

Answers of the questions of the participants by various speakers

Answers of the questions to Prof. A.K. Singhvi

**Q-1:** Great to listen to you, Sir. One question, is there any formal committee to address or deal if any breach in these ethical aspects?

**Reply:** Most institutions are now expected to have committees for ethics and gender issues. Academies have an inter-academy panel and CSIR has recently adopted guide-lines and are implementing these. So I would assume that there is a general awareness. One should first seek redressal within its system but if it goes out of control then Academies can be contacted – but they only have moral/ advisory control and not statutory control.

**Q-2:** (Prof. A K Singhvi sir) Sir, As you talk about different ethics for being a responsible scientist. It all begins with a good education from primary level. I have seen so many government schools around my village but almost of them are very unprepared to transfer good education to their students. Students of 8th 9th classes are not even able to do basic sums. Every basic need is out of these students' reach. Moreover in other schools too the practical approaches are missing and almost the curious minds become uninterested till they come to high school. Is this a failure of our education system or something else? Are these ethics difficult to implement in a country with high population and poverty etc?

**Reply:** Ethics is a responsible social conduct and applies to all- in academics and out of it. Human values, relationships and responsibilities are same irrespective of one's latitude and longitude. The difference arises from variations in priorities, value system and culture, discipline and whether the social leaders have a vision that is myopic or a long term with global good in mind. Misplaced priorities have led to commercialization of education and this has resulted in marginalization of school teaching, that once was a worthy profession. We are thus producing qualified workers who are not necessarily good human beings. And this chain continues, ad infinitum.

Thus, what you state and observe is painfully true and a reality and is a reflection of priorities of those who govern us and on the society that support such a governance. Unfortunately, the society has lost its narrative on Education and I shudder to think of India, where superstition supersedes reason and this is buttressed by lack of respect for others rights and alternative narratives. And this is increasingly becoming all pervasive.

This was the reason I mentioned that rather than waiting for the governance systems to do anything, if each of us decides to train 10 students in a year with the same intensity as we will for our children, then a Wadia would have helped 2000 students per year and a IITR 10000 year. I feel it is time for academicians to take charge, assume a responsibility of delivering an evidence informed society that is reasonable and rational and ensure that all our teachers and students are well trained and competent. Let us not complain, but do it and make a difference.

This will be our socially responsible, ethical behaviour as a community.

Thanks for raising this question.

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## Answers of the questions to Prof. S. K. Tandon

**Q-1:** Sir, since, the use of plastic is an indicator of human influence. Why don't scientist use Plastic as a marker layer to define Anthropocene.

**Reply:** Microplastics are indeed found in the oceans, soils, terrestrial environments, and ice cores, can be used as local stratigraphic markers, but would have limited value for purposes of defining the base of the Anthropocene.

**Q-2:** (Prof S.K.Tandon) Sir, it was very interesting to listen you on the topic Anthropocene. You talked about changes which are brought by human activity during different times, which was severe in past decades. During lockdown and restricted human motions ,would we detect any change in Earth's motion and also in subsurface activity? As billions of humans' motions create a complex of different forces and after lockdown it has stopped to a limit. Those forces suddenly disappeared. Apart from clean water and climate and detecting small mag earthquakes, would there be any short term or long term effect on Earth system?

**Reply:** Apart from the points already mentioned by you, there should have been short-term changes in the atmosphere-hydrosphere-biosphere interactions regarding which I have not seen any reports. Other points mentioned by you like clean water, aerosol loading, and detection of small magnitude earthquakes have been noted and commented upon in published/ unpublished reports.

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## Answers of the questions to Dr. Vineet Gahalaut

**Q-1:** What is the probability for such a dense populated country to implement measures for different hazards, given by Earth Scientists? Like a UT like Delhi has one of the most vulnerable structures to face large Earthquakes. Is there a gap between the scientific research and common people? And how can the people create a balance between nature and development? What can be the different measures to ensure the implementation of scientific research?

**Reply:** Excellent question. There is a huge gap between the scientific research and common people. Our understanding of hazards in most parts of India is quite good. But then there are problems when it comes to public. The biggest problem is the implementation of building codes. The moment we start following building codes as per the seismic hazard zonation map of India, damage and loss of lives can be easily minimised. To me, the enforcement of these codes is the only solution. General public, although aware of the hazard, do not take measures of structure reinforcement, thinking that the earthquake may not occur in their life time, or, earthquakes occur elsewhere, but not in my region. This is like assuming that accidents on road happen, but it would not happen to me. The issue is also linked with the poverty. But the implementation of building code is the biggest bottleneck in India.

**Q-2:** Sir, if we see the convergence rates at the eastern Himalaya, which is comparably high from the western and central Himalaya, also segmented and started rotating clockwise with respect to India. I want to ask is there any effect of the segmentation on the convergence rates at the eastern Himalaya.

**Reply:** The issue of segmentation has been discussed quite extensively while dealing with the extents of earthquake ruptures. It has also been proposed that the segmentation may help in accommodating the varying convergence rate from one block to the other. However, as we know that the plate motion and convergence is spatially variable in terms of magnitude and direction because the plates or the arcs actually rotate as spherical plates and not as planar surface. This is to ensure that the plates do not leave the earth's surface (remember the Euler's pole). So the motion along the arc can be linearly varying and may not require segmentation, as such.

**Q-3:** (Dr Vineet Gahalaut) Sir, in the displacement-time graph you have shown that if curve of motion of a particular place matches with the plate motion, then there is no strain accumulation and if it is less than there is strain accumulation in that area. Is it possible that displacement of any particular place is more than the plate motion, means the linear curve is above plate motion curve and if yes, what are the forces and structures there?

**Reply:** In case of rapid or accelerated slip during the postseismic deformation, the motion can be more than the plate motion. Similarly, during the accelerated slow slip, seen in some subduction zones, the motion at a site can be more than the plate motion.

**Q-4:** I am just curious to know that, recently it has been said that the Earth's magnetic pole is shifting (from Canada to Siberia). Since the geomagnetism of the Earth is generated due to the convection taking place in the Earth's core, and this convection is also the driving factor for the plate tectonics. So is it that the increasing number of earthquakes that we see now a days is related to that. so is there a connection in pole shift and earthquakes?

**Reply:** A very good once again. I am not sure whether the frequency of earthquakes has actually increased in recent times. In a geological process (an earthquake cycle is also a part of it), there are periods of activation and quiescence. So to declare whether the frequency of earthquakes have increased or decreased, we really need to have a very long time series, may be a few thousand years long time series of earthquakes. Unfortunately, the earthquake catalogue is only good and complete for a few hundred years. Thus, whether your perception of increased earthquake frequency is real or not, cannot be ascertained. Nevertheless, I came across a paper which talked about the similarity in the long term periodicity (~32 years) in earthquakes and a process at core-mantle boundary. But whether they influence or are linked with each other, we do not know as yet.

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## Answers of the questions to Dr. A. K. Bhaumik

**Q-1:** What are the evidences or indicators that prove the oil reserved or vice-versa from your study (or any old records) on Foraminifera in the KG Basin? If possible, please give us a statement on the economic viability of this oil reserves from paleontological point of view.

**Reply:** First of all say foraminifera never says about generation and accumulation of oil as both the vents are post-depositional events. Deposition of fossils within sediment is a syngenetic event and foraminifera only records those events, which they experience in the living time. Such as, influx of organic carbon, availability of food. Cooling or warming, presence of methane etc. After death, they can't record anything. So, basically foraminifera can give ideas about some parameters which may favourable for generation of a probable source rock. Mind that, a sediment having all quality of good source rock may not yield oil until and unless it experiences catagenesis.

However, foraminifera can help you to find the age of the rock, which is very important as I said in my presentation (6 geological intervals covers 91.5% of the global source rock). Here we may go for some sorts of assumption like, foraminiferal association shows some conditions are satisfactory (e.g. TOC very high, anoxic environment, muddy sediments) and the age of the sediments are within these 6 intervals (e.g. middle Cretaceous). Then we may think about a source rock. However, until and unless it is cooked properly we can't get oil. Also, oil and gas migrates to reservoir rock after its generation. Thus, we can't talk about oil or gas reserves using foraminifera.

However, if methane is produced during the deposition, then it will affect the habitat of foraminifera and similar reflection you will get in them including lighter d13C values.

I can't comment on the oil reserves in the KG basin. However, regarding gas hydrate, I can say the survey is not done enough to quantify the amount. As per my belief, still it is over estimated. But, if the estimation is correct, then it can change the energy scenario of India.

Hope this will satisfy you.

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## Answers of the questions to Dr. Pradeep Srivastava

**Q:1-** Does paleo flood correlate with paleolake sediments?

**Reply:** Pleofloods sediment only records extreme flood events of a river. Lake records are climate records. In case of our study in Ladakh we find that Lake record of Pangong Tso is in close correspondence. Phases with strong ISM rainfall are correlating well with increased flood frequency.

**Q-2:** (Dr Pradeep Srivastava) Sir, as you discussed about prediction of floods, are there difficulties in predicting floods while we have a more frequent change in monsoon, wind and precipitation patterns due to ongoing climate change? Moreover human encroachment to flood plains and riversides has made these floods more vulnerable. Don't we have any policy which restricts such human intervention or creating awareness among people, to avoid loss of humans and properties?

**Reply:** Modern floods can be predicted via monsoon nowcast. But this is short range predictions that allows lesser time to protect people, property and infrastructure. Long range predictions require longer records which we are limited to what we have through instrumental monitoring. This where geologists role is. Like here at Wadia Institute, we have generated 10 thousand years long flood record of floods from The Indus, The Ganga and the Brahmaputra. But still lot to is required to be done to improve the resolution of past data in time and space.

Yes, we do have regulations preventing people to live in the flood plains but this is upto implementing authorities how strongly they act.

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## Answers of the questions to Dr. Thamban Meloth

**Q-1:** As, Antarctica is a no-man land, what are the anthropogenic sources there?

**Reply:** Direct anthropogenic contamination sources to Antarctica are very negligible. However, minor amount of contaminants could reach Antarctica along with dust transportation from other continents. Since the atmosphere is well-mixed, whatever happens around the world will have its implications on Antarctica too. So the effect of greenhouse gases will be similar in Antarctica; however human impact due to ozone hole formation are much severe in Antarctica due to the extreme cold conditions and associated changes in atmospheric chemistry.

**Q-2:** From where aerosols are transported in Antarctica i.e. sources of long range transport?

**Reply:** Mainly three southern hemispheric continents – South America, Australia, Africa – due to the Westerly wind system.

**Q-3:** Which are instruments being used in aerosols measurement in Antarctica. Are all the instruments solar power driven?

**Reply:** All typical aerosol instruments are used (Aethalometer, Nephelometer, etc). Most of them are supported by regular power supply from stations. While many countries have been attempted, solar power system has limitations in Antarctica due to extended months of darkness during the winter and the extreme logistic challenges due to the harsh weather and maintenance issues.

**Q-4:** Sir, as you talked about Cryosphere and Climate change, I have few queries regarding this topic. 1. You told about temperature change in Arctic and Antarctic regions. Arctic region has experienced more temperature change during the last few decades ( $\sim 2^\circ\text{C}$ ). Is this change is due to fluid phase on North pole, resulting more absorption of heat energy compared to Antarctica and hence continuing a positive feedback cycle? Also the Arctic region is surrounded closely by different land masses, is this vicinity of continents are affecting the temperature change more, due to human impacts and what are the relations between oceanic currents in both the cases when landmasses are far and near the cryosphere ?

**Reply:** The Arctic is warming far more quickly than anywhere else on the planet, due to Arctic amplification. Secondly, Arctic is dominated by thin ( $\sim 2\text{ m}$ ) sea ice (frozen seawater), compared to the Antarctica that consists of thick (average thickness 2.5 km) land ice. So the impact is not same. Thin patchy exposure of ocean water in Arctic ice vulnerable to increased heat absorption, leading to increased ice loss in a feedback loop. Some more details are available at <http://www.sciencedirect.com/science/article/pii/S0921818111000397>

**Q-5:** (Dr. Thamban Meloth, NPAOR); 2. The western part of Antarctica is facing more temperature change than eastern part, which results a difference in thickness of ice sheets I think. As eastern part is more close to any landmass( South America), can we say this is one of the reason for the same? Also there are internal and external factors for the temperature change, which are dominating between them? 3. You talked about the core samples study in the Antarctic region, which preserves the past records of climate like carbon emission and temperature etc. Are we able to identify the climate change in past few years through core sample studies as the topmost part of the core sample would be more fragile than lowest part( Density difference)? 4. I heard about a recent news that in Italy they have covered a long range of glaciers with a sheet that reflects the heat energy and hence maintaining the glacier temperature. Is this possible for a very large area in different continents and what are the economical and other challenges?

**Reply:** (2). The East Antarctica is a huge and stable landmass, covered by thick ice. Compared to this, West Antarctica has only small land area and many parts are dominated by ice shelves (floating ice sheet extension to the sea) and fast flowing glaciers. The warmer ocean water is rising to the surface in West Antarctica, leading increased loss of ice from the bottom of ice shelves and glaciers. Further, the climatic pattern around West Antarctica and Antarctic Peninsula is bringing extratropical warm water to the Antarctic coast. And warmer sea temperatures near the western parts of Antarctica had a positive feedback with the upper atmospheric conditions found over the region. More details on this aspect can be read at: <https://advances.sciencemag.org/content/6/24/eaaz1490>. It is not true that eastern part is more close to the landmass. It is Antarctic Peninsula, which is part of West Antarctica, which is closer the South America. (3). Ice cores can be used to study past environmental and climatic changes during several thousands of years before or even few decades. It essentially depends on the core location. While the reduced density of firn in the top layers make the samples bit fragile, it can be still carefully collected and studied. So typically ice core retrieval in Antarctica can be continuous from surface. In interior Antarctica (known as Antarctic plateau), due to the fact that the moisture source is very far and it is very dry, the snow accumulation is very less (5 to 50 mm per year). Compared to this, snow accumulation in coastal regions of Antarctica (due to closeness of moisture source and high humidity), the snow accumulation can be extremely high (~10 to 50 cm per year). Ice cores drilled from coastal region could therefore, provide monthly/seasonal/annual time resolution, whereas that collected from Antarctic plateau typically provide decadal resolution. This means that while a 100 m ice core drilled from a coastal site would represent only about 100-500 years, but will provide a proxy record of seasonal to annual changes in climate, comparable to climatological data. Contrastingly, a 100 m core from Antarctic plateau would provide 5000-10000 years, but with very limited details on short-term climate changes. (4). Covering small glaciers with limited area (~2 km<sup>2</sup>) may be feasible in ideal places (like Alps where glaciers are easily accessible and has huge tourist income out of it), provided the cost involved and immediate societal benefit of the same is very high. However, such methods are absolutely impractical for places like the Antarctica where the ice sheets are huge (total Antarctic ice sheet cover is ~15 million km<sup>2</sup>) and the place is so remote and weather conditions are extremely hostile, and any such efforts would be futile.



**Q-6:** Sir, you have mentioned about the anthropogenic deposition over Antarctica and how it's increasing warming, but have you seen any kind of cryoconite holes (small meltwater depression surrounding some pollutant particles) in your field work? And if seen, have you tried to measure the geochemistry of that water or any meltwater of Antarctica, and find any abnormality, specially in the dissolved carbon concentration?

I'm interested to know, whether the glaciers are becoming carbon source or sink with time.

**Reply:** What I had mentioned was the dust material being transported from other continents have increased since the last few decades (Link to our recent paper is here for more reading: <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2019JD030675>). This is essentially due to the change in climate system around Antarctica (known as Southern Annular Mode), which itself has some influence from anthropogenic effects like ozone hole changes. Cryoconite holes – there are extensive cryoconite holes around coastal Antarctic region. Mainly because of the extensive melting that happens during summer time and availability of local dust/sediment material in the coastal sites. We are studying the biogeochemical cycling in such supraglacial ecosystems (Link to our recent paper on this aspect is here: <https://doi.org/10.1017/aog.2018.30>). On the issue of glaciers becoming source or sink – recent research shows that glaciers could be an important source of carbon due to the existence of uniquely adapted microbial communities, high rates of biogeochemical/physical weathering in ice sheets and storage and cycling of organic carbon ( $>10^4$  Pg C) and nutrients (Link to one interesting paper from our group on this aspect is here: <https://pubs.acs.org/doi/10.1021/es405246a>)

**Q-7:** Sir, does NCOAR also associated with the lake basins in Antarctica for climate reconstructions?

**Reply:** Yes, there a research team led by Dr. Rahul Mohan at NCPOR is working on late Quaternary climate reconstruction using lake sedimentary records. An example of such work is here: <https://www.sciencedirect.com/science/article/pii/S0031018214004040>

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## Answers of the questions to Dr. Rajesh Sharma

**Q 1:** Is Raman Spectroscopy applicable to find out the pressure and minerals in a diagenetic Foramina shell ?

**Reply:** The minerals in diagenetic Foramina shell can be identified by micro Raman spectroscopy. The target mineral should be a minimum a microscopic size (> 2-3 micron) or more. Use of Raman spectroscopy for calculating pressure is limited to certain minerals. It can be applied for estimating metamorphic pressure using quartz inclusions, also in alteration of sulphides with the availability of selected supergene minerals.

**Q 2:** Is there any Lab in North East where Raman Spectroscopy is feasible?

**Reply:** Yes, micro Raman spectroscopy instrument is available at Central Instrument Facility, IIT, Guwahati.

**Q-3:** Can Raman spectrometry can be applied to mammalian fossils?

**Reply:** More we do, more we learn, and definitely there should be useful data in terms of understanding material of fossilization and different stages as well. One can make efforts to find out change in material across the mammalian fossil.

**Q-4:** Are Lazulite and scorzalite occurs along the zone of other Himalayan thrusts or only in MCT zone??

**Reply:** Lazulite is currently reported/known from 2-3 locations in Lesser and Higher Himalaya, near MCT. Considering the wide range of its stability one can expect at other locations such as in pegmatite veins in Himalayan domains.

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## Answers of the questions to Dr. Vikram Gupta

**Q-1:** Professor # Do You Have any Prediction Landslides in the region of Himalaya?

**Reply:** Till date, there is not full proof early warning system in the Himalayan region which can accurately predict the occurrence of landslide in space and time. However, various organisations are working towards this, and in this regard warning system comprising various sensors that detect the surface & sub-surface movement, precipitation, water level, soil moisture contents, tilting of slope etc. have been installed at many locations in the Himalaya and various algorithms are being developed, which may be useful for the development of the early warning system.

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