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NEW LADINIAN AMMONOIDS FROM MT. SVILAJA (EXTERNAL DINARIDES, CROATIA)

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Abstract. A small collection of Ladinian ammonoids from Mt. Svilaja (External Dinarides) is here described for the first time. The ammonoids were collected from a thick succession, which yielded in its lower part the classic Lower Triassic ammonoid faunas of Muć, known since the XIX century. The collection comes from an interval yielding conodonts of the *hungaricus* Assemblage zone, and is composed of leiostraca (*Proarcestes*) and trachyostraca ammonoids. The latter consists of the new genus *Alkaites*, and the new species *A. dinaricus*, *Detoniceras svilajanus* and *Argolites trinodosus*. *Alkaites* n. gen. is characterized by involute coiling, v-shaped ventral side and five spiral rows of nodes. *D. svilajanus* n. sp. is distinguished by flat ventral side, and four rows of nodes with peculiar ratio 1:1:2:2 between perimbilical,1st lateral, 2nd lateral, and ventrolateral nodes. *A. trinodosus* n. sp. is characterized from any other species of *Argolites* by three rows of nodes.

At the present the new genus *Alkaites* and the three new species are known only from the study area. The dating of the new taxa is done by indirect correlations based on the distribution of *Detoniceras* and *Argolites* in other sections of the Southern Alps, as well as on the calibration of the *hungaricus* Assemblage zone with the ammonoid standard scale. The inferred age is Gredleri Zone (Lower Ladinian).

Riassunto. Viene descritta per la prima volta una piccola collezione di ammonoidi ladinici provenienti dall'area del Monte Svilaja (Dinaridi Esterne). Gli esemplari sono stati raccolti da una potente successione triassica nota sin dal XIX secolo soprattutto per la presenza, nella sua parte inferiore, della classica fauna ad ammonoidi del Triassico inferiore di Muć. La collezione di ammonoidi proviene da un intervallo che ha fornito conodonti della Zona di associazione a *hungaricus*, ed è composta da ammonoidi leiostraca (*Proarcestes*) e trachyostraca. I trachyostraca sono nuovi per la scienza e comprendono *Alkaites* n. gen., e tre nuove specie: *A. dinaricus*, *Detoniceras svilajanus* e *Argolites trinodosus*.

Alkaites è caratterizzato da avvolgimento involuto, ventre depresso a "v" e cinque serie spirali di nodi. *D. svilajanus* n. sp. si distingue per il ventre piatto e quattro serie spirali di nodi con un rapporto molto caratteristico tra i nodi periombelicali, I laterali, II laterali e lateroventrali, pari a 1:1:2:2. *A. trinodosus* n. sp. si distingue da tutte le specie di *Argolites* per la presenza di tre serie spirali di nodi.

Poiché *Alkaites* n. gen. e le tre specie nuove sono note al momento solo nell'area del Monte Svilaja, la loro datazione è fatta sulla base di correlazioni indirette. La datazione più probabile è Zona a Grederi (Ladinico inferiore) sulla base della distribuzione di *Detoniceras* e *Argolites* nelle sezioni delle Alpi meridionali e sulla base della correlazione della Zona di associazione a *hungaricus* con la scala standard ad ammonoidi.

Introduction

The External Dinarides are a geotectonic unit mostly composed of carbonate deposits representing relics of several vertically stocked carbonate platforms of different ages, type and paleogeographic setting. The unit extends in NW-SE direction from Slovenia in the north through Croatia, Bosnia and Herzegovina to Montenegro and Albania in the south. It consists from 6000 to 8000 m of prevalent carbonate rocks with three distinguished megasequences (Velić et al. 2001, 2003): 1) Middle Permian - Upper Ladinian, 2) Upper Norian - Upper Cretaceous, and 3) Paleocene - Middle Eocene.

The first megasequence (Middle Permian - Upper Ladinian) is interesting for some Triassic historically important ammonoid faunas which were described already in the XIX Century. This megasequence is characterized by carbonate and mixed siliciclastic-carbonate deposits originated on epeiric platform along the northern Gondwana margin. The Middle and Upper Permian consists of carbonates, mostly dolostones (Tišljar et al. 1991; Aljinović et al. 2003). The Lower Triassic is characterized by mixed clastic-carbonate deposits. The Mid-

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dle Triassic is mainly represented by shallow water limestones with numerous occurrences of volcanic and volcanoclastic rocks, predominantly in the Upper Anisian and Ladinian part (Pamić 1984). The Triassic sequence is transgressively overlain by uppermost Triassic or Lower Jurassic sediments which belong to the following megasequence already.

Two groups of ammonoid faunas were reported in literature from the first megasequence of the External Dinarides: the first is Early Triassic in age, and the second is Anisian-Early Ladinian in age. Rich Early Triassic ammonoid faunas were reported mostly from the area of Muć (Mojsisovics 1882; Kittl 1903; Krystyn 1974) while Anisian-Early Ladinian ammonoids were known only from few localities and among them most are situated in a wider area of Lika (Central Croatia). More important localities are Kunovac Spring (Salopek 1914 a,b), Pribudić (Prlj & Mudrenović 1988), Donje Pazarište (Salopek 1918) and Brotinja (Sakać 1992). Middle Triassic ammonoids from the Central Dalmatia (Knin surroundings, Mt. Svilaja, Jabuka) have not been studied in detail, even if they are quoted by almost all authors who studied geology of the area (Kerner 1908; Raić et al. 1984; Jelaska et al. 2003).

In 2002 two authors (BJ, TKJ) started a project focused on the revision of the biostratigraphy of the Triassic basement of the Adriatic-Dinaric carbonate platform in Mt. Svilaja area (Fig. 1) that belongs to the Middle Permian-Upper Ladinian megasequence of the External Dinarides. As a result of the first phase of the study a conodont zonation was introduced (Jelaska et al. 2003). Seven conodont zones coverning the Lower Triassic to Upper Ladinian-?Lower Carnian were recognized. In this second contribution we describe Middle Triassic ammonoids which are new for the science.

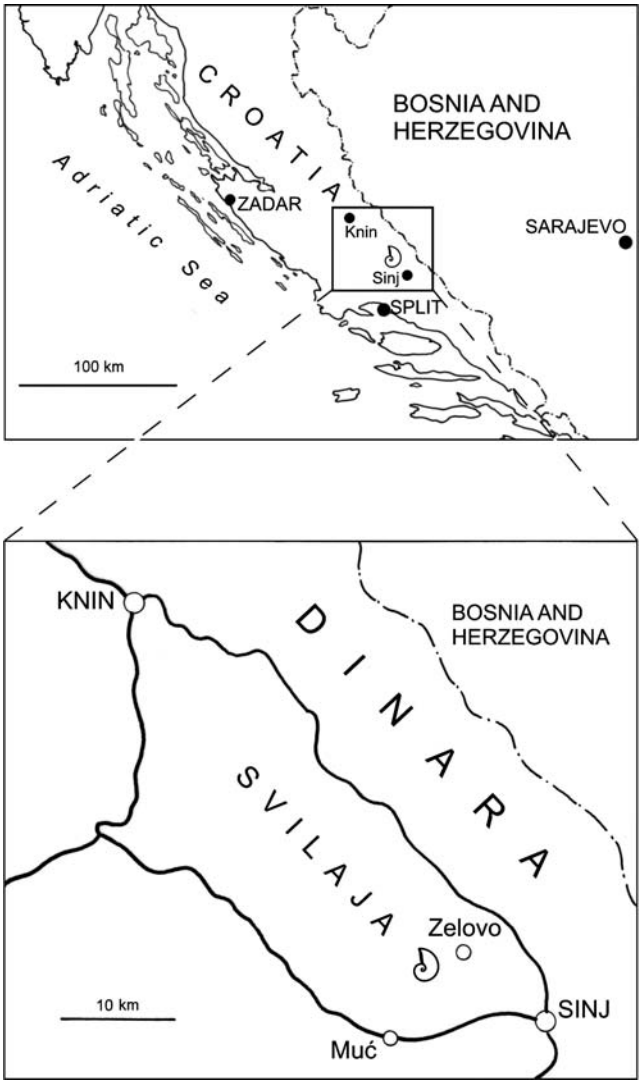


Fig. 1 - Location map of Mt. Svilaja.

Stratigraphic setting

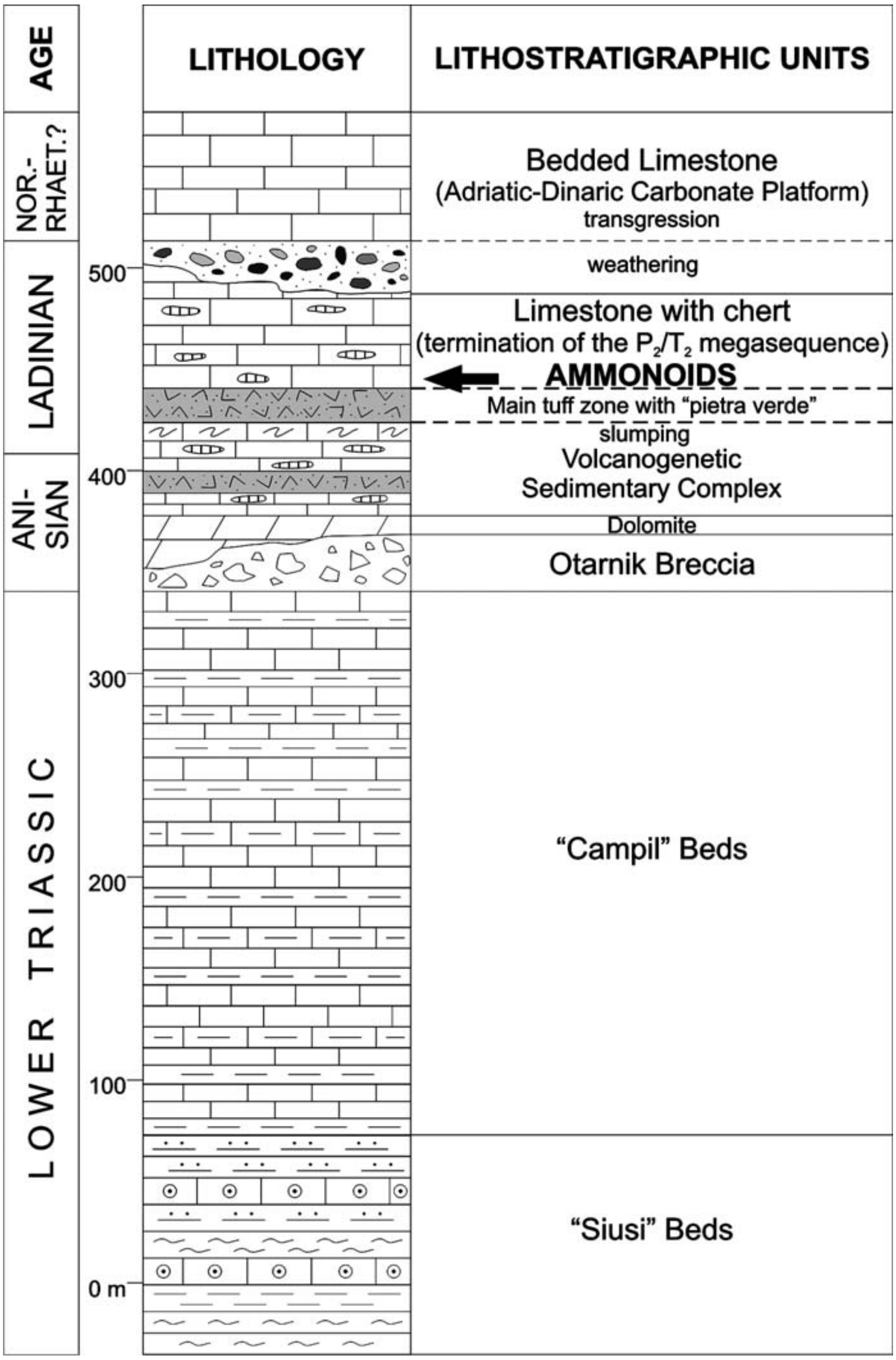
The Mt. Svilaja section, along the Mijići-Zelovo Sutinsko road, northwest of Sinj (Fig. 1; 43°42′51″ N, 16°32′8″ E WGS 84), is marked by a thick succession of Triassic rocks (Fig. 2). The succession starts with Lower Triassic shelf siliciclastics and carbonates whose lowermost part belongs to the Smithian *obliqua* Zone on the basis of conodonts (Jelaska et al. 2003). This part of the succession yields also historically important ammonoid faunas in the area of Muć (foothills of Mt. Svilaja). Lower Triassic ammonoid faunas were described firstly by Mojsisovics (1882), then by Kittl (1903). More recently the Muć area was studied also by Krystyn (1974), who recognized three ammonoid horizons from this interval.

Lower Triassic beds are unconformably overlain by the dolomitic Anisian Otarnik Breccia (Ivanović et al. 1978) which is composed of very coarse debris. The "Otarnik" intraformational carbonate breccia in a wider area laterally passes into the so-called "*Diplopora* Limestone" (or "Klimenta Limestone" according to Kerner 1916).

Mt. Svilaja area is also well known for the Middle Triassic outcrops of pyroclastic rocks. Vitrocrystalloclastic tuffs ("pietra verde") are accompanied with medium gray platy pelagic limestones with or without cherts, dolomites and marls. Limestones contain abundant bioclasts which originated from adjacent areas. The pyroclastic rocks can be interpreted as a result of rift tectonics (Pamić 1984; Jelaska 2003; Jelaska et al. 2003) and accompanying basalt magmatism (Ščavničar et al. 1984; Belak 2000; Marjanac 2000).

The main tuff zone with "pietra verde" is conformably overlain by bioclastic medium gray cherty limestones and dolomites characterized by an abun-

Fig. 2 - The Triassic succession exposed at Mt. Svilaja with the position of the ammonoid-bearing interval.



dance of calcareous algal skeletons, foraminifers, radiolarians, gastropods, bivalves, brachiopods (Jaecks et al. 2003), crinoids, serpulids, ammonoids and other fossils. This part belongs to the Ladinian conodont *hungaricus* Zone (Jelaska et al. 2003), and yields also *Diplopora annulata* (Schafhäutl) and *Teutloporella herculea* (Stoppani) (Tonći Grgasović, personal communication), two typical Ladinian dasycladacean algae (Grgasović & Sokać 2003). Ammonoids were collected in the interval from 5 to 15 metres above the main "pietra verde" bed. This interval is followed by 40-50 m of well bedded medium gray pelagic limestones with local marl laminae which are attributed to the *mungoensis* Zone (Ladinian) and *murchianus* Zone (Upper Ladinian-?Lower Carnian). These limestones represent the termination of the Middle Triassic of Mt. Svilaja and are capped by an emersion surface with karstification. The erosional surface is covered by terrigenous sediments including conglomerate as a result of Late Triassic transgression and marking the lower boundary of a new Mesozoic megasequence of the External Dinarides.

The Middle Triassic ammonoids of Mt. Svilaja

Occurrence and preservation

The ammonoids are recorded together with gastropods, bivalves, brachiopods, crinoids, corals, and al-

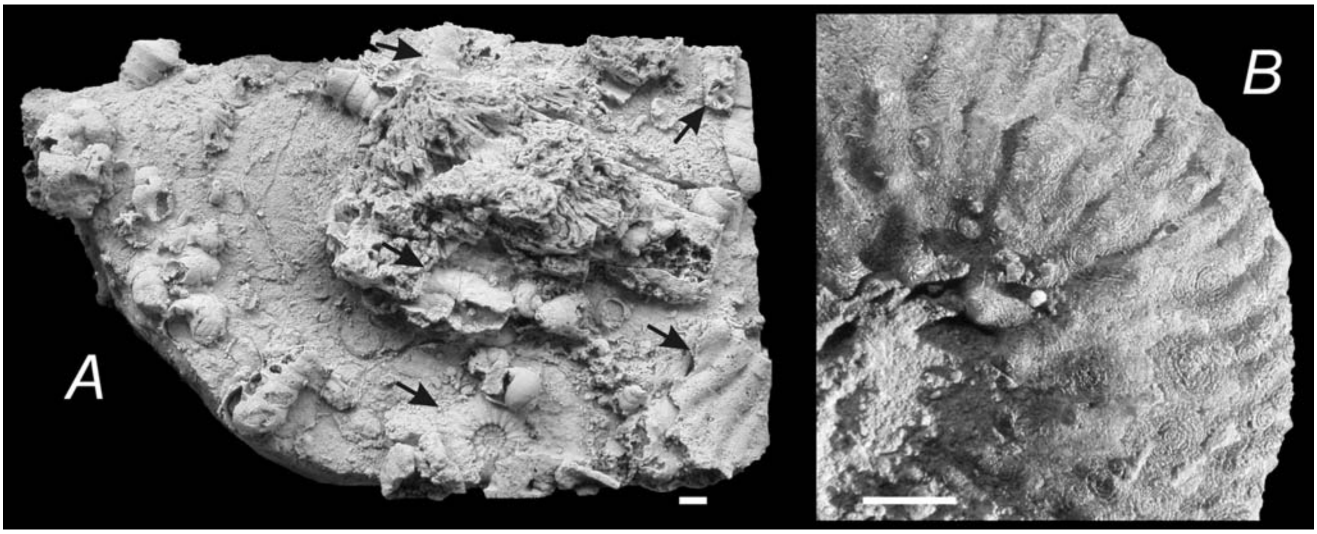


Fig. 3 - The preservation of ammonoids of the fossil-bearing interval under study. A) Sample BJ 2498, with gastropods and five ammonoids (black arrow), x0.75; B) detail of the test of the specimen BJ 2492, showing the spherulitic structure of the silica replacement, x2.5. Bar scale 0.5 cm.

gae mainly in bituminous calcarenite and occasionally calcirudite beds 5 to 15 m above the main tuff zone with "pietra verde" (Fig. 2). Most of the ammonoids were collected from blocks slightly moved from the primary beds, so they cannot be treated as true natural assemblage, but only as a "fauna" *sensu latu*.

The ammonoids show the same preservation (Fig. 3A) as the other groups. The shells were more or less completely filled by sediment, while the tests were replaced by silica. Nearly all of the specimens show the typical microstructure of the Beekite (Fig. 3B). Due to the calcareous composition of the matrix, the specimens have been extracted with acetic acid. A total number of twelve ammonoids have been prepared. The size of the specimens is very different, and the diameter of the specimens ranges from 8 to about 60 mm.

Taxonomical analysis

The classification of the specimens has been rather difficult because the studied specimens belong to or are similar to taxa poorly known and/or with complex taxonomy. One new genus and three new species are recognized: *Alkaites dinaricus* n. gen. et sp. (BJ 2492, 2503, 2504, 2581, 2582), *Detoniceras svilajanus* n. sp. (BJ 2496), *Argolites trinodosus* n. sp. (BJ 2493). *Proarcestes* sp. indet. (BJ 2495) is also identified.

The erection of monotypic taxa has been carefully pondered over. As a final result, we have taken this decision because the morphology of the specimens is so very well preserved that there are no doubts on their features. The attribution with inverted commas or with question marks of such well preserved specimens to taxa poorly known would have only added more confusion in the taxonomy of groups which are already rather complex.

Paleoecology

The ammonoid "fauna" is composed of trachyostraca (*Detoniceras*, *Alkaites* n. gen. and *Argolites*) as well as leiostraca (*Proarcestes*) ammonoids. *Detoniceras* is rather typical of shallow water carbonate platform and interplatform shallow basin environments (Manfrin & Mietto 1991; Fantini Sestini 1994; Calabrese & Balini 1995; Mietto & Manfrin 1995; Manfrin et al. 2005), while *Argolites* can be found also in open marine/deep water sediments (Epidauros, Greece: Renz 1939; Jacobshagen 1967). However, it is worth of note that in the Southern Alps the two genera frequently occur together, as in the carbonate platform of the Esino Limestone at Val Parina (Fantini Sestini 1994) and the top of the shallow water-lagoonal Cunardo Formation (Calabrese & Balini 1995).

Chronostratigraphic position of the new taxa

Alkaites dinaricus n. gen. et sp., *Detoniceras svilajanus* n. sp. and *Argolites trinodosus* n. sp. are known only from the study area where they were not collected from bed. In such a condition, obviously no biostratigraphy *sensu strictu* can be based on the new taxa. However some considerations on their chronostratigraphic significance have to be done, at least to provide the age for them.

Two procedures are tested and cross compared. A first estimate of the stratigraphic position of the new taxa is provided by the distribution of *Detoniceras* and *Argolites* in other sections. This estimate is compared with the distribution of conodonts which is already available for the Triassic succession of Mt. Svilaja (Jelaska et al. 2003). The quality of this calibration obviously relies on both the accuracy of calibration of

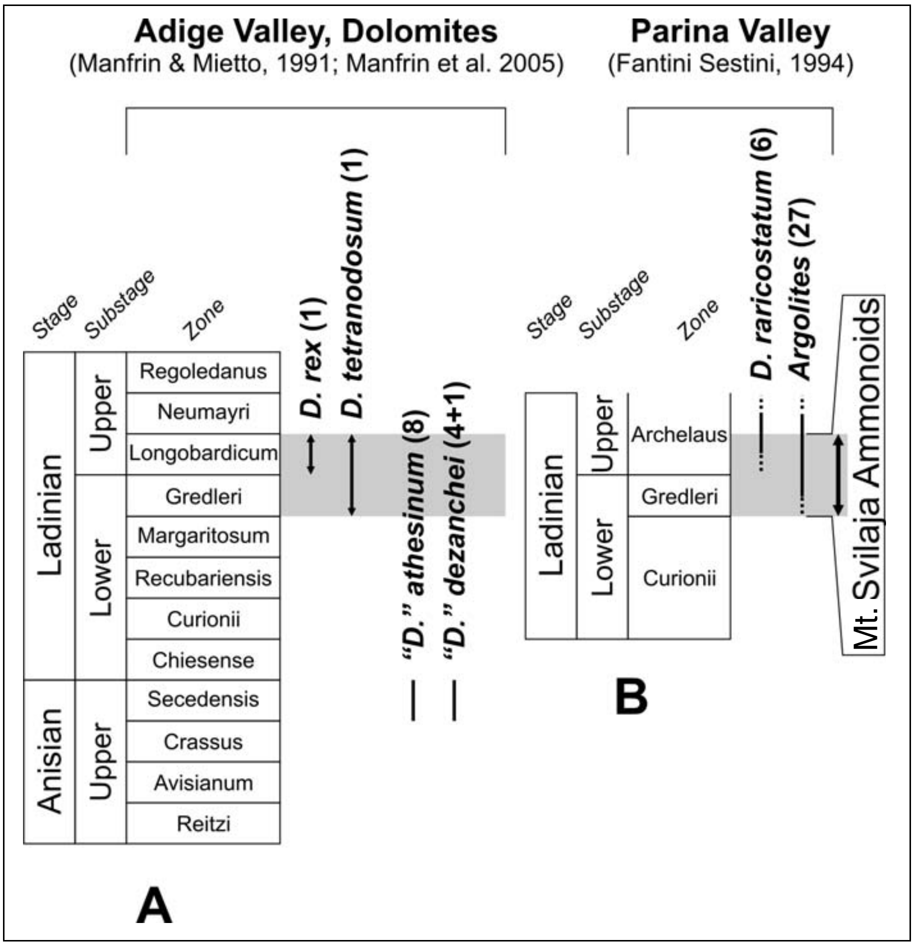


Fig. 4 - Calibration of the range of *Detoniceras* and *Argolites* in the Southern Alps. The number of specimens for each taxon is reported in brackets. Data are from Manfrin & Mietto (1991), Manfrin et al. (2005) and Fantini Sestini (1994). Chronostratigraphic remarks: A) the ammonoid zones are from Mietto & Manfrin (1995), with the update by Manfrin et al. 2005. The Mietto & Manfrin (1995) subdivisions are here treated as chronozones. The position of the Anisian/Ladinian boundary is drawn according to the GSSP recently established (Brack et al. 2005), and the boundary between Lower and Upper Ladinian is traced at the traditional position. B) the scale is from Fantini Sestini 1994.

the distribution of *Detoniceras* and *Argolites* and that of the conodont scale with the ammonoid scale. A general problem affecting the quality of Middle Triassic time-correlations is the instability of the standard scales. In particular, in the recent years, the subdivision of the Ladinian Stage into substages is interpreted in very different ways. The two main points of instability are the lower boundary of the Ladinian Stage (base of the Lower Ladinian), and the boundary between the Lower and Upper Ladinian. The problem of the base of the Ladinian has been recently stabilized with the selection of the GSSP of the Ladinan stage at the base of the Curionii Zone (Brack et al. 2005). The boundary between Lower and Upper Ladinian (Fassanian and Longobardian in the tethyan tradition) is still open. In literature it has been traced at the base of the Archelaus Zone (traditional boundary; Brack et al. 2005), or at the base of the Gredleri Zone (i.e., Krystyn 1983), or at the base of the Margaritosum (sub)Zone (i.e., Mietto & Manfrin 1995). For these reasons in the following discussion we will refer the distribution of the taxa firstly to chronozones, and only secondly to substages.

Calibration with ammonoids

The genus *Detoniceras* is up to now known only from the Southern Alps (Fig. 4) where it is rather facies controlled and restricted to faunas closely related to carbonate platform environments, which are normally poor in pelagic age-diagnostic ammonoids like *Eoprotrachyceras* and *Protrachyceras*.

Detoniceras rex Manfrin & Mietto, 1991 is known only from one specimen, found within the "Calcari della Val Vela" in Gola Valley (Trento). The age of this occurrence is Longobardicum (Sub)Zone (Mietto & Manfrin 1995) on the basis of the conodont fauna (Mietto 1982). *Detoniceras tetranodosum* (De Toni 1914) was found from neptunian dykes within the Tiarfin Platform in Valdepena (Belluno) together with ammonoids of the Gredleri to Archelaus Zone (Manfrin & Mietto 1991).

The genus *Argolites* is a little less facies controlled than *Detoniceras*, being reported from carbonate platform facies (Esino Limestone, Lombardy: Fantini Sestini 1994) as well as from pelagic ammonitico rosso facies (Epidauros, Greece: Renz 1939; Jacobshagen 1967). In both the areas the calibration of the occurrences are based on ammonoids. At Epidauros *Argolites* is referred to the Upper Ladinian (Longobardian in Jacobshagen 1967). In Parina Valley the position of *Argolites* is more well constrained, and the genus occurs in the Gredleri and Archelaus Zones (Fantini Sestini 1994). Fantini Sestini (1994) also reported in Parina Valley the co-occurrence of *Argolites* with *Detoniceras raricosta-*

tum Fantini Sestini, 1994 within the Archelaus Zone (Fig. 4; Fantini Sestini 1994: tab. 1, sites S746/1040). *Detoniceras* and *Argolites* are found together also in western Lombardy, at Mesenzana (Calabrese & Balini 1995), but in this locality the position of the two taxa lacks of any calibration.

After the analysis of the calibration of the range of the ammonoids we can come to the conclusion that the age of the Mt. Svilaja ammonoids is comprised within the Gredleri and the Archelaus Zones.

Calibration with conodonts

In the investigated section, five conodont zones (*constricta* zone, *trammeri* A. Z., *hungaricus* A. Z., *mungoensis* A. Z., *murchianus* zone) were recognized in the Middle Triassic (Jelaska et al. 2003). The ammonoid fauna here described was recovered from the level of the *hungaricus* A. Z. that was defined based on the first appearance of the nominate species. This assemblage zone consists of the name-bearing conodont element *Budurovignathus hungaricus* (Kozur & Vegh), accompanied by *Paragondolella trammeri* (Kozur) and rare specimens of *P. alpina* (Kozur & Mostler) group.

In the External Dinarides, the *hungaricus* A. Z. has been hitherto documented in western Slovenia (Kolar-Jurkovšek 1990) but its stratigraphic range has not been calibrated with ammonoids due to inadequate material.

At Epidauros, Greece, (Krystyn 1983) the position of the *hungaricus* A. Z. is slightly different. The first occurrence of *B. hungaricus* is already at the base of the Curionii Zone, while its last occurrence is in the topmost part of the Archelaus Zone. Being the first occurrence of *B. mungoensis* located in the upper part of the Gredleri Zone, the scope of the *hungaricus* A. Z. is restricted to the Curionii and Gredleri zones.

Conclusion

The ammonoid distribution suggests a possible age comprised between the Gredleri and the Archelaus Zone for the new taxa. However on the basis of the conodont data the Archelaus Zone should have to be excluded. If the boundary between Lower and Upper Ladinian is located at the traditional position between the Gredleri and Archelaus/Meginae zones, the age of the new taxa is late Early Ladinian.

Systematic paleontology

All the measurements, except for SGR, are in mm. D = diameter; H = max. whorl height in D; h = min. whorl height in D; U = umbilical width in D; W = whorl width in H; SGR = ((H-h)/h)x100.

Repository of the specimens: Paleontological Collection Jurkovšek, Kamnica 27, Dol pri Ljubljani, Slovenia, affiliated to the Natural History Museum of Slovenia, Ljubljana. Acronym is BJ.

Family Ceratitidae Mojsisovics, 1879

Subfamily Nevaditinae Tozer, 1994

Genus *Detoniceras* Manfrin & Mietto, 1991

Type-species: *Detoniceras rex* Manfrin & Mietto, 1991

Preliminary remarks. The subfamily Nevaditinae was defined by Tozer (1994, p. 124) in order to group some genera with intermediate features between the subfamily Paraceratitinae and the family Trachyceratidae. The typical features of the subfamily were described by Tozer as the smooth and flat or very slightly depressed venter, the external tuberculation, and the ceratitic suture line with three saddles. Tozer suggested that the Nevaditinae could represent a link between the Paraceratitinae and the Trachyceratidae, however it is worth of note that no phylogenetic analyses have been carried out so far on the Nevaditinae, so that the classification of this subfamily is purely morphologic. In such a general framework, *Detoniceras* Manfrin & Mietto, 1991 is here attributed to this subfamily, on account of morphologic features as the tabulate to slightly depressed venter and the external nodes (Manfrin & Mietto 1991, p. 126).

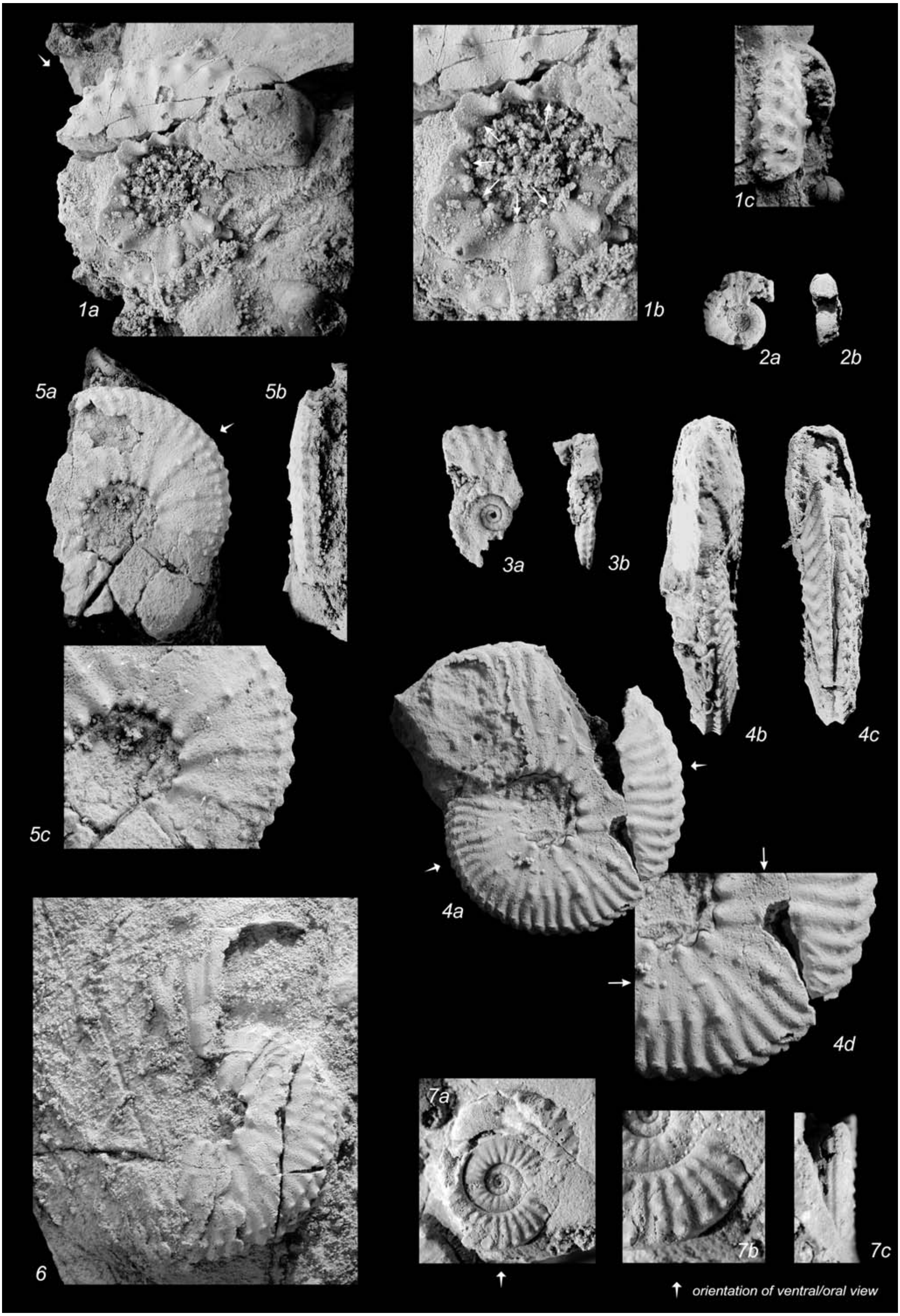
PLATE 1

Fig. 1 - *Detoniceras svilajanus* n. sp., holotype (BJ 2496), a) lateral view, x1; b) detail of the umbilical area with the position of the weak primary ribs marked with arrows, x1.5; c) ventral view, x1.

Figs. 2a-b, 3a-b, 4a-d, 5a-b, 6 - *Alkaites* n. gen. *dinaricus* n. sp. Fig. 2 - Specimen BJ 2581: a) lateral view, b) ventral view, x2. Fig. 3 - Specimen BJ 2582, a) lateral view, b) ventral view, x1.5. Fig. 4 - Holotype (BJ 2492): a) lateral view, x1, b) oral view, x1, c) ventral view, x1, d) detail of the ornamentation of the lateral side with the position of the first row of lateral nodes indicated with arrows, x1.5. Fig. 5 - Paratype (BJ 2503): a) lateral view, x1, b) ventral view, x1, c) detail of the lateral side, with 1st lateral nodes marked with arrows, x1.5. Fig. 6 - Paratype (BJ 2504), partly embedded in matrix, x1.

Fig. 7 - *Argolites trinodosus* n. sp., holotype (BJ 2493): a) lateral view, x1, b) detail of the lateral view showing the difference between the ornamentation of the inner whorls with respect to the outer whorl, x2, c) ventral view, x1.

All the specimens are whitened with Ammonium Chloride, except for Fig. 7.


1a
1b
1c
2a
2b
5a
5b
3a
3b
4b
4c
5c
4a
4d
6
7a
7b
7c
orientation of ventral/oral view

Detoniceras svilajanus n. sp.

Pl. 1, fig. 1a-c

Type series. Holotype: specimen BJ 2496 (Pl. 1, fig. 1).

Derivatio nominis. From Mount Svilaja (Croatia).

Stratum typicum and locus typicus. Bioclastic cherty limestones, Mt. Svilaja section, Croatia.

Diagnosis. Slightly involute *Detoniceras* with flat ventral side. Ornamentation with very weak ribbing and with four rows of nodes in periumbilical, 1st lateral, 2nd lateral and ventrolateral position. Ratio between the nodes of the four rows is 1:1:2:2 (periumbilical/1st lateral/2nd lateral/ventrolateral nodes). Ribbing characterised by two types of primary ribs, both starting at the periumbilical margin. The first type of ribs starts with a periumbilical node and bears also one 1st lateral node, as well as one 2nd lateral and one ventrolateral node. The second type of primary ribs is intercalated between the ribs of the first type. They bear only two nodes, in 2nd lateral and ventrolateral position.

Description

The specimen is about 45 mm in diameter, but it is not complete (Pl. 1, fig. 1a-b). Part of the shell is collapsed, and both the umbilical area and part of the ventral side of the first half of the last whorl are covered by silicified remains. The rest of the shell, in particular the last quarter of the outer whorl, is very well preserved.

The coiling is slightly involute. Whorl section semielliptical, with maximum thickness at about ½ of whorl height. The lateral sides are rather convex, while the ventral side is flat (Pl. 1, fig. 1c).

Ornamentation consisting of four rows of nodes and of radial ribs. The general pattern of ornamentation is dominated by nodes, which are arranged in periumbilical, 1st lateral, 2nd lateral and ventrolateral position. The periumbilical nodes (about 6 in the last half whorl) are rounded and spiny. The 1st lateral row is located at about ½ of whorl height and consists of true strong and well developed spines. The number of these spines in half whorl (6) is exactly the same as the number of the periumbilical nodes. The 2nd lateral row is located a little outside of whorl height, and consists of spiny nodes very slightly elongated in spiral direction. The spacing of the nodes of the 2nd lateral row, is half of the spacing of periumbilical and 1st lateral nodes. As a consequence, the number of the 2nd lateral nodes in half whorl is two times the number of the periumbilical and 1st lateral nodes. Ventrolateral nodes are more elongated in spiral direction than the 2nd lateral nodes and look like flat. Their number and spacing is exactly the same as for the 2nd lateral nodes. The ventrolateral nodes occupies alternating positions on the two sides of the flat ventral side.

The ribs are very weak and can be subdivided into three types: primary, weak primary and intercalatory/bifurcate. Primary ribs (about 6 in half whorl) start at the periumbilical node and then continue to the 1st lateral spine (Pl. 1, fig. 1a-b). Outside the 1st lateral spine the primary ribs becomes weaker. They are almost straight until the 2nd lateral nodes, then they slightly bend forward and then end at the ventrolateral node.

The second type of ribs (weak primary) is visible especially on the first quarter of the whorl (white arrow on Pl. 1, fig. 1b). These very weak ribs start at the periumbilical margin without any nodes. They bear only one 2nd lateral and one ventrolateral node. The third type of ribs (intercalatory/bifurcate) starts at about ½ of whorl height. It consists of so weak ribs that normally it is not clear weather they are true intercalatory ribs or weather they bifurcate from a primary rib at the 1st lateral spine. In any case they bear only one 2nd lateral and one ventrolateral node.

The suture line is not exposed.

Discussion

The attribution of the specimen to *Detoniceras* Manfrin & Mietto, 1991 is mostly based on the flat ventral side, but it is also supported by the four rows of nodes as well as by the spirally flattened ventrolateral nodes. Within the genus *Detoniceras*, great similarities can be found with *D. rex* Manfrin & Mietto, 1991 (type of the genus), because of the morphology of the ventral side and the involute coiling, while the other species of the genus look more different. The coiling of *D. tetranodosum* (De Toni, 1914), *D. ? athesinum* Manfrin & Mietto, 1991, and *D. ? dezanchei* Manfrin & Mietto, 1991 is more evolute. Moreover *D. ? athesinum* Manfrin & Mietto, 1991, and *D. ? dezanchei* Manfrin & Mietto, 1991 show a depressed and v-shaped ventral side.

The separation of the single specimen at hand from *Detoniceras rex*, and the following erection of *D. svilajanus* n. sp. require explanations because also *D. rex* is a monotypic species. No information on the population variability of *D. rex* is available, but after the direct comparison of the specimen from Mt. Svilaja with the holotype of *D. rex* we come to the conclusion that the differences between the two specimens cannot be explained by intraspecific variability.

The main differences between *D. rex* and *D. svilajanus* n. sp. are the ribbing and the distribution of nodes. The ribs are strongly sculptured in *D. rex*, while they are very weak in *D. svilajanus* n. sp. The position of 2nd lateral nodes is also closer to the ventrolateral nodes in *D. rex* than in *D. svilajanus* n. sp. The lateral side is more inflated in *D. svilajanus* n. sp. than in *D. rex*. However, the most important difference in support of the separation of the two species is the organisation of the primary ribs, which also influences the ratio between periumbilical nodes and 1st lateral spines. The ratio is 1:1 in *D. svilajanus*, while it is about 1:1.5 in *D. rex* (i.e., in *D. rex* the number of 1st lateral nodes is 50% greater than the number of periumbilical nodes). This different ratio is related to a different pattern of the primary ribs. In *D. rex* all the primary ribs bear four nodes, but often two primary ribs start from the same periumbilical node. This organization increases the number of 1st lateral nodes with respect to the number of periumbilical nodes. In *D. svilajanus* the ratio periumbilical/1st lateral nodes is 1:1 because there is only one primary ribs for each umbilical node, and each of these ribs also bears one 1st lateral node. The weak primary ribs are intercalated to the first type of primary ribs, but they do not influence the number of periumbilical and 1st lateral nodes, because they bear only two nodes in 2nd lateral and ventrolateral position.

Chronostratigraphic position. Probably Gredleri Zone, uppermost Lower Ladinian. See "Chronostratigraphic position of new taxa" for details.

Genus *Alkaites* gen. n.

Type-species: *Alkaites dinaricus* n. sp.

Derivatio nominis. From Alka and the suffix -ites (masculine). The Alka is a famous historic tournament which is held every year in Sinj, to celebrate the defeat of Turkish of August 1715.

Diagnosis. Involute and compressed Ceratitids with depressed and v-shaped ventral side. Ornamentation with very dense and wavy ribs and with five rows of nodes. The nodes are in located in periumbilical, 1st lateral, 2nd lateral, 3rd lateral and ventrolateral position. The number of 1st and 2nd lateral nodes is almost equivalent to the number of periumbilical nodes, while the 3rd lateral and ventrolateral nodes are 3.4-3.8 time the number of the periumbilical ones.

Composition of the genus. *Alkaites dinaricus* n. sp.

Discussion

Alkaites gen. n. is attributed to the subfamily Nevaditinae Tozer 1994 on account of merely morphologic reasons such as the depressed v-shaped ventral side and the pattern of ornamentation. Within the subfamily Nevaditinae the genera which are more similar to *Alkaites* n. gen. are (in decreasing order) *Detoniceras* Manfrin & Mietto, 1991, *Chieseiceras* Brack & Rieber, 1986 and *Paranevadites* Tozer, 1994.

Alkaites gen. n. shows a pattern of ornamentation that is similar to *Detoniceras sensu stricto* (*D. rex* Manfrin & Mietto, 1991 and *D. tetranodosum* [De Toni, 1914]). The coiling is also similar to *Detoniceras s.s.*, in particular to *D. rex*. However *Alkaites* n. gen. is definitely separated from *Detoniceras s. s.* because the venter of the latter is flat instead of depressed and v-shaped. A depressed venter can be found in *D. ? athesinum* Manfrin & Mietto, 1991 and *D. ? dezanchei* Manfrin & Mietto, 1991, which were attributed with doubt to *Detoniceras* by Manfrin & Mietto (1991; Manfrin et al. 2005), but in these species the coiling is evolute instead of involute. In *D.? dezanchei* there are five rows of nodes, however the distribution of nodes in the different rows (ratios 1:1.5:2:2:2) follows, the same pattern of *D. rex*, as the number of 1st lateral nodes is about 1.5 time the number of periumbilical nodes, while the number of nodes in the outermost rows is two times the number of periumbilical nodes.

The depressed ventral side of *Alkaites* n. gen. suggests a comparison also with *Chieseiceras* Brack & Rieber, 1986. However no one of the six taxa that are attributed to *Chieseiceras* (Brack & Rieber 1986; Fantini Sestini 1994) show lateral nodes. *Paranevadites* Tozer, 1994 shows four rows of nodes, however its ventral side is flat. Moreover the ventrolateral an ventral nodes of *Paranevadites* are clavate, while they are slightly spirally flattened in *Alkaites* n. gen.

Remarks on the composition of the genus

Some species showing some morphological similarities with *Alkaites* are the above mentioned *Detoniceras? athesinum* Manfrin & Mietto, 1991 and *D. ? dezanchei* Manfrin & Mietto, 1991 as well as *D. raricostatum* Fantini Sestini, 1994. *D. raricostatum* shows a ventral side (Fantini Sestini, 1994, pl. 8, fig. 9-10) that seems to be close to v-shaped but it has only four rows of nodes instead of five. Moreover this species shows verly slow growing coiling and less compressed whorl section. These species known from very few specimens and from scattered localities, so that the possibility that they could be related to *Alkaites*, cannot be tested with the scarce material available. It is worth noting that the stratigraphic distribution of these species is disjoint (Fig. 4). *Detoniceras ? athesinum* Manfrin & Mietto, 1991 and *D. ? dezanchei* Manfrin & Mietto, 1991 are known from the Serpianenis (Sub)Zone (Mietto & Manfrin 1995), while *D. raricostatum* Fantini Sestini, 1994 is recorded in the Archelaus Zone (Fantini Sestini 1994).

Chronostratigraphic position. Probably Gredleri Zone, uppermost Lower Ladinian. See "Chronostratigraphic position of new taxa" for details.

Alkaites dinaricus n. sp.

Pl. 1, fig. 2a-b, 3a-b, 4a-d, 5a-b, 6

Type series. Holotype: specimen BJ 2492 (Pl. 1, fig. 4a-d). Two paratypes: BJ 2503 and BJ 2504. Specimens attributed to the species, but excluded from the type series: BJ 2581, BJ 2582.

Derivatio nominis. From the type area.

Stratum typicum and locus typicus. Bioclastic cherty limestones, Mt. Svilaja section, Croatia.

Diagnosis. As the genus is at the present monotypic, no specific feature is selected as peculiar for the species.

Description

The coiling is involute (U/D= 0.23) with SGR about 29.5%. at 58 mm of D. The whorl section is strongly compressed (H/W 1.95 at 58.75 mm of D); the maximum width is located at the position of the

2nd lateral node. The ventral side is narrow, depressed and v-shaped (Pl. 1, fig. 4b-c, 5b). The depression of the venter becomes weaker in the final part of the last whorl (specimen BJ 2492: Pl. 1, fig. 4c).

The ornamentation consists of ribs and five spiral rows of nodes. Ribs are dense and gentle, so that in cross section the surface of the lateral side looks like wavy. The ribs are rectiradiate to slightly prorsiradiate, with very weakly sinuous-falcoid course. Rib type is primary, intercalatory and bifurcate.

The nodes are arranged in five rows (Pl. 1, fig. 4a, 4d, 5a, 5c). In addition to periumbilical and ventrolateral nodes there are three rows in lateral position. With respect to the height of the whorl, the 1st lateral row is located at about 28-32%; the 2nd row at about 52-54% and the 3rd row at about 84-89%. The nodes in periumbilical, 2nd lateral and ventrolateral position are much stronger than the nodes of the 1st and 3rd lateral rows (Pl. 1, fig. 4d, 5c). The different rows show peculiar distribution of nodes. Usually the number of nodes of the 1st and 2nd lateral rows is equivalent or just a little higher than the number of periumbical nodes, while the number of 3rd lateral and of ventrolateral nodes is much higher.

The specimen BJ 2503 (Pl. 1, fig. 5a, 5c) shows in 140° 5 periumbilical nodes, accompanied by 5 1st lateral, 5 2nd lateral, 17 3rd lateral and 17 ventrolateral nodes (ratios: 1:1:1:3.4:3.4). A rather similar distribution is shown by specimen BJ 2504 (Pl. 1, fig. 6). At about 45 mm of D in 180° the numbers of nodes are: 6 periumbilical, undefined 1st lateral, 6-7 2nd lateral, 22-23 3rd lateral, and 22-23 ventrolateral nodes, equivalent to ratios 1:nv:1-1.1:3.8:3.8. The holotype BJ 2492 shows locally an increasing in the frequency of nodes. At 45 mm of D, and only for a quarter of whorl, it shows 7 perimbilical nodes, then 8-9, 10, 26, 26, corresponding to ratios 1:1.14-1.28:1.42:3.7:3.7 (Pl. 1, fig. 4d).

The distribution of ribs with respect to the nodes is also peculiar. The primary ribs start from the periumbilical nodes, and usually there is only one primary rib for each periumbilical node (Pl. 1, fig. 4d, 5c). Each primary rib bears one very weak 1st lateral and one well developed and rounded 2nd lateral node. Intercalatory ribs start between the periumbilical and 2nd lateral node, but sometimes they also may start just outside of the row of the 2nd lateral nodes. Normally they never bear any 1st or 2nd lateral node (Pl. 1, fig 5a, 5c), however occasionally a very few of them bear one 1st lateral and/ or one 2nd lateral node (Pl. 1, fig. 4d). The branching point of the bifurcate ribs is the 2nd lateral node. All the ribs bear one 3rd lateral and one ventrolateral node. They great number of 3rd lateral and ventrolateral nodes is due to the frequency of secondary ribs *vs* primary ribs. On average, there are 2-3 secondary ribs between two primary ribs.

The suture line is not visible.

Inner whorls

Two very small specimens (BJ 2581and BJ 2582: PL. 1, fig. 2, 3) are attributed to the new species, but excluded from the type-series, then they are described separately from the type-specimens. These small specimens show evolute coiling with low SGR and subcircular to suboval whorl section up to 5-6 mm of D. In this early stage of growth the ornamentation consists only of very weak ribs. At about 6-7mm of D there SGR increases, together with the appearance of ventrolateral nodes and of periumbilical swellings.

Dimensions:

Specimen	D	H	h	U	W	H/W	U/D	SGR (%)
BJ 2492 (Holotype)	58.75	25.45	19.65	13.65	~13.0	~1.95	0.23	29.5

Discussion

Alkaites dinaricus n. sp. is so peculiar that it is difficult to find similar species to compare with. The distribution of nodes on the innermost with respect to the outernmost rows are in some respects similar with *Detoniceras svilajanus* n. sp. In both the species one or two of the innermost lateral rows of nodes show the same frequence than the nodes in periumbilical position. In the former species the ratio is 1:1:1:3.4-3.8:3.4-3.8, while in the latter is 1:1:2:2.

Chronostratigraphic position. As for the genus.

Family Trachyceratidae Haug, 1894

Subfamily Arpaditinae Hyatt, 1900

Genus *Argolites* Renz, 1939 emend. Fantini Sestini, 1994

Type-species: *Arpadites mojsisovicsi* De Lorenzo, 1896

Argolites trinodosus n. sp.

Pl. 1, fig. 7a-b

Type series. Holotype: specimen BJ 2493 (Pl. 1, fig. 7a-b).

Derivatio nominis. From *trinodosus*, *-a*, *-um*. The name points out the most typical feature of the species.

Stratum typicum and locus typicus. Bioclastic cherty limestones, Mt. Svilaja section, Croatia.

Diagnosis. *Argolites* with primary ribs and three rows of nodes in periumbilical, lateral and ventrolateral position.

Description

Coiling very evolute (U 46% of D at D= 31.6mm), with very slow spiral growth rate (SGR= 19.48) and without any umbilical egression. Subrectangular whorl section, with vertical umbilical wall and almost parallel lateral sides. Rounded periumbilical and ventrolateral margins. The umbilical seam is located on the external part of the lateral side, very close to the shoulder. Ventral side with two low and smooth keels separated by a sulcus (Pl. 1, fig. 7b). Sulcus and keels show the same width.

The ornamentation changes from the inner to the outer whorls (Pl. 1, fig. 7a). On the outer whorl there are ribs and three rows of nodes. The ribs are primary (about 12-13 in half whorl) with rectiradiate to slightly prorsiradiate direction and straight to slightly concave course. Each rib bears three nodes in periumbilical, lateral and ventrolateral position. Lateral nodes are located at about ½ of whorl height.

The inner whorls show simplified ornamentation with primary ribs and one row of periumbilical swellings. Rib direction is rectiradiate to slightly prorsiradiate and the course is straight to slightly convex. The periumbilical swellings become true rounded nodes in the second half of the last but one whorl. The lateral nodes appear together with the change of the periumbilical swellings. The third row of nodes, in ventrolateral position is for sure present on the outer whorl, where they become gradually stronger.

The suture line is not visible.

Dimensions:

Specimen	D	H	h	U	W	U/D	SGR
BJ 2493 (Holotype)	31.6	9.2	7. 7	14.7	-	0.46	19.48

Discussion

The specimen at hand is referred to *Argolites* Renz, 1939 emend. Fantini Sestini (1994, p. 264-265), because of the evolute coiling, combined with the two keels on the ventral side and the well developed ventrolateral nodes. It differs, however, from all of the species of *Argolites*. The species which is more similar to *A. trinodosus* n. sp. is *A. paronai* (Mariani,1902). The main features shared by the two taxa are the almost straight and well spaced ribs. However, *A. paronai* shows only two rows of nodes in umbilical and ventrolateral position, while *A. trinodosus* n. sp. bears also a third row of nodes in lateral position.

The other species of *Argolites* show more strong differences. *Argolites mojsisovicsi* (De Lorenzo, 1896) has two rows of nodes as *A. paronai*, but its nodes are much stronger and more rounded. *Argolites arpaditoides* (Mojsisovics, 1882) shows only one row of nodes, in ventrolateral position. *Argolites fortis* Fantini Sestini, 1994 and *Argolites celtitoides* (Airaghi, 1902) do not have any row of nodes. *Argolites arietiformis* (De Toni, 1914) looks like to have 4 keels on the ventral side, probably because of the serration of the ventrolateral termination of the ribs. *Argolites* spp. A and B of Fantini Sestini (1994) have crenulated keels.

Chronostratigraphic position. Probably Gredleri Zone, uppermost Lower Ladinian. See "Chronostratigraphic position of new taxa" for details.

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REFERENCES

Aljinović D., Sremac J. & Ibrahimpašić H. (2003) - Permian and Lower Triassic Facies of Velebit Mt. and the Gorski Kotar Region (NW Part of External Dinarides). In: Vlahović. I. & Tišljar, J. (eds) - Evolution of Depositional Environments from the Palaeogene to the Quaternary in the Karst Dinarides and the Pannonian Basin. 22nd IAS Meeting of Sedimentology, Opatija - September 17-19, 2003, *Field Trip Guidebook:* 185-207, Zagreb.

Belak M. (2000) - Postaja 2: profil Sutina - Zelovo Sutinsko. Kristaloklastični i vitroklastični tufovi (pietra verde) s proslojcima silificiranih dolomita, vapnenca, tufita, rožnjaka. In: Jelaska V. et al. - Geološka povijest i strukturna evolucija Vanjskih Dinarida. 2. hrv. geol. kongres, Cavtat- Dubrovnik, May 17-20, 2000, *Vodić ekskurzija,* A-1: 1-12, Zagreb.

Brack P. & Rieber H. (1986) - Stratigraphy and Ammonoids of the lower Buchenstein Beds of the Brescian Prealps and Giudicarie and their significance for the Anisian/ Ladinian boundary. *Ecl. geol. Helv.*, 79 (1): 181-225, Basel.

Brack P. & Rieber H. (1993) - Towards a better definition of the Anisian/Ladinian boundary: New biostratigraphic data and correlations of boundary sections from the Southern Alps. *Ecl. geol. Helv.*, 86 (2): 415-527, Basel.

Brack P., Rieber, H., Nicora A. & Mundil R. (2005) - The Global boundary Stratotype Section and Point (GSSP) of the Ladinian Stage (Middle Triassic) at Bagolino (Southern Alps, Northern Italy) and its implication for the Triassic time scale. *Episodes*, 28: 233-244, Beijing.

Calabrese L. & Balini M. (1995) - The discovery of ammonoids in the Cunardo Formation (Varese). A chronostratigraphic interpretation. *Riv. It. Paleont. Strat.*, 101 (3): 367-370, Milano.

Fantini Sestini N. (1994) - The Ladinian ammonoids from Calcare di Esino of Val Parina (Bergamasc Alps, Northern Italy). Pt. 1. *Riv. It. Paleont. Strat.*, 100 (2): 227-284, Milano.

Grgasović T. & Sokač (2003) - Review on fossil dasycladacean associations in the Triassic of Croatia. In: Yuan Xunlai & Mu Xinan (eds): Fossil Algae and Stromatolites. *Acta Micropaleont. Sin.*, 20/1: 75-79, Nanjing.

Ivanovic A., Sikirica V. & Sakać K. (1978) - Tumac Osnovne geološke karte SFRJ, list Drniš M 1:100.000. *Savezni geol. zavod*, 1-59, Beograd.

Jacobshagen V. (1967) - Cephalopoden-Stratigraphie der Hallstätterkalke aus Asklepieion von Epidauros (Argolis, Griechenland). *Geologica et Paleontologica*, 1: 13-33, Marburg.

Jaecks G.S., Leighton L.R., Kolar-Jurkovšek T., Jurkovšek B. & Jelaska V. (2003) - Phylogenetic analysis of a likely productide from the Triassic, and the implications for survival through the Permo-Triassic extinction. *Geological Society of America,* 2003 Seattle Annual Meeting, Abstracts with Program, 66-1: 230, Seattle.

Jelaska V. (2003) - Carbonate Platforms of the External Dinarides. In: Jelaska V., Gušic I., Cvetko Tešovic B., Buckovic D., Bencek Đ., Fucek L., Oštric N. & Korbar, T. - Field Trip A2. Initiation, Evolution and Disintegration of the Mesozoic Carbonate Platform, Central Dalmatia. *Field Trip Guidebook,* 22nd Meeting of Sedimentology, 67-71, Opatija.

Jelaska V., Kolar-Jurkovšek T., Jurkovšek B. & Gušic I. (2003) - Triassic beds in the basement of the Adriatic-Dinaric carbonate platform of Mt. Svilaja (Croatia). *Geologija,* 46/2: 225-230, Ljubljana.

Kerner F. (1908) - Die Trias am Südrande der Svilaja-planina. *Verh. Geol. R.-A.*, 12: 259-289, Wien.

Kerner F. (1916) - Erläuterungen zur Geologischen Karte Sinj-Split. *Verlag Geol. R.-A.,*116 p., Wien.

Kittl E. (1903) - Die Cephalopoden der oberen Werfener Schichten von Muć in Dalmatien. - *Abhandl. Geol. Reichsanst.* 20/1: 1-77, Wien.

Kolar-Jurkovšek T. (1990) - Mikrofavna srednjega in zgornjega triasa Slovenije in njen biostratigrafski pomen (Microfauna of the Middle- and Upper Triassic of Slovenia and its biostratigraphic significance). *Geologija*, 33: 21-170, Ljubljana.

Krystyn L. (1974) - Die Tirolites Fauna (Ammonoidea) der untertriassischen Werfener Schichten Europas und ihre stratigraphische Bedeutung. *Sitzungsb. Osterr. Akad. Wiss., Mathem.-naturws. Kl.*, Abt. I., 183/1-3: 29-50, Wien.

Krystyn L. (1983) - Das Epidauros-Profil (Griechenland) - ein Beitrag zur Conodonten-Standardzonierung des tethyalen Ladin und Unterkarn. In: H. Zapfe (ed.) - Das Forschungsproject "Triassic on Tethys Realm" (IGCP Project 4). *Schr. Erdwiss. Komm., Österr. Akad. Wiss.*, 5: 231-258, Wien.

Manfrin S. & Mietto P. (1991) - *Detoniceras* nuovo genere di ammonoidi triassici dedicato ad Antonio De Toni, nel centenario della sua nascita. *Mem. Sc. Geologiche*, 43: 125-135, Padova.

Manfrin S., Mietto P. & Preto N. (2005) - Ammonoid biostratigraphy of the Middle Triassic Latemar platform (Dolomites, Italy) and its correlation with Nevada and Canada. *Geobios*, 38: 477-504, Kidlington.

Marjanac T. (2000) - Triassic of Dalmatia - Evidence of a failed rift (Muc section). PANCARDI 2000, *Vjesti Hrvat. geol. dr.,* 37/2: 117-126, Zagreb.

Mietto P. (1982) - A Ladinian conodont-cluster of *Metapolygnathus mungoensis* (Diebel) from Trento area (NE Italy). *N. Jb. Geol. Paläont. Mh.*, 1982 (10): 600-606, Stuttgart.

Mietto P. & Manfrin S. (1995) - A high resolution Middle Triassic ammonoid standard scale in the Tethys Realm. A preliminary report. *Bull. Soc. Geol. France*, 166 (5): 539-563, Paris.

Mojsisovics E.v. (1882) - Die Cephalopoden der mediterranen Triasprovinz. *Abh. k. k. Geol. Reichsanst.*, 10: 1-322, Wien.

Pamić J. (1984) - Triassic magmatism of the Dinarides in Yugoslavia. *Tectonophysics*, 109: 273-307, Kidlington.

Prlj N. & Mudrenović V. (1988) - Srednjotrijaski amoniti iz podrucja Pribudica (Middle Triassic ammonites from Pribudic, South Croatia, Yugoslavia). *Geol. vjesnik* 41: 15-24, Zagreb.

Raić V., Papeš J., Sikirica V. & Magaš N. (1984) - Tolmac za list Sinj. Osnovna geološka karta SFRJ 1:100.000. / Explanation of Sheet Sinj. Basic Geological Map of SFR Yugoslavia 1:100.000. Savezni geološki zavod: 49 pp., Beograd.

Renz C. (1939) - Nachträge zu den tieftriadischen Cephalopodenfaunen der Argolis. *Prakt. Akad. Athenes*, 14: 235-255, Athens.

Sakać K. (1992) - *Discoptychites oenensis* n. sp. and the accompanying ammonite fauna from Anisian deposits in Brotinja, Lika, Central Croatia. *Natura Croatica* 1: 27-40, Zagreb.

Salopek M. (1914a) - Trijadicka fauna kod Kunovac vrela u Lici (Die triadische Fauna von Kunovac vrelo in der Lika). *Vjesti Geol. povjerenstva* 3-4: 185-186, Zagreb.

Salopek M. (1914b) - O naslagama o okamninama kod Kunovac-vrela u Lici / On the sediments with fossils near the Kunovac spring in Lika. *Prirodoslovna istraivanja Jugosl. akad. znan. umjet.* 4: 1-24, Zagreb.

Salopek M. (1918) - O ladinickim škriljavcima kod Donjeg Pazarišta (Über ladinische Schifer bei Donje Pazarište). *Prirodoslovna istraivanja Jugosl. akad. znan. umjet.* 13: 1-20, Zagreb.

Ščavnićar B., Šušnjara A. & Prohic E. (1984) - The Geologic Column of the Lower Triassic in the Zmijavac Valley (Muć, Southern Croatia). - In: Babic, L. & Jelaska, V. (eds) - Contribution to Sedimentology of Some Carbonate and Clastic Units of the Coastal Dinarides. 4th

IAS Regional Meeting, 1984 Split, *Excursion Guide - book*: 87-97, Zagreb.

Tišljar J., Vlahović I., Sremac J., Velić I., Veseli V. & Stankovic D. (1991) - Excursion A - Velebit Mt., Permian - Jurassic. In: Velić, I. & Vlahović, I. (eds) - Some Aspects of the Shallow Water Sedimentation on the Adriatic Carbonate Platform (Permian -Eocene). Excursion Guide-book of the Second International Symposium on the Adriatic Carbonate Platform, May 1991, Zadar, 1-50, Zagreb.

Tozer E.T. (1994) - Canadian Triassic ammonoid faunas. *Geol. Surv. Canada Bull.* 467: 663 p., Ottawa.

Velić I., Vlahović, I., Dragicević, I. & Matičec, D. (2001) - Jadranska karbonatna platforma od srednjega perma do srednjega eocena - paleogeografski pregled / Adriatic Carbonate Platform from the Middle Permian to the Middle Eocene - a Palaeogeographic Overview. - In: Dragicević, I. & Velić, I. (eds) - 1. znan. skup Karbonatna platforma ili karbonatne platforme Dinarida. *Knjiga saetaka* / 1st Scientific Meeting Carbonate Platform or Carbonate Platforms of Dinarids, October 1 -2, 2001, Zagreb, *Abstracts*: 22, Zagreb.

Velić I., Tišljar J., Vlahović I., Matičec D. & Bergant S. (2003) - Evolution of the Istraian Part of the Adriatic Carbonate Platform from the Middle Jurassic to the Santonian and Formation of the Flysch During the Eocene: Main Events and Regional Comparison. - In: Vlahović I. & Tišljar, J. (eds) - Evolution of Depositional Environments from the Palaeogene to the Quaternary in the Karst Dinarides and the Pannonian Basin. 22nd IAS Meeting of Sedimentology, Opatija - September 17-19, 2003, *Field Trip Guidebook:* 3-17, Zagreb.