acta
geologica
polonica

Vol. 46, No. 1-2, pp. 81-88 Warszawa 1996

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# Comparison of the Cenomanian through Middle Turonian faunas and facies between Central and Eastern Europe

ABSTRACT: The German-Polish Basin, the Russian Platform, and adjacent regions as the Northern Caucasus, Mangyshlak, and Kopet-Dag are parts of the Northern Temperate Realm (= Boreal Realm), and belong to the European Paleobiogeographic Province *sensu* NAIDIN (1969). This is clearly testified by the Cenomanian and Turonian inoceramid assemblages as well as the ammonites and belemnites. The inoceramid zonation as applied in Western Europe can be easily used in Eastern Europe. This identity is also valid for the distribution of bio- and eco-events (*Schloenbachia/virgatus* Event, *Chondrites* Event, *Mytiloides* Event, *lamarcki/cuvieri* Event) and the stratigraphic location of the barren intervals in this part of the mid-Cretaceous.

The gaps in the Middle and Upper Cenomanian and at the Cenomanian/Turonian boundary in Eastern Europe are greater than in Western Europe. For lithological comparisons especially the limy offshore development is useful. This comparison shows the whole facies similarity and the same time location of the important facies changes. The basal greensand of the Crimea area can be compared with the Early Cenomanian greensand of the southern Münsterland and eastern Subhercynian regions. The unfossiliferous Upper Cenomanian limestones of the Crimea are closely comparable to the so-called "Arme *Rhotomagense* Schichten", and the reddish marls and argilliferous limestones with the "Rotpläner" facies in Western Europe.

## INTRODUCTION

Western, Central, and Eastern Europe belonging to the Northern Temperate Realm (=Boreal Realm) are located north of the Tethyan Realm. Both realms were separated by smaller and larger islands uplifted during the Late Cretaceous time. The largest of them were Mid-European Island (Ardennes, Rhine Slate Mountains, Thuringian Slate Mountains including the western part of the Ore Mountains), Sudetic Islands (West and East Sudetic Islands), and the Ukrainian Shield. The more or less nar-

rower connecting routes between Boreal and Tethan realms mark deposits of the Elbe Valley, the Cracow region, and the Ukrainian Shield. These connections enabled the south-north and north-south flowing currents and faunal migrations. The Northern Lower Temperate Realm corresponds to the European Paleozoogeographic Province *sensu* NAIDIN (1969, 1979).

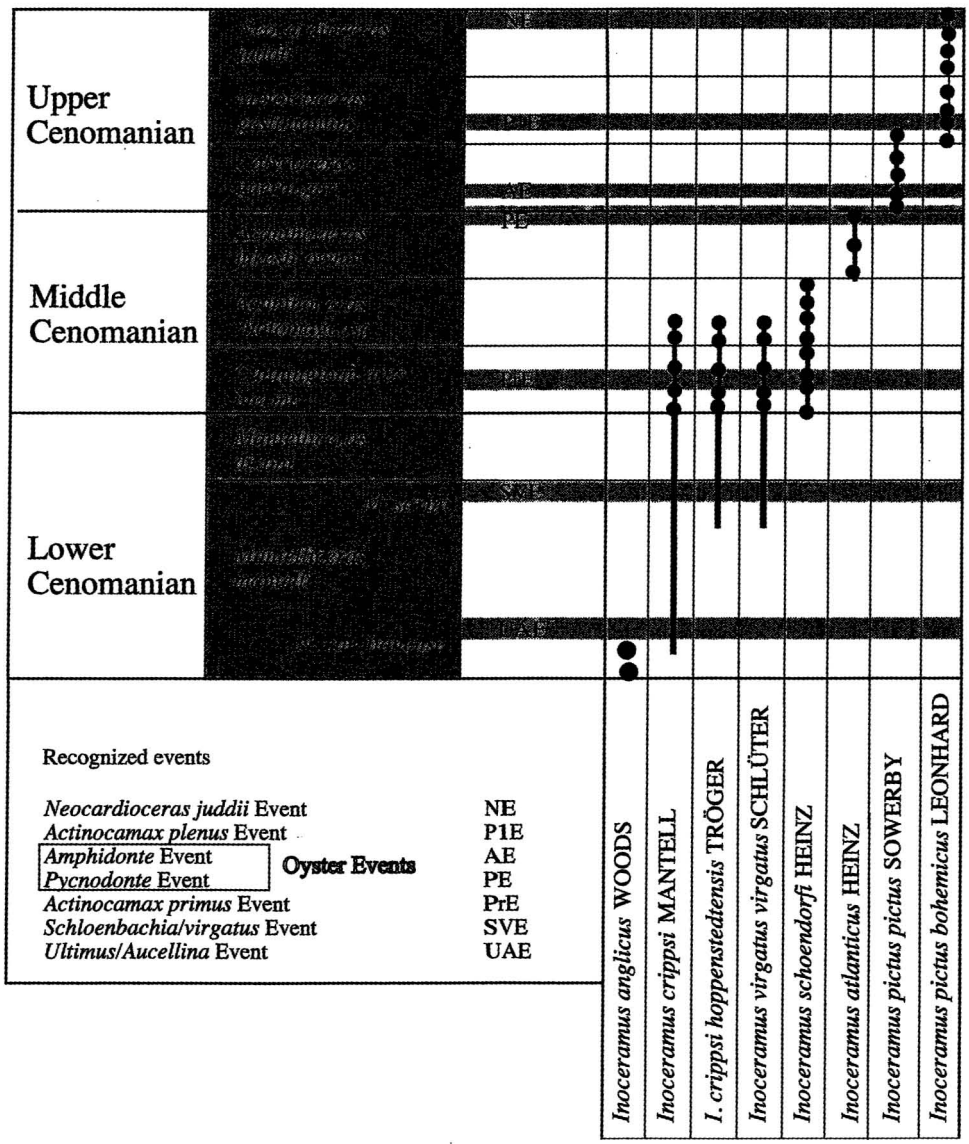


Fig. 1. Ammonite zonation, events, and vertical ranges of selected inoceramid species in the Cenomanian of Western Europe

Provided comparisons between eastern and western European mid-Cretaceous successions are based on the successions of the Münsterland Basin, the Subhercynian Basin, and the Crimea area. These regions provide the most complete successions of the Cenomanian and Turonian stages. In Eastern Europe, in contrary to the Crimean area, there are vast areas (*e.g.* Ukrainian and Perkaspian Depressions, southern parts of the Russian Platform) where the Cenomanian and Turonian occur but the successions are strongly reduced.

## COMPARISON OF INOCERAMID ASSEMBLAGES AND EVENTS SUCCESSION

Inevitably one of the most important members of the Cenomanian to Middle Turonian biota in Northeuropean Biogeographic Province are inoceramids. The Lower and Middle Cenomanian is characterized moreover by a common occurrence of the ammonites of the genera *Schloenbachia*, *Mantelliceras*, *Turrilites*, *Mariella*, *Hyphoplites*, and *Acanthoceras*. This ammonite fauna, described from the Crimea by MARCINOWSKI (1980), is also typical of the time equivalent deposits in the Münsterland and Subhercynian Basins, and represented by the same species. Besides in both areas there occur representatives of the genera *Phylloceras*, *Gaudryceras*, *Anagaudryceras*, and *Tetragonites*, proving Tethyan influences in the Boreal Cretaceous. In the Upper Cenomanian and Lower Turonian the ammonites are rare or are simply absent in the discussed regions (NAIDIN 1979).

Inoceramid assemblages of the Cenomanian in Western Europe are shown (*see* Text-fig. 1) when compared with those of the Crimean region appear to be the same, and this also concerns the succession of the most important bio- and eco-events. As it is seen in the complete successions in the Münsterland and Subhercynian Basins, the basal Cenomanian is still characterized by the occurrence of typically Albian inoceramid species *Inoceramus anglicus* WOODS, and associated bivalve *Aucellina gryphaeoides* (PARKINSON) and belemnite *Neohibolites ultimus* (D'ORBIGNY). This basal part is followed by an overlapping interval with co-occurring *I. anglicus* WOODS and *I. crippsi crippsi* MANTELL. This part is characterized by the *Aucellina/ultimus* Event (ERNST & *al.* 1983). Often the boundary is marked by a gap with co-occurring *I. crippsi crippsi* MANTELL and Upper Albian fossils (*e.g.* Langenstein section).

The species *Neohibolites ultimus* (D'ORBIGNY) was observed at the base of the Lower Cenomanian in the Crimea (NAIDIN 1979). It is possible that this part can be compared with the *Aucellina/ultimus* Event of ERNST & *al.* (1983). In the Crimea it is directly overlain by marls and limestones with *I. crippsi crippsi* MANTELL (Trudoljubovka section, *see* Text-fig. 4).

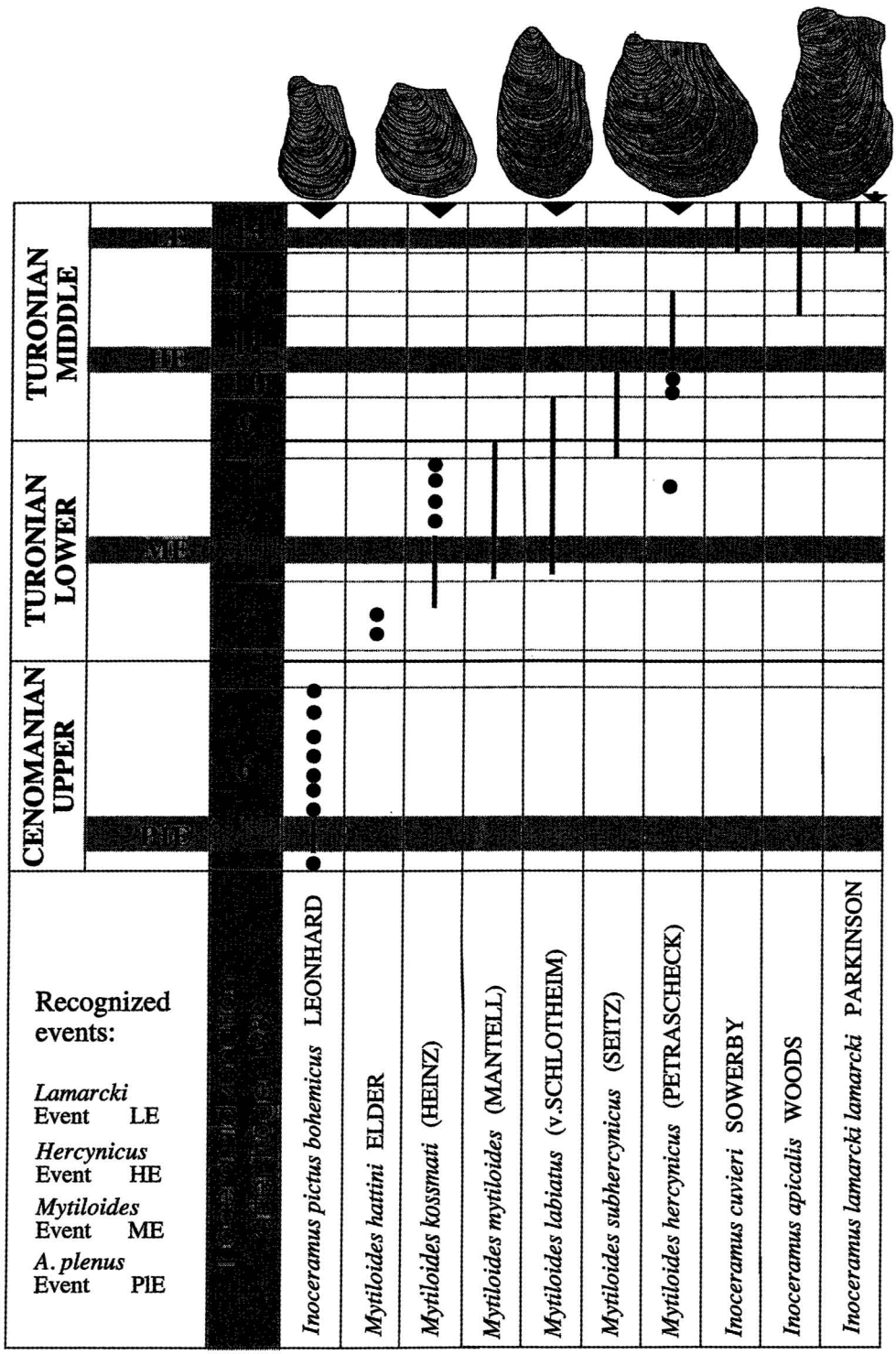


Fig. 2. Inoceramid zonation, events, and vertical ranges of inoceramid species in the Upper Cenomanian through Middle Turonian in Western Europe

Higher parts of the Lower Cenomanian in both regions are characterized by an assemblage consisting of *I. crippsi crippsi* MANTELL, *I. crippsi hoppenstedtensis* TRÖGER, *I. virgatus virgatus* SCHLÜTER (this species particularly common within the *Schloenbachia/virgatus* Event), and *I. virgatus scalprum* BÖHM. In the Middle and Upper Cenomanian inoceramids are already much more rare. This interval is characterized by the occurrence of *I. schoendorfi* HEINZ, *I. atlanticus* HEINZ, and *I. pictus pictus* SOWERBY (*see* Text-fig. 1). East of the Crimea the representatives of the *I. pictus* group were reported from Kopet-Dag and Mangyshlak (Text-fig. 3). High similarity between the Crimea and the Münsterland and Subhercynian sections are further underlined by the events succession in the Upper Cenomanian: oyster events at the Middle/Upper Cenomanian boundary, the *plenus* Event, and the *Chondrites* Event at the bottom of the *plenus*-bank (*see* Text-fig. 4).

The inoceramid assemblages of the Lower and basal Middle Turonian (Text-fig. 3) and their zonation, as observed in complete sections in Saxony, the Subhercynian Basin and Münsterland (TRÖGER 1995, *unpublished DFG report*) have also been recognized in Poland (WALASZCZYK 1992).

According to NAIDIN (1979), there are a lot of gaps in the Upper Cenomanian and basal Turonian in the area of the Russian Platform. A small gap at the Cenomanian/Turonian boundary was also reported from Crimea (NAIDIN & ALEKSEEV 1980). The Turonian of Crimea starts with the reddish marls with *Mytiloides mytiloides* (MANTELL) and *M. labiatus* (SCHLOTHEIM). The lowest Turonian part with *M. kossmati* (HEINZ) and *M. hattini* ELDER is absent here. Well represented is also *Mytiloides hercynicus* (PETRASCHECK). Higher parts of the Middle Turonian are characterized by *Inoceramus apicalis* WOODS, *I. cuvieri* SOWERBY, and *I. lamarcki lamarcki* PARKINSON. The two latter species occur within the *cuvieri/lamarcki* Event (Text-fig. 2).

## COMPARISON OF FACIES DEVELOPMENT

There are two main facies types within the Cenomanian and Turonian of the German-Polish Basin:

(1) Nearshore sediments surrounding the uplifted blocks consisting of Precambrian and Variscan basement. These are composed of sandstones with intercalated conglomerates, greensands and greensandstones interfingering with clays and marls. The observable sections are mostly incomplete, with gaps noted at the base of the Cenomanian, in the Middle Cenomanian, Upper Cenomanian, and at the Cenomanian/Turonian boundary. Such paleogeographic-facies location characterized the Cretaceous basins of Regensburg, Saxony, North Bohemia, and of the Sudetes.

(2) Marls, variable limestones and chalk of the inner parts of the German-Polish Basin. In the Münsterland and Subhercynian Basins there are small gaps, associated partly with hardgrounds, flint layers, and facies changes, in the Middle Cenomanian (*T. acutus* Zone), in the Upper Cenomanian, and at the Lower/Middle Turonian boundary (Bochum Greensand, Bochum Conglomerate) according to ERNST & *al.* (1983). In the southern Münsterland Basin and in eastern part of the Subhercynian Basin (Langenstein section) the greensand characterizes the basal Cenomanian. The topmost Cenomanian through basal Middle Turonian is characterized by red to pink colored marls and limestones interfingering with black to gray colored marls and limestones (so-called Rotpläner facies).

| Inoceramid species \ Localities | MANGYSHLAK | KOPET-DAG | CRIMEA | SUBHERCYNIAN BASIN |
|---|---|---|---|---|
| *Inoceramus anglicus* WOODS | ● | ○ | ○ | ● |
| *Inoceramus crippsi crippsi* MANTELL | ● | ● | ● | ● |
| *Inoceramus crippsi hoppenstedtensis* TRÖGER | ● | ● | ● | ● |
| *Inoceramus virgatus virgatus* SCHLÜTER | ● | ● | ● | ● |
| *Inoceramus virgatus scalprum* BÖHM | ○ | ● | ● | ● |
| *Inoceramus schoendorfi* HEINZ | ○ | ○ | ● | ● |
| *Inoceramus atlanticus* HEINZ | ○ | ○ | ○ | ● |
| *Inoceramus pictus pictus* SOWERBY | ● | ○ | ○ | ● |
| *Inoceramus pictus bohemicus* LEONHARD | ● | ○ | ○ | ● |
| *Mytiloides hattini* ELDER | ● | ○ | ○ | ● |
| *Mytiloides mytiloides* (MANTELL) | ● | ● | ● | ● |
| *Mytiloides labiatus* (v. SCHLOTHEIM) | ● | ● | ● | ● |
| *Mytiloides subhercynicus* (SEITZ) | ● | ● | ○ | ● |
| *Mytiloides hercynicus* (PETRASCHECK) | ● | ● | ● | ● |
| *Inoceramus apicalis* WOODS | ● | ● | ● | ● |
| *Inoceramus cuvieri* SOWERBY | ○ | ○ | ○ | ● |
| *Inoceramus lamarcki lamarcki* PARKINSON | ● | ● | ● | ● |
| *Inoceramus lamarcki stuemckei* HEINZ | ● | ● | ● | ● |
| *Inoceramus inaequivalvis* SCHLÜTER | ● | ○ | ○ | ● |

Fig. 3. Cenomanian and Lower – Middle Turonian inoceramids of the Subhercynian Basin and main localities in Eastern Europe and western Asia; ● – present, ○ – absent

Facies developent of the Cenomanian and Lower–Middle Turonian in Eastern Europe is very similar. According to NAIDIN (1979), upper parts of the Middle Cenomanian and the Upper Cenomanian are represented by terrigenous sediments or are absent (hiatuses). At the Cenomanian/ Turonian boundary there is a condensation horizon widespread over large areas of the Russian Platform. A limy development with nearly complete sections is spread over the Crimea Mountains. Lithological markers which can be compared with equivalent markers in the German-Polish Basin are as follows (*see* Text-fig. 1):

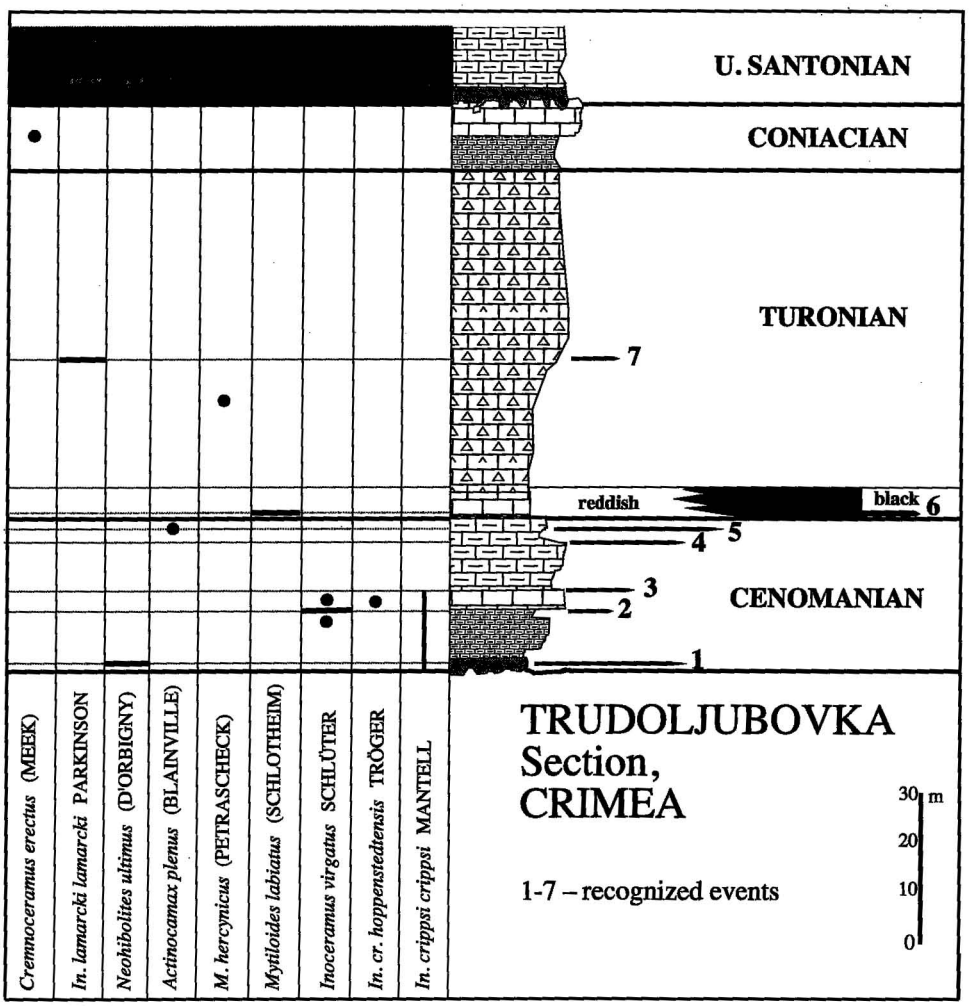


Fig. 4. Cenomanian and Turonian succession of the Trudoljubovka section, Crimea; chronostratigraphy, events, and vertical ranges of inoceramid and belemnite species

— Greensand at the base of the Cenomanian;
— Poorly fossiliferous limestones, comparable with "Arme *Rhotomagense* Schichten" in the Upper Cenomanian;
— Facies change from limestones to marls and argillaceous limestones at the bottom of the *plenus* bank;
— A small gap in the basal Lower Turonian;
— Reddish-colored marls in the Lower Turonian (Trudoljubovka section) interfingering with gray to black colored marls and argillaceous limestones.

All the above listed facies similarities testify similar ecological conditions in Western and Eastern Europe.

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