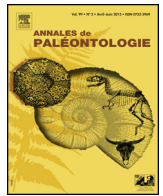




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Original article

Macroinvertebrate fauna and depositional environment of the lower Upper Cenomanian Oberhäslich Formation in the Saxonian Cretaceous Basin (Germany)

Macrofaune d'invertébrés et milieux de dépôts de la formation Oberhäslich du Cénomanién supérieur basal dans le bassin crétacé de Saxe (Allemagne)

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ABSTRACT

In Saxony (southeast Germany), the global early Late Cretaceous transgression is reflected by the onlap of shallow-marine siliciclastics of the lower Upper Cenomanian Oberhäslich Formation (*Calycocheras naviculare* Zone) onto the eastern Erzgebirge, the central part of the emergent Mid-European Island. Based on detailed logging of sections south of Dresden and the study of extensive collection material, the depositional environment and macroinvertebrate assemblages of the Oberhäslich Formation have been reconstructed. This unit, with a mean thickness of 10–15 m, usually shows a fining-upward trend that may become reversed towards the top, was laid down in a single 3rd-order sea-level cycle and is capped by an unconformity at the base of the overlying upper Upper Cenomanian Dölzsch Formation (sequence boundary Cenomanian 5; junction of the *Calycocheras naviculare* and *Metoicoceras geslinianum* zones). The macroinvertebrate assemblage of the Oberhäslich Formation, collected mainly from bioturbated, fine- or rarely medium-grained, quartz-rich sandstones, is fairly diverse, comprising nearly 50 taxa, predominantly bivalves (94.3%). Most conspicuous and abundant are relatively large forms such as *Rhynchostreon* (*R.*) *suborbiculatum* (25%) and *Inoceramus pictus* spp. (21%), eponymous taxa of the *Rhynchostreon suborbiculatum*/*Inoceramus pictus* assemblage. Non-bivalve benthic invertebrates are rare and represented by rather poorly preserved irregular and regular echinoids, siliceous sponges, a few gastropods, crustacean remains and a single starfish. Common *Thalassinoides* and *Ophiomorpha* burrows indicate that crustaceans were an important part of the infauna. Pervasive bioturbation resulted in a post-depositional homogenization of the sediments while all body fossils are preserved as (composite) internal moulds. The guild structure of the *Rhynchostreon suborbiculatum*/*Inoceramus pictus* assemblage shows a predominance of epifaunal and semi-infaunal suspension feeders (95.3%), suggesting eutrophic and unstable “green-water conditions” of an inner-shelf setting. Deposit-feeding biota are rare. The common occurrence of articulated bivalves and storm-induced shell beds indicate episodic rapid burial, most probably by tempestites. A current-influenced, well-oxygenated and nutrient-rich environment slightly below fair-weather base is inferred for the fine-grained sandy, fossiliferous sediments of the Oberhäslich Formation.

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R É S U M É

En Saxe (sud-est de l'Allemagne), la transgression globale du Crétacé Supérieur est enregistrée par l'onlap des dépôts siliciclastiques peu profonds de la formation Oberhäslich du Cénomanién supérieur basal (Zone à *Calycocheras naviculare*) sur l'Erzgebirge oriental, partie centrale émergée de l'Europe (« Mid-European Island »). À partir d'une exploitation détaillée de coupes géologiques au sud de Dresde et de l'étude d'un vaste échantillonnage paléontologique, l'environnement de dépôt et les assemblages de

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macrofaune d'invertébrés de la formation Oberhäslich ont été reconstruits. Cette unité, d'une épaisseur moyenne de 10 à 15 m, montre habituellement une tendance à la hausse du niveau marin qui peut s'inverser à son sommet ; elle est intégrée dans un cycle de 3^e ordre et est coiffée par une discordance à la base de la formation Dölzschchen (Cénomaniens supérieur terminal, limite de séquence du Cénomaniens 5, jonction des zones à *Calyoceras naviculare* et à *Metoicoceras geslinianum*). L'assemblage de macrofaune d'invertébrés de la formation Oberhäslich, recueilli principalement dans des grès à grain fins, plus rarement à grain moyen, riches en quartz bioturbé, est assez diversifié et comprend près de 50 taxons, principalement des bivalves (94,3 %). Les plus remarquables et abondants sont des formes relativement grandes telles que *Rhynchostreon* (*R.*) *suborbiculatum* (25 %) et *Inoceramus pictus* spp. (21 %), taxons éponymes de l'assemblage à *Rhynchostreon suborbiculatum*/*Inoceramus pictus*. Les invertébrés benthiques non-bivalves sont rares et représentés par des échinides réguliers et irréguliers mal préservés, des éponges siliceuses, quelques gastéropodes, des restes de crustacés et une seule étoile de mer. Les traces fréquentes de types *Thalassinoides* et *Ophiomorpha* indiquent que les crustacés étaient une partie importante de l'endofaune. La bioturbation omniprésente a abouti à une homogénéisation post-dépôt des sédiments alors que tous les fossiles sont conservés sous forme de moules internes. La structure de guildes de l'assemblage à *Rhynchostreon suborbiculatum*/*Inoceramus pictus* montre une prédominance des suspensivores d'épifaune et de semi-endofaune (95,5 %), ce qui suggère des conditions « d'eaux vertes eutrophes » et instables d'un milieu de plateforme interne. Les biotas comprenant des dépositivores sont rares. L'occurrence fréquente de valves en connexion et de couche de coquilles indique un enfouissement rapide épisodique, probablement par des tempêtes. Les sédiments fossilifères sableux à grains fins de la formation Oberhäslich sont interprétés comme issus d'un environnement riche en nutriments, bien oxygéné et influencé par les courants, situé légèrement sous la limite d'action des vagues de beau temps.

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1. Introduction

In Saxony (Germany), the area between Meißen, Dresden, Pirna and the Czech border is characterized by sedimentary rocks of early Late Cretaceous age (Cenomanian–Coniacian Elbtal Group), the exposures of which more-or-less follow the Elbe river valley (Fig. 1A). Following a first transgression in the late Early Cenomanian (Meißen Formation), the main progression of the global early Late Cretaceous transgression is documented by the onlap of shallow-marine sandstones of the lower Upper Cenomanian Oberhäslich Formation onto Paleozoic rocks of the eastern Erzgebirge, the central part of the Mid-European Island. During this time, extensive shallow-marine siliciclastic environments developed in the Saxonian Cretaceous Basin, characterized by a diverse and abundant invertebrate fauna, derived from the Oberhäslich Formation. Based on detailed logging of sections south of Dresden and the study of extensive collection material housed in the Museum für Mineralogie und Geologie of the Senckenberg Naturhistorische Sammlungen Dresden, the depositional environment and macroinvertebrate assemblage of the Oberhäslich Formation have been reconstructed.

2. Geological setting

The Elbtal Group (Tröger and Voigt in Niebuhr et al., 2007) was laid down in a relatively narrow basin, the so-called Saxonian Cretaceous Basin (SCB), between the Osterzgebirge as the central part of the Mid-European Island in the southwest and the West-Sudetic Island (Lausitz Block) in the northeast (Fig. 1B, C). During the early Late Cretaceous, the SCB connected the Bohemian Cretaceous Basin (BCB) in the southeast with the wide Boreal epicontinental shelf sea in the northwest. The strata of the Elbtal Group show thus great overall similarity in terms of bio- and lithofacies to coeval successions in the BCB. Today, the fill of the SCB is preserved in a tectonic halfgraben whose active northeastern margin is represented by the Lausitz Fault (Fig. 1A), an important structural element of Late Cretaceous inversion in central Europe (Voigt, 2009).

A first marine transgression from the north started during the late Early Cenomanian (*Mantelliceras dixonii* Zone), only reaching the extreme northeast of the present-day outcrop belt of the

Elbtal Group. The resulting Meißen Formation (lithostratigraphy after Tröger and Voigt in Niebuhr et al., 2007; Fig. 2) consists of conglomeratic bioclastic limestones that reflect high-energy nearshore conditions. It ranges into the Middle Cenomanian (Wilmsen and Nagm, 2014) and is thus a lateral equivalent of the fluvial to estuarine Middle Cenomanian Niederschöna Formation that back-fills river valleys in the Osterzgebirge (Voigt, 1998). The major phase of the early Late Cretaceous transgression followed during the Late Cenomanian, having taken place in two main pulses. During the first pulse in the *Calyoceras naviculare* Zone (early Late Cenomanian), the shallow-marine and fossiliferous sands of the Oberhäslich and the more distal clayey silts of the Mobschatz formations accumulated, often missing on swell areas (Tröger, 2003). The second pulse, dated as mid-Late Cenomanian *Metoicoceras geslinianum* Zone (*plenus* Transgression of authors), resulted in the onlap of the Dölzschchen Formation onto formerly emergent basement areas and the final drowning of remaining islands in the Elbe-Zone (e.g., Tröger, 1955, 2003; Voigt et al., 1994; Voigt et al., 2006; Wilmsen et al., 2011; Janetschke and Wilmsen, 2014). In the aftermath of the Late Cenomanian facies leveling and submergence of the pre-transgression topography, homogeneous and more widespread sedimentation patterns of a graded shelf became established during the Early Turonian (Voigt, 1994, 1999; Janetschke and Wilmsen, 2014). The proximal area of the Elbsandsteingebirge (Fig. 1A) was dominated by sandy nearshore facies (Schmilka Formation) while in the distal Dresden–Meißen area, offshore marls and silty limestones (so-called Pläner) were deposited (Brießnitz Formation). In between, there was a facies transition zone near Pirna (Faziesübergangszone) in which intercalated Pläner and sandstone deposits occur (Fig. 2).

3. Scope and methods

Strata of the Elbtal Group have been a classical field of paleontological research in Germany for almost two centuries (e.g., Geinitz, 1871–1875, 1872–1875; see also recent revision of Cretaceous fossils from Saxony by Niebuhr and Wilmsen, 2014). However, quantitative paleoecological studies integrating sedimentological, paleontological and taphonomic data have only rarely been carried out so far (see brief paleoecological account of Föhlisch, 1998 on

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