Short Course on

Reconstruction of the Asian Monsoon System: New Approaches and Techniques

17-30 October, 2016

Indian Institute of Technology Kanpur

Overview

The present day water resource infrastructure and the contingency planning in Monsoon Asia, as informed by instrumental observations, does not take into account the possibility of large scale changes in precipitation and/or spatiotemporal patterns. A longer-term assessment of monsoon variability is crucial to identify the full frequency spectrum of monsoon behavior. This should be developed from a spatially expansive network of precipitation, circulation, and drought sensitive proxy records, spanning the last several centuries to millennia, at resolutions comparable to the instrumental record. Clearly, proxy data from a large number of (well-dated) samples from various locations in the continental environments in India are required to confidently reconstruct the southwest monsoon variability.

Speleothems have proven to be valuable multi-proxy high-resolution climate archives, providing access to paleoclimate records on timescales ranging from seasonal to millennial. They provide:

- the opportunity to trace the leads and lags of global climate events as well as detailed seasonal rainfall or temperature records (due to the extremely high precision of Uranium-series dating methods).
- the opportunity for continental and inter-continental comparisons between spatially-separated speleothem records, as well as with other palaeoclimate archives.
- high quality calibration data for climate reconstructions and thereby increase the reliability of future climate models.

Recent cave monitoring and laboratory experiments and modeling efforts have paved the way for more quantitative, nuanced interpretations of speleothem time-series, thus increasing the reliability of speleothem-based paleo-climate reconstructions.

The last decade and a half has seen a proliferation of large number of high quality absolute-dated speleothem oxygen isotope ($\delta^{18}O$) records from monsoonal regions both north and south of the equator. These records provide a remarkably coherent depiction of how the monsoon systems of Asia-Australia, Africa, and the Americas vary on millennial and

orbital timescales. In contrast, far fewer efforts have been made toward using speleothems to reconstruct monsoon variability over the last few millennia on societal relevant timescales (e.g. sub-annual to multi decadal). This is due in part, to difficulty in extracting meaningful climate information from a rather small range in $\delta^{18}O$ values (~ 2.0 ‰), which is typical of the most late Holocene records from monsoonal locations. Nonetheless, with proper site/cave/sample selection combined with deeper integration of modern dynamical climate processes and application of simulated oxygen isotope data in precipitation from isotope-enabled GCM, significant strides have been made in better characterization and dynamical understanding of monsoon variability over the South Asia and elsewhere. The isotope-enabled GCMs in particular are increasingly being used to aid the interpretation of speleothem $\delta^{18}O$ records.

There is very little expertise available in India to handle the speleothem analysis although potential deposits are spread in different parts of India. A part of the reason is the lack of specialized analytical facilities such as U-series dating facilities in India. This course will highlight the challenges, caveats, and promises of speleothem-based approach to reconstructing the Indian/Asian summer monsoon variability over the last few millennia on societal relevant timescales at resolutions that are comparable to the instrumental record.

Objectives

The primary objectives of the course are as follows:

i) Expose the participants to fundamental concepts in global climate change
ii) Train the participants with field methods for sample/data collection for paleoclimatic research with special reference to continental archives
iii) Making participants aware of the critical issues in paleoclimatic research in terms of analytical methods and data interpretation
iv) Capacity building for improving paleoclimatic research in the country and developing collaborative projects amongst the Indian and overseas researchers

Teaching Faculty

Dr. Ashish Sinha is the Chair at the Department of Earth Sciences at California State University, Dominguez Hills. Dr. Sinha's research centers on climate change with a particular focus on high-fidelity reconstruction of precipitation patterns in tropical and monsoonal locations over the past several millennia. His research is a central component of a larger collaborative effort among several domestic and international research institutions that seek to quantify earth's natural climate variability and learn how climate system respond to changes in boundary conditions. To this end, Dr. Sinha and his colleagues use stable isotope geochemistry of cave-calcite deposits (speleothems) to generate instrumentally-calibrated and absolute-dated records from sites across the tropical/subtropical regions and provide vital tests for the state-of-the-art climate models, thereby improving confidence in predictions of future climate change.

Dr. S K Tandon is a well-know sedimentologist and has worked on carbonate systems for more than 3 decades. He is currently based at IIT Kanpur and has been involved in paleoclimatic research using fluvial archives in several parts of India notably in Rajasthan and Ganga plains. His major contribution so far has been to understand the response of the river systems to long- and short-term climate change using sedimentary archives in western India.

Dr. Rajiv Sinha is a Professor and Head of the Department of Earth Sciences at IIT Kanpur. He has worked on the Quaternary history of the Gangetic rivers for over two decades emphasizing on development of stratigraphic framework and landscape evolution using cliff sections and drill cores. Integrating sedimentology, oxygen isotope composition of carbonates and sediment mineralogy and geochemistry, he reconstructed the paleoclimatic history of the alluvial plains of the Ganga for the last 100 Ka. Some of his other significant contributions include Late Quaternary paleoclimatic reconstruction of the saline lakes in Thar Desert and Antarctica using a multi-proxy approach.

Course Coordinator

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Registration Form

Name (Dr/Mr/Mrs/Miss): ……

Father's Name: ……

Date of Birth (DD/MM/YY): ……

Gender (Male/ Female): ……

Nationality: ……

Present position: ……

Contact Information:

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Contact Number: (Office / Mobile): ……

Email: ……

Areas of research:

Explain how this course would be useful for your research:

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Details of payment (Bank draft for the requisite amount should be made in the name of "Registrar, IIT Kanpur"): ……

Date: Signature

Please send the completed form along with bank draft to:
Dr. Rajiv Sinha, Department of Earth Sciences, IIT Kanpur-208016, India (rsinha@iitk.ac.in)