Remarks on the type locality and current status of the foraminiferal species *Rzehakina epigona* (Rzehak, 1895)

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ABSTRACT

A likely topotype locality is proposed for *Rzehakina epigona*. As the type specimen of *Silicina epigona* Rzehak, 1895 is assumed to be lost, we undertook a search for new material in the type area, Zdounky village in Moravia. A single locality provided a total of 138 *Rzehakina* specimens. The greenish grey marly clays sampled here contain a rich fauna of both planktonic and benthic foraminifers belonging to the *Abathomphalus mayaroensis* Zone. In addition to *R. epigona*, rare specimens attributable to *R. inclusa*, *R. lata*, *R. minima* and even a typical form of *R. fissistomata* are present at the Zdounky locality.

Biometrical analysis was carried out on 52 complete specimens using the involution value "Z" and the length/breadth ratio. Most of the *Rzehakina epigona* topotypes form a tight cluster with "Z" values between 4 and 15%, although forms that appear transitional to *R. lata* have Z values of around 20%. The length/breadth ratio is more variable, with values ranging between 1.2 and 2.0. However, the Z value measured from Rzehak's type figure is significantly higher and outside the range of variability of this cluster of specimens. We conclude that Rzehak's drawing may be imprecise. Unfortunately, we were not able to study the inner structure of these specimens owing to the lack of internal filling in these specimens. The unfavourable preservation and low abundance of specimens from the type locality do not enable a proper revision of the species *Rzehakina epigona* at this time.

INTRODUCTION

The species *Silicina epigona* Rzehak, 1895 is perhaps the best known among all the rzehakinid foraminifera. It is the type species of the genus *Rzehakina*, and as such serves as the model for the whole Superfamily Rzehakinacea. The genus *Silicina* Bornemann is considered to be a "genus of uncertain status" due to insufficient and misidentified type material (Loeblich & Tappan, 1987).

Thalmann (1949) first recognized the significance of *Rzehakina epigona* for the biostratigraphy and interregional correlation of Upper Cretaceous and Palaeogene deep-sea sediments. The occurrence of *Rzehakina epigona* and related species is used to recognise zones in a number of regional foraminiferal zonations (e.g., Bolli, 1966; Geroch & Nowak, 1984; Kaiho *et al.* 1993; Olszewska, 1997). The last occurrence of *Rzehakina epigona* and allied forms coincides worldwide with the Palaeocene/Eocene boundary event.

As the type species of the genus, *Rzehakina epigona* serves as the model for the whole group of late Cretaceous to early Palaeogene rzehakinids. Since 1895 when Rzehak first published the description of *Silicina epigona*, a number of authors have proposed new species that are either synonymous with *Rzehakina epigona*, or are closely allied with it (Table 1). Most of these species have been described from the Carpathian flysch deposits in Poland (Grzybowski, 1896, 1901; Friedberg, 1901; Liebus & Schubert, 1903; Jurkiewicz, 1967), but additional species have been described from Trinidad (Cushman & Jarvis, 1928; Cushman & Renz, 1946), northern Italy (Montanaro-Gallitelli, 1955), the Soviet Far East (Serova *et al.*, 1980, Serova *in* Kalishevich *et al.*, 1981; Turenko, 1983) and Japan (Fukuta, 1957). The current status of these species is given in Table 1.

Rzehakina epigona is widely regarded to be a morphologically variable species. Several of the species of *Rzehakina* described subsequently (Table 1) have been regarded as junior synonyms of *R. epigona* by various authors. A number of authors have regarded some of these forms (e.g., *R. fissistomata*, *R. inclusa*, *R. lata*, *R. mimima*) to be subspecies of *R. epigona* (e.g., Cushman & Jarvis, 1928; Geroch, 1960; Jurkiewicz, 1967; Hiltermann, 1974; Serova, 1987).

In view of its morphological variability and the number of closely related species or "subspecies" described in the literature, it would be worthwhile to investigate the morphological variability of

In: Hart, M.B., Kaminski, M.A., & Smart, C.W. (eds) 2000. Proceedings of the Fifth International Workshop on Agglutinated Foraminifera. *Grzybowski Foundation Special Publication*, 7, 71-80.

Table 1. Current status of species here regarded as belonging to the genus *Rzehakina*.

Species	Author	Type level/Type locality	Comments
Silicina epigona	**Rzehak, 1895**	Zdounky, Czech Republic.	Rzehak's type collection no longer exists.
Agathammina dubia	Grzybowski, 1896	Campanian red clays, Subsilesian Unit, Wadowice Poland	Regarded by Kaminski & Geroch (1993) as a junior synonym of *R. epigona*
Spiroloculina complanata	Grzybowski, 1901	Reported from the Inoceramus beds in a well from Bartne, Magura Unit near Gorlice, Poland	No specimens preserved in the Grzybowski Collection. Regarded as a possible senior synonym to *R. minima*, pending revision
Spiroloculina fissistomata	Grzybowski, 1901	Reported from wells in the Magura Unit, near Gorlice Poland	Neotype was designated by Kaminski & Geroch (1993).
Spiroloculina inclusa	Grzybowski, 1901	An outcrop of the Inoceramus beds in Siary, Magura Unit near Gorlice Poland	A lectotype was designated by Kaminski & Geroch (1993).
Spiroloculina occulta	Grzybowski, 1901	Reported from a well in Ropica Górna, Magura Unit, near Gorlice Poland	Type specimen re-illustrated by Kaminski & Geroch (1993).
Spiroloculina simplex	Grzybowski, 1901	Reported from the Inoceramus beds in Bartne and Przegonina, Magura Unit, near Gorlice, Poland	No specimens are preserved in the Grzybowski Collection. Regarded as *nomen dubium.*
Miliolina tenuis	Friedberg, 1901	Reported from the Inoceramus beds in Stobiernia, Poland; Skole Unit of the Carpathians	Described based on a single specimen (probably *R. epigona*). The species was regarded as *nomen dubium* by Kaminski *et al.* (1993)
Spiroloculina waageni	Liebus & Schubert, 1903	Campanian-Maastrichtian Puchov Marls of Slovakia	A suspected synonym of *R. epigona*. The Schubert collection no longer exists.
Rzehakina epigona var. *lata*	Cushman & Jarvis, 1928	Palaeocene, Lizard Springs, Trinidad	Ample material from the type locality is preserved in the Cushman Collection.
Rzehakina epigona var. *minima*	Cushman & Renz, 1946	Palaeocene, Lizard Springs, Trinidad	Ample material from the type locality.
Rzehakina spiroloculinoides	Montanaro-Gallitelli, 1955	Campanian to Maastrichtian, Fucoid Marls near Serramazzoni, Italy	Characterised by its elongated biconcave test, and few chambers. Two type specimens are preserved in the author's collection at the University of Modena, Italy
Rzehakina sogabei	Fukuta, 1957	Campanian, Rumoi Coal field, Hokkaido, Japan	Characterised by its flat, strongly asymmetrical test.
Rzehakina uryuensis	Fukuta, 1957	Campanian, Rumoi Coal field, Sorachi Province, Hokkaido, Japan	Characterised by its flat, symmetrical test. Only forms known from marginal marine environments.
Rzehakina fissistomata asimetrica	Jurkiewicz, 1967	Palaeocene Czarnorzeki Shales, Silesian Unit, near Krosno Poland	Now regarded to be an aberrant specimen of *R. fissistomata.*
Rzehakina kakyineica	Serova, *in* Serova *et al.*, 1980	Palaeocene Ivtygiinska Fm., Koryakskoye Mtns, N. Kamchatka	Characterised by its evolute coiling and large angle of translation between whorls.
Rzehakina sakhalinica	Serova, *in* Kalishevich *et al.* 1981	Lower Palaeocene, Sinegorka horizon, Sakhalin Island	A suspected synonym of *R. fissistomata.*
Rzehakina macilenta	Turenko, 1983	L. Campanian to Maastrichtian, Lower Krasnoyarsk Member, Sakhalin Island	Similar to *R. fissistomata*, but chambers are more evolute.

Rzehakina epigona based on type material as a first step towards a revision of the group. Unfortunately, this has not been possible until now owing to uncertainty regarding the locations of the type material and type localities of Rzehak. In this study we report the current status of the Rzehak material and propose a type locality that provides topotype material, including specimens of *Rzehakina epigona*.

Previous studies

The palaeobiogeography and morphology of *Rzehakina epigona* and related forms was studied in detail by Thalmann (1949), Scott (1961) and Hiltermann (1974). The *R. epigona* group has now been reported from Upper Cretaceous to Palaeogene agglutinated foraminiferal assemblages from the Atlantic, Caribbean, Mediterranean, and Pacific regions. *Rzehakina epigona* was recorded from the Velasco Shale of Mexico (Cushman, 1926; White, 1928), the Lizard Springs Formation of Trinidad (Cushman & Jarvis, 1928; Kaminski *et al.* 1988), from a sample of presumed Palaeocene age dredged from the Burdwood Bank of the Falklands Plateau (Macfadyen, 1933), from the Upper Cretaceous of Ecuador (Hiltermann, 1974), from the Upper Cretaceous Colon Shale of western Venezuela (Fuenmayor, 1989), and from the Upper Cretaceous to Lower Palaeogene of the Alpine-Carpathian region of southern and central Europe (Rzehak, 1895; Jedlitschka, 1935; Majzon, 1943; Noth, 1951; Geroch, 1960; Pokorny, 1960; Hillebrandt, 1962; Grün, 1969; Mjatliuk, 1970; Hiltermann, 1974; Sandulescu, 1972; Beckmann *et al.* 1982, Geroch & Nowak, 1984; Olszewska, 1997). In the Atlantic region, Beckmann (1994) recorded its range as Santonian to Upper Palaeocene (P5) in Trinidad. Krasheninnikov & Pflaumann (1977) reported specimens from the Upper Cretaceous of DSDP Site 368 on the Cape Verde Rise, and Volat *et al.* (1996) reported its range as Campanian to Maastrichtian offshore Gabon. In the Pacific region, it was reported from the Palaeocene Lodo Formation of California (Mallory, 1959), the "Teratian to Teurian" [Coniacian/Santonian to Palaeocene] of New Zealand (Hornibrook *et al.*, 1989; Scott, 1961), from the Campanian to Maastrichtian Rosario Formation of southern California (Sliter, 1968), from the Maastrichtian to Palaeocene of Kamchatka (Serova, 1969) and Sakhalin Island (Serova, 1987), from the Turonian to Lower Senonian of Japan (Takayanagi, 1960; Kaiho *et al.*, 1993; Kaiho & Hasegawa, 1994), and from the Palaeocene of DSDP Site 283 in the Tasman Sea (Webb, 1975). In Hokkaido, Kaiho *et al.* (1993) defined a mid-Turonian "R. epigona Interval Zone (KB3)" based on the FO of the species. In Papua New Guinea, Milner (1997) found *Rzehakina epigona* in the Palaeocene Burns Peak Beds and Moogli Mudstone.

Studied Material

As Rzehak originally stated (1895, p. 215), his new species was based on a single specimen from Zdaunek in Mähren. Rzehak unfortunately did not mention the depository of the type. In the explanation to the plates he stated that the "K. K. Naturhistorisches Hofmuseum in Wien" owns the figured specimens, with several exceptions. Unfortunately, it appears that the type specimen of *Silicina epigona* constitutes one of these exceptions. We made enquiries at the Naturhistorisches Museum Wien (i.e., the former "K.K. Naturhistorisches Hofmuseum"), but no specimens described in Rzehak's paper are preserved in the micropalaeontological collections (Fred Rögl, personal communication to MB).

The other possibility was to search for Rzehak's collection in the Czech Republic. It is possible that Rzehak kept the types represented by single specimens in his personal collection. Rzehak was a professor at the German Technical University in Brno ("Deutsche technische Hochschule in Brünn"). After the Second World War, its buildings (including the collections) were taken over by the Masaryk University Brno. Some of Rzehak's micropalaeontological material is housed in the collections of Masaryk University, but this consists only of unidentified specimens and washed residues.

As the type specimen is assumed to be lost, we undertook a search for new material in the type area. Rzehak reported the type locality as Zdaunek village (the German name for Zdounky near Kromeriz) in Mähren (= Moravia). Unfortunately, Rzehak did not give the precise details of the locality. From the geological map of the area (unpublished geological map 1:25000, square M-33-107-B-c of Chmelík, 1967; Archives of the Czech Geological Survey) it was apparent that the *Rzehakina*-bearing Senonian-Palaeocene sediments are restricted to a belt of tectonic slices on the southeast margin of Zdounky village (Figure 1).

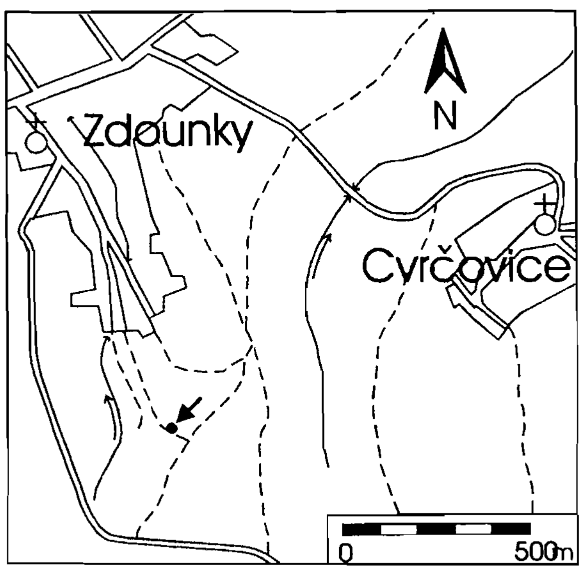

Figure 1. Location of the new Zdounky locality (marked by arrow) providing topotypes of *Rzehakina epigona* (Rzehak).

The area around Zdounky shows signs of former limestone exploitation for local lime production, which mostly took place during the 19th century. For this study, samples were collected from all accessible outcrops, including eluvial clays.

A single locality provided a noteworthy number of rzehakinids (Bubík *et al.*, 1995). This is small excavation in a slope near the eastern boundary of the sports shooting-range, in a small abandoned quarry (Figure 2a). The excavation is 8 m wide, and its low cut exposes 0.9 m of marly clays and marls disturbed both tectonically and by recent downslope movements. Marly clays are greenish grey with thin brown red and yellowish grey streaks and lenses, and include rare angular fragments of fine-grained calcareous sandstone.

To obtain sufficient numbers of *Rzehakina* specimens, about 20 kg (yes, twenty!) of greenish grey marly clay was processed. The marly claystones with rzehakinids were easily disaggregated using washing soda and washed over a 0.1 mm mesh sieve. The majority of the obtained residues were treated using 4% hydrochloric acid to concentrate the minor noncalcareous component, which includes agglutinated tests. The total of 138 *Rzehakina* specimens were obtained, out of which 52 were selected as useful for biometric study. The rest are apparently juveniles, fragments, and damaged specimens with broken last chambers. All specimens are silicified, more or less deformed, and without contrasting chamber infill. Some representative specimens are illustrated in Plate 1.

Methods

For biometrical analysis, the comparatively well-preserved specimens of *Rzehakina* were selected without regard to subjective species determination, with the expectation that this assignment will result from evaluation of the biometrical data. All selected specimens were first sketched using "camera lucida". Biometrical parameters were measured on the drawings. Measurements of type specimens can be regarded as "standards". These were taken from the published type figures. The following measurements were taken in standardised way (Figure 2):

1. Length (L) and breadth (B). The test outline is circumscribed within a minimal rectangle oriented parallel to the long axis (this may not be necessarily parallel with the median axis in the case of assymetrical specimens).

2. The "Involution value (Z)" of Hiltermann (1974). This parameter express the proportion (in percentage) of the central area (c) between the spiral sutures of the ultimate and penultimate chambers along the test breadth (b). Both (b & c) measurements were taken on the axis perpendicular to the median axis. The median axis is drawn through the points where the spiral sutures of the ultimate and penultimate chambers meet.

The L/B ratio is a measure of the elongation of the test, and "Z" can be thought of as the degree of embracing of the early part of the test by the last whorl. Owing to the lack of contrasting infill of the chamber lumina in the topotype specimens, it was not possible to measure the proloculum diameter or count the number of chambers.

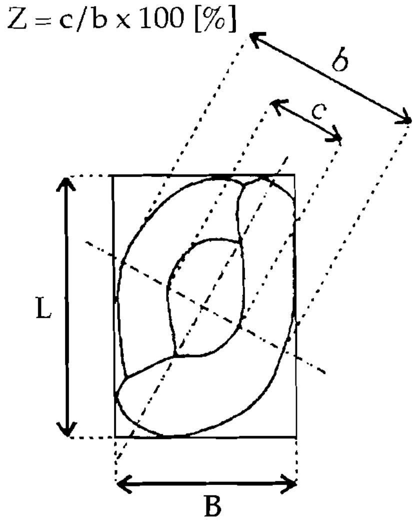

Figure 2. Biometrical parameters measured on drawings of *Rzehakina*.

RESULTS

Biostratigraphy

The greenish grey marly clays contain a rich fauna of both planktonic and benthic foraminifers. Among the planktonic taxa *Abathomphalus mayaroensis* (Bolli), *Contusotruncana contusa* (Cushman), *Globotruncanella petaloidea* (Gandolfi), *Globotruncanita stuarti* (Lapparent), *G. angulata* (Tilev), *Globotruncana arca* (Cushman), *G. rosetta* (Cars.), *G. linneiana* (d'Orbigny), *G. orientalis* Nagg., *Rugoglobigerina scotti* (Brönnimann), *R. rotundata* Brönnimann, *Racemiguembelina fructicosa* (Egger), *Planoglobulina acervulinoides* (Egger) are frequent. Calcareous benthos is represented *by Reussella szajnochae* (Grzybowski), *Aragonia velascoensis* (Cushman) and numerous representatives of genera *Dentalina, Gavelinella, Gyroidinoides, Pleurostomella, Ramulina, Osangularia, Allomorphina* and *Lenticulina*. Calcareous taxa predominates over the agglutinated ones like *Remesella varians* (Glaessner), *Spiroplectammina dentata* (Alth), *Tritaxia tricarinata* (Reuss), *Hormosina velascoensis* (Cushman) and *Dorothia pupa* (Reuss). Evidence of a latest Maastrichtian age is provided by the presence of the *Abathomphalus mayaroensis* Zone and the CC26 nannofossil Zone (Bubík *et al.*, 1995). Rzehakinids represented by *Rzehakina epigona* (Rzehak) and single occurrences of *R. minima* (Cushman & Renz), *R. inclusa* (Grzybowski), *R. fissistomata* (Grzybowski) and *R. lata* (Cushman

& Jarvis) are rather rare elements of the benthic assemblage at this locality.

The streaks of brown red marly clays provided abundant early Middle Eocene planktonic foraminifera of the P11 Zone with *Subbotina frontosa* (Subbotina), *Morozovella subbotinae* (Morozova), *M. aragonensis* (Nuttall), *M. lehneri* (Cushman & Jarvis), *Globigerinatheka barri* Brönnimann etc. The mixed benthic assemblage consists of *Plectina dalmatina* (Schubert), *Marssonella* sp., *Spiroplectammina* sp., *Heterolepa perlucida* (Nuttall), *Oridorsalis* sp., *Stilostomella* sp. etc. A similar taphocoenosis with higher P/B ratio was found within the streak of yellowish grey marl. The Eocene foraminifera occur rarely in residues from the Maastrichtian grey marly clays, probably as a result of tectonic disturbances.

Description of Topotypes

Rzehakina epigona (Rzehak, 1895)

Plate 1, Figs 1a - 4b

Diagnosis. Test elliptical, with pointed anterior and posterior ends, compressed, with central part strongly excavated on both sides. Periphery bluntly angular, usually of keeled appearance due secondary compression resulting from compaction of the sediment. Coiling is planispiral, semi-evolute, with two chambers per whorl. The internal diameter of chambers is thickest near the middle, and tapers towards the ends. The chambers of early whorls are oval in cross section; chambers of later whorls are triangular in cross section. Chambers embrace the chambers of preceding whorl with a relatively broad calus-like cover of the agglutinated wall mass. Wall finely agglutinated with a smooth surface. Aperture a small oval or rounded-triangular opening.

Topotypes. 138 specimens from Zdounky in Moravia (housed in the collections of the Czech Geological Survey, Brno Branch). Representative specimens are figured on Plate 1.

Dimensions. Length of specimens from Zdounky ranges between 0.29 and 0.65 mm.

Variability. The most variable character of *Rzehakina epigona* is the L/B ratio, which ranges between values of 1.2 and 2.0. Values of the involution index ("Z") form a relatively tight cluster between 4 and 15% (see Figure 3 below), though forms that appear transitional to *R. lata* reach Z-values of around 20%. Another variable character is the bilateral symmetry of the test. Relatively symmetrical specimens prevail over strongly asymmetrical ones.

Remarks. *Rzehakina epigona* differs from the closely related *R. lata* by its more involute and often more elongated test. *Rzehakina inclusa* (Grzybowski) differs from *R. epigona* in being more involute (with "Z" values near zero), and in having an umbilical plug that obscures the early chambers of the test. As a result, the test of *R. inclusa* is more biconvex. The species *R. fissistomata* (Grzybowski) is more evolute than *R. epigona*, and has a well-developed coil suture. *Rzehakina minima* Cushman & Renz is smaller, more evolute, and thinner than *R. epigona*.

DISCUSSION

An exhaustive biometrical study of the variability of *R. epigona* based on fossil material from New Zealand was carried out by G.H. Scott (1961). Scott's rzehakinids were found mostly in Haumurian-Teurian sediments (approximately equivalent to Maastrichtian-Palaeocene) in New Zealand. Scott separated microsphaeric and megalospheric forms based on proloculum size to obtain homologous groups for comparison. The measured parameters were length and width, evaluated statistically by linear regression. The main axes plotted within the length-width diagram of each sample for each group highlight differences in growth ratios between some of the samples. Alongside the predominantly planispiral microsphaeric gamma and megalospheric alpha groups, Scott distinguished beta and delta groups based on their non-planispiral coiling. He considered all four groups to be different reproductive generations of a single species (*R. epigona*). In our opinion, the beta and, especially, the delta group fit well within the definition of the genus *Silicosigmoilina*. Although Scott did not propose to include *Silicosigmoilina* within the synonymy of *Rzehakina*, he considered the geometry of the early chambers an unreliable criterion for the generic classification of the Rzehakinidae. In our opinion, the figured specimens of Scott's alpha group strongly resemble *Rzehakina lata* Cushman & Jarvis, while the gamma group compares well with *R. minima* Cushman & Renz.

Another important contribution to the knowledge of *Rzehakina* was the study of Serova (1969), who reviewed the morphological characteristics of the North American and European species known up to then. Serova dismissed Scott's view concerning the validity of *Silicosigmoilina*. She recognised four species of *Rzehakina* (*epigona*, *fissistomata*, *inclusa*, & *minima*) in the Upper Cretaceous and Lower Tertiary of the Pacific province based on her measurements of the "degree of elongation" of the test (our L/B) and the "degree of involution" of the chambers. She regarded *R. minima* to be a separate species based on its highly evolute test, but considered *R. lata* (sensu Cushman, 1946) to be a composite group that probably included some of the European species.

The first rigorous morphometrical study of *Rzehakina* was carried out by Hiltermann (1974), who compared the measured parameters of over 150 specimens from Ecuador, Austria, and Poland. Hiltermann discussed 22 quantitative and

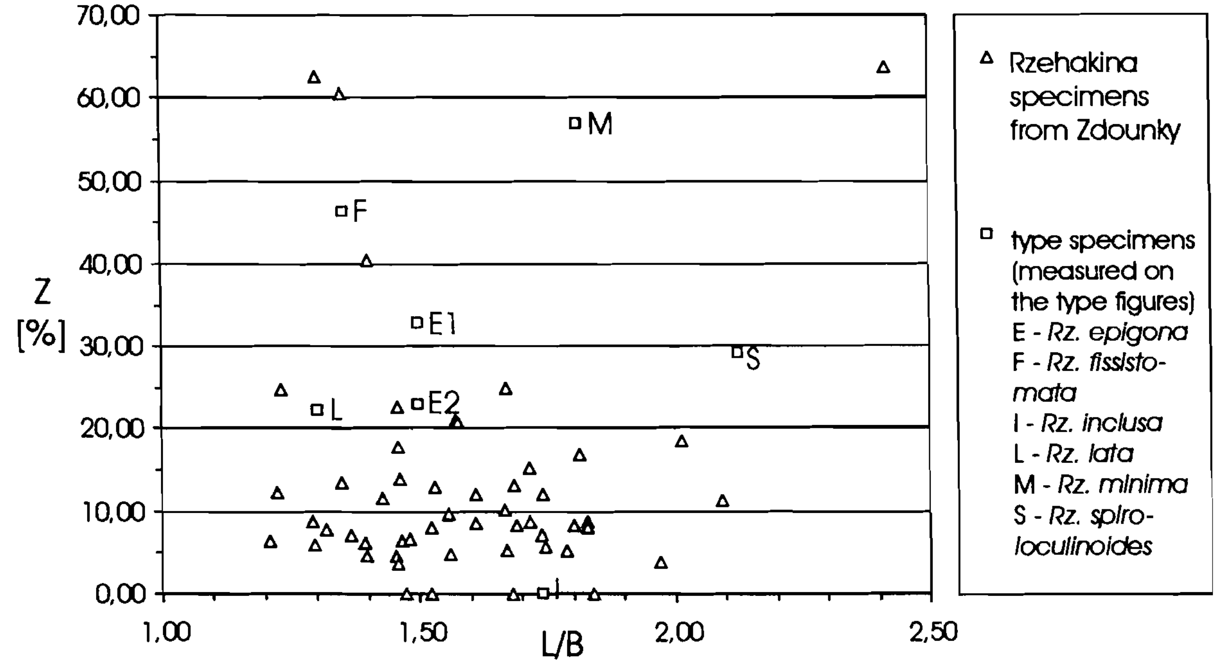

Figure 3. Variability of *Rzehakina* specimens from Zdounky (L/B - Z diagram). Points E1 and E1 are two possible interpretations of the type figure measurements that take into account the (in)accuracy of the drawings of Rzekak (1895).

group. Among these, the newly introduced involution value ("Involutionsvert") abbreviated "Z" was most valuable. This variable expresses the degree of embracing of the older part of the test by the last two chambers, or the relative width of central area respectively. Hiltermann compiled distributional data from the literature, and measured specimens figured by earlier authors from original figures. Based on this morphometrical data, Hiltermann distiguished five different forms (*epigona, fissistomata, inclusa, minima* and *bowsheri*) which he regarded to be subspecies of *Rzehakina epigona* The Caribbean species *R. epigona lata* of Cushman & Jarvis was considered to fall within the range of variability of *R. epigona epigona*. Hiltermann demonstrated that the five subspecies can be ranked to form a continuous series in terms of increasing "Z" values, although other morphological parameters such as the L/B index partially overlap. However, the stratigraphic ranges of these five forms are partially disjunct, with *R. epigona* (*sensu stricto*) possessing the longest range. While these five forms are no doubt closely related, most authors now consider them to be separate species.

A new graphical approach to document the variability of *Rzehakina* populations based on the involution value "Z" and the length/breadth ratio plotted on a single diagram was introduced by Bubík (1999). The preliminary results obtained from a test set of rzehakinids from the Carpathian Flysch (the Uzgrun section in the Czech Republic) confirmed that through the use of this diagram it is possible to distinguish morphological groups which can then be assigned to individual species. For the purpose of this study, length (L), breadth (B), thickness (T), and the involution value (Z) were measured on 52 specimens selected from Zdounky. The combination of the L/B ratio with "Z" on a single x-y plot yielded a better separation of points than L–B and B/T–Z diagrams. For comparison, biometrical data of the type specimens of different *Rzehakina* species described from the literature (plotted as squares in Figure 3) serve as important reference points (Table 2).

The L/B - Z diagram (Figure 3) reveals that in addition to *R. epigona*, rare specimens attributable to *R. inclusa*, *R. lata*, *R. minima* and even a typical form of *R. fissistomata* are present in the Zdounky material. The latter species is considered to be a Palaeocene marker species (the index taxon of the R. fissistomata Zone of Geroch & Nowak, 1984). Its occurrence in the Senonian is still poorly understood. In addition to the clearly determinable specimens, several morphological transitional forms occur, including *R. epigona-lata* and *R epigona-?spiroloculinoides*.

The bulk of the specimen set subjectively referable to *R. epigona* comprises a relatively compact grouping with most specimens having Z-values centred around 10%, and with L/B ratios between 1.2 and 2.0. The Z values are lesser than those delimited for *R. epigona* in the measured set from the Uzgrun section of the Magura flysch (Bubik, 1999). What is worse, both alternative versions of the Z-value measured from Rzehak's type figure are significantly greater than, and outside the range of variability of, this cluster of specimens. This brings into question whether or not the measured specimens from Zdounky are conspecific with *R. epigona*.

Table 2. Type specimens of different *Rzehakina* species (measured from type figures) used in the biometrical analysis (Figure 3).

SPECIES	SPECIMEN STATUS	REFERENCE	FIGURE
R. epigona	holotype	Rzehak (1895)	pl. VI, fig. 1a
R. fissistomata	neotype	Kaminski&Geroch (1993)	pl. 15, fig. 2
R. inclusa	lectotype	Kaminski&Geroch (1993)	pl. 15, fig. 4a
R. lata	holotype	Cushman&Jarvis (1928)	pl. 13, fig. 11a
R. minima	holotype	Cushman&Renz (1946)	pl. 3, fig. 5
R. spiroloculinoides	holotype	Montanaro-Gallitelli (1958)	pl. 2, fig. 1

In our view, the measured set of specimens from Zdounky is indeed representative, and we believe that collecting additional specimens from the same level in the type area would not bring different results. The possibility for inaccuracy in the (probably) hand-drawn type figure should also be taken into account. On the type figure, the coil sutures (which are important for the measurement of Z) are not clearly visible. It is possible that both extreme variants of Z estimated from the type figure may still be inaccurate, and the true Z-value may possibly be lower.

Difficulties with measurements of Z from type figures were also encountered with *R. lata*, *R spiroloculinoides*, and especially with *R. minima*. The type figure of the latter species probably depicts a specimen in transparency, and therefore the spiral suture was estimated rather instinctively based on observations of fossil material.

CONCLUSIONS

The type specimens of the species *Rzehakina epigona*, described by Rzehak (1895) from the Carpathian flysch, are not preserved in the Rzehak collections and are presumed lost.

A topotype locality for *Rzehakina epigona* is identified near Zdounky village in Moravia, which is likely to be one of the original localities of Rzehak. Unfortunately, specimens of *Rzehakina* recovered from upper Maastrichtian marls at this locality are rare and not preserved in a manner that enables study of their internal structure. As a result, we do not believe it prudent to designate a neotype based on these topotypes.

The measured set of *Rzehakina epigona* topotypes from Zdounky may be defined biometrically as a group with L/B ratio between 1.2 and 2.0, and "Z" between 4 and 15%, although transitional forms to *R. lata* reach "Z" values of about 20%. *Rzehakina lata* generally differs by its broader test and higher "Z" value between 20 and 30%; the *R. fissistomata* group is delimited by "Z" between 40 and 50%; and *R. minima* is a variable species with "Z" between 30 and 60% and forms a relatively large field in the diagram (Bubík, 1999). The validity and relationship of *R. spiroloculinoides* to the other species is not yet clear, as no specimens were found that resemble the holotype.

For a more accurate measure of the variability of the whole *Rzehakina* group, it would be worthwhile to measure and plot topotypes of each of the above-mentioned species on the L/B - Z diagram. Any future revision of the genus will also require finding a neotype locality for *R. epigona* that provides ample, well-preserved specimens.

ACKNOWLEDGEMENTS

M. Bubík acknowledges a travel grant from the Grzybowski Foundation for supporting his attendance at IWAF-5 in Plymouth. We thank Felix Gradstein (Oslo) for reading a draft of the manuscript and offering helpful comments. This is contribution no. 59 of the Deep-Water Agglutinated Foraminiferal Project.

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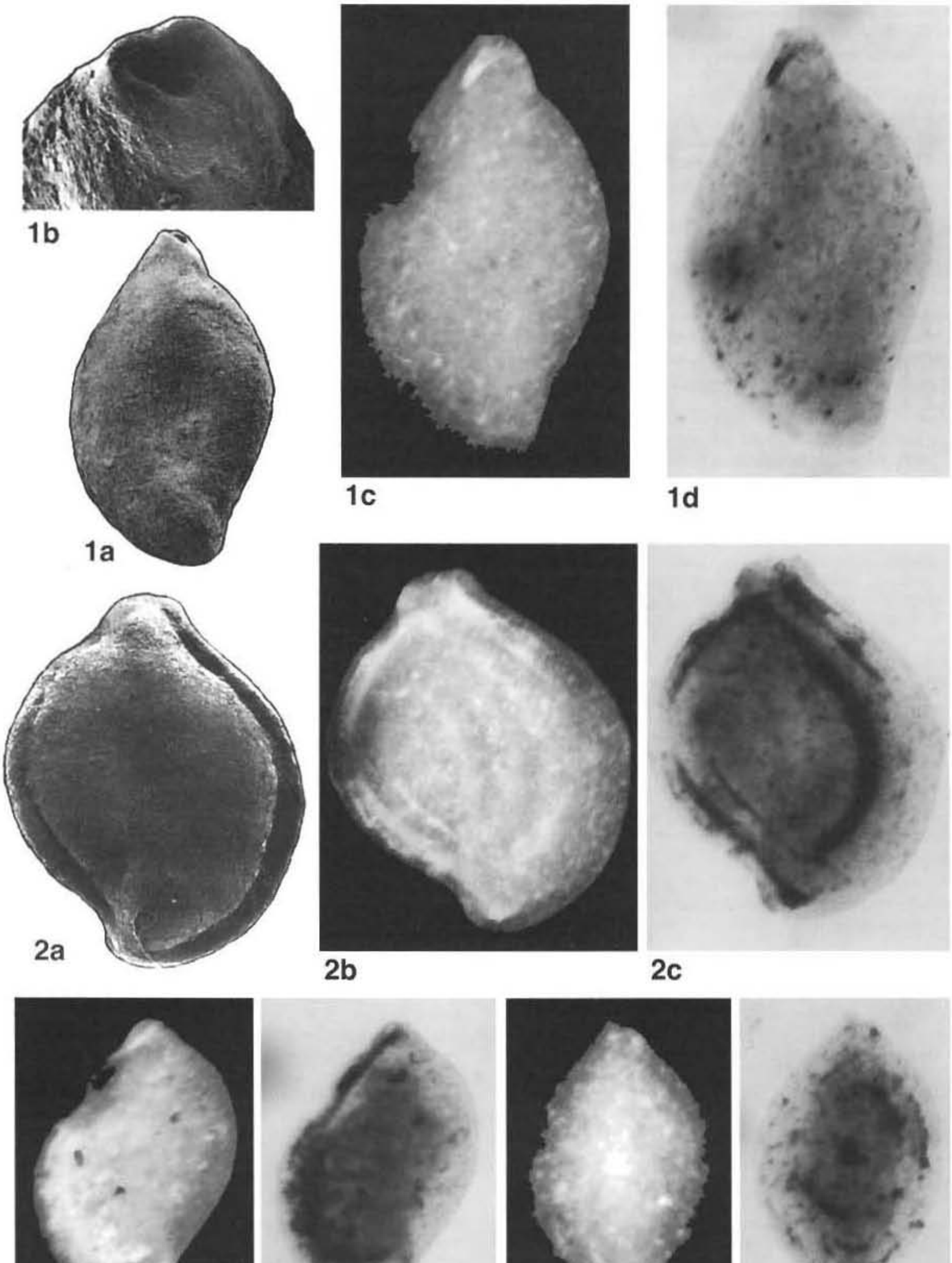

Plate 1. Topotype specimens of *Rzehakina epigona* from Zdounky, Czech Republic. SEM and light microscope photos. 1a. x70; 1b. x400; 1c. photographed in immersion with reflected light, x86; 1d. immersion with transmitted light, x86. 2a. x100; 2b,c. x86. 3a-4b. x86.