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UPPER DEVONIAN–LOWER CARBONIFEROUS FORAMINIFERAL PALEOBIOGEOGRAPHY AND PERIGONDWANA TERRANES AT THE BALTICA-GONDWANA INTERFACE

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Abstract: A new paleobiogeographic subdivision of the Perigondwana terranes is based on the study of Upper Devonian and Lower Carboniferous calcareous foraminifers. The Brunovistulian, Moesian and Zonguldak terranes in Central and SE Europe and Asia Minor (the Brunovistulian group of terranes) show close paleobiogeographic relationships to the East European foraminiferal association. Consequently, they are regarded as a part of the Fennosarmatian Province which represented a centre for the diversification for most groups of Upper Devonian and Lower Carboniferous calcareous foraminifers. A lower degree of similarity with the East European Platform can be distinguished in the East Avalonian foraminiferal fauna while that of the Armorican group of terranes displays distinct differences constituting the separate Armorican Province. The results obtained support the idea that the Brunovistulian group of terranes formed the southern margin of Laurussia which was colliding with the Armorican group of terranes during the Variscan orogeny. In this respect, Brunovistulian group of terranes held a geotectonic position similar to that of East Avalonia even though the accretionary history of the terranes was different.

Key words: Upper Devonian, Lower Carboniferous, Perigondwana terranes, paleobiogeography, calcareous foraminifers.

Introduction

The most important feature in the evolution of calcareous foraminifers is the fact that the highest rates of evolution can be observed in complicated multilocular forms, while the small number of morphological features recognized in fossil unilocular forms makes them inappropriate for such studies.

The first period of differentiation of multilocular, calcareous foraminiferal faunas can be distinguished in the late Devonian–early Carboniferous. In this period, the benthonic mode of life in shallow shelf environments predestined calcareous foraminifers to become a useful tool for paleobiogeographic studies. To determine the relationships of Perigondwana terranes, it would evidently be useful to study early Paleozoic foraminiferal paleobiogeography in detail. However, less diversified assemblages of primitive unilocular foraminifers and the poor knowledge of their distribution makes them inadequate for such a study. Nevertheless, even in the Frasnian to late Tournaisian there seem to be paleobiogeographic differences between terranes which can have some impact on the study of relations at the Gondwana-Laurussia interface.

After the break-up of Pannontia many microplates were derived, especially from Gondwana (Erdtmann 2000). The lower Paleozoic history of Baltica was characterized by the successive accretion of Perigondwana terranes. However, most of the paleogeographical models that have been proposed, for example, by McKerrow & Scotese (1990), Dalziel (1997), Torsvik (1996) are too general or concentrated to a certain region. Recent studies of lower Paleozoic paleogeography (e.g. Erdtmann 2000; Paris 2000; Robardet et al. 1994; Belka et al. 1997; Ebner et al. 1998; Stampfli 1996; Kozur & Göncüoglu 2000) seem to distinguish a complicated mosaic of terranes at the Gondwana-Laurussia interface, not only within the Armorican group of terranes, but also in Central Europe and on the southeastern Laurussian margin. However, most studies are regionally focused and only Erdtmann (2000) included most of the known terranes in his paleogeographical reconstruction and summarized the often conflicting state of knowledge.

It is beyond the scope of this paper to discuss the paleobiogeographical relations of all Perigondwana terranes. Consequently, as the distribution of calcareous foraminiferal fauna in the upper Devonian and lower Carboniferous was restricted to shallow shelf environments, only terranes with a microcontinental affinity and a rich foraminiferal record will be included.

Terranes of the Caledonian-Variscan orogeny

The most common features which have been applied to distinguish Perigondwana-derived terranes are the Cadomian consolidation of the basement, paleomagnetic data, the "Mediterranean" faunal affinity or sedimentological criteria (Ordovician glacigenic sediments). However, all these criteria have their drawbacks and should be combined (Erdtmann 2000). Thus, a Cadomian consolidation usually regarded as a part of the Panafrican consolidation (Ziegler 1986) has recently been reported in the Urals and Taymir (Puchkov 1998; Glasmacher et al. 1998). Zelazniewicz (2000) even assumes a Cadomian orogeny at the southern margin of the Baltica. Even though such assumptions must still be verified, one has to be more careful in applying a single criterion for determining a Gondwana affinity.

There is a growing consensus on the importance of strike-slip transfer and rotations of terranes which is reflected in the most recent paleobiogeographic models. This does not only concern Perigondwana terranes. For example, the Baltica seems to have been detached from the West-African-South-American part of Protogondwana, showing a prominent counterclockwise rotation and significant latitudinal transfer during the early Paleozoic (Erdtmann 2000).

As it was already stressed, in the following contribution, attention will be directed only to discussion of the position of particular terranes in connection with upper Devonian–lower Carboniferous foraminiferal paleobiogeography.

In Western Europe, two major groups of terranes between Baltica (Laurussia) and Gondwana have generally been distinguished:

1) The East Avalonian terrane group which was accreted to the southern margin of Baltica during the Caledonian orogeny and during the Variscan orogeny. It formed the southern promontory of Laurussia.

2) The Armorican terrane group was accreted to the southern Laurussian margin during the Variscan orogeny. Its major constituents include the Middle/North Armorican Terrane, the Central Iberian Terrane, Barrandian and the Saxothuringian Terrane. Other smaller terranes are also reported (Robardet et al. 1994; Paris 2000). Some authors also include the Intra-Alpine Terrane in this group (Paris 2000).

In Central Europe, a similar situation can be distinguished (see Fig. 3). The Caledonian accreted terranes include the Lysogory, Malopolska and Brunovistulian terranes (Kalvoda 1995; Belka et al. 1997). In the Armorican terrane group, the Saxothuringian and Perunica terranes can be included along with the Intra-Alpine terranes more to the south and southeast.

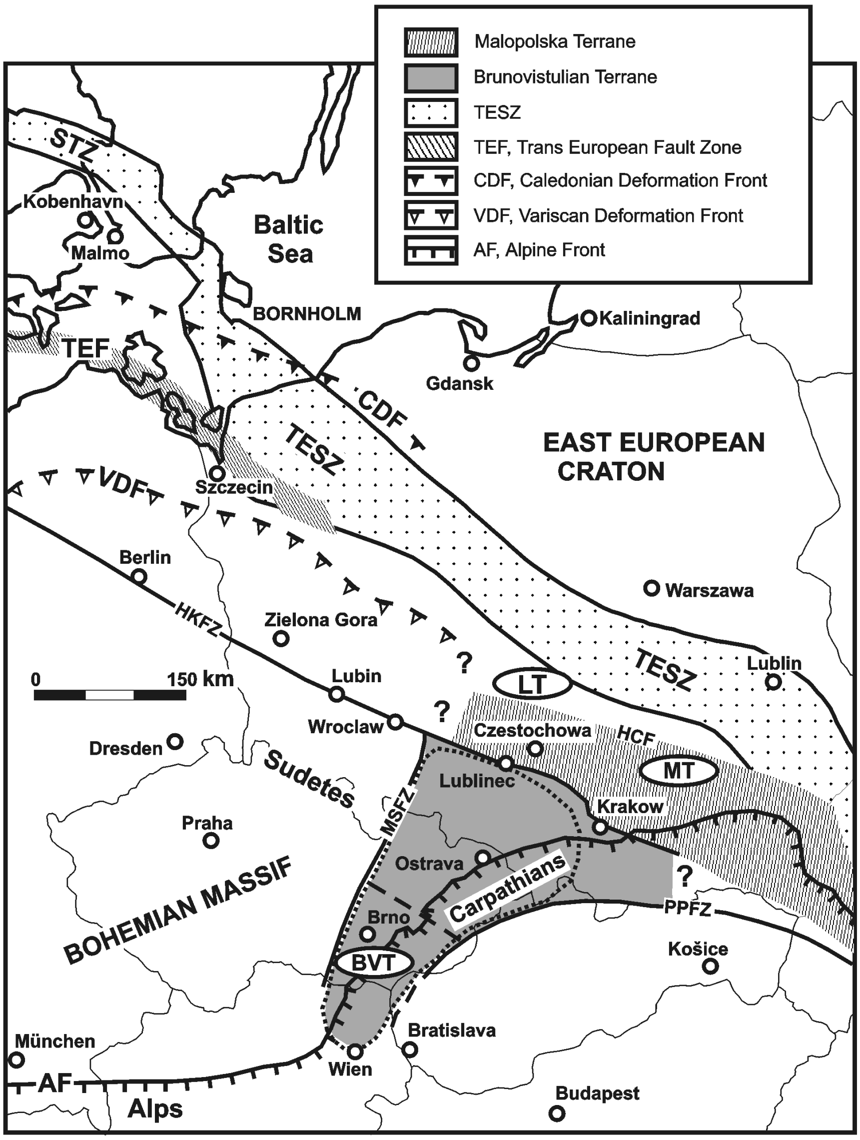

Fig. 1. Structural setting of the Brunovistulian, Malopolska and Lysogory terranes. Modified according to Bula et al. (1977). **BVT** — Brunovistulian Terrane, **MT** — Malopolska Terrane, **LT** — Lysogory Terrane, **HKFZ** — Hamburg-Krakow Fault Zone, **HCF** — Holy Cross Fault, **TESZ** — Trans-European Suture Zone, **MSFZ** — Moravo-Silesian Fault Zone, **PPFZ** — Peri-Pieninian Fault Zone, **VDF** — Variscan Deformation Front, **CDF** — Caledonian Deformation Front, **AF** — Alpine Front.

These include the Peri-Mediterranean Terrane and the Noric-Bosnian Terrane as major units (Neubauer & Handler 2000; Kováč et al. 1993; Schönlaub & Histon 2000).

In the southeast, at the contact with the East European Platform, the Moesian and Balkan terranes (Yanev 1997) and the Zonguldak Terrane and other possible terranes in Turkey (Göncüoglu 1997) can be distinguished. As the Central and South-Eastern European terranes are not so well known and have been distinguished only recently, a brief description will be provided.

The Brunovistulian Terrane (BT — see Fig. 1) was included into the Avalonian group of terranes by Kalvoda (1995). This terrane has a Cadomian basement and detrital muscovites in the lower Cambrian clastics showing the same age (Belka et al. 2000). Jachowicz & Přichystal (1997) and Fatka & Vavrdová (1998) have reported Lower Cambrian acritarch assemblages showing a pronounced similarity with assemblages known from the East European Platform. The Cambrian trilobite fauna shows affinity to the Baltic Province (Belka et al. 2000). On the other hand, the middle Devonian trilobite fauna correlates well with the Barrandian area (Chlupáč 1969) contrary to the benthonic (coral and brachiopod) faunas which are essentially dissimilar to the Barrandian ones (Galle et al. 1995). It seems that the Brunovistulian Terrane was located close to the Baltica as early as in the Cambrian and may has joined the Malopolska Terrane in the early Devonian (Belka et al. 2000). Important dextral translations are reported by Grygar (1997).

The Malopolska Terrane (MT — see Fig. 1) is separated from the Brunovistulian Terrane by a tectonic unit known as the Krakow-Lubliniec Fault Zone. The Krakow-Lubliniec Fault Zone is a part of the largely concealed Hamburg-Krakow Fault Zone (see Fig. 1) which is parallel to the Trans-European Suture Zone (TESZ) and continues southeast of Krakow, where Carpathian flysch is thrust over the Paleozoic basement (Bula & Jachowicz 1997). According to Belka et al. (2000), the Malopolska Terrane possesses a Cadomian basement; lower Cambrian sediments yield detrital muscovites and zircons of both Cadomian and Baltica provenance. Upsection, the change in provenance from Cadomian to Baltic sources appears. Belka et al. (2000) thus assumed that the Malopolska Terrrane was the first Perigondwanan microplate, which was accreted to the margin of Baltica. Lewandowski (1992) assumed a significant dextral translation of the terrane in the Devonian.

The Lysogory Terrane (LT — see Fig. 1) is separated from the Malopolska Terrane to the south by the Holy Cross Fault. To the north it is delimited by the TESZ. The basement is unknown. Middle and Upper Cambrian rocks comprise detrital muscovites, both Baltic and Cadomian in affinity. It is assumed that the unit had been situated very close to Baltica in the late Cambrian, even though the Cambrian fauna shows

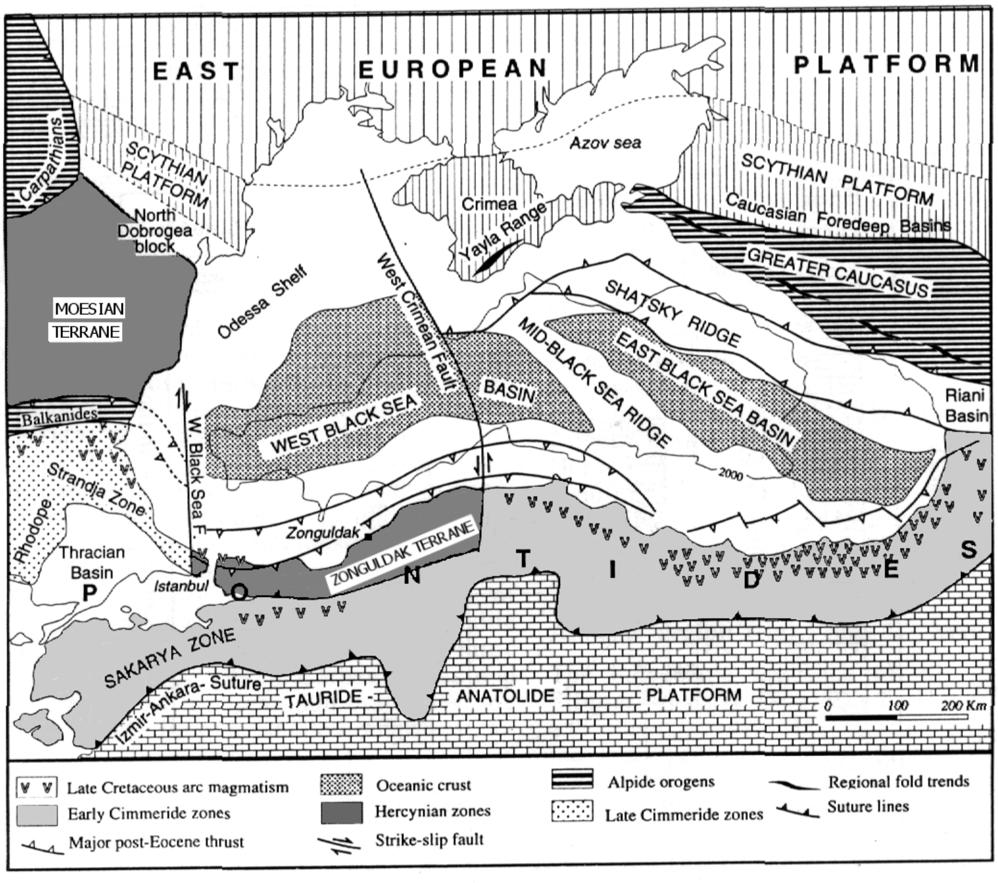

Fig. 2. Tectonic map of the Black Sea region showing the position of the Moesian and Zonguldak terranes. Modified after Okay et al. (1994).

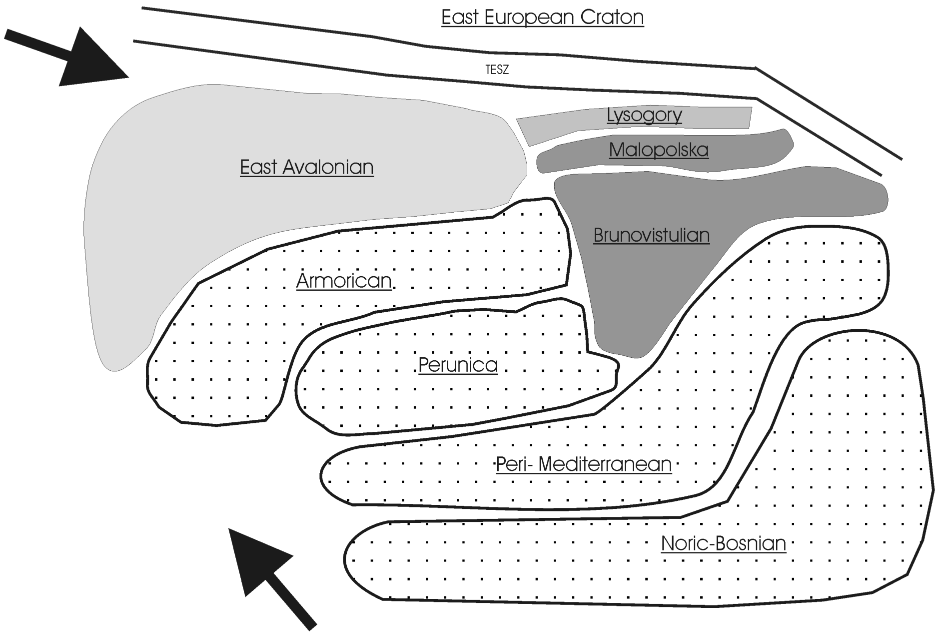

Fig. 3. Sketch of the microcontinents in the Central European Variscides. Terranes of the Brunovistulian group coloured dark, dotted — terranes of the Armorican group and light East Avalonia. The relation of enigmatic Lysogory Terrane is not quite clear. The arrows indicate predominating sinistral translation of the East Avalonian Terrane and predominating dextral translation of the remaining Perigondwana terranes (see Table 1).

Gondwanan (Avalonia or Armorica) rather than Baltic affinities (Belka et al. 2000).

In the Moesian Terrane (see Fig. 2), Yanev (1997) reported, based both on Ordovician acritarchs and trilobites, the presence of a cool Mediterranean Province. He assumed attachment to the Dobrogea periphery of the Eastern European Platform in the middle to upper Devonian and continuing collision in the Carboniferous and Variscan collision with the Balkan Terrane along the Thracian Suture. Crowley et al. (2000) mentioned "Cadomian-aged" deformation of arc-related tholeiites along the northern margins of Central Dobrogea which forms the northern part of the Moesian Terrane. Ordovician glaciomarine sediments in the Balkan Terrane (Yanev 1997a) as well as Bohemian-type lower Paleozoic fauna (Yanev 1997a) suggest a relationship to the Armorican terranes.

In the Zonguldak Terrane (see Fig. 2) Kozur & Göncüoglu (2000) reported Cadomian oceanic and island arc sequences and assumed the lowermost Devonian accretion to the East European Platform. The presence of Ordovician trilobites of Welsh affinity may indicate a position close to East Avalonia. On the basis of the presence of the entirely continental Triassic, they also assume a slightly more northerly position of the Zonguldak Terrane in comparison with the Moesian Terrane. This more northerly original position is easily compatible with the Mesozoic evolution of the Black Sea, a period during which the Zonguldak Terrane drifted southward (Görür et al. 1997). On the other hand, Sengör (1984) put the Istanbul series into the Cimmerian continent and Stampfli (1996) regarded the Zonguldak Terrane (Pontides) as the eastern end of the Intra-Alpine Terrane. According to Göncüoglu (1997), both the Moesian and Zonguldak terranes drifted away from Gondwana during the Cambrian.

Table 1: Review of Perigondwana terranes at the Laurussia and Gondwana interface in Central and South-Eastern Europe.

Terrane	Basement	Accretion to Baltica (Laurussia)	Final translation	Foraminiferal affinity
Eastern Avalonia	Cadomian	Ord-Sil	Sinistral	Fennosarmatian different subprovince
Lysogory	unknown	?	?	Fennosarmatian Province
Malopolska	Cadomian?	Upper Cambrian	Dextral	Fennosarmatian Province
Brunovistulian	Cadomian	Lower Paleozoic	Dextral	Fennosarmatian Province
Moesian	?Cadomian	?lower Devonian	?dextral	Fennosarmatian Province
Zonguldak	?Cadomian	Lower Paleozoic	?dextral	Fennosarmatian Province
Armorican group	Cadomian	Dev-Carb	Dextral	Armorican Province

Upper Devonian–Lower Carboniferous Paleobiogeography

Calcareous foraminifers represent a climatically sensitive group and their distribution patterns provide useful information for reconstructing the paleoclimate and paleogeography. On this basis, we can distinguish three Devonian-lower Carboniferous paleogeographical realms: the tropical/subtropical Paleotethyan, North American and the boreal Siberian realms (Mamet & Belford 1968; Lipina 1973; Kalvoda 1990). The North American realm, even though positioned in the tropical and subtropical belt, contained a less diversified, but far from impoverished fauna, in some respects similar to the Siberian one, probably reflecting the complicated migrational pattern of foraminiferal taxa (Kalvoda 1990). The relations of the main realms have been discussed by Kalvoda (1999).

In the original concept of Mamet (Mamet & Belford 1968; Mamet 1977) the Paleotethyan Realm included both the Laurussian and Gondwana shelves. Vdovenko (1980) conditionally included the North African margin into the West European Province, however, she stated that in the foraminiferal faunas stenobiont forms with wide paleobiogeographical distributions predominate and that there are relatively little data. It is evident that the older paleobiogeographic interpretation should be revised to incorporate new paleotectonic concepts distinguishing different terranes with Gondwanan and Baltic affinities within the Paleotethyan Realm.

In the following, I will try to elucidate the affinity of the foraminiferal faunas of some Perigondwana terranes. Attention will be concentrated on those time intervals when paleobiogeographical differences within the Paleotethyan Realm arising from terrane affinity are still apparent (the late Devonian, Tournaisian) and best data are available. Three foraminiferal assemblages seem to fit best to this conditions: the upper Frasnian *Multiseptida-Eonodosaria-Eogeinitzina* assemblage, the upper Famennian *Quasiendothyra* assemblage and the upper Tournaisian Kizel-Kosvin assemblage.

Multiseptida-Eonodosaria-Eogeinitzina assemblage (see Fig. 4)

We begin our review of the foraminiferal dispersal in the late Frasnian when the great uniformity of foraminiferal fauna paralleled the worldwide distribution of reef ecosystems (Kalvoda 1986) and the first diversification event can be seen. The Paleotethyan Realm was characterized by the presence of advanced multi-chambered genera such as *Eogeinitzina, Frondilina, Eonodosaria, Multiseptida, Nanicella* and the primitive Tournayellidae. However, this complete assemblage is present only on the East European Platform and in the Urals. Less diversified assemblages can also be found outside the Paleotethyan Realm, both in the North American realm and in the Omolon-Kolyma and Tian Shan regions (Kalvoda 1990a) as well as in the Armorican Province.

In the Armorican Province of the Paleotethyan Realm, the upper Frasnian foraminiferal assemblage has only been described in the South Armorican Terrane (Vachard 1994). The southern Armorican assemblages seem to be far less diversified than the East European ones. The absence of important

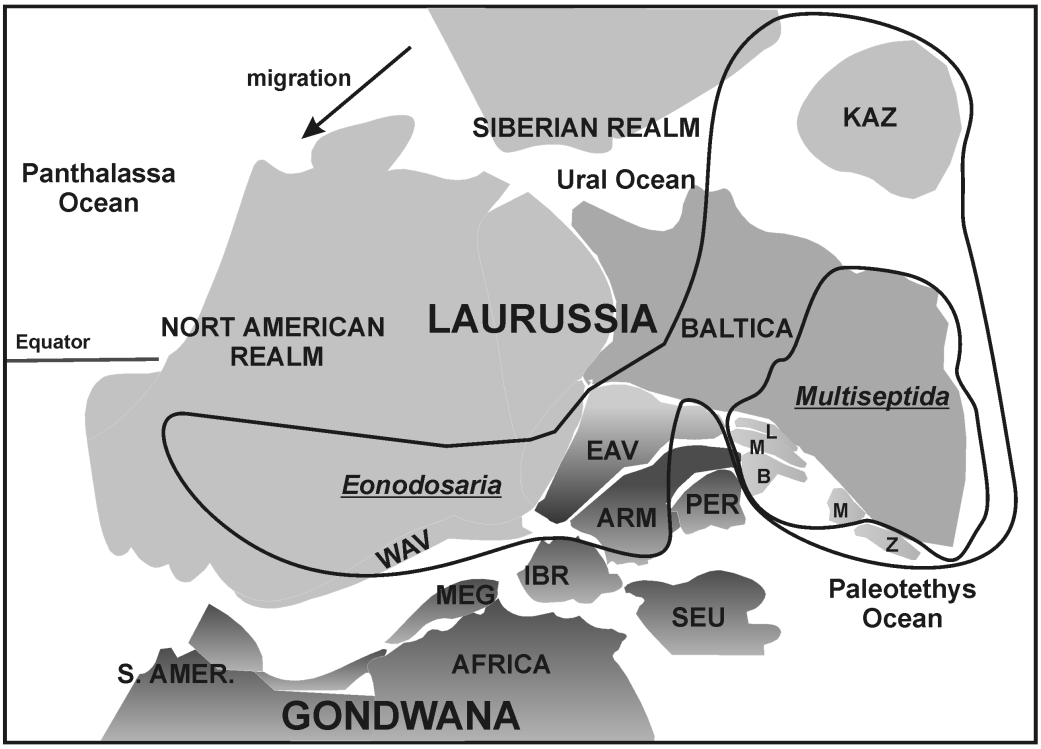

Fig. 4. Simplified paleogeographical map and foraminiferal paleobiogeography during the late Frasnian. **L** — Lysogory Terrane, **M** — Malopolska Terrane, **B** — Brunovistulian Terrane, **M** — Moesian Terrane, **Z** — Zonguldak Terrane, **Kaz** — Kazakhstan continent, **SEU** — Southern Europe, **IBR** — Iberia, **ARM** — Armorica, **PER** — Perunica, **EAV** — Eastern Avalonia, **WAV** — Western Avalonia, **MEG** — Meguma. Dark lines — boundaries of the faunal assemblages. The shading shows the relation of Perigondwana terranes to the Fennosarmatian Province. Based on the data presented in the text and in the paper by Kalvoda (1990a). North American occurrences of *Multiseptida* not included.

genera, *Multiseptida* and *Frondilina* as well as primitive Tournayellidae, is significant.

On the other hand, in the Brunovistulian Terrane, the upper Frasnian foraminiferal assemblage contains all the multilocular genera found in the East European Platform and the Urals (Kalvoda 1990a). This favours the close contact and communication of this terrane with the East European Platform.

A similar situation is observed in the Moesian Terrane where upper Frasnian assemblages, very similar to those of the Eastern European Platform, are reported by Yovcheva (1980).

In the Zonguldak Terrane, Dil (1976) reported only *Eonodosaria* from the upper Frasnian assemblage, but only one outcrop was studied and so the data available may not be representative.

In the Avalonian Terrane, diversified assemblages of the Upper Frasnian have not been described.

Quasiendothyra assemblage (see Fig. 5)

For the *Quasiendothyra* assemblage, the successive occurrence of *Quasiendothyra bella* (Chernysheva), *Quasiendothyra communis* (Rauser) *Quasiendothyra regularis* Lipina, and the diversification of *Quasiendothyra* ex gr. *communis* (Rauser), *Quasiendothyra kobeitusana* (Rauser) and *Quasiendothyra konensis* (Lebedeva) are characteristic. The first diversification of *Quasiendothyra* and Tournayellidae at the base of the upper Famennian (the P. marginifera conodont zone) has been found only in the Paleotethyan Realm. In other realms the data are not sufficient. The higher upper Famennian (the P. expansa conodont zone) is marked by the worldwide dispersal of the *Quasiendothyra* fauna. This fauna has also been recorded outside the Paleotethyan Realm, in the Omolon-Kolyma region, in Alaska as well as in Australia (Kalvoda 1990a). This migration of Paleotethyan fauna in both the Southern and Northern Hemispheres suggests climatic warming in this interval (Kalvoda 1986).

In the Armorican Province, Vachard (1988) reported a poor *Quasiendothyra* fauna (communication of R. Conil) from the D-C boundary at La Serre in Montagne Noire while Krylatov & Mamet (1969) report a richer assemblage in Corsica. The *Quasiendothyra* fauna seems to be absent in Spain as well as in the Pyrenees and in Asturias even though favorauble facies for such fauna are present (Conil 1977). A more diversified *Quasiendothyra* fauna has been described in the eastern part of the Saxothuringian Terrane by Zukalová (1976).

On the other hand, Conil & Lys (1970) reported rich uppermost Famennian *Quasiendothyra* assemblages in the Avalonian Terrane. In the Zonguldak Basin, a *Quasiendothyra* fauna very similar to the eastern European association was described by Dil (1976). *Quasiendothyra* assemblages of the lower and upper part of the upper Famennian, very similar to the Fennosarmatian occur in the Brunovistulian Terrane (Kalvoda 1990a). The absence of *Quasiendothyra* fauna in the Moesian Terrane is probably due to poor exposure and in general missing data on upper Famennian foraminifers.

Upper Kizel-Kosvin Assemblage (see Fig. 6)

In the Tethyan Realm, the upper Tournaisian is characterized by the diversification and widespread occurrence of the Upper Kizel fauna (*Spinoendothyra, Inflatoendothyra, Eoforschia, Dainella, Paraendothyra*) which is typical for the Kizel Cycle of Lipina (1963). It is followed by the succes-

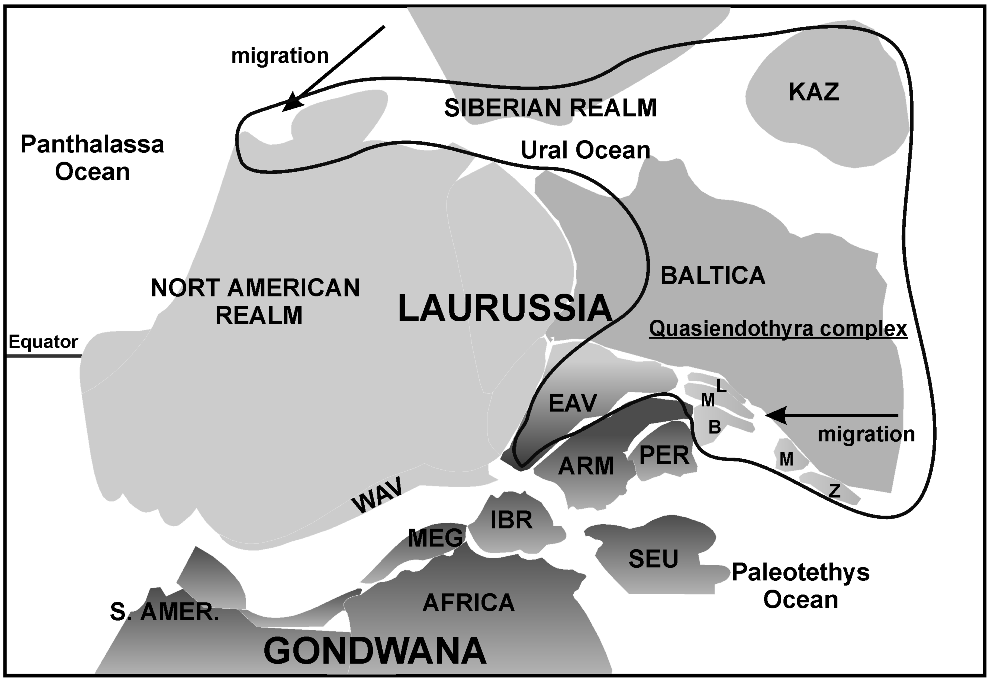

Fig. 5. Simplified paleogeographical map and foraminiferal paleobiogeography during the late Famennian. See explanations in Fig. 4.

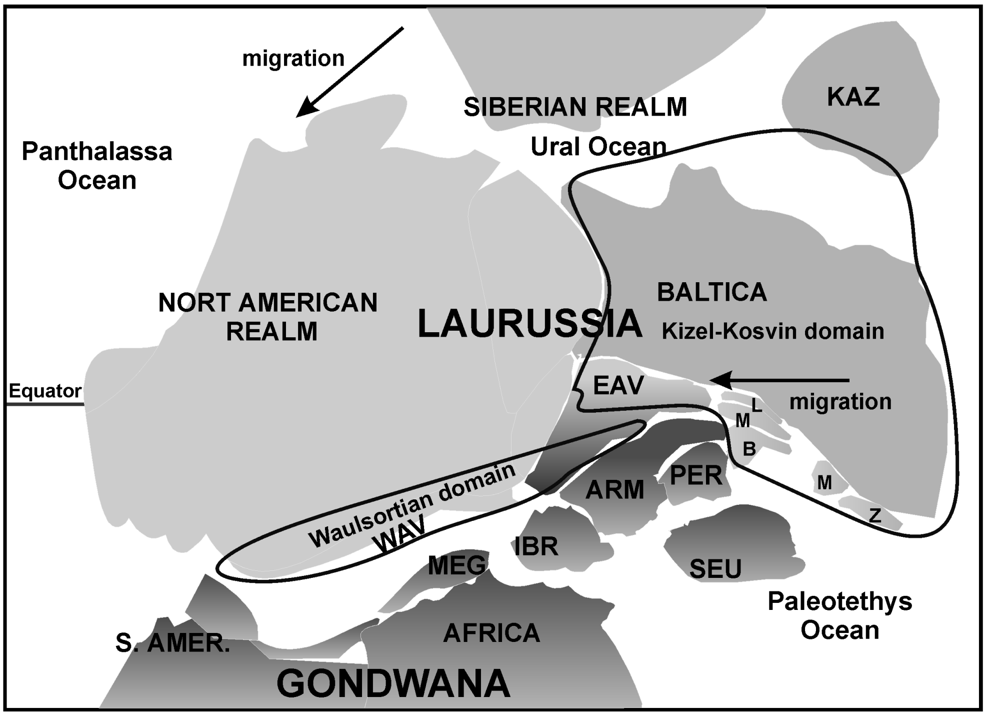

Fig. 6. Simplified paleogeographical map and foraminiferal paleobiogeography during the latest Tournaisian. See explanations in Fig. 4.

sive occurrence of *Dainella, Eotextularia, Tetrataxis, Urbanella, Endospiroplectammina, Globoendothyra, Plectogyranopsis, Pseudolituotubella, Eoparastaffellina, Eoendothyranopsis, Eoparastaffella, Omphalotis* (Kalvoda 1990a; Hance et al. 1997) best known from the Kosvin Horizon. The centre of diversification was again the East European Platform and the Ural Mts. The acme of the migration and proliferation of Paleotethyan calcareous foraminifers seems to coincide with the period of the G. typicus-lower S. anchoralis Zone (Kalvoda 1990). Because the association of several genera is characteristic of the assemblage, a taxon name was not applied. The assemblage corresponds broadly to the Spinoendothyra, Endothyra elegia-Eotextularia diversa and Eoparastaffella-Eoendothyranopsis zones in Eastern Europe (see Table 2).

In the Zonguldak Terrane, upper Tournaisian assemblages showing close relation to the East European Platform have been described by Dil (1976).

In the Brunovistulian Terrane, upper Tournaisian foraminiferal assemblages were reported by Kalvoda (1983, 1990a). On the basis of a joint study of conodonts, he has shown the upper Tournaisian age of the fauna regarded, by Conil (1977) as Visean and he supposes a close relationship to the foraminiferal faunas of the East European Platform.

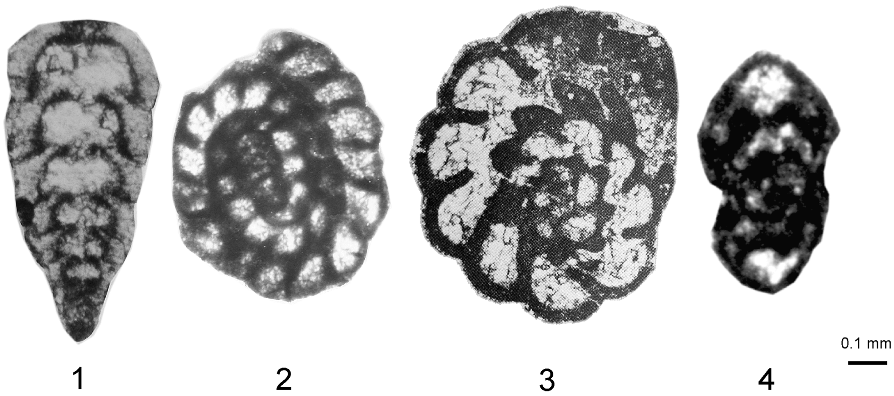

Fig. 7. Some important taxa of the described foraminiferal assemblages. **1** — *Multiseptida corallina* Bykova — *Multiseptida-Eonodosaria-Eogeinitzina* assemlage; **2** — *Quasiendothyra kobeitusana* (Rauser) — *Quasiendothyra* assemblage; **3** — *Paraendothyra nalivkini* Tchernysheva — Upper Kizel-Kosvin assemblage; **4** — *Eoparastaffella simplex* Vdovenko — Upper Kizel-Kosvin assemblage. All specimens are from the southern part of the Moravian Karst (Czech Republic).

Stage	Substage	Moravia	Namur and Dinant Synclinorium	Eastern Europe	Tian Shan	Western Siberia	Omolon and Kolyma Massif	Kuznets Basin	North America	Conodont Zonation
VISEAN	UPPER	Asteroarchaediscus- -L.paraammonoides Zone	Neoarchaediscus Zone: δ	E. tenebrosa Zone	H. gibba longa - - N. parvus Zone	E. aff.kazachstanica - - A. karreri- - H. gibba Zone	E.ermakiensis Zone	E. ermakiensis Zone	16	G. bilineatus
VISEAN	UPPER	Neoarchaediscus Zone	Neoarchaediscus Zone: α–γ	E. ikensis Zone E. proikensis Zone	B. rotula- - F. prisca Zone Pl. spirillinoides Zone	M. excelsaformis- E. diversa- - Eoendothyranopsis Zone			15	
VISEAN	MIDDLE	Pojarkovella nibelis - Koskinotextularia Zone	P. nibelis- -Koskinotextularia Zone	E. compressus Zone					14 13	Unzoned interval ?
VISEAN	MIDDLE / LOWER	V. eospirillinoides - - G. oblongus Zone	Eoparastaffella Zone: β–δ	Pl. spirillinoides - - U. rotundus Zone	Ps. paraprimaevus- - Viseidiscus Zone T. perfida Z.	? E. diversa- - L.cf.grandis - Tetrataxis Zone	E. diversa Zone	M. excelsa- - E. diversa Zone ?	12 11 10	
VISEAN	LOWER	Tetrataxis- - Eoparastaffella simplex Zone	Eoparastaffella Zone: α	Eoparastaffella - Eoendothyranopsis	O. paraturkestanica Z.			S. evoluta- - E. diversa- - Tetrataxis Zone	9	G. texanus S. anchoralis
TOURNAISIAN	UPPER		Tetrataxis - P. diversa Zone	E. elegia-P. diversa Z.	D. chomatica - E. michoti Z.					
TOURNAISIAN	UPPER	Paraendothyra Zone	Tournayella - Granuliferella - Paraendothyra Z.	Spinoendothyra Zone Tuberendothyra - Laxoendothyra Z.	E. turkestanica - P. tchikmanica Zone	E. inflata- - P.tchernyshinensis Zone	Latiendothyr.- - Spinoendoth. Z.: γ β α	T. tuberculata - Pseudoplanoendothyra Zone	8	G. typicus Upper ----- Lower
TOURNAISIAN	MIDDLE	Chernyshinella tumulosa - Spinobrunsiina Zone	Spinobrunsiina Zone	Chernyshinella - - S.krainica Zone	B. malevkensis - - E. minima Zone	?	Chernyshinella Zone: β	T. discoidea - L. parakosvensis Zone	7	Upper S. crenulata - - S. isosticha
TOURNAISIAN	MIDDLE	Chernyshinella glomiformis Zone	Ch. glomiformis - P. tchernyshinensis Zone				Chernyshinella Zone: α		pre 7	S. crenulata
TOURNAISIAN	LOWER	Quasiendothyra kobeitusana - - Quasiendothyra konensis Z.	 Quasiendothyra Zone: ε	Q. kobeitusana - Q. konensis Zone	Q. kobeitusana - Q. konensis Z.	Q. kobeitusana Zone	Quasiendothyra Zone: Endothyra - Paracalligelloides Zone	rare Quasiendothyra		S. sandbergi S. duplicata S. sulcata
FAMENNIAN							Quasiendothyra Zone: α–ε			S. praesculata P. expansa
FAMENNIAN		Quasiendothyra communis - Quasiendothyra regul. Z.	Quasiendothyra Zone: α–δ	Q. communis Zone	Q. communis - S. lebedevae Zone	?				P. postera P. trachytera P. marginifera
FAMENNIAN		Q. communis-E. evlanensis Interzone	Septatournayella Zone	Q. bella Zone	V	S. nana Z.	?			P. rhomboidea P. crepida P. triangularis
FRASNIAN		Multiseptida corrallina - Eonodosaria evlanensis Z.	Nanicella Zone	T. multiformis - E.evlanensis Zone	IV	M. corrallina - E.evlanensis Zone	E. evlanensis - N. porrecta Zone	T. multiformis - E. evlanensis Zone	E. evlanensis - M. corrallina Zone	P. gigas A. triangularis
FRASNIAN / GI.		Nanicella Zone		N. bella Zone ?	III	S. horrida- - N. polypora Zone				P. asymmetricus

In the Moesian Terrane, upper Tournaisian foraminifers have only been described in the Gomotarci borehole. They correlate well with the Donbas. Therefore the Moesian Platform is included in the Donets-Dobrogea Province (Vdovenko et al. 1981).

The East Avalonian Terrane seems to contain some differences between the impoverished upper Tournaisian foraminiferal fauna of the Dinant Basin and the British SE Province on one side and the more diversified fauna of the Namur Basin and especially the British Central Province on the other (Conil et al. 1979; Kalvoda 1983a). The former regions show only a weak foraminiferal record in the upper Tournaisian due to the significant presence of Waulsortian reef facies. In this respect, we can see some similarities with the southern Laurentian margin where the Waulsortian Facies is also widespread (Lane 1982).

A part of the upper Tournaisian foraminiferal fauna of the Namurian Basin and the British Central Province was originally regarded as "Visean" (Conil & Lys 1964; Conil et al. 1979). Kalvoda (1983, 1983a) pointed out that the "Visean" assemblages of the latter regions as well as of the Campine-Brabant Basin are partly Tournaisian in age and show a close relationship to the Eastern European faunal associations.

Conclusions

The distribution of foraminiferal faunas in the late Devonian and early Carboniferous of the Paleotethyan Realm shows important differences between the Armorican terrane group and the southern Perigondwana terranes (in part the West European Province of Vdovenko 1980) on one side, and the East European Platform shelves on the other. Vdovenko's (1980) term "West European Province" is misleading for the inclusion of the Avalonian Terrane with its more diversified fauna. In a similar way, the terms Perigondwana or Mediterranean Province could be misleading because not all Perigondwana terranes could be included within such a province. Consequently, we prefer to employ the term Armorican Province to include the Perigondwana terranes characterized by incomplete foraminiferal phylogeny and foraminiferal assemblages lower in diversity than the assemblages of the East European Platform and the Urals. This region, which represented a diversification centre of many groups of late Devonian and early Carboniferous calcareous foraminifers, is defined here as the Fennosarmatian Province.

The Brunovistulian group of Perigondwana terranes includes the Brunovistulian, Malopolska, Moesian and Zongul-

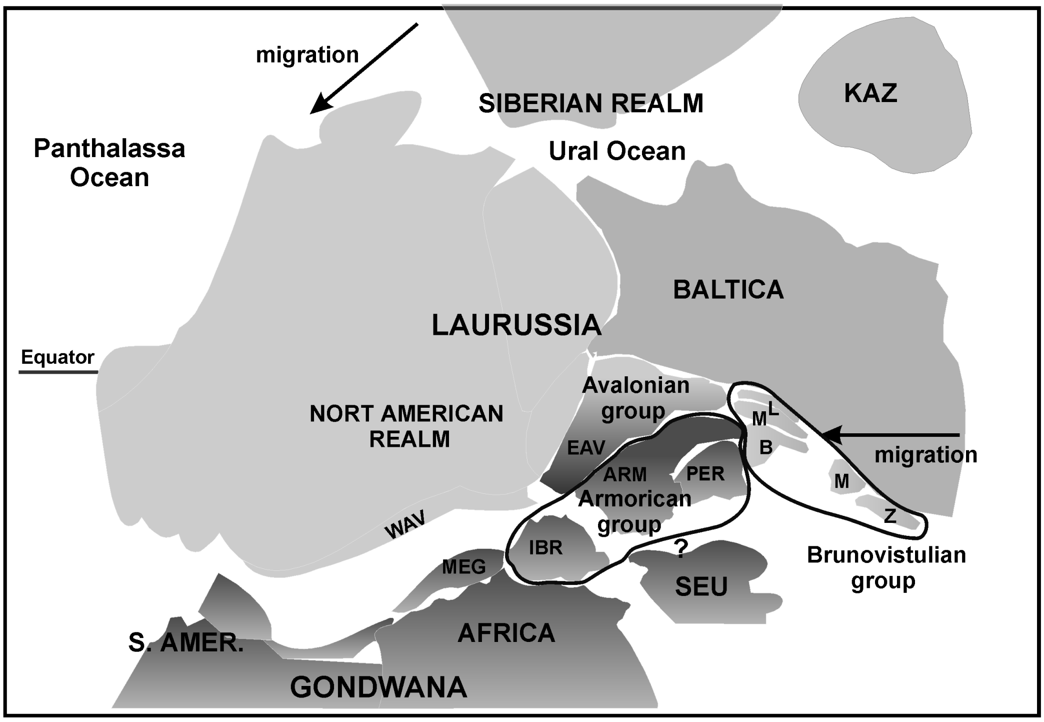

Fig. 8. Simplified paleogeographical map and groups of Perigondwana terranes based on foraminiferal paleobiogeography. See explanations in Fig. 4.

◄

Table 2: The correlation chart of the most important late Devonian and early Carboniferous foraminiferal zonations which represents one of the bases for paleobiogeographical reconstructions. In the chart we can see the correlation of the discussed upper Frasnian, upper Famennian and upper Tournaisian-lower Visean foraminiferal assemblages. The Paleotethyan Realm includes Namur and Dinant Synclinorium, Eastern Europe, Moravia and Tian Shan. Siberian Realm includes Western Siberia, Omolon and Kolyma Massif and Kuznets Basin. Modified after Kalvoda (1990a).

dak terranes, which show a close similarity to the East European faunal associations and can be regarded as a part of the Fennosarmatian Province (see Fig. 8). These terranes underwent a paleogeographical evolution different from the rest of the Perigondwana terranes — during the Variscan orogeny they were situated on the southern margins of Laurussia (Yanev 1997; Göncüoglu 1997; Kalvoda 1995; Belka et al. 1997) in a geotectonic position similar to that of the East Avalonian Terrane. Thus the presented data support the idea of continuation of the TESZ SE-wards through the Black Sea to Asia Minor (Pharaoh et al. 1997). They are not in accordance with the position of the Brunovistulian, Moesian and Zonguldak terranes in the southern foreland of the Variscan belt (Matte et al. 1990; Stampfli 1996) and correlation with the Aquitaine and Montagne Noire Terrane.

The foraminiferal fauna of East Avalonia also shows a similarity with the East European associations, but some differences seem to exist. These are seen in the absence of the upper Frasnian diversified *Multiseptida-Eonodosaria-Eogeinitzina* assemblage and the presence of Waulsortian reef facies linking East Avalonia with the southern margin of Laurentia. This may reflect the fact that in contrast to the dextral translation of the Brunovistulian group and the majority of Perigondwana terranes, the final accretion of East Avalonia was sinistral.

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