

BROCHURE
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CONSULTANCY SERVICES



WADIA INSTITUTE OF HIMALAYAN GEOLOGY

(An autonomous research Institute of Dept. of Science and Technology,
Govt. of India)

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The Wadia Institute of Himalayan Geology (WIHG) is an autonomous Institute of the Department of Science & Technology, Ministry of Science and Technology, Govt. of India. During the last quarter century the Institute has expanded and grown into a Centre of Excellence in the Himalayan Geosciences with scientists and staff working in diverse fields probing deep earth structure and rocks of the mountains, glaciers, river systems, lakes, groundwater, landslides, etc.

Sophisticated analytical facilities in the Institute are run by competent scientists and technical staff, generating data for Scientists of the Institute as well as for other Universities and organisations. With 50 glorious years of existence, the Institute has developed expertise and building and infrastructure extends consultancy for site selection and geological mapping for geotechnical, environmental, and hydropower projects.

In the past WIHG has technically empowered several mega and small infrastructure projects relating to hydroelectricity, tunnels, railways, road alignments, groundwater and mineral wealth surveys etc. The institute's well-equipped state of the art laboratories and other infrastructure are sound and ready to undertake consultancy projects related to:

- Selection of sites for Hydroelectric projects, buildings, infrastructures, dams, bridges, rail route or any other construction related activities in the Himalayan terrain.
- Selection of sites for potential source of groundwater and water quality check including quantification of pollutants.
- Micro earthquakes, site response, subsurface imaging, Global Positioning System (GPS) & multichannel analysis of surface waves (MASW) studies and monitoring using different geophysical instruments.
- Large scale engineering geological, geomorphological and geotechnical mapping of the area, including landslide related studies and their monitoring.
- Understanding palaeoseismic history and neotectonic activity related information of an area.
- Minerals and mining related issues and geochemical mapping / investigations of the terrain.
- River behaviour and Riverbed material mining. Mitigation to extreme hydrological events.
- Environmental issues related to water bodies.
- Analytical services for various kinds of analyses of rocks and minerals

Facilities

The Institute has well equipped laboratories and high level experts that produce data on standards that are globally competitive. The laboratory facilities housed in the institute's premises include:

- **X-Ray Fluorescence Sequential Spectrometer (XRF** - Bruker S8 Tiger) for determination of major and trace elements in rocks/materials.
- **Inductively Coupled Plasma Mass Spectrometer (ICP-MS** - ELAN-DRC-E) for determination of major, trace and rare earth elements.
- **Electron Probe Micro Analyser (EPMA** - CAMECA - SX-100) for quantification of element concentrations in minerals, WD spectra of minerals and generation of BSE and

optical images.

- **Continuous flow Isotope Ratio Mass Spectrometer (IRMS)** with attachments like Gas bench system, Gas Chromatograph, Elemental analyser and BrF₅ Laser Fluorination system for stable isotope analysis. Attachment of Keil Carbonate System and MAT-253 is to analyse samples with smaller amount.
- **Total organic carbon analyser: helps in estimating the organic carbon content in soil/sediment.**
- **Laser Ablation Multi-Collector Inductively Coupled Plasma Mass Spectrometer (LA-MC-ICPMS Neptune plus)**, with 193 excimer (ArF) Laser Ablation system for in-situ micro-geochronology and isotopic studies of minerals and solutions.
- **Scanning Electron Microscope (SEM- Zeiss EVO 40 EP with EDAX attachment)** to study the surface morphology of materials including micro fossils and minerals.
- **Laser Micro Raman Spectrometer - (Horiba Jobin Yvan - HR)** for Raman analysis of polyatomic species of solid and fluid phases for the applications in Geology, Mineralogy, Gems, Fluid inclusions and Archaeological studies.
- **X-ray Diffractometer (XRD- PAN analytical, X-Pert PRO MPD)** with X'cellerator fast detector and Expert High score offline data processing software integrated with ICDD and ICSD database for search match and qualitative and quantitative phase analysis
- **Luminescence dating facility** houses three Riso TL-DA-20 Reader for dating the material covering part of Quaternary Geology and Archaeology.
- **Water Chemistry Laboratory** for water analysis equipped with Ion chromatograph, Spectrophotometer, Portable Water Analysis Kit and Instruments for Bacteriological Analysis.
- **Geotechnical Laboratory** for characterization of basic engineering/geotechnical properties of soil and rocks.

Besides, the institute has nation's best Earth Science library with >10000 reference books and all periodicals. The 63 scientists of the institute work in different fields of Geosciences and the details on expertise available with different aspects are as follows:

Expertise available in Geomorphology and Environmental Geology

The Geomorphology and Environmental Geology (GEG) Group has various state-of-art laboratory facilities such as (i) Water Chemistry Lab, (ii) Remote Sensing Lab, (iii) Geotechnical Lab and (iv) Field based facilities/equipments for glaciological studies. The GEG Group has excellent expertise and man power to carryout scientific investigations and to provide professional advice for the following investigations and intellectual services.

Water Resource assessment

- Identification of Hill aquifers,
- Feasibility surveys for Hand pumps and Tube/bore wells,
- Water quality analyses,
- Watershed management (including rainwater harvesting),
- Rejuvenation/recharge of springs,
- Mountain Hydrometeorology, water management and policy decisions.



Remote Sensing Lab

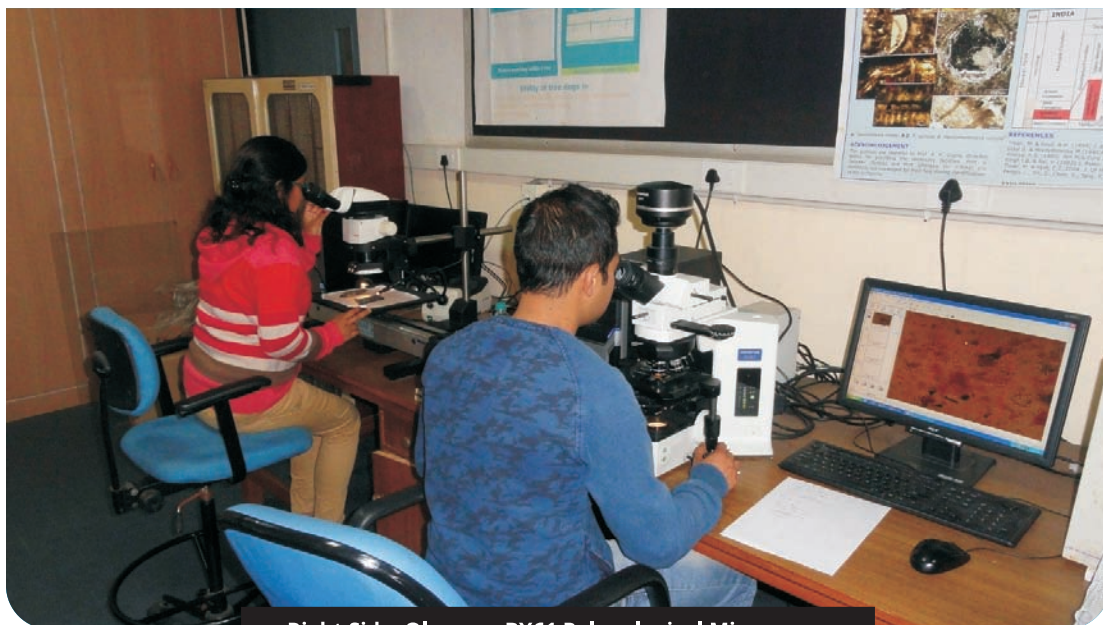
Engineering Geological studies including site selection for:

- (i) Engineering/geotechnical properties of soil and rocks,
- (ii) Water reservoirs and storage dams,
- (iii) Hydroelectric projects,
- (iv) Slope instability and landslide studies for multifaceted infrastructural projects such as hydro-power development, tunnels, bridges and road alignments/construction,
- (v) Monitoring of active landslides and mitigation measures.

Geoenvironmental studies for:

- (i) Environment impact assessment of Infrastructural development projects (such as hydropower development, tunnels, bridges and road alignment/construction and Power Transmission corridors),
- (ii) Mass movement, flash floods,
- (iii) Road, Rail and tunnel alignment in the mountainous terrain,
- (iv) Delineation of active faults and active tectonics and its impact/presence on major man-made establishments and structures,
- (v) Change detection studies including land use and land cover,
- (vi) Erosion studies for reservoir and watershed management for Environment impact assessment,
- (vii) Mountain hazards (glacial hazards) including snow and rock avalanche, debris & rock falls, Glacial Lake Outburst Flood (GLOF) and Landslide Lake Outburst Flood (LLOF),
- (viii) Physical impact by snow melt runoff.

The GEG Group in the recent past acted as consultant for several state and central government organizations including NTPC, RITES, LANCO, PWD, BRO, SIDCUL, UP Jal Sansathan and many other private agencies.



Right Side: Olympus BX61 Palynological Microscope

Expertise available in Biostratigraphic investigations

Biostratigraphy Group works on those Consultancy projects where general geological, stratigraphical or palaeontological especially invertebrate, vertebrate, mega/micro fossils inputs are required. It also carries an expertise on the study of microfossils, (sp. Benthic and planktic foraminifera). Analysis of Total Organic Carbon (TOC) using TOC-analyser, grain-size analysis using Laser Particle Size Analyzer, and interpretation of paleoclimatic data are also carried out.

The group also works in the field of (i) Dendrochronology: Dating of illegally felled trees, fire occurrence, Chronological productivity (basal area increment in trees, pure and mixed crops) and dating of wood which is used in archaeological monuments. It also helps in establishing a high resolution climate records on millennium time scales. (ii) Quaternary palynology, paleoclimate and reconstruction of vegetation history.

Expertise available in Petrology and Geochemistry Group

The Petrology and Geochemistry Group of the Institute focuses on understanding the mountain building and crustal evolution in the geodynamic framework of the India-Eurasia convergence. The crustal evolution models of the Himalaya are investigated through petromineralogical, geochemical, geochronological and fluid inclusion studies of magmatic and metamorphic rocks. The scientists of the group are dedicated to carry out research on magmatism, metamorphism, fluid inclusion studies for understanding exhumation of rocks, genesis of economic minerals, and chemically characterizing mineral and rocks from the NW and NE Himalaya. The group has expertise to handle sophisticated instruments, and state of the art laboratories to carry out various analyses that include:

- Petrography of rock thin section and mineral analyses.
- Qualitative analysis of major, trace and rare earth elements in rocks/earth and synthetic materials using X-Ray Fluorescence Sequential Spectrometer (XRF- Bruker S8 Tiger),



Mass Spectrometer DELTA V PLUS Isotope Ratio MS and GAS Bench LASER Fluorination



LASER Ablation Multi-collector Inductively Coupled Mass Spectrometer (LAMCICPMS)

Inductively Coupled Plasma Mass Spectrometer (ICP-MS - ELAN-DRC-E), and X-ray Diffractometer (XRD- PAN analytical, X-Pert PRO MPD).

- Materials/Minerals characterisation using Raman spectroscopy, EPMA, EDX and isotope analysis.
- Quantification of element concentrations in minerals, WD spectra of minerals and generation of BSE and optical images using Electron Probe Micro Analyser (EPMA-CAMECA: SX-100).
- Surface micro-morphology of materials, including micro fossils and minerals using Scanning Electron Microscope (SEM- Zeiss EVO 40 EP with EDAX attachment).
- Oxygen and carbon stable isotopes analysis of carbonate, silicate and water samples with Isotope Ratio Mass Spectrometer (IRMS) having attachments like Gas bench system, Gas Chromatograph, Elemental analyser and BrF5 Laser Fluorination system. Analyses of smaller samples using Keil Carbonate System can also be done.

- Dating of rocks using radiogenic and non-traditional isotopes, in-situ micro-geochronology and isotopic studies of accessory minerals and solution mode isotopic analysis by Laser Ablation Multi-Collector Inductively Coupled Plasma Mass Spectrometer (LA-MC-ICPMS Neptune plus with 193 excimer (ArF)).
- Raman analysis of polyatomic species of solid and fluid phases for the applications in Geology, Mineralogy, Gemstone, Fluid inclusions and Archaeological studies through Laser Micro Raman Spectrometer (Horiba Jobin Yvan make - HR model).

River, lake and ground water analyses, Sediment Budgeting of the Himalayan river systems, Erosion studies on fast eroding catchments, Hydrograph separation of snow melt and rain composition using stable isotopes.

Expertise available in Sedimentological Investigations

The Sedimentology Group provides information on sedimentary sequences, sedimentation history, basin evolution and Quaternary tectonics. The scientists associated with this group provide consultancy in mapping of sedimentary terrains, landscape and sedimentary style of river valleys, understanding past extreme hydrological events, grain size analysis, clay mineral analysis, petrological studies, environmental magnetism, dating of Quaternary sediments, pottery and brick samples and active tectonic and palaeoseismic history of an area.

Sedimentology lab facilities

1. **Laser- Particle Size Analysis (Malvern Mastersizer 2000E):**

Malvern Mastersizer 2000E is an instrument to analyse grain size of unconsolidated material of less than 1 mm size. It gives the volume percentage of the particles in different size ranges.

2. **Vibratory Sieve Shaker:**

It is used to provide grain size of unconsolidated sediment sample size ranging from 63 μm to 2 mm.

3. **Clay mineral slide preparation:**

Clay fractions can be separated from the bulk sediment using wet sieving and Stokes settling methods. The separated clay fraction can be used for preparing clay slides for clay mineralogy.



Laser- Particle Size Analysis (Malvern Mastersizer 2000E)

4. **Petrographic microscopes:**

Petrography of sedimentary rocks and unconsolidated sediments are done here using Trinocular Research Microscope.

5. **Sediment dating (Luminescence Dating):**

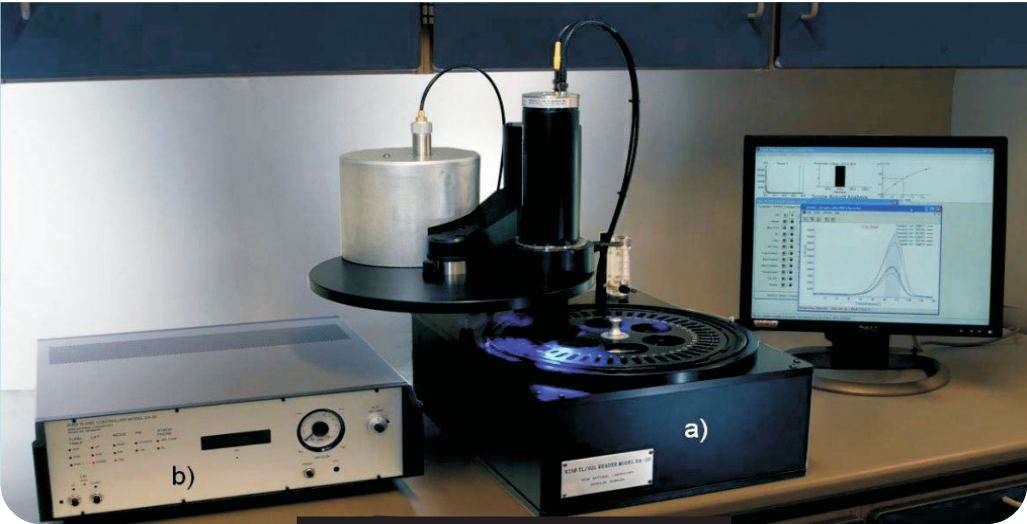
Luminescence dating provides absolute age and has very important application in Quaternary geology and archaeology. It utilizes multi and single grain luminescence readers. The events that can be dated by luminescence technique include:

- (i) The most recent depositional episode (application in sediment dating) and
- (ii) The most recent heating event (application in archaeology, bricks and pottery dating).

Multigrain Riso TL/OSL-DA-20 reader can date sand sized clean quartz and feldspar grain. This instrument has 5 % accuracy.

Single Grain Riso TL/OSL-DA-20 reader

Single Grain Riso TL/OSL-DA-20 reader has an additional laser attachment to hit on a single grain of quartz mineral.



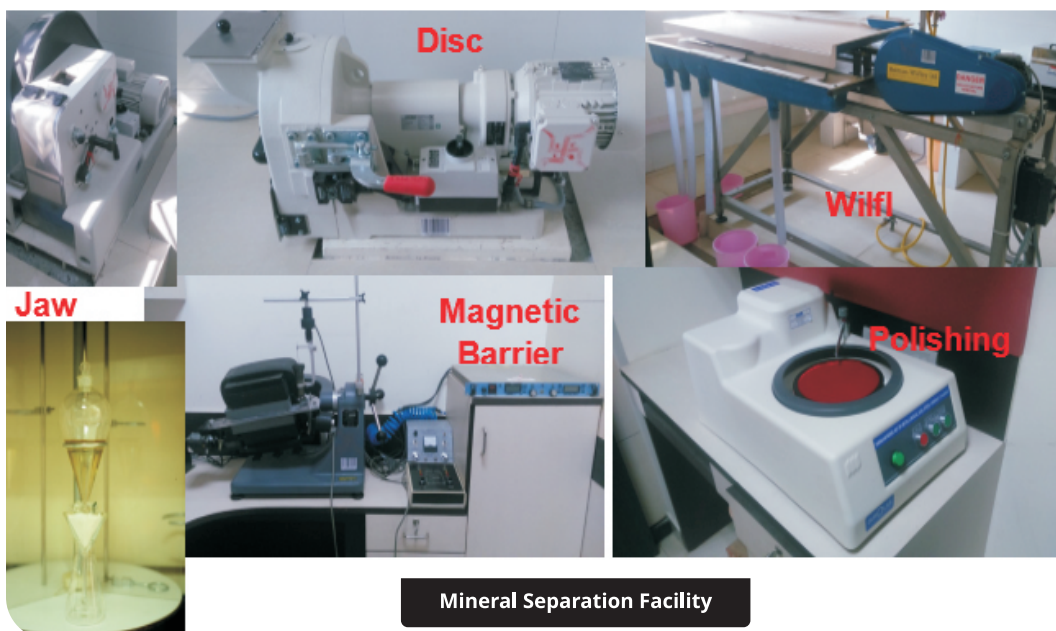
a) TL/OSL Reader b) Controller



Expertise available in Structure and Tectonics Investigations

1. **Geological Mapping of the Himalayan fold thrust-belt on different spatial scales:**
 - (i) Lithological Mapping,
 - (ii) Structural Mapping,
 - (iii) Geological Cross-section Preparation,
 - (iv) Shear Zone Mapping,
 - (v) Mapping of Faults and Lineaments,
 - (vi) Mapping of Different Morphotectonic Units.
2. **Structural Analysis of structure data generated in the field:**
 - (i) Analysis of tectonic fabrics particularly along active faults and shear zones,
 - (ii) Graphical Representation of Structural data.
3. **Neotectonics and Plaeoseismological Studies:**
 - (i) Delineation of active faults and fault scarps and their analyses, using High Resolution Remote Sensing Products /Satellite Imageries Data and GIS,
 - (ii) Microtopography using High Precision and Accuracy Instruments, Total Station, Real Time Kinematic GPS, and subsequent Field check.
 - (iii) Seismic hazard assessment based on earthquake energy.
 - (iv) Activity of fault zone at intermediate time-scale (~5 Ma) to understand the fault behavior for earthquake assessment.
4. **Tectonic Geomorphic/Quaternary Mapping of different levels of Surfaces and Morphotectonic Units.**
5. **Paleoseismological Studies using Trench Excavation.**
6. **Fission Track Dating (FTD) for Thermal History determinations of Sedimentary basin: A tool for preliminary investigations in Oil Exploration.**

The Fission Track Dating is being conducted at WIHG, Dehradun following the "External Detector Method (EDM)".



Mineral Separation Facility

Expertise available in Geophysical Investigations

Microearthquake studies around dams, nuclear power plant and MAJOR structures:

Monitoring of earthquake activities, Microearthquake (MEQ) studies, Delineation of active seismic zones and Micro-zonation and mapping of seismically active faults etc.



V sat linked Real Time Seismic monitoring lab and display of Trillium 240 Broadband Seismometer and Taurus Digitizer

MASW method: To estimate ground strength and to derive load-bearing capacity of subsurface up to 30 m in 1-D, 2-D, and 3-D (Geotechnical studies): Multichannel analysis of surface waves (MASW) method is one of the seismic survey methods evaluating the elastic condition (stiffness) of the ground for geotechnical engineering purposes. MASW first measures seismic surface waves generated from various types of seismic sources such as sledge hammer analyse the propagation velocities of those surface waves, and then finally deduce shear-wave velocity (V_s) variations below the surveyed area that is most responsible for the analyzed propagation velocity pattern of surface waves. Shear-wave velocity (V_s) is one of the elastic constants and closely related to Young's modulus. Under most circumstances, V_s is a direct indicator of the ground strength (stiffness) and therefore commonly used to derive load-bearing capacity. MASW also can provide the information in 1-D, 2-D, and 3-D formats.

GPS METHOD: GPS receivers are used to position survey markers, buildings, bridges and other large infrastructures. GPS is widely used in mapping, including aerial mapping, landslide mapping and other Geographical Information System (GIS) applications. GPS is used to provide the information on seismically active zones and to monitor movements across seismic fault lines. Shrinking of reservoirs due to water loading and un-loading can be measured with GPS Network around the reservoirs.



Subsurface Imaging

Expertise for subsurface imaging in terms of resistivity variation is available in the Geophysics Group. For shallow depth and high resolution images, group owns a multichannel electrical resistivity tomography system (ERT) ARESII with 48 electrodes having capability of measurement of 2D/3D resistivity variation using DC resistivity method, Induced Polarisation and Self potential method. The resistivity imaging provide geophysical input for Slope stability and slope deformation studies, Land slide studies (geotechnical and engineering geological studies), Ground Water exploration (hydrogeology studies) and environmental studies.

Subsurface imaging of the kilometres depth range (upto 50 km) is accomplished using natural source EM method and the group owns broad band magnetotelluric system for the purpose. Subsurface resistivity variations obtained from this can be utilized for Crustal Studies, Ground Water Exploration (Deep aquifers) and Geothermal Exploration.

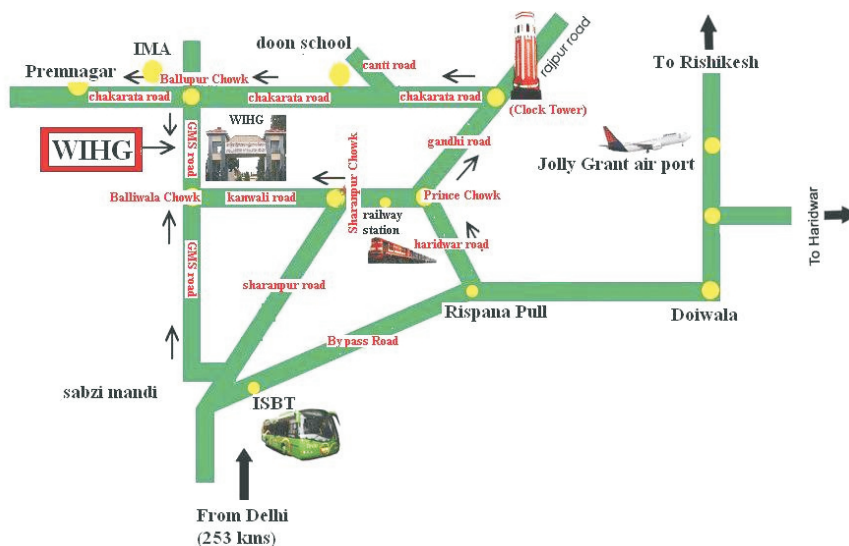
The Geophysics Group also offers resistivity surveys and studies for:

- (i) engineering-geological sub-surface surveys (for civil engineering, dams and dikes monitoring, utility mapping, landslides),
- (ii) environmental monitoring and mapping (waste sites, leakages, pollution plumes),
- (iii) hydrogeological surveys (ground water explorations),
- (iv) archaeological investigations,
- (v) geothermal investigations,
- (vi) deep crustal studies.



LOCATION

The Wadia Institute is situated at 33, General Mahadeo Singh Road and lies about 400m east of Ballupur crossing on Chakrata Road.



Wadia Institute of Himalayan Geology

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