

New scallop (*Bivalvia: Pectinida*) findings in the Middle Miocene deposits of Northern Croatia

Croatian Natural History Museum



Hrvatski prirodoslovni muzej

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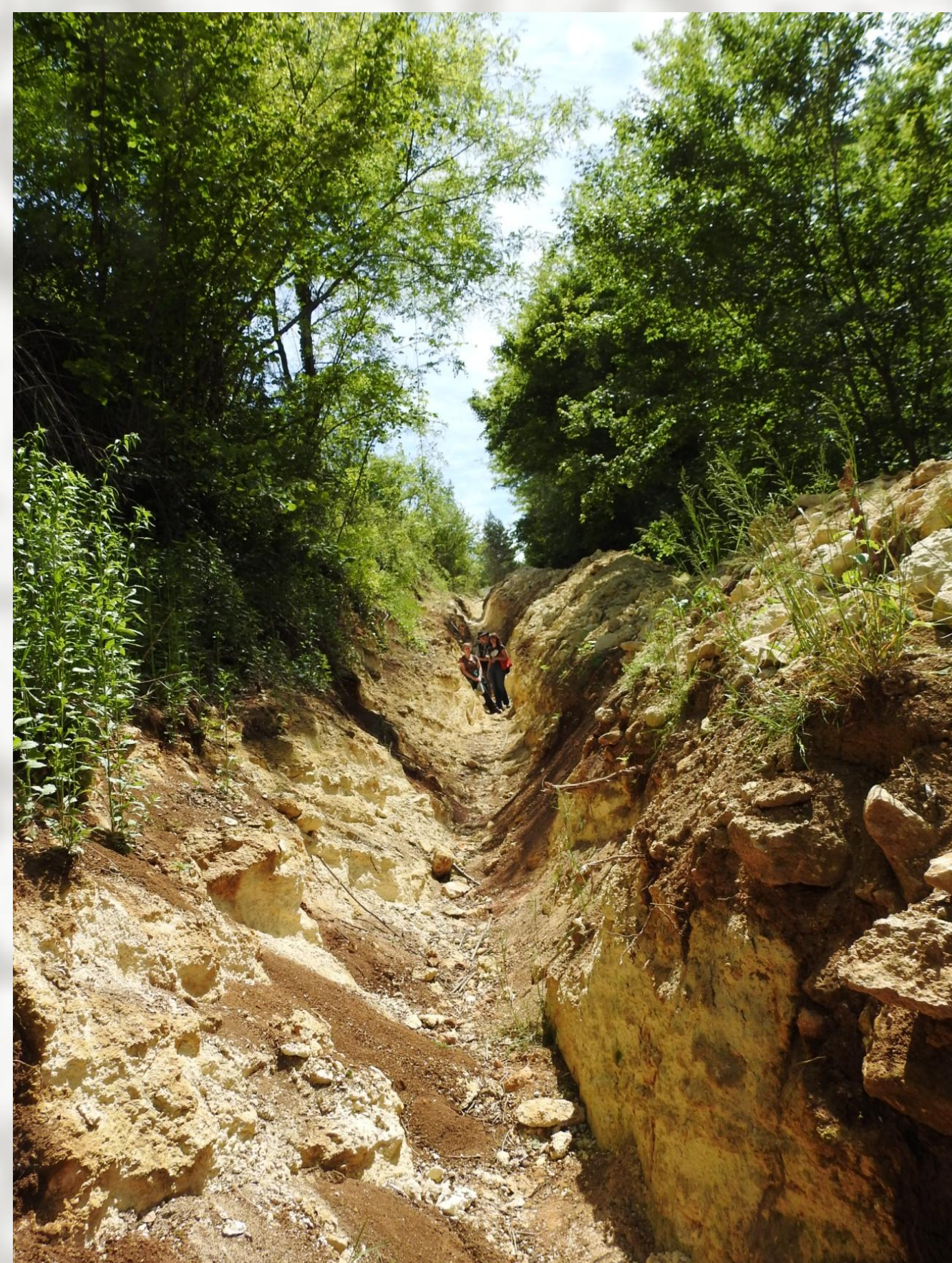


Figure 1. Miocene deposits at Vukovoj locality

INTRODUCTION

During the year 2020 we conducted the field work with the biology student E. Gujić in the area of Klenovnik, Hrvatsko Zagorje, searching for the possible topic of his Master thesis. Excavations for plumbing in the wider area of Vukovoj (Klenovnik County) revealed Miocene marine deposits (Figure 1), also present in the surroundings. From the two outcrops of coralline algal dominated biocalcarenes, we collected several specimens of the *Gigantopecten nodosiformis* (Pusch, 1837), which was chosen as a symbol of the last (8th) NCSEE Workshop (Studencka, 2019).

VUKOVOJ LOCALITY

Miocene deposits at the Vukovoj locality (Figures 1 and 2) are represented with a variety of lithologies. In the basement of the succession we recorded well lithified fossiliferous calcarenites, porous calcarenites with partially dissolved small clasts of grey dolomites from the basement rocks and well layered fine-grained deposits. The overlying horizon comprises chaotic bioclastic deposits with mollusc fragments, which might point to a stormy episode (tempestites). The upper part of the succession is dominated by bioclastic deposits with coralline algae, in the literature known as "Lithothamnion Limestone" (e.g., Basso et al., 2008). Pectinid shells were collected from biocalcarenes with coralline algae. The thickness of the succession varies between 7 and 35 m.

RESULTS

Large-sized species *Gigantopecten* (originally: *Pecten*) *nodosiformis* (Pusch, 1837) is particularly well researched, as it can be clearly recognized in the sediment, due to its large shells with nodes on top of radial ribs (Figure 3). They inhabited fully marine shallow-water environments (e.g., Harzhauser et al., 2003 and references therein). These facultatively mobile scallops are also recorded from several Middle Miocene (Badenian – Langhian) localities in Northern Croatia (Figure 2), e.g., on the Medvednica Mt. (e.g., Kochansky, 1944; Kochansky-Devidé, 1957), Slavonian mountains area (e.g., Šparica et al., 1972, 1986; Šparica & Crnko, 1973; Jamičić, 1988; Korolija & Jamičić, 1988); Moslavačka gora Mt. (e.g., Korolija & Crnko, 1985), Kostajnica area (Jovanović & Magaš, 1980); Sisak area (e.g., Pikija, 1986) and Varaždin area (e.g., Šimunić et al., 1982). Part of these specimens is today housed in the Croatian Natural History Museum (CNHM) in Zagreb. From the so far analyzed microfossil assemblages, we recorded benthic foraminifers *Amphistegina* sp. div., *Sphaerogypsina* sp. and agglutinated foraminifers, and coralligenous algae *Lithothamnion roverei* Airoldi, 1932 (Figure 3).

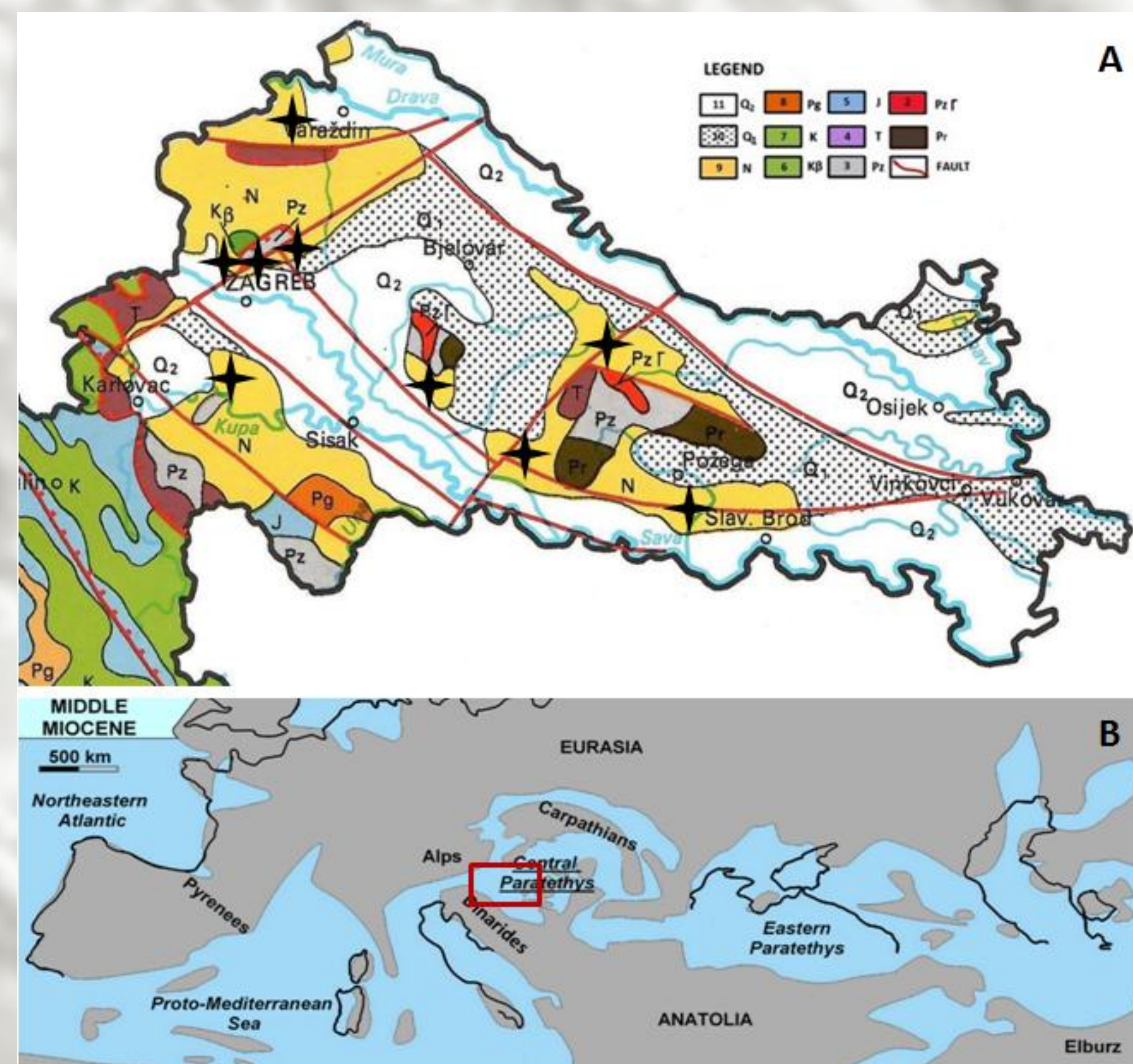


Figure 2. (A) Geographical location of the Badenian localities in Northern Croatia with records of *Gigantopecten nodosiformis* (modified after Sremac et al., 2022 and references therein) marked by four-point star (after references in the text). Legend: 1. Precambrian metamorphic rocks; 2. Paleozoic granites; 3. Paleozoic sedimentary rocks; 4. Triassic carbonates, sporadically clastites; 5. Jurassic carbonates with scarce volcanoclastites; 6. Cretaceous dominantly carbonate rocks; 7. Cretaceous basalts; 8. Paleogene limestones; 9. Neogene clastic and carbonate rocks; 10. Pleistocene, dominantly unconsolidated clastites; 11. Holocene unconsolidated clastites. (B) Paleogeographical location of the Northern Croatian Basin in the Central Paratethys during the Badenian marked by red rectangle (modified after Sremac et al., 2022 and references therein).

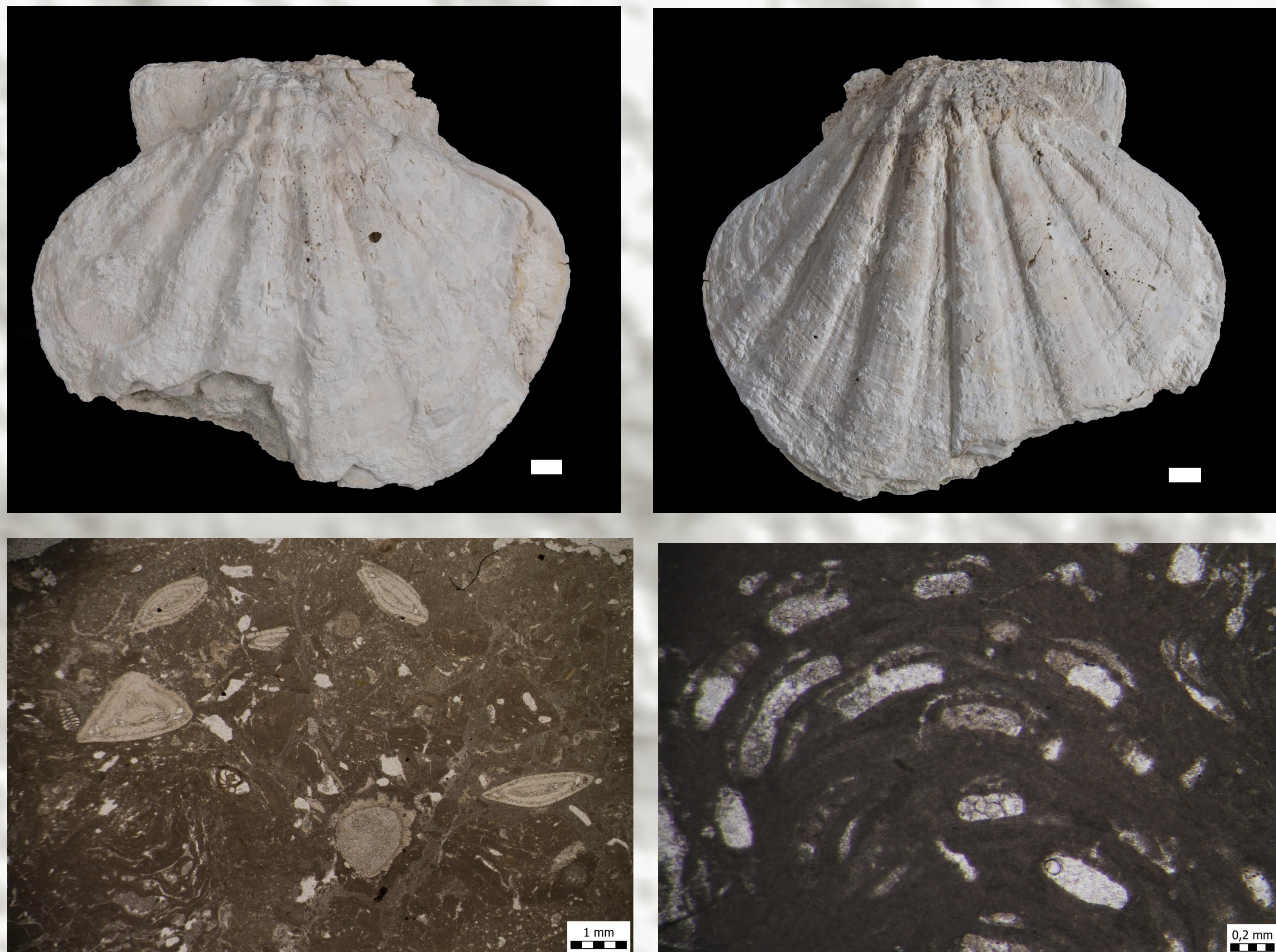


Figure 3. (A) *Gigantopecten nodosiformis*, left valve; (B) *Gigantopecten nodosiformis*, right valve. Scale bars: 10 mm; (C) *Amphistegina* sp. div., *Sphaerogypsina* sp. and agglutinated foraminifers; (D) *Lithothamnion roverei*.

DISCUSSION AND CONCLUSION

Klenovnik Miocene calcarenites were deposited during the Middle Miocene (Badenian - Langhian) at the southwestern margin of the Central Paratethys (e.g., Šimunić et al., 1982; Pavelić & Kovačić, 2018 and references therein). The Badenian is the time of marine transgressions which affected the vast areas of the Central Paratethys (e.g., Rögl, 1998) and also the time of the Miocene Climatic Optimum (Figure 4) (e.g., Zachos et al., 2001; Harzhauser et al., 2003 and references therein). Records of *Gigantopecten* scallops in the Central Paratethys correspond to the favourable climate and eustatic sea-level highstand (e.g., Harzhauser et al., 2003 and references therein). Species *Gigantopecten nodosiformis* is recorded in the Miocene deposits of the Atlantic and Mediterranean provinces since the Early Miocene, from where it migrates to the Central Paratethys around the Early/Middle Miocene (e.g., Mandić, 2004 and references therein). Bivalves of the genus *Gigantopecten* Rovereto, 1899 (*Bivalvia: Pectinida*) are common in the Middle Miocene (Badenian) deposits of the Central Paratethys as described in e.g., Schultz (2001), Mandić (2004 and references therein) and Studencka (2019 and references therein). As described in Studencka (2019 and references therein), the oldest occurrences of *G. nodosiformis* in the Paratethys area are recorded from the Karpatian deposits of southwestern Moravia, Austria and Hungary. In Austria it was also found in the earliest Badenian (Mandić, 2004). In Polish and Ukrainian part of the Carpathian Foredeep Basin *G. nodosiformis* occurs only in the Lower Badenian deposits, in Austria and Slovakia is recorded also in the Upper Badenian, findings in Romania range from the Lower to the Upper Badenian (Studencka, 2019 and references therein) and in Slovenia it is associated with the Middle Miocene (Badenian) "Lithothamnion limestones" (Mikuž, 2009). Findings of *G. nodosiformis* from Badenian deposits in Northern Croatia are mostly recorded within the Upper Badenian deposits (e.g., Jamičić, 1988; Šparica et al., 1972), or only Badenian without detailed division (e.g., Kochansky, 1944; Kochansky-Devidé, 1957; Korolija & Crnko, 1985; Jovanović & Magaš, 1980; Korolija & Jamičić, 1988; Pikija, 1986; Šparica et al., 1986; Šimunić et al., 1982). We plan to conduct further research, which will give more insight into the paleoecology and paleogeography of the Klenovnik area in Northern Croatia. The comparison among the localities in the vicinity of the area of the assumed „Trans-Tethyan“ corridor gives further insight into the possible open marine corridors and migration routes during the Badenian, similar to those proposed by Kováč et al. (2017).

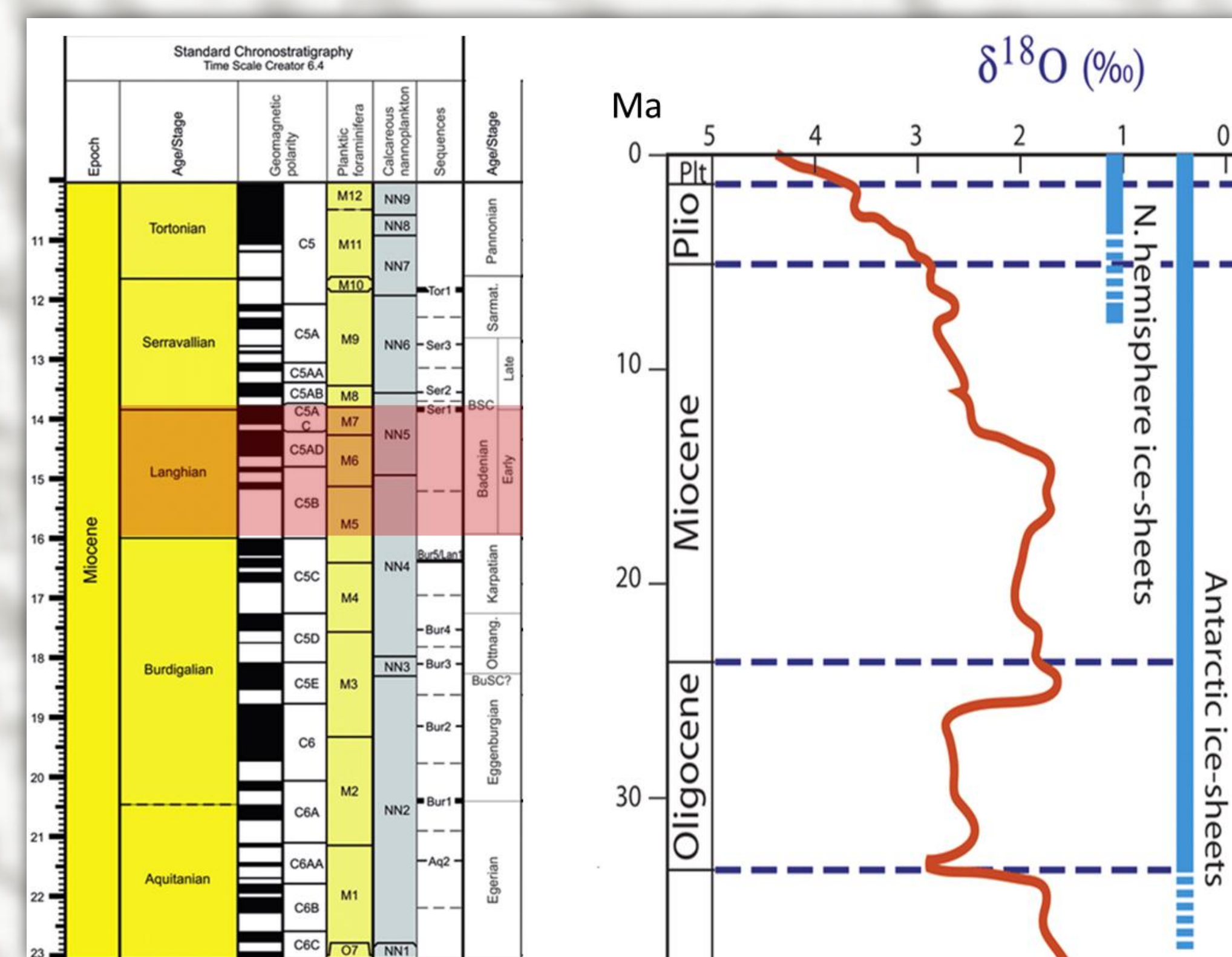


Figure 4. Chronostratigraphic chart (modified after Kováč et al., 2018) and Cenozoic temperature curve modified after Hart (2012 and references therein).

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