



Biogeochemistry of Microelements in Mountain Ecosystems (Kyrgyz Republic)

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Opinion

It is known that the Kyrgyz Republic is a high-mountain country in Central Asia, where 90% of the country's territory is located at an altitude of more than 1000 m above sea level and about 40% is more than 3,000 meters. The average altitude above sea level is 2,750m (the highest is 7,439 m and the lowest is 401m, the highest peaks are: Pobeda Peak (7,439m), Khan-Tengri Peak (6,995m), Lenin Peak (7,439m). The mountainous territories of Kyrgyzstan (Tien Shan, Pamir-Alai) are characterized by high altitudinal zoning, complex geological structure (Paleozoic rocks, metamorphic complexes) and a variety of ecosystems from deserts to glaciers. Biogeochemical features of the republic include natural geochemical anomalies (for example, the mercury-antimony province of Khaidarken), uranium-natural-technogenic Mailu-Suu, Min-Kush, Kadji-Sai, Kumtor, etc., gold ore, etc., a high content of a number of macro and micro elements. The soils of the highlands of Kyrgyzstan (mountain dark chestnut soils, gray-earth soil) are characterized by a high content of humus (4.73%) in the upper layer, N, P and K, and are also rich in microelements-Cu, Sr, Cr, Fe, Zn, Cu, Ni, Ba, Pb, Mo, and W. At the same time, high-altitude and arid climates are characterized by a deficiency of microelements such as Zn, B, Mn, and Cu, which are essential for the biological growth of plants, animals, and humans. However, an accurate assessment of each microelement requires a zonal analysis for each region. The most common deficiency in the republic is P and K, which reduces crop yields on most arable land and affects the quality of agricultural crops and, naturally, humans [1-3].

Key Ecological and Biogeochemical Features of the Mountainous Territories of Kyrgyzstan:

- a) **Altitudinal Zonation:** A sharp change in landscape, climate, and soil and vegetation cover with altitude determines the specific migration patterns of elements. Leaching: Intense precipitation in the highlands washes mobile elements (Calcium, Magnesium, Potassium) from the upper zones into the valleys.
- b) **Natural and Natural-Technogenic Anomalies:** The presence of Mercury-Antimony, Uranium Natural-Technogenic, Gold-Ore and other ore provinces that create natural and technogenic (Anthropogenic) geochemical anomalies.
- c) **Soil Cover:** Predominance of Skeletal, Shallow Soils, often containing limestone, marble and other carbonate rocks. The migration processes of chemical elements in the soil-plant-water system are significantly affected by sharp temperature changes (up to -40°C) and intense erosion processes.
- d) **Technogenic Load:** Ecosystems are vulnerable due to pollution from the mining industry, tailings ponds, mine waste dumps, as well as global climate change processes (Desertification, Melting glaciers).
- e) **Biodiversity:** Unique High-Mountain Ecosystems require specific study of the migration of chemical elements in the Soil-Water and soil-plant systems. The content of Macro-

and Microelements in mountain rivers is subject to seasonal dynamics.

The natural deficiency of vital micronutrients in the republic is one of the region's most serious biogeochemical problems. Due to the peculiarities of soil formation in the mountains, there is a shortage of: iodine-almost the entire country is a zone of severe iodine deficiency; fluorine-most mountain water sources have below-normal fluoride levels; and selenium and cobalt-deficiencies in the soils of high-altitude pastures. Kyrgyzstan's mountainous regions are particularly rich in iodine and iron. Iodine is a vital micronutrient required for the synthesis of thyroid hormones, which regulate metabolism, growth, tissue development, and brain and nervous system function (the daily requirement is 150mcg). Due to Kyrgyzstan's mountainous terrain and poor soils, natural iodine deficiency is common, leading to the risk of goiter. Kyrgyzstan is among the regions with severe natural iodine deficiency, covering almost 100% of the country. Specific efforts are being made in this area, and a State Program to Reduce Iodine Deficiency Disorders in the Kyrgyz Republic has been adopted. Iodine deficiency in the republic is common in regions (Jalal-Abad, Talas, and Naryn regions) where the availability of iodized salt is only 25-30% of the population, while approximately 70% of children in the country suffer from iodine deficiency. Thus, the highly mountainous republic with an average altitude of 2,750 m creates a unique ecological background, where biogeochemical cycles are highly dependent on climatic conditions (low temperatures, moisture deficit, etc.). Therefore, Professor *V.V. Koval'skii* [4] identified the following basic units in his biogeochemical zoning: region, subregion, and biogeochemical provinces, as well as mountain areas, and separately identified mountain biogeochemical units.

The mountainous region is characterized by an uneven distribution of macro- and microelements, high activity of natural geochemical and biogeochemical processes, and the presence of natural and natural-technogenic provinces. These conditions create specific biogeochemical provinces that determine the composition of local flora and fauna and also require consideration in agricultural development and environmental protection activities [5,6].

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Conflict of Interest

None.

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