

# CV OF JYOTISANKAR RAY



1. Name in full (In capital letters): **RAY JYOTISANKAR**
2. Date of birth: 25<sup>th</sup> March, 1958
3. Official Designation, Address, Telephone No and email: Professor, Department of Geology, University of Calcutta, 35, Ballygunge Circular Road, Kolkata- 700 019, Mobile-9433090415; E-mail: [jsray65@hotmail.com](mailto:jsray65@hotmail.com), [jyotisankar.geocal@gmail.com](mailto:jyotisankar.geocal@gmail.com),
4. Residential Address with Telephone No.: Block-1, Flat-5A, Lavanya Project, Orchid, Bishnupur, Daspara, Rajarhat, Kolkata- 700 135, Mobile- 9433090415, 9674814430
5. Field of specialization and expertise: **Geology (Igneous Petrology, Mineralogy and Geochemistry)**
6. Number of Research/Technical papers, Books published.: **Eighty-nine (89) published peer- reviewed papers; and three edited books**
7. Affiliation to Scientific/Technical Committees at State/National/International level:
  - Coordinator, DST-FIST program Dept. of Geology, CU (2005-2007).
  - Member, National Working Group, IGCP-453 (Ancient and Modern Orogens) [2001-2005]
  - Local Secretary, Indian Sc. Congress, (Earth System Science Section), 2013
  - Member, UG Board of studies, CU (Calcutta University) (2008 to date)
  - **Head, Dept. of Geology, University of Calcutta (2001-2003)**
  - **Convener, Ph.D. RAC , Dept of Geology, University of Calcutta (2006 to date)**
  - **Guest Professor in the Dept. of Lithospheric Research, University of Vienna, Austria (2009)**
  - **Head, Dept. of Geology, University of Calcutta (2006-2008)**
  - **Head, Dept. of Geology, University of Calcutta (2015-2017)**
  - **Head, Dept. of Geology, University of Calcutta (2019-2021)**
  - **Member of Senate, CU (2015-2017)**
  - **Member of Senate, CU (2019-2021)**
  - External Expert, Ph.D. RAC (Dept. of Geology, Jadavpur University):(2015 to date)
  - Expert Member, Board of Studies, (Geology), Kazi Nazrul University, Asansol, West Bengal
  - Expert Member, Board of Studies, (Dept of Earth and Remote Sensing), JIS University, Kolkata (2015 to date)

- Expert Member, Board of Studies, (Dept of Earth Sciences), Techno India University, Kolkata (2018 to date)
- **Coordinator, Earth Sciences (for West Bengal College Service Commission, Kolkata); 2016 to date**
- Member of Selection Committee for recruitment of Faculty, Geological Sciences Department, Jadavpur University, Kolkata(2015, 2016, 2018,2019)
- Expert member in Asiatic Society for selection of several awardees (2020, 2021)
- Member of Selection Committee for recruitment of Faculty, Earth Sciences for Odisha Public Service Commission (OPSC) (2022)
- Member of Selection Committee for recruitment of Faculty, Geology Department, Dibrugarh University, Dibrugarh, Assam (2012)
- Member of Board of studies (for syllabus framing) in Vidyasagar University, Midnapore, West Bengal (2016)
- Served as Expert in UGC, New Delhi for evaluation of SAP- proposals (2012)
- Served as Expert in UGC, Guwahati for evaluation of SAP- proposals (2014)
- Member of Selection Committee for recruitment of Faculty, Geology Department, Utkal University, Bhubaneswar, Odisha (2010)
- Served as External Expert for selection of faculty (CAS) in Ashutosh College, Kolkata and Jogamaya Devi College, Kolkata
- Served as External Expert for selection of faculty (CAS) in Hooghly Muhassin College, Hooghly, West Bengal
- Member of Selection Committee for recruitment of Faculty, Geology Department, Ravenshaw University, Cuttack, Odisha (2021)
- Member of Selection Committee for recruitment of Faculty, Geology Department, Fakir Mohan University, Balasore, Odisha (2020)
- Member of Selection Committee for recruitment of Faculty, Geology, Beherampore University, Beherampore, Odisha (2012)
- Member of Selection Committee for recruitment of Faculty, Geology Department, Presidency University, Kolkata (2019)
- Member of Selection Committee for recruitment of Faculty, Geology, Central University, Thiruvavur, Tamil Nadu (2022).
- External Expert, evaluators of Field Session Programs, Geol. Surv. India
- **Expert member for West Bengal Public Service Commission, Kolkata (2022)**
- **Advisor, Union Public Service Commission, Dholpur House, New Delhi, (2007 to date)**

8. Member of Learned Societies/Associations/Academies:

- Life member, Geological Society of India, Bangalore
- Geological, Mining and Met. Society of India, Kolkata
- Life Fellow, Mineralogical Society of India, Mysore

8a. Details of Employment				
Employer	Position held	Date of Joining	Date of Leaving	Pay with Scale of pay
Regional Engineering College, Durgapur, West Bengal (Now NIT)	Lecturer in Geology	1985	1986	Rs. 700-1600
Durgapur Government College, Durgapur, West Bengal (Under WB education Service)	Lecturer in Geology	1986	1992	Rs. 700-1600
University of Calcutta	Lecturer in Geology	1992	1993	Rs. 2200-4000
University of Calcutta	Sr. Lecturer in Geology	1993	2000	Rs. 3000-5000
University of Calcutta	Reader in Geology	2000	2005	Rs.12000-18200
<b>University of Calcutta</b>	<b>Professor of Geology</b>	<b>2005</b>	<b>continuing</b>	<b>Rs.37400-67000 (Present Basic Pay- Rs.2,11, 800/-)</b>

9. A brief biographical account (within 100 words)

Prof. Jyotiskar Ray has almost thirty-six years teaching and research experience in the fields of Igneous Petrology, Mineralogy and Geochemistry. He has worked on a number of igneous rock complexes of India and abroad. He has made significant contribution in understanding the petrogenesis of eastern Deccan volcanics, Sylhet trap differentiation centres, Khasi mafic rocks, ultramafic- mafic intrusive of Singhbhum Craton, geochronology of Nazca Ridge basalts, Naga-Manipur Ophiolite rock- complexes, oversaturated syenite plutons and layered gabbro-anorthosite rocks of Southern granulite terrane . Dr. Ray has successfully guided eleven students for their Ph.D. and supervised five post- doctoral students.

## ACADEMIC ATTAINMENTS OF THE CANDIDATE

(a) Degree	University/Institute	Year	Remarks (if any)
<b>Higher Secondary</b>	West Bengal Board of Higher Secondary Education [Subjects taken- Beng, Engl, Phys, Chem, Maths and Mechanics]	1974	First Division
<b>B.Sc. (Hons.)</b>	Presidency College under Calcutta University [Subjects taken- Geology (Hons.), Chem and Maths. (Pass)]	1978 (Result published)	First class
<b>M.Sc. (Geology)</b>	Calcutta University	1981 (Result published)	First class
<b>Ph.D. (Science)</b>	Calcutta University: Geology (Petrology, Geochemistry, Mineralogy)- Ph.D.work done at Presidency College, Kolkata	1990 (degree awarded)	Supervisor- Late Prof. Mihir K. Bose
<b>Post-Doctoral Fellow</b>	SOEST, University of Hawaii at Manoa, USA [worked on Trace element and Isotope Geochemistry]	2003-2004	NSF fellowship (worked with Late Prof. J. J. Mahoney)
<b>(b) Awards/Special Attainments</b>			
<ul style="list-style-type: none"> <li>• National Scholarship (1978)-for having outstanding B.Sc. results</li> <li>• Book grant from Calcutta University (1978)- [Jagattarini Prize]- for securing highest marks among all B.Sc. Part- II (Hons) candidates of Calcutta University</li> <li>• S.L. Biswas Memorial Award (1985) from the Asiatic Society for outstanding contribution in the field of Petrology (within ten years after M.Sc.)</li> <li>• Medal for Best paper (Scientific contribution) [1993]- from the Geological , Mining and Metallurgical Society of India, Kolkata</li> <li>• <b>M.R. Srinivasa Rao award (2012)- conferred by the Geological Society of India, Bangalore for outstanding contribution in Petrology</b></li> <li>• <b>National Geoscience Award (2018) –under Basic Science category, conferred by Ministry of Mines, Government of India (for contribution in the field of Petrology)</b></li> </ul>			
<b>(c) Other Relevant Information</b>			

Regular reviewer for the following international and national journals-  
Journal of Earth System Sciences, Geological Society of India, Proc. National Academy of Sciences (Earth and Planetary Sciences), Current Science, Geological Journal, Mineralogical Magazine, Acta Geochimica, Geoscience Frontier etc.

Guest Editor (along with Prof. N.V. Chalapathi Rao, BHU) of a special issue titled '*Deccan Traps and other Flood Basalt provinces : Recent Research trends*' (published by the *Journal of Earth system Science*, 2021-2022) [ISSN: 0973-774X]

(d) Brief critical views on the Contribution of the Candidate Towards the Advancement of Science and Technology

**The Candidate (Prof. Jyotisankar Ray) is an experienced teacher and researcher in the fields of Igneous Petrology, Geochemistry and Mineralogy. He (along with his research-students) has done commendable work to elucidate petrogenetic aspects of several igneous rock complexes of India. In recognition of Prof Ray's outstanding research-contribution, the Ministry of Mines, Government of India has conferred the prestigious National Geoscience award to him in the year 2018. Prof. Ray is also a recipient of M.R. Srinivasa Rao award from the Geological Society of India (2012). He has produced many excellent students who are already well- established in several national and international University/research Institutions.**

#### **List of Publications by Jyotisankar Ray in peer reviewed journals**

1. Paul, Madhuparna, **Ray, Jyotisankar**, Koeberl, C., Patel, S.C., Sheikh, J.M., Manikyamba, C., Gayen, M and Bhattacharjee, N. (2022). Petrology of Paleoproterozoic mafic-ultramafic rock suites of western Iron Ore Group, eastern India using chemistry of minerals. *Geological Magazine* (In press).
2. Manikyamba, C., Santosh, M, Subramanyam, K.S.V., Harshitha Reddy G., Ray, Jyotisankar, Kasr Asima, and Pahari, Arijit (2022): Forearc and back-arc mantle characteristics of the mafic-ultramafic rocks of Simlipal Complex, Singhbhum craton, India. *Lithos*, v.432-433, 106889.
3. Debaleena Sarkar, **Jyotisankar Ray**, Papiya Banerjee and Suranjana Kayal, 2022. Modal-data based simple statistical analysis as effective petrogenetic indicator: a case study from Kadavur Gabbro- Anorthosite Complex, Tamil Nadu, Southern India. *Current Science*.v.123, pp.601-605.
4. Moumita Chowdhury, **Jyotisankar Ray**, Rohit Pandey, Debaleena Sarkar and Paulomee Guha, 2022. Petrogenetic implications of mineral chemistry and mode-based statistical studies of Sholayar alkaline syenite complex, Southern Granulite Terrane, India. *Journal of Earth System Science*, <https://doi.org/10.1007/s12040-022-01932-y> (Article No.-1932)
5. Dey, P., **Ray, Jyotisankar.**, Sheikh, J.M., Patel, S.C. and Koeberl, C., Chakraborty, A., 2022. Insights into petrogenetic processes from a part of eastern Deccan volcanic

province, India, using cluster analyses of mineral-chemical data. *Journal of Earth System Science*, 131-163. (Special issue on Deccan) <https://doi.org/10.1007/s12040-022-01909-x>

6. Dey, P., **Ray, Jyotisankar.**, Sheikh, J.M., Patel, S.C. and Koeberl, C., 2022. Petrogenetic implications of Fe-Mg substitution in clinopyroxene lattices of basaltic suites of Khandwa area in the eastern Deccan volcanic province, central India. *Geological Journal*, doi:10.1002/gj.4559

7. Dey, P., **Ray, Jyotisankar.**, Sheikh, J.M., Patel, S.C. and Koeberl, C., Dutta, S., 2022. Olivine decandency of continental flood basalts in the light of recent experiments: a case study from Khandwa, Eastern Deccan Volcanic Province. *Journal of Earth system science*. v..131, Article- 0210

8. Ganguly, S., Dey, P., **Ray, Jyotisankar**, Talukdar, S., Saha, A., Koeberl, C., 2022 Cluster analysis of mineral-chemical data of basaltic rocks from Linga, Eastern Deccan Volcanic Province (EDVP) and its petrogenetic implications. *Journal of the Geological Society of India* (In press)

9. Rasmi Ranjan Mahapatra, Priyanka Mukherjee, Madhuparna Paul, Subrata Chakraborti, **Jyotisankar Ray**, Sohini Ganguly, Christian Koeberl, C. Manikyamba and Sonia Sarkar, 2022. Style of fractional crystallization in basalts from the Paleoproterozoic western Iron Ore Group of Singhbhum Craton, Eastern India: Implications from One Atmosphere Experimental Studies. *Journal of the Geological Society of India*, v. 98, pp.627-634

10. Asima Kar, **Jyotisankar Ray**, Subhajit Sinha, Rajib Kar, C. Manikyamba, Madhuparna Paul and Payel Dey, 2022. Geology of the Simlipal volcano-sedimentary basin of Singhbhum revisited: a simplistic interpretation. *Journal of the Geological Society of India*, v.98, pp.329-334.

11. **Jyotisankar Ray**, Madhuparna Paul, Rajib Kar, Janisar M. Sheikh, Suresh C. Patel, Deepak Kumar Sinha, Rakesh Sadasivan, Parvej Alam, Sanchari Chatterjee, Samhati Sarma, Ayendril Saha, 2021. Experimental study on soda granites of the Singhbhum Craton, eastern India, and its petrogenetic significance. *Geological Journal*, DOI: 10.1002/gj.4232.

12. C.S. Sindhuja, Arijit Pahari, C. Manikyamba, M. Santosh, Li Tang, **Jyotisankar Ray**, K.S.V. Subramanyam, Madhuparna Paul, I. Gonzalez-Alvarez, P.C. Sruthi, 2021. Crustal stabilization: Evidence from the geochemistry and U–Pb detrital zircon geochronology of quartzites from Simlipal Complex, Singhbhum Craton, India. *Geoscience Frontiers*, v. 13 (1): 101257, DOI: 10.1016/j.gsf.2021.101257

13. Payel Dey, **Jyotisankar Ray**, Janisar M Sheikh, Suresh C. Patel, Christian Koeberl, 2021. Windowing petrogenesis of continental flood basalts through mineralogical investigations: a case study from the Eastern Deccan Volcanic Province. *International Journal of Earth Sciences (Geol. Rund.)*, DOI: [10.1007/s00531-020-01960-3](https://doi.org/10.1007/s00531-020-01960-3)

14. **Jyotisankar Ray**, Satyananda Maiti, C. Manikyamba, Madhuparna Paul, Payel Dey, Satabdi Misra, 2020. Enigma of Dangoaposi and Jagannathpur Lavas of Singhbhum Craton, Eastern India: Possible Solution. *Journal of the Geological Society of India*, v.96 (4), pp.356-362.

15. Madhuparna Paul, **Jyotisankar Ray**, C. Manikyamba, Sohini Ganguly, M. Rajanikanta Singh, Saraswati Pachal, Debaleena Sarkar, 2020. Mafic volcanic rocks of western Iron Ore Group, Singhbhum Craton, eastern India: Geochemical evidence for ocean-continent convergence. *Geological Journal*, v. 56(3), DOI: 10.1002/gj.3944
16. Thungyani N Ovung, Biswajit Ghosh, **Jyotisankar Ray**, 2020. Petrogenesis of neo-Tethyan ophiolites from the Indo-Myanmar ranges: a review. *International Geology Review*, DOI: 10.1080/00206814.2020.1775137
17. Manikyamba, C., A. Pahari, M. Santosh, **Jyotisankar Ray**, S. Challa, K.S.V. Subramanyam, M.R. Singh, 2020. Mesoarchean gabbro-anorthosite complex from Singhbhum Craton, India. *Lithos* 366-367 (105541), DOI: 10.1016/j.lithos.2020.105541
18. Payel Dey, **Jyotisankar Ray**, Dinesh Pandit, Christian Koeberl, Sohini Ganguly, Sounak Chakraborty, Mehuli Ghosh, Indu Ray, 2020. Petrogenetic aspects and role of liquid immiscibility from parts of eastern Deccan volcanic province, India. *Geological Journal*, 55(2), pp. 1-20. DOI: 10.1002/gj.3704
19. A Eslami, **Jyotisankar Ray**, M Paul, S Sarkar, M Banerjee, M Noghreyan and P Dey, 2019. Mineral chemistry perspective of Nainophiolite mélange, Central Iran. *Current Science* v. 116 (10), pp. 1742-1747.
20. Saha A., Santosh M., Ganguly S., Manikyamba C., **Ray Jyotisankar** and Dutta J., 2018. Geochemical cycling during subduction initiation: evidence from serpentinized mantle wedge peridotite in the south Andaman ophiolite suite. *Geoscience Frontier* v. 9(6), pp. 1755-1775.
21. Ovung T.N., **Ray Jyotisankar**, Ghosh B. Koeberl C., Topa D. and Paul M., 2018. Clinopyroxene composition of volcanics from the Manipur Ophiolite, Northeastern India: implications to geodynamic setting. *International Journal of Earth Sciences (Geol. Rundsch.)*, v.107(4), pp.1215-1229. DOI: 10.1007/s00531-017-1529-y
22. Ovung T.N., **Ray Jyotisankar**, Ghosh B, Mandal D, Dasgupta P. and Paul, M., 2017. Occurrence of Népouite in the serpentinite of Manipur Ophiolite belt, Northeastern India: implication for melt-rock interaction in a supra-subduction Zone. *Journal of the Geological Society of India* v. 90, pp.154-158.
23. Saha A., Ganguly S., **Ray Jyotisankar**, Koeberl, C, Thoni M, Sarbajna C, and Sawant S.S., 2017. Petrogenetic evolution of Cretaceous Samchampi-Samteran Alkaline Complex, Mikir Hills, Northeastern India: Implications on multiple melting events of heterogeneous plume and metasomatized sub-continental lithospheric mantle. *Gondwana Research* v.48, pp 237-256.
24. Ghosh B., Morishita T., **Ray Jyotisankar**, Tamura, A., Mizukami, T., Soda Y. and Ovung T.N., 2017. A new occurrence of titanian (hydro)andradite from the Nagaland Ophiolite, India: Implications for element mobility in hydrothermal environments. *Chemical Geology* v.457, pp 47-60
25. Ovung T.N., **Ray Jyotisankar**., Teng X., Ghosh B., Paul M., Ganguly P., Sengupta S. and Das S., 2017. Mineralogy of the Manipur Ophiolite Belt, North East India: Implications for Mid-Oceanic Ridge and Supra-Subduction Zone origin. *Current Science* v.112, pp 2122-2129.



26. Singh M.R., Manikyamba C., Ganguly S., **Ray Jyotisankar**, Santosh M., Singh T.D. and Kumar B.C., 2017. Paleoproterozoic arc basalt-boninite-high magnesian andesite Nb-enriched basalt association from the Malangtoli volcanic suite, Singhbhum Craton, eastern India: Geochemical record for subduction initiation to arc maturation continuum. *Journal of Asian Earth Sciences* v. 134, pp 191-206.
27. Banerjee M, **Ray Jyotisankar**, Adhikary N, Nandy S, Manikyamba C, Paul M, Chakraborty D and Eslami A., 2017. Discussion on 'Experimental studies to constrain parental magma of Malangtoli volcanics from Singhbhum Craton of the Eastern Indian Shield'. *Journal of Geological Society of India*, v.90, pp. 120
28. Acharjee S, **Ray Jyotisankar**, Dey P, Bhattacharyya D, Banerjee M, Chattopadhyay B, Sengupta S, Bhatt A. K, Chowdhury D, Dwivedi A.K, Mahato S, Jana A.R, Maithani P.B and Ramesh Babu P.V., 2016. Mineral chemistry of tourmaline from Mashak Pahar, South Puruliya Shear Zone (SPSZ), eastern Indian Shield. *Jour. Earth System Sciences* v. 125(8), pp 1681-1696.
29. Banerjee M, **Ray Jyotisankar**, Adhikary N, Nandy S, Manikyamba C, Paul M, Chakraborty D and Eslami A., 2016. Experimental Studies to constrain parental magma of Malangtoli volcanics from Singhbhum Craton of the Eastern Indian Shield. *Journal of the Geological Society of India* v. 88, pp 245-255.
30. Singh M.R., Manikyamba C., **Ray Jyotisankar**, Ganguly S., Santosh M., Saha A., Rambabu S. and Sawant S.S., 2016. Major, trace and platinum group element (PGE) geochemistry of Archean Iron Ore Group and Proterozoic Malangtoli metavolcanic rocks of Singhbhum Craton, Eastern India: Inferences on mantle melting and sulphur saturation history. *Ore Geology Reviews* v.72(2), pp 1263-1289.
31. Manikyamba C, **Ray Jyotisankar**, Ganguly S., Singh M. R., Santosh M., Saha A. and Satyanarayanan M., 2015. Boninitic metavolcanic rocks and island arc tholeiites from the Older Metamorphic Group (OMG) of Singhbhum craton, eastern India: geochemical evidence for Archean subduction processes. *Precambrian Research* v.271, pp.138-159.
32. Hazra, S., **Ray, Jyotisankar**, Manikyamba, C., Saha, A. and Sawant S.S., 2015. Geochemistry of PGE in mafic rocks of East Khasi Hills, Shillong Plateau, NE India. *Jour. Earth Sys. Sci.* v.124(2), pp.459-475.
33. Ganguly, S., **Ray, Jyotisankar**, Koeberl, C., Saha, A., Thoni, M. and Balaram V., 2014. Geochemistry and petrogenesis of lava flows around Linga, Chhindwara area in the Eastern Deccan Volcanic Province (EDVP), India. *Journal of Asian Earth Sciences*, Elsevier, v.91, pp.174-193.
34. Ghosh B., **Ray, Jyotisankar** and Morishita, T., 2014. Grain scale plastic deformation of chromite from podiform chromitite of the Naga- Manipur Ophiolite belt, India: implication to mantle dynamics. *Ore Geology Reviews*, v.56, pp.199-208.
35. **Ray Jyotisankar**, Saha A., Koeberl C., Thoni M., Ganguly S. and Hazra S., 2013. Geochemistry and Petrogenesis of Proterozoic Mafic Rocks from East Khasi Hills, Shillong Plateau, Northeastern India. *Precambrian Research*, v.230, pp.119-137.



36. Chaudhuri S., **Ray Jyotiskankar**, Koeberl C., Thoni M., Dutta R. and Saha A. and Banerjee M., 2014. Petrology and Geochemistry of the Ultramafic- mafic Mawpyut Complex, Meghalaya: a Sylhet Trap differentiation centre in northeastern India. *Geological Journal* v. 49(2), pp 111-128.
37. Ray J.S., Mahoney J., Duncan R., **Ray Jyotiskankar**, Wessel P. and Naar D., 2013. Chronology and Geochemistry of Lavas from the Nazca Ridge and Eastern Seamount Chain: a ~ 30 Myr hotspot record. *Journal of Petrology*, v. 53(7), pp.1417-1448.
38. Bhattacharjee N., **Ray Jyotiskankar**, Ganguly S. and Saha A., 2012. Mineralogical study of Gabbro-Anorthosite from Dumka, Chhotanagpur Gneissic Complex, Eastern Indian Shield. *Jour. Geol. Soc. India.*, v.80 (4), pp.481-492.
39. Ganguly S., **Ray Jyotiskankar**, Koeberl C. Ntaflos T. and Banerjee M., 2012. Mineral Chemistry of Lava Flows from Linga area of the Eastern Deccan Volcanic Province, India. *Jour. Earth Sys. Sci.* v.121 (1), pp.91-108.
40. Saha A., **Ray Jyotiskankar**, Ganguly S., and Chatterjee, N., 2011. Occurrence of melanite garnet in syenite and ijolite-melteigite rocks of Samchampi-Samteran alkaline complex, Mikir hills, northeastern India. *Current Science*.v.101, (10),pp.95-100.
41. Mukhopadhyay Sarmistha, **Ray Jyotiskankar**, Balaram, V., Keshav Krishna, A., Ghosh, B. and Mukhopadhyay, S., 2011. Geochemistry and petrogenesis of syenites and associated rocks of the Elagiri complex, Southern Granulite Terrane, India. *Journal of Asian Earth Sciences, Elsevier*.v.42, pp.1256-1270.
42. **Ray Jyotiskankar**, Saha A., Ganguly S., Balaram V., Keshav Krishna A. and Hazra S, 2011. Geochemistry and Petrogenesis of Neoproterozoic Mylliem Granitoids, Meghalaya Plateau, Northeastern India. *Jour. Earth Sys. Sci.* v.120 (3), pp.459-473.
43. Mukhopadhyay S., **Ray Jyotiskankar**, Chattopadhyay B., Sengupta S., Ghosh B. and Mukhopadhyay S., 2011. Significance of Mineral Chemistry of Syenites and associated rocks of Elagiri complex, Southern Granulite Terrane of the Indian Shield. *Jour. Geol. Soc. India.* v.77 (2), pp. 113-129.
44. Sengupta P. and **Ray Jyotiskankar**, 2011. Petrology of the Mafic Sill of Narshingpur-Lakhnadon Section, Eastern Deccan Volcanic Province. *Jour. Geol. Soc. India.* v.77(4), pp.309-327.
45. Sengupta P. and **Ray Jyotiskankar**, 2010. Petrogenesis of Flood Basalts of the Narsingpur-Harrai-Amarwara-Lakhnadon section of Eastern Deccan province, India. In: *Ray Jyotiskankar, Sen Gautam and Ghosh Biswajit (Eds) Topics in Igneous Petrology. Springer, Netherlands*, pp.191-238.
46. Saha A., Ganguly S., **Ray Jyotiskankar** and Chatterjee N., 2010. Evaluation of phase chemistry and petrochemical aspects of Samchampi-Samteran differentiated alkaline complex of Mikir Hills, Northeastern India. *Jour. Earth Sys. Sci.*, v.119(5), pp.675-699.

- 47.Saha A., Ganguly S., **Ray Jyotisankar** and Dhang A., 2010. Vanadium bearing titaniferous magnetite ore bodies of Ganjang, Karbi-Anglong district, NE India. *Jour. Geol. Soc. India.* v.76 (1), pp. 26-32.
- 48.Saha A., Dhang A., **Ray Jyotisankar**, Chakraborty S. and Moecher D., 2010. Complete preservation of ophiolite suite from south Andaman: A mineral chemical perspective. *Jour. Earth Sys. Sci.* v.119 (3), pp.365-381.
- 49.Hazra S., Saha P., **Ray Jyotisankar** and Podder A., 2010. Simple statistical and mineralogical studies as petrogenetic indicator for Myllem porphyritic granites of East Khasi Hills, Meghalaya, NE India. *Jour. Geol. Soc. India.* v.75(5), pp. 760-768.
- 50.Chaudhuri S., Saha, R, **Ray Jyotisankar** and Bhaduri S.K., 2009. Mawpyut Intrusive complex of Jaintia Hills District, Meghalaya, Northeastern India: A case study for Magmatic Differentiation. *Jour Geol. Soc. India.* v.74 (3), pp. 385-394.
- 51.Hazra S. and **Ray Jyotisankar**, 2009. Nature of Mafic Magmatism in “Khasi Greenstone” around Laitlyngkot, East Khasi Hills, Meghalaya, North Eastern India. *Indian Jour. of Geology*, v.79, nos-1-4, pp.47-58.
- 52.Maity B., **Ray Jyotisankar** Chattopadhyay B., Sengupta S., Nandy S. and Saha A., 2008. Contrasting Petrological Variants in Newer Dolerite Dyke Swarm Around Bisoi, Eastern Indian Shield: Insights from Petrography and Mineral Chemistry. In: Srivastava R. K., Ch. Sivaji and Chalapathi Rao N. V. (Eds), *Indian Dykes* (Narosa Publishers), pp.447-470.
- 53.Hazra S, **Ray Jyotisankar** and Saha A., 2008. Mineral-Chemical Studies of Proterozoic Mafic Rocks of Meghalaya, North Eastern India. *Jour. Geol. Soc. India.* v.72, pp.679-690.
- 54.Chakraborty S and **Ray Jyotisankar**, 2008. Petrology of Recent Barren Island Volcanics of Andaman Sea, *Indian Journal of Geology*, v. 77 no. 1-4, pp.13-21.
- 55.Sengupta P. and **Ray Jyotisankar.**, 2007. Mineral chemistry of basaltic lava flows from Narsingpur – Harrai – Amarwara – Lakhnadon areas of Eastern Deccan, Central India. In: *Ray Jyotisankar. And Bhattacharyya C. (Ed.), Igneous Petrology 21st Century perspective* (Allied Publishers), 2007, pp.37-72.
- 56.Ghosh B, Mahoney J. and **Ray Jyotisankar**, 2007. Mayodia ophiolites of Arunachal Pradesh, North-Eastern Himalaya, India. *Jour. Geol. Soc. of India*, v.70, no.4, pp.595-604.
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- 58.Maitra M., Bose M.K. and **Ray Jyotisankar**, 2006. Interpretative Mineral chemistry of ultramafic rocks of Chalk Hills, Tamil Nadu. *Jour Geol. Soc. India*, v. 68, pp.831-840.

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83. Mukhopadhyay I, **Ray Jyotisankar** and Guha S.B., 1994. Amphibolitic rocks around Kotturu, Khammam District, Andhra Pradesh: structural and petrological aspects. *Indian Jour. of Geochem*, v.9 (1&2), pp.39-53.
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89. **Ray Jyotisankar**, 1984. On the komatiite of Palasbani, Singhbhum District, Bihar. *Current Science*, v.53(15), pp.806-807.

#### **Edited Books:**

1. **Ray Jyotisankar**, Sen Gautam and Ghosh Biswajit (Eds.), 2011. **Topics in Igneous Petrology: a Tribute to Prof. Mihir K. Bose**, Springer, Netherlands, online access, ISBN: 978-90-481-9599-2.
2. **Ray, Jyotisankar** and Bhattacharyya, C (Eds), 2007. **Igneous Petrology: 21st Century perspective**, Allied Publishers, New Delhi, ISBN : 81-8424-260-3.
3. **Chalapathi Rao N. V. and Ray Jyotisankar (Eds)**, 2022. **Deccan Traps and other Flood basalt provinces: Recent research trends**, Journal of Earth System Science, Springer, [Special Issue] ISSN : 0253-4126 (print)

#### **Technical Reports (Atlas):**

1. Desertification and Land Degradation Atlas of India (Based on IRS AWiFS data of 2011-13 and 2003-05) prepared by SAC, ISRO and other collaborating agencies including University of Calcutta presented by **Ray, Jyotisankar**; Banerjee, A and Paul, M. in June 2016.
2. Desertification and Land Degradation Atlas of Selected Districts of India (Based on IRS LISS III data of 2011-13 and 2003-05), Volume 2 prepared by SAC, ISRO and other collaborating agencies including University of Calcutta presented by **Ray, Jyotisankar**; Paul, M; Dey, P; Sarkar, D and Chowdhury, M. in June 2018.

(e) List of Ten Important and Recent Publications preferably with impact factor and citations.

1. Ovung T.N., **Ray Jyotisankar**, Ghosh B. Koeberl C., Topa D. and Paul M., 2018. Clinopyroxene composition of volcanics from the Manipur Ophiolite, Northeastern India: implications to geodynamic setting. *International Journal of Earth Sciences (Geol. Rund.)*, v.107(4), pp.1215-1229. DOI: 10.1007/s00531-017-1529-y. IF: 2.523
2. Payel Dey, **Jyotisankar Ray**, Janisar M Sheikh, Suresh C. Patel, Christian Koeberl, 2021. Windowing petrogenesis of continental flood basalts through mineralogical investigations: a case study from the Eastern Deccan Volcanic Province. *International Journal of Earth Sciences (Geol. Rund.)*, v.110, pp.447-466. DOI:10.1007/s00531-020-01960-3. IF: 2.523
3. Rasmi Ranjan Mahapatra, Priyanka Mukherjee, Madhuparna Paul, Subrata Chakraborti, **Jyotisankar Ray**, Sohini Ganguly, Christian Koeberl, C. Manikyamba and Sonia Sarkar, 2022. Style of fractional crystallization in basalts from the Paleoproterozoic western Iron Ore Group of Singhbhum Craton, Eastern India: Implications from One Atmosphere Experimental Studies. *Journal of the Geological Society of India*, v. 98, pp.627-634. IF: 1.459
4. Ghosh B., Morishita T., **Ray Jyotisankar**, Tamura, A., Mizukami, T., Soda Y. and Ovung T.N., 2017. A new occurrence of titanian (hydro) andradite from the Nagaland Ophiolite, India: Implications for element mobility in hydrothermal environments. *Chemical Geology* v.457, pp 47-60. IF: 4.015
5. Ray J., Mahoney J., Duncan R., **Ray Jyotisankar**, Wessel P. and Naar D., 2013. Chronology and Geochemistry of Lavas from the Nazca Ridge and Eastern Seamount Chain: a ~ 30 Myr hotspot record. *Journal of Petrology*, v. 53(7), pp.1417-1448. IF: 4.515
6. Manikyamba C, **Ray Jyotisankar**, Ganguly S., Singh M. R., Santosh M., Saha A. and Satyanarayanan M., 2015. Boninitic metavolcanic rocks and island arc tholeiites from the Older Metamorphic Group (OMG) of Singhbhum craton, eastern India: geochemical evidence for Archean subduction processes. *Precambrian Research* v.271, pp.138-159. IF: 4.725
7. Ghosh B., **Ray, Jyotisankar** and Morishita, T., 2014. Grain scale plastic deformation of chromite from podiform chromitite of the Naga- Manipur Ophiolite belt, India: implication to mantle dynamics. *Ore Geology Reviews*, v.56, pp.199-208. IF: 3.809
8. **Ray Jyotisankar**, Saha A., Koeberl C., ThoniM.,Ganguly S. and Hazra S., 2013. Geochemistry and Petrogenesis of Proterozoic Mafic Rocks from East Khasi Hills, Shillong Plateau, Northeastern India. *Precambrian Research*, v.230, pp.119-137. IF: 4.725
9. **Jyotisankar Ray**, Satyananda Maiti, C. Manikyamba, Madhuparna Paul, Payel Dey, Satabdi Misra, 2020. Enigma of Dangoaposi and Jagannathpur Lavas of Singhbhum Craton, Eastern India: Possible Solution. *Journal of the Geological Society of India*, v.96 (4), pp.356-362. IF: 1.459
10. Saha A., Ganguly S., **Ray Jyotisankar**, Koeberl, C, Thoni M,SarbajnaC, and Sawant S.S., 2017. Petrogenetic evolution of Cretaceous Samchampi-Samteran AlkalineComplex, Mikir Hills,Northeastern India: Implications on multiplemelting events of heterogeneous plume and metasomatizedsub-continental lithospheric mantle. *Gondwana Research* v.48, pp 237-256. IF: 6.051

**(f) Specific contribution of the candidate**

(A brief statement, regarding the most significant achievements of the candidate: **JYOTISANKAR RAY**; biographical or general nature should be avoided).

[Specific contribution of the Candidate is given below]

<b>Name</b>	<b>JYOTISANKAR RAY</b>
<b>Year of Birth</b>	<b>1958</b>
<b>Address</b>	<b>Dept. of Geology, University of Calcutta, 35, Ballygunge Circular Road, Kolkata- 700 019, Mobile- 9433090415</b>

**Specific Contribution of the candidate**

*Prof. (Dr.) Jyotisanakar Ray- eminent petrologist in this country, is known for his exceptionally high quality researches and sustained dedication as an academician (and as a researcher) for a span of more than three decades. Dr. Ray has made fundamental contributions in understanding the evolution of the Indian shield, particularly the checkered tectonomagmatic history of the country. Prof. Dr. Ray's contribution is summarized below:*

*(i) work done on Sylhet Trap volcanic provinces- and its centres of differentiation:- Dr. Ray and his research-students have taken up studies on two poorly studied differentiated complexes; these are Mawpyut of Jaintia Hills District, Meghalaya while the other one is Samchampi- Samteran complex, Mikir Hills, North Eastern India.*

*(ii) Khasi mafic igneous rocks (north eastern India): Dr. Ray (along with his co- workers) have extensively studied the Precambrian (~ Neoproterozoic ) mafic volcanics rocks of the Shillong plateau, North Eastern India (popularly known in the literature as Khasi Greenstone rocks).*

*(iii) Novel Petrological work done in the Deccan Trap provinces- (mostly eastern Deccan volcanic provinces). Systematic studies on Eastern Deccan volcanic provinces indicate plume- related sources .Dr. Ray has paid attention to relatively less- attended Eastern Deccan Lava flows.*

*(iv) Ophiolites and Recent Volcanics of Andaman: Prof. Dr. Ray and his co-researchers have already made some breakthrough contribution on the geological aspects of several Tethyan ophiolites*

*(v) Petrology of Dibang Valley (Arunachal Pradesh) Ophiolite*

*(vi) Petrology, Geochemistry and Mineralogy of Manipur- Nagaland Ophiolite*

*(vii) Statistical and Experimental Studies on the Granitoid bodies of Raghunathpur area of Purulia , West*



*Bengal, Lingtse granite of Sikkim and Porphyritic granite bodies of Myllem, East Khasi hills, Shillong- Prof. Dr. Ray, on the basis of sustained field work, petrographic analyses, statistical parameters (coupled with experimental studies) delineated the petrological aspects of these granite bodies.*

*(viii) Work done on Oversaturated Syenite of Southern Granilite Terrane- work shows liquid immiscibility plays an important role as the differentiation mechanism*

*(ix) Work done on Newer Dolerites of Singhbhum region of Eastern Indian Shield: The investigated Newer Dolerites indicate presence of at least four distinct petrographic types viz, dolerite, porphyritic dolerite, micropegmatitic dolerite and gabbro.*

*(x) Petrology, Geochemistry and Tectono-magmatic setting Iron Ore Group of lavas, Malangtoli lavas and Older Metamorphic Group rocks*

*(xi) Establishment of Experimental Petrology Laboratory in the Department of Geology, Calcutta University and Experimental Studies on Rajmahal Basalt, Malangtoli basalts and serpentinites of Manipur Ophiolite belt*

*(xii) Publication of Books (edited volumes) with National and International Publishing Houses- one edited book was published from Springer, Netherlands while the other book was published from Allied Publishers, New Delhi. Recently (in 2022) Prof. Ray (along with Prof. N.V. Chalapathi Rao) has guest-edited a special volume (on Deccan Traps) in the Jour of Earth System Sc.*

### Details of Doctoral, Post-Doctoral supervision and M.Sc. Thesis supervision

Sr. No	Name of the Research Scholar (and present affiliation)	Title of Thesis	Doctorate or Master's Level	Year of Completion (or in Progress)	Joint supervisor (if any)
1	Dr. Manoj Maitra (worked as a Director, Geological Survey of India and now a faculty Techno India University, Kolkata)	Petrology and Geochemistry of the ultramafic-mafic-alkaline rock association of Salem, Tamil Nadu	Ph.D.	2000 (awarded)	Late Prof. Mihir K. Bose, Presidency College, Kolkata
2	Dr. Biswajit Ghosh (Presently working as Associate Professor, Dept. of Geology, Calcutta University)	"Petrology and Geochemistry of ophiolitic rocks in the Mayodia-Hunli sector of Dibang Valley district, Arunachal Pradesh, North Eastern India"	Ph.D.	2001 (awarded)	----
3	Dr. Piyali Sengupta (Presently working as a DST- woman scientist at Presidency University, Kolkata)	Structure, Petrology and Geochemistry of the Deccan Traps, south of Narsingpur, Madhya Pradesh	Ph.D.	2006 (awarded)	-
4	Dr. Indrani Mukhopadhyay (Presently working as a High- school Teacher, Kharagpur, West Bengal)	Petrology and Geochemistry of the rocks in the area around Kallur, Khammam district, Andhra Pradesh	Ph.D.	2009 (awarded)	-
5	Dr. Sharmistha Mukhopadhyay (worked as a DST- woman scientist 2016-2019; at Calcutta University, Kolkata)	Petrology and Geochemistry of Syenite pluton and associated rocks of Elagiri, Tamil Nadu, Southern India	Ph.D.	2011 (awarded)	-
6	Dr. Abhishek Saha (Presently working as a Scientist in National Institute of Oceanography, Goa)	Petrology and Geochemistry of Samchampi-Samteran ultramafic-mafic-alkaline Complex, Karbi-Anglong district,	Ph.D.	2012 (awarded)	-

		Assam, North eastern India			
7	Dr. Sampa Hazra (Presently working as a Geologist in State Water Investigation Directorate, Govt. of West Bengal)	Petrology and Geochemistry of Mafic Rocks and Porphyritic Granitoids around Laitlyngkot, East Khasi Hills Distict, Meghalaya, North-Eastern India	Ph.D.	2013 (awarded)	-
8	Dr. Srinanda Chaudhuri (worked as a Director, Geological Survey of India)	Petrology and Geochemistry of Ultramafic - mafic complex of Mawpyut, Jaintia Hills District, Meghalaya, North - Eastern India	Ph.D.	2013 (awarded)	-
9	Dr. Sohini Ganguly (Presently working as a DST Inspire Faculty, Goa University, Goa)	Petrology and Geochemistry of Deccan Trap Lava Flows Around Linga, Chhindwara district, Madhya Pradesh, Central India	Ph.D.	2014 (awarded)	-
10	Dr. Thungyani N. Ovung (presently a faculty on the NIT, Raipur)	Petrology of Igneous members Manipur Ophiolite Belt, Jessami-Moreh Areas, North eastern India	Ph.D.	2019 (awarded)	Dr. Biswajit Ghosh (CU)
11	Payel Dey (presently working in a DST- SERB project, in Geology Dept, CU)	Petrology and Geochemistry of Deccan Traps lava flows around Khandwa, Madhya Pradesh, Central India	Ph.D.	Submitted in April 2022 (now in the process of examination)	---
12	Madhuparna Paul (presently working in a DAE, AMD project, in Geology Dept, CU)	Petrology and Geochemistry of Mafic volcanic rocks and associated intrusive rocks in the western part of Iron Ore Group, Singhbhum craton, Eastern India	Ph.D.	(Departmental Seminar has been held in Sept 2022)	Dr. C Manikyamba (NGRI, Hyderabad)

13	<b>Part- time research Fellows</b> (working with Prof. Jyotisanakar Ray) <ul style="list-style-type: none"> <li>• Debaleena Sarkar</li> <li>• Moumita Chowdhury</li> <li>• Asima Kar</li> <li>• Sonu Hansda</li> </ul>				
<b>POST DOCTORAL RESEARCH SUPERVISION</b>					
1.	Dr. F.K. Kabeto (Under C.V. Raman International Fellowship)	Study of NW Ethiopian Flood Basalts in the light of Petrology, Geochemistry, Isotope Geology and Experimental Studies for constraining Petrogenetic Evolution	Post Doctoral Research work	March – September 2012 ( for six months duration)	--
2.	Dr. Abhishek Saha (CSIR Post-Doctoral Research Associate)	Petrology and Geochemistry of Granitoids occurring in the Shillong- Meghalaya plateau, northeastern India	Post Doctoral Research work	Two years ; starting from March 2014	--
3.	Dr. Anindita Dey (UGC- D.S. Kothari Fellowship)	Petrology and Geochemistry of high grade rocks in parts of SGT and their bearing on Petrogenetic evolution	Post Doctoral Research work	Three Years from 2019 (presently a faculty of Delhi University)	--
4.	Dr. Saheli De (UGC- D.S. Kothari Fellowship)	Evolution of Cuddapah basin in the light of sedimentological and magmatic studies	Post Doctoral Research work	Three Years from 2019 (presently a faculty Amity University, Mohali)	--

**M.Sc. Thesis guidance- Supervised 99 students for their M.Sc. thesis (1992- to date)**

## SUMMARY SHEET RELATED TO CANDIDATURE OF JYOTISANKAR RAY

1. Name of the Candidate: **JYOTISANKAR RAY**

2. Name of the Sectional Committee: **Earth and Planetary Sciences**

3. Academic distinctions and Awards / Recognition:

(National or International recognitions. For example: Awards from recognized bodies/societies like all the National Academies, ISCA, CSIR, ICAR, DST, DBT etc.)

- *National Geoscience Award (2018) –under Basic Science category, conferred by Ministry of Mines, Government of India (for contribution in the field of Petrology)*
- *M.R. Srinivasa Rao award (2012)- conferred by the Geological Society of India, Bangalore for outstanding contribution in Petrology*
- *Visiting Professor, Dept. of Lithospheric Research, , University of Vienna, Austria (2009)*
- *S.L. Biswas Memorial Award (1985) from the Asiatic Society for outstanding contribution in the field of Petrology*

4. Significant teaching/research contribution\*:

*(1) Thirty –six years teaching and research experience in the fields of Igneous Petrology, Mineralogy and Geochemistry. (2) Pioneer research work done by the candidate on several igneous rock- complexes of India and abroad (published about 90 peer- reviewed research papers in several national and international journals) (3) Successfully supervised eleven students for their Ph.D. and supervised five students for their post- doctoral studies.*

5. Publications (Ten best publication with Impact Factor):

- 2018, International Journal of Earth Sciences (Geol. Rund.), v.107 (4), pp.1215-1229. IF: 2.523
- 2021, International Journal of Earth Sciences (Geol. Rund.), v.110, pp.447-466. IF: 2.523
- 2022, Journal of the Geological Society of India, v. 98, pp.627-634. IF: 1.459
- 2017, Chemical Geology, v.457, pp 47-60. IF: 4.015
- 2013, Journal of Petrology, v. 53(7), pp.1417-1448. IF: 4.515
- 2015, Precambrian Research, v.271, pp.138-159. IF: 4.725
- 2014, Ore Geology Reviews, v.56, pp.199-208. IF: 3.809
- 2013, Precambrian Research, v.230, pp.119-137. IF: 4.725
- 2020, Journal of the Geological Society of India, v.96 (4), pp.356-362. IF: 1.459
- 2017, Gondwana Research v.48, pp 237-256. IF: 6.051

6. Editorial Board Member of National/International journal/Society/Body or Co-Chairing International conference technical session/ Patent (only filed with ref no. or granted will be considered)/Technology Transfer (with valid documentation): Guest Editor (along with Prof. N.V. Chalapathi Rao, BHU) of a special issue titled '*Deccan Traps and other Flood Basalt provinces : Recent Research trends*' (published by the Journal of Earth system Science, 2021-2022) [ISSN: 0973-774X]

7. List of Extramural Research Projects / Peer Reviewed Projects with amount of funding and your Role

(as a Project Leader/Principal Investigator or Co-PI):

(1) PGE characterization and lava flow correlation in selected areas of Eastern Deccan volcanic province. 28,02,160/- DST- SERB [as P.I.] (2) Characterization of Soda granites and related uranium metallogeny around Chamaru-Nengtasai, Saraikela-Kharsawan district, Jharkhand.” 27,00,500/- BRNS, DAE [as P.I.] (3) Assessing the role of plume-head for continent- generation in the Khasi Greenstone Belt of Meghalaya, North Eastern India. 9,00,000/- DST-SERC [ as P.I.] (4) Tracking Kerguelen Plume Activities in North-Eastern India in the Light of Continental Flood Basalt-Related Differentiation Centers. 7,00,000/- UGC [as P.I.] (5) Petrochemistry of rocks from Eastern Ghats mobile belt and Dharwar belt along selected corridors studies in South India 1,00,000/- CSIR [as P.I.] (6) Petrotectonic Style of Manipur Ophiolite Belt, North Eastern India. 12,00,000/- DST-SERC [ as P.I.] (7) Geological and Geochemical Investigations of Precambrian Mafic magmatism of Singhbhum craton, Eastern India: Implications on Mantle Processes. 14,00,200/- DST-SERC [as Co- P.I. (with Dr. C. Manikyamba, NGRI as P.I.) ](8) Desertification Status Mapping of India-second cycle. 16,00,000/- ISRO, Govt. of India [as P.I.] (9) Laboratory analyses of Bengal basin offshore project (WB-OS-1). 20,00,000/- ONGC, Kolkata [as Coordinator]

#### **8. Seminar/Symposia/Training organized:**

(As Chief Organizer/Convener/Secretary – with name of the event, role, duration of the event, organizer etc)

- (a) **National Seminar** on-“Igneous Petrology : 21st Century Perspective “, 2005, 18<sup>th</sup>. February
- (b) **National Workshop and Training Course on:** “Recent Developments in Techniques to constrain petrogenesis of Igneous Rocks”-2006-2007, December 26,2006-January 8,2007.
- (c) **National Seminar** on “Plume Signature in Geological History”, January 8, 2008
- (d) **National Seminar** on : “Ophiolites: Present and Future trends of Researches, 2008, August 29
- (e) **National Seminar** on : “Styles of Magmatism in the Indian Shield, 2010, Nov.11
- (f) **International Seminar** on AOGS (Asia- Oceania Geoscience Society) , 2010 at Hyderabad
- (g) **International Seminar** AOGS (Asia- Oceania Geoscience Society)- held in Singapore, 2009
- (h) **International Seminar** AOGS (Asia- Oceania Geoscience Society) organized at Bangkok, Thailand, Sept 2007

#### **9. Any other activity :**

Prof. Ray took active part in organizing campus- recruitment for the students of Geology Dept, CU; many students were employed through the campus- recruitment process. Notable employers were : M/S Arrow Energy Limited (CBM exploration MNC), M/S Somika –Aurum, Emami Group, M/S Baldota (MSPL), M/S Balaji Steel, M/S Salva Resources, Jindal Steel and Power, M.N. Dastur& Co, Kolkata, M/S Jain Group of Companies, M/S Comant Technology etc.

#### **10. Abstract publication: Presented outcome of research activities in several National and International Seminars/workshops, research- findings published in the Abstract volumes.**