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Neogene Longitudinal Profiles And Early Quarternary River Valleys Of Volga And KamaInterfluve

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Abstract- Buried Neogene and early quarternary river valleys within Volga and Kamainterfluve have a wide spread occurance and are almost single sources of information on the long-lived period of the territory development for this time. Researching them gives extensive information on river network development, as well as on various relief development aspects; it is an important source of paleo-geografical reconstruction.

In article, research results of valley longitudinal profiles for the rivers developing within Volga and Kamainterfluve throughout the late Neogene and early quarternary time are presented. These researches are received on the basis of paleo-valleys situation reconstruction for rivers of this period.

The analysis of paleo-valleys longitudinal profiles allows to draw a conclusion that late Neogene and early quarternary river valleys were shorter than the modern. Biases of Neogene valleys (pre-akchagyl) rivers exceeded bias values of the modern rivers, the akchagyl ones were comparable to them. The rivers of early quarternary time had the least biases. The main role in change of longitudinal profiles and biases of the rivers was played by eustatic factor.

Keywords: Neogene valleys, early quarternary valleys, reconstruction, longitudinal profiles, falling size, biases, Volga and Kamainterfluve.

1. Introduction

For over 150 years ancient river valleys within Volga and Kamainterfluve are known. Systematic research of buried river valleys began in the 30th – 40th of the XX century. The age of these valleys was defined as Neogene. The most significant works which gave the first ideas of Neogene valley network configuration, deposit age composing them and morphology of valleys were researches by N. V. Kirsanova [1,2], S. G. Kashtanova [3], G. I. Gorecki [4]. Further representations about the Neogene valleys were expanded due to works of G. V. Obediyentova [5], A. V. Sidneva [6], G.P. Butakova [7]. One of the last reconstruction of Neogene valleys arrangement was performed in 1997 under the leadership S. A. Maramchin and E. I. Ulanova by drawing up "The summary geological map of pre-Pleistocene deposits of the Republic of Tatarstan in scale 1: 200 000» [8]. However data of these authors in many respects contradicted the previous researches.

Until recently the age the Neogene valleys of Volga – Kamainterfluve was defined as Miocene – Pliocene. Now the time interval of quarternary system is expanded to 2,6 million years, the Gelasian layer was included in structure of quarternary system as the lower division of Pleistocene [9,10,11] Due to these changes development of the river valleys put in the Neogene (Miocene) came to end in early quarternary time.

In work the new data on morphometric characteristics (longitudinal profiles, biases) of Pleistocene and early quarternary river valleys received on the basis of river provision reconstruction for Paleocene Volga and Kamainterfluve are submitted. Comparison of longitudinal profiles for Neogene and modern river valleys allows to estimate feature erosive processes development at the Neogene - early quarternary and in modern time.

2. Data and Methods

The technique of morphometric features research for Neogene and early quarternary paleo-valley is based on geo-informational mapping methods use. In the real research GIS possibility for Neogene river valleys of Volga Kama interfluves were used for reconstruction of paleo-relief.

In the course of work with share sources the actual material on 1486 wells which opened Neogene and early quarternary deposits; 1005 of them were built through all thickness of deposits. In the MapInfo 6.0 program the actual material was attached to topographical basis with scale 1: 200,000. As a result the map of the actual material was received. Processing of material was carried out by Krigging method in the Surfer 8.0 program. By means of the last digital distribution models capacities the Neogene - early quarternary deposits and the erosive surface buried under the Neogene - quarternary deposits were created.

On the basis of model operation data in the MapInfo 6.0 program maps of Neogene erosive surface were constructed, situation reconstruction of both Neogene and early quarternary paleo-valleys is carried out. Reconstruction of valley network allowed to estimate longitudinal profile change of river valleys on extent of the Neogene - early quarternary age in connection with particular river sites. And, for a number of rivers we succeeded to trace change of biases for various stages of paleo-river development. On the same sites or for the modern rivers in general the river biases were counted. Longitudinal profiles of paleo-rivers valleys were calculated according to the lowest marks of regional sole deposits stratigraphic divisions modern for encroachment line of the water surface.

Creation of longitudinal profiles and calculation of the Neogene, early quarternary and modern valleys falling and biases was carried out by means of MS Excel mathematical apparatus on the basis of electronic maps input data.

3. Results and discussion

The common planned drawing of Neogene - early quarternary valley river network is close to the modern network of Volga and Kamainterfluve [12]. It confirms the stability of river valleys development in the Neogene - quarternary age. Paleo-Volga and Paleo-Kama (fig. 1) were the main rivers throughout the Neogene - Quarternary age.

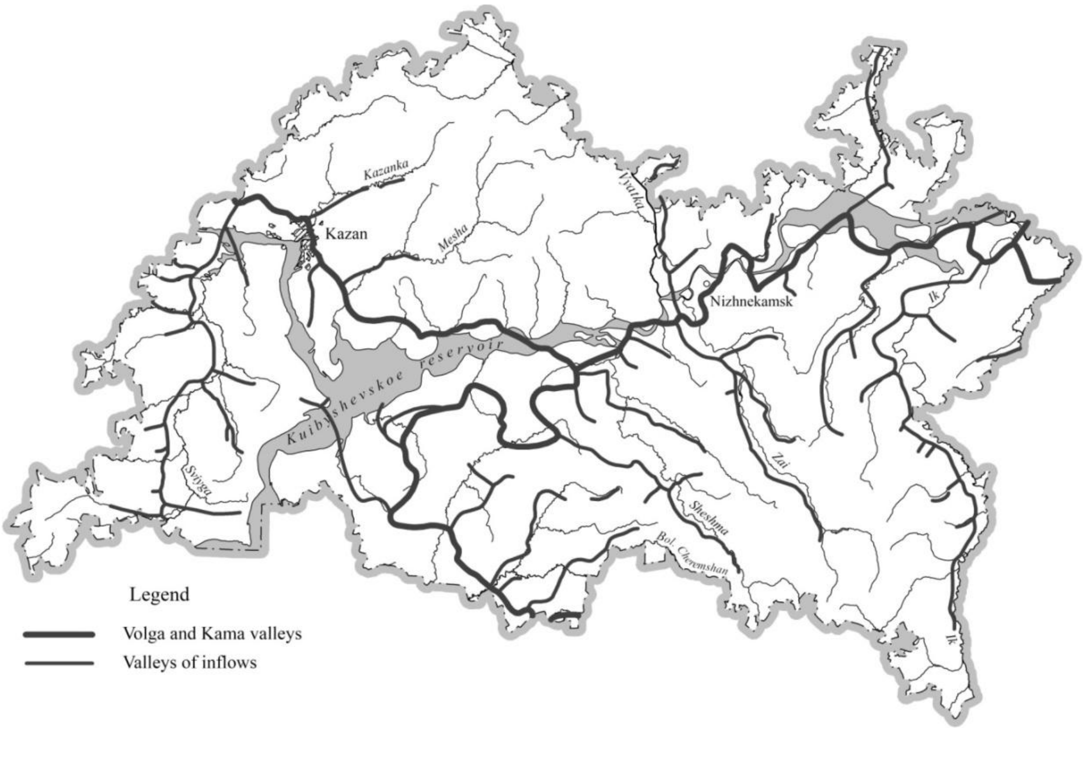

Fig. 1 Reconstruction of valley arrangement for Neogene - Early Quarternary river network of Volga and Kamainterfluve.

The underlay of Neogene valleys within the modern Volga and Kamainterfluve began in late Miocene. River valleys passed the complex development process in Pliocene; in early quarternary age the last development stages took place. According to stratigraphic scale data, the time span of river valleys development made about 4,0 million years [11,13]. During such a long period there was a repeated change of erosion and accumulation in river valleys.

The deposits of river valleys were laid in late Miocene and belong to Neogene and quarternary systems. According to regional stratigraphic scale these deposits are referred to 4 circles: Pontic, Cimmerian, Akchagyl and Gelasian (tab. 1).

River longitudinal profiles were made on sole regional stratigraphic divisions which allowed to trace their time history.

The paleo-rivers valleys longitudinal profile analysis showed that paleo-valleys of both Neogene and early quarternary age were shorter than the modern. However it is necessary to consider the fact that upper courses paleo-valleys were destroyed in further development of Volga and Kama interfluverelief during quarternary age. On the basis of paleo-rivers longitudinal profiles reconstruction it was established that pre-akchagyl cuttings in upper paleo-valley courses were cut by territory subsequent alignment process in quarternary time, as well as a result of river network development in the late Neogene and early quarternary time, due to higher erosion basis. Perhaps, the reason is that now the remained upper paleo-valley courses develop generally by Chistopolsk and

Table 1.Scheme of Russian and regional comparison
Stratigraphic scale

Russian stratigraphic scale [11,13]				Regional scale	
				South of the European Russia [13]	Kazan Volga region and Prikamye (Volga – Kamainterfluve)
SYSTEM	SERIES	Subseries	***Layers***	***Regional layers***	***Stratum***
QUATERNARY	PLEISTOCENE	Paloepleistocene	*Gelasian*	*Gelasian*	*Biclyan*
					Acculayev
					Chistopol
NEOGENE	PALEOPLEOCENE	Upper	*Pyachensk*	*Ackchigil*	*Socolsk*
		Lower	*Zanklsk*	*Kimmerian*	*Chelninsk*
	MIOCENE	Upper	*Messine*	*Pontian*	*Sheshminsk*

Biklyansk deposits. Especially well it is traced on the left-hand inflows of paleo-Kama where lower valley reaches develop into various range of pre-akchagyl and akchagyl deposits, starting from the Sheshminsk, and upper courses only have early quarternary age formations.

Longitudinal profiles of pre-akchagyl cuttings (Sheshminsky, NaberezhnyeChelny layers) differ by the considerable heights and rather great

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biases values (fig. 2 – 5). On some sites the pre-akchagyl paleo-rivers biases can by far exceed bias values of the modern rivers. In table 2 bias values of the pre-akchagyl valleys are given in separate sites and biases of the modern rivers on the same sites are added for comparison.

Pre-akchagyl Paleo-Kama and Paleo-Volga had considerable biases within the studied territory.Biases of Paleo-Kama averaged from 0,1 – 0,2 m/km and reached the maximum of 0,3 – 0,5 m/km. Biases of pre-akchagyl Volga bottom could reach 0,8 – 1,0 m/km, and on some sites come near to 3,5 – 5,0 m/km. Such bias sizes on separate sites can be bound to karst development in the valley bottom.

Table 2.Comparison of biases (m/km) for pre-akchagyl and the modern river beds

River, site (settlements)	Riverbed bias (m/km)		Correlation
	of pre-ackchigil	to modern	
Volga, Salmach – Sokura	0,90	0,03	30,0
Kama, NaberezhnyeChelny – Kamsky Glades	0,27	0,02	13,5
Ika, Verkhn. Styarle – Tumutuk Blagodarovka – Kuzyakino	1,00 0,17	0,16 0,12	6,3 1,4
Zai, Nish. Maktama – Kaleykino Poruchikovo – Aksarino	2,06 1,00	0,56 0,40	3,7 2,5
Sheshma, Star. Kuvak – Sheshminsky fortress Novotroitsk – Novosheshminsk	1,81 1,12	0,34 0,23	5,3 4,9
Sulcha, Aksubayevo – Karasa	3,10	0,64	4,8
Kichuy, Dobromysh – Blagodatnaya	0,98	0,52	1,9

Biases of pre-akchagyl rivers Sulchi, Sheshma, Darling, Ika made 0,7 **-** 1,1 m/km, on separate sites and 1,0 – 3,0 m/km closer to the upper courses. The received values are close to the data provided by other authors. G.I. Gorecki [4] gives value of biases for Paleo-Kama (on site NaberezhnyeChelny – Belyakhcha) – 0,1 m/km, Paleo-Zai –0,45 – 1,1 m/km. According to G. P. Butakova [7], biases of Pliocene Volga bed (Volzhsk – Kazan) made 0,48 m/km, Ika (river ostium of Tumbarlinka – river ostium. Haze) – 1,05 m/km, Sheshma (river ostiumKuvak – Ekaterina's Settlement) – 0,85 m/km. The greatest biases are characteristic for small paleo-rivers of Zakamya RT where their values can exceed biases of the modern rivers beds by 3 – 5 times.

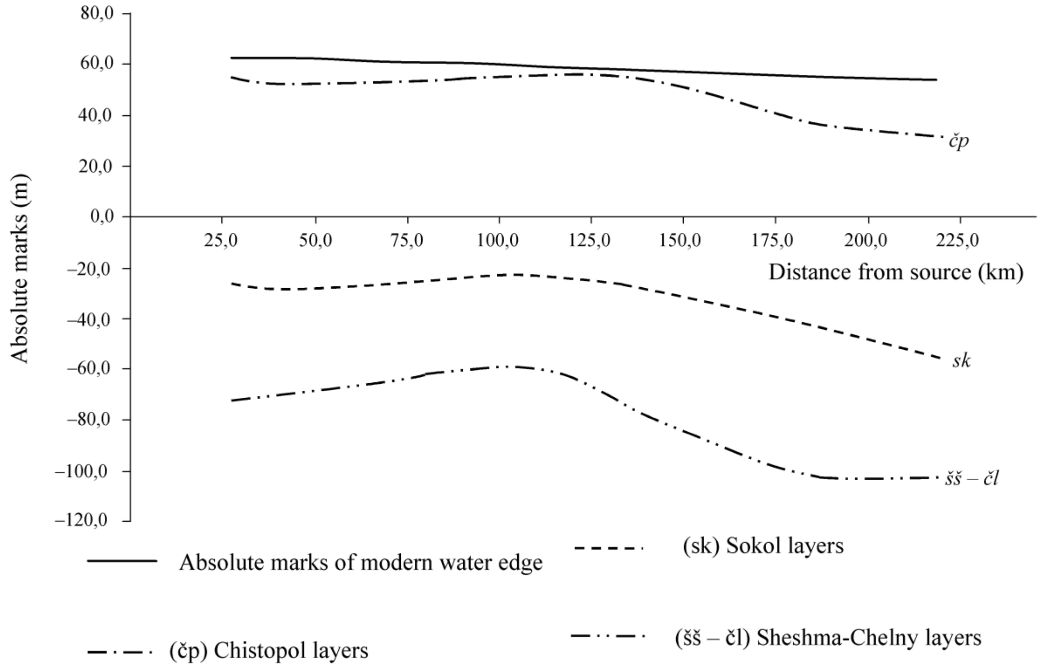

Fig. 2 Longitudinal profiles of Kama and Paleo-Kama (accordingly to bottom of stratigraphic layers)

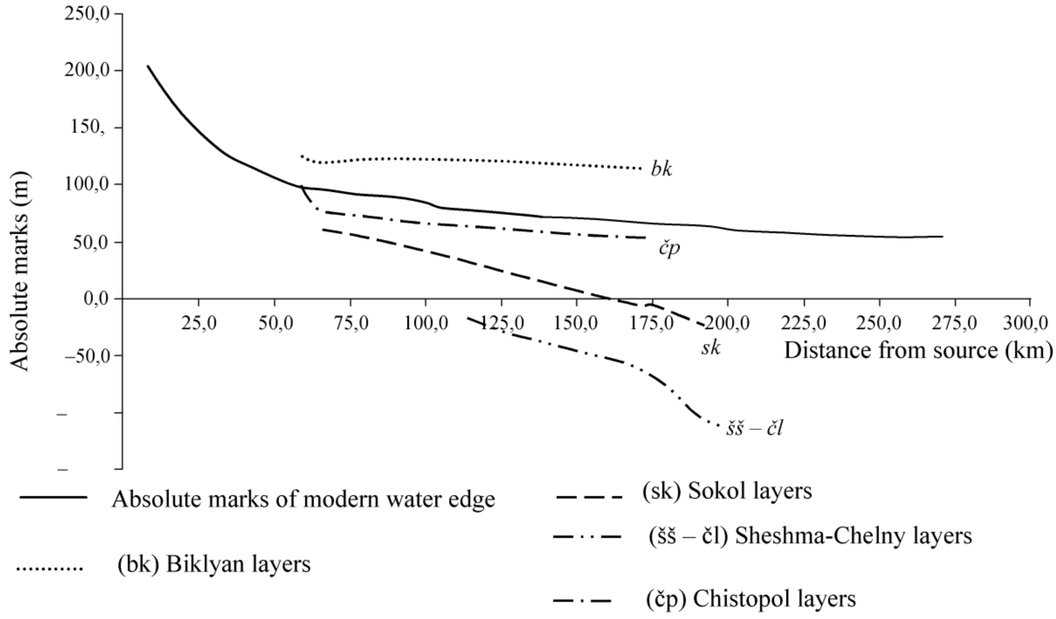

Fig.3 Longitudinal profiles of Sheshmay and Paleo-Sheshma (accordingly to bottom of stratigraphic layers).

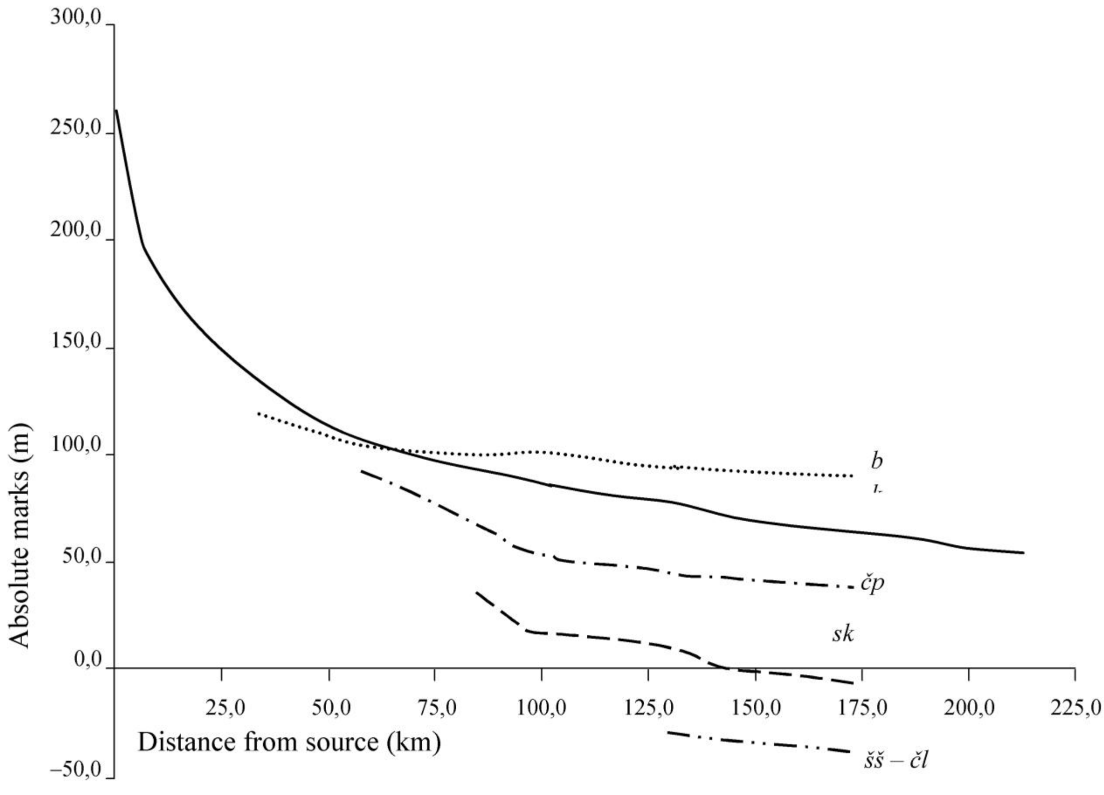

Fig.4 Longitudinal profiles of Zay and Paleo-Zay (accordingly to bottom of stratigraphic layers). Legend on Fig.3

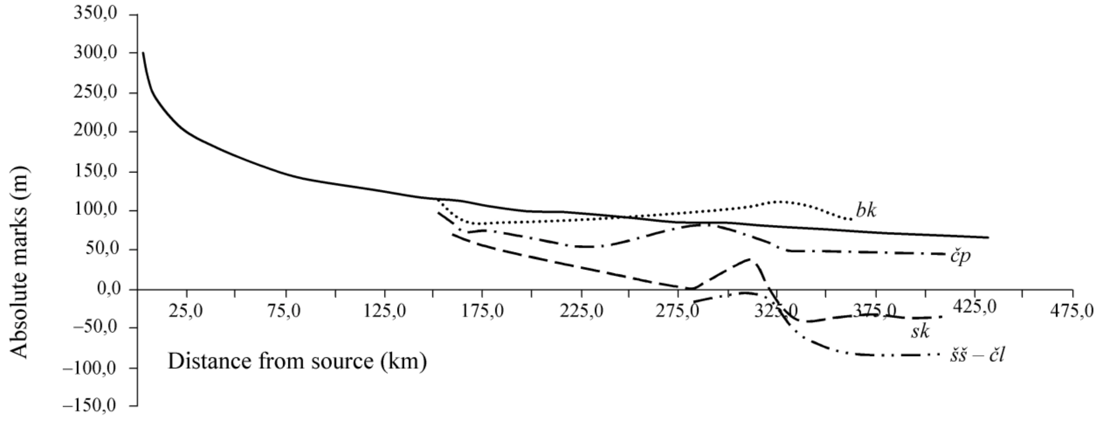

Fig.5 Longitudinal profiles of Ik and Paleo-Ik (accordingly to bottom of stratigraphic layers). Legend on Fig.3

Longitudinal profiles of akchagyl cuttings are closer to longitudinal profiles of the modern rivers. On average, biases of Paleo-Volga and Paleo-Kama at the beginning of Sokolsky time did not exceed 0,3 m/km, for Chistopolsky – 0,1 m/km. Longitudinal profiles of the Sokolsky time beginnings paleo-rivers were characterized by biases from 0,6 to 1,0 m/km, in the beginning of Chistopolsky time – up to 0,1 m/km. Generally, for all paleo-rivers the common tendency of increase in biases to upper courses is characteristic. The least biases are characteristic for the rivers of Biklyansky time.

Thus, the greatest biases are characteristic for valleys of the pre-akchagyl river network formed in this territory during the maximal lowering of the Caspian Sea level. Further development of the river network happened during the most powerful for all Neogene – Quaternary Period Caspian (akchagyl) reservoir transgression. Biases of paleo-river valleys for this period are comparable to biases of the modern rivers.

On many sites paleo-valley deformations of longitudinal profiles are recorded. The positive deformations which are expressed in anomalously high provision of sole Neogene deposits are prevailing. So, in the valley of river Ika on a part of Tumutuk – B. Chekmak, the Neogene sole height changes from minus 18,0 to plus 60,0 and further to minus 34,0, thus deformations are traced on all stratigraphic layers (fig. 5). Such deformations are bound to tectonic structures activation of the latest time [14,15].

4. Summary

It is established, that late Neogene and early quarternary river valleys were shorter than the modern. Biases of Neogene valleys (pre-akchagyl) rivers exceeded bias values of the modern rivers, the akchagyl ones were comparable to them. The rivers of early quarternary time had the least biases.

5. Conclusion

Thus, as a result of the conducted researches it was established that at all stage of the Neogene - early quarternary time valley network development within the studied region rivers were shorter than the modern. Longitudinal profiles of pre-akchagyl cuttings are characterized by the considerable sizes of heights falling and rather great biases values. On some sites the pre-akchagyl paleo-rivers biases can by far exceed bias values of the modern rivers. It confirms that height differences of the studied territory also differed in high values. The least biases are characteristic for early quarternary valley cuttings. Development of Volga and Kamainterfluve valley network in the Neogene - early quarternary time happened against scale fluctuations of the Caspian Basin level. The main role in change of longitudinal profiles and biases of the rivers was played by eustatic factor.

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