Palaeogeography, Palaeoclimatology, Palaeoecology 290 (2010) 81–88

Contents lists available at ScienceDirect

Palaeogeography, Palaeoclimatology, Palaeoecology

journal homepage: www.elsevier.com/locate/palaeo

New paleontological evidence of the Carnian strata in the Mežica area (Karavanke Mts, Slovenia): Conodont data for the Carnian Pluvial Event

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ARTICLE INFO

Article history:
Received 12 December 2008
Received in revised form 12 May 2009
Accepted 6 June 2009
Available online 17 June 2009

Keywords:
Conodonts
Triassic
Carnian
Biostratigraphy
Slovenia

ABSTRACT

The Carnian carbonate succession in the Mežica area called "Raibl Beds" (Karavanke Mts, Slovenia) on the north of the Periadriatic Line in the Eastern Alps includes three clastic horizons of marly–shaly rocks. The most interesting is the second clastic horizon that contains unique layers or lenses of micritic limestone. Although many samples were collected for conodonts, only one single sample yielded well preserved Carnian (Julian) specimens. The monospecific conodont fauna is marked by elements of *Nicoraella ? budaensis* that enables us to reconstruct a multielemental apparatus. The sporomorph associations of the first and the second clastic horizons are well correlated to the humid sub-phases in the "Raibl Beds". The recovered conodont fauna verifies the Julian age of the second clastic horizon in the Mežica area and it provides new significant information for definition of the Carnian Pluvial Event in the Karavanke Mts.

1. Introduction

The Triassic period was characterized by widespread aridity as evidenced in sedimentary records. Yet, during the Carnian period there existed a short humid event as a result of increased rainfall marked by a sudden input of siliciclastics (Simms & Ruffell, 1989; De Zanche et al., 2000; Gianolla et al., 2003; Preto et al., 2005; Hornung & Brandner, 2005). The causes of the humid event are yet still a matter of discussion, but it seems that all effects are related to the rifting of Pangea (Simms & Ruffell, 1989). In the Northern Calcareous Alps a distinct climatic shift was documented by the "Reingraben Wende" (Schlager & Schöllnberger, 1974; Hornung & Brandner, 2005). A humid climate pulse, known as the "Carnian Pluvial Event" (CPE), has been recognized in different parts of Tethys (Hornung et al., 2007a,b; Preto et al., 2008). In Europe, this event has been recognized in continental and shallow marine successions as well as in the deep marine settings (Kozur, 2000; Kozur & Weems, 2007; Kozur & Bachmann, 2008; Rigo et al., 2007; Hornung et al., 2007a; Hornung & Brandner, 2008).

A direct link of the CPE in timing of major faunal and floral turnover, yet not synchronous for the marine and terrestrial taxa due to their dependence to different environmental factors, was pointed out already by Simms & Ruffell (1989). There exists an extensive list of taxa that appear during or after the CPE, and among them those scleractinian corals that became important reef builders at this time (Stanley, 1988, 2003; Turnšek, 1997; Flügel, 2002), whereas a high extinction rates for ammonoids, bryozoa and crinoids have been evidenced (Simms & Ruffell, 1989; Hornung et al., 2007b; Rigo et al. 2007). A significant marine invertebrate turnover was greatest at the lower/middle Carnian boundary that is evidenced also in the conodont record (Krystyn, 1983, 1991; Noyan & Kozur, 2007; Hornung et al., 2007a; Rigo et al., 2007).

Precise age for the CPE in the Dolomites is based on ammonoid, conodont and palynomorph biostratigraphy (Gianolla et al., 1998, 2003; De Zanche et al., 2000; Keim et al., 2001, Rigo et al., 2007). Based on ammonoid and conodont data a Julian age (Julian 1/IIc to Julian 2/II) for the CPE was demonstrated that constraints its duration up to the Julian/Tuvalian boundary (approximately 1 Ma) (Hornung & Brandner, 2005; Hornung et al., 2007a; Rigo et al., 2007; Preto et al., 2008).

In order to define the Carnian Pluvial Event in Slovenia we studied the Carnian "Raibl Beds" in the Northern Karavanke Mts that are part of the upper structural horizon of the Eastern Alps (Fig. 1). Stratigraphic development of this area is presented in the generalized stratigraphic column (Fig. 2) and it is almost identical to the one of the Northern Calcareous Alps (Placer et al., 2002). Paleontologically the most interesting part is the second clastic horizon. There occur particular layers or lenses of micritic limestone that were repeatedly sampled and treated for conodonts over a long period of time (1980–2007). Our aim was to recover conodonts that had proven their utility for precise dating as well as for regional correlation.

A single sample yielded a well preserved monospecific conodont fauna constituted by *Nicoraella ? budaensis* Kozur & Mock that enables also apparatus reconstruction. This species was hitherto documented from the Carnian strata of Hungary (Buda Mts), Italy (Sicily) and

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doi:10.1016/j.palaeo.2009.06.015

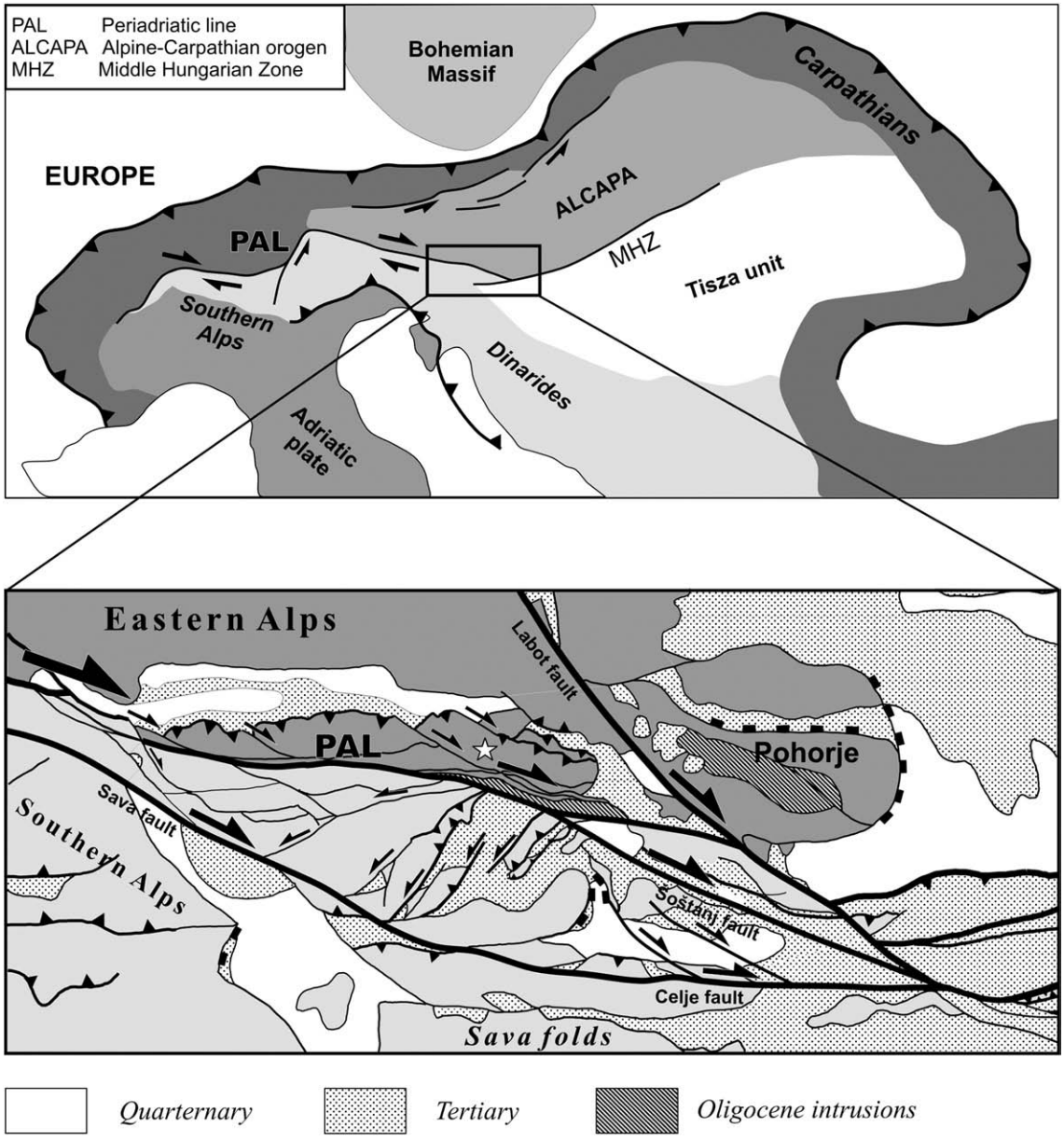

Fig. 1. Structural sketch of northern and central Slovenia with surrounding areas (modified after Fodor et al., 1998).

Slovenia (Karavanke Mts) (Kozur & Mock, 1991; Kolar-Jurkovšek et al., 2005). The recovered conodont fauna confirms the Julian age of the second clastic horizon in the Mežica area. In this study a summary of biostratigraphical evidence for the Carnian Pluvial Event in the Karavanke Mts is given.

2. Geological setting

The Carnian beds of the Mežica area have been part of several geological studies due to extensive mining activity (Fig. 3A and B). In order to make a paleoenvironmental reconstruction of the region several biostratigraphic studies have been carried out (Jurkovšek, 1978; Jelen & Kušej, 1982; Jurkovšek & Kolar-Jurkovšek, 1997, Jurkovšek et al, 2002; Kaim et al., 2006; Pungartnik et al., 1982). The studied section is situated north of the Periadriatic Line that represents one of the most remarkable fault systems of the Alps, and it separates the Southern Alps from the northerly lying Western, Central and Eastern Alps (Fig. 1). The Carnian rocks of the Raibl Group in the western Karavanke Mts include three clastic horizons that occur in similar lithology in a wider area of the Eastern Alps (Figs. 2 and 3C). In the Mežica area, each clastic horizon is characterized by the presence of oolitic–oncoidal limestone containing diverse Carnian fauna (Fig. 3). These beds were first described by Teller (1896) as Cardita Shales according to prevailing bivalve genus *Cardita*, and this name was retained until the twentieth century. Zorc (1955) differentiated the first and the second clastic horizons only, and he termed them Raibl Beds. Štrucl (1961, 1971) distinguished the three Cardita Shales and correlated them with the 80 km distant Bleiberg area. A Carnian fauna was collected in the first clastic horizon and it revealed several common cephalopod species with the Bleiberg locality (Jurkovšek, 1978). Presence of several isocrinid species of the genera *Laevigatocrinus* and *Tyrolecrinus* from the three clastic horizons and the oolitic–oncoidal beds resting below them was established, and absence of encrinids is obvious (Jurkovšek & Kolar-Jurkovšek, 1997). More recent paleontological discovery from the oolitic–oncoidal footwall of the second clastic horizon is the finding of *Thecospira haidingeri* (Suess), the earliest thecideide brachiopod (Jurkovšek et al., 2002; Kolar-Jurkovšek et al., 2003). Two gastropod assemblages were described from the Mežica area, the older almost monospecific from the base of the first