

**Academy of Scientific and Innovative Research
(AcSIR)
Centre for Excellence in Earth System Research
CSIR - National Geophysical Research Institute,
Hyderabad**

Faculty Areas offered by AcSIR

1 NAME OF THE FACULTY: Physical Sciences

2. LABORATORY PROFILE

In order to coordinate and formulate geophysical studies in a systematic manner, a Planning Committee for Geophysics was constituted by Government of India in 1946. Consequently, the Central Board of Geophysics (CBG) was formed which was taken over by the Council of Scientific & Industrial Research (CSIR) leading eventually to the establishment of the National Geophysical Research Institute (NGRI) in 1961 with a mandate for basic and applied research in Earth Sciences. Over the last 50 years, NGRI has evolved into a world renowned centre for advanced studies with multidisciplinary Earth Science research programs that are in tune with the mission of CSIR. Together with focus on understanding *basic* earth processes, the charter of NGRI envisages research in several vital applied geo-science themes of societal relevance. The academic features of the institute include the following:

- Project mode R & D collaborations with scientists from several countries
- Our Scientists as 'Guest Faculty' in different Universities in India and abroad
- 56 Ph.Ds. since 2005
- 250 JRF/SRF/RA and Project Assistants
- 125 Summer Trainees from ISM, IITs and various other Universities



The Charter of NGRI

- (i) Research for innovation and development of methods and techniques for geophysical exploration for minerals, groundwater and energy resources, etc., through
 - theoretical and experimental studies in geophysical prospecting methods and interpretation techniques
 - development and fabrication of geophysical instruments
 - aerial, ground and marine geophysical surveys supplemented by the use of geological and geochemical investigations wherever needed and
 - management studies for optimum resource exploration
- (ii) Investigations of the solid earth through studies in geodynamics, seismology, geomagnetism, gravity fields, paleo-magnetism, geochronology, geochemistry, geothermics, geo-hydrology, geo-electrical, rock mechanics, physical properties of rocks etc., with special emphasis on application
- (iii) Providing technical consultancy service to the industry, the proceeds of which shall be fed back to the research and development program of the Institute
- (iv) Promoting the use of geophysical methods in the country for the search of natural resources, engineering applications and the study of the earth's interior
- (v) Participation in International Geophysical Programs
- (vi) Liaison and coordination with various academic and professional organizations in India and abroad in the field of geosciences

THE OUTLOOK: A BROAD VISION 2030

Over the last half a century, there has been an ever escalating demand for earth's vital natural resources especially those pertaining to sustainable water, minerals, metals and fossil fuels. Strategies for finding, exploiting and sustaining such resources have been largely built around innovations in science and technology. However, these developments have had degenerating effects on the environment and the climate. In addition to providing a comprehensive understanding of the basic research in earth processes, NGRI has been active in developing eco-friendly exploration strategies. Currently, NGRI aspires to transform itself into a unique centre for excellence with the following objectives that are relevant for high quality science as well as the societal and strategic needs.

- R & D towards assessment and budgeting of water resources, development of insightful methodologies for exploration of ground water in arid and hard-rock areas with special care for geogenic and anthropogenic contamination, participation in societal missions for augmenting water resources for agriculture, industry and human consumption.
- Ensuring energy security for the country by exploration for hydrocarbons (especially petroleum, clean coal, gas hydrates), atomic minerals and geothermal energy.
- To develop models for site specific seismic hazard prognostication and build capabilities for real time Tsunami warning systems.
- To build capabilities for high resolution multi-scale imaging of the earth's interior, establishing precise time and duration of geologic processes to understand Earth's dynamic evolution and thereby steer mineral exploration and geo-environmental strategies.

- To achieve the above, NGRI is keen to establish an advanced centre built around accomplished scientists and laboratory facilities based on contemporary technology.

3. MAJOR RESEARCH AREAS

R & D Thrust Areas

- **Lithosphere and Earth's Interior (Structure, Composition, Dynamics and Evolution)**
- **Groundwater Hydrology (Exploration, Assessment and Management)**
- **Exploration for Energy Resources and Minerals (Hydrocarbons including Gas Hydrates and Coal Bed Methane, Geothermal Energy, Uranium, Base and Noble Metals and Diamonds)**
- **Earthquakes: Monitoring and Hazard Assessment**
- **Shallow Surface Geophysics (Geotechnical and Engineering Applications)**
- **Geo-Environment (Environmental Pollution & Paleo-climates)**
- **Instrumentation (Geophysical Instrumentation)**

4. DETAILS OF THE CLUSTER LABORATORIES

Year of Establishment:	1961
Address:	National Geophysical Research Institute (CSIR) Uppal Road, Hyderabad – 500007 (India)
Phone:	+91-40-23434700, +91-40-23434711
Fax:	+91-40-23434651, +91-40-27171564
Web:	http://www.ngri.org.in
Email:	acsir@ngri.res.in
Director:	Prof.M K Sen
Co-ordinator (s):	Dr. R.K. Tiwari and Dr. S.K. Ghosh
Degrees Offered:	Ph.D. (Earth Science)

5. CURRENT RESEARCH

Currently NGRI is engaged in cutting edge basic and applied research dealing with various processes of earth's interior, exploration for natural resources (mineral, hydrocarbon, ground water and geothermal energy), seismic hazards and environmental studies and mathematical modelling in geosciences. (For details see against item no. 6).

6. MAJOR R & D PROJECTS AT NGRI

Supra Institutional Project (SIP)

The Evolution of the Indian Lithosphere: Focus on Major Earth Processes and Resources with special reference to Deccan Traps and Dharwar Craton

Networked Project (NGRI and 6 other CSIR Laboratories)

Sustainable Development and Management of water resources in different problematic terrains

Main Lab Projects

Lithosphere and Earth's Interior, Palaeo-climates

- Structural and remote sensing studies of high-grade terrains, Southern India
- Thermal and geodynamic evolution of Indian lithosphere and seismogenesis of earthquakes
 - (i) Age, Sr, Nd, Pb isotopic studies of alkaline intrusions from the Deccan volcanic province
 - (ii) Age & Paleomagnetism of Eastern Dharwar Craton kimberlites
 - (iii) Migration of the Indian subcontinent during the Cretaceous
 - (iv) Age & paleomagnetism of mafic dyke swarms in the Dharwar craton
- Heat flow, heat production and crustal thermal structure of the Indian shield
- Late quaternary paleoclimatic studies using isotopic and trace elemental proxies from corals and speleothems
- The deep structure and evolution of the Indian subcontinent with special reference to Cratons (SECRAT)
- Modelling of non-linear behaviour of earth system using geophysical and geological properties
- Linear and non-linear time series analyses and modelling of geo-processes
- Innovative techniques for modelling of geophysical data
- Seismological and mineral physics constraints on the evolution of upper 660-km depth of the Gondwanaland with special reference to India and Antarctica
- Numerical simulations of convection in the Earth's deep interior and lithospheric mapping of the Sikkim Himalaya
- Behaviour of Hydrous minerals at the High Pressures
- The Phanerozoic magmatism, mantle sources and tectonics: Geochemical and isotopic approaches

Groundwater Hydrology and Geo-environment

- Delineation of groundwater resources in the Deccan trap region of Chandrabhaga river basin
- Environmental geophysics–development of methodology for protection & conservation of soil and groundwater in dry land environ
- Investigating hydrodynamics of hard rock aquifers and assessment of groundwater potential and their scale dependency (Indo-French Centre for Groundwater Research)
- Recharge and evaporation process, its evaluation and quantification
- Exploration, assessment and management of groundwater resources: Estimation of subsurface fresh water discharge to sea
- Environmental impact assessment and suggest the remediation of pollutants derived from mining and industrial activities
- Ecology and environmental studies in and around Greater Hyderabad

Exploration for Energy Resources and Minerals

- Structure, tectonics and subsidence studies of the Bay of Bengal basin with Implications for hydrocarbon prospects
- Exploration of natural resources and studies of the Indian and lithosphere by gravity and magnetic methods
- Controlled source seismic experiments for delineation of lithospheric structure
- Exploration for natural resources and studies on lithosphere using magnetotellurics

- Deep resistivity sounding and controlled source audio-frequency magnetotelluric studies for upper crustal structure and natural resources
- Exploration of gas-hydrates along the Indian margins
 - (a) Study of various basins for the presence of hydrocarbons
 - (b) Characterization of geothermal water using multi-isotope and noble gas signatures
- Electrical and electromagnetic field and physical modelling for shallow subsurface studies
- Petrology, geochemistry of the mafic-ultramafic and alkaline rocks of Dharwar Craton; Bundelkhand; Central India and Deccan flood basalt province and mineralization through space and time
- High-resolution multi-parameter airborne geophysical survey for mineral, oil & groundwater exploration and development of interpretational techniques for airborne data

Shallow Surface Geophysics (Geotechnical and Engineering Applications)

- Development of geophysical methods with special emphasis on 3D seismic methodology for site characterization of geological formations at shallow depths for mineral, engineering and archaeological projects

EARTHQUAKE HAZARD ASSESSMENT

- Study of the Indian plate geodynamics through intense seismic and GPS campaign mode monitoring
- Lithospheric structure, deformation and tectonics of the eastern Himalaya and Andaman arc regions. Structure and seismogenesis of the Koyna-Warna region
- Study of seismogenic earthquake sources in SCR and Kopili lineament, NE India for seismic hazard assessment
- Paleoseismic studies in NE India
- Application of synthetic aperture radar interferometry (InSAR) to measure ground deformation for seismic hazard studies in and around India
- Study of crust-mantle structure and source process underlying the Kachchh seismic zone, Gujarat, India
- Space-geodesy for kinematics of Indian plate and Indian Ocean basin, applied to earthquake hazard and subsidence studies

Instrumentation

- Spectral IP method in the detection of hydrocarbon soil contamination using experimental Lab-view setup

SPECIAL ACTIVITIES

- Studies on seismotectonics and geodynamical processes between Antarctica and Southern Indian Peninsula
 - (A) Continuous GPS monitoring between India and Antarctica; (B) Continuous operation of seismological observatory at Maitri, Antarctica
- Magnetic Observatory
 - Study of Magnetic variations on island chains on the active continent margin of India to estimate through electromagnetic induction, the structure of the ocean floor along east coast and Andaman & Nicobar island chain]

Grant in Aid Projects

(a) National

- Development of in site Chemical oxidation remediation technology for contaminated soil and ground water due to organic pollutants.
- Plate kinematics, geodynamics and earthquake occurrence process in the Andaman Nicobar region using real time geodetic and seismological observations & earthquake awareness centre at Port Blair.
- Tsunami modelling and inundation Studies for the east and west coast of India due to earthquakes in Sumatra and Makran subduction Zones.
- High resolution seismic imaging by P and S waves using passive sources in using seismically active zones of Koyna-Warna region of India- a pilot study.
- To study the physics of intraplate earthquakes in the Kachch seismic zone, Gujarat, India.
- Study of source processes, site response and seismic hazard using the local broadband and strong motion data bases of the 2001 Bhuj earthquake sequence, Gujarat, India including the available world wide data on strong seismicity.
- Ammonoid sequence magnetic stratigraphy integration in the Kachchh Jurassic.
- Late Quaternary palaeo-climatic and palaeo-oceanographic studies in the North Indian Ocean using isotopic and trace elemental process from sediment cores and corals.
- Studies on cobalt exploration.
- Seismic structure and tectonics of the Indian plate in Arunachal Himalaya.
- Modeling of hydro- seismicity in the seismically active Koyna – Warna region, Maharashtra.
- Monitoring Indian Shield seismicity with 10 BBS to understand seismotectonics of the region using VSAT connectivity.
- Estimation of the ground motion and site effects of Indo-Gangetic Plains from seismic structure.
- Geodynamics of Indo Burmese arc region: Geodetic measurement and geological investigations.
- Western India schools earthquake lab programme.
- Chronology of Upper sedimentary formation in the Vindhyan and Cuddapah Basins.
- Real time monitoring of earthquake for short term forecast and understanding seismogenesis in the Koyna region, Western India.
- High resolution seismic imaging of the Kumaon – Garhwal Himalaya using ambient ground noise & modelling the state of stress.
- Establishing permanent GPS stations at Ongole, Vishakhapatnam and Allavali in Andhra Pradesh and at Silchar in Assam.
- Plume-Arc interaction and evolution of the Meso-Archaean Holenarsipur nucleus, Karnataka, India.

(b) International Collaborative Projects

NGRI has been actively engaged in several international collaborative programs with countries such as Germany, France, U.K., Australia, U.S.S.R., Japan, U.S.A., to name a few. Currently, NGRI is involved with the following project.

1. The Thermal Evolution of the Peninsular India: Past Behaviors and Future potential (Indo-Australia)
2. Long-term system evolution of the Krishna-Godavari basin and its Hinterland in eastern India: A partnership for enhancing offshore hydrocarbon exploration success (Indo-Australia)
3. Tectonothermal evolution of Gondwana suture zone in Southern India (Indo-Japan)
4. Hydrology and water resources from space over the Indian Continent (Indo-French)
5. Palaeomagnetism of a great dyke and Vindhyan supergroup of rocks of India: A contribution to Precambrian geodynamics (Indo-French)
6. Impacts of meso-scale Watershed Development in Andhra Pradesh (India) and their implications for designing and implementing improved WSD policies and programs (Indo-Australia)
7. Socio-economic Assessment of the rural Vulnerability of water users under stressors of global changes in the Hard rock area of South India (Indo-French)
8. Resource assessment and quality of groundwater in hard rock environment (Indo-French)
9. Coupling water flux and stable isotopes measurements to analyze irrigation efficiency in overexploited aquifers of southern India (Indo-French)
10. The transient geophysical processes in areas of strong natural and human-induced impacts: field observations and physical modelling (Indo-Russia)
11. Study of source processes, site response and seismic hazard using the local broadband and strong motion data bases that of the 2001 Bhuj earthquake sequence, Gujarath, India Including the available World Wide Data on strong seismicity (Indo-Russia)
12. To investigate ground motion and site response In Indo-Gangetic plains which are vulnerable to earthquakes from Himalaya and have remained unexplored in terms of seismic Hazard Assessment and its quantification (Indo-Mexico)
13. Density Distribution and Dynamics of the Lithosphere across Active Collision Zones from New Generation Satellite Gravity Mission(s) (Indo-German)
14. Upgradation of Hyderabad magnetic observatory to INTERMAGNET status – refinement of low-latitude studies and re-examination of secular variations in Indian region (Indo-German)
15. High resolution seismic imaging of central Himalayas (Indo-U.K.)
16. Reservoir modelling and simulation study for enhanced oil recovery using gas injection (gas-EOR) (Indo-Norwegian)
17. Reservoir modelling for enhanced oil recovery (EOR) using fractals and 4-D seismic (Indo-Norwegian)

7. MAJOR LABORATORIES / RESEARCH FACILITIES AT NGRI

(A) Observatories

1. Magnetic (since 1964):

- ‡ Fluxgate Magnetometer (digital-0.1 nT)
- ‡ La Cour Magnetometer (Analog- 1 nT)
- ‡ Decl. - Incl. Magnetometer (– 0.1 nT)

2. Seismology (working since 1967):

- Very Broad Band Geoscope (360s-20Hz)
- Benioff & Press-Ewing Seismometers
- Broad band Seismometers (120s-50Hz)
- Operating 3 networks: AP, NE, Koyna
- 28 Seismograph units deployed, 16 with VSAT connectivity
- Part of Tsunami Warning Network (operated by IMD and INCOIS)

3. Geothermal (since 2009)

- ‡ Facilities for measurement of air temp., relative humidity, solar radiation, precipitation, wind speed and direction

4. Magnetotelluric (since 2007)

- ‡ Observatories at Koyna
- ‡ 5C Magnetic and EM signals for monitoring ionospheric and Earthquake disturbances

5. International Space-Geodesy Observatory for Earth System Studies

a. GPS/GNSS, Geodetic (since 1994):

- ‡ GPS Receivers at HYDE, Mahendragiri and Maitri Stations (Antarctica)
- ‡ Networked to 31 GPS and 11 GLONAS

b. Absolute Gravity (since 2007):

- ‡ FG-5 Absolute Gravimeter with μ Gal accuracy

(B) Experimental/Analytical Facilities:

Deep Earth Probes

- Over 100 seismic units (Broadband/Short period)
- Controlled Source Seismic (CSS) investigations using RF telemetry, 3D Cable telemetry system & Stand alone 3component seismic units
- MT systems to record signals from 1000 to 0.00001 Hz covering AMT, MT and LMT range of frequencies with inroads into Marine MT
- Deep resistivity units (Zonge probes, 10-20000 Ω m) capable of probing up to 5-6 Km
- Field Gravimeters (0.01 mGal accuracy)

Shallow Surface Geophysics

- 3D Seismic Data Acquisition System
- IP and frequency/time domain EM equipment
- Ground Penetrating Radar (GPR)
- VTEM HELI-BORNE (time domain electro magnetic. System)
- Heli-Borne Magnetic, Radiometry,
- Frequency Domain E.M. System

Measuring active crustal deformation

- GPS Systems, 15 units

Petro physics and Geotechnical Studies

- Heat Flow & Thermal Conductivity, Radiometric measurements Laboratory
- Universal Testing Machine (100 tons), Bridgeman-Birch high-pressure apparatus, Keithly electrometer, strain measuring sensors
- Rock Mechanics Lab

Compositions and chronology

Bulk

- XRF, ICP-MS, AAS, ICP-OES
- TIMS, MC-ICP-MS and IRMS
- Tritium and Carbon (Organic/Inorganic) Dating Lab
- Thermoluminescence (TL), Optically Stimulated Luminescence (OSL) Dating

Facility

- Fission Track Thermochronology (FTT) Laboratory
- Rb-Sr Lab

In-situ

- EPMA, SEM, FTIR & Laser Raman
- LAM-MC-ICP-MS & LAM-ICP-MS

Hydrocarbons & Environmental

- IRMS, GC, GC-MS-MS, Aquifer Modeling Lab

Technical Support Services

1. Maps and Drawing Section
2. Rock-Ccutting and Thins Section Lab
3. Digital Photography
4. GIS Lab
5. **IT Infrastructure**
 - Over 600 PCs and WSs connected through campus wide LAN/VLANS,
 - High-power computing clusters-3
 - Total network has 10 Gbps backbone, end-user enabled with 1 Gbps
 - Video conferencing facility
 - Internet facility provided to each user through 2 Internet Leased Lines (Bandwidths of 2mbps and 4 mbps).
 - The security of the computers in the campus-wide LAN is being taken care of with installation of firewall, centralized anti-virus software installed and every desktop connected to the campus-wide LAN
 - An in-house web based mailing facility is being provided to the staff of NGRI
 - A state-of-the-art video conferencing facility has been provided to enable effective interaction among the CSIR labs
6. **Knowledge Resource Centre (Library)**
 - Established in October 1961
 - Collection of about 20,000 books on Physics, Mathematics, Geology, Geochemistry and Geophysics.
 - 15 Indian journals in the field of Earth Science are being subscribed
 - Providing print and online access to more than 1500 journals published by M/S Elsevier, Springer Verlag, Blackwell-Wiley, Geological Society of America, Geological Society, London, Society of Exploration Geological Society of American Geophysical Union, and Seismological Society of America etc., going back to Volume 1 Issue 1.
 - CD-ROM library having more than 150 CDs

- Bibliographic database “GeoRef” containing the earth science literature from 1785 A.D. to present is also subscribed and can be accessed online too.
- Library is having access to Science Citation Index database “Web of Science” and also database on Indian and foreign patents
- Library provides inter-library loan and document delivery service of available scientific journals
- Library is managed by well trained professional staff. Library collection is managed by library software “SOUL” developed by Inflibnet Centre of UGC.

Supporting Services:

Generator backup of 1780 KVA, UPS (300 KVA), Transport, Horticulture, Telecommunications, Workshop

8 AMENITIES ON THE CAMPUS

- (i) **Hostels:** 80 Bed accommodations for male and female students in two hostels located within the campus.
- (ii) **Recreation:** The Staff Club of NGRI organises various activities related to cultural, club tours, sports and games, health related lectures/camps for its members. It is also, in coordination with CSIR Sports Promotion Board, organizing various sports events for men and women for indoor and outdoor games.
- (iii) **Food Court:** A food court facility for break-fast, lunch, tea/coffee and other snacks etc, at nominal rates.
- (iv) **Lecture Halls/Seminar Hall/Conference Rooms:** The institute has a-state-of-the-art ‘S. Balakrishna’ Hall (350 seating capacity), Conference Room, Lecture halls (2), Seminar Halls (2) with well equipped data projection systems, computers.
- (v) **Community Centre (2):** community centres for staff members to hold social gathering and other functions, festivals etc.
- (vi) **Sports Complex:** Indoor (Shuttle) as well as Outdoor (Basketball, Tennis and Volleyball) Courts
- (vii) **Health Care Centre:** Well equipped dispensary at campus with 2 resident doctors and 4 visiting specialists doctors, Gym and Yoga Centre within the Hostel
- (viii) **Staff Club Hall:** TV, Carom Boards, TT, Bridge, Chess, Newspapers and Magazines facilities for staff club members.
- (ix) **Guest House:** NGRI Guest house has 22 Double rooms and 8 VIP rooms with 1 running and 1 executive dinning hall.
- (x) **Post Office:** A post office within the campus.
- (xi) **Bank:** An extension counter of State Bank of Hyderabad in the Institute
- (xii) **Staff Quarters:** There are various types of staff quarters (Type-I, II, III, IV, V and VI) available within the NGRI Campus.
- (xiii) **NGRI School:** High school up to 10th standard (Affiliated to Secondary Board of School Education, Andhra Pradesh) within the campus of NGRI.