QUATERNARY GEOLOGY, GEOMORPHOLOGY AND TECTONICS IN THE ISKAR RIVER VALLEY SYSTEM, THE DANUBIAN PLAIN (BULGARIA)

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Abstract: The Quaternary in the Iskar River watershed in the Danubian plain is represented by differing in genetic type continental sediments: eolian, alluvial, deluvial, proluvial, gravitational, etc. They reflect the regional and local paleographic and tectonic circumstances and build various geomorphological forms. Their thickness is within the range of several centimetres to 140 m.

Key words: Quaternary geology, geomorphology, tectonics, paleogeography

The Quaternary in the investigated region is represented by differing in genesis and age sediments belonging to the Plio-Pleistocene, the Pleistocene and the Holocene. They are situated everywhere on top of a diverse pre-Quaternary base, which has a different degree of denudation and is uneven, weathered or karstified. The thickness of the sediments is also different (10 to 140 m) and they are covered by contemporary soil. The sediment layers have been the subject of investigation of many specialists (Gounchev, 1935, Boykov, 1936, Yaranov, 1956, 1961, Mihailov, 1961, Blagoeva, 1966, 1968, Minkov, 1968, Wiegank, 1977, Filipov, 1983, Filipov et al., 1989, 1990, 1992, 1993, 1994, Tzankov et al., 1991, 1994, Evlogiev, 1988, 1995, Vaptzarov et al., 1993, Angelova et al., 2001 and others). Regardless of the considerable number of the studies on the Quaternary, there are still many debatable problems. The trend during the last years is to state that the tectonic factor has been considered for the preparation of the correlation schemes, although this is still not quite so.

Formation of the Covering Gravel. Polygenic gravels with sandy-clayey filler refer to this formation. They cover the ridges between the valleys, the structural and erosion-denudation steps, the old river terraces and other morphological forms. The gravels are of alluvial-denudation origin and have a considerable thickness, which diminishes gradually to the north from 20 m to 0.5 m. They are situated on top of uneven washed-out and denudated variegated base (surface) and are covered by red clays or directly by loess. The gravel is polygenic, with different composition, not cemented, unsorted, well rounded, with sizes from 1-2 to 10 cm.

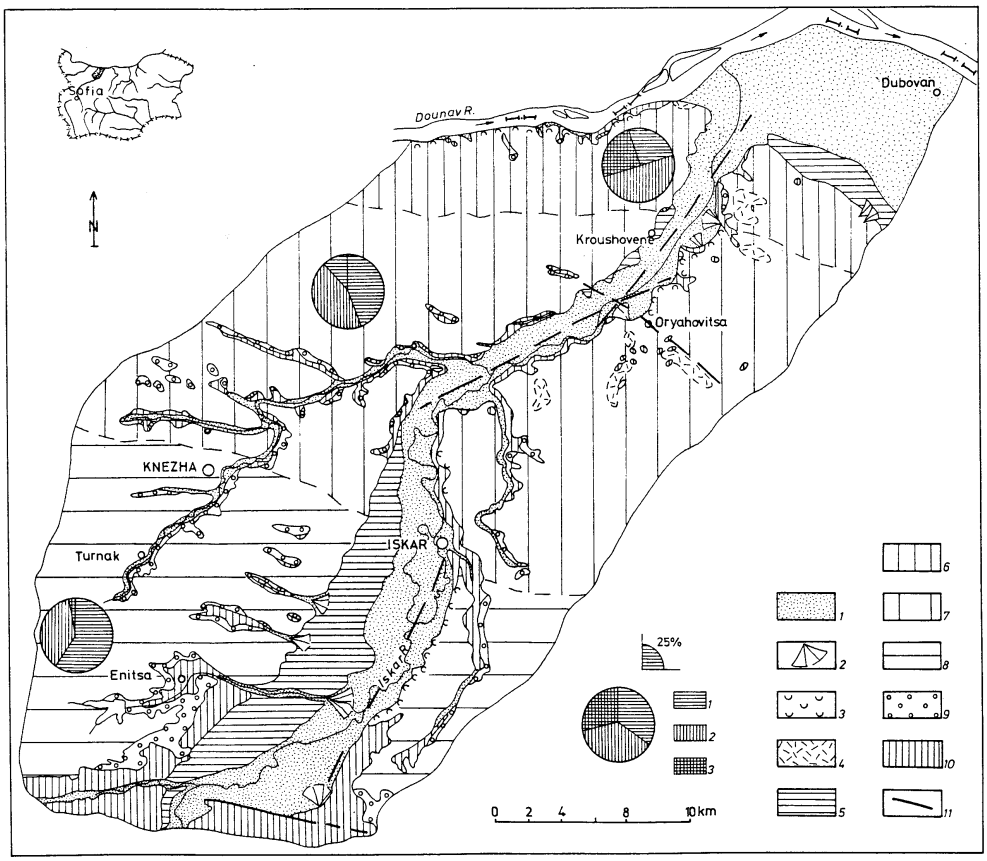
The composition includes granite-porphyries, gabro, gneiss, diorite, syenite, limestone, quartz, flint, sandstone, etc. The gravel is sometimes slightly cemented by clayey-sandy or limy-sandy binder with brown colour due to iron hydroxides. The age has been determined on the basis of the fauna found near Enitsa and Pissarovo as well as on other mammal fauna (*Ellephas meridionalis Nesti* and *Anancus arvernensis* Cr. and Gob.) belonging to zones MNQ17 and MNQ18 of Mein, 1975, 1979 (Evlogiev, 1995, Spasov, 2000 and others).

Red Clay Formation. It includes the reddish limy-sandy aleuritic clays between the loess complex and the diverse base. The greater part of the formation is built by clayey-mica minerals and calcite. The terrigenic component consists mainly of different grained quartz originating from the base. Its structure is cryptocrystalline, pelitic to micro-scale pelitic. The density is from 1.97-2.25 g/cm^3, the porosity reaches 20-30 % and the magnetic susceptibility – 9-261 x 10^{-6} SI. The high carbonate (between 30 and 50 %) and increased iron hydroxide content is typical for these minerals. Their thickness varies strongly within the range of 1 m to 20 m. The age is debatable.

Eolian Sediment Formation. The loess complex with the buried soils are most widely distributed and with considerable thickness, compared to other lithological varieties in the studied region (Fig. 1). The highest loess thickness in Bulgaria (up to 150 m) has been established here near the Dolni Vadin village (Filipov, 1983). It has been established on the basis of the terrain investigation, the review of reference literature, borehole information and comparison with other regions, that no continuous stratigraphic sections exist for the loess complex. The number of the loess horizons in the neighbouring areas varies from 1 to 6. This means that there were differences in the sediment accumulation due to complex reasons. For the present, no lithostratigraphic units are introduced for the loess complex, because there is no basic section belonging to the full glacial cycle, i.e. from the Danubian to the Wurmian. The loess complex covers all pre-Quaternary formations, its thickness being strongly variable in N-S and E-W direction. The loess varieties are classified in regional plan according to the percent clay-aleurite-sand ratios as: sandy, typical, and clayey. *The sandy loess* has light yellow to light brown colour. It is fine-grained, slightly cemented, crumbling, with macro-pores. The angular to semi-rounded quartz grains with sizes of 1-2 mm are predominant. The ratio between the ingredient components is 15-20:50:15-20 % (Fig. 1). *The typical loess* is a limy-clayey-aleuritic rock of light brown-yellowish and yellowish to gray-yellowish colour. It is fine-grained, light, porous, loose, with loose texture and pelitic-aleuritic to fine-aleuritic, micro-scale pelitic structure. The ratio between the building components is shown in Fig. 1. The calcium carbonate (up to 30 % of the total mass) is the main reason for the formation of

the infiltration limestones and concretions (loess dolls). Its density is 1.50-2.30 g/cm^3 and its magnetic susceptibility is within the range from 7 to 275 x 10^{-6} SI. The total porosity varies from 30 to 55 %. The suffusion subsidence (the relief forms obtained due to loess subsidence) in the region around the Staroseltsi and Kroushovene villages) is a characteristic feature of the typical loess. The clayey loess is a dark yellow to yellow-brown dense limy-clayey-aleuritic rock with porous texture and crypto-crystalline pelitic structure with more expressed plastic properties. The clayey substance is predominant. The ratio between the basic components is 50-70:20-30:1-2 %. The amount of the calcium carbonate is 20-40 % of the total mass.

Fig. 1. Geological map of the Quaternary sediments in the Iskar River watershed in the



Danubian plain (after the Geological map of Bulgaria in scale 1:100000, quadrangle maps Knezha, Gigen – after Filipov et al., 1990 with ammendments): 1-4 – Holocene: 1 – alluvial deposits; 2 – proluvial deposits; 3 – grvitational deposits and sediments; deluvial deposits: 5-8 – Pleistocene: 5 – alluvial deposits of 1st and 2nd over flood level terraces; 6-8: eolian sediments and deposits: 6 – sandy loess; 7 – typical loess; 8 – loam; 9 – Gravel Cover Formation; 10 – pre-Quaternary rock complexes; 11 – faults. (The clay:aleurite:sand percentage correlation in the loess is given in the circular diagrams).

There are maximum 6 loess and 5 buried soil horizons in the loess complex and no typical regularity is observed. The greatest thickness is observed in the fifth loess horizon – 40 m, and

for the buried soils – in the fourth horizon (6 m). The buried soil horizons have a higher clay content – from 5 to 15 %. The humus content diminishes in the older soil horizons at the expense of the increased calcium carbonate amount. The soil density is 1.78-2.13 g/cm^3 and the magnetic susceptibility is from 51 to 284 x 10^{-6} SI. The loess complex in the studied region has poor fossil flora and fauna. The following species have been established in the upper parts of the section (near the Dolni Vadim and Trastenik villages): *Bradybaena fructicum Mull.*, *Helicopsis striata Mull.*, *Chondrula tridens Mull.*, *Zebrina detrita Mull.*, *Abida frumentum Drap.*, *Helicella obvia Hartm.*, *Chondrula seductibilis Rosm.*, *Caracollina corcyrensis Rosm.*, *Cepaea vindobonensis Pfeif.* and other species typical for the whole Quaternary.

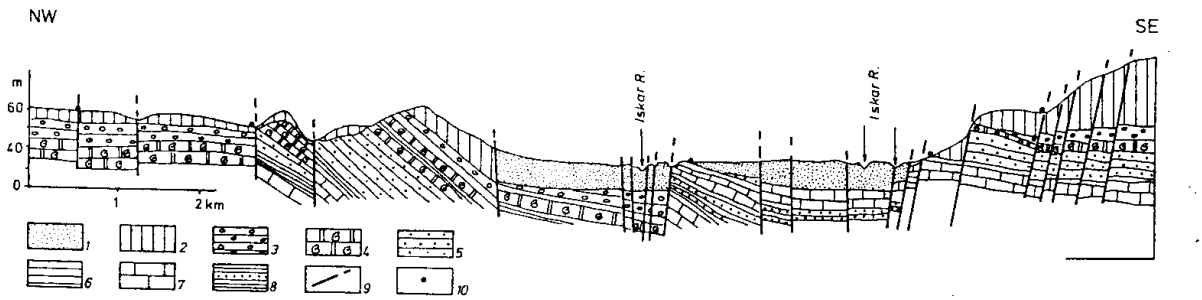
Alluvial Sediment Formation. It includes the accumulative covers of the high (average altitude of 80-90 m, 60-75 m – river terraces), average high (40-48 m, 25-35 m) and low (18-25 m, 25-35 m) terrace complexes. The alluvial deposits are represented by well processed gravel, sand and clays. Their thickness is very changeable – from 1-2 m to 20 m. Only the age of the first over-flood terrace has been confirmed till now by the found species as *Theodoxus transwersalis Pfeif.*, *Theodoxus danubialis Pfeif.*, *Fagotia acicularis Fer.*, *Fagotia esperi Fer.*, *Amphimelania hollandre Fer.* (Kojumdgieva, Geofund of the Committee on Geology).

The most widespread genetic types of Quaternary sediments in the studied region are the eluvial and gravitation ones. Their formation was started as early as before the Holocene and was activated during the Holocene and the contemporary stage.

In tectonic respect the investigated region falls within the Lom structure as a part of the Moezian microplate. The regional movements were negative till the Plio-Pleistocene. The Carpathian-Balkan orogenic arc was strongly risen during the Wallachian tectonic phase as a result of vertical compression, while the dried Fore-Carpathian basin was disintegrated due to concentric extension (Balla, 1985), forming two Plio-Pleistocene steps covered by considerable accumulative cover. Small graben structures were formed along the fault systems (in the region of Dolni Vadin, between Bregare and Kroushovene, near Koinare and the lowlands along the Danube River). Activation of fault structures has been established for the time of the Pleistocene: in the region of Dolni Vadin with a total value of the Quaternary movements of 60 m; the normal fault along the Iskar River between the villages of Bregare and Kroushovene, which was active during the whole of the Quaternary (this structure is also seismically active and paleoseismic deformations have been established along it for the period of the Plio-Pleistocene, the Middle Pleistocene, the beginning of the Holocene as well as during its reactivation at the time of the Vrancea earthquake in 1977) (Fig. 2). The Quaternary

tectonic movements were the main reasons for the formation and development of the relief, its local deformations established in the river terraces, the denudation levels, the gravitation forms, karst, etc.

Fig. 2. Geological-geomorphological profile in the region of the Bregare paleoseismic dislocation: 1 – Holocene – alluvial sediments; 2 – Pleistocene – loess complex; 3-8 – Neogene: 3 – Meotian – conglomerates; 4 – Lower Sarmatian – organogenic limestones; 5 –



Lower Sarmatian – sandstones; 6 – Lower Sarmatian – clays; 7 – Badenian limestones; 8 – Badenian – sands and clays; 9 – faults; 10 – springs.

The investigated territory is of extreme priority for the Bulgarian territory. The performed investigations on the Quaternary sediments in the Iskar River watershed in the Danubian plain confirmed: their dependence on the regional and local paleogeographic and tectonic circumstances and their contrasts; the relation in the formation of the loess complex with the continental glacial epochs in Europe; the considerable genetic diversity and rapid facial changes. It has to be pointed out that not all the possibilities have been used concerning their stratigraphy, especially for the weathering products before the big glacial period and the interstadials. The correlations should be based on the particular local stratigraphic scheme and then – on the general regional scheme.

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