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MIGRATION OF BIOMICROELEMENTS IN CLAYEY SOILS

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Abstract
This article provides a theoretical analysis of the differential biogeochemical migration of biomicroelements in contaminated soils and the biosphere. It emphasizes the crucial role of biomicroelements in the exchange of substances between living and nonliving matter.

Keywords: Trace elements, biogeochemistry, biosphere, Vernadsky's concept, Matter cycle, ecological stability, human health.

Introduction

The biosphere is a unique natural shell of the Earth, in which living and non-living matter exist in close interdependence. In this environment, there is a constant cycle of chemical elements, their transition from one state to another, and an inextricable connection with the activities of living organisms [1.15-b].
Microelements are chemical elements that are necessary for living organisms in very small quantities, but without which the normal course of life processes is impossible [2. 33-b]. Elements such as iron, copper, manganese, zinc, cobalt, molybdenum, iodine, fluorine and selenium are involved in the activity of enzymes, hormone synthesis, blood formation, strengthening the immune system and many other biological processes [3.21-b].
The cycle of biomicroelements in the biosphere is one of the main research areas of biogeochemistry. Their movement through the soil-plant-animal-human chain ensures the stability of life processes [4.56-b].
As Vernadsky noted, the distribution of any element in the biosphere cannot be fully explained without living organisms. Therefore, the role of biomicroelements in the biosphere is of decisive importance not only in biological, but also in geochemical processes [1.88-b].
The need of living organisms for biomicroelements is met through the soil. Therefore, it is important to know and analyze the elemental composition of soils.

The main part

The importance of biomicroelements Biomicroelements are part of organic and inorganic compounds necessary for life and play an important role in metabolic processes [2.89-b].

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Many of them are components or active centers of enzymes. For example, iron is a component of hemoglobin and cytochromes, and participates in oxygen transport and redox reactions [1.65-b]. Copper is a component of mycoenzymes and ensures the activity of oxidases. Zinc is a stabilizer of many hormones and proteins [3.141-b].

Iodine is necessary for the synthesis of the thyroid hormones thyroxine and triiodothyronine. Its deficiency leads to endemic goiter [5.177-b]. Cobalt is a component of vitamin B12 and is involved in blood formation. Selenium is a component of the antioxidant enzyme glutathione peroxidase and protects cells from oxidation [4.102-b].

Thus, although biomicroelements are needed in small quantities, they ensure the normal course of all basic physiological processes in the body. Their deficiency or excess poses a health risk.

The circulation of biomicroelements in the biosphere occurs through the soil-plant-animal-human chain [1.73-b]. Microelements are present in the soil as minerals, and plants absorb them through their roots. Elements accumulated in plant tissues are a source of food for animals and humans [2.140-b].

Microorganisms play an important role in these processes. For example, some bacteria convert iron from free to biologically active forms and participate in the sulfur and nitrogen cycles [6.97-b].

As a result, biomicroelements constantly move between the living and non-living parts of the biosphere.

If this natural cycle is disrupted, that is, if there is a deficiency or excess of elements, the ecological stability of the biosphere will be disrupted [3.210-b].

Vernadsky, in his work Biosphere, described the biosphere as a huge chemical laboratory. He believed that living organisms are the main geochemical force on the Earth's surface, controlling the circulation of substances [1.88-b]. The distribution of trace elements in the biosphere is also directly related to the activity of living matter.

As Vernadsky noted, living matter accelerates the migration of chemical elements, transferring them from one phase to another, thereby ensuring the continuous renewal of the biosphere [2.140-b]. Therefore, the study of the cycle of biomicroelements is important not only for understanding biological, but also for understanding geochemical laws.

If we analyze biomicroelements in irrigated compacted soil sections, the following diagram will appear. (Figure 1)

The total and mobile forms of biomicroelements such as Cu, Zn, Mn, B, and Mo were studied in cross-sections in the colmatized soils located in the Sokh River basin and floodplain. The results of the study showed that the amount of microelements decreases with depth in the soil profile, while in dark brown soils, higher concentrations are maintained compared to light gray soils.

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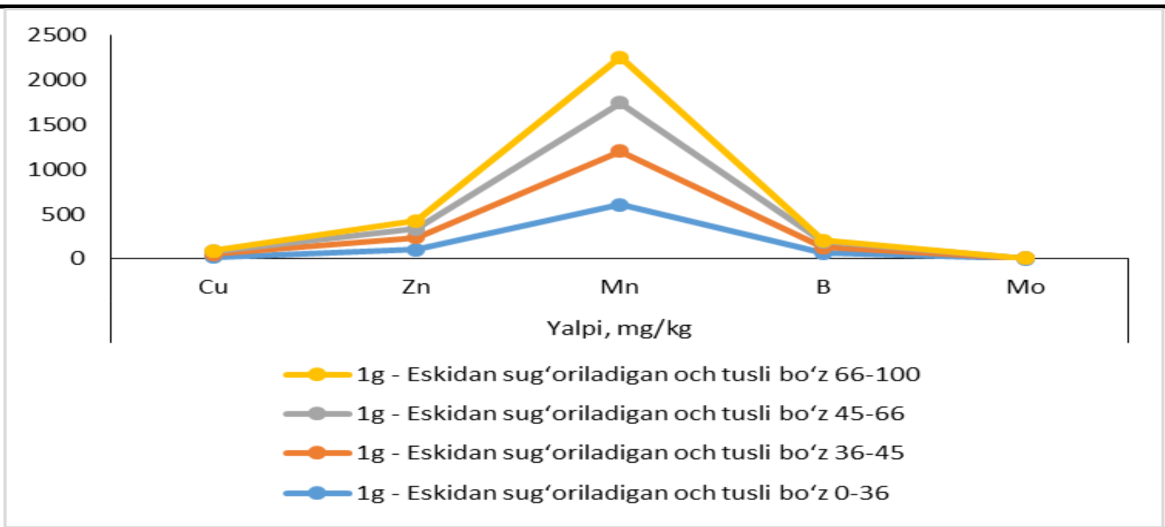

Figure 1. Biomicroelements in colmatized soils formed in the Sokh River cone and floodplaindifferential

The colmatized soils formed in the Sokh River cone and its basin are geomorphologically complex, and their chemical composition is closely related to a number of processes - leaching, filtration, redeposition and erosion. Soil fertility in these areas largely depends on the amount of microelements and their mobility. In particular, Cu, Zn, Mn, B and Mo are among the most important elements regulating the physiological processes of plants. The study was conducted in two soil sections of the Sokh River cone basin - 1g (formerly irrigated light gray) and 2g (formerly irrigated dark brown) soils. In each section, samples were taken at 4 depth intervals (0-36; 36-45; 45-66; 66-100 cm). 1g-Old irrigated light gray soils: In terms of gross forms: Cu was in the range of 24.2-31.6 mg/kg, decreasing to 7.4 mg/kg in the 66-100 cm layer, Zn was 130 mg/kg in the upper layer and 86 mg/kg in the lower layer. Mn was decreasing from 610 mg/kg to 510 mg/kg, B was 63-66 mg/kg in the upper layer and 15 mg/kg in the lower layer, Mo was decreasing from 2.6 mg/kg to 1.4 mg/kg.
Movable shapes:A decrease was observed in Cu from 2.3-2.4 mg/kg to 0.41 mg/kg, Zn from 1.61 mg/kg to 0.91 mg/kg, Mn from 187 mg/kg to 116 mg/kg, B from 0.31 mg/kg to 0.21 mg/kg, and Mo from 0.25-0.28 mg/kg to 0.21 mg/kg.
1g - On previously irrigated, sandy brown soilsGeneral forms:Cu is 33-36 mg/kg, with 8.1 mg/kg in the lower layer, Zn is 88-100 mg/kg, with 51 mg/kg in the lower layer, Mn reaches 780 mg/kg, with 670 mg/kg below, B fluctuates from 67-73 mg/kg below to 17.6 mg/kg, Mo fluctuates from 2.2-3.2 mg/kg to 1.6 mg/kg.
Movable shapes:Cu from 1.8-2.2 mg/kg to 0.51 mg/kg, Zn from 1.61-1.37 mg/kg to 0.67 mg/kg, Mn from 177 mg/kg to 111 mg/kg, B from 0.22–0.20 mg/kg to 0.14 mg/kg, Mo from 0.28-0.29 mg/kg to 0.18 mg/kg.
The decrease in microelements with depth in silted soil sections is explained by several reasons. The higher content of organic matter in the upper layers means that these layers contain more organic compounds (humus content) that retain microelements in a complex state. Due to the strong filtration in the silted cone, small fractions are washed down, but the main part of the microelements remains in the upper layer. Under the influence of irrigation, the processes of washing and redeposition in previously irrigated areas lead to uneven differentiation and migration

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of microelements in the layers. The effect of soil type is that silted brown soils have a strong ability to retain microelements, which is why they have higher values than 1g soils.

Conclusion. The study of the biomicroelement composition of the colmatized soils formed in the Sokh River cone and its spread showed that the total and mobile forms of elements such as Cu, Zn, Mn, B and Mo systematically decrease with depth in the soil profile. This is explained by the relatively higher content of organic matter, fine dispersed particles and soil cationization complexes in the upper layers.

Among the studied sections, brown soils with a grayish tint (2g) It was found that the content of biomicroelements is richer than that of light gray soils (1g). This is due to the mechanical structure, humus reserves, and stronger sorption properties of these soils.

In general, it was proven that the distribution of biomicroelements in compacted soils is closely related to geomorphological conditions, filtration processes, irrigation history, and soil genetic type. The results of the study have practical significance in assessing the agrochemical state of the region and managing the balance of microelements important for plants.

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