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Bojan OGORELEC

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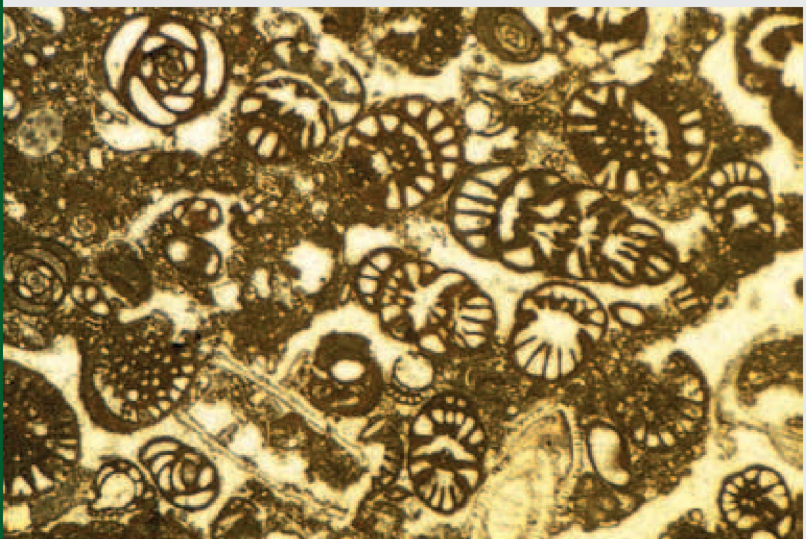
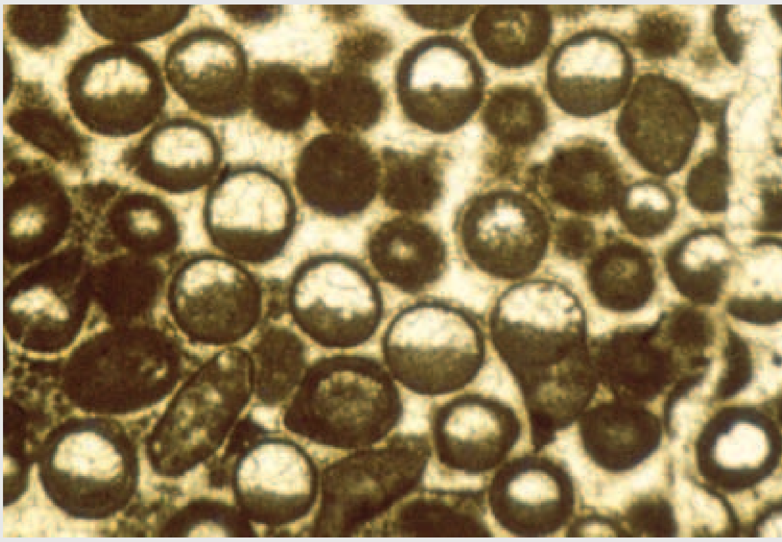

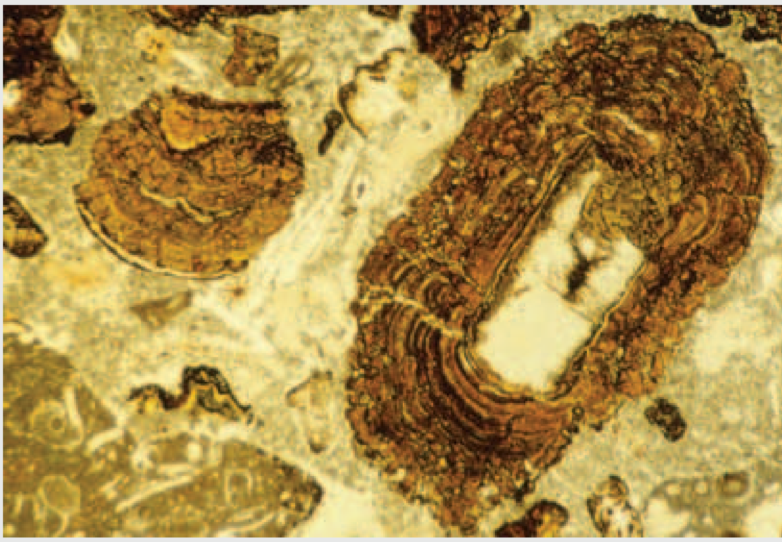

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Mikrofacies mezozojskih karbonatnih kamnin Slovenije

Microfacies of Mesozoic Carbonate Rocks of Slovenia

Bojan OGORELEC

Geološki zavod Slovenije, Dimičeva ul. 14, SI-1000 Ljubljana;
e-mail: bojan.ogorelec@geo-zs.si

Ključne besede: mikrofacies, karbonatne kamnine, zgornji perm, trias, jura, kreda, Slovenija
Key words: microfacies, carbonate rocks, Upper Permian, Triassic, Jurassic, Cretaceous, Slovenia

Steklo tanko, kos apnenca, tanek snop svetlobe – čarovnija,
nam pričara morje plitvo, plažo, ocean globine.

Izvleček

Karbonatne kamnine mezozojske starosti so v Sloveniji precej razširjene, saj zavzemajo kar okrog 40 % njenega ozemlja, njihova celotna skladovnica pa je debela preko 5000 metrov. V mikrofaciesu apnencev in dolomitov prepoznamo skoraj vse strukturne tipe, saj so nastajali v različnih sedimentacijskih okoljih, značilnih za karbonatne kamnine, tako v odprtih in zatišnih delih karbonatnega šelfa, lagunah in na obrežnih ravnicah, na različnih vrstah grebenov, pregibih in v bazenu. Večkrat so karbonatno sedimentacijo spremljali tudi dotoki terigenega materiala in produkti vulkanskih aktivnosti. Med diagenetskimi procesi raziskanih karbonatnih kamnin imata največji obseg dolomitizacija in okremenitev.

V prispevku je predstavljenih 250 mikroskopskih posnetkov značilnih apnencev in dolomitov s slovenskega prostora. V uvodnem delu, v katerem so za orientacijo dodani shematski litostratigrafski stolpci, je na kratko predstavljen geološki razvoj karbonatnih kamnin. Zaradi celostnega prikaza »karbonatnega obdobja« so poleg mezozojskih plasti v pregledu zajeti tudi zgornjepermski apnenci in dolomiti.

Abstract

Carbonate rocks of Mesozoic age are widespread in Slovenia where they consitute about 40 % of its territory, and attaining total thickness of more than 5000 metres . With respect to microfacies almost all structure types can be recognized, the limestones and dolomites being formed in various sedimentary environments, such as in open and in restricted parts of carbonate shelf, in lagoons and on coastal plains, in different types of reefs, on slopes and in the basin. Carbonate sedimentation was often accompanied also by the supply of terrigenous material and products of volcanic activity. Among diagenetic processes in investigated carbonate rocks the most extensive are dolomitization and silicification.

In the present text 250 microscopic photographs of characteristic limestones and dolomites from Slovenian territory are assembled. In the introductory part, to which for orientation schematic stratigraphic columns are added, the geologic development od these carbonate rocks is briefly outlined. For the sake of completeness in presenting the »carbonate era« in the overview, Upper Permian limestones and dolomites are also described next to Mesozoic beds.

Vsebina / Contents

Carbonate rocks are born ...
(James N.P., 1979)

Ob 50. obletnici izida klasifikacije karbonatnih kamnin *(Folk 1962, Dunham 1962, Ham (ed.) 1962)*.

UVOD

Karbonatne kamnine mezozojske starosti gradijo okrog 40 % slovenskega ozemlja (Buser & Komac, 2002). V tej, preko 5.000 metrov debeli skladovnici apnencev in dolomitov, ki jih le mestoma prekinjajo klastične sedimentne kamnine, vulkaniti in piroklastiti, zasledimo skoraj vse facialne razvoje, značilne tako za plitvomorska karbonatna okolja kot za globljemorska okolja. Na majhnem prostoru je razvito celotno zaporedje sedimentnih kamnin v stratigrafskem razponu od devona do kvartarja. Ta raznolikost je v precejšnji meri posledica dejstva, da je slovenski prostor stičišče treh velikih geotektonskih enot – Alp, Dinaridov in Panonskega bazena. Intenzivna tektonska dogajanja, dviganje in spuščanje terena, so povzročila, da se lahko ob številnih prelomih in narivih stikajo različni razvoji posameznih formacij, istočasno pa s tem večkrat niso opazni bočni prehodi med različnimi okolji sedimentacije. V vsakem pogledu je naše ozemlje lahko »mala zbirka« razvojev mezozojskih karbonatnih kamnin na prostoru nekdanje zahodne Tetide.

Čeprav iz naslova publikacije ni razvidno, zbrano gradivo presega okvire mezozoika, saj **so vključeni tudi zgornjepermski apnenci in dolomiti**. Ti so v objavo zajeti zato, ker se z njimi pričenja zvezna karbonatna sedimentacija na enoviti Slovenski plošči, ki je obstajala od zgornjega perma do sredine anizija (Buser, 1989).

K pripravi monografije je avtorja vodila želja po predstavitvi rezultatov mikrofacialnih analiz več desetletnih raziskav apnencev in dolomitov slovenskega ozemlja. Te raziskave so v prvih letih potekale predvsem v sklopu izdelave Osnovne geološke karte SFRJ v merilu 1 : 100.000, ki je bila zaključena leta 1989, nadalje projekta Mezozoik v Sloveniji, v zadnjem času pa preko geoloških projektov v okviru nacionalnega raziskovalnega programa Javne agencije za raziskovalno dejavnost Republike Slovenije. Precej podatkov je bilo zbranih tudi pri raznih aplikativnih raziskavah, kot so raziskave rudišč živega srebra v Idriji ter svinca in cinka v Mežici, nadalje iz globokih geotermalnih in naftnih vrtin, kamnolomov, predorov in cestnih usekov, v zadnjih letih pa tudi z raziskavami za novo Formacijsko geološko karto Slovenije v merilih 1 : 50.000 in 1 : 25.000.

Težišče oziroma predmet predstavljene monografije je, kot pove njen naslov, **mikrofacies.** Medtem, ko ima pojem *facies* že dolgo zgodovino, odkar ga je sredi 19. stoletja, kot eno najbolj pomembnih definicij v geologijo uvedel Gressly (1838), pa je ime *mikrofacies* približno sto let mlajše. Prvi ga je leta 1943 predlagal Brown za tisti del kamnine, ki ga vidimo v preparatu pod mikroskopom. Kasneje se je ta pojem med geologi zakoreninil in močno razširil, še posebno po svetovnem naftnem kongresu v Parizu leta 1951, za kar je posebej zaslužen Cuvillier (1952, 1962). Danes pojem *mikrofacies* opisuje združbo vseh sedimentno-petrografskih in paleontoloških značilnosti v območju mikroskopskega merila preparata. Vezan je predvsem na karbonatne kamnine – apnence in dolomite.

Kasneje so k poznavanju mikrofaciesa v svetu največ prispevali Carozzi (1960, 1989), Folk (1962) in Dunham (1962), slednja s klasifikacijama karbonatnih kamnin, Ham (1962) in Bathurst (1971), posebno pa Flügel (1978, 1982, 2004), ki je sistematično zbral vse dotedanje vedenje o mikrofaciesu in raziskovalnih metodah ter predstavil nove, poglede na praktičen pomen mikrofacialnih raziskav karbonatnih kamnin. Knjiga *Microfacies of Carbonate Rocks* (Flügel, 2004) je bogato dokumentirana s fotografijami značilnih fosilov pod mikroskopom. Nekaj predstavljenih vzorcev v teh publikaciji izvira tudi iz slovenskega prostora. Wilson (1975) je na osnovi Flüglovih idej (1972) izdelal in v prakso uvedel pojem *standardni mikrofacies* (SMF – Standard Microfacies Type), ki sloni na 24 osnovnih vrstah mikrofaciesa ter devetih značilnih okoljih nastanka karbonatnih kamnin. Poseben odmev je Wilsonova klasifikacija mikrofaciesa doživela v naftni geologiji in v računalniški informatiki sedimentnih kamnin. S sedimentacijskimi okolji in modeli karbonatnih kamnin so se v zadnjem obdobju poleg omenjenih avtorjev intenzivno ukvarjali še Milliman (1974), Reading (1978), James (1979), Scholle s sodelavci (1983), Tucker & Wright (1990), Bosellini (1991), James & Kendall (1992), Einsele (1992) ter drugi (npr. Elf-Aquitaine 1975; AGIP 1988).

V Sloveniji se je pojem mikrofacies pojavil že dokaj zgodaj, saj ga že leta 1961 omenjata E. Flü-

GEL in A. RAMOVŠ pri opisu zgornjetriasnega dachsteinskega apnenca z Begunjščice. Poudarek v tem članku je na opisu fosilne flore in favne ter na primerjavi z ustreznim apnencem v Severnih Alpah. Na žalost ta objava ni dokumentirana s slikami.

Leta 1966 je Rajka RADOIČIĆ izdala za tisti čas, izvrsten in bogato ilustriran ter obsežen prispevek o mikrofaciesu jurskih plasti v Dinaridih, ki zajema tudi opise in slike več vzorcev apnencev iz južne Slovenije.

Po tem začetku je pri študiju mikrofaciesa karbonatnih kamnin v Sloveniji prišlo do desetletnega zatišja. Apnenci so bili takrat predmet predvsem paleontoloških analiz in stratigrafskih določitev v okviru Osnovne geološke karte (OGK). Močan zagon sedimentologiji in pri tem tudi mikrofacialnim raziskavam predstavlja obdobje po letu 1973, ko je zaživel projekt Mezozoik v Sloveniji. V okviru le-tega je prišlo do celovitih raziskav triasnih, jurskih in krednih formacij s težiščem na apnencih in dolomitih. Tovrstne raziskave so se sicer s formalno drugačnimi naslovi v okviru raznih projektov nadaljevale, tako da se je na Geološkem zavodu Slovenije v dvajsetih letih zbralo in preiskalo preko 25.000 mikroskopskih preparatov. Njihov izbor predstavlja potrebno osnovo in material za pričujočo publikacijo.

V zbranem gradivu je prikazan le **mikrofacies,** ki ga prepoznamo v zbruskih apnencev in dolomitov slovenskega prostora. Makrofosili ter izolirana mikroflora in mikrofavna (npr. radiolariji, konodonti, nanoplankton, pelodi in drugo) zato niso zajeti v slikovnem materialu, zelo skromno pa tudi v literaturi. Večina člankov in publikacij, ki so bile natisnjene v šestdesetih in sedemdesetih letih prejšnjega stoletja, obravnava litologijo, paleontologijo, regionalni razvoj ali stratigrafijo mezozojskih karbonatnih kamnin na slovenskem. Posebej to velja za tolmače k posameznim listom OGK 1 : 100.000. Več sedimentologije je zajete v tolmačih k novejšim geološkim kartam, meril 1 : 50.000 (JURKOVŠEK et al., 1996) ali 1 : 25.000 (JURKOVŠEK, 2010; ČAR, 2010), delno tudi v publikaciji *Geological development in Slovenia and Croatia – Guidebook*, ki je izšla ob priliki 16. evropskega mikropaleontološkega kongresa (DROBNE,1979). Celovit in zgoščen prikaz biostratigrafije in litologije zgornjepermskih in mezozojskih kamnin je prikazan v *Geologiji Slovenije* (PLENIČAR, M., OGORELEC, B. & NOVAK, M., ur., 2009) in sicer v poglavjih, ki zajemajo zgornji perm (SKABERNE et al., 2009), trias (DOZET & BUSER, 2009), juro (BUSER & DOZET, 2009) ter kredo (PLENIČAR, 2009). Pregleden prikaz geoloških razvojev po geotektonskih enotah je zajet v delih S. BUSERja (1979a), P. MIOČa (2003) in U. PREMRUja (2005). Ko govorimo o faciesu karbonatnih kamnin, moramo omeniti tudi pregledne prispevke o njihovih facialnih razvojih (PLENIČAR & PAVLOVEC, 1984), o njihovih facialnih značilnostih (PLENIČAR & PREMRU, 1975), kamninah kot možnih matičnih plasteh za nastanek ogljikovodikov (OGORELEC et al., 1996) ter o njihovi izotopski sestavi (OGORELEC et al., 1999b).

Osnovna namena publikacije sta dva. V prvi vrsti je ta namenjena študentom geologije, ki se prvič srečujejo s pojmom mikrofacies ter tujim raziskovalcem zaradi spoznavanja naših karbonatnih kamnin in njihove primerjave s sosednjimi ozemlji. Koristna pa bo lahko tudi drugim, saj mikrofacies v mnogočem povezuje sedimentologe s paleontologi, regionalnimi geologi in tektoniki. Zaradi boljše preglednosti gradiva je v uvodnem delu podan zgoščen litološki opis celotne skladovnice mezozojskih in zgornjepermskih kamnin v Sloveniji.

Gradivo je vsebinsko razdeljeno po geoloških obdobjih, pri čemer je težišče publikacije slikovno gradivo z 250 fotografijami mikroskopskih preparatov. Uvodni tekst, dopolnjen z nekaterimi litološkimi stolpci ter literaturo, predstavlja le potrebno ogrodje, da kamnine postavimo v čas in prostor. Tuja literatura je zelo okrnjena, citirana samo zaradi primerjave karbonatnih kamnin slovenskega s sosednjima, alpskim in dinarskim prostorom.

Glede na to, da prihaja do tiska pričujoče publikacije prav ob 50. obletnici za karbonatno sedimentologijo pomembnega dogodka, namreč izida enega temeljnih del petrografije apnencev in dolomitov – *Klasifikacije karbonatnih kamnin* (HAM, 1962), se avtor na ta način pridružuje praznovanju tega jubileja.

Narava vedno eno iz drugega ustvarja
in nič ne nastane prej, predno drugo ne preide.

(*Titus Lucretius Caro* (99–55 pnš. –
»De rerum natura«)

Skladi Dachsteinskega apnenca na Kaninu

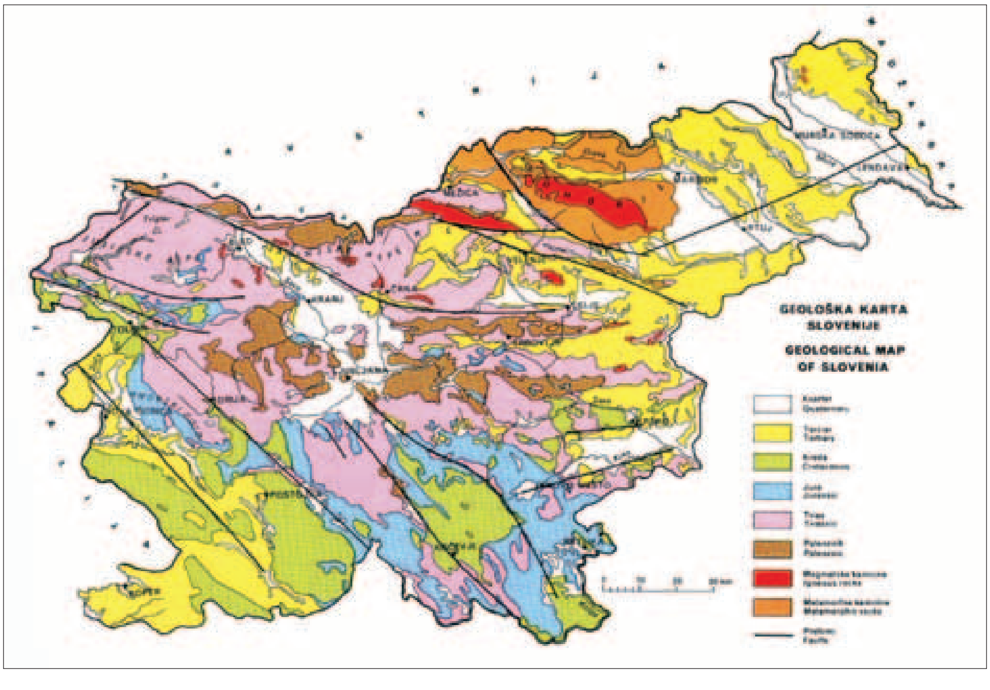
Dachstein limestone on Mt. Kanin

KRATEK PREGLED LITOLOGIJE IN RAZVOJA MEZOZOJSKIH KARBONATNIH KAMNIN SLOVENIJE

Po odložitvi kopenskih klastičnih kamnin, je prostor Slovenije v zgornjem permu zajela obsežna transgresija morja in začela se je sedimentacija karbonatnih kamnin. Ozemlje je bilo vse od zgornjega perma do sredine anizija sestavni del enotne, plitve karbonatne plošče, poznane kot *Slovenska plošča* (Buser, 1989), ki se je raztezala še v Furlanijo, Istro in na prostor Panonskega bazena. V aniziju je ta plošča razpadla in se razdelila na *Dinarsko karbonatno ploščo* na jugu in *Julijsko karbonatno ploščo* na severu, ločil pa ju je *Slovenski bazen* (Cousin, 1973; Buser, 1989). Karbonatna sedimentacija se je v večjem ali manjšem obsegu na obeh ploščah nadaljevala vse do zgornje krede, ko je prišlo do razpada Dinarske karbonatne platforme in nastanka več vmesnih flišnih bazenov.

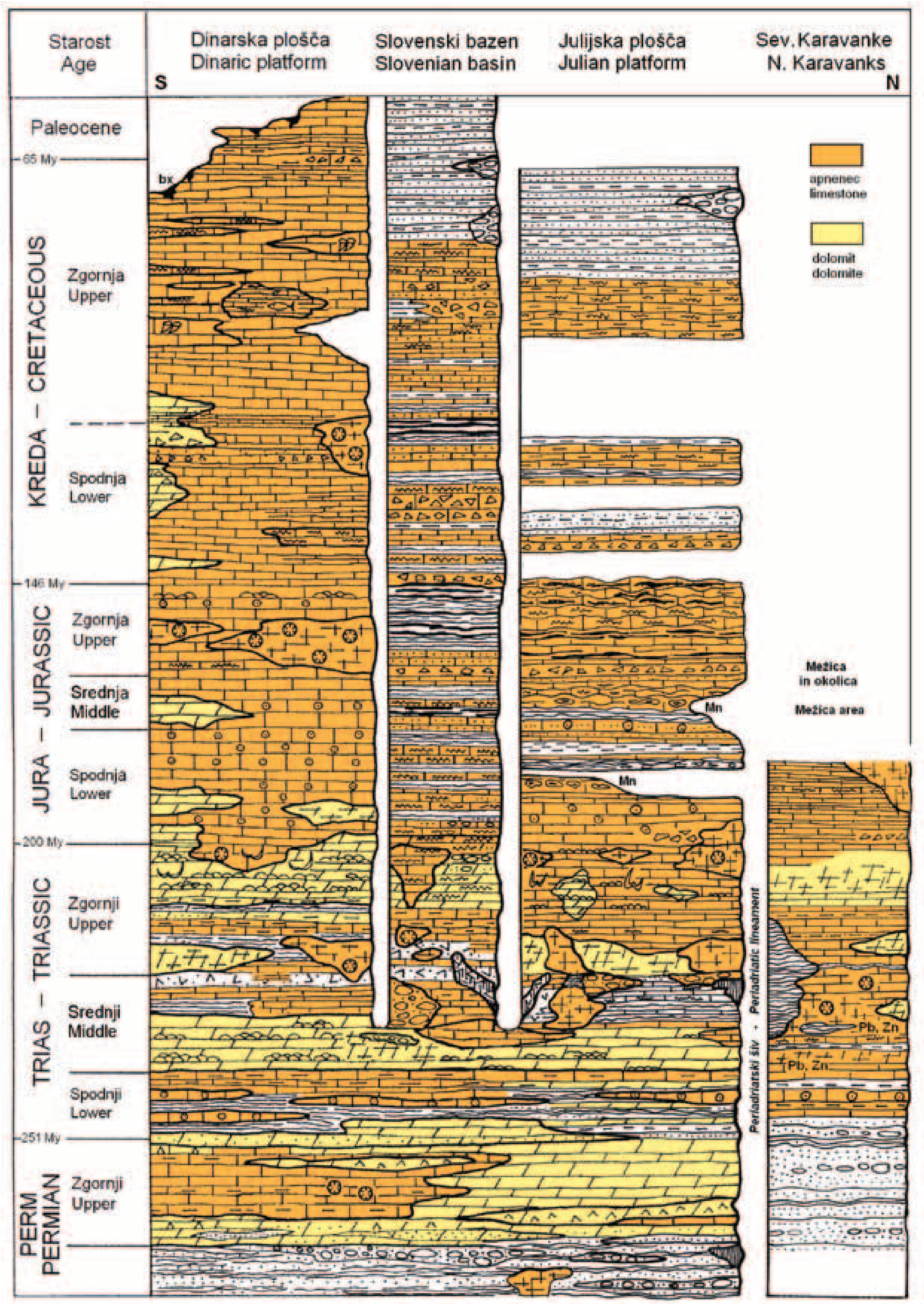
Na sliki 2 je prikazan litološki razvoj zgornjepermskih in mezozojskih karbonatnih kamnin v posameznih paleogeografskih enotah – na Dinarski in Julijski karbonatni plošči, v Slovenskem bazenu ter posebej v Severnih Karavankah, ki ležijo severno od Periadriatskega lineamenta. Na sliki 3 so shematsko predstavljena njihova sedimentacijska okolja. Zaradi močne tektonike in z njo povezane narivne zgradbe slovenskega ozemlja, so lahko odnosi med posameznimi litološkimi enotami in geološkimi formacijami prikazani le shematsko.

V zadnjem času se kot približni sinonim za Dinarsko karbonatno ploščo uporabljajo izrazi *Karbonatna platforma zunanjih Dinaridov* (Grandić et al., 1999), *Jadransko-Dinarska karbonatna platforma* (Gušić & Jelaska, 1993) ali enostavno *Jadranska karbonatna platforma* (Gušić & Jelaska, 1990, Velić et al., 2002; Vlahović et al., 2005; Jež, 2011), glede na to, da je bila to največja karbonatna plošča na Jadranski mikroplošči v obdobjih jure in krede. V pričujoči monografiji še vedno uporabljam »star« izraz Dinarska karbonatna plošča.



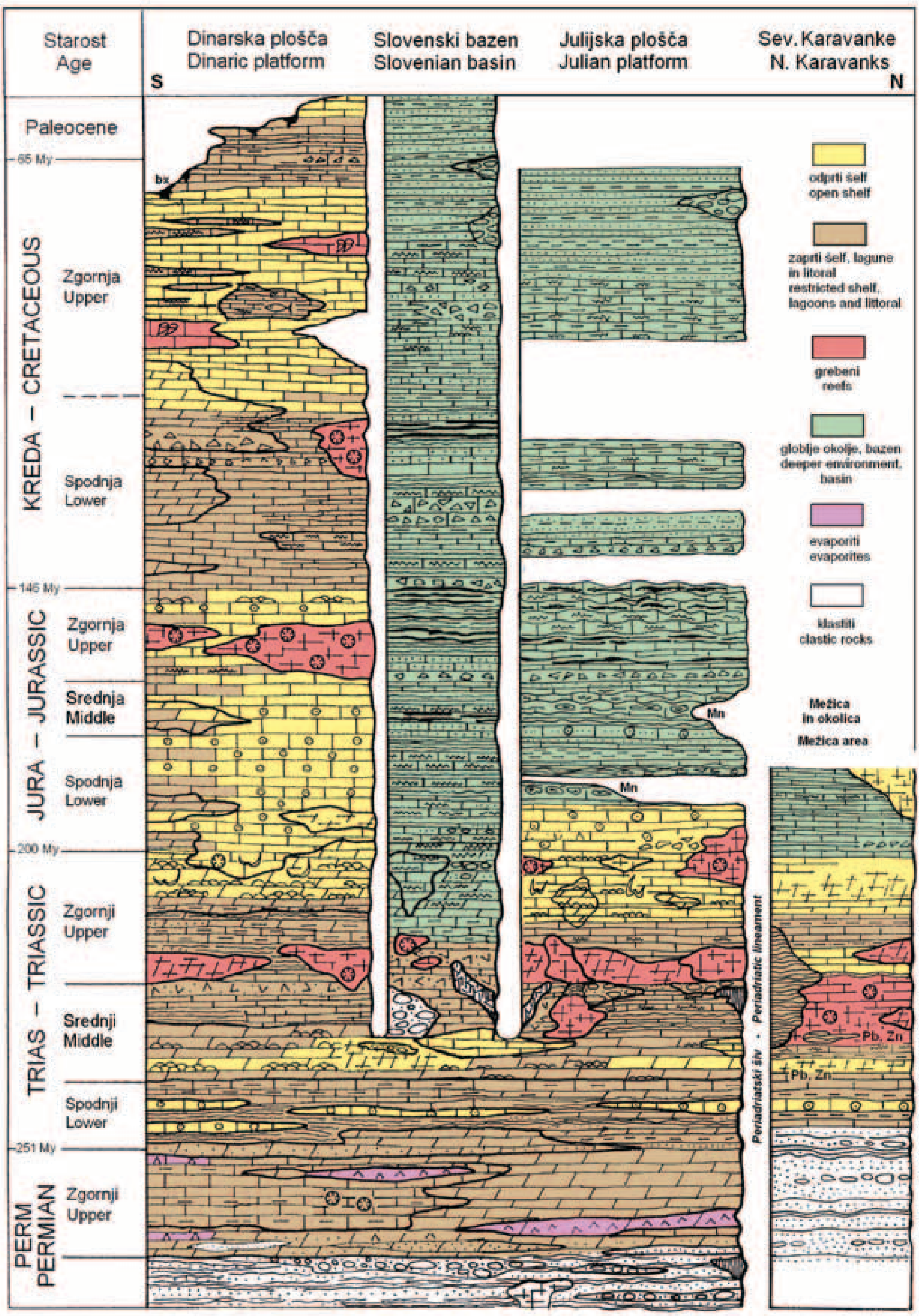
Sl. 1.
Pregledna in poenostavljena geološka karta Slovenije (priredil M. Pleničar)

Fig. 1.
Simplified overview geological map of Slovenia (adapted by M. Pleničar)



Sl. 2. Shematski prikaz razvoja zgornjepermskih in mezozojskih plasti v različnih paleogeografskih enotah Slovenije. Apnenčev in dolomitni razvoj sta naznačena z barvami (po podatkih Osnovne geološke karte 1 : 100.000 (večji del), po literaturnih podatkih in po podatkih lastnih raziskav).

Fig. 2. Schematic depiction of Upper Permian and Mesozoic beds development in various paleogeographic units of Slovenia. Limestone and dolomite development are shown in colours (adapted mainly according to the Basic Geological Map 1 : 100,000, literature and personal research data).



Sl. 3. Sedimentacijska okolja zgornjepermskih in mezozojskih karbonatnih kamnin v Sloveniji
Fig. 3. Sedimentary environments of Upper Permian and Mesozoic carbonate rocks in Slovenia

V nadaljevanju slede zelo zgoščeni opisi litologije po posameznih geoloških obdobjih s poudarkom na karbonatnih formacijah in njihovih mikrofacialnih ter diagenetskih značilnostih. Glede na to, da so triasne plasti v Sloveniji najbolj razširjene ter istočasno tudi najbolj pestro razvite, jim je v monografiji namenjenega največ prostora.

ZGORNJI PERM

Zgornjepermske plasti so v Sloveniji zastopane s karbonatnimi kamninami. Litološko so precej pestro razvite. V zahodnem delu Posavskih gub – med Ljubljano, Škofjo Loko in Idrijo dosežejo debelino do 250 metrov. Tod prevladujeta plastovit, temno siv do črn apnenec in laporast apnenec nad dolomitom, vmes pa se večkrat pojavljajo tanke pole skrilavega laporovca. Po kraju Žažar pri Vrhniki so poimenovane kot *Žažarska formacija* (Ramovš, 1958), ki je ekvivalent *Belerofonski formaciji* v Alpah (Heritsch, 1934; Buser et al., 1988; Kolar-Jurkovšek et al., 2011). V vzhodnem delu Posavskih gub, pri Laškem, Izlakah, Sevnici in na Bohorju so zgornjepermske plasti debele le do nekaj deset metrov in so razvite pretežno dolomitno. V bazalnih plasteh, tik nad klastiti Grödenske formacije, vsebujeta apnenec in dolomit še precej terigene primesi kremena in sljude. Apnenec je v splošnem izredno bogat s fosili, predvsem s skeletnimi algami, ehinodermi in foraminiferami. Delež karbonata v apnencu se giblje med 85 in 97 %.

Značilni mikrofacies algnega apnenca Žažarske formacije. Zgornji perm. Dolina Idrijce pri Masorah. Merilo 1 mm

Characteristic algal limestone facies of Žažar Formation. Upper Permian. Idrijca valley at Masore. Scale 1 mm

V Južnih Karavankah je zgornjepermsko zaporedje razvito dolomitno, kot *Karavanška formacija,* ki je debela do 300 metrov (Buser et al., 1988). Za spodnji del te formacije je značilen do 80 m debel paket satastega dolomita (Rauhwacke).

Sedimentacijsko okoje zgornjepermskih plasti je bil zelo plitev in zaprt šelf z lagunami in sabkami, ki je imel povezavo s širšim prostorom Tetide. Na to kaže univerzalna flora in favna indoarmenskega tipa. Za zaprti šelf in lagune so značilni različki algnega biomikritnega apnenca tipa packstone, za sabke pa satasti dolomiti in evaporitni minerali, od katerih sta zastopana sadra in anhidrit.

V biomikritnem apnencu so prisotne foraminifere (*Agathamina* sp., *Glomospira* sp., *Hemigordius* sp., *Reichelina* sp., *Climacammina* sp., *Geinitzina* sp., *Ammovertella* sp., *Ichtyolaria* sp., *Staffella* sp.), skeletne alge *Gymnocodium bellerophontis*, *Vermiporella nipponica*, *Permocalculus fragilis*, *Velebitella triplicata*, *Mizzia velebitana*, *M. cornuta*), brahiopidi, ehinodermi in polži (*Bellerophon* sp.), lokalno pa se pojavljajo še manjše kopuče koral vrste *Waagenophyllum indicum* (Ramovš, 1958, 1986a; Buser et al., 1988; Skaberne et al., 2009).

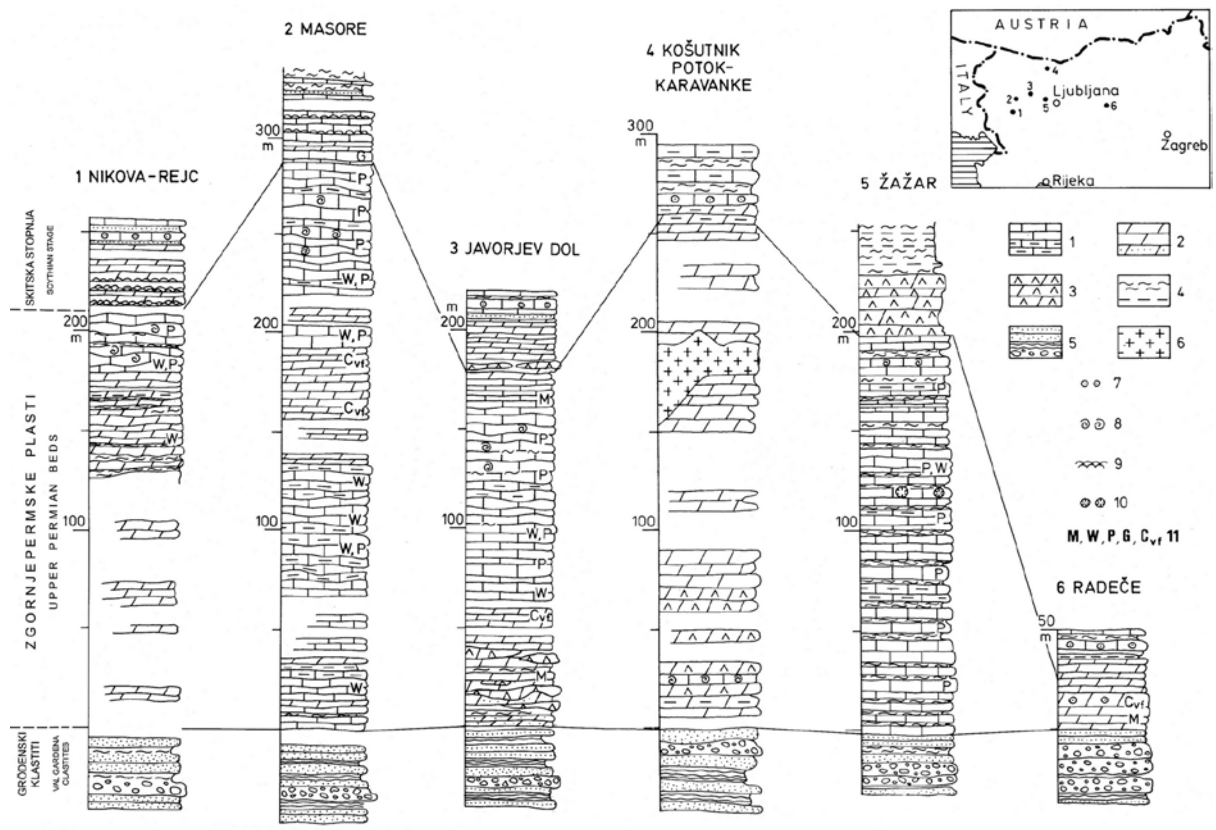
Permsko-triasna (P/T) meja je zaznamovana z nenadnim izginotjem številnih fosilnih vrst, predvsem alg in foraminifer ter s spremembo izotopske sestave ogljika v apnencih in dolomitih. Spodnjetriasni karbonati so obogateni z do 5 ‰ lažjim izotopom ogljika kot zgornjepermski (Dolenec T. et al., 1995, 1999a,b,c, 2004). Tik pod P/T mejo se ponekod pojavlja tanjša plast oolitnega apnenca (Dolenec, M. & Ogorelec, 2001; Dolenec, M. 2004), ki jo lahko primerjamo s Tesero horizontom v Alpah (Assereto et al., 1972). Paleontološko je bila P/T meja v Sloveniji v zadnjih letih dokazana na osnovi konodontne conacije (Kolar-Jurkovšek & Jurkovšek, 2007; Kolar-Jurkovšek et al., 2011) in foraminifer (Nestell et al., 2011). Takoj nad permsko/triasno mejo je značilna drobna foraminifera *Earlandia*.

Med diagenetskimi procesi, ki so zajeli zgornjepermske karbonatne kamnine, ima daleč največji obseg dolomitizacija, v manjši meri pa sta prisotni še okremenitev in dedolomitizacija. Ob dedolomitizaciji je prišlo v plasteh z evaporitnimi minerali do izločanja epsomita, kar je lepo vidno v idrijskem rudniku živega srebra.

Pretežni del dolomita je zgodnjediagenetskega značaja in je nastal po evaporitnem modelu dolomitizacije (Shinn & Ginsburg, 1964). Na aridno klimo v zgornjem permu kažejo poleg sadre in ahidrita tudi izotopske analize $\delta^{18}O$ (Polšak & Pezdič, 1978; Dolenec T. et al., 1981; Ogorelec et al., 1999b) ter visoke vsebnosti Na^+ za karbonate (Ogorelec & Rothe, 1979).

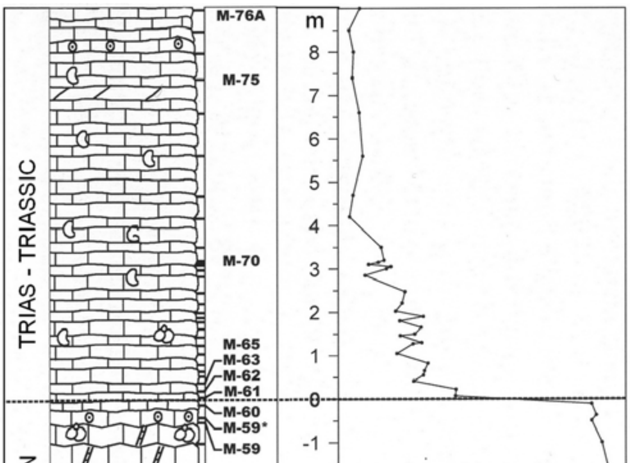
Obdobje zgornjega perma je bilo zaradi specifičnih sedimentacijskih razmer in klime ugodno za nastanek stratiformnih rudišč svinca in cinka. Taka nahajališča so pogosta v vzhodnih Posavskih gubah in sicer v vrhnjem delu zgornjepermskega zaporedja (Puharje pri Šoštanju, Iskra, 1969) ter na meji med zgornjim permom in spodnjim triasom (Mokronog, Bohor, Ledina pri Sevnici, Drovenik et al., 1980).

Zgornjepermske plasti slovenskega prostora imajo v splošnem enak ali zelo podoben mikrofacies kot ga kažejo apnenci in dolomiti iste starosti na sosednjih ozemljih – npr. v Karnijskih Alpah (Buggisch, 1974; Buggisch et al., 1976; Holser & Schönlaub, 1991; Magaritz & Holser, 1991; Noé, 1987), v Dolomitih (Bosellini & Hardie, 1973), na



Sl. 4. Litološki stolpci zgornjepermskih plasti v Sloveniji (Buser et al.,1988)

Fig. 4. Lithological columns of Upper Permian beds in Slovenia (Buser et al., 1988)



Sl. 5. Litologija in izotopska sestava karbonatnega ogljika na permsko-triasni meji v profilu Masore pri Idriji. Opazen je izrazit padec $\delta^{13}C$ na meji (Dolenec, T. et al., 2004)

Fig. 5. Lithology and stable isotope composition of carbonate carbon across the Permian-Triassic boundary in the Masore section at Idrija (Dolenec, T. et al., 2004)

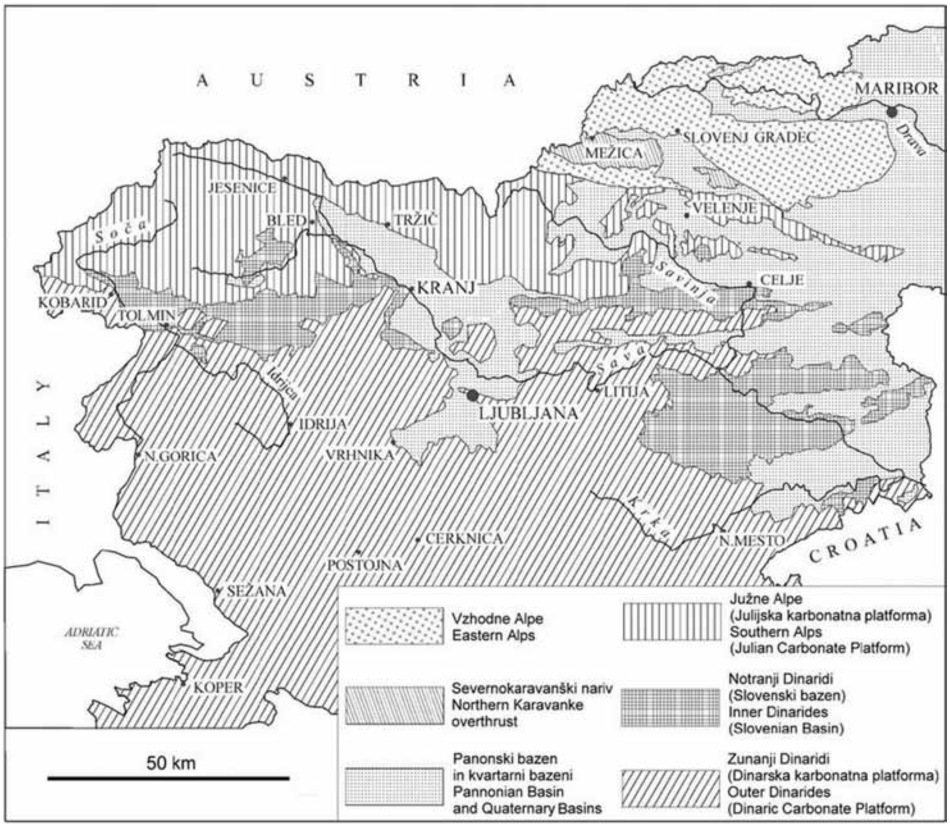
Velebitu (Kochansky-Devidé, 1979; Sremac, 1991, 2005) in na Madžarskem (Haas, 2001; Haas et al., 2004, 2006).

TRIAS

Triasne kamnine so v Sloveniji med vsemi najbolj razširjene, saj zavzemajo skoraj eno četrtino njenega ozemlja in skupno debelino celo do 3800 metrov (Buser, 1979), pri čemer karbonatne kamnine močno prevladujejo nad klastičnimi in piroklastičnimi različki (sl. 2). Kažejo izredno pestro litologijo z značilnostmi alpskega razvoja znotraj Tetide, podobnega ali enakega tistemu v Severnih Alpah.

V spodnjem triasu je karbonatno sedimentacijo na plitvem šelfu spremljal dotok terigenega, večji del drobnozrnatega materiala s kopnega, v spodnjem aniziju pa so karbonati povsem prevladovali. Koncem anizija (Buser, 1989), na Idrijskem pa že v srednjem aniziju (Čar, 1985, 2010), se je pričela Slovenska karbonatna plošča zaradi intenzivne tektonike diferencirati, na *Dinarsko karbonatno ploščo* na jugu in *Julijsko karbonatno ploščo* na severu z vmesnim *Slovenskim bazenom* (sl. 6). Ta je na prostoru osrednje Slovenije obstajal vse do sredine jurske periode, ko se je razširil še na ozemlje Julijske karbonatne plošče, proti Dinarski karbonatni plošči pa je obstajal vse do konca krede.

Podrobnejši opisi paleogeografskega razvoja triasa na celotnem prostoru Slovenije, paleotektonike in biostratigrafske razčlenitve so podani predvsem v delih: Buser, 1979, 1980b, 1988, 1996;



Sl. 6.
Današnji položaj geotektonskih enot v zahodni in osrednji Sloveniji in razširjenost sedimentov nekdanje Jadranske in Dinarske karbonatne plošče ter Slovenskega bazena (Buser, 1996, Buser et al. 2007).

Fig. 6.
Actual position of geotectonic units in western and central Slovenia with extent of sediments of the ancient Julian and Dinaric carbonate platforms and the intermediate Slovenian basin, respectively (Buser 1996, Buser et al., 2007).

Sl. 7. Bahamski šelf z osrednjim globokim jarkom, oceanskim jezikom (Tongue of the Ocean – TOC). Dimenzije tega jarka lahko primerjamo s Slovenskim bazenom, ki je v času od anizija do zgornje krede potekal preko osrednje Slovenije (http://www.keysdisease.blogspot.com/)

Fig. 7. Bahama shelf with the central Tongue of the Ocean trough (TOC). Its size is comparable to the Slovenian basin which existed in the central part of Slovenia from Anisian to Upper Cretaceous (http://www.keysdisease.blogspot.com/)

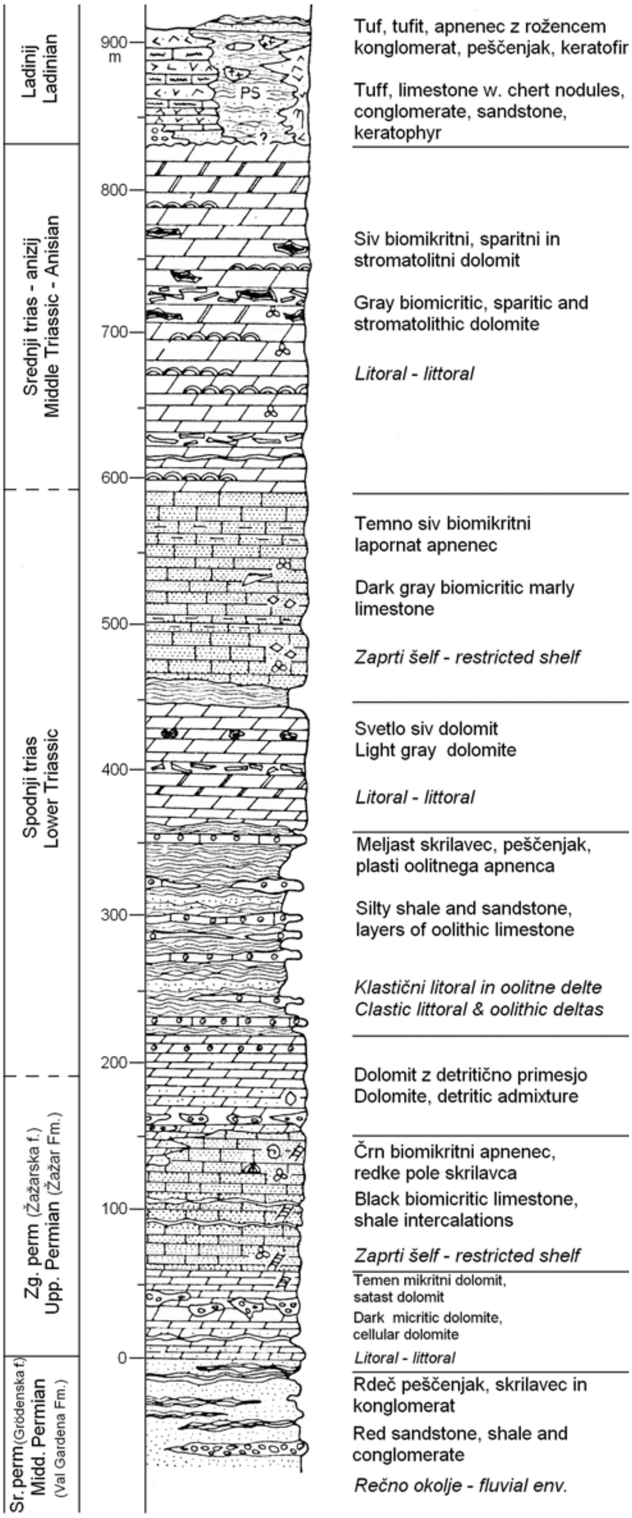
Dozet & Buser, 2009; Premru, 1980, 1982, 2005; Buser et al., 2007, 2008; Placer, 2009.

Recentni primer, kako je izgledal in bil oblikovan tak paleogeografski prostor na Slovenskem v času triasa imamo na Bahamskem otočju (sl. 7), kjer sicer enotno, zelo plitvo karbonatno ravnico razdvaja do 900 metrov globok jarek Tongue of the Ocean. Po dimenzijah nekaj sto kilometrov ga lahko primerjamo z nekdanjim Slovenskim bazenom.

Na sl. 8 je shematski prikaz litološkega razvoja triasnih kamnin v Sloveniji z izbranimi stratigrafskimi stolpci.

SPODNJI TRIAS (induanij in olenekij)

Debelina spodnjetriasnega zaporedja je dokaj različna. Giblje se med 40 in 500 metri, v Južnih Karavankah pa doseže tudi do 600 metrov (Buser, 1980a). Plasti so na celotnem slovenskem prostoru južno od Periadriatskega lineamenta precej enotno razvite. V spodnjem delu zaporedja, ki je debelo do 250 metrov, se menjavajo klastiti in karbonati, posebej pa na terenu izstopajo oolitne plasti. Dolomit in apnenec spodnjega dela spodnjega triasa, imata zaradi primesi terigenega kremena in sljude peščen izgled. Nekarbonatni delež mestoma doseže tudi 50 %. Klastite sestavljajo rdečkasti glinavci, laporovci in meljevci. Apnenec je po sturkturi največkrat biomikrit ali pelmikrit. Odlagal se je v zelo plitvem, zatišnem delu šelfa, ki je imel občasno značilnosti lagun in litorala. Večkrat je popolnoma ali delno dolomitiziran, značilne zanj pa so tudi bioturbacijske teksturne oblike. Tanjše leče ter gnezda sadre in



Sl. 9. Shematski stolpec zgornjepermskih in spodnjetriasnih plasti na Žirovskem (Ogorelec & Grad, 1986)

Fig. 9. Schematic column of Upper Permian and Lower Triassic beds of Žiri area (Ogorelec & Grad, 1986)

anhidrita kažejo na lokalne in občasne evaporitne pogoje sedimentacije. Na idrijsko-žirovskem ozemlju je v najvišjem delu spodnjetriasnega zaporedja razvit t.i. pasnati apnenec (Mlakar, 1969; Kolar-Jurkovšek et al.; 2011).

Spodnjetriasni oolitni dolomit. Hematitni pigment je obarval ooide rdečkasto. Rimske Toplice. Merilo 1 mm

Lower Triassic oolitic dolomite. Owing to hematite pigment ooids are of reddish colour. Rimske Toplice. Scale 1 mm

Ooliti so nastajali v medplimskih kanalih in deltah, kjer je bila energija okolja višja. Značilna zanje je rdečkasta barva, kot posledica hematitnega pigmenta. Jedra ooidov je večkrat zajela kasnodiagentska dolomitizacija, ki se kaže v do 300 μm velikih dolomitnih romboedrih. Med ooidi so pogosto pomešane ploščice ehinodermov ter drobne hišice polžev, opisanih kot vrsti *Natica gregaria* in *Holopella gracilior*, večkrat pa so prisotne tudi drobna zrna kremena in sljude.

V vrhnjem delu spodnjetriasnega zaporedja se delež terigene komponente zmanjšuje. Prevladuje temnejši biomikritni ali pelmikritni laporasti apnenec (mudstone do packstone) nad svetlejšim dolomitom. Med fosili so zastopane foraminifere, v nekaterih plasteh so številni ostrakodi, ploščice ehinodermov in drobne školjke, prisotni pa so tudi konodonti (Kolar-Jurkovšek & Jurkovšek, 1995, 1996, 2007). Za stratigrafijo tega dela spodnjetriasnih plasti, je med foraminiferami najbolj pomembna *Meandrospira pusilla*.

Severno od Periadriatskega lineamenta, posebno v okolici Črne na Koroškem, so spodnjetriasne plasti razvite pretežno klastično, glede na to, da pripada prostor Severnih Karavank vzhodnoalpskemu geotektonskemu bloku. Razvite so kot peščenjaki, skrilavi meljevci in konglomerati tipa »Buntsandstein« (Mioč, 1983) in so brez fosilnih ostankov (Štrucl, 1971).

Spodnjetriasne plasti slovenskega prostora kažejo v velikem delu enak ali zelo podoben mikrofacies, kot ga imajo kamnine iste starosti na sosednjih ozemljih – npr. Werfenske plasti v Severnih Alpah (Mostler & Rössner, 1984), v Karnijskih Alpah (Holser & Schönlaub, 1991), v Dolomitih (Assereto et al., 1972), na Madžarskem (Nagy, 1968; Haas, 2001), na avstrijskem delu Južnih Karavank (Anderle, 1970), na Svilaji v dalmatinski Zagori (Ščavničar et al., 1983; Jelaska et al., 2003) in drugod, kar kaže na zares obsežno in enotno sedimentacijsko okolje v času spodnjega triasa.


Starost in debelina
Age and thickness
Dinarska plošča
Dinaric platform
Slovenski bazen
Slovenian basin
Julijska plošča
Julian platform
Sev. Karavanke
N. Karavanks
Periadriatic lineament
S
N
JURA
TRIAS - TRIASSIC
PERM - PERMIAN
Spodnja
Lower
Norij in retij
Norian & Rhaetian
Karnij
Carnian
Jul & Tuval
Cord.
Zgornji - Upper
Ladinij
Ladinian
Anizij
Anisian
Srednji - Middle
Spodnji trias
Lower Triassic
Zgornji perm
Upper Permian
Srednji - Middle
shelf: 500 - 1500 m
basin < 250 m
80 - 400 m
50 - 600m
20-800 m
15-600 m
40 - 500 m
10 - 400 m
600 m
300-350 m
1000 - 1200 m
300-400 m
100 - 150m

Sl. 8. Shematski prikaz litološkega razvoja zgornjepermskih in triasnih karbonatnih kamnin v Sloveniji, s stolpci in objekti, ki so zajeti v tem delu.

Fig. 8. Schematic presentation of lithostratigraphic development of Upper Permian and Triassic carbonate rocks in Slovenia with columns and objects, presented in this work.

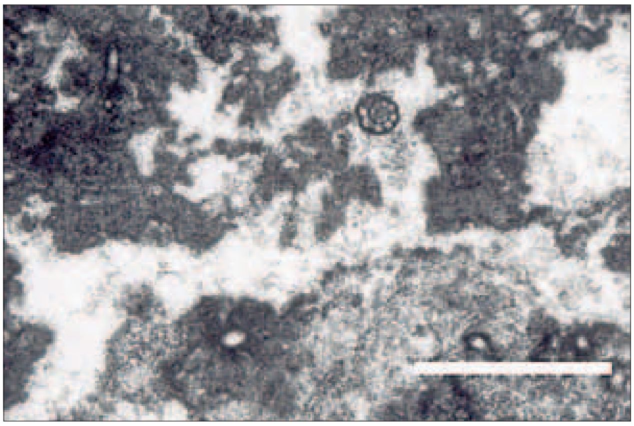
1 – Rejc - Vojskarska planota (Buser et al., 1988), **2** – Žažar (Ramovš, 1958), **3** – Masore (Buser et al., 1988, Dolenec, T. et al., 2004), **4** – Spodnja Idrija (Dolenec, T. & Ramovš, 1998, Dolenec, T. et al., 1999a, Dolenec, M. & Ogorelec, 2001), **5** – Javorjev dol - Sovodenj (Grad & Ogorelec, 1980), **6** – Zadnja Smoleva (Demšar & Dozet, 2002), **7** – Puharje - Šoštanj (Iskra 1969), **8** – Tržič - Lom (Dolenec et al., 1981), **9** – Košutnik (Buser et al., 1988), **10** – Brsnina pri Jelendolu (Dolenec, T. et al., 1998, Dolenec, T. et al., 1999b, Dolenec, M. 2004), **11** – Mokrice (Poljak - ed., 2011), **12** – Orlica (Aničić, 1991), **13** – Bohor (Ogorelec, 1979), **14** – Mišji Dol - Laško (Ramovš & Aničić, 1995), **15** – Višnja Gora (Dozet, 2000), **16** – Rajndol pri Kočevju (Dozet & Silvester, 1979), **17** - Pleše (Dozet, 1999), **18** – Želimlje (Mušič, 1992), **19** – Idrija - rudnik (mine) (Čar et al., 1980), **20** – Tehovec pri Polhovem Gradcu (Jurkovšek et al., 1998), **21** – Toško čelo (Novak, 2001), **22** – Dednik pri Polhovem Gradcu (Grad & Ogorelec, 1980), **23** – Karavanke - cestni predor (road tunnel) (Ogorelec et al., 1999a), **24** – Mežica (Štrucl, 1970, 1971), **25** – Todraž pri Gorenji vasi (Ogorelec, 1978), **26** – Kisovec pri Zagorju (Ogorelec, 1978), **26a** – Križna gora (Demšar & Dozet, 2003), **27** – Bled - grad (castle) (Flügel et al., 1993), **28** – Kranjska Gora (Ramovš, 1987), **29** – Topla (Štrucl, 1974, Drovenik & Pungartnik, 1988), **30** – Kamna Gorica (Skaberne et al., 2003), **31** – Mežica (Štrucl, 1984), **32** – Peca (Bole, 2002), **33** – Idrija - Cerkno (Šmuc & Čar, 2002), **34** – Borovnica (Dozet, 1979), **35** – Lesno Brdo (Jelen, 1990), **35a** – Rovte (Jurkovšek, 1994), **36** – Idrija - Čekovnik (Cigale, 1978), **37** – Cerkno (Čar et al. 1981), **38** – Hudajužna (Senowbari-Daryan & Schäfer, 1979; Turnšek et al., 1982), **39** – Zg. Idrijca (Mlakar, 1969; Čar, 2010), **40** – Perbla pri Zatolminu (Turnšek et al., 1987), **41** – Vršič (Jurkovšek et al., 1984), **42** – Belca v Karavankah (Jurkovšek, 1987; Kolar-Jurkovšek et al., 2005), **43** – Menina (Ramovš & Šribar, Lu., 1983), **44** – Log pod Mangartom (Ogorelec et al., 1984), **45** – Tamar (Ogorelec et al., 1984), **46** – Mežica (Pungartnik et al., 1982), **47** – Helenski potok pod Peco (Jurkovšek, 1978, Jurkovšek & Kolar-Jurkovšek, 1997; Jurkovšek et al., 2002), **48** – Kočevje (Dozet, 1990b), **49** – Šmarjetna gora (Kolar, 1979), **50** – Dolenjske Toplice (Premru et al., 1977), **51** – Preserje pri Borovnici (Ogorelec, 2009), **52** – Borovnica - Bistra (Ogorelec, 1988; Ogorelec & Rothe, 1989), **53** – Trnovski gozd - Lokve (Ogorelec & Rothe, 1989), **54** – Dolenja Trebuša - Čepovan (Ogorelec & Rothe, 1989), **55** – Laze pri Sevnici (Ogorelec & Dozet, 1997), **56** – Kobla (Buser & Ogorelec, 2008; Rožič, 2008, Rožič et al. 2008, 2009), **57** – Kobariški Stol (Ogorelec, 1984.), **58** – Krn (Ogorelec & Buser, 1996), **59** – Batognica pri Krnu (Babić, 1980/81), **60** – Begunjščica (Flügel & Ramovš, 1961, Turnšek, 1997), **61** – Mangart (Jurkovšek et al., 1990; Črne et al., 2007), **62** – Uršlja gora (Ramovš & Rebek, 1970; Mioč & Šribar, 1975)

SREDNJI TRIAS

Anizij

Anizijske plasti so v Sloveniji razvite precej enotno, večji del kot plastovit dolomit, ki kaže pogoste znake medplimske sedimentacije s stromatoliti in izsušitvenimi porami (Grad & Ogorelec, 1980; Dolenec et al., 1981). Apnenec je razvit v manjšem obsegu kot biomikrit. Med fosili prevladujejo foraminifere (*Meandrospira dinarica, Pilammina densa, Glomospirella irregularis, G. grandis, G. semiplana, Trochammina* sp.), mestoma so prisotne tudi alge (*Physoporella pauciforata*). V severnem delu Julijskih Alp je med Mojstrano in Kranjsko Goro ohranjen masiven grebenski apnenec, ki ga gradijo predvsem alge in trombolitne tvorbe (Ramovš, 1987). Enak razvoj kaže tudi grajska stena nad Blejskim jezerom (Flügel et al., 1993).

Debelina anizijskih plasti doseže do 600 metrov.



Meandrospira dinarica v stromatolitnem dolomitu z izsušitvenimi porami. Anizij. Zakamnik nad karavanškim cestnim predorom. Merilo 1 mm

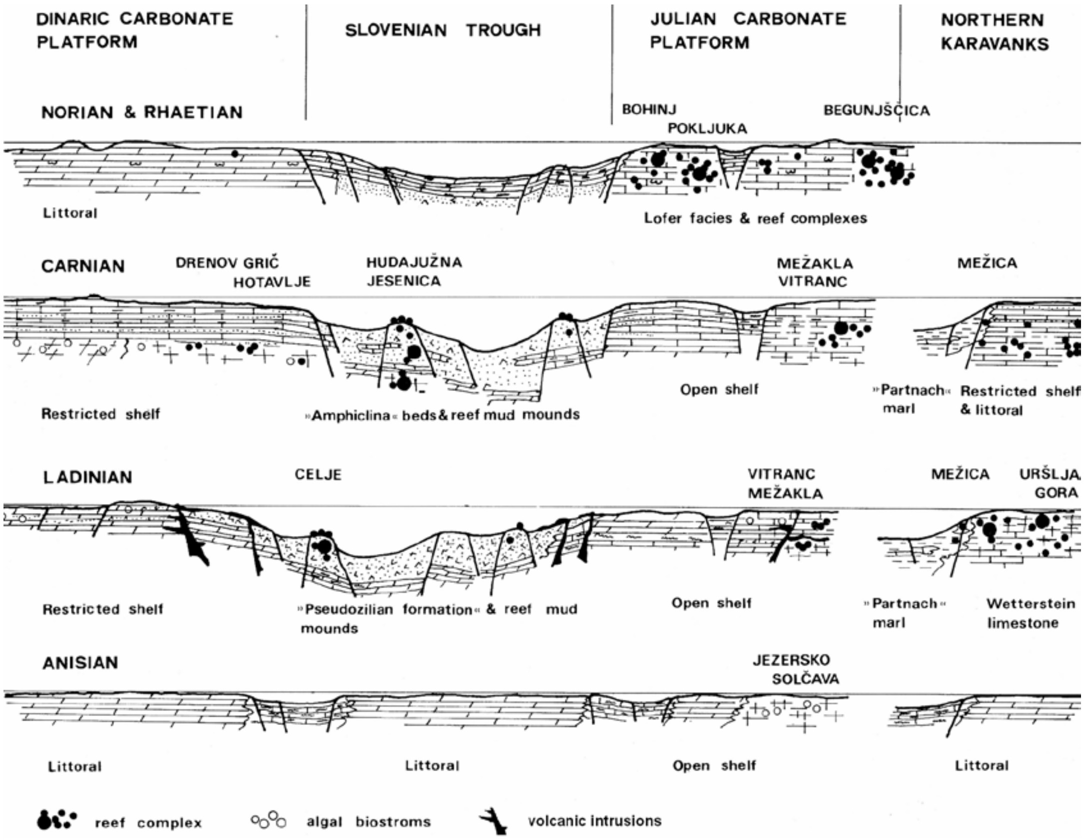
Meandrospira dinarica in stromatolitic dolomite with shrinkage pores. Anisian stage. Zakamnik above Karavanke highway tunnel. Scale 1 mm

Severno od Periadriatskega lineamenta izdanja v Topli pod Peco plastovit dolomit, ki je oruden s svinčevimi in cinkovimi minerali (Štrucl, 1974). Nad njim leži temen mikritni apnenec z gomolji rožence.

Sredi anizija je Slovenska plošča pričela razpadati. Tako se je sedimentacija od srednjega triasa dalje odvijala na treh geotektonskih enotah v različnih okoljih. Na širšem Idrijskem je prišlo do lokalnih okopnitev in nastanka debelejših konglomeratnih in peščenih plasti (Čar & Čadež, 1977; Čar, 2010). Za globlji razvoj anizija, kakršnega poznamo v Karavankah pri Tržiču, na Idrijskem in v vzhodnih Posavskih gubah, so značilni amoniti in konodonti (Kolar-Jurkovšek, 1983, 1991).

Ladinij

Ladinijske plasti so litološko med najbolj pisanimi, saj se hitro menjavajo različni litološki tipi. Izdanjajo na več krajih v osrednji Sloveniji,



Sl. 10. Poenostavljen prikaz paleogeografskega razvoja v Sloveniji v obdobju med anizijem in koncem triasa s položajem koralno-spongijskih grebenov (Turnšek et al., 1984)
Fig. 10. Simplified sketch of the paleogeographic development in Slovenia from Anisian to the end of Triassic with position of coral-sponge reefs (Turnšek et al., 1984)

na širšem Idrijskem in Cerkljanskem, v predgorju Julijskih Alp in v Karavankah, v večjem obsegu pa severno od Periadriatskega lineamenta, predvsem na pogorju Pece.

Rezultat intenzivne tektonike v času idrijske tektonske faze (Buser, 1980b) je močna razkosanost ozemlja v osrednji Sloveniji. V globljih jarkih je prišlo do vulkanskih izlivov spilitno-keratofirske asociacije (bazalti, kremenovi keratofirji, porfir,...) ter sedimentacije njihovih tufov in tufitov (Buser, 1979; Dozet & Buser, 2009). Nekateri tektonski bloki so okopneli, na kar kažejo debele plasti pobočnih breč in konglomeratov. V Južnih Karavankah in v delu Julijskih Alp je to Ugoviška breča (Buser, 1986b; Jurkovšek, 1987), na Idrijskem pa konglomerat med Idrijo in Rovtami ter Stopniški konglomerat (Mlakar, 1969; Čar & Čadež, 1977; Čar & Skaberne, 2003; Čar, 2010). Na Dinarski in Julijski karbonatni plošči so se zaradi občasne povezave z bazenom lokalno odlagali temni apnenci z roženci in vmesnimi plastmi tufov, v osrednjem delu Slovenskega bazena pa Psevdoziljske plasti, za katere je značilno menjavanje temnih skrilavih glinavcev, peščenjakov in tufov; apnenci so podrejeni. Apnenec je po strukturi ponavadi biomikritni mudstone ali wackestone, med fosili pa so poleg tankih lupin mehkužcev zastopani predvsem konodonti (Kolar-Jurkovšek, 1983, 1991; Kolar-Jurkovšek & Placer, 1987; Placer & Kolar-Jurkovšek, 1990; Kolar-Jurkovšek & Ružnar, 2006) in radiolariji (Goričan, 1997; Goričan & Buser, 1990; Skaberne et al., 2003). Med makrofosili so pomembni amoniti in školjke (Jurkovšek, 1983, 1984; Ramovš & Jurkovšek, 1983; Ramovš, 1989). V piroklastitih najdemo na Idrijskem tudi manjše grebenske kope (Čar, 2010).

V Kamniško-Savinjskih Alpah je iz zgornjega ladinija zanimiva *Korošiška formacija*. Leži nad zrnatim dolomitom in zelenim tufom. Apnenec je rahlo bituminozen, črn biomikrit z gomolji roženca. Med fosili so prisotne školjke (Jurkovšek, 1984), amoniti in skeleti rib ter plazilcev (Celarc, 2004a; Celarc & Žalohar, 2010).

V Severnih Karavankah je na območju Mežice obstajal v času ladinija in cordevola preko 1000 metrov debel kompleks masivnega, mestoma plastovitega apnenca in dolomita, znanega kot Wettersteinski apnenec (Štrucl, 1970, 1971). Najbolj značilen tak masiv je pogorje Pece. Apnenec je oruden s cinkovo in svinčevo rudo (Štrucl, 1971, 1984; Brigo et al., 1977; Drovenik et al., 1980). Spodnji del Wettersteinske formacije je bolj masiven in kaže grebenski razvoj s koralami in hetetidami (Turnšek, 1997; Bole, 2002), njen vrhnji del, ki je že cordevolske starosti, pa se je večji del odlagal v medplimskem okolju odprtega šelfa in vsebuje pogoste stromatolitne in loferitne plasti. Proti jugu prehaja Wettersteinski apnenec v temne glinavce in laporovce z redkimi polami apnenca. Te plasti, znane kot *Partnaška formacija*, so nastajale v zaprtem in nekoliko globljem delu šelfa. Mestoma so v tem paketu prisotne tudi leče in gomolji evaporitnih mineralov, predvsem sadre (Štrucl, 1971; Mioč 1973).

ZGORNJI TRIAS

Karnij

Karnijske plasti so najbolj razširjene v zahodni Sloveniji. Znotraj njih stratigrafsko ločimo plasti cordevolske, julske in tuvalske podstopnje. Zastopane so v plivomorskem in globljemorskem razvoju. Celotno karnijsko obdobje je trajalo 14 milijonov let.

V novejšem obdobju se pojem *cordevolska podstopnja* opušča (Celarc, 2004b; Lucas et al., 2010), ker naj bi te plasti po fosilni združbi pripadale že spodnjemu delu julske podstopnje. Glede na poseben, bolj grebenski facies masivnega apnenca in dolomita, kakršen je poznan iz obdobja najnižjega dela karnija v Sloveniji, in glede na tradicijo pri izdelavi Osnovne geološke karte, pa je cordevolska podstopnja v pričujoči monografiji ohranjena še kot samostojna stratigrafska enota.

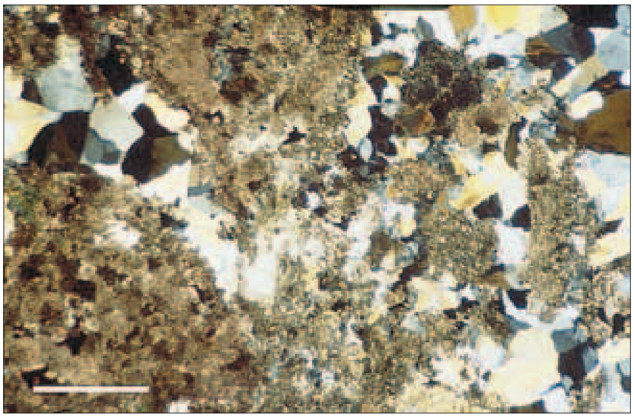
Kamnine **cordevolske starosti** so razvite le karbonatno, večji del kot svetel, masiven zrnat dolomit, v katerem je prvotna struktura kamnine ohranjena le poredko. Po fosilih, predvsem dazikladacejskih algah in koralah sklepamo, da predstavlja cordevolski dolomit nekdanje grebene, katere je kasneje intenzivno zajela dolomitizacija. Apnenci cordevolske starosti grade večji del Mežakle in Pokljuke v Julijskih Alpah (Ramovš, 1988; Ramovš & Turnšek, 1984; Turnšek & Buser, 1989) ter obsežne predele v Kamniško-Savinjskih Alpah (Krvavec, Velika planina, Menina – Premru, 1974, 2005; Ramovš & Šribar, 1993; Celarc 2004a; Žalohar & Celarc, 2010), v manjših krpah pa se pojavljajo tudi na Idrijskem, prostoru med Cerknim in Ljubljano ter v vzhodnih Posavskih gubah. Zaradi paleozakrasevanja in lokalnih emerzij (Buser, 1980b) je apnenec večkrat obarvan rdečkasto in vsebuje žepe rdeče gline in boksita. Tak apnenec je zanimiv kot okrasni kamen. Pridobivajo ga v kamnolomih Hotavlje in Lesno Brdo pri Vrhniki (Ramovš, 1995, 2000). V dolomitu in apnencu so na vseh omenjenih območjih med fosili najbolj pogoste skeletne alge (*Diplopora annulata*, *Diplopora annulatissima*, *Gyroporella ladinica*), ki so mestoma kamenotvorne (Ramovš, 1988, 1992; Dozet, 1979, 2004; Čar, 2010).

Poseben, plastovit razvoj dolomita poznamo na Vojskarski planoti v Zgornji Idrijci in v Gačneku, kjer v 40 metrov debelem profilu zasledimo teksture, ki so značilne za litoralno medplimsko okolje (Čar, 2010).

Na območju Severnih Karavank se je v cordevolu nadaljevala sedimentacija plastovitega apnenca in dolomita v vrhnjem delu Wettersteinske formacije.

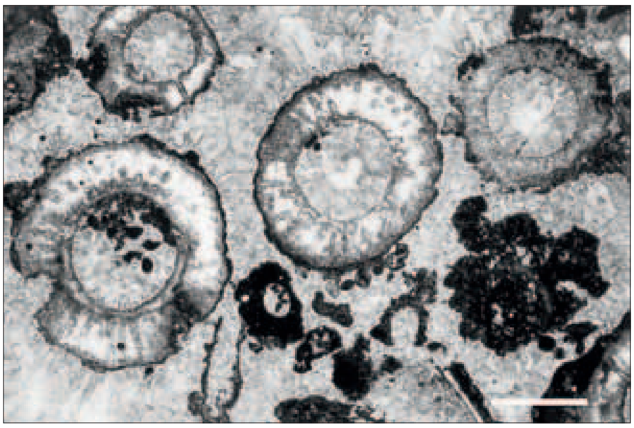
Debelina cordevolskega dolomita in apnenca je lahko precej različna in doseže v različnih tektonskih enotah Slovenije od nekaj deset do 600 metrov.

Kamnine **julske in tuvalske podstopnje** so pestro, pretežno karbonatno razvite. Med apnenci in dolomiti se pojavljajo plasti laporovca ter vložki klastitov in tufov. Njihova debelina znaša med 100 in 400 metri. Klastiti in tufi ima-



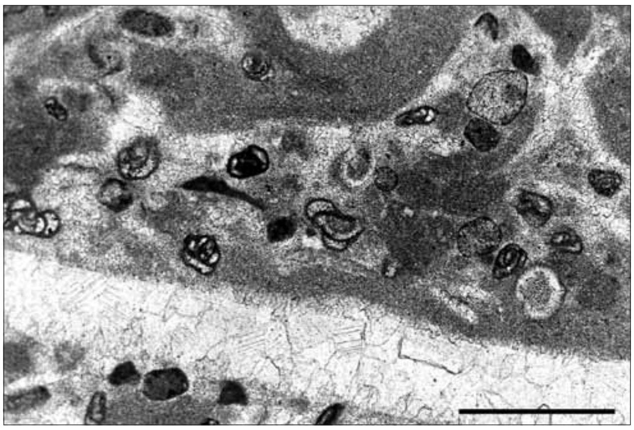
Močno okremenjen sparitni dolomit. Vzorec je z dna najgloblje vrtine v Sloveniji (Ljut-1 pri Ljutomeru, 4025 m). Domnevno triasna starost. Merilo 1 mm

Sparry dolomite, intensely silicified. Sample from the bottom of the deepest borehole in Slovenia (Ljut-1 at Ljutomer, 4025 m). Presumably Triassic age. Scale 1 mm



Biosparitni apnenec s preseki alge *Diplopora annulata*. Cordevol. Ušivec na Veliki planini. Merilo 1 mm

Biosparitic limestone with *Diplopora annulata* algae. Cordevolian substage. Ušivec on Velika planina. Scale 1 mm



Biomikritni apnenec s foraminiferami in školjčnimi lupinami. Značilen facies plasti julsko-tuvalske starosti. Črna voda v Tamarju. Merilo 0,5 mm

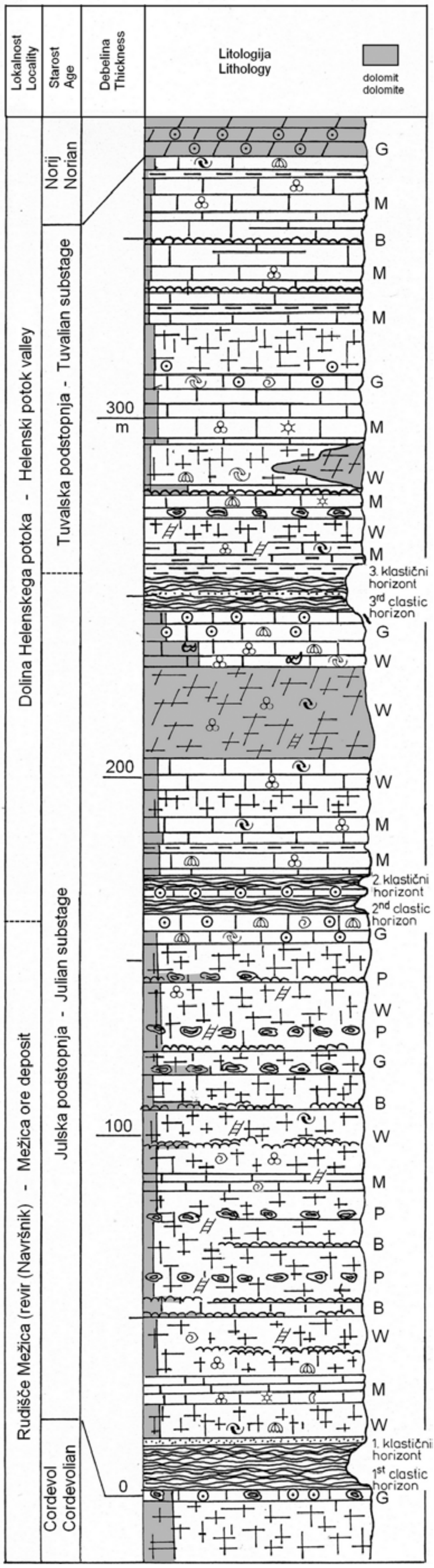
Biomicritic limestone with foraminifers and bivalves. Characteristic facies of Julian-Tuvalian beds. Črna voda in Tamar valley. Scale 0.5 mm jo od severa proti jugu na Dinarski karbonatni plošči vedno večji obseg, tako da na Idrijskem in Kočevskem že prevladujejo nad karbonati (Cigale, 1978; Dozet, 1990a).

V nasprotju s cordevolskim dolomitom, so se julske in tuvalske plasti odlagale na zaprtem plitvem šelfu, pogosto v lagunah. Temna barva apnenca in piritni pigment kažeta na redukcijske razmere v sedimentacijskem okolju. Apnenec je pogosto laporast in ima mestoma budinažasto teksturo. Delež organske snovi se v poprečju giblje okrog 1 % in doseže največ do 4 %, njen izvor pa je večji del terestričen (Ogorelec et al., 1996a). Po strukturi je apnenec mikriten in biopelmikriten tipa mudstone do packstone, med fosili pa prevladujejo tankolupinske školjke (Jelen, 1990; Jurkovšek, 1994), skeletne in neskeletne alge (*Poikiloporella duplicata, Clypeina besici*), ostrakodi in drobne foraminifere (*Nodosaria ordinata*, *Glomospira* sp., *Diplotremina astrofimbriata, Lamelliconus multispirus*, *Ammodiscus parapriscus*, *Frondicularia pupiformis*) (Oblak, 2001) ter školjke vrste *Triadomegalodon idrianus* (Čar, 2010). Na nekoliko bolj razgibano okolje kažejo posamezni ooidi in onkoidi. Apnenec je pogosto zajela tako zgodnje- kot poznodiagenetska dolomitizacija ter karstifikacija z žepi in plastmi boksitov (Dozet, 1979, 2004; Buser, 1980b).

Vrhnji del julskega in tuvalskega zaporedja je pogosto zastopan s sivim dolomitom, med katerim so redke plasti laporovca, mestoma pa tudi več metrov debele plasti tufskega glinavca. Ta dolomitni paket postopno preide v svetlejši, plastnat dolomit brez vmesnih lapornih pol, v *Glavni dolomit*. Starost tega dolomita je določena z do nekaj cm velikimi megalodontidnimi školjkami, foraminiferami, algami (*Poikiloporella duplicata*) ter konodonti (Kolar-Jurkovšek, 1991).

Poseben razvoj julsko-tuvalskega zaporedja so Amfiklinske plasti, ki so na Cerkljanskem in v Baški grapi debele do 250 metrov (Buser, 1986b). Zanje je značilno menjavanje temno sivega do črnega laporastega biomikritnega apnenca, skrilavega laporovca, kremenovega peščenjaka, apnenčevih konglomeratov ter tufov in tufitov. V tem kompleksu se na širšem Cerkljanskem pojavljajo na več mestih od nekaj pa do 40 metrov debeli grebeni (Senowbari-Daryan & Schäfer, 1979; Čar et al. 1981; Turnšek et al., 1984), katere gradijo predvsem spongije in v manjši meri korale (Turnšek, 1997). Po teksturnih značilnostih apnencev in po postopni zrnavosti v plasteh sklepamo na sedimentacijo Amfiklinskih plasti na pregibnem delu karbonatnega šelfa proti Slovenskemu bazenu (Turnšek et al., 1984).

V Julijskih Alpah opazujemo tako plitvomorski kot globljemorski razvoj julskih in tuvalskih plasti. Plitvomorski razvoj opazujemo npr. v Tamarju in Logu pod Mangartom (Ogorelec et al., 1984; Jurkovšek, 1987). Apnenec, ki je biomikriten (wackestone do packstone), vsebuje številne skelete foraminifer, drobnih megalodontidnih in drugih školjk ter ploščic ehinodermov; večkrat je dolomitiziran. Pogosto je laporast (do 15 % nekarbonatne primesi, večinoma glina in organska

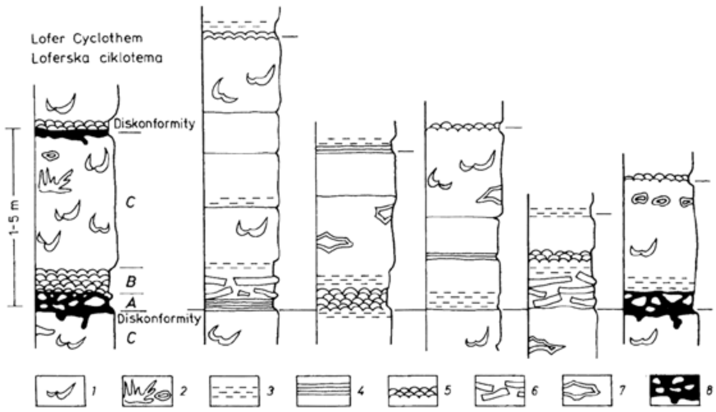


Sl. 11. Razvoj karnijskih plasti v mežiškem rudišču in Helenski grapi pod Peco (prirejeno po Pungartniku in sod., 1982).

Fig. 11. Development of Carnian beds in Mežica mine and Helena gorge at the foot of Mt.Peca (adapted after Pungartnik et al., 1982).

snov). Za globljemorski razvoj je značilen gost biomikritni apnenec z gomolji roženca. V favni prevladujejo tankolupinske školjke, kalcitizirani radiolariji in naplavljene ploščice ehinodermov (Ogorelec et al., 1984; Jurkovšek 1987). V teh plasteh so bili na Kozji dnini pod Triglavom najdeni fosilna riba *Birgeria* sp. (Jurkovšek & Kolar-Jurkovšek, 1986), črv *Valvasoria carniolica* (Kolar-Jurkovšek & Jurkovšek, 1997) in številni drugi fosili (Dobruskina et al., 2001; Bitner et al., 2010), v zahodnih Karavankah pa alga *Clypeina besici* (Kolar-Jurkovšek & Jurkovšek, 2003), makroflora (Dobruskina et al., 2001), foraminifere in konodonti (Kolar-Jurkovšek et al., 2005).

Julske in tuvalske plasti so v Severnih Karavankah pri Mežici zastopane z do 350 metrov debelim zaporedjem apnenca in dolomita (sl. 11), ki je razvito v 20 ciklotemah loferskega tipa, značilni zanje pa so trije klastični horizonti skrilavca, meljevca in laporovca (Štrucl, 1970, 1971; Pungartnik et al., 1982). Klastične horizonte povezujemo z evstatičnimi fazami in humidnim klimatskim sunkom, znanim kot CPE (Carnian Pluvial Event – Kolar-Jurkovšek & Jurkovšek, 2010). Nekatere plasti so izredno bogate s fosili (Jurkovšek 1978; Jurkovšek & Kolar-Jurkovšek, 1997; Kaim et al., 2006; Jurkovšek et al., 2002; Kolar-Jurkovšek & Jurkovšek, 2009, 2010). Na bolj razgibano okolje znotraj plitvega šelfa kažejo posamezne oolitne plasti in onkoidi.



Sl. 12. Različni tipi ciklotem v Dachsteinskem apnencu na Krnu (Ogorelec & Buser, 1997)

Na levi je klasična loferska ciklotema po Fischerju (1964).

1 – megalodontide; 2 – korale in onkoidi; 3 – apnenec z izsušitvenimi porami (loferit); 4 – laminit; 5 – stromatolit; 6 – tempestitne plasti (»nadplimski konglomerat«); 7 – korozijske votline; 8 – emerzijska breča z rezidualno karbonatno glino

Fig.12. Various types of cyclothems in the Dachstein limestone on Mt. Krn, Julian Alps (Ogorelec & Buser, 1997).

Classical Lofer cyclotheme after Fischer (1964) is on the left.

1 – Megalodontids; 2 – Corals and oncoids; 3 – Limestone with shrinkage pores (loferite); 4 – Laminite; 5 – Stromatolite; 6 – Tempestite layers (»flat pebble conglomerate«); 7 – Solution cavity; 8 – Emersion breccia with residual carbonate clay

Loferitni dolomit z izsušitvenimi porami prerašča stromatolitna plast, nad njo pa je mikritni dolomit. Značilen facies medplimskega okolja. Dachsteinski apnenec, norij. Grudnica nad Slapom ob Idrijci. Merilo 1 cm

Loferitic dolomite with shrinkage pores, overgrown by stromatolite layer and micritic dolomite. Characteristic facies of the intertidal environment. Dachstein limestone, Norian. Grudnica above Slap ob Idrijci. Scale 1 cm

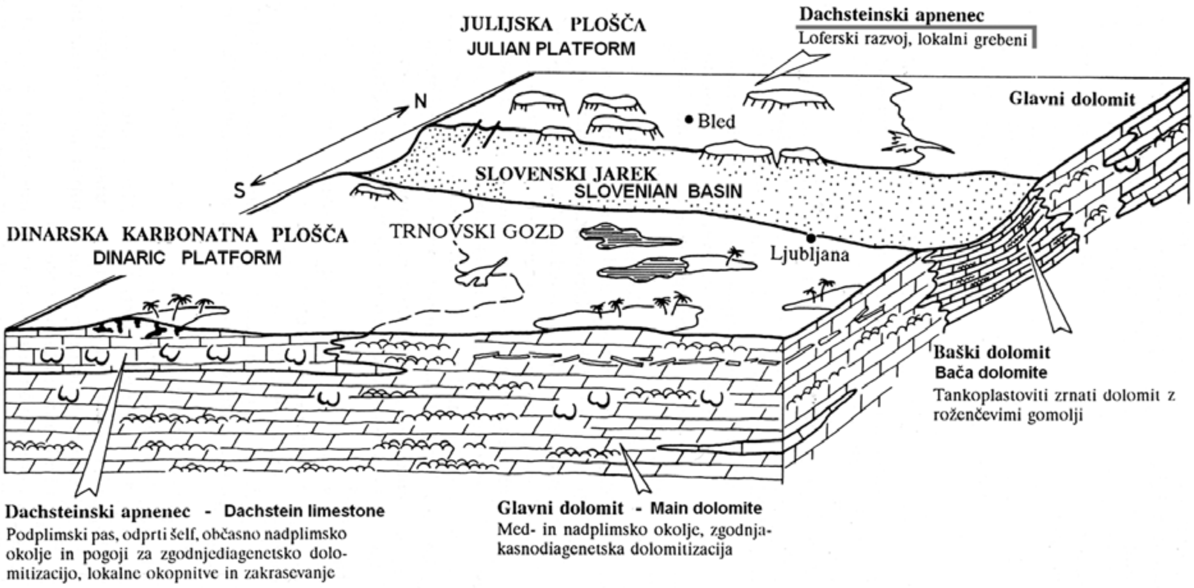
Norij in retij

Kamnine norijske in retijske starosti so v Sloveniji zastopane v treh razvojih. Na obeh karbonatnih ploščah, Julijski in Dinarski, se pojavljata Glavni dolomit in njegov lateralni različek Dachsteinski apnenec, v Slovenskem bazenu pa sta razvita Baški dolomit in Železnikarski apnenec (sl. 13). Glavni dolomit in Dachsteinski apnenec zavzemata precejšen obseg in sta najbolj razprostranjeni formaciji v Sloveniji. Gradita pretežni del Julijskih Alp, velik del Notranjske, severni del Trnovskega gozda in del Dolenjske.

Kompleks Glavnega dolomita je debel med 800 in 1300 metri, prav toliko pa je lahko debel tudi Dachsteinski apnenec. Apnenec je v večjem delu razvit na Julijski platformi, medtem ko na Dinarski karbonatni platformi prevladuje dolomit. Debelina Baškega dolomita je tri do štirikrat tanjša in je ocenjena na največ 400 metrov (Buser, 1986b).

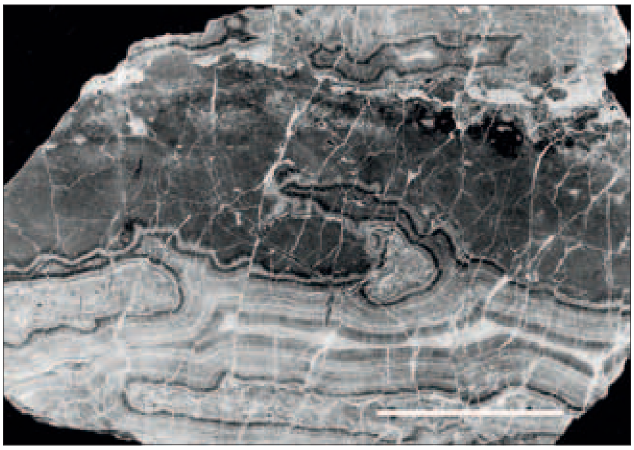
Dachsteinski apnenec je debeloplastnat in kaže značilen loferski razvoj, kakršen je poznan iz Severnih Alp (Fischer, 1964; Zankl, 1971; Piller & Lobitzer, 1979; Piller, 1981), Dolomitov (Bosellini, 1967; Bosellini & Rossi, 1974) ali Madžarske (Haas, 1994). Posamezne cikloteme (sl. 12) sestavljajo do 2 metra debele plasti biomikritnega in biosparitnega apnenca, katerega prekinjajo tanke stromatolitne in loferitne plasti ter lokalno tudi medplastovne breče z glinenim vezivom.

Med fosili so najbolj pogoste foraminifere (*Triasina hantkeni, Aulotortus* gr. *sinuosus, A. permodiscoides*, *A. friedli*, *Miliolipora cuvillieri, Galeanella* sp.), alge (*Macroporella retica*) in ehinodermi. V nekaterih plasteh so velike megalodontidne školjke kamnotvorne. Dachsteinski apnenec se je odlagal na plitvem, odprtem in priobrežnem šelfu, z občasnimi medplimskimi in nadplimskimi pogoji (Ogorelec, 1988; Ogorelec & Rothe, 1992; Dozet & Ogorelec, 1990). Plasti,



Sl. 13. Shematski paleogeografski prikaz sedimentacijskih okolij v noriju in retiju na ozemlju zahodne Slovenije

Fig. 13. Schematic paleogeographic presentation of sedimentary environments during Norian and Rhaetian in Western Slovenia



Korozijska votlina s kokardno teksturo sparitnega kalcita nakazuje paleozakrasevanje. Dachsteinski apnenec v Smrekovi Dragi na Trnovskem gozdu. Merilo 5 cm

Solution cavity filled with sparry calcite of cockade textureindicating paleokarstification. Dachstein limestone from Smrekova Draga on Trnovski gozd. Scale 5 cm

ki so se odlagale v litoralnem okolju, so večkrat dolomitizirane.

Na Julijski karbonatni plošči se znotraj formacije Dachsteinskega apnenca pojavljajo večji grebenski masivi (Begunjščica, Pokljuka, Bohinj) ali manjši grebeni z bogato koralno favno (Turnšek & Ramovš, 1987; Turnšek & Buser, 1991; Turnšek, 1997). Občasno je na obeh, Dinarski in Julijski karbonatni plošči prišlo do kratkotrajnih okopnitev njunih posameznih delov. V takih primerih se je razvil paleokras. Slednji je posebno lepo razvit na Kaninskem pogorju in na Krnu (Babić, 1980/81; Ogorelec & Buser, 1996). Enako favno in mikrofacies, kot ju opazujemo v grebenskem apnencu slovenskega dela Alp, kažejo tudi norijsko-retijski grebeni v Severnih Alpah (Zankl, 1971; Flügel, 1981; Piller, 1981; Stanton & Flügel, 1989; Flügel & Koch, 1995; Turnšek et al., 1999).

Glavni dolomit kaže monoton, popolnoma dolomiten razvoj. Zanj je značilno ciklično menjavanje debelejših dolosparitnih in biomikritnih plasti s tanjšimi stromatolitnimi plastmi, loferiti, mestoma tudi z nadplimskim konglomeratom in emerzijskimi brečami. Med fosili so zastopane velike megalodontide, foraminifere in alge. Lokalno so prisotne tudi plasti in leče z onkoidi in vadoznimi pizoidi (Ogorelec, 1988; Dozet, 1991). Glavni dolomit se je, sprva kot apnenec, odlagal na zelo plitvem zaprtem šelfu z obsežnimi medplimskimi ravnicami, v plitvejšem delu šelfa kot Dachsteinski apnenec. Dolomitizacija je bila zgodnjediagenetska z »evaporative pumping« modelom (Illing et al., 1965), kasneje pa je kamnino zajela še kasnodiagenetska dolomitizacija. Tudi dolomit kaže večkrat znake paleozakrasevanja. Manjše in večje korozijske votline zapolnjuje conarni sparitni cement, večkrat je vmes tudi rdeč interni mikrit.

V istem obdobju, ko sta se odlagala na platformi Dachsteinski apnenec in Glavni dolomit, sta v bazenu in njegovem obrobju nastajala **Baški dolomit** in **Železnikarski apnenec** (Buser, 1979; Ramovš, 1970; Gale, 2010). Karbonatni sediment v obeh formacijah je mikriten, z zelo redkimi fosili, drobnimi foraminiferami (Rožič, 2006, 2008; Rožič & Kolar-Jurkovšek, 2007; Buser & Ogorelec, 2008; Rožič et al., 2009; Gale, 2010) in konodonti (Kolar-Jurkovšek, 1982, 1991, 2011), značilne za obe formaciji pa so vmesne plasti in gomolji roženca.

JURA

Prostor Slovenije je, enako kot v srednjem in zgornjem triasu, tudi v juri pripadal trem geotektonskim enotam, ki istočasno predstavljajo tudi različna sedimentacijska okolja. Južna Slovenija je bila sestavni del Dinarske karbonatne plošče, za katero sta značilni plitvomorska sedimentacija in velika debelina karbonatnih kamnin, ki v juri

Zakrasel jurski apnenec. Kolk na Trnovskem gozdu
Karstified Jurassic limestone. Kolk on Trnovski gozd

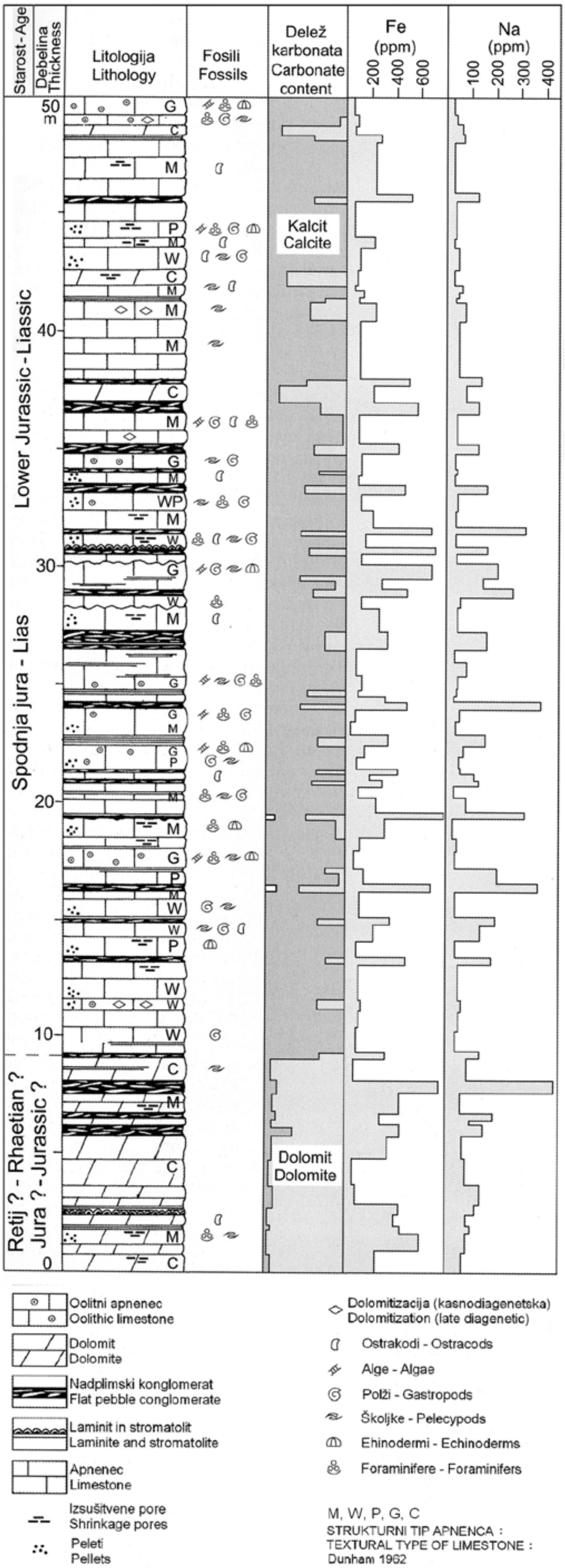
dosežejo preko 1500 metrov (Buser, 1989; Buser & Dozet, 2009). Na severu je karbonatno ploščo omejeval Slovenski bazen, severno od njega pa je obstajala Julijska karbonatna plošča. Ta je v doggru razpadla, tako da se je bazen razširil tudi na ta prostor.

Dinarska karbonatna plošča

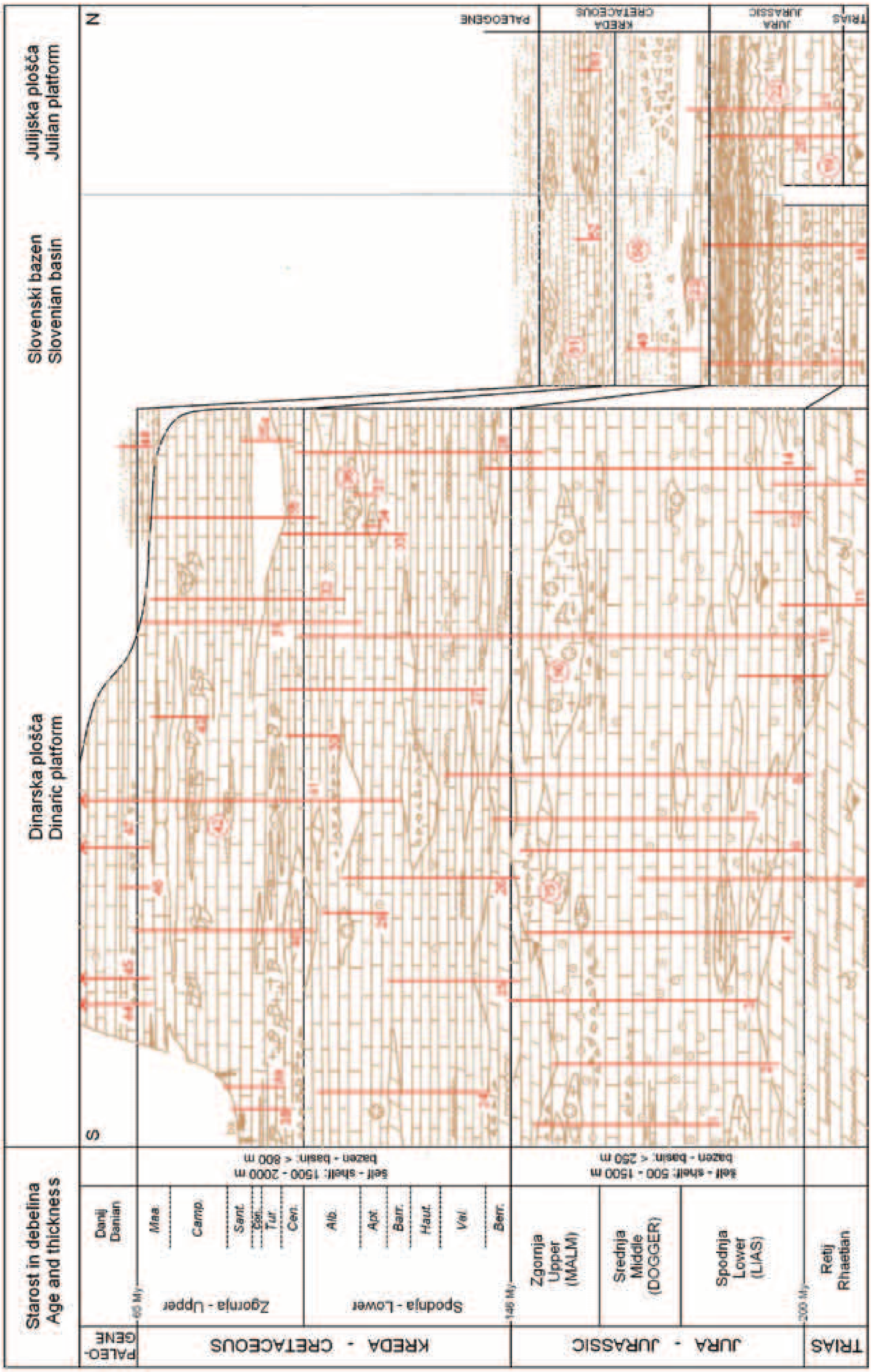
Prehod zgornjetriasnega Glavnega dolomita in Dachsteinskega apnenca v jurske plasti ni oster. Ponekod je na kontaktu razvit do nekaj deset metrov debel paket intraformacijske breče (npr. Čepovan, Grčarevec), ki je nastala v kratkotrajnih emerzijskih fazah (Buser, 1979b; Ogorelec & Rothe, 1992; Jurkovšek et al., 1996). Stromatoliti, ki so značilni za Glavni dolomit, postopno izginjajo, še vedno pa so v spodnjeliasnih plasteh pogoste teksturne oblike litoralnega okolja – izsušitvene pore in razpoke, nadplimski konglomerat in laminiti (Ogorelec 1988, 2009; Orehek & Ogorelec, 1979, 1980; Dozet, 1992a, 1998).

V srednjem in zgornjem liasu ter doggru opazujemo različna okolja znotraj karbonatnega šelfa (Buser, 1979b; Orehek & Ogorelec, 1979, 1981; Strohmenger & Dozet, 1990, Dozet, 1992a,b). Na Trnovskem gozdu, Hrušici, Logaški planoti in na Gorjancih se je sedimentacija odvijala na odprtem delu šelfa z višjo energijo. Prevladujejo oolitni apnenci (Buser, 1973,1978; Strohmenger et al., 1987; Ogorelec & Dozet, 2000), ki lahko dosežejo debelino tudi več sto metrov. Med njimi se ponekod pojavljajo plasti z velikimi onkoidi. Lokalno so pogoste litiotidne školjke, ki gradijo lumakele (Buser, 1978; Buser & Debeljak, 1996, Debeljak & Buser, 1998; Ramovš, 2000).

Med fosili, ki jih opazujemo v zbruskih spodnjejurskih - liasnih plasti, sta pomembni algi *Paleodasycladus mediterraneus* in *Sestrosphaera liasina*, med foraminiferami pa so določene vrste *Orbitopsella praecursor, Involutina liassica, Agerella martana, Trocholina turris, Pseudo-*



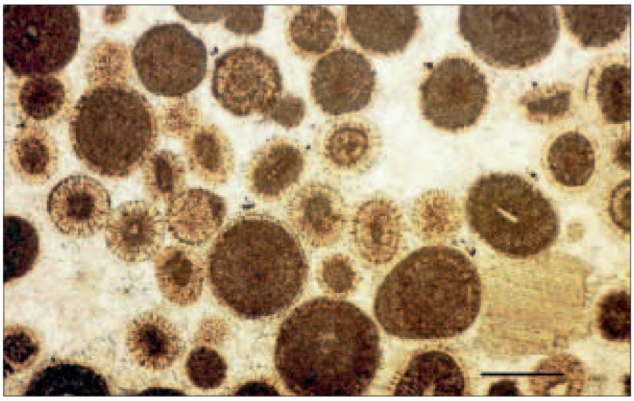
Sl. 15. Spodnjeliasne plasti v Preserju pri Borovnici (Ogorelec, 2009)
Fig.15. Lower Liassic beds in Preserje near Borovnica (Ogorelec, 2009)


Julijska plošča
Julian platform
Slovenski bazen
Slovenian basin
Dinarska plošča
Dinaric platform
Starost in debelina
Age and thickness
PALEO-GENE
KREDA - CRETACEOUS
JURA - JURASSIC
TRIAS
Zgornja - Upper
Spodnja - Lower
Danij
Danian
Maa.
Camp.
Sant.
Con.
Tur.
Cen.
Alb.
Apt.
Barr.
Haut.
Val.
Berr.
Zgornja
Upper
(MALM)
Srednja
Middle
(DOGGER)
Spodnja
Lower
(LIAS)
Retij
Rhaetian
šelf - shelf: 1500 - 2000 m
bazen - basin: < 800 m
šelf - shelf: 500 - 1500 m
bazen - basin: < 250 m
S
N
PALEOGENE
KREDA
CRETACEOUS
JURA
JURASSIC
TRIAS

Sl. 14. Shematski prikaz litološkega razvoja jurskih in krednih karbonatnih kamnin v Sloveniji z vrisanimi litostratigrafskimi stolpci in z literaturnimi podatki.

Fig. 14. Schematic presentation of lithologic development of Jurassic and Cretaceous carbonate rocks in Slovenia with the position of lithostratigraphic sections and their reference data.

1 – Jugorje - Gorjanci (Orehek & Ogorelec, 1980/81), **2** – Prezid, Kočevsko (Dozet & Šribar, 1981, Dozet, 1992a,b), **3** – Mala gora - Kompolje (Strohmenger & Dozet, 1990, Strohmenger et al., 1987), **4** – Bela Krajina, Kočevski Rog (Dozet, 1996), **5** – Južna Slovenija (Kočevska gora, Goteniška gora, Dozet, 1990c, 1999), **6** – Krka - Mali Korinj (Strohmenger & Dozet, 1990, Dozet, 1993), **7** – Travna gora - Jelenov žleb (Orehek & Ogorelec, 1980/81), **8** – Racna gora pri Loškem Potoku (Orehek & Ogorelec, 1980/81), **9** – Čepovan - Lokve (Ogorelec & Rothe, 1992), **10** – Trnovski gozd (Orehek & Ogorelec,1979), **11** – Smrekova Draga na Trnovskem gozdu (Ogorelec & Rothe, 1992), **12** – Preserje pri Borovnici (Ogorelec, 2009), **13** – Bistra pri Verdu (Ogorelec & Rothe, 1992), **14** – Vrhnika - Logatec (Orehek & Ogorelec, 1980/81), **15** – Suha Krajina (Dozet, 1995), **16** – Trnovski gozd (Turnšek, 1966, 1969, 1972, 1997; Turnšek et al., 1981), **17** – Laze pri Sevnici (Ogorelec & Dozet, 1997), **18** – Kobla (Buser & Ogorelec, 2008; Rožič, 2005, 2008, 2009), **19** – Batognica pri Krnu (Babić, 1980/81), **20** – Julijske Alpe - Trenta (Jurkovšek et al., 1990), **21** – Mangart (Jurkovšek et al., 1990; Šmuc, 2005), **22** – Bovec (Ogorelec et al., 2006), **23** – Zalilog (Babić & Zupanič, 1978), **24** – Delnice (Dozet & Šribar, 1991), **25** – Podhosta, Kočevski Rog (Orehek & Ogorelec, 1985), **26** – Kočevsko (Dozet, 1990), **27** – Trnovo (Koch, 1988; Koch et al., 1989; Koch & Ogorelec, 1990), **28** – Logatec (Šribar, 1979), **29** – Slovenski vrh - Kočevje (Turnšek et al., 1992), **30** – Dutovlje (Koch & Ogorelec, 1987), **31** – Nanos (Koch, 1977, 1978; Koch et al., 1998; Šribar Lu., 1995), **32** – Nanos - Nadrt (Jež, 2011), **33** – Sabotin (Koch, 1988), **34** – Sabotin - Mrzlek (Koch et al., 2002), **35** – Sabotin (Jež, 2011), **35a** – Kališe - Logatec (Jež, 2011), **36** – Kanalski vrh (Grötsch, 1991), **37** – Kanalski vrh - Levpa (Grötsch et al., 1994), **38** – Matarsko podolje (Jež, 2011), **39** – Matarsko podolje - Hrušica (Jež et al., 2011), **40** – JZ Slovenija (Šribar & Pleničar, 1991), **41** – Kras (Jurkovšek et al., 1996; Jurkovšek, 2008, 2010), **42** – Komen (Ogorelec et al., 1987a, 1996b; Jurkovšek et al., 1996; Jurkovšek & Kolar-Jurkovšek, 2007), **43** – Senožeče (Pleničar & Jurkovšek, 1996; Pleničar, 2005), **44** – Kozina (Delwalle & Buser, 1990), **45** – Čebulovica (Ogorelec et al., 2001), **46** – Kras - K/T meja (K/T boundary) (Ogorelec et al., 1995, 2007; Hansen et al., 1995; Pugliese et al., 1995; Riccamboni, 2005), **47** – Dolenja vas (Drobne et al., 1988, 1989, 1995), **48** – Goriška Brda (Šribar, 1965), **49** – Bohor, Krško (Buser et al., 1982a), **50** – Podbrdo - Zalilog (Babić & Zupanič, 1978), **51** – Banjška planota (Turnšek & Buser, 1976), **52** – Doblar - volčanski apnenec (Volče limestone) (Ogorelec et al., 1976, 1987b), **53** – Bovec (Kuščer et al., 1974; Radoičić & Buser, 2004)



Oolitni apnenec. Spodnjeliasne plasti v Preserju pri Borovnici. Merilo 1 mm

Oolitic limestone from the Lower Liassic succession in Preserje at Borovnica. Scale 1 mm

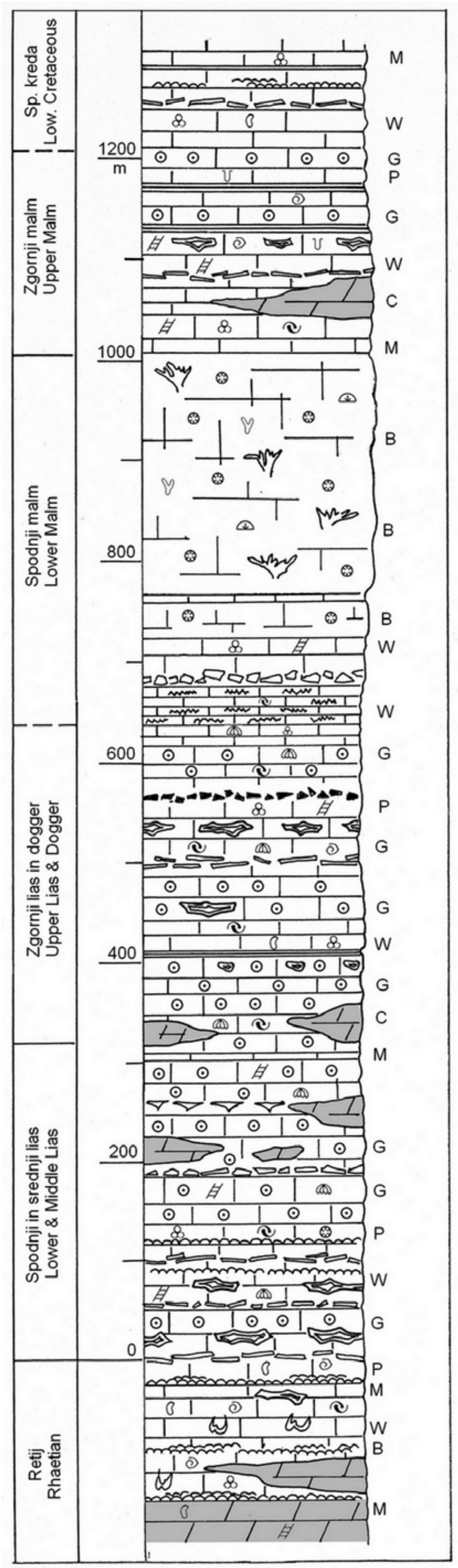
Onkoidi v zgornjeliasnem apnencu. Prelaz Vahta na Gorjancih. Merilo 5 cm

Oncoidal limestone of Upper Liassic succession. Vahta pass on Gorjanci Mts. Scale 5 cm

cyclammina liassica in *Haurania deserta* (Šribar, 1979a in podatki iz različnih tolmačev k Osnovni geološki karti 1 : 100.000). Številni so tudi, sicer za stratigrafijo manj pomembni, primerki alge *Thaumatoporella parvovesiculifera,* ehinodermi, mikrogastropodi, školjke, ostrakodi, mestoma pa tudi drobni brahiopodi. V doggerskih plasteh sta določeni foraminifera *Mesoendothyra croatica* in alga *Selliporella donzelli.* Na Hrušici in na Trnovskem gozdu so poredke kopuče koral in plasti krinoidnega apnenca.

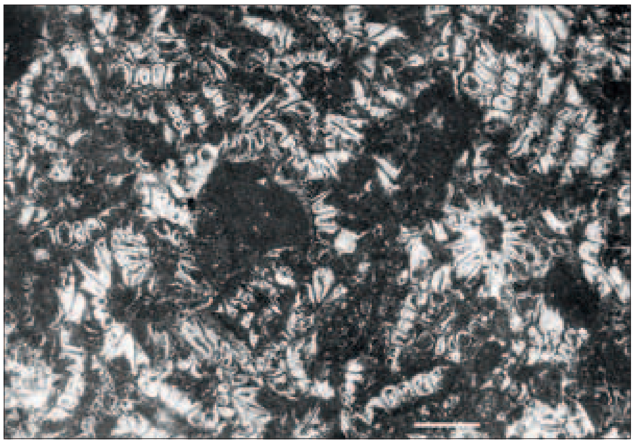
Na Notranjskem nastopa v spodnji in srednji juri temno siv biomikritni in pelmikritni apnenec, ki kaže na sedimentacijo v bolj zatišnih in zaprtih delih šelfa z lagunami in občasno redukcijskimi pogoji (Orehek & Ogorelec, 1981). Večkrat se med apnencem pojavljajo leče zrnatega dolomita. Na Kočevskem zasledimo mestoma tudi tanjše plasti premoga (Dozet, 1998). Debelina spodnje- in srednjeliasnih plasti znaša 200 do 400 metrov, zgornjeliasnih in doggerskih pa prav tako do 450 metrov (Buser, 1979b).

V spodnjem malmu se je preko Trnovskega gozda, ki je v tem času predstavljal severni rob Dinarske karbonatne plošče, vlekel več deset km dolg in nekaj km širok koralno-stromatoporidni greben. Debel je do 500 metrov (Turnšek, 1966,



Sl. 16. Shematski profil jurskih plasti na Trnovskem gozdu (Orehek & Ogorelec, 1979)

Fig. 16. Schematic columnar section of Jurassic beds on Trnovski gozd (Orehek & Ogorelec, 1979)



Gruča alg vrste *Clypeina jurassica* v mikritnem apnencu. Zgornja jura – malm. Cestni usek med Vrhniko in Logatcem. Merilo 1 mm

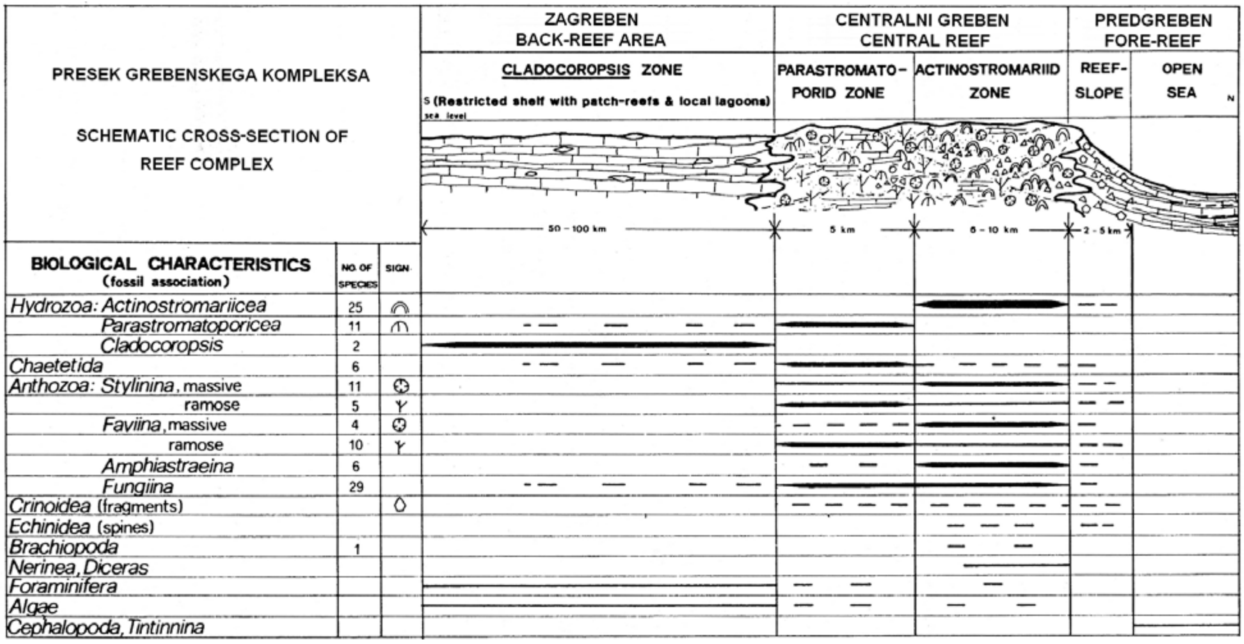
Algal limestone with *Clypeina jurassica*. Upper Jurassic – Malm. Old road cut between Vrhnika and Logatec. Scale 1 mm

1969, 1972, 1997; Turnšek et al., 1981). Med grebeni, ki so se s prekinitvami vlekli še v Suho Krajino in preko Gorjancev v Liko na Hrvaško (Velić et al., 2002) so se odlagale medgrebenske breče ter plastoviti apnenci s hidrozojem *Cladocoropsic mirabilis*.

Za zgornji malm (kimmeridgij in tithonij) so zopet značilni oolitni in biomikritni apnenci z algama *Clypeina jurassica* in *Salpingoporella annulata* (Buser, 1979b; Orehek & Ogorelec, 1981; Strohmenger & Dozet, 1990) ter z aberantnimi tintinidami (Kerčmar, 1961). Med foraminiferami

Malmski koralni greben. Selovec na Trnovskem gozdu

Malmian coral reef. Selovec on Trnovski gozd



Sl. 17. Shematski presek malmskega bariernega grebenskega kompleksa v Sloveniji s facialno conacijo in favnističnimi združbami (Turnšek et al., 1981)

Fig. 17. Schematic cross section of the Malmian barrier-reef complex in Slovenia showing its facies zonation and faunal associations (Turnšek et al., 1981)

so ugotovljene troholine (*Trocholina alpina* in *T. elongata*), *Protopeneroplis striata, Pfenderina salernitana, Kurnubia palestinensis, K. jurassica* in *Nautiloculina oolithica* (Šribar, Lj. – analize za OGK). Nekatere plasti kažejo znake litoralne sedimentacije. Na Trnovskem gozdu je del karbonatnega kompleksa popolnoma dolomitiziran.

Slovenski bazen

Jurske plasti v pelagičnem razvoju so razvite na širšem prostoru Tolmina in Bovca, v predgorju Julijskih Alp in v zahodnem delu Južnih Karavank, v manjšem obsegu pa tudi v vzhodnem delu Posavskih gub.

Liasne plasti, ki dosežejo debelino do 300 metrov, so zastopane s ploščastim mikritnim apnencem z gomolji roženca, med katerim so tudi tanke plasti glinastega laporovca. Med fosili sta prisotni foraminiferi *Ophthalmidium leischneri* in *Involutina liassica* ter radiolariji in spongije. Ob robovih bazena so se odlagali debelejši paketi apnenčevih breč, ki so splazele po pregibu z roba šelfa (Rožič, 2006, 2008; Rožič & Popit, 2006; Buser & Ogorelec, 2008). Med kosi breče so pomešani tudi ooidi. Breča in plasti drobnejših kalkarenitov pogosto kažejo postopno zrnavost in laminacijo. Na Begunjščici so ploščasti apnenci z roženci impregnirani z manganovimi oksidi in vsebujejo številne amonite.

Doggerske in spodnjemalmske plasti se težko določijo s fosili, debele pa so le nekaj deset metrov. Zastopane so z glinastimi skrilavci, radiolariti in s plastmi mikritnega in biomikritnega apnenca z roženci (Buser, 1979b; Ogorelec & Dozet, 1997). Med fosili se pojavljajo foraminifera *Globigerina helvetojurassica* in radiolariji (Goričan, 1997).

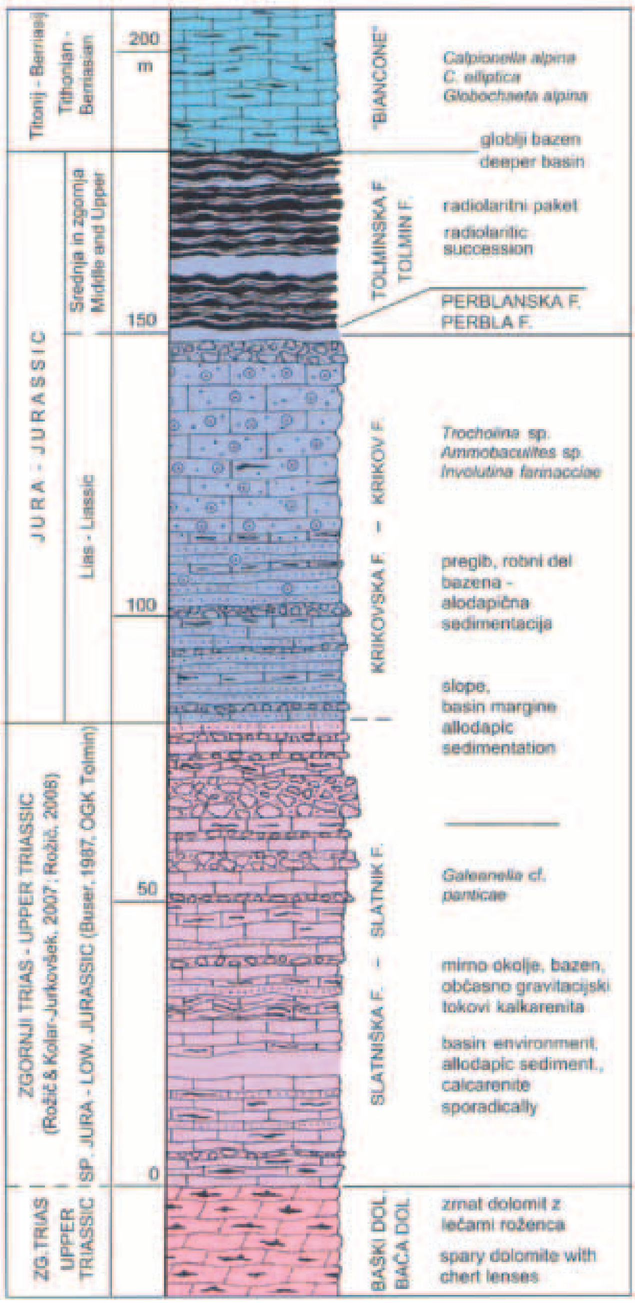
Zgornji malm – tithonij je v do 50 metrov debeli skladovnici zastopan z belim in svetlosivim gostim mikritnim apnencem tipa »biancone«, ki vsebuje gomolje in pole roženca. V apnencu so pogoste kalpionele in radiolariji. Enak apnenec se je odlagal zvezno še v spodnji kredi, berriasiju in spodnjem valanginiju, tako da doseže celoten paket kalpionelidnih apnencev do 250 metrov (Cousin, 1981; Buser, 1986, 1987; Jurkovšek, 1987; Jurkovšek et al., 1990).

Julijska karbonatna plošča

Spodnjejurske plasti so razvite v plitvomorskem faciesu odprtega šelfa. V njih se menjavajo biosparitni, oolitni in mikritni apnenci, mestoma pa so prisotne tudi stromatolitne in loferitne plasti. Na kontaktu z zgornjetriasnimi karbonati so ponekod emerzijske breče in neptunski dajki, oboji zapolnjeni z rdečkastim glinastim vezivom (Babić, 1980/81; Jurkovšek et al., 1990; Črne et al., 2007).

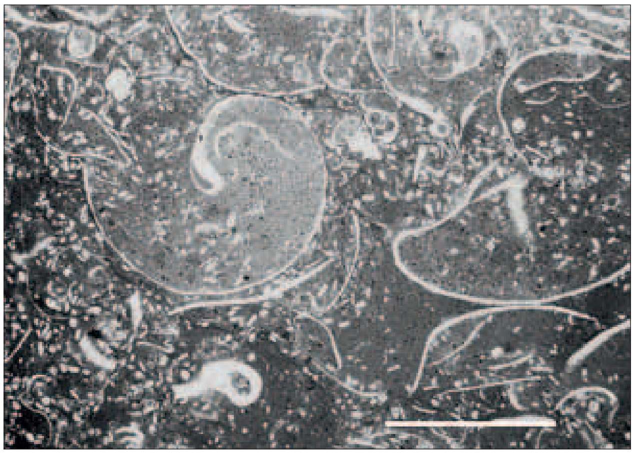
V zgornjem liasu je bila Julijska karbonatna plošča razkosana na več blokov, ki so bili različno poglobljeni. Na njih se je pričela pelagična sedimentacija ter kondenzacija sedimentov (Buser, 1986a; Jurkovšek et al., 1990; Šmuc, 2005). Na Mangartu, Rombonu, v Trenti ter v Dolini Triglavskih jezer izdanjajo rdečkasti biomikritni apnenci tipa »ammonitico rosso«, ki vsebujejo železove in manganove gomolje (Jurkovšek et al., 1990; Šmuc, 2005; Ogorelec et al., 2006). Opisani apnenci kažejo zelo podoben mikrofacies, kot je poznan s klasične lokalnosti gomoljastih globljemorskih apnencev v Severnih Alpah (npr. Adnet pri Salzburgu – Böhm et al., 1999).

Nad manganskim horizontom leži še do nekaj deset metrov rdečega in rjavkastega mikritnega apnenca z radiolariji in gomolji roženca doggerske in malmske starosti, nato pa berriasijski apnenec z gomolji roženca tipa »biancone«.



Sl. 18. Globljemorski razvoj zgornjetriasnega Baškega dolomita in jurskih plasti na Kobli (Buser & Ogorelec, 2008)

Fig. 18. Deeper-marine development of Upper Triassic Bača dolomite and Jurassic beds on Mt. Kobla, Julian Alps (Buser & Ogorelec, 2008)



Biomikritni apnenec z lupinami moluskov in radiolarijev. Pelagični facies. Dogger. Dolina Triglavskih jezer. Merilo 1 mm

Biomicritic limestone with mollusc shells and radiolarians. Pelagic facies. Dogger. Triglav lakes valley. Scale 1 mm

Manganski gomolji v jurskem apnencu. Dogger. Grapa Slatnek pri Bovcu

Manganese nodules in Jurassic limestone. Dogger. Slatnek gorge near Bovec

Vzhodne Alpe

V Severnih Karavankah so spodnjejurske plasti v okolici Uršlje gore razvite kot rdečkasti ploščasti in gomoljasti rdečkasti apnenci z lečami roženca, ki so se odlagale v globljem morju (Ramovš & Rebek, 1970; Mioč & Šribar, 1975).

KREDA

Čeprav je bila kredna perioda v mezozojskem obdobju najdaljša, saj je trajala kar 80 milijonov let, je na slovenskem prostoru razvita dokaj monotono, na Dinarski plošči kot debela skladovnica apnencev in dolomitov, v Slovenskem bazenu, ki je v tem času segal tudi na prostor Julijske karbonatne plošče, pa kot flišne plasti z vmesnimi paketi globljemorskih apnencev. Debelina krednih plasti na Dinarski plošči doseže do 2000 metrov, v bazenu pa do 800 metrov (Buser, 1989; Pleničar, 1979, 2009). Koncem krede je prišlo na južnem Primorskem in v Istri do dolgotrajnejše okopnitve. V istem obdobju je Dinarska karbonatna plošča razpadla na več manjših enot z vmesnimi flišnimi bazeni, ki so se že od zgornje krede pa vse do konca paleogena postopno selili od severa oziroma Bovškega proti jugu v osrednjo Istro (Buser, 1986b). Shematski prikaz razvoja krednih plasti je prikazan na slikah 2 in 3, posebej pa na sliki 14.

Dinarska karbonatna plošča

Spodnjekredne plasti so v plitvomorskem razvoju najbolj razširjene na Dolenjskem, Notranjskem, Hrušici in na zahodnem delu Trnovskega gozda. Razvite so dokaj monotono in kažejo značilnosti sedimentacije na zaprtem šelfu z lagunami in občasnimi medplimskimi pogoji. Glede na mikrofacies prevladujejo med apnenci tipi z mikritno osnovo (mudstone do packstone) ter s fosili, ki so značilni za bolj mirno okolje – foraminifere, ostrakodi, alge in moluski.

Litološko je prehod zgornjejurskih plasti v berriasijske postopen. Apnenec je po strukturi biopelmikriten, večkrat z izsušitvenimi porami in z laminacijo, mestoma rahlo laporast in zaradi sledov organske primesi ponavadi temnejše sive barve. Nekatere apnenčeve plasti je zajela tudi zgodnja ali/in poznodiagenetska dolomitizacija. Slednja se kaže v dolomitnih romboedrih, pogosto s conarno zgradbo ter z manjšimi lečami zrnatega dolomita.

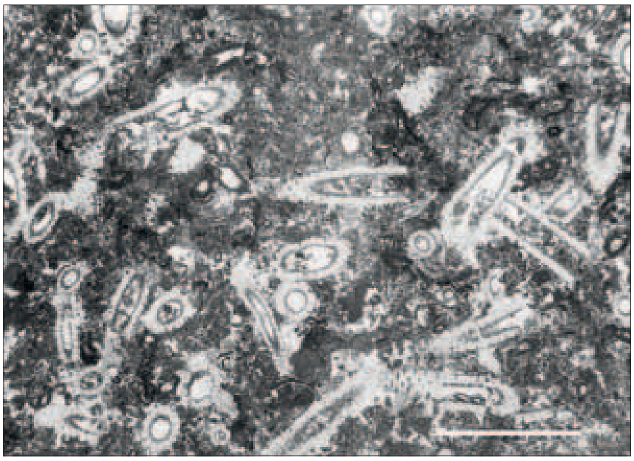
Šribarjeva (1979b) je celotno spodnjekredno zaporedje na Logaški planoti razdelila na osnovi mikrofosilne združbe v pet cenocon, enaka razdelitev pa je veljala tudi za prostor Trnovskega gozda (Koch, 1988; Koch et al., 1989) in za Kočevsko (Dozet, 1990c; Dozet & Šribar, 1991):

Za **berriasijske** in **valanginijske** plasti sta značilna in najbolj pomembna mikrokoprolit *Favreina salevensis* in alga *Salpingoporella annulata*. Favreine so mestoma tako številne, da so kamnotvorne. Med foraminiferami se pojavlja vrsta *Pseudocyclammina lituus*. V vrhnjem delu **valanginijskih** in v **hauterivijskih** plasteh so prisotne alga *Clypeina solkani,* foraminiferi *Pseudotextulariella salevensis* in *Orbitolinopsis capuensis,* v večjem številu pa so prisotni še ostrakodi in drobni moluski. Tudi v tem obdobju so poleg biomikritnih apnencev prisotni mikrofacialni tipi s pogostimi izsušitvenimi porami, ki kažejo na podobne paleogeografske razmere kot v valanginiju – zaprt šelf z lagunami in medplimskimi ravnicami (Orehek & Ogorelec, 1979, 1981; Šribar, 1979b; Dozet & Šribar, 1991).

Barremijski apnenec je zastopan z dazikladacejskimi algami vrste *Salpingoporella muehlbergeri*, **aptijski** pa z vrsto *Salpingoporella dinarica*, ki je v nekaterih plasteh na prehodu v albij izredno številna. V aptiju vrsto *S. dinarica* spremljajo še foraminifera *Palorbitolina lenticularis*, miliolide ter številni primerki mikroorganizma problematičnega izvora *Bacinella irregularis,* za katerega se domneva, da pripada cianobakterijskim tvorbam (Flügel, 2004). V tem obdobju je

Rudistni apnenec. Štanjel na Krasu

Limestone with rudist bivalves. Štanjel na Krasu



Biomikritni apnenec z algo *Salpingoporella dinarica*. Facies plitvega zaprtega šelfa. Aptij-albij. Nanos. Merilo 1 mm

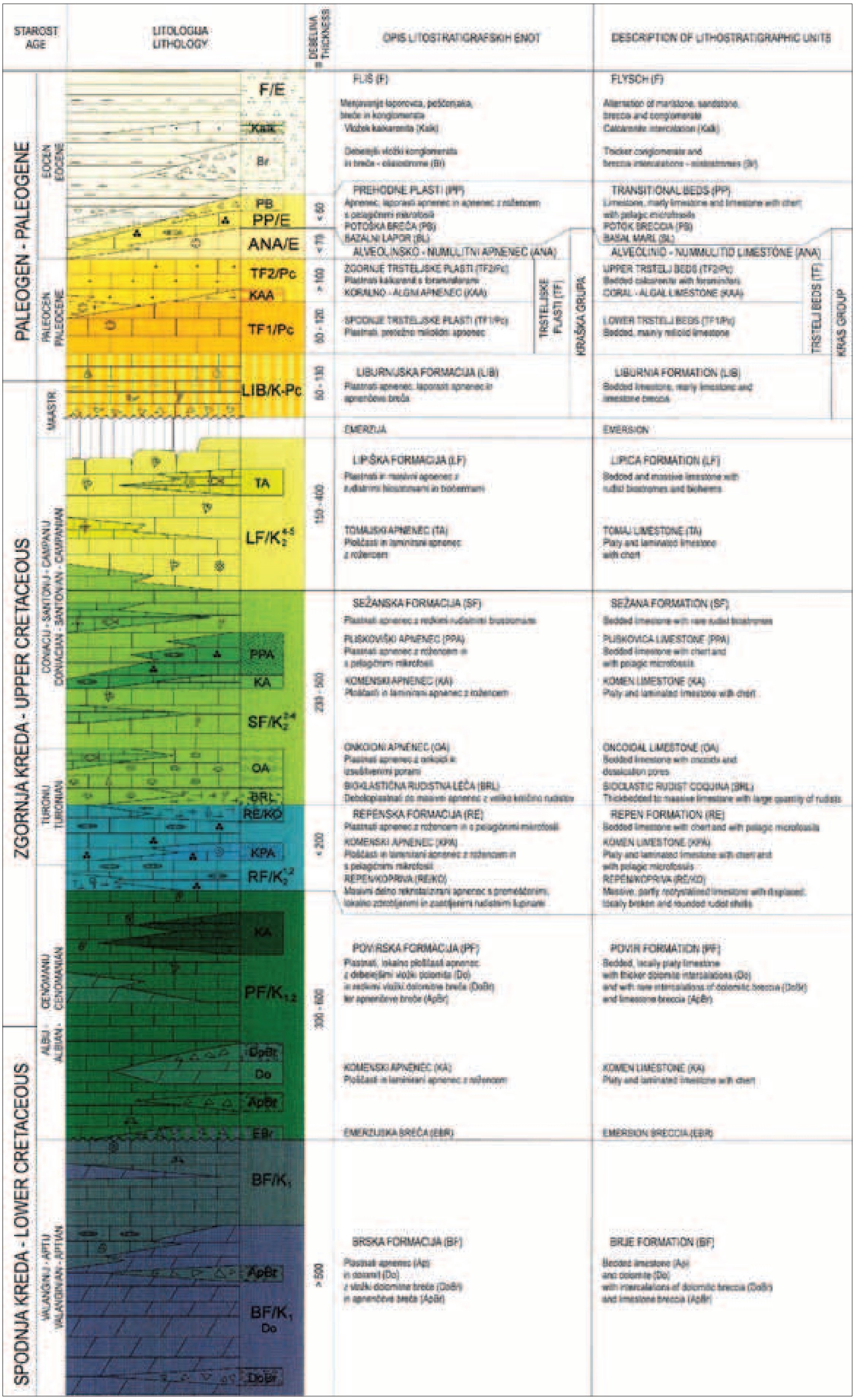
Biomicritic limestone with *Salpingoporella dinarica* algae. Shallow restricted shelf facies. Aptian-Albian. Nanos. Scale 1 mm

prišlo na Dinarski karbonatni plošči zaradi intenzivne tektonike do njene diferenciacije in do spremembe paleookolja. To je privedlo do bolj pestrega faciesa in več razlik v debelini posameznih cenocon znotraj posamezne serije (Koch et al., 1989). Lokalno je prišlo tudi do kratkotrajnih okopnitev posameznih delov plošče. Na Krasu je taka okopnitev nakazana z emerzijsko brečo na meji med Brsko in Povirsko formacijo (sl. 19) oziroma na meji med aptijem in albijem (Jurkovšek et al., 1996; Jurkovšek, 2008, 2010; Koch & Ogorelec, 1987). Apnenec od valanginijske pa vse do albijske starosti je pogosto dolomitiziran, delno ali v popolnosti; dolomitizacija ima poznodiagenetski značaj.

V vrhnji del spodnjekrednih plasti, ki je **albijske** starosti, Šribarjeva (1979b ter Dozet & Šribar, 1991) prišteva apnenčeve in dolomitne plasti z orbitolinami (*Orbitolina* ex gr. *texana)* ter foraminiferami (*»Valdanchella« dercourti*). Dokaj pogoste v tej cenoconi so tudi miliolide, med moluski pa rekvienije.

Višji energijski indeks znotraj spodnjekrednega zaporedja nakazujejo redke plasti z ooidi in psevdooidi. Oboji so bili v mirnejše okolje z mikritnim karbonatnim blatom naplavljeni in pomešani s peleti in drobnimi fosili. Lokalno so obstajali tudi manjši grebeni in biostrome koral, hidrozojev in alg. Iz berriasija in valanginija je znan tak koralni greben pri Zavrhu na Banjški planoti (Turnšek & Buser, 1974), iz časa aptija in albija pa so opisani koralni grebeni iz Kanalskega vrha in okolice na Banjški planoti (Turnšek & Buser, 1974; Grötsch, 1991; Grötsch et al., 1994) in s Kočevske gore (Turnšek et al., 1992). V aptiju je bil na Sabotinu manjši algni greben, zgrajen v večjem delu iz vrste *Lithocodium aggregatum* (syn. *Bacinella irregularis*) (Koch et al., 2002).

Znotraj hauterivijskega zaporedja se na zahodnem delu Trnovskega gozda in na Sabotinu pojavlja 15 do 40 metrov debel paket črnega biomikritnega in biopelmikritnega ploščastega bituminoznega apnenca z gomolji roženca (»Trnovski ploščasti apnenec«, Pleničar & Buser, 1967), ki

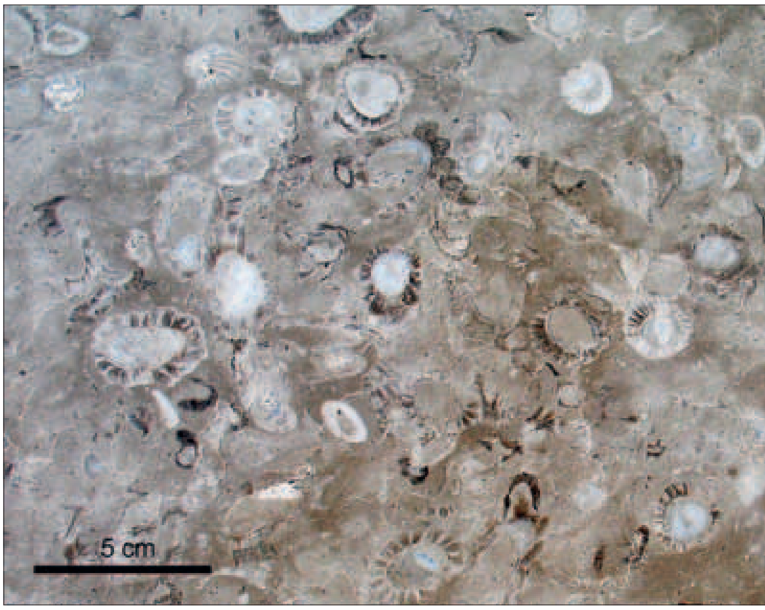


Sl. 19. Litostratigrafski stolpec krednih in paleogenskih plasti severnega dela Tržaško-komenske planote (JURKOVŠEK, 2010)
Fig. 19. Lithostratigraphic column of Cretaceous and Paleogene beds of the northern part of Trieste-Komen plateau (JURKOVŠEK, 2010)

vsebuje do 1,1 % C_{org}. Analize več vzorcev kažejo, da ta apnenec lahko uvrščamo med potencialne matične kamnine za nastanek ogljikovodikov z nizko sposobnostjo njihovega generiranja (Ogorelec et al., 1996a).

Zgornjekredne plasti so se odlagale na bolj odprtem in plitvem šelfu z višjim energijskim indeksom. Značilne zanje so svetla barva apnencev, debele plasti in bogata rudistna favna (Pleničar, 2005; Pleničar & Jurkovšek, 1996, 1998). Zastopani so sicer vsi tipi apnencev, vendar pa sta tipa packstone in grainstone najbolj pogosta. V večjem obsegu zgornjekredne plasti izdanjajo na Tržaško-komenski planoti in na Nanosu, v manjšem obsegu pa tudi na Javornikih, Dolenjskem in Kočevskem. Zaradi velikih debelin posameznih plasti, zanimivega izgleda in dobrih tehniških lastnosti kamna, so le-te zanimive kot arhitektonski kamen, ki ga predvsem na Krasu lomijo v številnih kamnolomih. Dolomitnih plasti je precej manj kot v spodnjekrednem zaporedju.

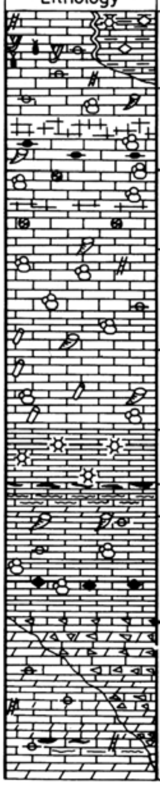
Kljub enoličnemu litološkemu razvoju je možno natančno razčleniti zgornjekredne plasti na osnovi fosilov, predvsem rudistov in foraminifer, (Šribar & Pleničar, 1990; Pleničar, 1960, 1979, 2005, 2009; Jež, 2011). Taka razdelitev je za prostor jugozahodne Slovenije prikazana na sl.19. Za **srednji in zgornji cenomanij** je med foraminiferami značilna *Broeckina (Pastrikella) balcanica*, za **zgornji turonij** neskeletna alga *Aeolisaccus kotori*, za obdobje **coniacija in spodnjega santonija** foraminifera *Pseudocyclammina sphaeroidea* za **zgornji santonij in campanij** *Keramospherina tergestina*, za **maastrichtij** pa *Orbitoides media*



Rudistni rožasti apnenec (»fiorito«) (*foto: B. Jurkovšek*)
Rudist ornamental limestone (»fiorito«) (*photo: B. Jurkovšek*)

in *Rhapydionina liburnica* (Šribar & Pleničar, 1990).

Na območju Tržaško-komenske planote so izdvojene formacije: *Povirska formacija* cenomanijske starosti, *Sežanska formacija* zgornjeturonijske, coniacijske in santonijske starosti ter *Lipiška formacija* santonijske in campanijske starosti (Jurkovšek et al., 1996; Jurkovšek, 2008, 2010; Jurkovšek & Kolar-Jurkovšek, 2007). Znotraj Repenske formacije, ki obsega spodnji tu-



Litologija Lithology	Cenocona - Assemblage zone	Makrofavna - Macrofauna	Starost - Age
	VIII. Cenocona - Assem. z. *Rhapydionina liburnica* / VIII. Cenocona - Assemblage zone *Gansserina gansseri*	*Gyropleura* sp. *Bournonia* sp.	Zgornji maastrichtij Upper Maastrichtian
	VII. Cenocona - Assemblage zone *Orbitoides media*	*Hippurites (Vacc.) braciensis* *Joufia reticulata*	Spodnji do srednji maastrichtij Lower-Middle Maastrichtian
	VI. Cenocona - Assemblage zone *Keramosphaerina tergestina*	*H. (Orbignya) nabresinensis* *H. (Vacc.) salopeki* *Katzeria hercegovinaensis*	Zgornji santonij-campanij Upper Santonian-Campanian
	V. Cenocona - Assemblage zone *Pseudocyclammina sphaeroidea* *Idalina antiqua*	*Radiolites praegalloprovincialis* *Hippurites (Vacc.) cornuvaccinum*	Coniacij-spodnji santonij Coniacian-Lower Santonian
	IV. Cenocona - Assemblage zone *Aeolisaccus kotori*	*Medeella zignana* *M. acuticostata* *Rhynchonella contorta*	Zgornji turonij Upper Turonian
	III. Cenocona - Assemblage zone *Pithonella* sp., Calcisphaerulidae		Spodnji turonij Lower Turonian
	II. Intervalna cona - Interval zone	*Eoradiolites* sp.	Cenomanij → turonij Cenomanian → Turonian
	II. Cenocona - Assemblage zone *Broeckina (Pastrikella) balcanica*	*Chondrodonta joannae* *Neocaprina gigantea, N. nanosi* *Sphaerulites foliaceus*	Srednji-zgornji cenomanij Middle-Upper Cenomanian
	I. Intervalna cona - Interval zone / I. Cenocona - Assemblage zone Miliolidae, Ostracoda		Zgornji albij-spodnji cenomanij Upper Albian-Lower Cenomanian

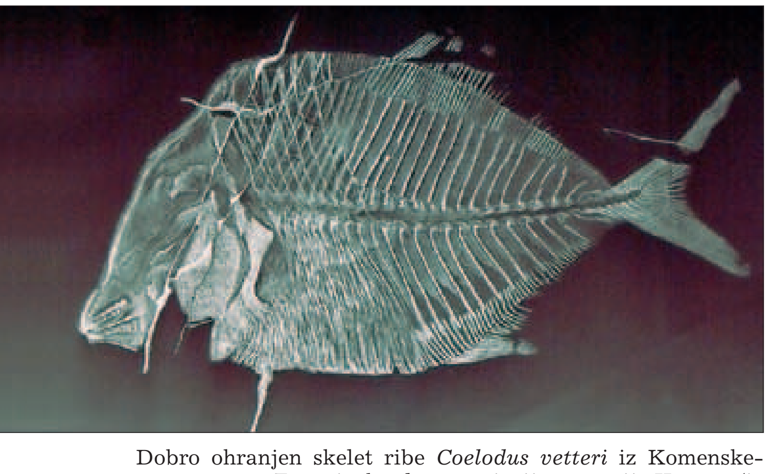
Sl. 20. Zgornjekredne cenocone v jugozahodni Sloveniji (Šribar & Pleničar 1991)
Fig. 20. Upper Cretaceous assemblage zones in south-western Slovenia (Šribar & Pleničar, 1991)

ronij, so v posameznih nivojih izredno številne kalcisfere, ki so lahko celo kamenotvorne (kalcisferski packstone) in kažejo na evstatični dvig morske gladine med cenomanijem in turonijem (Jenkyns 1985, 1991; Haq et al., 1987; Jurkovšek et al., 1996; Jurkovšek, 2010) oziroma na potopitev platforme.

Sedimentološko in mikrofacialno posebnost znotraj spodnjega dela Sežanske formacije predstavlja več metrov debel horizont z velikimi onkoidi (Onkoidni apnenec, Jurkovšek et al., 1996; Jurkovšek, 2010). Ta onkoidni horizont je splošno razširjen in prepoznaven na celotni Dinarski karbonatni plošči (Gušić & Jelaska, 1990; Tišljar et al., 2002).

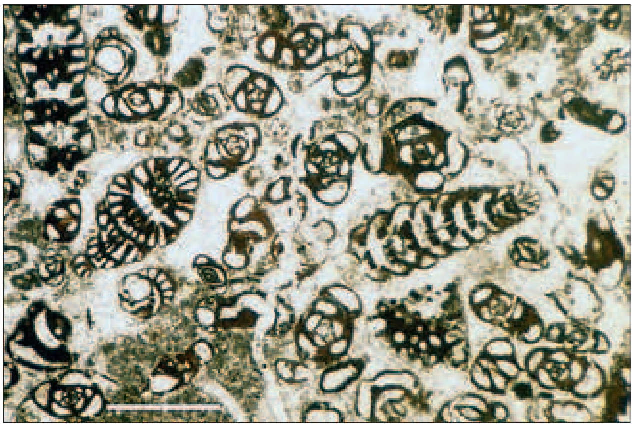
Na prostoru Dinarske karbonatne plošče sta obstajali v zgornji kredi dve izrazitejši emerzijski fazi, katerih posledica so stratigrafske vrzeli. Prva taka faza, v obdobju zgornjega cenomanija do conijacija je obstajala na severnem robu plošče in jo najbolj zasledimo na Sabotinu, medtem ko je imela proti Nanosu že manjši obseg, le del coniacija (Jež, 2011). Na Krasu te vrzeli ne opazujemo. Druga emerzijska faza je imela večji časovni razpon, ponekod na Krasu precej manjši obseg med campanijem in maastrichtijem, proti jugu (Matarsko podolje, Istra) pa je okopnitev obstajala že od santonija pa vse do eocena (Drobne, 1979; Buser, 1980; Jurkovšek et al.,1996; Otoničar, 2006, 2007; Jež, 2011). Rezultat emerzijskih faz in zakrasevanja so žepi boksitne gline.

Na Tržaško-komenski planoti so znotraj celotnega zgornjekrednega zaporedja posebnost črni ploščasti in bituminozni apnenci z rožencem, v literaturi poznani kot »komenski ribji skrilavci«, saj vsebujejo lokalno številne fosilne ostanke rib (Gorjanović-Kramberger, 1895; Jurkovšek et al., 1996: Jurkovšek, 2010; Cavin et al., 2000; Palci et al., 2008). Prvotno so bili ti apnenci vezani na tri horizonte znotraj albijsko-cenomanijskega, turonijskega in senonijskega zaporedja (Buser, 1968), novejše raziskave pa so pokazale, da je takih horizontov precej več. V intervalu od cenomanija do santonija pripadajo Komenskemu apnencu, v



Dobro ohranjen skelet ribe *Coelodus vetteri* iz Komenskega apnenca. Zgornja kreda – coniacij, santonij. Komen (iz Gorjanović-Kramberger, 1895). Dolžina ribe 23 cm

Well preserved fish skeleton of *Coelodus vetteri* from Komen limestone. Upper Cretaceous–Coniacian, Santonian. Komen (from Gorjanović-Kramberger, 1895). Lenght of sample 23 cm



Biosparitni apnenec s preseki foraminifer *Rhapydionina liburnica* in številnih miliolid. Facies plitvega odprtega šelfa. Maastrichtij. Tabor pri Štorjah. Merilo 1 mm

Biosparitic limestone with foraminifers *Rhapydionina liburnica* and numerous miliolids. Shallow open shelf facies. Maastrichtian. Tabor at Štorje. Scale 1 mm

santonijsko-campanijski Lipiški formaciji pa se pojavlja Tomajski apnenec (Jurkovšek et al., 1996; Jurkovšek, 2008, 2010). Po strukturi je Komenski apnenec biomikriten in biopelmikriten, pogosto z milimetrsko laminacijo. Odlagal se je v plitvih zaprtih lagunah z anaerobnimi pogoji in z medplimskimi ravnicami. Te prepoznamo po natrganih laminah (»flat pebble conglomerate«), stromatolitih in izsušitvenih porah. Mikrofosilna združba je skromna in neznačilna (foraminifere, ostrakodi, alge – predvsem *Thaumatoporella parvovesiculifera*), na občasno povezavo lagun z odprtim morjem pa sklepamo po prisotnosti pelagičnih fosilov. Poleg rib so v apnencu prisotni še drugi makrofosili, kot so kopenske rastline, sakokome, amoniti in drugi (Jurkovšek & Kolar-Jurkovšek, 1995, 2007; Dobruskina et al., 1999; Summesberger et al., 1996, 1999). Tomajski apnenec vsebuje tudi plasti biokalkarenita, ki kažejo večkrat postopno zrnavost. Kalkarenit naj bi se odlagal kot alodapični apnenec v lokalnih poglobitvah znotraj anoksičnih bazenov (Ogorelec et al., 1987). Kljub črni barvi in vonju po bitumnu vsebuje Komenski apnenec skromen delež organskega C, večji del do 0,8 % in le izjemoma do 1,7 %. Za njegovo naftno potencialnost je neugodna sestava organske snovi, saj je pretežno terestričnega izvora (Ogorelec et al., 1996a, b).

Kredno obdobje zaključujejo apnenci Liburnijske formacije, katera se nadaljuje še v spodnji paleocen. Biosparitni rudistni apnenec se menjava z biomikritnimi različki in mestoma s stromatolitnimi plastmi, haraceje pa kažejo na sedimentacijo v brakičnem palustrinskem okolju. V spodnjem delu Liburnijske formacije, ki jo označujejo Vremske plasti in je še maastrichtijske starosti, je najbolj značilna foraminifera *Rhapydionina liburnica*, ki jo spremljajo še miliolide, rizokodiji, ostrakodi in moluski, predvsem giroplevre (Drobne, 1981; Drobne et al., 1989,1995; Pleničar et al., 1992; Hötzl & Pavlovec, 1979). Mestoma se v tem faciesu pojavljajo tudi tanjši sloji premoga, katerega so pred časom še odkopavali (Vremski Britof, Lipica, Sečovlje; Hamrla, 1959).

Kredno-terciarna (K/T) meja je v Sloveniji razpoznavna na Krasu, kjer je bila raziskana v več profilih, pri Dolenji vasi (Drobne et al., 1988, 1989, 1995, 1996, 2009), na Sopadi pri Štorjah (Ogorelec et al., 2007), Kozini (Delvalle & Buser, 1990) in Čebulovici (Ogorelec et al., 2001). Na italijanski strani je raziskana pri Padričah (Padriciano, Brazzati et al., 1996) in pri Bazovici (Basovizza, Riccamboni, 2005). Njena geološka posebnost je v tem, da je razvita v plitvomorskem faciesu, kar je posebnost in enkratnost v celotnem mediteranskem prostoru.

Meja poteka znotraj 0,2 do 2 metra debele emerzijske breče, ki je nastala v medplimskem okolju zaprte lagune, za katerega so značilne izsušitvene pore, strukture rizokodijev (*Paronipora* sp.), stromatolitne lamine in žepi boksita (Jurkovšek et al., 1996; Ogorelec et al., 2007; Drobne et al., 2009). Apnenec tik pod mejo je svetel biomikrit in pelmikrit (wackestone in packstone), ponekod pa rahlo laporast in temen biomikrit z giroplevrami in foraminiferami (Drobne et al., 1995; Pugliese et al., 1995). Biomikritni apnenec prevladuje tik nad mejo v spodnjem daniju in kaže vse znake palustrinskega faciesa (Otoničar & Košir, 1998; Ogorelec et al., 2001; Košir, 2004). Meja je poleg spremembe biote zaznamovana tudi s spremembo izotopske sestave apnenca (izjemna, do 8 ‰ obogatitev z lahkim izotopom $\delta^{13}C$ prav na meji, Dolenec et al., 1995; Ogorelec et al., 1995, 2007), povišano vsebnostjo iridija (Hansen et al., 1995) in prisotnostjo steklenih sferul (Gregorič et al., 1998).

Globljemorski razvoj krede

Globljemorski razvoj sedimentnih kamnin se je nadaljeval iz jure v kredno obdobje na prostoru Slovenskega bazena, ki se je v tem času še bolj razširil proti severu. Za to globlje okolje je značilen klastični razvoj, predvsem fliš z vmesnimi apnenčevimi brečami (Pleničar, 1979, 2009). Fliš se pojavlja v dveh debelejših paketih – kot spodnja flišna formacija, debela 100 do 400 metrov v aptiju in albiju (Cousin, 1970) ter kot zgornja, do 800 metrov debela flišna formacija v zgornji kredi (Buser, 1986). Izvorni material za karbonatne breče so bili plitvomorski apnenci, ki so se trgali z roba Dinarske platforme in plazeli po pregibu, fliš pa se je sedimentiral s severozahoda (Ogorelec, 1970; Kuščer et al., 1974). Celotna debelina globljemorskega krednega zaporedja znaša med 500 in preko 1000 metri, najbolj celovito pa so te plasti razvite v Slovenskem bazenu na Tolminskem (Buser, 1986a,b) in v vzhodnih Posavskih gubah, med Krškim in Gorjanci, medtem ko se v osrednji Sloveniji pojavljajo bolj fragmentarno.

S stališča karbonatne sedimentologije in mikrofaciesa so znotraj krednega globljemorskega razvoja zanimivi le trije faciesi oziroma paketi kamnin:

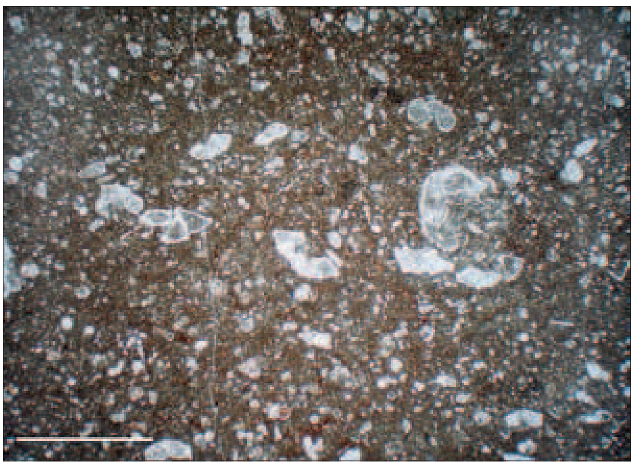
- beli in svetlosivi ploščasti apnenci berriasijske starosti, ki se nadaljujejo še iz zgornje jure,
- laporasti apnenci tipa »scaglia« albijske do turonijske in »senonijske« starosti ter
- Volčanski apnenec »senonijske« starosti.

Najstarejše kredne plasti globljemorskega razvoja pripadajo belemu mikritnemu apnencu tipa »biancone« (mudstone in wackestone) z gomolji roženca, ki predstavlja nadaljevanje sedimentacije iz vrhnjega dela jure. Gre za zgornji del 100 do 250 metrov debelega paketa apnenca, kateremu berriasijsko in spodnjevalanginijsko starost določajo kalpionele (*Calpionella elliptica, C. alpina, Tintinopsella hungarica)* in radiolariji (Pleničar, 1979, 2009; Šribar, 1981; Buser, 1986).

Na prostoru Slovenskega bazena iz obdobja od valanginija do barremija zaenkrat niso znani nikakršni sedimenti, tako da pričenja sedimentacija transgresijsko na plasteh »biancone« apnenca s flišem šele v aptiju, medtem ko pričenja sedimentacija fliša in vmesnih apnenčevih breč v okolici Bohinja že v valanginiju (Budkovič, 1978; Buser, 1986), njihova sedimentacija pa je trajala do konca spodnje krede. Starost tega fliša je določena z nanoplanktonom (Buser & Pavšič, 1978; Pavšič & Goričan, 1987; Pavšič, 1994).

V spodnjem delu zgornje krede, cenomaniju in turoniju, so se na širšem Tolminskem odlagali rdečkasti ploščasti in laporasti apnenci, ki se menjavajo z laporji, polami rožencev in s kalkareniti, formacija pa je znana kot »pisana scaglia« (Buser, 1986b). Na širšem območju Mangarta se tovrstni sedimenti javljajo že v albiju (Šmuc, 2005). Starost teh plasti je določena z nanoplanktonom (Pavšič, 1979) in globotrunkanami (*Globotruncana helvetica, G. schneegansi*, *G. sigali*; Buser, 1986b).

Pisani »scaglii« sledi od 100 do največ 300 metrov debela formacija Volčanskega apnenca. Za ta apnenec je značilno menjavanje tankih plasti biomikrita, kalcirudita in kalkarenita, vmes pa so pogoste pole in gomolji roženca. Kalciruditne plasti pogosto kažejo postopno zrnavost in laminacijo (Ogorelec et al., 1976). Plasti so se odlagale s turbiditnimi tokovi na obrobju bazena, biomi-



Biomikritni laporasti apnenec (»scaglia«) z globotrunkanami, radiolariji in kalcisferami. Pelagično okolje. Zgornja kreda – campanij. Koritnica pri Bovcu. Merilo 1 mm

Biomicritic marly limestone (»scaglia«) with globotruncanas, radiolarians and calcispheras. Pelagic environment. Upper Cretaceous – Campanian. Koritnica at Bovec. Scale 1 mm

Volčanski apnenec zgornjekredne starosti (campanij – santonij). Alodapični apnenec se je odlagal s turbiditnimi tokovi v pelagičnem okolju. Kalkarenit s postopno zrnavostjo prehaja navzgor v mikritni apnenec. Doblar v Soški dolini. Merilo 2 cm

Volče limestone of Upper Cretaceous age (Campanian – Santonian). Allodapic limestone deposited by turbidites in pelagic environment. Calcarenite with graded bedding passing into micritic mudstone. Doblar in Soča valley. Scale 2 cm

kritne pole tipa mudstone pa so produkt mirnih pelagičnih faz. Volčanski apnenec tako lahko prepoznamo kot karbonatni fliš ali alodapični apnenec. Avtohtoni fosili so pelagični, predvsem globotrunkane in radiolariji, med naplavljenimi drobci pa se javljajo tudi odlomki rudistnih lupin, ehinodermov in drugih školjk. Med globotrunkanami so najbolj pogoste *Globotruncana arca*, *G. calcarata*, *G. conica*, *G. elevata* in *G. lineiana lineiana* (določila L. Šribar, v Ogorelec et al., 1976), ki so razširjene od zgornjega turonija do campanija. Severno od Kobarida prehaja oziroma nadomešča Volčanski apnenec rdeč laporast apnenec tipa scaglia (Ogorelec, 1970; Kuščer et al., 1974; Buser, 1986b; Šmuc, 2005), znan kot »scaglia rossa«, ki vsebuje poleg tistih globotrunkan, ki nastopajo v Volčanskem apnencu, še druge njihove vrste (Radoičić & Buser, 2004).

Nad Volčanskim apnencem in rdečo scaglio nastopa zopet do 600 metrov debel paket flišnih plasti. V kosih debelozrnate flišne breče senonijske starosti, ki leži nad Volčanskim apnencem, so bile na Banjški planoti določene številne korale (Turnšek & Buser, 1976). Flišni bazen se je od campanija dalje postopno pomikal čedalje bolj proti jugu, na Goriška Brda, na Tržaško ozemlje in v Istro (Buser, 1986b).

Vzhodne Alpe

V okolici Zreč in Stranic pri Slovenskih Konjicah leži med klastiti, katere sestavljajo glinavci, meljevci in laporovci ter premoška plast, grebenski apnenec s številnimi rudisti (Pleničar, 1971, 1993, 2005). V laporovcih so pogoste tudi solitarne korale (Turnšek, 1994). Razvoj teh plasti avtorji (Hamrla, 1988; Turnšek, 1994; Pleničar, 1971, 2009) primerjajo z gosauskim razvojem krede v Severnih Alpah. Apnenci gosauskega faciesa v pričujoči monografiji niso predstavljeni, ker niso bili zajeti v raziskave.

Zahvale

Predstavljena monografija oziroma slikovni atlas o mikrofaciesu mezozojskih karbonatnih kamnin Slovenije je rezultat avtorjevega več desetletnega terenskega dela ter mikroskopskih raziskav apnencev in dolomitov. Foraminifere in alge, ki se pojavljajo v številnih vzorcih, je določila kolegica Ljudmila Šribar, več vzorcev koral, hidrozojev in spongij pa mi je prijazno posredovala akademičarka dr. Dragica Turnšek. Obema velja iskrena zahvala.

Atlas bi bil vsebinsko zagotovo bolj okrnjen, če avtorju pri izbiri golic in stratimetrijskih profilov ne bi pomagali terenski geologi Geološkega zavoda Slovenije. Za to sodelavo se prisrčno zahvaljujem danes žal pokojnima prof. dr. Stanku Buserju in Karlu Gradu, nadalje dr. Bogdanu Jurkovšku, Saši Orehek, dr. Ladislavu Placerju, mag. Bogoljubu Aničiću, Martinu Tomanu, Urošu Premruju, dr. Stevu Dozetu, Matevžu Demšarju, doc. dr. Dragomirju Skabernetu, enako prof. dr. Jožetu Čarju z ljubljanske Univerze, kolegoma iz rudnika Mežica Janku Kušeju in Mihi Pungartniku ter prof. dr. Romanu Kochu z Univerze v Erlangenu. Za njihovo strokovno pomoč, diskusije in nasvete se jim lepo zahvaljujem.

Posebna zahvala velja tudi žal že pokojnemu Andreju Stoparju, ki je vseskozi sodeloval z izdelavo več tisoč mikroskopskih preparatov. V zadnjih letih se mu je pri izdelavi zbruskov pridružil Mladen Štumergar. Celotna računalniška obdelava slik in tabel je delo Staneta Zakrajška, pri končni pripravi monografije pa so sodelovali še Bernarda Bole, dr. Matevž Novak, dr. Jernej Jež in Luka Gale. Prav lepa hvala tudi ostalim neimenovanim, ki so kakorkoli pripomogli k izidu te publikacije. Hvala tudi ženi Heleni za njeno vzpodbudo in potrpežljivost pri mojem delu.

Za angleški prevod se lepo zahvaljujem prof. dr. Simonu Pircu, dr. Bogdanu Jurkovšku, prof. dr. Jožetu Čarju in dr. Matevžu Novaku pa za strokovno recenzijo tega dela in številne nasvete, ki so privedli k izboljšavi in uravnoteženosti besedila in slikovnega gradiva. Velika večina vzorcev je bila raziskana v okviru programov in projektov, ki jih je financirala Javna agencija za raziskovalno dejavnost Republike Slovenije, Geološkemu zavodu Slovenije in Uredništvu Geologije pa se zahvaljujem za vso podporo pri realizaciji monografije.

Microfacies of Mesozoic Carbonate Rocks of Slovenia

At the 50th anniversary of publishing of carbonate rocks classification *(Folk 1962, Dunham 1962, Ham (ed.) 1962).*

INTRODUCTION

Carbonate rocks of Mesozoic age constitute about 40 % of Slovenia's surface (Buser & Komac, 2002). In this more than 5000 meters thick succession of limestones and dolomites, only locally interrupted by clastic deposits, volcanites and pyroclastics, almost all facial developments characteristic of shallow water carbonate environments as well as those of deeper seas and oceans can be recognized. In a small area the entire succession of carbonate rocks can be encountered over a stratigraphic range from Devonian to Quaternary. Responsible for this diversity is to a large extent the position of the Slovenian territory on the contact of three vast geotectonic units – Alps, Dinarides and Pannonian basin. As a result of intense tectonic activity, various developments of individual formations can appear in contact along faults and overthrusts, and therefore lateral transitions between different sedimentary environments are often not observable. Our territory is by all means a true »little collection« of various Mesozoic rocks developments in realm of the ancient western Tethys.

Although this is not evident from the title of the present publication, the assembled materials exceed the frames of Mesozoic, since also **Upper Permian limestones and dolomites are included.** The reason for their consideration in this publication is that by them the continuous carbonate sedimentation began on the integral Slovenian platform, that comprised the entire Slovenian territory, and existed from the Upper Permian to the middle of Anisian (Buser, 1989).

The author was led to writing this monograph by the wish to present the results of microfacial analyses of several decades of research of limestones and dolomites from the Slovenian territory. This research was initially performed mostly in the frame of elaborating the Basic Geologic Map of SFR Yugoslavia at the scale of 1 : 100,000 that lasted 25 years all to its conclusion in 1989, and further within the project Mesozoic in Slovenia active in the eighties of former century, and more recently within a number of geologic projects in frame of the national research programme of the Public agency for research activity of Republic Slovenia. An appreciable amount of data resulted from various applied research, such as that connected with the Idrija mercury deposit and the Mežica lead and zinc deposit, further with deep geothermal and oil drilling, with quarries, tunnels and road cuts, and more recently within research associated with the new Formation geologic map of Slovenia at the scales of 1 : 50,000 and 1 : 25,000.

The focus and main object of the present monograph is, as indicated by its title, the **microfacies.** Whereas the term *facies* has a long history, having been introduced to geology as one of the most important conceptions in the first half of nineteenth century by Gressly (1838), the term *microfacies* is rather new, about hundred years younger. The first researcher to propose it for the appearance of rock in thin-section under the microscope was Brown in 1943. Later this term got rooted among geologists and it became widespread, especially after the world oil congress in Paris in 1951, much thanks to Cuvillier (1952, 1961). At present the term *microfacies* denotes all sedimentary-petrographic and paleontologic characteristics within the microscopic scale of the thin-section. It is principally associated with the carbonate rocks – limestones and dolomites. Later major contributions to the global knowledge of microfacies were supplied by Carozzi (1960, 1989), Folk (1962) and Dunham (1962), the latter two by their classifications of carbonate rocks, Ham (ed.,1962) and Bathurst (1971), and especially by Flügel (1978, 1982, 2004) who systematically reviewed all former aspects of microfacies and research methods, presented new perspectives on practical relevance of microfacial examination of carbonate rocks. His overview is richly documented by photographs of characteristic fossils through microscope. Wilson (1975) on the basis of Flügel's ideas from 1972 introduced into practice the concept of standard microfacies (SMF – Standard Microfacies Type), founded on 24 basic types of microfacies and nine characteristic environments of carbonate rock formation. Wilson's classification has met with a most favorable reception in oil geology and computer modelling of sedimentary rocks. Sedimentary environments and carbonate rocks modelling have been the object of intense research next to the above mentioned authors also by Milliman (1974), Reading (1978), James (1979), Scholle et al. (eds.,1983), Tucker & Wright (1990), Bosellini (1991), James & Kendall (1992), Einsele (1992) Elf-Aquitaine (1975), AGIP (1988) and others.

In Slovenia the concept of microfacies appeared relatively early, having been mentioned already in 1961 by E. Flügel and A. Ramovš in description of the Upper Triassic Dachstein limestone from Mt. Begunjščica. Emphasis in that paper was on description of fossil flora and fauna, and comparison with equivalent limestone from the Northern Alps. Unfortunately this publication was not documented with illustrations.

In 1966 Rajka Radoičić published at that time an excellent and richly illustrated voluminous treatise on microfacies of Jurassic beds in the Dinarides which comprises also descriptions and figures of several limestone samples from southern Slovenia.

After this start in microfacial studies of carbonate rocks in Slovenia a ten years long intermission followed. In those times limestones were an object of largely paleontologic analyses and stratigraphic determinations in the frame of mapping for the Basic Geological Map of Yugoslavia. A strong impulse to sedimentology and with it also to microfacial research was given in the times after 1973, when the project Mesozoic in Slovenia was started. In its frame started systematic integral research of Triassic, Jurassic and Cretaceous s that was focused mainly in limestones and dolomites. This kind of investigations, formally under different titles within the frame of various projects continued , so that over 25,000 thin-sections were made and examined at the Geological Survey of Slovenia. They have served as a basis and material for the present publication.

The collected material comprises only the **microfacies** as recognized in thin-sections of limestones and dolomites of Slovenian territory. Macrofossils and isolated microflora and microfauna (e.g. radiolarians, conodonts, nanoplankton, pollen and others) are therefore not contained in the illustrative materials nor in the references. The majority of papers and publications issued in the sixties and seventies of the former century is concerned with lithology, paleontology, regional developments or stratigraphy of Mesozoic carbonate rocks in Slovenia. This is especially true for the explanatory notes to individual sheets of the Basic Geological Map 1 : 100,000. Sedimentology is more extensively represented in the explanatory notes to the more recent geologic maps at scales of 1 : 50,000 (Jurkovšek et al., 1996) and 1 : 25,000 (Jurkovšek, 2010; Čar, 2010) as well as in the publication *Geological development in Slovenia and Croatia – Guidebook* issued for the 16th European Micropaleontological Congress (Drobne, 1979). A complete listing of references for biostratigraphy and lithology of Upper Permian and Mesozoic rocks appears also in *The Geology of Slovenia* (Pleničar, Ogorelec & Novak, 2009) in chapters covering the Upper Permian (Skaberne et al., 2009), Triassic (Dozet & Buser, 2009), Jurassic (Buser & Dozet, 2009) and Cretaceous (Pleničar, 2009), while a succint overview of geologic developments in individual geotectonic units appears in works by S. Buser (1979a,b), P. Mioč (2003) and U. Premru (2005). When considering facies of carbonate rocks also several summary contributions should be mentioned, on their facial developments (Pleničar & Pavlovec, 1984), facial characteristics (Pleničar & Premru, 1975), on these rocks as potential source rocks for genesis of hydrocarbons (Ogorelec et al., 1996), and on their isotopic composition (Ogorelec et al., 1999b).

The basic goal of the present publication is twofold. Principally it is destined to foreign researchers, to introduce them our carbonate rocks and their comparison with those of neighboring territories, and to geology students who for the first time encounter the notion of microfacies. It should be useful also to others, as the conception of microfacies linking sedimentologists with paleontologists, regional geologists and tectonitians. To enable a better understanding of the materials, in the introductory part a summarized lithological description of the entire succession of Mesozoic rocks in Slovenia is given.

As to contents, the materials are presented according to geological time with the main accent of publication put on figures with 250 photographs of microscope thin-sections. The introductory text, completed with additional lithologic columns and references, serves only as a necessary framework for putting the rocks in proper time and space. The foreign references are reduced to a minimum, and they are intended primarily to students to enable them comparisons of carbonate rocks from Slovenia with those of the neighboring Alpine and Dinaric regions.

Since the issuing of this publication coincides with the 50th anniversary of a very important event for the carbonate sedimentology, the publication of one of the basic texts on petrography of limestones and dolomites – of Classification of carbonate rocks (Ham, 1962), the author in this way joins to the celebration of this jubilee.

A SHORT SUMMARY OF LITHOLOGY AND CARBONATE ROCK DEVELOPMENT IN SLOVENIA

After the deposition of continental clastic rocks an extensive transgression of the sea in Upper Permian covered the territory of Slovenia with carbonate rocks. The area was from Upper Permian to middle of Anisian a constituting part of an uniform shallow carbonate platform, known as *the Slovenian platform* (Buser, 1989) that extended farther to Friuli, Istria and the Pannonian basin region. In the Middle Anisian this platform disintegrated into *the Dinaric carbonate platform* in the south and *the Julian carbonate platform* in the north, separated by *the Slovenian basin* (Cousin, 1973; Buser, 1989). Carbonate sedimentation on these two platforms to greater or lesser extent continued all to the Upper Cretaceous when the Dinaric carbonate platform disintegrated with forming of several intermediate flysch basins.

On figure 2 the lithologic development of Upper Permian and Mesozoic carbonate rocks in Slovenija is shown in individual paleogeographic units – the Dinaric and Julian carbonate platforms, in the Slovenian basin, and separately in the actual Northern Karavanke Mts., an area north of the Periadriatic lineament. On Fig. 3 schematic overview of corresponding sedimentary environments is shown. Owing to strong tectonics and resulting nappe structure of Slovenian territory the relationships between individual lithologic units and geologic formations can be shown only schematically.

Lately new terms are used as approximate synonyms for the Dinaric carbonate platform, such as: *Platform of the Outer Dinarides* (Grandić et al., 1999), *Adriatic-Dinaric carbonate platform* (Gušić & Jelaska 1993), or simply *Adriatic carbonate platform* (Gušić & Jelaska, 1990, Velić et al., 2002; Vlahović et al., 2005; Jež, 2011) in respect that it was the broadest carbonate platform on the Adriatic microplate in Jurassic and Cretaceous. However, in this monograph an »old« term Dinaric carbonat platform is still used.

In the following very condensed descriptions of lithology in particular geologic times are given with emphasis on carbonate formations and their microfacial and diagenetic characteristics. Since the Triassic beds are the most widespread in Slovenia and also of the highest diversity, the most space in monography is devoted to them.

UPPER PERMIAN

Upper Permian beds in Slovenia are represented with carbonate rocks. Their lithology is diverse. In western part of the Sava folds, between Ljubljana, Škofja Loka and Idrija, they attain a thickness of up to 250 meters. Bedded, dark grey to black limestone and marly limestone prevail over dolomite with several thin sheets of intercalated shaly marlstone. They are named after the town of Žažar near Vrhnika the *Žažar Formation* (Ramovš, 1958), which is an equivalent of the *Bellerophon Formation* in the Alps (Heritsch, 1934; Buser et al., 1988; Kolar-Jurkovšek et al., 2011). In the eastern part of Sava folds, at Laško, Izlake, Sevnica and on Mt. Bohor, the Upper Permian beds are just a few tens of meters thick, and occurring in a prevailingly dolomitic development. In the basal beds, just above the clastics of the Gröden (Val Gardena) formation, the limestone and dolomite still contain appreciable terrigenous admixture, mostly of quartz and mica. Limestone in general is extraordinarily rich with fossils, especially skeletal algae, echinoderms and foraminifers. The proportion of carbonate in the limestone varies between 85 and 97 %.

In Southern Karavanke Mts. the Upper Permian succession occurs in a dolomitic development as the *Karavanke Formation,* which is up to 300 meters thick (Buser et al., 1988). For the lower part of this formation also an up to 80 m thick horizon of cellular dolomite (Rauhwacke) is characteristical.

The sedimentary environment of Upper Permian beds was a very shallow and restricted shelf with lagoons and sabkhas, connected to the wider region of Tethys. This is indicated by the uniform flora and fauna of the Indo-Armenian type. Characteristic for the restricted shelf and lagoons are varieties of the algal biomicritic packstone, and for sabkhas cellular dolomites and evaporitic minerals, of which gypsum and anhydrite are present.

In the biomicritic limestone foraminifers (*Agathamina* sp., *Glomospira* sp., *Hemigordius* sp., *Reichelina* sp., *Climacammina* sp., *Geinitzina* sp., *Ammovertella* sp., *Ichtyolaria* sp., *Staffella* sp.), skeletal algae *Gymnocodium bellerophontis*, *Vermiporella nipponica*, *Permocalculus fragilis*, *Velebitella triplicata, Mizzia velebitana*, *M. cornuta*), brachiopods, echinoderms and gastropods (*Bellerophon* sp.) occur, locally also smaller patch reefs with coral species *Waagenophyllum indicum* (Ramovš, 1958, 1986a; Buser et al. 1988; Skaberne et al., 2009).

The Permian-Triassic (P/T) boundary is marked by a sudden disappearance of numerous fossil species, especially of algae and foraminifers, and by a change of carbon isotopic composition in limestones and dolomites. The Lower Triassic carbonates are enriched with the up to 5 ‰ lighter carbon isotope with respect to the Upper Permian ones (Dolenec T. et al., 1995, 1999a, b, c, 2004).

Just below the P/T boundary in places a thinner bed of oolitic limestone appears (Dolenec, M. & Ogorelec, 2001; Dolenec M., 2004) that can be compared with the Tesero horizon in the Alps (Assereto et al., 1972). Paleontologically the P/T boundary in Slovenia was proved lately on basis of the conodont zonation (Kolar-Jurkovšek & Jurkovšek, 2007; Kolar-Jurkovšek et al., 2011) and foraminifers (Nestell et al., 2011). Just above the Permian/Triassic (P/T) boundary the characteristic small foraminifer *Earlandia* occurs.

Among the diagenetic processes affecting the Upper Permian carbonate rocks, dolomitization has by far the larges extent, and to a lesser extent silificication and dedolomitization are present also. As a result of dedolomitization in beds with evaporitic minerals epsomite precipitated, which can be observed in the Idrija mercury mine.

The major part of dolomite is of early diagenetic origin, and it formed according to the evaporitic model of dolomitization (Shinn & Ginsburg, 1964). Aridic climate in Upper Permian is indicated next to gypsum and anhydrite also by isotopic analyses of $\delta^{18}O$ (Polšak & Pezdič, 1978; Dolenec et al., 1981; Ogorelec et al., 1999b) and Na^{+} contents that are high for carbonates (Ogorelec & Rothe, 1979).

Owing to specific sedimentary conditions and climate, the time of Upper Permian was favorable for formation of stratiform lead and zinc deposits. Such deposits are abundant in the eastern Sava folds, namely in the upper part of the Upper Permian sequence (Puharje near Šoštanj, Iskra, 1969) and at the boundary between the Upper Permian and Lower Triassic (Mokronog, Bohor, Ledina near Sevnica, Drovenik et al., 1980).

The Upper Permian beds in Slovenia have in general the same or very similar microfacies as the limestones and dolomites of same age in neighbouring areas, e.g. in the Carnic Alps (Buggisch, 1974; Buggisch et al., 1976; Holser & Schönlaub, 1991; Magaritz & Holser, 1991; Noé, 1987), Dolomites (Bosellini & Hardie, 1973), on Mt. Velebit (Kochansky-Devidé, 1979; Sremac, 1991, 2005) and in Hungary (Haas, 2001; Haas et al., 2004, 2006).

TRIASSIC

Triassic rocks are in Slovenia the most abundant of all, covering almost a quarter of its territory, and their total thickness attains up to 3800 meters (Buser, 1979), with carbonate rocks decidedly predominating over clastic and pyroclastic rock types (Fig. 2). They are distinguished by an extraordinary diversity of lithologies with characteristics of Alpine development within the Tethys which is similar or identical to that known in the Northern Alps).

In Lower Triassic the carbonate sedimentation on shallow shelf was accompanied by supply of terrigenous, largely fine-grained terrestrial material, while in Lower Anisian the carbonates completely prevail. End of Anisian (Buser, 1989), in the Idrija area already in Middle Anisian (Čar, 1985, 2010), the Slovenian platform started to differentiate as a result of intense tectonics, into *the Dinaic carbonate platform* in the south, *the Julian carbonate platform* in the south, and the intermediate *Slovenian basin* (Fig. 6). The latter persisted in the central Slovenian region all to the middle of Jurassic period when it extended also to the Julian carbonate platform territory, while toward the Dinaric carbonate platform it existed till the end of Cretaceous.

More detailed descriptions of paleogeographic development inTriassic on the integral Slovenian territory, of paleotectonics and biostratigraphic subdivisions are found above all in the works by Buser, 1979, 1980b, 1988, 1996; Dozet & Buser, 2009; Premru, 1980, 1982, 2005; Buser et al., 2007, 2008, and Placer, 2009.

A recent example of how this paleogeographic region in Slovenia might look like in Triassic time is given by the Bahamas archipelago (Fig. 7) where the unique very shallow carbonate plain is split by the up to 900 meters deep trench, the Tongue of the Ocean. By the dimension of several hundred kilometers' this trench is comparable with the size of the ancient Slovenian basin.

In Fig. 8 a schematic presentation of lithologic development of the Triassic rocks in Slovenia is given with selected stratigraphic columns.

LOWER TRIASSIC (Induan and Olenekian)

Thickness of the Lower Triassic sequence is highly variable. It varies between 40 and 500 meters, while it attains up to 600 meters in the Southern Karavanke Mts. (Buser, 1980a). In the entire Slovenian region south of the Periadriatic lineament the beds appear in a rather uniform development. In the lower part of sequence which is up to 250 meters thick clastic and carbonate beds alternate with oolitic layers that are especially distinctive in the field. Dolomites and limestones have a sandy appearance owing to admixture of terrigenous quartz and mica. The non-carbonate component locally attains as much as 50 %. Clastites are represented by reddish claystones, marlstones and siltstones. As to texture, the limestone is mostly biomicrite or pelmicrite. It was deposited in a very shallow restricted part of shelf that possessed at times characteristics of lagoons and littoral. It is often entirely or partly dolomitized, and bioturbation structural features are also typical. Thinner lenses and nests of gypsum and anhydrite indicate local and periodic evaporitic conditions of sedimentation.

Oolites formed in intertidal channels and deltas with higher energy index. Characteristic is their reddish color resulting from hematitic pigment. Nuclei of ooids were often subjected to late diagenetic dolomitization manifested by up to 300 µm large dolomitic rhombohedrons. Between ooids occur often plates of echinoderms and tiny gastropod shells of *Natica gregaria* and *Holopella gracilior* species, and also fine terrigenous grains of quartz and mica.

In the upper part of the Lower Triassic succession terrigenous content decreases. A darker biomicritic or pelmicritic marly limestone (mudstone to packstone) prevails over the lighter colored dolomite. Among fossils foraminifers, and in certain beds also abundant ostracods, echinoderm plates and thin valves of species *Claraia clarai* are represented. Some conodonts are present too (Kolar-Jurkovšek & Jurkovšek, 1995, 1996, 2007). The most important for stratigraphy is foraminifer *Meandrospira pusilla*.

North of the Periadriatic lineament, especially in surroundings of Črna na Koroškem, the Lower Triassic beds appear in an clastic development, in respect that the region of the Northern Karavanke Mts. is a part of the Eastern Alpine geotectonic unit. They are developed as sandstones, shaly siltstones and conglomerates of the Buntsandstein type (Mioč, 1983), and they contain no fossil remains (Štrucl, 1971).

Lower Triassic beds on the Slovenian territory generally display the same, or a very similar microfacies to beds of same age in neighbouring areas, e.g. the Werfen beds in Northern Alps (Mostler & Rössner, 1984), in Carnic Alps (Holser & Schönlaub, 1991), Dolomites (Assereto et al., 1972), Hungary (Nagy, 1968; Haas, 2001), in Austrian part of Southern Karavanke Mts. (Anderle, 1970), at Mt. Svilaja in Dalmatian Zagora (Ščavničar et al., 1983, Jelaska et al., 2003) and elsewhere, which indicates a vast and uniform sedimentary environment in the Lower Triassic.

MIDDLE TRIASSIC

Development of **Anisian beds** in Slovenia is rather uniform, mostly as bedded dolomite that exhibits frequent indications of intertidal sedimentation with stromatolites and shrinkage pores

(Grad & Ogorelec, 1980; Dolenec et al., 1981). Limestone is less common than dolomite. Among fossils foraminifers (*Meandrospira dinarica, Pilammina densa, Glomospirella irregularis, G. grandis, G. semiplana, Trochammina* sp.) prevail, locally also algae (*Physoporella pauciforata*) occur. In northern part of Julian Alps between Mojstrana and Kranjska Gora massive reef limestone is preserved, consisting primarily of algae and thrombolitic structures (Ramovš, 1987). The same development is present also in the castle rock wall above the Bled lake (Flügel et al., 1993).

Thickness of Anisian beds attains up to 600 meters.

North of the Periadriatic lineament, at Topla below Mt. Peca bedded dolomite is exposed which is mineralized with lead and zinc ores (Štrucl, 1974). It is overlain by dark micritic limestone with chert nodules.

In the middle of Anisian the Slovenian platform begun to disintegrate. As a result the sedimentation from Middle Triassic on took place on separate geotectonic units in different environments. For the deeper marine development of Anisian as known in Karavanke Mts. near Tržič, in Idrija area and in eastern Sava folds ammonites (*Balatonites balatonicus*, Buser, 1979a) and conodonts (Kolar-Jurkovšek, 1983, 1991) are characteristic.

Ladinian beds are distinguished by a highly diverse lithology of various rapidly alternating lithologic types. They are exposed in a number of localities in central Slovenia, in broader Idrija and Cerkno areas, in foothills of Julian Alps and Karavanke Mts., and in a larger extent north of the Periadriatic lineament in the Peca mountains.

As a result of intense tectonics during the Idrija tectonic phase (Buser, 1980b) the territory of central Slovenia became drastically dismembered. In deeper trenches volcanic effusions of spilitic-keratophyric association (basalts, quartz keratophyres, porphyries …) occurred, accompanied by deposition of their tuffs and tuffites (Buser, 1979; Dozet & Buser, 2009). Some blocks became subaerially exposed as indicated by thick beds of slope breccias and conglomerates. In Southern Karavanke Mts. and part of Julian Alps they appear as the Ukve (Ugovizza) breccia (Buser, 1986b; Jurkovšek, 1987), and in surroundings of Idrija as the Stopnik conglomerate (Mlakar, 1969; Čar & Čadež, 1977; Čar & Skaberne, 2003; Čar, 2010). On Dinaric and Julian platforms in some places dark limestones with chert and interbedded tuff layers deposited, and in the central part of Slovenian basin the Psevdozilja beds that are characterized by an alternation of dark shaly claystones, sandstones and tuffs with subordinate limestones. Texture of limestone is generally biomicritic mudstone or wackestone, and among fossils in addition to thin mollusc shells especially the conodonts (Kolar-Jurkovšek, 1983, 1991; Kolar-Jurkovšek & Placer, 1987; Placer & Kolar-Jurkovšek, 1990; Kolar-Jurkovšek & Rižnar, 2006) and radiolarians occur (Goričan, 1997; Goričan & Buser, 1990; Skaberne et al., 2003). Important macrofossils are ammonites and bivalves (Jurkovšek, 1983, 1984; Ramovš & Jurkovšek, 1983; Ramovš, 1989).

Interesting in the Upper Ladinian of Kamnik-Savinja Alps is the *Korošica Formation* that overlies granular dolomite and green tuff. The limestone is a slightly bituminous black biomicrite containing chert nodules. Among fossils bivalves (Jurkovšek, 1984), ammonites and fish as well as reptile skeletons occur (Celarc, 2004a; Celarc & Žalohar, 2010).

In the Northern Karavanke Mts., in Mežica area an over 1000 meters thick complex of massive, in part bedded limestone and dolomite occur in Ladinian and Cordevolian, known as the Wetterstein limestone (Štrucl, 1970, 1971). The most characteristic such massif is the Mt. Peca group. The limestone is mineralized with zinc and lead ores (Štrucl, 1971, 1984; Brigo et al., 1977; Drovenik et al., 1980). The lower part of *Wetterstein Formation* is more massive, and includes reef limestones with corals and chaetetides (Turnšek, 1997; Bole, 2002), whereas its upper part, already of Cordevolian age, was deposited largely in intratidal zone of an open shelf. The rocks contain frequent stromatolitic and loferitic beds. Southwards the Wetterstein limestone passes into dark mudstones and marlstones with rare limestone interbeds. These beds, known as the *Partnach Formation*, were sedimented in a restricted, somewhat deeper part of shelf. In this packet locally also lenses and nodules of evaporitic minerals, mostly gypsum occur (Štrucl, 1971; Mioč, 1973).

UPPER TRIASSIC

Carnian beds are the most abundant in western Slovenia. Within them stratigraphically the Cordevolian, Julian and Tuvalian rocks can be distinguished. They occur in the shallow marine and in deeper marine development. The entire Carnian time lasted 14 million years.

Lately, the term *Cordevolian substage* is beeing abandoned (Celarc, 2004b; Lucas et al., 2010) because the fossil assemblage of these beds belongs already to the lower part of the Julian substage. However, considering the distinctive, more reefal facies of massive limestone and dolomite known from lowermost Carnian in Slovenia, as well as the traditional subdivision in the Basic Geologic Map, Cordevolian substage is kept as a separate stratigraphic unit in this monograph.

Rocks of **Cordevolian age** occur only in carbonate development, mostly as light, massive saccharoidal dolomite with primary texture of rock only exceptionally preserved. The fossils, predominantly dasycladacean algae and corals, allow the supposition that the Cordevolian dolomite represents ancient reefs that were later subjected to intense dolomitization. Limestones of this age compose the larger part of Mts. Mežakla and Pokljuka in the Julian Alps (Ramovš, 1988; Ramovš & Turnšek, 1984; Turnšek & Buser, 1989) and extensive areas in Kamnik-Savinja Alps (Krvavec, Velika planina, Menina – Premru, 1974, 2005; Ramovš & Šribar, 1993; Celarc 2004a; Žalohar & Celarc, 2010), whereas in smaller outcrops they appear also in the region between Cerkno and Ljubljana and in eastern Sava folds. As a result of paleokarstification (Buser, 1980b) the limestone is often reddish colored, and it contains pockets of red clay and bauxite. Such limestone has been appreciated as ornamental stone. It is being extracted in quarries at Hotavlje and Lesno Brdo near Vrhnika (Ramovš, 1995). In dolomite and limestone of the mentioned areas, the most frequent fossils are skeletal algae (*Diplopora annulata*, *Diplopora annulatissima*, *Gyroporella ladinica*), that are locally rock-forming (Ramovš, 1988, 1992; Dozet, 1979; 2004; Čar, 2010).

A special bedded development of dolomite is known on the Vojsko plateau at Gačnek, where in a 40 meters thick succession structures typical for littoral intertidal environment can be found (Mlakar, 1969; Čar, 2010).

In the region of Northern Karavanke Mts. the sedimentation of bedded limestone and dolomite as the top part of the *Wetterstein Formation* continued in Cordevolian.

Thicknesses of Cordevolian dolomite and limestone may be very variable, from several tens meters up to 600 meters in different geotectonic units of Slovenia.

Rocks of **Julian and Tuvalian substages** are variable, mainly carbonatically developed. Within limestones and dolomites also layers of marlstones and packages of clastites and tuffs occur. Their thickness varies between 100 and 400 meters. In the southwards direction on the Dinaric carbonate platform clastites and tuffs become more and more abundand, so that in the Idrija and Kočevje areas they already prevail above the carbonates (Cigale, 1978; Dozet, 1990a).

In contrast to Cordevolian dolomite, the Julian and Tuvalian beds were deposited on restricted shallow shelf, often in lagoons. Dark color of limestone and pyritic pigment indicate anoxic conditions in the sedimentary environment. Limestone is often marly and locally with boudinage structural features. Organic matter content varies around an average of 1 %, at most to 4 %, and its origin is largely terrestrial (Ogorelec et al., 1996a). According to texture the limestone is micritic and biopelmicritic mudstone to packstone. Predominant fossils are thin-valved bivalves (Jelen, 1990; Jurkovšek, 1994), skeletal and nonskeletal algae (*Poikiloporella duplicata, Clypeina besici*), ostracods and smaller foraminifers (*Nodosaria ordinata*, *Glomospira* sp., *Diplotremina astrofimbriata*, *Lamelliconus multispirus*, *Ammodiscus parapriscus*, *Frondicularia pupiformis*) (Oblak, 2001) and bivalves of *Triadomegalodon idrianus* species (Čar 2010). A somewhat more agitated environment is indicated by individual ooids and oncoids. Limestone was often affected by early- as well as late-diagenetic dolomitization and karstification with pockets and layers of bauxites (Dozet, 1979, 2004; Buser, 1980b).

The upper parts of Julian and Tuvalian sequence are often represented by grey dolomite with rare marlstone intercalations, and locally also with several meters thick layers of tuffaceous claystone. This dolomitic packet gradually passes to lighter-colored bedded dolomite without intercalated marly sheets, the *Main dolomite*. Age of this dolomite is determined by up to several cm large megalodontid bivalves, foraminifers, algae (*Poikiloporella duplicata*) and conodonts (Kolar-Jurkovšek, 1991).

A distinct development of Julian-Tuvalian sequence are the Amphiclina beds, which in Cerkno area and in Baška grapa attain thicknesses of up to 250 meters (Buser, 1986b). Characteristic for them is interbedding of dark grey to black marly biomicritic limestone, shaly marlstone, quartz sandstone and conglomerate, tuffs and tuffites. In this complex several up to 40 meters thick reefs occur in the wider Cerkno area (Senowbari-Daryan & Schäfer, 1979; Čar et al., 1981; Turnšek et al., 1984). They are mainly built of sponges and to a lesser degree of corals (Turnšek, 1997). Structural characteristics of limestones and graded bedding in beds allow to interpret the sedimentation of Amphiclina beds as taken place in the transitional zone of carbonate shelf toward the Slovenian basin (Turnšek et al., 1984).

In Julian Alps the shallow- as well as the deeper-marine development of Julian and Tuvalian beds can be observed. The shallow marine development crops out e.g. at Tamar and Log pod Mangartom (Ogorelec et al, 1984; Jurkovšek, 1987). The biomicritic limestone (wackestone to packstone) contains numerous foraminiferal tests, small megalodontids and other bivalves, echinoderm plates. It is often dolomitized, largely marly, containing up to 15 % noncarbonate admixture, mostly clay and organic matter. For the deeper sea development dense biomicritic limestone with chert nodules is characteristic. Among fauna thin-valved bivalves, calcitized radiolarians and washed-in plates of echinoderms prevail (Ogorelec et al., 1984; Jurkovšek, 1987). In these beds on Kozja dnina below Mt. Triglav the fossil fish *Birgeria* sp. was found (Jurkovšek & Kolar-Jurkovšek, 1986), a worm *Valvasoria carniolica* (Kolar-Jurkovšek & Jurkovšek, 1997) and other fossils were found (Dobruskina et al., 2001; Bitner et al., 2010), while in the western part of Southern Karavanke Mts. algae *Clypeina besici* (Kolar-Jurkovšek & Jurkovšek, 2003) and radiolarians (Kolar-Jurkovšek et al., 2005).

Julian and Tuvalian beds in Northern Karavanke Mts. are represented at Mežica with an up to 350 meters thick succession of limestone and dolomite developed in 20 cyclothems of lofer type, for which three clastic horizons of shale, siltstone and marlstone are characteristic (Štrucl, 1970, 1971; Pungartnik et al., 1982). Certain beds are extremely rich with fossils, especially crinoids (Jurkovšek, 1978; Jurkovšek & Kolar-Jurkovšek, 1997; Kaim et al., 2006; Kolar-Jurkovšek & Jurkovšek, 2009, 2010; Jurkovšek et al., 2002). A rather agitated environment within the shallow shelf is indicated by individual oolitic layers and oncoids.

Rocks of **Norian and Rhaetian ages** are represented in Slovenia by three developments. In both Julian and Dinaric carbonate platform the Main dolomite and its lateral variety, the Dachstein limestone occur, and in Slovenian basin the Bača dolomite and Železniki limestone (Fig.13). Main dolomite and Dachstein limestone cover large areals, and are the most widespread rock formations in Slovenia. They build most of the Julian Alps, a large part of Notranjska, northern part of Trnovski gozd and part of Dolenjska.

The thickness of Main dolomite is between 800 and 1300 meters, the same as also of the Dachstein limestone. Limestone predominates on the Julian carbonate platform, whereas on the Dinaric platform dolomite prevails. Thickness of the Bača dolomite is 3 to 4 times smaller, and is estimated to at most 400 meters (Buser, 1986b).

Dachstein limestone is thickly bedded, and it occurs in the typical lofer develoment as known in the Northern Alps (Fischer, 1964; Zankl, 1971; Piller & Lobitzer, 1979; Piller, 1981), Dolomites (Bosellini, 1967; Bosellini & Rossi, 1974) or in Hungary (Haas, 1994). Individual cyclothems (Fig. 12) consist of up to 2 meters thick beds of biomicritic and biosparitic limestone which are interrupted by thin stromatolitic and loferitic layers, and locally also interbedded by breccias with clayey matrix.

Among fossils the most abundant are foraminifers (*Triasina hantkeni, Aulotortus* gr. *sinuosus, A. permodiscoides*, *A. friedly*, *Miliolipora cuvillieri, Galeanella* sp.), algae (*Macroporella retica*) and echinoderms. In certain beds large megalodontid bivalves are even rock-forming. The Dachstein limestone was deposited on a shallow open and near-shore shelf with periodic intertidal and supratidal conditions (Ogorelec, 1988; Dozet & Ogorelec, 1990; Ogorelec & Rothe, 1992). The beds deposited in littoral environment are often dolomitized.

On Julian platform larger reef massifs occur within the *Dachstein limestone Formation* (e.g. Begunjščica, Pokljuka, Bohinj), and smaller reefs containing a rich coral fauna (Turnšek & Ramovš, 1987; Turnšek & Buser, 1991; Turnšek, 1997). On both Dinaric and Julian carbonate platforms periodically short-term emersions of their individual parts occurred. In such occasions paleokarst developed. It is best preserved in Kanin Mts. and on Mt. Krn (Babić, 1980/81; Ogorelec & Buser, 1996). Equal fauna and microfacies as found in reef limestone of Slovenian part of the Alps occur also in Norian-Rhaetian reefs in the Northern Alps (Zankl, 1971; Flügel, 1981; Piller, 1981; Stanton & Flügel, 1989; Flügel & Koch, 1995; Turnšek et al., 1999).

Main dolomite has a monotonous, entirely dolomitic development. Characteristic is cyclic interchanging of thicker dolosparitic and biomicritic beds with thinner stromatolitic layers, loferites, locally also supratidal conglomerate and emersion breccias. Among fossils large megalodontids, foraminifers and algae are represented. Locally also beds and lenses with oncoids and vadose pisoids appear (Ogorelec, 1988; Dozet, 1991). Main dolomite deposited initially as limestone on very shallow restricted shelf with wide coastal plains, in the shallower part of shelf as Dachstein limestone. Dolomitization was early diagenetic according to the evaporative pumping model (Illing et al., 1965). Later the rock was affected also by the late diagenetic dolomitization. Dolomite also shows often indications of paleokarstification. Smaller and larger corrosion vugs are filled with zonal sparitic cement, commonly accompanied by red internal micrite.

In the same time, when Dachstein limestone and Main dolomite were depositing on the platforms, **the Bača dolomite** and **Železniki limestone** were formed in the basin and on its margins (Buser, 1979; Ramovš, 1970; Gale, 2010). The carbonate sediment in both formations is micritic, with very rare fossils, i.e. small foraminifers (Rožič, 2005, 2006, 2008; Rožič & Kolar-Jurkovšek, 2007; Buser & Ogorelec, 2008; Rožič et al., 2009; Gale et al., 2010) and conodonts (Kolar-Jurkovšek, 1982, 1991, 2011) but characteristic for the two formations are interbeds and nodules of chert.

JURASSIC

As in the Middle and Upper Triassic the territory of Slovenia also in Jurassic belonged to three geotectonic units that at the same time represented distinct sedimentary environments. Southern Slovenia was a part of the Dinaric carbonate platform with typical shallow water sedimentation and imposing thickness of carbonate rocks which attains in Jurassic more than 1500 meters (Buser, 1989; Buser & Dozet, 2009). To the north the carbonate platform bordered on the Slovenian basin, and north of it the Julian carbonate platform still existed. The latter disintegrated in Dogger, and was replaced by the basin.

Dinaric carbonate platform

The transition of Upper Triassic Main dolomite and Dachstein limestone to Jurassic beds is not sharp. Only locally an up to several tens of meters thick package of intraformational breccia occur on the contact, which formed during short-term emersion phases accompanied by paleokarstification (Buser, 1979b; Ogorelec & Rothe, 1992; Jurkovšek et al., 1996). Stromatolites which are typical for Main dolomite gradually disappear, but frequent structural features of the littoral environment – shrinkage pores and desiccation cracks, supratidal conglomerate and laminites – still persist in the Lower Lias beds (Ogorelec, 1988, 2009; Orehek & Ogorelec, 1979, 1980; Dozet, 1992a, 1998).

In Middle and Upper Lias as well as in Dogger various environments within the carbonate shelf can be recognized (Buser, 1979b; Ore-

HEK & OGORELEC, 1979, 1981; STROHMENGER & DOZET, 1990, DOZET, 1992a,b). On Trnovski gozd, Hrušica, Logatec plateau and on Gorjanci Mts. sedimentation took place on the open shelf with a higher energy. Oolitic limestones prevail (BUSER 1973, 1978; STROHMENGER et al., 1987; OGORELEC & DOZET, 2000) which may attain a thickness of several hundred meters. Within them locally layers with large oncoids appear. Locally lithiotid bivalves are frequent, so that in places they form coquinas (BUSER, 1978; BUSER & DEBELJAK, 1996; DEBELJAK & BUSER, 1998; RAMOVŠ, 2000).

Among important fossils that can be observed in thin-sections of Lower Jurassic – Liassic beds algae *Paleodasycladus mediterraneus* and *Sestrosphaera liasina*, and foraminifers *Orbitopsella praecursor, Involutina liassica, Agerella martana, Trocholina turris, Pseudocyclammina liassica, Haurania deserta* were determined (ŠRIBAR, 1979a, and data from explanatory books to Basic Geologic Map 1 : 100,000). Abundant are also stratigraphically less characteristic species of alga *Thaumatoporella parvovesiculifera,* echinoderms, microgastropods, bivalves, ostracods, and locally also tiny brachiopods. In Dogger beds the foraminifer *Mesoendothyra croatica* and alga *Selliporella donzelli* were determined. On Mt. Hrušica and Trnovski gozd rare coral buildups and layers of crinoidal limestone occur.

In Notranjska dark grey biomicritic and pelmicritic limestone occurs in Lower and Middle Jurassic, that indicates sedimentation in rather secluded and restricted parts of shelf with lagoons and periodic anoxic conditions (OREHEK & OGORELEC, 1981). Within the limestone often lenses of sparry dolomite occur. In Kočevje area locally also thinner coal seams appear (DOZET, 1998). Thickness of Lower and Middle Lias beds varies from 200 to 400 meters, and of Upper Lias and Dogger beds up to 450 meters (BUSER, 1979b).

In Lower Malm a several tens kilometers long and several kilometers wide coral-stromatoporidic reef extended across the Trnovski gozd, which at that time represented the northern margin of Dinaric carbonate latform. The reef is up to 500 meters thick (TURNŠEK, 1966, 1969, 1972, 1997; TURNŠEK et al., 1981). Between the reefs that extended with interruptions to Suha Krajina and across Gorjanci to Lika in Croatia (VELIĆ et al., 2002) sedimentation of interreef breccias and bedded limestones with hydrozoan *Cladocoropsic mirabilis* took place.

For the Upper Malm (Kimmeridgian and Tithonian) are again characteristic oolitic and biomicritic limestones with algae *Clypeina jurassica* and *Salpingoporella annulata* (BUSER, 1979b; OREHEK & OGORELEC, 1981; STROHMENGER & DOZET, 1990), and with aberrant tintinnidas (KERČMAR, 1961). Among foraminifers the trocholinas (*Trocholina alpina* in *T. elongata*), *Protopeneroplis striata, Pfenderina salernitana, Kurnubia palestinensis, K. jurassica* in *Nautiloculina oolithica* were recognized (ŠRIBAR LJ. – Analyses for BGM). Certain beds indicate littoral sedimentation. On Mt. Trnovski gozd a part of the carbonate complex is completely dolomitized.

Slovenian basin

Jurassic beds in pelagic development are found in the broad region of Tolmin and Bovec, in foothills of Julian Alps and in western part of Southern Karavanke Mts., and in a reduced extent also in eastern part of Sava folds.

Lias beds, attaining a thickness of up to 300 meters, are represented by platy micritic limestone with chert nodules, intercalated with thin shaly marlstone layers. Among fossils foraminifers *Ophthalmidium leischneri* and *Involutina liassica,* radiolarians and sponges occur. Along basin margins thicker packets of calcareous breccias sedimented sliding down the shelf edge (ROŽIČ, 2006, 2008; ROŽIČ & POPIT, 2006; BUSER & OGORELEC, 2008). Between breccia fragments also ooides are found. Breccia and beds of finer calcarenites often display graded bedding and lamination. On Mt. Begunjščica platy limestones with chert are impregnated with manganese oxides, and they contain numerous ammonites.

Dogger and Lower Malm beds are not easily determined by fossils. Their thickness is several tens of meters only. They are represented with shales, radiolarites and beds of micritic and biomicritic limestone with chert nodules (BUSER, 1979b; OGORELEC & DOZET, 1997). Among the fossils foraminifer *Globigerina helveto-jurassica* and radiolarians appear (GORIČAN, 1997).

Upper Malm – Tithonian is represented in the up to 50 meters thick succession with white and light grey micritic limestone of the biancone type containing chert nodules and sheets. In limestone calpionellas and radiolarians are frequent. The same limestone type continued to sediment also in Lower Cretaceous, in Berriasian and Lower Valanginian, so that the entire package of calpionellid limestones can be up to 250 meters thick (COUSIN, 1981; BUSER, 1986, 1987; JURKOVŠEK, 1987; JURKOVŠEK et al., 1990).

Julian carbonate platform

The Lower Jurassic beds are developed in a shallow water facies of the open shelf. In them biosparitic, oolitic and micritic limestones alternate, and locally also stromatolitic and loferitic beds are present. On the contact with Upper Triassic carbonates emersion breccias and neptunian dikes occur in places, both impregnated with reddish clayey matrix (BABIĆ, 1980/81; JURKOVŠEK et al., 1990; ČRNE et al., 2007).

In Upper Lias the Julian platform became dissected into several blocks that subsided to various depths. On them pelagic sedimentation and condensation of sediments started (BUSER, 1986a; JURKOVŠEK et al., 1990; ŠMUC, 2005). On Mts. Mangart and Rombon, in Trenta valley and in the Valley of Triglav lakes reddish biomicritic limestones of the »ammonitico rosso« type outcrop that contain iron and manganese nodules (JURKOVŠEK et al., 1990; Šmuc, 2005; Ogorelec et al., 2006). The variegated limestones exhibit a microfacies that is very similar to the one known from the classic locality of nodular deeper water limestones in Northern Alps (e.g. at Adnet near Salzburg – Böhm et al., 1999).

The manganese-bearing horizon is overlain by several meters thick reddish and brownish micritic limestone with radiolarians and chert nodules of Dogger and Malm age, followed by Berriasian »biancone« type limestone with chert nodules.

Eastern Alps

In Northern Karavanke Mts. Lower Jurassic beds occur in the area of Uršlja gora and surroundings as reddish platy and nodular reddish limestones with chert lenses, deposited in a deeper sea (Ramovš & Rebek, 1970; Mioč & Šribar, 1975).

CRETACEOUS

Although Cretaceous period is the longest one in Mesozoic era, lasting for whole 80 millions years, its development in Slovenian region is rather monotonous. On the Dinaric platform as a thick sequence of limestones and dolomites, and in the Slovenian basin, that at that time extended also to the region of the Julian carbonate platform, as flysch beds with intermediate packets of deeper water limestones. Thickness of Cretaceous beds on the Dinaric carbonate platform attains up to 2000 meters, and in the basin up to 800 meters (Pleničar, 1979, 2009; Buser, 1989) ; OGK Explanatory books). At the end of Cretaceous a long period of subaerial exposure started in southern Primorska and in Istria. In the same time the Dinaric carbonate platform disintegtrated to several smaller units with intermediate flysch basins that starting in the Upper Cretaceous all to the end of Paleogene gradually shifted from the north, resp. from the Bovec area southwards to central Istria (Buser, 1986b).

Schematic presentation of development of Cretaceous beds is shown on figures 2 and 3, and separately on figure 14.

Dinaric carbonate platform

The Lower Cretaceous beds are the most extensively represented in shallow water development in Dolenjska, Notranjska, on Mt. Hrušica and on western part of Trnovski gozd. Their development is rather monotonous, having characteristics of sedimentation on restricted shelf with lagoons and periodical intertidal conditions. With respect to microfacies among limestones prevail types with micritic matrix (mudstone to packstone) and fossils typical for quieter environments – foraminifers, ostracods, algae and molluscs.

The lithologic transition of Upper Jurassic to Berriasian beds is gradual. The limestone texture is biopelmicritic, often with desiccation cracks and lamination. The rock is locally slightly marly, and owing to traces of organic matter usually of medium to darker grey color. Some limestone beds were affected by early or/and late diagenetic dolomitization. The latter is manifested by dolomite rhombohedrons, often of zonal structure, and by smaller lenses of sparry dolomite.

Šribar (1979b) subdivided the entire Lower Cretaceous succession on Logatec plateau into five cenozones on the basis of microfossil assemblages. The same subdivision is valid also for the Trnovski gozd (Koch, 1988; Koch et al., 1989) and Kočevje areas (Dozet, 1990c; Dozet & Šribar, 1991).

Characteristical of **Berriasian and Valanginian stage** and the most important are the microcoprolite *Favreina salevensis* and algae *Salpingoporella annulata*. Favreinas are locally so numerous that they become rock-forming. Among the foraminifers species *Pseudocyclammina lituus* appears. In the upper part of **Valanginian and Hauterivian** beds alga *Clypeina solkani* and foraminifers *Pseudotextulariella salevensis* and *Orbitolinopsis capuensis* are present. In larger numbers occur also ostracods and tiny molluscs. In those times were present next to biomicritic limestones also microfacial types with frequent desiccation cracks that indicate paleogeographic conditions similar to those in Valanginian, i.e. restricted shelf with lagoons and intertidal plains (Orehek & Ogorelec, 1979, 1981; Šribar, 1979b; Dozet & Šribar, 1991).

Barremian age of limestone is supported by dasycladacean algae *Salpingoporella muehlbergeri*, and the **Aptian age** by species *Salpingoporella dinarica*, which is extraordinarily numerous in some beds at transition to Albian. In Aptian *S. dinarica* is accompanied by foraminifer *Palorbitolina lenticularis*, miliolids and numerous specimens of microorganism of problematic origin *Bacinella irregularis* Radoičić, for which it is assumed to belong to cyanobacteria (Flügel, 2004). Due to intense tectonics thedifferentiation of Dinaric platform and changes of paleoenvironment occurred in this time. This resulted into a greater diversity of facies and of thicknesses of individual cenozones within particular series (Koch et al., 1989). Locally also short-lived emersions of some parts of platform occurred. In the Kras area such an subaerial exposure is indicated by emersion breccia on the boundary between the Brje and *Povir Formations* (Fig. 19), i.e. on the boundary between Aptian and Albian (Koch & Ogorelec, 1987; Jurkovšek et al. 1996; Jurkovšek 2010;). Limestone of Valanginian to Albian age is often dolomitized, partly or totally, the dolomitization being of late diagenetic character.

To the upper part of Lower Cretaceous beds, of **Albian** age, Šribar (1979b and Dozet & Šribar 1991) attributed limestone and dolomite beds containing orbitolinas (*Orbitolina* ex gr. *texana*) and foraminifers (*»Valdanchella« dercourti*). Quite frequent in this beds are also miliolids, and requienids among the molluscs.

A higher energy index within the Lower Cretaceous succession is indicated by rare beds containing ooids and pseudoooids. Both were transported into the quieter environment with micritic carbonate mud, and mixed between pellets and tiny fossils. Locally also smaller reefs and biostromes of corals, hydrozoans and algae existed. Such coral reef is known from Berriaian and Valanginian at Zavrh on Banjščice plateau (Turnšek & Buser, 1974), and from Aptian and Albian coral reefs at Kanalski vrh and environs on Banjščice plateau (Turnšek & Buser, 1974; Grötsch, 1991; Grötsch et al., 1994), and on Kočevska gora (Turnšek et al., 1992) were described. In Aptian a smaller algal reef consisting predominantly of *Lithocodium aggregatum* (syn. *Bacinella irregularis*) existed on Mt. Sabotin (Koch et al., 2002).

Within the Hauterivian succession occurs in western part of Trnovski gozd and on Mt. Sabotin a 15 to 40 meters thick packet of black biomicritic and biopelmicritic platy and bituminous limestone with chert nodules (»Trnovo platy limestone«, Pleničar & Buser, 1967) which contains up to 1.1 % C_{org}. Analyses of a number of samples indicate that this limestone could be regarded as a potential source rocks for hydrocarbons with low capability for their generation (Ogorelec et al., 1996a).

Upper Cretaceous beds were deposited on a more open and shallow shelf of a higher energy index. For them are characteristic light color of limestones, thick beds and rich rudist fauna (Pleničar, 2005; Pleničar & Jurkovšek, 1996, 1998). All types of limestones are represented, but packstone and grainstone are the most frequent. The Upper Cretaceous beds are exposed to a larger extent on the Trieste-Komen plateau and on Mt. Nanos, and to a lesser extent on Javorniki Mts., in Dolenjska and Kočevje area. Owing to great thicknesses of individual beds, interesting appearance and good technical properties they are appreciated as architectural stone, and are quarried especially in the Kras region in numerous quarries. Dolomite beds are considerably less frequent than in the Lower Cretaceous succession.

In spite of monotonous lithologic development the Upper Cretaceous beds can be biostratigraphically well subdivided on basis of fossils, especially foraminifers and rudists (Šribar & Pleničar, 1990; Pleničar, 1960, 1979, 2005, 2009; Jež, 2011). Such division is shown on Fig. 20 for the region of southwestern Slovenia. For **Middle and Upper Cenomanian** among foraminifers *Broeckina (Pastrikella) balcanica* is characteristic, for **Upper Turonian** the nonskeletal alga *Aeolisaccus kotori*, for **Coniacian and Lower Santonian** foraminifer *Pseudocyclammina sphaeroidea*, for **Upper Santonian and Campanian** *Keramospherina tergestina*, and for **Maastrichtian** *Orbitoides media* and *Rhapydionina liburnica* (Šribar & Pleničar, 1990).

In the Trieste-Komen plateau region formations were defined in addition to cenozones : the Povir formation of Cenomanian age, Sežana formation of Upper Turonian, Coniacian and Santonian, and the Lipica formation of Campanian (Jurkovšek et al., 1996; Jurkovšek, 2008, 2010, Jurkovšek & Kolar-Jurkovšek, 2007). Within the Repen formation comprising Lower Turonian in certain levels extremely numerous calcispheres occur that may become even rock-forming (calcispheric packstone), indicating a sea-level rise between the Cenomanian and Turonian (Jenkyns 1985, 1991; Haq et al., 1987, Jurkovšek et al., 1996; Jurkovšek, 2010), i.e. the subsidence of the platform.

A sedimentological and microfacial peculiarity within the lower part of Sežana formation is represented by a several meters thick horizon with large oncoids (Oncoidal limestone, Jurkovšek et al., 1996; Jurkovšek, 2010). This oncoidal horizon is widespread and is recognizable as a marker horizon throughout the Dinaric carbonate platform (Gušić & Jelaska, 1990; Tišljar et al., 2002).

In the region of Dinaric carbonate platform two well-marked emersion phases occurred in the Upper Cretaceous that resulted in stratigraphic gaps. The first such phase in the interval from Upper Cenomanian to Coniacian happened on the northern edge of platform and it can be best recognized on Mt. Sabotin, wheras toward Mt. Nanos its extent is already smaller, covering only a part of Coniacian (Jež, 2011). In Kras area this gap cannot be recorded. The second emersion phase covered a wider time-span. In places on Kras subaerial exposure lasted for an insignificant time-range between Campanian and Maastrichtian, while more to the south (Matarsko podolje, Istria) it existed already from Senonian on, and lasted up to Eocene (Drobne, 1979; Buser, 1980; Jurkovšek et al., 1996; Otoničar, 2006, 2007; Jež, 2011). Results of emersion phases and karstification are pockets of bauxitic clay.

Within the Upper Cretaceous succession on the Trieste-Komen plateau black platy and bituminous limestones with chert nodules are characteristic, known in literature as »the Komen fish-shales« for the numerous fossil remains of fishes (Gorjanović-Kramberger, 1895; Jurkovšek et al., 1996; Jurkovšek, 2010; Cavin et al., 2000; Palci et al., 2008). Primarily (Buser, 1968) these limestones were attributed to three horizons within the Albian-Cenomanian, Turonian and Senonian succession, however newer research revealed more horizons. In the interval from Cenomanian to Santonian they belong to the Komen limestone, and in the Santonian-Campanian part of the Lipica formation horizons of Tomaj limestone occur (Jurkovšek et al., 1996; Jurkovšek, 2008, 2010). The texture of Komen limestone is biomicritic and biopelmicritic, often with millimeter-scale lamination. It was deposited in shallow restricted lagoons under anaerobic conditions and on intertidal plains. The latter are indicated by torn laminae (»flat pebble conglomerate«), stromatolites and shrinkage pores. The microfossil assemblage is poor and atypical (foraminifers, ostracods, algae – mainly *Thaumatoporella parvovesiculifera*). Periodic communication of lagoons with the open sea is indicated by pelagic fossils. Next to fishes also other macrofossils occur in limestone, such as plants, saccocomas, ammonites and others (Jurkovšek & Kolar-Jurkovšek, 1995, 2007; Dobruskina et al., 1999; Summesberger et al., 1996, 1999). The Tomaj limestone contains beds of biocalcarenite as well, often showing graded bedding. Calcarenite is believed to have been deposited as allodapic limestone in local deepenings occurring within anoxic basins. owing to tectonics (Ogorelec et al. 1987). In spite of black color and smell of bitumen the Komen limestone contains only a scarce proportion of organic C, in major part up to 0.8 %, and only exceptionally to 1.7 %. Unfavorable for oil potential is the composition of organic matter which is predominantly of terrestrial origin (Ogorelec et al., 1996a,b).

The Cretaceous time is terminated by limestones of the *Liburnian Formation* which continues further to Lower Paleocene. Biosparitic limestone is alternating with biomicritic varieties, and locally with stromatolitic beds. Characeans indicate sedimentation in brackish palustrine environment. In the lower part of Liburnian formation which is marked by Vreme beds, and is still of Maastrichtian age, the most characteristical foraminifer *Rhapydionina liburnica* (Stache) occurs, which is accompanied by miliolids, rhizocodia, ostracods and molluscs, especially gyropleuras (Drobne, 1981; Drobne et al., 1989, 1995; Pleničar et al., 1992; Hötzl & Pavlovec, 1979). In this facies also thinner coal seams appear in places, which were mined in the past (Vremski Britof, Lipica, Sečovlje; Hamrla, 1959).

The Cretaceous-Tertiary (K/T) boundary in Slovenia is recognizable in Kras region where it was studied in several sections, at Dolenja vas (Drobne et al., 1988, 1989, 1995, 1996, 2009), on Sopada near Štorje (Ogorelec et al., 2007), at Kozina (Delvalle & Buser, 1990), and Čebulovica (Ogorelec et al., 2001). On Italian side of the area it was studied at Padriče (Padriciano, Brazzati et al., 1996) and Bazovica (Basovizza, Riccamboni, 2005). Its geologic peculiarity is a shallow water facies development which is extraordinary and unique for the entire Mediterranean domain.

The very boundary lies within a 0.2 do 2 meters thick emersion breccia deposited in an intertidal environment of a restricted lagoon with characteristic shrinkage pores, rhizocodium structures (*Paronipora* sp.), stromatolitic laminae and bauxite pockets (Jurkovšek et al., 1996; Ogorelec et al., 2007; Drobne et al., 2009). Limestone just below the boundary is light biomicrite and pelmicrite (wackestone and packstone), locally slightly marly, and dark biomicrite with gyropleuras and foraminifers (Drobne et al., 1995; Pugliese et al., 1995). Biomicritic limestone prevails just above the boundary in Lower Danian, and shows all characteristics of palustrine facies (Otoničar & Košir, 1998; Ogorelec et al., 2001; Košir 2004). In addition to the change of biota the boundary is marked also by a change of isotopic composition of limestone – an extraordinary, up to 8 ‰ enrichment with light $\delta^{13}C$ isotope exactly at the boundary (Dolenec et al., 1995; Ogorelec et al., 1995, 2007), an increased iridium contents (Hansen et al., 1995), and presence of glassy spherulae (Gregorič et al., 1998).

Deeper-marine development of Cretaceous

Deeper-marine development of sedimentary rocks in the region of Slovenian basin continued from Jurassic into Cretaceous that, in addition, advanced northwards. For this deeper environment beds with intermediate limestone breccias are characteristic, in short the clastic development of Cretaceous (Pleničar, 1979, 2009). Flysch occurs in two thicker packets – as the lower flysch formation, 100 to 400 meters thick, in Aptian and Albian (Cousin, 1970), and as the upper, up to 800 meters thick flysch formation in the Upper Cretaceous (Buser, 1986). The source material for carbonate breccias were shallow-marine limestones that broke off the edge of the Dinaric platform, and slided down the slope, while the flysch was deposited from the northwest (Ogorelec, 1970; Kuščer et al., 1974). The total thickness of deeper-marine Cretaceous succession varies between 500 and more than 1000 meters. The most complete development of these strata of the Slovenian basin is found in Tolmin area (Buser, 1986a,b) and in eastern Sava folds between Krško and Gorjanci Mts., whereas in the Bovec area and in central Slovenia they occur rather fragmentarily.

From the standpoint of carbonate sedimentology and microfacies only three facies types or rock packets are interesting within the Cretaceous deeper water development:

- white and light grey platy limestones of Berriasian age, that continue from the Upper Jurassic,
- marly limestones of »scaglia« type of Albian to Turonian and »Senonian« ages, and
- the Volče limestone of »Senonian« age.

The oldest Cretaceous beds of deeper-marine development belong to the white micritic limestone of the biancone type (mudstone and wackestone) with chert nodules. It represents the continuation of sedimentation from the upper part of Jurassic. It is the uppermost part of a 100 to 250 meters thick limestone packet of which the Berriasian and Lower Valanginian age is determined by calpionellas (*Calpionella elliptica*, *C. alpina*, *Tintinopsella hungarica)* and radiolarians (Pleničar, 1979, 2009; Šribar, 1981; Buser, 1986).

In the region of the Slovenian basin no sediments from Valanginian to Barremian are known at present. The succession starts transgressively with flysch rocks on biancone beds not earlier than in Aptian, whereas the sedimentation of flysch and intermediate limestone breccias in environs of Bohinj started already in Valanginian (Buser, 1986; Budkovič, 1978); their deposition lasted to the end of Lower Cretaceous. Age of this flysch has been dated by nanoplankton (Buser & Pavšič, 1978; Pavšič & Goričan, 1987; Pavšič, 1994).

In the lower part of Upper Cretaceous, i.e. in Cenomanian and Turonian, reddish platy and marly limestones were deposited in the wider Tolmin area. They are interbedded with marlstones, chert sheets and with calcarenites, and the formation is known as »scaglia variegata« (Buser, 1986b). In the wider surroundings of Mt. Mangart such sediments appear already in Albian (Šmuc, 2005). Age of these beds is determined with nanoplankton (Pavšič, 1979) and globotruncanas (*Globotruncana helvetica*, *G. schneegansi*, *G. sigali*; Buser, 1986b).

The variegated scaglia is followed by 100 to at most 300 meters of Volče limestone Formation. Characteristical for the Volče limestone is alternation of thin layers of biomicrite, calcirudite and calcarenite with frequent intermediate chert sheets and nodules. The calciruditic beds often show graded bedding and lamination (Ogorelec et al., 1976). These beds were deposited by turbidity flows at basin margins, whereas the biomicritic sheets of mudstone type result from quiet pelagic phases. Thus, Volče limestone can be recognized as carbonate flysch or allodapic limestone. Autochthonous fossils are pelagic, mainly globotruncanas and radiolarians, while among the washed-in particles fragments of rudist valves, of echinoderms and of other bivalves occur. The most common globotruncanas are *Globotruncana arca*, *G. calcarata*, *G. conica*, *G. elevata* and *G. lineiana lineiana* (determined by L. Šribar, in Ogorelec et al., 1976) that occur from Upper Turonian to Campanian. North of Kobarid the Volče limestone passes into, or is replaced by, red marly limestone of the scaglia type (Ogorelec, 1970; Kuščer et al., 1974; Buser, 1986b; Šmuc, 2005) known as scaglia rossa, which contains in addition to species of globotruncanas, occurring in Volče limestone, also other ones (Radoičić & Buser, 2004).

Above the Volče limestone and red scaglia again an up to 600 meters thick packet of flysch beds occurs. In fragments of coarse-grained flysch breccia of Senonian age that overlies the Volče limestone numerous corals were determined on Banjščice plateau (Turnšek & Buser, 1976). The flysch basin gradually shifted from Campanian on more and more southward, to Goriška Brda, to Trieste area and Istria (Buser, 1986b).

Eastern Alps

In surroundings of Zreče and Stranice near Slovenske Konjice a reef limestone with numerous rudists lies between clastites, consisting of claystones, siltstones, marlstones and a coal seam (Pleničar, 1971, 1993, 2005). In marlstones solitary corals are also frequent (Turnšek, 1994). Development of these beds has been compared by authors (Hamrla, 1988; Turnšek, 1994; Pleničar, 1971, 2009) to Gosau development of Cretaceous in the Northern Alps. Limestones of the Gosau facies are not considered in the present monography since they were not a subject of our researches.

Literatura – References

AGIP S.p.A. (Sartorio D. & Venturini S.) 1988: Southern Tethys Biofacies. AGIP, 235 p., S. Donato Milanese.

Anderle, N. 1970: Stratigraphische und tektonische Probleme im Bereich des österreichischen Anteiles der Westkarawanken zwischen Rosenbach und Thörl unter Berücksichtigung der alpinen Orogenese. Geologija, 13: 116-132.

Aničić, B. 1991: Geološke razmere na Orlici = Geological setting of the Orlica mountain. Geologija, 33: 233-287.

Aničić, B. & Dozet S. 2000: Mlajše paleozojske in mezozojske kamenine na severnem obrobju Krške kotline = Younger Paleozoic and Mesozoic rocks in the northern Krško depression borderland, Slovenia). Geologija, 43/1: 13-36, doi:10.5474/geologija.2000.001.

Assereto, R., Bosellini, A., Fantini Sestini, N. & Sweet, W.C. 1972: The Permian–Triassic Boundary in the Southern Alps (Italy). Bull. Canad. Petrol. Geol., 20: 176-199.

Babić, Lj. 1980/81: The prigin of "Krn breccia" and the role of the Krn area in the Upper Triassic and Jurassic history of the Julian Alps. Vesnik Zavoda za geol. i geof. istraž. A Geologija, 38/39: 59-88.

Babić, Lj. & Zupanič, J. 1978: Kosmatovi "Železnikarski vapnenci i dolomiti" i Zaliloški krovni škriljevci u predgorju Julijskih Alpa: podaci o stratigrafiji, faciesu i paleogeografskom značenju. = Kossmat's "Kalke und Dolomite von Eisnern" and "Dachschiefer von Salilog" in the Julian Prealps: data about stratigraphy). Geol. vjesnik, 30/1: 21-42.

Bathurst, R.G.C. 1971: Carbonate Sediments and their Diagenesis. Dev. Sediment. 12, Elsevier Publ., Amsterdam: 620 p.

Bitner M.A., Jurkovšek, B. & Kolar-Jurkovšek, T. 2010: New record of the inarticulate brachiopod genus Discinisca from the Upper Triassic (Carnian) of the Julian Alps, NW Slovenia. Neues Jahrb. Geol. Paläontol. Abh., 257/3: 367-372.

Böhm, F., Ebli, O., Krystin, L., Lobitzer, H., Rakus, M. & Siblik, M. 1999: Fauna, Stratigraphy and Depositional Environment of the Hettangian - Sinemurian (Early Jurassic) of Adnet (Salzburg, Austria). Abh. Geol. B.-A., 56/2: 143-271.

Bole, B.2002: Karbonatne kamnine Pece = Carbonate rocks of Mt. Peca, Slovenia. Geologija 45/1: 59-69, doi:10.5474/geologija.2002.005.

Bosellini, A. 1967: La tematica deposizionale della Dolomia Principale (Dolomiti e Prealpi Venete). Boll. Soc. Geol. It., 68/2: 133-169.

Bosellini, A. 1991: Introduzione allo studio delle rocce carbonatiche. Italo Bovolenta, Ferrara: 317 p.

Bosellini, A. & Hardie, L.A. 1973: Depositional thema of a marginal marine evaporite. Sedimentology, 20: 5-28.

Bosellini, A. & Rossi, D. 1974: Triassic Carbonate Buildups of the Dolomites, Northern Italy. Soc. Econ. Paleont. Min. Spec. Publ., 28: 209-233.

Bradner, R. & Resch, W. 1981: Reef Development in the Middle Trassic (Ladinian and Cordevolian) of the Northern Limestone Alps near Innsbruck, Austria. In: Toomey, D.F. (ed.): SEPM Spec. Publ., 30: 203-231.

Brazzati, T., Caffau, M., Cozzi, A., Cucchi, F., Drobne, K. & Pugliese, N. 1996: Padriciano Section (Karst of Trieste, Italy). In: Drobne, K. et al. (eds.): Int. workshop Postojna '96: The role of impact processes in the geological and biological evolution of planet Earth, Ljubljana: 189-198.

Brigo, L., Kostelka, L., Omenetto, P., Schneider, H.J., Schroll, E. Schulz, O. & Štrucl, I. 1977: Comparative Reflections on Four Alpine Pb-Zn Deposits. In: Klemm, D.D. & Schneider, H.J. (eds.): Time and Strata-Bound Ore Deposits. Springer Verl., Berlin: 273-293.

Brown, J.S. 1943: Suggested use of the word microfacies. Econ. Geol., New Haven 38: 325 p.

Budkovič, T. 1978: Stratigrafija Bohinjske doline = The stratigraphic sequence of the Bohinj Valley. Geologija, 21/2: 239-244.

Buggisch, W. 1974: Die Bellerophonschichten der Reppwand (Gartenkofel), Oberperm, Karnische Alpen; untersuchungen zur Fazies und Geochemie. Carinthia II (1975), Klagenfurt:17-26.

Buggisch, W., Flügel, E., Leitz, E. & Tietz, G.F. 1976: Die fazielle und paläogeographische Entwicklung im Perm der Karnischen Alpen und in den Randgebieten. Geol. Rundschau, 65: 649-690.

Buser, S. 1968a: Osnovna geološka karta SFRJ 1 : 100.000, list Gorica. Zv. geol. zav., Beograd.

Buser, S. 1968b: Razvoj jurskih skladov v slovenskih Zunanjih Dinaridih = Development of Jurassic strata in Outer Dinarides of Slovenia. Prvi kolokvij o geologiji Dinaridov 1: 59-67.

Buser, S. 1973: Tolmač lista Gorica – Osnovna geološka karta SFRJ 1 : 100.000. Zv. geol. zav., Beograd: 50 p.

Buser, S. 1974: Neue Feststellungen im Perm der westlichen Karawanken. Carinthia II, 164/ 84: 27-37.

Buser, S. 1978: Razvoj jurskih plasti Trnovskega gozda, Hrušice in Logaške planate = The Jurassic strata of Trnovski gozd, Hrušica and Logaška planota. Rud. met. zb., 4: 385-406.

Buser, S. 1979a: Triassic beds in Slovenia. In: Drobne, K. (ed.): Geological Development in Slovenia and Croatia. Guidebook 16th Europ. Micropal. Colloq., Ljubljana: 17-26.

Buser, S. 1979b: Jurassic beds in Slovenia. In: Drobne, K. (ed): Geological Development in Slovenia and Croatia. Guidebook 16th Europ. Micropal. Colloq., Ljubljana: 27-36.

Buser, S. 1979c: Tolmač lista Celje, Osnovna geološka karta SFRJ 1 : 100.000. Zv. geol. zav., Beograd: 72 p.

Buser, S. 1980a: Tolmač lista Celovec, Osnovna geološka karta SFRJ 1 : 100.000. Zv. geol. zav., Beograd: 62p.

Buser S. 1980b: Stratigrafske vrzeli v paleozojskih in mezozojskih plasteh v Sloveniji – Simpozium iz regionalne geologije i paleontologije. Rud. geol. fakultet Beograd: 335-344.

Buser, S. 1986a: Osnovna geološka karta SFRJ 1 : 100.000, list Tolmin in Videm. Zv. geol. zav., Beograd.

Buser, S. 1986b: Tolmač lista Tolmin in Videm (Udine). Osnovna geološka karta SFRJ 1 : 100.000. Zv. geol. zav., Beograd:103 p.

Buser, S. 1989: Development of the Dinaric and the Julian Carbonate Platforms and of the intermediate Slovenian Basin (NW Yugoslavia). Mem. Soc. Geol. It., 40 (1987): 313-320.

Buser, S. 1996: Geology of Western Slovenia and its paleogeographical evolution. In: Drobne, K., Goričan, S. & Kotnik; B. (eds.): Int. workshop Postojna '96: The role of impact processes in the geological and biological evolution of planet Earth, Ljubljana: 111-123.

Buser, S. & Debeljak, I. 1996: Lower Jurassic beds with bivalves in south Slovenia. Geologija, 37/38 (1994/95): 23-62.

Buser, S. & Dozet, S. 2009: Jura = Jurassic. In: Pleničar M., Ogorelec, B. & Novak, M. (eds.): Geologija Slovenije = The Geology of Slovenia, Geološki zavod Slovenije, Ljubljana: 215-254.

Buser, S. & Komac, M. 2002: Geološka karta Slovenije 1 : 250.000 = Geologic Map of Slovenia 1 : 250.000. Geologija, 45/2: 335-340, doi:10.5474/geologija.2002.029.

Buser, S. & Ogorelec, B. 1987: Carnian Amphiclina Beds – Hudajužna. Guidebook, Int. Symp. Evol. Karstic Carbonate Platforms, Trieste: 13-18.

Buser, S. & Ogorelec, B. 2008: Globjevodne triasne in jurske plasti na Kobli = Deep-water Triassic and Jurassic beds from Mt. Kobla (W. Slovenia). Geologija, 51/2: 181-189, doi:10.5474/geologija.2008.019

Buser, S. & Pavšič, J. 1978: Spodnjekredni nanoplankton med Sevnico in Brestanico. Rud.met. zb., 2/3: 199-205.

Buser, S., Grad K. & Pleničar, M. 1967: Osnovna geološka karta SFRJ 1 : 100.000, list Postojna. Zv. geol. zav., Beograd.

Buser, S., Grad, K. & Pleničar, M. 1970: Tolmač lista Postojna, Osnovna geološka karta SFRJ 1 : 100.000. Zv. geol. zav. Beograd: 62 p.

Buser, S., Pavšič, J. & Radoičić, R. 1979: Spodnjekredne plasti v Bohinju. Rud. met. zb., 26/4, 385-393.

Buser, S., Pavšič, J. & Aničić, B. 1982a: Globokomorske kredne plasti v vzhodni Sloveniji = Deep sea Cretaceous beds of Eastern Slovenia. X jub. kongr. geol. Jug., Budva, 1: 11-23.

Buser, S., Ramovš, A. & Turnšek, D. 1982b: Triassic reefs in Slovenia. Facies, 6: 15-24.

Buser S., Grad, K., Ogorelec, B., Ramovš, A. & Šribar, L. 1988: Statigraphical, paleontological and sedimentological characteristics of Upper Permian beds in Slovenia, NW Yugoslavia. Mem. Soc. Geol. It., 34 (1986): 195-210.

Buser, S., Kolar-Jurkovšek, T. & Jurkovšek, B. 2007: Triasni konodonti Slovenskega bazena = Triassic conodonts of the Slovenian Basin. Geologija, 50/1: 9-28, doi:10.5474/geologija.2007.001

Buser, S., Kolar-Jurkovšek, T. & Jurkovšek, B. 2008: Slovenian Basin during Triassic in the Light of Conodont Data. Boll. Soc. Geol. It., 127/2: 257-263.

Carozzi, A. 1960: Microscopic Sedimentary Petrography. Wiley Publ. Co., New York: 485 p.

Carozzi, A.V. 1989: Carbonate rocks depositional models. A mocrofacies approach. Englewood Cliffs (Prentice Hall): 604 p.

Cavin, L., Jurkovšek, B. & Kolar-Jurkovšek, T. 2000: Stratigraphic succession of the Upper Cretaceous fish assemblages of Kras (Slovenia). Geologija,43/2: 165-195, doi:10.5474/geologija.2000.013

Celarc, B. 2004a: Geološka zgradba severovzhodnega dela Kamniško-Savinjskih Alp = Geologic structure of Northeastern part of Kamnik-Savinja Alps. Disertacija, Univ. Ljubljana, NTF, Odd. geol., Ljubljana: 137 p.

Celarc, B. 2004b: Problematika »cordevolskih« apnencev in dolomitov v slovenskih Južnih Alpah = Problems of the "Cordevolian" Limestone and Dolomite in the Slovenian part of the Southern Alps. Geologija, 47/2:139-149, doi:10.5474/geologija.2004.011.

Celarc, B. & Kolar-Jurkovšek, T. 2008: The Carnian-Norian basin-platform system of the Martuljek mauntain group (Julian Alps, Slovenia): progradation of the Dachstein carbonate platform. Geol. Carpathica, 59/3: 211-224.

Celarc, B. & Žalohar, J. 2010: Ladinijske plasti v Kamniško-Savinjskih Alpah in Južnih Karavankah. In: Hitij T. et al. (ur.): Kraljestvo Tetide, Okameneli svet triasnih vretenčarjev Kamniško-Savinjskih Alp. Scopolia Suppl. 5:148-156.

Cigale, M. 1978: Karnijske plasti v okolici Idrije = Carnian beds in the Idria region. Geologija, 21/1: 61-75.

Cousin, M. 1970: Esquisse géologique des confins italo-yougoslaves: leur place dans les Dinarides et les Alpes méridionales. Bull. Soc. Géol. Fr. 7/XII-6: 1034-1047.

Cousin, M. 1973: Le sillon slovéne: les formations triasiques, jurassiques et néocomiennes au Nord-Est de Tolmin (Slovénie occidentale, Alpes méridionales) et leurs affinités dinariques. B.S.G.F., 7/15, 3-4: 327-339.

Cuvillier, J. 1952: Le notion de «microfacies» et ses applications. VIII Congr. Nation. Methan Petrol., Sect. I.: 1-7

Cuvillier, J. 1962: Etude et utilisation rationelle de microfacies. Rev. Micropal. 4/1: 3-6.

Čadež, F. 1977: Sadra in anhidrit na Idrijskem = Gypsum and Anhydrite Occurrences in Idria Region. Geologija, 20: 289-301.

Čar, J. 1989: Okolje nastanka anizijskega dolomita nad srednjetriasno erozijsko diskordanco v Idrijskem rudišču = Depositional environment of the Anisian dolomite above the Middle Triassic erosional diskonformity in the Idrija ore deposit. Rud. met. zb., 36/2: 395-407.

Čar, J. 2010: Geološka zgradba idrijsko-cerkljanskega hribovja – Tolmač h Geološki karti idrijsko-cerkljanskega hribovja med Stopnikom in Rovtami 1 : 25.000. Geološki zavod Slovenije, Ljubljana: 127 p.

Čar, J. & Čadež, F. 1977: Klastični vložki v srednjetriadnem dolomitu na Idrijskem = Middle Triassic Dolomite Intercalated with Clastic Sedimentary Rocks in Idrija Region. Geologija, 20: 85-106.

Čar, J. & Skaberne, D. 1995: Ladinijske plasti Stopnika = Ladinian beds of Stopnik. Geološki zbornik, 10: 22-25.

Čar, J., Gregorič, V., Ogorelec, B. & Orehek, S. 1980: Sedimentološki razvoj skitskih plasti v idrijskem rudišču = Sedimentological development of Scythian beds in the Idrija mercury deposit. Rud. met. zb., 27/1: 3-20.

Čar, J., Skaberne, D., Ogorelec, B., Turnšek, D. & Placer, L. 1981: Sedimentological characteristics of Upper Triassic (Cordevolian) circular quite water coral bioherms in Western Slovenia, Northwestern Yugoslavia. In: Toomey, D.F. (ed.): European Fossil Reef Models. SEPM Spec. Publ., 30: 233-240.

Črne, A.E., Šmuc, A. & Skaberne, D. 2007: Jurassic neptunian dikes at Mt. Mangart (Julian Alps, NW Slovenia). Facies, 53:249-265, doi:10.1007/s10347-007-0102-8

Delvalle, D. & Buser, S. 1990: Microfacies analysis of limestone from the Upper Cretaceous to the Low-

er Eocene of SW Slovenia (Yugoslavia). Geologija, 31/32 (1988/89): 351-394.
Demšar, M. & Dozet, S. 2002: Nekaj razvojev zgornjepermskih plasti zahodno od Škofje Loke = Some developments of Upper Permian in the area west of Škofja Loka – Western Slovenia. Geologija 45/1: 189-200, doi:10.5474/geologija.2002.015
Demšar, M. & Dozet, S. 2003: Anizijske in ladinijske plasti v profilu nad Središko grapo pod Križno Goro, osrednja Slovenija = Anisian and Ladinian beds in the cross-section above Srednik Valley at Križna Gora, Central Slovenia. Geologija, 46/1: 41-48, doi:10.5474/geologija.2003.002
Dobruskina, I.A., Jurkovšek, B. & Kolar-Jurkovšek, T. 1999: Upper Cretaceous flora of Slovenia. Annales, Ser. Hist. Nat., 9/2-17: 243-256.
Dobruskina, I.A., Jurkovšek, B. & Kolar-Jurkovšek, T. 2001: Upper Triassic flora from "Raibl beds" of Julian Alps (Italy) and Karavanke Mts. (Slovenia). Geologija, 44/2: 263-290, doi:10.5474/geologija.2001.019
Dolenec, M. 2004: Permsko-triasna meja v Karavankah in zahodni Sloveniji: sedimentološki, izotopski in geokemični vidiki globalnih sprememb v zahodni Tetidi. Disertacija, NTF Univ. Ljubljana: 110 p.
Dolenec, M. & Ogorelec, B. 2001: Organic carbon isotope variability across the P/Tr boundary in the Idrijca Valley section (Slovenia): A high resolution study. Geologija, 44/2: 331-340, doi:10.5474/geologija.2001.025
Dolenec, T. & Pavšič, J. 1995: Elemental and stable isotope variations in the Cretaceous-Tertiary boundary sediments from the Soča Valley, NW Slovenia. Terra Nova, 7: 630-635.
Dolenec, T. & Ramovš, A. 1998: Isotopic changes at the Permian-Triassic boundary in the Idrijca Valley, W Slovenia). RMZ - Mater. Geoenviron. 45/3-4: 405-411.
Dolenec, T., Buser, S. & Dolenec, M. 1998: The Permian-Triassic boundary in the Karavanke Mountains (Slovenia): Stable isotope variations in the boundary carbonate rocks in the Košutnik Creek and Brsnina section. Geologija, 41: 17-27.
Dolenec, M., Dozet, S. & Lojen, S. 2006: Permsko-triasna meja ter zgornjepermski in spodnjeskitski skladi na jugovzhodnem obrobju Ljubljanskega barja, osrednja Slovenija = Permo-Triassic boundary and Upper Permian as well as Lower Scythian beds in the southeastern borderland of the Ljubljana *marsh,* Central Slovenia. RMZ – Materiali in geookolje, 53/2: 229-246.
Dolenec, T., Ogorelec, B. & Pezdič, J. 1981: Zgornjepermske in skitske plasti pri Tržiču = Upper Permian and Scythian beds in the Tržič area. Geologija, 24/2: 217-238.
Dolenec, T., Ogorelec, B., Lojen, S. & Buser, S. 1999a: Meja perm-trias v Masorah pri Idriji = Permian-Triassic boundary in the Idrijca Valley: Masore section. RMZ – Materiali in geookolje, 46/3: 449-452.
Dolenec, T., Lojen, S., Buser, S. & Dolenec, M. 1999b: Stable isotope event markers near the Permo-Triassic boundary in the Karavanke Mountains (Slovenia). Geol. Croatica, 52/1: 77-81.
Dolenec, T., Lojen, S. & Dolenec, M. 1999c: The Permian-Triassic boundary in the Idrijca Valley (Western Slovenia): isotopic fractionation between carbonate and organic carbon at the P/Tr transition. Geologija, 42: 165-170.
Dolenec, T., Ogorelec, B., Dolenec, M. & Lojen, S. 2004: Carbon isotope variability and sedimentology of the Upper Permian carbonate rocks and changes across the Permian-Triassic boundary in the Masore section (Western Slovenia). Facies 50, 287-299, doi:10.1007/s10347-004-0016-7.
Dozet, S. 1977: Triadne plasti na listu Delnice = The Triassic beds on the Delnice Map Sheet. Geologija, 20: 236-246.
Dozet, S. 1979: Karnijske plasti južno in zahodno od Ljubljanskega barja = Carnian beds south and west of the Ljubljana Moor. Geologija, 22/1: 55-70.
Dozet, S. 1980: Jurske plasti na kočevskem in južnovzhodnem Notranjskem = Jurassic beds in Kočevska and Southern Notranjska area. Rud. met. zb., 27/4: 443-457.
Dozet, S. 1990a: Triasni skladi Kočevske in Gorskega Kotarja = Triassic Beds of Kočevje and Gorski Kotar Area. Rud. met. zb., 37/2: 141-160.
Dozet, S. 1990b: Loferske cikloteme v glavnem dolomitu Kočevske = The Lofer Cyclothems in the Main Dolomite (Hauptdolomit) of the Kočevje Area. Rud. met. zb., 37/4: 507-528.
Dozet, S. 1990c: Biostratigrafska razčlenitev jurskih in spodnjekrednih plasti Kočevske in Gorskega Kotarja = Biostratigraphic subdivision of the Jurassic and Lower Cretaceous beds in Kočevje and Gorski Kotar area. Rud. met. zb., 37/1: 3-18.
Dozet, S. 1991: Norian oncoids in the Main Dolomite of the Kočevje area. Rud. met. zb., 38/1: 79-95.
Dozet, S. 1992a: Litostratigrafske enote in značilne mikrofacije kočevske jure. Lithostratigraphic Units and significant Microfacies of the Kočevje Jurassic. Rud. met. zb., 39/3-4: 287-305.
Dozet, S. 1992b: Litostratigrafija, diageneza, sedimentacijsko okolje in geokemija jurskih plasti na listu Delnice. Lithostratigraphy, diagenesis, environment and geochemistry of the Jurassic beds on the Delnice sheet. Rud. met. zb., 39/1-2: 193-209.
Dozet, S. 1993: Lofer cyclothems from the Lower Liassic Krka Limestones. Riv.It. Paleont. Strat., 99/1: 81-100.
Dozet, S. 1995: The Malm algal nodules (oncolites) from the Suha Krajina (Slovenia). Rud. met. zb., 42/3-4: 165-169.
Dozet, S. 1996: Foraminiferal and algal biostratigraphy of the Jurassic beds in Southeastern Slovenia. Rud. met. zb., 43/1-2: 3-10.
Dozet, S. 1997: Ambrus Beds – Important Key for Interpretation of Neocomian Paleogeography, Sea-Level Changes, depositional Setting and Tectonics in Suha Krajina Area (Slovenia). Geologija, 39 (1996): 119-131.
Dozet, S. 1998: Lower Jurassic dolomite – limestone succession with coal in the Kočevski Rog and correlation with neighbouring areas (southeastern Slovenia). Geologija, 41 (1999): 71-101.
Dozet, S. 1999: Pleška baritonosna formacija, osrednja Slovenija. Primerjava baritonosnih plasti in baritnih pojavov na območju Zunanjih Dinaridov = Barite-bearing Pleše Formation, Central Slovenia. Comparison of barite-bearing beds and barite occurences in the Outer Dinarides area. Geologija, 42 (2000): 41-68.
Dozet, S. 2000: Višnja gora formation, central Slovenia. Rud. met. zb. 47/2: 137-154.
Dozet, S. 2004: O karnijskem železnatem boksitu Kopitovega griča ter o plasteh v njegovi talnini in krovnini. On Carnian oolitic iron bauxite of Kopitov grič and on beds in its foot- and hanging wall. RMZ - Mater. Geoenviron. 51/ 4: 2191-2208.
Dozet, S. & Buser, S. 2009: Trias = Triassic. In: Pleničar M., Ogorelec, B. & Novak, M. (eds.): Geologija Slovenije = The Geology of Slovenia, Geološki zavod Slovenije, Ljubljana:161-214.

Dozet, S. & Ogorelec, B. 1990: Mikrofacije noričkih i retskih naslaga u južnoj Sloveniji = Microfacies of the Norian and Rhaetian beds in Southern Slovenia. 13. Kongres na geol. na Jugosl., Ohrid 1: 239-256.

Dozet, S. & Silvester, M. 1979: Skitske in zgornjekarnijske kamenine na Kočevskem. = Scythian and Upper Carnian rocks from the Kočevje region. Geologija, 22/2: 327-336.

Dozet, S. & Strohmenger, C. 1996: Late Malm carbonate breccias at Korinj and their significance for eustacy and tectonics (Central Slovenia). Geologija, 37/38 (1994/95): 215-223.

Dozet, S. & Strohmenger, C. 2000: Podbukovška formacija, osrednja Slovenija = Podbukovje formation, Central Slovenia. Geologija, 43/2: 197-212, doi:10.5474/geologija.2000.014

Dozet, S. & Šribar, L. 1981: Biostratigrafija jurskih plasti južno od Prezida v Gorskem Kotaru = Biostratigraphy of Jurassic beds south of Prezid in Gorski Kotar. Geologija, 24/1: 109-126.

Dozet, S. & Šribar, L. 1991: Spodnjekredni skladi na listu Delnice = Lower Cretaceous Beds on the Delnice Sheet. Rud. met. zb., 38/2: 161-190.

Dozet, S. & Šribar, L. 1998a: Lower Cretaceous Shallow-Marine Sedimentation and Biota on Dinaric Carbonate Platform between Logatec, Krka and Kolpa (Southern Slovenia). Geologija, 40 (1997): 153-185.

Dozet, S. & Šribar, L. 1998b: Biostratigraphy of Shallow Marine Jurassic Beds in Southeastern Slovenia. Geologija, 40 (1997): 223-232.

Dozet, S. & Turnšek, D. 1993: Litostratigrafske enote in biostratigrafska razčlenitev jurskih plasti na Logaški planoti = Lithostratigraphic Units and Biostratigraphic Subdivision of Jurassic Beds in Logatec Plain Area. Rud. met. zb., 40/1-2: 59-78.

Drobne, K. (ed.) 1979: Geological development in Slovenia and Croatia. 16th Europ. Micropal. Colloq.: Guidebook, Ljubljana: 258 p.

Drobne, K. 1979: Paleogene and Eocene beds in Slovenia and Istria. In: Drobne, K. (ed.): Geological development in Slovenia and Croatia. 16th Europ. Micropal. Colloq.: Guidebook, Ljubljana: 49-63.

Drobne, K., Ogorelec, B., Pleničar, M., Zucchi - Stolfa, M. L. & Turnšek, D. 1988: Maastrichtian, Danian and Thanetian Beds in Dolenja vas (NW Dinarides, Yugoslavia) – Microfacies, Foraminifers, Rudists and Corals. Razprave SAZU, IV/29-6: 147-224.

Drobne, K., Ogorelec, B., Pleničar, M., Barattolo, F., Turnšek, D., Zucchi - Stolfa, M. L. 1989: The Dolenja vas section, a transition from Cretaceous to Paleocene in the NW Dinarides, Yugoslavia. Mem. Soc. Geol. Ital., 40 (1987): 73-84.

Drobne, K., Ogorelec, B., Barattolo, F., Dolenec, T., Pleničar, M., Turnšek, D., Zucchi-Stolfa, M.L. & Marton, E. 1995: The Dolenja Vas section (Upper Maastrichtian, Lower and Upper Danian, Thanetian). Atti Mus. Geol. Paleont., Quaderno Spec. 3: 99-115.

Drobne, K., Ogorelec, B., Dolenec, T., Marton, E. & Palinkaš, L. 1996: Biota and abiota at the K/T boundary in the Dolenja Vas section, Slovenia. In: Drobne, K., Goričan, Š. & Kotnik, B. (eds.): The role of impact processes in the geological and biological of planet Earth. Intern. Workshop, Field-guide, Ljubljana: 163-181.

Drobne, K., Ogorelec, B., Pavšič, J. & Pavlovec, R. 2009: Paleocen in eocen v jugozahodni Sloveniji. = Paleocene and Eocene in South-Western Slovenia. In: Pleničar, M., Ogorelec, B. & Novak, M. (eds.): Geologija Slovenije = The Geology of Slovenia, Geološki zavod Slovenije, Ljubljana: 311-372.

Drovenik, M., Pleničar, M. & Drovenik, F. 1980: Nastanek rudišč v SR Sloveniji = The origin of Slovenian ore deposits. Geologija, 23/1: 1-157.

Drovenik, M. & Pungartnik, M. 1988: Nastanek svinčevo-cinkovega rudišča Topla in njegove značilnosti. Origin of the zinc-lead ore deposit Topla and its particularities. Geologija, 30: 245-314.

Dunham, R.J. 1962: Classification of carbonate rocks according to depositional texture. Amer. Ass. Petrol. Geol., Mem. 1: 108-121.

Einsele, G. 1992: Sedimentary Basins – Evolution, Facies and Sediment Budget. Springer Verl., Berlin: 628 p.

Elf - Aquitaine, 1975: Essai de caractérisation sédimentologique des dépots carbonates. Elf-Aquitaine, Boussens-Pau: 172 p.

Fischer, A.G. 1964: The Lofer cyclothems of the Alpine Triassic. In: Meeriam, D. F. (ed.): Symposium on cyclic sedimentation. Kansas Geol. Surv. Bull., 169/1: 107-150.

Flügel, E. 1972: Mikrofazielle Untersuchungen der Alpinen Trias, Methoden und Probleme. Mitt. Ges. Geol. Bergsbanstud., 21: 9-6.

Flügel, E. 1978: Mikrofazielle Untersuchungsmethoden von Kalken. Springer Verlag, Berlin: 454 p.

Flügel, E. 1981: Paleoecology and Facies of Upper Triassic Reefs in the Northern Calcareous Alps. In: Toomey D.F. (ed.): European Fossil Reef Models. SEPM Spec. Publ., Tulsa 30: 291-359.

Flügel, E. 1982: Microfacies analysis of limestones. Springer Verl., Berlin: 633 p.

Flügel, E. 2004: Microfacies of Carbonate Rocks – Analysis, Interpretation and Application. Springer Verl., Berlin: 976 p.

Flügel, E. & Koch, R. 1995: Controls on the diagenesis of Upper Triassic carbonate ramp sediments: Steinplatte, Northern Alps (Austria). Geol. Paläont. Mitt. Innsbruck, Festschrift Helfried Mostler 20: 283-311.

Flügel, E. & Ramovš, A. 1961: Fossilinhalt und Mikrofazies des Dachsteinkalkes (Ober-Trias) in Begunjščica-Gebirge, S. Karawanken (NW Slowenien, Jugoslawien). N. Jb. Geol. Paläont. Mh., 287-294.

Flügel, E. & Ramovš, A. 1970: Zur Kenntnis der Amphiclinen-Schichten Sloveniens. Geol. vjesnik, 2: 21-37.

Flügel, E., Ramovš, A. & Bucur, I. I: 1993: Middle Triassic (Anisian) Limestones from Bled, Northwestern Slovenia: Microfacies and Microfossils. Geologija, 36: 157-181.

Folk, R.L. 1962: Spectral subdivision of limestone types. Amer. Ass. Petrol. Geol. Mem., 1: 62-84.

Gale, L. 2010: Microfacies analysis of the Upper Triassic (Norian) »Bača Dolomite«: early evolution of the western Slovenian Basin (eastern Southern Alps, western Slovenia). Geol. Carpathica, 61/4: 293-308, doi:10.2478/v10096-010-0017-0.

Gale, L., Kolar-Jurkovšek, T., Šmuc, A. & Rožič, B. 2011: Integrated foraminiferal and conodont biostratigraphy from the Rhaetian strata of the Slovenian Basin (Southern Alps). In: CSIKI, Zoltan (ed.): 8th Romanian Symposium on Paleontology, Bucharest, 29-30 September 2011. Abstract book. Bucureşti: Ars Docendi: 46-47.

Goričan, Š. & Buser, S. 1990: Srednjetriasni radiolariji Slovenije (Jugoslavija) = Middle Triassic radiolarians from Slovenia (Yugoslavia). Geologija, 31/32 (1988/89): 133-197.

Goričan, Š. & Šmuc, A. 2004: Albian radiolaria and Cretaceous stratigraphy of Mt. Mangart (Western Slovenia). Razprave IV. Razr. SAZU, 45/3: 29-49.

Gorjanović-Kramberger, D. 1895: Fosilne ribe Komena, Mrzleka, Hvara i M. Libanona. Jugosl. akad. zn. umjet., 16: 1-67.

Grad, K. & Ferjančič, L. 1974: Osnovna geološka karta SFRJ 1 : 100.000, list Kranj. Zv. geol. zav., Beograd

Grad, K. & Ogorelec, B. 1980: Zgornjepermske, skitske in anizične kamnine na Žirovskem ozemlju = Upper Permian, Scythian and Anisian rocks in the Žiri area. Geologija, 23/2: 189-220.

Grandić, S., Boromisa- Balaš, E., Šušteršič, M. & Kolbah, S. 1999: Hydrocarbon possibilities in the Eastern Adriatic Slope zone of Croatian offshore area. Nafta, 50/2: 51-73.

Gressly, A. 1838: Observations géologiques sur le Jura Soleurois. N. Denkschr. allgem. schweiz. Ges. Naturwiss. 2, Neuchâtel.

Grötsch, J. 1991: Die Evolution von Karbonatplattformen des offenen Ozeans in der mittleren Kreide (NW Jugoslawien, NW Pazifik, NW Griechenland): Möglichkeiten zur Rekonstruktion von Meeresspiegeländerungen verschiedener Grössenordnung. Diss. Univ. Erlangen: 229 p.

Grötsch, J., Koch, R. & Buser, S. 1994: Fazies, Gildenstruktur und Diagenese des nördlichen Randes der Dinarischen Karbonatplattform (Barreme-Apt, W Slowenien). Abh. Geol. B.-A., 50: 125-153.

Gušić, I. & Jelaska, V. 1990: Stratigrafija gornjokrednih naslaga otoka Brača u okviru geodinamske evolucije Jadranske karbonatne platforme. Djela jugosl. akad. znan. umj., Razr. prir. znan., 69: 1-160.

Gušić, I. & Jelaska, V. 1993: Upper Cenomanian – lower Turonian sea-level rise and consequences on the Adriatic-Dinaric carbonate platform. Geol. Rundschau, 82/4: 678-686.

Haas, J. 1994: Lofer cycles of the Upper Triassic Dachstein platform in the Transdanubian Mid-Mountains (Hungary). IAS, Spec. Publ., 19: 303-322.

Haas, J. (ed.) 2001: Geology of Hungary. Eötvös University Press, Budapest: 317 p.

Haas, J., Hips, K., Pelikan, P., Zajzon, N.,Götz, A.E. & Tardi-Filacz, E. 2004: Facies analysis of marine Permian/Triassic boundary sections in Hungary. Acta. Geol. Hungarica, 47/4: 297-340.

Haas, J., Demeny, A., Hips, K. & Vennemann, T.W. 2006: Carbon isotope excursions and microfacies changes in marine Permian-Triassic boundary sections in Hungary. Palaeogeogr., Palaeoclim., Palaeoecol., 237: 160-181.

Ham, W.E. (ed.) 1962: Classification of Carbonate Rocks. A Symposium. Amer. Ass. Petrol. Geol. Mem., Tulsa 1: 279 p.

Hamrla, M. 1959: O pogojih nastanka premogišč na Krasu = On the conditions of origin of the coal beds in the Karst region. Geologija, 5: 180-264.

Hamrla, M. 1988: Prispevek h geologiji premogišč zreškega okoliša in uvrstitev njegovih premogov po odsevnosti = Contribution to the geology of coal deposits in the Zreče area and reflectance-based ranking of its coals. Geologija, 30 (1987): 343-390.

Hansen, H.J., Drobne, K. & Gwozdz, R. 1995: The K/T boundary in Slovenia. Dating by magnetic susceptibility, stratigraphy and iridium anomaly in a debris-flow. In: Montanari, A. & Coccioni, R. (eds.): ESF 4th Int. Workshop, Ancona: 84-85.

Haq, B.U., Hardenbol, J. & Vail, P.R. 1988: Mesozoic and Cenozoic chronostratigraphy and Cycles of sea level change. In: Wilgus, B.S. et al. (eds.): Sea level changes: an integrated approach. SEPM Spec. Publ. 42: 71-108.

Heritsch, F. 1934: Die Oberpermische Fauna von Žažar und Verzdenec in den Savafalten. Vestnik Geol. Inst. Kr. Jugoslavije, 3/1, Beograd.

Holser, W.T. & Schönlaub, H.P. (eds.) 1991: The Permian-Triassic Boundary in the Carnic Alps of Austria (Gartnerkofel Region). Abh. Geol. Bundesanst., Wien 45: 232 p.

Hötzl, M. & Pavlovec, R. 1979: Excursion L: Vremski Britof = Vreme Beds. In: Drobne, K. (ed.): 16th Europ. Micropal. Coll., Ljubljana: 225-228.

Illing, L.V., Wells, A.J. & Taylor, J.C. M. 1965: Penecontemporary dolomite in the Persian Gulf. In: Pray, L.C. & Murray, R. C. (eds.): Dolomitization and limestone diagenesis, a symposium. Soc. Econ. Paleont. Min. Spec. Publ., 13: 89-111.

Iskra, M. 1969: Geološka starost rudonosnih plasti v Puharju = Zinc and Lead Ore Deposit in Puharje (Slovenia). Geologija, 12: 161-164.

James, N.P. 1979: Introduction to Carbonate Facies Models. In: Walker, R.G (ed.): Facies Models. Geosci. Canad. Reprints, 1: 105-107.

James, N.P. & Kendall, A.C. 1992: Introduction to carbonate and evaporite facies models. In: Walker, R.G. & James, N.P. (eds.): Facies models. Response to sea level change. Geol. Ass. Canada: 265-275.

Jelaska, V., Kolar-Jurkovšek, T., Jurkovšek, B. & Gušić, I. 2003: Triassic beds in the basement of the Adriatic-Dinaric carbonate platform of Mt. Svilaja (Croatia). Geologija, 46/2: 225-230, doi:10.5474/geologija.2003.019.

Jelen, B. 1990: Karnijska školjčna favna na Lesnem brdu in njen paleobiološki pomen = The Karnian bivalves (Mollusca) from Lesno brdo, Slovenia, NW Yugoslavia and their paleobiological significance. Geologija, 31/32 (1988/89): 11-127.

Jenkyns, H.C. 1985: The Early Toarcian and Cenomanian-Turonian anoxic events in Europe: comparisons and contrasts. Geol. Rundschau 74/3: 505-518.

Jenkyns, H.C. 1991: Impact of Cretaceous Sea Level rise and Anoxic Events in Mesozoic Carbonate Platform of Yugoslavia. Amer. Assoc. Petrol. Geol. Bull. 75/6: 1007-1017.

Jež, J. 2011: Zgornjekredna sedimentacijska dinamika severnega obrobja Jadranske karbonatne platforme (zahodna Slovenija). Disertacija, NTF Univerza v Ljubljani: 185 p. + table.

Jež, J. & Otoničar, B. 2009: Evolucija severovzhodnega obrobja Jadranske karbonatne platforme med cenomanijem in santonijem: primer iz Sabotina (Z Slovenija). In: Horvat, A. (ur.): Razprave, poročila (Geološki zbornik 20), 19. posvetovanje slov. geologov, Ljubljana: 64-68.

Jež, J., Otoničar, B., Fuček, L. & Ogorelec, B. 2011: Late Cretaceous sedimentary evolution of a northern sector of the Adriatic Carbonate Platform (Matarsko Podolje, SW Slovenia). Facies 57/3: 447-468, doi:10.1007/s10347-010-0249-6

Jurkovšek, B. 1978: Biostratigrafija karnijske stopnje v okolici Mežice = Biostratigraphy of the Carnian beds in the Mežica area. Geologija, 21/2: 173-208.

Jurkovšek, B. 1983: Fassanske plasti z daonelami v Sloveniji = Fassanian beds with daonellas in Slovenia. Geologija, 26: 29-70.

Jurkovšek, B. 1984: Langobardske plasti z daonelami in pozidonijami v Sloveniji = Langobardian beds with daonellas and posidonians in Slovenia. Geologija, 27: 41-95.

Jurkovšek, B. 1986: Osnovna geološka karta SFRJ 1 : 100.000, list Beljak in Ponteba. Zv. geol. zav., Beograd.

Jurkovšek, B. 1987: Tolmač lista Beljak in Ponteba, Osnovna geološka karta SFRJ 1 : 100.000 = Geological map of SFRJ 1 : 100.000, Sheet Villach and Ponteba, Explanatory text. Zv. geol. zav., Beograd: 58 p.

JURKOVŠEK, B. 1994: Karnijske plasti s školjkami južno od Rovt = Carnian beds with pelecypods south of Rovte. Geologija, 36: 195-205.

JURKOVŠEK, B. 2008: Geološka karta severnega dela Tržaško-komenske planote 1 : 25.000 = Geological map of the northern part of the Trieste-Komen plateau (Slovenia) 1 : 25.000. Geol. zavod Slovenije, Ljubljana.

JURKOVŠEK, B. 2010: Geološka karta severnega dela Tržaško-komenske planote 1 : 25.000 - Tolmač = Geological Map of the Northern Part of the Trieste-Komen Plateau 1:25.000 - Explanatory Book. Geološki zavod Slovenije, Ljubljana: 72 p.

JURKOVŠEK, B. & KOLAR-JURKOVŠEK, T. 1986: A Late Triassic (Carnian) fish skeleton (family Birgeriidae) from Slovenia, NW Yugoslavia. Neues Jahrb. Geol. Paläontol., Monatsh., 8: 475-478.

JURKOVŠEK, B. & KOLAR-JURKOVŠEK, T. 1997: Karnijski krinoidi iz okolice Mežice = Carnian crinoids from Mežica surroundings. Razprave IV. razr. SAZU 38/2: 33-71.

JURKOVŠEK, B. & KOLAR-JURKOVŠEK, T. 2007: Fossil assemblagesfrom the Upper Cretaceous Komen and Tomaj limestones of Kras (Slovenia). Neues Jahrb. Geol. Paläontol. Abh. 245: 83-92.

JURKOVŠEK, B., OGORELEC, B., KOLAR - JURKOVŠEK, T., JELEN, B., ŠRIBAR, L. & STOJANOVIČ, B. 1984: Geološka zgradba ozemlja južno od Vršiča s posebnim ozirom na razvoj karnijskih plasti = The Geological Structure of the Area South of Vršič with Special Regard to the Development of Carnian Beds. Rud. met. zb., 31: 301-334.

JURKOVŠEK, B., ŠRIBAR, L., OGORELEC, B. & KOLAR - JURKOVŠEK, T. 1990: Pelagične jurske in kredne plasti v zahodnem delu Julijskih Alp = Pelagic Jurassic and Cretaceous beds in the western part of the Julian Alps. Geologija, 31/32: 285-328.

JURKOVŠEK, B., TOMAN, M., OGORELEC, B., ŠRIBAR, L., DROBNE, K., POLJAK, M. & ŠRIBAR, LJ. 1996: Formacijska geološka karta južnega dela Tržaško-komenske planote – Kredne in paleogenske karbonatne kamnine 1 : 50.000 = Geological map of the southern part of the Trieste-Komen plateau – Cretaceous and Paleogene carbonate rocks 1 : 50.000. IGGG, Ljubljana: 143 p.

JURKOVŠEK, B., KOLAR - JURKOVŠEK, T. & OGORELEC, B. 1997: Rezultati geološke spremljave gradbenih del na odseku avtoceste med Divačo in Kozino = Geology of the Divača-Kozina motorway section Kras, Slovenia. Annales, 11: 161-186.

JURKOVŠEK, B., OGORELEC, B. & KOLAR - JURKOVŠEK, T. 1998: Spodnjetriasne plasti pri Tehovcu (Polhograjsko hribovje) = Lower Triassic beds from Tehovec (Polhov Gradec Hills, Slovenia). Geologija, 41 (1999): 29-40.

JURKOVŠEK, B., KOLAR-JURKOVŠEK, T. & JAECKS, G.S. 2002: Makrofavna karnijskih plasti mežiškega prostora = Macrofauna of the Carnian beds in the Mežica area. Geologija, 45/2: 413-418.

KAIM, A., JURKOVŠEK, B. & KOLAR-JURKOVŠEK, T. 2006: New associations of Carnian gastropods from Mežica region in the Karavanke Mountains of Slovenia. Facies, 52/3: 469-482, doi:10.1007/s10347-005-0040-2.

KERČMAR, D. 1961: Prve najdbe zgornjejurskih apnenih alg v Sloveniji. Geologija, 7: 9-24.

KOCH, R. 1977: Mikrofazielle Untersuchungen in der Kreide Sloweniens. Diss. Univ. Heidelberg: 123 p.

KOCH, R. 1978: Fazies und Diagenese eines Biostrom-Komplexes (Oberkreide, Jugoslawien). Ergänzungsband Erdöl und Kohle, Compendium 78/79, 41-64, Hamburg.

KOCH, R. 1988: Mikrofazielle und diagenetische Entwicklung kretazischer Karbonatgesteine im Jugoslawischen Raum. Habilitationsschrift Univ. Heidelberg: 210 p.

KOCH, R. & OGORELEC, B. 1987: Albian-Cenomanian beds – Kreplje at Dutovlje. In: Internat. Symp. Evolution of the Karstic Carbonate Platform, Guidebook, Trieste: 67-69.

KOCH, R. & OGORELEC, B. 1990: Biogenic constituents, cement types and sedimentary facies – Their Interrelations of Lower Cretaceous (Valanginian to Hauterivian) Peritidal Carbonate Sediments (Trnovo, NW Slovenia). In: HELING, D., ROTHE, P., FÖRSTNER, U. & STOFFERS, P. (eds.): Sediments and Environmental Geochemistry: 95-123.

KOCH, R., OGORELEC, B. & OREHEK, S. 1989: Microfacies and Diagenesis of Lower and Middle Cretaceous Carbonate Rocks of NW-Yugoslavia (Slovenia, Trnovo Area). Facies 21: 135-170.

KOCH, R., BUSER, S. & BUCUR, I.I. 1998: Biostratigraphy and facies development of Mid – to Late Cretaceous strata from the Nanos mountain (Western Slovenia, High Karst). Zbl. Geol. Paläont., Teil I, 11/12 (1996), 1195-1215.

KOCH, R., MOUSSAVIAN, E., OGORELEC, B, SKABERNE, D. & BUCUR, I.I. 2002: Development of a *Lithocodium*-Reef-Mound: An indication of "stress environment" (Middle Aptian, W-Slovenia). Geologija 45/1: 71-90, doi:10.5474/geologija.2002.006.

KOCHANSKY-DEVIDÉ, V. 1979 : Excursion D – Brušane, Velebit Mt. – Permian. In: DROBNE, K. (ed.): Geological Development in Slovenia and Croatia. Guidebook 16th Europ. Micropal. Colloq., 163-170.

KOLAR, T. 1979: Konodonti v škofjeloškem apnencu na Šmarjetni gori = Conodonts from Škofja Loka limestone of Šmarjetna gora. Geologija 22/2: 309-325.

KOLAR-JURKOVŠEK, T. 1982: Konodonti iz amfiklinskih skladov in baškega dolomita = Conodonts from Amphiclina Beds and Bača Dolomite. Geologija 25/1: 167-188.

KOLAR-JURKOVŠEK, T. 1983: Srednjetriasni konodonti Slovenije = Middle Triassic Conodonts from Slovenia – NW Yugoslavia. Rud. met. zb., 30/4: 323-364.

KOLAR-JURKOVŠEK, T. 1991: Mikrofavna srednjega in zgornjega triasa Slovenije in njen biostratigrafski pomen. Microfauna of Middle and Upper Triassic in Slovenia and its biostratigraphic significance. Geologija, 33: 21-101.

KOLAR-JURKOVŠEK, T. 2011: Latest Triassic conodonts of the Slovenian Basin and some remarks on their evolution. Geologija, 54/1: 81-90, doi:10.5474/geologija.2011.006.

KOLAR-JURKOVŠEK, T. & JURKOVŠEK, B. 1995: Lower Triassic conodont fauna from Tržič (Karavanke Mts., Slovenia). Eclogae geol. Helv., 88/3: 989-801.

KOLAR-JURKOVŠEK, T. & JURKOVŠEK, B. 1996: Contribution to the knowledge of the Lower Triassic conodont fauna in Slovenia. Razprave SAZU, Razr. IV., 37/1: 3-21.

KOLAR-JURKOVŠEK, T. & JURKOVŠEK, B. 1997: *Valvasoria carniolica* n. gen. n. sp., a Triassic Worm from Slovenia. Geologia Croatica, 50/1: 1-5.

KOLAR-JURKOVŠEK, T. & JURKOVŠEK, B. 2003: *Clypeina besici* Pantić (Chlorophyta, Dasycladales) from the "Raibl Beds" of the Western Karavanke Mountains (Slovenia). Geol. Carpathica, 54/4: 237-242.

KOLAR-JURKOVŠEK, T. & JURKOVŠEK, B. 2007: First record of *Hindeodus-Isarcicella* population in Lower Triassic of Slovenia. Paleogeogr., Palaeoclim., Palaeoecol. 252, 72-81.

KOLAR-JURKOVŠEK, T. & JURKOVŠEK, B. 2009: Holoturijski skleriti iz karnijskih plasti okolice Mežice = Holothurian sclerites of Carnian strata in the Mežica area, Slovenia. Geologija, 52/1: 5-10, doi:10.5474/geologija.2009.001.

Kolar-Jurkovšek, T. & Jurkovšek, B. 2010: New paleontological evidence of the Carnian strata in the Mežica area (Karavanke Mts., Slovenia): conodont data for the Carnian Pluvial Event. Palaeogeogr. palaeoclimatol. Palaeoecol., 290/1-4: 81-88, doi:10.1016/j.palaeo.2009.06.015.

Kolar-Jurkovšek, T. & Placer, L. 1987: Ladinijsko-karnijska mikrofauna iz pseudoziljskih plasti Posavskih gub. Geol. vjesnik, 40: 53-63.

Kolar-Jurkovšek, T. & Rižnar, I. 2006: *Budurovignathus mungoensis* (Conodonta) iz ladinijskega dela "Psevdoziljske formacije" (Posavske gube, Slovenija) = *Budurovignathus mungoensis* (Conodonta) from the Ladinian part of the "Pseudogailtal Formation" near Blagovica (Sava Folds, Slovenia). RMZ – Mater. Geoenviron., 53/1: 39-47.

Kolar-Jurkovšek, T. , Gazdzicki, A. & Jurkovšek, B. 2005: Conodonts and foraminifera from the "Raibl Beds" (Carnian) of the Karavanke Mountains, Slovenia: stratigraphical and palaeobiological implications. Geol. Quat., 49/4, 429-438.

Kolar-Jurkovšek, T., Jurkovšek, B. & Aljinović D., 2011: Conodont biostratigraphy and lithostratigraphy across the Permian-Triassic boundary at the Lukač section in western Slovenia. Riv. ital. paleontol. stratigr., 117/1, 115-133.

Komac, M. 2005: Statistics of the Geological Map of Slovenia at scale 1:250.000. Geologija, 48/1, 117-126, Ljubljana.

Kossmat, F. 1914: Geologie des Wocheiner Tunnels und der südlicher Anschlusslinie. Denkschriften d.k. Akademie der Wissenschaften, Bd. 82: 41-142.

Košir, A. 2004: *Microcodium* revisted: root calcification products of terrestrial plants on carbonate-rich substrates. Journ. Sedimentary Research, 74: 845-857.

Kuščer, D., Grad, K., Nosan, A. & Ogorelec, B. 1974: Geološke raziskave soške doline med Bovcem in Kobaridom = Geology of the Soča Valley between Bovec and Kobarid. Geologija, 17: 425-476.

Lucas, S.G. 2010: The Triassic chronostratigraphic scale: history and status. In: Lucas, S.G. (ed.): The Triassic Timescale. Geol. Soc. London Spec. Publ., 334: 17-39, doi:10.1144/SP334.2.

Magaritz, M. & Holser, W.T. 1991: The Permian-Triassic of the Gartenkofel-1 Core (Carnic Alps, Austria): Carbon and Oxygen Isotope Variation. In: Holser, W.T. & Schönlaub, H.P. (eds.): The Permian-Triassic boundary in the Carnic Alps of Austria (Gartenkofel region). Abh. Geol. B.-A. 45: 149-164.

Milliman, J.D. 1974: Marine Carbonates. Springer Verl. Berlin: 375 p.

Mioč, P. 1983: Tolmač lista Ravne na Koroškem, Osnovna geološka karta SFRJ 1 : 100.000. Zv. geol. zav., Beograd: 69 p.

Mioč, P. 2003: Outline of the geology of Slovenia. Acta Geologica Hungarica, 46/1: 3-27.

Mioč, P. & Šribar, L. 1975: Jurski skladi v severnih Karavankah = The Jurassic Beds in the Northern Karavanke Mountains. Geologija, 18: 87-97.

Mioč, P. & Žnidarčič, M. 1976: Osnovna geološka karta SFRJ 1 : 100.000, list Slovenj Gradec. Zv. geol. zav., Beograd.

Mioč, P., Žnidarčič, M. & Jerše, Z. 1981: Osnovna geološka karta SFRJ 1 : 100.000, list Ravne na Koroškem. Zv. geol. zav., Beograd.

Mlakar, I. 1969: Krovna zgradba idirjsko-žirovskega ozemlja = Nappe Structure of the Idrija – Žiri Region. Geologija, 12: 5-72.

Mlakar, I. & Čar, J. 2009: Geološka karta idrijsko - cerkljanskega ozemlja med Stopnikom in Rovtami 1 : 25.000, Geološki zavod Slovenije, Ljubljana.

Mostler, H. & Rössner, R. 1984: Mikrofazies und Paläokologie der höheren Werfener Schichten (Untertrias) der Nördlishen Kalkalpen. Facies, 10: 87-144.

Mušič, B. 1992: Zgornjepermijske in spodnjetriasne kamnine pri Skopačniku v Želimeljski dolini = Upper Permian and Lower Triassic Beds at Skopačnik in the Želimlje Valley (Ig, Slovenia). Rud. met. zb., 39/1-2: 241-259.

Nagy, E. 1968: Triasbildungen des Mecsek Gebirges. Ann. Hung. Geol. Inst.51/1, 239 p.

Nestell, G.P., Kolar-Jurkovšek, T., Jurkovšek, B. & Aljinović, D. 2011: Foraminifera from the Permian-Triassic transition in western Slovenia. Micropaleontology, 57/3, 197-222.

Noé, S.U. 1987: Facies and Paleogeography of the Marine Upper Permian and of the Permian-Triassic Boundary in the Southern Alps (Bellerophon Formation, Tesero Horizon). Facies, 16: 89-142.

Novak, M. 2001: Skitijske plasti Toškega Čela = Scythian beds in the Toško Čelo area. Geologija 44/2: 295-303, doi:10.5474/geologija.2001.021.

Novak, M. & Dozet, S. 2002: Primerjava julskih in tuvalskih plasti v dveh profilih na območju osrednjih Posavskih gub = Comparison of the Julian and Tuvalian beds in two cross-sections in the Central Sava Folds area (Slovenia). Geologija, 45/1: 47-57, doi:10.5474/geologija.2002.004.

Oblak, K. 2001: Carnian Foraminifera from the Kucler quarry at Lesno Brdo (Slovenia) = Karnijske foraminifere iz Kuclerjevega kamnoloma na Lesnem brdu. Geologija, 44/2: 305-316, doi:10.5474/geologija.2001.022

Ogorelec, B. 1970: Kredni fliš gornjega Posočja. Diplomsko delo. NTF Univ. Ljubljana: 28 p.

Ogorelec, B. 1988: Mikrofazies, Geochemie und Diagenese des Dachsteinkalkes und Hauptdolomits in Süd-West-Slowenien, Jugoslawien. Diss. Univ. Heidelberg: 173 p.

Ogorelec, B. 2009: Spodnje jurske plasti v Preserju pri Borovnici = Lower Jurassic beds at Preserje near Borovnica (Central Slovenia). Geologija, 52/2: 193-204, doi:10.5474/geologija.2009.019.

Ogorelec, B. & Buser, S. 1996: Dachstein Limestone from Krn in Julian Alps (Slovenia). Geologija, 39: 133-157.

Ogorelec, B. & Dozet, S. 1997: Upper Triassic, Jurassic and Lower Cretaceous Beds in Eastern Sava Folds – Section Laze at Boštanj (Slovenia). Rud. met. zb., 44/3-4: 223-235.

Ogorelec, B. & Dozet, S. 2000: Oolitic Limestone and Dolomite in Mesozoic Beds of Slovenia. Zbornik radova – 2. Hrvatski geol. kongres, Cavtat – Dubrovnik, 500-501 (preliminary report), Zagreb.

Ogorelec, B. & Grad, K. 1986: Zgornjepermske, skitske in anizične kamenine na žirovskem ozemlju. V: V. skup sedim. Jugosl. Brioni, Sažeci pred., Hrvatsko geol.društvo, 53-56, Zagreb.

Ogorelec, B. & Rothe, P. 1979: Diagenetische Entwicklung und faziesabhängige Na-Vertielung in Karbonat-Gesteinen Sloweniens. Geol. Rundschau, 68/3: 965-978.

Ogorelec, B. & Rothe, P. 1992: Mikrofazies, Diagenese und Geochemie des Dachsteinkalkes und Hauptdolomits in Süd-West-Slowenien. Geologija, 35: 81-181.

Ogorelec, B., Šribar, L. & Buser, S. 1976: O litologiji in biostratigrafiji volčanskega apnenca. On Lithology and Biostratigraphy of Volče Limestone. Geologija, 19: 125-151.

Ogorelec, B., Jurkovšek, B., Šribar, L., Jelen, B., Stojanovič, B. & Mišič, M. 1984: Karnijske plasti v Tamarju in pri Logu pod Mangartom = Carnian beds at Tamar and at Log pod Mangartom. Geologija, 27: 107-158.

Ogorelec, B., Orehek, S., Buser, S. & Pleničar, M. 1987: Komen Beds – Skopo at Dutovlje. Internat. Symp. Evolution of the Karstic Carbonate Platform, Guidebook, 61-66, Trieste.

Ogorelec, B., Dolenec, T., Cucchi, F., Giacomich, R., Drobne, K. & Pugliese, N. 1995: Sedimentological and geochemical characteristics of carbonate rocks from the K/T boundary to Lower Eocene in the Karst area (NW Adriatic platform). I. Hrv. geol. kongres, Zbornik radova (Proceedings), 2: 415-422.

Ogorelec, B., Jurkovšek, B., Šatara, D., Barić, G., Jelen, B. & Kapović, B. 1996a: Potencialnost karbonatnih kamnin za nastanek ogljikovodikov v zahodni Sloveniji = Carbonate rocks of west Slovenia as potential sources for hydrocarbons. Geologija, 39: 215-237.

Ogorelec, B., Jurkovšek, B. & Šribar, L. 1996b: Škrbina (Komen limestone) – The first pelagic episode (Cenomanian – Turonian transgression). In: Drobne, K., Goričan, Š. & Kotnik, B. (eds.): The role of impact processes in the geological and biological evolution of the planet Earth. Int. Workshop Postojna: 183-188.

Ogorelec, B., Orehek S. & Budkovič, T. 1999a: Lithostratigraphy of the Slovenian Part of the Karavanke Road Tunnel. Abh. Geol. B.-A., 56/2: 99-112.

Ogorelec, B., Dolenec T. & Pezdič, J. 1999b: Izotopska sestava O in C v mezozojskih karbonatnih kameninah Slovenije – vpliv faciesa in diageneze = Isotope composition of O and C in Mesozoic carbonate rocks of Slovenia – effect of facies and diagenesis. Geologija, 42 (2000): 171-205.

Ogorelec, B., Drobne, K., Jurkovšek, B., Dolenec, T. & Toman, M. 2001: Paleocene beds of the Liburnia Formation in Čebulovica (Slovenia, NW Adriatic – Dinaric platform). Geologija, 44/1: 15-65, doi:10.5474/geologija.2001.002.

Ogorelec, B., Buser, S. & Mišič, M. 2006: Manganovi gomolji v jurskem apnencu Južnih Alp Slovenije = Manganese nodules in the Jurassic limestone of Southern Alps in Slovenia. Geologija, 49/1: 69-84, doi:10.5474/geologija.2006.005.

Ogorelec, B. Dolenec, T. & Drobne, K. 2007: Cretaceous-Tertiary problem on shallow carbonate platform: Carbon and oxygen excursions, biota and microfacies at the K/T boundary sections Dolenja vas and Sopada in SW Slovenia, Adria CP. Palaeogeogr., Palaeoclimatol., Palaeoecol., 255: 64-76.

Orehek, S. & Ogorelec, B. 1979: Sedimentološke značilnosti jurskih in krednih karbonatnih kamenin na Trnovskem gozdu = Sedimentologic features of the Jurassic and Cretaceous carbonate rocks of Trnovski gozd. Geol. vjesnik, 32: 185-192.

Orehek, S. & Ogorelec, B. 1981: Korelacija mikrofacialnih in geokemičnih značilnosti jurskih in krednih kamenin južne karbonatne platforme Slovenije = Correlation of microfacial and geochemical characteristics of Jurassic and Cretaceous rocks of the southern carbonate platform in Slovenia. Zav. geol. i geof. istraž., Vestnik, A, 38/39: 171-185.

Otoničar, B. 2006: Razvoj paleokrasa v zgornjekrednih apnencih Matarskega podolja in Slavnika. Doktorska disertacija, NTF Univerza Ljubljana: 309 p.

Otoničar, B. 2007: Upper Cretaceous to Paleogene forbulge unconformity associated with foreland basin evolution (Kras, Matarsko podolje and Istria; SW Slovenia and NW Croatia). Acta Carsologica, 36/1: 101-120.

Palci, A., Jurkovšek, B., Kolar-Jurkovšek, T. & Caldwell, M.W. 2008: New palaeoenvironmental model for the Komen (Slovenia) Cenomanian (Upper Cretaceous) fossil lagerstätte. Cretaceous Research, 29/2, 316-328.

Pavšič, J. 1979: Nanoplankton v zgornjekrednih in paleocenskih plasteh na Goriškem = Nannoplankton from the Upper Cretaceous and Paleocene Beds in the Gorica Region. Geologija, 20: 33-83.

Pavšič, J. 1994: Biostratigraphy of Cretaceous, Paleogene and Eocene clastics of Slovenia. Razpr. IV. razr. SAZU, 35: 65-84.

Pavšič, J. & Goričan, Š. 1987: Lower Cretaceous Nannoplankton and Radiolaria from Vrsnik (Western Slovenia). Razpr. IV. razr. SAZU, 27: 15-36.

Piller, W. 1981: The Steinplatte Reef Complex, part of an Upper Triassic carbonate platform near Salzburg (Austria). In: Toomey, D.F. (ed.): European fossil reef models. Soc. Econ. Paleont. Min. Spec. Publ., 30: 261-290.

Piller, W. & Lobitzer, H. 1979: Die obertriassische Karbonatplattform zwischen Steinplatte (Tirol) und Hochkönig (Salzburg). Verh. Geol. Bundesanst., 2: 171-179.

Placer, L. 2009: Tektonska razčlenitev Slovenije = Tectonic subdivision of Slovenia. In: Pleničar, M., Ogorelec, B. & Novak, M. (eds.): Geologija Slovenije = The Geology of Slovenia, Geološki zavod Slovenije, Ljubljana: 43-60.

Placer, L. & Kolar-Jurkovšek, T. 1990: O starosti psevdoziljskih skladov v vzhodnih Posavskih gubah. Rud.-metal. zb., 37/4: 529-534.

Pleničar, M. 1960: Stratigrafski razvoj krednih plasti na južnem Primorskem in Notranjskem = The statigraphic development of Cretaceous beds in southern Primorska, Slovene Littoral and Notranjska Inner Carniola. Geologija, 6: 22-145.

Pleničar, M. 1971: Hipuritna favna iz Stranic pri Konjicah. Razprave IV. razr. SAZU, 14/8: 241-263.

Pleničar, M. 1979: Cretaceous beds in Slovenia. In: Drobne, K. (ed.): Geological Development in Slovenia and Croatia. Guidebook 16th European Micropaleontological Colloquium, Ljubljana: 37-48.

Pleničar, M. 1993: Radiolites from the Cretaceous Beds of Stranice near Slovenske Konjice (Slovenia). Razprave IV. razr. SAZU, 34/3: 45-103.

Pleničar, M. 2005: Upper Cretaceous Rudists in Slovenia. Opera 39, SAZU, Ljubljana: 255 p.

Pleničar, M. 2009: Kreda = Cretaceous. In: Pleničar, M., Ogorelec, B. & Novak, M. (eds.): Geologija Slovenije = The Geology of Slovenia, Geološki zavod Slovenije, Ljubljana: 255-302.

Pleničar, M. & Buser, S. 1967: Kredna makrofavna Trnovskega gozda = The Cretaceous Macrofauna in the Western Part of the Trnovski Gozd. Geologija, 10: 147-159.

Pleničar, M. & Dozet, S. 1994: Contribution to the Knowledge of Upper Cretaceous Beds in Kočevje and Gorski Kotar Area (NW Dinarides). Geologija, 36 (1993): 183-194.

Pleničar, M. & Jurkovšek, B. 1996: Patch reef near Senožeče. Razprave SAZU, IV, 37/3: 37-83.

Pleničar, M. & Jurkovšek, B. 1998: Zgornjesantonijski rudisti osrednjega dela Tržaško-Komenske planote. The Upper Santonian Rudists of the Central Part of the Trieste-Komen Plateau. Razprave SAZU, IV, 34/1: 3-53.

Pleničar, M. & Pavlovec, R. 1984: Facialni razvoji nekaterih mezozojskih in kenozojskih karbonatnih kamnin Slovenije. Nafta, 35/1, 5-10.

Pleničar, M. & Premru, U. 1975: Facialne karakteristike sjeverozapadnih Dinarida = Facial characteristics of Northwestern Dinaric Alps. II. godišnji znanst. skup savjeta za naftu JAZU: 47-54.

Pleničar, M. & Premru, U. 1977: Osnovna geološka karta SFRJ 1 : 100.000, list Novo mesto. Zv. geol. zav., Beograd.

Pleničar, M., Drobne, K. & Ogorelec, B. 2002: Rudists and Larger Foraminifera below the Cretaceous-Tertiary Boundary in the Dolenja Vas Section. In: Kollman, H.A. & Zapfe, H. (eds.): New Aspects on Tethyan Cretaceous Fossil Assemblages. Österr. Akad. Wissen. 9: 231-239.

Pleničar, M., Ogorelec, B. & Novak, M. (eds.) 2009: Geologija Slovenije = The Geology of Slovenia. Geološki zavod Slovenije, Ljubljana: 612 p.

Poljak, M. (ed.) 2011: Geološka karta Krške kotline 1 : 25.000 = Geological Map of the Krško Basin, Slovenia 1 : 25.000. Geološki zavod Slovenije (v tisku/ in print), Ljubljana.

Polšak, A. & Pezdič, J. 1978: Paleotemperature relations of the Carboniferous and Permian periods in the Dinarids and Alps based on the oxygen isotope method and their paleogeographic applications. Geol. Vjesnik, 30/1: 167-187.

Premru, U. 1974: Triadni skladi v zgradbi osrednjega dela Posavskih gub = Trias in geologischen Bau der mittleren Savafalten. Geologija, 17: 261-297.

Premru, U. 1980: Geološka zgradba osrednje Slovenije = Geologic structure of Central Slovenia. Geologija, 23/2: 227-278.

Premru, U. 1982: Geološka zgradba južne Slovenije = Geologic structure of southern Slovenia. Geologija, 25/1: 95-126.

Premru, U. 1983: Tolmač lista Ljubljana, Osnovna geološka karta SFRJ 1 : 100.000. Zv. geol. zav., Beograd: 75 p.

Premru, U. 2005: Tektonika in tektogeneza Slovenije. Tektonska zgradba in geološki razvoj Slovenije = Tectonics and tectogenesis of Slovenia. Tectonic structure and geologic development of Slovenia. Geološki zavod Slovenije, Ljubljana: 518 p.

Premru, U., Ogorelec, B. & Šribar, L. 1977: O geološki zgradbi Dolenjske = On the Geological Sructure of the Lower Carniola. Geologija, 20: 167-192.

Premru, U. in sod. 1982: Osnovna geološka karta SFRJ 1 : 100.000, list Ljubljana. Zv. geol. zav., Beograd.

Pugliese, N., Drobne, K., Barattolo, F., Caffau, M., Galvani, R., Kedves, M., Montenegro, M.E., Pirini-Radrizzani, C., Pleničar, M. & Turnšek, D. 1995: Micro and Macrofossils from the K/T Boundary through Paleocene in the Northern Adriatic Platform. In: Vlahović, I. et al. (eds.): Proc. 1st Croatian Geol. Congress 2: 505-513.

Pungartnik, M., Brumen, S. & Ogorelec, B. 1982: Litološko zaporedje karnijskih plasti v Mežici = Lithologic succession of Carnian beds in Mežica. Geologija 25/2: 237-250.

Radoičić, R. 1966: Microfacies du Jurassiques des Dinarides externes de la Yougoslavie. Geologija, 9: 5-377.

Radoičić, R. & Buser, S. 2004: Biostratigrafija zgornjekrednih pelagičnih apnencev okolice Bovca v Julijskih Alpah = Biostratigraphy of Late Cretaceous pelagic limestones from surroundings of Bovec in the Julian Alps (Slovenia). Geologija, 47/2: 151-177, doi:10.5474/geologija.2004.012.

Ramovš, A. 1958: Razvoj zgornjega perma v loških in polhograjskih hribih = Die Entwicklung des Oberperms in Bergland von Škofja Loka und Polhov Gradec. Razprave SAZU, IV, 4: 451-622.

Ramovš, A. 1977: Geološki sprehod na Peco. Proteus, 40/2: 51-57.

Ramovš, A. 1985a: Geološke raziskave severnih Julijskih Alp in njihov biostratigrafski razvoj. Jeklo in ljudje. Jeseniški zbornik, 5: 391-428.

Ramovš, A. 1985b: Stratigrafska sestava in tektonski položaj Triglava in okolice = Stratigraphische Zusammensetzung und tektonische Lage des Triglav und seiner Umgebung. Rud. met. zb., 32/3-4: 163-171.

Ramovš, A. 1986a: Reef building organisms and reefs in the Permian of Slovenia, NW Yugoslavia. Mem. Soc. Geol. It., 34: 189-193.

Ramovš, A. 1986b: Marine development of the uppermost Žažar beds and the lowermost Scythian beds. In: Permian and Permian – Triassic boundary of the South Alpine segment of the Western Tethys. IGCP Project 203, Excursion Guidebook, Bologna: 39-42.

Ramovš, A. 1987: The Anisian Reef Development between Kranjska gora and Mojstrana (Slovenia, NW Yugoslavia). Razprave SAZU, IV, 27/1: 3-13.

Ramovš, A. 1988: Razvoj karnijske stopnje v vzhodnem delu severnih Julijskih Alp = Ausbildung der Karn-Stufe in östlichen Teil der nördlichen Julischen Alpen. Geologija, 30 (1989): 67-82.

Ramovš, A. 1989a: Razvoj ladinijske stopnje v severnih Julijskih Alpah = Ausbildung der Ladin-Stufe (Mitteltrias) in den nördlichen Julischen Alpen. Geologija, 31/32 (1988): 241-266.

Ramovš, A. 1989b: Razvoj skitskih plasti (spodnji trias) v severnih Julijskih Alpah = Development of the Scythian (Lower Triassic) in the Northern Julian Alps (Slovenia). Rud. met. zb., 36/4: 623-636.

Ramovš, A. 1995: Hotaveljčan skozi čas. Marmor Hotavlje, Ljubljana: 128 p.

Ramovš, A. 2000: Podpeški in črni ter pisani lesnobrdski apnenec skozi čas. Mineral, Ljubljana: 115 p.

Ramovš, A. & Aničić, B. 1995: Untertrias und Unteranis – Ausbildung im Mišnica Tal, östlich von Rimske Toplice, Ostslowenien. Rud. met. zb., 42/3-4: 143-155.

Ramovš, A. & Jamnik, A. 1991: The first proof of the deeper marine Norian (Upper Triassic) beds with conodonts and holothurian skeletons in the Kamnik Alps (Slovenia). Rud. met. zb., 38/3: 365-367.

Ramovš, A. & Jurkovšek, B. 1983: Razvoj ladinijskih plasti nad Šupco južno od Vršiča = Development of the Ladinian beds at Šupca south of Vršič. Geol. zb. 4: 81-91.

Ramovš, A. & Rebek, R. 1970: Razvoj jurskih skladov med Mežico in Slovenj Gradcem = The Development of the Jurassic Beds between Mežica and Slovenj Gradec. Geologija, 13: 105-114.

Ramovš, A. & Šribar, Lu. 1993: Cordevolski greben na Menini = The Cordevolian reff on the Menina, Kamnik – Savinja Alps, Slovenia). Geologija, 35 (1992): 73-80.

Ramovš, A. & Turnšek, D. 1984: Lower Carnian Reef Buildups in the Northern Julian Alps (Slovenia, NW Yugoslavia). Razprave SAZU, IV, 25/4: 161-200.

Ramovš, A. & Turnšek, D. 1991: The Lower Norian (Latian) Development with Coral Fauna on Razor and Planja in the Northern Julian Alps (Slovenia). Razprave SAZU, IV, 32/6: 175-213.

Ramovš, A., Aničić, B. & Dozet, S. 2001: Comparison of Lower Triassic Developments in Eastern Sava Folds and Northern Julian Alps (Slovenia). RMZ – Mater. Geoenviron., 48/3: 415-432.

Reading, H.G. (ed.) 1978: Sedimentary Environments and Facies. Blackwell Sci. Publ. Oxford: 557 p.

Reading, H.G. (ed.) 1996: Sedimentary envirimnents and facies. Process, facies, stratigraphy. Third ed., Blackwell Publ., Oxford: 688 p.

Riccamboni, R. 2005: Evidenze del passaggio Cretacico – Terziario nel Carso triestino e sloveno. Tezi di laurea in Paleontologia (Trieste), Trieste: 206 p.

Rožič, B. 2005: Stratigrafski razvoj jure v zahodnem delu Slovenskega bazena. Geol. zbornik, Ljubljana, 18: 107-111.

Rožič, B. 2006: Sedimentology, stratigraphy and geochemistry of Jurassic rocks in the western part of the Slovenian Basin. Ph.D. Thesis, NTF University of Ljubljana:148 p.

Rožič, B. 2008: Upper Triassic and Lower Jurassic limestone from Mt Kobla in the northern Tolmin Basin: tectonically repeated or continuous succession? RMZ – Mater. Geoenviron., 55/3: 345-362.

Rožič, B. 2009: Perbla and Tolmin formations: revised Toarcian to Tithonian stratigraphy of the Tolmin Basin (NW Slovenia) and regional correlations. Bull. Soc. Geol. France, 180/5:411-430, doi:10.2113/gssgfbull.180.5.411.

Rožič, B. & Kolar-Jurkovšek, T. 2007: Zgornjetriasni apnenčevi razvoji Slovenskega bazena na Kobli in Slatniku. Geol. zbornik, 19: 96-99.

Rožič, B. & Popit, T. 2006: Residemented limestones in Middle and Upper Jurassic succession of the Slovenian Basin. Geologija, 49: 219-234, doi:10.5474/geologija.2006.016.

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, doi:10.1007/s10347-008-0164-2.

Scholle, P.A., Bebout, D.G. & Moore, C.H. (eds.) 1983: Carbonate depositional environments. Amer. Ass. Petrol.Geol. Mem., 33, Tulsa: 708 p.

Senowbari- Daryan, B. & Schäfer, P. 1979: Zur Paläontologie des Riffes innerhalb der Amphiclinen – Schichten bei Hudajužna, Slowenien. Razprave SAZU, IV. 23/3: 99-118.

Shinn, E.A., Lloyd, R.M. & Ginsburg, R.N. 1969: Anatomy of a modern carbonate tidal flat Andros Island, Bahamas. Jour. Sed. Petrol., 39: 1202-1228.

Skaberne, D., Goričan, Š. & Čar, J. 2003: Kamnine in fosili (radiolariji) iz kamnoloma Kamna Gorica. Vigenjc, Glasilo Kovaškega muzeja v Kropi, II: 85 99.

Skaberne, D., Ramovš, A. & Ogorelec, B. 2009: Srednji in zgornji perm = Middle and Upper Permian. In: Pleničar, M., Ogorelec, B. & Novak, M. (eds.): Geologija Slovenije = The Geology of Slovenia. Geološki zavod Slovenije, Ljubljana: 137-154.

Sremac, J. 1991: Zone *Neoschwagerina craticulifera* in the Middle Velebit Mt. (Croatia, Yugoslavia). Geologija, 34: 7-56.

Sremac, J. 2005: Equatorial Shelf of the Palaeozoic Supercontinent – Craddle of the Adriatic Carbonate Platform. Geologia Croatica 58/1: 1-19.

Stanton, R.J. Jr. & Flügel, E. 1989: Problems with Reef Models: The Late Triassic Steinplatte “Reef” (Northern Alps, Salzburg, Tyrol, Austria). Facies, 20: 1-138.

Strohmenger, C. & Dozet, S. 1990: Stratigraphy and geochemistry of Jurassic carbonate rocks from Suha Krajina and Mala gora mountain (Southern Slovenia). Geologija, 33: 315-351.

Strohmenger, C. & Dozet, S. & Koch, R. 1987: Diagenesemuster – Stratigraphie: Oolith-Horizonte im Jura von SW Slowenien. Facies, 17: 253-266.

Summesberger, H., Jurkovšek, B. & Kolar-Jurkovšek, T. 1996: Aptychi associated with ammonites from the Lipica Formation (Upper Cretaceous, Slovenia). Ann. Naturhist. Mus. Wien, 97-A: 1-19.

Ščavničar, B., Šušnjara, A. & Prohić, E., 1983: The geologic column of the Lower Triassic in the Zmijavac valley (Muč, Southern Croatia). In: Babić, Lj. & Jelaska, V. (eds.): Contribution of Sedimentology of Some Carbonate and Clastic Units of the Coastal Dinarides. Excursion Guidebook. 4th IAS Regional Meeting, Split: 13-35.

Šmuc, A. 2005: Jurassic and Cretaceous stratigraphy and sedimentary evolution of the Julian Alps, NW Slovenia. Založba ZRC, Ljubljana: 98 p.

Šmuc, A. & Čar, J. 2002: Upper Ladinian to Lower Carnian Sedimentary Evolution in the Idrija-Cerkno Region, Western Slovenia. Facies, 46: 205-216, doi:10.1007/BF02668081.

Šmuc, A. & Goričan, Š. 2005: Jurassic sedimentary evolution of a carbonate platform into a deep-water basin, Mt. Mangart (Slovenian-Italian border). Riv. Ital. Paleontol. Stratigr., 111: 45-70.

Šribar, L. 1965: Meja med krednimi in terciarnimi skladi v Goriških Brdih = The Boundary between Cretaceous and Tertiary in Goriška Brda. Geologija, 8: 121-129.

Šribar, L. 1979a: Biostratigrafija mejnih plasti med juro in kredo v južni Sloveniji = Biostratigraphy of the Jurassic-Cretaceous boundary layers from South Slovenia). Geologija, 22/1: 113-116.

Šribar, L. 1979b: Biostratigrafija spodnjekrednih plasti na Logaški planoti = Biostratigraphy of Lower Cretaceous beds from the Logatec plain. Geologija, 22/2: 277-308.

Šribar, L. 1981: Kredne plasti v vzhodnih podaljških Karavank in Posavskih gub = Cretaceous beds in the eastern extensions of the Karavanke Alps and the Sava folds. Geologija, 24/2: 303-317.

Šribar L. & Pleničar M. 1990: Zgornjekredne cenocone v jugozahodni Sloveniji = Upper Cretaceous assemblage zones in southwestern Slovenia. Geologija, 33: 171-205.

Šribar, Lu. 1995: Evolucija gornjokredne Jadranskodinarske karbonatne platforme u jugozapadnoj Sloveniji. Magistarski rad, Sveučilište u Zagrebu, Zagreb: 89 p.

Štrucl. I. 1970: Stratigrafske in tektonske razmere v vzhodnem delu severnih Karavank = Stratigraphie und Tektonik der östlichen Teil der Nordkarawanken. Geologija, 13: 5-20.

Štrucl, I. 1971: On the Geology of the Easten part of the Northern Karavankes with Special Regard to the Triassic Lead-Zinc Deposits. In: Müller, G. (ed.): Sedimentology of parts of Central Europe, Guidebook, VII Int. Sediment. Congress, Heidelberg: 285-301.

Štrucl, I. 1974: Nastanek karbonatnih kamenin in cinkovo svinčeve rude v anizičnih plasteh Tople = Die Entstehungsbedingungen der Karbonatgesteine und Blei-Zinvererzungen in dem Anisschichten von Topla. Geologija, 17: 299-397.

Štrucl, I. 1984: Geološke, geokemične in mineraloške značilnosti rude in prikamnine svinčevo-cinkovih orudenj mežiškega rudišča = Geological and geochemical characteristics of ore and host rock of lead-zinc ores of the Mežica ore deposit. Geologija, 27: 215-327.

Tišljar, J., Vlahović, I., Matičec, D. & Velić, I. 1995: Platformni facijesi od gornjeg titona do gornjega alba u zapadnoj Istri i prijelaz u tempestite, klinoformne i rudistne biolititne facijese donjega cenomana u južnoj Istri = Platform Facies from the Upper Tithonian to Upper Albian in Western Istria and Transition into Tempestite, Clinoform and Rudist Biolithite Facies of the Lower Cenomanian in Southern Istria. In: Vlahović, I. & Velić, I. (eds.): 1. Hrvatski geol. konges, Vodič ekskurzije, Zagreb: 67-110.

Tišljar, J., Vlahović, I., Velić, I. & Sokač, B. 2002: Carbonate Platform megafacies of the Jurassic and Cretaceous Deposits of the Karst Dinarides. Geol. Groatica, 55/2: 139-170.

Tucker, M.E. & Wright,V.P. 1990: Carbonate sedimentology. Blackwell, Oxford: 482 p.

Turnšek, D. 1966: Zgornjejurska hidrozojska favna iz južne Slovenije = Upper Jurassic Hydrozoan Fauna from Southern Slovenia. Razprave SAZU, IV, 9/8: 355-428.

Turnšek, D. 1969: Prispevek k paleoekologiji jurskih hidrozojev v Sloveniji = A Contribution of the Paleoecology of Jurassic Hydrozoa from Slovenia. Razprave SAZU, IV, 12/5: 209-237.

Turnšek, D. 1972: Zgornjejurske korale iz južne Slovenije = Upper Jurassic Corals of Southern Slovenia. Razprave SAZU, IV, 15/6: 145-261.

Turnšek, D. 1994: Upper Cretaceous Reef building Colonial Corals of Gosau Facies from Stranice near Slovenske Konjice (Slovenia). Razprave SAZU, IV, 35/1: 3-41.

Turnšek, D. 1997: Mesozoic Corals of Slovenia = Mezozojske korale Sovenije. Zbirka ZRC SAZU, 16, Ljubljana: 512 p.

Turnšek, D. & Buser, S. 1966: Razvoj spodnjekrednih skladov ter meja med juro in kredo v zahodnem delu Trnovskega gozda = The Development of the Lower Cretaceous Beds and the Boundary Between Jurassic and Cretaceous Formations in the Part of Trnovski gozd. Geologija, 9: 527-542.

Turnšek, D. & Buser, S. 1974: Spodnjekredne korale, hidrozoji in hetetide z Banjške planote in Trnovskega gozda = The Lower Cretaceous corals, hydrozoans and chaetetids of Banjška planota and Trnovski gozd. Razprave SAZU, IV, 17/2: 81-124.

Turnšek, D. & Buser, S. 1976: Knidarijska favna iz senonijske breče na Banjški planoti = Cnidarian Fauna from the Senonian Breccia of Banjška planota (NW Yugoslavia. Razprave SAZU, IV, 19: 37-88.

Turnšek, D. & Buser, S. 1989: The Carnian reef complex on the Pokljuka (NW Yugoslavia). Razprave SAZU, IV, 30: 75-127.

Turnšek, D. & Buser, S. 1991: Norian - Rhaetian Coral Reef Buildups in Bohinj and Rdeči rob in Southern Julian Alps (Slovenia). Razprave SAZU, IV, 32/7: 215-257.

Turnšek, D. & Ramovš, A. 1987: Upper Triassic (Norian-Rhaetian) reef buildups in the northern Julian Alps (NW Yugoslavia). Razprave SAZU, IV, 28: 27-67.

Turnšek, D., Buser, S. & Ogorelec, B. 1981: An Upper Jurassic reef complex from Slovenia, Yugoslavia. In: Toomey, D.F. (ed.): Eurpoean Fossil Reef Models. SEPM Spec. Publ., 30: 361-369.

Turnšek, D., Buser, S. & Ogorelec, B. 1982: Carnian Coral-Sponge Reefs in the Amphiclina Beds between Hudajužna and Zakriž (Western Slovenia). Razprave SAZU, IV, 24/2: 51-98.

Turnšek, D., Buser, S. & Ogorelec, B. 1984: The Role of Corals in Ladinian – Carnian Reef Communities of Slovenia, Yugoslavia. Paleontographica Americana, 54: 201-209.

Turnšek, D., Buser, S. & Ogorelec, B. 1987: Upper Carnian Reef Limestone in Clastic Beds at Perbla near Tolmin (NW Yugoslavia). Razprave SAZU, IV, 27/3: 37-64.

Turnšek, D., Pleničar, M. & Šribar, Lj. 1992: Lower Cretaceous Fauna from Slovenski vrh near Kočevje (South Slovenia). Razprave SAZU, IV, 33/8: 205-257.

Turnšek, D., Dolenec, T., Siblik, M., Ogorelec, B., Ebli, O. & Lobitzer, H. 1999: Contributions to the Fauna (Corals, Brachiopods) and Stable Isotopes of the Later Triassic Seinplatte Reef/Basin – Complex, Northern Calcareous Alps, Austria. Abh. Geol. B.-A., 56/2: 121-140.

Velić, I. 2007: Stratigraphy and Palaeobiography of Mesozoic Benthic Foraminifera of the Karst Dinarides (SE Europe). Geologia Croatica, 60/1: 1-113.

Velić, I., Matičec, D., Vlahović, I. & Tišljar, J. 1995: Stratigrafski slijed jurskih i donjokrednih karbonata (bat-gornji alb) u zupadnoj Istri = Stratigraphic Succession of Jurassic and Lower Cretaceous Carbonates (Bathonian - Upper Albian) in Western Istria. In: Vlahović, I. & Velić, I. (eds.): 1. Hrvatski geol. kongr., Vodič ekskurzija: 31-66.

Velić, I., Tišljar , J., Vlahović, I., Velić, J., Koch, G. & Matičec, D. 2002: Paleogeographic Variability and Depositional Environments of the Upper Jurassic Carbonate Rocks of Velika Kapela Mt. (Gorski Kotar Area, Adriatic Carbonate Platform, Croatia), Geol. Croatica, 55/2: 121-138.

Vlahović, I., Tišljar, J., Velić, I. & Matičec, D. 2005: Evolution of the Adriatic Carbonate Platform: Paleogeography, main events and depositional dynamics. Paleogeography, Palelclimatology, Paleoecology, 220/3-4: 333-360.

Wilson, J.L. 1975: Carbonate Facies in Geologic History. Springer Verl., Berlin: 471 p.

Zankl, H. 1971: Upper Triassic carbonate facies in the Northern Limestone Alps. In: Müller, G. (ed.): Sedimentology of Parts of Central Europe, Guidebook. 8. Int. Sedim. Congress, Heidelberg: 147-185.

Žalohar, J. & Celarc, B. 2010: Geološka zgradba Kamniško-Savinjskih Alp. V: Hitij T. et al. (eds.): Kraljestvo Tetide, Okameneli svet triasnih vretenčarjev Kamniško-Savinjskih Alp. Scopolia Suppl. 5, 43-53.

TABLE – PLATES

Tabla 1 – Plate 1

Zgornji perm – Upper Permian

1 Rekristaliziran mikritni apnenec s terigenimi zrni kremena in sljude. Bazalna plast zgornjepermskega zaporedja. Čadovlje pri Tržiču, X nikoli, preparat je obarvan z alizarinskim barvilom

Recrystallized micritic limestone with terrigenous grains of quartz and mica. Basal layer of the Upper Permian succession. Čadovlje at Tržič, XN, alizarin red staininig

2 Biomikritni wackestone s številnimi preseki skeletnih alg vrste *Gymnocodium bellerophontis* in foraminiferami. Alge in foraminifere so bile v času diageneze izlužene, moldične pore pa so zapolnjene z avtigenim kremenom (belo). Masore pri Spodnji Idriji. Preparat je obarvan z alizarinskim barvilom

Biomicritic wackestone with numerous algae of *Gymnocodium bellerophontis* species. Algae and foraminifers were leached during early diagenesis and moldic pores were filled with authigenic quartz (white). Masore at Spodnja Idrija, alizarin red staining

3 Biomikritni algni packstone s polži in fragmenti ehinodermov. Masore pri Spodnji Idriji

Biomicritic algal packstone with gastropods and echinoderm fragments. Masore at Spodnja Idrija

4 Rekristaliziran gimnokodijski packstone s foraminifero *Hemigordius* sp. in ploščico ehinoderma. Javorjev dol pri Sovodnju. Značilni facies Žažarske formacije

Recrystallised gymnocodian packstone with foraminifer *Hemigordius* sp. and echinoderm plate. Javorjev dol at Sovodenj. Characteristic facies of Žažar Formation

5 Žila sadre v mikritnem dolomitu. Karavanški cestni predor, 802. m, X nikoli

Gypsum vein in micritic dolomite. Karavanke road tunnel, 802. m, XN

6 Kristali anhidrita v sparitnem dolomitu. Karavanški cestni predor, 670. m, X nikoli

Anhydrite crystals in sparry dolomite. Karavanke road tunnel, 670. m, XN

Tabla 1 – Plate 1

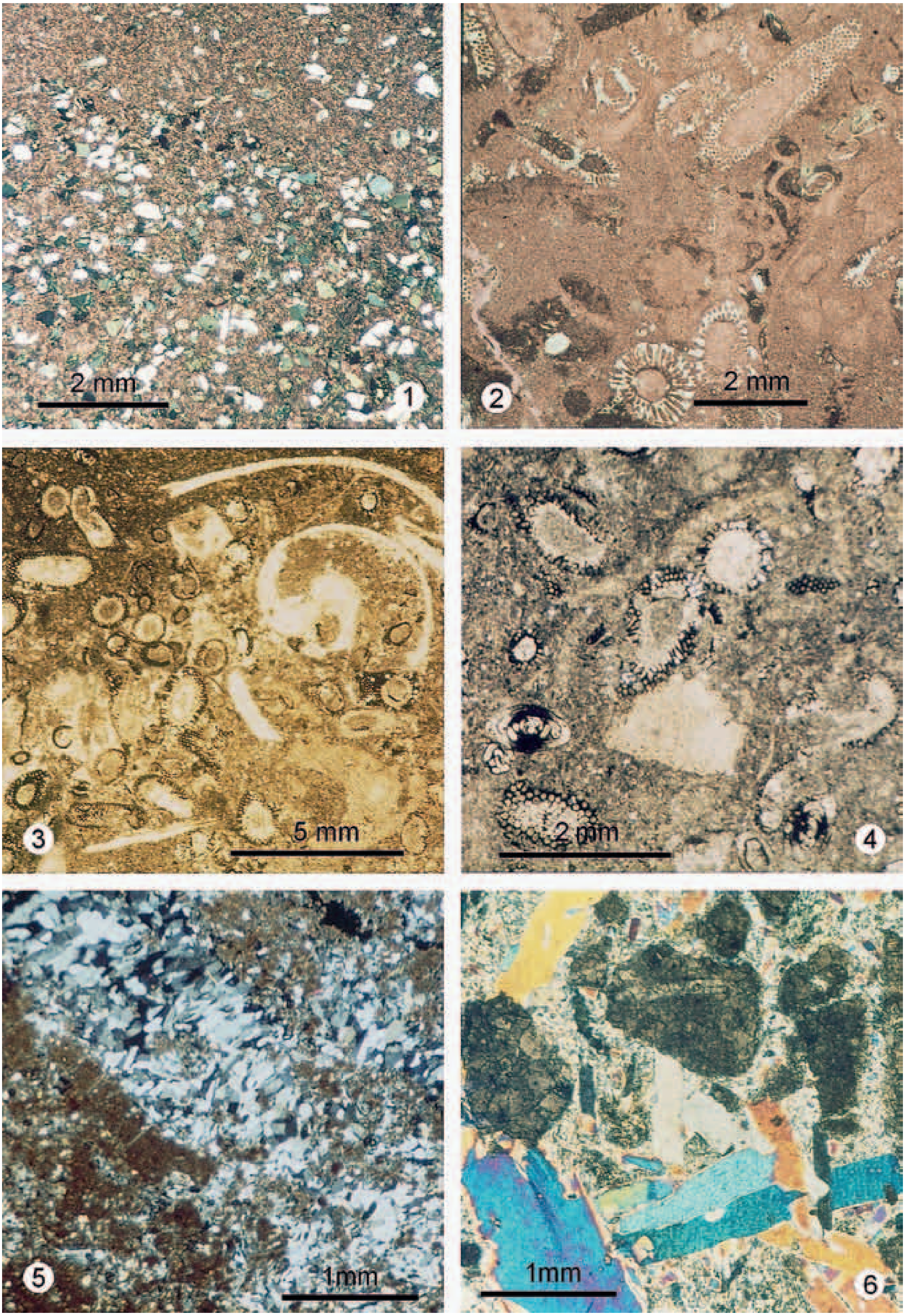


Tabla 2 – Plate 2

Zgornji perm – Upper Permian

1 Izpran gimnokodijski packstone s ploščicami ehinodermov. Struga Idrijce pri Spodnji Idriji

Washed gymnocodian packstone with echinoderm plates. Idrijca river bed at Spodnja Idrija

2, 3 Rekristaliziran biomikritni packstone. Skeleti alg in foraminifer so bili v času diageneze izluženi, moldične pore pa so bile zapolnjene z avtigenim kremenom. Masore pri Spodnji Idriji. Preparat je obarvan z alizarinskim barvilom, sl. 2 - presevna svetloba, sl. 3 - X nikoli

Recrystallised biomicritic packstone. Algal and foraminiferal skeletons were leached during early diagenesis and moldic pores were later cemented by authigenic quartz. Masore at Spodnja Idrija. Alizarin red staining, Fig. 2 in plane-polarized light, fig. 3 - XN

4 Prečni presek korale *Waagenophyllum indicum* v mikritni osnovi. Preko koralitov poteka stilolitni šiv. Malenski vrh nad Poljanami

Transverse section of *Waagenophyllum indicum* coral in micritic matrix. Coralites are crossed by a stylolite. Malenski vrh above Poljane

5 Mikritni dolomit s presekom alge *Permocalculus fragilis*. Kalcitni skelet alge je bil v času diageneze izlužen (moldična poroznost), nato pa zapolnjen z anhidritom. Karavanški cestni predor, 650. m, X nikoli

Micritic dolomite with *Permocalculus fragilis* algae. Calcitic algal skeleton was leached during early diagenesis (moldic porosity) and later cemented by anhidrite. Karavanke road tunnel, 650. m, XN

Tabla 2 – Plate 2

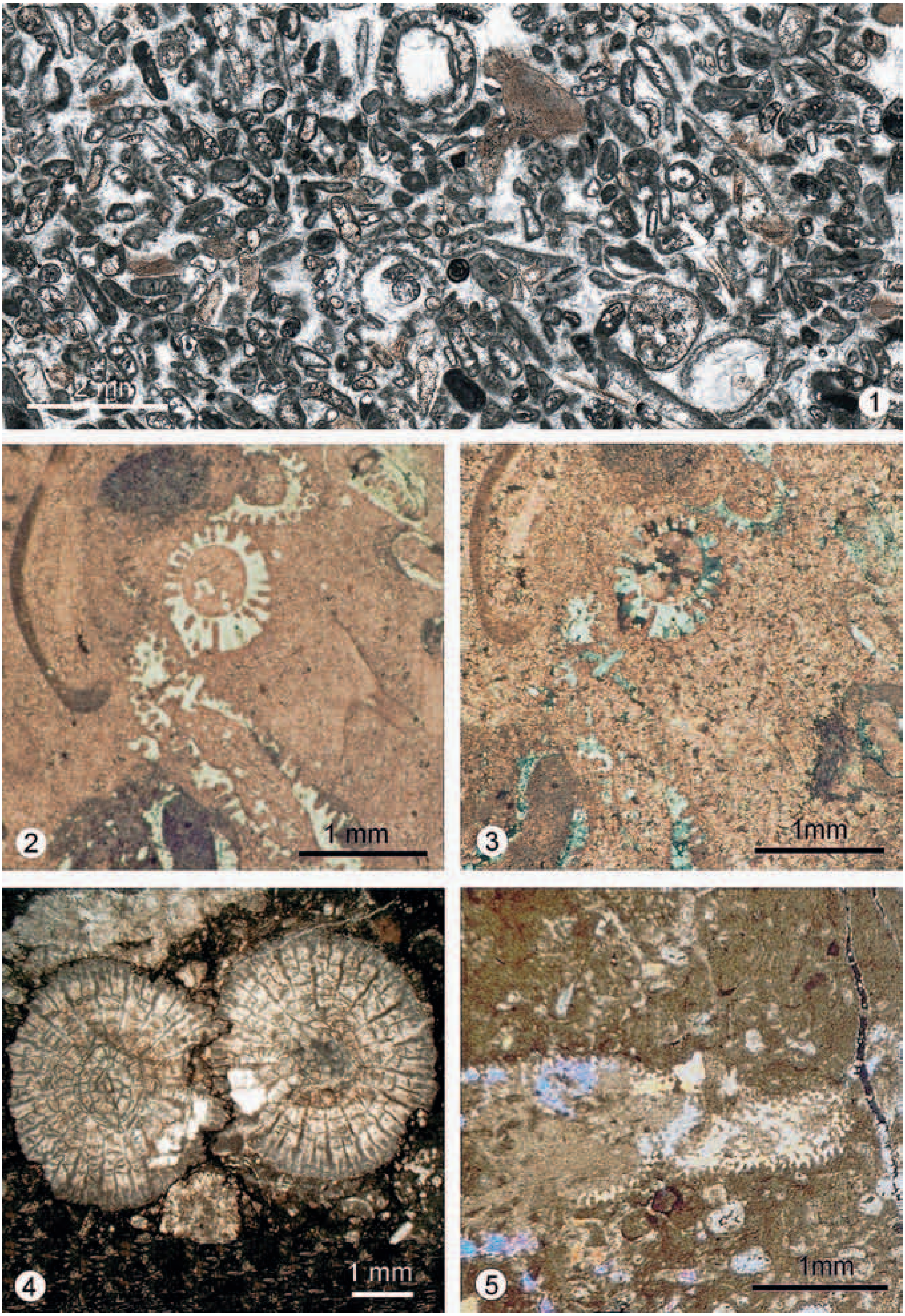


Tabla 3 – Plate 3

Zgornji perm in permsko/triasna meja –
Upper Permian and Permian/Triassic boundary

1 Rekristaliziran biomikritni wackestone s preseki foraminifere *Climacammina* sp. in skeleti alg. Javorjev dol pri Sovodnju

Recrystallized biomicritic wackestone with *Climacammina* sp. foraminifer and algae. Javorjev dol at Sovodenj

2 Oolitni dolomit (oosparit) s še opazno prvotno strukturo kamnine. Izlužene moldične pore po ooidih sta v pozni diagenezi zapolnila sparitni kalcit in kremen. Potok Košutnik pri Tržiču. Preparat je obarvan z alizarinskim barvilom

Oosparitic dolomite with preserved primary oolitic texture. Leached moldic pores after ooids were cemented by sparry calcite and some quartz during late diagenesis. Košutnik creek at Tržič. Alizarin red staining

3, 4 Oolitni grainstone. Večino ooidov je zajela poznodiagenetska dolomitizacija. Struga Idrijce pri Spodnji Idriji, Tesero horizont na P/T meji. Preparat je obarvan z alizarinskim barvilom

Oolitic grainstone. Most of ooids were subjected to dolomitization during late diagenesis. Idrijca river bed at Spodnja Idrija, Tersero horizon at P/T boundary. Alizarin red staining

5 Sparitni dolomit (grainstone) z ohranjeno oolitno strukturo. Pore zapolnjuje poznodiagenetski sparitni kalcit. Redka terigena zrna kremena. Talnina premogovnika Velenje. Preparat je obarvan z alizarinskim barvilom

Sparry dolomite (grainstone) with preserved oolitic structure. Intergranular pores are cemented by late diagenetic sparry calcite. Some terrigenous quartz grains. Footwall of Velenje coal mine. Alizarin red staining

6 Sparitni dolomit s slabo ohranjeno prvotno oolitno teksturo in z gnezdi sfalerita. Pb-Zn rudišče Trebelno pri Mokronogu, permsko/triasna meja

Sparry dolomite with poorly preserved primary oolitic structure and with sphalerite crystals. Pb-Zn mine Trebelno at Mokronog, Permian/Triassic boundary

Tabla 3 – Plate 3

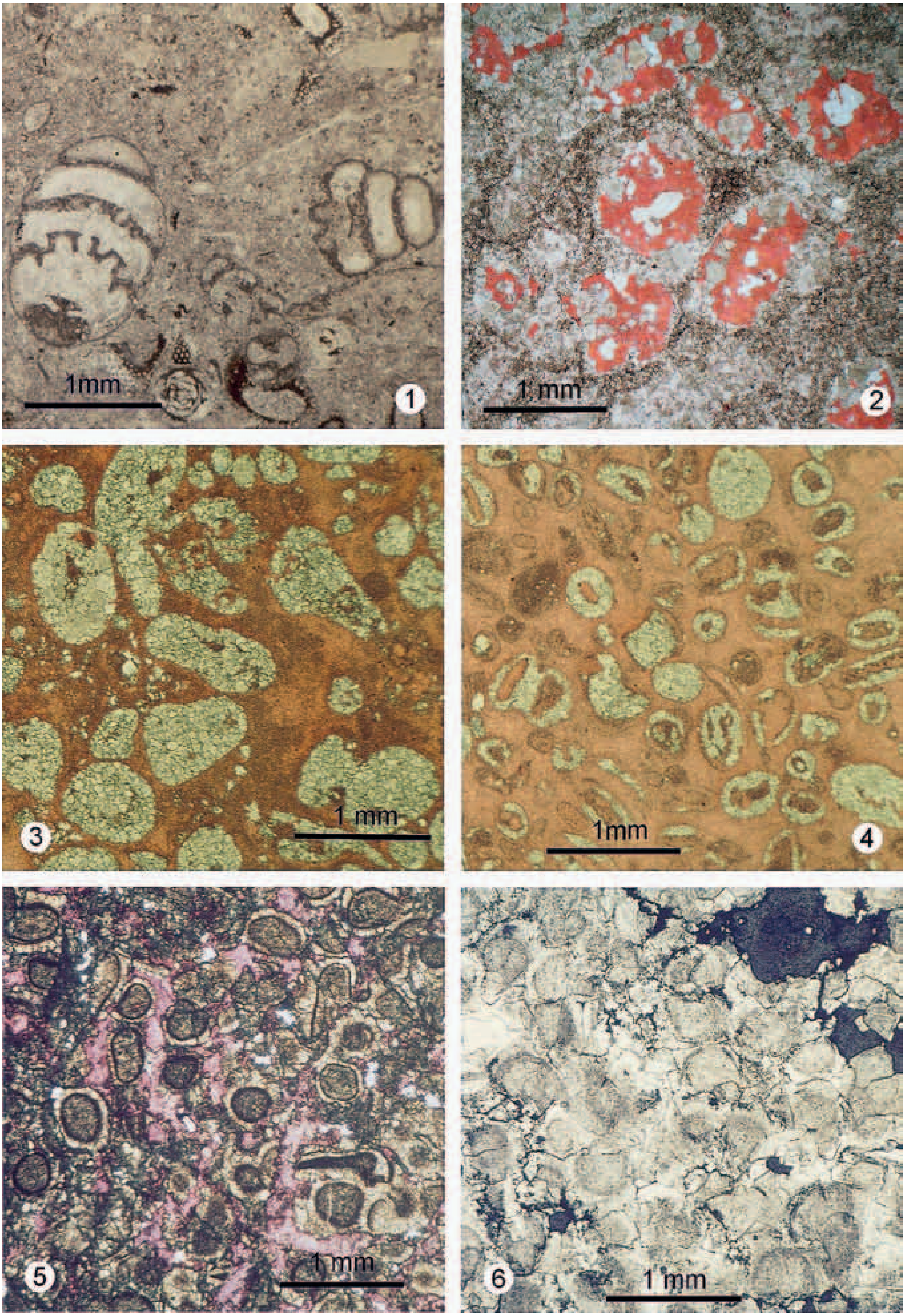


Tabla 4 – Plate 4

Zgornji perm – Upper Permian

1 Satasti mikrosparitni dolomit. Pore, nastale z izluževanjem evaporitov, zapolnjuje kalcitni cement (rdeče). Javorjev dol pri Sovodnju. Preparat je obarvan z alizarinskim barvilom

Microsparitic cellular dolomite. Vugs, caused by leaching of primary evaporite minerals are cemented by calcite (red). Javorjev dol at Sovodenj. Alizarin red staining

2 Gimnokodijski apnenec (packstone) s posameznimi foraminiferami in ploščicami ehinodermov. Rejc na Vojskarski planoti

Gymnocodian packstone with some foraminifers and echinoderm plates. Rejc on Vojsko plateau by Idrija

3 *Permocalculus fragilis* in kopuče cianobakterij v mikritni osnovi – algni floatstone. Mažgon pri Jagrščah

Algal floatstone with *Permocalculus fragilis* and microbial clusters. Mažgon at Jagršče

4 Sparitni dolomit z znaki dedolomitizacije (kalcitizacije). Najvišji horizont zgornjepermske Žažarske formacije. Javorjev dol pri Sovodnju

Sparry dolomite, displaying dedolomitization (calcitization). Uppermost horizon of the Upper Permian Žažar Formation. Javorjev dol at Sovodenj

5 Mikritni dolomit (mudstone) z redkimi kalcitiziranimi radiolariji. Bazalne plasti Karavanške formacije. Čadovlje pri Tržiču

Micritic dolomite (mudstone) with radiolarians. Basal beds of Karavanke Formation. Čadovlje at Tržič

6 Oolitni grainstone s sparitnim kalcitnim cementom. Tesero horizont na P/T meji. Masore pri Spodnji Idriji

Oolitic grainstone with sparry calcite cement. Tesero horizon at the P/T boundary. Masore at Spodnja Idrija

Tabla 4 – Plate 4

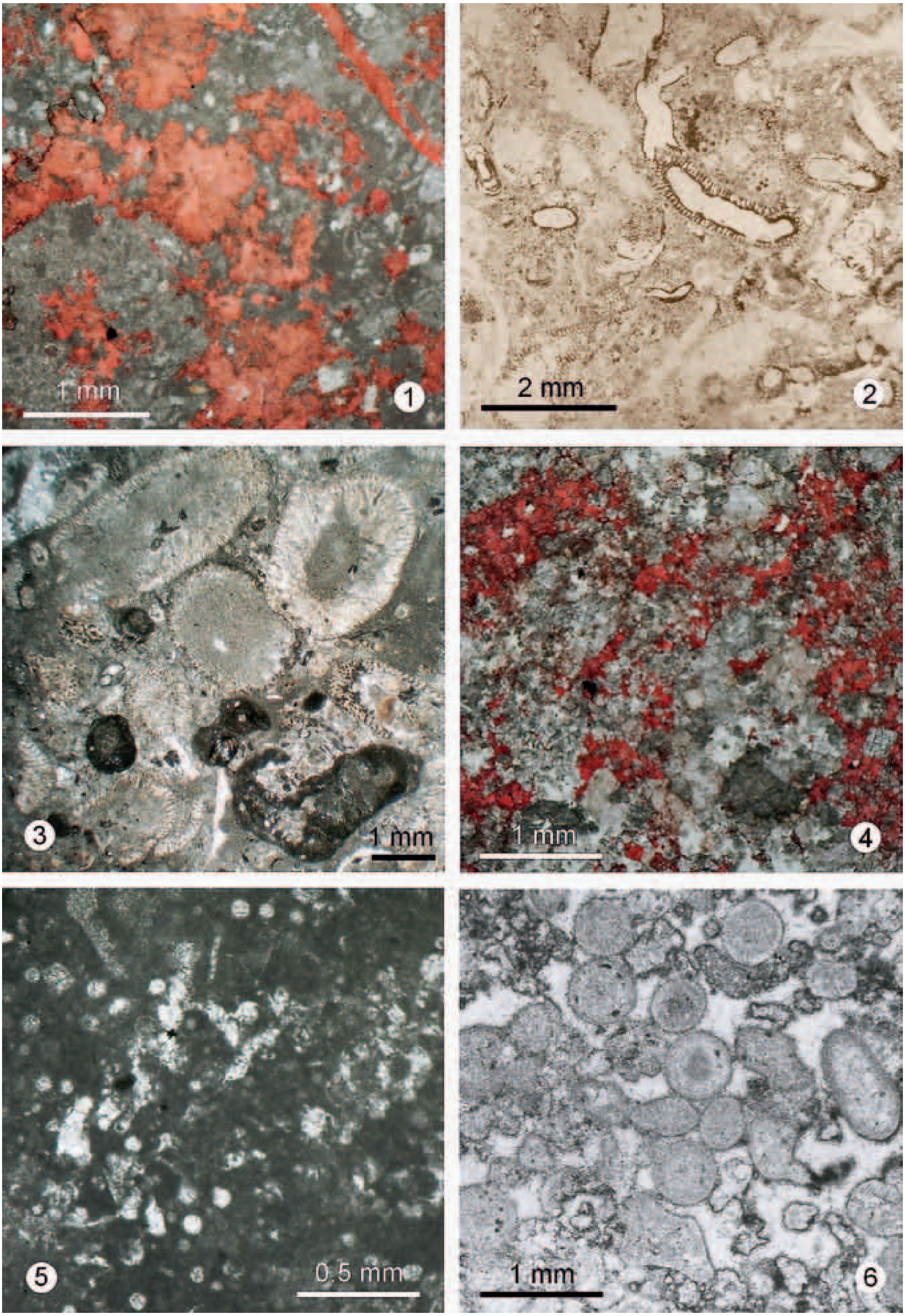


Tabla 5 – Plate 5

Spodnji trias – Lower Triassic

1, 2 Gastropodni wackestone. Številni preseki drobnih polžev. Redka zrna terigenega kremena (na sl. 1). Zalog na Bohorju

Gastropod wackestone. Numerous sections of small gastropods. Rare grains of detrital quartz (on Fig. 1). Zalog at Mt. Bohor

3 Oolitni packstone. V enem od ooidnih jeder je opazen mikrogastropod. Apnenec je rahlo dolomitiziran. Lom pri Tržiču

Oolitic packstone. Microgastropod can be seen in nucleus of one of ooids. Limestone is partly dolomitized. Lom at Tržič

4 Biosparitni grainstone s številnimi gastropodi. Značilni facies spodnjetriasnega zaporedja. Čebine nad Trbovljami

Biosparitic grainstone with numerous gastropods. Characteristic facies of Lower Triassic succession. Čebine at Trbovlje

5 Dolomitiziran bioosparitni packstone. Spodnji del preparata je obarvan z alizarinskim barvilom, zato je lepo viden obseg dolomitizacije. Podlipa pri Vrhniki

Dolomitized bioosparitic packstone. Lower part of the thin-section is stained by alizarin red, displaying the extent of dolomitization. Podlipa at Vrhnika

6 Dolomitiziran gastropodni wackestone. Med polže je ujet tudi večji ooid, ki je rdeče obarvan s hematitom. Laško

Dolomitized gastropod wackestone. Among gastropods some ooids are present. Their reddish color is due to hematite pigment. Laško

Tabla 5 – Plate 5

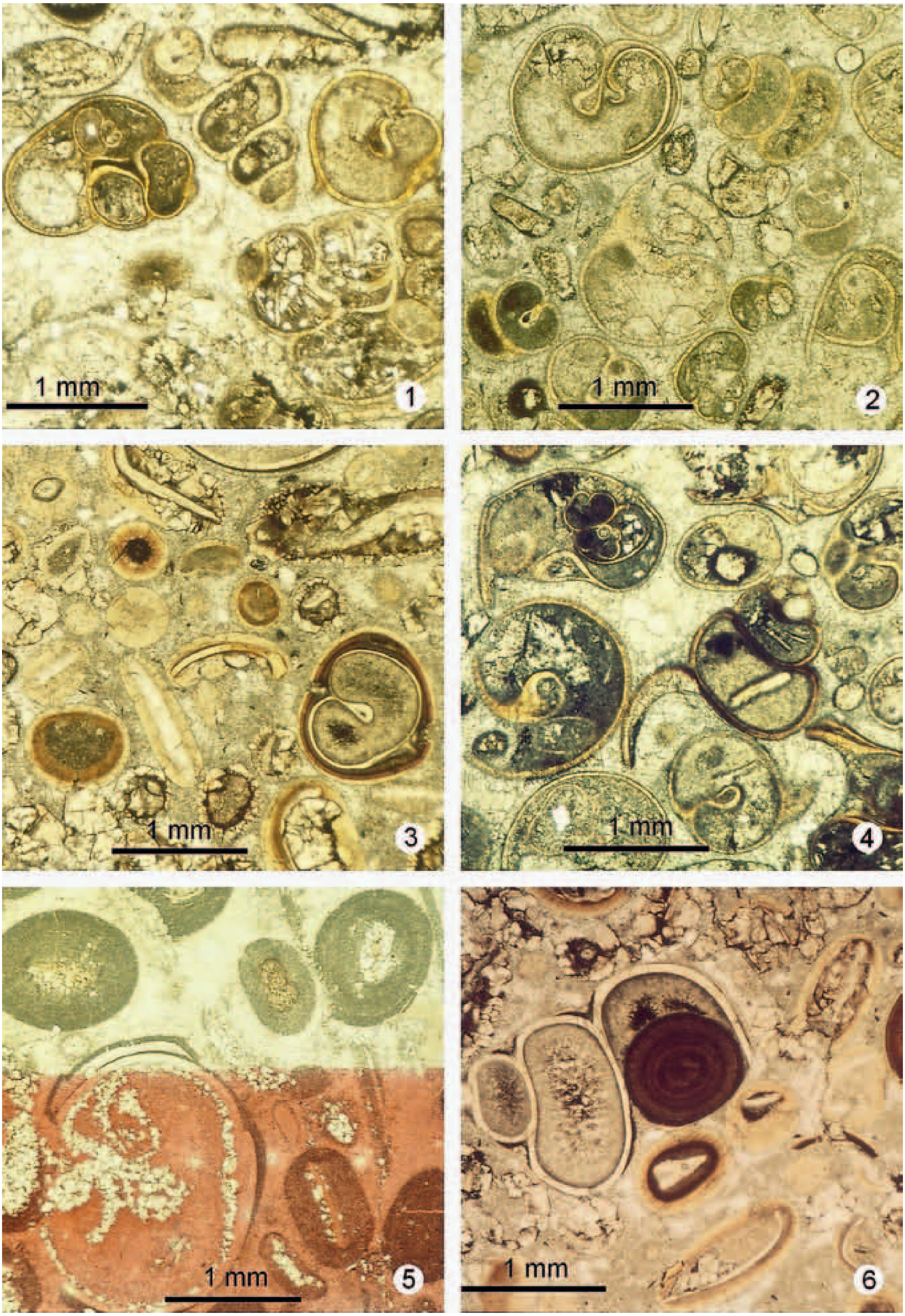


Tabla 6 – Plate 6

Spodnji trias – Lower Triassic

1, 4 Oosparitni grainstone (detajl). Ooidi so zaradi železovih hidroksidov obarvani rdečkasto. Na sl. 4 so vidna zajedanja med posameznimi ooidi zaradi raztapljanja apnenca v času diageneze. Kamnolom Kisovec pri Zagorju

Oosparitic grainstone (detail). Ooids are reddish stained due to ferroan hydroxides. Kisovec quarry at Zagorje

2 Oosparitni dolomitni grainstone z medzrnskimi porami, nastalimi pri dolomitizaciji (belo). Izlake

Oosparitic dolomitic grainstone with intergranular pores, formed during dolomitization (white). Izlake

3 Oosparitni grainstone. Apnenec je zajela vadozna diageneza; jedra ooidov so bila izlužena in kasneje zapolnjena s sparitnim kalcitom. Laško

Oosparitic grainstone. Sediment was affected by vadose diagenesis. Ooid nuclei were leached and moldic pores were later cemented by sparry calcite. Laško

5 Oosparitni grainstone – detajl. Jedra večine ooidov so selektivno dolomitizirana; viden je tudi obrobni kalcitni cement. Vzorec je obarvan z alizarinskim barvilom. Masore pri Spodnji Idriji

Oosparitc grainstone – detail. Ooid nuclei show selective dolomitization, rim calcite cement is evident too. Alizarin red staining. Masore at Spodnja Idrija

6 Oosparitni dolomitni packstone. Ooidi so opazni le po konturah in večjih dolomitnih zrnih. Ledina nad Sevnico

Oosparitic dolomitic packstone. Primary rock structure is recognized by ooid contours and larger dolomite crystals. Ledina over Sevnica

Tabla 6 – Plate 6

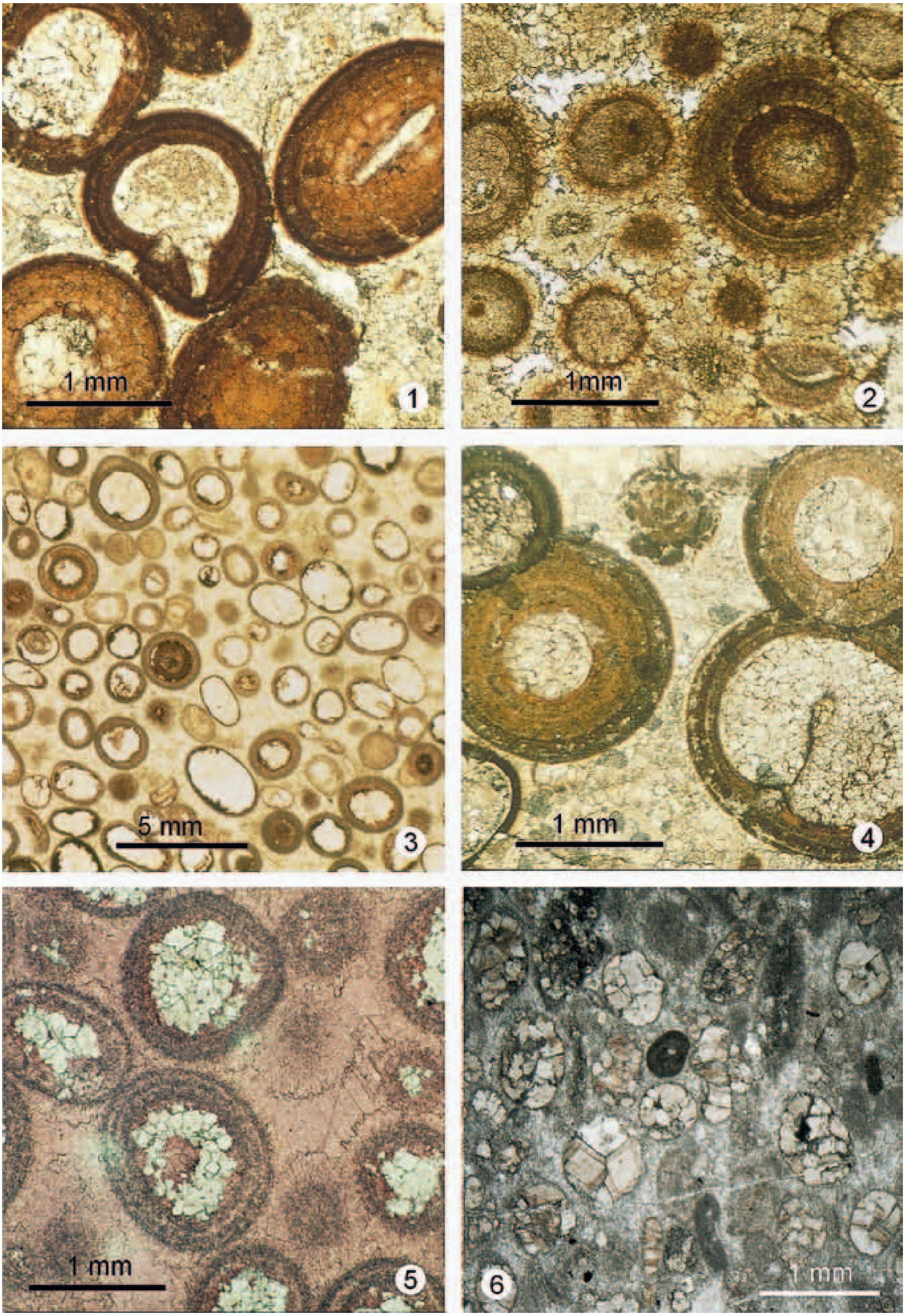


Tabla 7 – Plate 7

Spodnji trias – Lower Triassic

1 Rekristaliziran in dolomitiziran mikritni wackestone s preseki foraminifere *Earlandia*. Bazalne plasti tik nad P/T mejo. Masore pri Spodnji Idriji

Recrystallized and dolomitized micritic wackestone with foraminifer *Earlandia*. Basal beds just above the P/T boundary. Masore at Spodnja Idrija

2 *Meandrospira pusilla* v rekristaliziranem mikrosparitnem apnencu (mudstone) z redkimi terigenimi zrni kremena. Tehovec pri Katarini nad Medvodami

Meandrospira pusilla in recrystallized microsparitic limestone (mudstone) with rare terrigenous quartz grains. Tehovec by Katarina above Medvode

3 Izpran oopelmikritni dolomit – packstone. Številni ooidi so pomešani med pelete. Medzrnska poroznost, nastala pri pozni dolomitizaciji. Rimske Toplice

Washed oopelmicritic dolomite – packstone. Numerous ooids are mixed among pellets. Intergranular porosity caused by late dolomitization. Rimske Toplice

4 Biosparitni packstone, ki ga sestavljajo ploščice ehinodermov. Vrhnji del spodnjetriasnega zaporedja. Zakamnik nad karavanškim cestnim predorom

Biosparitic packstone composed of echinoderm plates. Upper part of Lower Triassic succession. Zakamnik above the Karavanke road tunnel

5 Biosparitni dolomitni grainstone, ki ga sestavljajo same ploščice ehinodermov. Lom pri Tržiču

Biosparitic dolomitic grainstone, composed solely of echinoderm plates. Lom at Tržič

6 Pelmikritni packstone z velikim intraklastom (spodaj) in ooidi. Dedjek pri Polhovem Gradcu

Pelmicritic packstone with one large intraclast (below) and ooids. Dedjek at Polhov Gradec

Tabla 7 – Plate 7

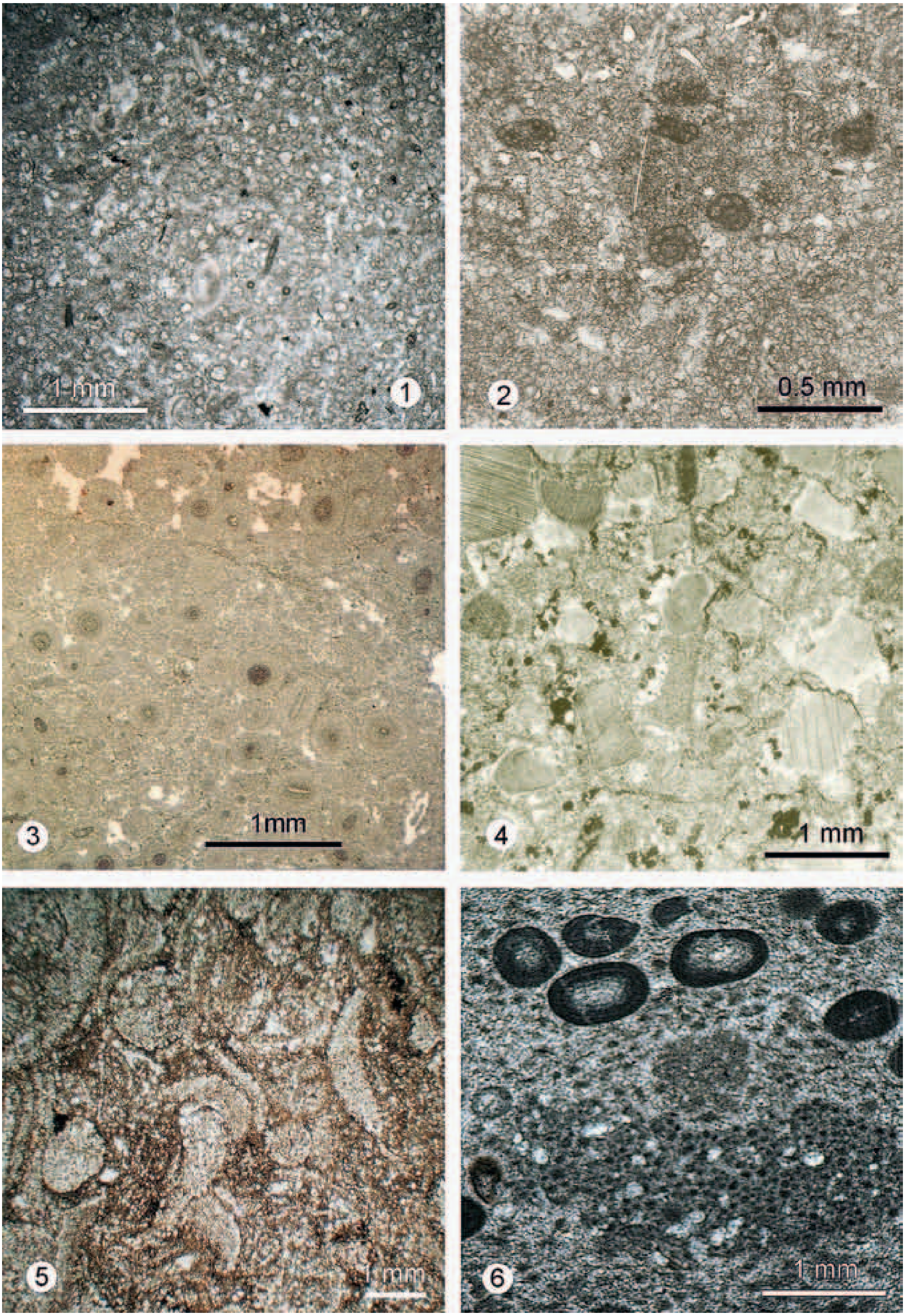


Tabla 8 – Plate 8

Srednji trias (anizij) – Middle Triassic (Anisian)

1 Izpran intrabiosparitni packstone. Kamnino gradijo pretežno foraminifere in ehinodermi. Baba nad Cerknim

Washed intrabiosparitic packstone. Foraminifers and echinoderm plates are the main rock constituents. Baba over Cerkno

2 Biopelmikritni packstone s foraminifero *Meandrospira dinarica*. Talnina premogovnika Velenje

Biopelmicritic packstone with foraminifer *Meandrospira dinarica*. Footwall of Velenje coal mine

3 Kontura školjčne lupine v mikrosparitnem dolomitu. Todraž pri Gorenji vasi, vrtina P3/169 m

Microsparitic dolomite with poorly preserved bivalve shell. Todraž at Gorenja vas, borehole P3/169 m

4 Fragmenti školjčnih lupin, inkrustrirani z ovoji cianobakterij – bafflestone. Detajl stromatolitne plasti. Geopetalna struktura z internim mikritom v medprostorih. Todraž pri Gorenji vasi, vrtina P3/157 m

Molluscan fragments, encrusted by cyanobacteria – bafflestone. Detail of stromatolite layer. Geopetal fabric with internal micrite in some pores. Todraž at Gorenja vas, borehole P3/157 m

5 Detajl izsušitvene pore z geopetalno strukturo (interni mikrit) v stromatolitnem dolomitu. Todraž pri Gorenji vasi, vrtina P3/142 m

Shrinkage pore in stromatolitic dolomite – detail with geopetal fabric (internal micrite). Todraž at Gorenja vas, borehole P3/142 m

6 Detajl izsušitvene pore v stromatolitnem dolomitu z dvema generacijama cementov – obrobni cement pripada dolomitu z evhedralnimi zrni, osrednji del por pa zapolnjuje sparitni kalcit (rdeče). Preparat je obarvan z alizarinskim barvilom. Kamnolom Kotredež pri Zagorju

Shrinkage pore in stromatolitic dolomite – detail with two generations of cement: euhedral dolomite crystals as rim cement (generation A) and sparry calcite (red, generation B). Alizarin red staining, Kotredež quarry near Zagorje

Tabla 8 – Plate 8

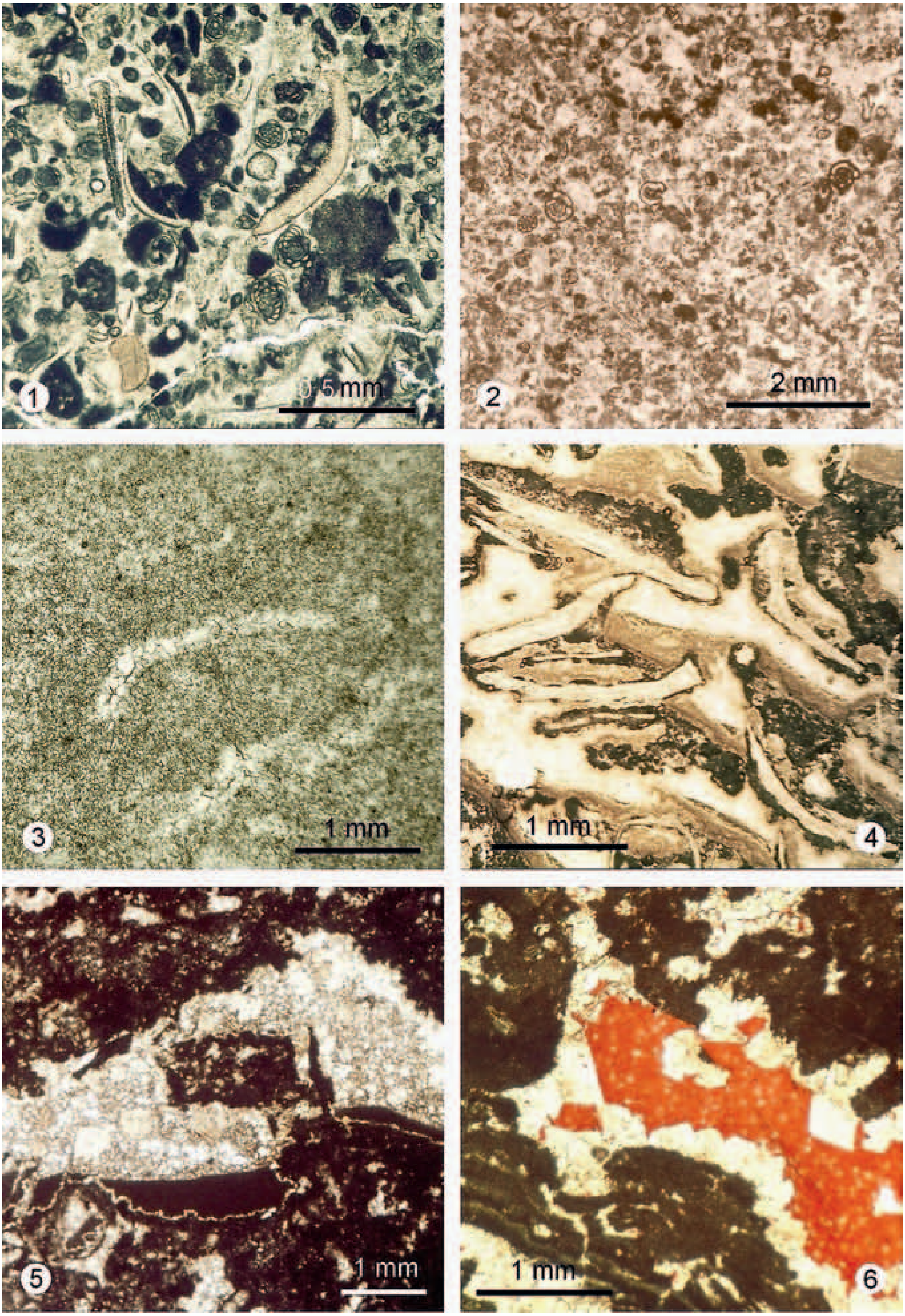


Tabla 9 – Plate 9

Srednji trias (anizij) – Middle Triassic (Anisian)

1 Intrabiosparitni grainstone s preseki skeletnih alg. Stena pod Blejskim gradom

Intrabiosparitic grainstone with skeletal algae. Bled castle wall

2 Preseki dasikladacejskih alg v grebenskem apnencu. Stena pod Blejskim gradom

Sections of Dasycladal algae in reefal limestone. Bled castle wall

3 Izsušitvena pora v mikritnem dolomitu – detajl. Dve generaciji cementa – obrobni kalcit generacije A (rdeče) in sparitni dolomit generacije B (belo). Preparat je obarvan z alizarinskim barvilom. Todraž pri Gorenji vasi, vrtina P3/138 m

Shrinkage pore in micritic dolomite – detail. Two generations of cement – rim calcite cement of generation A (red) and sparry dolomite of generation B (white). Alizarin red staining. Todraž at Gorenja vas, borehole P3/138 m

4 Mikrosparitni dolomit (mudstone). Pore, nastale pri poznodiagenetski dolomitizaciji in žilo zapolnjuje kalcit (rdeče). Vzorec je obarvan z alizarinskim barvilom, kamnolom Kotredež pri Zagorju

Microsparitic dolomite mudstone. Pores, formed during late diagenesis and a vein are cemented by calcite (red). Alizarin red staining. Kotredež quarry at Zagorje

5 Biosparitni grainstone sestavljajo fragmenti alg (opazne po konturah in mikritnih ovojih) in redke foraminifere. Rudnik Črna pri Kamniku

Biosparitic grainstone with algal fragments (recognized by contours and micritic envelopes) and some foraminifers. Črna mine at Kamnik

6 Sparitni dolomit, impregniran s sfaleritnimi kristali. Rudnik Topla pri Mežici

Sparry dolomite, impregnated by sphalerite crystals. Topla mine near Mežica

Tabla 9 – Plate 9

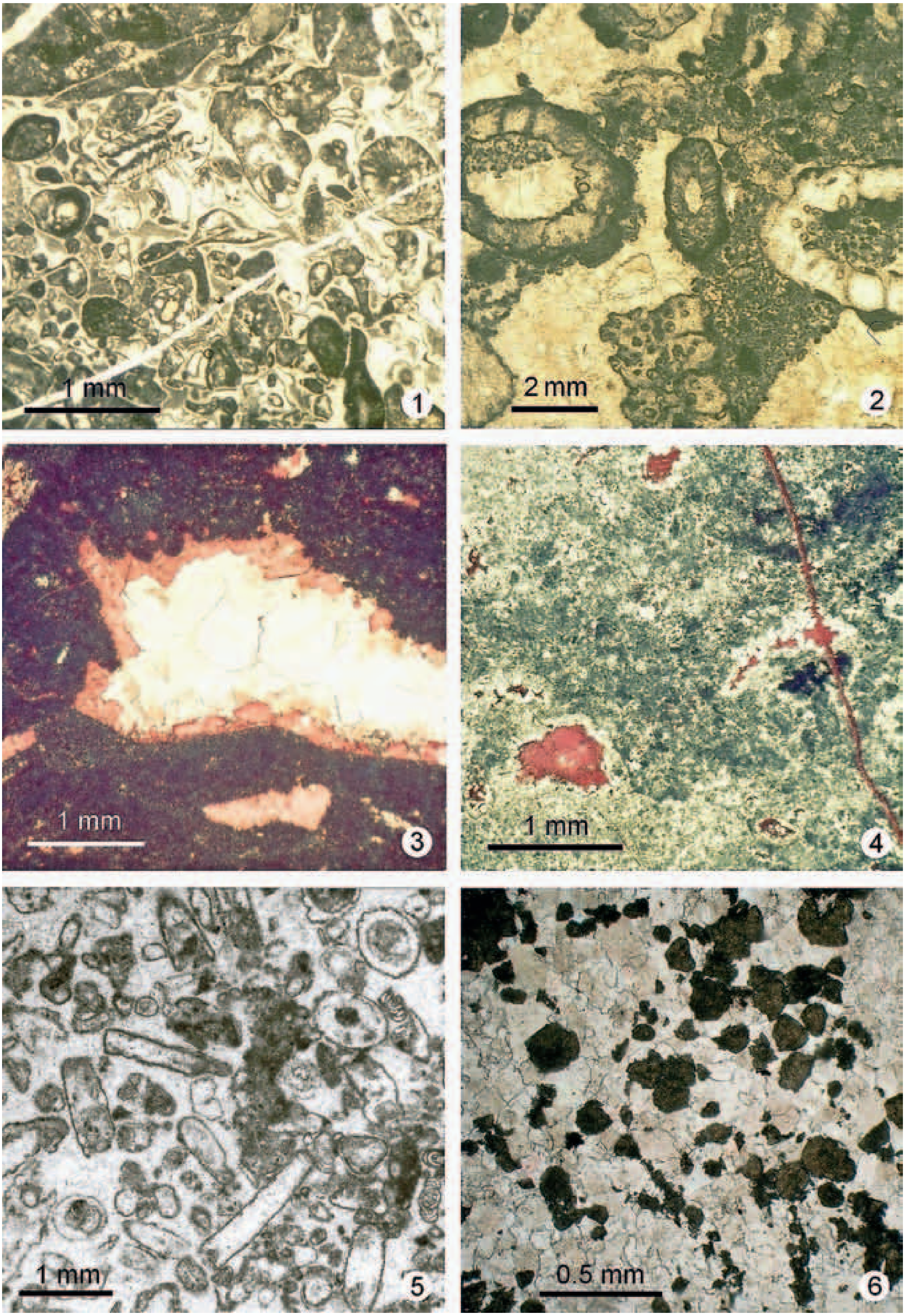


Tabla 10 – Plate 10

Srednji trias (ladinij) – Middle Triassic (Ladinian)

1, 2 Rekristaliziran intrasparitni packstone. Mikritni intraklasti so zaradi tektonike sploščeni in dajejo kamnini videz trakaste teksture. Na sl. 2 so prisotni tudi fragmenti ehinodermov (puščica).

Recrystalized intrasparitic packstone. Micritic intraclasts are due to tectonics flat and give appearance of ribbon structure to the rock. Some echinoderm fragments on fig. 2.

1 – Kamna Gorica
2 – Kotredež pri Zagorju

3 Mikritni apnenec (wackestone) s tankolupinskimi školjkami in radiolariji. Kamnolom Kamna Gorica

Micritic wackestone with thin-valved bivalves and radiolarians. Kamna Gorica quarry

4 Intramikritni apnenec, v katerem so pomešani drobci vulkanskih kamnin. Psevdoziljske plasti. Kotredež pri Zagorju

Intramicritic limestone with fragments of volcanic rocks. Psevdozilja beds. Kotredež at Zagorje

5 Drobnozrnata konglomeratna breča, ki jo sestavljajo dolomitni drobci in kalcitno vezivo (rdeče). Preparat je obarvan z alizarinskim barvilom. Miklajč na Vojskarski planoti

Fine-grained conglomeratic breccia, composed of dolomite grains and calcite matrix (red). Alizarin red staining. Miklajč on Vojsko plateau

6 Laminiran roženec s skeleti radiolarijev. Plast znotraj karbonatno – tufskega zaporedja. Kobilji curk pri Robu

Laminated chert with radiolarian tests. Layer within carbonate – volcanic succession. Kobilji curk at Rob

Tabla 10 – Plate 10

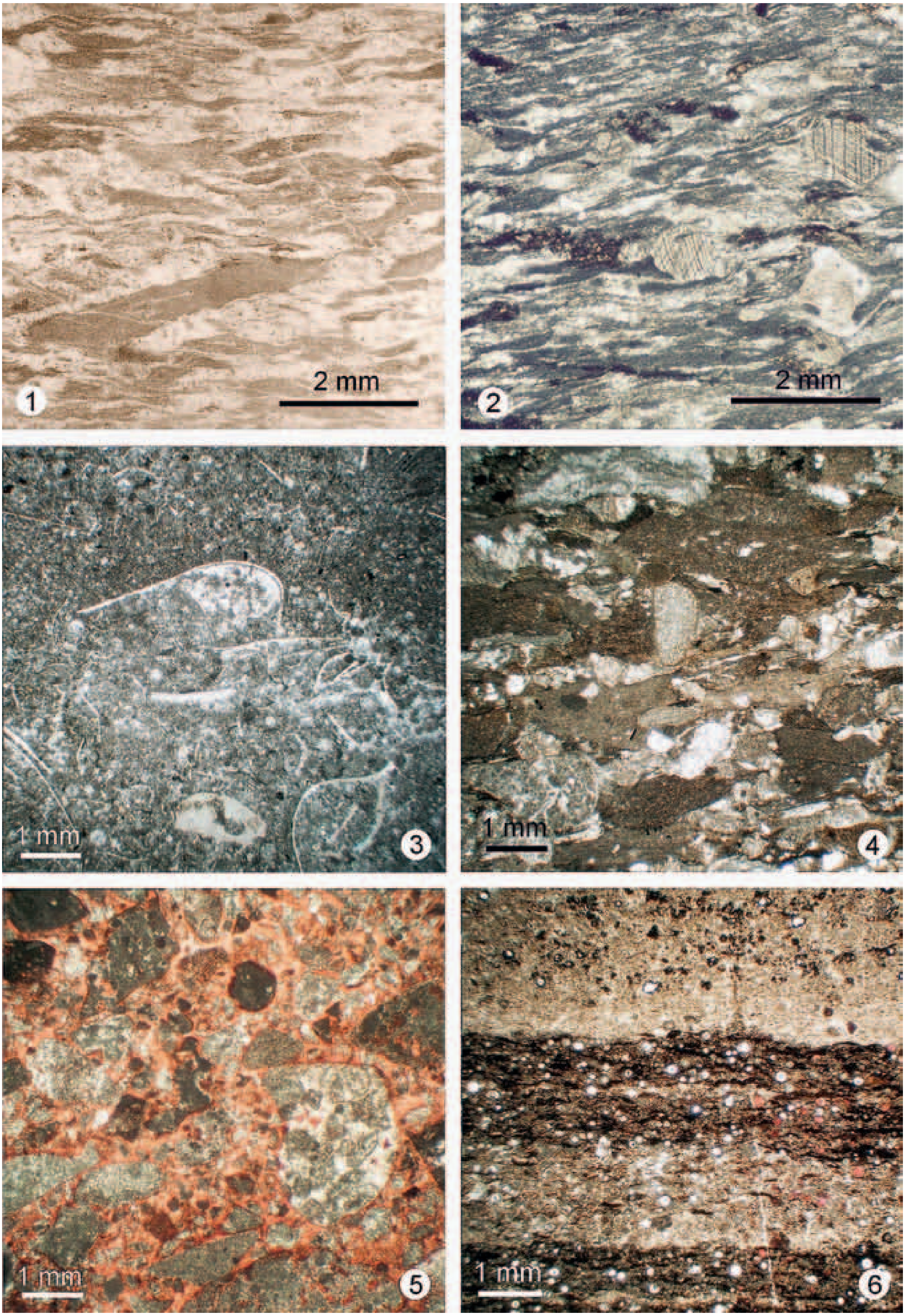


Tabla 11 – Plate 11

Srednji trias (zgornji ladinij) – Middle Triassic (Upper Ladinian)

1 Bioklastični framestone z dazikladacejnimi algami vrste *Diplopora* sp. Velika planina – Pod Frato

Bioclastic framestone composed of dasycladacean algae of *Diplopora* sp. Velika planina – Pod Frato

2, 4 Preseki alge *Diplopora* sp. v apnencu tipa grainstone (sl. 2) in v izpranem mikritu (sl. 4). Sl. 2 - Velika planinna, sl. 4. - Okrešelj v Savinjskih Alpah

Sections of algae *Diplopora* sp. in grainstone (Fig. 2) and in washed micrite (Fig. 4). Fig. 2 - Velika planina, Fig. 4 - Okrešelj in Savinja Alps

3 Gastropodi v biosparitnem apnencu tipa grainstone. Njihovi skeleti so opazni po mikritnih ovojih. Velika planina, odcep za Konja

Gastropods in biosparitic grainstone. Their shells can be recognized by micritic coatings. Velika planina, turning towards Konj

5 Bioklastični grainstone s preseki dazikladacejnih alg in cianobakterij, ki obraščajo nekatere algne skelete. Ostenje pod Prisojnikom

Bioclastic grainstone with dasycladacean algae and clusters of cyanobacteria. The latter overgrew some of algal skeletons. Prisojnik rock wall, Julian Alps

Tabla 11 – Plate 11

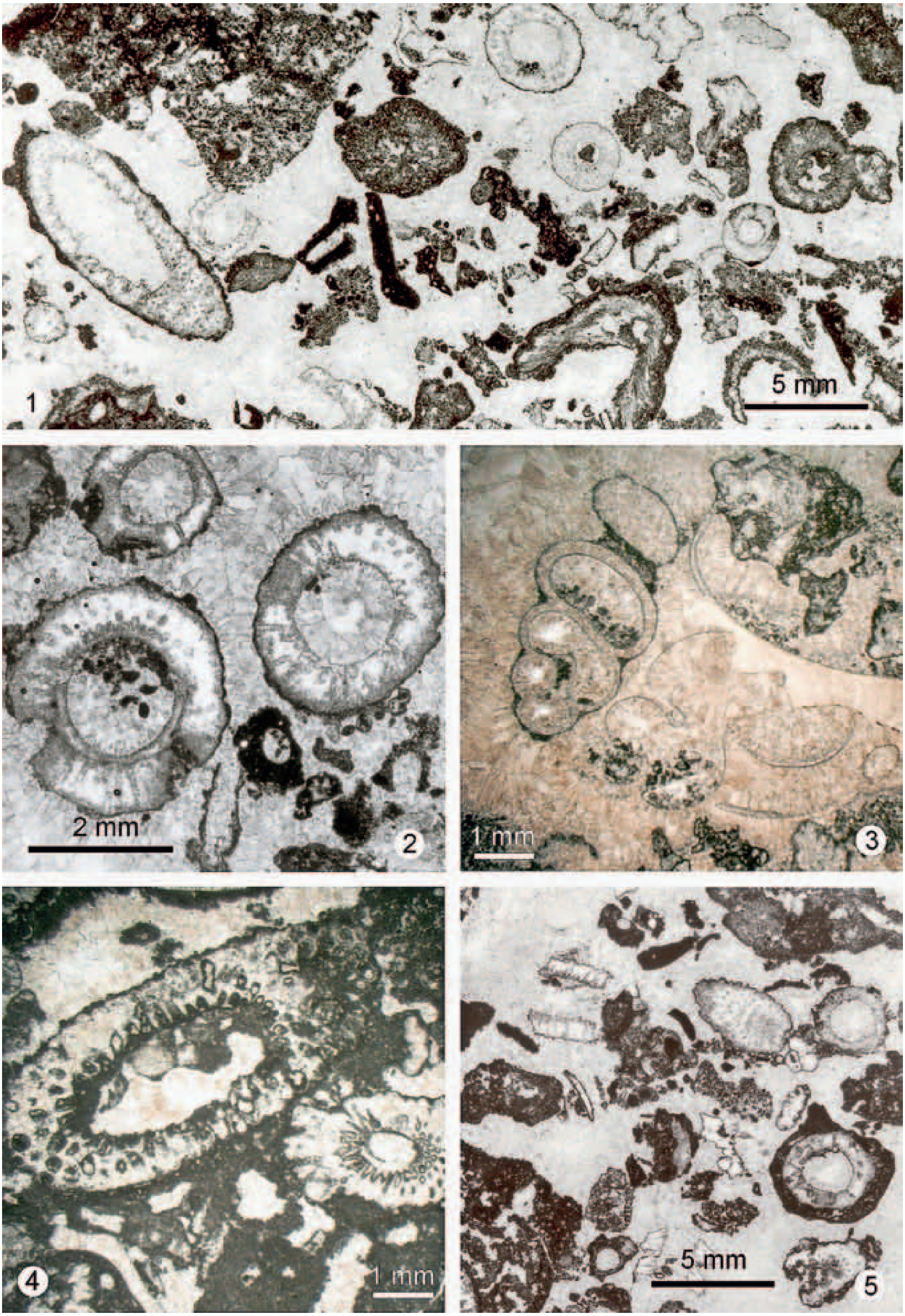


Tabla 12 – Plate 12

Zgornji trias (karnij) – Upper Triassic (Carnian)

1, 2 Biomikritni packstone s preseki školjčnih lupin. Sl. 2 – detajl. Kamnolom Drenov grič pri Vrhniki
Biomicritic packstone with bivalve shells. Fig. 2 – detail. Drenov grič quarry at Vrhnika

3, 4 Mikritni wackestone s posameznimi ostrakodi in školjčnimi lupinami. Sl. 3 – Limbarska gora nad Moravčami, sl. 4 – kamnolom Drenov grič pri Vrhniki
Micritic wackestone with ostracods and bivalve shells. Fig. 3 – Limbarska gora above Moravče, Fig. 4 - Drenov grič quarry at Vrhnika

5 Alga *Poikiloporella duplicata* v stromatolitnem apnencu. Ščura nad Spodnjo Trebušo
Poikiloporella duplicata algae in stromatolitic limestone. Ščura above Spodnja Trebuša

6 Sferoidalni onkoidni packstone. Gačnik na Vojskarski planoti
Spheroidal oncoidal packstone. Gačnik on Vojsko plateau

Tabla 12 – Plate 12

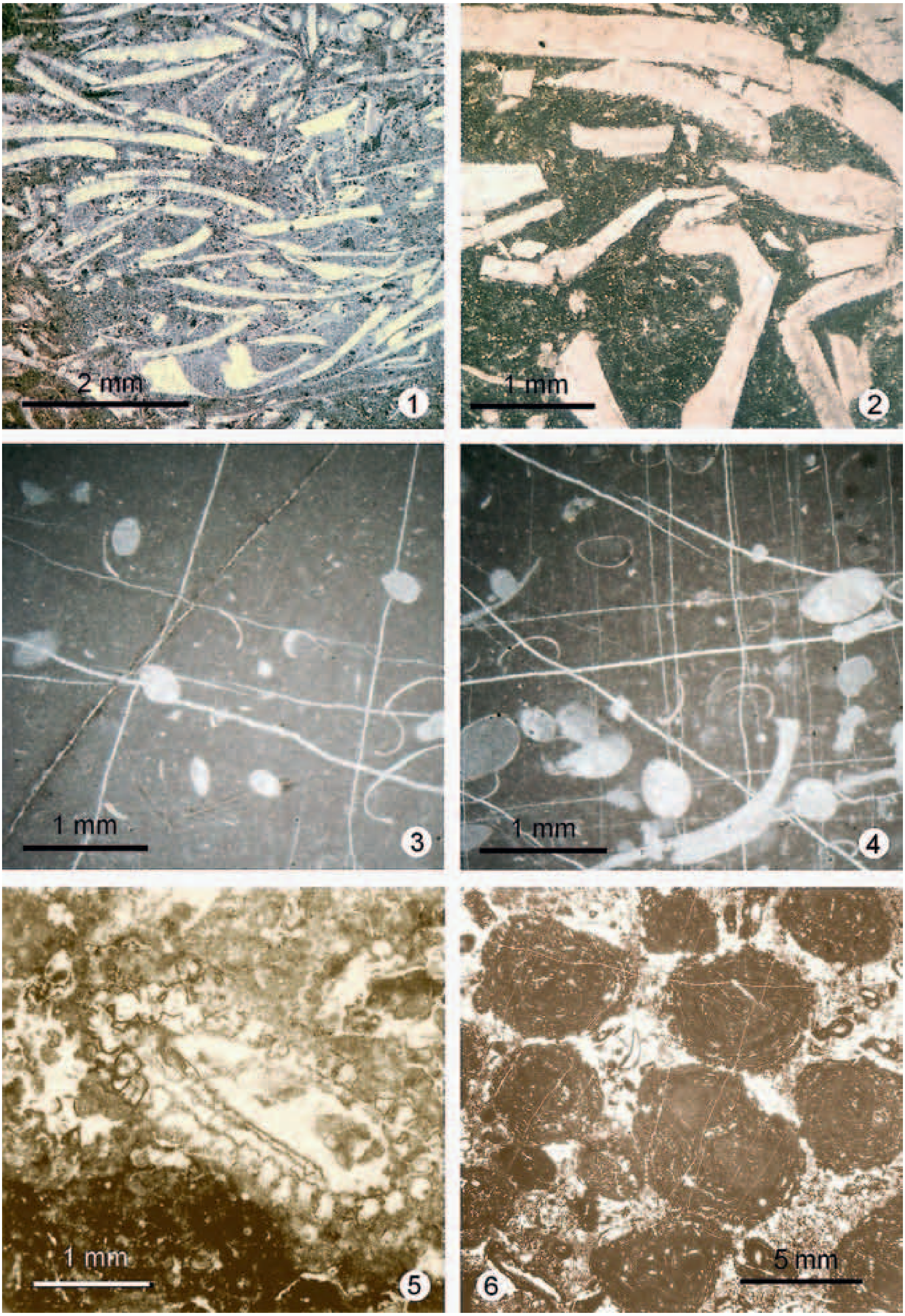


Tabla 13 – Plate 13

Zgornji trias (karnij) – Upper Triassic (Carnian)

1 Stromatolitni dolomit z izsušitvenimi porami. V večji pori sta opazni dve generaciji cementa – obrobni cement A in sparitni dolomit B. Borovnica

Fenestral stromatolitic bindstone. Two generations of cement are present in fenestrae – rim cement of generation A and sparry dolomite of generation B. Borovnica

2 Mikritni apnenec z velikimi izsušitvenimi porami, v katerih opazujemo dve generaciji cementa – obrobni cement A in sparitni kalcit B ter geopetalno strukturo internega mikrita. Črna pri Kamniku

Micritic limestone with shrinkage pores. Two generations of cement are present – rim cement A and sparry calcite B. Geopetal texture of internal micrite. Črna at Kamnik

3 Ploščice ehinodermov (rdeče) v dolomikritni osnovi. Pri dolomitizaciji kamnine so te ohranile prvotno kalcitno sestavo. Vzorec je obarvan z alizarinskim barvilom. Tamar

Echinoid plates (red) in dolomicritic matrix. Their primary calcitic composition was preserved during dolomitization. Alizarin red staining, Tamar

4 Izpran pelmikritni packstone. Ščura nad Spodnjo Trebušo

Pelmicritic packstone. Micritic matrix is mostly washed. Ščura above Spodnja Trebuša

5 Sparitni dolomit. Pore, nastale pri dolomitizaciji apnenca, zapolnjuje sparitni kalcit (rdeče). Vzorec je obarvan z alizarinskim barvilom. Tamar

Sparry dolomite. Vugs, formed during dolomitization of primary calcite are cemented by sparry calcite. Alizarin red staining. Tamar

6 Sparitni dolomit s polji poznodiagenetskega kalcita. Vzorec je obarvan z alizarinskim barvilom, Krma v Julijskih Alpah

Sparry dolomite with fields of late diagenetic calcite cement. Alizarin red staining. Krma in Julian Alps

Tabla 13 – Plate 13

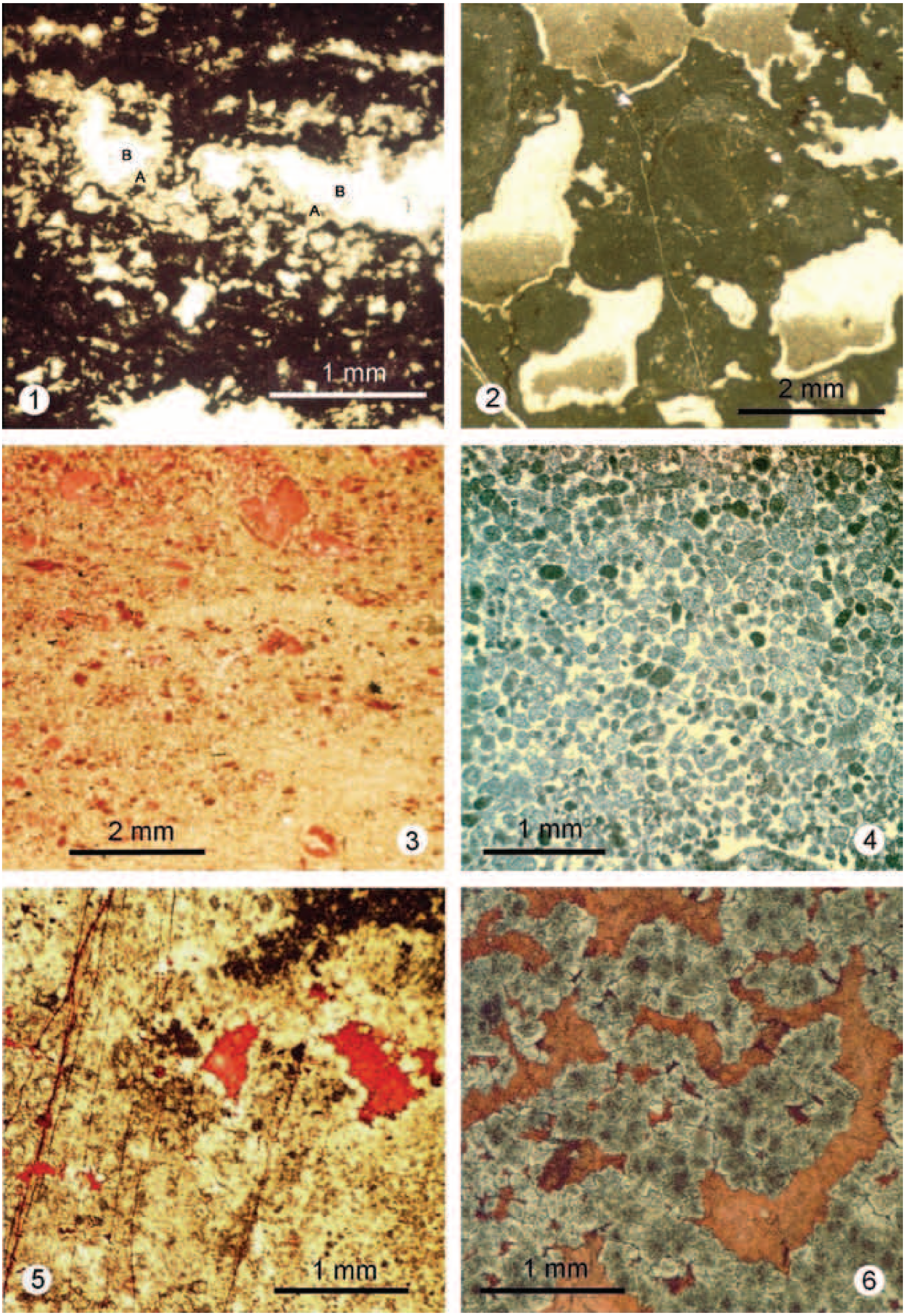


Tabla 14 – Plate 14

Zgornji trias (cordevol) – Upper Triassic (Cordevolian)

1, 2 Selektivna dolomitizacija pizoida v biosparitnem grainstonu. Na sl. 2 pizoid prečka stilolitni šiv. Krma v Julijskih Alpah

Selective dolomitization of a pisoid in biosparitic grainstone. Pisoid on Fig. 2 is cut by stylolite. Krma in Julian Alps

3 Presek rdeče alge *Solenopora cassiana*. Apnenec je zajela poznodiagenetska dolomitizacija. Krma v Julijskih Alpah

Transve section of red algae *Solenopora cassiana*. Limestone was affected by late diagenetic dolomitization. Krma in Julian Alps

4 Moldično poro po neznanem organizmu v biosparitnem grainstonu zapolnjujeta obrobni dolomitni cement generacije A (beli evhedralni kristali), osrednji del pore pa sparitni kalcit (rdeče). Vzorec je obarvan z alizarinskim barvilom. Krma v Julijskih Alpah

Moldic vug in biosparitic grainstone (caused after an unknown organism) is cemented by two generations of cement – dolomite rim cement A (white, euhedral crystals) and sparry calcite in the central part (red). Alizarin red staining. Krma in Julian Alps

5 Sparitni dolomit z evhedralnimi conarnimi kristali, delno kalcitiziran (rdeče) in prepreden z avtigenim kremenom (belo). Vzorec je obarvan z alizarinskim barvilom. Gnezdo v grebenskem apnencu. Kamnolom v Hotavljah

Dolosparite with euhedral conar crystals, partly calcitized (red) and cut by authigenic quartz (white). Alizarin red staining. Lens in reefal limestone. Hotavlje quarry

6 Sparitni dolomit z evhedralnimi conarnimi kristali. Leča v grebenskem apnencu kamnoloma Lesno Brdo pri Vrhniki

Dolosparite with euhedral conar crystals. Lens in reefal limestone of quarry Lesno Brdo at Vrhnika

Tabla 14 – Plate 14

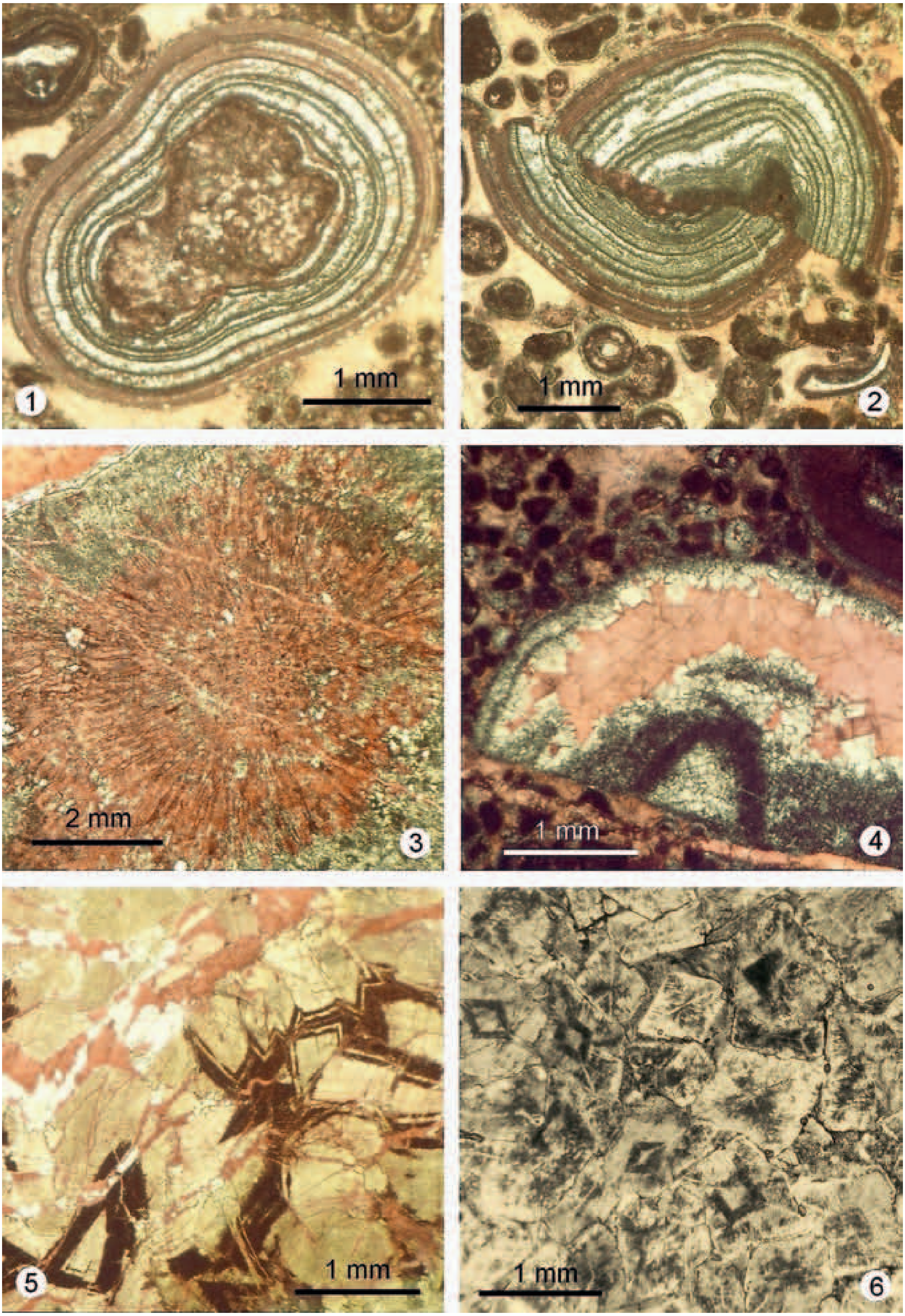


Tabla 15 – Plate 15

Zgornji trias (karnij) – Upper Triassic (Carnian)

1, 2 Ogrodje grebenskega apnenca sestavljajo členkaste spongije vrste *Alpinothalamia slovenica*. Hudajužna

Reef framework formed by encrusting sphyntozoan sponges *Alpinothalamia slovenica*. Hudajužna

3 Vzdolžni presek členkaste spongije vrste *Solenolmia manon* v grebenskem apnencu tipa framestone. Hudajužna

Longitudinal section of sphynctozoan sponge *Solenolmia manon* in reefal framestone. Hudajužna

4 Kristali pirita v grebenskem spongijskem apnencu. Desno zgoraj je ploščica ehinoderma. Hudajužna

Pyrite crystals in reefal spongiostromate limestone. Echinoid plate in upper right corner. Hudajužna

5 Detajl vzdolžnega preseka členkaste morske gobe *Colospongia dubia* v grebenskem apnencu. Hudajužna

Detail of longitudinal section of sphyntozoan sponge *Colospongia dubia* in reefal framestone. Hudajužna

6 Prečni preseki korale *Margarosmilia richthofeni* v grebenskem apnencu tipa framestone. Cordevol-jul. Pokljuka (zbirka D. Turnšek)

Transversal section of *Margarosmilia richthofeni* coral in reefal framestone. Cordevolian-Julian. Pokljuka (D. Turnšek collection)

Tabla 15 – Plate 15

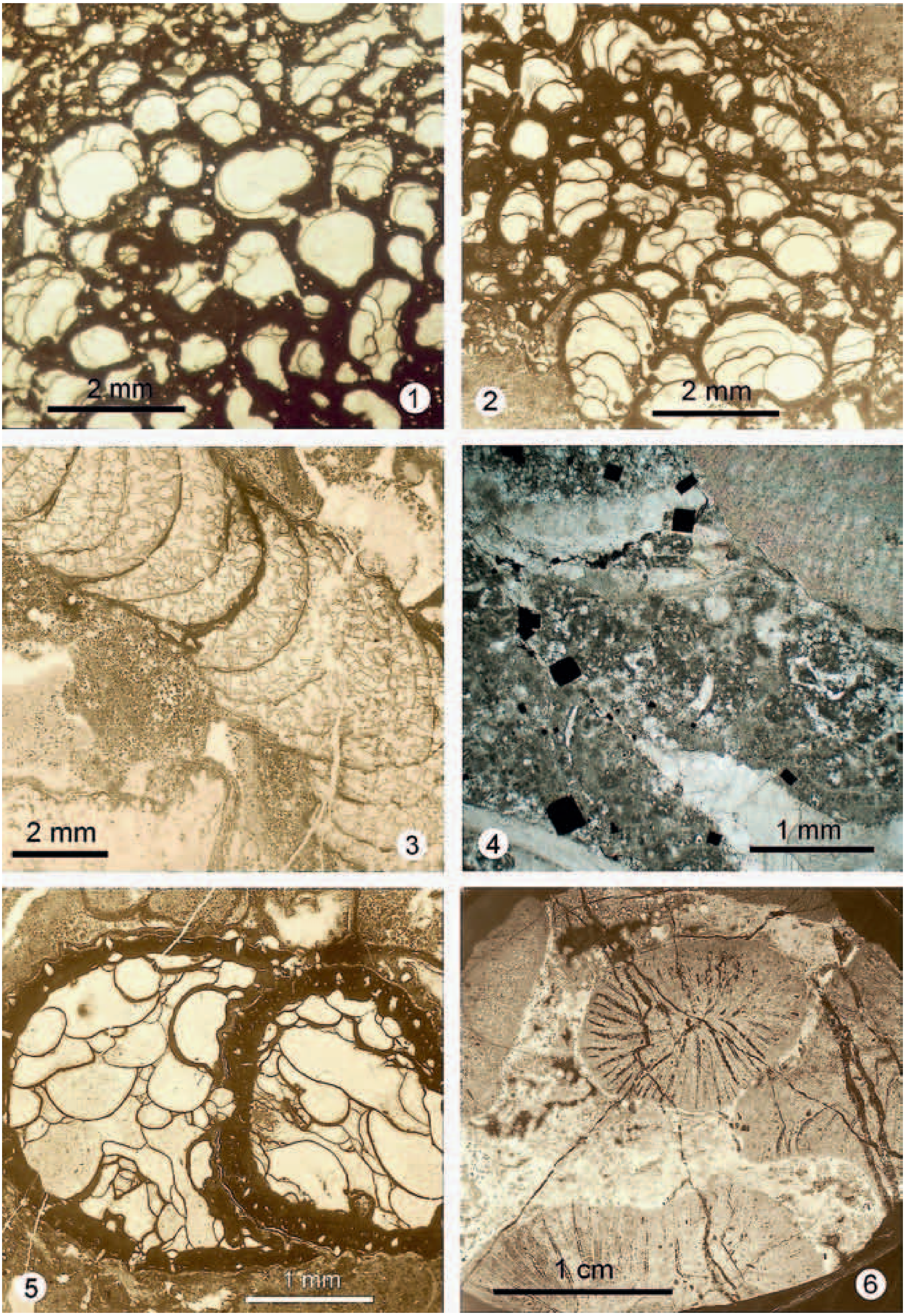


Tabla 16 – Plate 16

Zgornji trias – karnij (jul in tuval) – Upper Triassic – Carnian (Julian and Tuvalian)

1,2 Onkoidno-ooidni grainstone s številnimi bioklasti. Posamezni ooidi in fragmenti moluskov so inkrustirani s cianobakterijami. Apnenec je tudi delno piritiziran. Helenski potok pri Mežici, 2. klastični horizont

Oncoidal-ooidal grainstone with numerous bioclasts. Some ooids and molluscan fragments are encrusted by cyanobacterian mats. Limestone is partly pyritized. Helena creek at Mežica, 2nd clastic horizon

3,5 Onkoidno-oolitni packstone (rudstone). Osnova apnenca je rahlo izpran laporni mikrit. E – ploščice ehinodermov. Helenski potok pri Mežici, 2. klastični horizont

Oncolitic-oolitic packstone (rudstone). Matrix of limestone is a partly washed marly micrite. E – echinoderm plates. Helena creek at Mežica, 2nd clastic horizon

4 Oolitni grainstone. V jedrih nekaterih ooidov so ploščice ehinodermov. Pikov vrh nad Helensko grapo pri Mežici

Oolitic grainstone. Nuclei of some ooids are echinoderm plates. Pikov vrh above Helena creek at Mežica

6 Neskeletne alge s filamenti v stromatolitni plasti. Številne izsušitvene pore, zapolnjene s sparitnim kalcitom. Dolenja Trebuša - Čepovan

Nonskeletal algae with filaments in stromatolitic layer. Numerous small fenestrae are cemented by sparry calcite. Dolenja Trebuša - Čepovan

Tabla 16 – Plate 16

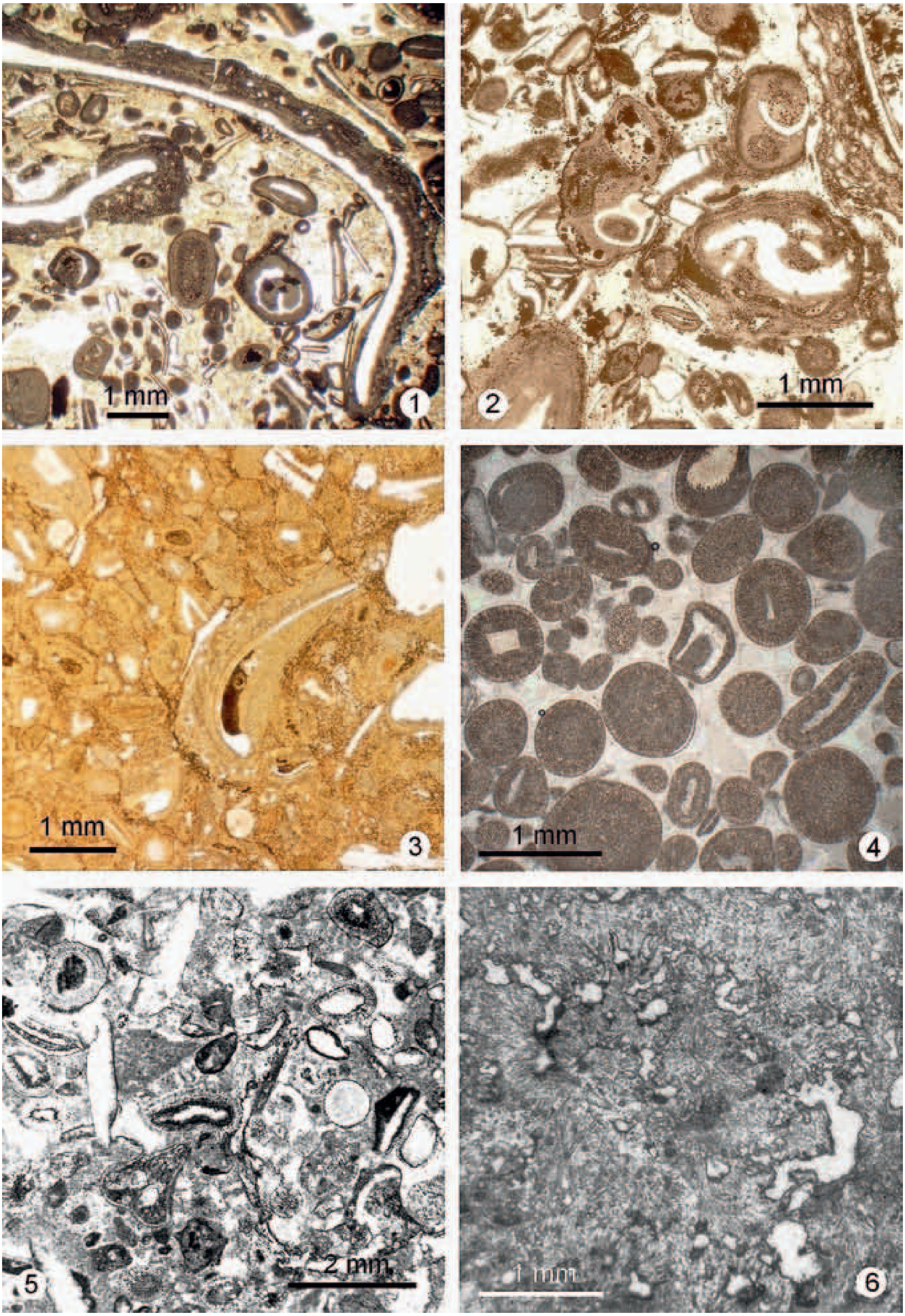


Tabla 17 – Plate 17

Zgornji trias – karnij (jul in tuval) – Upper Triassic – Carnian (Julian and Tuvalian)
Globljemorski razvoj – Deep water environment

1 Lapornat wackestone s kalcitiziranimi radiolariji in drobirjem tankolupinskih moluskov. Kozja dnina v Vratih pod Triglavom

Marly wackestone with calcitised radiolarians and fragments of thin-walled molluscans. Kozja dnina in Vrata below Triglav

2 Pelmikritni packstone z velikimi in drobnimi peleti ter redkimi terigenimi zrni kremena (belo). Belca v zahodnih Karavankah

Pelmicritic packstone with pelets and rare terrigenous quartz grains (white). Belca valley in western Karavanke Mts.

3, 5 Biomikritni packstone z radiolariji in filamenti pelagičnih organizmov. Belca v zahodnih Karavankah

Biomicritic packstone with radiolarians and pelagic filaments. Belca valley in western Karavanke Mts.

4 Biomikritni packstone s fragmenti moluskov in foraminiferami. Belca v zahodnih Karavankah

Biomicritic packstone with mollusc fragments and foraminifers. Belca valley in western Karavanke Mts.

6 Spikulitni packstone z delno kalcitiziranimi spikulami spongij. Belca v zahodnih Karavankah

Spiculite packstone with partly calcitized sponge spicules. Belca valley in western Karavanke Mts.

Tabla 17 – Plate 17

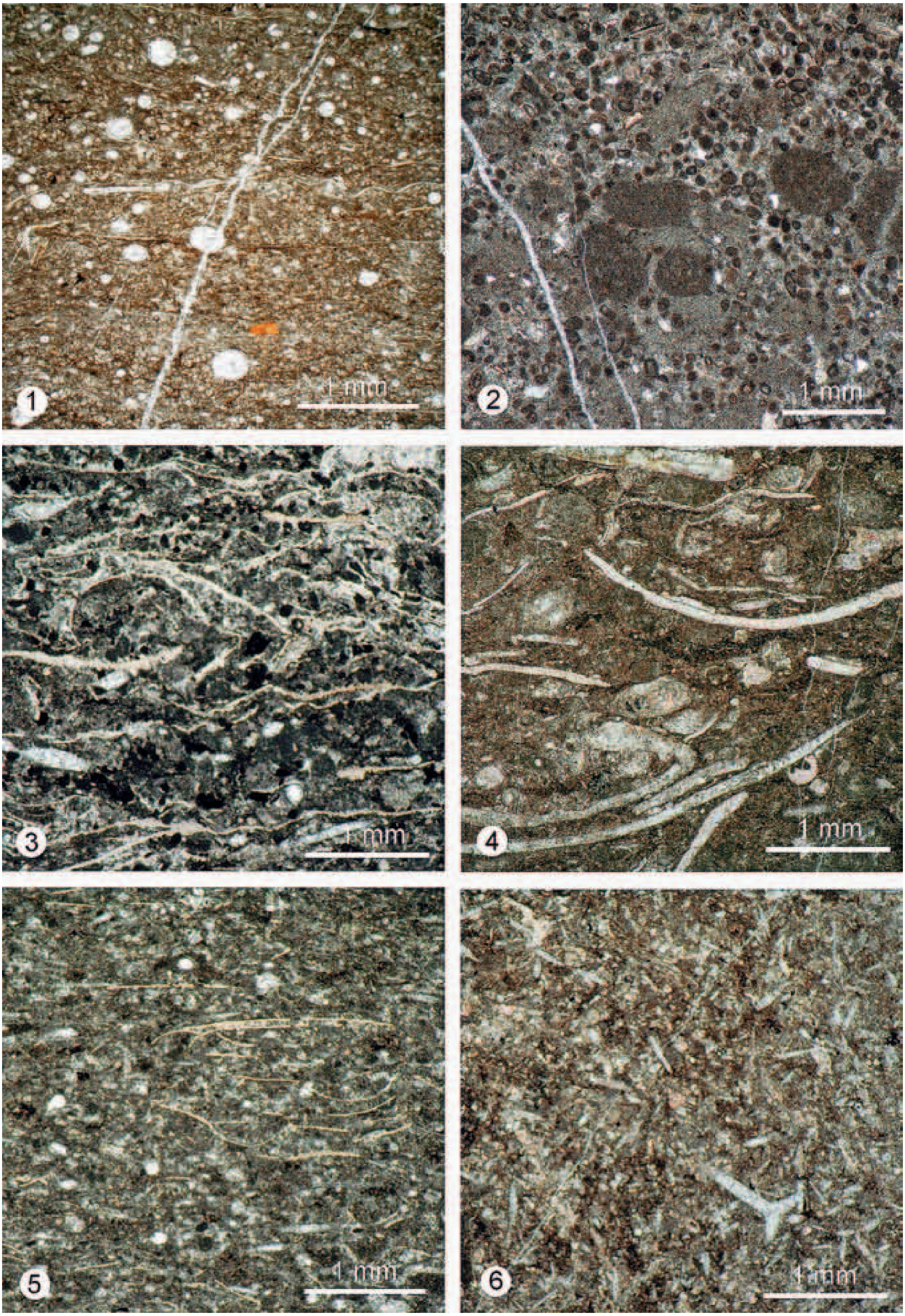


Tabla 18 – Plate 18

Zgornji trias (norij in retij) – Upper Triassic (Norian and Rhaetian)
Medplimsko okolje – Intertidal environment

1, 2 Stromatolitni loferit z drobnimi izsušitvenimi porami. Nekatere pore na sl. 1 so zapolnjene z internim mikritom. Sl. 1 – Grudnica pri Čepovanu, Sl. 2 – Begunjščica nad Ljubeljem

Stromatolitic fenestral limestone – loferite. Some fenestra on fig. 1 are filled with internal micrite. Fig. 1 – Grudnica at Čepovan, Fig. 2 – Mt. Begunjščica above Ljubelj road pass

3, 4 Laminirana stromatolitna tekstura z ohranjeno strukturo cianobakterij. Sl. 3 in 4 - Dolenja Trebuša - Čepovan

Laminated stromatolitic texture with preserved cyanobacteria. Figs. 3 and 4 - Dolenja Trebuša - Čepovan

5 Izsušitvene pore v mikritni osnovi – loferit. Pore kažejo geopetalno strukturo z internim mikritom in gravitacijskim cementom (puščice). Apnenec je delno zajela poznodiagenetska dolomitizacija. Dachsteinski apnenec, Smrekova draga na Trnovskem gozdu

Shrinkage pores in micritix matrix – loferite. Geopetal texture is visible in fenestrae, evident by internal micrite and stalactitic cement (arrows). Limestone is partly affected by late diagenetic dolomitization. Dachstein limestone , Smrekova draga on Trnovski gozd

6 Detajl s sl. 5

Detail from fig. 5

Tabla 18 – Plate 18

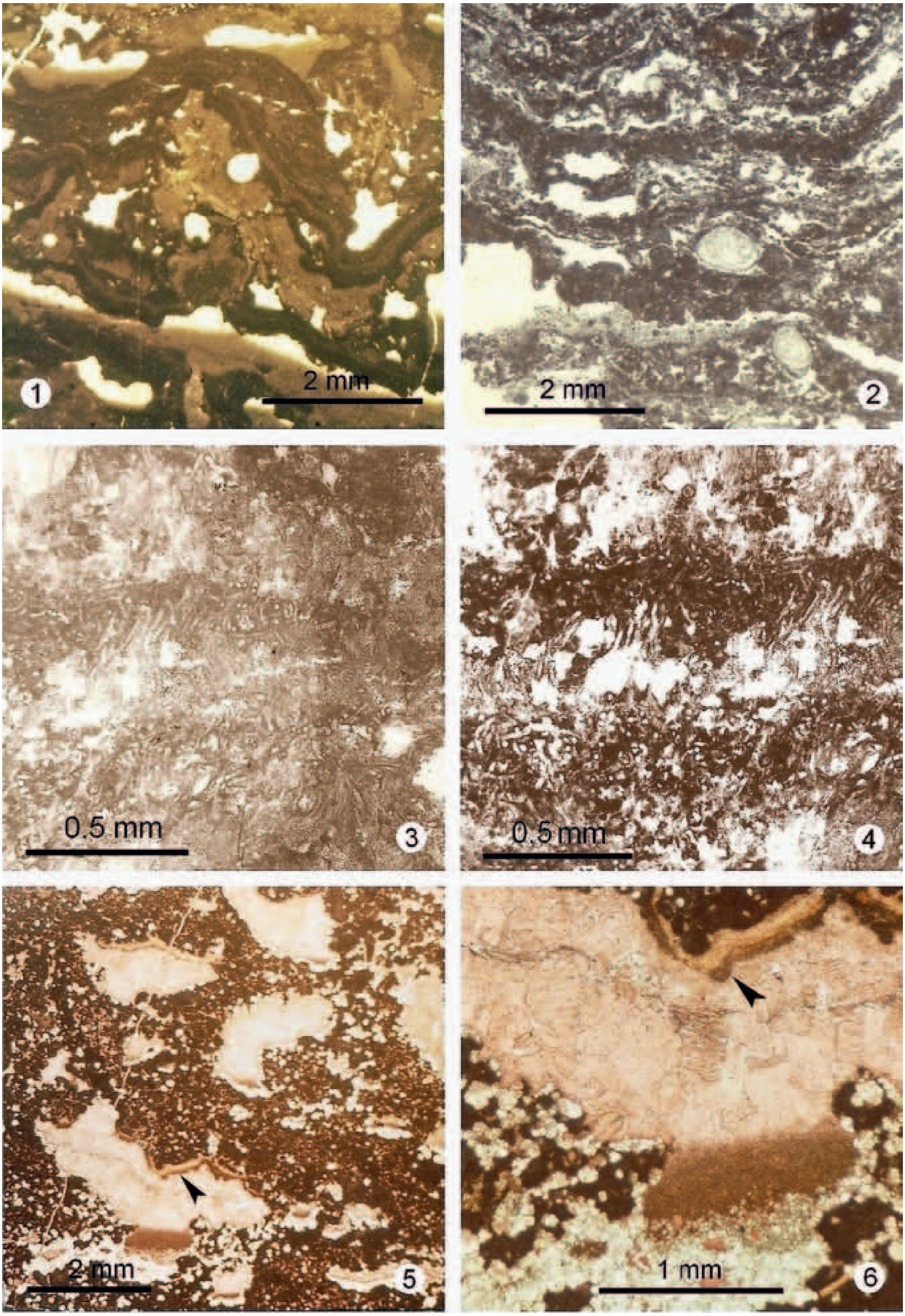


Tabla 19 – Plate 19

Zgornji trias (norij in retij) – Upper Triassic (Norian and Rhaetian)

Medplimsko okolje – Intertidal environment

1 Stromatolitni dolomit. Izsušitvene pore so bile v pozni diagenezi zapolnjene s sparitnim kalcitom (rdeče). Vzorec je obarvan z alizarinskim barvilom. Begunjščica nad Ljubeljem

Stromatolitic dolomite. Shrinkage pores were filled by sparry calcite (red) during late diagenesis. Alizarin red staining. Mt. Begunjščica above Ljubelj road pass

2 Izsušitvena pora v izpranem pelmikritnem packstonu. Poro zapolnjuje interni mikrit, gravitacijski cement (puščica) in sparitni kalcit. Dachsteinski apnenec, Begunjščica

Shrinkage pore in washed pelmicritic packstone. Pore is filled by internal micrite, gravitational cement (arrow) and sparry calcite. Dachstein limestone, Mt. Begunjščica

3 Mikritni mudstone z redkimi intraklasti in izsušitvenimi porami – loferit. Čepovan

Fenestral mudstone with rare intraclasts and shrinkage pores – loferite. Čepovan

4 Stromatolitni dolomit – bafflestone z izsušitvenimi porami. Glavni dolomit. Borovnica

Stromatolitic dolomite – bafflestone with shrinkage pores. Main dolomite. Borovnica

5 Laminiran dolomit z izsušitvenimi razpokami, ki kažejo na medplimsko okolje in z drobnimi izsušitvenimi porami. Dolenjske Toplice, vrtina V8/335 m

Laminated dolomite with desiccation cracks and fine shrinkage pores. Dolenjske Toplice, borehole V8/335 m

6 Pelmikritni loferit z izsušitvenimi porami, ki jih zapolnjuje sparitni kalcit. Smrekova draga na Trnovskem gozdu

Pelmicritic loferite with shrinkage pores, filled by sparry calcite. Smrekova draga on Trnovski gozd

Tabla 19 – Plate 19

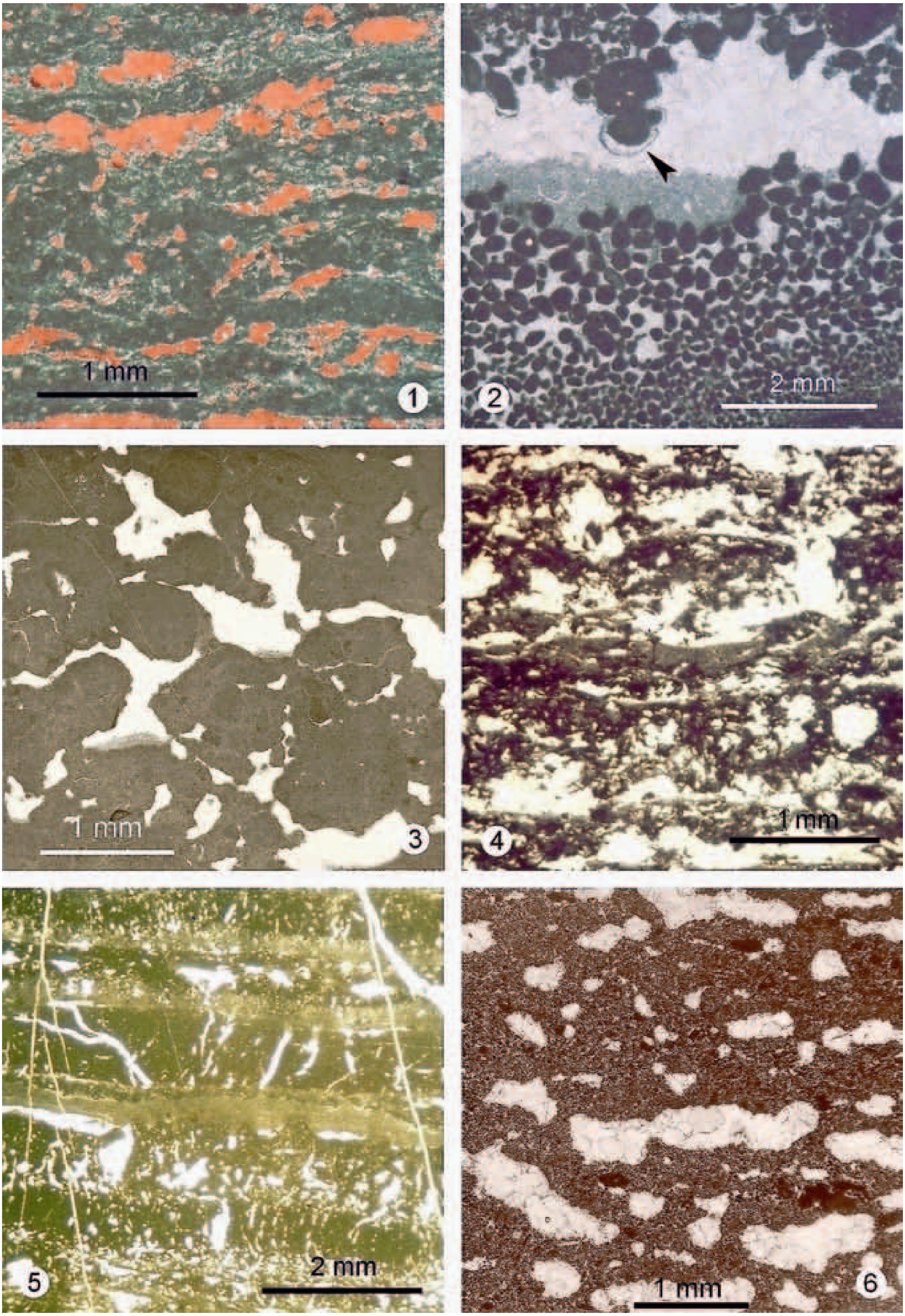


Tabla 20 – Plate 20

Zgornji trias (norij in retij) – Upper Triassic (Norian and Rhaetian)

1 Grainstone s številnimi preseki alge *Thaumatoporella parvovesiculifera* in peleti. Smrekova draga na Trnovskem gozdu

Algal grainstone with algae *Thaumatoporella parvovesiculifera* and pellets. Smrekova draga on Trnovski gozd

2 Korozijska votlina z internim mikritom, v katerega so bile naplavljene lupine ostrakodov. Polovnik pri Bovcu

Solution cavity filled by internal micrite with washed in ostracod fragments. Mt. Polovnik at Bovec

3 Izpran pelmikritni packstone z izsušitvenimi porami – loferit. Pore zapolnjuje sparitni kalcit. Grudnica pri Čepovanu

Washed pelmicritic packstone with shrinkage pores – loferite. Fenestrae are filled by sparry calcite. Grudnica at Čepovan

4 Laminiran dolomit z izsušitvenimi porami in razpokami ter strukturami po stromatolitnih filamentih. Medplimsko okolje. Borovnica

Laminated dolomite with shrinkage pores, desiccation cracks and structures, after stromatolitc filaments. Supratidal environment. Borovnica

5 Presek alge (solenopore) v izpranem intrabiomikritnem apnencu. Javorški vrh na Trnovskem gozdu

Section of algae (Solenopora) in washed intrabiomicritic limestone. Javorški vrh on Trnovski gozd

6 Rekristalizirani koraliti v pelmikritnem apnencu – framestone. Moldične pore po koralitih zapolnjuje sparitni kalcit. Dachsteinski apnenec, Čepovan - Lokovec

Coralite contours in recrystallized pelmicritic framestone. Moldic pores are cemented by sparry calcite. Dachstein limestone, Čepovan – Lokovec

Tabla 20 – Plate 20

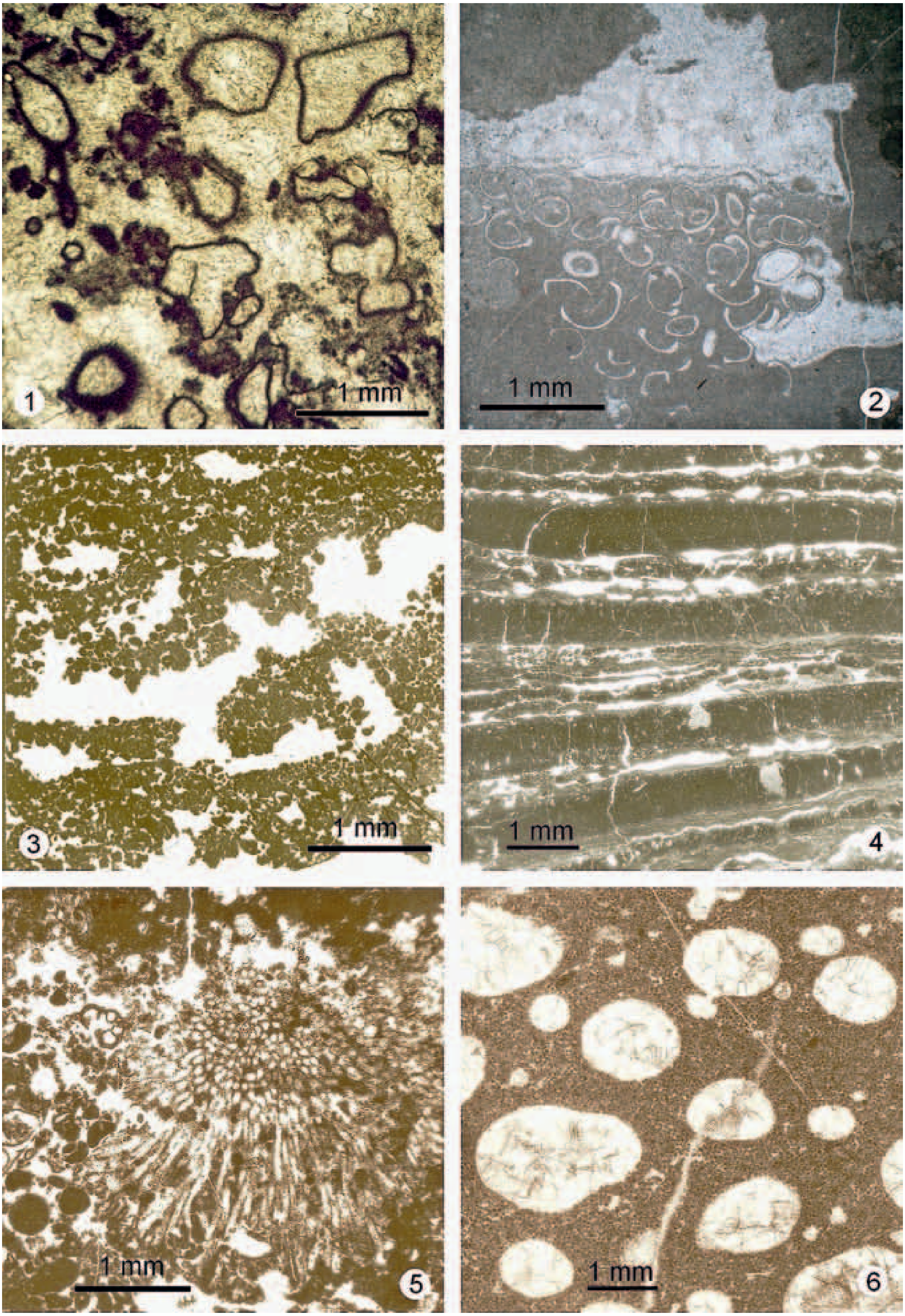


Tabla 21 – Plate 21

Zgornji trias (norij in retij) – Upper Triassic (Norian and Rhaetian)

1 Vadozni pizoidi, inkrustirani s cianobakterijami in s sparitnim cementom v medprostorih. Glavni dolomit. Koprivnik pri Kočevju

Vadose pisoids, encrusted by cyanobacteria. Sparry dolomite between the pisoids. Main dolomite. Koprivnik at Kočevje

2 Vadozni pizoidi v intramikritnem dolomitu z izsušitvenimi porami. Trenta

Vadose pisoids in the intramicritic dolomite with shrinkage pores. Trenta

3 Večkratno preraščanje algnega onkoida, inkrustiranega z ovoji cianobakterij. Glavni dolomit. Spodnja Trebuša - Čepovan

Multiple owergrowth of algal oncoide, encrusted by cyanobacteria. Main dolomite. Spodnja Trebuša - Čepovan

4 Onkoid v pelmikritnem packstonu, ki ga je zajela poznodiagenetska dolomitizacija. Begunjščica

Algal oncoid in fenestral pelmicritic packstone, affected by late dolomitization. Mt. Begunjščica

5 Intramikritni dolomit z izsušitvenimi porami (A) prehaja v horizont z vadoznimi pizoidi (B), te pa prerašča stromatolitni bafflestone z izsušitvenimi porami (C). Korozijske votline med pizoidi zapolnjuje več generacij dolomitnega cementa (kokardna struktura). Glavni dolomit. Krn v Julijskih Alpah

Intramicritic dolomite with shrinkage pores (A) pass to horizon with vadose pisoids (B), owergrown by stromatolitic bafflestone with shrinkage pores (C). Solution cavities in pisoid horizon are filled with two generations of sparry dolomite (cockade texture). Main dolomite. Mt. Krn in Julian Alps

Tabla 21 – Plate 21

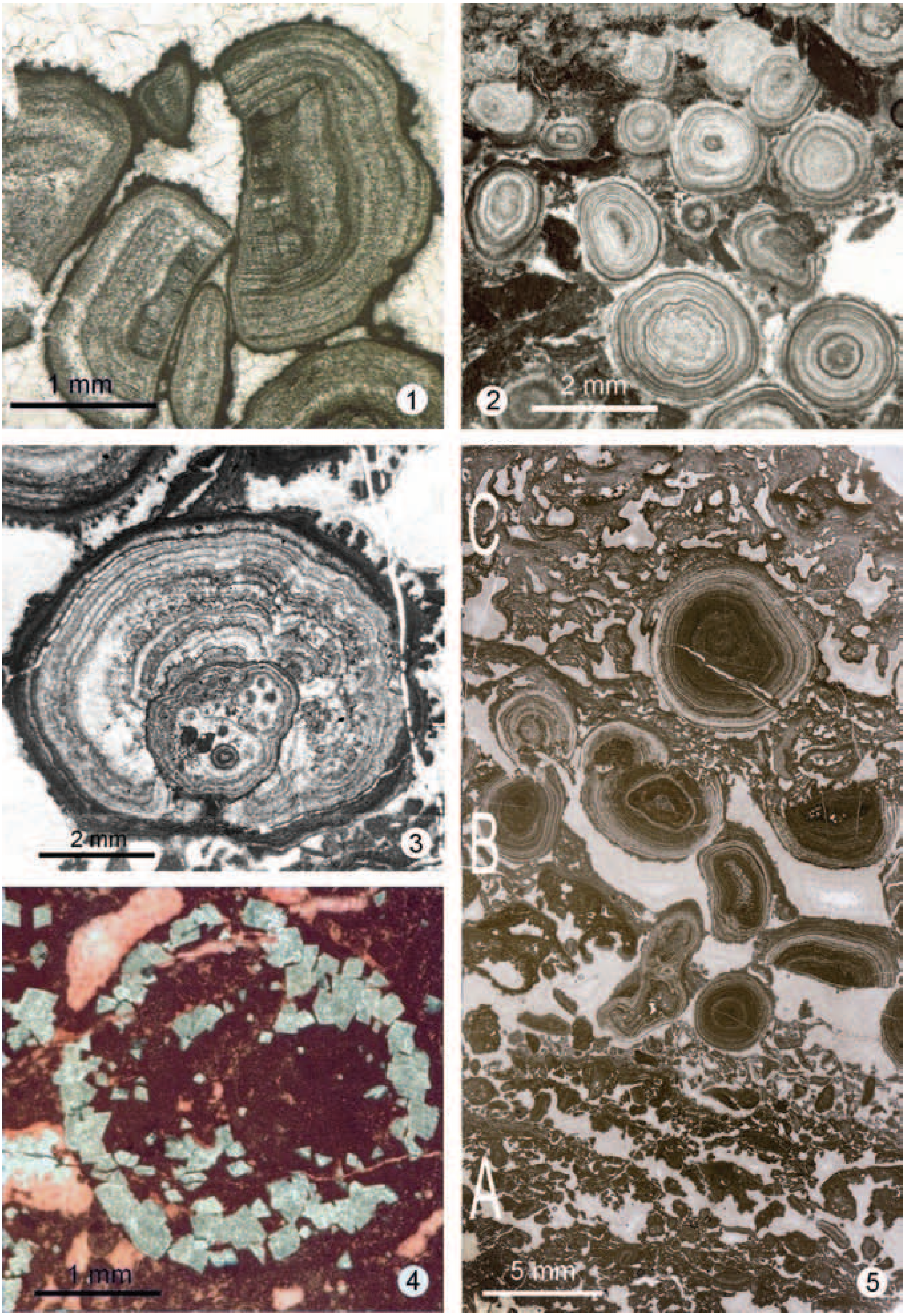


Tabla 22 – Plate 22

Zgornji trias (norij in retij) – Upper Triassic (Norian and Rhaetian)

1 Spongija *Cheilosporites* v mikritnem apnencu – framestone. Dachsteinski apnenec. Nomenj pri Bohinjski Bistrici

Cheilosporites sponge in micritic framestone. Dachstein limestone. Nomenj at Bohinjska Bistrica

2 Grebenski apnenec – framestone s koralami in s korozijskimi votlinami. Te zapolnjujeta dve generaciji sparitnega kalcita. Nomenj pri Bohinjski Bistrici

Reef framestone with corals and small solution cavities, filled with two generations of sparry calcite. Nomenj at Bohinjska Bistrica

3,4 Gastropodni grainstone. Hišice polžev so ohranjene po mikritnih ovojih. Dachstainski apnenec. Čepovan – Lokavec

Gastropode grainstone. Gastropod shells are preserved after micritic envelopes. Dachstein limestone. Čepovan - Lokavec

Tabla 22 – Plate 22

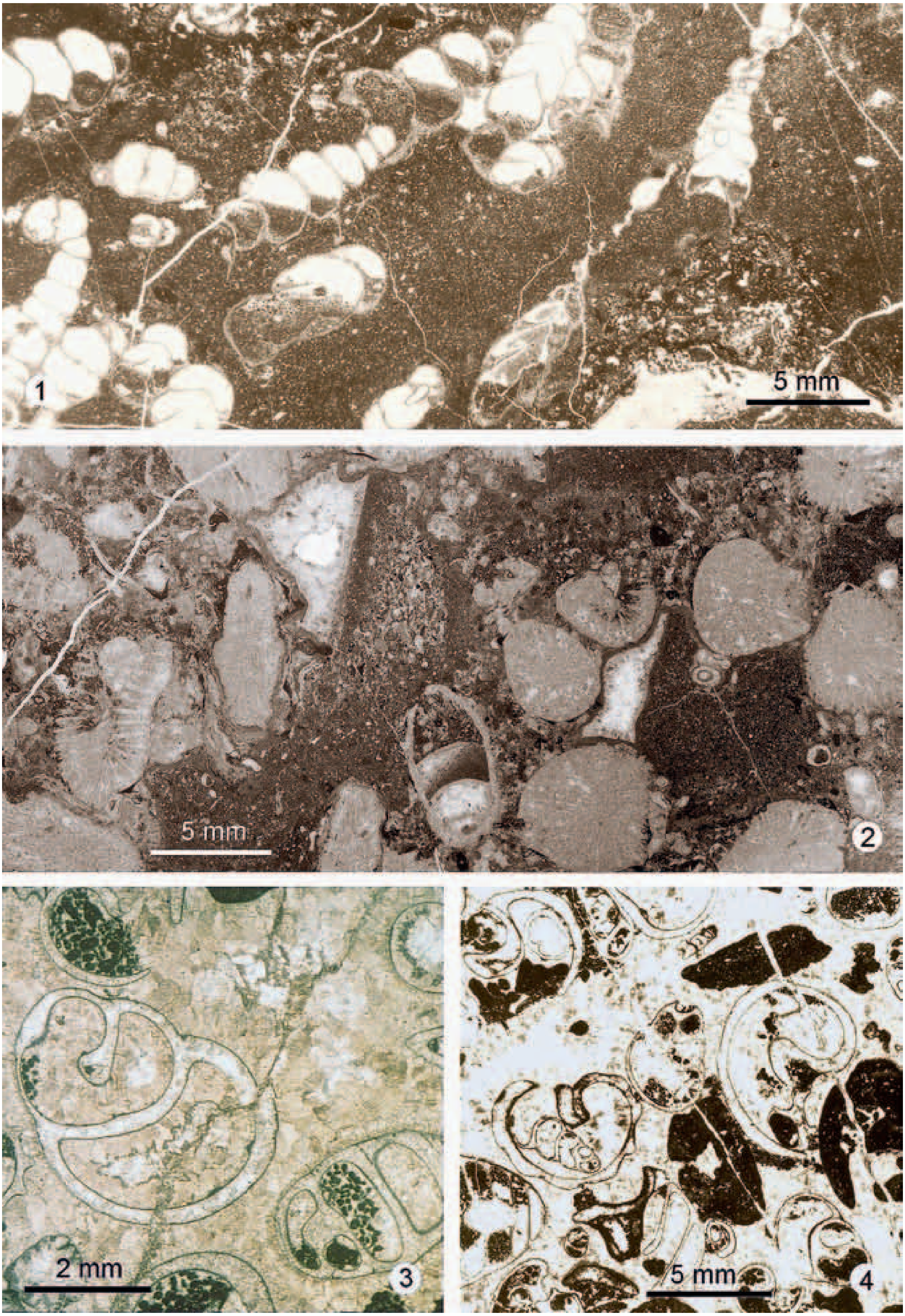


Tabla 23 – Plate 23

Spodnja jura (lias) – Lower Jurassic (Lias)

1 Biomikritni mudstone z lupinami moluskov in s foraminiferami. Preserje pri Borovnici
Biomikritic mudstone with bivalve shells and some foraminifers. Preserje at Borovnica

2 Alga *Paleodasycladus mediterraneous* v biosparitnem apnencu – grainstone. Preserje pri Borovnici
Paleodasycladus mediterraneous algae in biosparitic grainstone. Preserje at Borovnica

3 Intrapelmikritni packstone z izsušitvenimi porami. V večji pori je viden gravitacijski cement (puščica). Javorški vrh na Trnovskem gozdu
Intrapelmicritic packstone with shrinkage pores. In a larger pore gravitational cement (arrow) is visible. Javorški vrh on Trnovski gozd

4 Školjčne lupine v intramikritnem packstonu. Dežnikasta poroznost pod lupino, pore zapolnjuje sparitni kalcit. Javorški vrh na Trnovskem gozdu
Bivalve shells in intramicritic packstone. Umbrella porosity under some shells; pores are filled with sparry calcite. Javorški vrh on Trnovski gozd

5 Moldična poroznost po fragmentu debelolupinske školjke v oosparitnem apnencu. Pora je zapolnjena s sparitnim kalcitom. Javorški vrh na Trnovskem gozdu
Moldic porosity after thick-walled shell fragment in oosparitic limestone. The pore was later filled by sparry calcite. Javorški vrh on Trnovski gozd

6 Ooidi z mikritno strukturo, naplavljeni v pelsparitni packstone. Racna gora pri Ložu
Ooids with micritic structure, washed in pelsparitic packstone. Racna gora at Lož

Tabla 23 – Plate 23

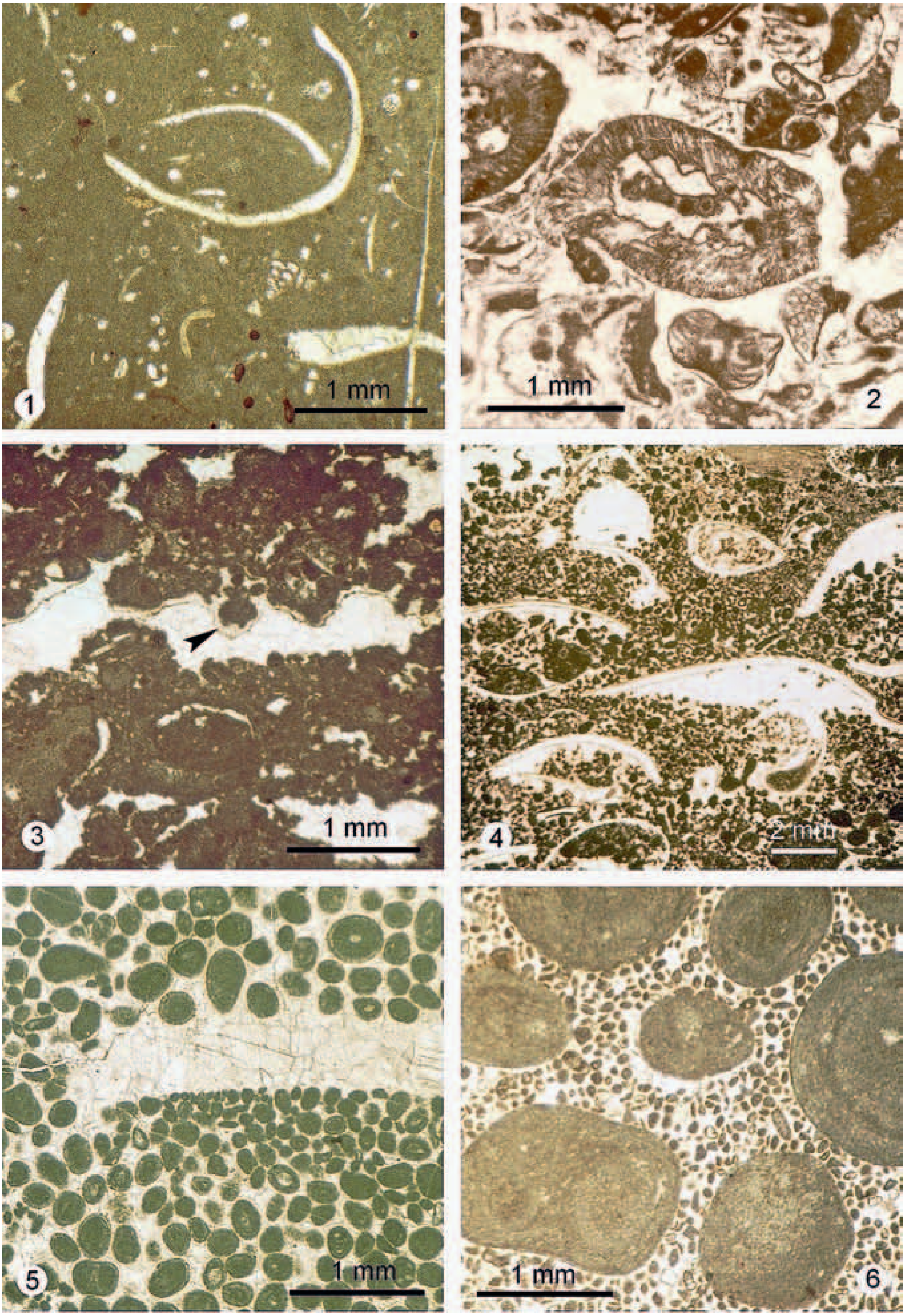


Tabla 24 – Plate 24

Spodnja jura (lias) – Lower Jurassic (Lias)

1 Oolitni grainstone s školjčnimi lupinami, ki so na konveksni strani inkrustirane z ovoji cianobakterij. Dežnikasta poroznost pod lupinami školjk. Dolenjske Toplice, vrtina V6/120 m

Oolitic grainstone with bivalve shells. On the convex side they are encrusted by cyanobacterial mats. Umbrella porosity under shells. Dolenjske Toplice, borehole V6/ 120 m

2 Ooidi v mikritni osnovi – packstone. Različna struktura ovojev (mikritna in radialna struktura kalcita). Grčarevec – Kalce

Ooids in micritic matrix – packstone. Micritic and radial-fibrous texture of ooid envelopes. Grčarevec – Kalce

3 Oosparitni grainstone s teksturo »polmeseca«, ki je rezultat meteorske diageneze in izluževanja evaporitnih ali aragonitnih kristalov. Geopetalna struktura. Javorški vrh na Trnovskem gozdu

»Half moon« ooids in oospatitic grainstone. Nuclei in most ooids have dropped to the bottom of the concetric outer layers, forming geopetal fabric. Such ooids are product of evaporite or aragonite solution process during meteoric diagenesis. Javorški vrh on Trnovski gozd

4 Oosparitni grainstone z različno velikimi ooidi z radialno strukturo. Nekateri ooidi so zdrobljeni in ponovno »regenerirani«. Gozd pri Colu

Oosparitic grainstone. Ooids of different diameter have radial-fibrous envelopes. Some ooids are broken and show »regeneration«. Gozd at Col

5 Oosparitni grainstone. Jedra nekaterih ooidov so ploščice ehinodermov. Javorški vrh na Trnovskem gozdu

Oosparitic grainstone. Echinoid plates serve as nuclei in some ooids. Javorški vrh on Trnovski gozd

6 Sparitni dolomit z ohranjeno strukturo ooidov. Onek pri Kočevju

Sparry dolomite with preserved primary ooid structure. Onek at Kočevje

Tabla 24 – Plate 24

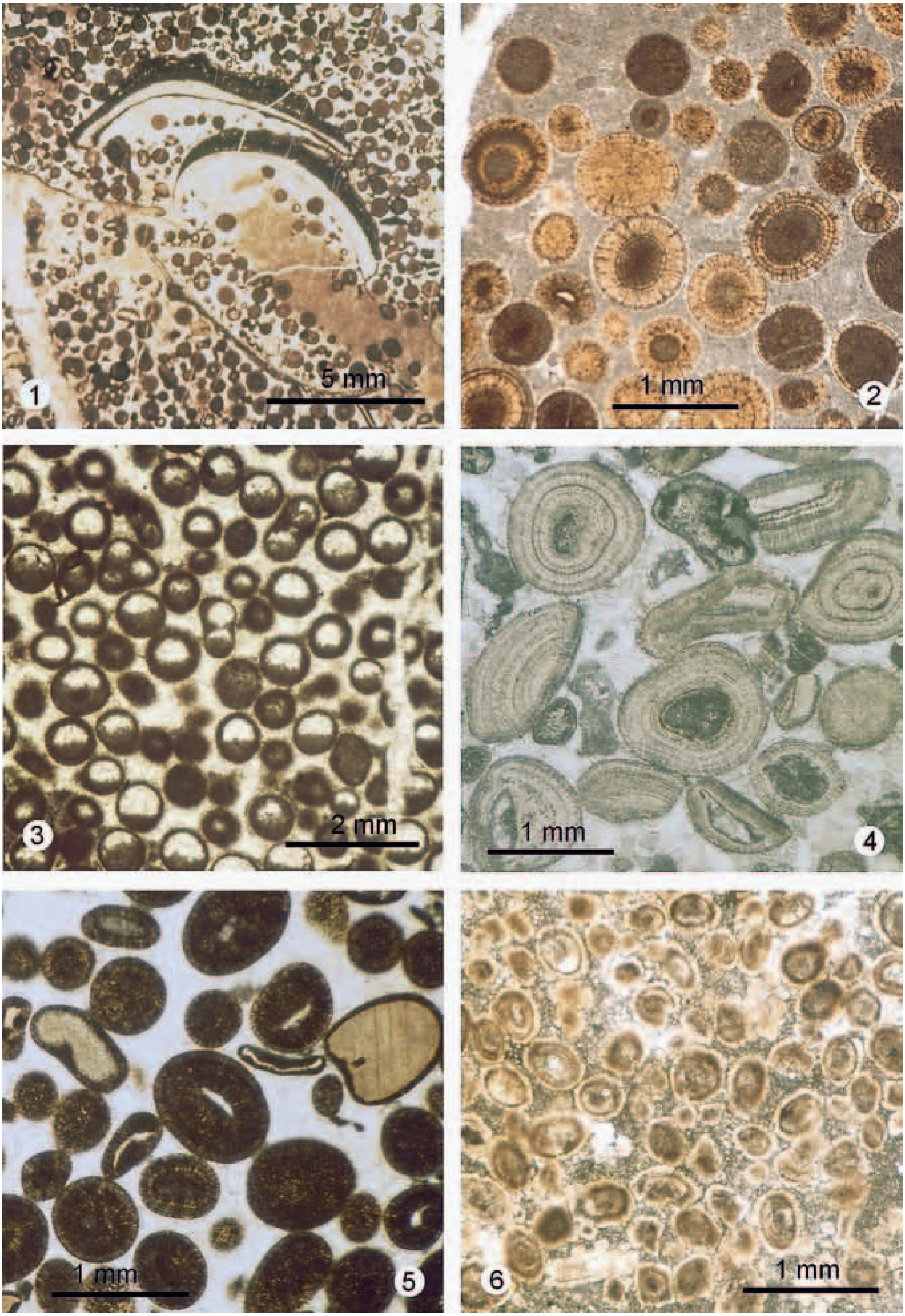


Tabla 25 – Plate 25

Spodnja jura (lias) – Lower Jurassic (Lias)

1 Oolitni apnenec – grainstone, ki ga je zajela selektivna poznodiagenetska dolomitizacija. Ta je osredotočena na mikritna jedra ooidov. Ploščice ehinodermov kot jedra nekaterih ooidov. Vrhpeč pri Trebnjem

Oolitic grainstone affected by selective late diagenetic dolomitization, focused on micritic nuclei of ooids. Echinoid plates in some ooid nuclei. Vrhpeč at Trebnje

2 Oosparitni grainstone, ki ga je zajela selektivna poznodiagenetska dolomitizacija. Ta prodira iz cementa v ooide. Vrhnika – Logatec

Oosparitic grainstone, affected by selective late diagenetic dolomitization, prograding from pores into ooid grains. Vrhnika – Logatec

3 Detajl oosparitnega apnenca. Opazni sta dve generaciji cementa – obrobni cement A (puščica) in sparitni kalcit B. Javorški vrh na Trnovskem gozdu

Detail of oosparitic limestone. Two generations of cement – rim cement A (arrow) and sparry calcite are evident. Javorški vrh on Trnovski gozd

4 Oosparitni grainstone z značilno mešano zgradbo ooidov – mikritnimi jedri in radialnimi kristali v zunanjih ovojih. Verd pri Vrhniki

Oosparitic grainstone with typical mixed ooid composition – micritic ooid nuclei are owergrown with radial-fibrous calcite lamellae. Verd at Vrhnika

5 Oolitni apnenec – grainstone. Zaradi tektonike so ooidi rahlo deformirani. Izstopa obrobni cement. Krka (zbirka S. Dozeta)

Oolitic grainstone. Ooids are slightly deformed due to tectonics. Rim cement is most evident. Krka (S. Dozet collection)

6 Oosparitni grainstone s stalaktitičnim cementom (puščica) pod nekaterimi ooidi, ki kaže na diagenezo v meteorskem okolju. Grčarevec – Kalce

Oosparitic grainstone. Stalactitic cement under some ooids (arrow) is indicating diagenesis in meteoric environment. Grčarevec – Kalce

Tabla 25 – Plate 25

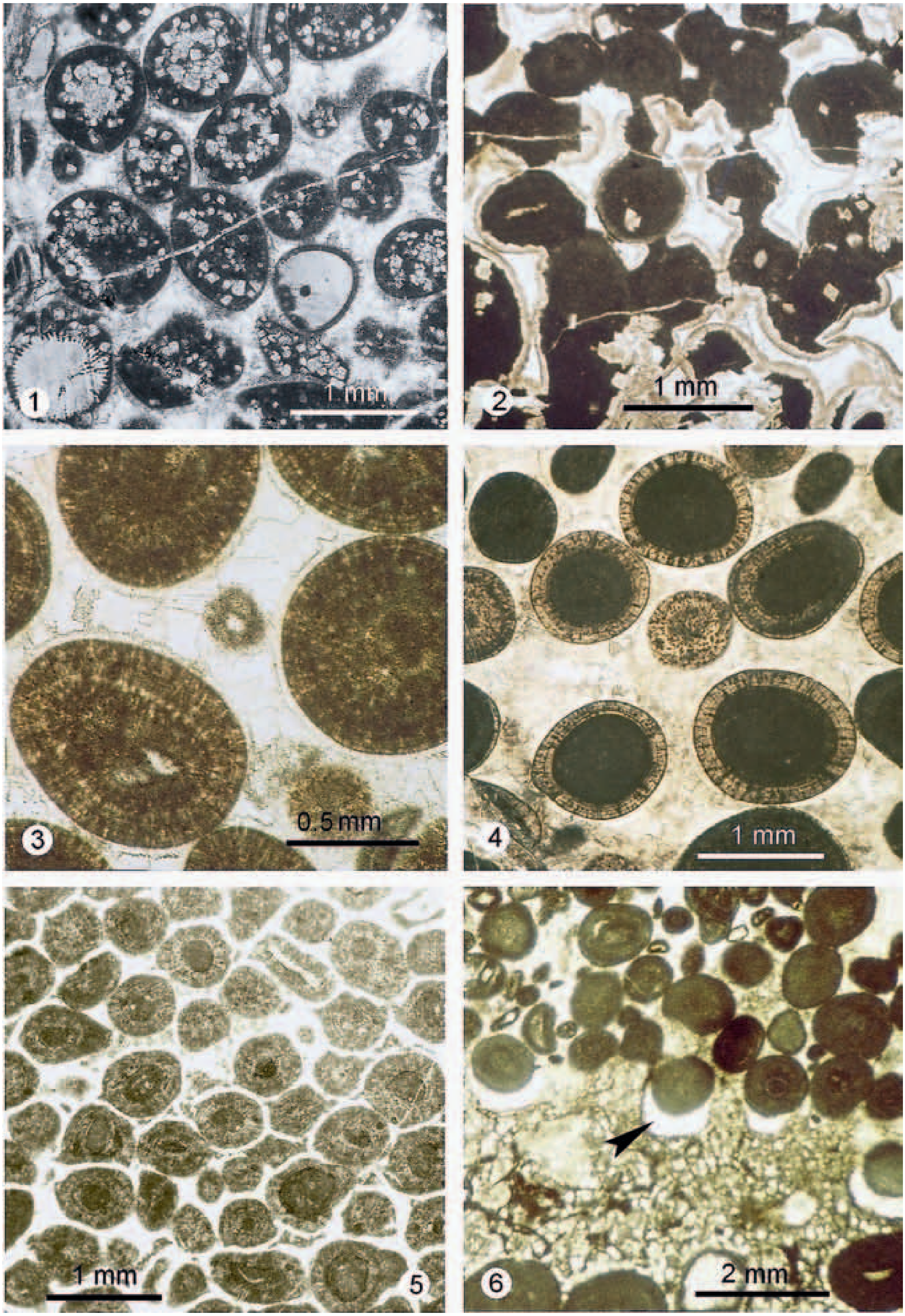


Tabla 26 – Plate 26

Spodnja jura (lias) – Lower Jurassic (Lias)

1 Bioosparitni grainstone z ooidi, iglicami ehinodermov in rekristaliziranimi koraliti. Kozjak pri Dobrniču (zbirka S. Dozeta)

Bioosparitic grainstone with ooids, echinoid spines and recrystallized coralites. Kozjak at Dobrnič (S. Dozet collection)

2 Ooidi, naplavljeni v pelsparitni packstone. Racna gora pri Ložu

Ooids washed into pelsparitic packstone. Racna gora at Lož

3 Intrabiosparitni grainstone s foraminifero (prehodna oblika med *Mayncina* sp. in *Lituosepta* sp.) Javorški vrh na Trnovskem gozdu

Foraminifer in intrabiosparitic grainstone (transitional form from *Mayncina* sp. in *Lituosepta* sp.) Javorški vrh on Trnovski gozd

4 Lumakela drobnih brahiopodov v biosparitnem grainstonu. Javorški vrh na Trnovskem gozdu

Lumachelle of fine brachiopod valves in biosparitic grainstone. Javorški vrh on Trnovski gozd

5 Rekristaliziran presek spongije – detajl. Kamnolom Vrhpeč pri Trebnjem

Section of recrystallized sponge – detail. Vrhpeč quarry at Trebnje

6 Sparitni dolomit z odprtimi medzrnskimi porami, ki so nastale pri pozni dolomitizaciji kamnine. Prvotna oolitna tekstura je še ohranjena. Bistra pri Vrhniki

Sparry dolomite with open intergranular pores, formed during the late dolomitization. Primary oolitic structure is still evident. Bistra at Vrhnika

Tabla 26 – Plate 26

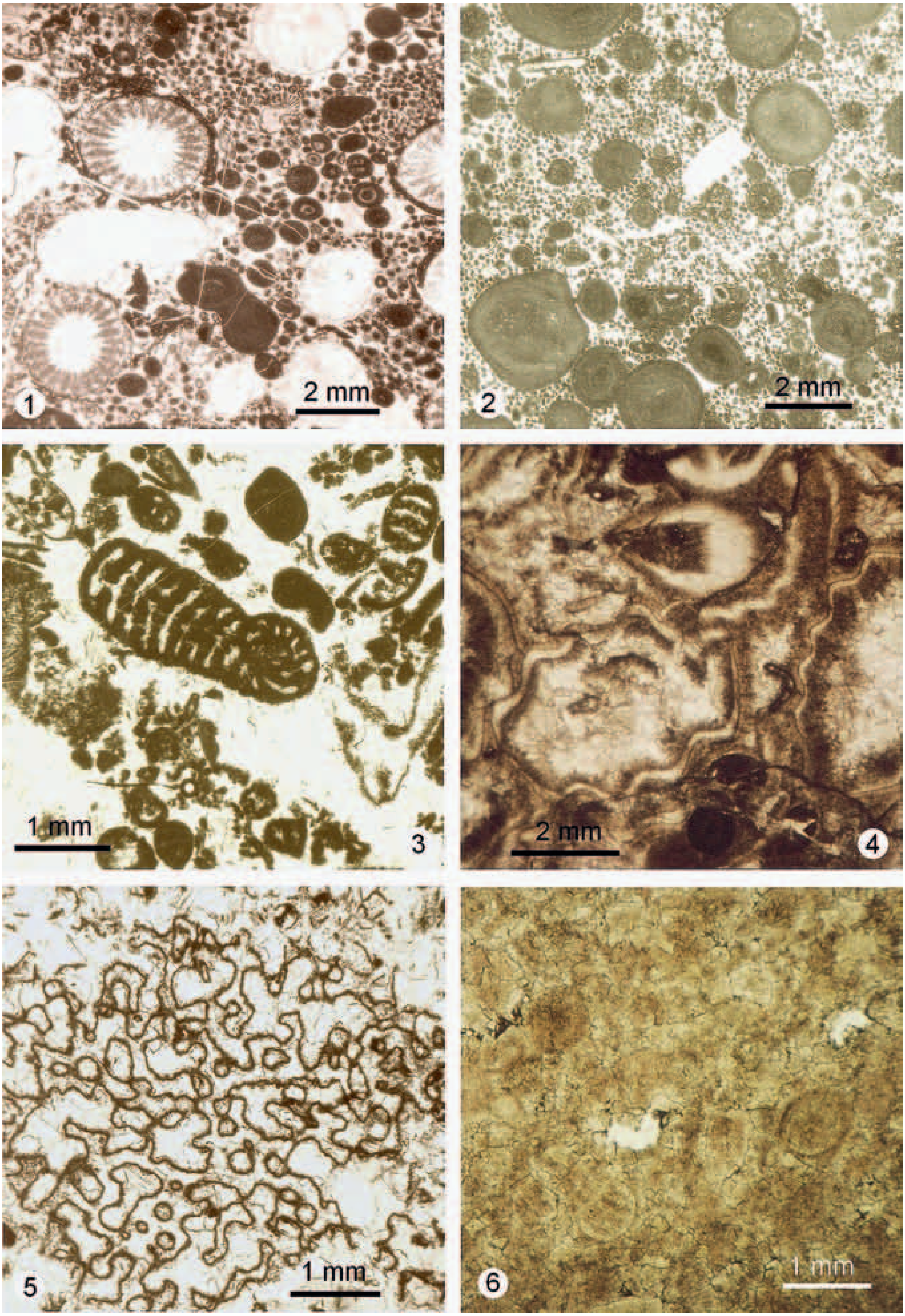


Tabla 27 – Plate 27

Zgornja jura – Upper Jurassic

1 Biomikritni apnenec – packstone s številnimi algami, moluski in ooidi. V večjih skeletih alg sta vidna stalaktitični cement (puščica) in interni mikrit. Ambrus v Suhi Krajini (zbirka S. Dozeta)

Biomicritic limestone – packstone with numerous algae, molluscan shells and smal ooids. In larger algal fragments stalactitic cement (arrow) and internal micrite are evident. Ambrus in Suha Krajina (S. Dozet collection)

2 Detajl vzorca s slike 1

Detail of the sample on Fig. 1

3 Preseki alge *Clypeina jurassica* v intrapelmikritnem apnencu. Zgornja jura – malm, Krnica na Trnovskem gozdu

Clypeina jurassica algae in intrapelmicritic matrix. Upper Jurassic – Malm, Krnica on Trnovski gozd

4 Fragmenti alge *Clypeina jurassica* v drobnozrnatem oolitnem apnencu – grainstone. Drobci alg so obdani z oolitnimi ovoji. Zgornja jura – malm. Krnica na Trnovskem gozdu

Clypeina jurassica fragments in fine grained oolitic grainstone. Algal fragments are coated by oolitic envelopes. Upper Jurassic – Malm. Krnica on Trnovski gozd

5 Presek alge *Clypeina jurassica* v pelmikritni osnovi. Apnenec je zajela poznodiagenetska dolomitizacija. Vrhnika - Logatec

Algae *Clypeina jurassica* in pelmicritic matrix. Limestone was affected by late diagenetic dolomitization. Vrhnika – Logatec

Tabla 27 – Plate 27

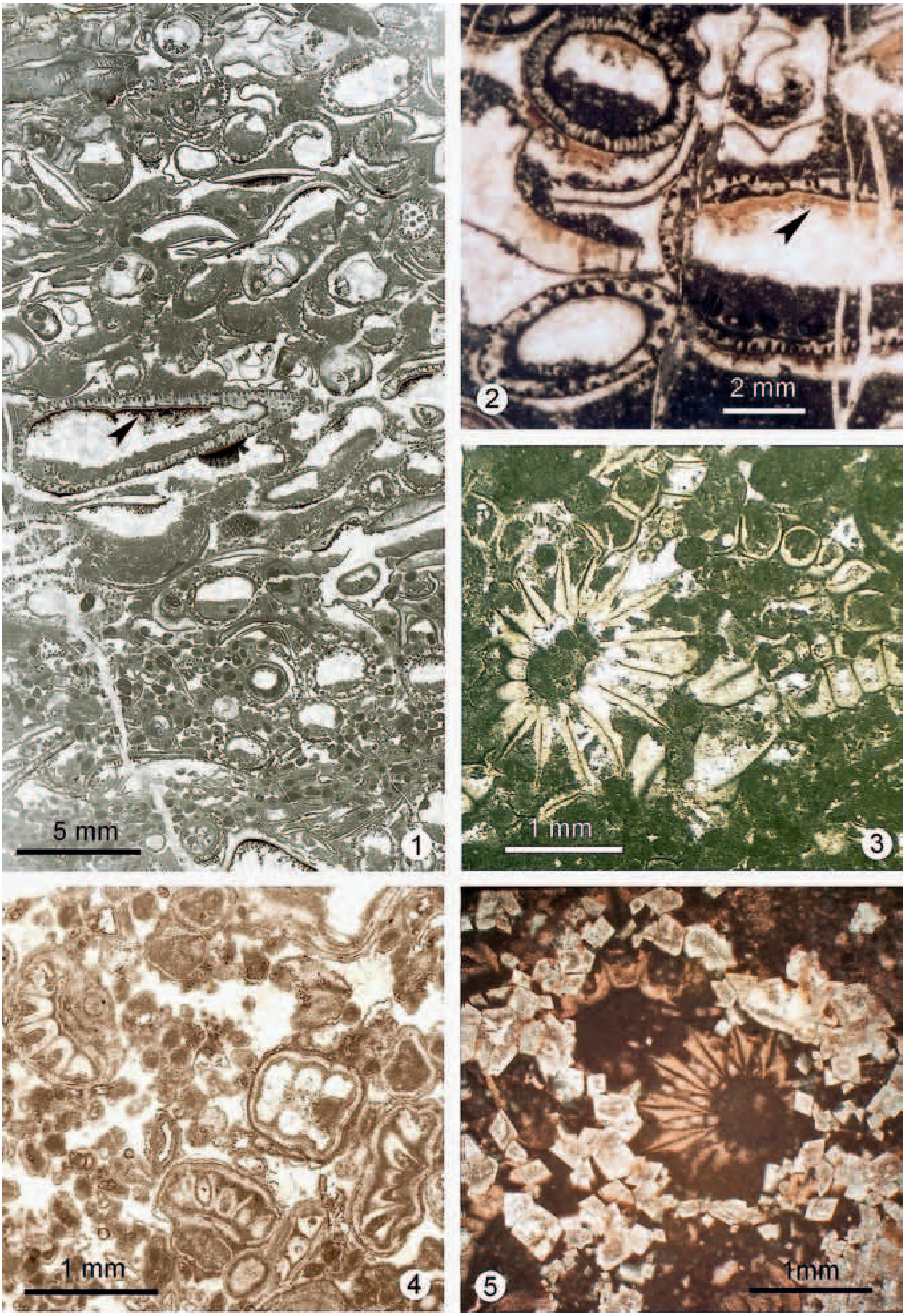


Tabla 28 – Plate 28

Zgornja jura – Upper Jurassic

1 Biointrasparitni grainstone. Večja školjčna lupina (puščica) je inkrustirana z ovoji cianobakterij. Krnica na Trnovskem gozdu

Biomicritic grainstone. Molluscan shell (arrow) is encrusted by cyanobacteria. Krnica on Trnovski gozd

2 Intraoosparitni grainstone. Nekateri intraklasti so prevlečeni z oolitnimi ovoji. Vrhnika - Logatec

Intraoosparitic grainstone. Some intraclasts are coated with oolitic laminae. Vrhnika -Logatec

3 Intrapelmikritni packstone z izsušitvenimi porami – loferit. Oolitni ovoji okrog večjih intraklastov. Krnica na Trnovskem gozdu

Intrapelmicritic packstone with shrinkage pores – loferite. Oolitic laminae around bigger intraclasts. Krnica on Trnovski gozd

4 Intrabiosparitni apnenec z velikimi tintininami – packstone. Vrhnika – Logatec, stara cesta (Snežni grič)

Intrabiosparitic packstone with large tintinnids. Vrhnika – Logatec, old road (Snežni grič)

5 Intrapelmikritni packstone z izsušitvenimi porami – loferit. Racna gora pri Ložu

Intrapelmicritic fenestral packstone – loferite. Racna gora at Lož

Tabla 28 – Plate 28

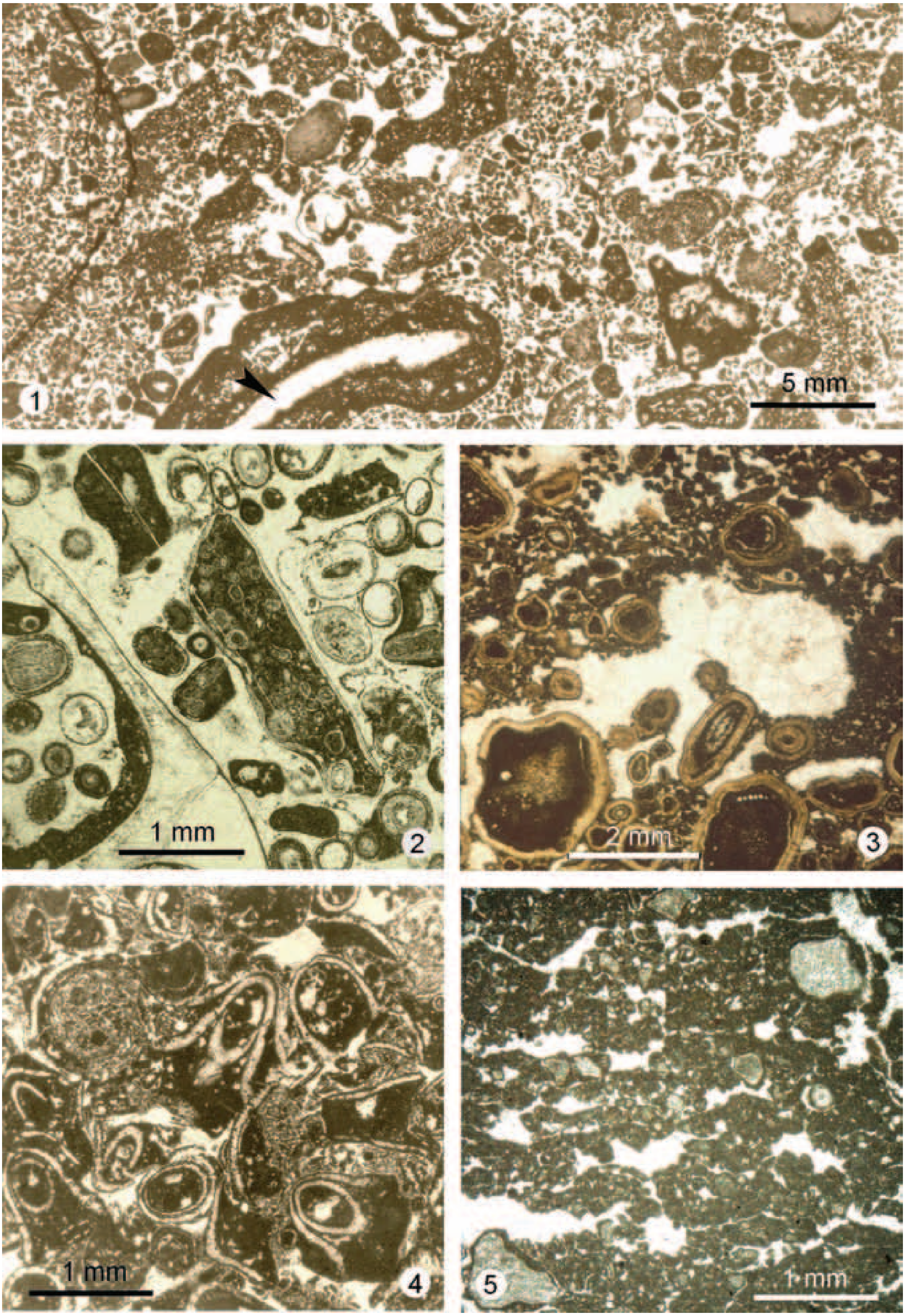


Tabla 29 – Plate 29

Zgornja jura (malm) – Upper Jurassic (Malm)
Grebenski razvoj – Reef facies

1 Koraliti razvejane kolonijske korale *Stylosmilia corallina*. Malm, Kal nad Kanalom, negativni odtis (zbirka D. Turnšek)

Corallites of dendroid colonial coral *Stylosmilia corallina*. Malm, Kal nad Kanalom, negative imprint (D. Turnšek collection)

2 Korala *Dermosmilia laxata* v mikritni osnovi. Zatišni greben. Col na Trnovskem gozdu, negativni odtis (zbirka D. Turnšek)

Dermosmilia laxata coral in micritic matrix. Inner-reef facies. Col on Trnovski gozd, negative imprint (D. Turnšek collection)

3 Presek korale *Fungiastrea*. Otlica na Trnovskem gozdu

Section of *Fungiastrea* coral. Otlica on Trnovski gozd

4 Presek korale *Clausastraea pseudoconfluens*. Kal nad Kanalom, negativni odtis (zbirka D. Turnšek)

Section of *Clausastraea pseudoconfluens* coral. Kal nad Kanalom, negative imprint (D. Turnšek collection)

5 Presek stromatoporoida *Ellipsactinia*. Turški klanec na Trnovskem gozdu, negativni odtis

Ellipsactinia stromatoporoid. Turški klanec on Trnovski gozd, negative imprint

Tabla 29 – Plate 29

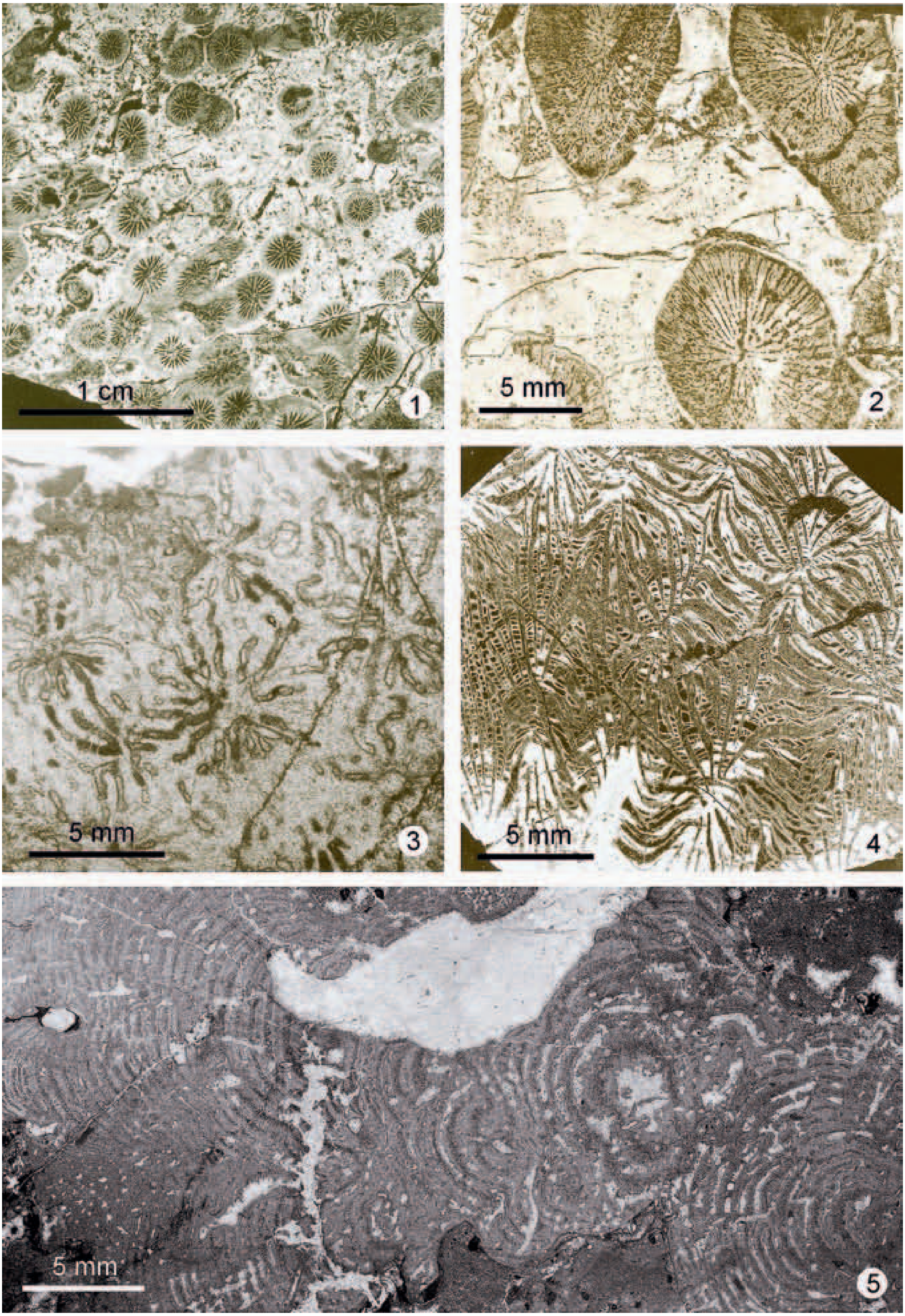


Tabla 30 – Plate 30

Jura in spodnja kreda – Jurassic and Lower Cretaceous
Globljemorski razvoj – Deeper-marine facies

1 Biomikritni packstone s številnimi ploščicami ehinodermov, posameznimi foraminiferami in redkimi zrni glavkonita (zeleno). Dogger. Mangart, talnina manganskega horizonta

Biomicritic packstone with numerous echinoderm plates. Some foraminifers and glauconite grains (green) are present too. Dogger. Mt. Mangart, footwall of manganese horizon

2 Radiolarijski spikulit – packstone. Mikritna osnova je močno okremenjena. Dogger-Malm. Bavšica pri Bovcu. X nikoli

Radiolaria-bearing spiculitic packstone. Micritic matrix is heavily silicified. Dogger-Malm. Bavšica at Bovec. XN

3 Krinoidni packstone s ploščicami ehinodermov. Dogger. Mangart

Crinoidal packstone with echinoderm plates. Dogger. Mt. Mangart

4 Aptihi in kalpionele v mikritni osnovi – wackestone. Tithonij-berriasij. Čisti vrh v Trenti

Aptychus-bearing wackestone with some calpionellids. Tithonian-Berriasian. Čisti vrh in Trenta

5, 6 Kalpionele v mikritni osnovi – wackestone. Na sl. 6 so prisotni še radiolariji. Berriasij

Calpionellid wackestone. In Fig. 6 some radiolarians are present too. Berriasian

5 - Vas na Skali v Trenti
6 - Bavšica pri Bovcu

Tabla 30 – Plate 30

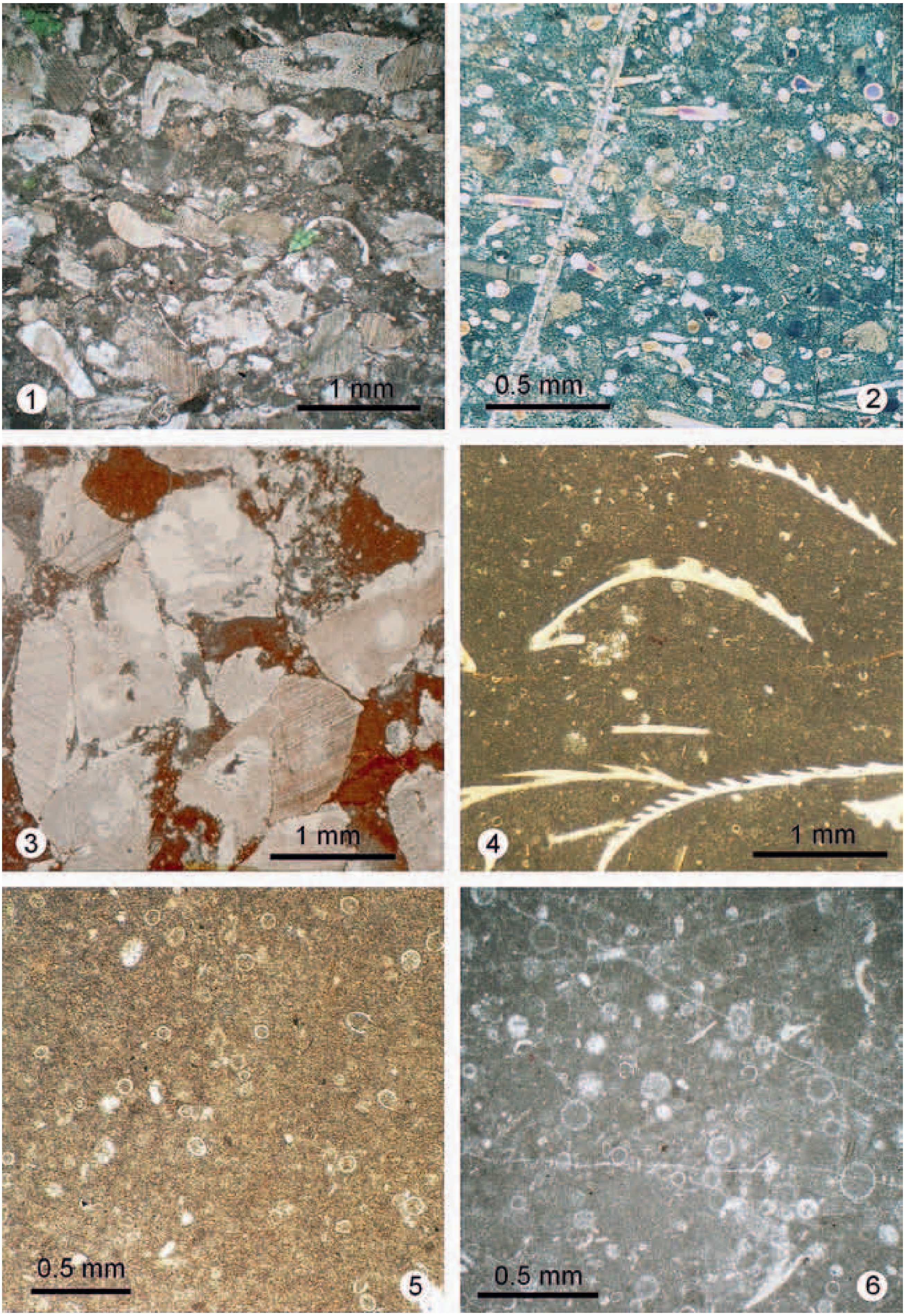


Tabla 31 – Plate 31

Srednja jura (dogger) – Middle Jurassic (Dogger)
Globljemorski razvoj, manganski horizont –
Deeper-marine environment, manganese horizon

1 Manganove skorje obraščajo ploščico ehinoderma. Ravni Laz pri Bovcu
Manganese crusts on echinoid plate. Ravni Laz at Bovec

2 Manganovi mikrogomolji v biomikritnem apnencu – packstone. Ravni Laz pri Bovcu
Mn-micronodules in biomicritic packstone. Ravni Laz at Bovec

3 Biomikritni packstone s ploščicami ehinodermov, drobci školjčnih lupin, foraminifer in juvenilnih amonitov. Dolina Triglavskih jezer
Biomicritic packstone with echinoid plates, shell debris, foraminifers and juvenile ammonites. Triglav lakes valley

4 Biomikritni apnenec z juvenilnimi amoniti in ehinodermi. Dolina Triglavskih jezer
Biomicritic limestone – packstone with juvenile ammonites and echinoids. Triglav lakes valley

5 Detajl Fe-Mn gomolja s conarno »stromatolitno« teksturo. Jezero v Lužnici pod Krnom
Detail of Fe-Mn nodule showing zonar »stromatolitic« structure. Jezero v Lužnici below Mt. Krn

6 Krinoidni apnenec. Ploščice ehinodermov so obdane z manganovimi ovoji. Dolina Triglavskih jezer
Crinoidal packstone. Echinoderm plates with manganese encrustations. Triglav lakes valley

Tabla 31 – Plate 31

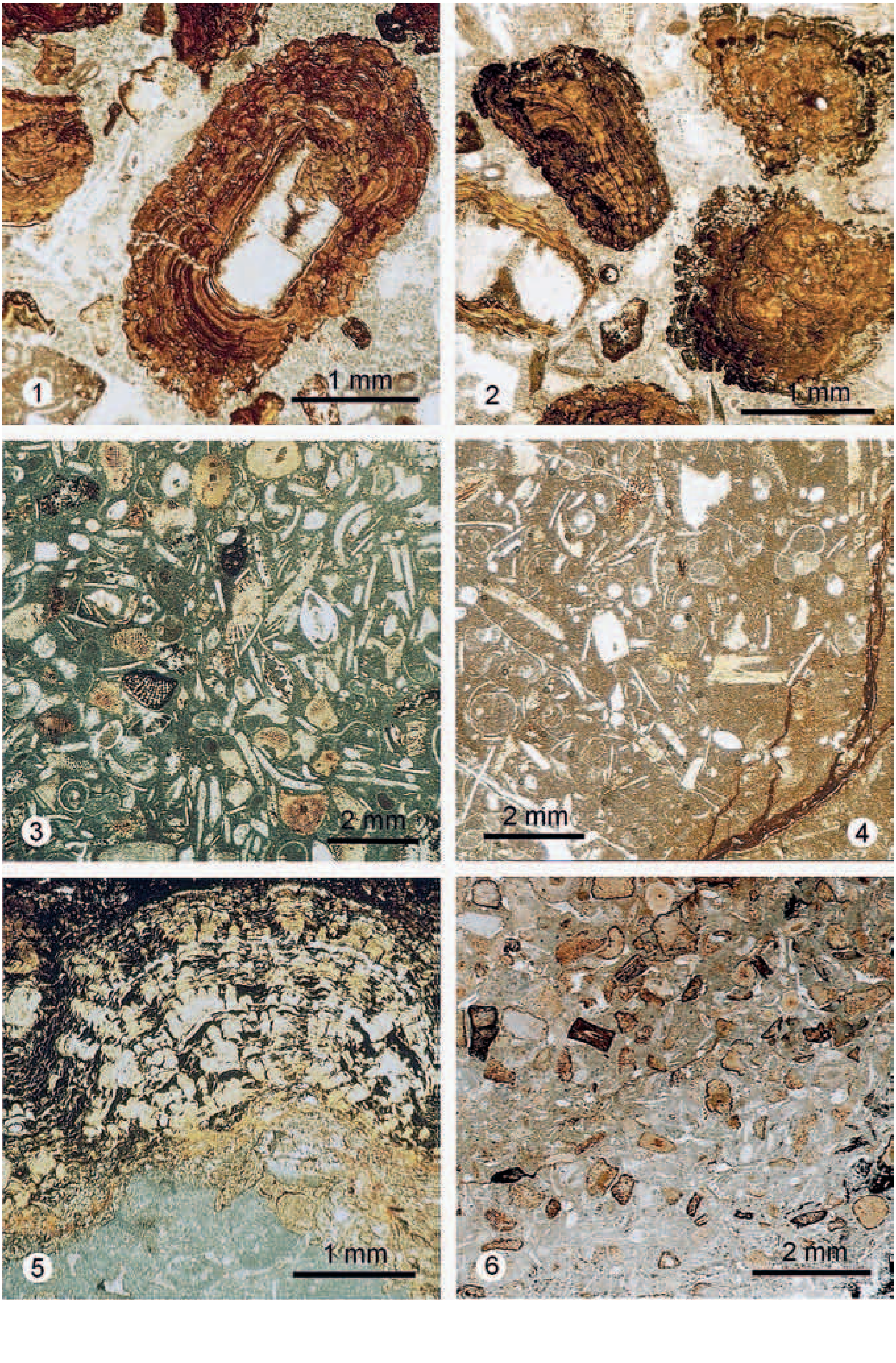


Tabla 32 – Plate 32

Spodnja kreda – Lower Cretaceous

1 Pelmikritni packstone. Valanginij. Dvor pri Žužemberku
Pelmicritic packstone. Valanginian. Dvor at Žužemberk

2 Drobni onkoidi v rahlo izpranem pelmikritnem packstonu. Hauterivij. Dvor pri Žužemberku
Small oncoids in pelmicritic, partly washed packstone. Hauterivian. Dvor at Žužemberk

3, 4 Favreinski apnenec – packstone s številnimi prečnimi in vzdolžnimi preseki mikrokoprolitov raka *Favreina salavensis*. Berriasij. Logatec - Vrhnika
Packstone with numerous radial and longitudinal sections of microcoprolite of decapod crabs *Favreina salavensis*. Berriasian. Logatec - Vrhnika
Fig. 4 – detail

5 Biomikritni apnenec s problematičnim mikrofosilom *Bacinella irregularis*. Barremij. Sviščaki pod Snežnikom
Microproblematic fossil *Bacinella irregularis* in biomicritic limestone. Barremian. Sviščaki at Snežnik

6 Biomikritni wackestone s preseki alge *Salpingoporella dinarica*. Aptij. Trnovo pri Novi Gorici
Algal wackestone with *Salpingoporella dinarica*. Aptian. Trnovo at Nova Gorica

Tabla 32 – Plate 32

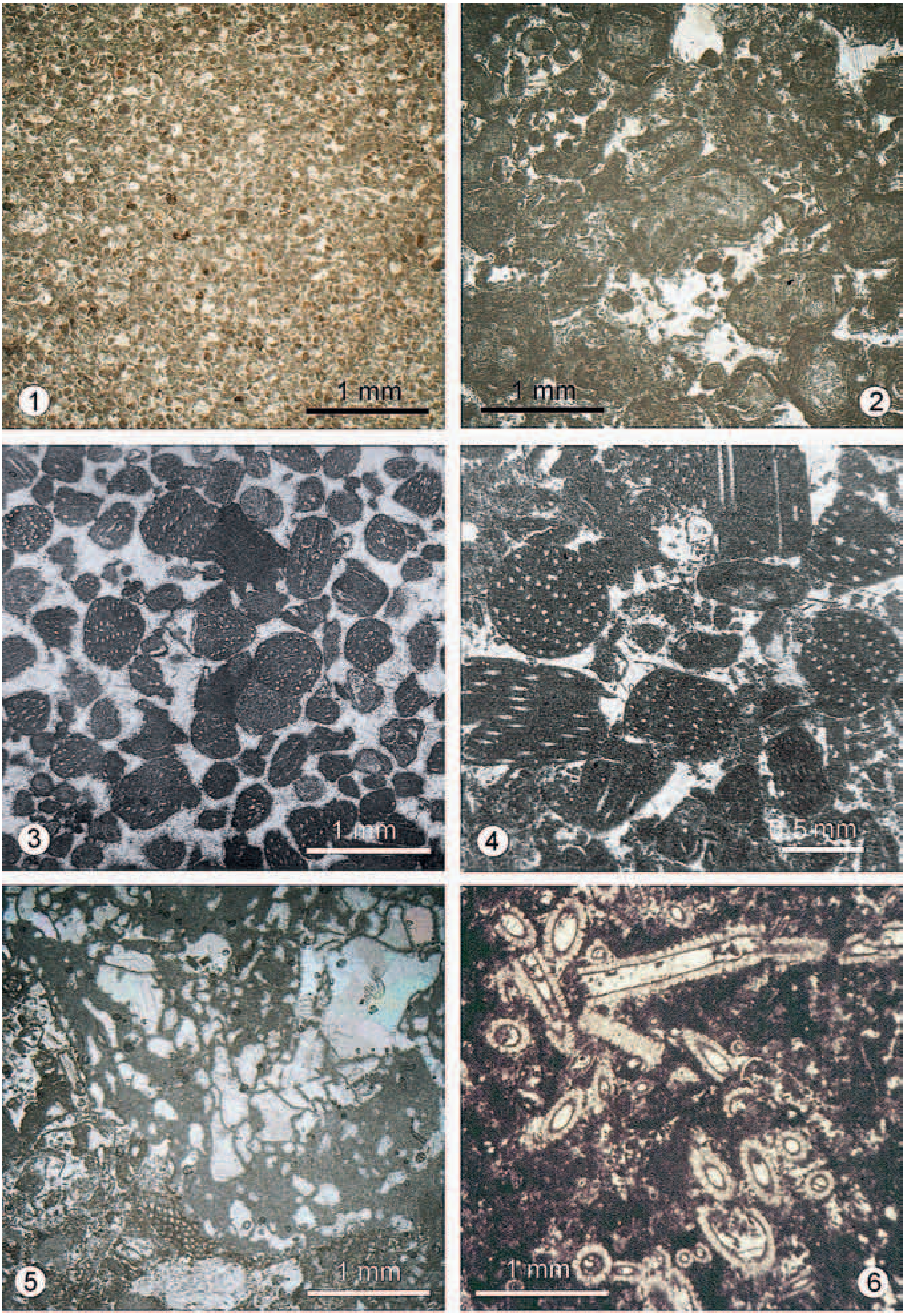


Tabla 33 – Plate 33

Spodnja kreda – Lower Cretaceous

1 Dolomitni romboedri s conarno rastjo v mikritnem apnencu. Poznodiagenetska dolomitizacija. Valanginij. Kočevski Rog – Podturn

Dolomite rhombohedrons with porphyrotopic zonar fabrics in micritic matrix. Late diagenetic dolomitization. Valanginian. Kočevski Rog – Podturn

2 Stromatolitni apnenec – bindstone z izsušitvenimi porami. Aptij. Snežnik

Stromatolitic boundstone with shrinkage pores. Aptian. Mt. Snežnik

3 Intraoosparitni packstone. Jedra več ooidov predstavljajo foraminifere. Albij. Nadrt na Hrušici (zbirka J. Ježa)

Intraoosparitic packstone. Foraminifers as nuclei in some ooids. Albian. Nadrt on Hrušica (J. Jež collection)

4 Biomikritni mudstone/wackestone z lupinami ostrakodov. Albij. Nadrt na Hrušici (zbirka J. Ježa)

Biomicritic mudstone/wackestone with ostracod slells. Albian. Nadrt on Hrušica (J. Jež collection)

5 Koraliti grebenske korale *Dermosmilia cretacica*. Barremij – sp. aptij. Osojnice na Banjški planoti (zbirka D. Turnšek)

The colony of reef-forming coral *Dermosmilia cretacica*. Barremian – Lower Aptian. Osojnice on Banjšice plateau (D. Turnšek collection)

6 Laminiran mikritni apnenec z neizrazito stromatolitno strukturo in s stilolitnimi šivi. Valanginij. Dvor pri Žužemberku

Laminated micritic limestone with indistinctive stromatolitic texture and stylolites. Valanginian. Dvor at Žužemberk

Tabla 33 – Plate 33

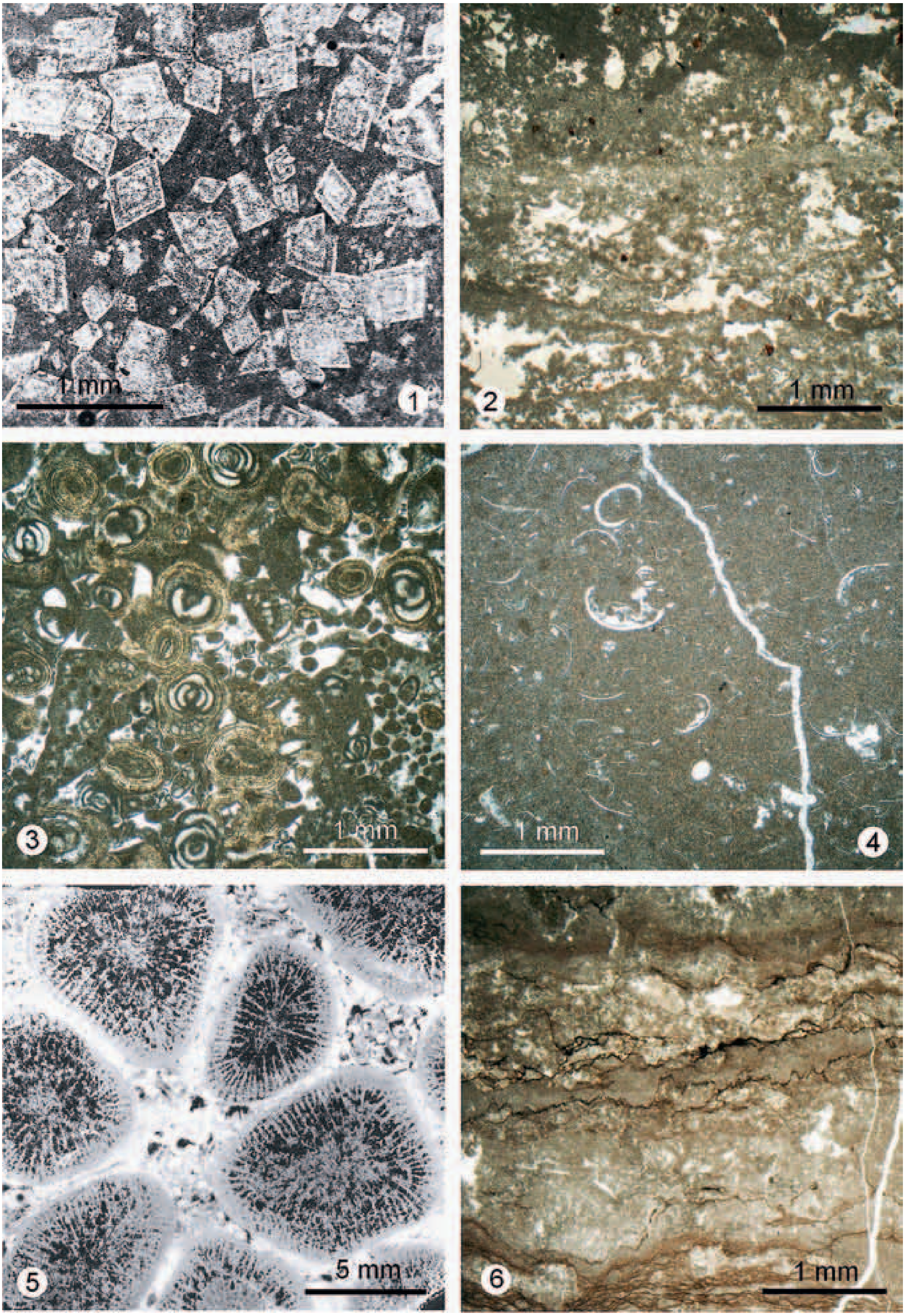


Tabla 34 – Plate 34

Spodnja in zgornja kreda – Lower and Upper Cretaceous

1 Orbitolina *Mesorbitolina subconcava* v pelmikritnem apnencu tipa wackestone. Albij. Trnovo pri Novi Gorici

Mesorbitolina subconcava in pelmicritic wackestone. Albian. Trnovo at Nova Gorica

2 Presek alge *Thaumatoporella parvovesiculifera* v pelbiomikritnem apnencu – packstone. Turonij. Nanos (zbirka J. Ježa)

Thaumatoporella parvovesiculifera in pelbiomicritic packstone. Turonian. Mt. Nanos (J. Jež collection)

3 Orbitoline v intrabiosparitnem apnencu – grainstone. Spodnji cenomanij. Sabotin (zbirka J. Ježa)

Intrabiosparitic grainstone with orbitolinas. Lower Cenomanian. Mt. Sabotin (J. Jež collection)

4 Intraklasti, foraminifere in peleti v izpranem apnencu tipa packstone. Redke izsušitvene pore. Cenomanij. Nadrt na Hrušici (zbirka J. Ježa)

Washed intrabiopelmicritic packstone with rare shrinkage pores. Cenomanian. Nadrt on Hrušica (J. Jež collection)

5 Oolitni boksit. Santonij – turonij. Nanos – Podraška bajta (zbirka J. Ježa)

Oolitic bauxite. Santonian – Turonian. Mt. Nanos – Podraška bajta (J. Jež collection)

6 Foraminiferni miliolidni apnenec – packstone. Santonij (Lipiška formacija). Rodik pri Kozini

Foraminiferal miliolid packstone. Santonian (Lipica Formation). Rodik at Kozina

Tabla 34 – Plate 34

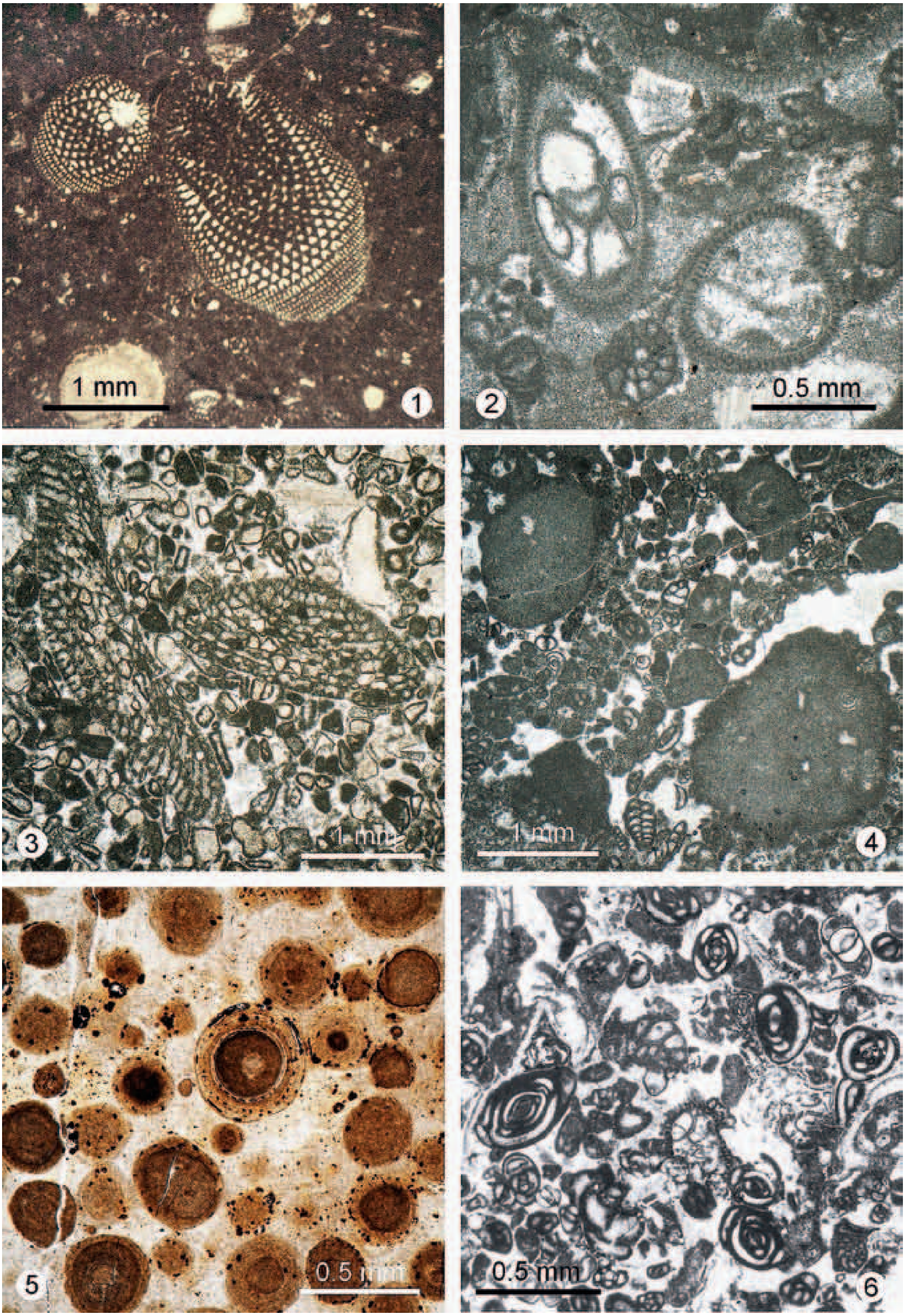


Tabla 35 – Plate 35

Zgornja kreda – Upper Cretaceous

1 Izpran biopelmikritni packstone s foraminifero *Dicyclina schlumbergeri*. Santonij – campanij (Lipiška formacija). Gabrk pri Sežani

Foraminifer *Dicyclina schlumbergeri* in washed biopelmicritic packstone. Santonian – Campanian (Lipica Formation). Gabrk at Sežana

2 Izpran miliolidni packstone. Santonij – campanij (Lipiška formacija). Gabrk pri Sežani

Washed miliolid packstone. Santonian – Campanian (Lipica Formation). Gabrk at Sežana

3 Mikritni apnenec – mudstone z izsušitvenimi porami – loferit. Maastrichtij (Liburnijska formacija). Suhadole pri Štorjah

Mudstone with shrinkage pores – loferite. Maastrichtian (Liburnia Formation). Suhadole at Štorje

4 Močno izpran mikritni apnenec – packstone. Maastrichtij (Liburnijska formacija). Vremski Britof

Washed micritic packstone. Maastrichtian (Liburnia Formation). Vremski Britof

5, 6 Algni wackestone s številnimi preseki vrste *Decastronema* (ex. *Aeolisaccus*) *kotori* (sl. 5) in D. barattoloi (sl. 6) ter posamezne foraminifere (*Fleuryana adriatica*). Turonij – Santonij (Sežanska Formacija)

Wackstone with numerous sections of *Decastronema* (ex. *Aeolisaccus*) *kotori* (fig. 5), D. barattoloi (fig. 6) and some foraminifers (*Fleuryana adriatica*). Turonian – Santonian (Sežana Formation)

5 - Veliki Medvedjak pri Sežani
6 - Nanos (zbirka/collection of J. Jež)

Tabla 35 – Plate 35

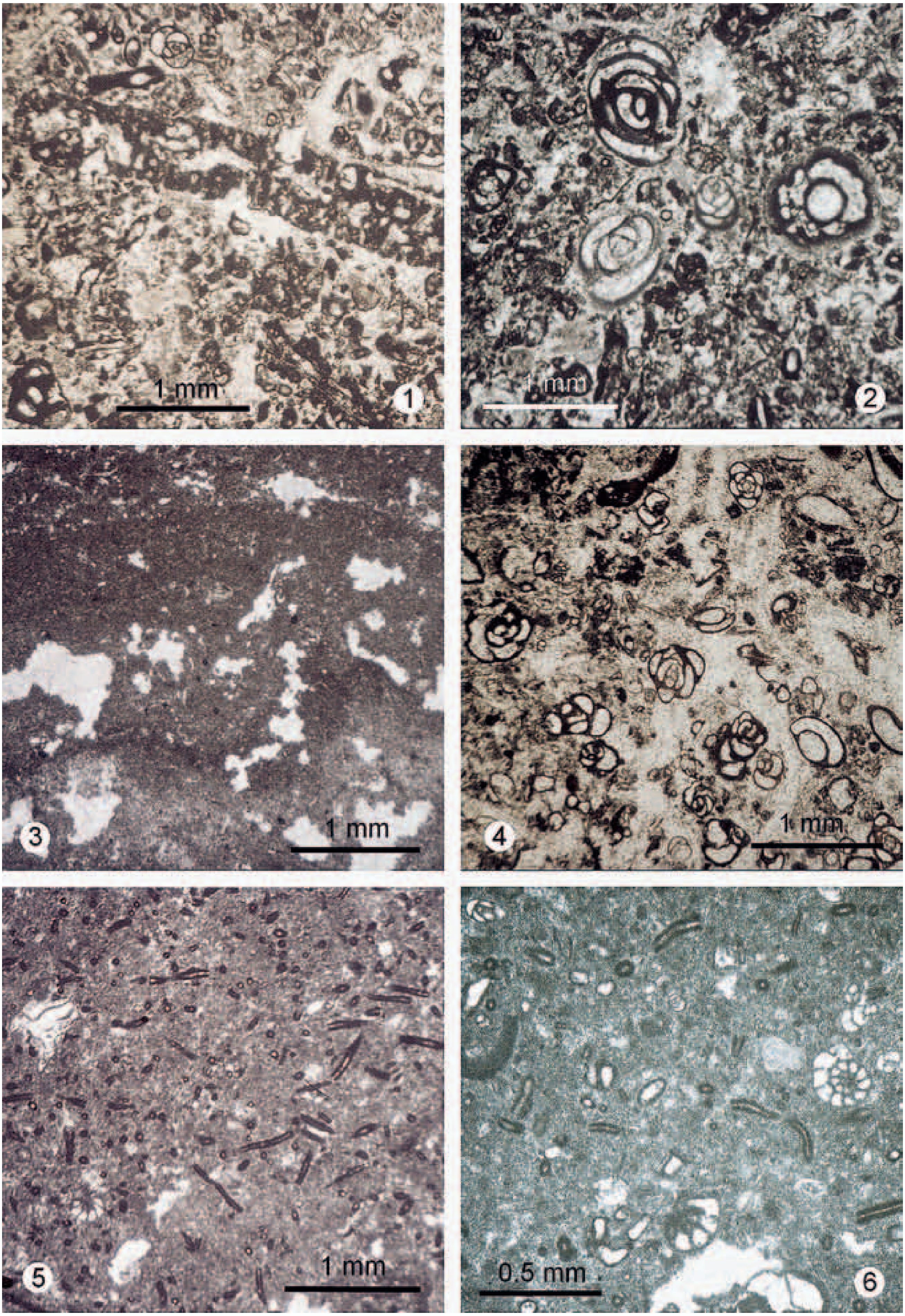


Tabla 36 – Plate 36

Zgornja kreda – Upper Cretaceous

1 Biomikritni wackestone s presekom rudistne lupine, ki jo je zajela intenzivna endolitizacija. Maastrichtij. Liburnijska formacija. Senadole pri Štorjah

Biomicritic wackestone with a section of rudist shell, affected by intensive endolitization. Maastrichtian. Liburnia Formation. Senadole at Štorje

2, 3 Debelozrnat biokalkarenit iz drobcev rudistnih školjk.

Coarse-grained biocalcarenite, composed of rudist shell fragments.

2 - Turonij /Turonian. Kopriva pri Dutovljah
3 - Cenomanij/Cenomanian. Nadrt na Hrušici (zbirka/collection of J. Jež)

4 Biopelmikritni packstone s številnimi preseki foraminifere *Orbitoides media* Maastrichtij. Prestranek pri Postojni

Biopelmicritic packstone with numerous sections of foraminifer *Orbitoides media* Maastrichtian. Prestranek at Postojna

5 Biopelmikritni packstone s številnimi kalcisferami in posameznimi pelagičnimi foraminiferami. Coniacij. Komenski apnenec znotraj Sežanske formacije. Lipa pri Komnu

Biopelmicritic packstone with numerous calcispheres and some pelagic foraminifers. Coniacian. Komen limestone in Sežana Formation. Lipa at Komen

6 Korala *Eugyra lanckoronensis* aptijske starosti. Primerek je presedimentiran v zgornjekredno flišno brečo. Kanalski Lom na Banjšicah (zbirka D. Turnšek)

Eugyra lanckoronensis coral of Aptian age, resedimented into Upper Cretaceous flysch breccia. Kanalski Lom on Banjšice plateau (D. Turnšek collection)

Tabla 36 – Plate 36

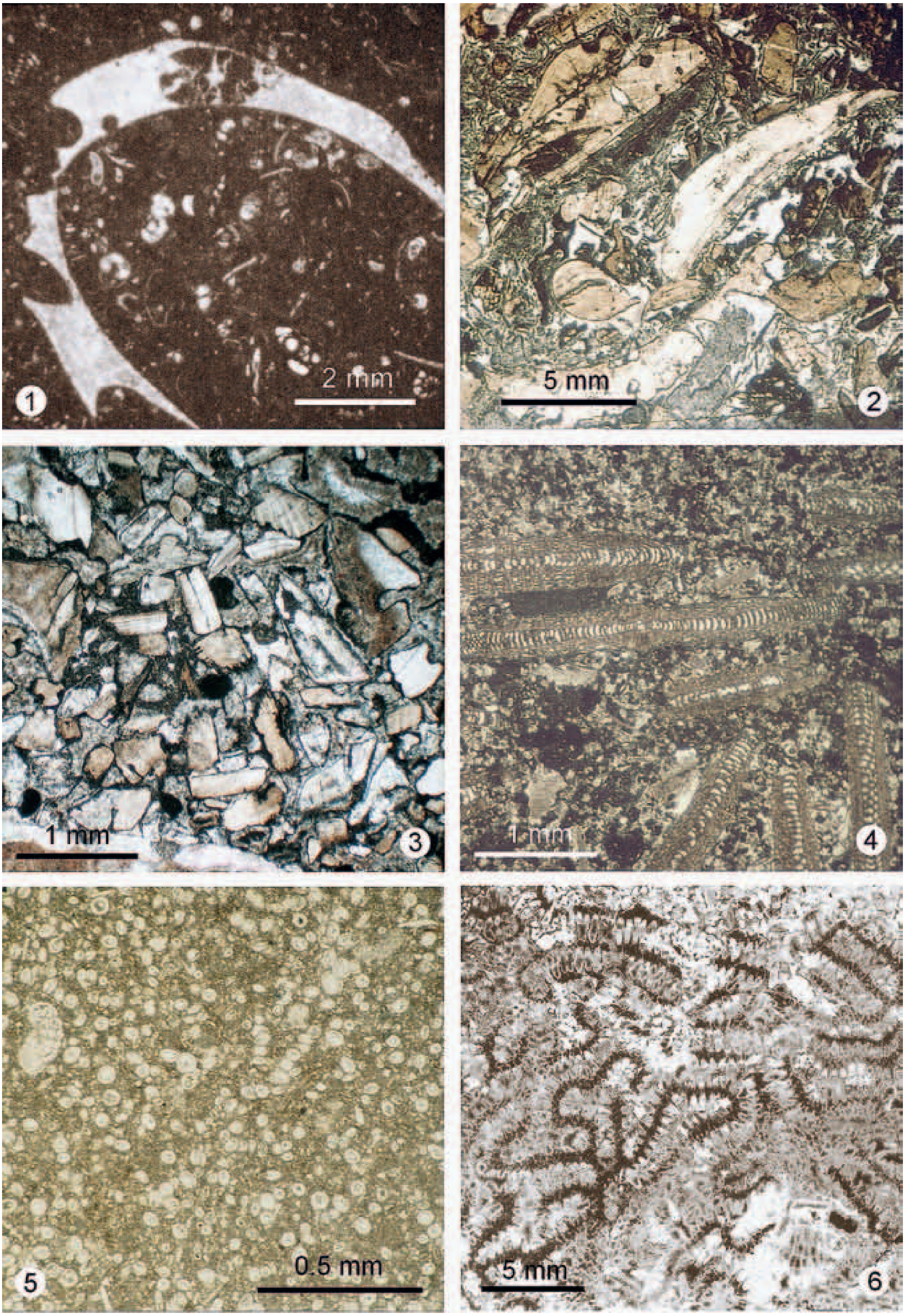


Tabla 37 – Plate 37

Zgornja kreda – Upper Cretaceous
Komenski apnenec – Komen limestone

1, 2 Laminiran mikritni apnenec, bogat z organsko snovjo.

Laminated micritic limestone, rich in organic matter.

1 - Coniacij / Coniacian. Skopo pri Dutovljah / Skopo at Dutovlje
2 - Cenomanij / Cenomanian. Škrbina pri Komnu / Škrbina at Komen

3 Biomikritni apnenec – wackestone z miliolidami in drugimi foraminiferami (*Pastrikella balcanica*), bogat z organsko snovjo. Cenomanij. Tomačevica pri Komnu

Biomicritic wackestone with miliolids and other foraminifers (*Pastrikella balcanica*), rich in organic matter. Cenomanian. Tomačevica at Komen

4 Laminiran biomikritni wackestone s foraminiferami in neskeletnimi algami. Cenomanij. Mali Dol pri Komnu

Laminated biomicritic wackestone with foraminifers and nonskeletal algae. Cenomanian. Mali Dol at Komen

5, 6 Intramikritni apnenec –packstone s pigmentom organske snovi, algo *Thaumatoporella parvovesiculifera* in foraminiferami. Coniacij

Intramicritic packstone with organic matter, algae *Thaumatoporella parvovesiculifera* and foraminifers. Coniacian

5 - Skopo pri Dutovljah / Skopo at Dutovlje
6 - Konjske stope pri Tomaju

Tabla 37 – Plate 37

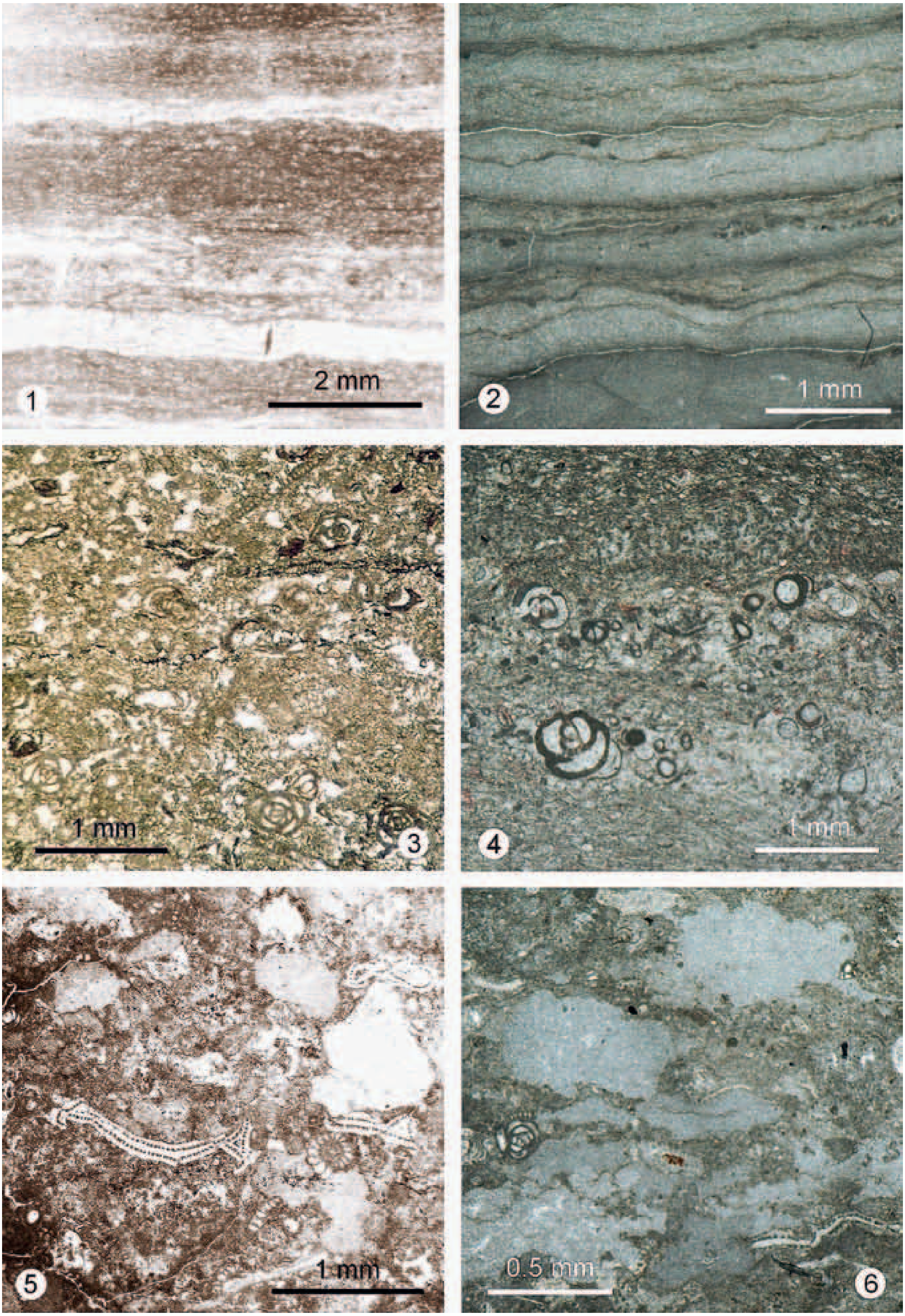


Tabla 38 – Plate 38

Zgornja kreda – Upper Cretaceous

1 Mikritni apnenec – wackestone z oogoniji haracej. Maastrichtij. Kozina

Charophyta gyrogonites in micritic wackestone. Maastrichtian. Kozina

2 Izpran biomikritni apnenec – packstone s foraminiferami *Rhapydionina liburnica*, *Dicyclina schlumbergeri* in številnimi miliolidami. Maastrichtij. Vremski Britof

Washed biomicritic packstone with foraminifers *Rhapydionina liburnica*, *Dicyclina schlumbergeri* and miliolids. Maastrichtian. Vremski Britof

3, 4 Rapidioninski apnenec – packstone s foraminiferami *Rhapydionina liburnica* (prečni in vzdolžni preseki). Maastrichtij.

Foraminiferal packstone with transversal and longitudinal sections of *Rhapydionina liburnica*. Maastrichtian

3 - Tabor pri Štorjah / Tabor at Štorje
4 - Senadole pri Štorjah / Senadole at Štorje

5 Mikritni apnenec s številnimi kalcitnimi prizmami in kolonijo *Paronipora* sp. (ex. *Microcodium*). Pedogeni karbonat z rizolitnimi tvorbami. Kredno/terciarna meja. Sopada pri Sežani

Micritic limestone with numerous calcitic elements and a colony of *Paronipora* sp. (ex. *Microcodium*). Pedogenic carbonate with rhizoids. Cretaceous/Tertiary boundary. Sopada at Sežana

6 Intramikritni apnenec z večjimi izsušitvenimi porami, v katerih nastopa stalaktitični cement. Kredno/terciarna meja. Štorje pri Sežani

Intramicritic limestone. Stalactitic calcite cement in some shrinkage pores. Cretaceous/Tertiary boundary. Štorje at Sežana

Tabla 38 – Plate 38

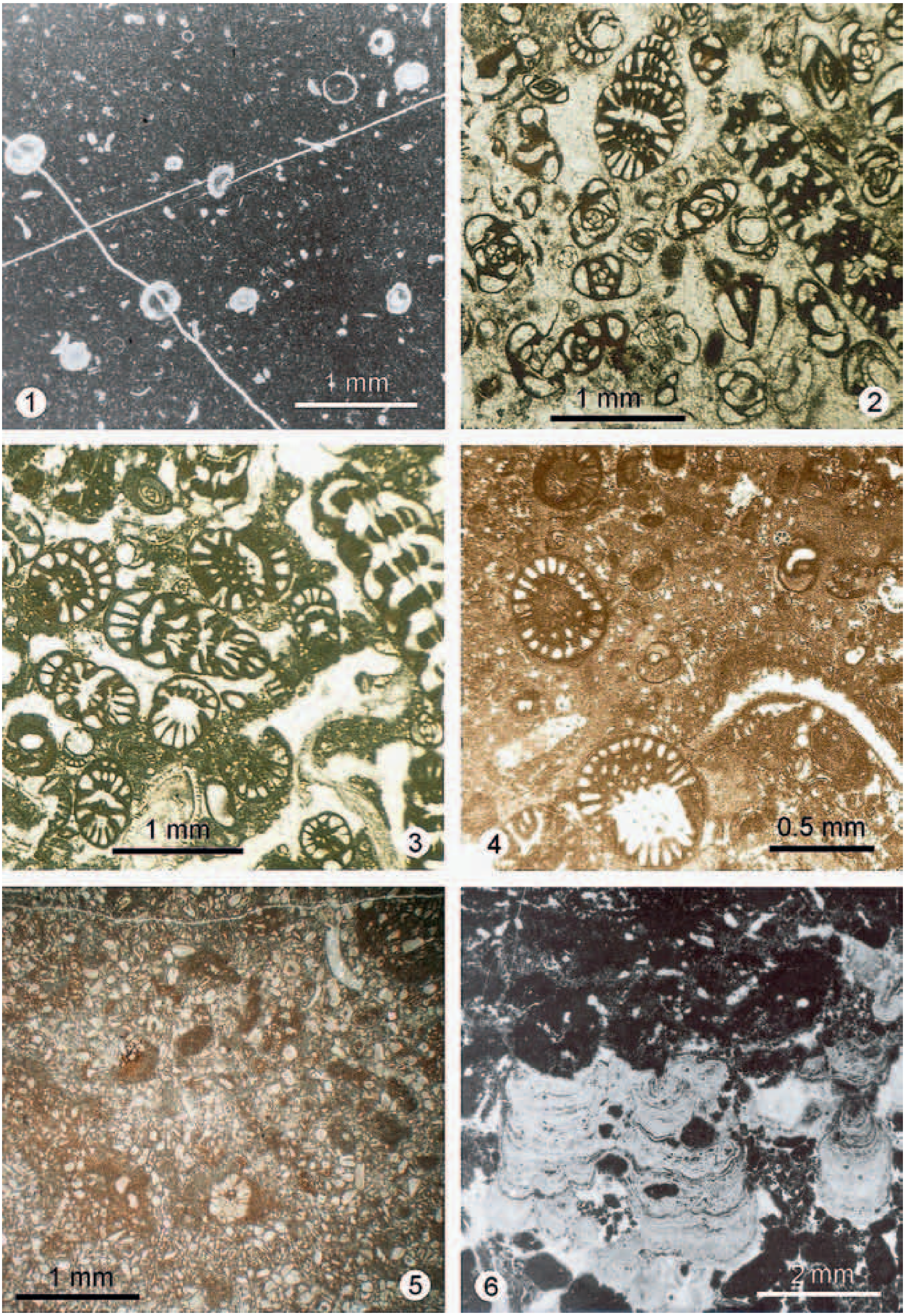


Tabla 39 – Plate 39

Kreda – Cretaceous
Globljemorski razvoj – Deeperwater environment

1 Spikulit – močno okremenjen mikritni packstone s številnimi spikulami spongij. Senon. Koritnica pri Bovcu

Spiculite – silicified micritic packstone with numerous sponge spicules. Senonian. Koritnica at Bovec

2 Detajl vzorca s slike 1

Detail of sample from fig. 1

3, 4 Foraminiferni wackestone s številnimi globotrunkanami, drobirjem pelagičnih foraminifer in kalcisferami. Senon

Foraminiferal wackestone with numerous globotruncanas, pelagic foraminifers debris and calcispheres. Senonian

3 - Koritnica pri Bovcu / Koritnica at Bovec
4 - Volčanski apnenec. Kolovrat nad Tolminom / Volče limestone. Kolovrat above Tolmin

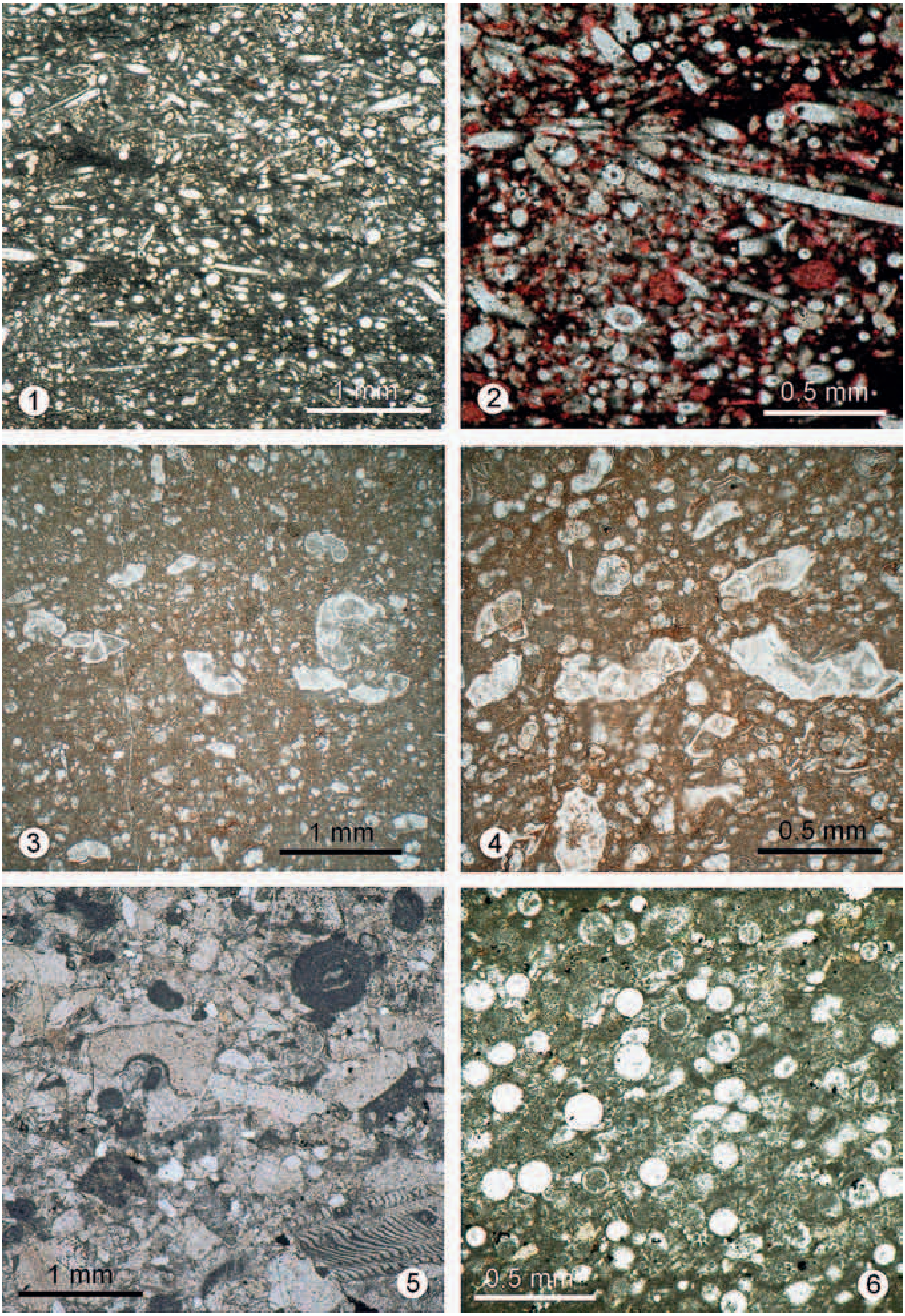
5 Biokalkarenit z odlomki rudistnih lupin in ehinodermov, redka drobna zrna terigenega kremena. Bazalni del plasti Volčanskega apnenca. Senon. Drežnica pri Kobaridu

Biocalcarenite, composed of rudist fragments, echinoderm plates and some terrigenous quartz grains. Basal part of Volče limestone beds. Senonian. Drežnica at Kobarid

6 Radiolarijski packstone – radiolarit. Albij. Bavšica pri Bovcu

Radiolarian packstone – radiolarite. Albian. Bavšica at Bovec

Tabla 39 – Plate 39



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Slike na naslovni strani – Cover photo:

1	2
3	4

1 – Zgornjekredni rapidioninski apnenec. Tabor pri Štanjelu
Upper Cretaceous *Rhapydionina* limestone. Tabor at Štanjel

2 – Spodnjejurski oosparitni grainstone. Trnovski gozd
Lower Jurassic oosparitic grainstone. Trnovski gozd

3 – Poznodiagenetsko dolomitiziran spodnjekredni apnenec. Kočevski Rog
Lower Cretaceous limestone dolomitized in late diagenesis. Kočevski Rog

4 – Srednjejurski apnenec z manganovimi gomolji. Bovec
Middle Jurassic limestone with manganese nodules. Bovec

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