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Ecospace variability along a carbonate platform at the northern boundary of the Miocene reef belt (Upper Langhian, Austria)

Thomas Wiedl [a,*], Mathias Harzhauser [b], Andreas Kroh [b], Stjepan Ćorić [c], Werner E. Piller [a]

[a] Institute of Earth Sciences, Paleontology and Geology, University of Graz, Heinrichstrasse 26, 8010 Graz, Austria
[b] Natural History Museum Vienna, Burgring 7, 1010 Vienna, Austria
[c] Geological Survey of Austria, Neulinggasse 38, 1030 Vienna, Austria

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ABSTRACT

The south-western edge of the Leitha Mountains in the southern Vienna Basin (Austria) exposes parts of an Upper Langhian (Middle Badenian) shallow water (<30 m) carbonate platform. The study of its ecospace comprises sedimentological and palaeontological data of 4 up to 36 m thick carbonate sections of the Müllendorf quarries which have been logged and subjected to detailed investigation and sampling. The sedimentary record is dominated by coralline algal debris sands which represent 7 distinct lithofacies (bioclastic coralline algal-mollusc facies, *Hyotissa* facies, *Isognomon* facies, coral facies, rhodolith facies, bryozoan facies). All these facies are described in detail in respect to lithology and biota and are palaeoecologically interpreted. Striking features of these limestone successions are periodical intercalations of coral- and mollusc-rich horizons. Their formation had been triggered by water turbidity and low amplitude changes in relative sea level. These relations are especially interesting as the platform carbonates formed at the northern edge of the Langhian Peri–Mediterranean reef belt. Water turbidity, as ecological master factor, and depth played the fundamental role in ecosystem and community expression within ecospace. The lateral distribution and the ecological relations between the various facies types allow proposing an ecospace-occupation model.

1. Introduction

Each level of organization occupies a specific volume (or functional region respectively) within an ecospace which is e.g. the ecosystem for the community or the niche for the species (Valentine, 1969; Brenchley and Harper, 1998). The term "ecospace" is commonly afflicted with functional meanings (e.g. Bambach, 1983; Novack-Gottshall, 2007) but used here only in sense of spatial (i.e., potential habitat available for the establishment of necessary ecologic interactions) connotation (sensu Buatois and Mángano, 1993). Several physical and chemical factors, which are on the one hand limiting and on the other hand modulating, influence geographical distributions of marine carbonate producing organisms within an ecospace (Brenchley and Harper, 1998).

Typical representatives of these carbonate producing organisms are corals and coralline algae. These were the main constituents of the Miocene carbonate platforms in Europe and also in the area of the Paratethys Sea. Causes for development of either coral reefs (s.s.) or coral bearing coralline algal limestones within the same ecospace are so far not considered for the Central Paratethys. A key location to discuss this problem is the Leitha platform in the southern part of the Vienna Basin. Its limestones, broadly known as Leitha Limestones (sensu Keferstein, 1828), are dominated by coralline algal debris and have been deposited during Langhian and early Serravallian times (corresponding to the Badenian age of the regional Paratethyan stratigraphy; Steininger and Papp, 1978). The coral bearing strata at the south-western rim of the Leitha Mountains (Fig. 1a, b) are known for a moderately diverse coral fauna (e.g. Reuss, 1871). The former interpretation of these strata as coral reefs (e.g. Schaffer, 1908; Dullo, 1983; Tollmann, 1985) was re-evaluated and it was shown that the term coral carpets (sensu Reiss and Hottinger, 1984) is more appropriate (Piller and Kleemann, 1991; Piller et al., 1996, 1997; Riegl and Piller, 2000). A well studied locality is the Fenk quarry NNW of Grosshöflein (Burgenland province, N 47°50'42.65", E 16°28'36.04"). As type locality of the Badenian Leitha Limestone (Steininger and Papp, 1978) it comprises a ca. 20-m-thick succession of coralline algal limestones with frame-building coral carpets and non-frame-building biostromal coral communities with horizons of coral debris, in situ coral colonies and oyster/*Isognomon* horizons (Steininger and Papp, 1978; Piller and Kleemann, 1991; Riegl and Piller, 2000). A currently much larger outcrop, exposing a lateral time-equivalent succession of these units, is the Müllendorf quarry (Fig. 1c, d), well known for its fossil richness (Abel, 1928; Kühnelt, 1931; Reidl, 1937, 1941; Toth, 1950; Schaffer, 1961; Kühn, 1963; Kristan-Tollmann, 1964, 1966; Kleemann, 1982; Schultz, 2001, 2003, 2005; Kroh, 2005). In contrast to other limestones of the

* Corresponding author.
E-mail addresses: thomas.wiedl@uni-graz.at (T. Wiedl), mathias.harzhauser@nhm-wien.ac.at (M. Harzhauser), andreas.kroh@nhm-wien.ac.at (A. Kroh), stjepan.coric@geologie.ac.at (S. Ćorić), werner.piller@uni-graz.at (W.E. Piller).

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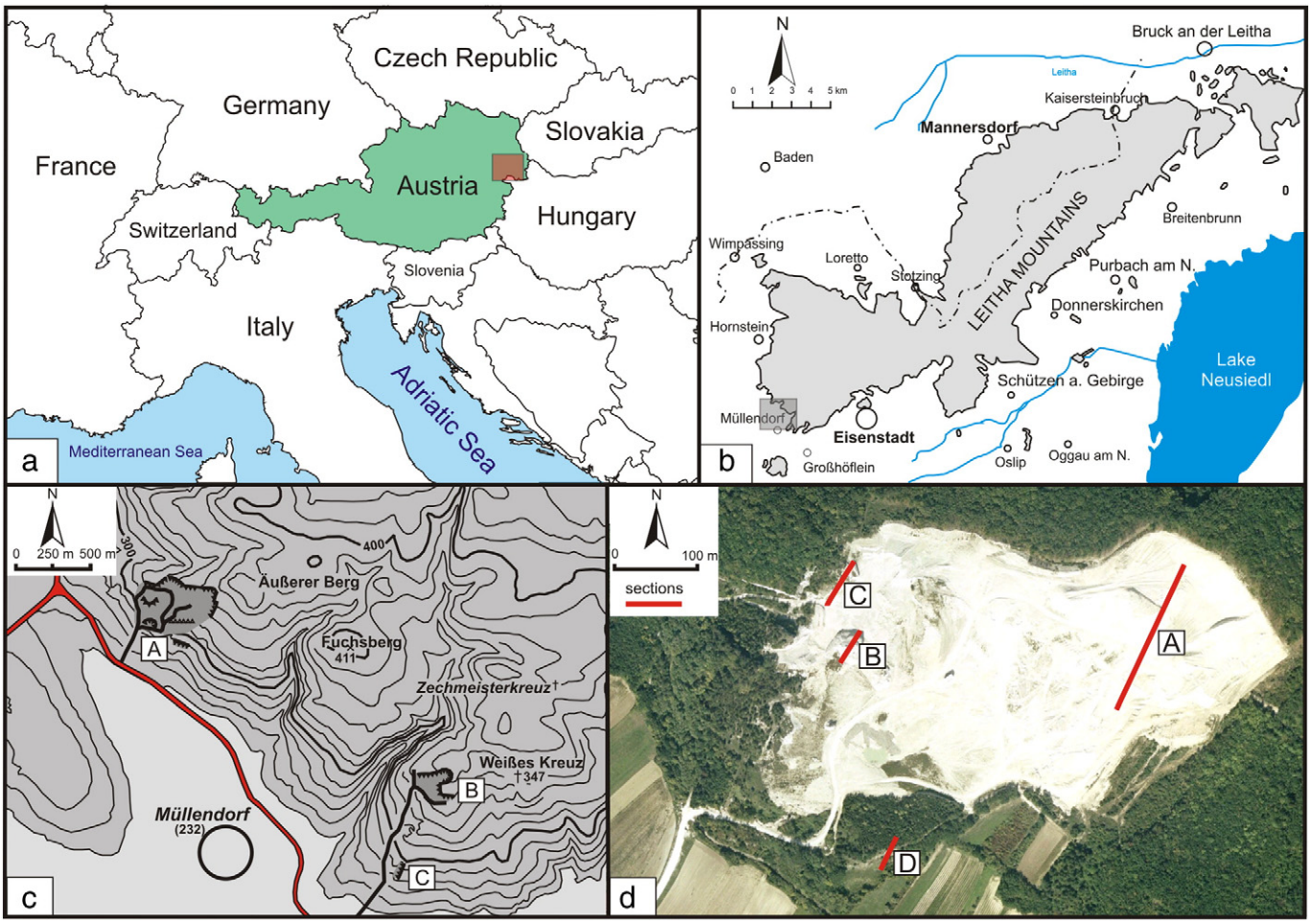

Fig. 1. Location of the studied area. **a** Map of Europe with Austria in the centre. The study area is highlighted with a brown rectangle. **b** Geographic map (inset in a) of the Leitha Mountains spanning the border region of Lower Austria and Burgenland provinces. **c** Map with contour lines (metres above sea-level) of the study area. (A) Müllendorf quarry system, (B) Upper Fenk quarry system, (C) Lower Fenk quarry. **d** Satellite image ((C)2010 Google) of the quarry system of the Mühlendorfer Kreidefabrik Margit Hoffmann-Ostenhof GmbH, corresponding to A in c. The studied sections are indicated by letters A–D.

Leitha Mountains, these show a soft, chalky appearance, (e.g. Reidl, 1937; Kapounek, 1938), which is caused by post-depositional diagenetic leaching (Dullo, 1983).

The goal of this study is the reconstruction and recognition of environmental factors and their role in modulating a Langhian ecospace within which facies changes are the expression of altered ecospace utilization. Therefore, the sedimentary successions of the south-western part of the Leitha Mountains enable insights into dynamic near-shore environments of a Central Paratethyan carbonate platform where settlement of the sea-floor by corals or specific bivalve associations was limited to narrow niches. In addition, rhythmic bedding of coral and bivalve accumulations is a characteristic feature of these sediments.

2. Study area

The study area is located at the south-western edge of the Leitha Mountains in the Burgenland province between Hornstein and Großhöflein (Fig. 1b, c). The Leitha Mountains represent a mountain chain spanning ca. 35 km from southwest to northeast with a maximum width of ca. 17 km (Fig. 1b). The Leitha Mountains have a crystalline core dominated by mica schists of the Lower Austroalpine nappe system which is covered by Badenian and Sarmatian limestones (Pascher and Brix, 1994). During the Middle Miocene the Leitha Mountains formed a topographic high or island with extensive carbonate production, giving rise to a carbonate platform (Tollmann, 1955; Dullo, 1983; Riegl and Piller, 2000; Schmid et al., 2001; Strauss et al., 2006; Harzhauser and Piller, 2010). The investigated sections (A: N47°51′29.65″, E16°27′22.62″, B: N47°51′29.48″, E16°27′4.87″; C: N47°51′31.38″, E16°27′03.34″) are located within and in the south (D: N47°51′20.65″, E16°27′5.10″) in a more basinwards position of the active quarry system (Fig. 1d) of the Mühlendorfer Kreidefabrik Margit Hoffmann-Ostenhof GmbH. Most of the limestones have a soft, light-colored, chalky character and underwent a complex diagenetic pathway. They passed through a freshwater phreatic environment, characterized by undersaturated waters flowing rapidly through the sediment, which allowed a leaching without coeval precipitation (Dullo, 1983). They contain high amounts of fossils with calcitic skeletons such as oysters, pectinids, echinoids and cirripedians (e.g. Suess, 1860; Reidl, 1937; Kroh, 2005) while shells of aragonitic skeletons are dissolved and commonly replaced by calcite (Suess, 1860; Kleemann, 1982; Dullo, 1983). These organisms are preserved as molds or steinkerns. The presence of corals, for example, is only documented as voids or sediment-filled corallites.

3. Materials and methods

This study combines sedimentological and palaeontological data. Four sections have been logged and subjected to detailed investigation and sampling within the study area that has an extension of ca.