GEOINFORMATICS 2021

EAGE

21164

The importance of an integrated approach in solving scientific and practical issues of geology, geomorphology, paleogeography of the Left Bank of the Middle Dnieper

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SUMMARY

Development of relief and paleogeography of the territory of the hydrographic basin of the Left Bank of the Middle Dnieper in the middle and late Pleistocene in the publications of researchers are most often associated with direct and side effects of the Dnieper glaciation. This applies, in particular, to the problem of restructuring the quaternary hydrographic network of the territory. The glacier squeezed out compensatory shafts, created dams and before him there were glacial pools. These were changed the course of erosion-accumulation processes in the riverbeds, valleys, and the entire basin. This inevitably caused the restructuring of the hydrographic network: intra-valley, intra-system and intersystem structures of the hydrographic system. Glacioisostasis also plays an important role. Specific examples of restructuring is interception collision, upper and lateral collisions. Hydrographic basin of the Left Bank of the Middle Dnieper is located on the Dnieper-Donetsk depression (DDD), which according to a set of geological, geophysical, paleogeographic, paleogeomorphological data is an active geodynamic structure. Studies of various issues of Quaternary geology, geomorphology and paleogeography of the Left Bank of the Middle Dnieper should be conducted on a comprehensive basis, which is created geology, geophysics, paleogeomorphology. It is necessary to take into account and link the results obtained for this area, as well as the results of research in other regions.

Introduction. The territory of development of the modern hydrographic network of the basin of the Left Bank of the Middle Dnieper is of considerable practical and scientific interest. It is almost entirely located within the Dnieper-Donetsk depression (DDD). Various mineral and other natural resources are concentrated here, and various constructions (hydraulic, reclamation, etc.) are underway. DDD has a complex structural and tectonic structure, geodynamically with the Paleozoic, which is reflected in its paleogeographical history. Now there are works in which various, including debatable, questions of geological and geomorphological development of the territory in the middle-late quarter stage of the territory are considered rather one-sidedly, without sufficient analysis of known geological, geophysical, paleogeographical, paleogeomorphological data and also taking into account new facts and approaches of other territories. The purpose of this material is to draw attention to them, to analyze, to use in solving various controversial issues of geology and geomorphology of the hydrographic basin of the Left Bank of the Middle Dnieper.

Method and/or Theory. Theories, methods and materials were used in the study:
• *general systems theory* identify elements of the natural system and the relationships between them;
• *geomorphosystem analysis* reveals the structure and dynamics of the geomorphosystem of the territory
• *structural-tectonic analysis* examines the geostructure of the territory;
• *paleogeographic analysis* reconstructs the evolution of the natural system of the territory;
• *paleogeomorphological analysis* reconstructs the history of the geomorphosystem of the territory;
• *morphostructural analysis* reveals the influence of geological structure on the development of the geomorphosystem of the territory in the Mesozoic-Cenozoic;
• *neotectonic analysis* reveals the influence of neotectonic structure on the development of the geomorphosystem of the territory;
• *cartographic method* uses and compares various general and special maps.

Examples (Optional). Various scientific and applied issues of geology, geophysics, paleogeography, paleogeomorphology, geomorphology of the Left Bank of the Middle Dnieper were studied at different times by soviet and ukrainian researchers - V. Bondarchuk, M. Balukhovsky, G. Bushinsky, M. Veklych, V. Halytsky, V. Gavrish V. Gontarenko, G. Goretsky, G. Dolenko, P. Zamoriy, E. Kabyshev, V. Kitik, B. Lichkov, Z. Lyashkevych, B. Malyuk, O. Marynych, D. Sobolev, V. Sologub, I. Chebanenko, A. Chekunov, I. Chervanev, M. Chirvinskaya and others. They obtained important data that can be directly and indirectly taken into account for interpretations of various issues of debatable nature of quaternary geology, paleogeography, geomorphology of this area, which in recent years have been raised in the works of Yu. Lavrushin, A. Matoshko, V. Chugunny, V. Pazynych, A. Karpenko. (Karpenko, 2018; Matoshko and Chugunny, 1993; Pazinich, 2007).

Results of investigations. Development of relief and paleogeography of the territory of the hydrographic basin of the Left Bank of the Middle Dnieper in the middle and late Pleistocene in the publications of researchers are most often associated with direct and side effects of the Dnieper glaciation. This applies, in particular, to the problem of restructuring the quaternary hydrographic network of the territory. According to some researchers (Karpenko, 2018), glacial tongues densely filled the valleys of the Dnieper, Desna, Sejm and other rivers. This changed the position of the channels. The glacier squeezed out compensatory shafts, created dams and before him there were glacial pools. As a result, the bases of erosion rose and this significantly changed the course of erosion-accumulation processes in the riverbeds, valleys, and the entire basin. This inevitably caused the restructuring of the hydrographic network: intra-valley, intra-system and intersystem structures of the hydrographic system. In such a development scenario, *glacioisostasis* also plays an important (if not the main) role. Specific examples of restructuring, in particular, is *interception*. Among their known types, within the hydrographic basin of the Left Bank of the Middle Dnieper are interception of the *collision* that occur during system self-development (*evolutionary path*) and interception of *upper* and *lateral* collisions which are caused directly or indirectly by *external* factors (*catastrophic path*).

To such external factors of hydrographic network reconstructions in the middle and late Pleistocene of the Left Bank of the Middle Dnieper, most authors include mainly cover glaciers and lake basins that formed *in front of them*, including the so-called *glacioisostasis* flowing lakes. Here are some geological

data (for example, the direct occurrence of the Dnieper moraine on lake sediments). Fluctuations in the level of lakes changed the basis of erosion and the passing of morpholithogenesis (erosion, transit, accumulation) within the hydrographic basin. Overflow of the pool with meltwater and loose sediments created supports (dams) in river valleys, which could lead to overflow of water through watersheds into neighboring basins.

An external factor that could to give reconstructings in the hydrographic network in the Dnieper basin is also called *glacioisostasis*, which could act *simultaneously* with the glacier (created compensatory shafts in front of its edge) and appear *after* the disappearance of the glacier. References are often made to theoretical works (T. Jameson, E. Artyushkov, S. Ushakov, M. Kras) made for others glaciodynamic zones of *cover continental glaciations* (Baltic, Canadian shield), where the glacier was fed and its capacity was kilometers. *Apparently*, it would not be entirely expedient to extend this *isostatic model* to the Left Bank of the Middle Dnieper, where only individual glacial tongues with a thickness of tens of meters could exist With such a thickness of glacial bodies, it was unlikely that isostatic shafts could occur in front of a glacier even a few meters high, which could be enough to form glacial lake basins. To show the role of isostasis after the disappearance of the glacier, they sometimes point to the lake sediments on the Ukrainian ihield raised by it for tens of meters, which had previously accumulated in the Dnieper Valley. It should also be noted that in the areas of the Canadian and Baltic Shields, the Eastern European Plain (Estonia, the Volga Region), which were blocked by glaciers, after the rise of glaciers, local seismic shocks, probably of a glaciostatic nature, are often recorded. On the map of earthquake epicenters of Ukraine (Atlas of natural conditions..., 1978), seismic centers in the Dnieper basin are not identified.

It should be noted that few geologists and geomorphologists call *tectonics* an important external cause of reconstructions in the hydrographic network of the Left Bank of the Middle Dnieper, which, in our opinion, contradicts *many known facts*.

After all, the hydrographic basin of the Left Bank of the Middle Dnieper is almost entirely located on the platform geostructure of the Dnieper-Donetsk depression (DDD), which is expressed on the surface by a relatively low-contrast Dnieper lowland. However, according to a set of geological, geophysical, paleogeographic, paleogeomorphological data, DDD is an *active geodynamic structure*, in the structure of which there are 2 main structural elements - *actually DDD* and *avlacogen*. The prehistory of the DDD begins with the reef, when, according to most scholars, due to the collapse of the Sarmatian shield, *a rift split (**avlacogen***) was formed, which separated the Ukrainian Shield (US) and the Voronezh Anteclisis (VA). Avlakogen increased and included in the lowering more and more adjacent areas and so formed DDZ. *Subsequently, the tectonic evolution of avlacogen and the actual DDD determined the main features of their paleogeographical history.* In the Ordovician- Carboniferous there was a large polygenic accumulative plain. From north-west to south-east it was crossed by a *paleovalle*y, which ended in a large *paleodelta*. The tropical vegetation developed in the gave a lot of organic material, which was later transformed into coal deposits of the Donetsk basin. In the Devonian and early Permian, the arid climate prevailed here, and in the lakes and lagoons of the plains *evaporites (rock salt*) accumulated. In the late Permian-Triassic, DDD was isolated, and salt continued to accumulate in self-contained lake basins. From the Early Jurassic (toar), the DDD periodically connected with the seas to the south and southeast of it (bayos, kelway-early chimerage). In the late chimerage-alb there is a rise, in the tour-campaign there is a fairly wide connection with the southern seas. In Maastricht, there is again a rise, which was cut by a narrow strait connecting them and the DDD. In the early and middle Eocene, a massive uplift continues, and in the late Oligocene, a wide connection with the southern seas is restored. From the torton the seas moved away from the DDD to the south, but continued to periodically advance into its south-western part (approximately to the latitude of present-day Zaporizhia). In the Paleozoic and Mesozoic in the DDD periodically the seas penetrated from the north and northeast. In the neotectonic (Neogene-Quaternary) stage in the DDD there are radical changes in orohydrography: its axis is increasingly shifted from east to west. During the Quaternary there was a "skew" of the exposed surface in the DDD and the Dnieper came close to the US, and in some places went into its territory (Atlas paleoheohrafichnykh kart…, 1960; Paleogeomorphological atlas..., 1983; Komliev, 2005).

Avlacogen. This basic element of DDD is still tectonically active. This is expressed in modern relief. Specific orohydrography has been developed over avlacogen. Rectangular bends of riverbeds, single hills formed by subtectonic processes (salt tectonics) and local tectonic structures (and oil and gas) indicate significant geodynamic activity. According to geological and geophysical data, avlacogen is differentiated into tectonic blocks, the delineation of which is determined by diagonal and orthogonal systems of tectonic faults. The general direction of avlacogen is quite clearly expressed in orohydrography in its south-eastern and north-western parts. In the central part, the aulacogen intersects crosswise with a strip of north-east-south-west directions, to which the rivers Vorskla, Psyol, Khorol, Sula are confined, and at depth gypsometric ledges, flexures, anticline structures of Paleozoic rocks, and salt predominate. It should be noted that when crossing the edges (especially southwestern) avlakogen valleys of these rivers dramatically change the direction, which coincides with the general (including Uday, Khorol, Orzhitsa, Oreli and other rivers). In this zone in river valleys interceptions are fixed, and in the buried relief gradient sites, ladders, inversions of the buried and exposed reliefs, the increased heat stream is observed. In recent years, the data obtained on the *structures of the central type* (CCT), and especially the *morphostructures of the central type* (MCT) (Bortnyk, 2002), indicate the latest and current geodynamic activity of avlacogen and DDZ, in general.

It is also necessary to mention the trans-regional *North-Ukrainian horst-graben zone* (NUHGZ) of tectonic-magmatic activation in the Mesozoic-Cenozoic orthogonal system of faults, identified by some researchers (Goyzhevsky et al., 1977). Which is characterized by submeridional and sublatitudinal extensions of orohydrographic elements. NUHGZ cross the valleys of the Dnieper and Desna. Within its borders, on the right bank of the Dnieper, is the Chornobyl-Chistogalivsky glaciodislocation complex, which continues to the south along the Kaniv Mountains, the Moshnogorsky Ridge, and the Pivykha Mountain. These phenomenal objects, according to some researchers, were formed by the powerful dynamic action of the Dnieper glacier. It should be noted that they are all located in the hinged (transitional) zone of the US, its northeastern slope and DDD. In the buried relief of this zone there are directed towards the DDD, and in the crystalline basement of the system of subparallel tectonic cracks, a complex mosaic of different igneous and metamorphic rock complexes.

The geodynamic activity of this area is evidenced by other data, in particular the *geophysical traverses* of the Eastern European platform, which within the hinge zone are detected rises in the roof of the asthenosphere (Geotectonics of Volyn-Podolia, 1990).

Accumulated data on Antarctica, Greenland, directly indicate the presence of large lake systems under their ice sheets. This may be a confirmation of the interpretation of some geological data (moraine occurrence on lake sediments) on the existence of subglacial lakes during the onset of glaciers within the Eastern European plain.

Some researchers observing the geological cuts of the Dnieper moraine in the territory of Zhytomyrsky Polissya, note the peculiarities of the inclusion of large rocks in the moraine, which seem to "float" in it. According to him, at this time there was a cold pool of water, where ice floated with the rocks included in them, which fell to their bottom (Koshik et al., 1976, 1987). Some of our data (Komliev, 1988; Komliev, 2013; Komliev et al., 1985) directly indicate the absence of excavation of the Dnieper glacier on the underlying surface (according to the comparison of the variabilities of chemical composition ilmenite in the moraine and directly below it are placer bodies). This fully confirms the modern view that excavation *is not possible* according to the *laws of physics*, because the glacier, in order to move, and not cling to the protrusions of the underlying surface, must be *plastic* or swim on the water. Here, it may be appropriate to mention the ***drift*** hypothesis, which was central to Quaternary geology before the advent of glacialism.

Observations of ice sheets on other planets provide important information. Despite different opinions about the composition of Martian ice (ordinary, dry, other), the seasonal dynamics of the ice cover on Mars attracts attention, which during the Martian year then decreases significantly (ice evaporates), then re-formed. In this regard, the idea of embryonic (local) glacial centers, which, in the epoch of cooling, could be formed within the territory of Ukraine, is gaining popularity.

Conclusions. Studies of various issues of Quaternary geology, geomorphology and paleogeography of the Left Bank of the Middle Dnieper should be conducted on a comprehensive basis, which is created by various related geological disciplines, geophysics, paleogeomorphology. It is necessary to take into account and link the results obtained for this area, as well as the results of research in other regions. Research on controversial issues related to continental glaciation of the territory of Ukraine should no longer use the incompletely analyzed own materials, as well as new research data on the ice sheets of Antarctica, Greenland, our planet, and other planets (Mars).

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