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Geomorphology history and process: A Review

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Abstract

The origin and evolution of topographic and bathymetric features created by physical, chemical or biological processes operating at or near the Earth's surface Geomorphologists seek to understand why landscapes look the way they do, to understand landform history and dynamics and to predict changes through a combination of field observations, physical experiments and numerical modelling. Geomorphologists work within disciplines such as physical geography, geology, geodesy, engineering geology, archaeology, climatology and geotechnical engineering. This broad base of interests contributes too many research styles and interests within the field.

Key words: topographic, Geomorphologists, archaeology etc

Introduction

Over millions of years, the Earth has gone through many changes which have shaped its current form and structure. From a dust ball according to nebular hypothesis, to the current form, the Earth has transformed a lot. Developmental stages which formed the current habitable world include both internal and external forces. The meteoritic impact, volcanic activities, and erosion activities of rivers, winds, glaciers, oceans, etc. along with the sea floor spreading and plate tectonic activities have been constantly working to shape the Earth as we see now. Many of these activities occur during a short interval, while some take millions of years to create various climatic, geologic, and geomorphic regimes. All of these never-ending processes are still continuously going on and shaping our Earth currently. The most notable of all these processes are geomorphic processes since they create the shape and form of the Earth as we see it now. Hence, the study of these geomorphic processes is critical to understand the phenomena and process that are occurring in nature. Having its derivation from Greek words, γεω (Earth), μορφη (morph/form), and λογος (discuss), geomorphology literally means “a discussion on Earth’s form.” Since the fourth century BC, many people have studied the formation of the Earth by relating to various observations in the field. Ancient Greeks and Romans such as Aristotle, Strabo, Herodotus, Xenophanes, and many others discussed about the origin of the valleys, formation of deltas, presence of seashells on mountains, etc. After observing the seashells on the top of the mountains, Xenophanes speculated that the surface of the Earth must have risen and fallen from time to time, thus creating river valleys and mountains (c. 580–480 BC).

History

The cone itself is a volcanic edifice, representing complex interaction of intrusive igneous rocks with the surrounding salt. The lake occupies an "over deepening" carved by flowing ice that once occupied this glacial valley. Other than some notable exceptions in antiquity, geomorphology is a relatively young science, growing along with interest in other aspects of the earth sciences in the mid-19th century. This section provides a very brief outline of some of the major figures and events in its development.

- **Ancient geomorphology**

The study of landforms and the evolution of the Earth's surface can be dated back to scholars of Classical Greece. Herodotus argued from observations of soils that the Nile delta was actively growing into the Mediterranean Sea, and estimated its age. Aristotle speculated that due to sediment transport into the sea, eventually those seas would fill while the land lowered. He claimed that this would mean that land and water would eventually swap places, whereupon the process would begin again in an endless cycle.

- **Early modern geomorphology**

The term geomorphology seems to have been first used by Laumann in an 1858 work written in German. Keith Tinkler has suggested that the word came into general use in English, German and French after John Wesley Powell and W. J. McGee used it during the International Geological Conference of 1891. John Edward Marr in his The Scientific Study of Scenery considered his book as, 'an Introductory Treatise on Geomorphology, a subject which has sprung from the union of Geology and Geography.

- **Climatic geomorphology**

During the age of New Imperialism in the late 19th century European explorers and scientists travelled across the globe bringing descriptions of landscapes and landforms. As geographical knowledge increased over time these observations were systematized in a search for regional patterns. Climate emerged thus as prime factor for explaining landform distribution at a grand scale. The rise of climatic geomorphology was foreshadowed by the work of Vladimir, Vasily Dokuchaev and Andreas Schimper. William Morris Davis, the leading geomorphologists of his time, recognized the role of climate by complementing his "normal" temperate climate cycle of erosion with arid and glacial ones. Nevertheless, interest in climatic geomorphology was also a reaction against Davisian geomorphology that was by the mid-20th century considered both un-innovative and dubious. Early climatic geomorphology developed primarily in continental Europe while in the English-speaking world the tendency was not explicit until L.C. Peltier's 1950 publication on a per glacial cycle of erosion.

- **Quantitative and process geomorphology**

This landscape, with its high altitude plateau being incised into by the steep slopes of the escarpment, was cited by Davis as a classic example of his cycle of erosion. Geomorphology was started to be put on a solid quantitative footing in the middle of the 20th century. Following the early work of Grove Karl Gilbert around the turn of the 20th century, a group of mainly American natural scientists, geologists and hydraulic engineers including William Walden Rubey, Ralph Alger Bagnold, Hans Albert Einstein, Frank Ahnert, John Hack, Luna Leopold, A. Shields, Thomas Maddock, Arthur Strahler, Stanley Schumm, and Ronald Shreve began to research the form of landscape elements such as rivers and hills lopes by taking systematic, direct, quantitative measurements of aspects of them and investigating the scaling of these measurements. These methods began to allow prediction of the past and future behavior of landscapes from present observations, and were later to develop into the modern trend of a highly quantitative approach to geomorphic problems. Many groundbreaking and widely cited early geomorphology studies appeared in the Bulletin of the Geological Society of America, and received only few citations prior to 2000 when a marked increase in quantitative geomorphology research occurred

- **Contemporary geomorphology**

Today, the field of geomorphology encompasses a very wide range of different approaches and interests. Modern researchers aim to draw out quantitative "laws" that govern Earth surface processes, but equally, recognize the uniqueness of each landscape and environment in which these processes operate. Particularly important realizations in contemporary geomorphology include:

1) That not all landscapes can be considered as either "stable" or "perturbed", where this perturbed state is a temporary displacement away from some ideal target form. Instead, dynamic changes of the landscape are now seen as an essential part of their nature.

2) that many geomorphic systems are best understood in terms of the stochasticity of the processes occurring in them, that is, the probability distributions of event magnitudes and return times. This in turn has indicated the importance of chaotic determinism to landscapes, and that landscape properties are best considered statistically. The same processes in the same landscapes do not always lead to the same end results.

Processes

- **Aeolian processes**

Aeolian processes pertain to the activity of the winds and more specifically, to the winds' ability to shape the surface of the Earth. Winds may erode, transport, and deposit materials, and are effective agents in regions with sparse vegetation and a large supply of fine, unconsolidated sediments. Although water and mass flow tend to mobilize more material than wind in most environments, Aeolian processes are important in arid environments such as deserts.

- **Biological processes**

The interaction of living organisms with landforms, or bio geomorphologic processes, can be of many different forms, and is probably of profound importance for the terrestrial geomorphic system as a whole. Biology can influence very many geomorphic processes, ranging from biogeochemical processes controlling chemical weathering, to the influence of mechanical processes like burrowing and tree throw on soil development, to even controlling global erosion rates through modulation of climate through carbon dioxide balance. Terrestrial landscapes in which the role of biology in mediating surface processes can be definitively excluded are extremely rare, but may hold important information for understanding the geomorphology of other planets, such as Mars.

- **Fluvial processes**

Rivers and streams are not only conduits of water, but also of sediment. The water, as it flows over the channel bed, is able to mobilize sediment and transport it downstream, either as bed load, suspended load or dissolved load. The rate of sediment transport depends on the availability of sediment itself and on the river's discharge. Rivers are also capable of eroding into rock and creating new sediment, both from their own beds and also by coupling to the surrounding hills lopes. In this way, rivers are thought of as setting the base level for large-scale landscape evolution in no glacial environments. Rivers are key links in the connectivity of different landscape elements.

- **Glacial processes**

Glaciers, while geographically restricted, are effective agents of landscape change. The gradual movement of ice down a valley causes abrasion and plucking of the underlying rock. Abrasion produces fine sediment, termed glacial flour. The debris transported by the glacier, when the glacier recedes, is termed a moraine. Glacial erosion is responsible for U-shaped valleys, as opposed to the V-shaped valleys of fluvial origin.

- **Hill slope processes**

Talus cones on the north shore of Isfjorden, Svalbard, Norway. Talus cones are accumulations of coarse hill slope debris at the foot of the slopes producing the material. The Ferguson Slide is an active landslide in the Merced River canyon on California State Highway 140, a primary access road to Yosemite National Park. Soil, regolith, and rock move down slope under the force of gravity via creep, slides, flows, topples, and falls. Such mass wasting occurs on both terrestrial and submarine slopes, and has been observed on Earth, Mars, Venus, Titan and Iapetus. Ongoing hill slope processes can change the topology of the hill slope surface, which in turn can change the rates of those processes. Hill slope that steepen up to certain critical thresholds are capable of shedding extremely large volumes of material very quickly, making hill slope processes an extremely important element of landscapes in tectonically active areas

- **Igneous processes**

Both volcanic (eruptive) and plutonic (intrusive) igneous processes can have important impacts on geomorphology. The action of volcanoes tends to rejuvenize landscapes, covering the old land surface with lava and tephra, releasing pyroclastic material and forcing rivers through new paths. The cones built by eruptions also build substantial new topography, which can be acted upon by other surface processes. Plutonic rocks intruding then solidifying at depth can cause both uplift and subsidence of the surface, depending on whether the new material is denser or less dense than the rock it displaces.

- **Tectonic processes**

Tectonic effects on geomorphology can range from scales of millions of years to minutes or less. The effects of tectonics on landscape are heavily dependent on the nature of the underlying bedrock fabric that more or less controls what kind of local morphology tectonics can shape. Earthquakes can, in terms of minutes, submerge large areas of land creating new wetlands. Isostatic rebound can account for significant changes over hundreds to thousands of years, and allows erosion of a mountain belt to promote further erosion as mass is removed from the chain and the belt uplifts. Long-term plate tectonic dynamics give rise to orogenic belts, large mountain chains with typical lifetimes of many tens of millions of years, which form focal points for high rates of fluvial and hill slope processes and thus long-term sediment production

- **Marine processes**

Marine processes are those associated with the action of waves, marine currents and seepage of fluids through the seafloor. Mass wasting and submarine land sliding are also important processes for some aspects of marine geomorphology. Because ocean basins are the ultimate sinks for a large fraction of terrestrial sediments, depositional processes and their related forms (e.g., sediment fans, deltas) are particularly important as elements of marine geomorphology.

Conclusion

The word "geomorphology" was first coined and used between the 1870s and 1880s to describe the morphology of the surface of the Earth. But it was popularized by William Morris Davis who proposed the “geographical cycle” also known as “Davis cycle”. He proposed that the development of landscapes occurs as due to alternate action of uplift and denudation. He assumed that uplift occurs quickly and then the uplifted land mass erodes gradually to form the topography of the region. He hypothesized that upliftment is a quick action, whereas denudation is a time-taking process.

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