MOUNTAIN LANDSCAPES STRUCTURE

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Abstract. ***Mountain landscapes are a complex natural-geographic system, which is characterized by stratification by altitudinal regions. This article analyzes the vertical zonality of mountain landscapes, climate, soil, flora and fauna, changes in altitude. This work may be useful for scientists and practitioners conducting research in the fields of natural geography and ecology.***

Keywords: Mountain landscapes, vertical zonality, altitudinal regions, climatic zonality, soil types, vegetation cover, fauna, biogeographic regions, mountain ecosystems.

Introduction. Mountain landscapes are one of the most complex and diverse natural and geographical systems of our planet, characterized by their altitudinal stratification, variable climate and biodiversity. Mountain ecosystems are not only a source of important natural resources, but also play a major role in maintaining the global ecological balance. Mountains are watersheds for rivers, regulate climate processes, ensure soil fertility and create habitats for unique plant and animal species.

Main part. The formation and development of mountain landscapes depends on various factors, among which geological processes, climatic zonation, hydrological conditions and anthropogenic impact play an important role. As a result of altitudinal stratification, different climatic regions are formed, which leads to the zonal distribution of soil, flora and fauna.

Modern research shows that mountain landscapes are undergoing serious changes as a result of anthropogenic impact, improper management of land resources and climate change. In particular, degradation of pastures, soil erosion and deforestation are intensifying environmental problems in mountain areas. Therefore, it is an important task to study the ecological state of mountain landscapes, assess their natural resource potential and develop scientifically based proposals for their protection using GIS technologies.

This article analyzes the vertical zonation of mountain landscapes, the main factors affecting the formation of natural complexes, and their ecological state. Also, scientific proposals are developed on strategies for the rational use of mountain landscapes and their protection. Mountainous regions differ from plains in natural conditions and the diversity of landscapes. The diversity of the nature of mountains is also associated with neotectonic movements and exogenous processes. The uplift of mountain structures during the neotectonic stage occurred unevenly both in time and space. The highest mountain ranges, systems, and massifs correspond to the areas where neotectonic uplifts with the greatest amplitude occurred. The elevation of the mountains decreases with the transition of plain and mountain landscapes to medium-high, and later high-mountain landscapes. But the youth of high-mountain landscapes is due not only to the fact that the formation phase of high mountains is the initial stage of uplift, but also to the fact that the sculptural "alpine" relief of high mountains is very young in terms of geological age. Intensive weathering led to the "spreading" of the primitive surface, deformed by glacial-nival processes in the form of dome-shaped uplift (Gvozdetsky, 1965).

Mountains also affect atmospheric circulation, changing the direction of air currents. Mountains are areas that absorb kinetic energy due to an increase in friction force and a decrease in the speed of air flow when they collide with mountains.

In summer, mountains serve as a source of heat, since the air above them is warmer than above the plains. The humidity of the air also increases in most cases with increasing altitude. On a planetary scale, mountains (mountainous countries, regions) receive 8-10 times more precipitation than adjacent plains (Petrosyants, 1974).

The amount of atmospheric precipitation in the mountains increases up to certain heights (up to 2000-3000 m in temperate latitudes and humid tropics, up to 2000-3000 m in dry tropics, up to 400 m in dry soils and up to 1000 m in high polar latitudes). With increasing altitude, the surface runoff also increases 3-4 times. As a result, erosion also increases and solid runoff increases 5-10 times. Table 4 shows the soil erosion depending on the slope and exposure of the slopes.

The development of the biocomponents of mountain landscapes occurred simultaneously with the rise of the mountains, mountain species and subspecies of plain species were formed. At the same time, mountain species had the opposite effect. In general, the flora and fauna in the mountains are 2-5 times richer than in the plains. The mountains contain 30-50% of endemics, all these factors cause the altitudinal zonation to differ from the zonation in the plains. There are also zonations in the mountains that are not found in the plains (for example, high-altitude meadows). In mountainous regions, latitudinal zonation is complicated by altitudinal zonation, latitudinal geographic zones alternate with altitudinal zones, and in the foothills, landscapes are diversified (changed) within two adjacent zones. However, in any case, the altitudinal zonation begins with the zone corresponding to the zone in which this mountain region is located. The geography of mountainous regions differs sharply from the hydrography of the plains. Mountains are areas that accumulate and store moisture in the form of snow and ice, but all this water flows to the plains. The mountain landscape has its own influence on mountain rivers and their waters. Mountain waters, being low-temperature, differ in their chemical and biological composition from those at low temperatures. Mountain rivers perform a huge erosional work in their upper reaches, and as the flow slows down further, mountain rivers form accumulative plains that are widespread throughout the globe.

Dependence of soil erosion on slope slope and exposure (g per 1 km2 of surface area)

Sloping exposure	Slopes	slope
North	1010	1958
South	1412	2339
East	1825	2906
West	695	1887

The soil cover of the mountains also has its own characteristics: mountain soils are not thick, but rather loose, rich in humus, which accumulates a certain amount of heat due to the high level of direct radiation.

The uniqueness of landscapes in the mountains is also reflected in their fauna and flora. One of the important features of mountain nature is its dynamism. The change in altitude itself, mainly due to tectonic processes, is one of the important factors in the reproduction of the entire natural situation in the mountains.

Tectonic processes and epeirogenic movements in the mountains are much more intensive than on the plains, and therefore, landscape complexes and their constituent components change faster in the mountains. The energy sources of mountain landscapes, which cause the dynamism of the natural environment, are also richer. For example, the radiation balance of the coniferous-deciduous forest zone in the Caucasus Mountains is 35 kcal per sq. km of surface, while in taiga forests this figure is 22 kcal (Chikalin 1972).

With increasing altitude, not only radiation, but also gravitational forces that replenish the energy base of mountain landscapes increase. With an increase in the level of landscape energy supply, all landscape-forming processes in the mountains also intensify, and the material cycle increases.

Usually, mountain landscapes are characterized by extreme dynamism (variability). Mountain landscapes are characterized by the intensity of the processes of erosion of the slopes - denudation and gravity, and there are two reasons for this intensity: First, in the process of tectonic uplifts (sometimes volcanic eruptions) in the mountains, a very large reserve of gravitational potential energy is accumulated, which is spent on the processes of denudation and development of mountain landscapes. All gravitational movements occur in connection with this. The effect of gravity is manifested in combination with the power of flowing waters to transport rock fragments. In short, the potential energy of gravity is the most important source of energy in mountain landscapes.

The second reason for the dynamics of mountain landscapes is the continuous water cycle in the atmosphere. In the process of circulation, water evaporated from the oceans and plains falls as liquid and solid precipitation. Since water in the mountains falls to the Earth's surface at high absolute heights, a certain part of the potential energy accumulated due to solar energy is stored for a certain period in the snow, firn and glaciers of high mountains, and the rest is immediately spent in denudation processes following erosion, floods and rains. Due to these reasons, the intensity of denudation and gravity processes in the mountains also leads to an intensive natural dynamic development of landscapes. Human activity in mountainous areas, in turn, accelerates this dynamics. As noted above, the diversity of natural conditions in the mountains primarily depends on altitudinal zonality (vertical zoning). The landscape-forming factors of altitudinal zones differ from the landscape-forming factors of latitudinal zones. All the diversity expressed in the differences of geographical landscapes on the Earth's surface is the result of the combination and interaction of zonal and azonal factors. The basis of latitudinal and altitudinal zonality is the general law - in latitudinal zonality, the temperature gradually decreases from lower latitudes to higher latitudes, and in altitudinal zonality, the absolute height of the place increases. However, the climatic conditions of zonality (heat, the ratio of heat and moisture, etc.) vary differently in latitude and in the mountains with altitude. In both cases, the ratio of heat and moisture due to the decrease in temperature is the most important factor in landscape stratification.

S.V. Kalesnik (1970) considered altitudinal zonality to be azonal phenomena, along with the sectorality of geographical zones. Altitudinal zonality is an azonal phenomenon by its nature, since the tectonic movements that form mountains serve as a condition for altitudinal zonality. Geographical zones of mountains are the product of the formation and erosion of zones on the plains. However, most scientists include altitudinal zonality in zonal phenomena. According to A.G. Isachenko, there are three types of zonal patterns - latitudinal zonality, sectoral (meridional zonality) and altitudinal zonality (regionalization).

In mountainous regions, latitudinal zonality is complicated by altitudinal zonality, latitudinal geographic zones alternate with altitudinal zones, and in the foothills, landscapes are diversified (changed) within two adjacent zones. But in any case, the altitudinal zonality begins with the zone corresponding to the zone in which this mountainous region is located. The specific features of mountain landscapes are especially clearly manifested in high mountains. As the altitude increases, the similarities in the landscapes of different continents and even hemispheres increase. In low and medium-altitude mountains, the diversity of landscapes also increases. Here, one can note the names of dozens of plant-soil zones and representatives of the animal and plant world. With increasing altitude, the diversity of landscapes gradually decreases, and in high mountains, below the level zone, only alpine (high-mountain) meadows are located. Thus, altitudinal zonation in the mountains (if the height of the mountains allows it) ends with the nival zone, depending on the geographical location and height of the mountains. This zone is almost the same everywhere according to the landscape features.

The absolute height of the altitudinal zones in the mountains depends on the nature of the zone in which this mountainous region is located. For example, in the north of the Scandinavian Peninsula (in the tundra zone) the highlands begin at 500 m, and on the slopes of Kilimanjaro (in the equatorial forest zone) at 4800 m.

In each geographical sector, altitudinal zonation has its own characteristics, which depend on the continentality of the climate, the intensity and regime of moisture. For example, the meadows of the alpine (high mountain) zone are more characteristic of the oceanic sectors, and the mountain-steppe zone is characteristic of the continental (inland) sector.

The structure of altitudinal zonality also depends on orography. Its large differences also depend on the position of the slopes in relation to the sun's rays and the prevailing winds. The zonal-sectoral patterns of the altitudinal zonality type are often complicated by orography.

The existence of altitudinal zonality due to relief is primarily due to the effect of the gradient and the change in the amount of atmospheric precipitation with height.

In the zonal structure of the geographical crust on the plains and in the mountains, there are both similarities and significant differences. Their similarity is manifested in the decrease in heat with increasing altitude in the mountains and from the equator to the poles on the plains, as well as in the totality and consistency of zones due to the generality of zonal evolution in the geographical crust. The thermal factor is of decisive importance in the formation of both latitudinal zonality and altitudinal zonality, but in both cases its essence is different: latitudinal zonality is based on the change in the angle of incidence of sunlight along the latitude, and altitudinal zonality is based on the increase in altitude above sea level. As you climb up in the mountains, the thickness and density of the atmosphere decrease, so the amount of water vapor and dust particles in it, and, consequently, the radiation consumption, decreases. The intensity of solar radiation in the mountains increases by about 10% for every 1000 m of altitude. At the same time, effective radiation, especially long-wave radiation, increases faster with height, and as a result, the radiation balance decreases, which causes a decrease in air temperature with height. As altitude increases, atmospheric pressure also decreases (1 mm per 11-15 m), and the conditions for the saturation of water vapor also change. On average, for every 100 m of altitude increase in the mountains, the temperature decreases by 0.5 in the lower 4 km of the troposphere, by 0.60 above 4 km, and by 0.7-0.80 near the tropopause. However, this indicator, called the temperature gradient, depends on the time of year and day, the nature of the air mass, the relief, and other factors.

In most mountain systems of the temperate zone, the total number of active temperatures (above +100) decreases by 1700 for every 100 m of height, and in dry tropical conditions by 2500 (in the Andes - 3000) (Ryabchikov, 1972).

The manifestation of altitudinal zonality in the mountains is due to a decrease in air temperature towards the top and an increase in the amount of precipitation and atmospheric humidity. However, the change in humidity conditions does not correspond to latitudinal zonality in terms of direction and intensity. In general, vertical climate change is very close to zonal climate change, but not exactly the same. The intensity of solar radiation increases with altitude in the mountains, and decreases from the equator to the poles. If atmospheric pressure in the mountains decreases consistently and uniformly, then there are baric zones between the equator and the poles.

In the horizontal direction, humid and arid zones alternate. Precipitation in the mountains depends on the barrier effect of the relief. Under the influence of mountain barriers, air masses move upwards, moisture condensation increases, and the amount of precipitation increases up to certain heights. It should be noted that as moisture reserves decrease, the amount of precipitation also begins to decrease. The level at which the greatest amount of precipitation falls varies and is higher in dry regions than in humid regions. For example, in the Alps, the highest level at which precipitation falls is about 2,000 m, in the Caucasus at 2,400-3,000 m, and in the Tien Shan at 3,000-4,000 m. In the polar latitudes, the increase in precipitation is up to 1,000 m. Due to the fact that precipitation in the mountains is associated with the accumulation of air masses in front of the slopes of mountain ranges and the upward movement of air masses, the amount of precipitation on the slopes facing the wind can be several times greater than on the slopes facing the wind. The distribution of precipitation in the mountains is very diverse, depending on orographic features (the location of the ranges relative to each other, the exposure of the slopes, the fragmentation of the surface, etc.). Absolute altitude also plays an indirect role in the increase in precipitation.

There is only an external similarity between altitudinal and latitudinal zones. Some altitudinal zones (for example, the alpine meadows of Tibet and the Eastern Pamirs, the high-mountain cold deserts) have no analogues in latitudinal zonality. At the same time, the zonal deserts of the passat region on the plains have no analogues in the mountains. Altitudinal zones also differ from latitudinal zones in many structural and functional features. Altitudinal zones also differ from latitudinal zones in terms of air thinness, the peculiarities of atmospheric circulation, seasonal fluctuations in temperature and pressure, the characteristics of specific geomorphological processes (depressions, mudflows and avalanches, etc.), glaciers, and soil profiles. In the mountainous regions south of the taiga zone, there are mountain-taiga forests, and in most mountains there is no forest zone. In the mountains of temperate and subtropical latitudes, alpine meadows develop under conditions of low temperatures, good drainage, and high levels of ultraviolet radiation. In equatorial latitudes, they are replaced by the paramos mountain-meadow zone, consisting of complex woody plants. The flow of atmospheric precipitation increases with altitude in the mountains, but this is not observed from the equator to the poles. Due to the 3-4-fold increase in surface runoff and improved drainage with altitude, there are almost no swamps in the upper parts of the mountains, and the tundra is replaced by meadows. The spectrum of altitudinal zonation in the taiga zone consists of taiga, tundra, and permanent snow zones. However, the mountain tundra develops under different conditions than the latitudinal tundra zone, which develops under conditions of polar night and day. In addition, the altitudinal zones of any mountainous region, each mountain range, and even some of its slopes have qualitatively individual characteristics.

The development of the biocomponents of mountain landscapes occurred simultaneously with the rise of these mountains. The flora and fauna of the mountains are 2-5 times richer in species than in the plains. Also, in the mountains, especially in the seasonally humid conditions of the subequatorial region, the number of endemic species is 30-50%.

The structure of altitudinal zonation depends primarily on their location in a particular geographical region, its sector and zone, and their height. The regular alternation of altitudinal zones from the foothills of the mountains to the highest peaks forms the structure (spectrum) of altitudinal zonation. A.M. Ryabchikov (1972) together with Y.N. Lukashova developed a profile of the zonal structure in the mountains. One of them represents altitudinal zonation in the humid oceanic sectors of the continents (-Fig.), and the other - altitudinal zonation in the continental sectors. A comparison of the profiles shows that they are more common in the mountains, mainly in the continental sectors, as a result of the influence of high-pressure anticyclone zones. This phenomenon also leads to the fact that the snow line is 700-1000 m higher than in the humid sectors. The highest snow line on Earth is observed at an altitude of 6500 m on the western slope of the Lluyalyako volcano (6723 m) in the Andean mountain system. A.M. Ryabchikov (1972) suggests that this is due to the proximity of the Andean mountain wall, which is about seventy thousand meters high, and also to the powerful permanent South Pacific maximum. The profiles show that in the continental sector, zones of semiarid and semihumid landscapes are more developed, and in the humid sectors, zones of semihumid and semiarid landscapes are more developed.

The structure of altitudinal zonality depends primarily on their location in a particular geographical region, its sector and zone, and their height. The regular alternation of altitudinal zones from the foothills of the mountains to the highest peaks forms the structure (spectrum) of altitudinal zonality. In different mountain systems, in some of their parts, different types and spectra of altitudinal zonality are observed. In the altitudinal zonality spectrum (lat. spectrum visible, appearance), altitudinal regions (subalpine meadow region, alpine meadow region, subnival region, etc.) are first distinguished, which are characterized by a complex of natural conditions. These regions, in turn, are grouped into zones (Gvozdetsky, 1979). Zones are divided according to the type of mountain landscape (mountain-forest, mountain-meadow, mountain-steppe, etc.), and regions according to the subtype of mountain landscapes.

The number of zones in the altitudinal zonality spectrum (more or less) depends on the geographical location and altitude of the mountain region at a given time: the higher the mountain region and the closer it is to the equator, the more complete it is; the closer it is to the poles and at a lower altitude, the fewer zones there are in the altitudinal zonality spectrum. The altitudinal zonality spectrum becomes more complex as it approaches the equator, the number of zones increases, zones that are not typical for mountains of high latitudes appear, and the boundaries of similar zones (for example, mountain-meadow, glacier) move up. The structure of altitudinal zonality also depends on whether the mountains are closer or further from the ocean, that is, in which sector of the geographical region they are located. While the mountains of the temperate zone located along the ocean coast are dominated by mountain-forest and mountain-meadow zones, the mountains in the continental sector are characterized by mountain-steppe, mountain-taiga, and mountain-tundra zones.

In the continental sectors of the continents, deserts and semi-deserts have developed in the mountains due to the influence of the high-pressure anticyclone region (-line). In these mountains, the snow line passes 700-1000 m higher than in the humid sectors. Due to the proximity to the high mountain barrier and the South Pacific maximum, on the western slope of the Llullayaylaco volcano (6723 m) in the Andes, the snow line passes at an altitude of 6500 m. Because along the eastern edge of this maximum, the cold southern winds blowing parallel to the Andes reach warmer latitudes and do not bring precipitation. The vast plains of deserts near the tropics are surrounded by altitudinal zones of semiarid landscapes of different latitudes. The equatorial core of humid mountain landscapes is much narrower than in the humid sectors of the continents, but is much better expressed. Between the humid and desert zones lie the spectrum of intermediate zones. In the continental sector, there are no altitudinal zones of semiarid and semihumid landscapes, and in the humid sectors, there are no altitudinal zones of arid landscapes, but rather altitudinal zones of semihumid and humid landscapes.

In the continental sector, the equatorial core expands at altitudes of 1000-2000 m. Within these altitudes, more precipitation falls along the slopes of the mountains than above or below. At an altitude of 3000 m, the foggiest zone - “cloud forests” (nebelwaldes) - is located. Above them is the zone of montane forests (seca de la montagna), which can be considered the upper limit of mountain forests. In the equatorial latitudes, between the zone of the thorny forest and the rocky-sandy deserts, there are high mountain meadows (paramos) with shrubby and tree-like complex flowers (tree-like yellow-headed (krestovnik) 4-8 m high, spherical espeletsia, etc.), and in the southern and northern latitudes, there are shrubby high mountain sedge steppes (halka). Above the mountain deserts and steppe deserts of the Southern Hemisphere, there are high mountain tropical steppe deserts with evergreen shrubs, tree-like sedges (punas) and deserts with sparse thorny shrubs and cushion-shaped opuntias (tolas).

In various mountain systems, in some of their parts, different types and spectra of altitudinal zonality are observed. In the altitudinal zonality spectrum, first of all, altitudinal regions are distinguished, which are characterized by a complex of natural conditions (subalpine meadow region, alpine meadow region, subnival region, etc.). These regions, in turn, are grouped into zones (Gvozdetsky, 1979). Zones are divided according to the type of mountain landscape (mountain-forest, mountain-meadow, mountain-steppe, etc.), and regions are divided according to the subtype of mountain landscapes. The spectra of altitudinal zonality vary depending on the latitude zone and sector within which mountain structures are located, as well as on the orographic features of the mountain system. Each latitude zone has its own spectrum of altitudinal zonality, characterized by the number of zones, their distribution, and altitude boundaries. In orographically very complex mountain systems located at the junction of different latitude zones, altitudinal zonality has a particularly complex character. However, even in such cases, several spectra of altitudinal zonality can be distinguished. For example, in the Caucasus mountain system, 6-7 main zonal rows can be distinguished. The number of zones in the altitudinal zonality spectrum (more or less) depends on the geographical location and altitude of the mountain region at a given time: the higher the mountain region and the closer it is to the equator, the more complete it is; the closer it is to the poles and the lower its altitude, the fewer the number of zones in the altitudinal zonality spectrum. The spectrum of altitudinal zones becomes more complex as we approach the equator, the number of zones increases, zones that are not typical for mountains of high latitudes appear, the boundaries of similar zones (for example, mountain-meadow, glacier) move upwards. The structure of altitudinal zonality also depends on whether the mountains are closer or further from the ocean, that is, in which sector of the geographical region they are located. In the mountains of the temperate zone located on the ocean coast, mountain-forest and mountain-meadow zones are more common, while in the mountains of the continental sector, mountain-steppe, mountain-taiga and mountain-tundra zones are developed.

In the continental sectors of the continents, deserts and semi-deserts have developed in the mountains due to the influence of the high-pressure anticyclone region (Figure 2). In these mountains, the snow line passes 700–1000 m higher than in the humid sectors. Due to the proximity to the high mountain barrier and the South Pacific maximum, on the western slope of the Llullayaylaco volcano (6723 m) in the Andes, the snow line passes at an altitude of 6500 m. Because along the eastern edge of this maximum, the cold southern winds blowing parallel to the Andes reach warmer latitudes and do not bring precipitation. The vast plains of the deserts near the tropics are surrounded by altitudinal zones of semiarid landscapes of different latitudes. The equatorial core of humid mountain landscapes is much narrower than in the humid sectors of the continents, but is much better expressed. Between the humid and desert zones lie the spectrum of intermediate zones. In the continental sector, there are no altitudinal zones of semiarid and semihumid landscapes, and in the humid sectors, there are no altitudinal zones of arid landscapes, but rather altitudinal zones of semihumid and humid landscapes.

At altitudes of 1000–2500 m, more precipitation falls on the mountain slopes than on the upper and lower parts, and therefore the equatorial core expands legally (-drawings). At an altitude of 3000 m, “cloud forests” (nebelwaldes) are located. Above them are the coniferous forests (seca de la montana), which form the upper border of the forests. In equatorial latitudes, between the coniferous forests and the rocky-sandy deserts, there are high mountain grasslands (paramos) with shrubby and complex flowering woody plants, and in the southern subequatorial latitudes, there is a shrubby (halka) high mountain sedge steppe zone. Above the tropical deserts and sedge deserts of the Southern Hemisphere, there are high mountain sedge deserts (punas), where evergreen shrubs, tree-like sedges grow, and deserts (tolas), where sparse thorny shrubs and leafy opuntias grow.

The structure of altitudinal zonation also depends on orography. Its large variations also depend on the exposure of the slopes to sunlight and prevailing winds.

The spectra of altitudinal zonality vary depending on the latitude zone and sector within which the mountain structures are located, as well as on the orographic features of the mountain system. For each latitude zone, a separate spectrum of altitudinal zonality is characteristic, expressed in the number of zones, their distribution, and height boundaries. In orographically very complex mountain systems located at the junction of different latitude zones, altitudinal zonality has a particularly complex character. However, even in such cases, several spectra of altitudinal zonality can be distinguished. For example, in the Caucasus mountain system, 6-7 main zonal rows can be distinguished.

In each sector, depending on the degree of continentality of the climate, the intensity and regime of moisture, specific features of altitudinal zonality are manifested.

Along with absolute height, the exposure of the slopes, associated with the general extension and orientation of mountain structures, is an important factor in the stratification of mountain landscapes. The position of the slope exposure relative to the Sun and the prevailing winds leads to the position of the boundaries of the altitudinal zones by 300 - 800 m and more. Two types of exposures of mountain slopes can be distinguished: 1) solar or insolation exposures, facing the direction of the sun, and 2) wind or circulation exposures, facing air currents. The thermal and, as well as, water regime of the mountain slopes depends on the solar exposure. The southern slopes heat up more than the northern slopes, evaporation is greater. Therefore, the southern slopes are drier, other factors being equal. The boundaries of the altitudinal zones on them usually pass somewhat higher than on the northern slopes. Opposite solar exposures are especially pronounced at the junction of latitudinal geographic zones. In temperate latitudes, the effect of solar exposure is stronger than in polar and tropical latitudes. At high latitudes, during polar light days, all exposures of all slopes are illuminated almost equally, while at low latitudes, due to the Sun being high above the horizon, the differences in insolation of slopes with different exposures are smoothed out.

Wind exposures are of two types. Such exposures can create significant differences in the thermal regime of opposite slopes, enhancing the effect of solar exposure. This is typical for mountain ranges extending from west to east (Pyrenees, Alps, Crimea, Greater Caucasus, Himalayas, Central Asian mountains). The northern slopes of these ranges are influenced by cold air masses, while the southern slopes are more or less affected by cold air masses. Many of these mountain ranges are important watersheds, and sometimes their edges form the boundaries of geographical regions, sectors and zones (Urals, Himalayas, Cordillera, Andes, etc.).

The influence of wind exposures on the climate and landscapes of the slopes is manifested in the location of the slopes relative to the sources of moisture, that is, the slopes of moist air masses and the trajectories of cyclones. In the region of air masses moving from the west to the east, the main part of the precipitation falls on the western slopes of the mountain ranges, and in the monsoon sector - on the slopes facing the monsoons. For example, in the mountains of the Tien Shan-Aloy mountain system in Central Asia, the main part of the precipitation falls on the southern and southwestern slopes of the frontal ridges (mainly the Hissar ridge) in the spring due to the cyclones of the Iranian polar front, which move from north to south.

The leeward slopes of mountains, which are often affected by fyons, are much drier than the windward slopes. In dry climates, the effect of exposure is much greater. Especially at altitudes corresponding to the region of maximum precipitation, which is clearly visible only on one (windward) slope, the differences are large. In the Northern Tien Shan, the region of maximum precipitation is located between 1500 and 3000 m above sea level, and on the northern and western slopes within it, dark coniferous forests are widespread; on the opposite exposures, such forests are absent. The different location of the spectra of altitudinal zones and their sectoral variants correspond to the general scheme of the orographic structure of the land.

In mountain systems with a latitudinal and sublatitudinal orientation, the influence of remote landscape stratification and sectorality is clearly visible. In this case, both insolation and circulation (wind) exposure play a major role.

Conclusion. The structure of altitudinal zonality in mountains depends primarily on the geographical region and sector in which they are located, as well as on the height of these mountains.

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