Applications for PhD positions in Department of Earth Sciences (DES), IISER Kolkata

Minimum eligibility criteria:

Applications are invited for the Doctor of Philosophy (PhD) program in the Department of Earth Sciences from candidates having either:

1) Master's degree with at least **55% aggregate marks** in Geology / Applied Geology / Geophysics / Earth Sciences / Marine geology / Environmental Sciences / Environmental Studies / Environmental Science and Engineering / Biotechnology / Atmospheric Science / Geographical Science / Agricultural Science / Forensic Science or any other branch of Geological Sciences. OR

2) Master's degree with at least **55% aggregate marks** in Physics / Chemistry / Mathematics / Biological Sciences / Computational Seismology and interested in pursuing research with the DES faculty member in the matching specialization. OR

3) 4-year BS with at least **75% aggregate marks** in any subject and interested to pursue research with the DES faculty member in the matching specialization.

A relaxation of **5%** marks may be allowed for those belonging to SC/ST/OBC (non-creamy layer)/Differently-Abled, Economically Weaker Section (EWS) and other categories of candidates as per GoI norms. Candidates belonging to the respective reserved category need to submit relevant certificates and documents.

Interested candidates may apply though either of the two channels listed below

Channel 1: Externally funded category:

For candidates in the self-funded category, apart from satisfying minimal eligibility criteria, all candidates must have valid **CSIR-NET JRF / UGC-NET JRF and other equivalent fellowships.** Candidates must have **physics, chemistry and mathematics at 10+2 level**, and **at least one of these subjects at their bachelor level**.

Channel 2: Institute (IISERK) funded category:

For candidates in the institute-funded category, apart from satisfying minimal eligibility criteria, all candidates must have qualified in one of the following examinations, **GATE, UGC/CSIR NET (Category 2 & 3), INSPIRE or other equivalent examinations**. Candidates must have **physics, chemistry and mathematics at 10+2 level**, and **at least one of these subjects at their bachelor level**.

A. <u>The research areas in which the department is looking for young and bright minded externally funded (Channel 1) students only are listed below:</u>

1. <u>Environmental Sciences</u> - **Prof. Gopala Krishna Darbha** leads the Environmental Nanoscience and Hydrogeochemistry Group in the Department of Earth Sciences at IISER Kolkata. The group conducts interdisciplinary research at the interface of environmental geochemistry, nanoscience, and hydrological processes.

The overarching goal of the group is to understand the sources, transport, transformation, and remediation of emerging and conventional pollutants in natural systems. The major research thrust areas include:

1. **Assessment of pollutant distribution across environmental compartments** (air, water, soil, and food systems), with particular emphasis on identifying and quantifying human exposure pathways.
2. **Hydrogeochemical controls on metal transport** within river basins, sediments and soils, focusing on mobilization, speciation, and long and short-range dispersal of toxic elements.
3. **Distribution, transformation, and fate of micro- and nanoplastics** in Indian rivers and coastal environments, including their interactions with natural colloids and biogeochemical processes.
4. **Application of remote sensing and geospatial tools** to address large-scale environmental monitoring and pollution mapping challenges.
5. **Development of eco-friendly remediation materials** derived from industrial and agricultural waste for the removal of potentially toxic elements (e.g., chromium, lead, arsenic) and organic contaminants such as nanoplastics, dyes, perfluoroalkyl substances, and pesticides.
6. **Critical mineral recovery from mine waste**, employing integrated biological and chemical approaches to promote sustainable resource recovery and circular economy principles.

Through a combination of field investigations, advanced analytical techniques, laboratory experimentation, and modelling approaches, the group contributes to both fundamental understanding and applied solutions for environmental sustainability. Interested candidates with Chemistry, Biology, Marine, Geology and Engineering disciplines are highly encouraged to apply.

For recent publications, achievements, and ongoing projects, please visit: https://gkdarbha.wixsite.com/gopaladarbha

2. <u>Aerosol and Air Quality Research</u> – The Aerosol and *Air Quality Research lab* led by **Dr. Debananda Roy**, is looking for bright and motivated candidates to work in the area of *Air Quality Management and Modelling*.

The research area will focus on "comprehensive investigation of indoor and outdoor air quality through monitoring, physicochemical characterization, source apportionment, and modelling of particulate matter and emerging pollutants (including microplastics, black

carbon, bioaerosols, and transboundary contaminants), in order to assess their interactions and evaluate associated risks to human health and the environment". The PhD candidates can choose to work on any of the following research areas:

Indoor and Outdoor Air Quality: Monitoring and physicochemical (organic and inorganic) characterization of particulate matter.

Emerging Air Pollutants: Identification and characterisation of airborne emerging pollutants (such as *microplastics and black carbon*), along with an assessment of their risks to human health and the environment.

Source Apportionment Study: Identification of the source of airborne particulate matter.

Air Pollution Modelling: Receptor (chemical mass balance- CMB8.2; positive matrix factorization), dispersion (AERMOD), and human health risk (exposure pathway and HRT mass deposition) modelling.

Air Quality in the Underground Transportation System: Air quality levels and associated human health risk levels for the commuters.

Bioaerosol Research: Monitoring, modelling, and quantitative microbial risk assessment (QMRA)- probability of infection and noncancer risk.

Natural and Transboundary Air Pollutants: Identification and quantification of natural and transboundary air pollutants and their impacts on human and the environment.

Interaction Study: Interaction phenomena between emerging pollutants and toxic air pollutants.

B. The research areas in which the department is looking for young and bright minded students through both the channels (Channel 1: Externally funded and Channel 2: IISER Kolkata funded) are listed below:

1. Seismology – **Prof. Kajaljyoti Borah** is looking for bright and motivated PhD candidates to work on two different themes:

Channel 1: Externally Funded Category

Title: Evolution of Archean cratons: insight from Bastar craton

Objectives: Archean cratons have been the prime targets of the scientific community for a long time because they store records of the long Earth's history and they have economic significance as a major source of the World's minerals. The crustal thickness, crustal composition (inferred from seismic wave velocities), structure and physical properties of crust-mantle transition (commonly used as Moho by the seismologists), and lithospheric discontinuities are the key parameters for understanding the formation and evolution of cratonic lithosphere. This project is focussed at elucidating the origin and evolutionary history of the relatively unexplored Bastar craton along with other Archean cratons all over the globe by modelling the physical properties of the underlying crust and mantle using seismological data from these regions.

Channel 2: Institute (IISERK) funded category

Title: 3D- shear velocity anisotropic structure in the Indo Burma Ranges and its geodynamic implication

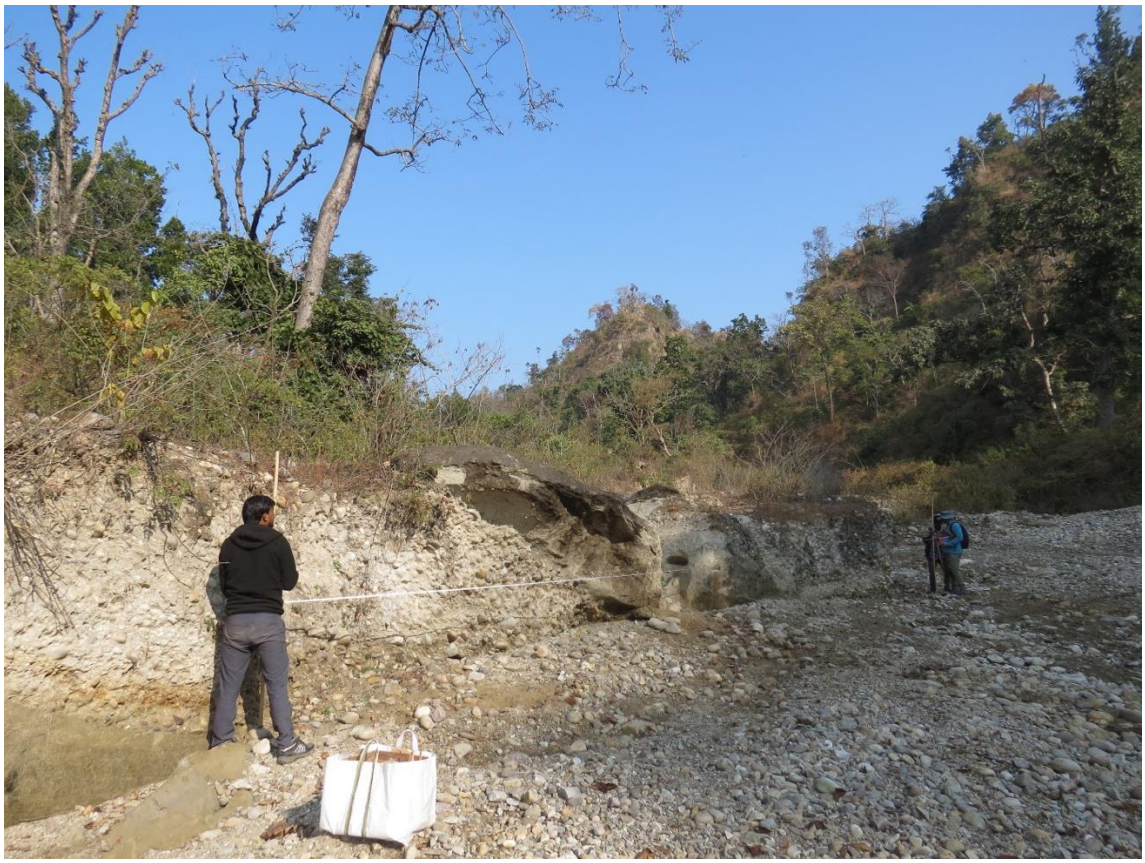
Objectives: Imaging 3-D shear velocity structure beneath Indo-Burma ranges and the adjoining regions by modelling receiver functions, surface wave data extracted from earthquake and ambient noise to unravel the deep structure across diverse geological terranes. Azimuthal anisotropy estimation from splitting analysis of teleseismic core-refracted phases, which can be used to decipher crust-mantle flow and mantle deformation patterns around the subducting slab.

2. Earth Surface Dynamics - The Earth Surface Dynamics Group, led by **Dr. Sanjay Kumar Mandal**, focuses on quantitative Earth-surface processes that shape Earth's surface and drive its evolution over geological timescales. Our research is motivated by a central question in the geosciences: how do tectonics, climate, and erosion interact as a coupled dynamical system, and what measurable signatures of that coupling are preserved in topography and the sedimentary record? We address this question using quantitative field measurements alongside geochemical and isotopic analyses, geospatial methods, and numerical modelling, with the Himalayan orogen as our principal field setting.

The Himalaya offers an exceptional opportunity to study these processes in an active, data-rich natural laboratory. Ongoing convergence between the Indian and Eurasian plates continues to drive crustal thickening and surface uplift, producing Earth's highest topography and one of its most dynamically evolving mountain belts. Monsoon-driven precipitation sustains intense erosion, generating sediment fluxes that are among the largest on the planet. The resulting material is transported through river networks and ultimately deposited in the foreland basin, where stratigraphic records preserve a detailed archive of orogenic and climatic history spanning tens of millions of years. This source-to-sink continuity, from actively deforming catchments to the foreland depocenter, makes the Himalayan system uniquely suited to quantifying rates, budgets, and timescales of erosion and sediment transfer and to linking these signals to tectonic and climatic forcing across a wide range of spatial and temporal scales.

Our current research is organised around three connected themes. (1) **Deformation and landscape evolution**: assessing how strain localisation, fault kinematics, and patterns of rock uplift govern orogenic topography and modulate erosional response. (2) **Terrestrial cosmogenic nuclides**: quantifying basin-averaged erosion rates, constraining sediment production and residence times, and estimating the pace at which landscapes adjust to tectonic and climatic perturbations. (3) **Sedimentary records and basin evolution**: integrating provenance analysis, stratigraphic synthesis, and basin-scale modelling to reconstruct the tectono-climatic evolution of Himalayan source-to-sink systems. Each theme can be pursued independently, but many of the most informative problems lie at their intersections; we therefore encourage doctoral projects that integrate approaches across themes. Prospective applicants are strongly encouraged to visit the group website (https://esd-iiserkol.in/) to explore our research in detail. We particularly welcome applicants with strong backgrounds in Geology/Geophysics or Physics, an interest in interdisciplinary field-based research, and the

motivation to tackle quantitative Earth-surface questions using integrated field, laboratory, and modelling approaches.



ESD researchers mapping, measuring, and sampling fluvial deposits—turning outcrops into quantitative constraints on Earth-surface change.

3. **Crustal Evolution and Precambrian Geology** - **Prof. Sukanta Dey** is looking for bright and motivated candidates to work on the following theme:

"*How did continental crust form in Early Earth?*"

The actual mechanism of continental crust formation in Early Earth (during the Archaean Eon) remains a significant research interest globally. Granite-greenstone belts provide vital clues to the mechanism and geodynamic setting of continental crust generation and related ore-deposit formation. Archaean rocks of diverse types are well exposed in the granite-greenstone belts of the cratonic blocks of India. This Ph.D. project aims to study the field, and age relationship and geochemistry of a few granite-greenstone belt rocks to understand their petrogenesis, role in crust formation and crust-mantle interaction, and to suggest a geodynamic model for Archaean 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. Candidates with a flair for fieldwork are encouraged to apply. Those with their own project ideas on early Earth crustal evolution are welcome to apply.

4. <u>Near-surface isotope and trace element geochemistry</u> – Prof. Tarun K. Dalai is looking for bright and motivated PhD candidates.

Requirements: Bachelor's in Physics/Chemistry/Earth Sciences and Master's in the field of Earth Sciences.

The prospective candidate can work on any of the following research areas in his lab.

Areas of research

1. The fate of biospheric and petrogenic carbon in the river basins: This project would use proxies of biospheric carbon (i.e. $^{13}C/^{12}C$ ratios and ^{14}C) and petrogenic carbon ($^{13}C/^{12}C$ ratios and rhenium) of suspended and bed sediments in the rivers in India. The eventual goal is to assess the net effect on the atmospheric carbon due to CO_2 consumption via silicate weathering vs. the release of CO_2 via oxidation of biospheric and petrogenic carbon in the river basins.
2. Behaviour of elements and isotopes during weathering and transport: The primary goal of this project is to test the robustness of isotopes of neodymium ($^{143}Nd/^{144}Nd$), lithium ($^{7}Li/^{6}Li$), strontium ($^{87}Sr/^{86}Sr$) as proxies of silicate weathering. We will use these isotopes and selected group of trace elements in our investigations.
3. The study of relative mobility of redox-sensitive elements (e.g., Mo, V, U) during weathering and transport. Understanding of cycling of these elements has implications for fractionation of their isotopes, contaminant transport and their utility as proxies for paleo-redox conditions.
4. Partitioning and geochemical behaviour of rhenium during weathering and surficial transport, and tracing anthropogenic rhenium contributions to rivers, estuaries, lakes and coastal ocean.

5. <u>Stable Isotope Geochemistry</u> – Prof. Prasanta Sanyal is looking for bright and motivated PhD candidates to work on the following topics:

Channel 1: Externally Funded Category

1. Past climate and its impact on ecology: Involves reconstruction of rainfall using oxygen isotopes of soil carbonate and hydrogen isotopes of plant molecules; carbon isotopes of soil carbonate and plant molecules. Fluvial and lake sediments will be used for this purpose.
2. Temperature reconstruction of past: Lipid components such as brGDGT, IsoGDGT and 3 OH Fatty acids will be used for this purpose.
3. Understanding the Nitrogen Cycle: Nitrogen and oxygen isotopes of dissolved nitrate will be used for this purpose.
4. Forensic Science: Use of stable isotopes in understanding adulteration in food and biomedical research.

Channel 2: Institute (IISERK) funded category

1. Understanding terrestrial water storage and its predictors.

   Details of the lab-work: www.iiserkol.ac.in/~silika

6. Paleontology - Dr. Subhronil Mondal is looking for motivated PhD candidates to work on diverse problems related to the evolutionary patterns and process of marine invertebrates across space and time.

For details, please check the lab webpage: https://sites.google.com/site/subhronilindia/Home

7. Metamorphic Petrology - The research group led by **Dr. Tapabrato Sarkar** is seeking motivated researchers passionate about the intersection of igneous/metamorphic petrology and the green energy transition. The project explores the genetic links between source rocks, fractionated granites and pegmatites to understand how rare and critical elements become concentrated within them.

As India's demand for critical minerals surges, driven by the digital revolution and the shift away from fossil fuels, the natural processes that concentrate these trace elements in certain reservoirs remain poorly understood. This PhD position will focus on the formation and evolution of crustal melts, specifically fractionated granites and pegmatites, which act as potential reservoirs for rare and critical elements. By integrating **field investigations, advanced geochronology, geochemistry, and thermodynamic modelling**, this study aims to provide insights on resources indispensable for a sustainable future.

Candidates with a strong background in igneous and metamorphic processes and eager to apply fundamental petrology to solve real-world economic challenges are welcome to apply.

For more information visit the group website: https://www.iiserkol.ac.in/~tapabrato/

8. <u>Computational Mineral Physics</u> – The research group led by **Dr. Gaurav Shukla** is looking for bright and motivated candidates interested in investigating deep Earth processes encompassing extreme conditions of pressure and temperature using computational tools. Further details may be found below:

The Earth's interior remains beyond the reach of direct human exploration. Despite this inaccessibility, understanding the evolution, structure, and dynamics of our planet—as well as those of other planets—depends heavily on the processes that occur deep within their interiors. To gain insights into these hidden regions, researchers employ several indirect investigative methods. Among these, first principles quantum mechanical-based studies have become especially prominent in recent years.

Over the past two decades, first principles quantum mechanical approaches have developed into essential tools for exploring the Earth's deep interior. These techniques are used alongside data from seismology, cosmochemistry, geochemistry, meteoritics, and high-pressure and high-temperature laboratory experiments. By integrating these diverse sources of information, scientists have been able to extract valuable data that supports the thermodynamic modelling of the Earth's interior.

At IISER Kolkata, the Computational Mineral Physics group applies first principles density functional theory (DFT) to study the dynamical stability and thermoelastic properties of likely mineral phases within the Earth. These studies consider pressure and temperature conditions extending up to those found in the Earth's inner core. The thermoelastic properties of minerals and melts are particularly significant, as they provide a critical link between seismic tomographic images and geophysical interpretations, including the mineralogy, composition, and temperature of the Earth's interior.

Cutting-edge high-pressure experimental techniques, when combined with quantum mechanical first-principles atomistic simulations, allow for robust estimation of a range of physical and chemical parameters. These estimates are crucial for advancing seismic and geodynamical studies of the Earth's interiors, offering deeper understanding of the planet's structure and behavior.

DES Autumn 2026 PhD Timeline:

- PhD application portal opens: **08.03.2026**
- Application portal closes: **07.05.2026**
- Publication of shortlist for the Interview: **14.05.2026 to 22.05.2026**
- Selection Interview window: **29.05.2026 to 19.06.2026**
- Publication of PhD interview results by: **25.06.2026**
- Pre-registration portal opens: **29.06.2026**