Sivaramakrishnan Rajan (India)

Scientist & Project Director, National Centre for Antarctic and Ocean Research, Headland Sada

Vasco-da-Gama, Goa, India

Personal

Born May 25, 1955, Trivandrum, India

Education

Ph. D (Geology & Geophysics) 1995 University of Hawaii, Honolulu, Hawaii, USA

M. Sc. (Geology) 1977 University of Kerala, Trivandrum, India

B. Sc. (Geology) 1975 University of Kerala, Trivandrum, India

Member, Commission on the Limits of the Continental Shelf

2007 present

- Chairman of the Sub-commission to examine the submission for an extended continental shelf made by Barbados
- Chairman of the Sub-commission to examine the submission for an extended continental shelf made by Suriname
- Vice-Chairman of the Sub-commission to examine the submission for an extended continental shelf made by Uruguay
- Member of the Sub-Commission to examine the submission for an extended shelf made by New Zealand, Australia and the partial submission by Mexico.
- Vice-Chairman of the Standing Committee of the Commission on provision of Scientific and Technical Advice to Coastal States.
- Vice-Chairman of the Editorial Committee of the CLCS to consider the amendments to the Rules of procedure.

Professional experience related continental shelf studies

1999-present

PROJECT DIRECTOR, Indian Continental Shelf project: A lead role in all the facets of management and implementation of the project comprising (a) a comprehensive desktop study of the various scientific and technical issues involved in obtaining the requisite data for defining the outer limits of the Indian continental shelf, (b) planning the various aspects of the requisite data collection, processing, synthesis and interpretation, (c) initiation, co-ordination and execution of a major multi-institutional national endeavor of marine geological/geophysical surveys in the Project area, including budgeting and scheduling (d) data synthesis and documentation as per the guidelines of the CLCS, and (e) establishment of a fully-functional state-of-the-art marine geophysical data archival and processing Centre at

the National Centre for Antarctic and Ocean Research, Goa. The database won 2009-10 Computer Society of India-Nihilent e-Governance Special Jury Award under *Project* — G2G Category.

2008

Myanmar continental shelf programme: As a part of the Government of India's initiative at providing scientific and technical guidance to the scientists from the Union of Myanmar-

(a) Carried out a comprehensive desktop study pertaining to the delineation the outer limits of the continental shelf of Myanmar beyond 200 M, based on public domain data; (b) organized a series of meetings with the officials and scientists from Myanmar to finalize the country's continental shelf work programme and to develop the protocol for processing of seismic data collected; (c) co-ordinated the task of bathymetric data interpretation and documentation; and (d) took a lead role in finalizing the technical documents pertaining to the seismic data processing and interpretation.

October 2005

Organized a five-day training workshop on "Delineation of the outer limits of the continental shelf" for scientists and officials from the Union of Myanmar, at Goa.

April 2005

Organized a five-day training workshop on "Delineation of the outer limits of the continental shelf" for scientists from Sri Lanka, at Goa.

September 2001

Delivered a series of lectures on the scientific aspects of Delineation of the Continental Shelf Limits under the provisions of UNCLOS, at the National Seminar organized by the National Hydrographic Office (India) and the Society for Indian Ocean Studies at Delhi.

Papers presented (of relevance to continental shelf studies)

November 2009

Rajan, S., Ashlesha Saxena, and Mukesh Adelkar, *Geospatial management and Law* of the Sea: The Indian Experience, Joint International Workshop of ISPRS WG IV/1, WG VIII/1 and WG IV/3 on Geospatial Data Cyber Infrastructure and Real Time service with special emphasis on Disaster Management: INCOIS, Hyderabad

September 2009

Rajan, S., 2009, Exploring for extended continental shelves beyond 200 nautical miles: National Conference on Earth System Processes and Disaster Management, Goa

February 2007

Rajan, S., 2007, UNCLOS 1982- Exploring for continental shelves beyond 200 nautical miles, Seminar on "India's EEZ and continental shelf- its exploration, exploitation and conservation", organized by the Indian Maritime Foundation, Pune

December 2007

Rajan, S., 2007, UNCLOS III, article 76 and the CLCS- The scientist as a lawyer? International Seminar on Law of the Sea, organized by the Indian Society of International Law, New Delhi

November 2005

Rajan, S., and N. Vijayalaxmi, 2005, Ocean Governance in a post-UNCLOS worldthe South Asian perspective: EWC/EWCA South Asia Regional Conference, New Delhi

September 2005

Vijayalaxmi S. N. and S. Rajan, 2005, Extending the Indian Continental Shelf — a preliminary study through CARIS LOTS: Halifax, Canada, CARIS 2005 — 10th International User Group Conference and Educational Session.

March 2004

Praveen Vohat, Dhananjai Pandey, John Kurian, U. K. Singh, Vijayalaxmi, N., S. Rajan and P. C. Pandey., 2004, Role of marine geophysical data in delineating Indian Legal Continental Shelf: International Hydrographic Seminar HYDRO-IND 2004, Mumbai.

January 2004

Vijayalaxmi, S. N., Rajan, S., Dhananjai Pandey and John Kurian., 2004, Determination of Foot of the Continental Slope for Delineating the outer limits of the Continental shelf through CARIS LOTS: Shimoga, VI Convention of Mineralogical Society of India & International Seminar on Earth Resources Management, Kuvempu University.

April 2002

Rajan, S., 2002, The Legal Continental Shelf from a geological perspective: Invited paper presented at the International Seminar on "Sedimentation and Tectonics in Space and Time", Dept. of Civil Engineering, SDM College of Engineering, Dharwar.

February 2002

Rajan, S., Pandey. P. C., and Subba Raju, L. V., 2000, Delineation of the outer limits of the Indian Continental Shelf-Some Scientific and Technical Observations: 26th Annual Convention and Seminar on Exploration Geophysics, Association of Exploration Geophysicists, Goa.

Professional positions held

Scientist and Project Director (Indian Continental Shelf Project) Since 1998 National Centre for Antarctic and Ocean Research, Headland Sada, Goa, India

Geologist Senior 1997-95 Marine Wing, Geological Survey of India, Cochin, India

Geologist 1990-84

Marine Wing, Geological Survey of India, Cochin, India

Geologist 1984-79

Engineering Geology Division, Geological Survey of India, Rajasthan, India

Professional Training

Degree Fellow in the Program on Environment East-West Center, University of Hawaii

1990-94

Short-term Course on Coastal Engineering Ocean Engineering Center, Indian institute of Technology, Chennai, India 1989

Photo-interpretation and Remote Sensing for Geotechnical Surveys Indian Institute of Remote Sensing, Department of Space, Dehradun, India 1983

Field Orientation Course in geological and geophysical Surveys Geological Survey of India Training Institute 1980-81

Honors, Awards

J. Watumull Merit Scholarship for the Most Outstanding graduate student in the Dept. of Geology and Geophysics, University of Hawaii 1993-94

East-West Center fellowship for doctoral research at the University of Hawaii 1990-94

Government of India National Merit Scholarship for academic excellence 1975-77

Kerala University Award and Merit Scholarship for academic excellence 1972-75

Participation in International Programmes/Training

"Arctic Program in India", Indo-European Union Workshop on Research Infrastructures organized by Department of Science & Technology, Government of India, at New Delhi. January 2010

International Symposium on the "Scientific and Technical aspects of the establishment of the Outer limits of the Continental shelf" organized by the Ministry of Foreign Affairs of Japan and the United Nations University, Tokyo. March 2006

Training course on "The outer limits of the continental shelf beyond 200 nautical miles and for preparation of a submission of a coastal State to the Commission on the Limits of the Continental Shelf", organized by the Division for Ocean Affairs and the Law of the Sea, United Nations Secretariat. Colombo, Sri Lanka.

May 2005

Conference on Legal and Scientific Aspects of Continental Shelf Limits, Reykjavik, Iceland.

June 2003

Professional experience as a Geoscientist

Currently associated with the following major geoscientific activities, in addition to the continental shelf program:

- Geophysical studies aimed at understanding the plate tectonic evolutionary history of the Southwestern continental margin of India and adjoining ocean basins.
- Geological and structural characterization of the Andaman subduction zone
- Study of seafloor hydrothermal systems along mid-ocean ridges with special reference to the study of hydrothermal sulphide deposits on the Central Indian Ridge

Professional experience pertaining to Polar Science

- Participated in the XXIII Indian Scientific Expedition to Antarctica (2003-04) as a member of the Scientific Task Force constituted by the Government for identification of a suitable site for the establishment of a new Indian Antarctic Base. Undertook reconnaissance traverses in the Vestfold Hills, Rauer Islands and the Larsemann Ranges in the Prydz Bay area, East Antarctica and identified a site suitable for the establishment of the Indian Research Base in the Larsemann Hills.
- Nodal officer responsible for the planning, co-ordination and implementation of all scientific and logistics activities related to the Indian Scientific endeavors in the Arctic.
- Principal investigator of a multi-institutional long-term monitoring program of the Kongsfjorden system at Ny-Alesund on the Svalbard archipelago, for climate change studies.

Professional experience pertaining to the Indian endeavors in the Integrated Ocean Drilling Program (IODP)

- Member Secretary of the National Committee for the co-ordination of Indian initiatives in IODP.
- Proponent of a proposal for deep-sea drilling in the Arabian Sea sector of the northern Indian Ocean, under IODP.

Teaching and research experience

Teaching Assistant, Department of Geology & Geophysics, University of Hawaii 1994-95

Lecturer, Department of Geology, University of Kerala, India 1978-79

Edited Volume

Rajan, S., and Pandey, P. C. (Editors), 2005, *Antarctic Geoscience, Ocean* — *Atmosphere interaction and Paleo-climatology*: A collection of peer-reviewed papers presented at the National Seminar on "Antarctic Geosciences, Ocean-Atmosphere interaction and paleoclimatology" organised by NCAOR and the Geological Society of India, November 2003.

Other Publications

Sruthi, K. V., S. Rajan, P. R. Rajani, P. J. Kurian, 2012. Factors controlling the distribution of major and trace elements of a sediment core from the eastern Arabian Sea and its environmental significance, submitted to *International Journal of Environmental Science & Technology*.

Dwijesh Ray, S Rajan and Rasik Ravindra, 2012. Role of subducting component and sub-arc mantle in arc petrogenesis: Andaman volcanic arc, Current Science (accepted).

Ray, D., Rajan, S., Ravindra, R. and Jana, A. 2011. Microtextural and mineral chemical analyses of andesite-dacite from Barren and Narcondam islands: evidences for magma mixing and petrological implications, *Journal of Earth System Science*, v. 120, p. 1-12.

Rajan, S. 2011. "Long-term monitoring of the Kongsfjorden System for climate change studies: The Indian initiatives" paper presented at the Seminar "From Pole to Pole — Indian and Norwegian Exploration and Research in the Arctic and Antarctic" organized by the Royal Norwegian Embassy, New Delhi, in collaboration with NCAOR and Norwegian Polar Institute, Tromsø, New Delhi, 3rd February 2011.

Pandey, D.K., Pandey, A. and Rajan S. 2011. Offshore Extension of Deccan Traps in Kachchh, Central Western India: Implications for Geological Sequestration Studies, *Natural Resources Research*, v. 20, p. 33-43.

Pandey, D. K., Pandey. A. and Rajan, S. 2010. Mode converted (P-SV) waves for imaging thin intercalated basaltic layers and its implications in carbon sequestration, *Natural Resources Research*, v. 19, p. 141-150.

Pandey, D.K., Rajan, S. and Pandey, A. 2010. Seismic imaging of Paleogene sediments of Kachchh Shelf, (western Indian margin) and their correlation with sealevel fluctuations, *Marine and Petroleum Geology*, Vol. 27, No. 6, 1166-1174.

Ray, D., Rajan, S. and Ravindra, R. 2010. Mineralogy of disseminated sulphides from the volcanics of Andaman Island, *Current Science*, v. 99, p.1021-1024.

Rajan, S. 2010. NCAOR Project for Ministry of Earth Sciences. Chapter in book, "Enablers of Change: Selected e-Governance initiatives in India", Piyush Gupta, R K Bagga, Sridevi Ayaluri (Eds.), Pages 104-112,

Dwijesh, R., Rajan, S., and Ravindra, R., 2009, Andaman Inner arc volcanoes: An evaluation of arc geochemistry and role of sediments in arc lavas, Geochimica et Cosmochimica Acta, Volume 73, Issue 13, Supplement 1, June 2009, Page A1077

Pandey, D. K., Rajan, S., and Ravindra R., 2009, A long-term drilling program for understanding of tectono-climatic evolution of northern Indian Ocean. White paper: WG6.6 — INVEST Meeting, Bremen.

Rajan, S and Glenn, C. R., 2008 (in press), Marl-chalk rhythmicity in the Pliocene Black Sea: A record of sedimentation response to climatic changes, accepted chapter in the forthcoming Special Publication of the International Association of Sedimentologists, UK "Authigenic minerals: sedimentology, geochemistry, origin, distribution and applications" (Eds. Ian Jarvis, Karl Follmi)

Rajan, S., and Khare N., 2008, Antarctica and the Southern Ocean: Paleoclimatology of the deep freeze, *Indian Journal of Marine Sciences*, 37(4), 386-390.

Pandey, D K, Chaubey, A K and Rajan, S., 2008, Seismic Characteristics of Glaciomarine sediments of East Antarctica. *Indian Journal of Marine Sciences*, v. 37(4), 412-418.

Singh, U.K., Rajan, S., Pandey D. K., 2008, Crustal Structure and Continent Ocean Boundary of Prydz Bay, East Antarctica based on Gravity Modelling" *Indian Journal of Marine Sciences*, v. 37(4), 419-423.

Rajan, S., 2007, UNCLOS-1982- Exploring for continental shelves beyond 200 nautical miles, (in) Proceedings of the Seminar on "*India's EEZ and continental shelf- its exploration, exploitation and conservation*", organized by the Indian Maritime Foundation, Pune, February 2007, pp. 16-26.

M. Thamban., A. Chaturvedi., A. Rajakumar., S. S. Naik., W. D'Souza., A. Singh., S. Rajan and R. Ravindra., 2006, Aerosol perturbations related to volcanic eruptions during the past few centuries as recorded in an ice core from the Central Dronning Maud Land, Antarctica, *Current Science*, 91, p. 1200-1207.

Singh, U. K., Tiwari, R. K., Singh, S. B., and Rajan, S., 2006, Prediction of Electrical Resistivity Structures using Artificial Neural Networks, *Journal of Geological Society of India*, v. 67, p. 234-242.

Rajan, S., Anju Tiwari and Dhananjai Pandey, 2005, The Deccan Volcanic Province: *Thoughts about its genesis*, www.mantleplumes.org/Deccan2.html

Rajan, S., and Khare, N., 2002, Emerging Visions in Indian marine Geosciences- the Southern Oceans, (in) Proceedings of the National Seminar on "Four Decades of Marine Geosciences in India- A Retrospective": Kolkata, Geological Survey of India, Spl. Publication No. 74, p. 70-76.

Rajan, S., Mackenzie, F. T., and Glenn, C. R., 1996, A thermodynamic model for water-column precipitation of siderite in Plio-Pleistocene Black Sea, *American Journal of Science*, v. 296, p. 506-548.

Glenn, C. R., Rajan, S., McMurtry, G. M., and Benaman, J., 1995, Geochemistry, mineralogy and stable isotopic results from Ala Wai estuarine sediments: Records of hypereutrophication and abiotic whitings, *Pacific Science*, v. 49, p. 367-399

Conference/Seminar Proceedings and abstracts

Rajan, S., 2011, Arctic climate observations from KONGSFJORDEN: Implications for global climate change: Third National Workshop on Climate Change, NCAOR, Goa, 20-22 September 2011.

Rajan, S. 2010. Antarctic Continental Shelf and the Law of the Seas: A future winter of discontentment?, Paper presented at the National Conference on Science and

Geopolitics of Arctic & Antarctic (SaGAA 2011), organized by LIGHTS, New Delhi, 14-15 January 2011.

Rajan, S., and Khare, N., 2009, *Late Quaternary climatic history of East Antarctica: A textured mosaic?* AGU 2010 Ocean Sciences Meeting (Paper No. GO51B-05).

Gireesh, R., Pandey, D. K., and Rajan, S., 2009, *Basement structure of the Laccadive Ridge and Basin from multi-channel seismic reflection and gravity data*, AGU Fall Meeting 2009, San Francisco, USA.

Thamban, M., Chaturvedi, A., Rajakumar, A., Naik, S. S., D'Souza, W., Singh, A., Mukherji, S., Rajan, S., and Ravindra, R., 2006, *Volcanic history and change during the past few centuries as recorded in an ice core from the central Dronning Maud Land, East Antarctica*: SCAR Open Science Conference, Hobart, 12-14 July 2006.

Thamban, M., Chaturvedi, A., Rajakumar, A., Naik, S. S., D'Souza, W., Singh, A., Rajan, S., and Ravindra, R., 2006, *Aerosol perturbations related to volcanic eruptions and climate change during the past few centuries as recorded in an ice core from the central Dronning Maud Land, Antarctica*: National Seminar on Antarctic Science: Indian contributions in Global Perspectives, Goa, 25-26 May 2006.

Rajan, S., Khare, N., Tiwari, A., and Pandey, D. K., 2005, *Proxies and Pitfalls* — the Late Quaternary Glacial Evolution of Schirmacher and Larsemann Oases, East Antarctica: National Seminar on Earth Science of East Antarctica, New Delhi, 15-16 Sept., 2005.

U. K. Singh., D. N. Murthy., K. Veeraswamy., S. Rajan., and T. Harinarayana, 2005, *Deep Resistivity Structure and Thermal Regime beneath the Schirmacher Oasis, East Antarctica and Magnetotelluric Geophysical Method*: National Seminar on Earth Science of East Antarctica, New Delhi, India, 15-16 September 2005, 69p.

Rajan, S., 2003, *Carbonate rhythmites in the Plio-Pleistocene Black Sea: A record of sedimentation response to climatic changes*: Annual General Body Meeting of the Geological Society of India, Goa, November 2003.

Rajan, S., 2002, *Geochemical Characterization of Freshwater Lakes in the Schirmacher Oasis, Antarctica*: A research proposal presented at the "Joint Workshop on Indo-Russian Scientific Collaboration in Polar Science", ILTP, Goa, April 2002.

Glenn, C. R., and Rajan, S., 2000, Authigenic marl-chalk rhythmicity in Plio-Pleistocene Black Sea sediments: 31st International Geological Congress, 6-17 August 2000, Rio de Janeiro, Brazil.

Rajan, S., and Khare, N., 1998, *Global Warming, Rising Sealevel and Response Strategies: A SAARC Perspective:* International Seminar on "Sustainable Use of the Indian Ocean: A SAARC Perspective", New Delhi, India.

Rajan, S., and Glenn, C. R., 1997, *Millennial-scale climatic signals from the carbonate record of the Plio-Pleistocene Black Sea*: International Symposium on "Isotopes in the Solar System", Physical Research Laboratory, Ahmedabad, India.

Rajan, S., and Glenn, C. R., 1997, Source identification of sedimentary organic matter from stable carbon isotope analyses of individual compounds: International Symposium on "Isotopes in the Solar System", Physical Research Laboratory, Ahmedabad, India.

Rajan, S., and Siddiqi, T., 1994, *Growth of electricity use in India and strategies for reducing Greenhouse gas emissions*: Ann. Conference on South Asia, University of Wisconsin-Madison, Abstracts, p. 126.

Siddiqi, T., and Rajan, S., 1994, *The role of new technologies in reducing future emissions of carbon dioxide from energy use in India*: Paper presented at the International Conference on India at the University of Pennsylvania, PA.

Rajan, S., Mackenzie, F. T., and Glenn, C. R., 1993, *A thermodynamic model of endogenic siderite precipitation in Plio-Pleistocene Black Sea*: Ann. Meeting of Geol. Soc. America, Boston, Mass., Abstracts with programs, A 318-319.