STOP 2.2.

Topic: Middle Permian clastic deposits
Leaders : Ivo Velić, Igor Vlahović, Josip Tišljar, Jasenka Sremac & Dubravko Matičec

Introduction

A geological profile across the Central Velebit Mt. offers the best insight of the thick stratigraphic sequence characteristic of the Karst (Outer or External) Dinarides, in an almost continuous succession from the Upper Carboniferous (Kasimovian to Gzhelian) to the Upper Jurassic and the Tertiary (Fig. 1).

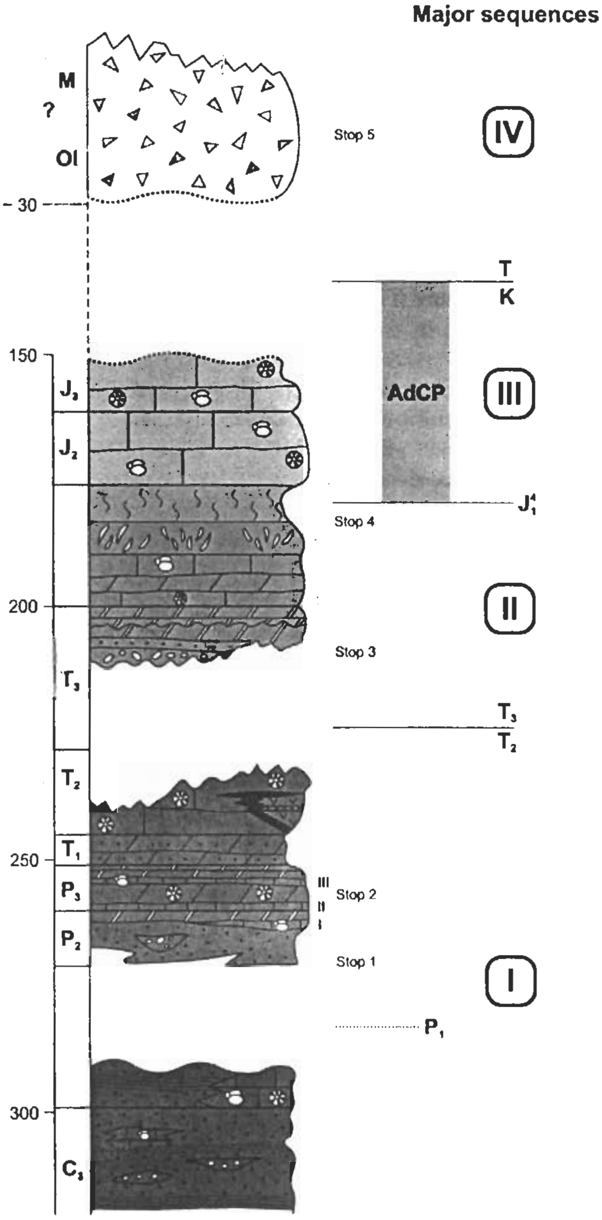

Fig. 1 Simplified geological column of the Central Velebit Mt. showing 4 major depositional sequences formed in a variable palaeogeographic settings. Time scale after Gradstein et al. (2004).

Within the Croatian part of the Karst Dinarides, somewhat older Upper Carboniferous rocks (Moscovian) can only be found in the Southern Velebit region in the vicinity of Gračac. During this field trip we will visit some of the typical localities along the Gospić–Karlobag regional road. On the way to our first stop, the Košna spring, near the Brušane village, the road cuts into the Carboniferous deposits. Lithologically, the Upper Carboniferous deposits are very heterogeneous, but alternation of sandstones and shales prevail. Within them, lenses and interbeds of conglomerates can be found, as well as very scarce carbonate lenses.

The Upper Carboniferous deposits are superimposed by Lower and Middle Permian clastic rocks, which are also heterogeneous, composed mostly of reddish sandstones and siltstones with lenses of pyritic sandstones, quartz conglomerates, and petromictic conglomerates.

Sandstones are fine-grained to coarse-grained, in some parts granular graywackes. Sorting is average to low, and grains are composed of quartz and variable lithoclasts – carbonates, clasts of metamorphic and eruptive rocks, claystones, as well as muscovite and chlorite.

The matrix is composed of chlorite–sericite aggregates with or without quartz (Sokač et al., 1976). The reddish colour is caused by the presence of ferruginous minerals, indicating continental influence – oxidation and weathering of older rocks. Infrequently, sandstones and siltites are coloured greenish.

Lower and Middle Permian clastic rocks were probably deposited within continental and deltaic environments. In older papers (e.g. Salopek, 1942) these rocks were described as equivalents of Val Gardena sandstones (Gröden sandstones), but later deposits at typical localities in the Southern Alps are younger, of Late Permian age (e.g. Italian Research Group – according to Krainer, 1993).

Petromictic conglomerates intercalated within fine- to medium-grained clastic rocks are known in the literature as *Košna conglomerates* (Salopek, 1942). They outcrop in an approximately 2 km wide lens-shaped formation within reddish sandstones and siltstones, with maximum thickness of ca. 100 m.

This sedimentary body overlies quartz conglomerates, and laterally pinches out into reddish clastics. *Košna conglomerates* are composed of weakly-sorted pebbles and cobbles of dark grey Lower Permian limestones (very similar to the Rattendorf and Trogkoffel deposits of Southern Alps), fusulinid limestones and dolomites, as well as pyritic and reddish sandstones (Figs. 2 and 3).

Fig. 2 Petromictic *Košna conglomerate* composed of weakly-sorted pebbles of Upper Carboniferous and Lower Permian limestones, pyritic and reddish sandstones and small quartz pebbles. Reddish and greyish matrix is sandy–quartz, in some places carbonate.

Fig. 3 Detail of the *Košna conglomerates* at the Košna spring.

Clasts are of variable size, from 1 to more than 30 cm, including small quartz pebbles. Matrix is sandy – containing quartz, in places carbonates, coloured reddish to grey.

STOP 2.3.

Carbonate succession Middle–Upper Permian

The youngest Palaeozoic deposits of the Velebit Mt. are characterised by an approximately 1000 m thick succession of carbonate rocks. Early- to late-diagenetic dolomites prevail, and within them 3 lenticular bodies of dark, organic-rich fossiliferous limestones are inserted.

Middle–Upper Permian carbonate succession starts with the *First zone of dark limestones* followed by dark grey, so called *Spotted* or *Mizzia dolomites* (after Salopek, 1942). These are medium-crystalline late-diagenetic dolomites, with 20–150 thick beds (mostly 40–60 cm). They are named after the numerous light-coloured spots 1–2 cm in diameter representing recrystallized fossils, most frequently algae (genus *Mizzia*), but also fusulinid foraminifera or other biodetritus. Generally, this part of the succession is very fossiliferous, but fossil remains were mostly destroyed by late-diagenetic dolomitization and recrystallization. However, in some places beds containing very well preserved algae and foraminifera, as well as macrofossils (corals, brachipods, and molluscs) can be found. Kochansky-Devidé (1965) has found rich assemblages of algae and benthic foraminifera within *Spotted dolomites*, among which the most important are fusulinids *Stafella elegantula* KOCHANSKY-DEVIDÉ, *Eoverbeekina salopeki* KOCHANSKY-DEVIDÉ, *E. paklenicensis* KOCHANSKY-DEVIDÉ, *Sphaerulina croatica* KOCHANSKY-DEVIDÉ, *Nankinella* sp., dasycladal algae *Mizzia velebitana* SCHUBERT, *M. yabei* (KARPINSKI), *M. cornuta* KOCHANSKY-DEVIDÉ & HERAK and *Velebitella triplicata* KOCHANSKY-DEVIDÉ, and gymnocodiaceans *Permocalculus plumosus* ELLIOTT and *Gymnocodium bellerophontis* (ROTHPLETZ).

The *Second zone of dark limestones* enriched in organic matter crops out between the *Spotted dolomites* and the grey *Schwagerina dolomites* (Salopek, 1942), and is best visible at the Kalvarija locality, a protected geological monument of nature (Fig. 4).

Fig. 4 The *Second zone of dark limestones* in the Brušane village south of the Brušane–Baške Oštarije. Protected geological monument Velnačka Glavica (Kalvarija).

They are composed of dark grey to black thin-bedded to platy bioturbated and bioclastic mudstones with chert nodules alternating with black mudstones, black calcitic shales and siltites, totally approximately 30 m thick. This zone is very fossiliferous: besides algae (especially dasycladal) and benthic foraminifera, numerous macrofossils have been found, among which the most important are brachiopods, gastropods, bivalves and cephalopods, as well as reef builders – sponges, corals, bryozoans and hydrozoans. In some areas bioconstructions (probably patch reefs) were destroyed and reworked by storms, and the resulting bioclasts were consequently transported into low-energy environments, now representing bioclastic lenses of molluscs and brachipods within black mudstones. The best preserved outcrop of this type can be found along the Brušane–Baške Oštarije road at the Paripov Jarak locality (Fig. 5; Marjanac & Sremac, 1988; Tišljar et al., 1991; Sremac, 2005).

Fig. 5 Roadcut along the Brušane–Baške Oštarije road near Paripov Jarak with preserved parts of biolithic bodies composed of numerous reef-builders – sponges, corals, bryozoans and hydrozoans, as well as numerous brachiopods, gastropods, bivalves, etc.

Rich fossil assemblages of the macrofossils within the second limestone zone have been reported already by Salopek (1942); Kochansky-Devidé (1965), and Sremac (1991) reported 175 taxa found within these limestones, classifying them as Neoschwagerina craticulifera Biozone. Along with almost all microfossils found in the *First zone of dark limestones* the following important fossils have also been found: dasycladal algae *Vermiporella nipponica* (ENDO) and *Salopekiella velebitana* MILANOVIĆ, fusulinids *Neoschwagerina craticulifera* (SCHWAGER), *N. occidentalis* KOCHANSKY & RAMOVŠ, *Kahlerina pachytheca* KOCHANSKY & RAMOVŠ, *Dunbarula nana* KOCHANSKY-DEVIDÉ, *Sphaerulina croatica* KOCHANSKY-DEVIDÉ, *Chusenella velebitica* KOCHANSKY-DEVIDÉ, *Dunbarinella velebitica* KOCHANSKY-DEVIDÉ and *Yabeina syrtalis* (DOUVILLÉ). Among macrofossils the most important index forms are sponges *Sinocoelia lepida* ZHANG & FAN and *Guadalupia cyllindrica* GIRTY, coral *Tanchintongia ogulineci* KOCHANSKY-DEVIDÉ, and brachiopods *Enteletes salopeki* SREMAC, *Ramovsina likana* SREMAC, *Megatscheryschewia kochanskae* SREMAC, *Leptodus nobilis* (WAAGEN) and *Martinia velebitica* SREMAC.

Schwagerina dolomites overlie the *Second zone of dark limestones*. These are composed of alternation of two different dolomite types: grey coarse-crystalline late-diagenetic dolomites and light grey, well-bedded early-diagenetic dolomites containing stromatolites and fenestral fabrics with interbeds of relic bioclastic fusulinid packstones–grainstones. Fossil remains, especially microfossils, are the same as in the *Second zone of dark limestones*, but according to Kochansky-Devidé (1965), calcareous algae are more abundant then benthic foraminifera. In some areas, several meters thick outcrops of reddish clastic rocks (siltstones and sandstones with conglomerate lenses) can be found within these dolomites, which might represent temporal and environmental equivalent to the Val Gardena sandstones of the Southern Alps.

The *Third zone of dark limestones*, outcropping at the southern slopes of the Grič hill on the Brušane–Baške Oštarije road, is intercalated between *Schwagerina dolomites* and so-called *Transitional dolomites* (Salopek, 1942). It is characterized by cyclical alternation of dark grey siltose bioclastic packstone–grainstones and thin-bedded to laminated black siltose mudstones and calcitic shales enriched in organic content (Fig. 6).

Fig. 6 The *Third zone of dark limestones* – cyclical alternation of massive dark grey siltose bioclastic packstone–grainstones and thin-bedded to laminated black siltose mudstones and calcitic shales.

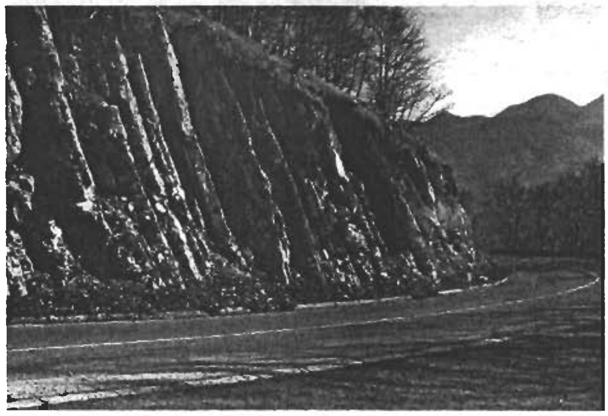

Fig. 7 Typical outcrops of very steeply inclined well-bedded *Transitional dolomites* exposed along the Brušane–Baške Oštarije road – these are the youngest Permian deposits within the Velebit Mt.

Fossil assemblage is similar to the second limestone zone (Kochansky-Devidé, 1965), although these beds contain more frequent specimens of the index fossils *Dunbarula nana* KOCHANSKY-DEVIDÉ and *Yabeina syrtalis* (DOUVILLÉ). Kochansky-Devidé (1965), with evidence based on findings of *Yabeina* within the *Second* and *Third zone of dark limestones*, proposed an Upper Permian age for this part of the sequence. Deposits of the *Third zone of dark limestones* are 79 m thick (Tišljar et al., 1991).

The youngest part of the Permian carbonate succession, light-coloured dolomite with shale intercalations, named by Salopek (1942) as *Transitional dolomite*, consistently overlies the *Third zone of dark limestones* at this locality. These are well-bedded dolomites characterized by alternation of light-coloured, mostly micro- to medium-crystalline early-diagenetic dolomites, grey to dark grey dolomicrites, and dark grey to brownish coarse-crystalline late-diagenetic dolomites.

STOP 2.4.

Clastic–carbonate deposits of Middle–Upper Triassic (Ladinian–Norian)

During the Ladinian, Carnian and Early Norian, in the area of Baške Oštarije, a carbonate platform emerged, as a consequence of regionally significant geological events during the Late Middle Triassic.

Clastic–carbonate deposits of the Middle–Late Triassic period crop out in the area of Prpići in Baške Oštarije (Fig. 8).

Fig. 8 In the Prpići settlement near Baške Oštarije clastic–carbonate rocks of Ladinian–Norian age (T_2^1–T_3^2) crops out between Anisian limestones (T_2^1) and Norian–Rhaetian *Main dolomite* (*Dolomia Principale, Hauptdolomit* – T_3^{2-3}).

The underlying deposits of Anisian age are palaeokarstified fossiliferous floatstones and rudstones, with interbeds of dark peloid–ooid packstone–wackestones with stromatolitic laminae (Fig. 9).

Fig. 9 The contact between palaeokarstified recrystallized Anisian limestones and Ladinian–Norian clastic rocks – detail from Fig. 8.

Darkened Anisian limestones are overlaid by 40–50 cm yellow–greenish tuffites, and approximately 5 m of reddish–pink haematitic siltites (greenish at weathered surface), containing granules and pebbles from the underlying limestones. Siltites are overlaid by a 1.5 m thick conglomerate with grey–green matrix; grains and pebbles mostly originated from the underlying Anisian limestones, but there are also pebbles of reddish sandstones (and rarely quartz/quartzites) 2–10 mm, rarely to 50 mm in size. The described deposits are of continental origin (including prolluvial deposits), deposited in palaeorelief depressions within karstified Anisian carbonates from Ladinian to Early Norian. Their thickness depends on the palaeorelief, and therefore is very variable. Consequently, it is common that at higher points of the palaeorelief clastic deposits are completely missing, and Upper Triassic dolomites immediately overlie Anisian limestones. The Upper Triassic *Main dolomites* (*Dolomia Principale, Hauptdolomit*) are characterized by cyclical deposition in peritidal shallowing-upward cycles, with alternation of grey to light grey fenestral stromatolitic, dolomicritic, dolopelmicritic, rarely oncoidal early-diagenetic dolomites with dark grey to brownish macrocrystalline late-diagenetic dolomites. Peritidal breccia occurs in places as a consequence of deposition within very shallow environments (some are probably reworked desiccation cracks). In the lowermost part, two layers of tuffite crop out (Fig. 10), while towards the upper part, late-diagenetic dolomites prevail, following gradual increase of deposits accumulated within protected subtidal shallows, with rare intercalations of early-diagenetic stromatolitic and fenestral dolomites.

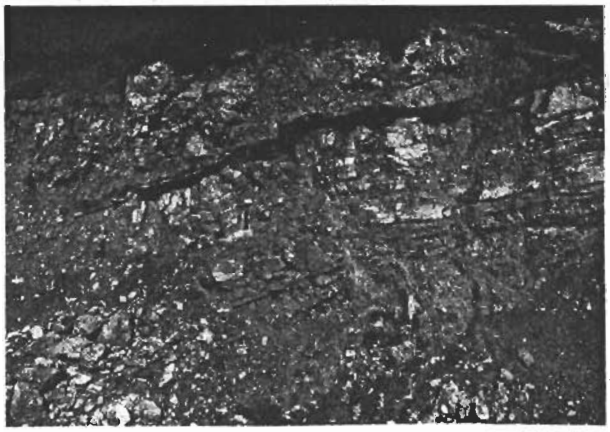

Fig. 10 Lower part of the Upper Triassic *Main dolomites* comprises two interbeds of tuffitic material. Prpići near Baške Oštarije – detail from Fig. 8.

Beds are 10–70 cm thick, most frequently 30–50 cm. Thickness of Late Triassic *Main dolomites* at the Baške Oštarije locality can be estimated at 250 m, which is less than usual for this lithostratigraphic unit; this is the consequence of an unusually long stratigraphic hiatus between the Middle and Late Triassic.

STOP 2.5.

Lower Jurassic shallow-marine carbonates (Hettangian to Pliensbachian)

In the Western part of the Baške Oštarije area and Eastern slopes of the Basača hill, the *Main dolomite* (*Dolomia Principale*, *Hauptdolomit*) is continuously overlaid by dolomites and limestones of the Lower Jurassic (Hettangian and Sinemurian – Fig. 11).

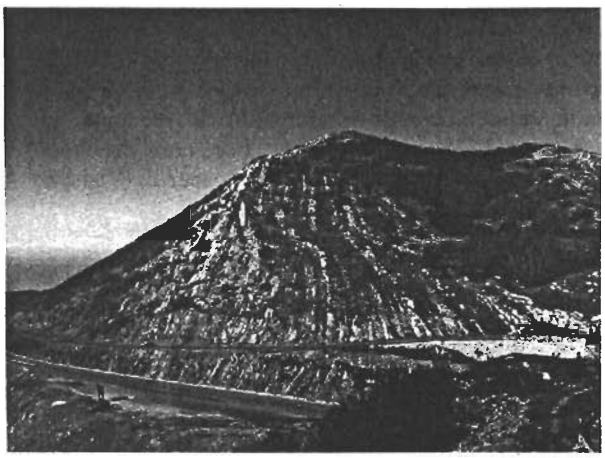

Fig. 11 Panoramic view from the Kubus locality at the oldest Lower Jurassic deposits characterized by the alternation of limestones and late-diagenetic dolomites.

At this locality, as in the other parts where this stratum crops out, within the continuous sequence, the boundary between Triassic and Jurassic is found at the base of first grey mudstones above dolomites. Since there are no elements allowing for a precise chronostratigraphic analysis, and furthermore, the investigated rocks contain no index fossils, this boundary has been described according to its lithostratigraphy: Triassic rocks comprising alternation of early- and late-diagenetic dolomites, accompanied by Jurassic rocks alternation of fossiliferous limestones and late-diagenetic dolomites.

Older Lower Jurassic deposits are well bedded (20–40 cm), with cyclically deposited limestones alternating with late-diagenetic dolomites. Most frequently, cycles are composed of grey to dark grey mudstone/wackestone – fenestral/laminated/stromatolitic mudstone – peloidal wackestone/packstone – peloid–ooid–bioclastic–intraclastic packstone/grainstone/rudstone. Towards the upper part, the layers gradually become thicker (20–90 cm), frequently with stromatolitic laminae and fenestral fabrics in the upper part of beds, and rare 10–70 cm thick ooid–bioclastic packstone/grainstones with cross bedding. Older Lower Jurassic deposits were accumulated within shallow subtidal environments of protected shallows with temporary shallowing into low intertidal and sporadic reworking of the carbonate sands from neighbouring high-energy shallows by stronger currents and storm waves.

Mudstones contain rare fossils, while intraclastic–bioclastic lithotypes comprise numerous calcareous algae, benthic foraminifera, bioclasts of bivalves and gastropods. The most common fossils are algae of the genus *Palaeodasycladus* and small lithuolid foraminifera, which presence (as well as a superposition of deposits) suggests that these deposits occurred during the Hettangian and the Early Sinemurian. The thickness of this unit in the area of Basača–Kubus is approximately 220 m. The Middle Lower Jurassic deposits are characterized by the occurrence of lituolid foraminifera of genera *Orbitopsella* (Fig. 12) and *Paleomayncina*, and litiothid bivalves (Fig. 13). In this part of the sequence dolomites are rare: only locally lenses of dark brown coarse-crystalline late-diagenetic dolomites occur (mostly within tectonically disintegrated zones).

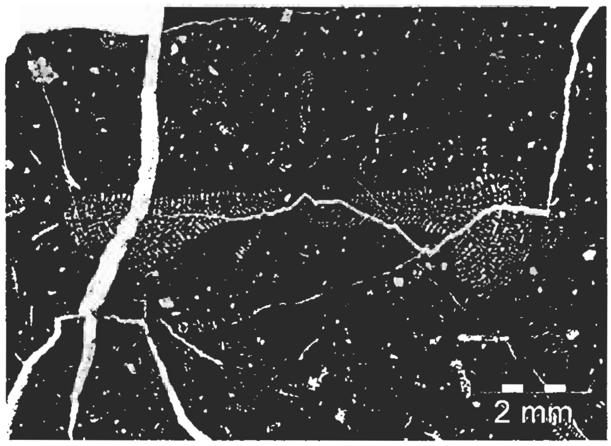

Fig. 12 Skeletal–peloid wackestone with *Orbitopsella praecursor* (GÜMBEL). Middle Lower Jurassic.

Fig. 13 Thick bed of tempestite coquina composed of reworked shells of lithiotid bivalves, including some shells preserved in living position (normal to the bedding). Regional road Gospić–Karlobag, W of Kubus.

This unit, approximately 200 m thick, can be divided into three parts: the first part, approximately 30 m thick, is characterized by the predominance of well-bedded (10–120 cm) black mudstones with thin interbeds (10–30 cm) of oncoid–bioclastic wackestone/packstones, rarely floatstones, with rare stromatolitic and fenestral laminations; the second part, approximately 110 m thick, is represented by a cyclical alternation of 20–80 cm thick dark grey to black mudstones and peloid–skeletal wackestones with 10–70 cm thick dark grey packstone/floatstones and grainstone/rudstones; the third, a 60 m thick section, is characterized by the alternation of 20–70 (rarely up to 150 cm) thick beds of mudstone and/or peloid–skeletal wackestones, rarely packstones, with 80–160 cm thick tempestite coquinas composed of lithiotid shells formed by redeposition of biodetritus into subtidal and lagoonal environments. In some layers shells in growth position can be found. In the uppermost part of this lithofacies, besides lithiotis coquinas nice brachiopod, tempestite coquinas can be found.

STOP 2.6.

Lower Jurassic bioturbated limestones (Toarcian)

Toarcian bioturbated limestones are usually referred to as *Spotty limestones* (Sokač et al., 1974, 1976; Tišljar et al., 1991; Velić & Sokač, 2005).

This unit is composed of intensely bioturbated mudstone/wackestones, which are characterized by their mottled appearance at bedding planes (Fig. 14), as a consequence of the variable amount of organic matter in the host rocks and bioturbations, as well as later diagenetic processes.

Fig. 14 Upper bedding plane of intensely bioturbated micritic *Spotty limestones* showing typical mottled appearance of yellowish, mostly horizontal bioturbations. Upper part of the Lower Jurassic.

Bioturbations are usually yellowish, mostly horizontal, sporadically subvertical, 8–20 cm in diameter.

Besides frequent mudstones to peloid wackestones, bioclastic–peloidal wackestones containing variable quantity of bivalves bioclasts, gastropods, echinoids, small foraminifera, cortoids, peloids and ooids can be found. Limestones are well-bedded (10–60 cm), and the upper part of the unit is commonly intensely late-diagenetically dolomitized. Total thickness of the unit is approximately 100–130 m. Although there are some fossils present, stratigraphically more important forms have not been found; however, according to the superpositional relationships within the Jurassic succession, it is clear that the *Spotty limestones* are of the late Early Jurassic age, i.e. Toarcian.

Deposition of the *Spotty limestones* represents a regionally important event recorded over the large part of the Karst Dinarides. As a consequence of the interaction between the global eustatic changes (recorded by the Oceanic Anoxic Event during the Toarcian) and synsedimentary tectonics, the joining of the Belluno and Ionian basins gave rise to the formation of the Adriatic Basin. This produced a new palaeogeographic entity, the Adriatic Carbonate Platform, which consequently became isolated from its counterparts, the Apenninic and the Apulian Carbonate Platforms. For more details on the regional palaeogeography see the paper by Vlahović et al. (2005).

STOP 2.7.

Oligocene–Miocene *Jelar breccia*

The *Jelar breccia* covers a large area of the W and SW slopes of the Velebit Mt. (Fig. 15), over 2 km wide and stretching for more than 100 km.

Fig. 15 Prominent peaks of Tulove Grede at SW slopes of the Velebit Mt. near the Sv. Rok road tunnel composed mostly of *Jelar breccia*.

However, within this zone, several outcrops of the tectonically disturbed underlying limestones have been found, which became progressively younger towards the West. The *Jelar breccia* are in contact with Oxfordian limestones, partly disconformable and partly faulted, and the first outcrops of underlying deposits are of the Neocomian age. Along the road towards Karlobag, several outcrops of underlying rocks have been found, mostly Neocomian, but near the coast Aptian, and at the coast Albian in age. This indicates that along the western slopes of the Velebit Mt. the *Jelar breccia* apparently covers a continuous succession of the Lower Cretaceous rocks, although heavily tectonized.

The composition of grains within the *Jelar breccia* is very interesting. *Jelar breccia* are massive carbonate breccia composed of various, mostly angular to subangular, weakly sorted rock clasts, mostly clast-supported, containing variable amount of fine-grained calcareous, grey, or reddish coloured matrix. Clast size is very variable, from several mm to boulders several dm in diameter, but the most common grains are 2–10 cm in diameter (Fig. 16).

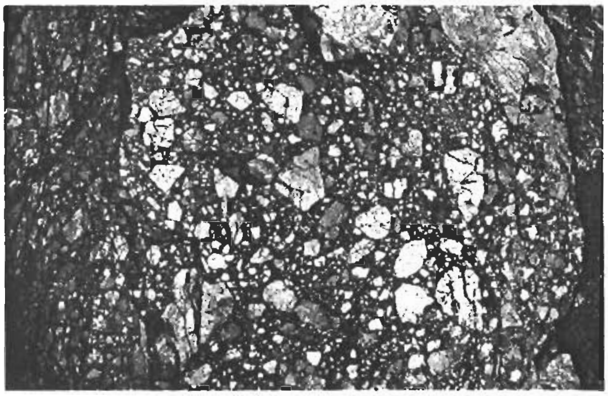

Fig. 16 *Jelar breccia* composed of angular clasts of Upper Cretaceous limestones within reddish calcareous matrix.

Along and near the contact with the Oxfordian limestones, very small and tectonized dark grey clasts of these rocks prevail, while not far away from the boundary, Neocomian massive grey-brownish mudstone clasts occur, which soon becomes the most abundant grains. These clasts are predominant, except in the area where tectonized Lower Aptian yellowish massive mudstones with palorbitolinids probably occur, where clasts of this lithology prevail.

However, a very interesting outcrop is visible in the central part of the zone covered by the *Jelar breccia*, where a significant fraction of the clasts, and at some spots nearly all, originated from the Upper Cretaceous rocks: yellowish recrystallized mudstones, packstones and bioclastic packstone/floatstones (of probable Cenomanian age) and very light, almost white calcisphaera limestones (probably originated during the regionally important geological event near the Late Cenomanian–Early Turonian transition). This occurrence provides further evidences for important tectonic activity along the faults which are today covered by the *Jelar breccia* (intense tectonics were instrumental to the considerable mechanical disintegration of source rocks essential for the formation of this tectonostratigraphic unit – see Fig. 17).

Fig. 17 Traffic sign along the regional road Gospić–Karlobag within the zone of the *Jelar breccia* shows simplified interpretation of their origin (and two "nice" geologists).

Consequently, today, Upper Cretaceous rocks are not found anywhere near these outcrops: the closest occurrences of the Cenomanian and Turonian deposits are more than 10 km North in the vicinity of Gospić (but across the Velebit Mt.), some 20 km Southeast (area of Marasi, Devčići, and Barić Draga), or some 2–5 km Southwest (across the Velebit channel, on the island of Pag).

The age of the *Jelar breccia* formation cannot be determined on the basis of their matrix, which contains no fossil remains, but can be estimated as Late Eocene to Oligocene/Miocene on the basis of clast composition (including Eocene clasts within *Jelar breccia* found in the vicinity of Baške Oštarije), superpositional relationships, and age of the largest tectonic activity in the area.

References

GRADSTEIN, F.M. et al. (2004): A Geologic Time Scale 2004.– Cambridge University Press, 611 p.

KOCHANSKY-DEVIDÉ, V. (1965): Karbonske i permske fuzulinidne foraminifere Velebita i Like – srednji i gornji perm.– Acta geologica, 5, 101–148, Zagreb.

KRAINER, K. (1993): Late- and Post-Variscan Sediments of the Eastern and Southern Alps.– In: Von RAUMER, J.F. & NEUBAUER, F. (eds.): Pre-Mesozoic Geology in the Alps. Springer-Verlag, Berlin–Heidelberg, 537–564.

MARJANAC, T. & SREMAC, J. (1988): Permski grebenski kompleks na srednjem Velebitu.– Geol. anali Balk. poluostrva, 51, 293–302, Beograd.

SALOPEK, M. (1942): O gornjem paleozoiku u okolini Brušana i Baških Oštarija.– Rad HAZU, 274, 218–272, Zagreb.

SOKAČ, B., NIKLER, L., VELIĆ, I. & MAMUŽIĆ, P. (1974): Osnovna geološka karta SFRJ, list Gospić 1:100 000, L 33–127.– Inst. geol. istraž. Zagreb, 1963–1967, Sav. geol. zavod Beograd.

SOKAČ, B., ŠĆAVNIČAR, B. & VELIĆ, I. (1976): Osnovna geološka karta SFRJ 1:100 000. Tumač za list Gospić, K 33–127.– Inst. geol. istr. Zagreb, 1967., Sav. geol. zavod Beograd, 64 str.

SREMAC, J. (1991): Zona Neoschwagerina craticulifera u srednjem Velebitu.– Geologija, 34, 7–55, Ljubljana.

SREMAC, J. (2005): Biolititi srednjega perma, Paripov jarak.– In: VELIĆ, I., BLAŠKOVIĆ, I., SREMAC, J., SOKAČ, B., POLLAK, D., KLJAJO, D. & VLAHOVIĆ, I. (2005): Ekskurzija A2 – Krški Dinaridi: taložne sekvencije, paleogeografska dinamika i recentni tektonski odnosi u Kapeli, Velebitu i Vinodolu.– 3. Hrvatski geološki kongres Opatija, 2005, Vodič ekskurzija, Hrvatski geološki institut, 33–36, Zagreb.

TIŠLJAR, J., VLAHOVIĆ, I., SREMAC, J., VELIĆ, I., VESELI, V. & STANKOVIĆ, D. (1991): Excursion "A" – Velebit Mt., Permian–Jurassic.– In: VLAHOVIĆ, I. & VELIĆ, I. (eds.): "Some aspects of the shallow water sedimentation on the Adriatic carbonate platform (Permian to Eocene). "The Second Int. Symp. on the Adriatic Carbonate Platform", Excursion guidebook, Zadar, May 1991., Inst. of Geology, Zagreb, 1–49, Zagreb.

VELIĆ, I. & SOKAČ, B. (2005): Brušansko–oštarijska antiklinala.– U: VELIĆ, I., BLAŠKOVIĆ, I., SREMAC, J., SOKAČ, B., POLLAK, D., KLJAJO, D. & VLAHOVIĆ, I. (2005): Ekskurzija A2 – Krški Dinaridi: taložne sekvencije, paleogeografska dinamika i recentni tektonski odnosi u Kapeli, Velebitu i Vinodolu. 3. Hrvatski geološki kongres Opatija, 2005, Vodič ekskurzija, Hrvatski geološki institut, 37–38, Zagreb.

VLAHOVIĆ, I., TIŠLJAR, J., VELIĆ, I. & MATIČEC, D. (2005): Evolution of the Adriatic Carbonate Platform: palaeogeography, main events and depositional dynamics.– Palaeogeography, Palaeoclimatology, Palaeoecology, 220, 333–360.