ГЕОЛОГІЧНІ НАУКИ

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FORMATION AND DEVELOPMENT OF THE LOWER CRETACEOUS AND MIDDLE PALEOGENE RIVER VALLEYS WITHIN THE CENTRAL PART OF THE UKRAINIAN SHIELD

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The paleogeographic terms of becoming and development of Lower Cretaceous and lover Paleogene of river valleys are considered within the limits of central part of the Ukrainian shield. That the evolution of the Lower Cretaceous and lover Paleogene river valleys occurred in close spatial and paragenetic relations both with the ore-bearing weathering crusts crystalline basement rocks and to each other, which shows: in the spatial arrangement of the river valleys, their configuration and structure; facies depositional environment; material composition, minerals and their spatial distribution.
Keywords: rivers valley, lover cretaceous, middle Paleogene, Ukrainian shield, lithology.

Formulation of the problem. River valleys are crucial in the partition of the land topography, flushing, erosion, transportation of washout elements, their accumulation and formation of a wide range of minerals within the river valleys. In addition, river valleys, their deposits and configuration are the indicators of tectonic and paleo geographic conditions. Unfortunately, the research of river valleys of the past are neglected today. At the same time, today numerous paleo alluvial deposits of different ages witnessing the geological history of the area were saved from erosion in the hidden landscape of Ukraine and the Ukrainian shield (US).

Analysis of recent research and publications. Analysis of lithology and mineral resources of the continental fluvial formations within the central part of the US has shown that a wide range of minerals is inherent in formational units, which were formed by erosion and redeposition of chemical decomposition products of different ages and different petrographic composition of the crystalline basement rocks. These include lower cretaceous and middle Paleogene formations, which have saved in form of winding strips that resemble the contours of river valleys, which were scheduled by M.F. Veklich, A.A. Goyzhevsky et al.

The study of the abovementioned continental formations was associated primarily with finding deposits of refractory clay and bauxite, ilmenite placers and to a lesser extent monazite placer, gold.

Spatial distribution, stratigraphic dismemberment, structure, lithology and mineral composition, geochemistry of continental sediments were highlighted in articles and reports of Y.B. Bass, N.M. Baranov, K.O. Bezner, G.I. Bushynskyy, Y.I. Vetrov, M.A. Voronov, V.H. Hevorkyan, G.F. Gorbenko, F.M. Diss, S.Y. Egorov, Y.T. Ermakov, V.V. Zakharov, V.O. Zielinska, V.G. Zlobenko, V.Y. Zosimovych, O.F. Zuev, A.V. Ivannikov, I.P. Illichova, M.N. Klyushnykov, M.S Kovalchuk, C.A. Lyulyeva, A.K. Mazur, B.U. Mastystyy, A.P. Nikitina, L.F. Plotnikov, V.T. Pogrebnoy, K.I. Romanov, V.K. Ryabchun, S.E. Selin, V.M. Semenenko, G.S. Solovyov, V.V. Sukach, O.A. Shevchuk, G.A. Schwartz et al.

Identification of previously unsolved problems. Unfortunately, despite the long-term studies of continental sediments, formation and development connection of river valleys is insufficiently studied. Spatial cositing of paleo valleys was described in the paper of N.P. Semeniuk and K.M. Zarutsky Morphology of paleo valleys, lithology, gold and titanic iron ore mineralization were highlighted in scientific studies of M.S. Kovalchuk, U.V. Kroshko, V.V. Sukach.

Extinct scientific interest in these entities is due to several factors: debating points related to paleo geographic conditions of deposits formation, lithofacies, facies and stratigraphic differentiation; thesis that all mineral deposits associated with these deposits are discovered and investigated, or hopeless; availability of better and more profitable fields of such minerals.

Since the formation of minerals is closely connected with certain stages of river valleys development and determined by the presence of some facies conditions, often the local one, and the authors held paleopotamological and lithological studies of paleo alluvial deposits having a different age.

The article aims formulating. Establish cause and effect relationships of minerals with defined petrotypes basement rocks and their metallogeny. Specify and complement data regarding the spatial distribution, structure, chemical composition and facies conditions of formation of the Apt-lower Albian and middle Eocene continental fluvial deposits and associated minerals.

The major study material statement. Lower cretaceous (Barremian-lower album) deposits are the most ancient continental formations within the central part of the Ukrainian shield. The formation of the lower cretaceous continental deposits preceded Triassic-lower cretaceous period of relief peneplanation and intensive chemical and biological weathering of crystalline basement rocks. As a result, shield and linear kaolin and lateritic weathered layer, sometimes exceeding 120 m, were formed over the foundation area rocks of different genesis, age and petrographic composition.

Common to weathered layers is kaolinite upper zone, which changes down the stratigraphy (depending on the substrate rocks) by hydro micaceous -kaolinite, kaolinite-montmorillonite, montmorillonite zones. Below which is a leaching zone of bedrocks. Weathering layer rocks of basic composition (amphibolite, anorthosite, gabbro, etc.) include also kaolinite-hydrogoethite-gypsite zone, which spreads on kaolinite.

Mesozoic weathering layer has become a major material source for the formation of both the lower cretaceous and Paleocene continental sediments.

At the beginning of the early Cretaceous (Berriasian-Valanginian age) most of the central part of the US was the firm land with the climate of late Jurassic [7, 8]. Climate humidity led to precipitation enhancement, which resulted in early formation of both temporary and permanent river streams within the firm land. During Hauterivian-Barremian age, in the central part of the US there was accumulation of kaolin clay with carbonaceous inclusions within the small-sized hollows, and on the eastern slope of the US there were locally accumulated argillaceous clays, shale oil (Rittmeister layers) [7, 8]. On the southern slopes of the central part of the US there was accumulation of terrigenous rocks of K1gr. set – gray and colorful secondary kaolins, bauxite rocks, siltstone and carbonaceous sands [4, 7, 8].

Further climate humidity and differentiated tectonic movements with a general tendency to raise the area caused intensification of fluvial streams erosion and formation of a powerful river network. At this time within the north-eastern slope of the central part of the US there was the accumulation of smilyanskii layers, and the Black Sea basin and its northern slopes there was the accumulation of rocks of Kodymska set [7, 8].

Initiation of river valleys took place in a soft eluvium substrate within the relatively limited area, mainly within the erosion-tectonic depressions, which formation is conditioned by fault block structure of crystalline substrate rocks and erosion activity of surface flowing water.

River paleo valleys had several flow streams directed at an angle to the central waterway. Length of paleo valleys sometimes exceeded 100 km. Maximum width of paleo valleys within the sedimentary rocks is 8.6 km [5]. Depth of river valleys cutting into is 50 m. Weathered layers of paleo valleys not always clearly marked in the hidden landscape. Their sides are sloping, smooth, raise to an average angle of 3^0-5^0, sometimes 35^0-45^0 and gradually move in watershed areas [5]. The thickness of continental sediments comes up to 36 m.

Overall lower cretaceous continental sediments form the lower cretaceous continental, platform, humid, pre-transgressive, sand-clay subformation. Its sediments contain mineralization and deposits of ilmenite, monazite, gold, bauxite, secondary kaolin and refractory clays [4, 5].

Lithology of the lower cretaceous continental sediments is colorful, discontinuous and largely determined by the composition of weathered layers of crystalline basement rocks with river paleo valleys [1, 2, 4, 5].

In particular, the bauxite prevalence in the lower Cretaceous continental formations caused by the erosion of weathered layers of main composition (gabbro, gabbro-anorthosite). At the same time, broad development of kaolin and clastic rocks caused by erosion of weathered layers of acidic, medium composition, sedimentary and metamorphic rocks [5-7].

The leading role in a continental formations structure belongs to clay rocks that often form a homogeneous thickness. Clay rocks are low kaolin and kaolin clays, siltstone, low siltstone, sand, heavily-arenarious secondary kaolins and kaolin clays. They consist of kaolinite with minor impurities of hydromica, gibbsite, hydrargillite, montmorillonite and volatile impurities of terrigenous material. Sometimes rocks contain quartz pebbles, debris of crystalline rocks of charred plant remains. The distribution of terrigenous material in clay rocks is uneven. Argillaceous rocks are marked with a few mixed terrigenous material represented by low differences. They are colorful: from white, various shades of gray to different shades of red.

Clastic rocks are less common. They are diverse-grained (from fine to gravel) oligomictic sands and sandstones, which sometimes contain small boulders (15 cm) and quartz pebbles, fragments of crystalline rocks and charred plant remains. Their color is predominantly gray (different colors), sometimes brown. Among clastic rocks there were found low siltstone sand (sandstone), clay- siltstone, siltstone-clay, low clayey, clay, hard clay [5]. Clay cement is of mechanical completion, basal. Rocks textures are transversal-, rolling-, flat-, simple-, complex-, indistinctly laminated, lensed, conglomerate- breccia. The degree of sediments sorting varies from average to low and sometimes none.

Chemogenic rocks are bauxite rocks that lie at the bottom, or middle part of the section. They are sometimes loose, sometimes relatively solid rocks, composed of red-brown, brown, gray-brown and gray favas. The space between them is filled with grayish-white sand-clayey mass. The favas are composed of clay dispersed substance, iron hydroxide loaded, with small grains of quartz, ilmenite and pyrite. Among the bauxites there were found rocky, loose, clay and sand variations.

Their color varies from gray to brown. Sometimes they contain fragments of crystalline rocks.

Organic rocks are brown coal and spread only on the southern slope of the central part of the US. Coal layers thickness is 4.0 m. Typically, the coal lies in the thick of kaolin or forms layers of a diverse-grained sand.

Transitions between all types of rocks are mostly gradual, indicating a gradual change in the hydrodynamic regime of paleo valleys [4, 5]. Often different types of rocks form closely layers and lenses of small thickness.

In genetic terms the continental sediments of erosion and tectonic paleo valleys are represented by deluvial- proluvial, proluvial-alluvial, alluvial (microfacies of the channels, riverine shallow, floodplain, oxbow lakes) facies [4, 5]. River network formed between rocks unstable to erosion (clay weathered layers) resulted in unstable river beds (with lateral permanent migration). Finally, there was formed a boundary of alluvial formations with several kilometers width.

Intense weathering processes in hot humid tropical climate provoked an overload of river valleys with terrigenous material, and in some areas – a suppression of streamflow by slope processes. In particular, the instability of river sides of paleo valleys to the processes of erosion led to the formation of deluvial-alluvial deposits. Intense rainfall led to the formation of proluvial-alluvial deposits deposits. Significant lateral channel migration led to the formation of dead channels.

For continental sediments that are associated with erosion and redeposition of weathered layers is typical reverse profile – at the bottom there are relatively sorted kaolin clays and sands, and at the top there are unsorted heavy sandy, pebbly-gravel clay deposits. This is due to the fact that the streams, which outwashed weathered layers, primarily carried well weathered fine-grained material, and then, in the deepening erosion, hard-grained material (from less destroyed horizons). The erosion of less weathered horizons of the weathering layers caused the appearance of more heavy terrigenous material in the alluvium.

An extensive marine transgression from the south to the north-east takes place in the Albian Age. A gradual increase of erosion base level caused attenuation of the rivers erosion, river flow suppression by slope processes. The increase of marine transgression from the south and north-east resulted in the river damming with deltas and lagoons formation. Transgression primarily used erosion and tectonic depression – a place of continental sediments. Coastal-marine oxbow lakes were formed. In these lakes there were formed carbonaceous clays, dark gray and gray secondary kaolins with plant roots, sometimes with thin layers of lignite. The floodplain and boggy conditions with the formation of brown coal periodically took place in floodplains in the south of the US. Those conditions had been swallowed by a restoration of river flow. During transgression the continental sediments were partially eroded.

In the late Cretaceous the sea basin increased considerably, and in the end of the late Cretaceous the sea regressed due to Laramide orogeny. In the Paleocene this area was an upraised denudation plain, which was divided by river network [7, 10].

In the middle Eocene the sea basin significantly expands and covers the northern and southern part of the area by waters [7, 10]. At the same time, within the upraised part of the US there were continental conditions of fluvial sedimentation. Inheritance of ancient river grid by a younger (the middle Eocene) hydrographical net (new streams used an old river valley) resulted in partial or complete erosion (in some areas of paleo valleys) of the lower Cretaceous paleo alluvial formations. Finally, the erosion products of the weathered layers were rewashed and the materials of weathered layers were redeposited at higher stratigraphic levels.

Buchatski sediments overlie the crystalline rocks and their weathered layers, the sea formations of the Jurassic, the continental and marine formations of the Cretaceous. Under the terms of formation the Buchatski deposits belong to the continental and coastal-marine facies. Among the continental entities there are: alluvial-deluvial, alluvial (placer, floodplain, oxbow, floodplain- boggy microfacies) facies.

Buchakski continental sediments preserved to this day in the form of winding linearly elongated strips that resemble the contours of the river valleys with numerous flow streams.

Overall the middle Eocene continental sediments form the middle Paleogene, continental, platform, terrigenous-clayey coal bearing, humid, pre-transgressive subformation. Its sediments contain occurrences and deposits of ilmenite, gold, kaolin and refractory kaolin clays.

The cross-section demonstrates the transfer of Buchakski continental sediments into Buchakski coastal-marine deposits. A distinctive feature of the deposits is the presence of glauconite, foramenifera fauna and higher carbonateness.

Buchakski continental formations are represented by clastic, clayey and organic species.

Clastic rocks are represented by diverse-grained (from heavy to fine-grained) sands and gray, dark gray and brown sandstones. The degree of sediments sorting widely varies, depending on the contents of clay component. Pebbles are rarely found in argillaceous cement.

Clay rocks are secondary kaolins, kaolin clays of different sand content and carbonaceous clays with interbedded clayey lignite, rarely, layers and lenses of gray, brownish-gray medium-grained sands. The content of carbon is growing up through the section. Secondary kaolins of light gray and gray colors are represented by the deposits with a thickness of 45 m. Here and there through the section there are two deposits of sheet bodies of secondary kaolins.

Organic rocks are brown coal, which is quite common and sometimes presents practical interest.

Tropical and subtropical climate contributed to the broad and active development of vegetation that served as material for lignite. Brown coal lies among sand-clayey thickness and is shaped as a reservoir-type body with irregular, sinuous contours. The layers composed of 2-5 packs of the coal separated by layers of sand and clay are prevalent. Sometimes lignite layers forms a small thickness in sandy soils. Growth of the deposits carbonaceousness is up through the section.

The Buchakskiy sea transgression went on rather slowly, as reflected in the correlation of continental and marine formations, changing of facies environments of continental sedimentation. As in the Late Cretaceous, using paleo valleys gradual transgression of the sea caused river damming, deceleration and suspension of river flow, formation of stagnant conditions and development of floodplain-boggy, oxbow facies environments.

Further transgression caused partial erosion and burial of Buchakski continental sediments. In the northeast it can be seen a gradual shift of continental facies in the marine, while in the south there is a sharp contact or almost complete erosion of continental formations in some areas.

Conclusions drawn from the study. Despite the partial and sometimes complete erosion of the Lower Cretaceous and middle Paleogene continental deposits they were saved to this day together with a set of host minerals, most importantly, in erosion and tectonic depressions and upraised blocks of the south of the US.

The formation of continental sediments proceeded the era of relief peneplanation and encrustation. Continental deposits are confined to tectonic-erosive depression that caused configuration of river valleys and ensured their safety from erosion to this day. Continental formations are represented by deluvial-proluvial, proluvial-alluvial, alluvial (microfacies of the channels, riverine shallows, floodplain, oxbow lakes, floodplain-boggy) facies. In terms of lithology the deposits are detrital, clayey chemogenic and organic rocks. The structure of fluvial formations has not more than three basic rhythms. Particle size analysis of pebble-gravel-sand material with coarse-grained parts of each rhythm showed (from the bottom to the top) gradual increase in the degree of sorting and cobbling of sediments if average grain size decreases. It should be noted that the sedimentation specific is associated with the erosion of weathered layers, migration of paleo rivers channels within the floodplain, rewashing of older fluvial formations, etc. It had led to appearance of more heavy material (including ilmenite, gold) in the second and third elementary rhythm. Erosion of less weathering horizons of weathered layers caused the appearance of more heavy terrigenous material in the top of the alluvium section.

A characteristic feature of alluvial formations is a scattered organic matter in sandy sediments of channel facies, as well as carbonaceous clays, carbonaceous secondary kaolins as a part of floodplain facies [4]. This indicates a relatively low velocity of ancient river flows, full-flow, floodplains watering, including the formation of oxbow lakes, boggy depressions.

Researches of paleo-alluvial deposits showed that evolution of lower cretaceous and middle Paleogene river valleys took place in close spatial and paragenetic connection with ore-bearing weathering mantle of crystalline basement rocks as well as internally, reflected in the spatial distribution of river paleo valley; their configuration and structure; facial sedimentation environment; material composition; minerals and their spatial distribution.

The minerals are characterized by persistent connection with certain lithofacies complexes and facies. Due to a discrete location of boreholes, a few specialized research. The search of continental sediments with different minerals is insufficient.

Inheritance of ancient river paleo valley by a younger one resulted in a partial erosion of the existing mineral occurrences and deposits, as well as geochronological transportation of materials at a higher stratigraphic levels.

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СТАНОВЛЕННЯ І РОЗВИТОК НИЖНЬОКРЕЙДОВИХ І СРЕДНЕПАЛЕОГЕНОВИХ РІЧКОВИХ ДОЛИН В МЕЖАХ ЦЕНТРАЛЬНОЇ ЧАСТИНИ УКРАЇНСЬКОГО ЩИТА

Анотація
Розглянуто палеогеографічні умови становлення і розвитку нижньокрейдових і среднепалеогенових річкових долин в межах центральної частини Українського щита. Встановлено, що еволюція нижньокрейдових і среднепалеогенових річкових долин відбувалася в тісному просторової і парагенетичних зв'язку як з рудоносною корою вивітрювання порід кристалічного фундаменту, так і один з одним, що відобразилося: в просторовому розташуванні річкових долин; їх конфігурації і при будуванні фаціальних обстановках накопичення опадів; речовинному складі; корисних копалинах і їх просторовому розміщенні.
Ключові слова: річкові долини, нижня крейда, середній палеоген, Український щит, літологія.

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СТАНОВЛЕНИЕ И РАЗВИТИЕ НИЖНЕМЕЛОВЫХ И СРЕДНЕПАЛЕОГЕНОВЫХ РЕЧНЫХ ДОЛИН В ПРЕДЕЛАХ ЦЕНТРАЛЬНОЙ ЧАСТИ УКРАИНСКОГО ЩИТА

Аннотация
Рассмотрено палеогеографические условия становления и развития нижнемеловых и среднепалеогеновых речных долин в пределах центральной части Украинского щита. Установлено, что эволюция нижнемеловых и среднепалеогеновых речных долин происходила в тесной пространственной и парагенетической связи как с рудоносными корами выветривания пород кристаллического фундамента так и друг с другом, что отобразилось: в пространственном расположении речных долин; их конфигурации и строении; фациальных обстановках осадконакопления; вещественном составе; полезных ископаемых и их пространственном размещении.
Ключевые слова: речные долины, нижний мел, средний палеоген, Украинский щит, литология.