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GEOLOGY OF THE NATIONAL PARK „PAKLENICA"

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Nationalni park „Paklenica" is situated in the Velebit Mt., one of the geologically ang geomorphologically most interesting regions of Dinarides. (Fig. 1).

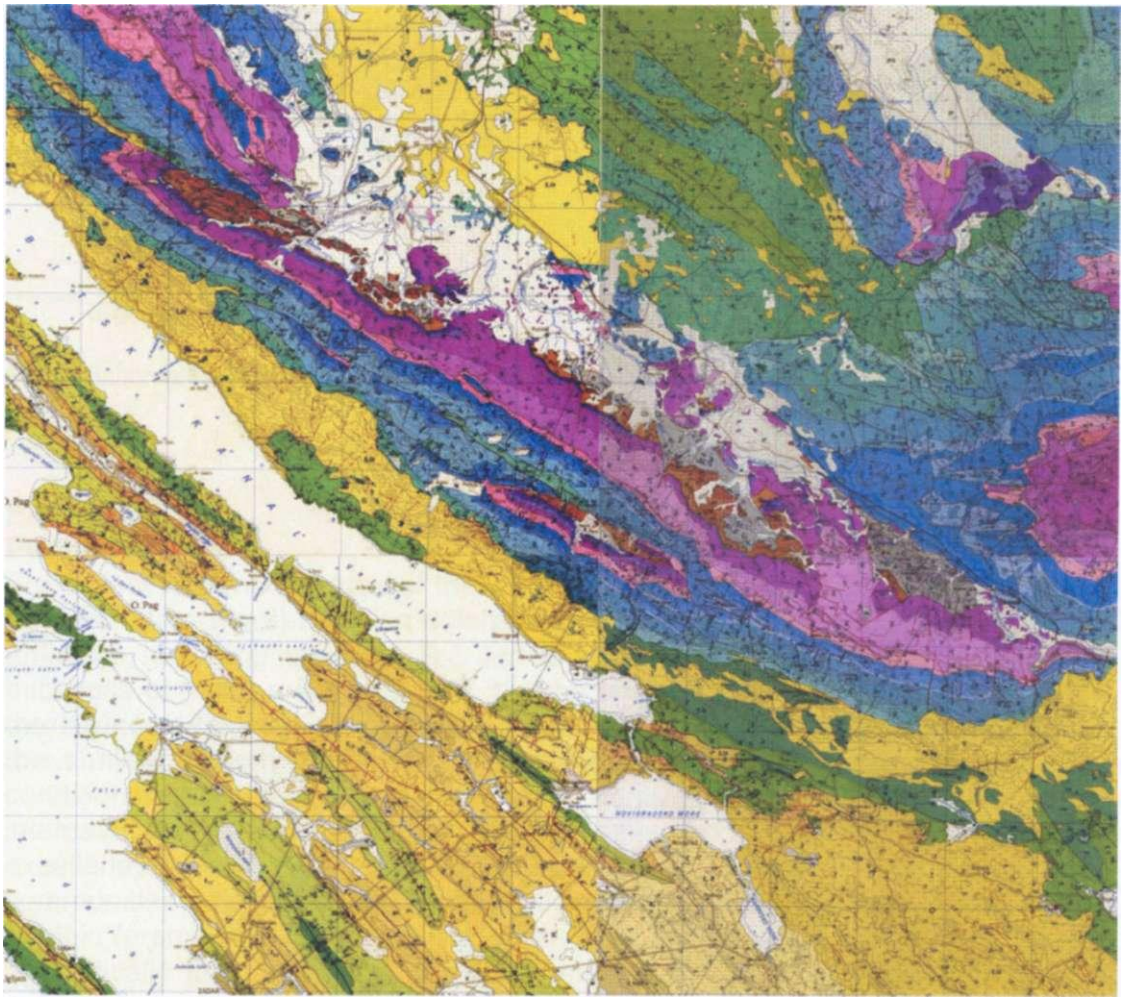

Fig. 1. Geological map of the wider area of Paklenica 1:100 000 (from the Basic Geological map of Yugoslavia, sheets Gospić and Zadar (Majcen et al., 1973; Sokač et al., 1976) . The oldest Permian rocks are brown and brownish-gray coloured. They are surrounded with Triassic (violet), Jurassic (blue) and Cretaceous rocks (green). Clastic Palaeogene rocks (yellow) are particularly well exposed along the Adriatic coast.

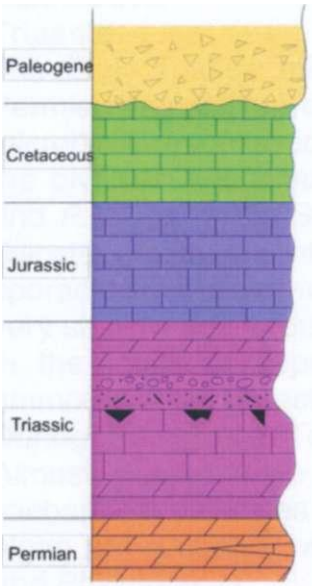

Fig. 2. Schematic geological column of the area of the National park Paklenica.

PALAEOZOIC

Permian

The oldest rocks in the area of the National park Paklenica belong to the Middle-Late Permian (Fig.2) Permian dolomites compose a core of the Velika Paklenica anticlyne, covering the area 9,5 km long and 1 km wide (Fig. 1). Minimum thickness of these rocks is 500 m, but the underlying horizon is not exposed on the surface (Salopek, 1952, from Sremac, 2005). Dolomites were deposited on the shallow bottom of the former tropical sea (Fig.3) in palaeoenvironmental conditions similar to the recent Bahama Bank. Within the Permian dolomites, intercalations of black limestones and shales occur sporadically, containing excellently preserved marine fossils.Rich and diverse shallow marine communities are composed dominantly of green and red calcareous algae, benthic foraminifera, calcareous sponges, bryozoans and brachiopods (Plate 1). Sporadically fossil molusks, sea lillies and echinoids occur. Some of the taxa were wide-spread in the Palaeotethys, but endemic species can be also found, particularly among brachiopods.(e.g. *Martinia velebitica).* Importance of the Velebit Palaeozoic microfauna can be recognized through the internationally accepted names of taxa, such as *Velebitella, Mizzia velebitana, Gyroporella likana;*

The most common Permian microfossil in the Permian of Paklenica is a small fusulinid foraminifera *Eoverbeekina paklenicensis.*

In the uppermost Permian horizons clastic intercalations become more common. These yellowish rocks were named .Transitional dolomite" by Salopek, 1952. A presumed continuous transition into the Early Triassic was confirmed by recent geochemical and isotope analyses. Evidences of the end-Permian catastrophe were so far traced at two sections at the Velebit Mt. (Fio et al. 2006 a,b)

MESOZOIC

Triassic

The Early Triassic mixed clastic and carbonate rocks continuously overly the Permian transitional dolomites. The first evidences of life after the PTB are microbialites. In clastic intercalations typical scythian fauna was found, including the bivalves *Anodontophora fassaensis, Pseudomonotis (Claraia)* cf. *tridentata* and *P.(C.)* cf. *kittlii.* Source of the clasts is combined - terrestrial and marine. Silicate grains are often cemented with dolomite. Ferruginous oolites occur sporadically. Ripple marks and cross-lamination in these rocks are typical for a very shallow and turbulent marine environment. Sea-level rise lead to the change in the mode of deposition. Campilian dolomites contain amonites, but the ammount of the terrestrial component in these rocks is still high.

During the Middle Triassic (Anisian) terrestric influence abruptly decreases. Almost pure marine carbonate rocks occur, among which late-diagenetic sacharoidal dolomites and laminated fine-grained dolomites prevail. Calcareous algae are common, with dominant genera *Diplopora, Macroporella, Oligoporella* and *Physoporella.*

Ladinian rocks have not been found in this area, and Late Triassic (Norian-Rhaetian) dolomites overly the Anisisan rocks. These rocks are well stratified, purely marine in origin and contain the indeks species *Gyroporella vesiculifera.* Three lithotypes can be distinguished in the Park: microbialites, dolomitized oolitic kalkarenites and pure crystalline dolomites.

Jurrasic

The highest parts of the Velebit Mt. Are built up of the Jurassic rocks, countinuously overlyying the Triassic rocks. Marine calcarenites and biolitites can be observed, with no clastic input from the land.

Lower Jurassic calcarenites contain calcareous algae *Palaeodasycladus barrabei, P. mediterraneus, Petrascula heraki, P. illyrica, Thaumatoporella parvovesiculifera,* and small gastropods. Bioaccumulated lithiotid limestones contain numerous lithiotid bivalves, foraminifer *Orbitopsella* ,calcareous algae, gastropods and brachiopods. These are the typical deposits of a carbonate shelf.

Middle Jurrasic deposits exhibit the visible environmental change. Fossil communities are less diverse, and dolomites can be well recognized in the field by their spotty outlook. Indeks taxa of microfossils were found in these rocks, such as *Selliporella donzelii, Teutloporella gallaeformis, Pfenderina salernitana* and *Meyendorffina bathonica.*

Upper Jurrasic limestones were continuously deposited on spotty dolomites. They contain a typical microfauna: *Kurnubia palastiniensis, Pseudocyclammina lituus, Griphoporella minima, Cylindroporella anici, Macroporella sellii, : M. pygmaea* i druge. Limestones are dark-coloured, kalkarenites to calcilutites in structure. Rather high amount of magnesium ions in calcite crystals indicate the warming in this period.

Cretaceous

Cretaceous rocks transgressively overly the Jurassic limestones. They are in most cases covered with Palaeogene Jelar beds, and outcrop sporadically in the southernmost part of the National park Paklenica. Calcareous breccias prevail, with scarce fossils of mollusks, foraminifera (e.g. *Orbitolina* cf. *discoidea)* and calcareous algae.

CAENOZOIC

Tertiary

Calcareous breccias cover the large areas on southwestern slopes of the Velebit Mt. More details on their composition and origin can be found in a separate article (Vlahovic et al.) in this Field Guide.

Quaternary

Glaciofluvial deposits, including the slope breccias, appear at several localities in the Park. Their are composed of angular carbonate fragments originating from higher parts of the Velebit Mt. Wurmian age was presumed for these deposits.

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PERMIAN-TRIASSIC BOUNDARY IN THE VELEBIT MT.

Jio, DC., Spangen6erg, J., Sremac, J., yCaftovic, I., \etit, I. and Mrinjek, T.

(Causes of Permian/Triassic Mass Extinction at The Velebit Mt, Croatia: Geochemical And Isotopical Insights. Reprint from 2nd Slovenian Geological Congress, Idrija, 2006)

A detailed paleontological, isotopic, organic and inorganic geochemical study, including major, trace and rare earth elements distribution, has been done for samples from the Rizvanusa locality, Velebit Mt. (SW Croatia), in order to explain environmental changes at the Permian/Triassic boundary. Continuous Permian/Triassic transitional beds in this area are mainly represented by early- to late-diagenetic dolomites. The most abundant fossils found within early-diagenetic dolomites are calcareous algae, foraminifera, calcisponges, bryozoans, brachiopods and mollusks. The drastic impoverishment of biota in the uppermost Permian is associated with a negative excursion at the transition of the $\delta^{13}C$ values of carbonates by up to 3‰ (P: -0.8 to +2‰, average +1.2±0.5‰; T: -1.3 to +0.9‰, 0.0±0.5‰), kerogen by up to 5‰ (P: -27.3 to -24.4‰, -25.8±0.9‰; T: -29.1 to -26.4‰, -27.5±0.4‰). The decrease in the $\delta^{13}C$ values in the carbonates and kerogens is synchronized with a drop in $\Delta^{13}C_{carb\text{-}ker}$ by 2‰, indicating lower productivity at the P/Tr transition. The $\delta^{15}N$ values vary between -2.4 to +8.2‰ (P: +3.7±2.8‰; T: