

Department of Earth Sciences (DES)

The Department of Earth Sciences (DES), IISER Kolkata is looking for bright and motivated students, who have completed their M.Sc./MS/M.Sc. Tech/M. Tech (with **minimum of 55% marks**) in: 1) Geology/Applied Geology/Geophysics /Earth Sciences/Marine geology/Environmental Sciences/Environmental Studies/Atmospheric Science/Environmental Engineering/Civil Engineering or any other branch of Geological sciences.

Or

2) Physics/Chemistry/Mathematics/Biological Sciences/Computational Seismology/interested to pursue research with the DES faculty member in the matching specialization.

Final year post-graduate students who are yet to obtain their degree may also apply; however, they must have completed their degree at the time of admission. Some of the important information about this program is provided below.

Eligibility for externally funded students: Candidates having valid **CSIR NET JRF / UGC-NET JRF / DST-INSPIRE / other equivalent fellowship** would be eligible to apply.

- Candidates must have **physics, chemistry and mathematics at 10+2 level**, and at least one of these subjects at their bachelor level.
- They can work with any faculty member in DES based on mutual research interest. The research areas in which department is looking for young and bright minds are listed below-

1. Environmental Science- Dr. Gopala Krishna Darbha is leading the environmental nanoscience and hydrogeochemistry group at the Department of Earth Sciences, IISER Kolkata. Their work is interdisciplinary focusing on environment-geochemistry-colloid science. Their study involves understanding the factors responsible for stability and transport of contaminants (such as plastics, pesticides, metals, persistent organic compounds) in the riverine environment and further their sorption onto rock and mineral surfaces under the prevailing environmental conditions (pH, T, humic acid, carbonates and other suspended particulate matter such as clay). They are currently working on i) impact of hydrogeochemistry on transport of metal contaminants along the lower Ganga river basin ii) understanding the distribution and fate of micro- to nano- plastics along east coast of India iii) fate of nanopesticides in the environment iv) modelling the transport of contaminants v) application of eco-friendly methods (sorption and photochemical) to remediate the potential toxic metals such as chromium, lead, arsenic, zinc as well the organic contaminants such as dyes, perfluoroalkyl compounds.

References-

- i) Effect of irrigation water type and other environmental parameters on CeO₂ nanopesticide-clay colloid interactions, Ekta Tiwari, Mithu Mondal, Nisha Singh, Nitin Khandelwal, Fazel Abdolapur Monikh, Gopala Krishna Darbha, **Environ. Sci.: Processes Impacts**, 2020, DOI: 10.1039/C9EM00428A
- ii) Nisha et al., Understanding the stability of nanoplastics in aqueous environments: effect of ionic strength, temperature, dissolved organic matter, clay, and heavy metals, **RSC Environmental Science: Nano**, 2019, Advanced article, <https://doi.org/10.1039/C9EN00557A>,
- iii) Removal and recovery of toxic nanosized Cerium Oxide using eco-friendly Iron Oxide Nanoparticles, Kanha Gupta, Nitin Khandelwal, Gopala Krishna Darbha, **Frontiers of Environmental Science and Engineering**, 2019, 14, 15

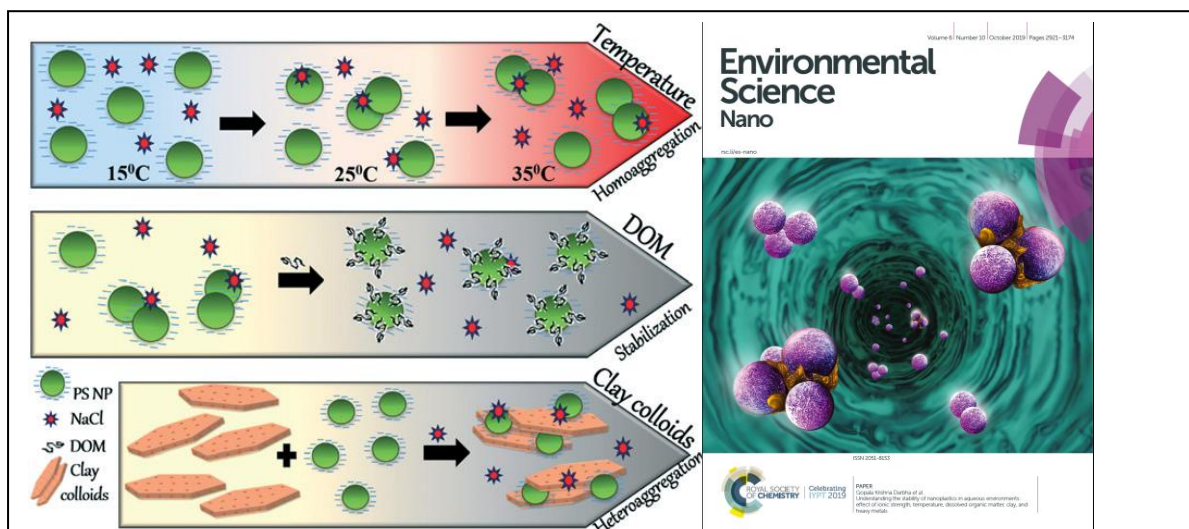


Figure 1: Stability of nanoplastics as a function of environmental factors (pH, T, dissolved organic matter, clay colloids) *Env.Sci.Nano*, 2019, 9, 11160-11169. The article has been selected as cover page article.

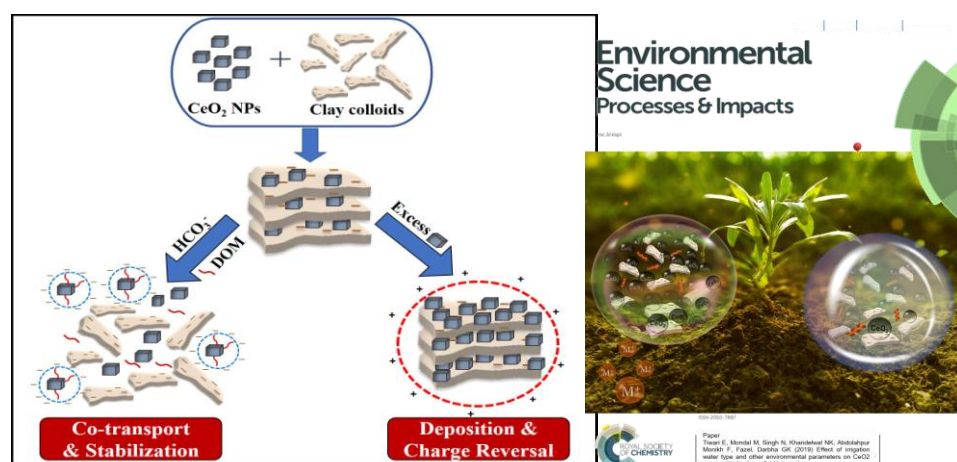


Figure 2: Fate and transport of CeO_2 nanopesticides in the soils. *Env.Sci.Procees Impacts*, 2020 (10.1039/C9EM00428A). The article has been selected as cover page article.

2. **Computational Mineral Physics Group-** The Earth's interior is inaccessible to mankind. However, the evolution of the Earth and the other planets, as well as their present structure and dynamics, depends on processes that take place in their deep interiors. There are several ways in which the Earth's interior can be probed indirectly. First principles quantum mechanical based studies being one of them. In the last two decades it has progressively grown into an indispensable tool which is employed in conjugation with results flowing out of seismology, cosmochemistry, geochemistry, meteoritics, and high pressure and temperature laboratory experiments to extract useful information that help us to thermodynamically model the Earth's interior. The Mineral Physics group here at IISER Kolkata performs first principles density functional theory (DFT) based studies to investigate the dynamical stability and thermoelastic properties

of probable phases inside the Earth at pressure and temperature conditions up to the Earth's inner core. Thermoelastic properties of minerals and melts are the crucial link that permit the seismic tomographic images of the Earth's interior to be translated into information of geophysical significance: mineralogy, composition, and temperature. State-of-the-art high pressure experimental techniques and quantum mechanical first-principles atomistic simulations complement each other and help us obtain robust estimates of various physical and chemical parameters needed for seismic and geodynamical study of Earth interiors. For a brief overview of the scope of first principles based studies in Geo-sciences one may refer to the following review article : J. Brodholt and L Vočadlo, MRS Bulletin, Vol 31, September 2006. Dr. Gaurav Shukla and Dr. Swastika Chatterjee are currently leading this group.

3. **Tectonic Geomorphology**- The successful candidate will have the opportunity to design and conduct research in one or more of the following areas: (1) deciphering the geomorphic sensitivity of landscapes to climate change and associated hazards on natural and human systems; (2) orogen-scale climate-erosion-tectonics coupling; (3) decoding tectonics from topography and geomorphic archives. The projects will be based on a combination of fieldwork, laboratory analysis, and computer models. The new students will be expected to conduct original research, present research findings in national or international conferences, and publish in peer-reviewed scientific journals. Currently Dr. Sanjay K. Mandal is leading this group and student is suppose to work with him.



Figure 1. Thick valley-fill straddling the Yamuna River in northwestern Indian Himalaya.



Figure 2. Fluvial landscape of the Yamuna basin in northwestern Indian Himalaya.

4. **Archean crustal evolution in central India: A granitoid perspective**

The actual mechanism of Archean crust formation remains a major research interest globally. Granitoids are the dominant rock type in Archean cratons. They provide vital clues to the mechanism and geodynamic setting of continental crust formation. Archean granitoids of diverse types are well exposed in the central India. This Ph.D. project aims to study the field and age relationship, and geochemistry of these granitoids to understand their petrogenesis, role in crust formation and crust-mantle interaction, and to suggest geodynamic model for Archean crustal evolution.



The project will provide an opportunity to the candidate to get involved in field mapping and detailed sampling in exotic terrains followed by petro-mineralogical study, whole-rock geochemistry and zircon U-Pb dating and Hf isotopic study. The student is supposed to work with Dr. Sukanta Dey.

References:

- Ghosh, J.G., 2004. 3.56Ga tonalite in the central part of the Bastar Craton, India: oldest Indianate. *Journal of Asian Earth Sciences*, 23, 359–364.
- Mondal, M.E.A., Hussain, M.F., Ahmad, T. 2019. Archaean granitoids of Bastar craton, Central India. In: S. Dey, J.-F. Moyen (Eds.), *Archean Granitoids of India: Windows into Early Earth Tectonics* Geological Society, London, Special Publications, 489, <https://doi.org/10.1144/SP489-2019-311>
- Hariharan, R., Mukhopadhyay, J., Beukes, N.J., Gutzmer, J., Belyanin, G.A., Armstrong, R.A., 2009. Evidence for an early Archaean granite from Bastar craton, India. *Journal of the Geological Society*, 166, 193–196.

Eligibility for institute funded students:

- Candidates must have qualified in one of the following examinations, **GATE, SLET, UGC/CSIR NET-LS, INSPIRE, other equivalent examination.**
- The institute will fund student interested to work in the **Computational Mineral Physics**- same as for externally funded students but do not have their own fellowship.

***Please note** that fulfilling the minimum essential criteria does not ensure that a candidate will be called for the interview. Additional criteria for shortlisting might be set by the department based on academic records, experience and research interest of the candidates. Reservations of candidates will be as per government norms. The departmental faculty profiles can be found at the URL: <http://www.iiserkol.ac.in>*