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# The first Early Jurassic ammonite find in central Poland

Grzegorz PIEŃKOWSKI [1]

**Key words:** *Tragophylloceras* cf. *loscombi* (Sowerby), palaeogeography, sea level changes, central Poland.

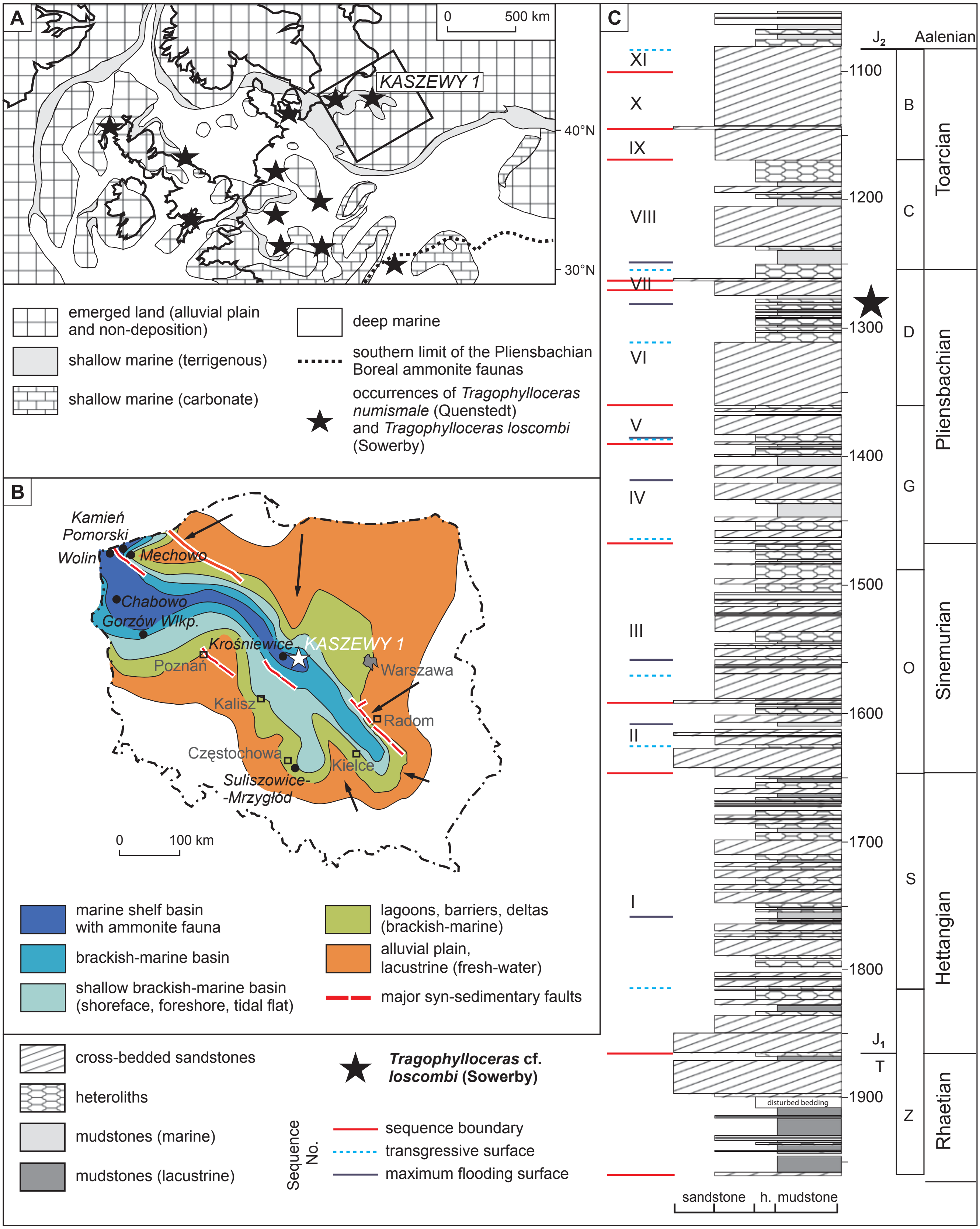
**Abstract.** *Tragophylloceras* cf. *loscombi* (Sowerby) has been found in the Kaszewy 1 borehole (central Poland), in the Upper Pliensbachian strata (Margaritatus Zone, Subnodosus Subzone), assigned to the Drzewica Formation. Hitherto, all ammonite finds in the epicontinental Lower Jurassic in Poland have been restricted to Western Pomerania (NW Poland). This find points to a wider extent of the transgressive event occurring in the late Margaritatus Zone, following widespread regression at the beginning of this zone. Rapid and pronounced sea level changes in the early Late Pliensbachian confirms the hypothesis linking these changes with glacioeustasy.

## INTRODUCTION

During Early Jurassic times terrigenous, continental, marginal-marine and marine sediments up to 1400 m in thickness were deposited in a large epeiric basin extending across Poland (Fig. 1). These strata were defined as the Kamienna Group (Pieńkowski, 2004) and they are represented by siliciclastic terrigenous sediments with thin, subordinate intercalations of siderite, lignite and very rarely dolomites or ankerites. The sedimentology, lithofacies, ichnofacies, as well as the sequence stratigraphy have been characterised in detail by Pieńkowski (2004). Subsequently, two key stratigraphical intervals (Triassic–Jurassic transition and Lower Toarcian) were characterized in terms of their chemostratigraphically and astrochronologically-tuned correlations (Hesselbo, Pieńkowski, 2011; Pieńkowski *et al*., 2012, 2014). Hitherto, rare finds of ammonites in the epicontinental (outside Carpathians) Lower Jurassic in Poland have been reported only from the Western Pomerania area (NW Poland – Table 1; Kopik, Marcinkiewicz, 1997). Most of those finds came from the marine Lower Pliensbachian (Jamesoni Zone and Ibex Zone) mudstones/shales (Mechowo IG 1, Kamień Pomorski IG 1 and other fragmentary cored boreholes) of the Łobez Formation (Table 1). Upper Pliensbachian marine strata in Western Pomerania have also yielded ammonite finds. In the Wolin IG 1 borehole (Fig. 1, Table 1), ammonites representing the Spinatum Zone (Apyrenum Subzone) have been found (Dadlez, 1975; Kopik, 1975). Further useful data were obtained from the Chabowo 2 borehole (Feldman-Olszewska, 1997). Although the borehole was only cored partially, it yielded the ammonite fossils *Amaltheus* (?*Proamaltheus*) cf. *wertheri* Lange and *Amaltheus* cf. *margaritatus* Montford, allowing more precise dating of the Upper Pliensbachian deposits to the Margaritatus Zone (Kopik, Marcinkiewicz, 1997). All these ammonite finds in Western Pomerania are associated with marked sea-level rises and facies changes, reflected by sequence stratigraphic correlation (Pieńkowski, 2004) – Fig. 1, Table 1.

A new fully cored Kaszewy 1 borehole (Fig. 1) was drilled in central Poland in 2008 by PGE Bełchatów S.A. to obtain geological information for projected $CO_2$ storage in the Lower Jurassic aquifers. The borehole has been located close to the top of a broad, anticlinal structure which origi-

[1] Polish Geological Institute – National Research Institute, Rakowiecka 4, 00-975 Warszawa, Poland;
e-mail: grzegorz.pienkowski@pgi.gov.pl



A
0 500 km
KASZEWY 1
40°N
30°N
emerged land (alluvial plain and non-deposition)
shallow marine (terrigenous)
shallow marine (carbonate)
deep marine
southern limit of the Pliensbachian Boreal ammonite faunas
occurrences of Tragophylloceras numismale (Quenstedt) and Tragophylloceras loscombi (Sowerby)
B
Kamień Pomorski
Wolin
Mechowo
Chabowo
Gorzów Wlkp.
Krośniewice
KASZEWY 1
Poznań
Warszawa
Kalisz
Radom
Częstochowa
Kielce
Suliszowice-
-Mrzygłód
0 100 km
marine shelf basin with ammonite fauna
brackish-marine basin
shallow brackish-marine basin (shoreface, foreshore, tidal flat)
lagoons, barriers, deltas (brackish-marine)
alluvial plain, lacustrine (fresh-water)
major syn-sedimentary faults
C
J2
Aalenian
XI
X
IX
VIII
VII
VI
V
IV
III
II
I
1100
1200
1300
1400
1500
1600
1700
1800
1900
B
C
D
G
O
S
Z
Toarcian
Pliensbachian
Sinemurian
Hettangian
Rhaetian
J1
T
disturbed bedding
sandstone h. mudstone
cross-bedded sandstones
heteroliths
mudstones (marine)
mudstones (lacustrine)
Tragophylloceras cf. loscombi (Sowerby)
Sequence No.
sequence boundary
transgressive surface
maximum flooding surface

**Table 1**

**Stratigraphical positions of ammonites hitherto found in Poland (C.P. – central Poland), new find of *Tragophylloceras* cf. *loscombi* (Sowerby) marked**

| Stage and Substage | | Zone | Subzone | NW POMERANIA | | | | | | | | | | | | | | | | C.P. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | *Hypoxynoticeras sphenotum* (Monke) | *Tropidoceras* sp. | *Liparoceras* (*Parinodiceras*) sp. | *Platypleuroceras aureum* (Simpson) | *Uptonia* cf. *distincta* Tutcher et Trueman | *Acanthopleuroceras maugenesti* (d'Orbigny) | *Acanthopleuroceras valdani* (d'Orbigny) | *Beaniceras* ?ex gr. *geyeri* Spath | *Beaniceras* ex gr. *luridum* Simpson | *Beaniceras* cf. *senile* Buckman | *Amaltheus* cf. *wertheri* Lange | *Amaltheus* cf. *margaritatus* Montfort | *Amaltheus laevigatus* Howarth | *Pleuroceras quadratum* Howarth | *Pleuroceras solare* (Phillips) | *Amauroceras* sp. | ***Tragophylloceras* cf. *loscombi* (Sowerby)** |
| PLIENSBACHIAN | Upper | Spinatum | Hawskerense | | | | | | | | | | | | | | | | | |
| | | | Apyrenum | | | | | | | | | | | | × | × | × | × | × | |
| | | Margaritatus | Gibbosus | | | | | | | | | | | | × | | | | | |
| | | | Subnodosus | | | | | | | | | | | × | × | | | | | × |
| | | | Stokesi | | | | | | | | | | | | | | | | | |
| | Lower | Davoei | Figulinum | | | | | | | | | | | | | | | | | |
| | | | Capricornus | | | | | | | | | | | | | | | | | |
| | | | Maculatum | | | | | | | | | | | | | | | | | |
| | | Ibex | Luridum | | | | | | | | × | × | × | | | | | | | |
| | | | Valdani | | | | | | × | × | | | | | | | | | | |
| | | | Masseanum | | | | | | | | | | | | | | | | | |
| | | Jamesoni | Jamesoni | | | | | × | | | | | | | | | | | | |
| | | | Brevispina | | × | × | × | | | | | | | | | | | | | |
| | | | Polymorphus | × | | | | | | | | | | | | | | | | |
| | | | Taylori | | | | | | | | | | | | | | | | | |

**Fig. 1. Palaeogeographical and stratigraphical background of the ammonite find in central Poland**

**A.** Palaeogeographical map of Europe in the Late Pliensbachian, showing occurrences of finds of *Tragophylloceras numismale* (Quenstedt) and *Tragophylloceras loscombi* (Sowerby). Modified from Thierry *et al.* (2000) and Meister *et al.* (2012). **B.** Palaeogeographical map of Poland in the Late Pliensbachian (Margaritatus Zone, Sudnodosus Subzone) showing selected boreholes and the range of marine influences. **C.** Simplified profile of the Lower Jurassic section in the Kaszewy 1 borehole with the position of the *Tragophylloceras* cf. *loscombi* (Sowerby) marked

nated in Mesozoic–Paleogene times, in the Alpine tectonic phase, due to Permian salt displacement. Core logging (Fig. 1C) revealed cyclic sedimentation following the pattern established by Pieńkowski (2004). The ammonite *Tragophylloceras* cf. *loscombi* (Sowerby) was found at a depth of 1281.5 m in a 1.5 m thick grey, finely laminated shale/mudstone bed (Fig. 1C). According to sequence stratigraphic correlation, these strata have been assigned to the Upper Pliensbachian.

## DIAGNOSIS

*Tragophylloceras* cf. *loscombi* (Sowerby)

*Material.* – 1 specimen (Fig. 2A–D), deposited in the Geological Museum of the Polish Geological Institute, specimen MUZ.PGI.80.VI.149

*Description.* – Small specimen, 1.7 cm in diameter, microconch. Only phragmocone preserved, body chamber missing. Umbilicus narrow. Whorls highly umbicular, highly oval, with wavy, fine ribbing (Fig. 2A–D), straight to slightly undulating (Fig. 2A, C); keel missing (Fig. 2B, D). The sinusoid shape of the ribbing is in places obliterated by compaction. Repeated, regularly-placed thicker ribs occur near the ventral side (Fig. 2D). The specimen is slightly deformed by compaction, preserved as an internal clayey mould.

*Remarks.* – *T. loscombi* (Sowerby) is the closest form to *T. numismale* (Quenstedt), probably a directly derived form (Meister, 1993). Sowerby's species differs by its narrower

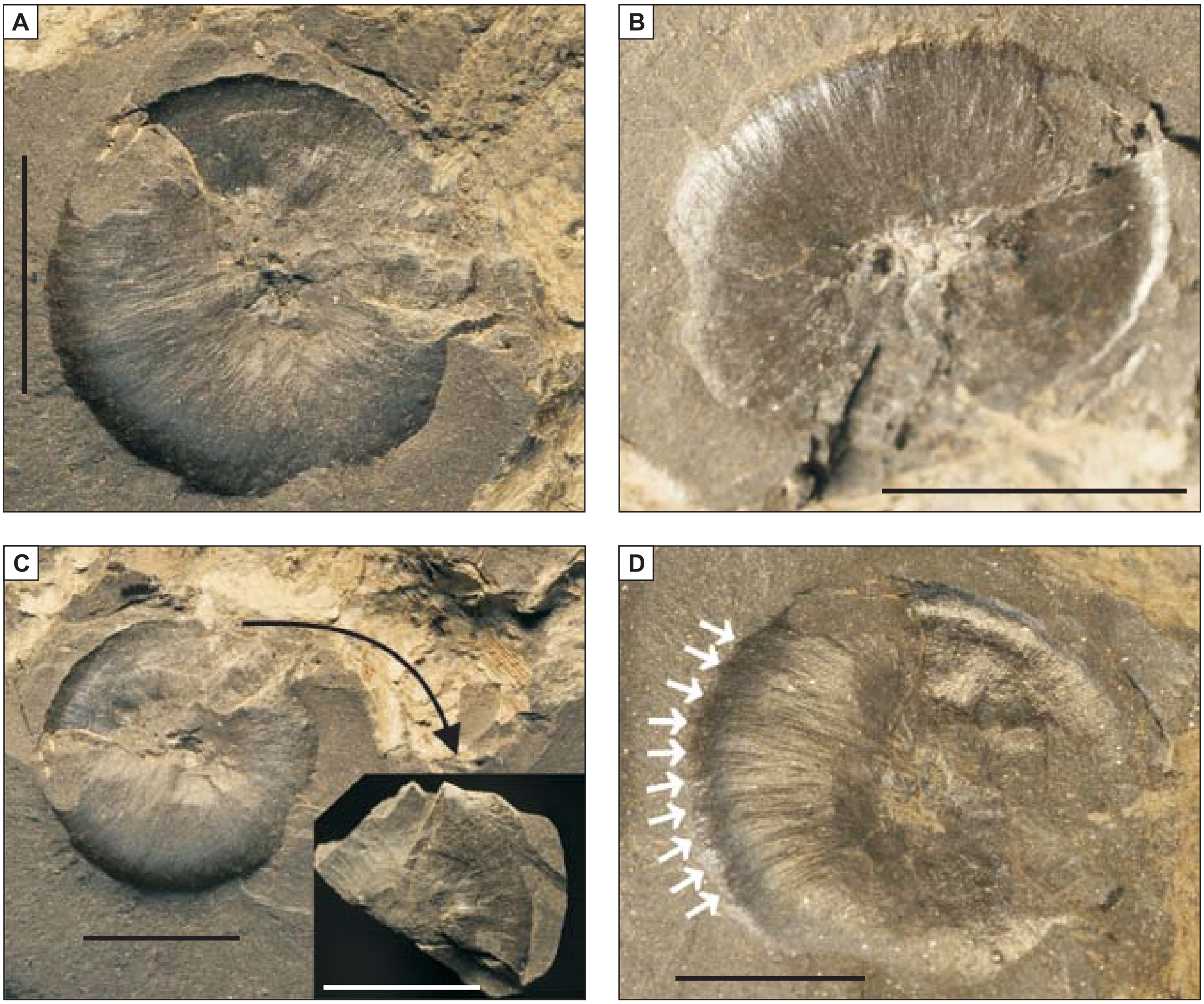


**Fig. 2. *Tragophylloceras* cf. *loscombi* (Sowerby)**

**A.** Frontal view of the phragmocone preserved as an internal clayey mould. Note visible ribbings on both sides of the shell. Scale = 1 cm. **B.** Oblique view of the phragmocone, showing the dorsal part and lack of a keel. **C.** Frontal view of the phragmocone showing very fine, straight to slightly undulated ribbing. Insert – a separated whorl. **D.** Slightly oblique view, note regularly-placed thicker ribs occurring near the ventral side (arrowed) and compaction of the phragmocone umbilicus (Meister, 1993, p. 127, fig. 4), wider whorl section on the lower part of the flanks (more suboval) and finer ribbing, less strongly expressed on the outer part. In *T. undulatum* (Smith) the ribs are more developed on the flanks and rather sinuous (Meister *et al*., 2012).

## DISTRIBUTION

Concerning its primary origin, *Tragophylloceras loscombi* (Sowerby) is attributed to the Mediterranean-Submediterranean Province, but subsequently this species spread over the Boreal Province as well, and it has been described from southern England and northwestern Germany (Howarth, Donovan, 1964; Hoffmann, 1982; Page, 2009) and also from the westernmost Pomerania (Lower Pliensbachian strata – Kopik, Marcinkiewicz, 1997; Fig. 1A, Table 1). The stratigraphical range of this species is rather wide, ranging from the Upper Carixian (upper Lower Pliensbachian) to the Lower Domerian (lower Upper Pliensbachian), more precisely from the upper part of the Ibex Zone (Centaurus Subzone) to the upper part of the Subnodosus Subzone of the Margaritatus Zone (Howard, Donovan, 1964; Table 1). Thus, *T. loscombi* (Sowerby) represents the latest species of the genus. It could have evolved from *T. undulatum* by weakening of the ornament (Howard, Donovan, 1964). According to Meister (1993), *T. loscombi* could have evolved from the Tethyan form *Juraphyllites nardii* (Meneghini), through *Tragophylloceras numismale* (Quenstedt), following a morphological trend in Pliensbachian *Tragophylloceras* which involves a heterochronic process (paedomorphosis by neoteny) to acquire a suboxycone morphology. According to Meister (1993), this major morphological change is concomitant with the 'ingression' of *Tragophylloceras* in the Euroboreal platform seas (Fig. 1A), where competition between taxa was strong. Exploring these possibilities, *Tragophylloceras* then exploited and improved the oxycone option.

## STRATIGRAPHICAL, PALAEOENVIRONMENTAL AND PALAEOGEOGRAPHICAL CONCLUSIONS

The host rock of the ammonite find has been examined for palynomorphs, in order to find additional biostratigraphical proxies to solve the question of Lower or Upper Pliensbachian. Unfortunately, only single finds of poorly preserved dinoflagellate cysts, belonging to the genus *Mendicodinium* (M. Hodbod, *pers. inf.*) do not allow a more precise age determination than Pliensbachian (which is already known from the rage of ammonite itself). Therefore, the assignation of the strata containing the ammonite to the Lower or Upper Pliensbachian can be based only on the sequence stratigraphic correlation (Pieńkowski, 2004; Fig 1C). Assigning these beds to the Lower Pliensbachian (still possible, assuming the wide stratigraphical range of *Tragophylloceras loscombi* (Sowerby)) is unlikely. The ammonite is located less than 20 m from the bottom of the Lower Toarcian deposits (Fig. 1C) and positioning the find in the Lower Pliensbachian would reduce the thickness of the whole Upper Pliensbachian succession to less than 20 m. However, this is inconceivable, considering that the thickness of the Upper Pliensbachian strata in the nearby Krośniewice IG 1 borehole (located less than 20 km to the NW) exceeds 200 m. Although there is a difference in thickness of the whole Lower Jurassic series between Krośniewice IG 1 (1087 to 1171 m; Dadlez, 1973) and Kaszewy 1 (782 m; Fig. 1C), the seismic cross section (Marek, 1973) does not show significant thickness changes of this order within the Lower Jurassic strata, these strata being reduced in thickness to the SE direction rather proportionally.

The beginning of the Late Pliensbachian (basal Stockesi Subzone of Margaritatus Zone) in Poland is identified with a prominent sequence boundary, associated with marked erosion. This erosion/non-depositional period was followed by the ensuing deposition of thick fluvial sediments, in many places representing the infilling of broad valleys (Pieńkowski, 2004). Fluvial sedimentation was followed by a widespread marine transgression, reaching to southern Poland (Pieńkowski, 2004; Gedl, 2007; Fig. 1B). This transgression (later Margaritatus Zone) is manifested by ammonite-bearing sediments in NW Pomerania and the presence of other marine organisms like bivalves, foraminifera and dinoflagellate cysts further to the SE (Pieńkowski, 2004; Gedl, 2007; Fig. 1B). The find of an ammonite in Kaszewy 1 in central Poland is associated with this transgression and confirms the wide range of the transgression along the Mid-Polish Trough (Fig. 1B). On that basis, the position of *Tragophylloceras loscombi* (Sowerby) would represent one of its latest occurrences, correlated with the Margaritatus Zone (Subnodosus Subzone). The rapid sea level fall at the beginning of the Margaritatus Zone was followed by an equally rapid sea level rise, which led to the restoration of nearshore depositional systems in the Mid-Polish Trough. The maximum flooding surface of the sequence VI (Fig. 1C; Pieńkowski, 2004) would correspond to the latest Stokesi/earliest Subnodosus subzone transition and can be correlated with a well-marked European transgression at the same time (Hesselbo, Jenkyns, 1998; de Graciansky *et al*., 1998). In the Pommerania region, this is confirmed by the occurrence of the ammonite *Amaltheus* (?*Proamaltheus*) cf. *wertheri* Lange in Chabowo 2 borehole (Fig. 1B, Table 1). The whole depositional sequence VI of the Polish Basin would then correspond to the sequences $Pl_4$, $Pl_5$ and $Pl_6$ of de Graciansky *et al.* (1998). Rapid sea-level rise, which could have reached some 30–50 m, created accommodation space that allowed sedimentation in the Polish Basin (Pieńkowski, 2004). Rapid and pronounced sea level changes within one ammonite zone would support hypothesis of glacioeustasy (Price, 1999; Korte, Hesselbo, 2011).

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