

Technical Lecture

On

Ocean-Climate Connection, Climate Change through Geological Past: Lessons for future

By

Professor Devesh K Sinha

Dean of Colleges

&

Professor of Oceanography and Marine Geology

Department of Geology, Centre of Advanced Studies
University of Delhi, Delhi-110007

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Dr. S. K. Garg
Principal

Deen Dayal Upadhyaya College, New Delhi

Dr. Manoj Saxena

Convener-Science Foundation

Associate Professor, Department of Electronics
Deen Dayal Upadhyaya College, New Delhi

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deveshksinha@yahoo.com

Oceans have played a major role in driving climate changes through geological past and continue to affect the Earth's climate in modern times. The present day debate on "Climate Change" is incomplete if we do not understand properly the role of oceans. Ocean water has large specific heat and thus has a vast storage of heat energy. Through their massive transport system in the form of ocean currents, the oceans transfer vast amounts of heat from tropics to pole and from surface to deep Ocean. A number of climatic phenomena are directly linked to the ocean circulation and ocean- climate interaction. For example

1. El Nino and La Nina are linked to **Humboldt Current** (Ocean) in Eastern Pacific- weakening of trade winds (Atmosphere)
2. Moderate climate of Europe and North America- Linked to Transport of heat through **Gulf Stream and Thermohaline circulation**
3. Asian Monsoon- linked to **Land- Sea temperature contrast** and transport of moisture from ocean- leads to high productivity in Arabian Sea
4. Walker circulation in the Pacific Ocean- linked to obstruction of **South Equatorial Current** at Indonesian Seaway
5. Permanent ice cap on Antarctica- linked to development of **Antarctic Circum Polar Current**
6. Thick ice caps on Green Land and ice land- linked to intensification of the **Gulf stream**

*The study of modern and past ocean circulation gives us answers to **many intriguing questions** like*

1. When and why did the Antarctic ice cap develop?
2. When and why did the Northern Hemisphere Ice sheet develop?
3. Why did the Northern Ice Sheet form later than Antarctic Ice sheet?
4. How did the large scale movement of continents and changing ocean- continent geometry affect climate?
5. Why has the Earth undergone a series of Glacial- Interglacial stages?
6. How can the past climate be inferred from Ocean Archives?
7. How did the formation of mountains like Himalaya cause climate changes in the world?
8. How is it possible that deepest part of the sea has oxygen and life?
9. How will the present climate change affect the biota?

The present "fear" of so called "**Global Warming**" is also linked to a possible abrupt change in **oceans thermohaline circulation**. Geological archives have shown that such a change occurred 12000 years back known as "**Younger Dryas**" when there was a shut down in the Thermohaline circulation leading to an Ice age in North America and Europe. Such a scenario is predicted if seas surface temperatures continue to rise in case of a "possible Global Warming". Much of the debate about an abrupt climate change and the parts of the world most affected can be understood through ocean circulation. The microorganisms living in the sea when preserved a fossil provide us clues to climate change in the past and predictability in future. The role of developed vs developing nation can also be addressed through a proper understanding of the ocean circulation. Large numbers of researchers from all over the world are joining this field and for many countries the funding on ocean studies is only next to space programme.



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University of Delhi, Delhi-110007

Dr. Devesh K Sinha is presently Dean of Colleges, University of Delhi and Professor of Oceanography and Marine Geology in the Department of Geology, Centre of Advanced Study at Delhi University. He was also Head of the Department and was Ex-Dean, Faculty of Science, University of Delhi. Prof. Sinha obtained his Graduate and Post-Graduate degrees in Geology from Banaras Hindu University with specialization in Micropaleontology and Paleoceanography. He obtained his Doctoral degree from the same University on "Late Neogene Paleoceanography of the Southwest Pacific Ocean" based on Deep Sea Cores recovered from International Ocean Drilling Programme – on Lord Howe Rise between Australia and New Zealand. Prof. Sinha later did his Post-Doctoral Studies from GEOMAR Research Centre for Marine Geosciences, University of Kiel, Germany on North Atlantic Thermohaline Circulation and "Heinrich Layers" based on RV-Sone-Cores from Portuguese margin. He also studied the recession of Alpine Glaciers, Switzerland due to climate change. After serving his alma mater for nearly two decades he joined University of Delhi where he continues to be a Professor, teaching Oceanography and Micropaleontology, Paleoclimate and Stratigraphy.

His research interest includes a) Refinement of Cenozoic Geological Time Scale; b) Paleoceanography of the last 6 million years; c) Understanding teleconnections in Earth –Ocean-Climate system on geological time scale and d) Effect of plate tectonics- closing and opening of ocean gateways and their effect on ocean circulation and climate change. He has significantly contributed to all the above aspects by publishing papers at national and international levels. Due to his contributions in paleoceanography, he has been invited by several organizations for sharing his expertise including National Science Foundation, USA where he was instrumental in framing initial phase of Integrated Ocean Drilling Programme (IODP) in Bengal Fan at - University of Colorado, USA. His research work has found very significant citations in international literature including his more than 10 refinements in Cenozoic Time Scale which have been incorporated in Geological Time Scale-2012 published by Elsevier recently.

Prof. Sinha has been member of several important academic committees including those of CSIR and ISRO and UGC. He is also at present Vice-President of the Paleontological Society of India. He was UGC Expert and Advisory Member of the CAS in Geology of Kumaun University, Nainital and at present UGC advisor at Utkal University, Bhubaneswar, and Banaras Hindu University. Prof. Sinha has been member of Governing Bodies of prestigious Institutions of Delhi University including Miranda College, Patel Chest Institute, BRA Centre for Biomedical Research, CPDHE, and Ex-Chairman of the Governing Body of Bhaskaracharya College of Applied Sciences. He was also Ex-Chairman of Departmental Promotional Committee of Delhi University, At present he is -Executive Council Member of Delhi University.

Prof. Sinha has chaired several technical sessions in National and International Conferences and has delivered invited talks and key note addresses at many prestigious national and international institutions including Indian Academy of Sciences, Bangalore, Indian Institute of Technology, Kanpur; National Institute of Oceanography, Goa; National Centre for Antarctic and Ocean Research, Goa; Cochin University of Science and Technology, Cochin, Utkal University, Bhubaneswar; GJ University Hisar, University of Kashmir, Srinagar, CSIR Centre for Mathematical Modeling and Computer Simulations, Bangalore; Indian Institute of Physics, www.du.ac.in Page 3 Bhubaneswar; Indian School of Mines, Dhanbad, S.N. Bose Institute of Physics, Kolkata, Department of Geology, Kumaun University, Nainital, Department of Geology, Madras University, Chennai, Indian Institute of Technology, Chennai, Indian Institute of Technology, Bhubaneswar, Wadia Institute of Himalayan Geology Dehra Dun, University of Colorado, University of Kiel, Yonsei University, South Korea, to name a few. He has been a frequent speaker at the INSPIRE programmes of DST. He was several times honoured as Guest speaker at Earth Day celebrations. Prof. Sinha has the privilege of being in the Expert Panel in a USA Academy-INSA –Public Expert interaction of Climate Change held at INSA, New Delhi, IIT Bombay, IIT Chennai, PRL Ahmadabad and West Bengal Academy of Sciences, Kolkata.

Prof. Sinha has also been a Participating Shipboard Scientist in International Oceanographic Expeditions conducted under JOINT GLOBAL OCEAN FLUX STUDIES (JGOFS) in Indian Ocean. Having a wide experience of sailing in Tropical Pacific, Atlantic and Indian Oceans to the freezing Baltic and North Sea, he has also Edited a book "Micropaleontology: Application in Stratigraphy and Paleoceanography" published from Alpha Science International Oxford, and Narosa Publishers, New Delhi. At present he has several International Research Projects on Global Cenozoic Ocean Circulation including a) Variation of Indonesian Throughflow during Late Neogene- (With Kochi -Japan) b) Paleoceanography of the Trans Tropical Pacific-(With Texas A & M University; USA) c) Late Neogene variation in ITCZ-(Kochi –Japan); d) Late Neogene History of Benguela Current (Bremen University, Germany) e) Variation in Indian Monsoon since Last Glacial Maximum-ISRO-International GeosphereBiosphere Programme, India. Prof. Sinha is in Expert Panel of reviewers in CSIR, ISRO, DST ,MOES and UGC. He is reviewer of papers published by Elsevier and other national and International Journals. Besides academics he loves music and is a vivid player of flute and mouthorgan. His family includes his wife, Son and all his research scholars.