

Role of the Department of Mines and Geology (DMG) in Advancing Engineering Geological Sciences in Nepal

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Received: September 5, 2025, Accepted: November 17, 2025

Abstract: The Department of Mines and Geology (DMG) is the main government institution of Nepal for advancing engineering geological sciences. Through systematic landslide hazard assessments, detailed mineral exploration, and regional geological mapping, DMG underpins sustainable infrastructure development and disaster risk reduction. By integrating modern technologies like GIS and Remote Sensing, LiDAR Survey, drone surveys and geophysical imaging, it enhances resource management and slope stability analysis, playing a crucial role in ensuring safe construction and environmental resilience across dynamic landscapes of the country.

Keywords: *Engineering geology, Landslide assessment, Mineral exploration, Geological mapping.*

Introduction

The Department of Mines and Geology (DMG), under the Ministry of Industry, Commerce and Supplies, Government of Nepal, serves as the apex body for geoscientific research, mineral exploration, and geological hazard mitigation in Nepal. Through systematic geological mapping, mineral resource assessment, landslide investigations, and the adoption of advanced geotechnical and geophysical technologies, DMG has played a major role in advancing engineering geological sciences in the country (DMG, 2025). This abstract highlights DMG's multidisciplinary contributions to infrastructure development, disaster risk reduction, and sustainable resource management (DMG, 2024; DMG, 2022; DMG, 2020; DMG, 2019).

Key contributions

Landslide hazard assessment and mitigation

DMG has been at the forefront of landslide research, conducting rapid and detailed field investigations in landslide-prone regions such as Dadeldhura, Lamjung, Parbat, and Achham (DMG, 2024). Landslide inventory databases for the Koshi, Bagmati, Gandaki, and Lumbini provinces have been completed, with ongoing work for the Karnali and Sudurpashchim provinces. These studies integrate:

- Field geology and geomorphology

- Drone-based topographic surveys
- Crack mapping and slope stability analysis
- GIS-based landslide susceptibility modeling

For instance, in Ramaroshan Rural Municipality (Achham), DMG used drone imagery and field data to prepare a landslide susceptibility map, identifying high-risk zones and recommending relocations and mitigation measures. Similar studies in Duwar (Lamjung) and Balaucha (Dadeldhura) have provided critical insights into the causes of slope instability, such as rainfall infiltration, poor drainage, and inappropriate land use. Following the Gorkha Earthquake 2015, a Stability Study of Settlements Affected by Landslides Triggered by the earthquake was conducted under the leadership of DMG with. The study encompassed several settlements across 19 districts and 125 local bodies (VDC/Municipality). In-depth stability assessments were conducted on 107 settlements in 8 districts, and detailed reports were submitted to the Home Ministry and NRA (National Reconstruction Authority).

Mineral exploration and resource characterization

DMG has identified a wide range of mineral resources across Nepal, from economic deposits to minor occurrences. Several key resources have been studied in detail, leading to assessments of their availability, quality, and economic potential, and the establishment of related mineral industries. Recent DMG exploration projects—including the Bojhe limestone and dolomite deposit (Khotang), granite deposit (Kavre), Jaitpani limestone deposit (Salyan), and magnesite deposit (Udaypur)—demonstrate the role of engineering geology in resource evaluation. Methods include:

- Core drilling and channel sampling
- Geological mapping at 1:1000 scale
- Chemical and mineralogical analysis
- Reserve estimation using vertical section and geostatistical methods

These efforts have not only identified economically viable deposits but also supported the cement

industry, reducing dependency on imports and promoting industrial growth.

Geological mapping and tectonic studies

DMG has conducted extensive geological mapping across Nepal, including Gorkha and Lamjung, to better understand the regional tectonic framework for engineering applications. To date, geological mapping covers 119,681 km² of Nepal's total 147,181 km².

Key outputs include:

- Identification of thrust zones (e.g., MCT)
- Stratigraphic correlation and structural analysis
- Mapping of lithological units and their engineering properties

These maps serve as foundational tools for infrastructure planning, especially in seismically active and geologically complex terrains.

Engineering and environmental geological studies

DMG prepare engineering geological maps of different parts of the country, especially the urban areas and some rapidly developing cities. These maps reconcile the maximum available information on the engineering geology of the studied areas like distribution of soil and hard rock formations, bearing capacity of the ground, earthquake-sensitive areas including liquefaction hazard maps, mass movement, flooding, and erosion activities, information on groundwater, existing and potential landfill sites within the cities, etc. in the form of a single integrated map.

Earthquake monitoring and research

Nepal lies within the active Himalayan continental collision zone, where earthquake probability is very high. Major events such as the 1934 Bihar–Nepal Earthquake (M 8) and the 2015 Gorkha Earthquake (Mw 7.8) highlight this seismicity. The DMG currently operates 42 seismic stations, 50 GPS stations for crustal deformation monitoring, and 36 accelerometers for strong-motion data. Alongside monitoring, DMG collaborates with international institutions on research that contributes to global seismic hazard assessments and supports Nepal's seismic risk reduction efforts.

Mining and environmental compliance

DMG monitors mining and exploration projects to ensure environmental sustainability and regulatory compliance based on the Mines and Mineral Regulations, 2056 and This includes:

- Review of IEE and EIA reports

- Mining scheme verification
- Inspection of operating mines
- Conflict resolution and community engagement

The use of drone technology for stockpile management and slope monitoring represents a modern approach to mine safety and environmental management.

Adoption of advanced technologies

DMG has integrated modern tools and techniques to enhance its engineering geological capabilities:

- Handheld XRF for field mineral identification
- ICP-MS for chemical analysis
- Digital geotechnical laboratories
- GIS and remote sensing for hazard zonation

These technologies improve the accuracy and efficiency of geological and geotechnical assessments.

Conclusion

The Department of Mines and Geology plays a key role in applying engineering geology to national development. Through landslide risk assessment, mineral exploration, geological mapping, and environmental monitoring, DMG supports safer infrastructure, disaster resilience, and sustainable resource use. Continued progress will rely on strengthened digital databases, enhanced technical capacity, and greater interdisciplinary collaboration to meet emerging geotechnical challenges.

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