NAT. CROAT. | VOL 2 | No 1 | 55 - 72 | ZAGREB | 1993

ISSN 1330-0520
UDK 551.24 (234.422.1)

Original scientific paper
Izvorni znanstveni članak

STRATIGRAPHIC AND TECTONIC POSITION OF PALEOGENE JELAR BEDS IN THE OUTER DINARIDES

KREŠIMIR SAKAČ
Croatian Natural History Museum, Demetrova 1, Zagreb, Croatia

JOSIP BENIĆ & STJEPAN BAHUN
Department of Geology and Palaeontology, Faculty of Science, University of Zagreb, Kralja Zvonimira 8, Zagreb, Croatia

VILI PENCINGER
Institute of Geology, Sachsova 2, Zagreb, Croatia

Sakač, K. & al.: Stratigraphic and tectonic position of Paleogene Jelar Beds in the Outer Dinarides. Natura Croatica Vol. 2, No 1, 1993, Zagreb.

It has been established that the breccias of the Jelar Layers in the regions of Drniš (Dalmatia) and Dabrica (Hercegovina) have been formed in Middle Eocene. These strata are spread over rather big areas in the western part of the Outer Dinarides but so far their definite age couldn't be established, and therefore they have been designated in general as Paleogenic. The Middle Eocenic age in the mentioned regions has been determined by their superposition. In the floor there are foraminiferal limestones of the older part of Middle Eocene, or Upper Cretaceous limestones, and in the roof Promina Beds of Younger Paleogene. By analyses of limestone nannofossils it could be proved that the younger part of the Promina Beds in the locus typicus belongs to the Lower Oligocene while the older part in Dabrica corresponds to the younger part of Middle Eocene. The Jelar Beds are a constituent of very complicated tectonic structures formed before the deposition of Promina Beds.

Key words: Jelar Beds, Middle Eocene, Lower Oligocene, Promina Beds, Nannofossils, Tectonics

Sakač, K. & al.: Stratigrafski i tektonski položaj Jelar naslaga u Vanjskim Dinaridima. Natura Croatica Vol. 2, No 1, 1993, Zagreb.

U područjima Drniša (Dalmacija) i Dabrice (Hercegovina) utvrđeno je da su breče Jelar naslaga nastale u srednjem eocenu. Te naslage imaju znatnu rasprostranjenost u zapadnom dijelu vanjskih Dinarida, ali dosada im se nije mogla utvrditi određenija starost, pa su općenito označavane kao paleogenske. Srednjoeocenska starost u navedenim područjima određena je njihovom superpozicijom. U podlozi su im foraminiferski vapnenci starijeg dijela srednjeg eocena, ili gornjokredni vapnenci, a u krovini Promina naslage mlađeg paleogena. Analizama vapnenačkih nanofosila dokazuje se da mlađi dio Promina naslaga na locus typicus pripada donjem oligocenu, dok njihov stariji dio u Dabrici odgovara mlađem dijelu srednjeg eocena. Jelar naslage u sastavu su veoma složenih tektonskih struktura nastalih prije taloženja Promina naslaga.

Ključne riječi: Jelar naslage, Srednji eocen, Donji oligocen, Promina naslage, nanofosili, tektonika.

INTRODUCTION

The coarse-clastic sediments, predominantly limestone breccias, spread widely in the region Lika and along the south-western slopes of the Velebit Mt., BAHUN (1963) denominated **Jelar Beds.** His opinion is that they are of Tertiary age for they lay on Mesozoic, mostly carbonaceous strata of various geologic periods, nowhere covered by younger sediments. The same Jelar layers have afterwards been found in complicated tectonic structures along the lower course of the Zrmanja river in Dalmatia, where their Tertiary age also could be proved (FRITZ et al., 1978). However, coarse-clastic Tertiary sediments were determined by many authors as local occurences; that led to the belief that it's a question of Promina Beds of the Younger Paleogene. Such claims are made for example, by POLŠAK (1957) for the surroundings of Rijeka and by CRNOLATAC and MILAN (1959) for a part of Lika. But already KERNER (1894) had mentioned "rosenrothe Breccien" for the region of Drniš and, like IVANOVIĆ and SAKAČ (1971), thought that the limestone Breccias of the Jelar type on the south-western slopes of the Promina Mt. are of Middle Eocenic age. The decision about the formation age depended on the age of the youngest rocks found in the breccias. In some localities that are fragments of Eocenic flysh and in the predominant part fragments of Paleogenic, Cretaceous of Jurassic, even Triassic, strata, so the youngest fragment is standard in the age determination of the breccias. Afterwards BAHUN (1974) connected the breccia genesis with reversed and overthrown movements, and so HERAK and BAHUN (1980) brought their disposition in connection with strong regional reverse and thrust movements and the age of their formation in general with Upper Eocene, as a "wild-flysh" equivalence of the Promina molasse. Recently, Jelar Beds are found in quite a number of localities, predominantly as less isolated occurrences, especially inside the tectonic unit Adriatic (HERAK, 1986), from Rijeka, over the Adriatic islands and inner Dalmatia, to Dabrica near Stolac in Central Hercegovina **(Fig. 1).** Such an actual disposition in a wider area is a consequence of the neotectonic desintegration of Adriatic region and the differential motions of its individual parts. For the disconnectedness and fragmentation of their cartographic registration the obvious reasons are either the strong Neogenic-Quarternary erosion or the wrong determination of their belonging during the earlier cartographic works. Therefore, for the future there can be expected that some "Paleogenic limestone clastics" and parts of breccias, now declared as Cretaceous or Jurassic, will be assigned to Jelar Beds. Such cases can be expected in Lika, Southern Croatia, and Western Hercegovina. Of course, for the correct definition of such areas it will be necessary to examine a great deal of localities like the here described Dabrica and Drniš regions, where their age is tried to be determined with more exactness.

This wide diffusion of the Jelar Beds gives them a great regional significance. That is true in view of the reconstruction of paleogeographic relations, sedimentary conditions, and tectonic disturbances during their formation but as well as with regard to the valuation of the intensity of later neotectonic movements. For all that, the Jelar Beds merit a better attention of sedimentology and tectonics experts.

THE DRNIŠ REGION

Jelar Beds in the Drniš region are found in a narrow belt between the canyon of the river Krka and the Lukovača area on the Promina Mt. (**Fig. 2**). There they are especially

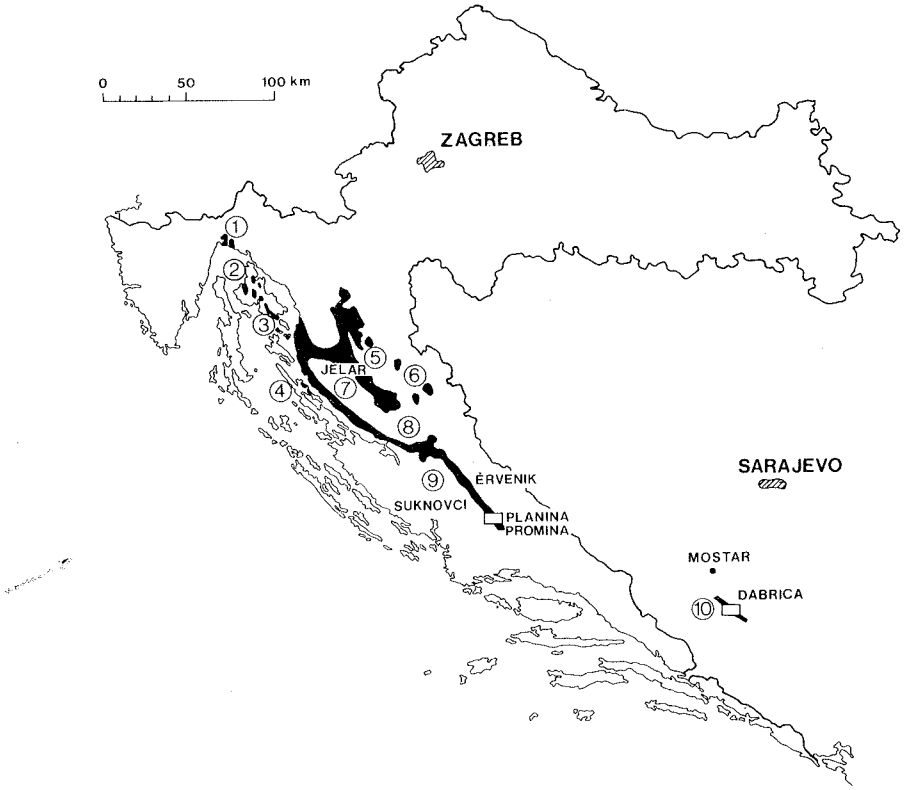


Fig. 1. Distribution of the Jelar beds. Localities: 1. - Surroundings of Rijeka, 2. - Krk Island, 3. - Goli and Prvić Islands, 4. - Pag Island, 5. - Central part of the Lika, 6. - River Una valley, 7. - Locus typicus of the Jelar beds, 8. - Velebit Mountain, 9. - River Zrmanja valley, 10. - Dabrica (Hercegovina)

prominent on the south-eastern slopes where their thickness reaches up to 200 m. They are formed of unbedded to feebly bedded limestone breccias with unrounded and unsorted fragments with a diameter from some millimetres to big blocks resulting from Cretaceous and Lower Paleogene limestones. Fragments of bauxitic oöids were also found. The cement of the breccias ist mostly sparry, with admixtures of limonite and bauxitic particles, therefrom their characteristic reddish colour. The Jelar Beds on the Promina Mt. begin with well-bedded reddish calcarenites, up to 10 m thick, which in the form of rather thin lenses occur in the upper part of the breccias, too (**Fig. 3**). The Jelar Beds are laying on Upper Cretaceous limestones or Eocene foraminiferal limestones, partly also on marls in their top part, with a very marked erosion discordance. The discordance is

perceptible by small occurrences and deposits of bauxite in the Lukovača area and also in more distant localities, e.g. Kučajska Glava near Ervenik. In some places in the Drniš region the Jelar Beds are covered by Promina layers of the Younger Paleogene. That is a transgressive erosive-discordant border accompanied by bauxite deposits, so in Suknovci (SAKAČ, 1972). The age of Jelar Beds with no fossils found would have been determined in the region Drniš indirectly, by the age of footwall and hanging rocks.

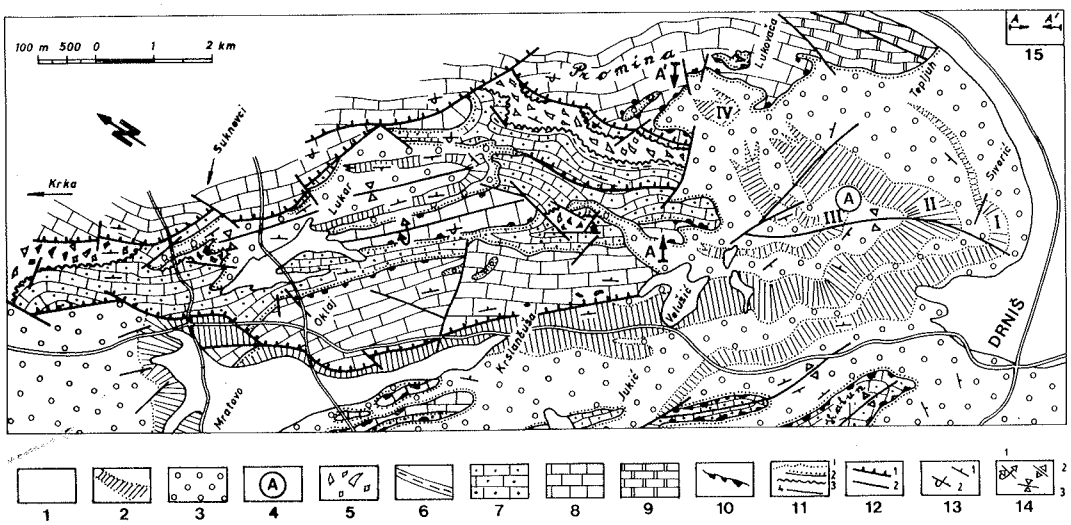


Fig. 2. Geological map of the Drniš-Promina area. 1. - Quaternary, 2. and 3. - Promina beds (Upper Eocene-Lower Oligocene, 2. - Marls and marly limestones, 3. - Conglomerates), 4. - Nannofossils sample location, 5. - Jelar beds, 6. - Marl and marly limestones in the upper part of the Foraminiferal limestones (Lutetien), 7. - Foraminiferal limestones (Lower Eocene and part of the Middle Eocene), 8. - Various types of shallow-water limestones (Turonian-Senonian), 9. - Limestones and dolomites (Cenomanian-Turonian), 10. - Bauxite outcrops, 11. - Geological boundary: 1-gradual transition, 2-transgresive, 3-erosional unconformity, 4-normal, 12. - Faults: 1-reverse, 2-normal, 13. - Dip of the beds: 1-decline, 2-overturned, 14. - Fold axis: 1-overturned anticline, 2-anticline, 3-syncline, 14. - Cross-section A-A1.

The foraminiferal limestones in the underlie of Jelar Beds in the Promina Mt. contain Lowel Eocene alveolines, as there are *Alveolina oblonga* d'ORBIGNY, *A. rutimayeri* HOTTINGER etc.; in a somewhat higher part that are *A. frumentiformis* SCHWAGER, A. ex gr. *levantina* HOTTINGER etc., then nummulitidae *Nummulites millecaput* BOUBLEE, *N. atacicus* LEYMERIE, *Assilina spira* DE ROISSY, *Orbitolites complanatus* LMK and other Middle Eocenic forms. In the top part of the foraminiferal limestones there are lenses of clayey limestones and marls with *Assilina exponens* SOWERBY and macrofossils *Chama*

granulosa d'ARCHIAC, *Ch. latecostata* BELLARDI, *Chlamys infumatus* LMK etc. At the end in some places there are thin-bedded brownish clayey limestones and marls with remnants of terrestrial flora, what could be taken as an indication of an adjacent land, resp. a rising of the sedimentation space. The thickness of the Mt. Promina foraminiferal limestones is about 120 m. Their great width on the southwestern mountain slopes resulted from complicated tectonic processes (Fig. 3).

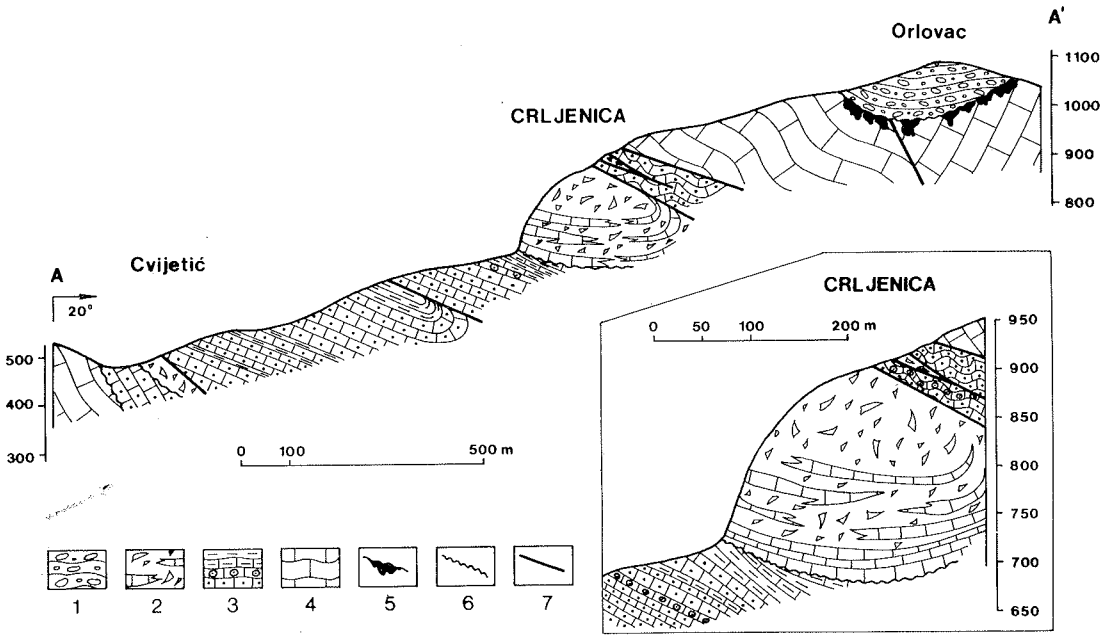


Fig. 3. Geological cross-section through the Upper Cretaceous and Paleogene deposits at the south-western slope of the Mountain Promina, 1. - Promina beds: Conglomerates (Lower Oligocene), 2. - Jelar beds (Middle Eocene), 3. - Foraminiferal limestones (Lower Eocene and part of Middle Eocene): 1-limestones, 2-Assilina limestones, 3-marly limestones, 4-marls, 4. - Rudist limestone (Turonian-Senonian), 5. - Bauxite, 6. - Erosiaonal-unconformity boundary, 7. - Fault

The Promina Beds of the Drniš region are marked by frequent lateral and vertical alterations of the sediment composition. After KERNER (1894), in the locus typicus they can be divided, along with a simplification of their composition and succession, in 7 components, i.e. in 4 conglomeratic and 3 carbonaceous-marly ones. Besides that, in the second carbonaceous-marly member there are coal deposits (the mines Siverić and Velušić) whilst limestones with a varied marine fauna occur inside several members of the Promina Beds. To this partition one more carbonaceus-marly member with a thickness of up to 8 m can be added: the one beneath the summit Čavnovka on the Promina Mt. with well conserved remnants of terrestrial flora in its composition.

There have been opinions that the basal conglomerates of the Promina Layers belongs to the Middle Eocene (e.g. KERNER, 1894) and the top conglomerates to the Lowel Oligocene (e.g. QUITZOW, 1941), but for that no valid proofs existed. After KÜHN (1948), the whole so far known paleontologic documentation pointed exclusively to an Upper Eocenic belonging of the Promina Beds, and that is commonly accepted (IVANOVIĆ et al., 1978). It is therefore to be noted that recent investigations have contributed to the knowledge about the age these strata. The new data refer to a determination of nannofossils out of sediment samples from the basis of the third conglomerate member collected above the mine of Siverić (**Fig. 4**). On the basis of the determined taxons it's sure that redeposited nannofossils from Cretaceous and Lower Paleogene strata are in question, but autochthonous species of Upper Paleogene are also present. (Determination by J. Benić).

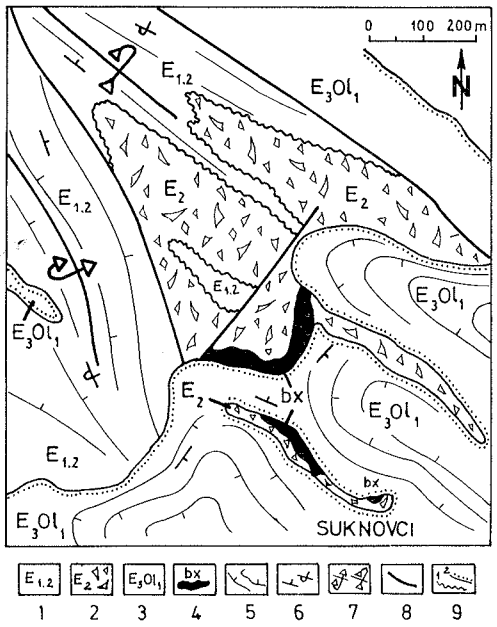


Fig. 4. Position of the Jelar beds in the Suknovci area (Drniš, Dalmatia). 1. - Foraminiferal limestones (Lower Eocene and the part of Middle Eocene), 2. - Jelar beds (Middle Eocene), 3. - Promina beds (Upper Eocene-Lower Oligocene), 4. - Bauxite outcrops, 5. - Traces of the beds, 6. - Dip of the beds, 7. - Overturned anticline and syncline, 8. - Faults, 9. - Geological boundary: erosional-unconformity and transgresive.

Redeposited Cretaceous species are: *Arkhangelskiella cymbiformis* VEKSHINA, *Cretarhabdus angustiforatus* BLACK, *Cribrosphaerella ehrenbergii* ARKHANGELSKY, and *Lucianorhabdus cayeuxi* DEFLANDRE. Redeposited species of Lower and Middle Eocene: *Chiasmolithus grandis* BRAMLETTE & RIEDEL, *C. solithus* BRAMLETTE & SULLIVAN, *Cyclococcolithus gammation* BRAMLETTE & SULLIVAN, *Discoaster lodoensis* BRAMLETTE & RIEDEL, and *Tribrachiathus orthostylus* SHAMRAI.

Autochthonous are the following species: *Blackites spinosus* DEFLANDRE & FERT, *Braarudosphaera bigelowi* GRAN & BRAARUD, *Coronocyclus nitescens* KAMPTNER, *Helicosphaera compacta* BRAMLETTE & WILCOXON, *Ericsonia formosa* KAMPTNER, *Isthmolithus recurvus* DEFLANDRE, *I. rhenanus* MARTINI.

In the presented list there are relatively few determined taxa. Most numerous are cyclococcolithae individuals of the species *Eriscsonia formosa* KAMPTNER, and most characteristic the species *Isthmolithus rhenanus* MARTINI which occurs during the cenozone NP-22 (PERCH-NIELSEN 1985) resp. during the Lower Oligocene. Besides that, the species *Isthmolithus recurvus* DEFLANDRE belongs to the span of the cenozone Np 19-22, i.e. appears in the middle of Upper Eocene and disappears in Lower Oligocene. Both species point to Lower Eocenic age of the younger part of the Promina Layers, what is a further proof for the earlier supposition of such an age of the younger part of these layers.

So, the Jelar Beds in the Drniš region have been formed in the period which started after the sedimentation of the foraminiferal limestones ended in Lower Lutetian and lasted till the beginning of the transgression and sedimentation of the Promina Beds, what commenced perhaps during Bartonian but at any rate with the start of Priabonian. This period Upper Lutetian - Bartonian was a period of strong tectonic unrest by the formation of clastic Jelar Beds.

The tectonic structures in the Drniš region refer to such conclusions about the period of Jelar Beds formation. It has been established that the Cretaceous and Older Paleogene strata are together with the Jelar Layers incorporated in very complicated tectonic structures. That are isoclinal folds, shelly structures, numerous reversed faults etc. Over such structures, on an intensively split paleorelief, formed during a transitory terrestrial phase in Middle Eocene, with a very accentuated erosive discordance, the Promina Layers sedimented. This transgressive coverage of Young Paleogene sediments in the Drniš region is much less tectonically disturbed than the Cretaceous and Older Paleogene strata, inclusive the Jelar Beds. That is especially obvious on the eastern slopes of Promina Mt. where the complicated underlaying tectonic structures are in contact with a rather large brachysyncline of Promina Layers, with the mentioned marly and conglomeratic zones predominantly gently inclined toward the structure axis. Consequently, the Jelar Layers belong to the older prepromina movements during Middle Eocene, before the sedimentation of the Promina Layers started.

THE DABRICA REGION

The geologic structure of Dabrica, a region near the small town of Stolac in Hercegovina, is alike the wider surroundings of Drniš. Here, too, carbonaceous Cretaceous layers, Kozina beds and foraminiferal limestones of Older Paleogene as well as lithological different clastic sediments, comparable with Promina Layers of Younger Paleogene, are present. Further on, at Koritnik, along the southern slopes of Jastrež Hill till Česta Mt. we found that Jelar Layers also present.

Jelar Beds, i.e. breccias are the same characteristics as on the Promina Mt., with the difference that in Dabrica there are no calcarenite inclusions. Jelar breccias are laying, with a well-marked erosive discordance, over Older Paleogene limestones and on Glumče

Hill, with a smaller outcrop, over Upper Cretaceous limestones too. (Fig. 6). The Jelar Beds form the footwall of clayey bauxite deposits which indicate a transitory terrestrial phase in Middle Eocene. The hanging wall is built by Promina Beds transgresively laying over Jelar strata. Consequently, the superpositional sequence of the Paleogene strata, i.e. the position of the Jelar Beds in the regions Dabrica and Drniš is identical. That means that the age of Jelar Beds at Dabrica, too, can be defined after the age of Promina Beds. However, the stratigraphic lineage of these layers in Dabrica, as well as their general characteristics, so far have not been unanimously interpreted.

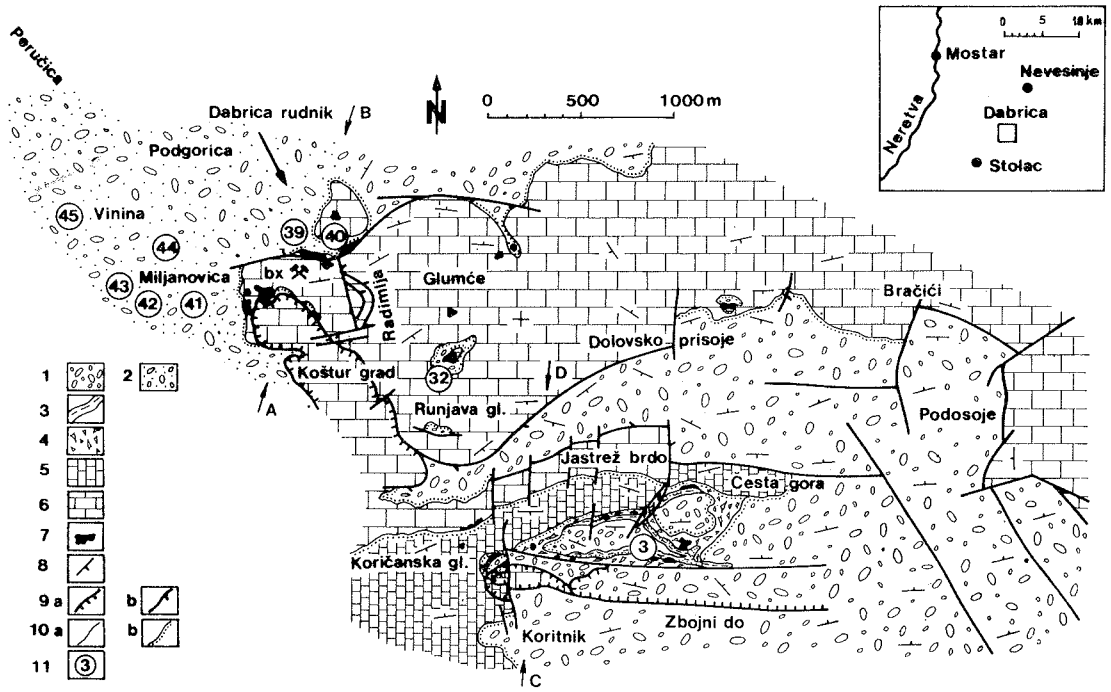


Fig. 5. Synthetic lithostratigraphic column Drniš-Promina area. 1. - Promina beds (Upper Eocene-Lower Oligocene: conglomerates, marls, marly limestones, limestones) 2. - Jelar beds (Middle Eocene), 3. - Foraminiferal limestones (Lower Eocene and part of the Middle Eocene), 4. - Kozina beds (Paleocene-Lower Eocene), 5. - Rudist limestones (Turonian-Senonian), 6. - Bauxite, 7. - Coal.

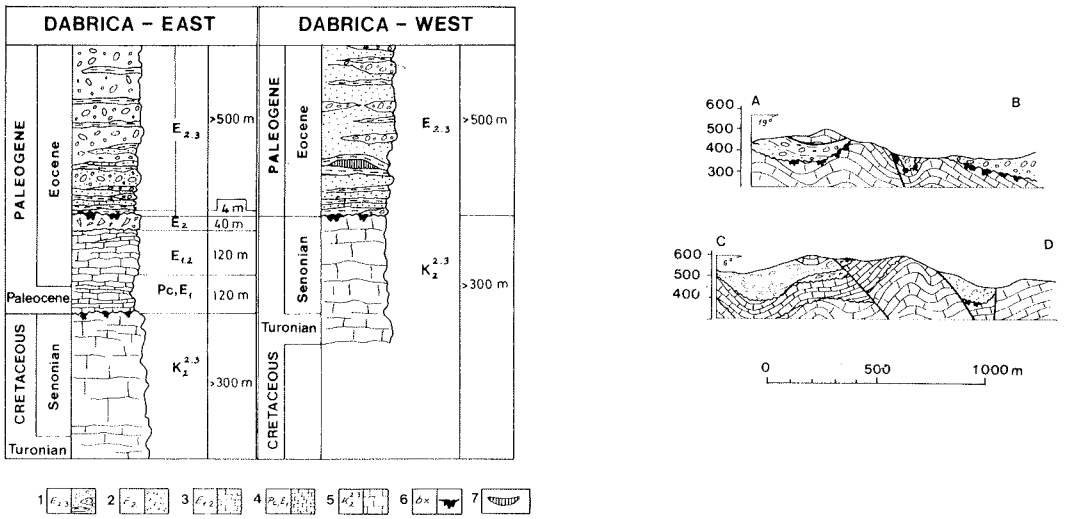


Fig. 6. Geological map of the Dabrica area. 1. - Dabrica East. Promina beds: Conglomerates with the marl lenses (Upper part of the Middle Eocene and Upper Eocene), 2. - Dabrica West. Promina beds: Conglomerates, calcarenites, marls (Upper parts of the Middle Eocene and Upper Eocene), 3. - Marls at the base of the Promina beds. Koritnik area, 4. - Jelar beds (Middle Eocene), 5. - Kozina beds and Foraminiferal limestones (Paleocene-Lower part of Middle Eocene), 6. - Rudist limestones (Turonian-Senonian), 7. - Bauxite, 8. - Dip of the bed, 9. - Fault: a) reverse, b) normal, 10. - Geological boundary: a) normal, b) erosional-unconformity, 11. - 3-45 Nannofossils sample locations.

The Younger Paleogene strata, i.e. the Promina Beds of Dabrica, are after some authors (MOJIČEVIĆ LAUŠEVIĆ, 1965, and others), of a twofold kind, flysh sediments in the western part of the region and molasse in the eastern. But already SLIŠKOVIĆ et. al. (1962) have pointed out that there exists an integer space of continous sedimentation, with facial environmental differences, and so a comparison with the development of the Promina Beds in north-western Dalmatia is possible.

Dabrica is an important occurrence of Eocenic macrofossils a very placer for that matter. OPPENHEIM (1901), who was the first to study this fauna, expressed the opinion that it is built up predominantly of Upper Eocenic forms and partly also of Middle Eocenic. KATZER (1918), in analyzing the coal occurrences in the older parts of these

strata, believed that the accompanying fauna there belongs to Middle Eocene. BUTKOVIĆ (1983) considered that the mollusk fauna from these strata pertain mainly to Upper Lutetian and partly to Upper Eocene. A synthesis of this macrofauna from the lower part of Eocenic Dabrica strata, now deposited in the Croatian Naturall History Museum in Zagreb, can be seen in small collection of fossil there. The following taxa have been determined **(Table 1)**.

Table 1. Taxa at display at the Croatian Natural History Museum in Zagreb.

Anthozoa: *Rhabdophyllia falax* OPPENHEIM, *Calamophyllia subtilis* OPPENHEIM, *Cyatomorpha dabricensis* OPPENHEIM, *Rhizangia brevissima* OPPENHEIM, *Pattalophyllia sinuosa* BROGNIART, *Trochosmilia (?) cocchii* d'ARCHIARDI.
Lamellibranchiata: *Anomia tenuistriata* DESHAYES, *Miltha illyrica* OPPENHEIM, *Miltha prominensis* OPPENHEIM, *Lucina saxorum* LMK, *Crassatella sinuosa* DESHAYES, *Meretrix incrassata* SOWERBY, *Cytherea rhomboidea* OPPENHEIM.
Gastropoda: *Pleurotomaria dalmatina* DAINELLI, *Diastoma costellatum alpinum* TOURNOUER, *Cerithium coracinum* OPPENHEIM, *Globularia vapincana* d'ORBIGNY, *Deshayesia alpina* d'ORBIGNY.

The Eocenic macrofauna, as analyzed by the mentioned authors, is well reflecting the sedimentation conditions. Here are fossils of typical marine organisms, as corals *Rhabdoohyllia, Stylocoenia* etc., then shells, as *Chlamys, Tellina, Arca* etc. Partly there occur brackish forms, e.g. gastropods of the group cerithia resp. genera *Tympanotos, Bayania* and others, and in particular layers there are found also freshwater snails of the genera *Melanopsis* and *Theodoxus*. A characteristic feature of that fauna is the absence of urchins and the scarcity of nummulites, otherwise abundantly present in identical strata of other Hercegovinian localities. So, these strata of the Dabrica region sedimented in brackish, freshwater and partly in marine media too.

Aiming to determine the age of the Dabrica Jelar Beds, resp. the period of their formation, the Eocenic clastites of Koritnik in their hanging wall were analyzed but also the clastites in the wider region. On that occasion new data were gained by analysis of nannofossils from sediment samples in several localities **(Fig. 6)**.

On the Jastrež Hill, as well as in the neighbouring localities, e.g. Dolovski Prisoj and Glumče Hill, the basis of clastites of the Younger Paleogene, resp. Promina Beds, is built of grey marls up to 4 m thick, transgressively laying on clayey bauxites. Upwards the marl becomes sandy and then conglomeratic with a gradual transition to a polymictic conglomarate. In marl samples No. 3 and 32 determined nannofossils are of Lutetian age **(Table 2)**.

In the western part of the Dabrica region the strata of the Younger Paleogene consist of basal conglomerates, bluish marls which can be clayey, sandy or limy, then sandstones

and conglomerates, and thin lenses and inclusions of coal and coaly clays (Fig. 7). In the vertical sequence one can distinguish a lower part with marls and sandstones with lenses

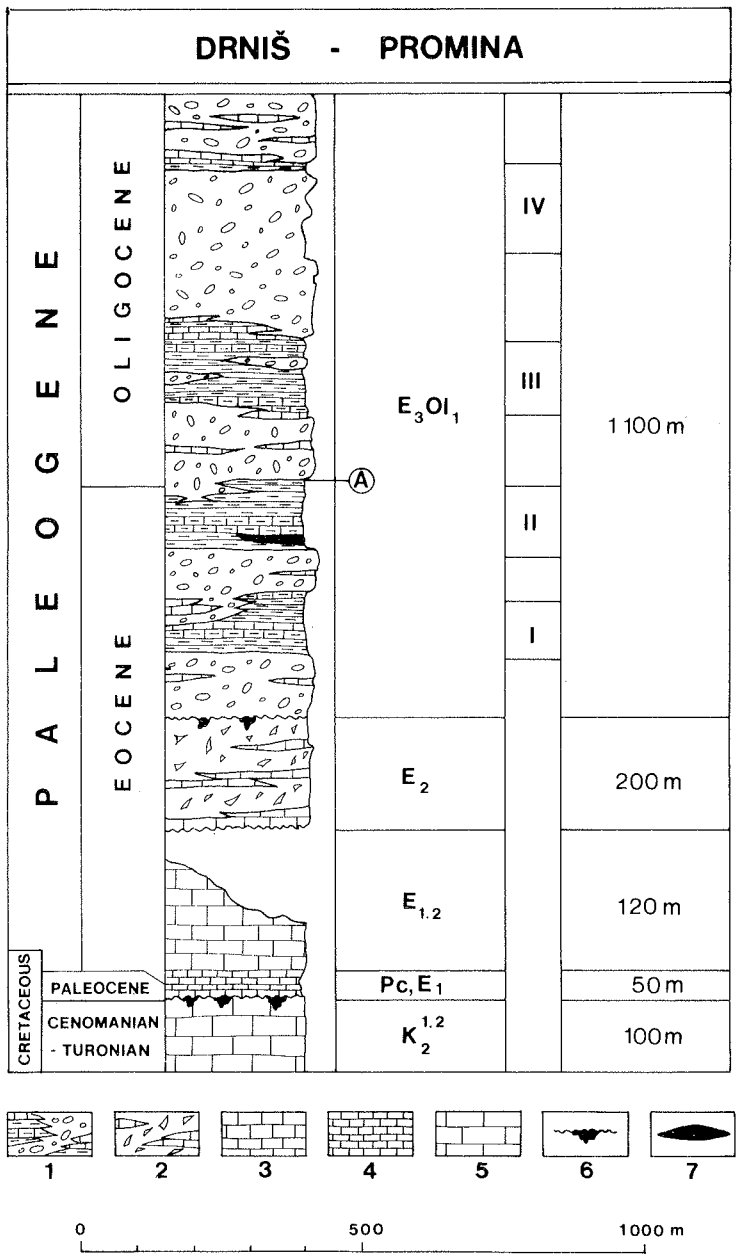


Fig. 7. Synthetic lithostratigraphic column. Dabrica area. 1. - Promina beds. Late Paleogene, 2. - Jelar beds, Middle Eocene, 3. - Foraminiferal limestone. Paleocene and the part of the Middle Eocene, 4. - Kozina beds. Paleocene and the part of Lower Eocene, 5. - Rudist limestones. Turonian-Senonian, 6. - Bauxite, 7. - Coal.

of calcarenites and conglomerates. The medium part of the strata consists predominantly of conglomerates with marl lenses, while the uppermost part is made of greyish-blue marls and well-bedded sandstones with conglomerates which appear in the form of various sedimentary bodies. The general feature of these strata is an intensive lateral and vertical alternation of the litho-members. From the lower part of these strata the nannofossil samples with the marks 39 till 45 are taken. The determined taxa by J. Benić are given in **Table 2.**

Table 2. Calcareous nannofossils from Dabrica

	3	32	39	40	41	42	43	44	45
Chiasmolithus consuetus	+								
Coccolithus eopelagicus	+	+			+			+	
Cyclococcolithus gammation	+	+	+	+	+	+			
Discoaster barbadiensis	+	+	+	+		+			
Discoaster lodoensis	+	+	+	+					
Discoaster multiradiatus	+		+					+	
Ericsonia formosa	+	+	+	+	+	+		+	
Markalius inversus	+								
Sphenolithus obtusus	+								
Sphenolithus radians		+	+		+		+		+
Braarudosphaera discula			+						
Coronocyclus nitescens			+						
Dictyococcites bisectus			+			+			
Chiasmolithus grandis			+						
Reticulofenestra dictyoda			+						
Braarudosphaera bigelowi				+					
Chiasmolithus expansus				+					
Chiasmolithus solitus						+			
Tribrachiatus orthostylus						+		+	
Calcidiscus protoannula							+		
Cruciplacolithus tenuis							+		
Cruciplacolithus primus								+	
Discoaster bifax								+	
Ericsonia cava									+
Ericsonia robusta									+
Heliolithus riedeli									+
Cribrosphaerella ehrenbergi						+			
Cretarhabdus angustiforatus							+		
Eiffellithus turriseiffeli							+		
Watznaueria barnesae							+		
Arkhangelskiella cymbiformis									+

Some communities of the calcareous nannoplankton are of a mixed composition. Partly they consist of redeposited species derived from Senonic resp. Paleocenic and older Eocenic strata. Autochthonous species (*Discoaster bifax, D. barbadiensis, Chiasmolithus grandis, Ericsonia formosa, Dictyococcites bisectus, Coronocyclus nitescens, Calcidiscus protoanulla*) refer to Upper Lutetian and Bartonian i.e. to an association with the zones *Discoaster tani* (NP-16) and *Discoaster saipanensis* (NP-17). Such a composition of the calcareous nannoplankton undoubtedly points out to a yunger Middle Eocenic age of the lower part of the Dabrica Promina Beds. In general, that is comformable to the standpoints of the macrofauna age these strata. According to that, the Dabrica Jelar Beds could be originated in Lutetian, after the end of sedimentation of the Eocenic foraminiferal limestones and before transgression and beginning of the Promina Beds sedimentation.

An important feature of the Dabrica region is a strong tectonic disturbance of the Cretaceous and older Paleogenic strata and a relatively gentle dislocation of the Promina Beds whose beds mostly are gentle inclined to north-northeast. However, along contacts with the floor the Promina Layers in numerous places are broken, crushed, generally stronger disturbed, especially along reversed faults. The intensity of tectonic movements in the Dabrica region had found its best illustration in many reversed faults as well as in horizontal shearings of smaller tectonic blocks. Thus, in the area of Koštur-grad Cretaceous limestones are overthrown on identical limestones and partly also on plastic marls of Promina Beds and bauxite deposits. A part of this by erosion destroyed thrust has been conserved in its former continuation towards southeast in Koritnik. There it comes in contact with the north-western end of smaller syncline of Paleogenic strata which enclose also the calcareous breccias of Jelar Beds.

CONCLUSION

The cognizance about the distribution of Jelar Beds in the Outer Dinarides is spreading by new discoveries of such layers on the islands of Northern Adria, in the inner part of the Dinarides and the so far isolated occurrence near Dabrica (Hercegovina). Till now these strata were generally designated as Paleogenic for they are without hanging walls and contain no fossils. But it some new localities in the regions Drniš (Dalmatia) and Dabrica (Hercegovina) it has been established by their superpositions that they are of Middle Eocenic age. In both regions they are laying discordantly on foraminiferal limestones of the older part of Middle Eocene whilst over them Promina Beds of Upper Eocene-Lower Oligocene (Drniš) resp. Upper Lutetian-Bartonian (Dabrica) identical layers transgressivelly are laying. By recent analyses of carbonaceous nannofossils it could be proved that a younger part of the same layers in Dabrica corresponds to the younger part of Middle Eocene, by what some earlier views based on macrofauna analyses have been confirmed.

The Jelar Beds in the Drniš Region are there in very complicated tectonic structures. Contrary to that, their roof strata (Promina Beds) are disturbed much less. That can be taken as an indirect proof that the complicated tectonic structures, like the Jelar Beds

inside them, are formed during the Middle Eocene before the Promina Beds sedimentation. New finds of Jelar Beds in the tectonic unit Adriatic in the Outer Dinarides can be taken as a hint for further necessary determinations of their distribution. Insufficiently examined petrographic composition as well as very complicated tectonic structures in which occur surely requIre further investigations of that significant stratigraphic member in the Western Part of the Dinarides.

REFERENCES

BAHUN, S., 1963: Geološki odnosi okolice Donjeg Pazarišta u Lici (Trijas i tercijarne Jelar-naslage). (Geological relations of the surroundings of Donje Pazarište in Lika (Croatia)). — Geol. vjesnik, **16**, 161-170. Zagreb

BAHUN, S., 1974: Tektogeneza Velebita i postanak Jelar-naslaga. (The Tektogenesis of the Mt. Velebit and formation of Jelar-deposits). — Geol. vjesnik, **27**, 35-51. Zagreb

BUTKOVIĆ, B., 1983: Prilog poznavanju eocenskih moluska Dabrice kod Stoca (Hercegovina). (Conntribution to knowledge of the Eocene Mollusks from Dabrica by Stolac, Hercegovina). — Glasnik Zemalj. muzeja Bosne i Hercegovine, Prir. nauke, **22**, 29-34. Sarajevo.

CRNOLATAC, I. & MILAN, A., 1959: Prilog poznavanju prominskih naslaga Like. (Ein Beitrag zur Kenntnis der Prominaschichten in der Lika). — Geol. vjesnik, **12**, 49-52. Zagreb.

ČIČIĆ, S. & PAPEŠ, J., 1970: Litostratigrafske odlike paleogena u Bosni i Hercegovini. (Litostratigraphic properties of Paleogene in Bosnia and Hercegovina). — Geol. glasnik, **14**, 33-40. Sarajevo.

ETTINGSHAUSEN, C., 1855: Die eozäne Flora des Monte Promina (in Dalmatien). — Denkschr. Akad. Wiss. (Math.-natur. Cl.). **8**, 1-28. Wien.

FRITZ, F., BAHUN, S. & PAVIČIĆ, A., 1978: Tektonski okvir karbonatnih klastita u području Zrmanje u području uzvodno od Obrovca. — Krš Jugosl. (Carsus Jugosl.), **9/6**, 1-10. Zagreb.

HERAK, M., 1986: A new Concept of Geotectonics of the Dinarides. — Acta geol., **16/1**, Prirodosl. istraž., 53, 1-42. Zagreb.

HERAK, M. & BAHUN, S., 1980: The role of calcaleous breccias (Jelar formation) in the tectonic interpretation of the High Karst Zone of Dinarides. — Geol. vjesnik, **31**, 49-59. Zagreb.

IVANOVIĆ, A. & SAKAČ, K., 1971: Stratigraphic position of Eocene limestone breccias of the Promina Mountain in Dalmatia. — Bull. sci. Cons. Acad. Yugosl. (A), **16/9-10**, 268. Zagreb.

IVANOVIĆ, A., SIKIRICA, V. & SAKAČ, K., 1978: Tumač osnovne geol. karte SFR Jugosl., M=1:1000 000, List Drniš, K-33-9, (Geology of the Sheet Drniš). Inst. goel. istraž. Zagreb, Savezni goel. zavod, Beograd.

KATZER, F. 1918: Die fossilen Kohlen Bosnies und der Hercegovina. I, pp. 403. Wien.

KERNER, F., 1894: Über die geologischen Verhältnisse der Gegend von Dernis in Dalmatien. — Verh. Geol. Reichanst., **2**, 75-81. Wien.

KÜHN, O., 1948: Das Alter der Prominaschichten und der Innereozänen Gebirgsbildung. — Jahrb. Geol. Bundesanst., **91/1-2**, 49-94. Wien.

MARTINI, E., 1971: Standard Tertiary and Quaternary calcareous nanoplankton zonation. In: FARINACCI, A.: Procceedings II Planctonic Conference, Roma, 739-785, Roma.

MOJIČEVIĆ, M. & LAUŠEVIĆ, M., 1965: Tumač Osnovne geološke karte SFR Jugosl. M=1:100 000, list Nevesinje. (Geology of the Sheet Nevesinje). Savezni geol. zavod, Beograd.

OPPENHEIM, P., 1901: Über einige alttertiäre Faunen der Österr.-ungar. Monarchie. — Beitr. Palaeont. Geol. Öster.-Ungar. Orients, **13**, 140-277. Wien.

PERCH-NIELSEN, K., 1985: Cenozoik calcareous nannofossils. In: BOLLI, H.M., SAUNDERS. J.B. PERCH-NIELSEN, K. : Plankton Stratigraphy, 427-554. Cambridge University Press, London.

POLŠAK, A., 1957: Nova nalazišta prominskih klastičnih sedimenata u Hrvatskom primorju. (Neue Fundorte klastischer Prominasedimente in Hrvatsko Primorje. Im Kroatischen Küstenland). — Geol. vjesnik, **10**, 91-103. Zagreb.

QUITZOW, H.W., 1941: Das Alttertiär des Priminaberges und eine mitteleocäne Gebirsbildung in Dalmatien. — Ber. Zweist. Bodenforsch., 10-12, 180-187. Wien.

SAKAČ, K., 1972: A new survey of Stratigraphic Bauxite-bearing horizons in Croatia (Yugoslavia). — Bull. sci. Cons. Acad. Yugosl., **17/7-8**, 221-223. Zagreb.

SLIŠKOVIĆ , T., PAPEŠ, J., RAIĆ, V. & LUBURIĆ, P., 1962: O tektonici i stratigrafiji južne Hercegovine. (Stratigraphy and structural geology of southern Hercegovina) — Geol. glasnik, **6**, 111-140. Sarajevo.

ZUPANIČ, J., 1969: Promina naslage planine Promine. (Promina formation of the Promina Mountain). — Geol. vjesnik, **22**, 477-498. Zagreb.

Received May 02, 1993

SAŽETAK

Stratigrafski i tektonski položaj Jelar naslaga u Vanjskim Dinaridima

K. Sakač, J. Benić, S. Bahun & V. Pencinger

Gruboklastične sedimente, pretežno vapnenačke breče, široko rasprostranjene u Lici, te duž jugozapadnih padina planine Velebit u Hrvatskoj BAHUN (1963) nazvao je Jelar-naslage. Mišljenja je da im je postanak vezan uz tektonske pokrete i da su tercijarne starosti, jer leže na različito starim mezozojskim većinom karbonatnim naslagama, a nigdje nisu pokrivene mladim sedimentima. Istovjetne Jelar naslage utvrđene su potom u složenim tektonskim strukturama duž donjeg toka rijeke Zrmanje u Dalmaciji, gdje se također mogla dokazati njihova tercijarna starost (FRITZ & al. 1978). Međutim, gruboklastične tercijarne sedimente zamijetilo je više autora kao lokalne pojave smatrajući

da se radi o Promina-naslagama mlađeg paleogena. Takve podatke iznosi npr. POLŠAK (1957) za okolicu Rijeke, a CRNOLATAC & MILAN (1959) za dio Like. No još je KERNER (1894) spomenuo "Rosenrothe Breccien" za područje Drniša, te je kao kasnije IVANOVIĆ & SAKAČ (1971) za vapnenačke breče tipa Jelar naslaga na jugozapadnim padinama planine Promine, smatrao da su srednjoeocenske starosti. Zaključci o vremenu postanka ovise o starosti fragmenata najmlađih stijena nađenih u brečama. Na nekim lokalitetima to su fragmenti eocenskog fliša, a na pretežnom dijelu sastavljene su od fragmenata ostalih paleozenskih, krednih, jurskih pa i trijaskih naslaga, tako da je starost Jelar naslaga mlađa od najmlađeg fragmenta. Kasnije (BAHUN, 1974) njihov postanak povezuje se s reversnim i navlačnim pokretima, pa su tako HERAK & BAHUN (1980) njihov raspored doveli u vezu sa snažnim regionalnim reversnim i navlačnim pokretima, a vrijeme postanka vezali uglavnom uz gornji eocen, kao "vildfliški" ekvivalent prominske molase.

Jelar naslage u području Drniša nalaze se u uskom pojasu između kanjona Krke i Lukovače na planini Promini (sl. 2). Tu se osobito ističu na jugozapadnim padinama te planine gdje im je debljina i do 200 m. One se sastoje od neuslojenih do slabo uslojenih vapnenačkih breča u čijem su sastavu nezaobljeni i nesortirani ulomci promjera od nekolko milimetara do veličine blokova, koji potječu od vapnenaca krede i od vapnenaca starijeg paleogena. Zamijećeni su i fragmenti i ooidi boksita. Vezivo breča većinom je sparitsko s primjesama limonita i česticama boksita, pa otud njihova karakteristična crvenkasta boja. Jelar naslage na planini Promini započinju s dobro uslojenim crvenkastim kalkarenitima debljine do 10 m, koji se kao tanje leće pojavljuju i u višem dijelu breča (sl. 3). Jelar naslage leže na vapnencima gornje krede ili na eocenskim foraminiferskim vapnencima, dijelom i na laporima u njihovom vršnom dijelu, s jako izračenom erozijskom diskordancijom. Diskordancija je obilježena pojavama i manjim ležištima boksita u predjelu Lukovača kao i na udaljenijim lokalitetima, na primjer na Kučajskoj glavi kod Ervenika. Jelar naslage na više mjesta u drniškom području prikrivene su Promina naslagama mlađeg paleogena i ta je transgresivna erozijsko-diskordantna granica praćena ležištima boksita, kao u Suknovcima (SAKAČ, 1972). Starost Jelar naslaga, u kojima nisu nađeni fosili, bilo je moguće odrediti u području Drniša posredno i to prema starosti naslaga koje su im u podini i u krovini.

Foraminiferski vapnenci u podini Jelar naslaga sadrže mnogobrojne oblike alveolina donjeg eocena i dijela srednjeg eocena, a glinoviti vapnenci njihovog mlađeg dijela faunu moluska i srednjoeocenskih numulitida.

Promina naslage u krovini Jelar breča u drniškom području prema općenito prihvaćenim dosadašnjim stajalištima navedenim kod IVANOVIĆ & al. (1978) su gornjoeocenske starosti. Međutim, nova istraživanja vapnenačkog nanoplanktona u uzorcima iz baze trećeg konglomeratnog člana poviše rudnika Siverić (sl. 2), pokazala su prema određenim taksonima da su to pretaloženi nanofosili iz naslaga krede i starijeg paleogena, ali da su prisutne autohtone vrste mlađeg paleogena. Navedena lista pokazuje relativno malo određenih taksona. Najbrojnije su jedinke vrste ciklokokolita *Ericsonia*

formosa KAMPTNER. Najznačajnija je vrsta *Isthmolithus rhenanus* MARTINI koja dolazi isključivo u cenozoni NP-22 (PERCH-NIELSEN, 1985), odnosno u donjem oligocenu. Osim toga vrsta *Isthmolithus recurvus* DEFLANDRE pripada rasponu cenzona NP 19-22, tj. pojavljuje se sredinom gornjeg eocena a nestaje u donjem oligocenu. Obje vrste navode na donjooligocensku starost mlađeg dijela Promina naslaga, što utvrđuje ranije pretpostavke o takvoj starosti mlađeg dijela ovih naslaga.

Prema tome Jelar naslage u području Drniša nastale su u razdoblju koje je uslijedilo nakon prestanka taloženja foraminiferskih vapnenaca u donjem lutetu, a trajalo je do početka transgresije i taloženja Promina naslaga što je započelo moguće u bartonu a svakako priabonu. To razdoblje gornji lutet - barton je razdoblje jakih tektonskih nemira što je bilo popraćeno nastankom klastičnih Jelar naslaga.

Geološka građa Dabrice, područja nedaleko Stoca u Hercegovini, slična je onoj šire okolice Drniša. I tu su prisutne karbonatne kredne naslage, Kozina naslage i foraminiferski vapnenci starijeg paleogena te litološki raznovrsni klastični sedimenti koji se mogu usporediti s Promina naslagama mlađeg paleogena. Osim toga u Koritniku, uzduž južnih padina Jastrež brda do Česta gore utvrdili smo nazočnost Jelar naslaga. Radi se o brečama istih obilježja kao na planini Promini s razlikom što u Dabrici nema leća kalkarenita. Breče leže s jako izraženom erozijskom diskordancijom na vapnencima starijeg paleogena, a na Glumče brdu gdje im je manji izdanak i na gornjokrednim vapnencima (sl. 6). One su podina ležišta glinovitih boksita koji obilježavaju kratkotrajnu kopnenu fazu u srednjem eocenu. Krovina boksita su Promina naslage, koje ujedno transgresivno leže preko Jelar naslaga. Na Jastrež brdu, kao i na susjednim lokalitetima, na primjer u Dolovskom prisoju i Glumče brdu, baza klastita mlađeg paleogena odnosno Promina naslaga su sivi lapori debljine do 4 m koji leže transgresivno na glinovitim boksitima. Naviše lapor postaje pjeskovit, pa konglomeratičan s postepenim prijelazom u polimiktni konglomerat. U laporima, u uzorcima 3 i 32 određeni nanofosili su lutetske starosti (Tablica 2).

U zapadnom dijelu područja Dabrice naslage mlađeg paleogena sastoje se od bazalnih konglomerata, plavičastih lapora koji mogu biti glinoviti, pjeskoviti ili vapnenački, zatim pješčenjaka i konglomerata, sporadično kalkarenita, te tankih leća i proslojaka ugljena i ugljevitih glina (Sl. 7). Iz donjeg dijela ovih naslaga uzeti su uzorci (39-45), a određene zajednice vapnenačkog nanoplanktona mješovitog su sastava. Dijelom se sastoje od pretaloženih vrsta koje potječu iz senonskih, odnosno paleocenskih i starijih eocenskih naslaga. Autohtone vrste upućuju na gornji lutet i barton, tj. pripadnost zonama *Discoaster tani* (NP-16) i *Discoaster saipanensis* (NP-17). Takav sastav vapnenačkog nanoplanktona nedvojbeno upućuje na mlađe srednjoeocensku starost donjeg dijela Promina naslage Dabrice. To je uglavnom podudarno sa stajalištima o starosti makrofauna istih naslaga. po tome Jelar naslage Dabrice mogle su nastati u lutetu i to nakon prestanka taloženja eocenskih foraminiferskih vapnenaca, a prije transgresije i početka sedimentacije Promina naslaga.

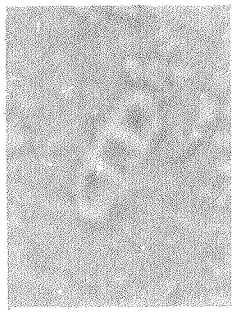
U novije vrijeme Jelar naslage pronalaze se na nizu lokaliteta, pretežno kao manje izolirane pojave, osobito unutar tektonske jedinice Adrijatik (HERAK, 1986) i to od Rijeke preko otoka Jadrana i unutrašnje Dalmacije do Dabrice kod Stoca u srednjoj Hercegovini (Sl. 1). Takav današnji njihov raspored na širem području posljedica je neotektonske dezintegracije područja Adrijatika i diferencijalnog pomicanja pojedinih njihovih dijelova. Nepovezanosti i fragmentarnosti njihovog kartografskog registriranja očito su uzroci, ili snažna neogensko-kvartarna erozija, i/ili pogrešna ocjena njihove pripadnosti prilikom prethodnih kartiranja. Stoga se u budućnosti očekuje da neki "paleogenski vapnenački klastiti" i dijelovi breča sada označeni kao kredni ili jurski, budu pribrojeni Jelar naslagama. Takva područja mogu se predvidjeti u Lici, južnoj Hrvatskoj i zapadnoj Hercegovini. Dakako da će za njihovo definiranje biti potrebno istražiti mnogo takvih lokaliteta kao što su ovdje opisani Dabrica i područje Drniša, gdje se nastoji točnije odrediti njihova starost. Tako široko rasprostranjene pojave Jelar naslaga daju ovim sedimentima veliko regionalno značenje. To se odnosi na rekonstrukcije paleogeografskih odnosa, sedimentacijskih uvjeta kao i tektonskih poremećaja u vrijeme njihovog nastanka, ali i na ocjenu intenziteta kasnijih neotektonskih gibanja. Zbog svega toga Jelar naslage zaslužuju znatniju pažnju sedimentologa i tektoničara.

PLATE - TABLE I

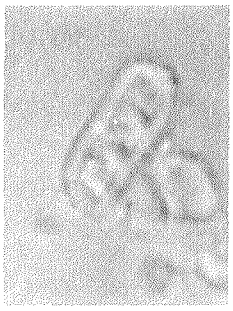
Siverić

1,2	*Isthmolithus recurvus* DEFLANDRE
3	*Isthmolithus rhenanus* MARTINI
4,7	*Braarudosphaera bigelowi* GRAN & BRAARUD
5,6	*Cyclococcolithus gammation* BRAMLETTE & SULLIVAN
8	*Pontosphaera multipora* KAMPTNER
9,10	*Coronocyclus nitescens* KAMPTNER
11,12	*Ericsonia formosa* KAMPTNER
13	*Reticulofenestra sp.*

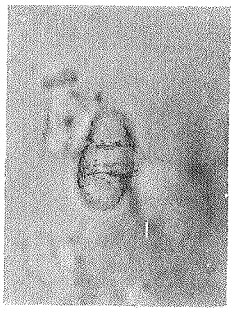
2000 x 1,3,4,7,9-13 =Si-29, 8=Si-56, 2,5,6 =Si-61



1

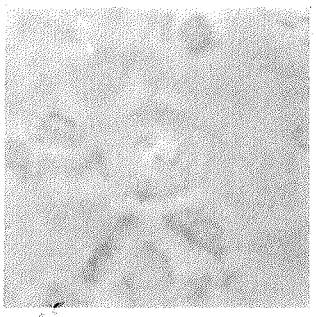


2



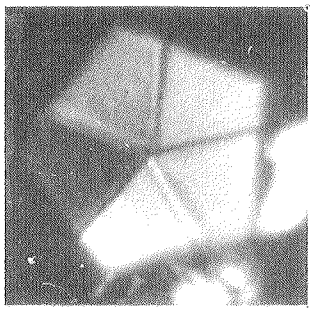
3

4



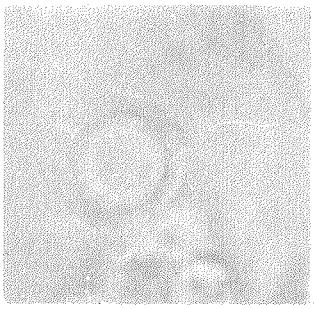
5

6

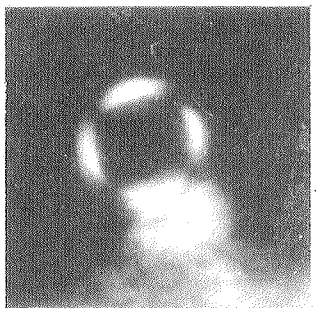


7

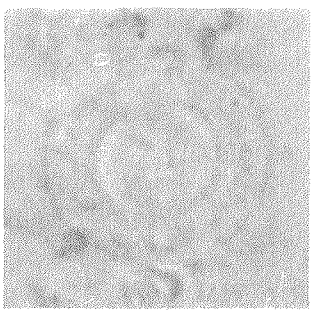
8



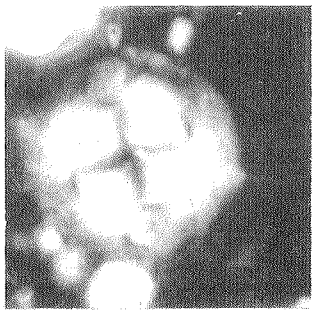
9



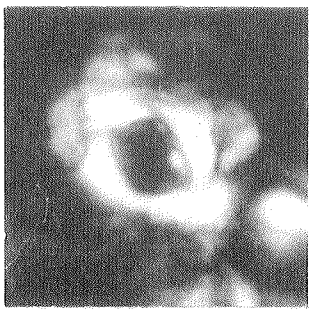
10



11



12



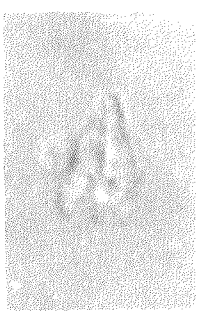
13

PLATE - TABLE II

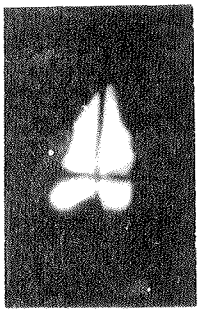
Dabrica

1-3	*Sphenolithus radians* DEFLANDRE
4	*Discoaster multiradiatus* BRAMLETTE & RIEDEL
5	*Discoaster bifax* BUKRY
6	*Discoaster barbadiensis* TAN
7	*Reticulofenestra dictyoda* DEFLANDRE
8-10	*Dictyococcites bisectus* HAY, MOHLER & WADE
11,12	*Ericsonia formosa* KAMPTNER
13,14	*Coronocyclus nitescens* KAMPTNER

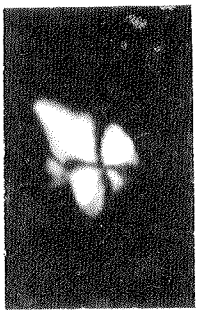
2000 x 1-4, 6-14 = Da-39 5 = Da-44



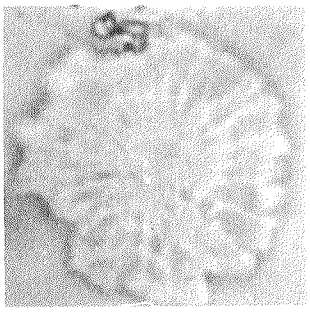
1



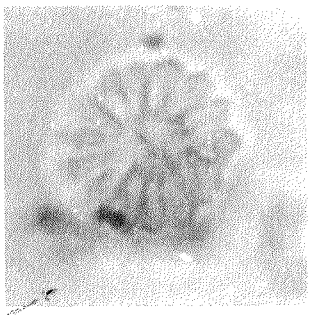
2



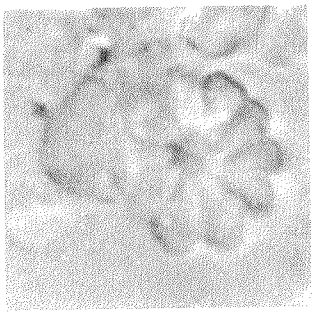
3



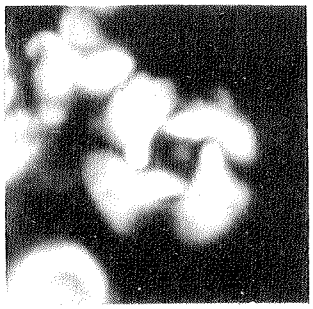
4



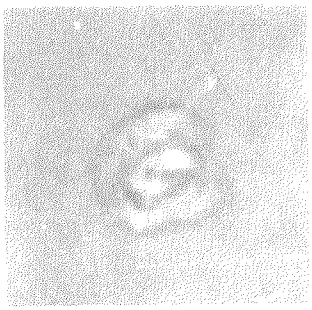
5



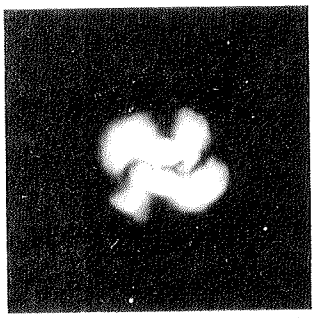
6



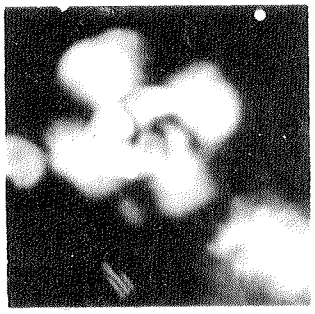
7



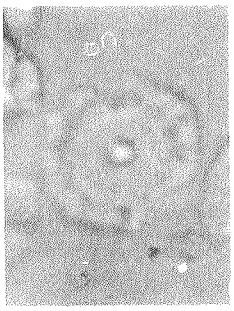
8



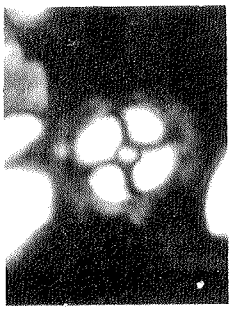
9



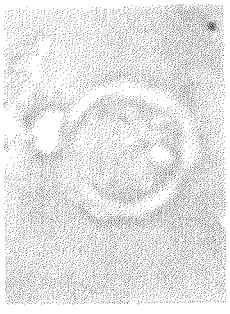
10



11



12



13

14