ІІІ. ПРИРОДНИЧА ГЕОГРАФІЯ: ТЕОРІЯ ТА ПРАКТИКА

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ЛІТОЛОГІЧНА ТА СЕДИМЕНТАЦІЙНА ХАРАКТЕРИСТИКА РУСЛОВОГО АЛЮВІЮ РІЧКИ УЖ

Мета. Визначити літологічні особливості та реконструювати умови седиментації руслового алювію річки Уж шляхом аналізу гранулометричного і петрографічного складу гравійно-галечникового матеріалу, його обкатаності та просторової диференціації алювіальних відкладів, з метою встановлення характеру їх нагромадження під час паводків у різних субсередовищах русла.

Методика. Дослідження базується на комплексному застосуванні літологічних методів, спрямованих на вивчення морфологічних, текстурних, гранулометричних та петрографічних характеристик алювіальних відкладів, що дозволяє реконструювати умови їхнього осадонагромадження. Методика включає такі етапи: польове обстеження та картування, аналіз внутрішньої текстури відкладів, гранулометричний аналіз, комплексний аналіз уламків, мінералогічний та фізико-механічний аналіз.

Наукова новизна. Уперше здійснено комплексну літологічну характеристику руслового алювію річки Уж у межах міста Перечин із реконструкцією умов його седиментації на основі порівняльного аналізу проб з різних глибин. Виявлено просторову диференціацію фракційного складу та текстурних ознак, що дозволяє уточнити механізми нагромадження алювіальних відкладів під час паводків різної інтенсивності.

Практична значущість. Практична цінність дослідження полягає у забезпеченні науково обґрунтованих даних для ефективного управління річковою системою Ужа, зокрема щодо мінімізації ризиків паводків та берегової ерозії. Отримані результати сприятимуть територіальному плануванню Перечина та прилеглих районів, розробці природоохоронних заходів, а також вдосконаленню моніторингу і управління водними ресурсами відповідно до європейських стандартів водного господарства.

Результати. У статті представлено результати дослідження основних літологічних характеристик алювіального гравійно-галькового шару русла річки Уж у межах міста Перечин. Розглянуто гранулометричний та петрографічний склад гравійно-галечникового матеріалу, ступінь його округленості, форму, а також особливості просторового розподілу фракцій. Окрему увагу приділено реконструкції умов осадонагромадження досліджуваного алювію. У ході польових робіт здійснено детальне відбирання проб із двох серій на різних глибинах, що дозволило визначити особливості текстури та складу відкладів у розрізі.

Встановлено, що алювіальні відклади у Перечинській ділянці в нижніх та середніх частинах акумулювались під час паводків у межах основного русла, тоді як верхня частина алювіального валу формувалась у дрібних рукавах, де неодноразово перероблялася наступними паводками. Виявлено суттєву присутність піщаного матеріалу, що осідав разом із гравійно-галечниковим під час короткочасних паводків високої потужності. Переважання дрібних фрагментів та майже повна відсутність валунів вказують на невисоку транспортну здатність потоку та незначний ухил русла річки.

На основі гранулометричного та петрографічного аналізів двох серій проб, відібраних на різних глибинах, встановлено суттєві відмінності у текстурі, складі та ступені округленості уламкового матеріалу. Гранулометричний аналіз показав, що у верхньому горизонті (0–35 см) переважає грубоуламкова фракція (>40 мм), яка становить 43,0% загальної маси зразка, тоді як дрібні фракції (<2 мм) складають 30,4%. Натомість нижній горизонт (70–92 см) характеризується середнім ступенем сортування, де дрібноуламковий матеріал становить 32,5%, а грубоуламковий — 27,6%, що свідчить про нижчу гідродинамічну енергію під час осадонагромадження. Серед літологічних різновидів домінують пісковики (до 68% у верхніх та 70% у нижніх зразках), представлені разом із вулканітами (андезити, базальти, дацити), алевролітами та гравелітами.

Ключові слова: гранулометричний склад, петрографічний склад, округлість, класифікація, умови седиментації, річка Уж, Україна

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LITHOLOGICAL AND SEDIMENTATION CHARACTERISTICS OF THE RIVERBED ALLUVIUM OF THE UZH RIVER

Objective. To determine the lithological features and reconstruct the sedimentation conditions of the channel alluvium of the Uzh River by analyzing the particle size distribution and petrographic composition of gravel-pebble material, its run-in and spatial differentiation of alluvial deposits, in order to establish the nature of their accumulation during floods in different subenvironments of the channel.

Methods. The study is based on the complex application of lithological methods aimed at studying the morphological, textural, granulometric and petrographic characteristics of alluvial deposits, which makes it possible to reconstruct the conditions of their precipitation. The technique includes the following stages: field survey and mapping, analysis of the internal texture of sediments, particle size analysis, complex analysis of fragments, mineralogical and physico-mechanical analysis.

Scientific novelty. For the first time, a comprehensive lithological characterization of channel alluvium of the Uzh River within the city of Perechyn was carried out with the reconstruction of its sedimentation conditions based on a comparative analysis of samples from different depths. Spatial differentiation of fractional composition and textural features has been revealed, which makes it possible to clarify the mechanisms of accumulation of alluvial sediments during floods of varying intensity.

Practical significance. The practical value of the study lies in providing scientifically based data for effective management of the Uzh river system, in particular on minimizing the risks of floods and coastal erosion. The results obtained will contribute to the territorial planning of Perechyn and adjacent areas, the development of environmental measures, as well as the improvement of monitoring and management of water resources in accordance with European standards of water management.

Results. The article presents the results of a study of the main lithological characteristics of the alluvial gravel-pebble layer of the Uzh river bed within the city of Perechin. The granulometric and petrographic composition of the gravel-pebble material, its degree of roundness, shape, and spatial distribution of fractions are considered. Particular attention is paid to the reconstruction of the sedimentation conditions of the studied alluvium. During field work, detailed sampling was carried out from two series at different depths, which made it possible to determine the texture and composition of the deposits in the section.

It has been established that alluvial deposits in the Perechyn section in the lower and middle parts accumulated during floods within the main channel, while the upper part of the alluvial embankment was formed in small branches, where it was repeatedly reworked by subsequent floods. A significant presence of sandy material was found, which settled together with gravel and pebbles during short-term high-power floods. The predominance of small fragments and the almost complete absence of boulders indicate the low transport capacity of the flow and the insignificant slope of the river channel.

Based on granulometric and petrographic analyses of two series of samples collected at different depths, the research identified significant variations in texture, composition, and roundness of debris materials. The granulometric analysis revealed that in the upper layer (0–35 cm) coarse debris (>40 mm) dominates, accounting for 43.0% of the total mass, while fine fractions (<2 mm) represent 30.4%. In contrast, the lower layer (70–92 cm) is medium-sorted, with 32.5% of fine debris and 27.6% of coarse components, indicating lower hydrodynamic energy during sediment deposition. Sandstone prevails among lithological types (up to 68% in upper and 70% in lower samples), accompanied by volcanic rocks (andesites, basalts, dacites), siltstones, and gravelites.

Keywords: granulometric composition, petrographic composition, roundness, grading, sedimentation conditions, Uzh river, Ukraine.

Introduction. For many reasons, such as technical, scientific, methodological and other, lithological studies are relatively simple, except perhaps for granulometric analyses, especially of sandy-clay fragments and physical and mechanical properties of rocks, which require a certain level of laboratory equipment. All other studies are carried out during the field stage of research, including primary analyses of the mineralogical composition of sediments. In view of the above circumstances, as well as the range of fundamentally important palaeogeographical tasks that can be solved with their help, the value of

lithological research in any territory becomes obvious. Lithological studies allow, in particular, to solve the following problems:

a) stratigraphic subdivision and correlation of sediments;

b) facial division of sediments;

c) palaeogeographical reconstruction of sedimentation stages (Yatsyshyn et al., 2009).

The Ukrainian part of the Uzh River basin is located within the Alpine folded structure and also covers the central part of the Carpathians with the adjacent Transcarpathian trough. The study area is located within the Chop-Mukachevo depression and the Chop-Berehove structural and facies zone. The Transcarpathian depression is represented by deposits from the Palaeozoic, Mesozoic and Cenozoic eras.

The relevance of this study is due to the insufficient development of the topic, the lack of lithological and sedimentary characteristics of the channel alluvium of the Uzh River. In this regard, there was a need to systematise materials and knowledge. This research is also relevant because lithological studies make it possible, in particular, to solve the problems of stratigraphy and correlation of sediments and paleogeographical reconstructions of the main stages of sedimentation of the Uzh River.

Studies of river sediments (particle size distribution, distribution, petrography) are important for understanding geomorphological and ecological processes within the river catchment (Deshmukh, 2024; [Lupin 2020; Khan & Valentino 2022; Li et al. 2023). The applied nature of the results of this study is also indicated by the works of Basu, Maju-Oyovwikowhe, Martins and others (Basu, 2003; Gert and Hilmar, 2004; Magar et al., 2016; Maju-Oyovwikowhe & Sunday, 2022; Martins, 2003). It is also important to note the results of the authors' previous research, which allow for a broader analysis of the chosen topic and the possibility of their continuation (Mykyta et. al.., 2022; Rusyn et. al.., 2023 a, b).

Based on the theoretical and practical principles of lithological research methods, we have carried out a lithological and sedimentological characterisation of the Uzh riverbed alluvium. All this will allow us to reconstruct the sedimentation conditions of the studied alluvial gravel and pebble stratum of the Uzh riverbed within the city of Perechyn, Zakarpattia Oblast, western Ukraine.

The purpose of the research is to determine the main lithological characteristics of the alluvial sediments of the Uzh riverbed within the city of Perechyn, in particular the granulometric and petrographic composition of gravel and pebble material and its roundness, as well as to reconstruct the conditions of sedimentation of these sediments.

Tasks to be solved:

- carry out a detailed analysis of the particle size of sand, gravel and pebble material;
- assess the extent of roundness of sandy-gravel and pebble debris in the riverbed;
- to determine the conditions and processes that affect the accumulation of alluvial sediments in different parts of the Uzh riverbed;
- analyse the transport capacity of the river flow and slope based on the collected information;
- contribute to improving the practice of monitoring and management of river systems, using the results obtained.

The practical significance of the results. The results of the study can be used to develop effective engineering measures to manage the riverbed, which will help reduce the risk of flooding, bank erosion and ensure the sustainable functioning of the river system.

The findings of the study can be used to create effective environmental protection plans that include the preservation and restoration of the natural conditions of river systems, planning the development of areas along the Uzh river, and to improve the practice of monitoring river systems.

The results can be used to improve the monitoring and management of water resources in the Uzh, including in the development of spatial development strategies for the basin. The study also provides a basis for monitoring the ecological status of the river system and its biodiversity. The collected data can be used to improve water resource management in the region and to implement European standards in the field of environmental safety, which is particularly relevant in the context of adaptation to climate change. In addition, the study of the lithological parameters of alluvium allows for a deeper understanding of the palaeogeographical conditions of sediment accumulation and solves the problem of stratigraphic correlation of Quaternary deposits, which is relevant in the context of climate change and the implementation of European Union standards in the field of environmental management.

Study area. The Uzh River originates in the mountains in the north-west of the Transcarpathian region at the foot of the Verkhovyna ridge. It is there, at an altitude of 970 m, that the two streams Uzh and

Uzhok merge into a single river. The upper part of the Uzh river basin is located on the slopes of the Verkhovyna ridge (absolute heights of about 1000-1200 m) and the Polonyna ridge (absolute heights of about 900-1480 m). Therefore, at first, the river flows in a wide intermountain valley, then skirts the western slopes of the Polonynskyi range, crosses the Volcanic Range and enters the plains near the city of Uzhhorod. The highest mountain in the basin is Polonyna-Runa, which is 1480 m high. The relief in the upper part of the river basin is medium- and low-mountainous, in the middle part it is ridge-like, and in the lowlands it is flat (Fig.1).

The river is 128 km long, 107 km within Ukraine. The basin covers 2750 km² (2010 km² within Ukraine). The total drop of the river is 775 m, with an average slope of 7.2%. The basin is asymmetrical and pear-shaped. It is 66 km long, with an average width of about 30 km and a width ratio of 0.47. The valley of the Uzh river is winding, V-shaped, at the source, below the villages of Luh, Zhornava, Sil, it has the form of a gorge, mostly dimpled, and below the city of Uzhhorod it is not clearly defined.

Figure 1 Location Map of the Study Area (compiled by the authors using the Google Earth service)

The Uzh river channel is moderately branched and winding. Near the source, it has several waterfalls with a drop of 0.3 - 0.5 m. The river is about 1 m wide in the upper reaches, gradually increasing to 15-30 m downstream, reaching 135 m near the city of Uzhhorod, and 0.1-0.6 m deep, with the greatest depth of 2.6 m. The bottom is uneven, coarsely stony and pebbly, sometimes rocky. Near the city of Uzhhorod, the bottom is mostly pebbly and silted up near the shore. The banks are steep and fragmentary with a height of about 1-2 m, sometimes reaching 6-8 m.

Materials and Methods. Lithological research methods are based on the study of sedimentary features that reflect certain components of the geographical environment of the Uzh River basin. Such features, in particular, are:

1) forms and conditions of sediment occurrence;
2) the bedding of the sediment layer;
3) general properties of the sediments (colour, composition, presence of organic remains (fossils) et. al.);
4) sediment granulometry;
5) morphometry, petrography (comprehensive analysis of fragments);
6) mineralogical composition (medium- and small-scale sediment fractions);
7) physical and mechanical properties of sediments;
8) other analyses, the use of which is determined by the peculiarities of the studied strata.

During the study of interlayer surfaces, special attention is paid to the analysis of strata contacts, as they indicate how sedimentation conditions change: abruptly or gradually, with the return or complete displacement of previous conditions, with or without erosion, and other important palaeogeographic events.

Bedding analysis. The internal texture of a sediment layer is understood as a set of features of the rock structure caused by the orientation and relative position of the sedimentary rock components. The internal bedding is expressed through the following changes in the characteristics of the rock components (Ivanina, 2008):

- changes in the material composition of the rock in individual layers;

- changes in the particle size distribution of sediments;
- layer-by-layer colour change (striping);
- inter-parallel arrangement of flattened particles.

Granulometric analysis. The most common lithological method for studying sediments is granulometric rock analysis, which involves dividing a certain volume of rock into groups of fragments of different sizes - fractions - and identifying their quantitative ratios. Although the method plays an auxiliary role in complex lithological studies, it provides the following:

- drawing conclusions about the conditions of sedimentation, in particular, changes in the dynamics of subaquatic (alluvial pebbles, sands, et. al..) and subaerial (loess, sands, et. al..) accumulation environments;
- obtaining characteristics of the physical properties of rocks;
- further research (mineralogical and other).

The following rules were followed during sampling for particle size analysis (Yatsyshyn et. al.., 2009):

1) onducting field surveys with a preliminary determination of the composition of individual layers;
2) large fractions (up to gravel) are taken into account approximately (their percentage in the sample);
3) small fractions (starting with sands) are selected with a weight of up to 0.5 kg;
4) the number of samples depends on the diversity of the rock layer composition;
5) a series of samples is taken from the same horizon vertically and horizontally.

Depending on the composition of the sediments, the following methods of granulometric analysis were used (Yatsyshyn et. al.., 2009) visual (approximate), sieve (the most common), and settling in calm water (to separate particles with a diameter of 0.1 mm or more from sand particles only). In a liquid, the falling velocity of small particles is constant and directly proportional to their diameter.

The following requirements were met during the sampling for granulometric analysis of sands (Pavlov, 2014):

a) the sample should characterise the average composition of the rock, so the sample is taken perpendicular to the formation surface;

b) the weight of the sample should be at least 150-200 g, taking into account that the weight for sieve analysis should be at least 50 g;

c) when working with coarse-grained sands containing inclusions of gravel grains, the sample weight should reach 400-500 g.

Comprehensive debris analysis. The description of morphology and petrography (complex analysis) was carried out primarily for coarse-grained debris - boulders, blocks, gravel, crushed stone, pebbles, and cobbles. Morphological studies of the debris are aimed at solving three tasks:

1) creating a basis for describing and classifying the debris;
2) reconstructing the history of debris exposed to abrasion in the sedimentary cycle;
3) determination of the mechanical and hydraulic behaviour of the debris during the transfer process.

Results and Discussion. The Perechyn section is located within the city of Perechyn, near the Perechyn-Svaliava road. The thickness of the channel alluvium is 92 cm. The gravel and pebble bed is exposed only in the upper part, due to the rather high water level. Unfortunately, the middle and lower parts of the alluvium thickness are not available for study (Fig. 2). The age of rocks and minerals in the section corresponds to the Holocene.

Figure 2 Perechyn section (author – Mykhailo Mykyta, date – 21/06/2024)

The alluvial unit is represented from top to bottom by the following lithological features. The bedrock deposits are not exposed in the section. From 0 to 20 cm, vegetation soil is observed, which is represented by light sandy loam, but layers of fine sand, which is dark brown in colour, are distinguished. The horizon is pierced by plant roots. No spots of manganese and iron ore were found in the gravel and pebble pack. The interlayering of sandstones and Neogene sands can be seen below, at a distance of about 30-70 cm, with their content increasing significantly with depth. The coarse-grained component of the samples includes various types of rocks, such as sandstones, siltstones, black flint, gravels, quartz and volcanic rocks.

Figure 3. The first series of samples in the Perechyn section (author – Mykhailo Mykyta, date – 21/06/2024)

The granulometric composition of this bed sediment layer is as follows (Table 1).

Table 1.

Results of granulometric analysis of the first series of samples (compiled by the authors)

Fraction diameter, mm	Granulometric composition of the sample	
	weight, kg	content, %
More than 40	2,80	43,0
40-10	1,20	18,4
10-2	0,53	8,2
Less than 2	1,97	30,4

The distribution of debris material in the first series of samples by fractions indicates a good sorting of alluvial material - the horizon is dominated by a coarse debris component, which makes up 43.0% and a fine debris component, which in turn accounts for 30.4% of the total mass of the sample. This fraction is represented mainly by sandstone. The coarse debris component of the sample includes various types of rocks, namely sandstones, which account for about 68% of the total amount of debris, and the remaining 32% is formed by volcanic rocks, namely andesites, basalts, dacites and gravels.

Among the fragments over 40 mm in size, of which there were 15, 5 different rocks were found - sandstones dominate in this fraction, with 9 of them. The fraction also contains 3 units of andesite, 1 basalt, 1 gravelite and 1 dacite. Sandstones are divided into two predominant groups by size: one group is represented by fragments measuring 45-50 mm in long axis, about 7 of them, and the other group includes sandstones measuring 80-90 mm in long axis (Fig. 4).

Figure 4. Debris larger than 40 mm in the first sample (author – Mykhailo Mykyta, date – 21/06/2024)

There were few boulders, with only 3 sandstones reaching 100-170 mm in long axis. The largest of the boulders was about 128 mm in size and weighed 350 grams.
Among the 40-10 mm fragments, 70% of the total number of fragments in the fraction are sandstones and gravels with veins of white quartz, the second component, about 27% of the total number of fragments in the fraction, is formed by volcanic rocks, namely andesites and basalts, the third component, about 3%, is black flint (Fig. 5).

Figure 5. Fragments measuring 40-10 mm in the first sample (author – Mykhailo Mykyta, date – 21/06/2024)

Among the 10-2 mm debris, 52% of the total debris in the fraction is from flysch rocks, namely sandstone and gravelites, and the remaining 48% is formed by volcanic rocks, namely andesites and dacites.
Among the fragments less than 2 mm in size, about 42% of the total fragments in the fraction are white quartz, the second component is sandstone, and about 26% are volcanic rocks, namely andesites and basalts.
The second series of samples was taken from a depth of 70-92 cm from the gravel and pebble layer, which is 35 cm below the sampling site 1 (Fig. 6).

Figure 6. Second series of samples in the Perechyn 1 section (author – Maryana Salyuk, date – 22/06/2024)

The granulometric composition of this bed sediment layer is as follows (Table 2).

Table 2.

Results of granulometric analysis of the second series of samples (compiled by the authors)

Fraction diameter, mm	Granulometric composition of the sample	
	weight, kg	content, %
More than 40	1,80	27,6
40-10	1,40	21,5
10-2	1,20	18,4
Less than 2	2, 10	32,5

The material in the sample is medium-sorted, with a slight predominance of small fragments of alluvial material, which accounts for 32.5% of the total mass of the sample debris. The coarse debris component of the horizon's alluvium accounts for 27.6 % of the total mass of the sample.

The coarse-grained component of the sample contains various types of rocks, namely sandstones, which dominate all fractions, andesites, basalts and black flint. Among the fragments over 40 mm in size (22), 4 rock types were identified - sandstones dominate in this fraction, with 14 of them. Also, 4 pieces of andesite, 2 gravelites and 2 argillites were found in the fraction (Fig. 7).

Figure 7. Debris over 40 mm in size in the second sample (author – Maryana Salyuk, date – 22/06/2024)

There are few boulders among the sample fragments, only one sandstone, which measured 102 mm in long axis (Fig. 8).

Among the 40-10 mm fragments, 68% of the total number of fragments in the fraction are sandstones and sandstones with quartz veins, the second component, about 29% of the total number of fragments in the fraction, is formed by volcanic rocks, namely andesites, the third component, about 3% is white quartz pebbles (Fig. 9).

Figure 8. Sandstone with a size of 102 mm (author – Maryana Salyuk, date – 22/06/2024)

Figure 9. Sandstone with a size of 40-10 mm in the second sample (author – Mykhailo Mykyta, date – 22/06/2024)

Among the debris with a size of 10-2 mm, 58% of the total amount of debris in the fraction is made up of flysch rocks, namely sandstone, the second component, about 17% is formed by volcanic rocks:

andesites and basalts. Gravelites and siltstones make up the third component of about 12%. And the fourth component, about 3%, is black flint.

Among the debris less than 2 mm in size, about 80% of the total debris in the fraction is made up of flysch rocks, namely sandstone and siltstone, while the remaining 20% of the total debris is made up of volcanic rocks.

To determine the roundness of the alluvial material of the Perechyn 1 section, we used mainly sandstones and volcanic rocks, since they, firstly, retain their original shape, and secondly, are the predominant component of the coarse debris fraction of the alluvium. We did not use black flint and quartz, as they are rare.

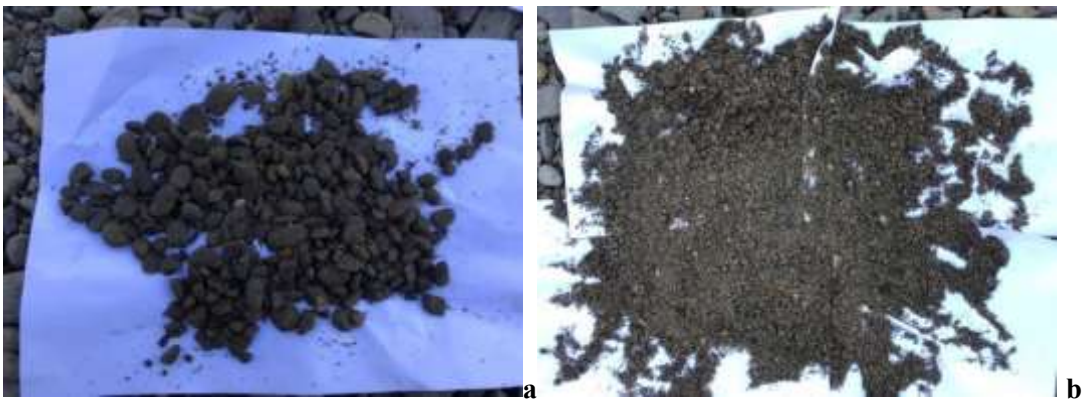
According to the degree of roundness, the first series of samples was divided as shown in Table 3.

Table 3.

The number of fragments with a diameter of more than 40 mm by the degree of roundness in the first series of samples ((compiled by the authors)

Roundness class	First series of samples
0	2
1	2
2	2
3	4
4	5

Among the fragments with a diameter of more than 40 mm from sample 1, very well-rounded fragments predominate, with 5 grains, while wellrounded fragments contain 4 grains and medium-rounded fragments contain 2 grains. As for the fragments that have no traces of roundness or are also called unrounded, there are 2 fragments, and 2 fragments that are poorly rounded. The degree of roundness in the other fractions of the first sample was determined as a percentage, as there is a large number of fragments. Of the 40-10 mm fragments, about 50% are medium-rounded fragments. However, about 50% of the fragments are well rounded, with rounded corners, worn edges and a rounded shape. Among the 10-2 mm fragments, well rounded fragments predominate (Fig. 10, a), accounting for 85% of the total number of fragments in the fraction and about 15 % of the extremely well rounded fragments. Debris with a size of less than 2 mm is classified as well rounded debris (Fig. 10, b).



a **b**

Figure 10. Well-rounded fragments: a - size 10-2 mm of the first series of samples; b - size less than 2 mm of the first series of samples (author – Mykhailo Mykyta, date – 22/06/2024)

The fragments of the second series of samples are divided according to the degree of roondness as shown in Table 4.

Among the fragments with a diameter of more than 40 mm from sample 2, very well rounded fragments (13 grains) predominate, with 2 fragments of good rounded and 2 fragments of medium rounded (Fig. 11). On the other hand, the number of unrounded fragments in the second set of samples was 2 fragments and the number of poorly rounded fragments was 3. The degree of roundness in other fractions was also determined as a percentage.

Table 4.

The number of fragments with a diameter of more than 40 mm by the degree of roundness in the second series of samples ((compiled by the authors)

Roundness class	Second series of samples
0	2
1	2
2	3
3	2
4	13

Figure 11. Medium-rounded fragments larger than 40 mm in size from the second series of samples (author – Mykhailo Mykyta, date – 22/06/2024)

Among the 40-10 mm fragments, about 10 % of the total number of fragments in the fraction are medium-rounded fragments, while the largest share of about 50 % is in the 3rd class of roundness, i.e. they are well rounded fragments and 40 % of the total number of fragments in the fraction are very well rounded fragments. Among the 10-2 mm fragments, the largest share of about 60 % of the total number of fragments in the fraction is accounted for by well rounded fragments with rounded corners, worn edges and rounded shapes (Fig. 12, a). Around 20 % are extremely well rounded fragments and the smallest share of around 20 % are medium rounded fragments. Fragments with a diameter of less than 2 mm are classified as well rounded fragments (Fig. 12, b).

a **b**

Figure 12. Well-rounded fragments: a - 10-2 mm in size of the second series of samples; b - less than 2 mm in size of the second series of samples (Mykhailo Mykyta, date – 22/06/2024)

Studies of the gravel and pebble strata of the Perechyn section have shown that most of the fragments are disc-shaped and flat-oblong.

The obtained lithological characteristics of the channel alluvium of the Perechyn section indicate, first of all, two stages of sedimentation of alluvial material. During the first stage of sedimentation, the lower and middle thickness of gravel and pebble material of the channel facies of alluvium was formed. However, in the Perechyn 1 section, the middle and lower parts of the channel alluvium thickness are not exposed and are not available for study. The gravel and pebble bed is exposed only in the upper part. It can be assumed that the first stage of sedimentation belongs to the later stages of alluvium accumulation. The second stage of sedimentation is related to the upper gravel and pebble strata.

If we compare the selected samples, we can observe that in sample 1, which was taken from the upper 0-35 cm of the gravel and pebble thickness, the material indicates a good sorting of alluvial material - the coarse fragment component dominates in the horizon, accounting for 43.0% and the fine fragment component, which in turn accounts for 30.4% of the total mass of the sample. Among the fragments with a diameter of more than 40 mm from sample 1, very well rounded ones predominate. If we analyse sample 2, which was collected from a depth of 70-92 cm from the gravel and pebble strata, which is 35 cm below the sampling site of sample 1, the lithological parameters and conditions of sedimentation are different. The material in the sample is medium-sorted, with a slight predominance of small fragments of alluvial material, which accounts for 32.5% of the total mass of the sample. The coarse debris component of the horizon's alluvium accounts for 27.6 % of the total mass of the sample. The fragments over 40 mm in diameter from sample 2 are also dominated by very well rounded fragments. It should be noted that the Perechyn 1 section contains few fragments larger than 100 mm, i.e. boulders. The petrographic composition of gravel and pebble grains in the Perechyn section includes sandstones, siltstones, black flint, quartz, gravelites and volcanic rocks.

Analysis of the collected lithological information suggests that alluvial deposits in the Perechyn section in the lower and middle parts are accumulated during floods in the sub-environment of the main channel. The upper part of the alluvial bund was piled up in shallow sleeves and repeatedly needed to be reworked during subsequent floods. There is sandy material in the stratum, which was deposited simultaneously with pebble and gravel material during sudden short-term floods that transported this material. The fact that the alluvium is dominated by small fragments of pebble and gravel and almost no boulders indicates the low transport capacity of the stream and the low slope of the river.

Conclusions and Suggestions. Lithological research methods are based on the study of sedimentary features that reflect certain components of the geographical environment. Among the lithological studies of the alluvial material of the Perechyn section in the light of the geomorphological and paleogeographical problems being solved, we performed comprehensive analyses of its coarse fragmentary component, in particular, granulometry, grading, roundness, shape of the available fragments and their orientation.

Analysing sample 1 of the Perechyn section, taken from the upper 0-35 cm of the gravel and pebble alluvium, the material shows good sorting of alluvial material - the horizon is dominated by coarse debris component (43.0%) and fine debris component, which in turn accounts for 30.4% of the total mass of the sample. Among the fragments over 40 mm in diameter from sample 1, very well rounded ones predominate.

In sample 2, which was collected from a depth of 70-92 cm from the gravel and pebble layer, the material is medium sorted, with a slight predominance of small fragments of alluvial material, which accounts for 32.5% of the total mass of the sample debris. The coarse debris component of the horizon's alluvium accounts for 27.6 % of the total mass of the sample. The fragments over 40 mm in diameter from sample 2 are also dominated by very well rounded fragments.

The obtained lithological characteristics of the alluvium of the Perechyn section indicate, first of all, two stages of sedimentation of alluvial material. During the first stage of sedimentation, the lower and middle thicknesses of gravel and pebble material of the channel facies of alluvium were formed. However, in the Perechyn 1 section, the middle and lower parts of the channel alluvium thickness are not exposed and are not available for study. The gravel and pebble pack is exposed only in the upper part. It can be assumed that the first stage of sedimentation belongs to the later stages of alluvium accumulation. The second stage of sedimentation is related to the upper gravel and pebble strata.

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