied with respect to the large paleo-landslides Masch et al. 1985.

by **Arun Prasanth** (SRF)

## अभिव्यक्तियाँ

### Landslides and Bhagirathi

It was quite interesting to think of geological field work when we were told by our supervisor to go to the Bhagirathi Valley in Uttarkashi district of Uttarakhand (India). On Day 1st I was full of mind that I will not leave any stone unturned to model the landslides of the region for prediction of their future occurrences. Later on as days passed, I realized that such disasters have more to say than we read in the bunch of research papers. I see here huge rock fall, tremendous debris slides of 10s-100s meter height with 100-300 m width along the road (NH-108). The rock exposures, which are visible to us by the road making blasts, tell quite complicated history of their genesis. Sometimes, it took 3-4 hours in only identifying the pattern of rock. The intimated metamorphic rocks keep you puzzled with their sudden spatial variation. The Quartzite and Schist rock play dominance in the rock empire here. However, we did our best to see the rock from all perspectives of the Geology and Geotechnique, but we find ourselves limited in extrapolating the inner story of exposure which is actually controlling the facial behavior along road.

It would be meaningless if I don't mention here the magnificent river "The Bhagirathi". The blue turbulent water to which when winds touch; feeling of it becomes as cool as ice. Its sharp turns which are in existence by the cutting of the mighty mountains make us aware of its hydraulic power. The consistent sound of its movement and song of birds along its bank drive you to some other world. But beauty never comes in easy way so the river destroys the path lying shelters when it is flooded. The roads, houses, shops, hotels and agricultural lands all went into vain when Bhagirathi came into flooded mood in June 2013.

by **Vipin Kumar** (JRF)

### Hour of need

A gaze at the Earth from the inevitable space seems breathtaking to all. One can simply adore its beauty and magnificent size, but less really understand the destructive processes going on that shape our dear planet every minute. Our basic academics at school level paint a pretty picture of the Earth and leave us in a daze of childish wonderment. However, any amateur ambitions of studying the Earth remain unheard in our conscience. Growing up we get caught up in the tangles of modern life; getting a good education becomes our priority subsequent to which attaining a job for a desired field or repute gets tricky in this fast money powered community. However, our troubles don't meet an end even after attaining a decent living nor do we achieve a peace of mind with the existing norms of society and tradition. But somewhere, little content is always found in doing some good towards the environment or other individuals.

Everyone has a visualization of an abundant future full of goodness yet we side track that constant lingering of warnings in our minds brought out by events of tragedy and misfortune. But misfortune is it really? Our bad actions have a miraculous effect of rebounding on us in mysterious fashions. Karma as we call it, often points its finger justly. I agree not all disasters are induced by humans but I blame our race for the ignorance to understand the consequences and causes responsible for them. Theories of new evolution of species to adaptation/hybridization in a now toxic world, climate change and other events of pseudo-natural calamities we read about from time to time. They are saying something which we mustn't discourage but strongly consider.

As youngsters, we are all given a good education from the beginning yet see ourselves getting driven into the power craze or success races of anarchy. I see that there is a good success rate there but what's their stand when the ground beneath their feet crumbles? Our mysterious nature being made up of oceans, climate, atmosphere, mountain chains and trenches, biotic life, etc. represents a vast beacon of knowledge blessed with fewer devotees. We witness changes in front of our eyes and simply curse our misfortune. It is more! It is nature's way of creating a balance to sustain in itself and yet we burden our development



*"All Birds find shelter during a rain. But an eagle avoids rain by flying above the clouds."*

and success on it. Why this ignorance? Is studying our planet really considered so trivial?

Put aside those rotten conformist beliefs and unite towards common growth of humanity. Because the wrath of nature when descends will fall equally on one and all. So why waste millions of lives imbibing futile trends of nascent lifestyles instead of delving in to research towards a sustainable and extended future? Give it a thought or rather give action to the thoughts that always ponder your minds.

Care less about biased ethics of development and aptly do your part of good towards the environment. Stop breathing the smog of mechanic repulse and living in the smug of fascist policies.

But I don't mean to control what's natural, for that's inevitable, an unfortunate boon from our creator. I only wish we accept these changes and adapt to it like all other animals of our living system do. And imagine being able to forecast events beforehand with strong senses and carry out the necessary mitigation measures.

Think like scientists because money has no real value in this universe nor has reputation. Wealth or fame cannot pave your way to safety. In a nutshell, life will expire before you know of the end. So, it's time you look up from your rudimentary phones and let your eyes do the photography. Nurture your interests with reality and explore life while it's still living. Inspire and inculcate better values in young minds. They will be the leaders of tomorrow's era and may they flourish life with fulfillment.

This article may impart less inspiration than criticism, but I hope it does the needful. An inspiration among young minds towards their duty to the Earth is the hour of need and it needs no further emphasis.

by **Shraddha Jagtap** (JRF)

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## अंतर्दृष्टि

Sedimentarily entered the domain of Geology,
Juvenile and shallow.
Metamorphically, recrystallized and moulded
to a new form and at times
the inability to take pressure resulted into fault.
Igneously, assimilated and ready to fill the cavities.
In this endless pit of learning,
the journey continues in the geological time scale.

by **Imlirenla Jamir** (JRF)

## Gift of God

*I'm a gift of God for*
*you people…*
*I' m water,*
*Trapping as glacier,*
*As crown of mountain,*
*Flowing freely,*
*Wetting thirsty ground,*
*Ornamenting it with*
*greenery,*
*Giving you life.*
*As I say…*
*I'm a gift of God*
*I'm vegetation,*
*Giving you oxygen,*
*Absorbing the poison,*
*Providing you food,*
*For your hunger;*
*Giving you wood,*
*For your good.*
*As I say…*
*I'm a gift of God*
*For you people…*
*I' m wind,*
*Unseen and untouched,*
*Like your soul,*
*Always invisible,*
*But…*
*Always around you,*
*To feel you alive.*
*As I say…*
*I'm a gift of God*
*I'm energy,*
*Have many faces of many*
*colours,*
*Sometimes black as*
*Coal too,*
*But…*
*With you always,*
*Protect you all time,*
*All day and all night,*
*Because…*
*I'm for you people,*
*Coming from Heaven,*
*To the Earth,*
*For only you people,*
*Come and take me,*
*In your leap,*
*Don't let me go!*
*Away from you…*
*A very far distance…*
*Where you could*
*never reach....*


by **Jooly Jaiswal** (JRF)

## A Trek to Nature's heart

Glacial terrains are known for its high-risk factors like remoteness, steep gradients, thick presence of snow/ice, debris (rock fragments), avalanches, glacial lake outbursts, and earthquakes threatening life in mountain areas. Inaccessibility and high elevation hinders development in mountain regions. Therefore, mountainous regions are often marginalized. Despite these limitations, we have opted to work in such a high altitude and harsh conditions and developed sophisticated techniques to monitor our glaciers in a rather simple manner. This time we were working at the one of the largest glacier of Himalaya. The great Gangorti glacier! It's great for nature and trek enthusiasts, also a pilgrimage. The 18 km (I think it is a little more than that!) trek to Gaumukh from Gangotri takes about 8 hours at a medium pace. The path, at some places, is quite tricky. The last couple of kilometres are quite rocky. I have felt the harsh cold of the glacier and dug a snow pit there. That breath-taking feeling still remains in my heart. Delights on the way- clumps of pretty woodrose bushes, the surefooted ibex herds you are sure to come across and 'bhojpatra tree' the bark of which was used to write the ancient holy manuscripts, clear, natural Himalayan mineral water from the springs you will cross. Making sure to bring back the 'Gangajal' - right from where it originates! There is Ganga arti by the river in the evening at Gangotri which is followed by evening prayers at the main temple. It is out of world experience to trek in Barren Mountain, with little vegetation, but suddenly you turn spiritual. One thing is for sure, it is not for fun, the journey tests your physical and mental strength.

by **Tanuj Shukla** (SRF)

## शोध पत्र


- Das Souvik, Mukherjee Barun K, Basu A R, **Sen Koushick.,** 2015, "Peridotitic minerals of the Nidar Ophiolite in the NW Himalaya: sourced from the depth of the mantle transition zone and above" Geological Society, London, Special Publications. Vol - 412, Issue-SP412-12.
- **Kamra, L.** (2015). Seasonal emanation of radon at Ghuttu, northwest Himalaya: Differentiation of atmospheric temperature and pressure influences. Applied Radiation and Isotopes, 105, 170-175.
- Paul, A., **Prasath, A.R.**, & Singh, R. (2015). Slip heterogeneities evaluated for earthquakes M> 4.0 using waveform modelling in the Garhwal region of Central Seismic Gap in Northwest Himalaya, India. Himalayan Geology, 36(2), 153-160.
- Vikram Gupta, Hemlata Nautiyal, **Vipin Kumar, Imlirenla Jamir,** Ruchika S. Tandon, 2015. Landslide hazards around Uttarkashi township, Garhwal Himalaya, after the tragic flash flood in June 2013. Nat Hazard DOI 10.1007/s11069-015-2048-4
- Vikram Gupta, Rajinder K. Bhasin, Amir M. Kaynia, **Vipin Kumar**, A.S. Saini, R.S. Tandon & Thomas Pabst, 2015. Finite element analysis of failed slope by shear strength reduction technique: a case study for Surabhi Resort Landslide, Mussoorie township, Garhwal Himalaya. Geomatics, Natural Hazards and Risk. DOI 10.1080/19475705.2015.1102778, Published Online 2nd Nov. 2015.


## उपलब्धियाँ एवं पुरस्कार

- **Mr. Arjun Pandey** and **Mr. Aravind A.** qualified the GATE examination in January, 2015.
- **Ms. Jooly Jaiswal** has been selected as a Geologist in Geological Survey of India.
- **Mr. Dhirendra Yadav** was recruited as Scientist at the Bhaba Atomic Research Centre, Hydrabad.
- **Ms. Priyanka Rao** joined the Geological Survey of India.
- **Mr. Mayank Joshi** and **Mr. Kaushick Sen** have been awarded the doctorate degree in the year 2015.
- **Ms. Shubra Sharma** received best poster award during *XII International Symposium on Antarctic Earth Sciences*, 13-17 July, Goa.
- **Mr. Rajeeb Mishra**, **Mr. S. Khogen Singh**, **Ms. Manju Negi** and **Ms. Rupa Ghosh** got promoted as Senior Research Fellows.

## शोध सारांश

### PhD Title: "FORMATION AND TECTONIC EVOLUTION OF ZILDAT OPHIOLITIC MÉLANGE, INDUS SUTURE ZONE, NW HIMALAYA, INDIA"


### Summary:

Mélanges (French 'mixtures') are the mappable units of chaotic rocks, formed in the accretionary wedge above a subduction zone, commonly found at the convergent plate margins. Mélange preserves signature of complex multi stage tectonic processes. The Zildat Ophiolitic Mélange (ZOM) is one such classical mélange that created mainly by coupling effect of subduction and accretion at the expense of Neo-Tethyan subduction and India-Eurasia collision.

The ZOM is characterised by disrupted multi-layered tectonic slices of composite lithology. It has oceanic lithospheric aggregates arranged in a block-in-matrix fashion which are highly disrupted in nature. The ZOM is a multilayer tectonic slices composed of ophiolite fragments, metabasic volcaniclastics, oceanic sediments and reworked clasts of various oceanic components.

The overall mélange package is heterogeneously deformed with a gradation of shearing intensity moving across the ZOM. A wide range of mineralogical assemblages found within the melange suggests a clock wise P-T evolution from a high-pressure (blueschist) condition to lower greenschist facies via epidote-amphibolite condition. The obtained P-T condition from the melange matrix cannot be correlated with the metamorphism of individual clasts present within ZOM.

Merging the various components present within the ZOM, it suggests a poly-metamorphic evolution of the melange.

A prominent fluid rock interaction is observed within the melange which caused by large scale mass movement, evaluated

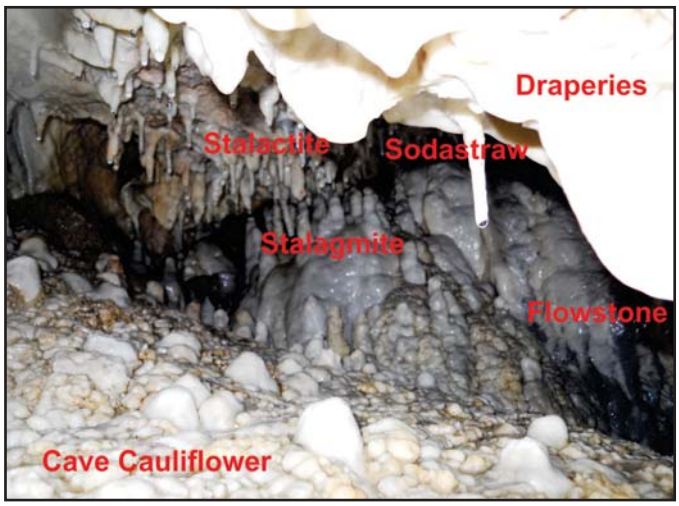
from geochemical studies. Stable Isotope study of ZOM carbonates show a bimodal distribution pattern of isotope values suggesting considerable amount of fluid infiltration prevailed at the last stage of mélange evolution. The restricted silica rich fluid was derived from the adjacent continental rock of Tso-Morari Crystalline at the latest stages of melange emplacement. The emplacement of ZOM is not uniform. It is squeezed up during continued continental convergence with the presence of two oppositely dipping thrust boundaries, where the rigid Nidar Ophiolitic Complex (NOC) acted as a fixed boundary back-stop. The presence of serpentine and talc can be acted as lubricator to assist the emplacement.

The bulk geochemical analyses of the basic (basalt) rocks of ZOM suggests their alkaline OIB affinity, formed in within plate tectonic setting. They hint a pre-subduction volcanism event, prior to the melange formation.

by **Kaushick Sen** (ESRF)

## फील्ड फोटो गैलरी

**1. Geomorphic Structure inside the Sahastradhara Cave, Dehradun.**




**Geological Importance:** ***As climate Recorder.***

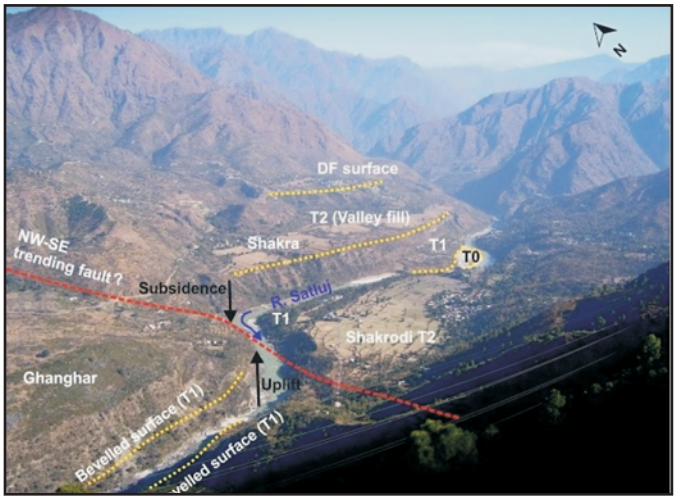
Their unique ability to be accurately dated over much of the late Quaternary period using the uranium-thorium dating technique, makes them special in the field of palaeoclimate. Stalagmites and flowstones are particularly useful for palaeoclimate applications because of their relatively simple geometry and because they contain several different climate records, such as oxygen and carbon isotopes and trace cations.

These can provide clues to past precipitation, temperature, vegetation and hydrological changes.

***by:*** **Jooly Jaiswal**, (JRF)

**2. Panoramic view of the Satluj valley (Himachal Pradesh, India).**

Panoramic view of the Satluj valley (Himachal Pradesh, India) around Shakra with three levels of valley-fills modified into T3, T2 & T1terraces.



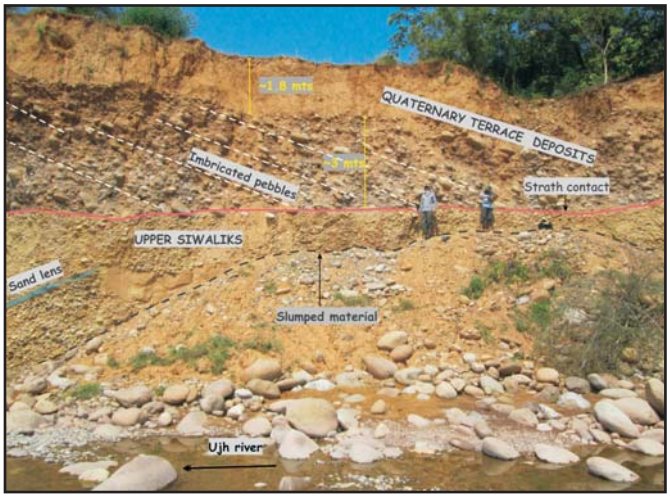

**Geological Importance:**

A prominent strath surface overlain by debris flow towards the downstream segment is inferred as an expression of differential movement along the inferred NW-SE trending fault (Shown in red dotted line) and sense of movement is marked by the black

***by:*** **Shubhra Shrama**, (SRF)

**3. Strath terrace along Ujh river valley, Jammu**

**Geological Importance:** ***Long time record of tectonic activity.***




Strath terraces result due to lateral downcutting of bedrock along valley sides and preserve a long time record of tectonic or climate activity.

The photograph shows a section of the strath race along the Ujh river overlying the Upper Siwalik beds dipping gently towards south.

***by:*** **Shraddha Jagtap**, (JRF)

**4. Seismites at P-T boundary (mass extiction between Permian & Triassic), Guryul Ravine in Kashmir**

The term Seismite was first proposed by Seilacher (1969) that literally means a redeposited sedimentary layer formed by unconsolidated submarine deposit that had become affected and deformed by seismic activity in a tectonically active region.

**Geological Importance:**

These seismite deposits preserving just below the paleontologically defined P-T boundary at Guryul Ravine (Kashmir, India) are the only evidences found in India for occurrence of very large earthquake and tsunamis, in close association with the end-Permian mass extinction.

***by:*** **S.Khogen Singh**, SRF

**5. Gullies & Ravine along Yamuna River, Uttar Pradesh.**

View of deeply incised gullies and highly Ravine topography along Yamuna River at Daulatpur region of Ganga foreland Basin, UP.

**Geological importance:**

Gullies and ravines are both erosional features. Gullies are formed as a result of localized surface run-off and developed from several rills. Ravines are basically an extensive systems of gullies developed along river courses.

***by:*** **Rupa Ghosh**, (SRF)

**6. Crossbedded Gravel, yamuna River, Uttar Pradesh.**

A large scale cross bedded Gravel mainly composed of calcrete clasts along Yamuna River, Ganga foreland basin, Uttar Pradesh.

**Geological importance:**

Cross beddings are near horizontal unit that is internally composed of inclined layers and occurs at various scales. It is a good indicator of paleocurrent direction.

***by:*** **Rupa Ghosh**, (SRF)

Cover photo: Panoramic view of Pawari landslide zone, Reckong Peo, Kinnaur, H.P. by Vipin Kumar