



Altitudinal Zonation and Geocological Classification of Mountain Landscapes: A Case Study of the Southwestern Gissar Range

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ABSTRACT

This article provides a scientific analysis of altitudinal zonation of mountain landscapes and their geocological classification. The study examines the vertical structure of mountain geosystems and the stepwise transformation of landscapes under the influence of climatic and geomorphological factors. It also highlights the formation patterns of landscapes based on soil types, vegetation cover, and ecological conditions specific to each altitudinal belt. In the case of the Southwestern Gissar mountain range, it was established that altitudinal zonation extends from desert zones to the glacial-nival belt, with each stage characterized by specific geocological features. The interaction of low, middle, and high mountain landscapes, as well as foothill (adir) zones, forms a complex landscape structure of the region. The results of the study are significant for improving the geocological classification of mountain landscapes, their scientific assessment, and ensuring sustainable use of natural resources.

Keywords:

mountain landscapes, altitudinal zonation, geocology, geosystem, Southwestern Gissar, vertical zonality, landscape classification.

Introduction.

Mountain landscapes are among the most complex and dynamic natural geosystems of the Earth. Their formation and development are determined by the interaction of relief, climate, geological structure, and biotic components. One of the most important laws in these geosystems is altitudinal zonation, which results in the complex differentiation of landscapes through the vertical succession of natural components.

Altitudinal zonation is directly associated with changes in climatic conditions, decreasing temperature and humidity regimes, as well as the vertical distribution of soil types and vegetation cover in mountainous regions. Therefore, each altitudinal belt forms specific landscape complexes, making this phenomenon a key criterion in geocological classification.

The Southwestern Gissar Range is one of the mountainous regions of Central Asia

characterized by complex tectonic and climatic conditions, where altitudinal zonation is clearly expressed. The transition from desert zones to the glacial-nival belt results in pronounced vertical differentiation of landscape structures.

Materials and Methods.

This article analyzes the features of altitudinal zonation and geocological classification using the Southwestern Gissar mountain range as a case study. The main objective is to reveal the vertical structure of mountain landscapes and identify their geocological patterns.

The Gissar Range is one of the largest mountain systems of the Pamir-Alay. It extends westward from the Mastchoh mountain node and then turns southwest, with its branches reaching the Amu Darya basin in the south. The range forms an anticline between the Kashkadarya, Surkhandarya-Sherabad, and Gissar valleys.

According to P. Baratov (1996), the Gissar Range is divided into two parts near 68°E

longitude via the upper course of the Kishtut River: (1) the Machitli Mountains extending southwest between the Kishtut and Qoratag rivers; and (2) the Hazrati Sultan Range, which continues along the border as a direct extension of Gissar.

The study area is bordered by Turkmenistan to the southwest, Tajikistan to the northeast, and the Kitob-Shahrisabz and Surkhandarya depressions to the west and east, respectively.

Results and Discussion.

Table 1. Altitudinal Zonation of the Southwestern Gissar Range

No.	Altitudinal Zone	Elevation (m)	Annual Precipitation (mm)	Dominant Vegetation	Soil Types
1	Desert	500–600/700	Up to 250	Wormwood (<i>Artemisia</i>), Saltwort (<i>Salsola</i>)	Light sierozem soils
2	Semi-desert	600/700–1200	250–400	<i>Burgan</i> , Wormwood (<i>Artemisia</i>), <i>Kavrak</i> (<i>Ferula</i>), <i>Qo'ziquloq</i>	Light and typical sierozem soils
3	Dry Steppe	1200–1500/1600	400–500	Wheatgrasses (<i>Agropyron</i> spp.), Astragalus, Almond (<i>Amygdalus</i>)	Typical and dark sierozem soils
4	Forest-Steppe and Forest	1500/1600–2800/3000	500–600	Wheatgrass, Wormwood, Rye, Juniper, Walnut, Pistachio, Cherry, Hawthorn	Mountain brown soils, Brown mountain-forest soils
5	Meadow-Steppe	2800/3000–3800	600–800	<i>Shashir</i> , Fescue (<i>Festuca</i>), Wild Oat (<i>Avena</i>), Foxtail Grass	Light brown mountain soils
6	Glacial-Nival	Above 3800	More than 800	Cushion plants	Meadow soils, Peat-bog soils

Source: Compiled by the author.

Foothill (Adir) Landscapes. Foothill landscapes (500–1000 m) are semi-xeromorphic–anthropogenic systems dominated by semi-desert and desert-steppe vegetation. These areas are significantly affected by human activities, particularly agriculture, which has replaced natural landscapes with anthropogenic ones.

Low Mountain Landscapes. Low mountain landscapes occupy elevations of 1000–2000 m. They are characterized by semi-xeromorphic conditions with dry steppe and semi-desert landscapes. These areas include sparse grasslands and shrub vegetation.

The mountain landscapes of the Southwestern Gissar were formed under active neotectonic processes, which contributed to pronounced altitudinal zonation. Since the foothill zones are adjacent to desert environments, the altitudinal belts begin from desert landscapes.

Based on literature review and field data, six altitudinal zones were identified: desert, semi-desert, dry steppe, forest-steppe and forest, meadow-steppe, and glacial-nival.

Geomorphologically, they consist of weakly dissected slopes formed on Mesozoic rocks.

Middle Mountain Landscapes. These landscapes occupy elevations of 2000–3000 m and are characterized by semi-hydromorphic conditions. The zone includes forest-steppe and dry steppe landscapes with juniper forests, shrubs, and grasslands. The relief is strongly dissected and consists of tectonic-erosional forms.

High Mountain Landscapes. High mountain landscapes occur above 3000 m and are classified as hydromorphic geosystems dominated by alpine meadows and glacial-nival

environments. The relief is shaped by glacial and cryogenic processes.

Conclusion. Altitudinal zonation and geoecological classification of mountain landscapes play a key role in understanding the internal structure and development of natural geosystems. The analysis shows that mountain landscapes are formed as complex vertical systems influenced by relief, climate, geology, and biotic components.

In the Southwestern Gissar Range, altitudinal zonation begins from desert zones and extends to the glacial-nival belt. Each belt is characterized by specific climatic, soil, and vegetation conditions. The sequential arrangement of low, middle, high mountain, and foothill landscapes reflects the vertical differentiation of geosystems.

From a geoecological perspective, each altitudinal belt differs in matter-energy exchange, moisture regime, and resistance to anthropogenic impacts. Biological components play a crucial role in maintaining landscape stability.

Overall, altitudinal zonation and geoecological classification in the Southwestern Gissar region provide an important scientific basis for understanding mountain geosystem evolution and for sustainable natural resource management.

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