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Microfacies and biostratigraphy of an Upper Triassic Dachstein limestone fore-reef block in the Jurassic Sirogojno carbonate-clastic Mélange (Zlatibor Mt., SW Serbia)

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Abstract. In the late Middle to early Late Jurassic carbonate-clastic Sirogojno Mélange in the Zlatibor Mountain there is one roughly 35 m thick overturned block with an intact Late Triassic fore-reefal Dachstein Limestone succession studied for its biostratigraphic age, content and microfacies characteristics. The succession starts with coarse-grained rudstones followed by meter-sized reefal blocks intercalated in partly layered resedimented grainstones and packstones with abundant reef-building organisms like calcareous sponges, corals and encrusting organisms. Inside this part of the succession open-marine influenced layers are rare. The succession continues with a partly turbiditic sequence and chaotic rudstones, densely packed with reef-derived material like broken reef-building organisms and shallow-water material like gastropods, bivalves and foraminifers. Grainstones with clear open-marine influence (e.g., thin-shelled bivalves, crinoids, conodonts) appear in between those rudstones, in cases lumachelle layers be composed of halobiids were deposited. To the end of the succession some layers show turbiditic bedding with mixed shallow-water and deep-marine grains and organisms, i.e. filaments and crinoids. On base of conodonts, foraminifers, calcareous algae, holothurians and halobiids throughout the whole studied succession, a middle Norian (Alaunian) to Rhaetian 1, most probably a late Norian (Sevatian) age can be assigned to this fore-reefal Dachstein Limestone succession, with a similar sedimentation pattern like Late Triassic Dachstein fore-reef limestone facies, e.g., in the Northern Calcareous Alps or the eastern Southern Alps. The study of this block in the Sirogojno Mélange closes an important gap in knowledge about the extent, facies and stratigraphy of the Dachstein Carbonate Platform evolution in the Dinarides.

Key words:
Western Tethys realm, Inner Dinarides, Facies, Triassic, Palaeogeography.

Апстракт. У касносредњем до ранокасном јурском Сирогојно карбонатно-кластичном Меланжу планине Златибор проучаван је преврнут блок дахштајнског предспрудног кречњака дебљине око 35 метара. На основу утврђене биостратиграфске старости, садржаја флоре и фауне и каракте-

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ристика микрофација одређена је његова горњотријаска сукцесија. Започиње грубозрним радстонима иза којих следе блокови спруда метарске величине инкорпорирани у делимично реседиментоване грејнстоне и пекстоне са бројним организмима – градитељима спрудова као што су кречњачке спонгије, корали и обавијајући организми. У оквиру овог дела сукцесије слојеви са отворено морским утицајима су ретки. Сукцесија се наставља са делимично турбидитском секвенцом и хаотичним радстонима са густо пакованим материјалом са спруда као што су разорени организми, градиоци спруда, и плитководни материјал представљен гастроподима, шкољкама и фораминиферима. Грејнстони са јасно видљивим утицајем отвореног мора (нпр. шкољке танких љуштура, криноиди, конодонти) појављују се између ових радстона. Понегде се депонују слојеви лумакела са халобијама. На крају сукцесије неки слојеви имају турбидидску слојевитост са мешаним плитководним и дубоководним зрнима и организмима тј. криноидима и филаментима. На основу присуства конодоната, фораминифера, кречњачких алги, холотурија и халобија, одређена је средњонаричка (алаунски поткат) до рано ретска (рет 1), највероватније касно норичка (севатски поткат), старост предспрудног дахштајнског кречњака. Сукцесија је сличних седиментолошких особености као и каснотријаске предспрудне фације дахштајнских кречњака, који се појављују у Северним кречњачким Алпима или источним Јужним Алпима. Изучавање блока у Меланжу Сирогојна испуњава значајну празнину у познавању простирања, фација и стратиграфије, као и целокупне еволуције Дахштајнске карбонатне платформе Динарида.

Кључне речи:
Област западног Тетиса, Унутрашњи Динариди, фације, тријас, палеогеографија.

Introduction

Dachstein Limestone (Late Triassic) in fore-reef facies is relatively rare in the Inner Dinarides and generally in the Balkan region. In the Inner Dinarides the microfacies, biostratigraphy and depositional history of Late Triassic reefal to fore-reefal Dachstein carbonates is practically unknown. The reasons are that the Late Triassic reef belt of the Dachstein Carbonate Platform in the Dinarides is not preserved due to younger tectonic processes, or it was not yet detected. However, this facies zone has not been described in detail for the Dinarides, and therefore, it provides the opportunity for a better understanding of the Late Triassic sedimentary history of the Dachstein Carbonate Platform and the Late Jurassic still controversially discussed geodynamic history (for recent reviews see Schmid et al., 2008, 2020 and Gawlick et al., 2020 and references therein) of the Inner Dinarides.

In general, the Triassic-Jurassic geodynamic evolution of the Dinarides is fairly well understood and similar in the whole Western Tethys realm (compare Gawlick & Missoni, 2019 and references therein), with few modifications for each region and mirrors a complete Wilson cycle: The rift stadium (Late Permian to the middle Anisian graben stage) is followed by a passive continental margin evolution subdivided into two stages. In the first stage (Middle to Late Triassic) deposition is characterized by formation of Late Triassic shallow-water carbonate platforms (Wetterstein and Dachstein Carbonate Platforms), whereas in the Early and Middle Jurassic deposition is characterized by more open-marine and deeper water limestones. In the Middle Jurassic the situation changed due to the onset of west-directed ophiolite obduction (Gawlick & Frisch, 2003; Gawlick et al., 2008; 2016), and the former passive continental margin attained a lower plate position. Trench-like foreland basins formed and propagated in the frame of the west-directed ophiolite obduction. During this process the older passive continental margin configuration get destroyed, eroded or overthrust. Therefore, some facies belts of the Middle Triassic to Middle Jurassic distal passive margin are not well preserved, in some cases they are metamorphosed, overthrust or only available as blocks in the different sedimentary mélanges (Gawlick et al., 2017a, b for further reading).

plete Middle–Late Triassic stratigraphic sequence. Missoni et al. (2012) and Sudar et al. (2013) clearly demonstrated the sedimentary mélange character

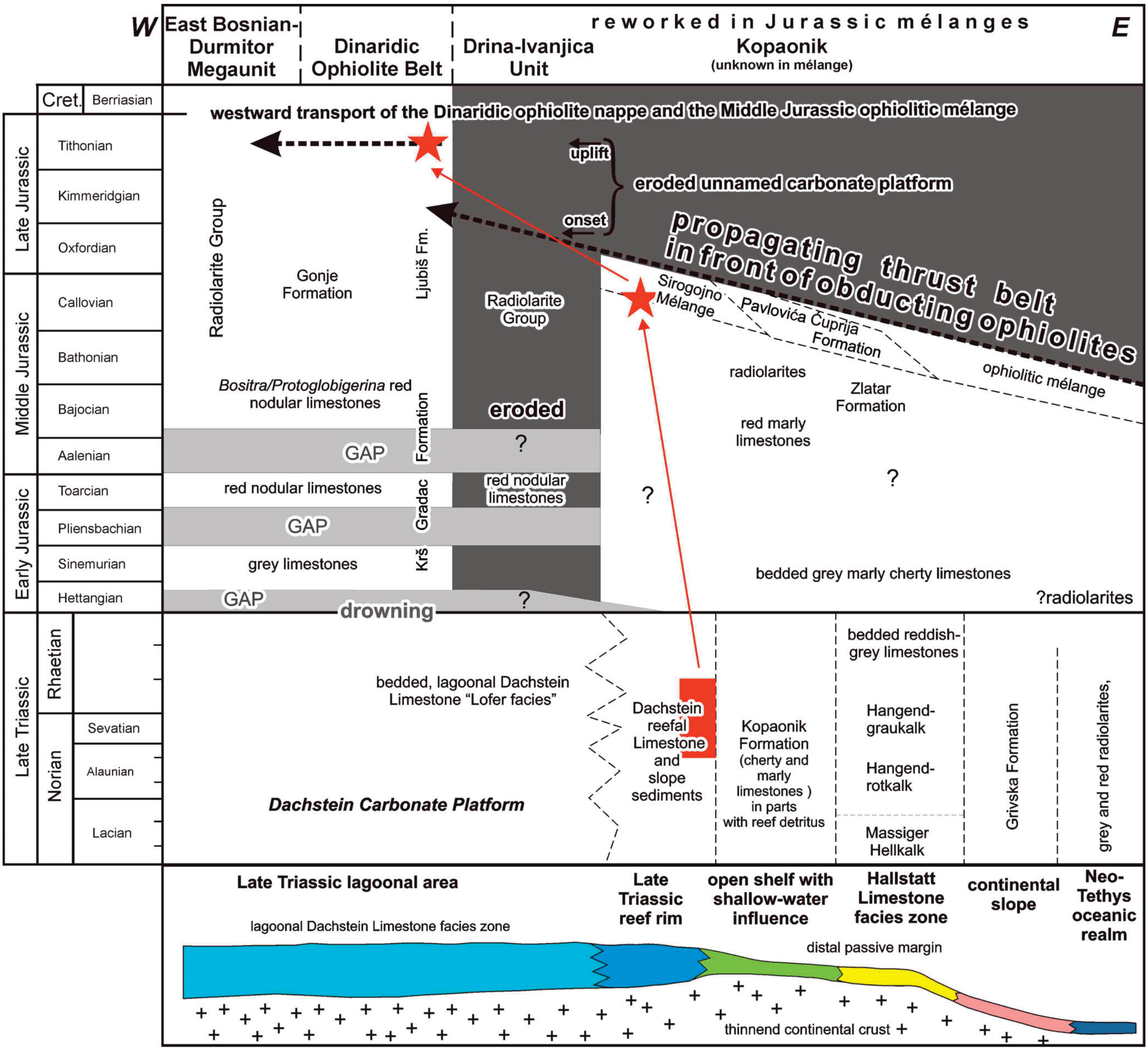

Fig. 1. Late Triassic to Late Jurassic stratigraphic table of the Inner Dinarides modified after Gawlick & Missoni (2019). The studied section is a resedimented block in the late Middle to early Late Triassic sedimentary Sirogojno carbonate-clastic Mélange. The original palaeogeographic position and multiphase west-directed transport (for details see Gawlick et al., 2020) of this far travelled Dachstein Limestone fore-reef block is indicated in red.

First studies on this overturned Dachstein reefal limestone block, but only from its lower part, were carried out by Dimitrijević & Dimitrijević (1991), who interpreted these reefal limestones as part of a complete Middle–Late Triassic stratigraphic sequence.

of the whole study area (Figs. 1, 2) and a reinvestigation of this Dachstein Limestone block started and was presented by Gawlick et al. (2017b). Dimitrijević & Dimitrijević (1991) assigned the age of these car-

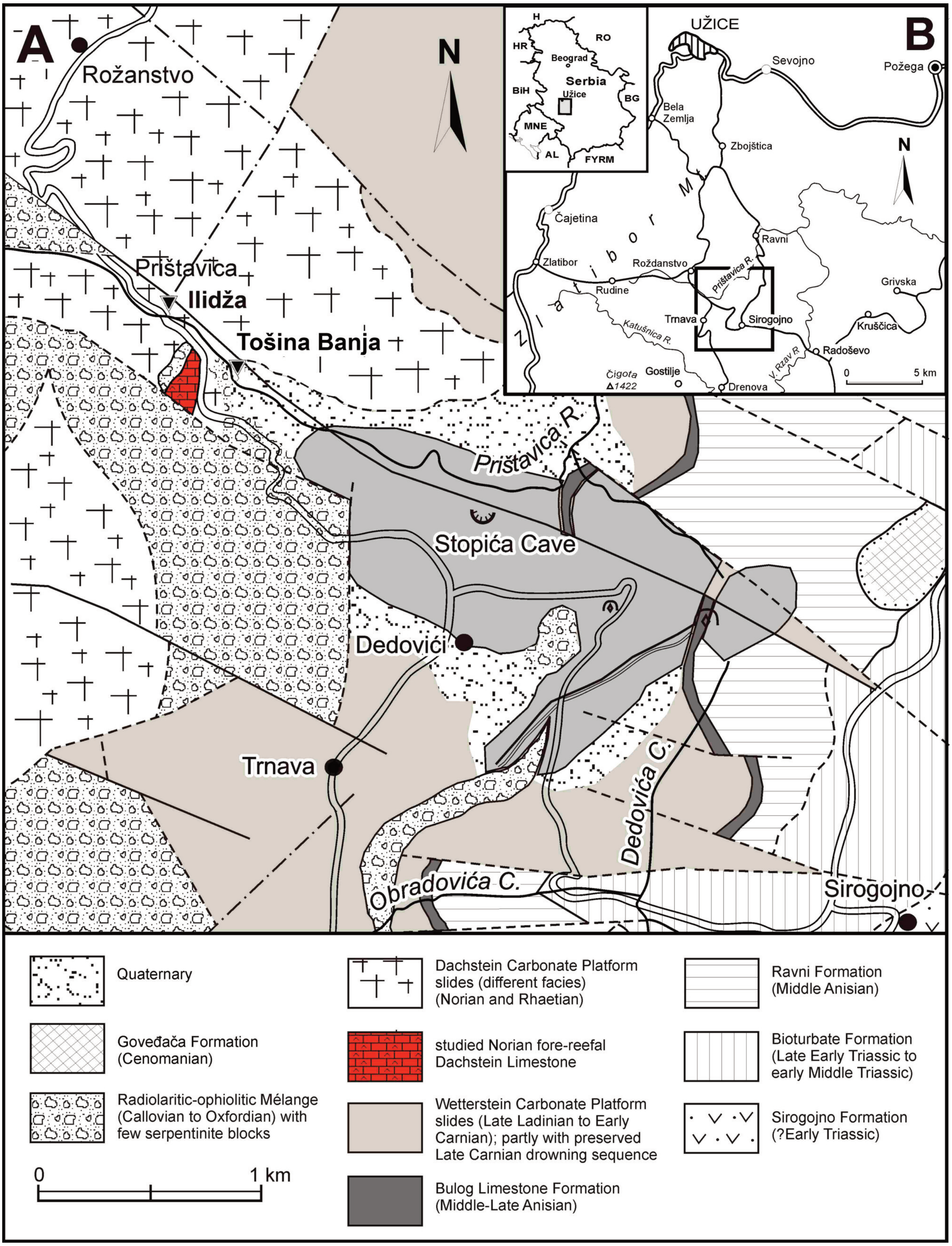

Fig. 2. A. *Modified geological map of the wider study area between Sirogojno and Rožanstvo villages (after* Radovanović *&* Popević*, 1999;* Missoni *et al., 2012;* Gawlick *et al., 2017a, b). The studied block marked in red.* ***B.*** *Geographical sketch map of the study area.*

bonates (“area of patch reefs” as part of the Dachstein Formation or “Dachstein Reef Complex”) on base of foraminifers and reef building organisms as (?upper) Carnian to Rhaetian, but did not recognized its block character. These authors distinguished inter-reef lagoons, reef sands, reef flat, reef framework, reef slope, and described corals, bryozoans, algae, and in places lumachelle nests of pelagic bivalves (*Monotis*? and halobiids). In the time of the early investigations (1980–1992) of this part of the section near to the road (Fig. 2) and in the surroundings of the samples OZ 8 and OZ 9 and near the samples SRB 461 and SRB 462 (Fig. 3) existed a lumachelle layer or nest with halobiid shells, but it was destroyed because of later non-controlled “exploitation”. Also, Dimitrijević & Dimitrijević (1991) described the reef framework consisting of two different faunal communities. The internal part of the reef framework is formed by colonial corals and *Alpinophragmium* with coralline algae. The external part of the reef contains hydrozoans, sponges, dasycladaceans and *Lamellitubus* sp. Also they described a third non reefal fauna with enigmatic hydrozoans like *Heterastridium conglobatum*, ahermatypic corals, sponges, solenoporaceans, foraminifera and microproblematic organisms.

Gawlick et al. (2017b) reinvestigated this block and assigned a Norian age for this succession based on conodont faunas. In contrast to Dimitrijević & Dimitrijević (1991), Gawlick et al. (2017b) described this succession as a Dachstein limestone fore-reef block consisting of coarse-grained reefal material, like reworked reef builders and crinoids, intercalated with finer-grained open-marine resediments consisting of a few cm-thick *Monotis* shell layers as well as a lot of *Halobia* shells and the conodonts *Norigondolella steinbergensis* and *Epigondolella* sp.

However, a detailed study on the microfacies evolution, faunal content and a more precise biostratigraphy, beside preliminary data by Gawlick et al. (2017b) was not carried out. The result of such a study is presented here. The aim of the investigation of this Late Triassic fore-reefal Dachstein Limestone succession in the late Middle to early Late Jurassic Sirogojno carbonate-clastic Mélange (Missoni et al., 2012; Sudar et al., 2013) is to reconstruct on base of the biostratigraphic age and a more detailed microfacies analysis the depositional history. Moreover, to compare its evolution and faunal content with well-known Late Triassic Dachstein reef limestone successions on the Western Tethys realm, i.e. in the Northern Calcareous Alps or the eastern Southern Alps.

The data of the microfacies analysis and of shallow-water organisms of this paper are mainly based on the results of a BSc thesis carried out by one of authors (Zöhrer, 2020).

Geological and geographic setting

The locality of the overturned block with the studied section has no specific name, and is situated along on the main road from Sirogojno to Rožanstvo villages, directly above the ruins of Tošina Banja (= spa) from one long road curve nearly to the bridge over the Prištavica river in the Ilidža area (Fig. 2; coordinates of the lower part of the section (Fig. 3: 3): x 19°50'27,3"E, y 43°42'27.0"N).

In the study area this Dachstein Limestone fore-reef block is part of the upper carbonate-clastic Sirogojno Mélange, which is here made of different 100 meter-sized blocks. This Mélange with several different other sedimentary mélanges below the overriding ophiolitic nappe stack (Gawlick et al., 2017a, b for an overview) belong to the Dinaridic Ophiolite zone, underlain by the East Bosnian–Durmitor Unit.

Originally the Sirogojno carbonate-clastic Mélange were described by Dimitrijević (1997) as a complete Early to Late Triassic sedimentary succession with the Drina-Ivanjica Unit as a provenance area. Recent research of Sudar et al. (2008, 2013), Missoni et al. (2012) and Gawlick et al. (2016; 2017b) have shown that the Sirogojno carbonate-clastic Mélange consists of far travelled blocks with a provenance area further to the east of the Drina-Ivanjica Unit (Sudar et al., 2013) (Fig. 1).

Results

In the lower part of the succession coarse-grained rudstones are overlain by meter-sized reefal blocks with intercalated open-marine influenced grainstones and packstones and blocks of framestones

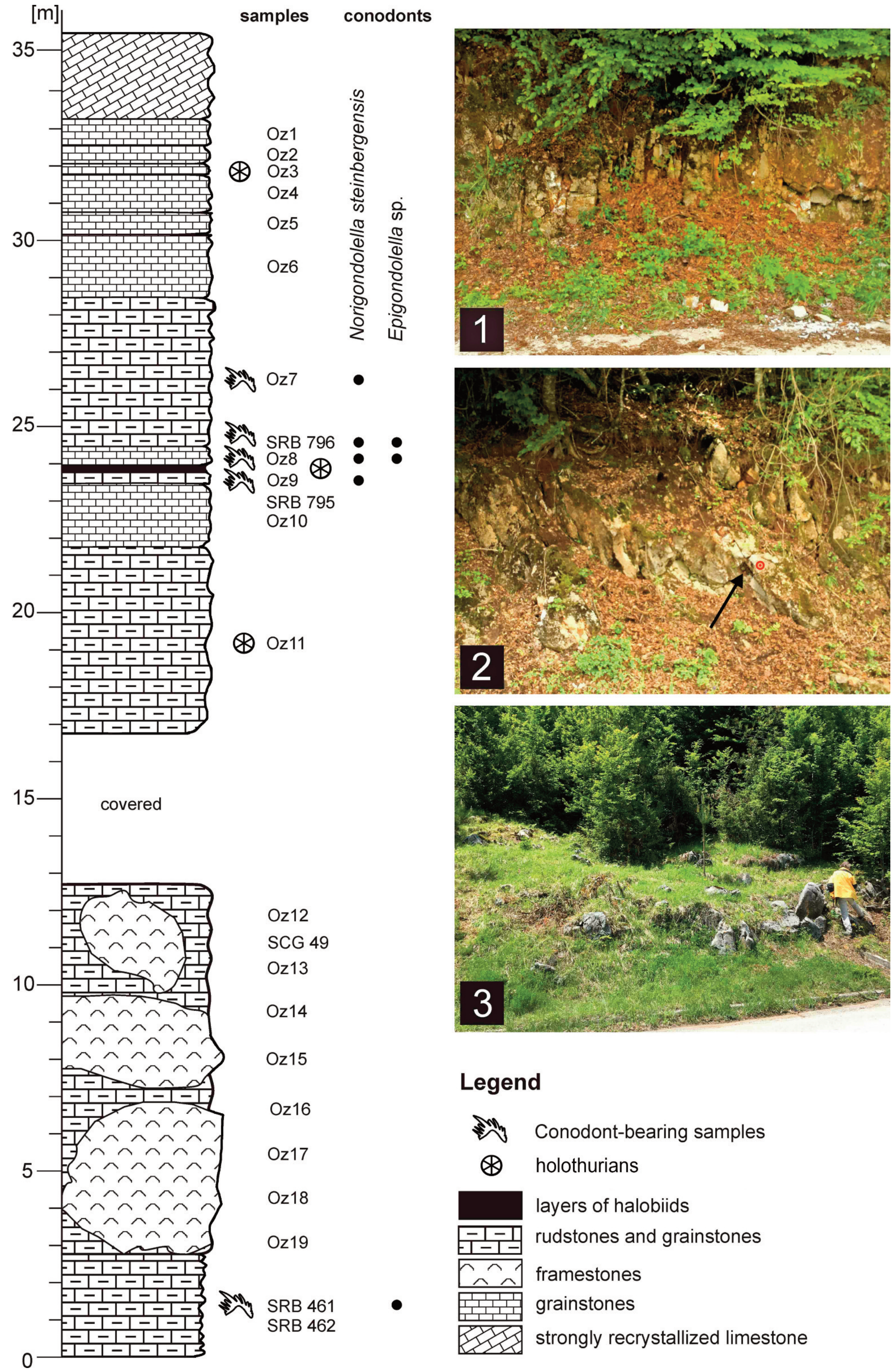

Fig. 3. *The overturned sedimentary succession of the investigated Dachstein limestone fore-reef block, illustrated in descending order, i.e. from their lower to the upper parts, with the described microfacies and position of the samples.* ***Photo 1.*** *Higher part of the succession with thin bedded reefal rudstones and few grainstone beds;* ***Photo 2.*** *Middle part of the succession with open-marine influenced grainstone and rudstone beds. Near the red point position of two distinctive halobiids coquina layers; one of them is shown by the arrow;* ***Photo 3.*** *Lower part of the succession with meter-sized reefal blocks intercalated in open-marine influenced grainstones and reefal rudstones.*

Fig. 4. *Outcrop photos of the reefal limestone and the halobiid layers.* ***1.*** *Reef crest block incorporated into finer-grained slope sediments from the lower part of the succession (Fig. 3: 3);* ***2.*** *Decimeter bedded grain-to rudstones with intercalated halobiids layer;* ***3.*** *Part of one halobiid layer (photo from 2013) destroyed in the past years.*

(lower part of the stratigraphic column and Fig. 3: 3). The succession continues with variable sized beds of open-marine influenced grainstones and rudstones with two distinct coquina layers of halobiid shells, marked by a red dot (Figs. 3: 2; 4: 2, 3). In Austrian geological literature it is known as *Halobia*-Lumachelle layer (e.g., Tollmann, 1976 and references therein), but the Serbian geological literature has no official name. The highest part of the succession is made of thin bedded reefal rudstones and few grainstone beds; strongly recrystallized (Fig. 3: 1). In general, the succession is characterized by a deepening upward trend.

Conodonts and holothurians

Only from the samples SRB 796, SRB 461, OZ7, OZ8 and OZ9 (Fig. 3) rare conodonts could be extracted: *Norigondolella steinbergensis* (Mosher), small *Epigondolella* sp. probably of the *E. abneptis/postera* or *bidentata* groups and very tiny multielements (*Hindeodella* sp.). The conodonts show an alteration of CAI 1.0 with the temperature ranges <50°C–80°C according to the conodont alteration index from Epstein et al. (1977).

From the samples OZ 3, OZ 8, OZ 9 and OZ 11 (Fig. 3) following holothurian sclerites could be determined: *Calclamna germanica* (Frizzell & Exline) and *Theelia variabilis* (Zankl).

Microfacies and shallow-water organisms

General the investigated succession can be subdivided into 3 different types of microfacies (Figs. 5, 6, 8, 9). Those microfacies types are: (a) open-marine influenced grainstones, (b) shallow-water influenced reefal rudstones and (c) framestones with packstone/grainstone infillings.

(a) Open-marine influenced grainstones: this microfacies type shows mostly angular-subangular intraclasts, bad sorting and only in cases preserved turbiditic bedding. The intraclasts consist of broken organism shells, reefal organisms, crinoids, bivalves, filaments, gastropods, foraminifers, peloids, micritic clasts and components with micritic envelopes. The

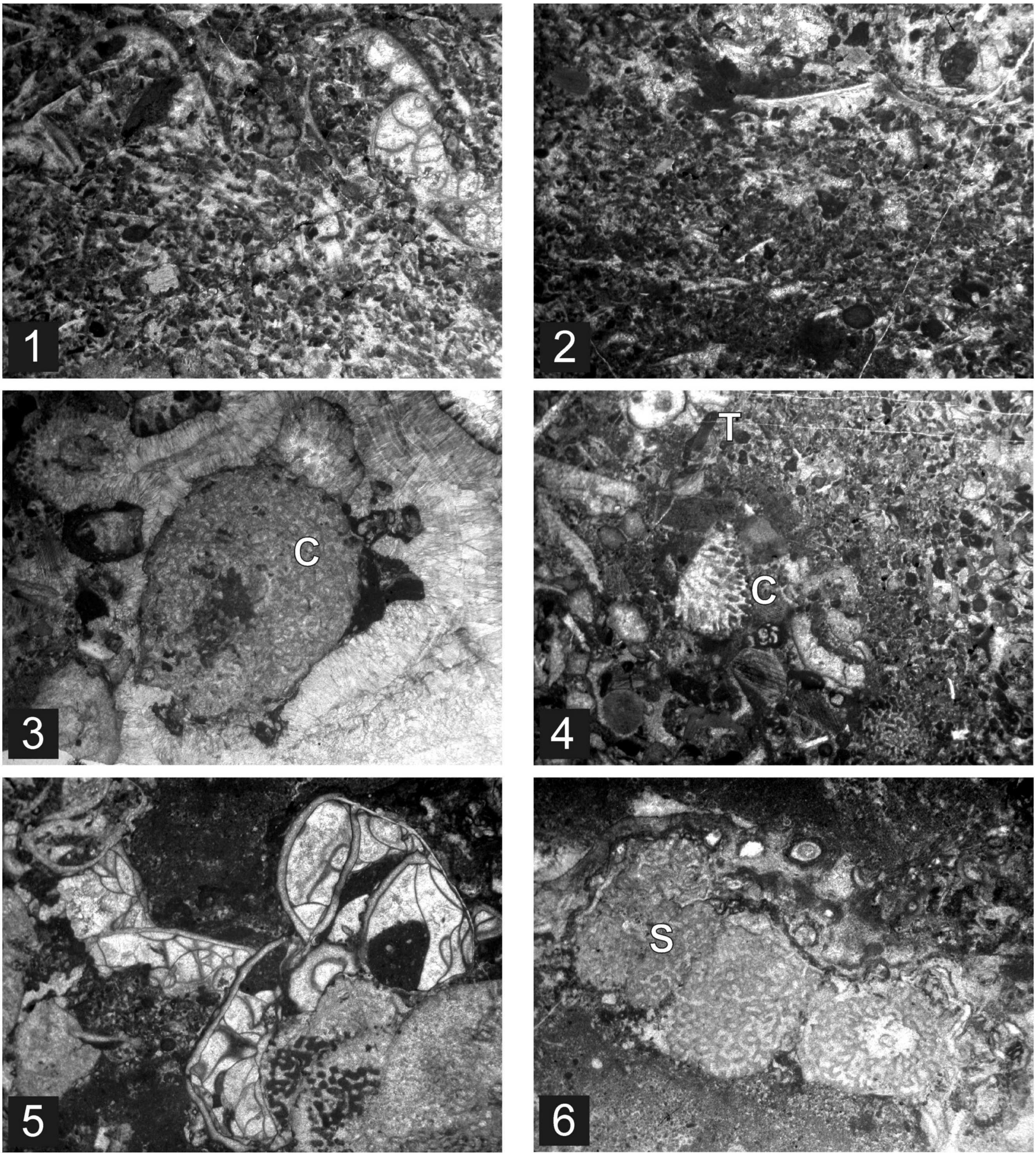

*Fig. 5. Characteristic microfacies of the investigated succession: **1.** Greyish grainstone with turbiditic bedding, moderate sorting and subangular intraclasts. The intraclasts consist of broken reefal organisms, crinoids, bivalves, foraminifers, gastropods, filaments and rarer broken ammonites and intraclasts with micritic envelopes. Sample OZ 10. Width of photo: 0,5 cm; **2.** Greyish grainstone with preserved turbiditic bedding, slightly angular intraclasts and bad sorting. The intraclasts consist of broken organism shells, reefal organisms, crinoids, bivalves, filaments, peloids, micritic clasts and foraminifers. Sample OZ 8. Width of photo: 1,4 cm; **3.** Greyish, slightly brownish bad sorted reefal rudstone with bedding, slightly rounded components as well as Cryptocoelia sp. (C) with superimposed, syndepositional cement crusts. Sample OZ 6. Width of photo: 1,4 cm; **4.** Greyish rudstone with slightly rounded intraclasts and partly graded bedding. The intraclasts consist of resedimented reef building organisms, crinoids, foraminifers, bivalves, chaetetid fragments (C) peloids and Tubiphytes (T). Sample OZ 3. Width of photo: 1,4 cm; **5.** Greyish framestone with mostly in-situ calcareous sponges and other reefal*

organisms which partly show microbial rims. The intraclasts consist mainly of shallow water organisms with a lot of broken organisms, shells, bivalves, foraminifers, encrusting organisms, rarer filaments. The encrusting sphinctozoan is distinguished as Uvanella sp. Sample OZ 14. Width of photo: 1,4 cm; ***6.*** *Greyish framestone with big in-situ reef building organisms, like the calcareous sponge ?Solenolmia sp. (S), as well as encrusting organisms. In between the reefal organisms, bad sorted grainstone infillings with well rounded, resedimented intraclasts and well preserved turbiditic bedding occur. The intraclasts consist of broken organism shells, foraminifers, bivalves, encrusting organisms and some crinoids. Sample OZ 16. Width of photo: 1,4 cm.*

sedimentation area characterize the distal part of the fore-reef/ slope position with lower water energy and open-marine influence.

(b) The reefal rudstones show angular-subangular intraclasts with bad sorting and often a chaotic fabric. Sometimes turbiditic bedding occurs in intercalated grainstones. The cavities are often filled with blocky calcite cement; also syndepositional radiaxial-fibrous cement occurs. The intraclasts of this facies zone consist mostly of big reef driven material like fragments of calcareous sponges, and corals, but also of broken organisms – shells, gastropods, encrusting organisms, algae, *Tubiphytes* morphotypes, bivalves, crinoids and foraminifers. The sedimentation area of this microfacies type shows high to very high-water energy in a proximal fore-reef position.

(c) Framestones with cavities filled with packstones and grainstones. The reef building organisms consist mostly of calcareous sponges and encrusting organisms. Partly thick microbial rims grow on those reef building organisms. In the packstone/grainstone areas bivalves, crinoids, filaments, foraminifers, intraclasts with micritic envelopes occur. The sedimentation area is generally in a deeper reef position. The water energy differs, which can be seen in the different infillings (packstones/grainstones). A clear open-marine influence is evidenced by crinoids, filaments and rare radiolarians. The determined shallow-water organisms: foraminifers and calcareous algae (Fig. 7), reef-building organisms (Fig. 8), and microproblematica (Fig. 9) point to a similar biostratigraphic age as the conodonts and are typical for the Late Triassic Dachstein reefal limestone.

In the different parts of studied succession beside mentioned conodonts, foraminifers (*Agathammina austroalpina*, *Alpinophragmium perforatum*, *Miliolipora cuvillieri*, *Aulotortus* cf. *tenuis*, *Diplotremina* sp., *Duostomina* sp., *Endotriada* sp., *Galeanella* sp. (cf. *tollmanni*), *Nodosaria* sp., *Ophthalmidium* sp., *Reophax* sp., foraminifera of the *Endoteba* group), calcareous algae (?*Clypenia* sp.), and also halobiids of the *Halobia salinaria* group were found (Fig. 4: 2, 3).

In the coarse-grained rudstones followed by meter-sized reefal blocks intercalated in partly layered resedimented grainstones and packstones of the lower parts of the section appear abundant reef-building organisms like calcareous sponges, corals and encrusting organisms are preserved (?*Actinotubella gusici*, *Baccanella floriformis*, *Bacinella ordinata*, *Microtubus communis*, *Muranella sphaerica*, ?*Radiomura cautica*, *Thaumatoporella parvovesiculifera*, *Celyphia* sp., ?*Cryptocoelia* sp., *Parauvanella* sp., ?*Solenolmia* sp., *Tubiphytes* sp., *Uvanella* sp., *Rivularia*-type cyanobacteria).

Biostratigraphic age of the succession

Determinated conodont species *Norigondolella steinbergensis* (Mosher) has a range from Alaunian 1 to the lowermost parts of Rhaetian 2 (Krystyn et al., 2009 and many other papers). The small *Epigondolella* sp. point to a late middle Norian (upper Alaunian) to early Rhaetian (Rhaetian 1) age of the succession. On the basis of these conodont fauna, we can conclude that the age of the whole succession is middle Norian (Alaunian) to the end of the Rhaetian 1, most probably late Norian (Sevatian).

Extracted holothurian species, the determined shallow-water organisms: foraminifers, calcareous algae, reef-building organisms, and microproblematica point to a similar biostratigraphic age range.

Depositional environment

In the lower part of the succession, consisting of rudstones (samples OZ 19, SRB 462, 481) and grainstones (samples OZ 15, 17) appear up to ten meter-sized framestone blocks (samples OZ 12, 13, 14, 16)

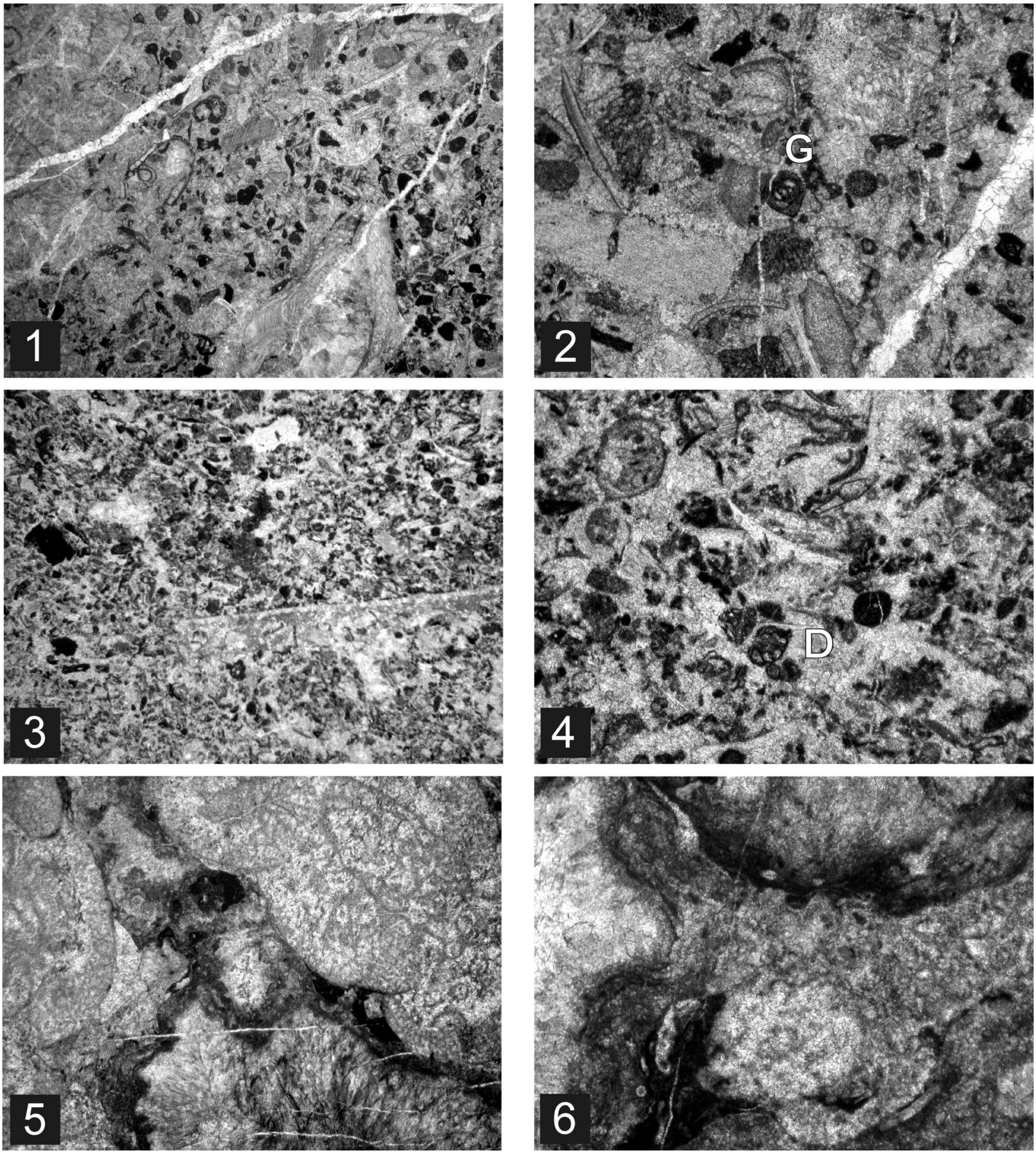

Fig. 6. *Microfacies of the Dachstein fore-reef limestones.* ***1.*** *Turbiditic grainstone with broken reef builders, brachiopod shells, broken foraminifers, crinoids, gastropods and other undeterminable broken organisms. Sample SRB 462. Width of photograph: 1.4 cm;* ***2.*** *Sample SRB 462. Beside crinoids, broken reef builders and shell fragments the foraminifera Galeanella sp. (cf. tollmanni) (G) is preserved. Width of photograph: 0.5 cm;* ***3.*** *Well sorted grainstone with shell fragments and broken reef builders. Sample SRB 795. Width of photograph: 1.4 cm;* ***4.*** *Enlargement of 3. Broken reef builders, undeterminable duostominid foraminifers (D), and shell fragments. Width of photograph: 0.5 cm;* ***5.*** *Reefal framework with recrystallized reef-builders. Sample SCG 49. Width of photograph: 1.4 cm.* ***6.*** *Reefal framework with recrystallized reef-builders and microencrusters framework. Sample SCG 49. Width of photograph: 0.5 cm.*

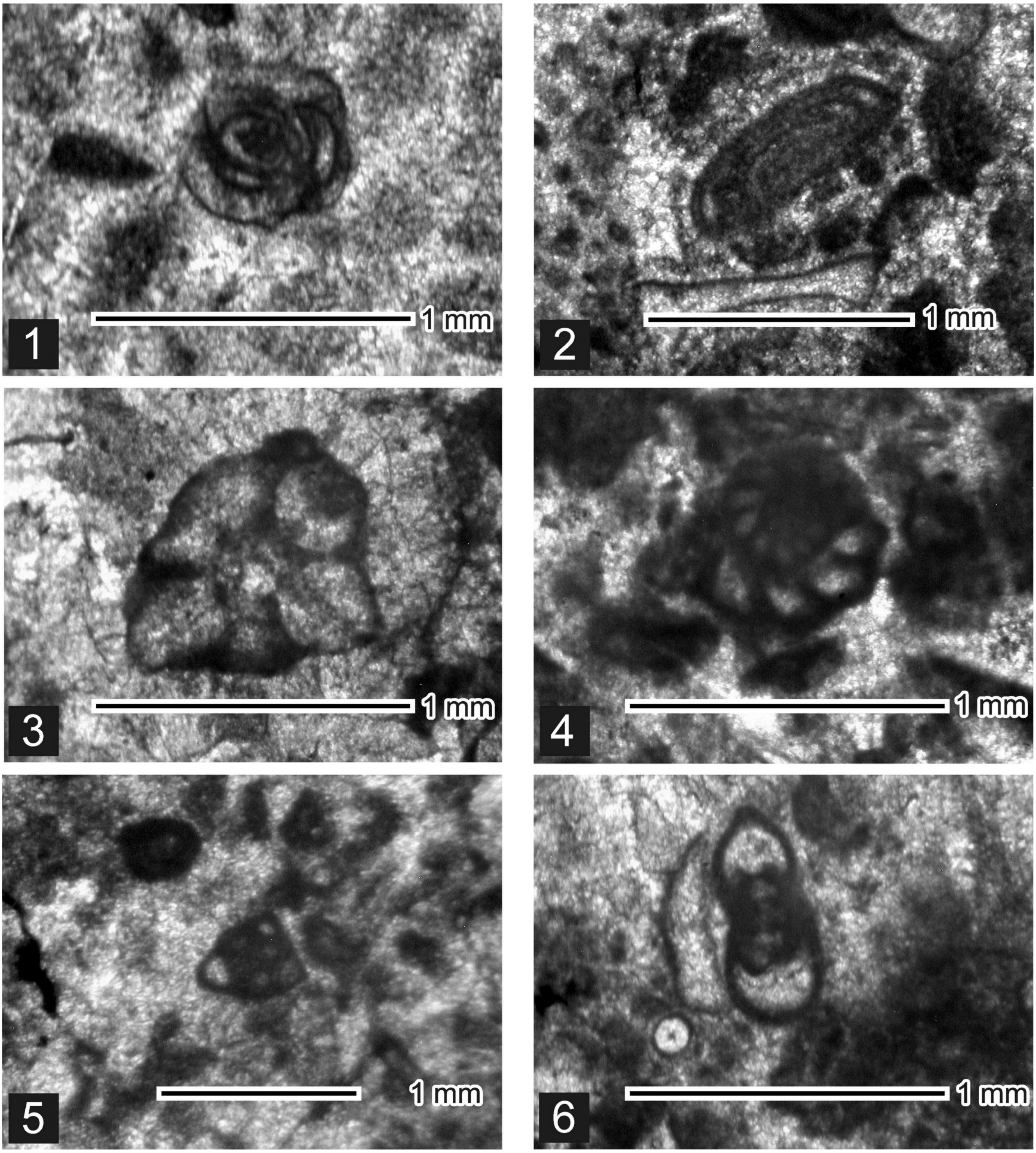

Fig. 7. *Determined fauna and flora of the Middle Norian to Lower Rhaetian reefal to fore-reefal Dachstein facies.* ***1.*** *Miliolipora cuvillieri (Bronnimann & Zaninetti). Sample OZ 1;* ***2.*** *Aulotortus cf. tenuis (Kristan). Sample OZ 9;* ***3.*** *?Clypenia sp. Sample OZ 5;* ***4.*** *Foraminifera of the Endoteba group. Sample OZ 8;* ***5.*** *Agathammina austroalpina (Kristan-Tollmann & Tollmann). Sample OZ 10;* ***6.*** *Endotriada sp. Sample OZ 19.*

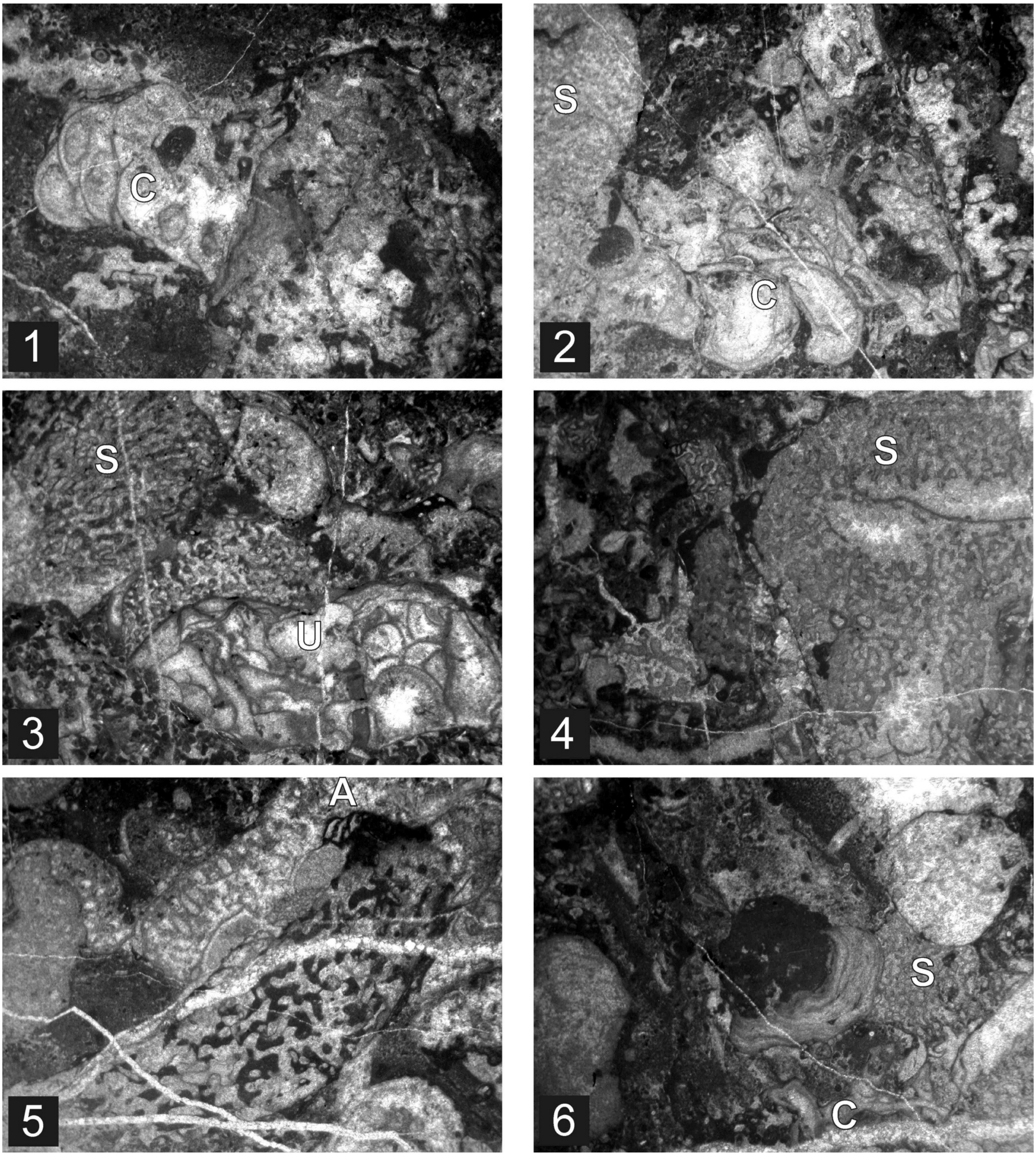

Fig. 8. Determined reef-building organisms. ***1.*** *Celyphia sp. (C) associated with various microencrusters. Sample OZ 12;* ***2.*** *Encrusting calcified sponge consortium with ?Solenomia sp. (S) and Celyphia sp. Sample OZ 18;* ***3.*** *Ecrusting sponges Uvanella sp. (U) and ?Solenomia sp. (S). Sample OZ 19;* ***4.*** *Fragments of calcareous sponge (?Solenomia, S). Sample OZ 2;* ***5.*** *Encrusting foraminifer Alpinophragmium perforatum (Flügel) (A) associated with calcified sponges. Sample OZ 11;* ***6.*** *Encrusting fabric developed by calcified sponge as well as the sponges Celyphia sp. (C) and ?Solenolmia sp. (S). Sample OZ 11. Width of all photos are 1,4 cm.*

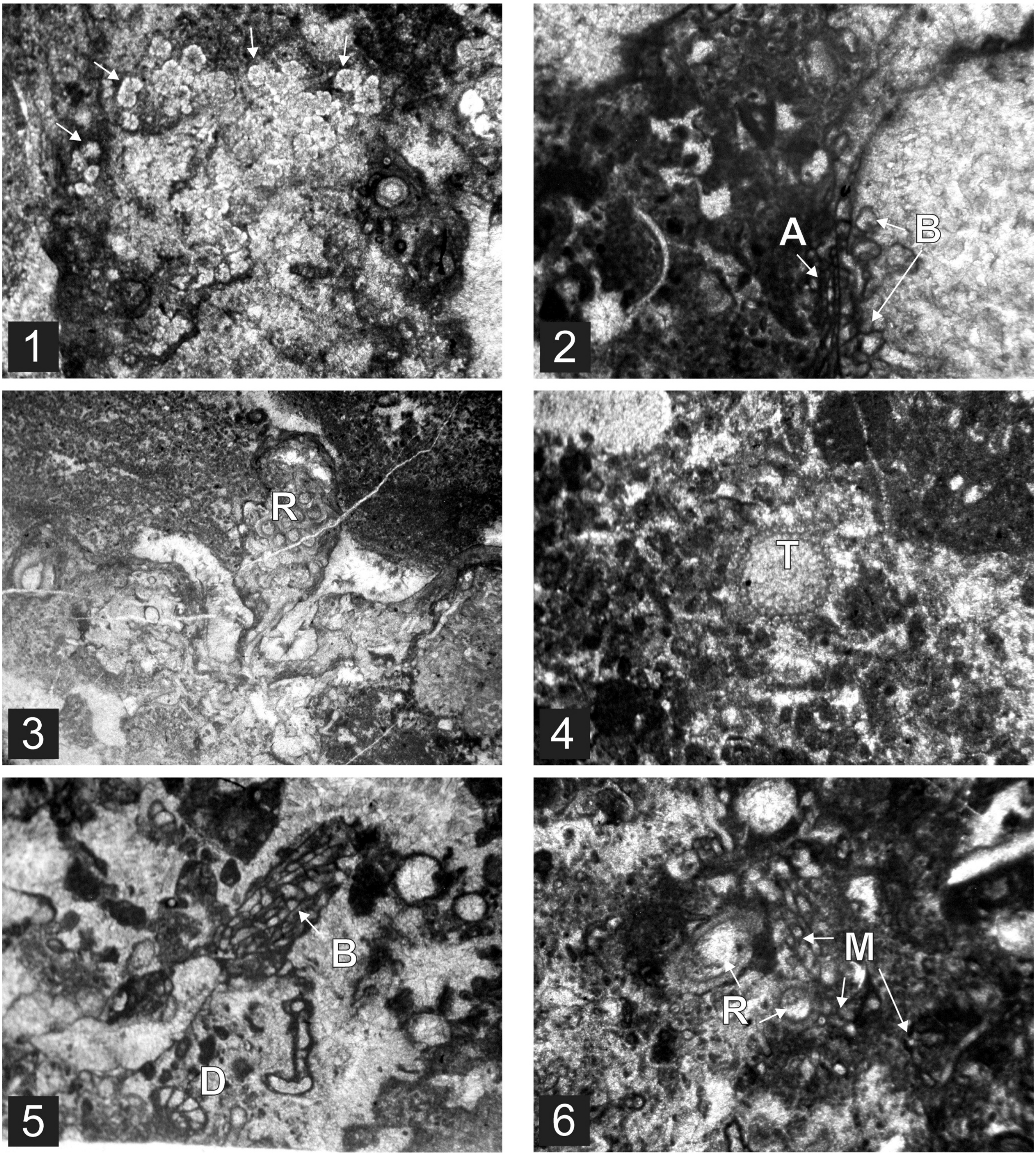

***Fig. 9.** Determined microproblematica. **1.** Baccanella floriformis (Pantić), arrows. Sample OZ 7. Width of photo: 0,5 cm; **2.** Bacinella ordinata (Pantić) (B) associated with ?Actinotubella gusici (Senowbari-Daryan) (A). Sample OZ 6. Width of photo: 0,5 cm; **3.** ?Radiomura cautica (Senowbadi-Daryan & Schaefer) (R). Sample OZ 16. Width of photo: 1,4 cm; **4.** Thaumatoporella parvovesiculifera (Raineri) (T). Sample OZ 17. Width of photo: 0,25 cm; **5.** Duostomind foraminifer (D) and ?Bacinella ordinata (Pantić) (B). Sample OZ 19. Width of photo: 0,5 cm; **6.** ?Radiomura cautica (Senowbadi-Daryan & Schaefer) (R), Microtubus communis (Flügel) (M). Sample OZ 18. Width of photo: 0,5cm.*

(Fig. 3). The framestones show *in-situ* calcareous sponges, encrusting organisms and few corals and were formed at a high-energy reef rim (Flügel, 2004). Soon after their formation they were transported together with the rudstones along a relative steep slope towards the open shelf and deposited at the base of the slope, as indicated by the intercalated turbiditic grainstones. For rimmed platforms it is very common in fore-reef to deeper slope settings, that metre-sized reef blocks were transported downslope into basinal sediments. Upsection open-marine influenced grainstones (sample OZ 10) were deposited (Standard Microfacies Type 5 – Wilson, 1975; Flügel, 2004). These grainstones (Fig. 7: 2, 3) are intercalated by up to 2 m thick rudstone beds (samples OZ 9 and OZ 6-OZ 2) with similar angular to subangular reefal components as documented from the framestones below. In general, the microfacies shows syndepositional cements, micrite is washed out. The rare st microfacies in the succession are allochthonous grainstones with resedimented shallow-water intraclasts and open-marine influence (samples OZ 1, OZ 8, OZ 10, and OZ 17). Here intraclasts are subrounded too well-rounded and appear in turbiditic bedding. Grain size, graded bedding and open-marine organisms indicate a sedimentation area in basin-ward directed lower slope position with lower water energy.

Discussion

For the Norian to Rhaetian Dachstein Limestone Formation as part of the Late Triassic Hauptdolomit/Dachstein Carbonate Platform it is accepted that the general facies zones can be subdivided into a lagoonal facies, back reef, reef core and a fore-reef facies giving way to the open-marine shelf (Hallstatt facies – Fig. 1). In the reefal area the facies zones clearly can be distinguished by the fauna, flora and sedimentation patterns (e.g., Zankl, 1969; Wurm, 1982; Satterley, 1994). Many authors (see Flügel, 2004 for a comprehensive overview and references) described the reefal Dachstein Limestone in different regions around the world, therefore in the following only a brief overview is given of the relevant facies zones (reef, fore-reef, and slope) as first described in the Northern Calcareous Alps to compare them with the evolution of the Dachstein fore-reefal succession in the carbonate-clastic Sirogojno Mélange.

First Zankl (1969) described the facies distribution and the fauna for the Mt. Hohe Göll and Mt. Hohes Brett in the Northern Calcareous Alps in detail. The fauna of the central reef facies consists up to 75% of calcareous sponges and calcareous corals and the remaining 25% can be distributed to calcareous algae, hydrozoans, bryozoans, foraminifera as well as microproblematica. Those organisms appear as so-called patch reefs, but the major volume of the central reef facies is built by reefal framework in different grain sizes, because soon after formation the reef-framework gets destroyed in such high-energy environment. In the fore-reef position *in-situ* reef building organisms are practically missing or not preserved. The sedimentation patterns of the reef framework in the fore-reef facies show some similarities, but can be distinguished with the chaotic and irregular bedding, as well as the angularity of the components. Often the reefal framework rests in a fine grained open-marine matrix with a greyish and sometimes reddish colour.

For the Mt. Gosaukamm in the Northern Calcareous Alps Wurm (1982) described a similar but slightly different development of the Dachstein reef limestone (compare Krystyn et al., 2009). According to Wurm (1982) a clear facies zonation, with the distribution of organisms, is not possible, because two microfacies types dominate most of Mt. Gosaukamm. One microfacies type consists of a coarse to medium grained fore-reef rudstones or floatstones, the other consists of reefal grainstones and packstones with slightly higher biodiversity as the coarse-grained reefal breccias. Some of these fore-reefal rudstones also show syndepositional vadose cementation, not described in the Mt. Hohe Göll area. The fauna and flora show a strong correlation with those from the Mt. Hohe Göll, but differ with a less frequent appearance of calcareous corals within the reef building organisms.

Satterley (1994) describes a similar development for Mt. Hochkönig Massive in the Northern Calcareous Alps as Zankl (1969) for Mt. Hohe Göll and Wurm (1982) for Mt. Gosaukamm. For the central reef facies Satterley (1994) stated closely placed patch reefs in between an abundant amount of reefal framework, which consists mostly of bedded rudstones and grainstones. Besides these sediments rarely floatstones, wackestones and packstones occur. The fore-reef facies consist of large separated patch reef blocks with an abundant amount of breccias and rudstones. Generally, the average grain size decreases with further distance to the reef facies.

Basin-ward (Gosausee Limestone facies in the Northern Calcareous Alps – Krystyn et al., 2009), but still in reef near position deposition is controlled by rare mass transport deposits from the reefal area and calcareous turbidites intercalated by open-marine low-energy wackestones with open-marine organisms. According to Schlager (1966) such turbidites consist of calcarenites with bad sorting, layered bedding, and consist mainly of reefal organisms like sponges, echinoderms, encrusting foraminifers and corals. In between those calcarenites several meter-thick beds with coarse Dachstein reefal material occur. Also, thin layers with *Halobia,* or *Monotis* lumachellas appear (compare Tollmann, 1976).

It is well known that in the Late Triassic a vast majority of the bivalves, along with ammonites, brachiopods, conodonts and radiolarians are extinct (Hallam, 1991; McRoberts & Newton, 1995). This is also applicable for the pelagic bivalves *Halobia* and *Monotis*, which both go extinct in the middle to late Norian. It is possible, that the distinctive *Halobia* lumachelle layer as well as the cm-thick *Monotis*-shell layers, which in area of Zlatibor Mt. are first described by Gawlick et al. (2017b), marks the stepwise mass extinction with its start in the Middle Norian (Onoue et al., 2016). But for an accurate statement to this topic further investigations are needed from sections in the Dinarides.

Comparing the sedimentary patterns and the fauna of the Dachstein reefal to fore-reefal Limestone in areas from the Northern Calcareous Alps and the Late Triassic Dachstein fore-reef succession in the Sirogojno carbonate-clastic Mélange, the similarities from a calcareous sponge dominated reef facies, fore-reef facies and a more open-marine reef-near facies are obvious. The fauna and flora show a reduced biodiversity compared to the Dachstein reef limestones in the type area, but this is most probably due to the fact that in the Northern Calcareous Alps more than 1000 m of Dachstein reefal Limestones along the southern margin of the Northern Calcareous Alps are preserved whereas this block covers only a limited age spectrum and short part of the whole Dachstein reefal Limestone succession.

In general, the described sedimentological patterns, the biostratigraphic age and the faunal/floral content of the Late Triassic Dachstein fore-reef succession in the Sirogojno carbonate-clastic Mélange are similar to other known Dachstein reefs and indicate a depositional realm in a Dachstein fore-reef Limestone position facies to the reef near open-marine Gosausee Limestone facies in the sense of Krystyn et al. (2009), comparable also with the Slatnik Formation in the eastern Southern Alps (Rožič et al., 2009).

However, there is a general difference of the studied Dachstein fore-reefal Limestone succession in the Sirogojno carbonate-clastic Mélange and age-equivalent successions in the Northern Calcareous Alps or as known from the eastern Southern Alps (Celarc et al., 2014 and references therein). In the Northern Calcareous Alps, the Lacke successions show a sedimentation pattern because of sea level variations and a general shallowing-upward trend (Reijmer & Everaas, 1991). In the Northern Calcareous Alps, it was possible to determine more reefal and shallow-water influenced calciturbidites due to the flooding events of the carbonate platform. In periods the Dachsteinkalk carbonate platform was flooded they produced the reefal framestones and reefal rudstones, which were deposited on a fore-reef to slope setting. In contrast, the Late Triassic Dachstein fore-reefal Limestone succession in the Sirogojno carbonate-clastic Mélange shows a general deepening trend. If it is really a general deepening trend throughout the whole latest late Norian or only a part of the whole Dachstein reefal Limestone succession with a short preserved deepening interval, similar as described from the Dachstein fore-reefal limestone succession of Mt. Jenner in the Northern Calcareous Alps (Missoni, 2004; Missoni et al., 2015) cannot be decided until more complete Dachstein reefal limestone successions in the Inner Dinarides are known.

Conclusion

The Dinarides formed together with the Western Carpathians, the Eastern and the Southern Alps the western passive continental margin of the Neo-Tethys Ocean and were in Late Triassic times part of the huge Hauptdolomit/Dachstein Carbonate Platform formed on this Triassic carbonate dominated shelf. Identical as proven in the Northern Calcareous Alps, the Late Triassic reefal belt was strongly affected by the Middle to early Late Jurassic mountain building process in the frame of west-directed ophiolite obduction. Related to thrusting the outer shelf and the distal part of the Dachstein Carbonate Platform were overthrust or eroded. In contrast to the Eastern and Southern Alps, where the reef rim is relatively well preserved in resedimented blocks in age-equivalent mélanges or along the southern rim of the Northern Calcareous Alps or the eastern Southern Alps in the Inner Dinarides only few remains of the Late Triassic Dachstein reefal facies are known, practically not studied.

This study closes an important gap in knowledge about the depositional history of the relatively unknown facies belt of the Late Triassic Carbonate Platform evolution (Dachstein Carbonate Platform), the reef belt. The faunal/floral content, microfacies characteristics and the reconstructed depositional environment of a Late Triassic (late Norian) fore-reefal to reefal Dachstein Limestone block in the Sirogojno carbonate-clastic Mélange proof the existence of a rimmed Late Triassic platform in the Inner Dinarides as known in the Eastern or Southern Alps. Also the transition between the platform edge and the adjacent open-shelf carbonates is identical as documented in the Eastern or Southern Alps.

Nevertheless, the studied section only provided the chance to investigate a relative short part of the whole Dachstein reef evolution, and detected differences in the evolution of the Dachstein reefs rim in the Eastern/Southern Alps and the Inner Dinarides may be the result of the short stratigraphic time span preserved in the studied section. Further effort is needed to detect more sedimentary succession of this facies belt in the Inner Dinarides to close still existing gaps in knowledge.

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References

Celarc, B., Gale, L. & Kolar-Jurkovšek T. 2014. New data on the progradation of the Dachstein carbonate platform (Kamnik-Savinja Alps, Slovenija). *Geologija*, 57 (2): 95–104.

Dimitrijević, M.D. 1997. Geology of Yugoslavia. Geological Institute Gemini, Belgrade, 1–187.

Dimitrijević, M.N. & Dimitrijević, M.D. 1991. Triassic carbonate platform of the Drina-Ivanjica element (Dinarides). *Acta Geologica Hungarica*, 34: 15–44.

Epstein, A., Epstein, J.B. & Harris, L.D. 1977. Conodont Color Alteration- an Index to Organic Metamorphism. *U.S. Geological Survey Professional Paper*, 995: 1–27.

Flügel, E. 2004. *Microfacies of Carbonate Rocks. Analysis, Interpretation and Application*. Springer, Berlin Heidelberg, 1–976.

Gawlick, H.-J. & Frisch, W. 2003. The Middle to Late Jurassic carbonate clastic radiolaritic flysch sediments in the Northern Calcareous Alps: sedimentology, basin evolution and tectonics – an overview. *Neues Jahrbuch für Geologie und Paläontologie, Abhandlungen*, 230: 163–213.

Gawlick, H.-J., Frisch, W., Hoxha, L., Dumitrica, P., Krystyn, L., Lein, R., Missoni, S. & Schlagintweit, F. 2008. Mirdita Zone ophiolites and associated sediments in Albania reveal Neotethys Ocean origin. *International Journal of Earth Sciences*, 97: 865–881.

Gawlick, H.-J. & Missoni, S. 2019. Middle-Late Jurassic sedimentary mélange formation related to ophiolite obduction in the Alpine-Carpathian-Dinaridic Mountain Range. *Gondwana Research*, 74: 144–172.

Gawlick, H.-J., Missoni, S., Suzuki, H., Sudar, M., Lein, R. & Jovanović, D. 2016. Triassic radiolarite and carbonate components from a Jurassic ophiolitic mélange (Dinaridic Ophiolite Belt). *Swiss Journal of Geosciences*, 109 (3): 473–494.

Gawlick, H.-J., Djerić, N., Missoni, S., Bragin, N.Yu., Lein, R., Sudar, M., & Jovanović, D. 2017a. Age and microfacies of oceanic Upper Triassic radiolarite components from the Middle Jurassic ophiolitic mélange in the Zlatibor Mountains (Inner Dinarides, Serbia) and their provenance. *Geologica Carpathica*, 68 (4): 350–365.

Gawlick, H.-J., Sudar, M.N., Missoni, S., Suzuki, H., Lein, R. & Jovanović, D. 2017b. Triassic-Jurassic geodynamic history of the Dinaridic Ophiolite Belt (Inner Dinarides, SW Serbia). Field Trip Guide, 13th Workshop on Alpine Geological Studies (Zlatibor, Serbia 2017). *Journal of Alpine Geology*, 55: 1–167.

Gawlick, H.-J., Sudar, M., Missoni, S., Aubrecht, R., Schlagintweit, F., Jovanović, D. & Mikuš T. 2020. Formation of a Late Jurassic carbonate platform on top of the obducted Dinaridic ophiolites deduced from the analysis of carbonate pebbles and ophiolitic detritus in southwestern Serbia. *International Journal of Earth Sciences*, 109: 2023–2048.

Hallam, A. 1981. The End-Triassic bivalve extinction event. *Palaeogeography. Palaeoclimatology, Palaeoecology*, 35: 1–44.

Krystyn, L., Mandl, G.W. & Schauer, M. 2009. Growth and Termination of the Upper Triassic Platform Margin of the Dachstein Area (Northern Calcareous Alps, Austria). *Austrian Journal of Earth Sciences*, 102 (1): 23–33.

McRoberts, C.A. & Newton, C.R. 1995. Selective extinction among end-Triassic European bivalves. Geology, 23 (2): 102–104.

Missoni, S. 2004. *Analyse der mittel- bis oberjurassischen Beckenentwicklung in den Berchtesgadener Alpen - Ein Schlüssel für das Verständnis der Platznahme der juvavischen Decken in den Nördlichen Kalkalpen*. PhD-Thesis, Montanuniveristät Leoben, Leoben,1–150.

Missoni, S., Gawlick, H.-J., Sudar, M.N., Jovanović, D. & Lein, R. 2012. Onset and demise of the Wetterstein Carbonate Platform in the mélange areas of the Zlatibor Mountain (Sirogojno, SW Serbia). *Facies*, 58: 95–111.

Missoni, S., Gawlick, H.-J., Bechtel, A., Bucur, I.I., Gratzer, R. & Prochaska, W. 2015. Mt. Jenner (Berchtesgaden, Germany) – a Late Triassic fore reef evolution of the Dachstein platform. *Berichte des Institutes für Erdwissenschaften Karl-Franzen-Universität Graz*, 21: 256.

Onoue, T., Sato, H., Yamashita, D., Ikehara, M., Yasukawa, K., Fujinaga, K., Kato, Y. & Matsuoka, A. 2016. Bolide impact triggered the Late Triassic extinction event in equatorial Panthalassa. *Scientific Reports*, 6: 29609.

Radovanović, Z. & Popević, A. 1999. Geological map of the Republic of Serbia, Užice 4, 1:50 000. Ministry of Science and Environmental Protection, Republic of Serbia.

Reijmer, J.J. & Everaars, J.S. 1991. Carbonate Platform Facies Reflected in Carbonate Basin Facies (Trias der Nördlichen Kalkalpen, Österreich). *Facies*, 25 (1): 253–278.

Rožič, B., Kolar-Jurkovšek, T. & Šmuc, A. 2009. Late Triassic sedimentary evolution of Slovenian Basin (Eastern Southern Alps): description and correlation of the Slatnik Formation. *Facies*, 55 (1): 137–155.

Satterley, A.K. 1994. Sedimentology of the Upper Triassic Reef Complex at the Hochkönig Massif (Northern Calcareous Alps, Austria). *Facies*, 30: 119–150.

Schlager, W. 1966. Fazies und Tektonik am Westrand der Dachsteinmasse (Österreich). II. *Mitteilungen der Gesellschaft der Geologie- und Bergbaustudenten in Österreich*. 17: 205–282.

Schmid, S.M., Bernoulli, D., Fügenschuh, B., Matenco, L., Schefer, S., Schuster, R., Tischler, M. & Ustaszewski, K. 2008. The Alpine-Carpathian-Dinaride-orogenic system: correlation and evolution of tectonic units. *Swiss Journal of Geosciences*, 101: 139–183.

Schmid, S.M., Fügenschuh, B., Kounov, A., Matenco, L., Nievergelt, P., Oberhansli R., Pleuger, J., Schefer, S., Schuster, R., Tomljenović B., Ustaszewski, K. van Hinsbergen D.J.J. 2020. Tectonic units of the Alpine collision zone between Eastern Alps and western Turkey. *Gondwana Research*, 78: 308–374.

Sudar, M.N., Gawlick, H.-J., Lein, R., Missoni, S., Jovanović, D. & Krystyn, L. 2008. Drowning and block tilting of Middle Anisian carbonate platform in the Middle Jurassic Zlatibor mélange of the Dinaridic Ophiolite Belt (SW Serbia). *Journal of Alpine Geology*, 49: 106–107.

Sudar, M.N., Gawlick, H.-J., Lein, R., Missoni, S., Kovács, S.†. & Jovanović, D. 2013. Depositional environment, age and facies of the Middle Triassic Bulog and Rid formations in the Inner Dinarides (Zlatibor Mountain, SW Serbia): evidence for the Anisian break-up of the Neotethys Ocean. *Neues Jahrbuch für Geologie und Paläontologie*, 269 (3): 291–320.

Tollmann, A. 1976. *Monographie der Nördlichen Kalkalpen. II. Analyse des klassischen nordalpinen Mesozoi-*

kums. Stratigraphie, Fauna und Facies der Nördlichen Kalkalpen. Franz Deuticke (Wien), 1–580.

Wilson, J. 1975. *Carbonate Facies in Geologic History*. Springer Verlag, 1–471.

Wurm, D. 1982. Mikrofazies, Paläontologie der Dachsteinriffkalke (Nor) des Gosaukammes, Österreich. *Facies*, 6: 203–295.

Zankl, H. 1969. Der Hohe Göll. Aufbau und Lebensbild eines Dachsteinkalk-Riffes in der Obertrias der nördlichen Kalkalpen. *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft*, 519: 1–123.

Zöhrer, O. 2020. *Microfacies and stratigraphy of an Upper Triassic Dachstein limestone fore-reef block in the Jurassic Sirogojno carbonate-clastic Mélange (SW Serbia)*. Bachelor Thesis, Montauniversität, Leoben, 1–29.

Резиме

Микрофације и биостратиграфија области предњег спруда горњотријаског дахштајнског кречњака у јурском Сирогојно карбонатно-кластичном Меланжу (планина Златибор, ЈЗ Србија)

Творевине јединице дахштајнског кречњака каснотријаске старости у фацији предњег спруда су релативно ретке у Унутрашњим Динаридима, и уопште у региону Балкана. Такође, у Унутрашњим Динаридима микрофације, биостратиграфија и депозициона историја каснотријаских спрудних до предспрудних дахштајнских карбоната практично нису познати. Разлог за то је што каснотријаски спрудни појас Дахштајнске карбонатне платформе у Динаридима није сачуван због млађих тектонских покрета или зато јер још увек није откривен. Како ова фацијална зона још увек није детаљно описана за области Динарида, и даље не постоји могућност бољег разумевања каснотријаске седиментне историје Дахштајнске карбонатне платформе и каснојурске геодинамичке историје Унутрашњих Динарида.

Ради решавања присутне дилеме о постојању/непостојању творевина дахштајнског кречњака на теренима ЈЗ Србије, на подручју планине Златибор проучаван је преврнут блок предњег спруда дахштајнског кречњака дебео око 35-так метара. Он се налази у горњем делу касносредњег до почетка каснојурског Сирогојно карбонатно-кластичног Меланжа, који је у овим теренима изграђен од различитих сто метарских блокова и заједно са неколико других седиментних меланжа, који се налазе испод навученог мноштва офиолитских навлака, припада Динаридској Офиолитској зони смештеној испод Источно Босанско-Дурмиторске јединице.

Истраживани блок се налази уз главни асфалтни пут између села Сирогојно и Рожанство, и то директно изнад рушевина Тошине бање од једне дугачке кривине пута до испред моста преко речице Приштавица у области Илиџа.

У доњем делу испитиване сукцесије поред грубо зрнастих радстона присутни су и спрудасти блокови метарских величина са ретким прослојцима грејстона и пекстона окарактерисаним утицајем отвореног мора и блоковима фрејмстона. У њима се налазе велике количине фрагментираних спрудотворних организама као што су кречњачке спонгије, корали и обавијајући организми а такође и разорени материјал од шкољака, гастропода, алги, *Tubiphytes* морфотипа, криноида, фораминифера и др. У свом средишњем делу сукцесија се наставља слојевима различитих величина грејнстона и радстона са утицајем отвореног мора где је доминатна фауна криноида, филамената, конодоната, фораминифера уз ретке радиоларије; такође су присутна и два раздвојена лумакелна слоја са шкољкама из *Halobia salinaria* групе. Највиши део сукцесије је представљен танко слојевитим спрудним радстонима и са неколико слојева јако рекристалисалих грејнстона. Поједине слојеве карактерише турбидитска слојевитост и присуство мешаних плитководних и дубоководних зрна и организама као што су криноиди и филаменти.

На основу присутних конодоната можемо закључити да је старост сукцесије у биостратиграфском интервалу од средњег норичког ката (алаунски поткат) до краја рета 1, и то највероватније у оквиру севатског потката касног норичког ката. Констатовани биостратиграфски

распон потврђује и присуство холотуријских склерита, као и детерминисани плитководни организми типични за каснотријаску јединицу кречњака Дахштајна: фораминифери, кречњачке алге, организми градиоци спруда и облици микропроблематика.

Овај јединствени блок је после почетних резултата DIMITRIJEVIĆ & DIMITRIJEVIĆ (1991), неколико пута био предмет истраживања (GAWLICK et al., 2017b; ZÖHRER, 2020), када је одређена његова старост и припадност у оквиру фације предњег спруда Дахштајнског кречњака. У овом раду су приказани детаљни подаци микрофацијалне анализе и фаунистичко/флористичког садржаја а и старост је доказана и прецизније утврђена преко других присутних фосила. На тај начин је са поуздано утврђеним карактеристикама и детаљно реконструисаном депозиционом историјом фације предњег спруда јединице Дахштајнског кречњака потврђено његово присуство и познавање у теренима Унутрашњих Динарида. Тиме је омогућено и упоређење његове еволуције и фауне са добро познатим каснотријаским сукцесијама Дахштајнског спрудног кречњака области Западног Тетиса (нпр. Северних кречњачких Алпа или источних Јужних Алпа).

Динариди су заједно са западним Карпатима, Источним и Јужним Алпима образовали западну пасивну континенталну маргину Неотетиског океана где се у времену касног тријаса формирао део велике главне Доломитско/Дахштајнске карбонатне платформе на овом тријаском карбонатном доминантном шелфу. Идентично како је доказано у Северним кречњачким Алпима, касно тријаски спрудни појас је био јако обухваћен са средњо до каснојурским процесом планинског образовања у оквиру обдукције офиолита усмерене ка западу. У зависности од јачине тог процеса спољашњи шелф и дистални део Дахштајнске карбонатне платформе су били преврнути или еродовани. За разлику од Источних и Јужних Алпа, где је ивица спруда релативно добро очувана у реседиментованим блоковима у старосно еквивалентним меланжима или дуж јужне ивице Северних кречњачких Алпа или источних Јужних Алпа у Унутрашњим Динаридима је познато само неколико остатака каснотријских Дахштајнских спрудних фација, који практично нису били ни проучавани.

Ова студија несумњиво затвара празнину у познавању депозиционе историје релативно непознатог фацијалног појаса еволуције каснотријаске карбонатне платформе (Дахштајнска карбонатна платформа) – њеног спрудног појаса у Унутрашњим Динаридима. Фаунистичко/флористички садржај, микрофацијалне карактеристике и реконструисана депозициона средина каснотријаског (касни норички кат) предње спрудног до спрудног Дахштајнског кречњачког блока у Карбонатно-кластичном Меланжу Сирогојна пружио је доказ о постојању ободне каснотријаске платформе у Унутрашњим Динаридима као што је то познато у Источним или Јужним Алпима. Такође је прелаз између платформне ивице и суседних карбоната отвореног шелфа идентичан прелазу документованом у Источним и Јужним Алпима.

Проучавана сукцесија је, и у просторном и геолошком смислу, релативно кратка али без обзира на то пружа добру основу за даља неопходно потребна истраживања еволуције целог Дахштајнског спруда Унутрашњих Динарида. Констатоване разлике у еволуцији ивице овог спруда у Источно/Јужним Алпима и у Унутрашњим Динаридима могу бити резултат кратког стратиграфског временског распона сачуваног у изучаваној динаридској секвенци. Зато су неопходна нова истраживања којима би се открила више седиментних сукцесија овог фацијалног појаса у Унутрашњим Динаридима да би затворили још увек постојеће празнине у познавању његових карактеристика.

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