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Upper Cretaceous of the Čerevićki Potok, Fruška Gora Mt., Serbia: state of art

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Abstract. The paper is dealing with three interpretations of well known section Čerevićki Potok (Fruška Gora Mt., Serbia): 1. According to Koch, *in*: Pethö (1906), undisturbed succession of 23 lithologically different members, „Hipersenonian"; 2. According to Pašić (1974; unpublished text is used in monography of Petković *et al*. 1976), tectonically disturbed lithologically different Maastrichtian blocks; and 3. According to Čičulić-Trifunović & Rakić (1977), tectonically disturbed stratigraphic column, the Srem-Slavonian type of the Upper Cretaceous sediments, south of Srem dislocation, Maastrichtian.

Key words: Čerevićki Potok section, lithologically different members/blocks, stratigraphic column „Hipersenonian", Maastrichtian, chaotic complex, Fruška Gora, Serbia.

Апстракт. У раду су приказане три интерпретације познатог профила у Черевићком потоку (планина Фрушка гора, Србија): 1. Према Косн-у, *у*: Pethö (1906), 2. Према Пашић, 1974, у: Петковић *и др.* (1976), и 3. Према Чичулић-Трифуновић & Ракић (1977).

Кључне речи: профил у Черевићком потоку, литолошки различити чланови/блокови, мастрихт, хаотични комплекс, Фрушка гора, Србија.

Upper Cretaceous fossiliferous sediments of the Čerevićki Potok (Fruška Gora Mt.), were identified in 1864. by Koch. Later, Koch continued with investigations of geology of Fruška Gora and published numerous papers during period from 1867 to 1903. A macrofauna that collected over many years, was given to Pethö. They, in 1882, together visited the Čerevićki Potok to supllement the collection. Pethö's uncompleted study of this very rich and diversified macrofauna was posthumous published in 1906. The described collection contain 164 species, mainly gastropods and bivalvia, more than half of which new species. These extremely paleontologically rich sediments he determined stratigraphicaly as HIPERSENONIAN as youngest deposits of the Upper Cretaceous, younger than the Gossau Beds. The interest in the Cretaceous taken for Maastrichtian of the Čerevićki Potok, has not diminished up to the present time.

Comprehensive data on Upper Cretaceous of the Čerevićki Potok and adjacent area were published by Petković *et al.* (1976). The authors presented results published by Stepanović (1940), Papp (1954), Pašić (1951), Pašić & Maksimovć (1952), Pejović (1970) and Grubić (1972), which had contributed to the knowledge and the number of macro and microfaunal taxa from the Čerevićki Potok.

Hancock & Kennedy (1993) published first informations about the presence of Campanian sediments in the Čerevićki Potok based on revision of the ammonite species *Sonneratia cereviciana* Pethö, 1906, a younger synonym of the Upper Campanian species *Pseudokossmaticeras brandti* (Redtenbacher). Radulović & Motchurova-Dekova (2002) also documented Campanian age of brachiopods from the some of the Čerevićki Potok blocks.

The Čerevićki Potok section after Koch, *in*: Pethö (1906)

The Cretaceous of the Čerevićki Potok (Fig. 1) lies over the basement (1. Grundgesteine des Gebirge), covered by Neogene (2. Sarmatische Stufe). This is an undisturbed succession of the relatively equal north-

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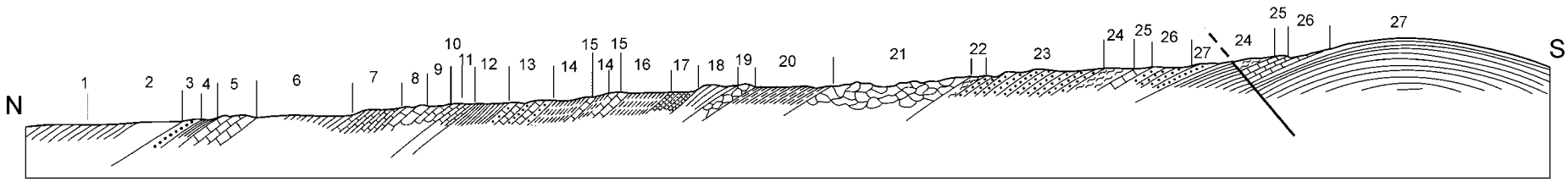

Fig. 1. Section Čerevićki Potok, Fruška Gora Mt. (according to KOCH, *in*: PETHÖ, 1906). **1,** Sarmatian beds; **2,** Porous, marly limestone (Leithakalk or *Amphisteginа*kalk); **3,** Serpentinite breccias; **4,** Ferruginous greenish freckled claystones; **5,** Compact, hard limestones; **6,** Schisty greenish freckled beds; **7,** Black coloured clayey marlstones with numerous fossils (the richest collection; lately, new species and genus were found); **8,** Block (thick bed) with hippurids (10 m thick, according to Koch) with big and small hippurids of species *Hippurites (P.) polystylus, H. Cornuvaccinum (Hippurites sulcatus)*; **9,** Black-brownish clayey marlstone with serpentinite (*Sphaerulites* marlstone); **10,** Orbitoides limestones (and *Radiolites crateriformis*); **11,** Carbonate-serpentinite sandstone (*Sphaerulites solutus*); **12,** Reddish greenish freckled claystones (similar to beds of blocks 4 and 6); **13,** Change of schists and sandstones, conglomerates and dark schists; **14,** Reddish schisty claystones; **15,** Thick bedded to massive, hard, gray limestones with fine calcitic schists 1.5–40 m thick. Claystones and limestones are very fossiliferous; **16,** Blue-blackish clayey marlstones with *Inoceramus crispi* etc.; **17,** Green sandstones, Koch's „Brachiopodenführende Serpentinbreccie"; **18,** Lime marlstones without fossils; **19,** Schisty serpentinites 20 m thick; **20,** Clayey marlstone with *Gryphaea vesicularis*; **21,** Big masses of serpentinites; **22,** Grayish, earthy schists; **23,** Sandstones and conglomerates; **24,** Dark, earthy schists; **25,** Brown, platy limestones with fragments of rudists and molluscs; **26,** Change of schists, sandstones and breccias around 200 m along the stream; **27,** Clayey schists.

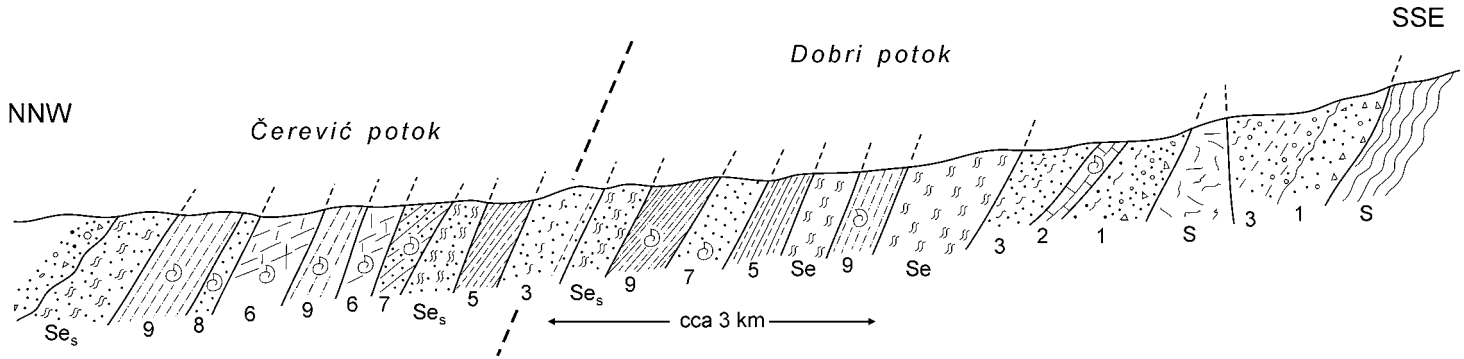

Fig. 2. Schematic section through Čerevićki–Dobri Potok, Fruška Gora Mt. (*in*: PETKOVIĆ *et al.* 1976). **Se,** serpentinites; **Se_s,** detritic serpentinites; **S,** schists in base; **1,** Conglomerates and breccias intercalated with coarse sandstones (basal part); **2,** Rudists limestones (*Hippurites cornucopiae*); **3,** Claystones, conglomerates, change of clayey marlstones and sandstones; **5,** Reddish marly limestones and gray marlstones; **6,** Debris limestones with rudists, corals and orbitoids (level with *Pironaea polystylos slavonica*; **7,** compact green and yellowish sandstones with small serpentinite grains (*Sphaerulites solutus*, brachiopods, ammonites etc.); **8,** Sandy compact gray limestones (orbitoids, corals, gastropods etc.); **9,** Gray, brown and black marlstones, micaceous and argillaceous and gray claystones (siltstones) with intercalations of yellowish sandstones of fine granulation (level with more fossils); **10,** Conglomerates of Neogene base.

ward dip, composed of 23 members (from younger to older), i.e. 3–5 some repeating members. The members are: serpentinite breccias, serpentinites (large mass), conglomerates, different sandstones (serpentinitic, ferruginous, carbonate and clayey), claystones, different clay-marly and marl-sandy sediments, limestones with orbitoids and rudists, hippuritid and marly limestones. Members 7, 8, 9, 10, 11, 16 and 17 are highly fossiliferous. Gastropods and bivalvia are dominant in the PETHÖ'S collection. Two members lithologically identical in diversified and numerous of fossils (127 species) are conspicuous members 7 („*Sphaerulites* mergel") and 9, also members 8 (*Hippurites/Pyronea/polystyla*) and 10 (*Orbitoides, Radiolites crateriformis*). These members are taken by PETHÖ to be the youngest Cretaceous sediments. Very interesting and rich in fossils serpentinitic sandstones of members 11 and 17, in addition to the abundance of rudist species *Sphaerulites solutus* and other molluscs, contain cephalopods and numerous brachiopods (member 17: KOCH'S „Brachiopodenführende Serpentinbreccie").

The KOCH-PETHÖ collection is deposited in the Hungarian Geological Institute in Budapest.

The section of the Čerevićki Potok according to PAŠIĆ, 1974, *in*: PETKOVIĆ *et al.* (1976)

„Pre-flysch Upper Cretaceous", distributed on northern slopes of western Fruška Gora, in middle and upper courses of the streams best exposed in the Čerevićki Potok section. On the geographic map the Čerevićki Potok source area designated as Dobri Potok and Orlovački Potok.

The authors emphasize that the section is schematic (Fig. 2), because the investigated area is tectonically much disturbed and largely covered by coluvial material. „The relationship of all horizons and their present-day place in the section and the description of some levels according to superposition from the lowermost are presented", they also noted that some blocks are tectonically moved to „different levels where is not their place superpositionally" (PETKOVIĆ *et al*. 1976).

In the fifties, studies of the Čerevićki Potok were recognized eight lithologically different blocks besides serpentinites and destroyed serpentinites (1–3, 5–9). Blocks 5 and 8 are not presented in Koch-Pethö's section. Some blocks are recurring:

Coarse basal breccia and conglomerates thick 40 m and more (block 1), in tectonic contact with serpentinite, appear in few tectonically separated parts. These composed of very coarse basal crystalline schists, serpentinites and quartz gravels in carbonate-ferruginous cement, which pass upward into fine-grained conglomerates with sandstone intercalations.

On the coarse basal sediments sporadically lies „lensoidal" limestone bearing rudists (block 2). This, 1.2 m thick limestone, contains numerous specimens of *Hippurites cornucopiae* (GRUBIĆ 1972).

Further, in the section, 6 blocks in tectonic contact (blocks 3, 5, 6, 7, 8 and 9) are described, which are repeatedly occuring, excluding 8 (sandstone with orbitoids, corals, gastropods):

*– two times basal member, serpentinite and blocks 5 (15 m redish marly limestones; in Dobri Potok about 30 m gray, platy marlstone), 6 (rudistid-orbitoides limestone corresponding to PETHÖ'S members 8 and 10 and, member 9 "*Sphaerulites *marlstone" between them) and 7 ("serpentinite sandstone" with* Sphaerulites solutus *another bivalvia and brachiopods, correspoding to PETHÖ'S members 11 and 17 with Sp. solutus, cephalopods and brachiopods, respectivelly KOCH'S "Brachiopodenführende Serpentinbreccie");*
– three times desintegrated serpentinite and block 3 (conglomerates, alternation of claystones, conglomerates, marlstone, sandstone and sporadically with intercalation of silicified limestone);
– four times block 9 (gray and black micaceous clayey marlstone and claystone with sandstone intercalations, which corresponds to PETHÖ'S members 7 and 9 abounding in chaotically mixed fossils). PAŠIĆ described from these two blocks 32 species not known from PETHÖ'S collection (some were new).

PETKOVIĆ *et al*. (1976) tried to interpret primary stratigraphic relationships to present the stratigraphic column, also nothing that tectonic movements disturbed the normal superpositional order. For construction the column they used data from the blocks everywhere in the Čerević area: Tancoš Maastrichtian limestone, blocks and/or km-blocks of basinal sediments of Srednje Brdo, Čitluk, Debeli Cer and flysch development north of the Srem dislocation.

Some species from Cretaceous of Čitluk Potok, like *Pironea polystylus slavonica* (HILBER) = in Pethö: *Hippurites (Pironea) polystilus* (PIRONA) emend. Pethö, some other rudist species and orbitoids were known as Maastrichtian markers (STEPANOVIĆ 1940; PAŠIĆ 1951; NEDELA-DEVIDE & POLŠAK 1961; MILOVANOVIĆ 1962; POLŠAK 1965; MILOVANOVIĆ & GRUBIĆ 1966; GRUBIĆ 1972). Consequently, for transgressive coarse clastics were accepted to be the Middle Maastrichtian and fossiliferous blocks the Upper Maastrichtian. The youngest Upper Cretaceous sediments, i.e. flysch, according to RADOŠEVIĆ & MARKOVIĆ (1967) also was ascribed to Maastrichtian.

RADOŠEVIĆ & MARKOVIĆ (1967) believed that the whole flysch series to be Upper Maastrichtian, and flysch sedimentation normally continued over fossiliferous sediments. They described three clearly different sedimentological parts (with *Inoceramus* in lower part). We would emphasize their opinion that the „upper part of the flysch, which really looks younger, resembles with the Ostružnica flysch in the Belgrade environment".

Fauna described by PAŠIĆ (1951) is preserved partially in the Paleontological collection of the Faculty of Mining and Geology, Belgrade.

Section of Čerevićki Potok, according to Basic Geological Map and Explanatory text, sheet Novi Sad, 1:100 000 (ČIČULIĆ-TRIFUNOVIĆ & RAKIĆ, 1977)

Two structural-facial zones of the Upper Cretaceous on the Fruška Gora are identified: Bačka-Banat flysch development, north of Srem dislocation, and southern, Srem–Slavonia development, between Srem and Fruška Gora dislocations („Čerević Upper Cretaceous *s.l.*"; Fig. 3). The Cretaceous of the Srem–Slavonia zone is partially outcropping around 20 km east–west.

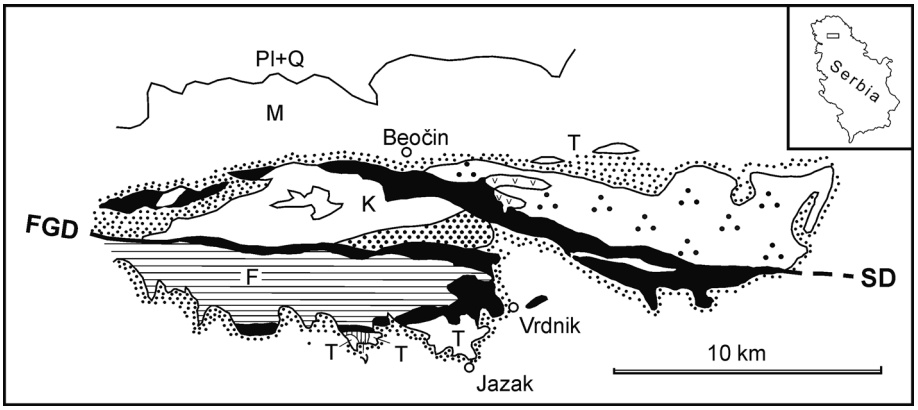

Fig. 3. Simplified and modified map of Fruška Gora area from Basic geological map of Novi Sad, 1:100 000. **SD,** Srem dislocation; **FGD,** Fruška Gora dislocation; **F,** Phyllitoids (metamorphosed Triassic?); **T,** nonmetamorphosed Triassic; **K,** Cretaceous; three dots – Cretaceous Flysch; **M,** Miocene; **Pl+Q,** Pliocene and Quaternary. (*in*: DIMITRIJEVIĆ 1997).

Transgressive position of Upper Cretaceous deposits over Jurassic schists is visible only in the middle of the zone, in the Ugljarski and Čitluk Potok vallies. The authors mentioned the difficulty of giving the stratigraphic column for the Srem–Slavonia development due to tectonic disturbance in the section Čerevićki Potok.

The stratigraphic column, described and given on the geological map starts with the trasnsgressive deposits of shallow-water coastal facies which consist of breccias, conglomerates, sandstones, brecciated limestones, reefal and massive limestones and sandy reefal limestone. Upward, prevailing are claystone, siltstone and fine-grained clayey sandstone which gradually pass into marlstones and marly limestones that close the Upper Cretaceous lithostratigraphic column of this formational zone. The latter, distributed in western area in Debeli Cer, Čitluk Potok and Srednje Brdo are not mentioned in the Čerevićki Potok by PETHÖ. Although paleontological evidence was not discovered in sediment of PAŠIĆ's block 5, they being lithologically similar, were compared to sediments of the mentioned localities (PETKOVIĆ *et al.* 1976).

Authors considered that fauna of shallow-water sediments, without exception, and basinal marly limestones of Čitluk Potok and Srednje Brdo are Maastrichtian. DANILOVA (1960) described an association of planktonic foraminifers from Čitluk Potok with species prevailing the Maastrichtian. DANILOVA (acc. to mem. of R. RADOIČIĆ) corrected this stratigraphic conclusion in some of the internal reports and limestones of Čitluk Potok asigned to the Campanian.

In the Srednje Brdo quarry very tectonically disturbed basinal sediments with planktonics are outcropped (see in: PETKOVIĆ *et al.* 1976). Marly reddisch limestones from a part of the quarry are Lower Campanian – *Globotruncanita elevata* zone (DE CAPOA *et al.* 2002). ČIČULIĆ-TRIFUNOVIĆ & RAKIĆ (1976), the Srednje Brdo sediments dated Maastrichtian, based on the presence of *Inoceramus balticus*.

Inoceramus balticus was found by Pašić in the Pethö's member 7. According to KÜHN (PAŠIĆ 1951) the species was wrongly ascribed by many authors to *Inoceramus cripsi* MANTELL *Inoceramus balticus*, respectivelly *Cetaceramus balticus* (BOEHM) WALASZCZYK, COBBAN & HARRIES, 2001, is the species characterizing Lower and Middle Campanian.

Fossils collected during geological mapping of the sheet Novi Sad, which were deposited in Geological Institute in Belgrade, have not been preserved.

Comment

Sediments in some Čerevićki Potok blocks contain an abundance of mixed fauna not only of different fossil groups, but also different environments (including brackish and paralian, according PAŠIĆ 1951), of different preservation and different ages. Some specimens from the same block are very well preserved and undamaged (well preserved sculptures of gastropods, sculptures and hinge apparatus of bivalvia). Many specimens collected undamaged were washed away from soft sediments of stream slopes. Well preserved numerous rudists and other molluscs will be good material for Sr-isotope measurement. Sr-isotope stratigraphy has recently been used in the revision of stratigraphic range for some rudist species previously considered Maastrichtian.

The sediments older than Upper Senonian have not documented so far; the youngest known are Maastrichtian limestones with orbitoids, siderolites, loftusias

and Pironea. An open question is whether sediments of the some blocks without paleontological evidence are younger than Cretaceous.

It should be mentioned that in the part of Fruška Gora flysch Oligocene sediments are documented on the base of nannofossils (CP19=NP25 biozone, De Capoa *et al.* 2002), what implies that the main tectonic events are not older than Chatian.

The observation of Radošević & Marković (1967) on the similarity of the upper part of Fruška Gora and Ostružnica flysch is confirmed by the finding also Oligocene nannofossils (CP19=NP25, De Capoa *et al.* 2002) in sediments of a part of Ostružnica Maastrichtian flysch.

Upper Cretaceous beds of the Čerevićki Potok were deposited in different shallow-water (and bathyal?) and different sedimentary environments. Some blocks of „pre-flysch Upper Cretaceous", i.e. „Srem–Slavonia structural-facial zone"of Fruška Gora indicate on a multiple preceding tectonic activity. Based on available data, Srednje Brdo block was also deformed by late Campanian tectonic events.

Cretaceous sediments, occuring in blocks between two tectonic lineaments – Srem and Fruška Gora dislocation, in fact are blocks of a chaotic complex including serpentinites, which are nowadays in a stratigraphic column incorrectly presented, as an undisturbed Upper Cretaceous succession.

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Резиме

Осврт на познавање горње креде Черевићког потока (Фрушка гора, Србија)

Богату и веома разноврсну фауну у седиментима Черевићког потока открио је KOCH 1864. године и уступио је Pethö-у на проучавање. Koch и Pethö, приликом заједничког обиласка овог локалитета 1882. године, допунили су збирку која је приписана најмлађем сенону, Хиперсенону. Њихови резултати су објављени у обимној студији након Pethö-ове смрти 1906. године.

Први публиковани податак о присуству кампанских седимената у Черевићком потоку дали су HANCOCK & KENNEDY (1993) на основу ревизије амонитске врсте *Sonneratia cereviciana* PETHÖ, 1906, која је млађи синоним горњокампанске врсте *Pseudokossmaticeras brandti* (REDTENBACHER, 1873). Кампанску старост једног од блокова Черевићког потока документовали су на основу брахиопода и RADULOVIĆ & MOTCHUROVA-DEKOVA (2002).

У овом тексту приказане су три интерпретације горњокредног профила у Черевићком потоку, према:

– KOCH у: PETHÖ (1906): непоремећена сукцесија 25 детаљно описаних, литолошки различитих, чланова најмлађег сенона – хиперсенона. Из појединих чланова сакупљена је богата, веома разноврсна фауна (преко 160 врста, а више од половине нових).

– ПАШИЋ 1974 (*у*: ПЕТКОВИЋ *и др*. 1976): у веома поремећеној горњој креди, између Сремске и Фрушкогорске дислокације, осим серпентинита и здробљних серпентинита, описано је, у тектонском контакту, 8 литолошки различитих блокова; неки од њих понављају се два, три или четири пута; иако је, на профилу јасно приказан тектонски склоп Черевићког потока, аутори су, укључивши блокове знатно ширег подручја Черевића, као и флишне седименте северно од Сремске дислокације, реконструисали стуб са претпостављеним стратиграфским редоследом. Горња креда Фрушке горе приписана је средњем и горњем мастрихту.

– ЧИЧУЛИЋ-ТРИФУНОВИЋ И РАКИЋ (1977): структурно-фацијална зона горње креде, јужно од Сремске дислокације, издвојена је као посебан Сремско-славонски тип горње креде мастрихтске старости. Аутори такође истичу велику поремећеност и тектонску расцепканост због чега је тешко дати детаљан литостратиграфски стуб. Стратиграфски стуб горње креде ове формационе зоне, приказан уз геолошку карту и описан, односи се на читаво подручје поменуте зоне, а завршава се лапорцима и лапоровитим кречњацима. Макро и микрофауна, која се у овим слојевима помиње као мастрихтска, уствари је кампанска (планктонски фораминифери, као и доњо-средњокампански *Inoceramus balticus*, одн. *Cetaceramus balticus*).

Коментар

Седименти неких блокова Черевићког потока садрже обиље измешане фауне, не само различитих фосилних група, него и различитих седиментационих средина (укључујући бочатне и паралске, према Пашић). Фосили су различитог степена очуваности и различите старости. Примерци фауне неких блокова су веома добро очувани и неоштећени (добро очуване скулптуре гастропода, скулптуре и бравни апарати бивалвија). Бројни рудисти и друге молуске могли би да буду веома добар материјал за Sr-изотопска мерења, с обзиром да је примена Sr-изотопске стратиграфије допринела ревизији стратиграфског положаја неких рудистних врста које су сматране мастрихтским маркерима.

Седименти старији од сенона до сада нису документовани; најмлађи мастрихтски кречњаци садрже фауну крупних фораминифера и пиронеа. Отворено је питање да ли су млађи од креде неки блокови у којима нису нађени макрофосили, а микропалеонтолошке анализе нису рађене. Такође треба поменути да су у делу Фрушкогорског флиша на основу нанофосила документовани седименти горњег олигоцена (као и у седиментима једног дела Оструженичког флиша у околини Београда), што упућује на закључак о непосредној постолигоценској старости главних тектонских збивања.

Горњокредни седименти Черевићког потока депоновани су у различитим плитководним (и батијалним?) седиментима и различитим седиментационим јединицама. Неки блокови "префлишне горње креде", одн. „Сремско-славонске структурно-фацијалне зоне" Фрушке горе указују на ранију вишекратну тектонску активност. Блок Средњег брда, према расположивих подацима, тектонски је био деформисан у кампану.

Кредне седименте, који се појављају у блоковима између Сремске и Фрушкогорске дислокације, а који су у ствари блокови хаотичног комплекса који укључује и серпентините, данас није прихватљиво приказивати у стратиграфском стубу као непоремећену горњокредну сукцесију.