Endogenic Geomorphic Movements and Evolution of Land Forms: a Descriptive Analysis

Dr.Laxmana.M.Pujar, Assistant Professor of Geography, Govt. First Grade College, Hirekerur.

Abstract

This paper attempts to study how **Endogenic force;** pressure within the earth, also known as internal forces. Such internal forces contribute to vertical and horizontal motions and lead to subsidence, land upliftment, volcanism, faulting, folding, earthquakes lead to diverse landforms. Clearly, the surface of the earth is not flat but is rather unevenly spread out due to the presence of landforms including mountains, plains, hills, etc. These uneven landforms are formed and deformed over a while, in an ongoing process, due to the influence of internal and external pressure from within and above the surface of the earth.

Simply put, we can define endogenic forces (internal) and exogenic forces (external) as the two major geomorphic pressures that lead to the earth's movements and give shape to the earth's surface. When these internal and external changes occur continuously, chemical changes and stress are triggered on the surface of the earth, which eventually leads to the formation of uneven terrains. The energy emanating from within the earth is the main force behind endogenic geomorphic processes. This energy is mostly generated by radioactivity, rotational and tidal friction and primordial heat from the origin of the earth. This energy due to geothermal gradients and heat flow from within induces diastrophism and volcanism in the lithosphere. Due to variations in geothermal gradients and heat flow from within, crustal thickness and strength, the action of endogenic forces are not uniform and hence the tectonically controlled original crustal surface is uneven. All processes that move, elevate or build up portions of the earth's crust come under diastrophism. They include: (i) orogenic processes involving mountain building through severe folding and affecting long and narrow belts of the earth's crust; (ii) epeirogenic processes involving uplift or warping of large parts of the earth's crust; (iii) earthquakes involving local relatively minor movements; (iv) plate tectonics involving horizontal movements of crustal plates. In the process of orogeny, the crust is severely deformed into folds. Due to epeirogeny, there may be simple deformation. Orogeny is a mountain building process whereas epeirogeny is continental building process. Through the processes of orogeny, epeirogeny, earthquakes and plate tectonics, there can be faulting and fracturing of the crust.

Key words: Endogenic forces, Geomorphic Movements, orogeny, epeirogeny, Land forms

Introduction

geological processes associated with energy originating in the interior of the solid earth. Endogenic processes include tectonic movements of the crust, magmatism, metamorphism, and seismic activity (MOVEMENT; MAGMATISM; and METAMORPHISM). The principal energy sources for endogenic processes are heat and the redistribution of material in the earth's interior according to density (gravitational differentiation).

The earth's deep heat originates chiefly from radiation. The continuous generation of heat in the earth's interior results in the flow of heat toward the surface. With the proper combination of materials, temperature, and pressure, chambers and layers of partial melting may occur at certain depths within the earth. The asthenosphere, the primary source of magma formation, is such a layer in the upper mantle. Convection currents may arise in the asthenosphere, and they are hypothesized to be the cause of vertical and horizontal movements of the lithosphere. In the zones of the volcanic belts of the island arcs and continental margins, the principal magma chambers are associated with superdeep dip faults (Zavaritskii-Benioff zones), slanting beneath the continents from the ocean side to depths of about 700 km. Under the influence of the heat flow or under the direct influence of the heat carried by rising abyssal magma, magma chambers form in the crust itself. Reaching the near-surface parts, the magma is intruded into them in the form of variously shaped intrusive bodies or is extruded onto the surface, forming volcanoes.

Gravitational differentiation has led to the stratification of the earth into geospheres of varying density. On the surface it is also manifested in the form of tectonic movements, which, in turn, lead to the tectonic deformation of crustal and upper mantle rocks (DEFORMATION). The accumulation and subsequent discharge of tectonic stresses along active faults causes earthquakes.

The two types of deep processes are closely interrelated: by lowering the viscosity of the material, radioactive heat promotes its differentiation, which accelerates the discharge of heat toward the surface. It is hypothesized that a combination of these processes leads to the temporal unevenness of the release of heat and light matter toward the surface, which, in turn, can be explained by the occurrence of tectonic-magmatic cycles in the history of the earth's crust, The spatial irregularities of the same abyssal processes may explain the division of the crust into more or less geologically active regions, for example, into geosynclines and platforms.

Endogenic processes have been responsible for shaping the earth's relief and the formation of many of the most important mineral resources.

Objective:

This paper intends to explore and analyze endogenic forces, pressure that originates inside the earth. These forces are also known as 'constructive forces' as they **various landforms** on the surface of the Earth.

What are Endogenic Forces?

Endogenic forces or endogenetic forces are the pressure that originates inside the earth, therefore also called internal forces. These internal forces lead to vertical and horizontal movements and result in subsidence, land upliftment, volcanism, faulting, folding, earthquakes, etc.

Features

- Endogenic forces are land building forces that play a crucial role in the formation of the earth's crust.
- These are also called internal pressure as they form, originate and are located below the surface of the earth.

- Primordial heat, radioactivity, tidal and rotational friction from the earth results in the creation of this energy.
- The main processes involved under this are volcanism, folding, and faulting.

Two Major Forms

- Slow movements: These are also referred to as Diastrophic forces. It results in changes over some time.
- Sudden motions: As the name suggests, these are the visible motions, and include significant landform changes like earthquakes and volcanic eruptions.

Slow Movements (Diastrophic forces)

In simple terms, Diastrophic forces can be defined as the pressure that is created due to the motion of the solid material on the earth's surface. This includes all the processes that raise, move or build up the parts on the earth's surface.

Diastrophism Involves the Following Processes.

Epeirogenic motions: this is the process of warping or upliftment of large parts of the earth's surface.

Orogenic movements: this is essentially the process of mountain building that involves major folding, and affects the long as well as narrow belts of the surface.

Earthquakes that occur due to relatively minor local movements. The horizontal motions of the crustal plates, or plate tectonics.

Two Major movements

1. Orogenic movements
2. Epeirogenic movements

Features of Horizontal Movements or Orogenic Movements These movements are caused by the horizontal pressure that acts on the surface of the earth from side to side. Orogenic movements or horizontal movements are also referred to as mountain building. They can be categorized into two major pressures such as the pressure of tension and pressure of compression. Orogenic motions create tension to the strata's horizontal layer, which further leads to massive structural deformation of the earth's surface.

Features of Vertical Movements or Epeirogenic Movements

- Epeirogenic movements are essentially responsible for the creation of plateaus and continents on earth.
- These powerful movements occur from the centre of the earth.
- Vertical movements can be responsible for both the upliftment as well as the subsidence of the continent.
- They cannot create variation in the horizontal rock strata unlike discussed in the previous type.

What are Exogenic Forces?

Exogenic forces or external forces are forces that draw their power from the earth's exterior or arise within the earth's atmosphere.

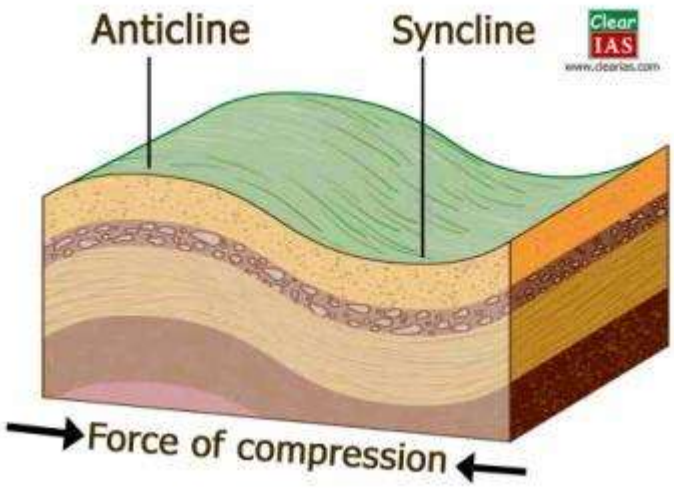
Exogenic forces cause land to wear down as a result of their action, therefore they are referred to as land wearing forces.

Exogenic Processes

Exogenic processes are processes that occur on the earth's surface as a result of exogenic pressures. Exogenic processes include weathering ,mass wasting, erosion, and deposition. All exogenic processes are referred to as denudation, which means "to peel away" or "to reveal." Geomorphic agents are natural elements capable of performing these exogenic processes (or exogenic geomorphic agents). For example, the wind, water, and waves.

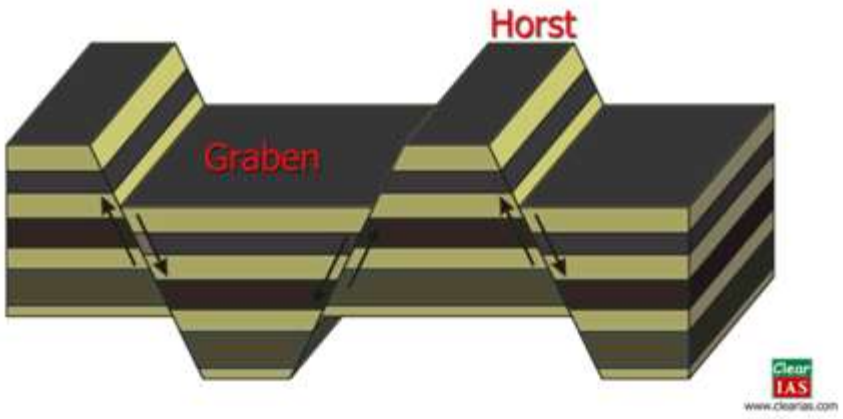
Endogenic Forces	**Exogenic Forces**
These are internal forces found deep within the Earth's core.	External forces that function and impact on the Earth's surface.
Because they form relief features on the Earth's surface, these forces are also called "constructive forces."	These forces are sometimes called 'destructive forces,' since they may cause existing landforms to be destroyed through weathering and erosion.
Earth's interior heat is the primary source of energy that drives endogenic motions.	Exogenic processes include weathering, erosion, mass wasting, and deposition.
Temperature and pressure differences across different strata of the ground cause density variations, which cause convection currents.	All motions, whether beneath the earth or on its surface, are caused by gradients from high to low pressure, from higher to lower levels, and so on.
The lithospheric plates (crust and upper mantle) are driven by convection currents in the mantle, and the motion of the lithospheric plates (tectonics) is the source of endogenic motions.	Exogenic forces get their energy from the atmosphere, which is influenced by the sun's ultimate energy as well as the tectonic gradient. Tectonic causes or endogenic forces are primarily responsible for the slopes of earth's surfaces.
Endogenic forces have after-effects that are only evident after they cause immediate damage.	Exogenic forces result in changes that are evident over hundreds or millions of years.
Examples: Earthquakes and volcanic eruptions.	Examples: Winds, rivers, glaciers etc

Forces of Compression:



- Forces of compression are the forces which push rock strata against a hard plane from one side or from both sides.
- The compressional forces lead to the bending of rock layers and thus lead to the formation of Fold Mountains.
- Most of the great mountain chains of the world like the Himalayas, the Rockies (N. America), the Andes (S. America), the Alps (Europe) etc are formed in this manner.

Forces of Tension:



- Forces of tension work horizontally, but in opposite directions.
- Under the operation of intense tensional forces, the rock stratum gets broken or fractured which results in the formation of cracks and fractures in the crust.
- The displacement of rock upward or downward from their original position along such a fracture is termed as **faulting**.
- The line along which displacement of the fractured rock strata take place is called as the **fault line**.

- Faulting results in the formation of well-known relief features such as **Rift Valleys and Block Mountains.** (E.g. Vindhya and Satpura Mountains)
- A rift valley is formed by sinking of rock strata lying between two almost parallel faults. (E.g. Valley of Nile, Rift valley of Narmada and Tapti)
- Rift valleys with steep parallel walls along the fault are called as **Graben** and the uplifted landmass with steep slopes on both sides are called as **Horst**.
- The very steep slope in a continuous line along a fault is termed as **Escarpment**

Endogenetic Landforms

- **Intermondane Plateau-** The Intermontane plateaus form either bordering the fold mountain range or are partly or fully enclosed by fold mountains. Vertical movements raise this extensive landforms of nearly horizontal rocks to thousands of meters above sea level. Example, Plateau of Tibet, surrounded by The Himalayas, Karakoram, Kunlun, Tien Shahon its two sides.
- **Structural plains**– These plains are formed by the uplift of a part of the sea floor or continental shelf. These are located on the borders of almost all the major continents. Example Great Plains plains of the USA.
- **Continental plateau**– Plateaus formed by the upliftment or extensive spreading of lava on the Earth's surface.
- **Fold mountains**– When the sedimentary rocks are subjected to compressional forces for millions of years, they get bent into up and down folds which lead to the formation of anticlines and synclines, such Earth movements occur from time to time and lift the folds to a considerable height which result into the formation of fold mountains. Example: The Himalayas in Asia, The Alps in Europe, The Rockies in North America, and The Andes in South America.
- **Block Mountains**– When the forces of tension acts on the rocks, they create faults in them. When the land between the two almost parallel faults is raised above the adjoining areas, it create block mountain. Example: The Vosges in France; Black Forest mountain in Germany
- **Rift Valley orGraben**: When a block between two normal faults is depressed, the valley formed in the faults is known as Rift Valley or Gr
- **Volcanic mountain**– Volcanic Mountains are formed when molten rock (magma) deep within the earth, erupts, and piles upon the surface. Magna is called lava when it breaks through the earth's crust. When the ash and lava cools, it builds a cone of rock. Rock and lava pile up, layer on top of layer. Examples: Mount St. Helens in North America, Mount Pinatubo in the Philippines, Mount Kea and Mount Loa in Hawaii

Conclusion

The Earth is shaped by many different geological processes. The forces that cause these processes come from both above and beneath the Earth's surface. Processes that are caused by forces from within the Earth are endogenous processes. By contrast, exogenous processes come from forces on or above the Earth's surface. Endo is a prefix meaning "in" while Exo is a prefix meaning "out".

There are three main endogenous processes: folding, faulting and volcanism. They take place mainly along the plate boundaries, which are the zones that lay on the edges of plates. These zones are weak. Endogenous processes cause many major landform features.

Many exogenous (extra-terrestrial) forces are as a result of other bodies in space. For example, the Moon causes tides in the Earth's oceans and other big bodies of water. Impacts from comets and meteoroids change the surface of the Earth. When they strike the Earth, they create craters which are holes, which can be very big or small, in the ground. Radiation from the Sun can cause aurorae, which are lights that can be seen at night near the poles.

References

1. Ritter, Dale F., R. Craig Kochel, and Jerry R. Miller. Process geomorphology. Boston: McGraw-Hill, 1995.
2. Simons, Martin (1962), "The morphological analysis of landforms: A new review of the work of Walther Penck (1888–1923)", Transactions and Papers (Institute of British Geographers) 31: 1–14.
3. Richardson, Douglas; Castree, Noel; Goodchild, Michael F.; Liu, Weidong; Marston, Richard A., eds. (2017). "Landforms & Physiography". International Encyclopedia of Geography, 15 Volume Set: People, the Earth, Environment & Technology. Wiley-Blackwell. pp. 3979–3980. ISBN 978-0470659632. Retrieved 2019-09-06.
4. Baker, Victor R. (1986). "Geomorphology From Space: A Global Overview of Regional Landforms, Introduction". NASA. Archived from the original on 2008-03-15. Retrieved 2007-12-19.
5. Twidale, C.R.; Lageat, Y. (1994). "Climatic geomorphology: a critique". Progress in Physical Geography. 18 (3): 319–334. doi:10.1177/030913339401800302. S2CID 129518705.
6. Goudie, A.S. (2004). "Climatic geomorphology". In Goudie, A.S. (ed.). Encyclopedia of Geomorphology. pp. 162–164.
7. Flemal, Ronald C. (1971). "The Attack on the Davisian System Of Geomorphology: A Synopsis". Journal of Geological Education. 19 (1): 3–13. Bibcode:1971JGeoE..19....3F. doi:10.5408/0022-1368-XIX.1.3.
8. Thomas, Michael F. (2004). "Tropical geomorphology". In Goudie, A.S. (ed.). Encyclopedia of Geomorphology. pp. 1063–1069.
9. Burke, Kevin, and Yanni Gunnell. "The African erosion surface: a continental-scale synthesis of geomorphology, tectonics, and environmental change over the past 180 million years." Geological Society of America Memoirs 201 (2008): 1–66.
10. Ethridge, Frank G.; Wohl, Ellen; Gellis, Allen; Germanoski, Dru; Hayes, Ben R.; Ouchi, Shunji (December 2012). "Memorial to Stanley A. Schumm (1927–2011)" (PDF). Memorials. The Geological Society of America.

11. MORISAWA, MARIE (1988-07-01). "The Geological Society of America Bulletin and the development of quantitative geomorphology". GSA Bulletin. 100 (7): 1016–1022. Bibcode:1988GSAB..100.1016M. doi:10.1130/0016-7606(1988)100<1016:TGSOAB>2.3.CO;2. ISSN 0016-7606.
12. Goldstein, Evan B (2017-04-17). "Delayed recognition of geomorphology papers in the Geological Society of America Bulletin". Progress in Physical Geography. 41 (3): 363–368. doi:10.1177/0309133317703093. S2CID 132521098.
13. Church, Michael (2010-06-01). "The trajectory of geomorphology". Progress in Physical Geography. 34 (3): 265–286. doi:10.1177/0309133310363992. ISSN 0309-1333. S2CID 140160085.
14. Whipple, Kelin X. (2004-04-21). "Bedrock rivers and the geomorphology of active orogens". Annual Review of Earth and Planetary Sciences. 32 (1): 151–185. Bibcode:2004AREPS..32..151W. doi:10.1146/annurev.earth.32.101802.120356. ISSN 0084-6597.
15. Merritts, Dorothy J.; Tucker, Gregory E.; Whipple, Kelin X.; Snyder, Noah P. (2000-08-01). "Landscape response to tectonic forcing: Digital elevation model analysis of stream profiles in the Mendocino triple junction region, northern California". GSA Bulletin. 112 (8): 1250–1263. Bibcode:2000GSAB..112.1250S. doi:10.1130/0016-7606(2000)112<1250:LRTTFD>2.0.CO;2. ISSN 0016-7606. S2CID 5844478.
16. Gregory, KJ, 1985: "The Nature of Physical Geography", E. Arnold
17. Allen, Philip A. (2008). "Time scales of tectonic landscapes and their sediment routing systems". Geological Society, London, Special Publications. 296 (1): 7–28. Bibcode:2008GSLSP.296....7A. doi:10.1144/SP296.2. S2CID 128396744.
18. Benda, Lee; Dunne, Thomas (December 1997). "Stochastic forcing of sediment supply to channel networks from landsliding and debris flow". Water Resources Research. 33 (12): 2849–2863. Bibcode:1997WRR....33.2849B. doi:10.1029/97WR02388.
19. Knighton, David. Fluvial forms and processes: a new perspective. Routledge, 2014.
20. Dietrich, W. E.; Bellugi, D.G.; Sklar, L.S.; Stock, J.D.; Heimsath, A.M.; Roering, J.J. (2003). "Geomorphic Transport Laws for Predicting Landscape form and Dynamics" (PDF). Prediction in Geomorphology. Geophysical Monograph Series. 135. Washington, DC. pp. 103–132. Bibcode:2003GMS...135..103D. doi:10.1029/135GM09. ISBN 978-1118668559.
21. Lidmar-Bergström, Karna (2020). "The major landforms of the bedrock of Sweden–with a view on the relationships between physical geography and geology". Geografiska Annaler. Swedish Society for Anthropology and Geography. 102: 1–11. doi:10.1080/04353676.2019.1702809.
22. Slaymaker, Olav (2004). "Geomorphic evolution". In Goudie, A.S. (ed.). Encyclopedia of Geomorphology. pp. 420–422.
23. Roy, Andre. Contemporary Meanings in Physical Geography: From What to Why?. p. 5.
24. Jones, David K.C. (2004). "Denudation chronology". In Goudie, A.S. (ed.). Encyclopedia of Geomorphology. pp. 244–248.
25. Lidmar-Bergström, Karna. "erosionscykel". Nationalencyklopedin (in Swedish). Cydonia Development. Retrieved June 22, 2016.
26. Goudie, A.S. (2004). "Cycle of erosion". In Goudie, A.S. (ed.). Encyclopedia of Geomorphology. pp. 223–224.
27. Leeder, M., 1999, Sedimentology and Sedimentary Basins, From Turbulence to Tectonics, Blackwell Science, 592 p. ISBN 0-632-04976-6.
28. Dietrich, William E.; Perron, J. Taylor (26 January 2006). "The search for a topographic signature of life". Nature. 439 (7075): 411–418. Bibcode:2006Natur.439..411D. doi:10.1038/nature04452. PMID 16437104. S2CID 4417041.

29. Knighton, D., 1998, Fluvial Forms & Processes, Hodder Arnold, 383 p. ISBN 0-340-66313-8.
30. Strahler, A. N. (1 November 1950). "Equilibrium theory of erosional slopes approached by frequency distribution analysis; Part II". American Journal of Science. 248 (11): 800–814. Bibcode:1950AmJS..248..800S. doi:10.2475/ajs.248.11.800.