

## Quaternary Geochronology using Luminescence: The Indian Scenario

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Nature is both complicated and simple. It is complicated because it is inclusive and tends to permit integrations of a large number of parameters and processes in a single paleo-archive. This makes the task of paleo -environmental, -geographical and - ecological reconstructions, difficult. And, the Nature is simple because, it requires that only the standard physical and chemical laws apply consistently through time, making a reconstruction of past a tangible proposition. Thus for example, the formation of sand dunes and sand beds of the past would have used the same physics, as the modern day dunes and beds. The basic interaction of parameters such as grain size, gravity, aerodynamics, entrapment, momentum transfer etc., would have and will remain the same through time. This fact paves the way towards decoding the complex record provided by sediments and rocks in the Nature. This ubiquitous applicability of natural laws, leads to the dictum - *the present is key to the past* and has been used to understand a variety of geological processes ranging from geological correlation to oil exploration and environmental change.

Geosciences and Geoscientist are set to play an important role in planning for a sustainable society. This is amply reflected by declaration of UN for multiple years to highlight Geosciences, such as the International year of Planet Earth. The range of issues that confront us due to increasing population and associated changes, increasing earth movement, increasing pressures on earth resources and the like that we need to understand entire geo-bio-hydro-cryo-atmosphere system. Decode their interaction and feed back to plan for a sustainable future.

India, with the simultaneous presence of highest mountains, cold and hot deserts, large and small rivers and oceans, a unique climate system -the monsoon and a large human impact, perhaps offers the best geological locale where a self consistent, process based climate record can be achieved. Some of the outstanding geo-science issues of societal import include,

1. a quantitative understanding of the relationship of climate and landscape,
2. time scales of soil formation,
3. impacts of climate change on humans and impact of humans on climate change,

4. how far the marginal eco and geo-systems can be stressed and thresholds beyond which their recovery becomes difficult,
5. how well the abrupt events that occur of decadal scale, get cycled through the landscape,
6. what are the critical threshold and relaxation times of landforms,
7. what has been response of rivers and water bodies to climate change and/or tectonics and what are the means to decouple to the effects of two major forcing functions, etc.

In the Indian context, climate and monsoon are, to an extent synonyms. And, given the critical dependence on monsoon for sustainable development, it becomes imperative to reconstruct and understand the record of monsoon on land. Reconstruction of terrestrial records of climate change contrasts with those using marine cores that provide proxies of monsoon winds. The relation of oceanic records with that of rainfall on land (and its spatial distribution), has not been understood as yet.

These issues can only be resolved by reconstructing a longer time series of climatic change on land and comparing these with the oceanic records. This in turn involves a deeper understanding of the relationships (in space and time) between climate, earth surface processes and the landforms. Estimation of reliable chronology then becomes a key element in these studies. For long, the chronology of terrestrial sequences has been based on radiocarbon. However it has been increasingly demonstrated that radiocarbon dating of sedimentary sequences is often beset with a variety of intractable problems. Over the past two decades, Luminescence dating has emerged as a powerful alternative to all other numerical dating methods. Luminescence dating relies on dosimetry of natural radiation environment using quartz and feldspars grains from sediments. The natural radiation environment is provided by the decay of natural radioactive elements like Uranium, Thorium, Potassium and Rubidium. A small contribution is from cosmic rays. The method enables age estimation of a variety of events in the history of a sediment sequence.

In the presentation, I shall provide an account of the methodological aspects of luminescence dating and discuss its application to a variety of situations ranging from deserts, wind transported dust, glacial ice and sediment deposits and lightning induced minerals. I will then demonstrate as to how these application are now changing basic concepts in the manner the sediments on the land have been interpreted and the manner their correlation with oceanic and ice core record is attempted. A paradigm shift is proposed. Two key concepts that emerge out from our work, are