LAWS OF DEVELOPMENT OF THE EARTH'S CRUST, PLANETARY RELIEF FORMS, ENDOGENOUS RELIEF OF THE EARTH'S SURFACE

Kayumov Odiljon Abduraufovich
Fergana Polytechnic Institute, Republic of Uzbekistan
E-mail: o.kayumov@ferpi.uz

Khakimova Kamola Rakhimonovna
Fergana Polytechnic Institute, Republic of Uzbekistan
E-mail: k.xakimova@ferpi.uz

Annotation:
Acquaintance with planetary forms of the Earth's surface formed by the action of endogenous processes, providing information about the mainland and oceanic types of the Earth's crust, their structure and large relief forms corresponding to each type of Earth's crust, features.

Keywords: mainland and oceanic crust, geosynclinal and riftogenic earthen crust, land platforms, Shields, Mobile region of the continents, young mountains and rejuvenated Mountains, alpine-Himalayan region, underwater continuation of the continents, shelf, mainland slope, mainland skirt, transition zone, ocean tag, mid-subtidal mountains, seismic regions.

INTRODUCTION
Large forms of the Earth's surface or planetary forms were formed under the influence of endogenous processes. Currently, the following planetary forms are distinguished: land platforms, mobile regions of continents, underwater continuation of continents, transition zone (geosynclinal regions), ocean floor and intermediate submarine mountains. The characteristics of the structure of the earth's crust were taken into account when distinguishing these forms.
According to geophysical data, the earth's crust is divided into continental and oceanic types. The thickness of the continental crust is on average 35 km, in young mountains (Himalayas) it is up to 70 km. It consists of three layers. Above is a layer of sedimentary rocks (up to 20 km thick) of different composition, age and genesis. Below it is a granite layer. The thickness of this layer is more than 30 km in the young mountains, and only 15-20 km in the plains. Below the granite layer lies the basaltic layer. Its thickness is 15-20 km.

The oceanic crust is very different from the continental crust. In a large area of the ocean floor, its thickness ranges from 5 km to 10 km. Beneath the sedimentary layer there is a dense intermediate layer with a thickness of several hundred meters to several kilometers. It is composed of basaltic lava and condensed sedimentary rocks. In the lower part of this layer there is a 4-7 km thick basalt layer. It is composed of gabbro, diorites, basalts and some ultra basic rocks. Thus, the oceanic crust differs from the continental crust by its thinness and the absence of a granitic layer.

At the border of continents and oceans, the current geosynclinal region (transition zone) has a diverse and complex structure of the Earth's crust. In the Caribbean, Japanese and other oceanic sediments, the crust is similar to the oceanic type. There is no granite layer, but the earth's crust is much thicker due to a thick layer of sediment. The structure of the earth's crust on the islands bordering the remote seas (Japan, Kuril) is close to the continental type. This crust is called geosynclinal crust [1,2,3,4].

a unique crust is observed in the middle underwater ridges. In underwater ridges, the earth's crust is composed of sedimentary, intermediate and basaltic layers, and the thickness of the dense layer (intermediate layer) is more than 1-2 km compared to the dense layer of the earth's crust at the bottom of the ocean. The combination of crust and mantle rocks in the basaltic layer under this layer was confirmed by the data of deep wells. This type of crust is called riftogenic crust. Large planetary landforms correspond to each of the above crustal types.

Continents and the underwater continuation of continents belong to the continental crust. The geophysical and geomorphological boundary of the continents is the lowest limit of the underwater continuation of the continents. Here, continental crust alternates with oceanic crust.

The oceanic crust developed at the bottom of the ocean. a geosynclinal type of crust is developed in the transition zone. The riftogenic crust corresponds to the middle submarine ridges.

MAIN PART

Megarelief of continents

Continents are creations with a complex structure, which was formed during the long-term evolution of the lithosphere. In explaining the evolution of the megarelief of the continents, A.Ye. Krivolyutsky (1977) used the geotectonic concept of "Geosynclines and platforms". He divides the development of continents into the VII stage.

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In the 1st stage of the geosynclinal period, a narrow geosynclinal-shallow sea basin complicated by deep faults is formed on the folded base. As the earth's crust sinks, thick volcanic and sedimentary rocks accumulate in it and undergo metamorphism.
In the II stage of the geosynclinal period, the earth's crust continues to bend in the geosyncline, but in its central part there is an uplift and islands are formed. The relief of the geosyncline becomes more complicated: synclines and anticlines appear at the bottom of the basin [5,6,7,8].
In the III stage of the geosynclinal period, there are strong tectonic movements in a large area of the basin, a general uplift is observed: magma penetrates between the layers: a granite layer is formed: a fold-flank structure is formed.
In the IV stage of the geosynclinal period, as a result of strong tectonic movements in the geosyncline, a high mountain relief is formed in its central part, volcanism increases, and deep depressions formed in the peripheral parts separate the mountain systems from each other. Epigeosynclinal mountains are formed instead of geosynclinal.
Stage V of material development is the period of transition from the geosynclinal regime to the platform, in which the uplifted mountain systems are eroded over time under the influence of exogenous processes. Eroded rocks are carried to low places under the influence of water, wind, ice, etc. In this case, the inner parts of the mountains, consisting of hard magmatic and morphic rocks, are exposed. High mountains are replaced by plains.
In the VI stage of the development of continents, strong tectonic movements are reversed again, and high mountains, i.e. rejuvenated mountains (epiplatform mountains) are formed in place of the plain. They are mainly composed of metamorphic rocks and are complicated by large cracks and magmatism processes along the terrain.
Stage VII is the platform period of development, in which, during geological periods, mountains are lost under the influence of denudation and denudation plains are formed in their place (on a folded base) [9,10,11,12]. Many parts of it are gradually sinking. Sea water covers uneven places where the earth's crust has sunk: a thick layer of sedimentary rocks is formed on the seabed. Tectonic structures with a folded base and a cover of subhorizontal sedimentary layers are called modern platforms (plates) by V. E. Khain.
The complex evolution of the formation of continents and the sequence of different stages is reflected in their tectonic and geological structure. In the territory of continents, relatively stable areas - platforms and areas with great tectonic mobility - geosynclines are distinguished. The fact that platforms and geosynclines have

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different structures and development has led to the emergence of different relief forms. Therefore, two types of morphostructures, such as platforms and geosynclines, are distinguished in the area of continents.

Megarelief of land platforms.

Platforms are the main structural elements of continents, and they are characterized by a less mobile tectonic regime, magmatism and earthquakes than geosynclines. The term "Platform" was first used by the Russian scientist A.D. Arkhangelsky (1932).

Differences in the classification, speed and amplitude of vertical vibration movements on platforms are not so great. Therefore, more than 50% of the platform area is occupied by lowlands, low plateaus, plateaus or the Baltic, Yellow and other shelf (continental shallow) seas.

Platforms are divided into old and young platforms depending on the age of the ground. The bottom of the ancient platforms is made of rocks formed in the Archaean and Proterozoic eras, and the upper part is made of rocks belonging to later periods. They occupy a large area between continental platforms. Examples of such platforms are platforms in Eastern Europe, Siberia, North China and Korea, South China, India, Africa-Arabia, South America, North America, Australia and Antarctica.

Platforms in the southern hemisphere differ from platforms in the northern hemisphere in the following features; for a long time, the ascent prevailed over the descent; the average height is high: there are high mountain massifs; shields and crystalline rocks occupy a large area; seismic movements are stronger; blast pipes are encountered. The Siberian and Indian platforms in the northern hemisphere are structurally similar to the southern platforms. The relief of the southern platforms has become much more complicated due to the fact that it has risen to a higher height as a result of tectonic movements, the further subsidence of the Pacific sediments in the Mesocene and the emergence of rift systems [13,14].

The topography of the ancient platforms mainly reflects latitudinal zonation, for example, the hills found on the accumulative plains of the Eastern European and North American platforms were formed from deposits brought by continental glaciers. The hills in the plains of North Africa and Central Australia were formed by eolian accumulation.

The relief features of the denudation plains formed on the platform shields depend on the geological structures of the denuded rocks. The fact that the crystalline rocks forming the floor of the platform are exposed to the surface in shields testify to the long-term denudation in these places. Such plains were formed in the Baltic, Canadian and other shields. In addition, step-like plains and plateaus, and table-like mountains are observed in hard rock shields.

Platforms are characterized by oblique and wide bent (syneclises) and raised (anteclises) structures. Some anteclises are not covered by sedimentary rocks as a result of their elevation over a long geological time and form structures called shields. Examples of such structures are Baltic, Canada, Anabar, Brazil and others. Denudation plains (middle Siberia, Deccan, Anatolia, Vitim highlands), plateaus and highlands (Brazil, Guyana, Akhaggar, Tibesti, Khybin, etc.) were formed in the structures of the platform such as shield and anteclise. New tectonic movements were important in the formation of such forms. Accumulative plains (Amazon, Orinoco, La Plata, Caspian, Great China, etc.) were formed in syneclises.

The floor of the young platforms was formed in place of the Paleozoic and Mesozoic folding zones. Denudation and accumulation plains are also developed on these platforms. Accumulator plains of Western Siberia, Turan, Kolyma were formed on the place of Paleozoic and Mesozoic platforms. Ustyurt, Paris basin, low mountains of Kazakhstan are examples of denudation plains. But the role of the mountain topography, especially the Mesozoic folding, is much greater in the young platforms compared to the old platforms. The structure and topography of the mountains are also very diverse. Some mountains, for example, the Urals, the Appalachians, the Great Suvayirgich ridge in Australia, are clearly represented in the relief. The connection of the young structure of the mountain-plains on the young platforms with the old structure is obvious. For example, the Urals, the ancient structure of the northern part of the Appalachians were uplifted during subsequent foldings. Some mountains, for example, the mountains of Scandinavia, Central Europe (Garths, Schwarzwald, Vosges, etc.) as a result of rift tectonic movements, their old structure does not correspond to the young structure [15,16].

Latitudinal zoning and vertical zoning are clearly expressed in the mountain topography of YOSH platforms. This is influenced by the fact that the mountain systems extend from north to south and their absolute height is large. For example, since the Ural Mountains cross different climatic regions, the topography of the Northern Urals, the Middle Urals, and the Southern Urals are very different from each other.

Megarelief of the moving region of continents

There are two types of mobile regions on continents: geosynclinal and epiplatform. In the geosynclinal region, the relief of young mountains formed in the alpine fold has developed in place of the former geosynclinal basins. Epiplatorma mountains were formed as a result of the re-uplift of platform mountains of different ages during the Alpine folding. These mountains are also called re-inhabited mountains.

In the geosynclinal region V.U. Hain separates the continental interior and continental margin regions.

The first region is located in the Mediterranean or Alpine-Himalayan region of the Alpine fold on the Eurasian continent. Continental and suboceanic crusts are developed in the western part of the region. Suboceanic crust is observed in the Mediterranean Sea, the Black Sea, and the South Caspian Sea. A thick layer of sediment is typical for them. For example, the sedimentary layer is 5-8 km thick in the Middle Sea, 15 km in the Black Sea, and up to 25 km in the South Caspian. To the east, mainly continental crust is found. Young mountains such as the Pyrenees, the Alps, the Carpathians, the Balkans, the Atlas, the Crimea, the Caucasus, Kopetdog, Hindikush, the Pamirs, and the Himalayas are located in this region.

According to the structure of the earth's crust, this part of the region has not yet become a continent, and according to the level of mobility, it has not yet become a continental platform. This is evidenced by the absolute height and vertical fragmentation of the relief. The highest mountain systems of the land, North and Pamir, are also located in this region. Intensive endogenous processes, strong earthquakes, active and recently inactive volcanoes, the thickest crust (for example, in the Himalayas - 70 km, in the Greater Caucasus - 60 km) are observed here. The "veins" of high mountains are located deep in the mantle [17,18].

The main forms of the megarelief of the Alpine fold mountains are: complex folded mountains, highlands, inter-mountain depressions and pre-mountain slope plains.

Geosynclinal in this region together with folded mountains, highlands (Asia Minor, Iran, Armenia, Tibet), intermountain valleys (Kura, Colchis, etc.), sub-mountain valleys (Mesopotamia, Indo-Ganges, Kuban, etc.) occurs. Highlands are mainly denudation morphosculptures. In the valleys, accumulative plains were formed.

Folded mountain ranges have a very complex structure. This is due to the formation of large folds that are strongly compressed, overturned, and overlap each other during the dome-like uplift of the geosynclines. In addition, the diversity of the lithological composition of the layers involved in the orogenic process, the outcrop of crystalline debris and intrusive rocks in some places complicates the morphology of folded mountains.

Fold mountains are divided into alpinotype and germanotype (G. Stille), or full (alpinotype) and "bullet-bullet" very large fold (S.S. Schultz). Alpinotype folds are characterized by complex fold structures rich in shifts and sharries (French-elongate, spread), and Germanotype fold structures with large radii and vertical surfaces complicated by many cracks, recumbent and irregularly shaped fold structures . S.S. According to Schultz, alpinotype (complete) folding is rare in mobile geosynclines. "bullet-bullet" very large folds create a wide range of structures and orographic macro- and microforms.

In general, alpine fold mountains on continents are the areas where denudation processes are most active and are the main source of sedimentary materials.

Although epiplatform mountains on continents have a platform structure, they are not inferior to young mountains in terms of tectonic activity. The Tocambrian, Caledonian soil that folded these mountains. formed during the Hertzian and Mesozoic folding stages.

Epiplatoframa mountains include Tianshan and Kunlun in Central Asia (Herzenian structures), Sayan and Baikal mountains in Eastern Siberia (Caledon and Tocambrian structures), mountains on the Red Sea coast of East Africa and the Arabian Peninsula (Tocambrian structure), North In America - Cordillera Mountains (Mesozoic and Tocambrian structure in some parts) and others.

Highlands are high-rise areas, but the relief is relatively weakly fragmented, and most of them have an arid-denudation morphosculpture. In some highlands, for example, in Tibet, relief forms formed under the influence of snow-glacial processes are also common.

The valleys (hollows) of the mountain range are located several thousand meters below the surrounding mountains and are filled with a thick layer of proluvial, alluvial, fluvioglacial or lake-marine (middle Danube lowland) deposits.

The foreland slope plains are parts of adjacent platforms that have been pulled down by geosynclinal tectogenesis. They are expressed in the form of pre-mountain accumulative (mainly alluvial and alluvial-proluvial) plains (Mesopotamia, Indo-Ganges, Kuban, etc.) in the current relief.

The tectonic deformation amplitude (oscillation width) of this type of mountains ranges from 5 km to 15 km in the alpine fold. Such mountain systems were described by V.Ye. Khain "reinhabited mountains", S.S. Schultz, N.I. Nikalaev and others "areas of formation of young mountains", V.V. Belousov "activated platforms", M.V. Muratov calls it "areas of epiplatform orogeny". The most important features of the epiplatform mountains are the fact that rift tectonic movements played a major role in their formation and the diversity of the relief. The mountains of East Africa, Asia and North America stand out in this region.

The epiplatform mountains of East Africa were formed on the site of the Tocambrian platform, which extends from the Zambezi River northward to the Red Sea. In this area, the highest palakhsa mountains were located directly near the rift valleys and formed the highlands of Ethiopia (Abyssinia). In some of the rift valleys, for example, Rudolph, Kiwi, Tanganyika, Nyasa, Natron and other branches were formed. Intrusive and effusive magmatism played a significant role in the formation of the relief. Many inactive and active volcanoes (Klimanjaro, Meru, Karisimbi, etc.) are located here [6].

The Asian epiplatform mountains were formed in structures of different ages, and the new major tectonic structures in it do not conform to the primary platform structure, as in East Africa. Strong tectonic activity in this region created the highest mountains on Earth: Tianshan (Victory-7439 m). Kunlun (Ulugmuztog-7723 m), Karakurum (Chogori-8611 m). The height difference between the mountain peaks and the bottom of the depressions between the mountains reaches 12 km. Elongated systems alternate with depressions over a short distance. Some depressions, such as Lake Baikal, were formed in the rift valley. Northern Tibet, Northern Baikal, Aldan, Patoma, Kolyma highlands, Gobi, Alashan plates are located. Arid denudation and nival-glacial morphostructures are widely developed in the terrain.

The Cordillera epiplatform mountain system in North America includes the Brooks, Mackenzie, Rocky, Eastern Sierra Madre Mountains, high plateaus to the west (Fraser, Columbia, Great Basin), lowlands (Yukon, Interior Plateau, Colorado), Mt. includes (Mexico). It is bounded from the west by the young mountains of the Pacific region of the Alpine fold. Its current megarelief is quite similar to the primary platform structure. Effusive volcanism plays an important role in the formation of the relief. Popocatepetl is one of the major volcanoes. Orisabo and others are still erupting. In addition, strong earthquakes are frequent. Since the Cordillera mountains stretch far from north to south, various geomorphological processes and landforms associated with them are observed. Among them, fluvial, glacial (in the north), arid-denudation (in the central and southern parts) are important.

One of the important features in the location of epiplotform mountains is their connection with riftogenic zones in the oceans. So, the continuation of the riftogenic zones in the oceans is also on the continents.

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