

Applied Geomorphology and Natural Resources Exploration

Understanding Earth's surface processes to unlock natural resources while preserving our planet's delicate balance.





What is Applied Geomorphology?

Problem-Solving Science

Defined by D.K.C. Jones as applying geomorphic understanding to solve problems in land use, resource exploitation, and environmental management.

Integrated Analysis

Links landform analysis with geological history, structure, and lithology to guide exploration and strategic planning decisions.

Human-Earth Interface

Focuses on human interaction with earth surface processes: both planned modifications and inadvertent environmental impacts.

Why Geomorphology Matters in Resource Exploration

Terrain Intelligence

Reveals terrain stability, erosion patterns, and sediment transport critical for locating mineral deposits and hydrocarbons in complex geological environments.

Supports sustainable development by balancing resource extraction with environmental management principles for long-term viability.

Risk Assessment

Helps predict natural hazards that affect exploration safety and infrastructure, preventing costly project delays and accidents.



Modern Tools Enhancing Applied Geomorphology



Remote Sensing

Satellite imagery and airborne sensors provide large-scale, detailed surface data enabling comprehensive terrain analysis from space.



GIS Integration

Geographic Information Systems integrate diverse datasets: topography, geology, seismic surveys, enabling precise mapping and multi-layered analysis.



Subsurface Data

Borehole databases combined with remote sensing improve subsurface understanding and exploration efficiency through data fusion.

Case Study: Remote Sensing in Mineral Exploration

Hatu Area, Xinjiang, China Success Story

01

Multi-Platform Integration

Combined Landsat TM/ETM+, Quickbird, and Hyperion data to identify alteration zones and mineralized geological structures.

02

Advanced Analysis

Applied spectral analysis techniques including Crosta method and matched filtering to reduce noise and enhance detection accuracy.

03

Discovery Success

Resulted in discovery of new gold-copper mineralization zones, demonstrating remote sensing's transformative power in complex terrains.





GIS in Oil & Gas Exploration: Ethiopia Example

1

Complex Terrain Challenge

Challenging topography with mountains, hills, and plains complicates seismic survey planning and increases operational risks.

2

GIS Optimization

Geographic Information Systems design optimal seismic line routes, significantly reducing costs and environmental impact risks.

3

Integrated Mapping

Combined geological maps using satellite imagery, digital elevation models, and seismic data improve target evaluation and operational safety.

Human Impact as Geomorphic Agents

Planned Modifications

- Constructed embankments and flood control systems
- River channel modifications for navigation
- Coastal defenses against erosion

Unplanned Environmental Changes

- Deforestation accelerating soil erosion
- Mining operations creating landscape instability
- Urbanization altering natural drainage patterns



Applied geomorphology assesses these impacts to guide mitigation strategies and sustainable resource management practices.

Predictive Modeling and Spatial Data Integration

Multi-Dataset Fusion

Combining geochemical, geophysical, and remote sensing data enhances mineral prospectivity mapping accuracy.

Advanced Algorithms

Knowledge-driven models (TOPSIS, ARAS, MOORA) validated by ROC/AUC analysis achieve prediction accuracy exceeding 70%.

Strategic Focus

Enables focused exploration in underexplored or inaccessible regions, saving valuable time and financial resources.





The Future: Integrating Technology and Geomorphology

1

Hyperspectral Revolution

Increasing use of hyperspectral imaging and high-resolution satellite data for detailed mineral and structural mapping capabilities.

2

Real-Time Integration

Real-time borehole data linked with GIS systems for dynamic exploration planning and adaptive resource management strategies.

3

Sustainable Focus

Emphasis on sustainable exploration practices balancing economic development needs with environmental stewardship responsibilities.



Applied Geomorphology: The Foundation of Future Resource Exploration

Data Transformation

Transforms raw geological data into actionable insights for discovery and strategic resource management decisions.

Technology Revolution

Integration with remote sensing and GIS technologies revolutionizes exploration efficiency and prediction accuracy.

Sustainable Future

Essential for meeting future resource demands while protecting the environment and supporting local communities worldwide.