2nd International Symposium on Jurassic Stratigraphy | pp. 623-639 | Lisboa, 1988

FURTHER DATA ON THE CORRELATION OF THE MIDDLE/UPPER TITHONIAN WITH THE LOWER/MIDDLE VOLGIAN BOUNDARY

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ABSTRACT

By some recently discovered very interesting ammonites from Poland and Austria as well as a thorough and critical reevaluation of old and new data from the literature of eastern Central Europe (Poland, CSSR, Hungary, Bulgaria) it can be demonstrated once more that the Middle/Upper Tithonian boundary corresponds approximately with the Lower/Middle Volgian boundary as shown by KUTEK & ZEISS (1974, 1975) and ZEISS (1977, 1983), and not with the Middle/Upper Volgian boundary as assumed by MESEZHNIKOV (1982) and JELETZKY (1984). All published data refering to the correlation of the ammonite succession of the submediterranean Neuburg Formation with that of the mediterranean sequences have also been reconsidered (ENAY & GEYSSANT 1975, OLORIZ 1978, OLORIZ & TAVERA 1982). All evidences confirm the correlation of the Middle Tithonian of the Submediterranean region with the upper part of the Lower Tithonian of the Mediterranean area. Only the precise level of the beginning of the Upper Tithonian (Simplisphinctes Zone) in the Neuburg Formation can be traced tentatively by indirect arguments, while the Microcanthum Zone is well documented by calpionellids (Zone A1 of Remane). Both zones are the equivalent of the Scythicus- and Zarajskensis zones by the evidence mentioned above.

RÉSUMÉ

Quelques ammonites très intéressantes récemment découvertes en Pologne et en Autriche ainsi que l'examen critique minutieux des données anciennes et récentes tirées de la litérature couvrant le Centre-Est de l'Europe (Pologne, U.R.S.S., Hongrie, Bulgarie) ont permis de démontrer, une fois de plus, que la limite Tithonique moyen/supérieur correspond à peu près à celle du Volgien inférieur/moyen comme l'ont montré KUTEK & ZEISS (1974, 1975), ZEISS (1977, 1983) et non pas à la limite Volgien moyen/supérieur comme l'affirment MESEZHNIKOV (1982) et JELETZKY (1984).

Toutes les données publiées, ayant pour objet la corrélation de la succession des ammonites de la Formation de Neuburg (subméditerranéen) avec celles des séquences méditerranéennes (ENAY & GEYSSANT 1975, OLORIZ 1978, OLORIZ & TAVERA 1982), ont aussi été revues. Elles confirment la corrélation du Tithonique moyen de la province subméditerranéenne avec la partie supérieure du Tithonique inférieur de l'aire méditerranéenne. Le niveau précis du début du Tithonique supérieur (Zone à Simplisphinctes) dans la Formation de Neuburg peut être tracé seulement en s'appuyant sur des arguments indirects ; en revanche, la Zone à Microcanthum est bien attestée par des Calpionelles (Zone A1 de Remane). Ces deux zones, par les arguments développés ci-dessus, sont l'équivalent des zones à Scythicus et à Zarajskensis.

INTRODUCTION

In earlier papers of the authors (KUTEK & ZEISS 1974, 1975; ZEISS 1977, 1983) it was suggested that the boundary of the Middle and Upper Tithonian is approximately equivalent to that of the Lower and Middle Volgian. Different correlations, in which a pre-late Tithonian age is claimed for a large part or the total of the Middle Volgian, have been recently been proposed by MESEZHNIKOV (1982) and JELETZKY (1984). JELETZKY'S correlation, which is partly based on Buchias, is a step-by-step correlation from the Russian Platform across Arctic regions to California and Mexico, and then back to Europe. MESEZHNIKOV'S correlation, in turn, heavily relies on a few specimens of ammonites from Franconia, tentatively assigned to Ilowaiskya or Zaraiskites; in this context it is worth noting once more that the Zaraiskites-like forms from Franconia (e.g. ZEISS 1968) have been considered by BARTHEL (1969) as parallel developments and therefore have been reinterpreted as hoemoemorph offshoots of Isterites (KUTEK & ZEISS 1975).

New and additional evidence for the correlation of the Middle/Upper Tithonian and Lower/Middle Volgian boundaries is presented and discussed in this paper, following a brief discussion on this topic in a paper by KUTEK & WIERZBOWSKI (1986). We shall procede by a critical evaluation of the fossil evidence from all localities concerned.

DISCUSSION OF THE FOSSIL EVIDENCE

Brzostówka, Central Poland

The lower part of the classic section of the Central Polish Volgian near Tomaszów Maz. has been described by KUTEK & ZEISS (1974). The sediments are here developed as shales with intercalated marls and limestones. The following succession of

ammonites has been recognized (some taxa are omitted):

Layer a-1, 40 cm (the lowest horizon exposed in the section): Ilowaiskya tenuicostata (Michailov), Pseudovirgatites passendorferi KUTEK & ZEISS (with three subspecies), Isterites subpalmatus (SCHNEID), I. spurius (SCHNEID).

Layer a-2, ca. 6 m: Pseudovirgatites passendorferi, P. puschi (with three subspecies), Isterites subpalmatus, I. spurius.

Layer a-3, ca. 1,5 m: Zaraiskites quenstedti (ROUILLIER), Z. scythicus (VISCHNIAKOFF), Isterites mazoviensis (KUTEK & ZEISS).

Layer a-4, 7-8 m: no ammonites
Layer b-1, 50 cm: Zaraiskites scythicus, Z. stschukinensis (MICHALSKI), Z. tschernyschovi (MICHALSKI).

Layer b-1, over 50 cm: no ammonites

It is of interest that the ammonite succession at Brzostówka provides evidence for an evolutionary link of the genus Zaraiskites with the genus Pseudovirgatites.

The base of the layer a-3 represents the base of the scythicus Zone and thus also the base of the Middle Volgian. The layers a-3, a-4 and b-1 belong to the scythicus Subzone, the lower subzone of the scythicus Zone, which is an equivalent to the panderi Zone of the Russian Platform.

The Lower Volgian layers a-1 and a-2 can be included into the pseudoscythica Zone, the uppermost zone of the Russian Lower Volgian, if this zone is defined as ranging up to the base of the Middle Volgian. However, is should be kept in mind that all the ammonites found in layers a-1 and a-2 at Brzostówka are missing in the pseudoscythica Zone of Central Russia (cf. MIKHAILOV 1964). Unpublished borehole-data from

the region around Brzostówka suggest that Ilowaiskya tenuicostata ranges down some dozens metres beneath the base of the Middle Volgian, and this interval, in the upper part of which Pseudovirgatites puschi is present, may well correspond to about one third of the total thickness of the Lower Volgian in that region, where the Volgian sediments do not display any lithological features indicative of stratigraphic discontinuity. On the other hand, a taxonomic reinterpretation of several ammonites described by DEMBOWSKA (1973) leads to the conclusion that ammonites comparable with those from the uppermost Lower Volgian of Brzostówka are encountered in Volgian sediments in vast regions of platform Poland. Thus, there is good reason for separating out a tenuicostata Zone as the uppermost zone of the Lower Volgian of Poland, possibly with a pushi Subzone in its upper part. Such a zone has not yet been established as a formal biostratigraphic unit because its base is not exposed in outcrops, and the paleontological material from the borehole intervals encompassing that boundary is still rather poor.

The tenuicostata Zone of Poland may well fill the stratigraphic gap between the pseudoscythica Zone and the panderi Zone of Central Russia - i.e.a. stratigraphic discontinuity in the classical Volgian sections of that region as has been pointed out by several authors, e.g. CALLOMON & BIRKELUND (1982).

Another point of interest is that an ammonite from Brzostówka, described and illustrated by LEWINSKI (1922-1923, p. 97, pl.11, fig.3) as 'Virgatites (Provirgatites?) bodhanowiczi sp.n.' is a form close to Pseudovirgatites scuposus (OPP.). The specimen has been found in LEWINSKI'S bed F, 5 m thick, in strata just above the layer b-2 of KUTEK and ZEISS (1974); Zaraiskites scythicus (VISCHN.) and Z. zarajskensis (MICHALSKI) have also been reported from bed F. From this it follows that the specimen of Pseudovirgatites has been found near the boundary of the sythicus and zarajskensis Subzones of the scyathicus

Zone. This interpretation is consistent with other stratigraphic data from Brzostówka.

Wozniki, Polish Outer Carpathians.

At Wózniki, specimens of Pseudovirgatites scruposus (OPP.) have been found together with calpionellids indicative of the Crassicolaria Zone in an exotic block, 4 m large, embodied in flysch sediments of the Subsilesian tectonic unit (KSIAZKIEWICZ 1974, MORYCOWA 1974). A fragment of an ammonite from the same block was considered to belong to Zaraiskites and had been compared to the zarajskensis-group.

Klentnice Beds, Austria and Moravia.

The list of the ammonites from these beds, described and illustrated by A.ZEISS (1977) includes: Pseudovirgatites scruposus (OPP.), P. sorgenfreii ZEISS, P. seorsus (OPP.), Ilowaiskya tenuicostata occidentalis ZEISS, Isterites austriacus KUTEK et ZEISS, and a Pavlovia. Zaraiskites scythicus (VISCH.) has been reported from the same beds by BACHMAYER (1958). A series of ammonites recently discovered by Pfarrer Josef Toriser of Karnabrunn/N.Ö. are under study by one of the authors and seem to contain more unknown boreal elements.

The ammonites have not been collected bed-by-bed, but the presence of Ilowaiskya, Pseudovirgatites and Zaraiskites in the same formation of an Tethyan region is worth to note (see also below).

Kyjov, Pieniny Klippen Belt, eastern Slovakia.

At Kyjov, in a section described by NEUMAYR (1871) and BIRKENMAJER (1963), strata displaying lithologies commonly found in Lower to Middle Tithonian sections of the Czorsztyn succession of the Pieniny Klippen Belt and containing unidentifiable

ammonites are overlain by white massive coquinas, ca. 10 m thick. Pseudovirgatites scruposus (OPP.) has been reported by NEUMAYR (1871) to occur in these coquinas together with a clearly Late Tihtonian assemblage of ammonites which includes, in addition to several lytoceratids and phylloceratids, Haploceras elimatum (OPP.), H. tithonium (OPP.), Glochiceras carachtheis (ZEUSCHN.), Substreblites zonarius (OPP.), Paraulacosphinctes transitorius (OPP.) and Micracanthoceras microcanthum (OPP.).

It is worth of note that the famous ammonite coquinas from Rogoźnik in Poland, which are of Early and Late Tithonian (hybonotum to fallauxi) Age (KUTEK & WIERZBOWSKI 1986), also belong to the Czorsztyn succession of the Pieniny Klippen Belt.

Transdanubian Midmountains, Hungary.

Several important ammonite successions from Lower to Upper Tithonian sections of the Hungarian Transdanubian Midmountains have recently been described by VIGH(1984). Here again the occurence of Pseudovirgatites is restricted to the Upper Tithonian. Most specimens of this genus, referred to as Pseudovirgatites cf. seorsus (OPP.), Pseudovirgatites sp. ex gr. seorsus and Pseudovirgatites sp., have been found in the microcanthum Zone. The presence of forms referred to as ?Pseudovirgatites aff. scruposus (OPP.) above the microcanthum Zone suggests that some representatives of Pseudovirgatites range up into higher horizons of the Upper Tithonian but the faunal association does not indicate clearly the Durangites Zone (see VIGH 1984, p.54).

Neskovci, Stara Planina, Bulgaria.

A specimen referred to as Zaraiskites sp. has been found by NOVAK (1971) in the Stara Planina in a rock containing cal-

pionelids indicative of the Crassicollaria Zone; it was suggested by SAPUNOV (1977, 1979) that the strata that yielded this specimen belong to the microcanthum Zone. The specimen displays the type of ribbing peculiar to the ammonites of the Zaraiskites zarajskensis group that is characteristic of the zarajskensis Subzone (the upper subzone of the scythicus Zone)

Vetlanka river, region of the Ural and Ilek Rivers, USSR.

The Vetlanka section is of special interest because in a 4,5m interval ascribed to the pseuscythica Zone (MICHAILOV 1964), there have been found, in addition to Ilowaiskya pseudoscythica (ILOV. et FLOR.), some ammonites not reported from Central Russia:

Ilowaiskya tenuicostata (MICHAILOV) and ammonites referred to as Pectinatites (Wheatleyites) aff. eastlecottensis (SALFELD), P.(W.) arkelli MICHAILOV and P.(W.) spathi MICHAILOV. As pointed out by COPE (1967), there is no proof that the latter ammonites belong to Pectinatites, whereas some of them, especially P. arkelli, could be related to the genus Pseudovirgatites.

These data suggest that in the Vetlanka section occur some sediments that are coeval with the tenuicostata Zone of Poland, and that have no stratigraphic counterparts in the discontinuous sections of Central Russia. However, there seems still to be some stratigraphic discontinuity in the Vetlanka section, as suggested by the reduced thickness of the sediments (the total thickness of the three Lower Volgian zones is about 9 m), and the presence of glauconite and phosphatic nodules (cf. MICHAILOV 1964). Nearby sections (MICHAILOV 1964, fig. 1-3) show a similar sequence, but are, except the Berdjanka river section, less well to subdivide.

Neuburg/Donau, Southern Germany

A key section for the correlation of the Volgian deposits of Poland with the Tithonian strata of the Mediterranean area is situated in the region of Neuburg/Danube. Here the whole sequence of Middle Tithonian strata could be observed in some quarries, partly abandoned now. They have been studied in detail by BARTHEL (1962, 1964, 1969, 1975, 1978), BARTHEL & GEYSSANT (1973), GROISS (1963), STREIT (1963, 1978), WELLNHOFER (1964), ZEISS (1960).

Due to the premature death of K.W.BARTHEL most of the large collection of bed-by-bed collected ammonites from these quarries have not been studied in detail. Thus we must refer to the outlines given by K.W.BARTHEL in his nunerous publications on the Neuburg area.

There are three main problems: 1) The correlation of the Neuburg sections with those of the mediterranean area, especially in Southern Spain and Italy. This correlation has been mainly discussed by ENAY & GEYSSANT (1975), OLORIZ (1978) and OLORIZ & TAVERA (1983). Other important results are contained in the papers of TAVERA (1985) and CECCA et al.(1986).
2) The correlation with the subboreal area, mainly of Central Poland and the Russian plattform. Contributions have been published by the present authors (KUTEK & ZEISS, 1974, 1975; ZEISS 1977, 1979, 1984) and MESEZHNIKOV (1982).
3) The problem of the Middle/Upper-Tithonian boundary. This problem has been handled with especially by BARTHEL in his various publications mentioned above and in those of the present authors.

We will discuss only as far as necessary here earlier correlations. Of course we consider that our new correlation chart is outdating earlier (always tentative) correlation attempts. This is important especially for those authors relying on the

1968 correlation of A.ZEISS using a fragment of a questionable Zaraiskites, now considered to represent a homoeomorph, diachronic Zaraiskites-like off-shot of Isterites. Such diachronic homoeomorphs often appear within Upper Jurassic Perisphinctinids and can hide true relationships and time correlation (e.g. the so- called 'Virgatosphinctes' of Siberia (= Praechetaites) which seem to represent a line descendant from Pseudovirgatites and have nothing to do with true Virgatosphinctes of the Pacific realm.

ad 1) Correlation with the Mediterranean Province

As shown in Fig.1 we follow what concerns the correlation of the lower and middle Neuburg Beds with the mediterranean region those authors mentioned under heading 1. After the discussions of ENAY & GEYSSANT (1975) and OLORIZ (1978) there seems little doubt about the equivalence of the rothpletzi/penicillatum Beds with the semiforme Zone and the lower part of the fallauxi Zone (richteri Subzone). The Lemencia fauna prevails in the upper part of the fallauxi Zone (admirandum Subzone) and occurs also in the ponti Zone. In Neuburg Lemencia is present in bed 42-60, i.e. in the ciliata Zone proper, and in the glaber Subzone of the palmatus Zone. In the higher parts of the Unterhausen Member of the Neuburg Formation there are only a few specimens of this genus. Besides, some poorly preserved mediterranean elements exist in bed 116 ('Pseudolissoceras, Sutneria, Virgatosimoceras'); because of their bad preservation they are better neglected from far-reaching correlations. The main component of fauna in bed 102-116 is the genus Isterites; above it becomes rarer, but typical forms have been found until and higher than bed 200 (BARTHEL 1969, p.141).

As the fauna as a whole does not change until bed 210, we think that this interval (200-210) belongs to the I. palmatus Zone, too. This zone can be compared with the Burckhardticeras Zone (M.ponti Zone) of the mediterranean province. But already

ENAY & GEYSSANT(1975) put on the question, if there could be an equivalent of the micracanthum Zone in the palmatus Zone. This seems not probable by the following consideration: Following BARTHEL (1969) the uppermost bed (238) contains early Crassicolaria; thus this bed can be compared on one side with the Z. zarajskensis Zone of the subboreal area (see above) and on the other with the transitorius Zone of Southern Spain, where first Crassicollarians appear. The beds below (212-237) were thought by BARTHEL (1969, p.150) to belong also to the Upper Tithonian due to nearly the same accompanying fauna as in bed 238.

As the beds of the I. palmatus Zone end with 210 (see above) the beds 212-237, containing no Crassicollarians, but a similar Upper Tithonian fauna should be the equivalent of the Simplisphinctes Zone of Southern Spain. Chitinoidellans have not been found in the Neuburg Formation presumably due to unfavorite facies conditions.

ad 2) Correlation with the Subboreal Province

The main correlation levels are of course those which yield Isterites species of the palmatus group in Neuburg and Central Poland. By this it is clear that we can correlate at least the uppermost pseudoscythica Zone (tenuicostata Subzone) with the I. palmatus Zone. The tenuicostata Subzone contains early species of Pseudovirgatites. Above follows the scythicus Zone with advanced Isterites: I. mazoviensis and I. pomerania. A similar species, I. austriacus has been found in the Klentnice beds in Lower Austria and is there associated in a horizon with Bu. rugosa (VETTERS 1905, ZAKHAVROV 1981, ZEISS 1977). Immediately above follows a horizon with the proper Ps. scruposus fauna: both horizons are here considered to build up the Ps. scruposus Zone, which has been correlated with the Simplisphinctes Zone of Southern Spain by Tavera (1985).

Stufe	Central Poland (Tomaszow Maz.)	S-Poland, Bulgaria (Wozniki, Neskovci)	CSSR, Austria, Hungary (Kylov, Klentnice etc.)		S-Germany (Neuburg/Donau)		S-Spain (Cordilleras Beticas)	Stufe
Middle Volgian	Zaraiskites zarajskensis	Z.cf.zarajskensis, Ps.scruposus, Crassicollaria div.sp.	Pa.transitorius Ps.(cf.)scruposus Ps.cf.seorsus (Crassicollaria)	(Slovakia)	Uppermost horizon (with early forms of Crassicollaria (238)		Paraulacosphinctes transitorius Zone (Crassicollaria)	Upper Tithonian (e.p.)
	Ps. (?) bohdanowiczi		Ps.scruposus	(L. Austria)	‚Purbeck facies of Early Upper Tithonian Age' (212-237)		Simplisphinctes abnormis Zone	
	Zaraiskites scythicus; Zaraiskites stschukinensis; Z.quenstedti, I.mazoviensis; a-3 – b-1		I.austriacus, Bu.rugosa					
Lower Volgian (e.p.)	Pseudovirgatites puschi, Isterites subpalmatus, I.spurius; a-2				Isterites palmatus	Upper Isterites beds (I.subpalmatus, I.spurius) (117-210)	Micracanthoceras (=Dj.) ponti Zone (= Burckhardticeras peroni Zone)	Middle Tithonian
	Ilowaiskya tenuicostata, Isterites subpalmatus, Pseudovirgatites puschi; a-1		Ilowaiskya tenuicostata occidentalis	(Moravia)		Middle(main) Isterites beds (with medit.elem.) (102-116); Sublithacoceras glaber (Lower Isterites beds, with Lemencia) (60-101)		
	Ilowaiskya pseudoscythica	[Rogocznik Coquina Mbr.]				Lemencia ciliata (main beds) (42-59)	Upper Fallauxi Zone (Admirandum/Bir.Sz.)	
					Ps.bavaricum	Rothpletzi / Penicillatum beds (22-42)	Lower Fallauxi Zone (Richteri Sz.); Semiforme Zone (= Verruciferum Z.)	

Tab.1

Tentative correlations around the Lower/Middle Volgian and Middle/Upper Tithonian boundary of Europe.

The moravian part of the Klentnice beds delivered until now only Ilowaiskya tenuicostata occidentalis and due to the occurence of this species in Poland is here assumed to be somewhat older than the beds yielding I. austriacus and Ps. scruposus in Lower Austria.

ad 3) Lower/Middle Volgian and Middle/Upper Tithonian boundary

The Lower/Middle Volgian boundary is drawn by all authors at the base of the Zaraiskites scythicus (=Dorsoplanites panderi) zone in eastern Europe. The lower boundary of this zone coincides in Central Poland with the top of the tenuicostata Subzone of the pseudoscythica Zone containing the beds with Isterites of the I. palmatus Group. This means that this boundary in the submediterranean area is situated at the top of the I. palmatus Zone. As demonstrated above this zone ends at the upper limit of the corresponding ponti Zone, i.e. at the Middle/Upper Tithonian boundary of Central Europe and of the Lower/Upper Tithonian boundary of Southern Europe. Also, if we would consider that the zone of I. palmatus could extend a little higher up into the Upper Tithonian, it could only mean a younger age of the Lower/Middle Volgian boundary and not a much older one as claimed by JELETZKY (1984) and MESEZHNIKOV (1982). All in all the divergent opinions of these two authors on these boundaries are not in concordance with the actual facts.

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