



YEAR-BOOK

2022-23



GEOLOGICAL SURVEY OF PAKISTAN
MINISTRY OF ENERGY (PETROLEUM DIVISION)
GOVERNMENT OF PAKISTAN

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1. Introduction

The Geological Survey of Pakistan (GSP) is an attached department of the Ministry of Energy (Petroleum Division), with its headquarters office located in Quetta. As per the charter, GSP is responsible for the study of the geology of the country in all pertinent details. With a well-balanced, efficient, and competitive organizational structure, GSP is capable of exploring mineral resources by undertaking geological, geophysical, drilling, and geotechnical investigations. The technical services of the GSP are regularly availed by various public and private sector organizations. To meet urgent demands in the fields of geological mapping and mineral exploration, the GSP also undertakes development projects. Additionally, the GSP addresses natural hazards from the very beginning, and currently, our officers are investigating tectonically active regions to better understand the behavior of faults and thus to reduce disaster risk in that particular region.

1.1 Functions and Core Activities

- Geological mapping and other geoscientific surveys.
- Scientific studies to accurately comprehend the nation's natural resources and ensure their wise management.
- Geotechnical investigations in connection with the construction of heavy civil engineering projects.
- Environmental and engineering geological studies.
- Estimates of geothermal energy resources.
- Description of on-shore and off-shore geological framework and understanding its formation, evolution, and resource potential evaluation.
- Studies of Natural hazards associated with earthquakes, volcanic activity, waste disposal, landslides, floods, subsidence, and recommendations for their prediction/mitigation.
- Provision of scientific support and technical assistance in legislative, regulatory, and management decisions to the federal, provincial, and local governments.

1.2 Institutional Structure

Following Pakistan's independence in 1947, the GSP was established. The department is headed by a Director General. The technical and other activities of the department are planned and directed by the Management Advisory Committee (MAC), which is chaired by the Director General with all Deputy Director Generals (BPS-20) and Directors (BPS-19) as its members.

TABLE 1: REGION-WISE DISTRIBUTION OF GAZETTED AND NON-GAZETTED STAFF OF GSP.

S.No.	NAME OF THE OFFICE	GAZETTED	NON-GAZETTED	TOTAL
1.	GSP Headquarters Office, Quetta	141	378	519
2.	GSP Regional Office, Lahore.	43	97	103
3.	GSP Regional Office, Karachi.	54	109	163
4.	GSP Regional Office, Islamabad.	26	53	79
5.	GSP Regional Office, Peshawar.	21	53	74
6.	GSP Regional Office, AJK.	4	13	17
7.	Geoscience Lab, Islamabad.	24	39	63
	TOTAL	313	742	1055

TABLE 2: CATEGORY-WISE DISTRIBUTION OF GAZETTED AND NON-GAZETTED STAFF OF GSP

S.No.	CATEGORY	NUMBER
1.	Geologists	156
2.	Geophysicists	21
3.	Chemists	27
4.	Drilling Engineers	25
5.	photogrammetrists	07
6.	Other Technical	08
7.	Administration and Accounts	09
8.	Technical Staff	313
9.	Ministerial Staff	132
10.	BPS 1-2 Staff	307
	TOTAL	1055

1.3 Budget and Finance

The GSP gets its annual budgetary allocation in the federal budget every year and additional allocation is gained from the federal Public Sector Development Project (PSDP) for executing development projects. The total budget of GSP for the year 2022-23 is 1,414.369 million.

FINANCIAL YEAR	2018-19	2019-20	2020-21	2021-22	2022-23
Rs. (In Millions)					
REGULAR BUDGET	582.296	582.00	612	682.791	1,114.369
DEVELOPMENT BUDGET	463.175	433.852	26.524	70.000	300.00
SUPPLEMENTARY BUDGET (From PSDP Projects)				150.00	
TOTAL	1045.471	1015.852	638.524	902.791	1,414.369

2. Activities, Progress, and Accomplishments (2022-23)

The Geological Survey of Pakistan (GSP) is an attached department of the Federal Ministry of Energy (Petroleum Division) that collects and provides detailed information on the geology and mineral resources of the country by carrying out different geological, geophysical, and geochemical surveys, and exploratory drilling operations. The performance of GSP for the last Financial Year 2022-23, is given below.

2.1 Regional Geological Mapping on 1:50,000 Scale

The geology of Pakistan is characterized by the interaction of Indian, Arabian, and Eurasian plates in different regions formed under different tectonic settings. This complex interaction has not only created sky-scraping mountain ranges in the northern areas but concurrently fabricated significant geological and tectonic features in other regions of Pakistan.

GSP is the premier geoscientific organization in the country and has been implementing statutory obligations of geological mapping and other geoscientific surveys. During the year 2022-23, GSP executed the regional geological mapping and mineral investigation (640 Km²) on a 1: 50000 scale in different regions of the country and mapped a total of 42 Toposheet (total area covered, 42X640= 26,880 Km²).

2.2 Economic Geology

During this period investigations were carried out for the following Economic Geology project.

- Exploration of Copper Prospects in Uthal and Adjacent Areas, Lasbella District Balochistan.
- Exploration & Evaluation of Lead, Zinc and Barite Deposits in Lasbella and Khuzdar Districts, Balochistan.
- Investigation of Pegmatites and Leucocratic Rocks for Lithium and other associated metals (Sn and W) surrounding Dasu and Gilgit City.
- Sedimentary Economic Potential of Nagarpakar Region, Sindh Pakistan.
- Investigation of Fly Ash (FA) from Thar Coalfield on Rare Earth Elements and Speciation of Selected Heavy and Trace Metals including Lithium.
- Development of Rock & Mineral Spectral Library of Pakistan.
- Geological Mapping and Economic Evaluation of Pegmatite Bearing Units with Special Emphasis on Lithium Shigar Valley, Skardu, Gilgit Baltistan.
- Geochemistry and Economic Evaluation of Jagran Granite (AJK) Neelum Valley with special emphasis on Lithium (Li) occurrence in Pegmatite.

- Preliminary Geochemical Studies for Economic minerals in sediments (Silt) of Kabul River and Warsak Dam.
- Reconnaissance Study of Copper and Gold Mineralization in Barit-Hunkoi Area, Danyor Nala, Gilgit-Baltistan.
- Geochemical Exploration of Precious and Industrial Minerals in Katpana and Kharan Deserts of Pakistan.
- Exploration of Newly Discovered Copper Deposits in District Swat and Shangla, Khyber Pakhtunkhwa.
- Exploratory Studies of Metallic and Non-Metallic Minerals along the Chaman Segment of the Chaman Transform Fault System.

2.3 Research Studies

- Integrated field Geological Studies of Kala Chitta Range, upper Indus basin, Pakistan.
- Compilation of District Geological Maps of Gilgit-Baltistan, Gilgit District Phase-1.

2.4 Geophysical Exploration

2.4.1 Magnetic & IP Survey

Exploration of Placer Gold and base metals through geochemical techniques (Magnetic at District Attock, Punjab and Darband area, district Mansehra, KP, Pakistan. Similarly, Geophysical studies were conducted for the exploration of Iron ore deposits at Spezand, Quetta.

2.5 Chemical Analyses

The Geological Survey of Pakistan has state-of-the-art research facilities for geochemical analysis. Various methods have been developed for the analysis of different samples, ranging from solid fuel (coal) to water, ores to minerals, and stream sediments.

During the financial year 2022-23, 1809 samples were analyzed by using XRD/DTA, ED-XRF, and Scanning Electronic Microscope (SEM-EDS) for 7923 estimations in Geoscience Advanced Research Laboratory, Islamabad, and other laboratories at Quetta, and Lahore.

2.6 Drilling Operations

The Geological Survey of Pakistan undertakes drilling operations under PSDP and Annual Field Programs. Recently purchased new drilling rigs have been deputed on PSDP projects to boost the drilling operations. Some of the important drilling projects are mentioned below.

- Drilled 06 boreholes with a cumulative depth of 1034.92 meters at Nagarparkar area, District Tharparkar, Sindh (under the Annual Field Project 2022-23, “Sedimentary Economic Potential of Nagarparkar Region, Sindh Pakistan”), (Ongoing).
- Drilled 02 boreholes with a cumulative depth of 352.2 meters at Spezand area, District Mastung, Balochistan (under the Exploratory Operations 2022-23, (Completed).

2.7 Internships

The Geological Survey of Pakistan is the main stakeholder in mineral exploration and is committed to professional excellence. During the period, 2022-23, **84** internees have got internships in different offices (both headquarters and regional offices) of GSP, for 01-06 months. The trainings were provided in the fields of structural geology, GIS-Remote Sensing, Petrography, Gemology, Geochemistry, and Economic geology.

3. Public Sector Development Programmes (PSDP)

Following PSDP Projects executed during 2022-23.

3.1 Ongoing (PSDPs)

1. “Geological Mapping of 50 Topo-sheets out of 354 Unmapped Topo-sheets of Outcrop Area of Balochistan Province” (2020-2023) (Total Cost: 127.595 Million).
2. “Pakistan National Research program on geological hazards (earthquakes and landslides), data acquisition along active faults and identification of potential landslide hotspot zones” (2021-24) (Total Cost: 412.769 Million).

1. “Geological Mapping of 50 Toposheets out of 354 Unmapped Toposheets of Outcrop Area of Balochistan Province”.

Objectives:

To geologically map the outcrop area in detail on a 1:50,000 scale and to maintain the database for the future exploration of the occurrences of metallic and non-metallic mineral potential, dimension stones, aggregates, and limestone reserves for the industry in the targeted potential areas of Balochistan.

Up-to-date Cumulative Progress:

Unmapped areas including parts of the Chagai, Khuzdar, Lasbela, and Zhob Districts were selected for detailed mapping based on mineral potential and geological complexity. An initial study of geological maps, topo-sheets, aerial photographs, and satellite imageries was conducted and field parties were been departed to carry out field works. Around 30 toposheets have been mapped that are sent for review and amendments to the Director General, GSP, and field officers are busy preparing the remaining geological maps of the areas. 60 samples of various rocks units, collected for petrographic analysis from Zhob ophiolites were classified as ultramafics: Lherzolite, harzburgite, dunite, and wehrlite; mafic rocks: gabbro and basalt; the metamorphic sole rocks were identified as quartz-mica schist and Greenschist. In addition, 15 samples of Khanozai's gabbroic rocks were examined and divided into three categories: gabbro, gabbro-norite, and olivine gabbro. After 33 thin sections from the Bela Ophiolites' mantle section were examined, it was found that the region is mostly made up of ultramafic rock units, particularly harzburgite and dunite, with a trace amount of Lherzolites. High peaks of the primary chromite-forming elements in the samples examined by SEM analysis suggested the existence of chromite grains dispersed throughout the samples. Similarly, 78 stream samples, collected from the Koh-i-Sultan volcanics in Chaghi District, revealed the presence of Cu, Mn, and Zn in higher concentrations.

2. “Pakistan National Research program on geological hazards (earthquakes and landslides), data acquisition along active faults and identification of potential landslide hotspot zones”.

Objectives:

The main focus of the project is to identify Earthquake-prone areas based on active fault margins assisted by the identification of landslide hotspots along the active fault margins, and the establishment of a new network of Globe Navigation Satellite Stations - GNSS (permanent as well as periodic), along with the establishment of a countrywide landslide inventory database.

Up-to-date Cumulative Progress:

Previous literature and maps are being studied by the field parties and about 65% of technical work has been completed. GNSS sites have been installed in parts of Gilgit-Baltistan,

AJK, Khyber Pakhtunkhwa, and Salt Range (Punjab). Field works are also conducted for GNSS based studies in parts of Gilgit-Baltistan, AJK, and Salt Range (Punjab). Similarly, landslide studies are carried out in parts of Azad Kashmir and Gilgit-Baltistan. The reports are being prepared and are submitted/under review.

4. Work Deposit Projects (WDP)

The Work Deposit Financial Arrangement for contractual work has been approved by the finance division, dated September 11, 2020. The provinces can now avail themselves of GSP's services for mineral exploration, which includes groundwater studies, geotechnical investigations, geohazard assessment, geochemical analysis, geological and geophysics investigations, and drilling operations. GSP has already provided services to several Organizations in the areas of mineral exploration, groundwater, geohazard assessment, geotechnical investigation, and drilling under the Work Deposit.

4.1 Ongoing Work Deposit Projects

The following Work Deposit Projects are being executed during 2022-23.

4.1.1. “Potential evaluation of Placer Gold in River Indus at District Attock”.

Objectives:

To identify prospective locations for placer gold accumulation through the use of geological, geophysical, and geochemical techniques and drilling operations.

Up-to-date Cumulative Progress:

1. The Geophysical survey reports (magnetic and IP) have been completed and submitted to the Mines and Minerals Department, Punjab.
2. The surface geochemical sampling (Pan + sluiced concentrates) has been completed and 133 collected samples have been sent to Geoscience Advance Research Laboratories (GARL), GSP, Islamabad for Lab analysis. Some of the samples (~20) have been analyzed using Atomic Absorption Spectroscopy (AAS) and the results have been shared with the Mines and Minerals Department of Punjab, Lahore. The report of the field survey and lab analysis has been submitted.
3. Drilling of 30 boreholes with a cumulative depth of 900.00 meters are being proposed using surface field survey, geochemical sampling data, and geophysical data. A percussion-type drilling is proposed that will be carried out by the contractor.
4. The final report will be submitted to the Mines and Minerals Department, Punjab following the drilling operation and subsurface sample testing.

4.1.2. Geological Mapping and Placer Gold Evaluation of KPK. (GSP-M&MD, KPK, Work Deposit Project).

Objectives:

1. To conduct geological mapping and mineral investigation of unmapped topo-sheets of Khyber Pakhtunkhwa at a scale of 1:50,000.
2. To locate possible placer gold potential zones by reviewing previous literature, geological maps, and processing satellite images. The field parties will carry out geological, geophysical, and geochemical investigations to verify the prospective zones.

Up-to-date Cumulative Progress:

1. The technical teams of geologists were deployed to perform geological mapping and mineral investigation of nine topo-sheets constituting an area of approximately six thousand square kilometers (6000 sq. km) in districts of Chitral, Swat, and Buner.
2. The Printed copies of these geological maps are submitted to the Directorate General Mines and Minerals, Khyber Pakhtunkhwa.
3. Fieldwork for surface geochemical sampling (Pan + sluiced concentrates) is carried out in Swabi and a total of twenty samples have been collected and sent for analysis, in the 1st phase of fieldwork.
4. Further, the magnetic survey is carried out in the first phase of fieldwork in the Swabi-1 block. After analyzing the results of the Magnetic survey, the IP survey will be carried out in selected locations in 2nd phase of fieldwork.

5. Future Plans

5.1 Major Activities are planned to be undertaken during FY 2023-24

5.1.1 Regular Field Projects 2022-23

- i. Regional Geological Mapping.
- ii. Mineral Exploration/Economic Geology.
- iii. Geophysical Surveys/Exploration.
- iv. Geochemical Investigation.
- v. Engineering Geology/Geo-hazard studies.

5.1.2 Approved PSDP Projects 2023-24:

1. “Geological Mapping of 50 Toposheets out of 354 Unmapped Toposheets of Outcrop Area of Balochistan Province” (2020-2023) (Total Cost: 127.595 Million). (Ongoing).
2. Pakistan National Research Program on Geological Hazards (Earthquakes & Landslides), Data Acquisition along Active Faults and Identification of Potential Landslide Hotspot Zones. (Approved by DDWP, on 31-03-2021). Total Cost: Rs. 412.769 Million. (Ongoing).
3. Instrumental Up-gradation of Geoscience Advance Research Laboratories (GARL), GSP, Islamabad to be used in Economic Mineral Exploration. (Approved by DDWP on 30-05-2022). Total Cost: Rs. 470.80 Million.
4. Accelerated Geological Mapping and Mineral Exploration Using Advanced Satellite Image Based Technologies for Unmapped Areas in Pakistan. (Approved by DDWP on 27-06-2023). Total Cost: Rs. 995.00 Million.

5.1.3 Proposed PSDP Projects 2023-24:-

1. Pakistan National Research Program on Geological Hazards (Earthquakes & Landslides), Data Acquisition along Active Faults and Identification of Potential Landslide Hotspot Zones.
2. Instrumental Up-gradation of Geoscience Advance Research Laboratories (GARL), GSP, Islamabad to be used in Economic Mineral Exploration
3. Accelerated Geological Mapping and Mineral Exploration Using Advanced Satellite Image Based Technologies for Unmapped Areas in Pakistan

6. Picture Gallery

6.1 Geological Field Activities



A geologist performing panning as part of the Placer Project to explore gold and other heavy minerals along the Indus River in District Attock, Punjab.



As part of the R&D project, a geologist in District Haripur, KPK, identifies Shear Sense Indicators for stress analysis.



As part of the R&D project, a geological team is collecting field data over an outcrop of Chagai intrusions, Chagai, Balochistan.



A GSP geologist performing petrographic analyses, as part of an R&D project, to determine the mineral content of the rocks.



Installation of GNSS on Bench Mark (1802), Tattu, Nanga Parbat during episodic remeasurement campaign 2022-23 to quantify the velocities/slip rate of NPHM.



A GSP team visits and inspects the site of the devastating Torkham Landslide, which occurred on April 18, 2023, and claimed the lives of seven people.

6.2 Geophysical Field Activities



A Geophysicist performing Induced Polarization (IP) Survey for the exploration of Sulphide Mineralization (i.e., Copper) in Chagai, Balochistan, as part of R&D project.



A Geophysicist performing Magnetic Survey for the ground follow up of aeromagnetic anomalies in Nokkundi, District Chagai, Balochistan.

6.3 Geochemical Activities



A Chemist analysing samples for heavy metals, as part of the Placer Project.



Chemist Dr. Raja Kareem Bux analyses samples for Gold and other precious metals as part of the R&D project.

6.4. Drilling Activities



Exploratory Drilling for Mineral Exploration in the Spezand Area, District Mastung, Balochistan.



Exploratory Drilling for Mineral Exploration in Nagarparkar Area, District Tharparkar, Sindh.