International Journal for Empirical Education and Research

A Geographical Description of Exogenesis Processes

Sulisław Pawlak

Faculty of Earth Sciences & Spatial Management

Maria Curie-Skłodowska University

Email: pawlaksulislaw075@yahoo.com (Author of Correspondence)

Poland

Abstract

The exogenesis processes are the processes that shape the land by forces coming on or above the Earth's surface (exogenesis forces).

These are processes that take place on the earth's surface. They are subdivided in two categories and they are Processes of Degradation, Processes of Aggradation

Keywords: Processes of Degradation; Processes of Aggradation; Factors Influencing; Rate of Weathering.

ISSN Online: 2616-4833 ISSN Print: 2616-4817

1. Introduction

Exogenesis processes is a blanket term for those processes which operate on or close to the surface of the Earth and which involve weathering, mass movement, fluvial, Aeolian, glacial, per glacial, and coastal processes. The term is normally used in contrast to the endogen etic processes, whose origin is within the Earth.

2. Processes of Degradation

Processes of degradation are those that destroy what has been built up by endogen etic or aggradation processes. These are:

a) Weathering
b) Mass Movement
c) Erosion
d) Transportation

3. Processes of Aggradation

Processes of aggradation are those that built up material.

a) Deposition

4. Weathering

Weathering is the breaking and decomposition of rocks at the earth's surface by physical and chemical processes. Weathering may be defined as the mechanical fracturing or chemical decomposition of rocks by natural agents at the surface of the earth.

Firstly, it involves two types of changes in the rocks:

a) Physical or mechanical changes, where in rocks are disintegrated, through temperature changes, frost action, biological activities, and wind actions.
b) Chemical changes in rocks are decomposed through static water, oxygen, carbon dioxide, and biological activities.

Secondly, the breakdown of rocks occurs at the place of rocks. Thirdly, there is no large-scale transport of weathered material except mass movement or mass translocation of weathered materials down the slope under the force of gravity.

5. Factors Influencing the Character & Rate of Weathering

These factors include

5.1. Composition and Structure of Rocks

Mineral composition, joint pattern, layering system, faulting, folding etc. largely affect the nature and intensity of weathering. For example, carbonate rocks having more soluble minerals are easily affected by chemical weathering. Rocks having vertical strata easily loosened and broken down due to temperature changes, frost action, water and wind action. The Rock having horizontal strata are more compact and are less affected by the mechanisms of disintegration and decomposition.

5.2. The Gradient of the Slope

The rocks in the region of steep hill slope are easily disintegrated due to mechanical weathering and the weathering materials are moved down in the form of rock fall, debris fall, etc. and expose for further weathering. The regions of gentle and moderate grounds slopes are less affected by mechanical disintegration.

5.3. Climate

The greater the amount of rainfall, the higher the rate of chemical weathering.

Temperature changes accelerate the rate of mechanical weathering. Seasonal variations in climate generate different conditions for weathering. In monsoon, climate rocks are subjected to mechanical disintegration due to hot and dry summer months whereas chemical and biological weathering is more dominant during wet monsoon months.

5.4. Vegetation Cover

Vegetation behind the rocks through roots and thus protect them from weathering and erosion but the same time the penetration roots weakness the rocks by breaking them into several blocks. Dense vegetations protect the ground surface from the direct sun rays. The microorganisms associated with the roots and encourage decomposition and disintegration of rocks throw Physico-biochemical weathering.

a) Time
b) Man’s Activity

There are three types of weathering agents

A. Physical or mechanical weathering agents
    a) Moisture & Water
    b) Frost
    c) Insulation(temperature)
    d) Wind

B. Chemical Weathering agents:
    a) Oxygen
    b) Carbon-dioxide
    c) Hydrogen

C. Biological Weathering Agents:

a) Vegetation
b) Animals mainly micro-organisms

5.5. Physical or Mechanical Weathering

The physical or mechanical weathering leads to fragmentation and breakdown of rock masses into big blocks and boulders, cobbles and pebbles, sand and silts.

5.5.1. Way of Mechanism

a) Block disintegration due to temperature
b) Thermal stress weathering results from expansion of contraction of rock, caused by temperature changes.

Some rocks are less affected by temperature changes such as plastic sedimentary rocks because the particles are separated by thin cementing laminate of silica.

On the other hand, crystalline rocks, like granites are affected by temperature changes as particles are closely associated with each other and these particles expand and contract with increased and decrease of temperature respectively. If temperature of granite rock is increased by 65.5 degree Celsius The rock expand by 2.54 cm per 30.48 M distance. The repetition of expansion and contraction of outer rock layers due to the diurnal range of temperature in the hot desert areas cause tension and stresses is which introduced parallel joints in the rock. The rocks, then, are in disintegrated along these joints and broken big blocks of rocks are dislodged from the main rock mass and fall down the slope under the impact of gravity.

c) **Granular disintegration due to temperature**

    The coarse-grained are more affected by shattering process in those hot deserts, which are characterized by high range of daily temperature. If the rocks are coarse-grained and are of different colors, they absorb insulation differently. Thus, different parts of same rocks are affected by differential expansion and contraction with causes stresses within the rocks due to which they are disintegrated into smaller particles. Marble is an example.

d) **Block disintegration due to frost**

This process is more active in those areas, which are very often characterized by alternate process of freezing and thawing of water mainly during night and day respectively. The more compact and highly consolidated rocks are less affected by frost actions. Water present in between particles of porous rocks freezes during night due to fall of temperature belong freezing points and thus expands due to increase in temperature during daytime. 10% thaws during daytime and contracts by 10% due to freezing. This diurnal freeze and thaw cycle causes alternate expansion and contraction, which introduce tension and stresses due to which rocks are disintegrated into smaller particles. An example of rock susceptible to frost action is chalk, which has many pore spaces for the growth of ice crystals. When water that has entered the joint freezes, the ice formed strains the walls of the joints and causes the joints to depend and widen. When the Ice thaws, water can flow further into the rock. Repeated freeze-thaws cycles weaken the rocks, which, overtime, break up along the joint into angular pieces.

e) **Exfoliation due to temperature and wind**

It occurs in places like hot deserts where the day temperature often soars to 40 degree Celsius and night temperature falls to below 10 degree Celsius. The repeated heating by day and cooling by night caused the outer layers of the rock to expand and contract alternately. Stress is created in the rock, producing cracks and gradually the outer layers of rock will peel off.

It is also known as onion weathering, refers to peeling off concentric shells of rocks due to combined actions of heat and wind in hot arid and semi-arid regions and monsoon lands. It is more common of crystalline rocks. The outer shells of rocks become loose due to high temperature during day time and comparatively low temperature during night respectively and these loosened shells are removed by strong winds.

- Salt wedging as water enters the holes and cracks in the surface of rocks; it often carries salt with it. As the water later evaporates, the salt is left behind. Overtime, these salt deposits build up creating pressure that can cause rocks to split and weaken.

6. Chemical Weathering

Chemical weathering is the dissolution, carbonation, oxidation, or hydrolysis of rock and mineral by chemical means only, mostly from reactions with water or the acids contained in rainwater. Other materials are formed in the process. Warm, tropical climates are ideal environments for chemical weathering to take place as the chemical reactions are quickened by the bountiful rain and warm temperature. Chemical weathering takes place in almost all types of rocks. The breakdown of rocks occurs because of chemical reactions between the minerals in the rocks and substances in the environment, such as water, oxygen, and weakly acidic rain water. Some Chemicals are dissolved and carried away from the weathering source, while others are brought in.

Chemical reactions breakdown the bounds holding the rocks together, causing them to fall apart, forming smaller and smaller pieces.

Chemical process involved in the weathering include carbonation, hydrolysis, hydration, and oxidation.

7. Dissolution

One of the most well-known solution weathering processes is carbonation.

Carbonation process by which dissolved carbon dioxide in rain water or moisture in surrounding air forms carbonic acid and reacts with the minerals in the rock. This process weakens the rock thus breaking it down in the process. e.g

Calcium Carbonate+ Water+ Carbon dioxide= Calcium Carbonate (soluble).

Carbonation takes place when carbon dioxide reacts with certain types of rocks forming a solution that can easily be carried away by water.

The reactions as follows:

Carbon-dioxide + Water=> Carbonic Acid,

Carbonic acid + Calcium carbonate=> Calcium-bicarbonate,

Dissolution is very common in areas that have a great deal of limestone. Acidic waters dissolve limestone allowing for additional water to gain entrance. Can cause skin holes and karst features as well as dissolution of statutes and gravestone. Hydrolysis occurs when water combines with the substances in rocks to form new types of substances, which are softer than the original rock types. These allows other forces such as mechanical weathering to more easily break them apart. It is a chemical reaction between the minerals in the rock and hydrogen in rain water. For example, during hydrolysis the feldspar in granite changes to Clay mineral which crumbles easily, weakening the rock and causing is to break down.

8. Oxidation

Oxidation takes place when oxygen combines with other elements in rocks to form new types of rock. These new substances are usually much software and thus easier for other forces to break apart. Oxidation solution process by which minerals in the rocks dissolve directly in water. The process by which oxygen combine

With water and minerals in the rock, such as calcium and magnesium. When iron reacts with oxygen, reddish brown iron oxide is formed. Iron-oxide craft crumbles easily and weakens the rock.

9. Hydration

Hydration process where minerals in the rock absorb water and expand, creating stress, which cause that disintegration of rocks.eg: UN hydrated Calcium Sulphate + Water => Hydrated Calcium Sulphate (expand)

10. Biological Weathering

Biological weathering is a form of weathering caused by the activities of living organisms-for example, the growth of roots or burrowing of animals. Tree roots are probably the most significant agents of biological weathering as they are capable of pricing apart rocks by growing into cracks joints. Plants also give off organic acids that help to break down rocks chemically.

11. Erosion

Erosion is the detachment of earth material from the surface. Once detached, agents like water or wind transport the material to a new location where it is deposited. Erosion is the process of weathering and transport of solids in the natural environment on their source and deposits them elsewhere. It usually occurs due to transport by wind, water, or Ice; by downslope Creep of soil and other material under the force of gravity; or by living organisms, such as burrowing animals, in the case of bio erosion. A certain amount of erosion is natural, and in fact, healthy for the ecosystem. For example, gravels continuously move downstream in watercourses. Excessive erosion however, causes serious problems, such as receiving water sedimentation, ecosystem damage and loss of soil... By definition, weathering is different in form an erosion. Weathering involves only the breakdown of rocks, whereas erosion involves the removal of debris produced by the breakdown. But in reality weathering and erosion are intimately involved with one another. Weathering disintegrates solid Rock and produces loose debris, and the results of weathering are seen everywhere. Erosion removes the debris and exposes fresh rock, which is then weathered, and the cycle continues.

11.1. Causes of Erosion

a) The rate of erosion tenses on many factors.
b) Climate factors include.
c) The amount and intensity of precipitation.
d) The average temperature, as well as the typical temperature range, and the wind speed, storm frequency.

The geological factors include the sediment or rock type, its porosity and permeability, the slope of the land, and if the rocks are titled, faulted, folded, or weathered.

The biological factors include ground cover from the vegetation or lack of thereof, the type of organisms inhabiting the area, and the land use.

11.2. Water Erosion

Water erosion is the detachment and airborne movement of small soil particles caused by the impact of raindrops on soil.

11.3. Sheet Erosion

Sheet Erosion is the detachment of soil particles by raindrop impact and their removal down slope by water flowing overland as a sheet instead of in definite channels or rills. The impact of the raindrop breaks apart the soil aggregate. Particles of clay, silt, and sand fill the soil pores and reduced infiltration. After the surface pores are filled with sand, silt, clay, overland surface flow of water begins due to the lowering of infiltration rates. Once the rate of falling rain is faster than infiltration, runoff takes place.

11.4. Rill Erosion

Rill erosion refers to the development of small, ephemeral concentrated flow paths, which function as both sediment source and sediment delivery systems for erosion on hill slopes. Generally, where water erosion rates on disturbed upland areas are greatest, rills are active. Flow depths in rills are typically on the order of a few centimeters or less and slopes may be quite steep. Gullies are steep-sided trenches formed by coalescence of many rills. Once started they are difficult to stop.

11.5. Bank Erosion

Bank erosion is the wearing away of the banks of a river.

11.6. Shoreline Erosion

Shoreline erosion, which occurs on both exposed and sheltered coasts, primarily occurs through the action of currents and waves but sea level change can also play a role.

11.7. Ice Erosion

Ice erosion can take one of two forms. It can be caused by the movement of ice, typically as glaciers, in a process called glacial erosion. It can also be due to freeze-thaw processes in which water in side pores and fractures in rock and may expand cause further cracking.

11.8. Wind Erosion

In arid climates, the main source of erosion is wind. Erosion can be the result of material movement by wind.

11.9. Gravity Erosion

Mass movement is the down slope movement of rock and sediments, mainly due to the force of gravity. Mass movement is an important part of the erosional process, as it moves material from higher elevations to lower elevations where other eroding agents such as streams and glaciers can then pick up the material and move it to even lower elevations. The most important factors are:

a) Saturation of material with water.
b) Vibrations from earthquakes.
c) Over steeping of slopes by undercutting and alternating freezing and thawing.

Water is an important factor in mass movement because it lubricants the unconsolidated material on slopes and adds weight to the mass, thereby promoting mobility and down slope movement. Heavy rainfalls, weather prolonged over many days or in a single storm, are particularly effective in triggering mass movement. Earthquakes, with their initial shock and aftershocks are capable of losing fragments of rocks on steep slopes and setting regolith in motion .A significant factor in mass movement in many areas has been the modification of natural slopes to Suit the needs of human communications. Slumping happens on hillside, occurring a long distance fracture zones, often within materials like clay that, once released, may move quite rapidly downhill... They will often show a spoon shaped iso static depression, in which the material has begun to slide downhill. In some cases, the slump is caused by water beneath the slope weakening it. In many cases, it is simply the result of poor engineering along highways where it is a regular occurrence. Surface creep is the slow movement of soil and rock debris by gravity which is usually not predictable expect through extended observation. However, the term can also describe the rolling of dislodged soil particles 0.5 to 1.0 mm in diameter by wind along the soil surface. Where precipitation rates exceed soil infiltration rates, runoff occurs. Surface runoff turbulence can often cause more erosion and then the initial raindrop impact. Thus, the process of rill evolution involves a feedback loop between flow detachment, hydraulics, and bed form. Flow velocity, depth, width, hydraulic roughness, local bed slope, friction slope, and detachment rate are time and space variable functions of the rill evolutionary process. Superimposed on this interactive processes, the sediment load, or amount of sediment in the flow, has a large influence on soil detachment rates in rills. As sediment load increases, the ability of the following water to detach sediment decreases.

12. Conclusion

Exocentric processes include geological phenomena and processes that originate externally to the Earth's surface. They are genetically related to the atmosphere, hydrosphere and biosphere, and therefore to processes of weathering, erosion, transportation, deposition, denudation etc.

References

1. Posner, M.I. (1980), Orienting of attention. Quarterly Journal of Experimental Psychology, 32: 3–25.
2. Smithson, P et al (2008) Fundamentals of the Physical Environment (fourth Ed.)
3. Ritter, D.F. 1967. Rates of denudation. Jour. Geol. Educ. 15, C.E.G.S. short rev. 6:154-59
4. Judson, S. 1968. Erosion of the land. Am. Scientist 56:356-74
5. Burbank, D.W., and Beck, R.A. 1991. Rapid long term rates of denudation. Geology 19:1169-72