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FLUVIAL CYCLICITY FROM THE SEDIMENTS OF THE LOZENETC FORMATION

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ABSTRACT. The aim of the current study is on the base of detailed lithofacial and architectural-element investigation of one section of the Lozenetc Formation from the area of town of Sofia to be demonstrated the fluvial style that has controlled the accumulation of this Formation in the central-southern part of the Sofia Basin.
Four elementary fluvial cycles were distinguished and characterized. Any one of them is building up by channel, near-channel (levee) and inter-channel (crevasse-splay and aggradational overbank fines) deposits. The channel deposits (element CH) are characterized by planar cross-bedded sands (lithofacies Sp) that demonstrate evidence for lateral accretion. The thickness of element CH is from 1.2 m to over 3.4 m. The levee deposits (element LV) are building up by irregular alternation of lithofacies Fl, Sr, Sh and Sl. The morphology of this element varies – from solitary ribbon-like beds, to compound bodies of intercalated wedges and lenses. The crevasse-splay deposits (element CS) are developed in two forms – proximal and distal, and form as solitary, as well as stacked units. The overbank aggradational deposits (element OF) are dominated by three lithofacieses – Fsc, Fm and Fl, and form mainly sheet-like bodies with thickness from 45 cm to over 2 m. Other specific feature of this element is the development of calcretes horizons (lithofacies P) in it.
The thickness of the elementary fluvial cycles increases from 3.15 m in the lower part of the outcrop to over 5.45 m in its upper part. The described sedimentary architecture defines the fluvial settings under which the studied succession was generated as anastomosing one.
Keywords: Neogene, Sofia Basin, anastomosing fluvial style, fluvial cyclicity

АЛУВИАЛНА ЦИКЛИЧНОСТ В СЕДИМЕНТИТЕ НА ЛОЗЕНЕЦКАТА СВИТА

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РЕЗЮМЕ. Цел на настоящото изследване е на базата на детайлни литофациални и архитектурно-елементи изследвания в един разрез на Лозенецката свита от района на град София да се демонстрира алувиалния стил контролирал формирането на отложенията на тази свита в централната-южна част на Софийския басейн.
Установени и характеризирани са четири елементарни алувиални цикъла. Всеки един от тях се се състои от руслови, прируслови и заливнотерасови (потокови и аградационно формирани) отложения. За русловите отложения (елемент CH) са характерни плоскопаралелни косослоести пясъци (литофациес Sp) които демонстрират белези на латерална акреция. Дебелината на този елемент е от 1.2 m до над 3.4 m. Прирусловите отложения (елемент LV) са изградени от незакономерно редуване на литофациеси Fl, Sr, Sh и Sl. Морфологията на отзи елемент е променлива – от единични лентоподобни тела, до съставни тела изградени от множество клинове и лещи. Извънрусловите потокови отложения (елемент CS) са развити под две форми – проксимална и дистална, и е представен както от единични тела, така и от пакети от тела. Заливнотерасовите аградационни отложения (елемент OF) са доминирани от три литофациеса – Fsc, Fm и Fl, и формират предимно пластоподобни тела с дебелина от 45 cm до над 2 m. Друга специфична черта на този елемент е развитието на калкретни хоризонти (литофациес P) в него.
Дебелината на елементарните алувиални цикли нараства от 3.15 m в долната част на разкритието до над 5.45 m в горната му част. Така описаната седиментна архитектура определя флувиалната обстановка, в условията на която е генерирана изучената последователност, като анастоматична.
Ключови думи: неоген, Софийски басейн, анастомиращ алувиален стил, алувиална цикличност

Introduction

According to Kamenov and Kojumdgieva (1983) the Neogene of the Sofia Basin is subdivided into four lithostratigraphical units. The lowermost of them – the Verigated terrigenous Formation, is probably Meotian in age. This unit is covered by the Gniljane Formation (Pontian inf.), presented by alternation of sands, silts and clays with lignite beds in its uppermost parts, separated as Balaš Member. The Gniljane Formation is overlaid by the Novi-Iskar Formation, which is dominated by lacustrine banded clays (Pontian to Dacian in age). The uppermost lithostratigraphical unit – the Lozenetc Formation, is presented by alternation of sands, silts and clays, Dacian to Romanian in age, which contains layers of lignite in its lower part, nominated as Novihan Member. The last three Formations form the Sofia Group.

On the base of new data about the western parts of the basin Angelova and Yaneva (1998) introduced new lithostratigraphic unit – Bogiovci Member of Lozenetc Formation, which is characterized by silty and sandy micrite limestones that alternate with sandy clays, muds, clayey sands and cobbly sands.

Already at the time of the development of the described above lithostratigraphical scheme of the subdivision of the

Neogene in the Sofia Basin, the origin of two of the units – Gniljane and Lozenetc Formation, is connected mainly with the fluvial settings (Kamenov, Kojumdgieva, 1983). This idea is developed further by Yaneva (2001) proposing more detail model for the fluvial sedimentation in the basin during the Pliocene.

Despite the relatively high degree of the lithological investigation of the Neogene fluvial sediments in Sofia Basin (Ajdanlijsky, Pazderov, 1994; Yaneva, 1997, 2001), the detail lithofacial researches on concrete sections are still rare. Among the main reasons for this is the rarity of the large outcrops of these sediments, because of their low degree lithification. Especially this is concerned to the sediments of the Lozenetc Formation, which, despite that occupy significant area of the basin, form large outcrops very rear.

The aim of the current study is on the base of detailed lithofacial and architectural-element investigation of one section of Lozenetc Formation from the area of town of Sofia to be demonstrated the fluvial style that has controlled the accumulation of this Formation in the central-southern part of the Sofia Basin. The studied section is situated in the foundations of the new building of the Geology-Geographical Faculty of the Sofia University in Lozenetc residential district (stratotype area of the Lozenetc Formation) inside which there were four 15 m high and 40-50 m long almost vertical escarps of the upper part of the Lozenetc Formation that give the opportunity for detail lithofacial and sedimentary architecture investigation.

The lithofacial and architectural-element description of the section is based on the nomenclature proposed by Miall (1977, 1978, 1985 and 1996), adapted to the specificities of the studied sediments. The color description of the sediments is based on the Rock-Color Chart of the GSA (1991). The calcretes description is according to the Netterberg (1980) and Goudie (1983) nomenclatures.

Section description

Three completely developed and preserved elementary fluvial cycles (EFC) are presented in the studied section (Fig. 1). The upper part of another one is outcropped in the bottom of the section. The lower part of the elementary fluvial cycles is build up by channel complex and the upper one – by levee, crevasse-splay and overbank fine deposits.

In the outcrop can be observed the channel complex (element CH) of three of the elementary fluvial cycles. As a rule the bottom of this element is represent by relatively flat erosional surface covered by coarse to medium grained massive to horizontal laminated sands (lithofacieses Sm and Sh) which upwards gradually pass into medium grained, well to pore sorted, medium to large scale planar cross-bedded sands (lithofacies Sp). The thickness of the sets varies from one over three meters. In two of the studied channel complexes the lamination of lithofacies Sp is heterolithic. The lamina thickness varies from 0.2 cm to over 2 cm. In one of the sets accretional surface was established. The color of the sands is pale yellowish to grayish (7-10YR7-8/5) and in the heterolithic sets pale brown to dark yellowish brown colors (5-10YR5-4/2) are observed.

In the uppermost parts of all three outcropped channel complexes thin beds (about 2 to 4 cm) of fine to medium grained massive to crudely bedded gravels (lithofacies Gm) with flat, slightly to well pronounced erosional bottom are developed. They are covered by thin beds of coarse to medium grained sands of lithofacies Sm and low-angle cross-bedded (lithofacies Sl) or current ripples (lithofacies Sr). In two cases the in lithofacies Sm thin dark red (5R3/6) Fe oxide crusts are developed. Macrofauna fossil remnants (chops and bones form small rodents) are found in lithofacies Sm also.

The thickness of element CH is from 1.2 m to over 3.4 m. The measurements of the paleocurrent indicators revealed domination of toward north and east orientated fluvial sedimentary paleotransport.

The near-channel setting is presented by levee deposits (element LV) which are building up by irregular alternation of fine laminated silty sands, sandy and muddy silts and hyposediments (lithofacies Fl), and pore to very pure sorted sands from lithofacieses Sr, Sh and Sl. The flaser and lenticular bedding are common. The morphology of this element varies – from solitary ribbon-like beds, to compound bodies of intercalated wedges and lenses. The total thickness of element LV is in the range of 0.6-0.7 m.

In the inter-channel (overbank) deposits crevasse-splay sands and aggradational formed fines are presented. The most common for the crevasse-splay (element CS) deposits are lithofacies associations as Sm-Sr, Sm-Sh or Sh-Sr ones, but lithofacieses Sl and Fl are also presented. The sands are usually pore sorted, medium to fine grained. In some beds solitary fossil bone fragments are established. The lower boundary of the element represent from flat lithological contact to erosional surface. Load casts are also established. Other typical for this element structures are the lenticular bedding and water escape ones. Synsedimentary deformations, which almost completely erase the lamination of the beds, are also established. The ripples – current, wavy and even climbing ones, are among the typical features of this element also. The wavy ripples are more characteristic for the upper parts of the element. Like in the upper parts of the element CH on the top of one crevasse-splay bed from the middle part of the outcrop thin dark reddish Fe oxide crust is established.

Usually element CS is presented by solitary units with thickness is in the range from 15 cm to over 65 cm. Stacked units, where the total thickness can reach over 1.2 m, are also presented. The character of the outcrop allows differentiating proximal and distal type of this element. The proximal one is characterized by the significant attendance of lithofacies Sm, while in distal ones this lithofacies is presented more restricted at the expenses of lithofacieses Sr, Sh and Sl.

The overbank aggradational deposits (element OF) are dominated by three lithofacieses – laminated to massive silts and mud (lithofacies Fsc), massive silts and hyposediments with desiccations cracks (lithofacies Fm) and lithofacies Fl.

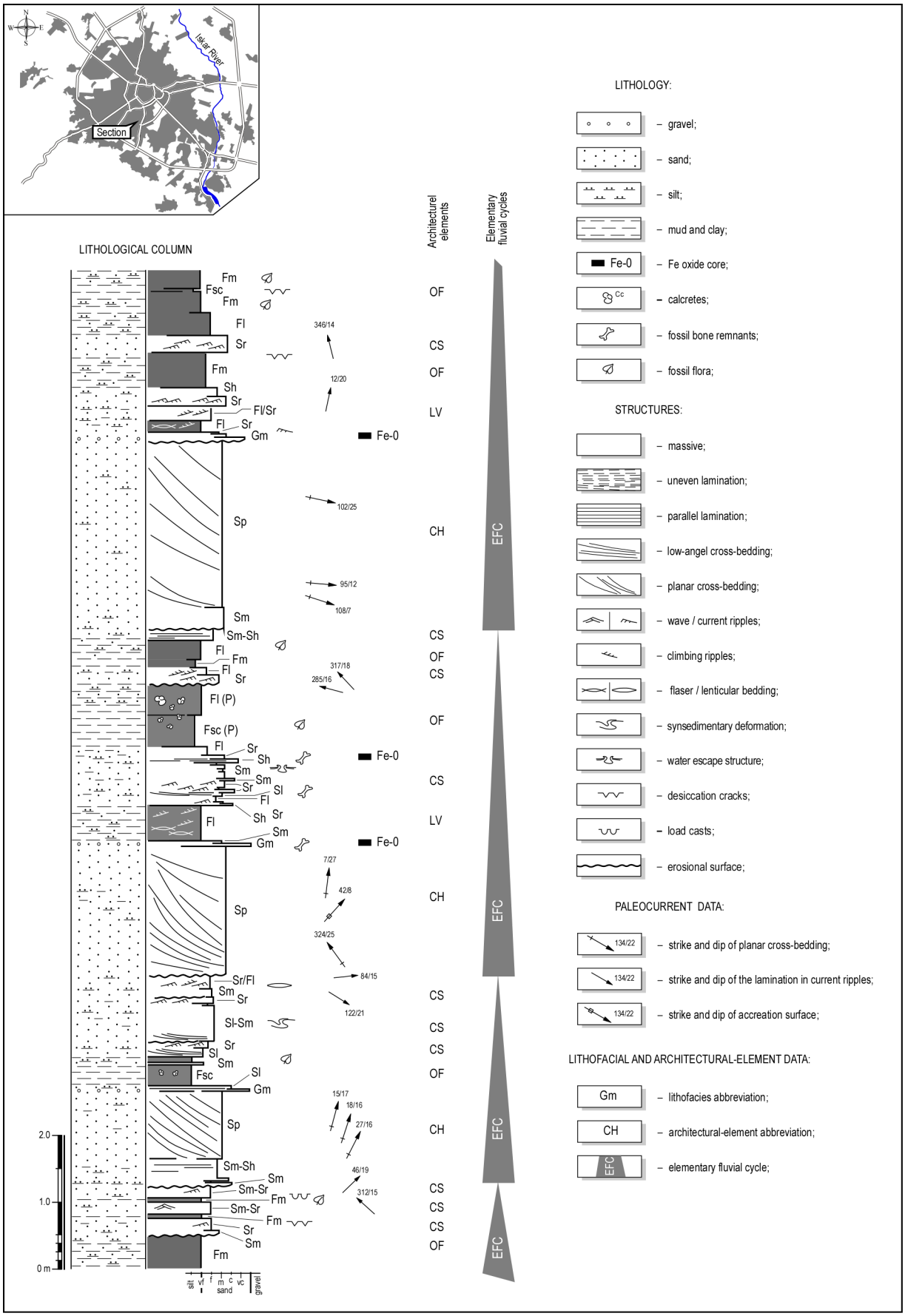

Fig. 1. Position, lithological column and lithofacial and architectural-element log of the studied section. Abbreviations – see the text

The color of the sediments if mainly in the grayish green gamma (5-10G4/2) but in some beds the yellowish brown (5-10YR4/2-4) colors are also presented. The grayish colored fines often contain coaled remnants of fossil plants. The morphology of the element is predominantly sheet-like. The thickness varies form 45 cm to over 2 m.

Among the specific features of element OF is the development of nodular calcretes (lithofacies P). They are presented in two elementary fluvial cycles as solitary small powder concretions as well as 80 cm thick horizon with increasing upwards density and size of concretions, which in lower parts are 1.5-2 cm in diameter powder calcretes while near the top of the horizon they are presented by larger (3-5 cm in diameter) honeycomb calcrete.

The thickness of the elementary fluvial cycles increases from 3.15 m in the lower part of the outcrop to over 5.45 m in its upper part.

Discussion

The described above sedimentary architecture define the fluvial settings, under which this succession was generated, most probably as anastomosing one. The development and preservation of the inter-channel overbank fines (element OF) which contain calcretes from one side, and the large scale development of the crevasse-splays (element CS) from the other side, are among the most prominent characteristics of the profiles, generated after operation of anastomosing rivers. Other specific feature of this fluvial style is the increasing quota of the lateral accretion development of the intrachannel bars and point bars, signs of which were established during this study also. The inter-channel sediments (aggradational fines and crevasse-splay deposits) clearly separate the channel complexes, which fact also support the hypothesis of the domination of the anastomosing fluvial setting during the generation of this part of the Lozenetc Formation in the studied area.

This data expand the paleoenvironmental model for the formation of the Lozenetc Formation proposed by Yaneva (2001). According to this author, during the Dacian to Romanian time the basin is dominated by fluvial depositional setting which have demonstrated clear lateral zonality, connected with the domination of the braided fluvial style near to the edges of the basin, while toward its central parts the influence of the meandering style of sedimentation increases till stay dominant. The character of the described above sedimentary architecture of the studied section sets it in transitional position in comparison of these two zones.

Other contribution of the present work to the existed understanding of the paleoenvironmental setting during the accumulation of the Lozenetc Formation is the data connected with the climatic condition during that time. The instructive in this direction are the red-colored Fe oxide crusts and the calcretes horizons established in the section. Yaneva (2001) describe development of four Fe hydroxide crusts in the sediments of the Gniljane Formation from the northern part of the basin, which are interpreted as evidence for multiple breaks of the sedimentation went in the conditions of hot and dry climate. The establishment of similar features in the section of the Lozenetc Formation from the southern part of basin, together with the development of carbonate paleosol profiles is no doubt other proof for the availability of semiarid climatic conditions during the Pleistocene time in the area of Sofia Basin.

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