

## **ESTIMATION OF THE ECOLOGICAL STATE OF THE TERRITORY ON THE LANDSCAPE BASIS - ON THE EXAMPLE OF HERTSE DISTRICT IN CHERNIVTSI REGION, UKRAINA**

**Vasile Gutsuliak<sup>1</sup>, M.V. Tanasiuk<sup>2</sup>**

**Key words :** landscape, ecological state of the territory, Chernivtsi region.

**Abstract.** Landscape-geochemical researches and geochemical problem solving of the territories are based on the principles of landscape geo-ecology and landscape studies. They contain corresponding methods of analysis and evaluation of a geochemical state. The task of a landscape-geochemical research is the evaluation of the ecological states and of the eco-situation within natural and anthropogenic geo-complexes. The object of the evaluation is landscape complexes of various ranges modified as a result of the anthropogenic influences; the subject is their ecological state as well as the conditions of favorability for human activity.

### **Introduction**

Conducting landscape-geochemical studies is one of the necessary aspects of the study of the ecological state of a territory that enables to investigate the degree of environment contamination, the migration ability of geo-complexes depending on the chemical composition and physical-chemical properties of their components, the possible areas of contaminating substances, the geochemical ability of accumulation landscape complexes to self-purification from contaminating substances etc.

The theoretical and methodological basis for the study and research of anthropogenic geo-systems is formed by the scientific works of Voloshyn I.M., Voropai L.I., Gutsuliak V.M., Denysko G.I., Isachenko A.G., Kovalchuk I.P., Malysheva L.L., Milkov F.M., Saieta Y.E., Shwebs G.I., Shevchenko L.M., Shyshchenko P.G. and others.

### **Main results of research and their discussion**

Hertsaiivsky district is situated in the south-western part of the before-Carpathian landscape area of Bucovina, in the eastern part of the Prut-Siret in-between interfluvial area. The Prut tributaries, which wash out loose sandy-clay

---

<sup>1</sup> Prof. Ph.D., Chernivtsi National University "Yuriy Fedkovitch", Ukraine, vgutsuleac@rambler.ru

<sup>2</sup> Assist. Prof. Ph.D. Chernivtsi National University "Yuriy Fedkovitch", Ukraine

residues, have formed a compound erosion relief. Range-hilly and sloping-wavy types of relief are common here. The slopes of ridges and valleys are complicated with landslides, which add a slight hilly character to the surface.

The climate in comparison with other areas of the before pre-mountain territory is drier and warmer, it corresponds to the moderate continental. Average January temperatures 5-5,5<sup>0</sup>C, July – 19-20<sup>0</sup>C. The total sum of the temperatures over +10<sup>0</sup>C in a year comprises 2600-2800<sup>0</sup>C. The average precipitation amount is 563 mm.

The soil covering of the territory is represented by grey and dark-grey forest-turf-podzol soils, meadow-swampy soils, which were formed on the loamy soil, contemporary diluvium and bedded with guarded clays. In the natural vegetation, motley-grass and cereals meadows dominate. Deciduous forests (common oak, beech forest, common hornbeam) are widespread, beech plantings prevailing, with occasional coniferous representatives.

The morphological structure of landscapes is characterized by the conjunction of valley-terrace, slope and water-bearing complexes. Valley-terrace complexes are represented by flood plains, low and medium terraces of the Prut River with meadow and ashed black earth under the complete belt of village settlements, motorways and agriculture lands.

Landscape complexes of high Prut terraces are intensively broken down with ashed black earth and dark-grey forest soils, and are mainly under agriculture lands. Slope and water-bearing landscape complexes of high above-Prut plains, hilly and erosion-landslide areas are covered with grey and light-grey forest soils, under meadows of secondary formation, arable plots, beech-oak-hornbeam woods. These landscape complexes are formed by kidney-like erosion-landslide meadow hollow units with motley-grass and cereals meadows, arable plots, and village buildings. Landscape complexes of slumping sloping valley of the Prut tributaries are widely spread there.

I. Territories of water-bearing units and their slopes: 1- Residues are formed by sandy loams, brownish-ashy podzol surface-clayed soil, under arable land; 2- Slopes of water-bearing units composed by forest-like sandy loam soils and loamy soils, with brownish-ashy surface-clayed washed-out soils, under ploughed fields and constructions.

II. Territories of slopes: 3- Gentle slopes (1-2), composed by loamy soils and clays, with light-grey forest washed-out soils under ploughed fields; 4- Slightly falling down slopes (3-5), formed by loamy soils and clays, with light-grey forest washed-out soils under ploughed fields, constructions and fragments of beech forests; 5- Falling down and steep slopes (3-5), formed by loamy soils and clays, with light-grey forest medium-and highly washed-out soils, under constructions and beech forests fragments; 6- Slopes of river valleys, gullies and ravines, formed

by loamy soils and sandy loam, with light-grey forest medium-and highly washed-out soils, under ploughed fields, constructions and beech forests fragments.

III. Territories of river valleys, gullies and ravines. 7- Bottoms of small rivers formed by sandy loam soils under meadows, pastures and hydrophytic associations; 8- Wide bottoms of small rivers formed by sandy loam soils and loamy soils, with alluvial meadow clayed soils under meadows, pastures, swamps with considerable parts of hydrophytic associations;

9- Gullies and temporary waterways made of loamy soils, with dark-grey forest highly washed-out soils, under motley-grass and cereals vegetation.

Geo-chemically, the district belongs to the family of geo-chemical landscape, which makes the transition from forest to steppe and meadow, from acid to calcium class. It is characterized by the medium water exchange, trans-eluvial, eluvial-accumulative, neo-eluvial elementary landscapes, availability of forest-like loamy soils and clays.

This district has many aspects common with other forest-steppe districts. Concentration coefficient of all 4 macro-elements is higher than 1 (from 1,03 to 1,22), indicating their high contents in ground waters. Moreover, their migration ability is rather high, especially calcium and sodium (correspondingly 7,7 and 3,5).

The properties of ground waters of Hertsa geo-chemical district are the following: according to alkali-acid condition – neutral or low-alkali; according to the hardness category - moderate-hard, hard and very hard (the average hardness is 10,2 mg-eqv/dm); by the degree of mineralization - fresh (average mineralization - 0,66 g/dm); by the limited norms of mineralization - good; by the chemical composition - hydrocarbonate-calcium, infrequently - hydrocarbonate-magnesium-calcium.

Cl is a good migrant in district waters; calcium also has a rather high coefficient of water migration. The concentration coefficient of macro-elements in waters is  $>1$ , especially Ca. The Hertsa geo-chemical district belongs to the forest-steppe type of landscapes according to the main geochemical parameters.

The general evaluation of the components of the ecological-geochemical state of a landscape and the level of ecological changes of the environment in connection with the contamination is carried out according to the 5-point system and the following criteria [1;2]: 1- favourable (there is no contamination); 2- relatively favourable (contamination is acceptable, the substance content exceeds the background one, but not more than the maximum permissible concentrations in all landscape components); 3- relatively unfavourable (concentrations in moderately dangerous chemical substances content exceed MPC in soils); 4- unfavourable (concentration is dangerous; there is excess of MPC in soils and air); 5- very unfavourable (concentration is very dangerous, substances content exceeds MPC in environment - soils, air, water, vegetation).

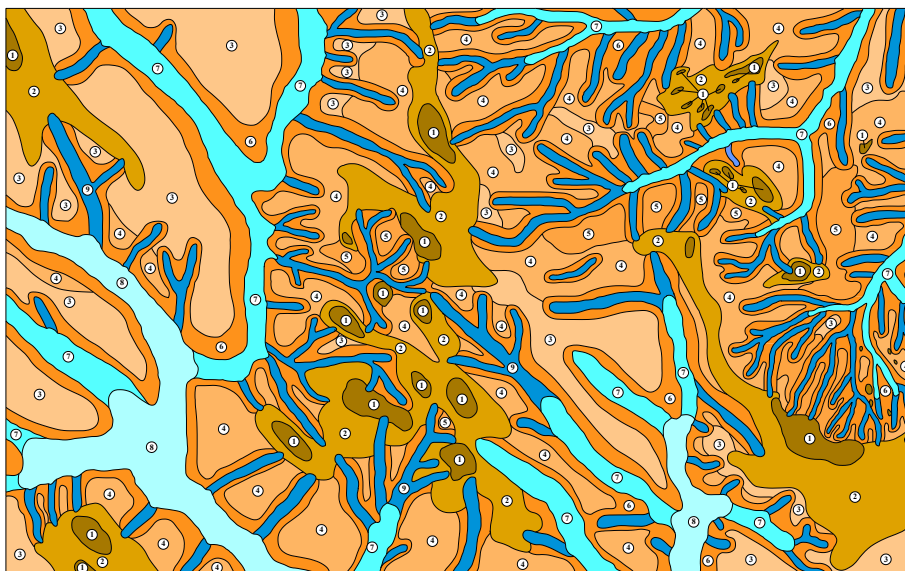


Fig. 1 - Fragment of the landscape map scheme of the territory of Petrashivka village in Hertsa district Chernivtsi region, Ukraine

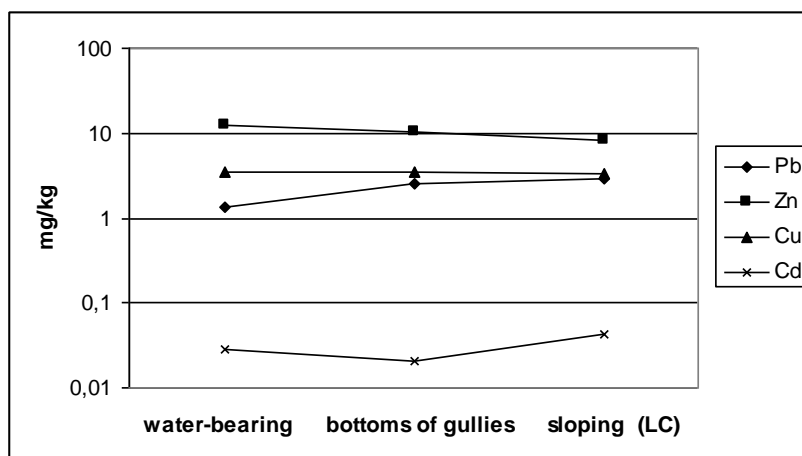


Fig. 2. Contents of heavy metals in landscape complexes of Petrashivka village, territory of Hertsa district Chernivtsi region, Ukraine

The content of microelements in landscape complexes of the territory is various. Analyzing the data received, we see that the lead content ranges from 1,31

to 2,89 mg/kg (when MPC is 30 mg/kg), zinc correspondingly from 8,07 to 12,63 (when MPC is 23 mg/kg), copper - from 3,34 to 3,54 mg/kg (while MPC is 100 mg/kg), cadmium data vary from 0,021 to 0,042 mg/kg and also do not exceed MPC (1,0 mg/kg).

Tab. 1 - Chemical composition of ground waters in the Petrashivka village of the Hertsa district Chernivtsi region, Ukraina

№	Sample code	Depth, m	pH	General hardness, mg-mqv/dm <sup>3</sup>	General mineralization, g/dm <sup>3</sup>	Na <sup>+</sup> +K <sup>+</sup>	Ca <sup>2+</sup>	Mg <sup>2+</sup>	Cl <sup>-</sup>	SO <sub>4</sub> <sup>2-</sup>	HCO <sub>3</sub> <sup>-</sup>	NO <sub>2</sub>	NO <sub>3</sub>	NH <sub>4</sub>	Fe <sup>2+</sup> Fe <sup>3+</sup>	Water type
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1	P1H	5,0	6,9	11,8	0,73	38,50	202,40	20,67	40,0	154,19	549,0	<0,01	<0,2	<0,08	0,25	HCO <sub>3</sub> -Ca
						1,54	10,10	1,70	1,13	3,21	9,0					
2	P2H	3,0	6,9	12,0	0,68	18,0	210,42	18,24	70,0	122,22	500,2	0,01	<0,2	<0,08	0,50	HCO <sub>3</sub> -Ca
						0,72	10,5	1,5	1,97	2,55	8,2					
3	P3H	0,8	6,7	11,2	0,63	17,50	170,34	32,83	40,0	113,9	512,4	<0,01	<0,2	<0,08	0,50	HCO <sub>3</sub> -Ca
						0,70	8,5	2,7	1,13	2,37	8,4					
4	P4H	1,0	6,7	11,7	0,62	9,25	162,32	43,78	35,0	109,83	536,8	<0,01	<0,2	0,08	0,25	HCO <sub>3</sub> -Ca
						0,37	8,1	3,6	0,98	2,29	8,8					
5	P5H	1,0	6,5	4,7	0,21	8,25	60,12	20,67	35,0	88,93	134,2	<0,01	<0,2	<0,08	0,50	HCO <sub>3</sub> - SO <sub>4</sub> -Ca
						0,33	3,0	1,7	0,98	1,85	2,2					
6	P6H	1,0	6,7	6,5	0,42	27,75	106,21	14,59	60,0	92,05	244,0	<0,01	<0,2	<0,08	0,25	HCO <sub>3</sub> - SO <sub>4</sub> -Ca
						1,11	5,3	1,2	1,69	1,92	4,0					
7	P7H	2,0	6,2	4,3	0,24	5,5	50,1	21,89	35,0	64,40	134,2	0,1	<0,2	0,08	0,50	HCO <sub>3</sub> - SO <sub>4</sub> -Ca
						0,22	2,5	1,8	0,98	1,34	2,2					

Having viewed the acquired characteristics and data, we can give the general estimation of the ecological situation in landscape complexes (Picture 1). According to the ecological-geochemical data, the territory of the research has a favourable situation, meaning the contamination is almost absent. The index of contamination intensity of landscape complexes reaches 15 (according to the estimating scale of the ecological danger of landscape contamination).

### Conclusions

Landscape-ecological investigations of residential geo-systems of the Hertsa region enabled us to distinguish and use in practice morphological units (ravines, territories), which reflect rather distinctly the structure, properties and a degree of transformation of landscape complexes. Correspondingly, these units are characterized as geo-ecological complexes and form the basis for distinguishing geo-ecological units.

According to the received ecological-geochemical data, the territory is ecologically favourable, it means there is almost no contamination. We should point out only some excess of zinc contents in the soils of water-bearing areas (12 mg/kg) and lead accumulation in the ravines of gullies bottoms (10 mg/kg). However, such concentration of heavy metals doesn't produce any danger for human activity.

**Bibliography:**

**Gutsuliak V.M. (2002)**, *Landscape Ecology: geochemical aspect*: teach. User / Gutsuliak V.M. - Chernivtsi: Ruta, - 247 sec.

**Gutsuliak V.M. (1994)**, *Geochemistry: Manual*. - Chernivtsi: Ruta, - 82s.

**Gutsuliak V.M. (1992)**, *Fundamentals of Landscape*: Teach. The user.-K.: SMC PA,1992.-60 p.

**Tanasiuk M.V. (2010)**, *Landscape-geochemical analysis of rural geo-systems* (for example Drachynetskoyi key areas of Bukovina) / Scientific Bulletin of Chernivtsi University: Collected Works. 2010. S. 38-41.

\*\*\* (1978), *Nature of Chernivtsi region* / edited by K.I. Gerenchuka - Lviv: High School, 1978. – 160 p.