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CONODONT BIOSTRATIGRAPHY OF TRIASSIC PELAGIC STRATA, ALBANIA

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Riassunto. Viene presentata per la prima volta una suddivisione biocronostratigrafica dei sedimenti pelagici triassici dell'Albania, sulla base dei conodonti. Tali sedimenti si estendono dal tardo Olenekiano (Spathiano) al Norico e talora anche al Retico inferiore. Il livello Spathiano più antico contiene *Neospathodus waageni.*, *N. triangularis* e *N. homeri*. L'Anisico basale (Egeico) è caratterizzato da *Chiosella timorensis*, il Pelsonico (Anisico superiore) è individuato da *Pararagondelella bulgarica* accompagnato da *Nicoraella kockeli* e l'Illirico (Anisico sommitale) è documentato dalla presenza di *Paragondolella bifurcata*, *P. excelsa* e dal complesso *Neogondolella constricta cornuta*. Invece la transizione Anisico-Ladinico ed il Ladinico inferiore permangono di problematica identificazione. La parte superiore del Ladinico (Longobardico) è ben dimostrata con *Budurovighatus diebeli* e *B. mostleri*. Il Carnico è indicato da *Paragondolella polygnathiformis* e *P. auriformis*, seguito da orizzonti con conodonti prevalentemente Norici come *Metapolygnathus primitius* e *Epigondoledla bidentata*. Il Norico sommitale ed il passaggio al Retico sono suggeriti dalla presenza di *Misikella hernsteini*, associata con *Epigondolella slovakensis*.

Le associazioni a conodonti forniscono un'inquadramento stratigrafico per i sedimenti pelagici per ciascuna delle zone tettoniche dell'Albania contenenti rocce triassiche e cioè delle zone di Korabi, Mirdita, Cukali, Krasta e delle Alpi Albanesi.

Abstract. A biostratigraphic scheme for the Triassic pelagic sediments in Albania, based on the distribution of conodonts, is presented for the first time. The investigated series range from Late Olenekian (Spathian) to the Norian or Early Rhaethian. The lowest Spathian level contains *Neospathodus waageni*, *N. triangularis* and *N. homeri*. The Aegean (Early Anisian) is characterised by *Chiosella timorensis*, the Pelsonian (Late Anisian) by *Pararagondelella bulgarica* and the presence of *Nicoraella kockeli*, whereas the Illyrian is documented by the presence of *Paragondolella bifurcata*, *P. excelsa* and the *Neogondolella constricta cornuta* complex. The Late Anisian to Early Ladinian transition remains problematic as well as the Fassanian (Early Ladinian). The Late Ladinian (Longobardian) is well documented by *Budurovighatus diebeli* and *B. mostleri*. The Carnian with *Paragondolella polygnathiformis* and *P. auriformis* and it is followed by more Norian conodonts like *Metapolygnathus primitius* and *Epigondoledla bidentata*. The uppermost Norian - Rhaetian boundary is verified by the presence of *Misikella hernsteini*, associated with *Epigondolella slovakensis*.

Conodont associations provide a biostratigraphic scheme of the Triassic pelagic facies for each tectonic zone of Albania, i.e. Korabi, Mirdita, Cukali, Krasta, Albanian Alps).

Introduction.

The stratigraphic study of Triassic deposits of Albania was addressed in the past of authors like Nopcsa (1906, 1929) and Arthaber (1908, 1909, 1911). More recently, many authors focused on the Triassic pelagic deposits of the Internal tectonic zones (Korabi and Mirdita), as well on the external zones (Krasta, Cukali and Albanian Alps) the greatest attention has been focused on Triassic (Gjata et al., 1987, 1989; Kelliçi et al., 1994; Kelliçi & De Wever, 1994; Meço, 1987, 1988; Peza et al., 1969, 1985; Pirdeni, 1987; Shehu et al., 1983; Theodhori, 1966, 1992; Xhomo et al., 1975, 1977, 1982).

In general, the biostratigraphy of pelagic Triassic has been treated on the basis of different microfossils as foraminifera, radiolarians, conodonts and rarely on ammonoids (Meço, 1968).

Several joint Italian-Albanian studies have been recently undertaken concerning the Lower-Middle Triassic of Mirdita zone (Muttoni et al., 1996, 1998; Germani, 1997; Gaetani et al., in prep.), but they remain limited in their extent.

The results on the Triassic in the Albanian Alps is to be presented in a series of papers co-authored with colleagues of the Department of Earth Sciences of the University of Milano, e.g. the Lower-Middle Spathian and Anisian conodonts of the Kçira sections and Anisian and Ladinian of the Albanian Alps zone.

This study reports Triassic conodont associations in Albania and proposes a generalized biostratigraphic scheme for the Spathian - Norian stages in Albania. Plates include conodont index species of the Pelsonian in the Cukali zone, Late Longobardian in the Albanian Alps zone and Carnian - Norian in the Cukali, Krasta, Mirdita and Korabi zones.

Field work was carried out by the author, whilst conodont determinations were partly checked by Prof. Dr. Alda Nicora (Milano) and Prof. Dr. Leo Krystyn

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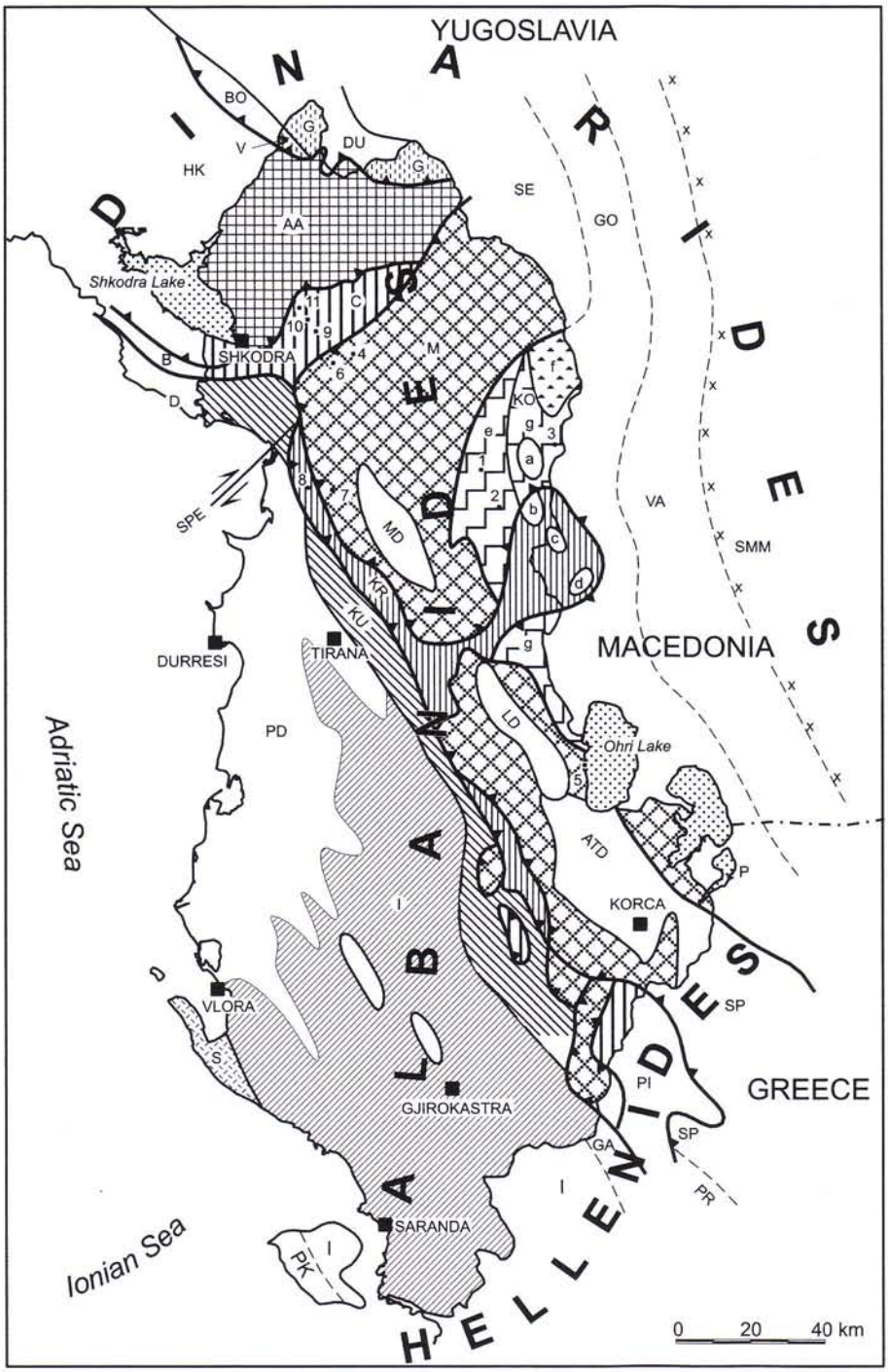


Fig. 1 - Tectonic sketch of Albanides (Albania) and relations with Dinarides (D, in the north) and Hellenides (H, in the south) (Meço & Aliaj in preparation, with modification): KO - Korabi zone (e - Çaja s/zone, f - Kollovozi s/zone, g-Malesi Korabit s/zone) = GO - Golija Zone (Dinarides) = P - Pelagonian Zone (Hellenides); M - Mirdita Zone = SE - Serbian Zone (D) = SP - Subpelagonian Zone (H); G - Gashi Zone = DU - Durmitor Zone (D); V - Vermoshi Zone = BO - Bosnian Zone (D); AA - Albanian Alps Zone = HK - High Karst Zone (D) = ?PR - Parnassos Zone (H); C&KR - Cukali and Krasta Zones = B - Budva Zone (D) = PI - Pindos Zone (H); KU - Kruja Zone = D - Dalmatian Zone (D) = GA - Gavrovo Zone (H); I - Ionian Zone = I - Ionian Zone (H); S - Sazani Zone = PK - Paksos Zone (H). SMM - Serbian – Macedonian Massif (D+H); VA - Vardar Zone (D). MD - Mati Depression; LD - Librazhdi Depression; ATD - Albanian - Thessalian Depression; PD - Periadriatic Depression; SPE - Shkoder - Peje (Scutari - Pec) transform fault; a,b,c,d - Windows of Kruja Zone. 1-11 - Location of Triassic sections: 1 - Luma section (Fig. 2); 2 - Bufli section (Fig. 3); 3 - Malesi Korabit section (Fig. 4); 4 - Kçira section (Fig. 5); 5 – Lini section (Fig. 6); 6 - Dushaj section (Fig. 7); 7 - Katundi Vjeter section (Fig. 8); 8 - Guri Zi section (Fig. 9); 9 - Zbuqi section (Fig. 10); 10 - Omaraj section (Fig. 11); 11 - Ura Shtrejte section (Fig. 12).

(Wien). Conodont classification and biostratigraphy mostly according to Hayashi (1968), Hirsch (1972, 1994), Budurov & Stefanov (1972), Kovacs (1983, 1994), Kozur (1989), Kozur & Mostler (1972), Kozur & Mock (1972), Krystyn (1980, 1983), Kovacs & Kozur, (1980), Budurov & Sudar (1990).

The material is housed in the Paleontological Cabinet at the Faculty Geology and Mining (FGJM), Tirana, Albania, catalogue n. FGJM: 101A, 102A; 103C-110C; 111K-115K; 116M, 117M, 118KO, A=Albanides; C=Cukali Zone; K=Krasta Zone; M=Mirdita Zone; KO Korabi Zone.

Geology and stratigraphy of the Triassic pelagic facies.

The geology of Albania (Albanides) is very complex. The Albanides exhibit a submeridional strike between Dinarides to the north and Hellenides to the south (Fig. 1).

Pelagic Triassic deposits, whose stratigraphy is being unraveled by conodonts, are widespread in the Korabi and Mirdita tectonic zones (Internal zones) and the Krasta, Cukali and Albanian Alps zones (External zones). A different character of facies is documented within these zones, though pelagic carbonate ones predo-

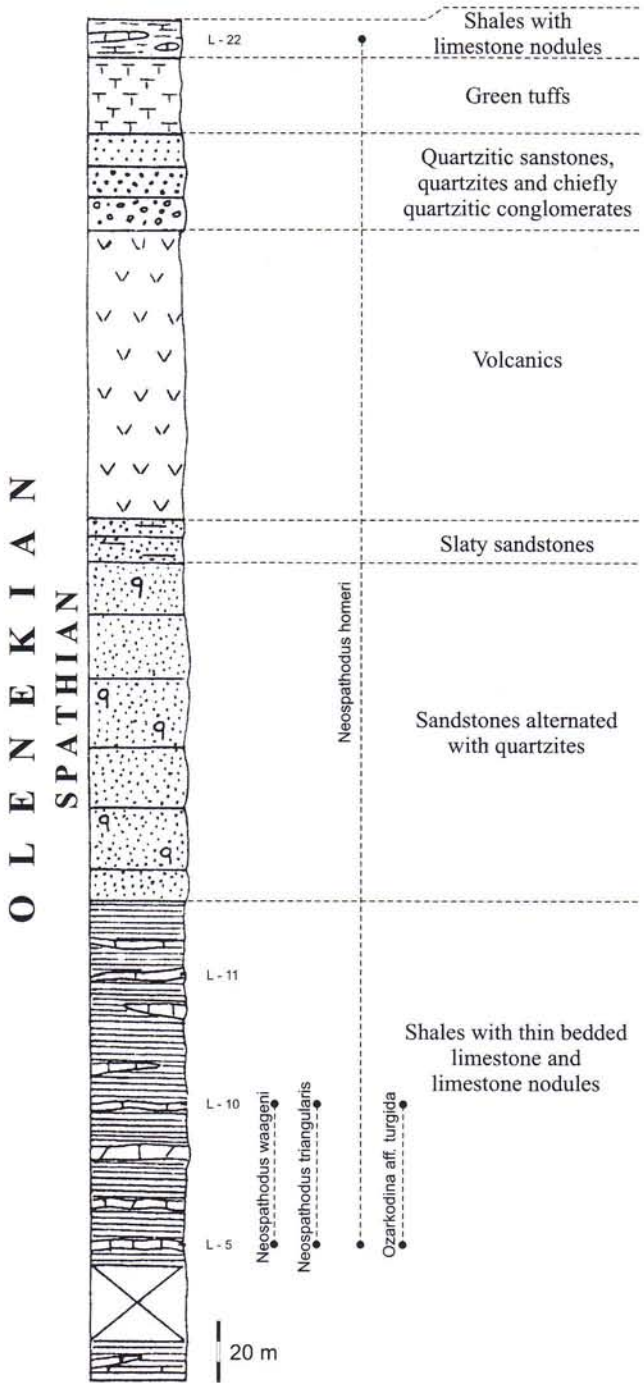


Fig. 2 - Biostratigraphic section of Luma, showing predominant lithologies, sample location and conodont occurrence. LOCATION of the section?

minate. The successions start with terrigenous and volcano-sedimentary facies (more evident in Korabi zone), followed upward by a reddish nodular limestone analogous to the Han Bulog facies (Lower Triassic-Anisian, mainly in Mirdita and Albanian Alps zones) and by limestone alternated with cherts and effusive rocks of Ladinian age, similar to the Knollenkalk (Pietra Verde) and Buchenstein beds. Usually the Upper Triassic is characterized by pelagic thin-bedded limestone, rich in bivalves, intercalated with cherts-radiolarites.

Several zones are distinguished within the Albanides:

Korabi zone.

The Korabi zone belongs to the eastern Albanides and overthrusts the western zones (Mirdita) (ISPGJ-IGJN 1983,1985). In a regional framework it is equivalent of the Goljia zone (Dinarides) and Pelagonian zone (Hellenides).

The Lower Triassic of this zone is exposed in the Luma section (Fig. 2) and starts with the Olenekian. From bottom to top, three main lithological units are distinguished:

(1) shales with lenses and interlayers of limestone and dolostones (about 145 m);

(2) alternating sandstones and quartzarenites (about 125 m);

(3) volcanics consisting of tuffs and tuffites and interstratified sandstone, topped by shales with carbonate lenses (Xhomo et al., 1985) (about 160 m).

The Luma section is of Spathian age (as are other sections of the Korabi zone, see below). Unlike sections of diverse zones (Mirdita, Cukali, etc.) it is characterized by the preponderance of terrigenous facies. It is the only section where *Neospathodus waageni* has been found and it is the earliest Triassic conodont species so far found in Albania (samples L 5, L 10). Moreover, a significant number of *N. triangularis, N. homeri, and Ozarkodina* aff. *turgida* was found. *N. homeri* is present in the upper part of this section (sample L22), indicating a Spathian age for the entire section.

In outcrops adjacent to the Luma section, isochronous Spathian facies are present. They are:

a) nodular, mottled limestone of Han Bulog facies (Nimça stream) with ammonoids; unlike the conodonts (*N. triangularis, N. homeri, Neogondolella jubata*), the ammonoid fauna is not well-preserved.

b) thin bedded limestone with embryonic ammonoids and nuclei of bivalves and gastropods (Kepi Ferizit) and analogous conodonts content. To date, *N. jubata* has been found only in this outcrop. The facies diversity of the Spathian units in such a short distances in Ãaja Subzone (Fig. 1) is explained among other factors, by the nappe tectonics.

The Middle Triassic (Anisian) in the Korabi zone is exposed more clearly along Bufli section (Fig. 3) which belongs to the southern part of Ãaja subzone. It is represented by argillaceous-sandy shales with limestone lenses where *Neospathodus homeri, Chiosella timorensis, Paragondolella bulgarica, Gladigondolella malayensis budurovi* were found.

In rare cases (Stanet e Preshit, which belongs to Malesia Korabit Subzone) the late Anisian (Illyrian) is

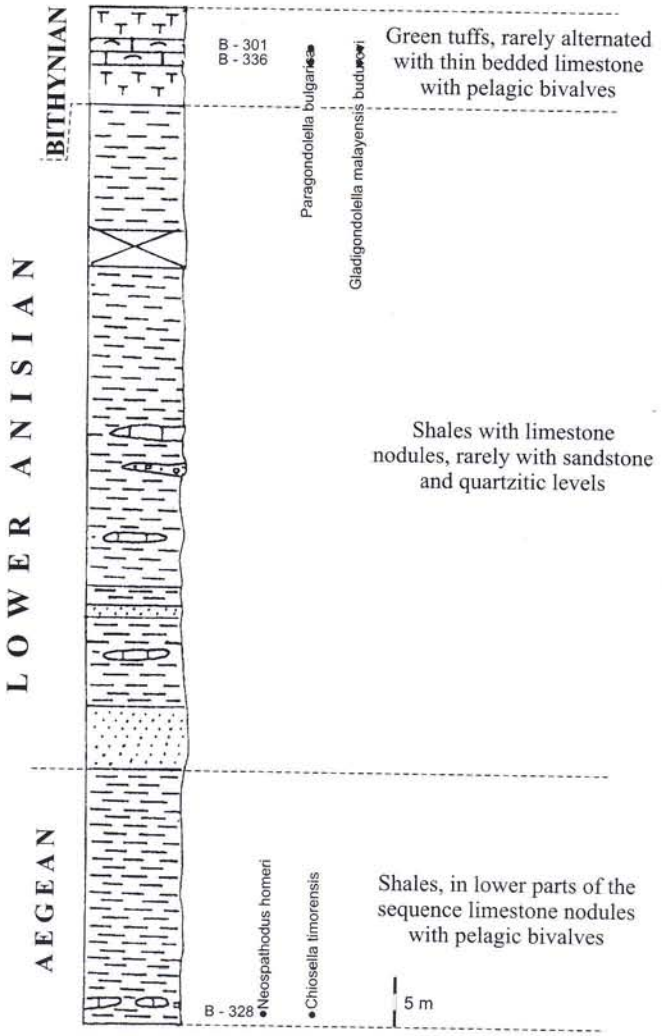


Fig. 3 - Biostratigraphic section of Bufli.

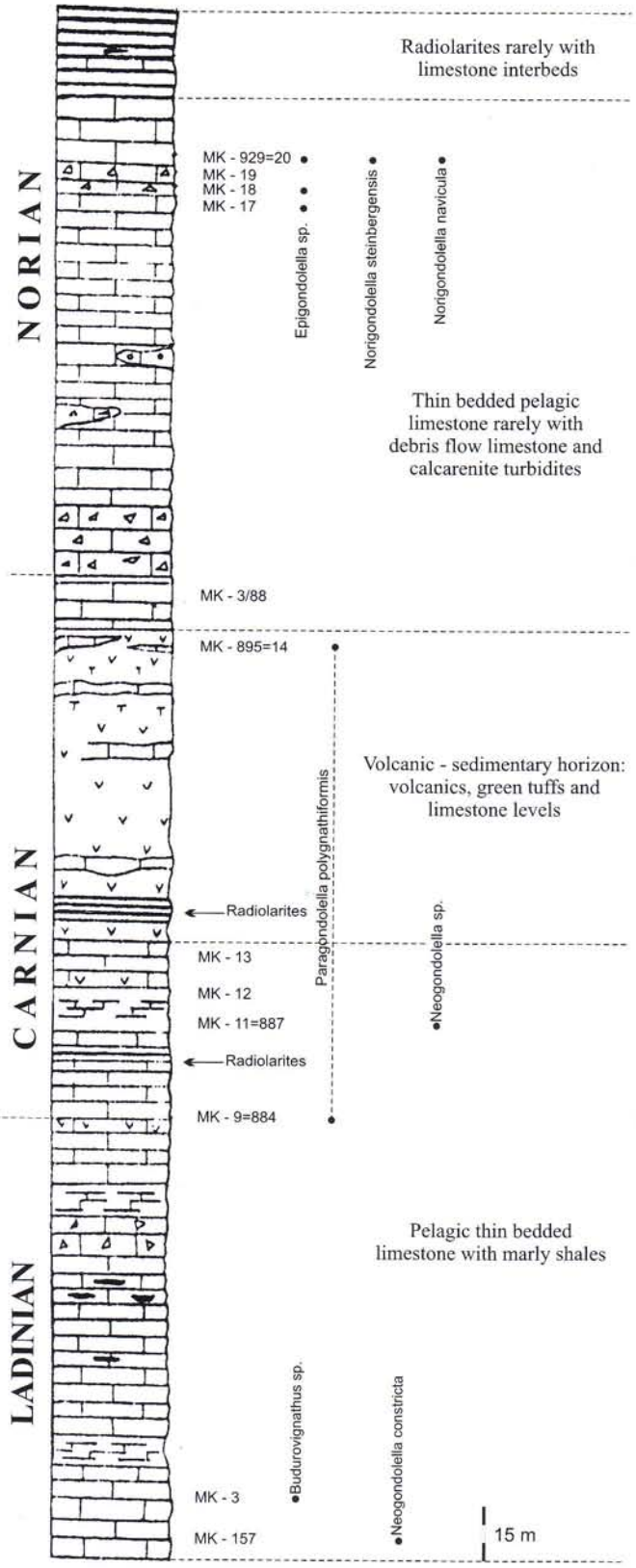


Fig. 4 - Generalized stratigraphic column of Malsi e Korabit.

highlighted by the occurrence of *Paragondolella bifurcata* and *N. constricta*. To be noted that in the present paper Aegean and Bithynian substages are considered as Early Anisian and the Pelsonian and Illyrian substages as Late Anisian. The Ladinian is not identified with precision by faunal data. Latest Anisian and Ladinian are mainly composed of platy limestone with cherty radiolarites. Volcanic rocks are locally present.

The Upper Triassic is represented by the Carnian and Norian stages (Fig. 4). Carnian rocks consist of thin-bedded limestone with cherts, rarely calcareous shales, radiolarites, calcareous debris flow as well as volcanics, i.e green tuffs with limestone lenses, yielding *Paragondolella polygnathiformis*. In a composite section (Fig. 4), nearly at the base of the Shkalla Rebive limestone, *P. auriformis*, still of Carnian age, occurs.

Norian rocks consist of thin to medium thick bedded pelagic limestone, with local debris flow and turbidites, topped by radiolarites. They are dated as Norian by *Norigondolella navicula* and *N. steinbergensis*.

In conclusion, the Korabi zone is characterized by volcano-sedimentary facies during the Spathian and Anisian. They consist of pelitic and argillaceous shales, often interbedded with carbonate lenses in which conodonts occur toward the top. Sandstones, quartzarenites, graywackes, conglomerates and volcanic rocks are scattered. From the Ladinian through the Carnian stage, lime-

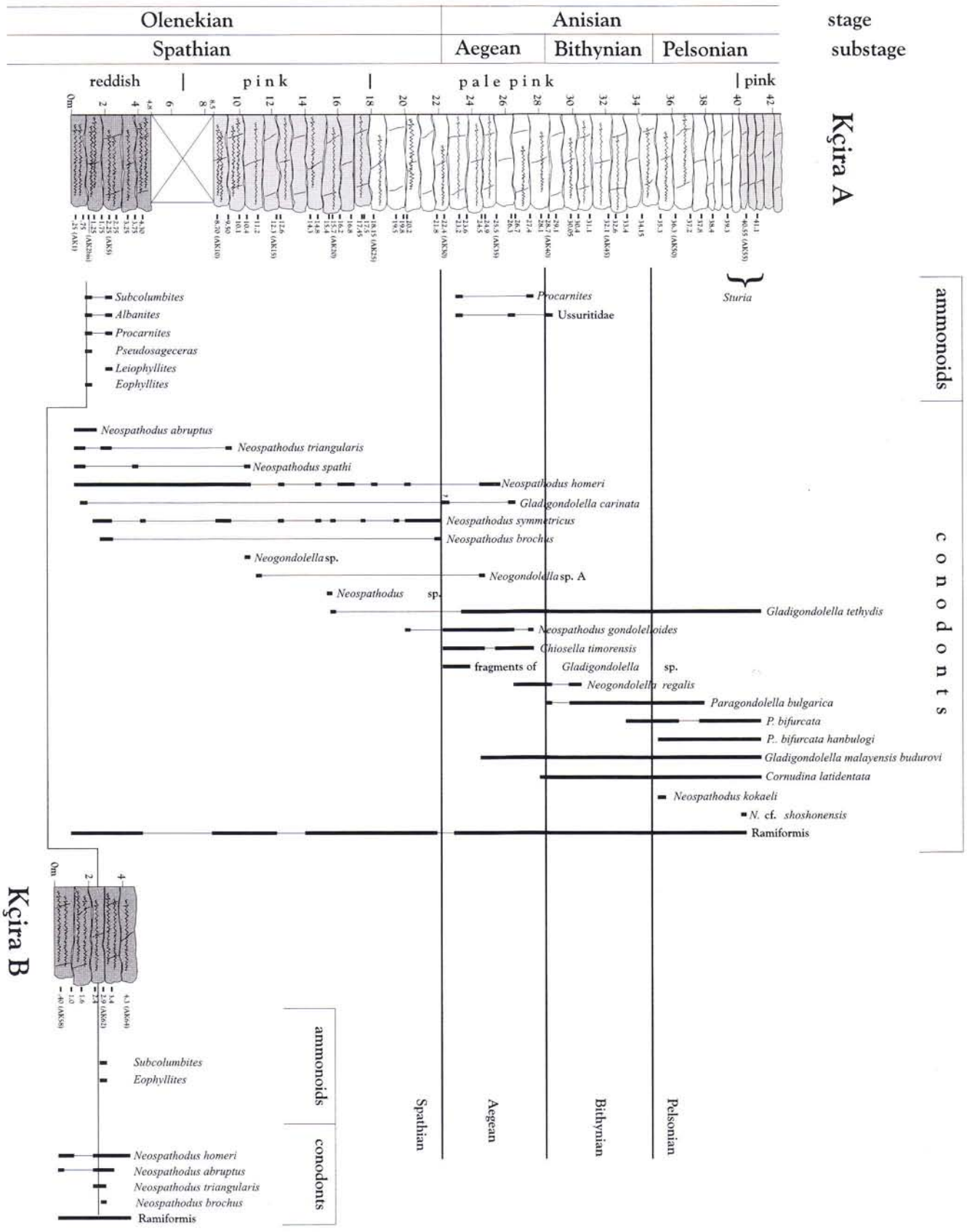


Fig. 5 - Biostratigraphic sections of Kçira: KçA, KçB and KçG. Location and conodonts from Muttoni et al. (1996), ammonoids from Germani (1997).

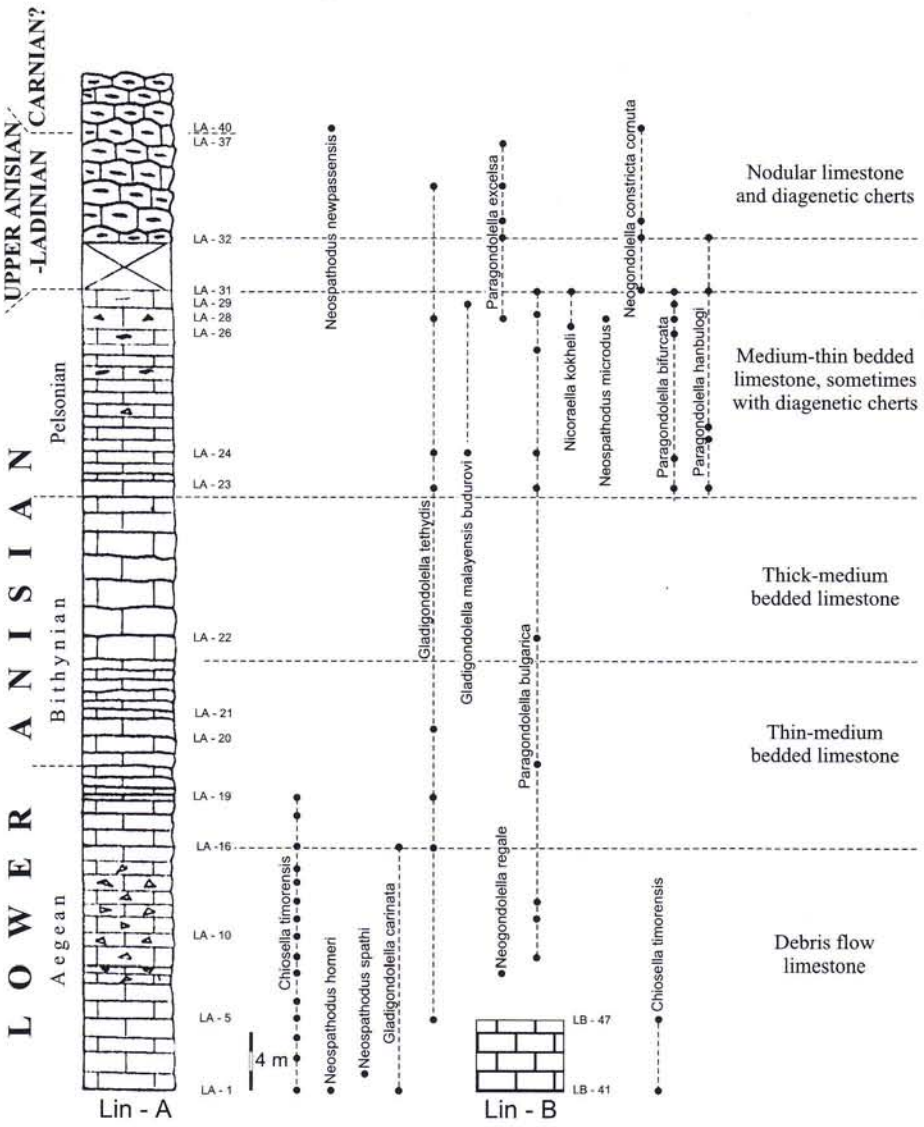


Fig. 6 - Biostratigraphic sections of Lin A and Lin B.

stone facies predominate, associated with abundant cherty radiolarites and, rarely, volcanic rocks. In the Norian stage volcanic rocks lessen or are absent while radiolarites increase.

Mirdita zone.

The Mirdita zone is located to the west of Korabi zone (Fig. 1). The most striking sections of Lower-Middle Triassic are those of Kçira (Fig. 5) (Muttoni et al., 1996) and that of Lini in the western side of Ohri Lake (Fig. 6). Both belong to the Qerret-Miliska subzone (central subzone of Mirdita zone), the latter representing the southward continuation of Kçira. The Kçira section consists entirely of nodular reddish to rose-pale rose limestone typical of the Han Bulog facies. Its total thickness reaches up to 42 m, covering the time interval from the Spathian to the base of the Pelsonian. In addition to the conodont fauna, the Kçira section has delivered ammonoids as well (Germani, 1997), among of which *Subcolumbites perrinismithi, S. europaeus, Prokarnites kokeni, Albanites albanus* are the more abundant species. In the intermediate-upper parts of the section the ammonoids are less abundant and poorly-preserved (*Leiophyllites* cf. *pitamaha, Procladiscites brancoi, Sturia sansonovinii).* The conodont fauna found in the whole section is significant and instrumental in setting the stage boundaries.

The Spathian is defined by *Neospathodus symmetricus, N. homeri, N. brochus, N. abruptus.* Aegean is characterized by the presence of *Neospathodus gondolelloides* and particularly of *Chiosella timorensis* and the bottom of the Bithynian and Pelsonian by the appearance of *Paragondolella bulgarica* and *Nicoraella kockeli*, respectively.

The 67-70 m thick Lini composite section is partly analogous with that of Kçira (specially Kçira A) and is made by two sections, some 100 m apart (Lini A and Lini B) (Fig. 6).

From bottom to top it consists of:

(1) 0-28 m of intermediate - thick bedded limestones, in general of grey to reddish colour, with rose to light rose tones. At specific levels limestone debris flow occur (between 5.7- 6.7 m and 9 -14 m) or platy limestone occur in between (18.8-20.2 m and 24-27 m).

(2) 28-38 m: same limestone as in level (1), massive bedded;

(3) 38-45 m: same limestone as in level (1);

(4) 45-53.4 m: same limestone as in level (1) with rare chert nodules.

(5) 53.4 - 56.4 m: covered interval;

(6) 56.4-67 m: dark grey limestone of Knollenkalk type, relatively thin-bedded with chert nodules, recalling the Buchenstein facies (Gaetani & Brack,1993), in which the top interval (65-67 m) is characterized by the predominance of cherts, in marked contrast with the limestone.

In the 67 m thick LA section, 40 samples were collected, 31 in the 53.4 m lower interval and 9 in the 8.2 m thick Knollenkalk limestone. Additionally, 7 samples were collected from the 4.7 m thick chiefly rose coloured limestone with amygdaloidal-lenticular structures expo-

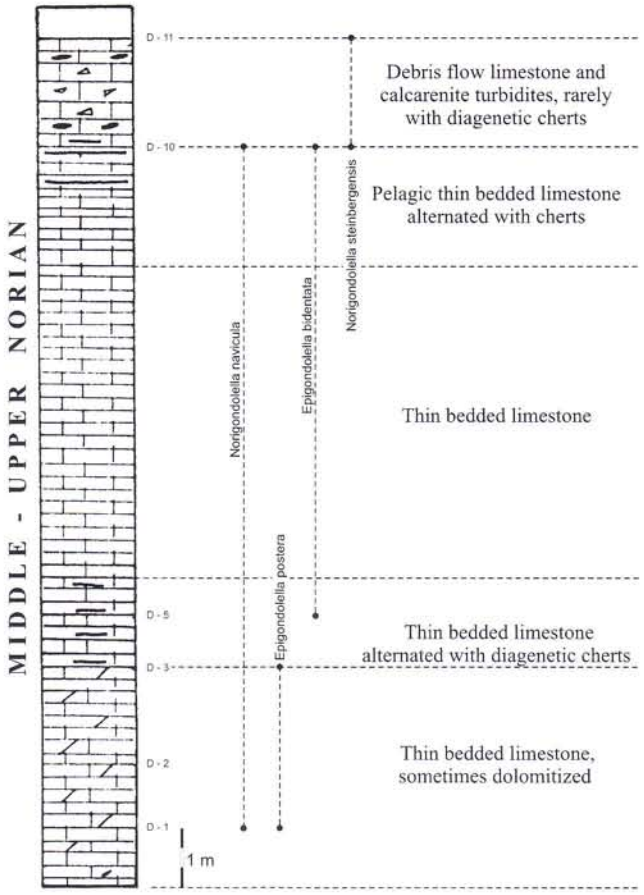


Fig. 7 - Biostratigraphic section of Dushaj.

sed in the LB section (Fig. 6), cropping out about 100 m northward from the LA section.

In general, abundant conodonts are present in the samples from both sections, with the exception of the limestones compared with the Buchenstein beds, which were poor, and samples LA-36 and LA-39, which were barren.

The lower 21 m (samples LA-1 to LA-19) of the Lini section start within the base of the Anisian stage, in which *Chiosella timorensis* predominates, associated with *Neospathodus homeri* (LA-1), *N. spathi* (LA-2), *Neogondolella regale* (LA-7), *Neogondolella shoshonensis* (LA-9) and *Paragondolella bulgarica* (LA-9, 10, 12). Moreover, representatives of *Gladigondolella*, particularly *Gl. tethydis*, *Gl. carinata*, and many other ramiform elements are found in several samples of this section.

In the following 30 m (samples LA-20 to LA-30) *Ch. timorensis* disappears, replaced by the predominance of *P. bulgarica* associated with *P. bifurcata*, *P. hanbulogi*, *Gladigondolella tethydis*, *Gl. malayensis budurovi*. A form resembling *Neospathodus microdus* is associated with *P. bulgarica*, *Gl. carinata* and ramiforms in sample LA-29. In sample LA-30, 0.6 m higher, abundant *P. bulgarica*, as well as *P. excelsa*, *P. bifurcata*, and a transition form between *Neospathodus germanicus* and *N. kockeli* occur.

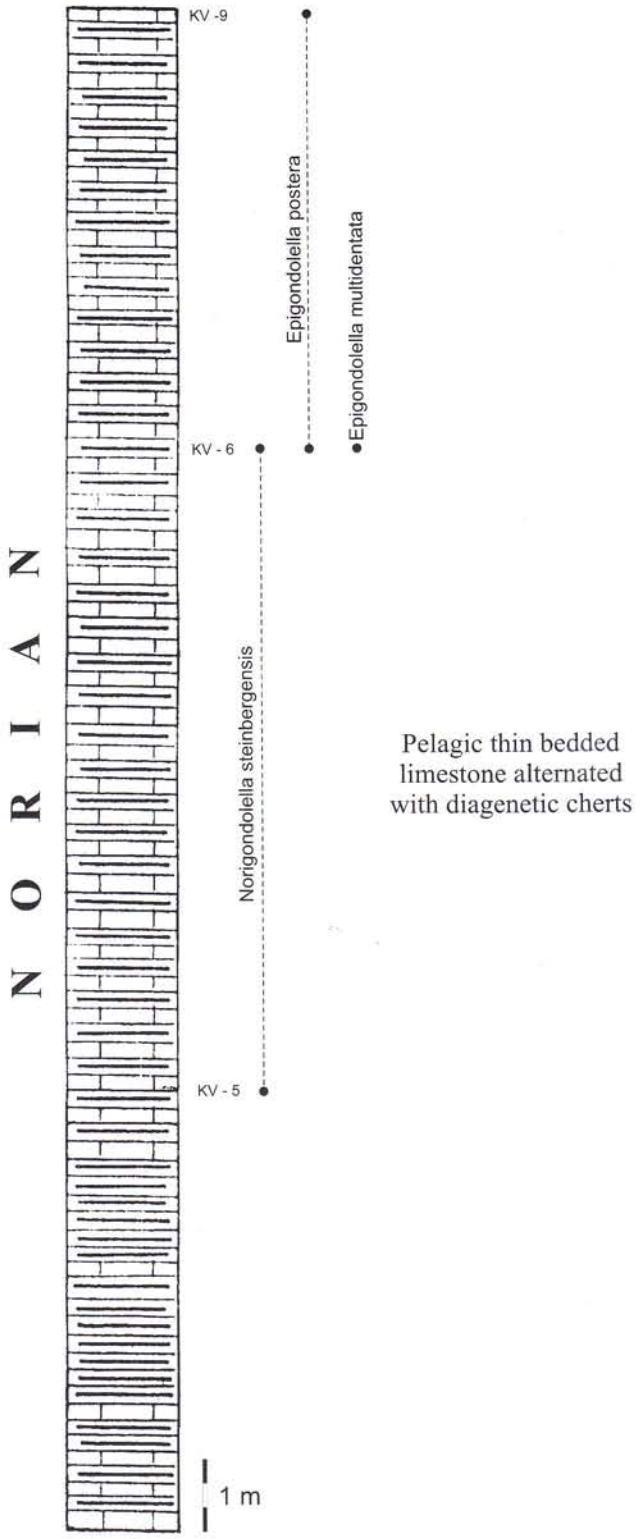


Fig. 8 - Biostratigraphic section of Katundi Vjeter (Rubik).

In the rich sample LA-31 *N. kockeli*, *N. germanicus* and their intermediary transition forms, as well as *P. bulgarica*, *P. excelsa*, *P. bifurcata*, *P. hanbulogi*, *Gladigondolella tethydis* are found.

The interval represented by samples LA-20 to LA-22 is of Bithynian age (Fig. 6), whilst the presence of *N. kockeli* confers a Pelsonian age to the interval between

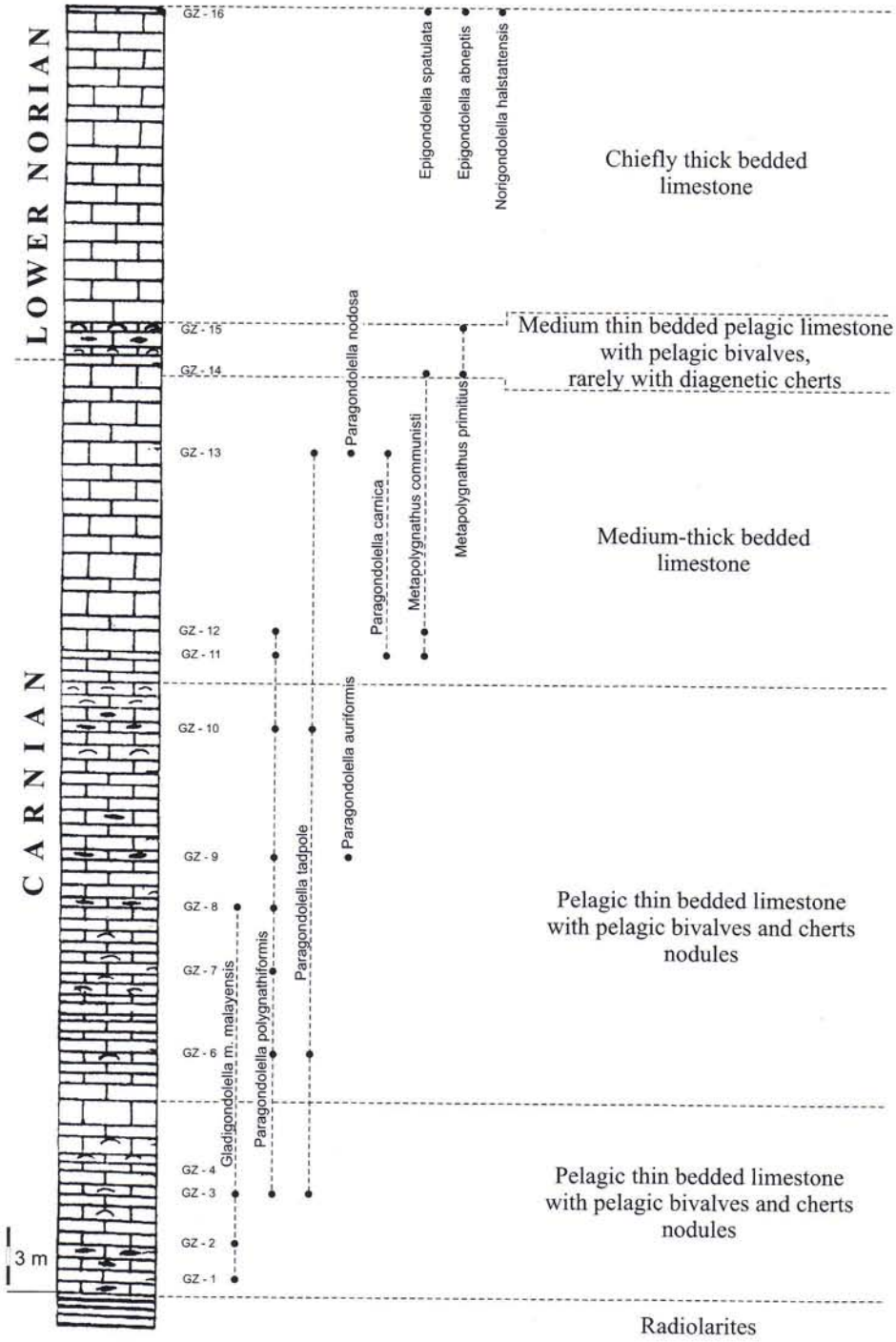


Fig. 9 - Biostratigraphic section of Guri Zi.

samples LA-23 and LA-30. The appearance of *Neogondolella constricta cornuta* in LA-31 suggests the base of the Illyrian.

The number of conodonts is considerably smaller than in prior samples in the cherty limestone of Buchenstein type, sample LA-32 yielded *P. hanbulogi* and *P. excelsa*, and samples LA-33 - 37 yielded *P. excelsa, Neogondolella constricta cornuta, Gladigondolella tethydis*. Sample LA-40 at the top of the LA section, yielded *Neospathodus newpassensis*.

A Late Anisian age is suggested for the 11 m thick interval between samples LA-32 to LA-37 (see also Papsova & Pevny, 1982).

A possible Early Carnian age may be attributed to sample LA-40 (Mosher, 1968) which contains *Neospathodus newpassensis*.

Samples LB-41 to LB-47, that belong to the auxiliary LB section, are characterized by *Ch. timorensis* (Fig. 6).

In conclusion, the nodular limestone facies of Han Bulog type is characteristic of Spathian and Anisian stages in the Mirdita tectonic zone. The Ladinian - Early Carnian stages remain less well known though the uppermost part of LA section (56.4 to 67 m) may correspond to these stages.

Carnian has been partly identified in the Kçira stream, approximately 300 m to the east of Kçira A section, where is represented by 4 m thick platy limestone with filaments of pelagic bivalves and with chert nodules and interlayers. The conodonts fauna consists of *Paragondolella polygnathiformis, P. tadpole, P. foliata foliata, Gladigondolella tethydis, Gl. malayensis*.

Better than anywhere, Norian has been evidenced in Dushaj (Fig. 7) and partly in Katundi Vjeter sections (Fig. 8).

The 13 m thick Dushaj section comprises from bottom to top:

a) thin bedded limestone, in part dolomitised. Pelagic facies with chert nodules and thin beds in defined intervals (3.5-5.2 m; 9.6-12 m).

b) ruditic limestone of debris flow type and turbidites with some cherts (the upper part of the section, 12-13.5 m).

The conodonts of this section are: *Norigondolella navicula* (sample D 10), *Epigondolella postera* (sample D 1,D 3), recrystallized *Epigondolella* (sample D 2), *Epigondolella postera* (sample D 3), *E. bidentata*, (sample D 5), *Norigondolella steinbergensis* (sample D 1, D 10) indicating the Middle to Late Norian ages.

In Katundi Vjeter section, about 20 m thick (Fig. 8), thin bedded limestone commonly with very thin (5-6 cm) cherty interlayers, predominate.

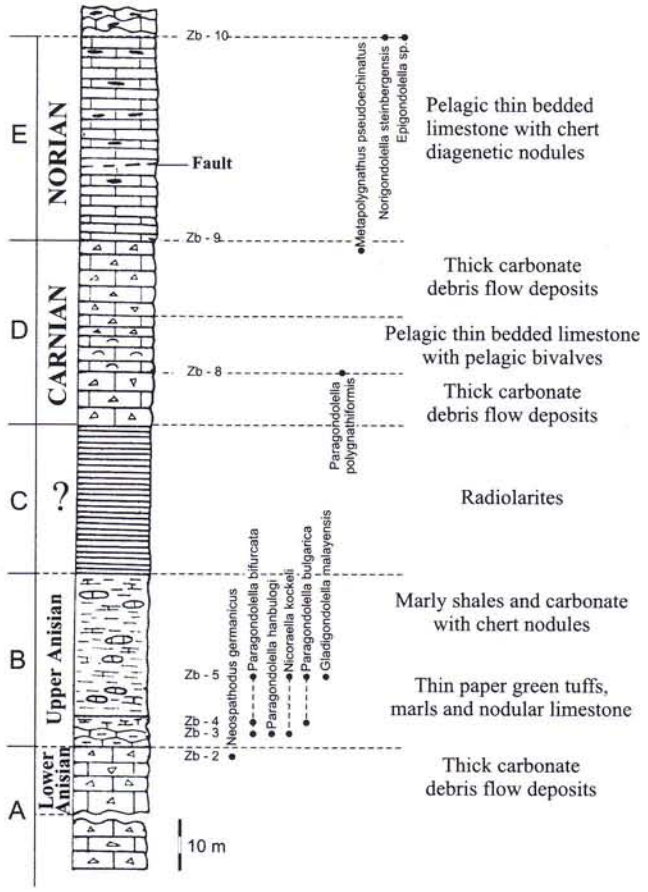


Fig. 10 - Biostratigraphic section of Zbuqi.

Conodonts were found only in three samples (KV 5, KV 6 and KV 9, at 5.9 m, 14.3 m and 19.8 m levels respectively). The species identified are: *Norigondolella steinbergensis* (KV 5, KV 6), *Epigondolella postera* (KV 6,KV 9), *E. multidentata* (KV 6) and suggest a Norian age for the thin bedded pelagic limestone facies with cherts.

Krasta Zone.

The Krasta zone is the eastern zone of the External Albanides (Meço et al., in prep.). In Albanian geologic literature it has been considered as a subzone of the Krasta-Cukali zone (ISPGJ-IGJN 1983, 1985). Guri Zi, situated several km south of the town of Shkodra, is the best investigated Triassic section belonging to this zone (Fig. 9). The geology of the area shows a remarkable imbricated structure (Theodhori, 1966). In the Guri Zi village, at the base of the section, the Paleogene flysch is exposed. An effusive series, composed of spilite, albitophyre, and green tuffs, 170 m thick (considered of Ladinian age by Theodori (1966) overthrusts the flysch.

A radiolarite sequence, about 15 m thick, follows. The pelagic Triassic limestones overlie the radiolarites showing a gradual transition and are covered by a tectonic wedge of Upper Cretaceous limestone with *Globotruncana* which in turn are overlain by the Paleogene flysch. This imbricated structure is clearly exposed further up the section.

The 60 m thick Carnian-Norian section consists of limestones (from bottom to top):

a) in the first 30 m, thin-bedded limestone with filaments of pelagic bivalves and interlayers of chert nodules predominate;

b) in the interval 30 to 43 m, the limestone becomes medium-thick bedded; there is no presence of cherts;

c) in the interval from 43 to 45 m, the limestone becomes again thin-medium bedded with filaments of pelagic bivalves and some cherts;

d) the upper interval (45-60 m) is composed of medium-thick bedded limestone, locally with filaments of pelagic bivalves and with no presence of cherts.

The pelagic limestone, from which samples (2 kg of each) were collected, produced:

GZ 1 to GZ 3, GZ 8*: Gladigondolella malayensis malayensis*;

GZ 3,GZ 6 to 12*: Paragondolella polygnathiformis*;

GZ 3, GZ 6, GZ 10, GZ 13: *P. tadpole*;

GZ 9: *P. auriformis*;

GZ 11 to GZ 13: *Paragondolella carnica*;

GZ 11, GZ 14: *Metapolygnathus communisti*;

GZ13: *Paragondolella nodosa*;

GZ 14, GZ 15: *Metapolygnathus primitius*;

GZ16: very rich (over 1000 specimens), including *Epigondolella spatulata*, *E. abneptis* and *Norigondolella halstattensis*.

Based on the conodont assemblages, a Carnian age is attributed to the interval between samples GZ 1 - GZ 14 (about 43 m thick) and a Norian age (up to the late Lacian) to the interval between samples GZ 14 - GZ 16 (about 17 m thick).

Cukali zone.

The Cukali zone is situated to the northeast of Krasta zone. It is interpreted as a large tectonic window between the Albanian Alps zone in the north and Mirdita zone in the south-southeast (Fig. 1). Three sections (Omaraj, Ura Shtrenjte and Zbuqi), located close to each other, were studied within the Cukali zone.

Zbuqi section. It is the southernmost section, 155 - 160 m thick (Fig. 10).

From bottom to top, five units were distinguished:

(A) (1) 13 m of grey to pale reddish-rose ruditic limestone;

(2) 3 m of reddish nodular and marly limestone;

(3) 1.6 m of grey to green tuffaceous carbonate shales.

(B) 27-28 m consisting of a sequence of carbonate shales and limestone lenses, with a 5 m thick interval of cherts, ending 5 m below the top;

(C) 30 m of radiolarites.

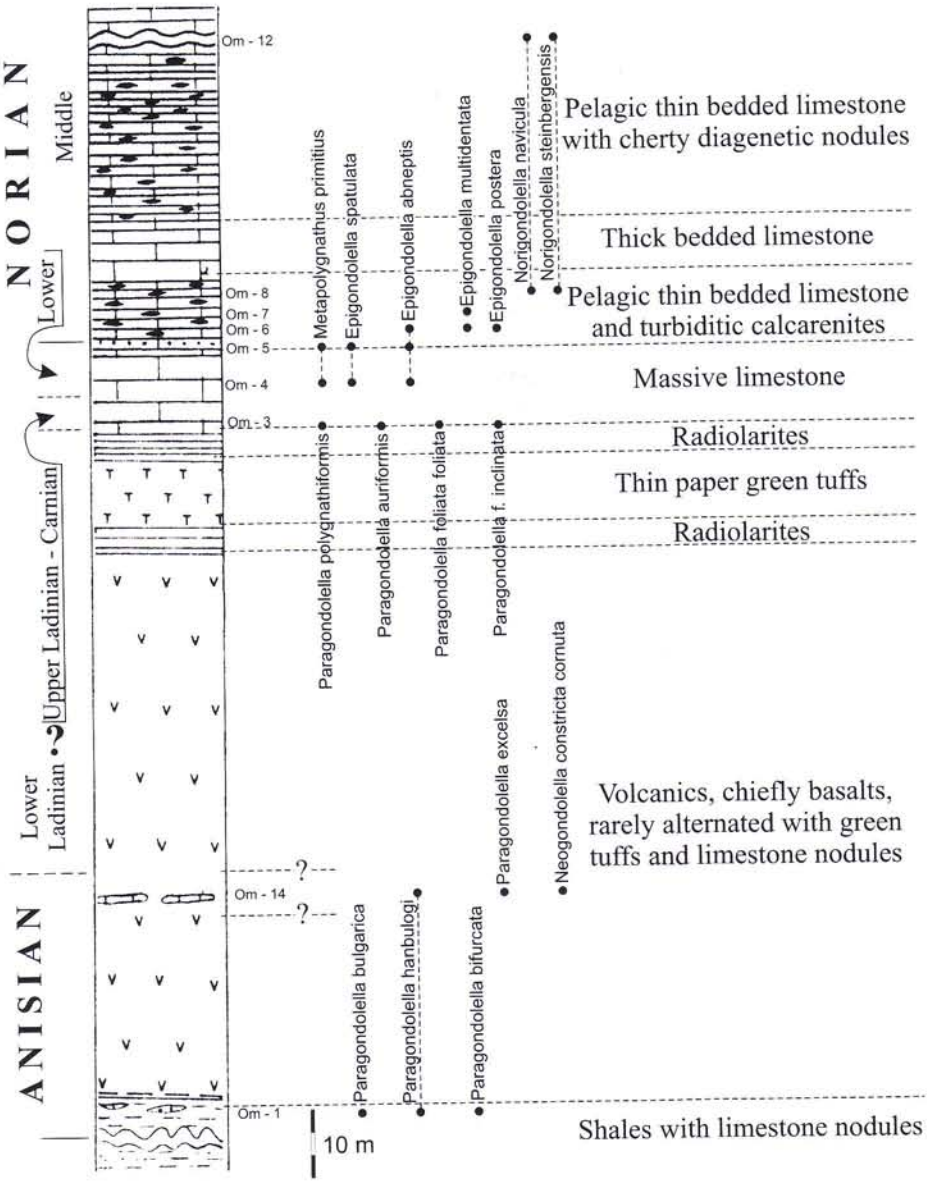


Fig. 11 - Biostratigraphic section of Omaraj.

39 m of thin-bedded allodapic limestone (debris flow) with filaments of pelagic bivalves.

(D) 45-46 m of thin-bedded limestone facies with nodular cherts and/or cherty interlayers.

Seven out of ten samples contain conodonts (Fig. 10):

Zb 2 (taken at 12 m above base): *Neospathodus germanicus* (Bithynian);

Zb 3 to Zb 5 (interval 25-30 m): *Paragondolella hanbulogi, P. bifurcata, Nicoraella kockeli* and in Zb 5 *Gladigondolella malayensis* (Pelsonian- Illyrian).

Zb 8 (60 m above Zb 5): *Paragondolella polygnathiformis* (Carnian);

Zb 9 - Zb 10 (113 m and 150 m): respectively *Metapolygnathus pseudoechinatus, Norigondolella steinbergensis* and *Epigondolella* sp. (Norian age);

The radiolarites between the Late Anisian and Norian time-intervals did not yield any conodonts.

Omaraj section. The second section studied in the Cukali zone was the Omaraj section, located south of the village of Omaraj (Fig. 11). It is 160 m thick and ranges from the Illyrian to the Middle Norian.

The section consists of, bottom to top:

a) shales with limestone lenses. They crop out directly on the Shullani stream bed (2-3 m);

b) volcanic rocks. Lavas are of alkali affinities from basics to acids. Within the volcanics also green tuffs and limestone lenses are present, at the levels 20 m and 35 m from the base of the section, respectively. In these lenses sample Om 14 was collected. (80 m);

c) two radiolarite levels. They have a thickness of 4 m each and are separated by a 10 m thick interval of tuffs and tuffites;

d) alternations of thick, thin-bedded and platy limestones. (100-160 m).

Ten out of 14 samples contained conodonts.

Om 1: *Paragondolella bulgarica, P. hanbulogi, P. bifurcata* (Illyrian);

Om 14: *P. excelsa, Neogondolella constricta cornuta, P. hanbulogi* (Illyrian);

Om 3 (precisely at the base of the massive limestone): *Paragondolella polygnathiformis, P. foliata foliata, P. f. inclinata, P. auriformis* (Carnian);

Om 4 to Om 5: *Metapolygnathus primitius, Epigondolella spatulata.*

Om 4 to Om 6 - *E. abneptis* (subsp. B, after Orchard, 1983), (Early Norian);

Om 6 and Om 7: *Epigondolella multidentata* (Middle Norian);

Om 6: *E. postera* (Middle Norian);

Om 7, Om 8, Om 12: *Norigondolella navicula, N. steinbergensis* (Middle Norian);

A single specimen resembling *Prionodina sweeti* was found in sample Om 11.

Samples Om 2, Om 9, Om 10 and Om 13 were barren.

In conclusion, the Omaraj section ranges from Illyrian to Norian (Alaunian), mostly in pelagic facies.

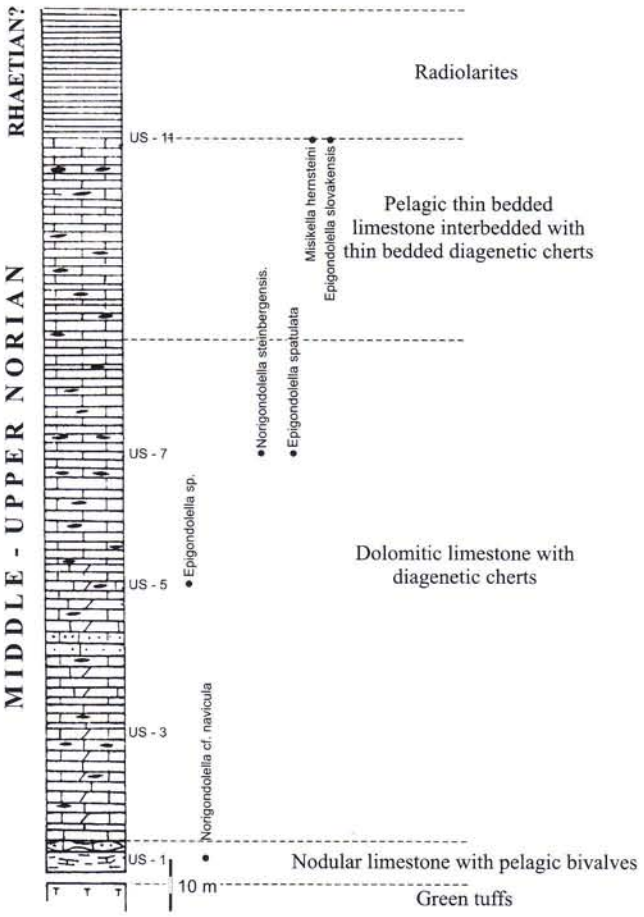


Fig. 12 - Biostratigraphic section of Ura e Shtrejte.

Ura Shtrenjte section. The third section studied in the Cukali zone was the Ura Shtrenjte section (Fig. 12).

It is almost 150 m thick and consists of pelagic facies, but unlike the two previous sections it is entirely of Norian age.

Above green tuffs follow from bottom to top:

a) carbonate shales and limestone debris flow with pelagic bivalves (5 m);

b) dolomitic limestone with cherts and some calcarenites (41 m);

c) calcarenites (4 m);

d) thin-bedded limestone and cherts (42-43 m);

e) thin-bedded limestone with cherts (36 m);

f) radiolarites (25 m).

The section is not rich in conodonts, which have been recovered from the following samples:

US 1: *Norigondolella* cf. *navicula*;

US 5: *Epigondolella abneptis*;

US 7: *Norigondolella steinbergensis*, *Epigondolella spatulata*;

US 11: *Misikella hernsteini*, *Metapolygnathus slovakensis*.

The sequence is mostly Norian (probably mostly early Norian). The Rhaetian stage is indicated by *Misikella hernsteini*, which is the first evidence of this taxon in Albania.

It can be concluded that the Triassic of the Cukali zone ranges from the Pelsonian to the Rhaetian. The carbonate pelagic facies predominates.

Albanian Alps Zone.

In the Albanian Alps zone, north of the Cukali zone, the Upper Longobardian (Ladinian) is documented by the conodonts *Budurovignathus diebeli*, *B. mostleri* and *B. mungoensis* in the sections of Gjuraj and Thethi. This new evidence resulted from investigations of the Lower-Middle Triassic in the Albanian Alps zone carried out in collaboration with colleagues from the Department of Earth Sciences of the University of Milano (Gaetani et al., in preparation).

The Triassic facies, discussed in this study, are summarized according to the geologic tectonic zones of Albania (Table 1).

Tectonic zones / Triassic stages	Korabi Zone	Mirdita Zone	Krasta Zone	Cukali Zone	Albanian Alps Zone
Norian	Medium-bedded limestone, turbidites and radiolarites	Thin bedded limestone with cherts	Medium-thick bedded limestone without cherts	Thin bedded limestone with cherts	Platform facies
Carnian	Thin bedded limestone with cherts	Thin bedded limestone with cherts	Thin bedded limestone with cherts	Thin bedded limestone with cherts	Platform facies
Ladinian	Platy limestone with cherts and volcanics	Partly nodular limestone with cherts (Buchenstein type)	Radiolarites and volcanics	Radiolarites and volcanics	Nodular limestone with chert and effusives (Buchenstein type)
Anisian	Volcano-sedimentary series	Nodular limestone (Han Bulog type)	No outcrops	Debris flow limestone, calcareous shales	Nodular limestone (Han Bulog type)
Spathian	Volcano-sedimentary series, partly nodular limestone	Nodular limestone (Han Bulog type)	No outcrops	Nodular limestone	No outcrops

Tab. 1 - Lithology of the conodont bearing facies in the tectono-stratigraphic zones of Albania.

		Korabi Zone	Mirdita Zone	Krasta Zone	Cukali Zone	Albanian Alps Zone	Albania
Norian	U		*bidentata*		*hernsteini, bidentata, slovakensis*	*platform facies*	*hernsteini, bidentata, slovakensis*
	M	*steinbergensis*	*multidentata*	*hallstattensis, spatulata,*	*postera, multidentata*		*postera, multidentata*
	E	*navicula*	*abneptis primitius*	*abneptis primitius*	*spatulata, primitius*		*spatulata, abneptis, primitius*
Carnian	U	?	?	?	?	*platform facies*	?
	M	*auriformis*	*tadpole auriformis*	*auriformis*			*tadpole auriformis*
	E	*polygnathiformis*	*polygnathiformis*	*polygnathiformis*	*polygnathiformis carnica*		*polygnathiformis*
Ladinian	Longobard	?	?	?		*mungoensis*	*mungoensis*
	Fassan	?	?	?	*foliata inclinata*	?	*foliata inclinata*
Anisian	Illir.	*constricta*	*constricta cornuta excelsa*	?	*constricta, constricta cornuta*	?	*constricta cornuta excelsa*
		?	*hanbulogi bifurcata*		*excelsa, hanbulogi*		*hanbulogi bifurcata*
	Pelson	?	*kokheli*	?	*kokheli*	*kokheli*	*kokheli*
	Bithyn.	*bulgarica*	*bulgarica*	?	*bulgarica*	*bulgarica*	*bulgarica*
	Aeg.	*timorensis*	*regale timorensis*	?	?	?	*regale timorensis*
Spath.		*homeri, jubata, triangularis, waageni*	*homeri, brochus, symmetricus, triangularis, abruptus*	?	?	?	*homeri, jubata, brochus, symmetricus, triangularis, abruptus waageni*

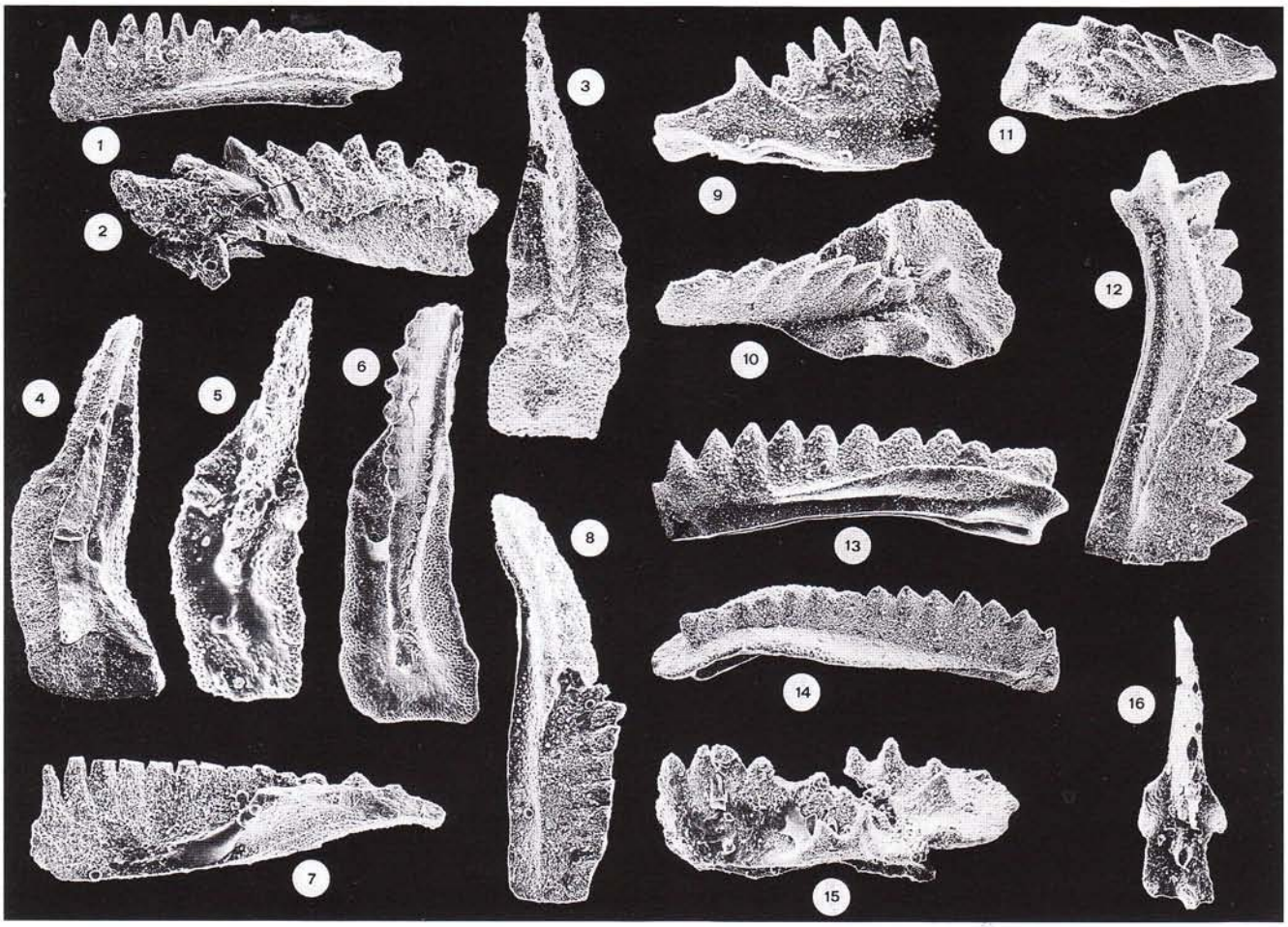
Tab. 2 - Significant conodont species and range in the tectono-stratigraphic zones of Albania.

PLATE 1

Fig. 1 - *Neospathodus germanicus* Kozur, lateral view, x 100, ZbuqI section, Zb 2, Cukali zone. Pelsonian.
Fig. 2 - Transition form between *Neospathodus germanicus* Kozur and *Nicoraella kockeli* (Tatge), lateral view, x 120, Gjuraj section, G 58, Albanian Alps zone, Pelsonian.
Fig. 3 - *Paragondolella hanbulogi* (Sudar & Budurov), lateral view, x 80, ZbuqI section, Zb 4, Cukali zone, Illyrian.
Fig. 4 - *Paragondolella hanbulogi* (Sudar & Budurov), upper - lateral view, x 75, Zbuqi section, Zb 4, Cukali zone, Illyrian.
Fig. 5 - *Paragondolella foliata inclinata* (Kovacs), lateral - upper view, x 75, Karma section, K 3, Cukali zone, Upper Ladinian.
Fig. 6, 9 - *Budurovignathus mungoensis* (Diebel), 6 - lateral view, x 85, Gjuraj section, G 101, 9 - upper view, x 90, Thethi section, Th 350, both Albanian Alps zone, upper Longobardian.
Fig. 7, 8 - *Budurovignathus diebeli* (Kozur & Mostler), 7 - upper - lateral view, x 120, Gjuraj section, G 101, 8 - lateral - upper view, x 100, Thethi section, Th 350. Both Albanian Alps zone, upper Longobardian.
Fig. 10, 11 - *Paragondolella auriformis* (Kovacs), both upper - lateral view, x 100, Malsi e Korabit section, Mk 3/88, Korabi zone, Carnian.
Fig. 12, 13 - *Paragondolella carnica* (Krystyn), 12 -- lateral view, 13 - upper view, both x 100, Karma section, K 4, Cukali zone, Carnian.
Fig. 14-16 - *Paragondolella polygnathiformis* (Budurov & Stefanov), 14, 16 - lateral view, x 75, 15 - lateral view, x 75. Guri i Zi section, Krasta zone: Fig. 14 - GZ 3; Figs. 15, 16 - GZ 11. Early Carnian.
Fig. 17 - *Paragondolella tadpole* (Hayashi), lateral view, x 80, Guri i Zi section, GZ 3, Krasta zone, Carnian.

PLATE 2

Fig. 1 - *Paragondolella tadpole* (Hayashi), lateral view, x 90, Guri i Zi section, GZ 3, Krasta zone, Carnian.
Fig. 2 - *Neospathodus newpassensis* (Mosher), lateral view, x100, Guri i Zi section, GZ 9, Krasta zone, Carnian.
Fig. 3-6 - *Metapolygnathus primitius* (Mosher), 3, 5 - upper view, x 90; 4 - lower view, x 90, from Figs. 3 to 5 Guri i Zi section, GZ14, Krasta zone, early Norian; Fig. 6 - upper view, x 75, Maknor section, M 3, Mirdita zone, early Norian.
Fig. 7, 8 - *Paragondolella communisti* (Hayashi), 7 - lateral view, x 90, 8 - lateral view, x 75, both Guri i Zi section, GZ 14, Krasta zone, Norian.
Fig. 9 - *Metapolygnathus abneptis* (Huckriede), lateral view, x 100, Guri i Zi section, GZ 16, Krasta zone, early Norian.
Fig. 10, 11 - *Epigondolella spatulata* (Hayashi), 10 - upper view, x 100, 11 - lateral - upper view, x 100, both Guri i Zi section, GZ 16, Krasta zone, Norian.
Fig. 12-14 - *Norigondolella hallstattensis* (Mosher), 12, 13 - lateral view, both x 100, 14 - lateral -upper view, x 75, Guri i Zi section, GZ 16, Krasta zone, Norian,
Fig. 15, 16 - *Epigondolella bidentata* (Mosher), 7 - lateral view, x 200, 8 - upper view, x 100, both Ura Shtrejte section, US 5, Cukali zone, Norian.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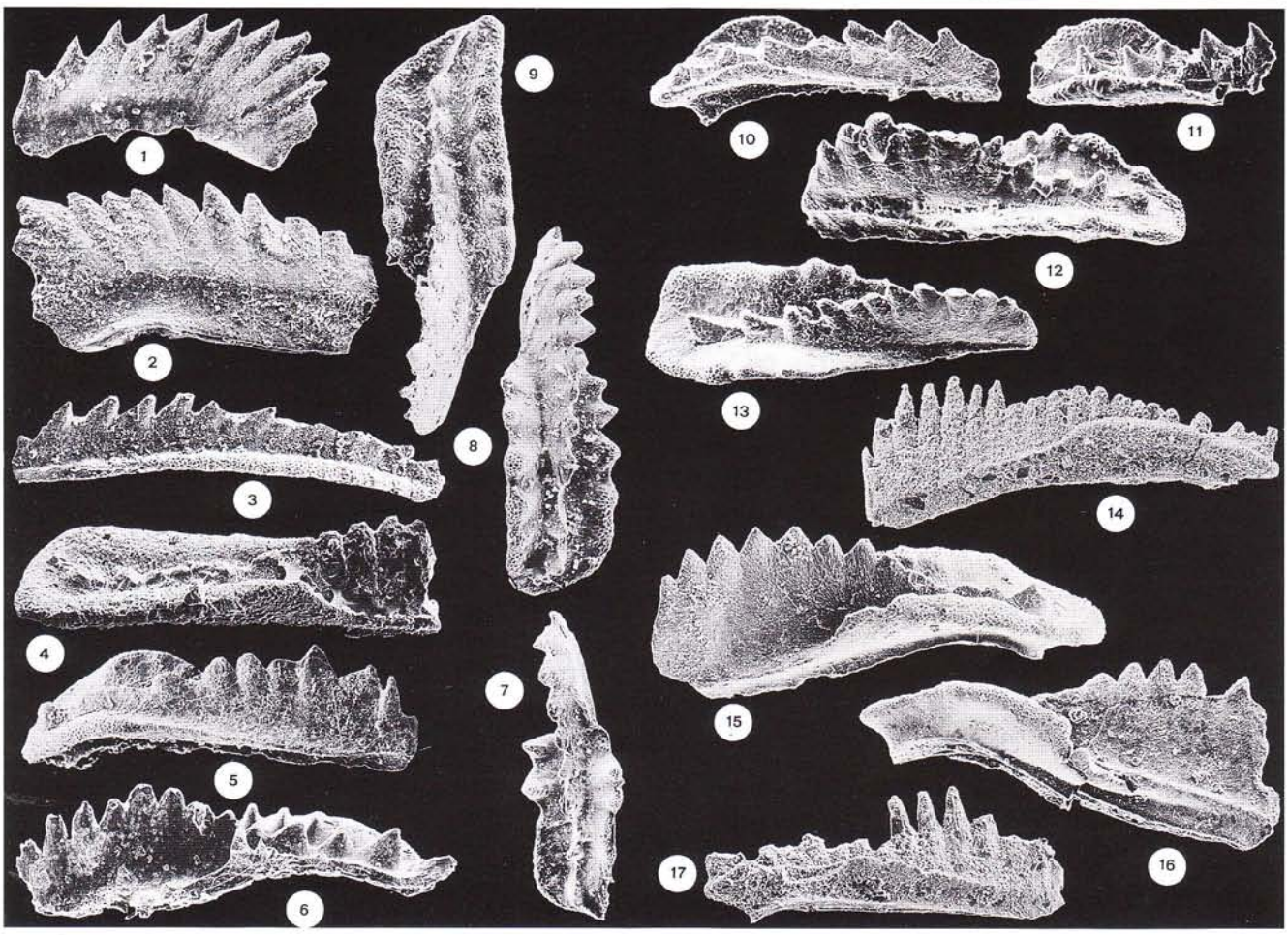
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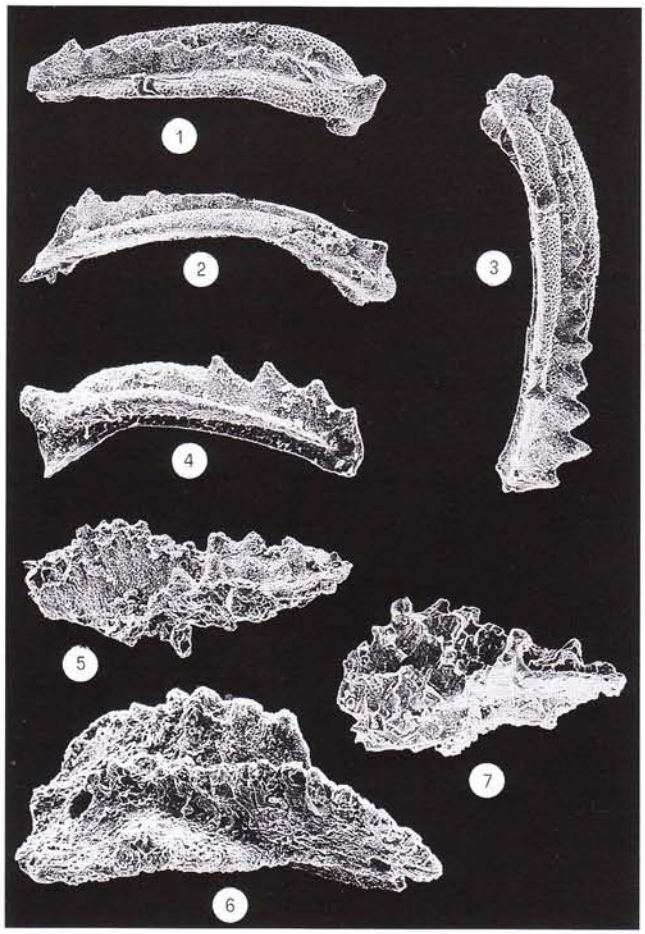

PLATE 3

Fig. 1- 3 - *Norigondolella navicula* (Huckriede), 1- lateral-upper view, x 75, 2 - lateral view, x 50, 3 - lateral-upper view, x 75. Ura e Shtrejte section, US 7, Cukali zone, Norian.
Fig. 4 - *Norigondolella steinbergensis* (Mosher), lateral view, x 100, Dushaj section, D 10, Mirdita zone, Middle to Late Norian.
Fig. 5 - *Epigondolella slovakensis* (Kozur), lateral view, x 75, Ura e Shtrejte-section, US 11, Cukali zone, late Norian.
Fig. 6 - *Metapolygnathus pseudoechinatus* (Kozur), lateral - upper view, x 100, Zbuqi section, Zb 9, Cukali zone, Norian.
Fig. 7 - *Epigondolella postera* (Kozur & Mostler), lateral view, x 100, Dushaj section, D 1, Mirdita zone, early Norian.

Conodont Association and Biostratigraphy.

A biostratigraphic scheme of the pelagic Triassic deposits in Albania, based on conodont assemblages (Kozur, 1989; Hirsch, 1994; Sudar, 1989; Budurov & Sudar, 1990), ranging from Spathian to Rhaetian has been established. From bottom to top the following assemblages are found:

1. homeri composed of *Neospathodus waageni, N. triangularis, N. homeri, N. abruptus, N. spathi, N. brochus* and *N. symmetricus,*
2. timorensis composed mainly of *Chiosella timorensis* and *Ch. gondolelloides.*
3.a. bulgarica - *Paragondolella bulgarica.*
3.b. bifurcata - *Paragondolella bifurcata, P. hanbulogi.*
3.c. cornuta - *Neogondolella cornuta, N. constricta* and *Paragondolella excelsa.*
4. kockeli - *Nicoraella kockeli, Neospathodus germanicus, N. microdus.*
5. tethydis - *Gladigondolella tethydis, Gl. carinata, Gl. budurovi malayensis.*
6. diebeli - *Budurovignathus diebeli, B. mostleri and B. mungoensis.*
7. polygnathiformis - *Paragondolella polygnathiformis, P. tadpole, P. auriformis, P. foliata foliata, N. f. inclinata.*
8. primitius - *Metapolygnathus primitius, M. communisti, Norigondolella halstattensis.*
9. abneptis - *Epigondolella abneptis, E. spatulata.*
10. postera - *Epigondolella postera, E. multidentata, Norigondolella halstattensis.*
11. steinbergensis - *Norigondolella steinbergensis, N. navicula, Epigondolella bidentata.*
12. hernsteini - *Misikella hernsteini* and *Metapolygnathus slovakensis.*

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