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# The Turonian/Coniacian (T/C) boundary in the Upper Cretaceous of the Elbe Valley/Saxony (Germany)

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ABSTRACT:

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Three lithofacies characterize the Turonian/Coniacian sequences in the Upper Cretaceous of the Elbe Valley. The marly lithofacies, between Weinböhla – Dresden – Heidenau, consists of marls and calcareous clays (Strehlen Formation). A transitional lithofacies, with alternations of marls, clays and blocky sandstones, follows to the southeast (area between Rosenthal – Pirna – Lohmen). A sandy lithofacies, with blocky sandstones, is developed even farther to the southeast (Elbsandsteingebirge). The T/C boundary is situated in the lower part of the Strehlen Formation in the marly lithofacies, known from several boreholes. Coniacian index ammonites are absent across the T/C boundary in the three investigated boreholes apart from a deformed and incomplete specimen of *Placenticeras* cf. *orbignyanum* (GEINITZ). Therefore, bivalves must be used to place the T/C boundary. The *Didymotis* event II (Dresden-Marienhof Borehole), with *Cremnoceramus waltersdorfensis* (ANDERT), lies at the top of the Upper Turonian *M. scupini* Zone. The rarity or absence of the bivalve *Didymotis* in the Dresden-Blasewitz and Graupa boreholes is caused by facies changes. The FAD of *Cremnoceramus rotundatus* (TRÖGER *non* FIEGE), especially the *C. rotundatus* Event (Graupa Borehole, Hinterjessen Marl), can be used to place the T/C boundary. A small interval below the FAD of *C. rotundatus* and above the *Didymotis* II event, which may belong to the basal Coniacian, yields *Cremnoceramus waltersdorfensis* (ANDERT), *Cremnoceramus waltersdorfensis hannovrensis* (HEINZ), *Mytiloides carpathicus* (SIMIONESCU) and *Placenticeras* cf. *orbignyanum* (GEINITZ). In the sandy lithofacies fossils are rare. It is not possible to place the boundary in either the Herrenleite Sandstone or in sandstone d. In the marly lithofacies of the Upper Cretaceous of Saxony bracketing of the T/C boundary is possible by means of planktonic foraminifera. It is possible to identify the evolution of planoconvex double-keeled globotruncanids of the *Dicarinella hagni – Dicarinella primitiva -Dicarinella concavata* group from the Upper Turonian. In the Dresden-Blasewitz and Dresden-Marienhof boreholes this group is represented in the T/C boundary interval by *Marginotruncana paraconcavata* PORTHAULT and *Dicarinella* cf. *concavata* (BROTZEN). They are of rare occurrence because they are facies controlled. It is not possible to recognize the boundary between the *schneegansi* and *concavata* zones because of the restricted occurrence and rarity of the index forms in the investigated sections. In the Dresden-Blasewitz and Dresden-Marienhof boreholes the benthonic species *Stensioeina granulata* (OLBERTZ) was identified.

## INTRODUCTION

The Turonian/Coniacian (T/C) was fixed during the Cretaceous Stage Boundaries Meeting in Brussels (1995) in the following manner after having discussed different criteria for the definition using ammonites, bivalves (especially inoceramids), echinoids, planktonic and benthonic foraminifera and nannoplankton:

"Thus, the boundary will lie between the LAD (last appearance datum) of *Prionocyclus germari* and the FAD (first appearance datum) of *Forresteria* (*Harleites*) *petrocoriensis*, and at the FAD of *Cremnoceramus rotundatus* (*sensu* TRÖGER *non* FIEGE) (KAUFFMAN & *al.* 1996)".

At the chosen basal boundary stratotype section, the Salzgitter-Salder Quarry in Lower Saxony (Germany), the FAD of *C. rotundatus* is coincident with the *C. rotundatus* Event, which lies immediately above the second *Didymotis* bioevent and an acme of *C. waltersdorfensis* (ANDERT) (WOOD & *al.* 1984, KAUFFMAN & *al.* 1996). Scaphitids and baculitids are common at several levels below and above the T/C boundary. The vertical range of *Scaphites kieslingswaldensis doylei* WRIGHT extends above the T/C boundary. The FAD of *Scaphites kieslingswaldensis kieslingswaldensis* LANGENHAN & GRUNDEY and of *Scalarites turoniensis* (SCHLÜTER) is situated significantly above the T/C boundary (*crassus* = *schloenbachi* Zone).

It is possible to recognize three facies developments in the Upper Turonian and Coniacian of the Upper Cretaceous of the Elbe valley, including the T/C boundary. A marly lithofacies (Strehlen Formation) is restricted to the NW part of the Upper Cretaceous of the Elbe Valley between Weinböhla – Dresden – Heidenau. The southernmost part of this marly lithofacies consists of the Graupa Marls (Upper Turonian and Lower Coniacian near Pirna, including the Bonnewitz Marls (Lower and Middle Coniacian). The adjacent transitional lithofacies between Pirna – Graupa – Königstein consists of an alternations of marls (Hinterjessen Marl – Lower Coniacian; Zatzschke Marl – Lower Coniacian; Brausnitzbach Marl – Lower Coniacian), clays (Zeichen-Burglehn Clay) and blocky sandstones (Herrenleite Sandstone – uppermost Turonian and Lower Coniacian; Liebethal sandstone-Upper Turonian and Lower Coniacian (?); Lohmen Sandstone – Lower

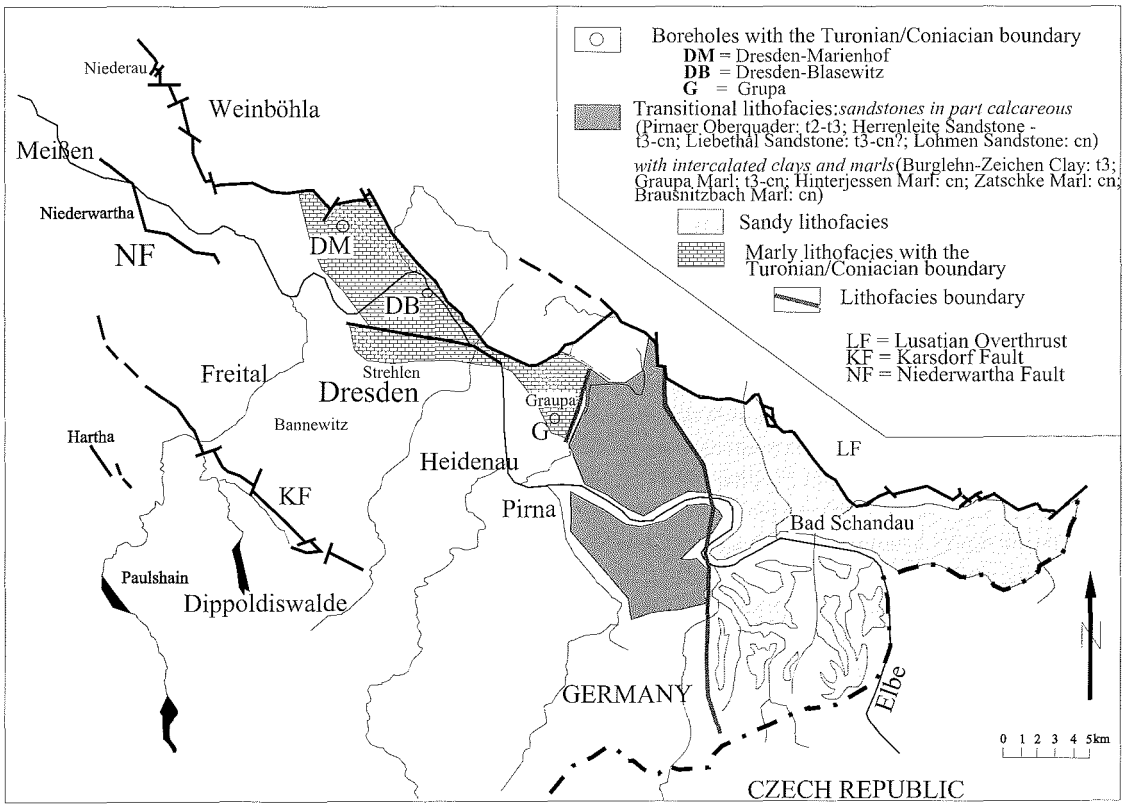


Fig. 1. Facies developments of the Upper Turonian and Coniacian in the Cretaceous of the Elbe Valley

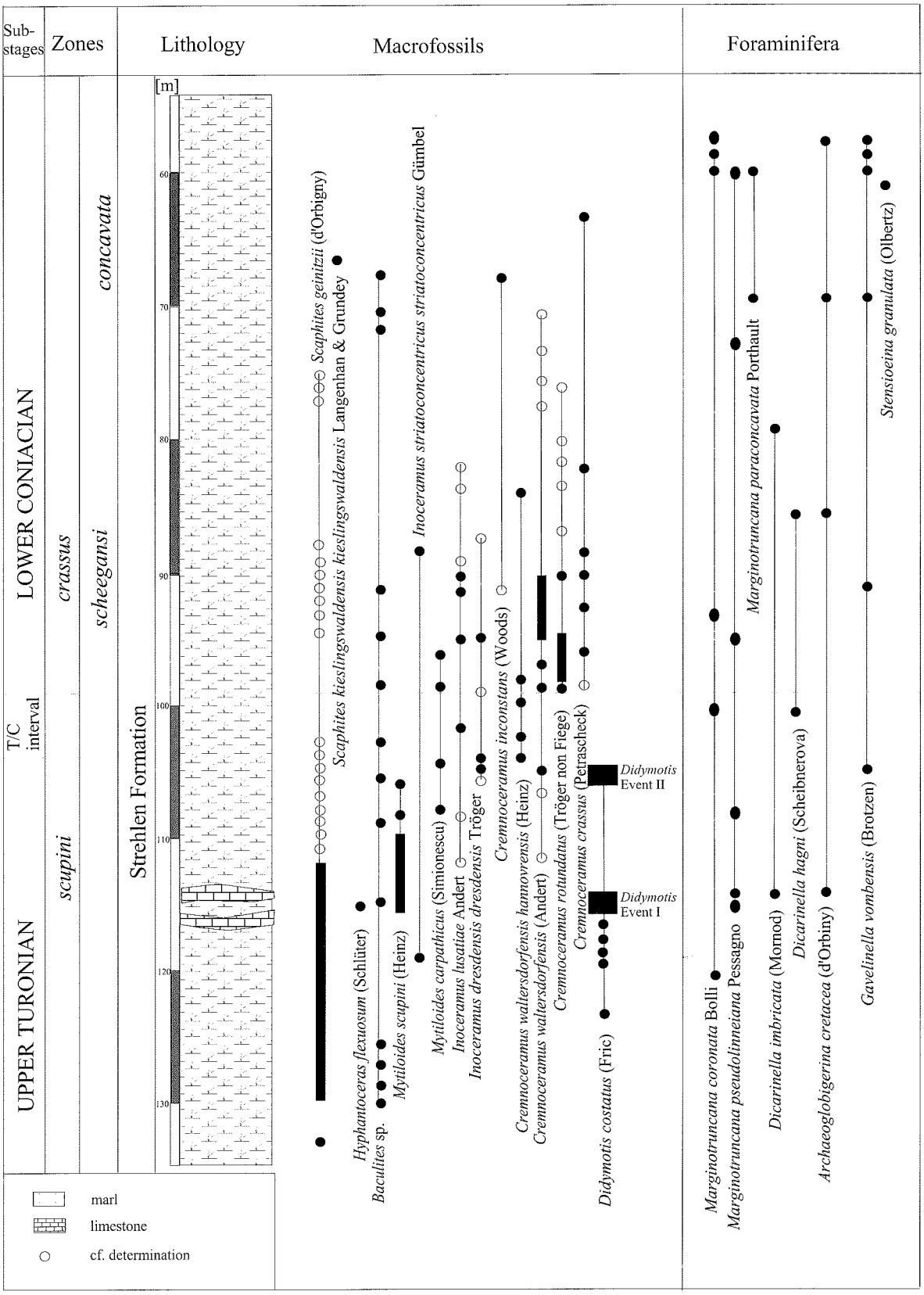


Fig. 2. Turonian/Coniacian boundary interval of the Dresden-Marienhof Borehole

Coniacian). The southern part of the Upper Cretaceous of the Elbe Valley (Elbsandsteingebirge) is characterized by a sandy lithofacies mainly with blocky sandstones (sandstones *d* and *e* of LAMPRECHT 1931). These facies changes are shown in Text-fig. 1.

The Upper Turonian and Lower Coniacian successions of the sandy and transitional lithofacies contain few fossils. It is not possible to place the T/C boundary. The marly lithofacies (Strehlen Formation, including the Graupa and Bonnewitz Marls) are, on the other hand, well suited for

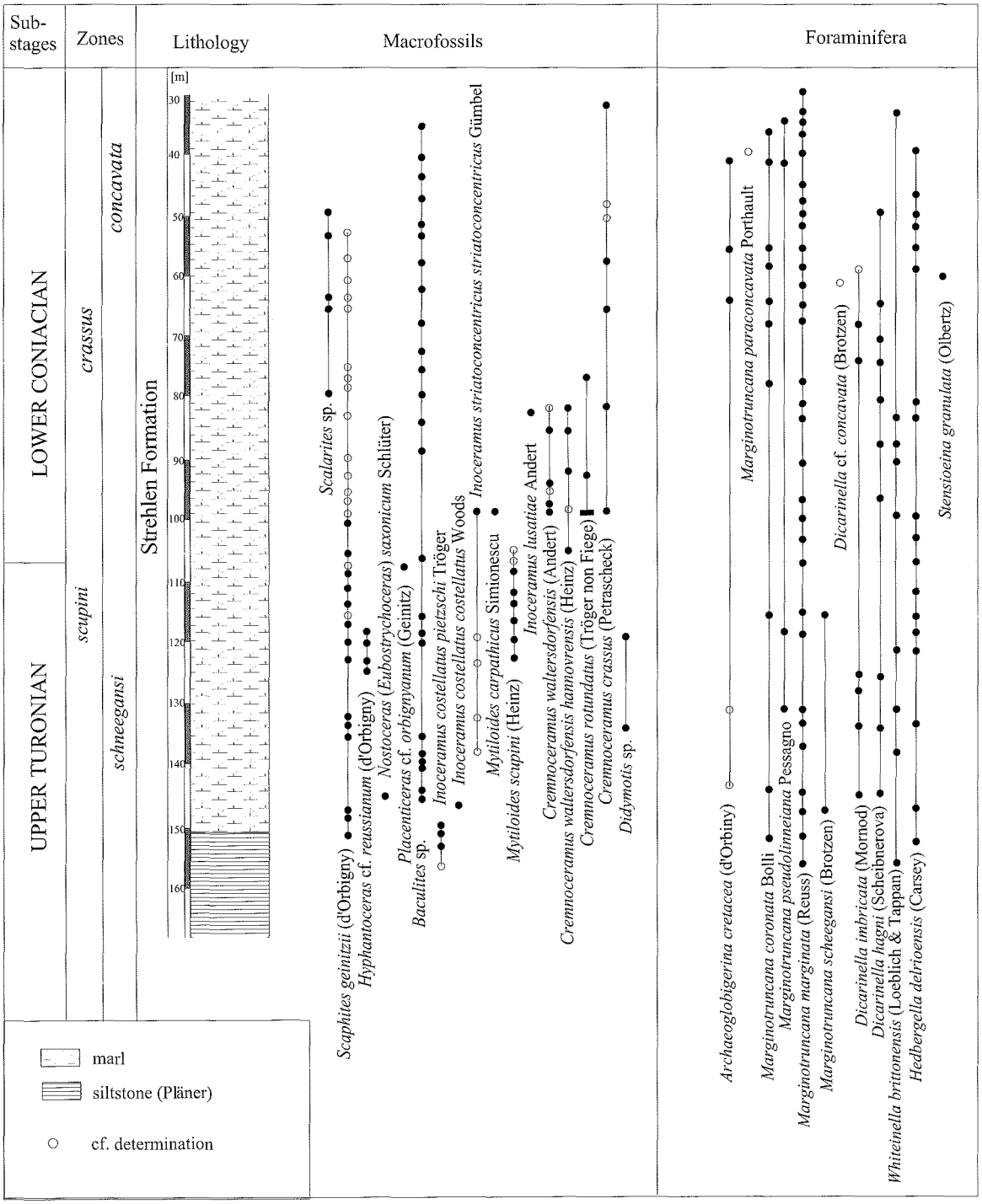


Fig. 3. Turonian/Coniacian boundary interval of the Dresden-Blasewitz Borehole

investigation of this boundary. However, extensive exposures of the Strehlen Formation are absent, except for the backfilled quarries in the vicinity of the Christus-church in Dresden-Strehlen and in Weinböhla. Upper and topmost Upper Turonian limestones were exploited in both cases. The entire Strehlen Formation was penetrated in the Dresden-Marienhof Borehole (Text-fig. 2), Dresden-Blasewitz Borehole (Text-fig. 3) and Graupa Borehole (Text-fig. 4).

The ranges of planktonic foraminifera in the T/C boundary interval, and their application to the delimitation of the boundary, have been the subject of discussion for a long time (see ROBASZYNSKI & *al.* 1979, WEIDICH 1984, ROBASZYNSKI & CARON 1995). According to the zonation presented by ROBASZYNSKI & *al.* (1979) the T/C boundary is situated at the top of the *Marginotruncana schneegansi* Zone, and the succeeding *Dicarinella concavata* Zone should be assigned to the lowermost Lower Coniacian. WEIDICH (1984) distinguished a *Dicarinella primitiva* Zone at the T/C boundary and equated this zone with the base of the Coniacian. However, ROBASZYNSKI & CARON (1995) demonstrated that *D. concavata* (BROTZEN) and *D. primitiva* both appear already in the Upper Turonian, together with the ammonite *Subprionocyclus neptuni* (GEINITZ); and that consequently the previously used *D. primitiva* Zone becomes redundant. They noted that the T/C boundary cannot readily be drawn by means of planktonic foraminifera. In spite of this, the entry of the planoconvex double-keeled globotruncanids seems to be a useful datum in Upper Cretaceous planktonic foraminiferal biostratigraphy.

The recorded ranges and first occurrences of many of the benthonic foraminifera in the T/C boundary interval differ greatly from author to author, depending on the facies and localities in question. TRÜMPER (1968) pointed to the large intraspecific variability of the genus *Stensioeina* BROTZEN and the consequent limited use of this genus in microfossil biostratigraphy. Following KOCH (1977), many authors took the base of the Coniacian at the FAD of *Stensioeina granulata* (OLBERTZ). However, KOCH used SEITZ's concept (based on inoceramids) for determining the T/C boundary. The base of the Coniacian as understood today is actually situated below SEITZ's inoceramid datum.

In the following sections, the faunal changes in bivalves, ammonites and foraminifera in the T/C boundary interval will be discussed.

## OCCURRENCE OF BIOSTRATIGRAPHICALLY IMPORTANT BIVALVES IN THE UPPER TURONIAN AND LOWER CONIACIAN SUCCESSION

### Upper Turonian

The *Mytiloides scupini* Zone in the three boreholes is characterized by the occurrence of *Mytiloides scupini* (HEINZ), *Inoceramus striatoconcentricus striatoconcentricus* GÜMBEL, and *Inoceramus dresdensis* TRÖGER. The *Didymotis* I and II events were observed in the higher parts of the *M. scupini* Zone of the Dresden-Marienhof Borehole. *Didymotis costatus* (FRIČ) is common. The following inoceramid species occur in the interval between the *Didymotis* I and II events, confirming its Late Turonian age:

*Mytiloides scupini* (HEINZ)
*Inoceramus dresdensis* TRÖGER
*Mytiloides carpathicus* (SIMIONESCU)
*Inoceramus lusatiae* ANDERT and ancestors
*Cremnoceramus* ex gr. *waltersdorfensis* (ANDERT)

There is a difference between the Dresden-Marienhof, Dresden-Blasewitz and Graupa boreholes concerning the occurrence of the *Didymotis* events I and II. *Didymotis* is very rare in the Upper Turonian of the Dresden – Blasewitz Borehole and is missing in the Graupa Borehole. It is possible that this is caused by the facies change to the SE in the direction of the sandy lithofacies, in which *Didymotis* is absent or rare. It is noteworthy that ČECH (1987) has also observed the *Didymotis* events in the marly lithofacies in the northern Czech successions and has not recorded *Didymotis* from the sandy lithofacies.

### Lower Coniacian

The Lower Coniacian starts with an acme of *Cremnoceramus rotundatus* (TRÖGER *non* FIEGE) in Lower Saxony. The FAD of *Cremnoceramus crassus* (PETRASCHECK) is situated above this level. This is also the case in the Graupa Borehole, in which there is a well developed *rotundatus* event. However, the FADs of *Cremnoceramus rotundatus* (TRÖGER *non* FIEGE) and *Cremnoceramus crassus* (PETRASCHECK)

(= *Inoceramus schloenbachi* BÖHM) are in the same bed in the Dresden-Marienhof and Dresden-Blasewitz boreholes. Between the *Didymotis* II event (Dresden-Marienhof) and the LAD of *Mytiloides scupini* (HEINZ) (Dresden-Blasewitz) an interval (T/C) of 5-7 metres is to be found which yields the following inoceramids:

*Cremnoceramus waltersdorfensis* (ANDERT)
*Cremnoceramus waltersdorfensis hannovrensis* (HEINZ)
*Inoceramus dresdensis* TRÖGER
*Mytiloides carpathicus* (SIMIONESCU)
*Inoceramus lusatiae* ANDERT

It is possible that the absence of the *C. rotundatus* event in these latter boreholes was caused by a gap, and that the T/C interval described represents a reduced *C. rotundatus* Zone.

## OCCURRENCE OF AMMONITES IN THE TURONIAN – CONIACIAN SUCCESSION

The index ammonite for the topmost Upper Turonian – *Prionocyclus germari* – and that for the basal Lower Coniacian – *Forresteria (Harleites) petrocoriensis* – were not found in the three boreholes. However, scaphitids and baculitids are common in the Upper Turonian/Lo-

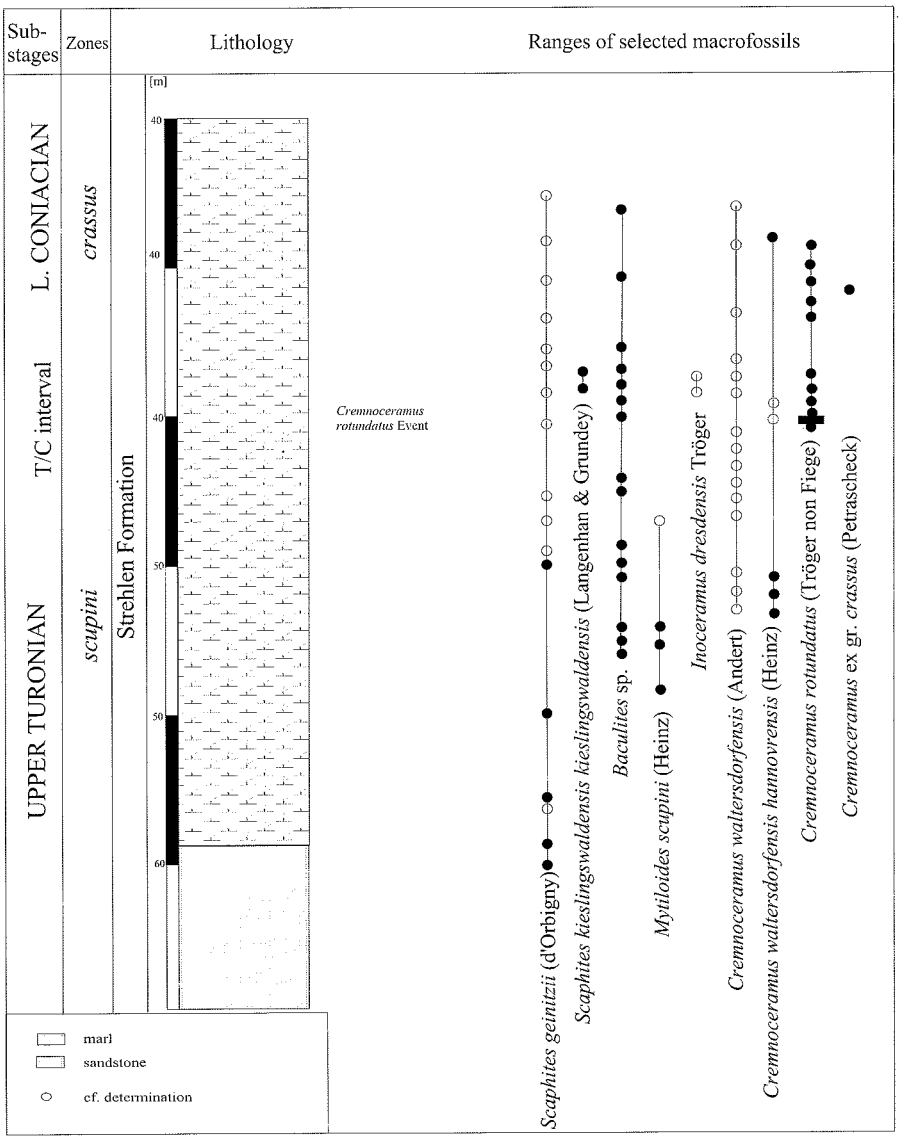


Fig. 4. Turonian/Coniacian boundary interval of the Graupa Borehole

wer Coniacian succession at several horizons. All of the ammonites are highly deformed by compaction, in the same way as the bivalves, and in most cases they are incompletely preserved. The hooks and shafts of the scaphitids are not preserved. For this reason they could be determined only as *Scaphites* sp. aff. *geinitzii* or *Scaphites* sp. In the Upper Turonian *M. scupini* Zone, *Scaphites geinitzii* (D'ORBIGNY) occurs together with *Hyphantoceras flexuosum* (SCHLÜTER) and *Hyphantoceras* cf. *reussianum* (D'ORBIGNY).

The Lower Coniacian *Scaphites kieslingswaldensis kieslingswaldensis* LANGENHAN & GRUNDEY first occurs above the *C. rotundatus* Event (Graupa Borehole). An incomplete and deformed specimen of *Placenticeras* cf. *orbignyanum* (GEINITZ), determined by H. SUMMESBERGER (Vienna), was found in association with *Mytiloides* cf. *scupini* (HEINZ) in the Dresden-Blasewitz Borehole near the T/C boundary. The FAD of *Scalarites* in the three boreholes is situated in the *C. crassus* Zone in each case. In conclusion it must be said that the Turonian/Coniacian boundary cannot be fixed using ammonites alone.

## OCCURRENCE OF PLANKTONIC FORAMINIFERA IN THE TURONIAN – CONIACIAN SEQUENCE

In the Dresden-Blasewitz Borehole the planktonic foraminifera fauna is composed of globotruncanids. In the T/C boundary interval the absence and/or rarity of the index forms renders it impossible to recognize the boundary between the *schneegansi* Zone and the succeeding *concavata* Zone. There is a significant development in the *hagni – primitiva – concavata* group involving the development of planoconvex tests through the migration of the keels onto the spiral side of the tests. *Marginotruncana schneegansi* occurs together with *M. coronata* BOLLI, *Dicarinella hagni* (SCHEIBNEROVA) and *D. imbricata* (MORNOD) in the 160 – 115 m interval, and does not range above this level. The FAD of *D. concavata*, represented by atypical, transitional forms referred to *D.* cf. *concavata*, is at 60 m depth, coincident with the FAD of *Stenioeina granulata*.

The composition of the foraminiferal fauna in the Dresden-Marienhof Borehole is remarkably homogeneous, especially in the T/C boundary interval. The proportion of planktonic species ranges between 70 and 90 %. *Marginotruncana paraconcavata* PORTHAULT (which replaces the species *Dicarinella concavata* in the Boreal Realm) was identified at a depth of 70 m. *Stensioeina granulata* (OLBERTZ) appears in the highest part of the section at a depth of 60 m. No representatives of the *schneegansi – renzi – sigali* group were identified, which means that the *schneegansi* Zone cannot be recognized in this borehole.

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