

FIELDS AND TOOLS OF GEOMORPHOLOGY

1. Introduction :

- Geomorphology (from the Greek, geo, the Earth, morphe, the form and, logos, the study) is the scientific study of the reliefs and the processes that shape them, on terrestrial planets.
- Geomorphologists analyze landscapes, seek to understand their history and evolution and to predict future changes through a combination of field observations, laboratory experiments and numerical modeling.
- Geomorphology is the science whose object is the description and explanation of the shapes of the earth's relief. This discipline was built within physical geography, then geosciences. It is practiced by geographers, geologists, ... according to methods and fields of research (geodesy, hydrology, geotechnics, etc.).
- All forms of the Earth's surface evolve in response to a combination of natural and anthropogenic processes, and tend to balance the processes of ablation and accumulation.
 - *All these processes operate in various spatial and temporal scales. Over time (small scales), the landscape is built up in particular by tectonic uplift and volcanism (structural geomorphology). It is therefore a question of the analysis of the natural environment, which is a geo-system: a set of territories endowed with their own structure and functioning, which is inscribed in space and time (spatio-temporal).*
- **The discipline is very old :**
 - ✓ *Shen Kuo (1031-1095), a great Chinese naturalist and politician, observes, for example, fossil shells in a cliff and conceives that it corresponds to an ancient coastline. Other formations inspire him with the idea that the Earth's surface is shaped and reshaped by erosion. Carlos Friedrich Naumann uses for the first time in 1858 in his geology textbook the expression morphology of the Earth's surface.*

2. Field of geomorphology :

- Geomorphology is a discipline that analyzes one of the components of the natural environment, in close relationship with the other disciplines of physical geography, hydrology, climatology and earth sciences (geology).
- Two fields share the scientific field of geomorphology :
 - a) **Structural geomorphology :**
 - b) **Dynamic geomorphology**

A. Structural geomorphology: concerns the influence of the structure (lithology and tectonics, see geodynamics) on the relief at different scales from plate tectonics to elementary structural forms (surfaces, escarpments, etc.).

B. Dynamic geomorphology: (formerly zonal or climatic geomorphology) specializes in the analytical study of external processes that contribute to the formation and evolution of landforms; erosion, alteration, ablation, transport, deposition, etc., build and modify formations (coastlines, hydrographic network, etc.).

It also concerns the particular aspect of such a form depending on a current climate or the legacies of a past climate (climatology and biogeography).

➤ ***Let's Start Schematically :***

- **structural geomorphology** explains the main lines of the relief - the main architecture or the structure –
- **while the dynamic geomorphology** retouches the main features of the landscape generally under the effect of the climate.

3. The aspects of geomorphology :

➤ ***The geomorphological study has a double aspect :***

- **The geometry of the topographic surface :**

- ✓ topography is the representation of the places and shapes of the terrain on a map,
- ✓ geomorphology interprets shapes:

- **Modeling:** the configuration of the surface is the morphography, qualitative or quantitative, it uses morphometric measurements on the ground or maps, aerial photographs, satellite images .

➤ ***Thus the notion of relief forms is inseparable from that of geological formations (terrains) associated with modeling.***

They constitute two category :

- i. **Superficial formations :** correlative to morphogenesis (formation and evolution of the relief). Their implementation accompanies the realization of the relief and their study is therefore fundamental to explain and date the relief,
- ii. **The underlying substrate :** in place, consisting of often much older rocks, placed in different paleogeographic conditions (old geographical distributions of the reliefs).

4. The tools of geomorphology :

- Technological evolution has allowed great progress in geomorphological knowledge. With these advantages, each of its tools, used, allows a finer interpretation of the reliefs and their evolution.
 - Then, in certain regions (mountains, large vegetation cover, highly urbanized areas, other planets of the solar system), the collection of field data is particularly difficult and requires the use of special techniques and methods.
- a) **Geomorphological mapping :** The cartography recapitulate information on the geometry, the arrangement, of the relief forms; the nature and structure of the surface formations; the processes including their duration, the rhythm of formation and the age of the relief forms.
 - b) **Geodetic methods :** (theodolites, GPS, etc.): allow (permit) the cartographic location, that of measuring points.
 - c) **Sedimentological or granulometric techniques:** allow the analysis of sedimentary deposits (granulometry, facies, etc.) by differentiating their erosion, transport, deposition conditions. The survey (examination) of the spatial position of the deposits makes (get) it possible to establish a relative dating of the geomorphological events (nested and stepped (gradation) terraces, deposits of moraines, loess, etc.).
 - d) **d) Meteorological and hydrological stations:** collect meteorological (air temperatures, precipitation) and hydrological variables (surface flows, watercourse (river) flows). These parameters play a fundamental role in the evolution of phenomena: floods, glacial, periglacial, gravity and torrential, coastal(littoral) etc.

f) Geophysical methods: replace drilling techniques. Generally, the materials of the subsoil have particular physical properties (speed of propagation of seismic waves, resistance to electric current, etc.). This study makes it possible to determine the nature and condition of the rock, the presence of water or ice, the temperature and the porosity, etc.

g) Satellite and photoaerial image analysis: Aerial photography and satellite imagery are considered as remote (distant) detection tools(instrumen). Satellites, in orbit around the planet, have several other uses, in particular that of identifying :

- The evolution of the coastline(seaboard).
- The fires(flame).
- Desertification
- The analysis of the satellite and photo-aerial image, brings(take) more precision for the comprehension of the relief (terrestrial and other planets) at different scales.

5. Erosion process :

- Traditionally, the term erosion designates all the processes of ablation, transport and sedimentation of rocky materials.
- Erosion in the broadest sense is a "trilogy" triptych. The erosion of the reliefs produces patterns(model) by ablation (notch of the rock mass) or by sedimentation (correlative deposits).

❖ Large transport agents

- running water ;
- the wind ;
- the glaciers.

a- Processus fluviatiles :

- Fluvial dynamics, or fluvial geodynamics, studies the geomorphological evolution of watercourses(river) (the resulting forms of fluvial morphology).
- Fluvial dynamics uses elements ranging from method and diagnosis to physical geography (including geomorphology), geology, sedimentology, hydraulics, hydrology, biology and fluvial ecology.

b- Wind turbine processes :

- Aeolian processes relate to the activity of the winds and more particularly, to the ability(potentiality) of the wind to erode, transport materials and then deposit them.
- This agent is particularly effective in desert regions, where aridity or cold are marked and having a large amount(quantity) of loose sediments.
- The term eolization designates the geomorphological processes relating to the action of the wind.

c- Glacial and Periglacial processes

➤ *All periglacial dynamics bring(take) together various(diverse) processes such as :*

- i. **Cryoturbation** : Cryoturbation or geliturbation is a geomorphological phenomenon affecting the surface layers of the soil subjected to alternations of freezing(glacial) and thawing Photography.1.



Photography.1.Cryoturbation process

- ii. **solifluxion effect** : Solifluxation is the descent, on a slope, of muddy materials softened by the increase in their liquid water content.



Photography.2. solifluxion process

During the hot season, the surface layer begins to melt and slides completely over the lower layer solidified by the frost (gel) at a speed of 0.5 to 1.5 cm per year. Photography.2.

iii. **Gelifraction**

- ✓ Cryoclasty or gelling, or gelifraction, is a geomorphological process of weathering of rocks, caused by the cycles of freezing and thawing of water. the volume of water increases by about 9%.

- ✓ The process of gelling (a type of fragmentation) of rocks is linked to the alternation of freezing-thawing experienced by water which fills their pores and cracks, resulting in the fragmentation of the rocks.



Photography.3. Gelefraction process

- ✓ The physical weathering of the cliffs, mainly through gelifraction, gave rise to rock shelters.
- ✓ Shales, as a result of their flaky, fragile nature, are more easily eroded by freezing (gelifraction).

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