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Jurassic Sequences of Sošice and Rovinj Localities (Karst Dinarides, Croatia) as Examples of Long-Distance Tectonic-Controlled Deposition on the Adriatic-Dinaric Carbonate Platform

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Abstract

During the Late Jurrasic Adriatic carbonate platform was characterized by complex palaeogeographical and depositional relationships. A major part of the platform remained within restricted lagoonal settings, but some areas of the platform were uplifted, emerged and karstified, characterised by local deposition of bauxites. However, the NE margin of the platform was contemporaneously partially drowned. Facies correlation from two choosen localities in Karst Dinarides, Croatia; Sošice and Rovinj, reveals that during the Late Jurassic increased accommodation loss on Sošice locality coincided with increased accommodation gain on Rovinj locality. This suggests tectonic movements that were synchronous but of different style consequently enabling the relative uplift on one side of the platform but subsidence on its opposite side. Therefore, it is assumed that the extensive drowning event induced by progressive block faulting on the NE Adriatic carbonate platform margin (where present-day Sošice locality is situated) caused a relative uplift on its SE area (where present-day Rovinj locality is situated) resulting in long term emersion event there.

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Introduction

The Adriatic Carbonate Platform is one of the largest Mesozoic carbonate platforms of the Perimediterranean region. Its deposits comprise a major part of the entire carbonate succession of the Croatian Karst Dinarides, which is very thick (in places more than 8,000 m), and ranges in age from the Middle Permian (or even Upper Carboniferous) to the Eocene [1].This platform represents a part of the broader shallow-water carbonate platform that extended from NE Italy to Turkey [1]. Only the inner platform facies crop out on the mainland and the islands along the NE Adriatic coast, as the platform margins are covered [1]. The NE platform margin is covered by Cretaceous/Palaeogene flysch deposits, Palaeozoic–Triassic nappes and Neogene deposits [2-5], while the SW margin is covered by Neogene and Quaternary deposits under the recent Adriatic Sea [6]. For this study we have choosen two distant localities, each characterised by the successions of its own unique sedimentary signature. For this work, they represent two Upper Jurassic key environments. These are; Rovinj locality, a shallow-water platform succession punctuated by an emersion, and, Sošice locality, a deep water succession with open basin characteristics. Biostratigraphic correlation usually plays a key role in lateral tracing of successions, which are several tens of kilometres apart. However, here the studied successions have been subdivided into informal lithostratigraphic units, which do not fully coincide with the biostratigraphic and/or chronostratigraphic units. Therefore, the ages of these litostratigraphic units are only approximately defined. In this paper we document facies changes within these selected successions of Karst Dinarides in order to reconstruct and analyse the events on these parts of Adriatic carbonate platform during Late Jurassic. By that, we use our own research results [60] as well as the published results of some earlier researchers.

Samples and Methods

For the purpose of this paper two Upper Jurassic successions were analyzed (Figure 1). At Sošice locality, situated in Žumberak Mt, SW from town of Zagreb, oriented rock samples were collected in the field. Samples are first analyzed in their natural state and then as the thin sections under the microscope. One thin section was produced when a thin sliver of rock was cut from the rock sample with a diamond saw and ground optically flat. It was then mounted on a glass slide and grounded smooth using progressively finer abrasive grit until the sample is only 30 μm thick. Then the sample, now as a thin section, was ready for viewing and imaging under the microscope. The succession on Rovinj locality was not sampled since it is very well described and documented in the works of earlier researchers. Thus, based on field and laboratory observation under the microscope, carbonate facies on Sošice locality were identified within the exposed succession and then correlated with previously published data obtained from Rovinj locality (Figure 2).

The Sošice succession

Description: In the Sošice area the Jurassic carbonates crop out in a thickness of 465 m. They are separated from the underlying Hauptdolomite and overlying Turonian breccias by tectonic contact, representing the most complete Jurassic sedimentary sequence in northwestern Croatia. For the purpose of this paper only Middle-Upper Jurassic part of this succession is taken into account. This part of the Jurassic succession is usually covered, preventing the continuous observation. However, in a few places small outcrops occur which clearly reveal typical characteristics of the distinguished lithostratigraphic units. Thus, within the Middle Jurassic-Upper Jurassic strata of Sošice locality, four informal lithostratigraphic units can be defined:.

1) The pelletal - bioclastic wackestones of first SO-1 unit form 0.2 to

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0.9 m thick beds which are typified by spheroidal - ellipsoidal pellets and "filaments", i.e. skeletal fragments of pelagic bivalves or their prodissoconchs [e.g. 7-9] embedded in micritic matrix (Figure 3A). Along with pellets and pelagic bivalves, protoglobigerinids, calcitized radiolarians, sponge spicules and ostracode bioclasts are relatively abundant locally. Tests of Middle Jurassic species *Mesoendothyra croatica* Gušić can be sporadically found (Figure 3B).

2) The second SO-2 unit is represented by ca. 75 m thick carbonate breccia (Figure 3C). The breccia is predominantly coarse-grained and has a heterogeneous composition. The size of lithoclasts is very variable; cm-sized clasts prevail but dm-sized ones also occur, locally. The clasts are mostly angular with more or less rounded corners. Fitting of neighboring grains is also variable; they are both grain-supported and mud supported with calcareous and/or marly matrix. In the calcareous matrix crinoid detritus occur. Gradation and horizontal lamination can be observed, locally. Three types of lithoclasts can be distinguished: (a) clasts which contain crinoid ossicles, peloids, ooids and foraminifera *Ophthalmidium martana* (Farinacci); (b) clasts containing a few sponge spicules and calcitized radiolarians; and (c) clasts which contain pellets and filaments [10].

3) The third SO-3 unit consists of pelletal - bioclastic wackestones characterized by the same compositional and structural features as the same litofacies type of the first unit. However, these wackestones

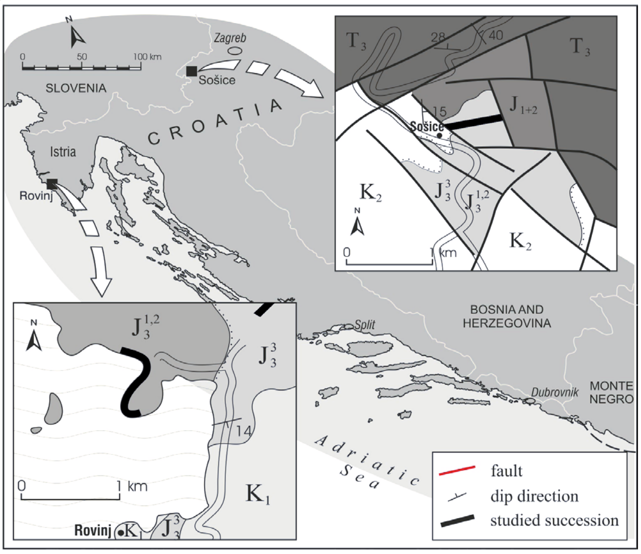

Figure 1: Geographical location and geologic background of studied successions area: Legend: T_3 -Upper Triassic, J_{1+2}- Lower and Middle Jurassic, $J_3^{1,2}$ - Oxfordian-Kimmeridgian, J_3^3 - Tithonian, K_1 - Lower Cretaceous.

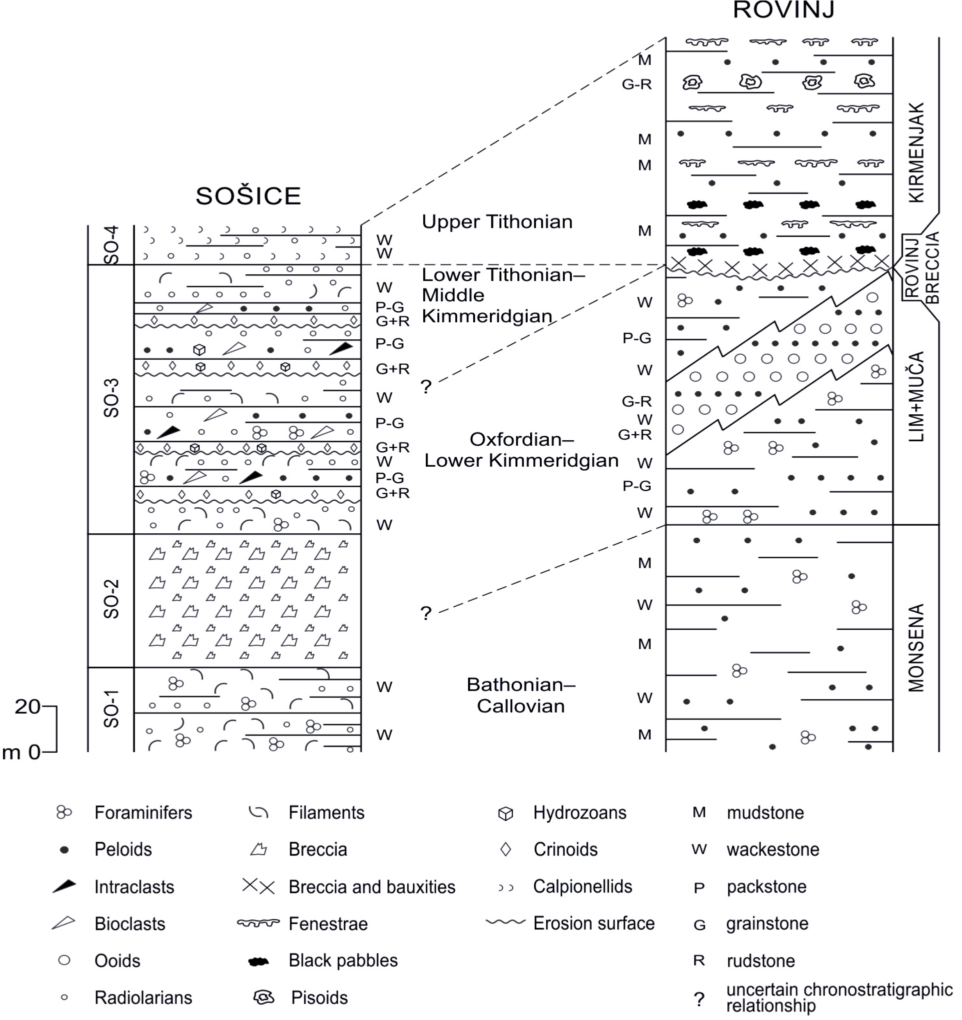

Figure 2: Correlation of studied stratigraphic columns. The column Rovinj according to [33-37], modified.

are irregularly punctuated by 0.05 to 0.2 m thick coarse-grained interlayers. These are separated from the wackestones by sharp and uneven erosional contacts at their base. The lower part of every interlayer is represented by bioclastic grainstone-rudstones that contain poorly sorted angular to subrounded crinoid and hydrozoan bioclasts, commonly with micritic envelopes and/or abraded surfaces (Figure 3D). Subroundeed intraclasts, peloids and molluscan bioclasts are less common. Within the individual coarse-grained interlayers, the size of particles gradually decreases upward, grading into peloidal - bioclastic packstones-grainstones which contain spheroidal peloids, intraclasts, foraminifers and molluscan bioclasts (Figure 3E). Among the foraminifers, *Nautiloculina oolithica* Mohler, *Protopeneroplis striata* Weynschenk, *Trocholina elongata* (Leupold), and *Pseudocyclammina lituus* (Yokoyama) have been determined. Such microfossil content collected from the last useful outcrop in this part of succession indicates Late Oxfordian [11,2].

4) The skeletal wackestones of the fourth SO-4 unit significantly differ from the underlying units; they are rich in calpionellids (Figure 3F). In these 0.02 to 0.1 m thick beds, *Calpionella alpina* Lorenz and *Calpionella elliptica* Cadisch have been determined, evidencing the Calpionella cenozone (Late Tithonian/Early Berriasian - [13, 14,15], Early/Middle Berriasian - [16,17]). Sponge spicules, crinoid bioclasts, and calcitized radiolarian tests are much rarer. Bioturbation occurs only locally. The wackestones of this unit are thinly bedded, sporadically marly, sedimentary structures are missing.

Interpretation (according to [60]): The occurrence of calcitized radiolarians, protoglobigerinids and skeletal fragments of pelagic bivalves or their prodissoconchs in the first unit clearly points to deeper water conditions. Comparing to underlying shallow-water Lower Jurassic lithostratigraphic units, it is obvious that depositional setting of this unit took place at least in the vicinity of the platform slope, i.e. in the toe-of-slope environment. The facies characteristics of the carbonate breccias of the second unit indicate slope collapse. Various mechanisms for triggering platform margin and/or slope collapse have been proposed, including seismic activity, storms and gravitational instability of high sediment accumulation on the slope [18-20]. Additionally, some authors suggest that re-sedimented material in carbonate slopes, including breccias, would form during relative transgressive or highstand of sea level, when the platform top is flooded [21-23]. Alternatively, several authors favor platform margin collapse in response to falls in relative sea level, as predicted by sequence stratigraphic models, [24-27]. As to breccias in the Sošice locality, a tectonic control may have played a crucial role. It is documented by three types of lithoclasts which are solely derived

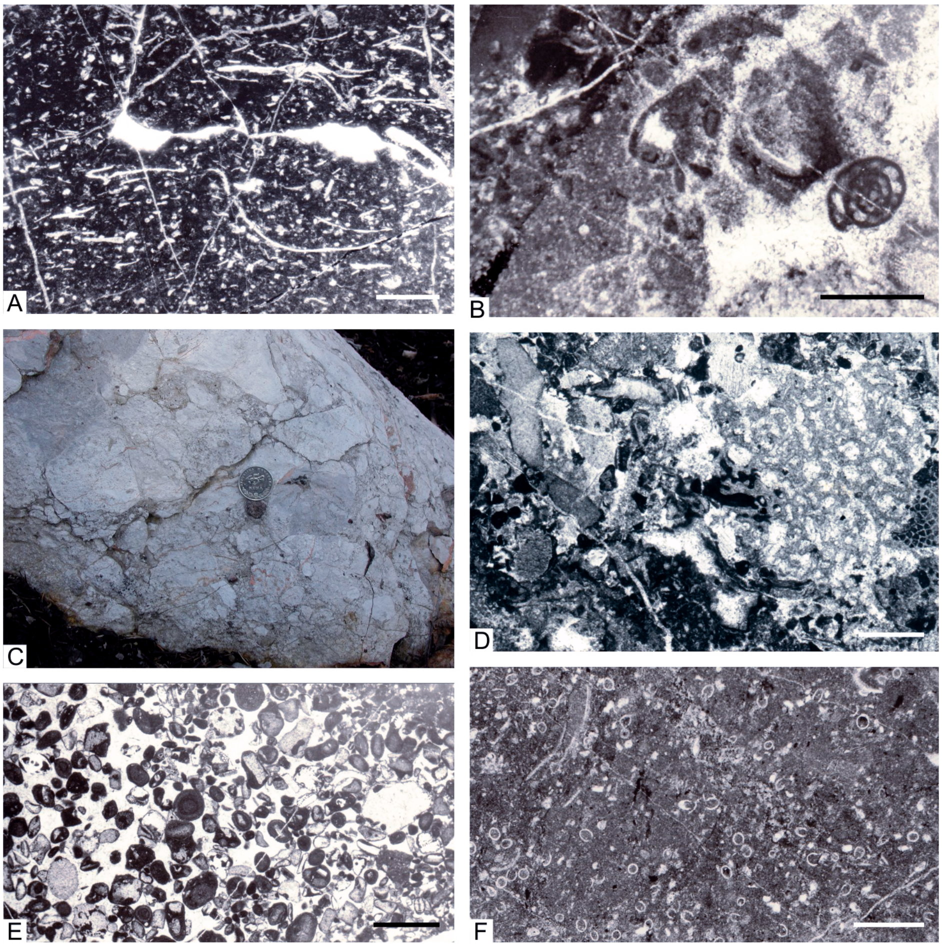

Figure 3: (A) Pelletal - bioclastic wackestone with "filaments". Unit SO-1. Scale bar 0.8 mm. (B) Pelletal - bioclastic wackestone with foraminifera *Mesoendothyra croatica* Gušić. Unit SO-1. Scale bar 0.8 mm (taken from [60]). (C) The outcrop of carbonate breccia. Unit SO-2. (D) Bioclastic grainstone-rudstone predominantly composed of crinoid and hydrozoan bioclasts. Unit SO-3. Scale bar 1.6 mm. (E) Peloidal - bioclastic packstone-grainstone. Unit SO-3. Scale bar 1.6 mm. (F) Skeletal wackestone with calpionelids. Unit SO-4. Scale bar 0.4 mm.

from the platform upper foreslope facies, while shallow-water particles derived from the platform margin are totally missing. Therefore, it could be supposed that the platform slope was subjected to intense seismic shocks in connection with the synsedimentary tectonics, producing angular fragments of already consolidated deposits. These were gravitationally moved down along the platform slope, forming a thick carbonate breccia wedge in the toe-of-slope environment, overlying the deposits of the first litostratigraphic unit. Such scenario is additionally emphasized by locally observed gradation of the calcareous breccia interbeds and matrix. A multiple accumulation process can be assumed since pretty thick interval of breccia wedge was formed. However, such multiplication can not be confirmed in the field due to the breccias outcrop distance as well as their scarcity.

Facies characteristics of the third unit further imply toe-of-slope sedimentary environment, as it has been described by many authors [e.g. 28-32]. The sedimentary textures and platform derived bioclasts, e.g. benthic foraminifera in the coarse-grained interlayers clearly indicate gravity re-deposition from a shallow-water platform margin into the adjacent deep-water environment. Due to variations in the turbiditic flow and in the amount of transported sediment, the coarse-grained layers are of variable thickness and grain size.

The thin beds of the fourth unit represent autochthonous pelagic carbonate mud deposition ("pelagic rain") within the basin environment. These areas were located well below the storm-weather wave-base and distant from the platform margin, as indicated by the lack of any sedimentary structures and coarse-grained bioclastic intercalations. More argillaceous intervals correspond to increased influx of fine-grained siliciclastic detritus, derived from the north, i.e. from the Hercynian ranges [5].

The Rovinj succession

Description: Inside the Middle-Upper Jurassic succession in the vicinity of Rovinj, earlier authors have distinguished five informal lithostratigraphic units [see 33-37];

1) The Monsena unit contains well-bedded peloidal foraminiferal mudstones to wackestones and rarely oncolite floatstones. Debris of molluscs, hydrozoans and echinoderms are rarely found and were drifted sporadically into this quiet environment where mud deposition predominated. The biofacies is quite rich and characterized by various benthic foraminifera such as *Pfenderina salernitana* Sartoni & Crescenti, *Pfenderina trochoidea* Smout & Sugden, *Satorina apuliensis* Foucade & Chorowicz, *Praekurnubia crusei* Redmond indicating Bathonian-Callovian age.

2) The Lim unit, consisting of peloidal-skeletal wackestones, less commonly peloid grainstones or packstones. Peloidal-skeletal wackestones are 0.3-0.9 m thick beds composed of micrite, sphaeroidal peloids and diverse platform allochems: foraminifers, molluscan and echinoderm fragments, less frequently green algae and algal oncoids. Rarely, fragmented, coarse-grained Cladocoropsis fragments are found, usually covered with thin micritic envelopes and/or coated with few oncoid envelopes. Rounded intraclasts are in places more abundant. Among the foraminifers, *Redmondoides lugeoni* (Septfontaine), *Kurnubia palastiniensis Henson*, *Praekurnubia crusei Redmond*, *Trocholina elongata* (Leupold), *Trocholina alpina* (Leupold), *Nautiloculina oolithica Mohler*, *Pseudocyclammina lituus* (Yokoyama), and *Chablaisia chablaisensis* (Septfontaine), as well as the dasyclad *Salpingoporella sellii* Crescenti, are the most common constituents, indicating Oxfordian-Early Kimmeridgian, i.e. the Macroporella selli Cenozone [12].

3) The Muča unit represents several kilometers long and several tens of metres thick lens-like sediment body inside the Lim Unit that distinctly differs from the Lim Unit by its composition. It consists of a successive series of coarsening-upward cycles, each composed of three texturally and compositionally different facies types; peloidal-skeletal wackestones can be found as the lower cycle member, ooid grainstones usually represent the middle cycle member while the bioclastic-ooidal grainstones, more rarely rudstones, make the upper cycle member. The thickness of the lower cycle members ranges from 0.2-0.4 m, whereas the thickness of the middle and upper cycle members are commonly equal, amounting to 0.4-0.7 m. The peloidal-skeletal wackestones have the same allochem content as the underlying wackestones of the Lim Unit. Small-scale cross-bedded ooid grainstones are composed of well-sorted ooids with peloidal and/or bioclastic nuclei and radial-fibrous microstructure. Intraclasts, foraminifers, and tiny molluscan fragments are much rarer. Bioclastic-ooidal grainstones, more rarely rudstones, differ from the underlying ooid grainstones by the presence of large amounts of various foraminifers, as well as by coarse-grained, frequently abraded coral, molluscan, and hydrozoan fragments. In a few places, entire coral heads are present. The surfaces of many of these bioclasts are coated and/or micritized. Distinct, large-scale cross-bedding is clearly visible. The foraminiferal association of this unit corresponds fully to that of the Lim Unit.

4) The Rovinj Breccia unit consists of 0.01-0.08 m sized, rounded to angular limestone fragments that belong, compositionally and texturally, to the underlying Lim Unit. Only sporadically these fragments were derived from the Muča Unit. The breccia cement is microcrystalline calcite, pigmented in places by Fe-minerals. The thickness of the breccia varies from a few decimetres to 8 metres; it has a lens-like form and is commonly separated from the Lim Unit by a sharp and uneven contact. In a few places, the breccia is overlain by significant quantities of bauxites composed, according [38], of boehmite, kaolinite, and hematite.

5) Overlying the breccia and bauxite, there is the Kirmenjak unit, composed of successive series of shallowing-upward cycles. The thicknesses of cycle members are variable. The black-pebble breccia, as the lower cycle member of the shallowing-upward cycles, consists of subrounded black and/or brown mudstone and/or fenestral mudstone fragments, inserted in a carbonate, clayey, or marly matrix. Its thickness ranges from 0.05-0.25 m. Mudstones as the middle cycle member with very rare pellets, foraminifers, ostracodes, and dasyclads are 0.4-1.2m thick. The foraminifer *Kurnubia palastiniensis* Henson, as well as the dasyclads *Salpingoporella annulata* Carozzi, *Clypeina jurassica* Favre, and *Campbelliela striata* (Carozzi), can be recognized in only a few places inside the mudstones, defining the Late Tithonian, i.e. the Clypeina jurassica and Campbelliela striata Subzone [12]. Bioturbation occurs frequently. This allochem content continues into the upper cycle member of fenestral mudstones with the distinct difference that the latter contains irregular fenestrae, molds of bioclasts, and/or dissolution vugs filled by drusy calcite. Only locally, fenestrae, molds, and vugs are roofed by microstalactitic cement, while some larger molds and dissolution vugs are lined at their bottom with crystal silt showing geopetal fabric. In the upper part of the Kirmenjak unit black-pebble breccia does not appear and there are shallowing- and coarsening-upward cycles starting with mudstones as the lower cycle member, fenestral mudstones as the middle cycle member, and ending with the pisoid-intraclastic grainstone-rudstones as the upper cycle member. The pisoid-intraclastic grainstone/rudstones contain angular to rounded micritic-pelletal intraclasts (sometimes with

fenestral fabric), with or without pisoid envelopes. Intergranular pores commonly contain variable amounts of crystal and pelletal silt; this internal sediment frequently shows grading and geopetal fabric. Meniscus and microstalactitic cements occur only sporadically.

Interpretation: The sedimentary signature of the Monsena and Lim units suggests a subtidal/lagoonal depositional environment, only occasionally agitated during deposition of Lim unit when more grainy peloid grainstones or packstones were deposited [39]. The abundance of ooids and the mud-free, sorted, and cross-bedded nature of the Muča middle cycle members indicate a high-energy oolite shoal environment, which migrated laterally over this subtidal/lagoon by the action of waves and currents, thus capping the adjacent micrite-rich deposits as the middle cycle member of one coarsening-upward cycle. When the weather became more stormy, waves and currents eroded the existing patch reefs, mainly composed of robust coral colonies, and coarse-grained skeletal fragments were transported by currents and waves onto the migrating oolite shoal, thus producing the upper cycle members of a single coarsening-upward cycle and with distinctive large-scale textural features. In this way, as the stormy conditions periodically affected this area, successive coarsening-upward cycles were produced. During the initial stage of regression that occurred in this area after the deposition of the Lim and Muča units, their deposits were subjected to multi-phased alternation of subaerial exposure and action of tidal and/or storm waves, in which they were partly cracked, fragmented, and transported over short distances, forming the Rovinj breccia unit. After the sea re-treated completely, karst topography was formed, with wide local depressions into which pelitic clayey material was brought (by fresh water flows?) and altered into bauxite. The Kirmenjak unit has been deposited in environmental conditions ranging from shallow subtidal to supratidal and vadose zone, as a result of tidal-flat progradation or aggradation in the subtidal zone. [34] interpreted the black-pebble breccia as indicators of the the existence of local swamps. However, blackening may occur not only within the swamps but also within the subtidal, intertidal, and supratidal zones, that is whenever dark organic substance is available and the geochemical and mineralogical conditions for its preservation and fixation are right [40]. After these swamps were dried up, swampy black and/or brown deposits, rich in organic matter, was fragmented by the action of tidal and/or storm waves, and then partly transported back to the adjacent subtidal (intertidal?) environment. After the swampy deposits were fully flooded or completely eroded, thus formed black-pebble fragments were gradually buried under subtidal mudstone, that is under middle cycle member. After each emergence of the middle cycle member in the upper part of the Kirmenjak unit, carbonate detritus (mainly intraclasts) was thrown onto the emergent surface from the adjacent subtidal environments by action of storm waves and high tides, and exposed to vadose diagenesis. During these periods, some intraclasts developed pisoid envelopes, and internal sediment was produced when pisoid-intraclastic grainstone-rudstones as the upper cycle member originated.

Discussion

The area of the present-day Karst Dinarides was involved in dramatic regional-scale changes during the Mesozoic. From the Late Permian to the Middle Triassic it was attached to the northern Gondwana shelf, where mixed deposition of siliciclastics and carbonates took place. The intense tectonic activity occurred throughout this area during the Middle Triassic [e.g. 41, 5] triggered gradual separation of a huge fragment dismembered from Gondwana shelf called the Adria microplate. This separation resulted in dramatic changes in the sedimentary environments leading to formation of an isolated carbonate platform during the Late Triassic where deposition of predominantly shallow water deposits took place (e.g. Dachstein Limestone, Hauptdolomite, Burano Anhydrite). During the early to middle parts of the Early Jurassic, environmental conditions on the broad Adria microplate periodically changed, namely from subtidal below the fair-weather wave-base to higher-energy subtidal above the fair-weather wave-base, i.e. cyclic sedimentation took place, overlying the Upper Triassic shallow water sequence with successive series of coarsening-upward cycles [e.g. 42, 43]. The disintegration of the Adria microplate took place during the late part of the Early Jurassic, when some parts of the shallow-water Adria microplate were drowned creating deep-water basin conditions. This drowning event was probably a consequence of larger-scale, complex plate-tectonic movements such as opening of the Dinaridic branch of the Neo-Tethys and break-up of Pangea [44-46]. The newly formed basins separated the remaining isolated shallow platform areas. One of these platforms was the Adriatic carbonate platform which was separated from the Apulian carbonate platform by the Adria basin that connected the Ionian basin with the Umbria–Marche and Belluno basins [45-50]. In this way, during the late part of the Early Jurassic the Adriatic carbonate platform became surrounded by deep-water basins; the Dinaridic branch of the Neo-Tethys in its NE side, and the Adria basin in its S-SW side (Figure 4a-d). As opposed to the events on the S-SW side of the Adriatic carbonate platform, its NE side experienced extensive drowning event due to the progressive block-faulting during opening of the Dinaridic branch of the Neo-Tethys. This led to gradual shift of the NE platform margin towards the S-SW in the amount of approximately 30 kilometers during the time-span Middle Jurassic-Late Jurassic, spreading the basinal area of the Dinaridic branch of the Neo-Tethys over the drowned part of the Adriatic carbonate platform [10, 51-53] (Figure 4a-d). These events are clearly visible within the Sošice succession. Going from the first to the fourth informal lithostratigraphic unit in the vertical sequence, i.e. starting from the Middle Jurassic, a gradual retreat of the Adriatic carbonate platform margin towards the S-SW is clearly noticeable. Thus, the first, Middle Jurassic, lithostratigraphic unit of Sošice was deposited in the toe-of-slope environment, the second one indicate synsedimentary tectonics, i.e. breaking of platform slope along the block faults during the platform margin shift towards the S-SW, the third, Upper Oxfordian, unit still suggests the toe-of-slope environment, while the fourth, Upper Tithonian, unit shows clear features of the basin environment distant from the platform margin (Figure 4a-d). On that way, during the time-span Middle Jurassic-Late Tithonian basinal area of the Dinaridic branch of the Neo-Tethys extensively expanded over the drowned marginal part of the Adriatic carbonate platform.

[54] pointed out that deepening and increasing in accommodation space in basins may be accompanied by the simultaneous uplift and drowning, i.e. tilting events on neighboring platforms. Thus, as the NE margin of the Adriatic carbonate platform experienced progressive block-faulting, i.e. drowning and shifting of its margin towards the S-SW as it is clearly visible in the sedimentary signature of Sošice locality, a pronounced uplift on the S-SW platform side can be supposed. In accordance with [54] model, these Middle and Late Jurassic block-faulting events from the NE platform margin had to cause a contemporaneous slight tectonic uplift in the S-SW platform area, causing gradual shallowing there. Such gradual shallowing is clearly evident from the sedimentary signature of the Rovinj succession, situated in the S-SW platform area, where one can

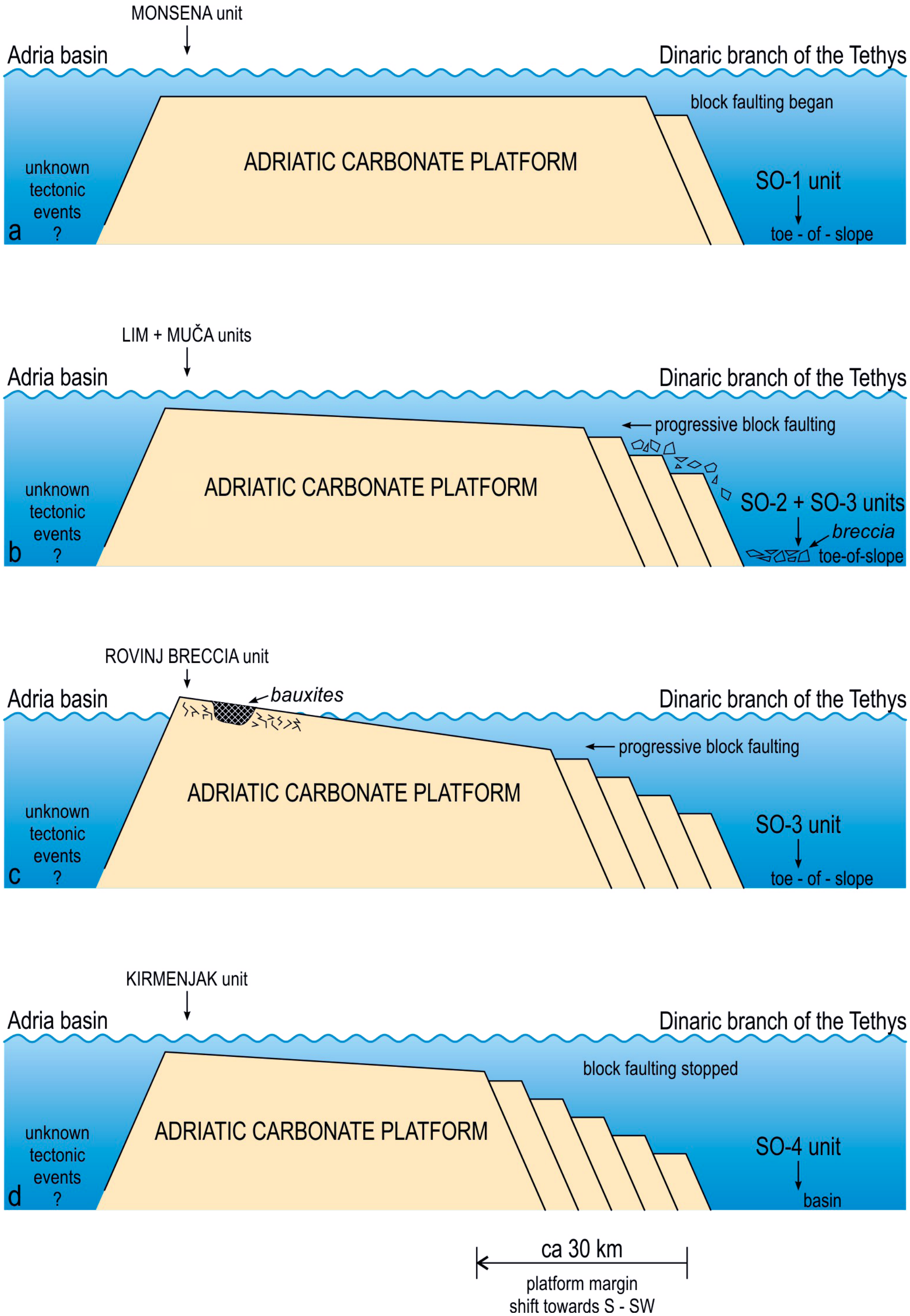

Figure 4 - Simplified schematic sketch shows the geodynamic evolution of the investigated areas (according [54] model, modified): a) during Bathonian-Callovian; b) during Oxfordian - Early Kimmeridgian, c) during Middle Kimmeridgian - Early Tithonian, d) during Late Tithonian (not to scale).

notice that an extensive regression took place with the deposition of Rovinj Breccia and significant quantities of bauxites during the Middle Kimmeridgian-Early Tithonian [34,37,55-57]. It can be assumed that this Middle Kimmeridgian-Early Tithonian regression recordered at Rovinj locality was the culmination of platform tilting, i.e tectonic uplift event in this side of platform triggered by gradual and progressive block-faulting and drowning event on its NE side (Figure 4c). The Upper Tithonian peritidal limestones of Kirmenjak unit that overly this Middle Kimmeridgian-Lower Tithonian emersion horizon, provide an evidence for sinking of the S-SW platform area. Namely, the opening of the Dinaric branch of the Neo-Tethys ocean stopped and its closure began during the Late Jurassic-Early Cretaceous [58,5]. It can be supposed that this significant geodynamic event stopped further subsidence and drowning at the NE Adriatic carbonate platform margin (nowadays Sošice locality), and, consequently, also stopped further uplift in its S-SW platform area (nowadays Rovinj locality). Therefore, due to the slight subsidence rate combined with global eustatic sea-level rise [59], the S-SW Adriatic carbonate platform area was drowned and levelled to its equilibrium. Thus, during the Late Tithonian, the peritidal depositional setting of Kirmenjak unit was established on the previously emerged S-SW part of the platform (Figure 4d).

Conclusion

Upper Jurassic synsedimentary tectonic movements clearly recognized on the Sošice locality were probably reflexions of the Jurassic phase of the Alpine tectonic cycle. The opening of the Dinaric branch of the Tethys and the thus induced drowning of the Adriatic carbonate platform margin where nowadays Sošice locality is situated, roughly coincided with an uplift within the S-SW Adriatic carbonate platform area where nowadays Rovinj locality is situated. Thus, according to [54] model it can be assumed that Adriatic carbonate platform became slightly inclined and the long-term accommodation loss on the NE part of the Adriatic carbonate platform margin resulted in accommodation gain on its S-SW side. The progressive block-faulting and shifting of the NE platform margin towards the S-SW played a major role in the development of the Sošice Middle Jurassic-Early Tithonian toe-of-slope environment, afterwards progressing into a Late Tithonian basinal depositional environment. This large-scale extensional movements the NE platform margin triggered simultaneous and gradual uplift on the S-SW platform area culminating there with an emersion during Middle Kimmeridgian-Early Tithonian. This uplifting stopped when further shifting at the NE Adriatic carbonate platform margin stopped, i.e. when the closing of the Dinaridic branch of the Neo-Tethys began during the Late Tithonian. This led to predominance of the subsidence rate that combined with global eustatic sea-level rise enabled the pronounced drowning of the S-SW Adriatic platform area and restoration of shallow-water platform environment there during the Late Tithonian.

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