

Radiolarian and conodont biostratigraphy of a latest Anisian radiolarite event in the High Karst Nappe (Dinarides, Montenegro)

GAWLICK, H.-J.¹, GORICAN, S.², LEIN, R.³ & MISSONI, S.¹

¹ University of Leoben, Department for Applied Geosciences and Geophysics, Prospection and Applied Sedimentology, Peter-Tunner-Strasse 5, 8700 Leoben, Austria; hans-juergen.gawlick@mu-leoben.at; s.missoni@daad-alumni.de;

² Paleontoloski institut Ivana Rakovca, ZRC SAZU, Novi trg 2, SI-1000 Ljubljana, Slovenia; spela@zrc-sazu.si;

³ University of Vienna, Centre for Earth Sciences, Althanstrasse 14, 1090 Vienna, Austria; richard.lein@univie.ac.at

In the High Karst Nappe in southern Montenegro radiolarites of unknown age topped the Upper Anisian Bulog Limestones (Late Pelsonian to Illyrian) in the investigated sections Boljevici near Virpazar and Obzovica on the road from Budva to Cetinje. Radiolarian faunas from the radiolarites as well as conodonts from the overlying red hemipelagic limestones prove an Illyrian age of the radiolarites. The time interval of the deposition of the up to 5 metre thick radiolarite successions is relatively short, and started and ended in the Illyrian.

In the section Boljevici the hemipelagic succession starts with red hemipelagic Bulog Limestone (Fig. 1/1) on top of shallow-water limestones equivalent to the Ravni Formation (Dedovici Member) (DIMITRIJEVIC & DIMITRIJEVIC 1991) in the Outer Dinarides or the Steinalm Formation in the Eastern Alps/West Carpathians (e.g., TOLLMANN 1976). The drowning of the platform can be dated by the occurrence of *Nicoraella germanicus*, *Nicoraella kockeli*, *Gondolella bulgarica*, and *Gondolella* cf. *bifurcata* as Late Pelsonian; these conodonts derive from the overlying Bulog Limestones. Deposition of the Bulog Limestone in this section lasted until the Illyrian, proven by the occurrence of *Gondolella excelsa*, *Gondolella trammeri*, and *Gondolella liebermanni*. The following radiolarians from the reddish laminated radiolarites on top of the Bulog Limestone prove an Illyrian age (*Spongosilicarmiger italicus* Zone to lower part of *Ladinocampe multiperforata* Zone; equivalent of *Reitziites reitzi* Ammonoid Zone): *Baumgartneria* cf. *retrospina*, *Cryptostephanidium cornigerum*, *Oertlispongus inaequispinosus*, *Paroertlispongus multispinosus*, and *Triassocampe scalaris*. The directly overlying sequence of the radiolarite is not exposed, but upsection follow Upper Ladinian to Lower Carnian shallow-water limestones and dolomites.

In the section Obzovica the drowning sequence of the carbonate platform is not exposed. Red limestones below the radiolarite succession belong to the Bulog Limestone. Upsection follows a five metre thick succession of red and partly grey well-bedded radiolarites. From the red radiolarites we isolated a well preserved Illyrian radiolarian fauna (*Spongosilicarmiger italicus* Zone; equivalent of *Reitziites reitzi* Ammonoid Zone) with: *Baumgartneria bifurcata*, *Baumgartneria* cf. *yehae*, *Cryptostephanidium cornigerum*, *Eptingium manfredi*, *Eptingium ramovsi*, *Falcispongus calcaneum*, *Hozmadia* sp., *Oertlispongus*

inaequispinosus, *Parasepsagon asymmetricus*, *Pseudostylosphaera japonica*, *Pseudostylosphaera tenuis*, *Spongostephanidium* sp., *Triassocampe deweveri*, *Triassocampe scalaris*. In the upper part of the radiolarite sequence up to ten centimetre thick intercalated hemipelagic filament-bearing limestones (Fig. 1/2) are of latest Anisian to earliest Ladinian age, proven by the following conodonts: *Gondolella excelsa*, *Gondolella trammeri*, and *Gladiogondolella tethydis*. Upsection the radiolarian cherts decrease rapidly and the following hemipelagic red

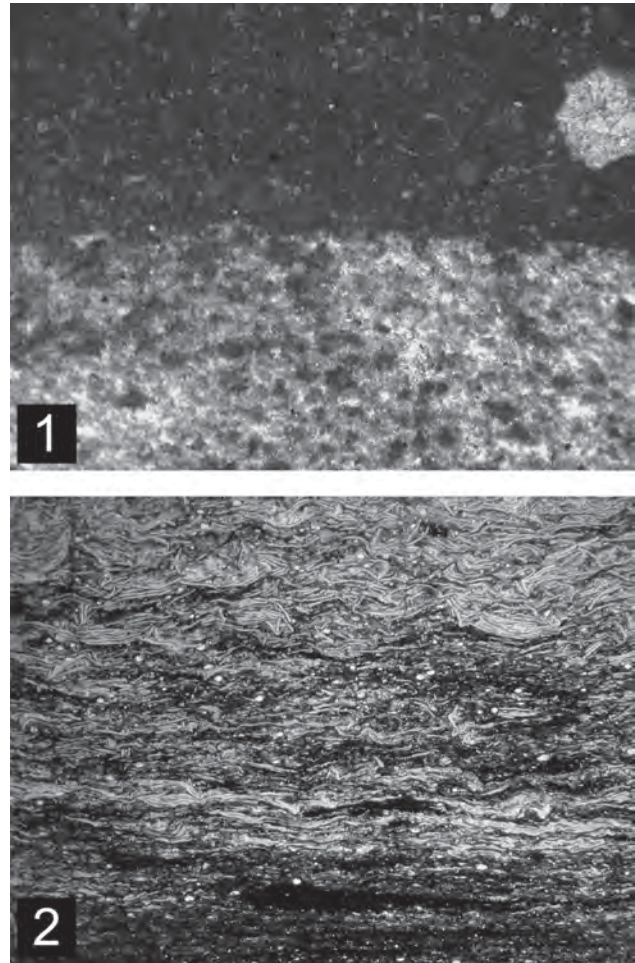


Fig. 1: Mikrofacies of the Late Anisian hemipelagic limestones (Bulog Formation) and cherty limestones/radiolarites of the Hochkarst nappe in Montenegro. **1.** Red micritic limestone with rare filaments, radiolarians and shallow-water clasts with intercalated fine-grained turbidites consist of shallow-water material. Late Pelsonian by means the occurrence of *Nicoraella kockeli* (sample MNE 5; section Boljevici). The sample derives directly from the top of the drownend Steinalm carbonate ramp (Dedovici member of Ravni Formation). Width of photo: 5 mm. **2.** Filament and radiolaria bearing siliceous Late Anisian (Illyrian) cherty limestone from the Late Anisian radiolarite sequence of the (sample MNE 80; section Obzovica). The cherty limestone is laminated and the filaments are enriched in layers representing low velocity – low density turbidites. This microfacies type resembles the Illyrian microfacies of the Reifling Formation in the Northern Calcareous Alps. Width of photo: 14 mm.

limestones are of Ladinian age, proven by conodonts. These red limestones pass continuously into grey hemipelagic limestones of Late Ladinian age (with *Gladigondolella tethydis* and *Gondolella foliata*), topped by shallow-water dolomites of Late Ladinian to Early Carnian age. This short-lasting latest Anisian radiolarite event in the succession of the High Karst Nappe is contemporaneous with the complete demise of shallow-water carbonate production in the whole western Tethyan realm and corresponds to the onset of the first radiolarites on the Neotethys Ocean floor, as proven in Albania (GAWLICK et al. 2008) and northern Croatia (GORICAN et al. 2005) as well as in the Meliata Unit in Slovakia and Hungary (KOZUR & MOCK 1997). In the late Anisian the huge parts of the passive margin facing the newly formed Neotethys Ocean became flooded and volcanic ashes and radiolarites were deposited in the whole Dinarides reaching the palaeogeographic realm of the High Karst Nappe. Obviously volcanics in our sections are preserved only as some thin intercalations of metabentonites. The latest Anisian radiolarite deposition corresponds also to the onset of intense volcanism in the Dinarides more to the north and in the Southern Alps in Italy. The studied successions are nice examples of short-lived hemipelagic basins that formed on continental margin during the late Anisian rifting and were later, in the Ladinian and Early Carnian, completely infilled with sediments of prograding carbonate platforms.

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The Hallstatt Mélange occurrence of Vodena Poljana in the Inner Dinarides (Zlatar Mountain, SW Serbia)

GAWLICK, H.-J.¹, SUDAR, M.², LEIN, R.³, MISSONI, S.², JOVANOVIC, D.⁴ & SUZUKI, H.⁵

¹ University of Leoben, Department for Applied Geosciences and Geophysics, Prospection and Applied Sedimentology, Peter-Tunner-Strasse 5, 8700 Leoben, Austria; hans-juergen.gawlick@mu-leoben.at; s.missoni@daad-alumni.de;

² University of Belgrade, Faculty of Mining and Geology, Department of Palaeontology, Dusina 7,

11000 Belgrade, Serbia; sudar@eunet.rs;

³ University of Vienna, Centre for Earth Sciences, Althanstrasse 14, 1090 Vienna, Austria; richard.lein@univie.ac.at;

⁴ Geological Institute of Serbia, Rovinjska 12, 11000 Belgrade, Serbia; djdivna@gmail.com;

⁵ Otani University, Koyama-Kamifusa-cho, Kita-ku, Kyoto 603-8143, Japan; hsuzuki@res.otani.ac.jp

The different mélanges in south-western Serbia represent a key to solve palaeogeographic questions and to reconstruct the passive margin arrangement of the Inner Dinarides facing the Neotethys Ocean to the east. Of special interest are the different carbonate-clastic radiolaritic mélange areas in the Zlatar Mountain below the Dinaridic Ophiolite Belt.

The present study describes an occurrence of a late Middle to early Late Jurassic mélange in the area of Vodena Poljana in the Zlatar Mountain, SW Serbia (Fig. 1). The section starts 8 kilometres south of Nova Varos on a forest road in direction to Vodena Poljana between the mountain peaks Krseljci and Gulaver. In this area a completely dismembered Anisian shallow-water to Late Anisian-Norian Hallstatt Limestone succession occurs in a late Middle to early Late Jurassic radiolaritic matrix. The dismembered succession occurs as big slides and as clasts in several polymictic mass-flow deposits between the radiolarites and cherty marls. Bigger blocks show partly well constrained parts of the original sedimentary succession, e.g., the Late Anisian drowning of the shallow-water Ravni carbonate ramp (equivalent to the Steinalm carbonate ramp in the Northern Calcareous Alps). The drowning of these carbonate ramp is dated by the occurrence of *Nicoraella germanica* (KOZUR), *Gladigondolella*-ME and *Gondolella* sp. in red Bulog Limestones (sample SRB 296) intercalated by turbidites with shallow-water material on top the shallow-water Ravni Formation. Upsection follows a section up to the Illyrian, dated by *Gondolella bulgarica* (BUDUROV & STEFANOV), *Gladigondolella tethydis* (HUCKRIEDE), and *Gladigondolella*-ME (sample A 4748); *Gladigondolella budurovi* KOVÁCS & KOZUR, *Gondolella bifurcata* (BUDUROV & STEFANOV), *Gondolella* cf. *cornuta* (BUDUROV & STEFANOV), and *Gondolella excelsa* (MOSHER) (sample A 4747); *Gladigondolella budurovi* KOVÁCS & KOZUR and *Gondolella bifurcata* (BUDUROV & STEFANOV) (sample A 4749). Also the occurrence of *Gondolella* cf. *cornuta* (BUDUROV & STEFANOV) in red limestone components in mass-flow deposits (sample SRB 301) confirm the age of the Late Anisian (Illyrian) drowning. Illyrian is proven in an other slide by the occurrence of *Gondolella transita* KOZUR & MOSTLER, *Gondolella* cf. *excelsa* (MOSHER), and *Gladigondolella tethydis* HUCKRIEDE from grey limestones (sample SRB 312); *Gladigondolella*-ME and *Gondolella basissymmetrica* (BUDUROV & STEFANOV) (sample A 4755). Early Ladinian reddish-grey limestones bear *Gondolella trammeri* KOZUR, *Gondolella excelsa* (MOSHER), *Gladigondolella tethydis* HUCKRIEDE, and *Gladigondolella*-ME (sample SRB 314; sample A 4756). Late Ladinian to Early Carnian grey limestones with some shallow-water debris contains *Gondolella* cf. *inclinata* KOVÁCS (sample SRB 316). The Ladinian limestones contain metabentonites and partly volcanics. Late Carnian