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The Karst Dinarides are Composed of Relics of a Single Mesozoic Platform: Facts and Consequences

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Abstract

Croatian geological literature during the mid nineteen-eighties and nineties was marked by the appearance of a new geotectonic concept of the Dinarides proposing that the recent, very complex structural setting is a direct consequence of a specific palaeogeographic relationship during the Mesozoic, i.e. the proposed existence of two carbonate platforms separated by a long-lasting deep marine area (interplatform trough).

Although the idea was very interesting and provoked discussion, resulting in the questioning of formerly established concepts, detailed analysis of available data indicate that the Karst Dinarides (External Dinarides) were formed by the destruction of a single, although morphologically considerably variable shallow water carbonate platform. This platform was in some periods very dynamic because of its palaeogeographic position during the Mesozoic, resulting in many periods of large-scale facies differentiation, especially during the Late Cretaceous. The final disintegration of the platform area culminated in the formation of flysch trough(s) in the latest Cretaceous and Palaeogene and the subsequent uplift of the Dinarides. Recently there have been some misunderstandings resulting from the imprecise use of newly established terms, which are, by circular logic, used to connect recent geotectonic relationships with Mesozoic palaeogeography without adequate material proof. Therefore, the terms Dinaricum and Adriaticum should be redefined and used only for description of the recent tectonic pattern, without implying a palaeogeographic component, since during the Mesozoic they represented a single entity.

Additional confusion is added by different names used for the same shallow water carbonate platform. Probably the best, although not the ideal name is the most frequently used one: the Adriatic Carbonate Platform. Its duration may be estimated from the Late Lias to the Late Cretaceous, representing the most important part of a thick carbonate succession in the Karst Dinarides (ranging from Carboniferous to Eocene).

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1. INTRODUCTION

During the last two decades, a new concept appeared in the literature proposing the existence of two Mesozoic carbonate platforms – Dinaric and Adriatic, separated by a deeper area – labile interplatform belt Epiadriaticum (HERAK, 1986, 1989, 1991, 1993), which has unformally divided the Croatian geological community into three groups. Two relatively small groups of Croatian and foreign researchers are directly involved in this problem and therefore have definite opinions, either supporting the idea of the existence of two platforms separated by a deeper basin during the Mesozoic (Fig. 1a – e.g. D'ARGENIO et al., 1971; HERAK, 1986, 1989, 1991, 1993; RADOIČIĆ, 1989a, b; CATI et al., 1989; DROBNE & TRUTIN, 1997; BLAŠKOVIĆ, 2001), or opposing this concept, i.e. proclaiming that during the Mesozoic this area represented a single, but more or less differentiated platform (Fig. 1b – POLŠAK, 1965b, 1981; JELASKA, 1973; TIŠLJAR, 1983, 2001; BUSER, 1989; VELIĆ et al., 1989, 2002b; DERCOURT et al., 1993; GUŠIĆ & JELASKA, 1993; GRANDIĆ et al., 1997, 1999; PAMIĆ et al., 1998, etc.), although frequently described under different names. The third group is the largest, comprising geologists who are not directly involved in this discussion. However, some of them use the proposed terms without adequate consideration.

Namely, although at first glance the problem of the existence of one or two carbonate platforms during the Mesozoic seems like an exclusively scientific question, interesting only for a relatively small number of specialists, the practical meaning of the chosen concept is extremely important, not only for the regional geological framework, but also for study of the hydrogeology, engineering-geology and petroleum geology of the entire area.

The aim of this paper is therefore to highlight the basic differences of the opposed concepts and analyse available material data on which they are founded. Additionally, we will comment on the reasons for the significant dynamics of this carbonate body during the Mesozoic, but we will also briefly discuss its duration and different names, suggesting which, in our opinion, is the best.

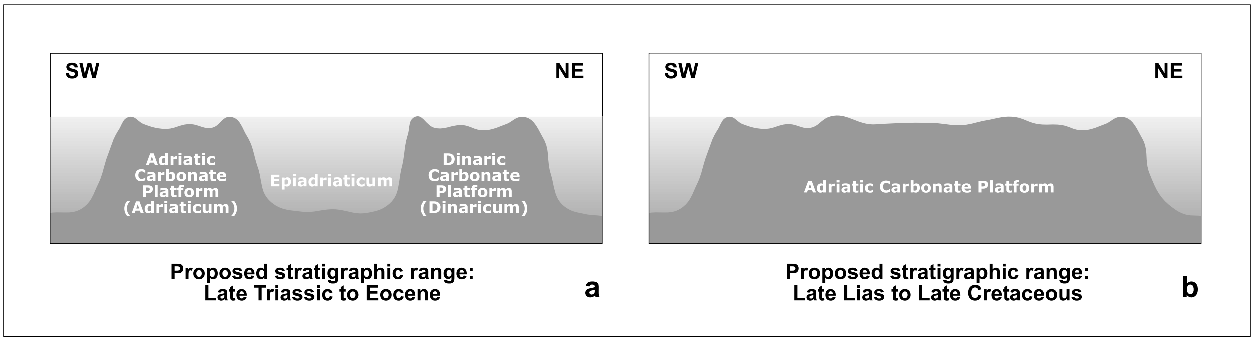

Fig. 1 Differences between a concept proposing the existence of two carbonate platforms (Adriatic and Dinaric) separated by a deep-marine realm (a), and the existence of a single Adriatic Carbonate Platform (b) during the Mesozoic. Note shorter stratigraphic range proposed in this paper for (b) – see section 4.

Our goal is to present the material in a very straightforward way, enabling a wider audience to understand the fundamental differences between the proposed concepts and to become aware of the importance of the different concepts in the interpretation of the general geology of the area.

2. ANALYSIS OF AVAILABLE DATA SUPPORTING THE EXISTENCE OF TWO PLATFORMS

The proposed concept of the existence of two Mesozoic carbonate platforms practically means that from the Late Triassic to the Eocene (HERAK, 1986, 1989, 1991, 1993) two individual carbonate platforms should have existed: the Adriatic (geodynamic synonime Adriaticum) and Dinaric (geodynamic synonime Dinaricum), separated by a long-lasting palaeogeographically deeper area, the interplatform trough Epiadriaticum (Fig. 1a), all on the same basement, i.e. Adria Microplate (DEWEY et al., 1973) or Apulian Promontory (RICOU et al., 1986; DERCOURT et al., 1993). In the original papers, the similarity of the stratigraphic successions on both supposed platforms was explained by their relative proximity, i.e. the possibility of communication across a deeper area. The Recent structural pattern of the Karst Dinarides (External Dinarides), according to this concept, represents a consequence of collision and shallow subduction of the Adriaticum below Dinaricum, while deposits of a supposed labile trough (Epiadriaticum) were mostly consumed during this process.

The Recent tectonic pattern of the Dinarides is quite complex, where the geodynamic complex of Adriaticum would generally correspond to the *Dalmatian zone* of AUBOUIN (1960) or to the *Adriaticum* of SIKOŠEK & MEDWENITSCH (1965) and the Dinaricum to the *High Karst Zone* of KOSSMAT (1924) or *High Dinaricum* of SIKOŠEK & MEDWENITSCH (1965), which are separated by major faults.

The concept of HERAK (1986, 1989, 1991, 1993) refreshed an interest for a regional interpretation of the origin of the Dinarides, especially of its strong mobilistic component, and therefore provoked significant scientific discussion. Probably the key issue in this concept is an attempt to connect the original Mesozoic palaeogeography with the regional geotectonic pattern of the Dinarides which were formed by later destruction of the carbonate producing area, i.e. to undertake a multidisciplinary endeavour to connect the scope of interest of sedimentologists and palaeontologists dealing with Mesozoic rocks with that of structural and regional geologists dealing with the recent structural pattern of the area.

However, the key question for the critical analysis of the proposed concept is the validity of evidence for the continuous existence of a labile interplatform belt – Epiadriaticum – the main prerequisite for the existence of two individual platforms is this deeper area separating them, i.e. without this area there are no separate platforms.

This supposed deeper marine succession of the Epiadriaticum should have a stratigraphic range from the Late Triassic to the Eocene. In the original papers (HERAK, 1986, 1989, 1991, 1993) only some relatively small outcrops of Kimmeridgian limestones (so-called "Lemeš deposits" and correlative "limestones with cherts and ammonites") and Palaeogene flysch deposits were designated as deposits of supposed Epiadriaticum in the area between Budva and the Slovenian troughs, and the rest is considered to be consumed under a regional nappe system. This means that from the entire supposed deep marine sequence, which, according to the International Stratigraphic Chart (ICS, 2000), should have lasted almost 190 MY, only 4 small outcrops of Kimmeridgian and 15 outcrops of Palaeogene deposits are preserved, representing only 11 MY, or less than 6% of the time for sediment deposition. Other mentioned outcrops belong to the marginal areas, and were influenced by the neighbouring open Tethyan realm. In other words, for more than 94% of the duration of the supposed deep marine trough within the Karst Dinarides there is no material record.

Additionally, there are several other issues raising doubt on this concept. Even if we accept the possibility that the most of the deposits of the supposed deeper marine trough were consumed during the subduction processes no traces of such rocks were documented in numerous wells drilled in the area of the Dinarides during the last few decades.

Furthermore, such a long-lasting deeper marine area would probably have been surrounded by specific marginal facies along the platform rims, e.g. reefs, sand bars and material transported down the slopes, whether as debrites or turbidites. However, within the Karst Dinarides there are no outcrops of deposits of this type (excluding Kimmeridgian deposits surrounding a short-lasting intraplatform trough formed by synsedimentary tectonics – VELIĆ et al., 1994, 2002a, or Upper Cretaceous deposits, when the platform area was already significantly differentiated – JELASKA et al., 2000; VELIĆ et al., 2002b). There are no records of such deposits in numerous wells drilled in the area, and there are even no elements indicating such deposits on seismic profiles (where such specific facies within well-bedded platform carbonates would be very recognisable).

Additionally, supposed consummation of practically all deposits of the deeper-marine trough undoubtedly indicates large-scale horizontal movements within the Dinarides, i.e. nappe structures, although recent structural investigations clearly indicate the predominance of relatively steep reverse faults (e.g. Ćićarija Mt., Velebit Mt., Biokovo Mt., etc.). From the structural point of view there is also a question of the possibility of having more or less circular outcrops of the aforementioned rocks, as presented in original papers, in the area characterised by strong collisional tectonics and clear linear orientation of structures.

Each of the aforementioned open questions, and especially when taken together, cast doubt on the possibility of the existence of a deeper marine area during such a long period, and in this way the possibility of the existence of two separate carbonate platforms.

However, even if we would be able to find appropriate answers to these previous questions there is an additional, crucial one: whether the limited proposed deeper marine, i.e. intraplatform trough deposits (which are found in only 19 small outcrops, representing less than 6% of the complete duration of the supposed trough) could be undoubtedly attributed to this environment? Such a supposed interplatform trough should be, by definition, characterised by continuous deeper marine deposition from the Late Triassic to the Eocene. Consequently, the main attribute of each sequence originating from this area has to be its continuous deeper marine succession, even if it is tectonized.

VELIĆ et al. (1994, 2002a) and BUCKOVIĆ (1995) studied sequences of Kimmeridgian limestones with chert and ammonites proposed as Epiadriaticum deposits in the original papers (HERAK, 1986, 1989, 1991). All the studied sequences are characterised by shallower marine underlying and overlying deposits, completely excluding the proposed origin – limestones with cherts and (very rare) ammonites were deposited within short-lasting intraplatform troughs (probable pull-apart basins) formed by synsedimentary tectonics, and which were gradually infilled by the progradation of perireefal material from its margins (Fig. 2).

A similar situation occurs with Palaeogene outcrops proposed as Epiadriaticum deposits – all deeper marine flysch deposits overlie shallow water Foraminiferal limestones which are transgressive over Cretaceous deposits of variable age. Therefore, palaeogeographical variety during the Palaeogene, when opposite coasts of the same flysch basin were characterised by different deposits and biota (e.g. DROBNE & TRUTIN, 1997) has nothing to do with the palaeogeographic relationships during the Mesozoic – it is the consequence of significant tectonic control, i.e. the final disintegration of the former platform area resulting in formation of the Dinaridic mountain chain. Furthermore, in the area where despite complex tectonics, the overlying sequence of deposits exists it is characterised by a clear regressive succession, from deep marine to shallow marine, coastal and alluvial deposits (so-called Promina deposits).

All the aforementioned arguments undoubtedly indicate that up to now there is an inadequate amount of material evidence to support the proposed concept of the existence of two platforms separated by a deep marine area from the Late Triassic to the Eocene. Therefore this concept, until supported by new evidence, can only be treated as hypothetical. We can conclude that the present day Karst Dinarides were formed by deformation of a single, but more or less differentiated Mesozoic platform – commonly referred to as the Adriatic Carbonate Platform (discussion on the name of the platform is given below), and that this mountain chain can be geotectonically subdivided into several geotectonic units.

From the palaeogeographic point of view it is clear that the area of the platform was a very dynamic entity, both concerning its general shape (irregular outer margins and incised deeper trough in its NW part and Budva–Cukali trough in its SE part – Fig. 3) and very variable lateral and vertical alternation of platform facies. Especially interesting is the fact that from the moment of its isolation in the Late Lias to its demise in the Late Cretaceous (discussed later) there were practically no periods when the entire platform was covered by the sea, i.e. without long-lasting terrestrial areas (i.e. islands) to a greater or lesser extent over the platform (TIŠLJAR et al., 2002).

Although the proposed terms Adriaticum and Dinaricum might be very attractive for a mere description of the recent structural pattern of the Dinarides (and are often used in this sense, without much consideration, as handy synonyms for the Adriatic Zone and High Karst

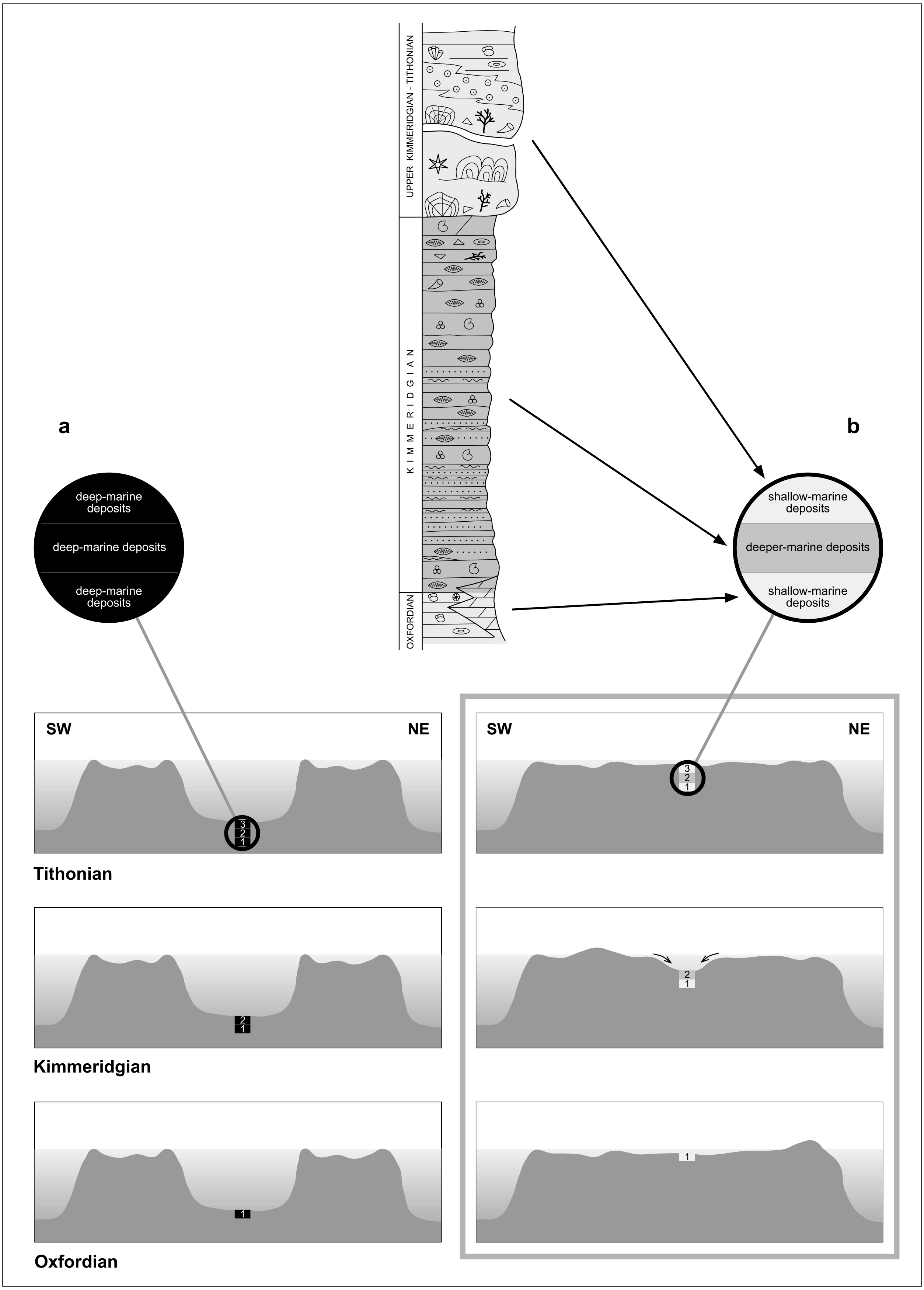

Fig. 2 A different interpretation of Kimmeridgian deposits: in the case of the existence of two carbonate platforms separated by a deep marine interplatform trough (a) all deposits of this deep basin should be of deep-marine origin (i.e. Oxfordian, Kimmeridgian and Tithonian deposits should be deep-marine). However, Kimmeridgian deposits of the Gorski Kotar area (upper part of the figure) indicate a different succession (b): shallow-marine Oxfordian deposits are overlain by deeper-marine (not very deep) Kimmeridgian deposits, i.e. limestone with chert deposited within the intraplatform trough, and this environment was gradually infilled by progradation of bioclastic material from its margins – Tithonian deposits are again of typical shallow-marine origin (for details see VELIĆ et al., 2002a).

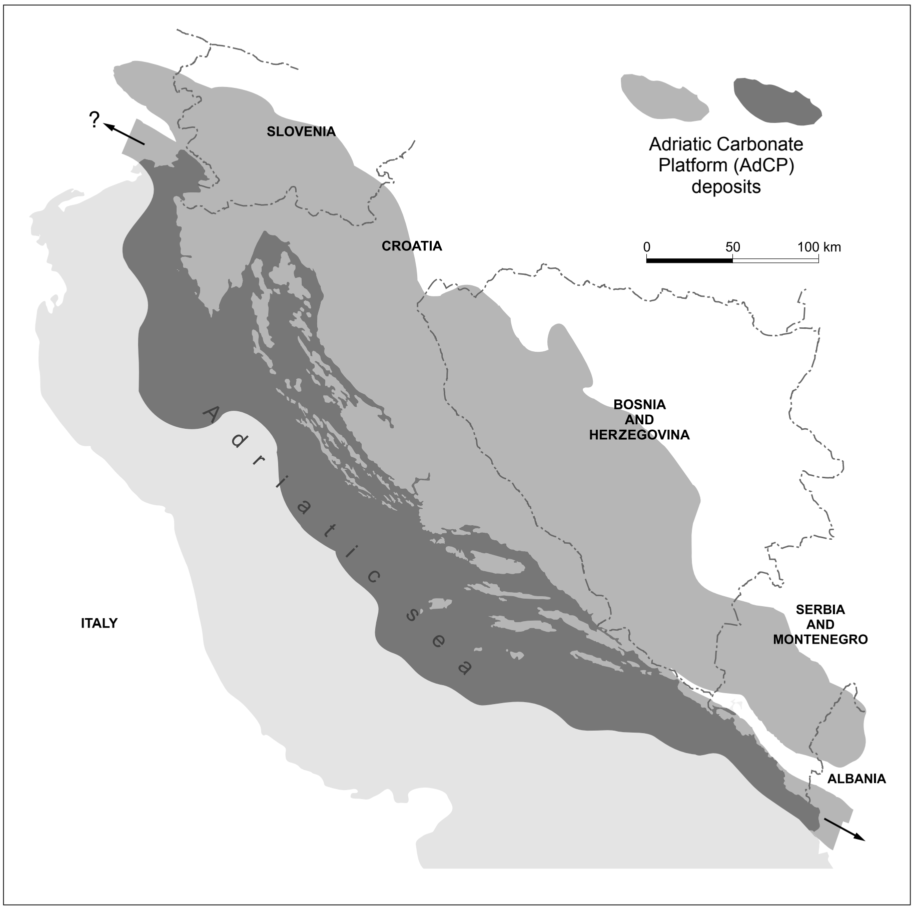

Fig. 3 The Recent distribution of Adriatic Carbonate Platform deposits on the mainland (grey) and under the Adriatic Sea (dark grey) – SW platform boundary after GRANDIĆ et al. (1999), NE after VELIĆ et al. (2002b). The area was compressed significantly during the Tertiary tectonic phase resulting in the uplift of the Dinarides. Also, note that despite the post-sedimentary tectonic deformation there is a continuous transition of the Adriatic Carbonate Platform towards the southeast (into Albania, Greece and Turkey) and probably towards the northwest (Italy).

Zone, respectively, which would correspond to their original definition by SIKOŠEK & MEDWENITSCH, 1965) they should not be used in this way before their careful and complete redefinition or clear notification. Namely, their definition in a palaeogeographic sense, i.e. as Mesozoic palaeogeographic entities (HERAK, 1986, 1989, 1991) undoubtedly indicates their palaeogeographic origin as two individual platforms separated by a deeper marine realm, and their recent structural position therefore represents only a secondary characteristic. Therefore, the authors have to be completely aware that even by using these terms only for description of the recent geotectonic setting they are inevitably indirectly indicating the existence of two different carbonate platforms during the Mesozoic.

3. DEPOSITIONAL DYNAMICS OF THE PLATFORM

One of the major characteristics of deposition in the area of the present day Karst Dinarides was the significant dynamics caused by palaeogeographic position on the mobile Adria Microplate. This mobility resulted in some periods of the platform history with important changes in its physiography, i.e. synsedimentary tectonic deformation has from time to time completely changed the large-scale facies distribution and architecture of this huge carbonate body, which was additionally eustatically controlled.

Some of the most dynamic periods in the geological history of the Karst Dinarides were:

– Middle Triassic, when the Adria Microplate separated from Gondwana (STAMPFLI & MOSAR, 1999);

– Late Lias, when a deep-marine trough connecting the Ionian and Belluno Basins opened, resulting in the disintegration of the huge platform formed on the Adria Microplate foundation, and formation of the isolated Adriatic, Apulian and Apenninic Carbonate Platforms (e.g. BERNOULLI, 1971; JELASKA, 1973; ZAPPATERRA, 1990, 1994; GRANDIĆ et al., 1999);

– Kimmeridgian, when completely different environments were established in the inner part of the platform (VELIĆ et al., 1994; TIŠLJAR et al., 1994), from transgression over emerged areas and formation of deeper intraplatform areas to emergence and formation of bauxite deposits (e.g. POLŠAK, 1965b; NATEVIĆ & PETROVIĆ, 1967; VUJISIĆ, 1972; VRHOVČIĆ et al., 1983; PAPEŠ, 1985; MIRKOVIĆ & MIRKOVIĆ, 1987; VELIĆ & TIŠLJAR, 1988; DOZET & MIŠIČ, 1997; MATIČEC et al., 2001, VLAHOVIĆ et al., 2001);

– Late Cretaceous, when significant differentiation of facies, which in some places had already begun in the Early Cretaceous (MATIČEC et al., 1996), culminated in the establishment of laterally completely different successions (e.g. GUŠIĆ & JELASKA, 1990, 1993; VLAHOVIĆ et al., 1994; TIŠLJAR et al., 1998, 2001; KORBAR et al., 2001; VELIĆ et al., 2002b, etc.) and disintegration of the platform resulting in a complete emersion of variable duration (e.g. JELASKA et al., 1994; ĆOSOVIĆ et al., 1994; MATIČEC et al., 1996);
– Tertiary, when continued deformation resulted in the formation of the flysch basin (mainly Palaeocene and Eocene) and the final collision in the area of the former carbonate platform (mainly Oligocene–Miocene), causing uplift of the Dinaridic mountain chain and formation of the recent geotectonic pattern (LAWRENCE et al., 1995).

One of the arguments for the supposed existence of two Mesozoic platforms separated by a deep-marine area was the recent structural pattern composed of two large-scale structural elements, usually referred to as the Adriatic Zone and High Karst Zone. Therefore, a question arises as to how this structure could have been formed within a single platform area? The answer is connected with the geological history of the area: as previously mentioned, the Late Cretaceous and Palaeogene periods were marked by the gradual disintegration of the platform, and formation of a labile belt, i.e. the flysch basin (or even several more or less parallel basins – DRAGIČEVIĆ & VELIĆ, 1994, 2002; VELIĆ et al., 2002b). Continuation of strong compression of the area resulted in the formation of reversed structures and uplift of the hinterland, and in some places with the formation of nappe structures. Steep planes of reverse faults (commonly more than 70º) were probably the consequence of inverse tectonics, i.e. reactivation of inherited structures – lineaments from the platform foundation. However, the recent structural pattern of Dinarides is very complex, and the main structural discontinuities are not only located on the boundaries between the large-scale structural units of the Adriatic Zone (or Adriaticum in Herak's concept) and the High Karst Zone (or Dinaricum in Herak's concept), but also within them (e.g. the Una–Knin–Drniš–Sinj–Jabuka–Buško blato tectonic line in the hinterland, where Upper Permian and Upper Eocene/Oligocene rocks are in direct contact). This requires additional tectonic interpretation which is beyond the scope of this paper, which deals primarily with the palaeogeographical aspect of the Karst Dinarides area.

Therefore, we could conclude the following succession of main events in the evolution of the Karst Dinarides area:

1) deposition of mixed carbonate–clastic sediments on an epeiric carbonate platform along the northern Gondwana margin during the Palaeozoic and Early Triassic.
2) an initiation phase characterised by the formation of steep faults in the basement and separation of the Adria Microplate (Midle Triassic);
3) a platform phase (from Late Triassic to Late Lias as a huge united platform on the Adria Microplate basement, from the Late Lias as an isolated Adriatic Carbonate Platform) with temporary synsedimentary deformation which were reinforced towards the end of the Cretaceous;
4) a disintegration phase characterised by the establishment of flysch basin(s) from the Late Cretaceous, and especially in the Palaeogene (Middle to Late Eocene);
5) tectonic contraction of the platform area resulting in the uplift of the Dinarides (Oligocene–Miocene).

4. STRATIGRAPHIC SPAN OF THE PLATFORM

The other important but complex issue needing significant reconsideration is the question of the stratigraphic span of the Adriatic Carbonate Platform.

During its evolution this huge carbonate body passed through different phases as a consequence of the previously mentioned significant dynamics caused by its palaeogeographic position. However, only one part although the significant one, of the entire carbonate sequence which is today incorporated into the Karst Dinarides (External Dinarides), can be attributed to the isolated Adriatic Carbonate Platform.

The first significant carbonate deposition documented in the area of the Karst Dinarides was of Permian age (occurrences of Carboniferous carbonates are very restricted), when a thick sequence of limestones and dolomites in lateral and vertical alternation with clastic deposits and evaporites was deposited in central Dalmatia, Bosnia and Lika (ŠUŠNJARA et al., 1992; TIŠLJAR, 1992) in the form of an *epeiric carbonate platform* of the northern Gondwana margin (Fig. 4a). During the Early Triassic, siliciclastic environments prevailed, while in the Middle Triassic carbonate facies with locally significant volcanoclastic influence were deposited. It is supposed that this was a period of separation of the Adria Microplate from the Gondwana (STAMPFLI & MOSAR, 1999), based on these regionally important occurrences and mainly clastic deposition in the Carnian.

This event might be interpreted as the beginning of the existence of the isolated, intraoceanic carbonate platform, since the area was no more under the influence of the continental environments (Fig. 4b). However, the Late Triassic succession of the so-called Main Dolomite (*Hauptdolomit*, *Dolomia Principale*) and Dachstein limestones represents a regional event characteristic for the very wide region of Central and Eastern Europe. Undoubtedly during this period the studied area represented only a part of a larger shallow water

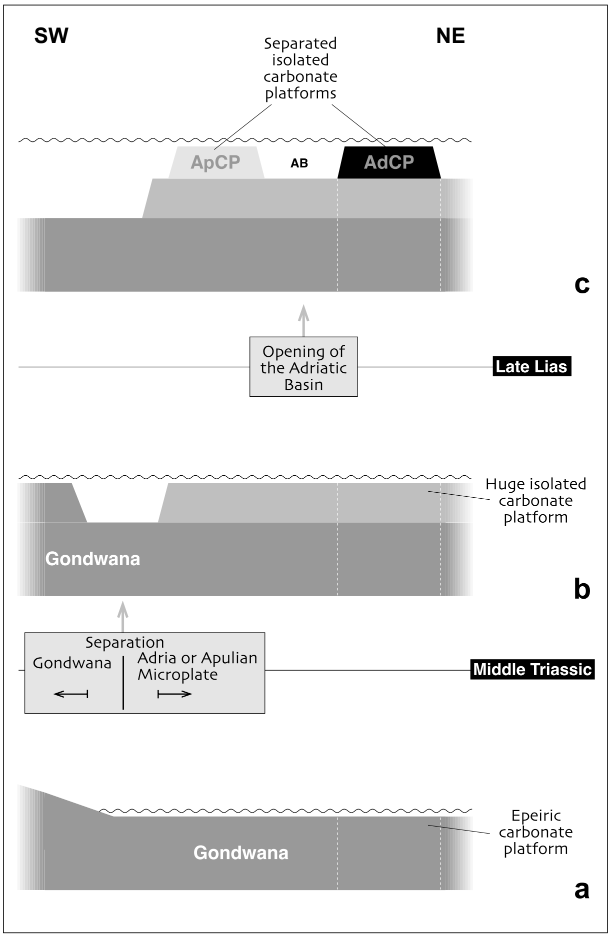

Fig. 4 Schematic illustration showing the main events before the separation of the Adriatic Carbonate Platform: (a) until the Middle Triassic rifting the study area represented a part of the epeiric platform located along the northern Gondwana margin; during this event the Adria Microplate or Apulian Promontory was separated, and a huge isolated platform was formed (b), which was partly disintegrated during the Late Lias, resulting in formation of the Adriatic Basin (AB) and Molise–Lagonero Basin (not shown), and the final separation and isolation (c) of the Adriatic Carbonate Platform (AdCP), the Apulian Carbonate Platform (ApCP) and the Apenninic Carbonate Platform (not shown).

carbonate platform, being connected, e.g. with the area of the future Apulian and Apenninic platforms.

The very beginning of the existence of the Adriatic Carbonate Platform as a palaeogeographical entity unfortunately cannot be documented in the investigated area of the Karst Dinarides, (because of the practically continuous inner platform shallow-water deposition from the Late Triassic – the margins of the platform are today covered by the Adriatic Sea), but in contemporaneous deposits drilled in the offshore wells in the Adriatic, there is clear evidence of the important event which took place in the Middle and Late Lias (BERNOULLI, 1971; JELASKA, 1973; ZAPPATERRA, 1990, 1994; GRANDIĆ et al., 1999). In these wells, which are located near the platform margin, a succession from shallow water Triassic and Early to Middle Lias deposits to the basinal Upper Lias and later rocks was documented – suggesting that during the Late Lias the Adria Microplate was segmented into smaller carbonate platforms and the new Adriatic Basin was formed (Fig. 4c), connecting deeper marine areas of the Belluno Basin to the north with the Ionian Basin to the south. Along the margins of this basin new carbonate platforms were born: the Apulian and Apenninic Carbonate Platforms along the western coast of the basin and the Adriatic Carbonate Platform along its eastern side. The south-western margin of the Adriatic Carbonate Platform is today covered by the recent Adriatic Sea, and can only be studied by geophysical methods and analysis of offshore wells. In contrast, the NE platform margin is exposed in the area of Žumberak Mt., Samoborska Gora Mt. and Karlovac area. Individualization of the platform is also recorded in the Late Lias (RADOIČIĆ, 1966; GUŠIĆ & BABIĆ, 1970; BUKOVAC et al., 1974, 1984; ŠIKIĆ & BASCH, 1975; BABIĆ, 1976; PLENIČAR et al., 1976; ŠIKIĆ et al., 1978; ŠPARICA, 1981; BUKOVAC & SOKAČ, 1989; VELIĆ et al., 2002b). However, DRAGIČEVIĆ & VELIĆ (2002), indicate that initial events connected with formation of the later NE margin of the Adriatic Carbonate Platform had already started in the Early Lias (late Sinemurian).

Although the Adriatic Carbonate Platform was mostly characterised by the profuse production of carbonates in predominately typical shallow water environments of the inner part of the platform, it was, during its history, commonly morphologically differentiated as a consequence of the interaction of eustatic sea-level changes and the important influence of synsedimentary tectonic deformation (POLŠAK, 1965a, b; JELASKA, 1973; TIŠLJAR et al., 1983; GUŠIĆ & JELASKA, 1990, 1993; TIŠLJAR & VELIĆ, 1991; VLAHOVIĆ et al., 1994, etc.). These events caused formation of temporary intraplatform lagoons and small basins (e.g. in Kimmeridgian – VELIĆ et al., 1994, 2002a; BUCKOVIĆ, 1995), occurrences of local or regional emersions in the Malm (e.g. POLŠAK, 1965a; NATEVIĆ & PETROVIĆ, 1967; VUJISIĆ, 1972; BUKOVAC et al., 1974, 1984; VRHOVČIĆ et al., 1983; MIRKOVIĆ & MIRKOVIĆ, 1987; VELIĆ & TIŠLJAR, 1988; TIŠLJAR et al., 1989, 1994; DOZET & MIŠIČ, 1997) or near the Aptian/Albian transition (VELIĆ et al., 1989; TIŠLJAR & VELIĆ, 1991), as well as temporary drowning of the platform (e.g. in large parts of the platform near the Cenomanian/Turonian transition – GUŠIĆ & JELASKA, 1990, 1993; JENKYNS, 1991; VLAHOVIĆ et al., 1994, 2002).

It is important to notice that the morphological differentiation was progressively more well expressed in the Late Cretaceous, when laterally different environments were established, from islands, spacious shallow-water areas to deeper parts, lagoons and carbonate ramps.

At the end of the Cretaceous, the major part of the platform emerged (except for its NE margin which was drowned during the Late Cretaceous and characterised by continuous flysch deposition from the Late Cretaceous to the Palaeogene – see DRAGIČEVIĆ & VELIĆ, 2002 - this Vol.), but the duration of this phase was very variable over different parts of the platform (e.g. see ĆOSOVIĆ et al., 1994). This event might be considered as the end of the Adriatic Carbonate Platform, since renewed carbonate deposition in the Palaeogene was largely controlled by regional tectonics, and areas of primary carbonate production were gradually overwhelmed by clastic deposition. The Palaeogene succession commenced in the Eocene (Palaeocene deposits are practically missing in the inner part of the former platform – DROBNE, 1977; DROBNE et al., 1991; ĆOSOVIĆ & DROBNE, 1998; VELIĆ et al., 2002b), with a transgression over very differentiated palaeorelief, resulting in significant lateral and vertical facies changes over small distances. Carbonate deposition took place along spatially restricted, relatively narrow carbonate ramps surrounding flysch basin(s) which were contemporaneously formed by intense tectonic compression of the area. A major part of the material was produced by large benthic foraminifera (miliolids, alveolinids, nummulitids and discocyclinids), and these deposits are therefore known as Foraminiferal limestones. Their net sedimentation rate was quite low, partly because of the probably originally slower carbonate production (major carbonate producers like green algae are practically missing in this primarily foramol type association), and partly because of the important reworking and transport of material towards the deeper parts of the contemporaneously forming basin(s). Carbonate production was incapable of keeping pace with the strong tectonic deformations which were significantly changing palaeogeographical relationships. Therefore the areas of carbonate production were generally retreating, and in this retrogradational sequence they were substituted by deeper marine environments, first "Globigerina marls" and than flysch deposits. However, reconstruction of the Palaeogene palaeogeography is complicated both by the important role of synsedimentary tectonics which caused formation of the Palaeogene foreland basins and by the very complicated recent structural pattern.

From the above discussion it is obvious that both temporal boundaries of the Adriatic Carbonate Platforms cannot be easily and unequivocally defined. However, on the basis of present knowledge probably the best approximation of its duration would be **a stratigraphic range from the Late Lias to the end of the Cretaceous**, when the Adriatic Carbonate Platform was completely isolated (i.e. surrounded by other platforms having specific names) and characterised by massive carbonate production resulting in a huge pile of practically pure carbonate deposits. In this definition common incorporation of carbonate deposits of wider stratigraphic range (e.g. Permian to Eocene – TIŠLJAR et al., 1991; VELIĆ, 2000; VELIĆ et al., 2002b; or Late Triassic to Eocene – PAMIĆ et al., 1998), originating from different palaeogeographic patterns, into the same palaeogeographic entity, would be avoided. This area was bounded by the Ionian, Adriatic and Belluno basins, as well as by Eastern Tethys, and its continuity towards the south is characterised by narrowing in the area of Montenegro and Albania (which is practically defined as the boundary of the Adriatic Carbonate Platform), but relics of the larger Mesozoic platform can also be found in Albania (Kruja platform), Greece (Gavrovo and Tripolitza platforms) and Turkey (Menderes platform). Therefore, by the Cenozoic, tectonic relics of the carbonate platform (parts of which are known under different names) became part of the mountain ranges of the Dinarides, Albanides, Hellenides and Taurides.

It is obvious that in this way, the defined Adriatic Carbonate Platform does not comprise all of the important carbonate successions of the karst Dinarides. Underlying deposits comprise mixed Permian to Lower Triassic clastic–carbonate deposits of the epeiric platform spreading along the northern Gondwana margins, thick Middle Triassic limestones, as well as Upper Triassic to Middle Lias carbonates representing a part of the huge Periadriatic carbonate platform covering the Adria Microplate drifting from Gondwana after the Middle Triassic segmentation (PAMIĆ et al., 1998). Overlying deposits comprise a succession of Palaeogene Foraminiferal limestones and flysch deposits which are mostly composed of carbonate clasts.

5. THE NAME OF THE CARBONATE PLATFORM OF THE KARST DINARIDES

The name of the Mesozoic carbonate platform, the disintegration of which provided the material for the Dinarides is also an interesting question. Although this platform was referred to by several different names (see TIŠLJAR et al., 2002, for some of the terms), those most recently used are the Dinaric Carbonate Platform, Adriatic–Dinaric Carbonate Platform and Adriatic Carbonate Platform, and therefore these are the only ones discussed here.

The main argument for usage of the term **Dinaric Carbonate Platform** is its apparent geographic connotation, because the rocks of the Mesozoic platform represent a part of the Dinaridic mountain range. However, there are several counterarguments:

(1) The Dinarides are, in a large part, composed of rocks which did not originate on the Mesozoic carbonate platform, e.g. pre-platform clastic and carbonate rocks (Palaeozoic, Triassic and Lower Jurassic), Eocene clastic and carbonate rocks, Neogene clastic rocks, postsedimentary breccias, different types of magmatic and metamorphic rocks and Quaternary deposits. Additionally, most of the highest mountains in the Dinaridic mountain range are located within the so-called Inner Dinarides, i.e. within the NE part of the Dinaridic mountain range

which is genetically not connected to the Mesozoic carbonate platform.

(2) The temporal designation of this term is erroneous: the Dinarides, which would represent a source for the designation of the platform, were produced by tectonic events which culminated in the Oligocene–Miocene (i.e. there were no Dinarides before that period). Therefore, the platform would be named after the mountain range formed more than 160 MY after the beginning of the platform existence and 30–40 MY after the end of the platform existence.

(3) Usage of this term inevitably causes confusion between the name of the platform and the product of its disintegration, and therefore possible misinterpretation of many phrases including "Dinaric units" or "Dinaric elements" which in theory, could refer either to the original Mesozoic platform or the recent tectonic pattern.

The mixed term **Adriatic–Dinaric Carbonate Platform**, used by some authors, is potentially confusing, since:

(1) the second part of the name also implies all the aforementioned problems connected with the term "Dinaric", especially concerning its temporal dimension;

(2) as a composite term it might confuse uninitiated readers on the possible existence of two platforms united into one (although in their original papers the authors have clearly indicated that they consider this area to be a united palaeogeographic entity, i.e. a single carbonate platform – e.g. GUŠIĆ & JELASKA, 1993; JELASKA et al., 1994).

The name **Adriatic Carbonate Platform** is probably the best, although not the ideal one (since the term "Adriatic" might include the entire Adriatic area, i.e. both coasts). However, carbonate platforms which are located along the SW coast of the Adriatic Sea, and which have the same foundation as the platform studied in this paper since they were formed on the Adria Microplate after its disintegration in the Late Lias, have their specific names – Apulian and Apenninic Carbonate Platforms. Concerning the temporal dimension this name for the platform would be definitely the most appropriate: the Adriatic Basin connecting deeper marine areas of the Ionian and Belluno Basins, i.e. precursor of todays Adriatic Sea, was formed in the Late Lias, and therefore the entire succession of the investigated Mesozoic carbonate platform was formed along the NE coast of this ancient deep marine trough.

Finally, this name would keep the priority of POLŠAK's (1965b) designation, since he called the entire shallow marine area which by its disintegration formed the Karst Dinarides (External Dinarides) as the "Adriatic Zone", and later as the "Adriatic Plate ("carbonate platform")" (POLŠAK, 1981), resulting in later establishment of the name "Adriatic Carbonate Platform" (GUŠIĆ & JELASKA, 1990).

Although this name of the platform has previously been shortened to "ACP" a better acronym would be "AdCP", since "ACP" is commonly used as an abbreviation for the Apenninic Carbonate Platform.

6. CONCLUSION

On the basis of the critical analysis of the available arguments for the supposed continuous existence of two separate platforms and a deeper marine area between them from the Late Triassic to the Eocene we may conclude:

– from the supposed complete sequence of deep marine succession only outcrops of Kimmeridgian and Palaeogene age have been found, i.e. for 94% of the supposed duration there is no adequate material evidence;
– deep marine deposits of other stratigraphic periods have not been found in deep wells within the Karst Dinarides area;
– at the surface, in the wells or on seismic profiles over the entire Karst Dinarides Area (which comprise the supposed Adriaticum, Epiadriaticum and Dinaricum geotectonic units) there are no elements indicating marginal platform facies (reefal/perireefal bodies, sand bars, slope deposits and turbidites) towards the supposed interplatform area;
– the recent tectonic pattern of the Dinarides is predominantly characterised by relatively steep reverse faults, and not by nappe structures with significant horizontal movements necessary for consumption of the supposed deep-marine deposits;
– detailed analysis of outcrops of the supposed intraplatform deposits indicate that their underlying deposits (in the case of Palaeogene flysch deposits) or both underlying and overlying deposits (in the case of the Kimmeridgian limestones with cherts and ammonites and Palaeogene flysch deposits with visible overlying deposits) are of the shallow-marine origin. These facts exclude their possible origin within continuous deep marine environments of the supposed interplatform trough.

On the basis of these presented facts we can, according to the up to now available data, conclude that **the area of the Karst Dinarides was formed by the tectonic disintegration of a single, but throughout the period of its existence, a more or less morphologically variable shallow-marine carbonate platform**. The supposed existence of two platforms divided by a deep marine interplatform area from the Late Triassic to the Eocene, cannot be theoretically excluded, but at present there is no adequate material evidence to support it.

This single carbonate platform was very dynamic because of its specific palaeogeographic position, resulting in several episodes of large-scale facies differentiation during its history. The dynamics of events in the platform area increased in the Late Cretaceous, and culminated in the Cenozoic by the formation of flysch troughs and the final uplift of the Dinarides, i.e. the formation of the recent tectonic pattern. However, this recent tectonic pattern cannot be uncritically equated with depositional basins during the Mesozoic, which is a common misconception.

There are discrepancies concerning the name of the Mesozoic platform of the present Karst Dinarides – we consider that the best, although not an ideal term, is the Adriatic Carbonate Platform.

According to the regional events and palaeogeography of the platform it may be concluded that the most appropriate time-span for its existence is a stratigraphic range from the Late Lias to the Late Cretaceous. However, it is obvious that the platform defined in this way cannot include all carbonate deposits occurring in the area of the Karst Dinarides: relatively large quantities of carbonates were also deposited during the Late Permian, Triassic, Early Jurassic and the Eocene.

It may be concluded that on the foundation of the Adria Microplate during the Mesozoic, a single, but morphologically variable Adriatic Carbonate Platform (AdCP) was formed, and its disintegration in the Cenozoic resulted in the formation of the Dinaridic mountain chain.

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