

GEOMORPHOLOGY AND MORPHOGENESIS OF THE BELI LOM RIVER VALLEY

GEOMORFOLOGIA ȘI MORFOGENEZA VĂII BELLI LOM

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Abstract: The present paper renders the results of a geomorphology research performed in North-Eastern Bulgaria. It focusses on the geomorphology and the main stages of evolution of the Beli Lom River. On the base of field research, geology and geophysics research, detailed analysis of the specialized literature, it is concluded that the formation of this impressing relict erosion relief can be explained only with the factor-geology time. It formed long before the limits of the Quaternary. The aim of the present paper is to draw scientists' attention on the issues regarding the Pleistocene – Holocene paleoclimatic conditions and relief in North – East Bulgaria and South - East Romania so to clarify its evolution.

Key-words: dry valley, rivers with constant flow, paleokarst, relict erosion relief, neokarst, Aptian, Albian

Cuvinte cheie: vale seacă, cursuri cu scurgere permanentă, paleokarst, paleorelief erodat, karst, Apțian, Albian

The Beli Lom river valley is located at the border between the relict river – valley net in North-East Bulgaria, well known in the studies as dry valleys, and the rivers with constant flow – in the central part of the South Misian (Danube) valley.

This circumstance induced special features in morphology, foundation and development of the valley as well as of the entire basin. Together with the dry valleys, it represents an enigmatic morphological phenomenon in Bulgaria mainland.

The purpose of this study is to clarify morphology, morphogenesis and the main stages in the development of the Beli Lom river valley.

According to K. Shkorpil the name of the river comes from the Albanian word 'lumi' – river, but according to V. Marinov it means deep engraved into the relief slowly flown river.

The Beli Lom river valley is located in south-west part of Ludogorie, between Samuil uplands in the east and Razgrad uplands in the west.

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The north boundary of the region passes along the watershed of dry valleys, which flow into the Danube River, while in the south it bounds with the water catchment basin of the Vrana River (left feeder of the Big Kamchia River). The western boundary passes along the watershed with the Cherni Lom River basin. In the east, there is the Topchiiska river.

In these outlined there develops the catchment basin of the Beli Lom River has about 1,300 km².

Morphologically it belongs to the South Misian plain, but hydrographically it belongs to the catchment basin of the Ruse Lom River, which is joined to the Black Sea basin through the transit valley of the Danube.

It begins from Razgrad uplands near Ostrovche village, Razgrad Municipality, 400 m above sea level. Its length is 142.1 km, with average rise – 1.7 %. The mouth of the Beli Lom River is 60 m above sea level. It flows into the Ruse River near Ivanovo village at ‘Smesovete’, where the Cherni Lom River flows.

The Beli Lom River and many of its left tributaries have constant flow. However, its right tributaries are dry valleys, ‘swallow holed’ into the karst, which supply the deeper aquifer levels. Here, shallow waters appear episodically, mainly into engraved slopes of the dry valleys, during snow thawing and intensive rainfalls.

Lithological - stratigraphic and tectonic precondition for the development of the relief. The researched region is distinguished due to low tectonic style; structurally, it belongs to the range of Misian platform.

The Beli Lom River is cut into sub-horizontally limestone layers, which outline the edges of canyon- shaped sections. They appear in the southern deep-engraved parts of the valley but in the northern sections, in the river valleys and ravines, there appear limestones, sands and clays.

The presence of the stratigraphic units from the Cretaceous system in a fixed sequence determines the availability of different morphology of the river valley in these sections.

There, where the sediments of Razgrad suite (formation) outcrop, the valley is runway – shaped, the slopes are relatively aslant, the valley bed is wide.

With the spreading of the limestones from Ruse suite (formation), the valley changes its pattern – gets narrow, canyon aspect. That is due to the bigger hardness of the limestones from this formation against wind erosion and pliability to karstification.

The relief in the North-East Bulgarian plain is mainly formed on early-aged limestones, which favour karst processes.

The Beli Lom River runs through the area with old (buried) and young karst. The wide spreading of strong karstificated, hydro-carbonated limestones are the main reason for the absence of shallow flow waters – availability of dry valleys, which drain the forms of epikarst and mesokarst. In Ludogorie region, the karst has evaluated mostly in the limestones of Ruse suite (formation).

In the catchment basin of the Beli Lom River the wide spreading have Quaternary agglomerates.

There are mostly gravel, rubble, sands, aleurite, clays loess (Pleistocene), also clay sands, and sandy clays, which fill out numerous lowers (Holocene). These agglomerates and mainly the loess complex in a bigger grade lack the main characteristics of the current relief and make unclear the transition between the separate denudation surfaces and between surfaces and slopes of the dry valleys or valleys, between the slope and valleys bed, etc.

The loess complex represents with 3 to 5 buried soil levels and with 4 to 6 loess soil levels. The whole lift is up 5 to 10 m in the south and increases up 30 to 40 m in the north. Above this, it has formed the current soil cover .

Morphology. As a result of the conducted field research within the borders of the catchment basin of the Beli Lom River, there were identified two pre-Quaternary morphostratigraphic (denudation surfaces) structures (Fig. 1).

The oldest level here dates back in the Sarmatian-Pontian and it is preserved along the watershed ridge in the range of Razgrad and Samuil uplands and this way enclose the springs of the Beli Lom River.

It is covered with loess and loess-like clays and its surface is karstified as in places the paleokarst meso-forms and microforms are fill with quartz-kaolin sands.

It is spread out in hypsometric interval 450 – 350 m. The big rise of the slopes (14 – 16°) and V – shaped cross – section in this part of the valley shows comparatively active current rising movements. The second denudation surface is from Pliocene (Levant), widespread in hypsometric interval 320 – 200 m.

These areas have undergone active river erosion and, consequently, they are strongly rended up. They are ‘tongue’ – shape and develop between the tributary valleys and glens of the Beli Lom River (Fig. 1) being disposed from south to north.

The evolution of the valley during the Quaternary is reflected in numbers and hypsometric lay of the remnants of old valley beds marking former profiles of balance. The terrace spectrum in the Beli Lom river valley cover flowed terrace – T₀ on 2 – 5 m and five overflowed terraces T₁ on 10 – 12 m, T₂ on 22 – 25 m, T₃ on 35 – 40 m, T₄ on 60 – 65 m and T₅ on 80 – 90 m. Due to the general wide-spreading of the loess cover the whole terrace complex is hardly under-covered.

The greatest widespread is registered by T₀ in the section Razgrad town – Dryanovets village (Fig.1). Here it develops on both banks of the river reaching 400 – 500 m width, with a maximum in Gecovo quarter. The present landforms are dominated by forms of complex geomorphological valleys (a close –meshed river – valley net, most of them dry valleys) and the karst geomorphological complex (present, active karst forms in combination with buried and fossil forms).

The aggregate in the development of the river-valley net in the region is that in the upper areas the valleys are slightly engraved into. The cross – section profile is wide, bed – shaped, in some places chest – shaped, the width of the riverbed

reaching 70 – 90 m. Loess and clay cover up the roughness of the pre-Quaternary relief.



Figure 1. Geomorphologic map of the Beli Lom Valley

The river valleys are deepest engraved in their middle sections, the hypsometric range 150 – 200 m, where they have canyon characteristics. The slopes are steep, almost vertical in certain places.

Between Senovo town and Pisanetc – Nisovo villages there can be observed expressive engraved meanders. One of the reasons for the canyon-shaped cross – section of the valleys is the lithological foundation represented by hard limestones of Ruse suite (formation).

Field research in the catchment basin of the Beli Lom River emphasizes the next characteristics in morphology of the valley. In section Razgrad – Dryanovets, it is widely open due to the removal of clay – marl limestones and has asymmetrical cross-section profile. The left valley slope is slight, terraced, with agricultural lands, while the right slope is steep and affected by erosion due to deforestation.

The asymmetric profile of the valley is especially well marked in the section Senovo quarter – Dryanovets village. Probably this asymmetry is induced by the northern and northwestern rise of the strata. The midstream of the Beli Lom River is closer to the northern watershed outlining the lack of symmetry in the catchment basin of the river. There are strongly developed left tributaries that compensate the right ones, which are poorly developed. The right tributaries of the river are shorter and deeper but the left ones are longer and with smaller rise. According to Krastev,

Krasteva (2003) this asymmetry have to relate to the displacement in southern direction of the watershed between indirect flow (with the Beli Lom River) and direct flow (to the Danube river) as well as to the geomorphological progress of the Danube valley and to the northern rise of the strata.

The Beli Lom river valley in the section between Dryanovets village and Senovo town has typical chest- shaped form – flat bed, which goes northward from Senovo, 500 – 600 m wide, steep almost vertical slopes. In the last 1 – 2 km of this section, the valley bed is reduced and the cross-section profile acquires canyon characteristics.

The typical feature of the longitudinal profile of the Beli Lom bed is the weak rise; thus, it forms meanders in its alluvial deposits, which fill up the wide (200 – 300 m) valley bed and mobile meanders (typical for the section Razgrad – Pisanets). On places, the river forms branches surrounded by small alluvial isles.

Downstream, the Beli Lom River makes several sharp changes in the direction. Probably these bends in the valley direction are due to tectonic destructions of the foundation. The first sharp bend occurs after the reservoir ‘Beli Lom’, the second one before Ushinci, the third bend at the Senovo town and the last one after Nisovo village, near the confluence with its biggest tributary – the Malki Lom River. The maximum depth of the erosion is 160 m.

It is interesting that the Beli Lom river has no right tributary glens and valleys in the section Gecovo quarter – Senovo town and no left tributaries between Dryanovets village and Senovo. This is due to the geological texture and palaeographic evolution of the region in these sections.

As young karst forms (shallow and underground), in the researched area, there are well represented the forms of the underground mesokarst – caves and niches. They are mostly attached to the slopes of the Beli Lom and the Malki Lom Rivers, etc.

Caves and big niches appear on the territory of Vetovo town, around Pisanets village, in the valley of the Malki Lom River near Svalenik village, in the territory of Nisovo village at the confluence of the Malki Lom with the Beli Lom, etc. The characteristic feature of the underground karst in the Beli Lom valley is that the cave entrances are mainly on the right valley slope and on floors. According to Krastev, Krasteva (2003) this is induced by the growth of the caves closely with the formation of the separated profiles of the river balance.

The dominant forms of the surface karst morphological complex are the dolines (sink hole). They developed on the Valogs and Uvalas in the blind dry karst valleys. The whirlpools are particularly widespread west of Ezerche village, north-west of Svalenik village, between Dryanovets village and Senovo town.

Main stages in the growth of the valley. Regarding the formation and development of the river – valley net on the Bulgarian territory it is affirmed the conception that the main stage in the formation of the river valleys is Quaternary (Galabov, 1966; Mihailov, Mishev, Popov, 1966; Minkov, 1968).

According to Krastev, 1974; Krastev, 1975 a,b; Krastev, 1977 a,b; Krastev, Stankova, Stoyanova, 2002, the river – valley net in North–East Bulgaria has relict characteristics e.g. its nascent and growth come out far from over Quaternary borders. As confirmation of this it can be shown some characteristic features of the rivers (dry valleys in North–East Bulgaria), in particular – the Beli Lom valley could not be explained only with the vital force of the river but with the factor – time.

For instance, the Beli Lom valley is deeply-engraved into resistant to erosion thick lifted limestones as the maximum engraving is 160 m; in the middle-stream and down-stream part, the valley has canyon characteristic; the average rise of the riverbed is small – 1.7% and the longitudinal profile is near to the ideal curve; on places in the middle-stream and down-stream constant flow is absent.

On other hand, the presence of engraved meanders proves the imposed epigenetic origin of the whole river – valley net, included the Beli Lom River.

Pre-Neogene stage. To the first sub-stage it is related the Early Apt when in Lower Cretaceous sea formed thick carbonate clays and carbonate sediments. At the end of Baram and in the beginning of Aptian the eastern part of South Misian plain underwent positive tectonic movements as a result of the activation of the North Bulgarian vaulted rising – also result of the activities of Austrian folded phase (Nikolov, 1969). Consequently, the sea basin regressed to western and south-western direction and, at the same time, there occurred processes of diagenesis and lithification of carbonate sediments. On newly created mainland, surface flow became active tracking the coastal line of the retreated sea basin. The extended speed of rising clearly outlined lines of an erosion – denudation relief, which dominated over the neighbouring areas.

Beginning with the Garg sub-age from the Apt age, it is mark the beginning of the second sub-stage.

In the conditions of a temperate humid and hot climate typical for the tropical zone, there formed huge surface paleokarst forms. In the evolution of the erosion-denudation relief it occurred fundamental changes, as the leading factor in morphogenesis become – karst processes. They are directly related to the lowering of the underground water. On the slopes of shallow lowering areas, there formed typical well-shaped and cracked shallow holes. Otherwise, this hydrographical net, which was preceded by shallow fractures gave certain direction of the karst process, predetermined the orientation in developing the karst forms (Kratsev, Krasteva, 2003).

During the third sub-stage (Albian age), it occurred the fossilisation on the already created tropical to subtropical paleokarst relief – agglomerations with subaquatic (sea) origin. After the regression of the Albian basin, it formed a wide polyfacial aligned surface, the area of which occupied the largest part of the dry valleys.

The fourth sub-stage can be referred to as the nascent stage of the river – valley net in North-East Bulgaria as a result of the regression of the water of

Albian basin in northern, north-western and western directions, due to the activation of North Bulgarian vaulted rising. With the regression of the shallow, epicontinental sea basin northwards and west – north-westwards, the first land increased its area and height.

The shallow flow has arisen and it was orientated towards the coastal line of the retreated sea basin.

Following the retreated coastal line onto the wide Albian surface, the river - valley net developed as a pro-form of the present one. The rivers during this sub-stage were characterized by great vitality determined by the climatic conditions – close to the tropical ones (Krastev, 1977a). This vitality was sufficient for engraving of the valleys into the Albian agglomerates, represented mainly by sands, clays and very seldom by marls. The slightly gradient and lithological substrata determined meandering of the rivers.

Parallel with the arising of the periphery, the south and southeast parts of the researched region was modelled and the Albian sediment cover was carried away from between watershed areas. Thus the initial river – valley net projected onto the pre-Albian denudation surface, formed on limestones of Ruse suite (Hotriv-Aptian). Parts from the Albian shallow sea agglomerates preserved only in wide paleokarst forms, which appeared during the Garg sub-age (Late Aptian age).

Deep engraving of the rivers – their meanders could be explained by the continuous rate of rising and with the big river discharge. Furthermore, the smooth, constant rising rate of southern and south-eastern periphery of the dry valleys could explain the absence of terraces along the valleys. This process continued until the beginning of the Neogene (Krastev, Stankova, Stoyanova 2002).

Fifth sub-stage. During the period end of the Albian till the end of Pliocene the palaeographic regime of these lands is unclear. According to Krastev, Krasteva (2003), if it supposed that through this long-time period (111 – 112 Ma BP) North–East Bulgaria region was mainland, it is very difficult to explain how paleokarst has been ‘spared’ from prolonged denudation. In the researched area, there are available compensable rhythms of sedimentation and denudation sequential changed during the whole period from Aptian until middle Miocene. Thus, the paleokarst preserved unaffected by planation processes until the beginning of the Paleogene despite tectonic activity in the region.

The Neogene stage. During this stage, there formed denudation surfaces. Their formation was induced by the lowering of the main erosion basin – the Black Sea, which led to the deepening of the rivers into the geological base.

In the researched area, there are available two denudation surfaces – Sarmatian-Pontian preserved on the level 350 – 450 m and Pliocene (Levant) on the level 220 – 320 m.

During the Miocene, the Sarmatian Sea occupied a wide part of South Misian plain.

In this large basin there settled mainly limestones, less marls, clays and clay sands. This Sarmatian surface grew due to its specific stability. It underwent

erosion processes and that is why the age of this primary surface is consented for Sarmatian– Pontian. It is the base for later development of the terrestrial forms.

In the second half of Neogene stage – Pliocene, due to local epeirogenetic elevations, the Sarmatian Sea reduced. This led to the separation of several Pliocene basins within South Misian plain, one of them being around Ruse town (Georgiev, 1991).

The Quaternary stage. During the transition from Pliocene to Pleistocene, significant immersions in the Black Sea basin led to different risings in our land. It activated regressive erosion not only in case of the rivers flowing directly in the Black Sea, but also for their tributaries. This led to the engravings of the rivers into the geological base and formation of the present river – valley net. It formed the Quaternary terrace complex – five up swamped terraces and two swamped ones.

During the Lower Pleistocene, it began intensive loess drifting and final fossilization in watershed ridges. During the Quaternary erosion – karst process in the Beli Lom valley destroyed paleokarst relief in the region.

Conclusion

On the basis of the analysis of up to now geological and geophysical research and terrain examinations in the region, it can be concluded that the morphological aspect and the spatial conduct of the separate elements in the Beli Lom river valley represent a summary result of karst and erosion – denudation processes. The lithological substrata – thick limestones and clay limestones and marls favoured denudation and erosion. There should be also mentioned the role of the tectonic movements during the Neogene – Quaternary periods – ascending movements in North Bulgarian upland and several multiple lowering movements in the erosion basis – the Danube river and the Black Sea.

The beginning of the evolution of the Beli Lom river valley assigns to the beginning of the Garg sub-age of the Aptian age when, in the conditions of a hot and humid climate typical for the tropic zone, there appeared huge surface paleokarst forms. Afterwards they fossilized from agglomerates with subaquatic (sea) origin of the Albian basin.

The arising of the Beli Lom river valley is assigned to the end of the Lower Cretaceous period, when on wide Alb sediment surface, the river net developed. Parallel with the rise in periphery, the south and southeast parts of the region underwent engraving and carrying out of the Albian sediment cover. Thus, the primary river – valley net developed on the pre-Albian denudation surface, formed onto the limestones of Ruse suite (Hotriv-Aptian).

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