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NEW DATA ON THE JURASSIC STRATIGRAPHY OF BRINJE (CROATIA – OUTER DINARIDES) – AN INTERESTING TUNNEL PROFILE FROM THE UPPER RHAETIAN TO JURASSIC

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In the region of the new highway building Bregana-Zagreb-Dubrovnik, in the part of the tunnel Mala Kapela South – Zuta Lokva from Brinje to Zuta Lokva, the mountain has been investigated by means of 200 thin-sections stratigraphically and microfacially, including both, outcrop samples (OT series) and from the tunnel itself (TM series). Palaeogeographically, the succession belongs to the Outer Dinarides of the Adriatic-Dinaric Platform.

The Triassic/Jurassic boundary is not marked by a lithological change, but is characterized by a gradual transition. The Jurassic series of a shallow water facies has been evidenced stratigraphically by means of benthic foraminifera from the Upper Sinemurian to Lower Pliensbachian to the Kimmeridgian (? Tithonian).

While the reconstruction of the general facies evolution in this area is comparable well known, e.g. TISLJAR (2002) and VELIC (2002), including also stratigraphical, sedimentological and mikrofacies data, the palaeogeographical position especially of the lower and middle-upper Jurassic series needs further precision.

The succession is composed as follows:

The oldest parts can be dated as uppermost Rhaetian with the occurrence of *Griphoporella curvata* (GÜMBEL) PIA and *Tetrataxis*? *inflata* KRISTAN and *Tetrataxis*? *nanus* KRISTAN-TOLLMANN. These are foraminifera-rich packstones containing also scattered remains of reef-building organisms.

The early Liassic consists of packstones of reduced thicknesses and couldn´t be dated biostratigraphically. The upper parts comprise dark-brownish and slightly bituminous mudstones, partly showing brecciation, algal laminites, foraminifera wackestones with *Palaeomayncina termieri* (HOTTINGER) or *Amijiella amiji* (HENSON), poorly fossilized peloidal packstones of presumably faecal origin and *Favreina* wackestones. A further characteristic microfacies type are wackestones, composed almost exclusively and in great abundances of the tubes of *Porferitubus buseri* SENOWBARI-DARYAN. The rare ooidal grainstones, sometimes with high abundance of oomoldic ooids, can be interpreted as tidal bar deposits since these are not in any connection to external platform facies. In conclusion, the Liassic sediments can be ascribed to a mud flat facies due to their microfacies characteristics. With the occurrence of *Palaeomayncina termieri* (HOTTINGER) they are of Upper-Sinemurian to Lower Hettangian age (BASSOULLET 1997). The microproblematicum *Porferitubus buseri* was so far only known from Norium-Rhaetium reefal limestones (BERNECKER 1996).

The Dogger couldn´t be dated stratigraphically, because of the lack of marker microfossils and partial dolomitization. In the area of Velika Kapela, a comparable Jurassic section with dolomitic parts in the Upper Liassic – Lower Dogger and the Oxfordian has been described by MATICEC et al. (1997). In the Upper Jurassic part of our section there are also mudstones, but much less frequent than in the Liassic. There are wackestones partly containing *Alveosepta jaccardi* (SCHRODT) enriched in certain layers, indicating the time-span Upper Oxfordian to Lower Kimmeridgian (BASSOULLET, 1997). Some kind of back-reef facies is represented by *Bacinella* bindstones with „Rivulariaceae“ and also biosparitic packstones with *Labyrinthina mirabilis* WEYNSCHENK and trocholinids. The occurring stromatoporoid-coral limestones and the laterally associated back-reef can be dated as Kimmeridgian with *„Kilianina“ rahonensis* FOURY & VINCENT, *Labyrinthina mirabilis* WEYNSCHENK and

Conicokurnubia orbitoliniformis SEPTFONTAINE. In the Gorski Kotar region, *C. orbitoliniformis* occurs in the lower part of the Kimmeridgian (*Heteroporella anici* Zone) according to TISLJAR & VELIC (1993). The most abundant stromatoporoid is *Actinostromina grossa* (GERMOVSEK). Further microfossils include *Mohlerina basiliensis* (MOHLER), *Thaumatoporella, Lithocodium-Bacinella* and fairly common *Nipponophycus ramosus* YABE & TOYAMA. Dasycladales are extremely rare in the whole investigated profile; in the Upper Jurassic we find rare *Salpingoporella* cf. *johnsoni* (DRAGASTAN) und *Dissocladella*? sp. For the reefal limestones, VELIC et al. (2002: S. 131) indicate a Middle Kimmeridgian/Tithonian age.

A carbonate slope/ramp facies is represented by fine-grained packstones with echinoid and sponge remains as well as tubiphyts. Noteworthy, that in this part also dolomites occur.

From the Oxfordian-Kimmeridgian boundary onwards the installation of a shallow water platform started first with lagoonal sediments. During the lower Kimmeridgian, after a regressional phase, the installation of a carbonate ramp took place, correlated with a sea-level highstand, followed by a regressive-transgressive cycle, leading also to the formation of the dolomites presumably under early-diagenetic (?evaporitic) conditions. These are followed by massive reefal limestones with a stromatoporoid-coral assemblage, representing a sea-level highstand und probably passing also into the Tithonian. This succession corresponds in its microfacies and lithology the most that one described by VELIC et al. (2002). Due to our new results, however, some minor modifications of facies zones are necessary for the region of Brnje.

The sedimentary Jurassic succession of shallow water origin, is clearly distinguished from the Jurassic series known from the Southern Alps, Eastern Alps or the Carpathians. This also accounts for the reconstructed thicknesses of different stratigraphic levels. In addition there a also differences in biofacies, e.g. the occurrence/absence of certain microfossils. For example, the larger benthic foraminifera *Conicokurnubia orbitoliniformis* SEPTFONTAINE so far known from Tunisia, Turkey (type-locality) and the Dinarides is missing in Kimmeridgian shallow water limestones of the Northern Calcareous Alps. Also in areas where the Triassic/Jurassic boundary isn´t marked by a carbonate platform drowning as in the Northern Calcareous Alps, such as the Dinarids or Morocco, certain microfossils that disappeared in the former persisted in the Liassic such as tetrataxid foraminifera (e.g. BASSOULLET et al., 1999).

In conclusion, these observations clearly demonstrate, that the Eastern and Southern Alps on the one side and the Dinarides on the other side were clearly separated palaeogeographically from each others in Early to early Late Jurassic times, whereas in Rhaetian and Late Jurassic times the sediments show a similar facies evolution. These results have to be proofed in a greater regional scale.

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