Distribution of the lingulate brachiopod *Thysanotos* in Central Europe

MICHAL MERGL

Západočeská univerzita, Pedagogická fakulta, Katedra biologie, Klatovská 51, 320 13, Plzeň

Abstract. A review of the distribution of the obolid brachiopod *Thysanotos siluricus* (Eichwald) and related species in Central Europe is given. The species *Thysanotos primus* (Koliha) and specimens assigned to *Thysanotos siluricus* (Eichwald) from Bohemia (Barrandian area) are newly compared with the topotypic specimens from Estonia and specimens from Poland. *Thysanotos* is a significant element of the early Ordovician (late Tremadoc and Hunneberg) faunas in the northern periphery of Gondwana and the southern margin of Baltica.

Abstrakt. Článok podává vzhľadom k stratigrafickým a geografickým rozložením obolidového brachiopoda *Thysanotos* v strednej Európe. Jeden druh *Thysanotos primus* (Koliha) a *Thysanotos siluricus* (Eichwald) z území Česka (Barrandianu) sú nové porovnávajú s topotypickými jedincom z Estónska a z jedincom z Polska. Rod je významným prvkom fauny stredneho ordoviku (pozdného tremadoku, hunnbergu) v severnej periferii Gondwany a v južnom okraji Baltiku.

Key words: Brachiopoda, Lingulata, Ordovician Bohemia

Introduction

The obolid brachiopod *Thysanotos siluricus* (Eichwald, 1840) is a significant and widespread species in the Tremadoc - Arenig transition interval of Central Europe, the Baltic area, and the South Urals. The type species and morphologically similar species have been reported from the East Baltic (Eichwald 1840, Mickwitz 1896, Walcott, 1912, Gorjansky 1969, Popov - Holmer, 1994, Puura 1996), Poland (Bednarczyk 1962, 1964), Bavaria (Sdzuz 1955), Central and East Bohemia (Koliha 1918, 1924, 1926, Prantl - Růžička 1941, Havlíček, 1982) and the South Urals (Popov - Holmer 1994). An extensive description and discussion about the stratigraphical and geographical distribution of *Thysanotos* has recently been given by Popov - Holmer (1994, 1995). There is not another lingulate brachiopod with such well-documented stratigraphical and geographical occurrences in the early Ordovician of the peri-Gondwanan area. The abundance of the species, taphonomic data, and the recent revision of associated fauna in Bohemia (Havlíček 1977, 1982, Mergl 1984, 1986, 1995) make possible a better understanding of the morphologic changes, environmental contingency and stratigraphical range of *Thysanotos* in Bohemia.

![Fig. 1. Outcropping unmetamorphosed Ordovician rocks in Bohemia with localities of *Thysanotos* and the stratigraphical range of *Thysanotos* in Bohemia.](image-url)


Lower Ordovician section in Komářov area (1) and Uvaly area (2): 1 - sandstones, 2 - cherts, 3 - siltstones and shales, C - Cambrian, K - Klabava Formation, M - Milina Formation, P - Proterozoic, T - Tětrnice Formation.
Material and repositories

The figured materials are deposited in the paleontologic collections of following institutes: The National Museum, Prague (abbreviation: NM), the Museum of Dr. B. Horák at Rokycany (MR), and the Geological Survey, Prague (MM).

Occurrence of genus Thysanotos in Europe

Estonia: Type specimens of Thysanotos siluricus came from the Pakerot locality near Paldiski in northern Estonia (Gorjansky 1969, Popov - Holmer 1994, Puura 1996). The species is common in the lower part of the Leetse Formation, with conodonts indicating the Hunneberg stage (Paroistodus proteus to Prioniodus elegans Biozone; Magi - Veira, 1976).

Poland: The distribution of Thysanotos siluricus in the Holy Cross Mountains in Poland has been revised by Bednarczyk (1964). The species is an index fossil of the Zbilutka beds and it is associated with the lingulate genera Leptembolon, Acrotreta, Siphonotretella, Ditreta, and Eurytreta (Bednarczyk 1964, Biernat 1973). The age was determined by Bednarczyk (1964, 1966, 1971) as Upper Tremadoc. However, the rocks with Thysanotos siluricus from the Zbilutka beds exposed at the Miedzygorz locality (eastern part of the Kielce region) are underlain by a conglomerate (Miedzygorz Formation) which yielded a chitinozoan assemblage characteristic of the Upper Arenig (Chlebovski - Szaniawski 1974). This contradicts occurrences of Thysanotos in other parts of the Holy Cross Mountains. Bednarczyk (1964) reported Thysanotos siluricus and another genera of the Leptembolon - Thysanotos assemblage from the chalcedonites of Wysocki, which belong to the Zbilutka beds. Wysocki chalcedonites were, by him as well as by Popov - Holmer (1995), compared in age with the Bjórkarholmen Limestone of late Tremadoc age. Nevertheless, Popov - Holmer (1994, 1995) considered the early Arenig age (Hunneberg stage) for all Thysanotos material in Poland.

Germany: Large obolids with concentric rugellate ornamentation have been reported under several names by Barrande (1868) from Hof in Bavaria, Germany. Sdzuy (1955) referred all Barrande’s specimens to Thysanotos siluricus. Unfortunately, the material is tectonically deformed and has obscure morphologic details. Specimens figured by Sdzuy (1955) are about half the size of specimens from Estonia and Bohemia. Thus, an unambiguous determination is difficult. The age of Bavarian Thysanotos siluricus is well proved by associated fauna, which have many faunal elements of Tremadoc age, a.o. the trilobite genera Parabolina, Triarthus, Diceratopyge, Proteauloma, Hopes, and Macropyge. Thysanotos siluricus is restricted in its occurrence to two younger zones of the Leimitz shales (Pharostomina Jerentaria and Macrocystella ? bavarica Zones). Based on the trilobite fauna, Bavarian trilobite zones have been compared with Rhabdinopora flabelliforme flabelliforme to R. flabelliforme norvegicum Zones of the Lower Tremadoc (Sdzuy 1970, Peng, 1990).

Thysanotos siluricus has been reported by Müller (1956) from the Frauenbach quartzites (Lower Tremadoc) in Thüringia. Specimens are poorly preserved and are not sufficient for an accurate determination.

Bohemia: Bohemian representatives of the genus Thysanotos are known from the Barrandian area in the upper part of the Tětnice Formation and the upper part of the Milina Formation, and from sandstones compared in age with the Milina Formation, exposed at Brežany, which is east of Prague. Thysanotos siluricus has also been reported in the Lipolice beds in the Železné hory (East Bohemia), but a new examination of the specimens does not support their assignment to Thysanotos. From the historic viewpoint, all occurrences in the Barrandian area were correlated in age with the beds bearing Thysanotos in the East Baltic (Koliha 1926), while finds from the Železné hory area were compared with the faunas of Bavaria (Prantl - Růžička 1941, Havlíček - Vaněk 1966).

South Ural Mountains: The species Thysanotos siluricus has been recently reported from the South Ural Mountains (Popov - Holmer 1994). These specimens attain a larger size than the toptype from northern Estonia. Faunas of the Alimbel Formation contain some elements of the Ceratopyge fauna (among others, the genera Ceratopyge, Orometopus and Shamardia), but the first appearance of T. siluricus is close to the base of the Arenig. Thysanotos siluricus is also present in the Kidryas and Akbulakskai Formations, referred to the lowermost Arenig, as is evident from the presence of conodonts of the Paroistodus proteus Biozone (Popov - Holmer 1994).

Systematic part

Class Lingulata Gorjansky - Popov, 1985
Order Lingulida Waagen, 1885
Superfamily Lingulacea Menke, 1828
Family Obolidae King, 1846
Subfamily Obolinae King, 1848

Genus Thysanotos Mickwitz, 1896

Type species: Obulus siluricus Eichwald, 1840
Synonym: Thysanobulus Havlíček, 1982

Thysanotos siluricus (Eichwald, 1840)
Pl. 1, figs. 1-6, pl. 2, figs. 1-4
1918 Obulus (Lingulobulus ?) Barrandei (Klouček);
Koliha, p. 7.
1924 Obulus (Lingulobulus) Feismanteli (Barr.) var.
Barrandei (Klouček); Koliha, p. 18, pl. 1, figs. 7,8 and pl. 2, figs. 5-7.
1982 Thysanotos siluricus (Eichwald, 1840); Havlíček, p.
24, pl. 2, figs. 1,2,5.
non 1941 Obolus (Mickwitzella) barrandei barrandei (Klouček); Prantl - Růžička, p. 7.
non 1941 Obolus (Mickwitzella) barrandei primus Koliha; Prantl - Růžička, p. 8.
non 1941 Obolus (Mickwitzella) cf. palliatius (Barrande); Prantl - Růžička, p. 9.
non 1941 Obolus (Linguolobus) feistmateli minor Koliha; Prantl - Růžička, p. 10.
(synonymy of Estonian material see Gorjansky (1969) and Popov - Holmer (1994).

Description of material from Bohemia:
Havlíček (1982).

Remarks: This species is a rather rare element in the Bohemian equivalent of the Ceratopyge fauna, which is considered late Tremadoc in age. As noted by previous authors (Havlíček 1982), the size, inner and external morphology of specimens from the Milina Formation are almost the same as in the topotypes described and figured by Gorjansky (1989) and Popov - Holmer (1994). The length of Bohemian specimens is 30 mm or more, which is inferred from available fragments. The length of specimens from Estonia reaches 25-27 mm (Gorjansky 1969, Popov - Holmer 1994). All adult specimens from Poland (the Holy Cross Mountains, locality Zalesie) available to the author have a length between 20-22 mm. Thus, the size of Bohemian specimens is bigger than the size of Baltic specimens. The larger size of specimens from Bohemia is a feature common to specimens from the South Urals which attain lengths of almost 40 mm. Unlike to topotypic specimen figured by Popov - Holmer (1994: Fig. 44C), which has convergent vascula lateralia, well-preserved specimens from the Milina Formation have diverging posterior vascula lateralia partitions.

A difference between Bohemian specimens and Estonian and Polish ones is the presence of a weak radial plication on the outer surface of the beak regions of ventral as well as dorsal valves (pl. 1, figs. 1c, 4c).

Prantl - Růžička (1941) described four species of large obolids from the Lipolitice beds in the neighborhood of the Brloh village in the Zelené hory (East Bohemia). Available material coming from the locality Všškovka near Brloh is tectonically compressed, but the size of the specimens (20-25 mm of width), their outline, nature of ventral pseudo-interarea and shape of pedicle groove are similar to specimens from Estonia and the Barrandian area. Unlike to topotypic specimens of Thysanotos siluricus, the specimens from the Lipolitice beds do not show prominent concentric ornamentation. The tectonic deformation of the shells produced concentric wrinkles, reminiscent of the concentric rugellae of Thysanotos, but all known specimens have a surface of valves covered by fine growth lines and concentric lamellae and are devoid of marginal spines. The valves probably belong to another, although closely related, rather thin-walled obolid genus (pl. 3, figs. 5-7).

Stratigraphical occurrence in Bohemia:
All specimens of the Barrandian provenance assigned to Thysanotos siluricus came from the upper part of the Milina Formation, at a level 3.5 - 4.5 m below the boundary between the Milina and Klabava Formations. This level is also the youngest level bearing Thysanotos in the Barrandian.

Geographical occurrence in Bohemia:
1. Prague Basin, Komárov area, localities Olešná, Milina, Kváň and Zaječov, (2) Úvaly area, Úvaly (old test pits).

Thysanotos primus (Koliha, 1924)
Pl. 2, figs. 5-8, pl. 3, figs. 1-4
1924 Obolus (Linguolobus) Feistmanteli (Barr.) var. Barrandei prima n. var.; Koliha, p. 19, pl. 1, fig. 6.
1982 Thysanotos primus (Koliha, 1924); Havlíček, p. 24, pl. 2, fig. 8.
1982 Thysanotos siluricus (Eichwald, 1840); Havlíček, p. 24, pl. 2, figs. 3, 4, 6.
1982 Thysanobolus linguides sp. n.; Havlíček, p. 21, pl. 2, figs. 10-13.

Emended diagnosis: Shell subcircular, medium to large in size, outline, convexity and internal structures

Fig. 2. Number of concentric rugellae per 1 mm in Thysanotos siluricus (Eichwald) and Thysanotos primus (Koliha).
Vertical scale - number of rugellae per 1 mm, horizontal scale - distance from the apex (in mm).
a, b - T. siluricus (Eichwald): (empty rectangles - specimens from Barrandian, full rectangles - specimens from Poland, Zalesie locality)
c, d - T. primus (Koliha): (empty circles - specimens from Jivina, full circles - specimens from Brťany).
of the valves the same as in *Thysanotos siluricus*. Ornamentation of evenly spaced coarse concentric rugel-лаe, in the anteromedian sector of large shells (between 10-17 mm of length) with 3-4 rugellae per 1 mm. Growth lamellae less numerous, distinct, with rows of marginal spines.

**Remarks:** Species *Thysanotos primus* has been considered identical with *Thysanotos siluricus* by Popov-Holmer (1994). However, although the size of rugellae and their density differs slightly among specimens of the same stratigraphical level, and their number per 1 mm generally decreases anteriorly in all shells measured, there are some characteristic features: *Thysanotos primus* generally possesses 3-4 rugellae per 1 mm anteriodiamanly (Text-fig. 2:d). Specimens from the Březany locality possess low number of rugellae and are assigned to *Thysanotos primus* (Text-fig. 2:c). Specimens assigned to *Thysanotos siluricus* from the Milina Formation have 4-6 rugellae per 1 mm (Text-fig. 2:a), and *T. siluricus* from Poland can show even 5-6 rugellae per 1 mm (Text-fig. 2:b). Popov-Holmer (1994) reported 4-6 rugellae per 1 mm in the adult topotypic specimens from Estonia. The number of marginal spines in growth lamellae and their size is the same as in topotypic specimens of *Thysanotos siluricus*. Specimens of *Thysanotos primus* from the type locality are generally smaller, usually 16 - 19 mm in a length and it never exceeds 20 mm. Although other differences between *Thysanotos siluricus* and *Thysanotos primus* are not distinct, the mentioned features are considered sufficient for their separation.

Species are also separated stratigraphically; *Thysanotos siluricus* occurs in the upper part of the Milina Formation, *Thysanotos primus* is restricted to the upper part of the Třenice Formation, about 20-30 m below (in the Komárov area) the layers with *Thysanotos siluricus*.

Locality Březany (abandoned quarry “Na Chrášnici” East of Prague) yielded numerous finds of tectonically affected obolids with a *Thysanotos*-like appearance (Koliha 1926, Haviček 1982). They were described as *Thysanotos siluricus* Mickwitz and *Thysanobolus lingo-lides* Haviček. Indeed, the latter species is merely a tectonically elongated specimen of the *Thysanotos*, as was proved by new material. Unlike typical *Thysanobolus siluricus*, specimens from the locality Březany have a coarser superficial ornamentation, with fewer concentric rugellae, and they are very similar to topotypic specimens of *Thysanobolus giganteus* (Koliha) (Haviček, 1982), remain very intricate. As no superficial ornamentation of the specimens is available and internal features are reminiscent of *Thysanobolus* and *Hyperobolus* the new better preserved material is necessary for their distinct generic affiliation.

**Stratigraphical occurrence in Bohemia:**

The species *Thysanobolus giganteus* is represented by two morphologically distinct subspecies (*L. insons insons* and *L. insons testis*) which is different from *L. lingulaeformis*. There is also abundant *Orbithele*, while *Schizambon*, *Paldiskia* and *Foveola* are missing in part of the Třenice Formation (level with common *Juvineilla praecedens* in the type locality) and to sandstones bearing *Protambonites kolhai* (probably time equivalent of the upper part of the Třenice Formation or lower part of Milina Formation; Haviček 1982).

**Geographical occurrence in Bohemia:** (1) Prague Basin, Komárov area, localities Jivina (quarries along road Jivina-Komárov), Medový Újezd (old quarry), (2) Úvaly area, Březany (“Na Chrášnici” quarry).

**Conclusion**

The traditional view of *Thysanobolus giganteus* (Eichwald) as an index fossil of the Upper Tremadoc has been recently rejected (Popov-Holmer 1994, 1994, Puura 1996). The authors considered the early Arenig stage (Hunneberg Stage) for all occurrences of the *Leptembolodon-Thysanobolus* assemblage. The age of the bra-chiopod association of the Třenice Formation is correlated with the Hunneberg Stage by these authors. This consideration, however, contradicts some stratigraphical data in Bohemia and Germany. Unlike Popov-Holmer (1995), the present author suggests a longer time span for *Thysanobolus siluricus* and related species. Material of this genus of Bohemian provenance indicates the presence of two close but distinct species separated stratigraphically. The older species *Thysanobolus primus* have slightly coarser ornamentation and is of smaller size. The tendency toward finer ornamentation and larger size indicate a younger stratigraphical age of specimens of Polish and East Baltic provenance as well as specimens from the Milina Formation of Bohemia. The limited stratigraphical range of the *Leptembolodon-Thysanobolus* assemblage, as supposed by Popov-Holmer (1995), is also questioned because of the long stratigraphical ranges of some species (*Orbithele ceratopygarum*, *Broeggeria salteri* and *Lamanska splendens*) which are known from the Björkasholmen Limestones (Upper Tremadoc) as well as rocks of the Hunneberg Stage. Genus *Pomeraniotreta*, described from Björkasholmen Limestone in Sweden, is known to be above *Thysanobolus*-bearing levels in Bohemia. Moreover, the Bohemian occurrence of *Thysanobolus siluricus* is associated with rich trilobite fauna, considered the equivalent of the *Ceratopyge* fauna (Mergl 1984). In addition, minor differences in shell morphology, such as convexity, size, the weak radial plications indicate the existence of phenotypically distinct populations, which were separated geographically as well as stratigraphically.

The longer time span of the *Thysanobolus* species in Bohemia may be also inferred from the associated faunas. Associated lingulate brachiopods are different from those in Estonia: in Bohemia, the obolid *Leptembolodon insons* is represented by two morphologically distinct subspecies (*L. insons insons* and *L. insons testis*) which is different from *L. lingulaeformis*. There is also abundant *Orbithele*, while *Schizambon*, *Paldiskia* and *Foveola* are missing in
Bohemia. Thysanotos primus is associated with the orthide brachiopod Jivinella praecedens, while Thysanotos siluricus is associated with its descendant Jivinella incola in the Barrandian. Specimens of Thysanotos primus from Břežany are associated with Protambonites kolihai, a descendant species of P. soror, which is known from the lower part of the Tienice Formation. The presence of Protambonites is of particular significance; besides Bohemia, a clitambonitid Protambonites has been reported from the earliest Tremadoc of the Iberian Chains in Spain (Havlíček - Josopait 1972), where it is associated with Billingsella sp. and Poramborthis hispanica. Younger beds yielded some trilobites indicating a Tremadoc age: Shumardia, Parapilekia, Pharostomina, Bavarilla (Josopait 1970). Genus Poramborthis and trilobite faunas correlated with Tremadoc faunas of Wales and Scandinavia have also been reported from Germany (Sdzuy 1955) and Bohemia (Havlíček 1977) in beds bearing Thysanotos siluricus. Protambonites has also been recently reported from the Cambro-Ordovician transition beds of Asturia in northern Spain (Villas et al. 1995). The co-occurrence of Protambonites with the earliest Thysanotos in Bohemia indicates an older age of the Thysanotos-bearing beds in Bohemia than early Arenig (Hunneberg). Unlike the distribution of Protambonites in South-Central Europe, in the South Urals the genus Protambonites is known from rocks of early Arenig age.

Thysanotos and the Thysanotos - Leptembolon assemblage have been considered as a typical Baltic element and this occurrence in Central Europe was explained by the immigration of temperate Baltic elements into the cooler peri-Gondwanan Mediterranean province in the Upper Tremadoc (Havlíček, 1982, 1989, Havlíček et al. 1994). New data support a quite opposite model; the Thysanotos - Leptembolon assemblage arose in the upper Tremadoc and persisted until the upper Arenig in the temperate parts (Perunica) of the peri-Gondwanan Mediterranean province. The immigration of the assemblage into marginal parts of Baltica took place in the Hunneberg Stage. A factor controlling the spread of the Thysanotos - Leptembolon assemblage may be a sea level drop and a cooling of the water mass during the Ceratopyge regressive event.

Taphonomy and paleoecology of Thysanotos in Bohemia

All specimens of Thysanotos siluricus associated with trilobite fauna in the Milina Formation have been found in reddish-brown cherts (originally siltstones or silty shales) with substantial amounts of originally phosphatic and calcareous bioclasts. Its shells are always mechanically broken, with thicker peripheral parts broken off. More complete valves have numerous net-like fractures of post-burial origin. There are not any abraded fragments or clusters of several intact specimens. This indicates, that shells of Thysanotos were not transported over long distances and its scarce occurrence reflects its rarity in the benthic community.

All specimens of Thysanotos primus from its type locality (Jivina near Komárov) came from the 0.5 m thick beds of fine greywacke, with thin lenses of reddish cherts. Shells are usually broken, but clusters of nearly intact specimens are known. This indicates the rapid burial and minimum transport of the shells. Specimens which belong to Thysanotos primus at the Břežany locality are mostly complete, intact, and commonly with closed or slightly twisted valves. This preservation indicates a rapid burial without transport, and the preservation near the dwelling site.

Available data indicate that Thysanotos preferred a sandy to silty bottom in a shallow subtidal environment, which was affected by casual tidal or storm currents. Its maximum occurrence is not associated with rich benthic faunas, and forms a distinct, low-diversity, filter-feeder community. An increasing diversity of benthic biotas significantly suppresses its abundance, but allows the size of Thysanotos to reach its maximum. This may be caused by a higher food supply and a higher competition among associated filter-feeders.

Acknowledgment: The author is indebted to Dr. R. Prokop CSc. for the possibility to study old material kept in the National Museum Prague, to R. Šarić and Z. Novotný for the loan of specimens from the collection of the Geological Survey in Prague.

The research has been supported by the Grant Agency of the Czech Republic, Grant 205/94/0759.

References

Explanation of plates

PI. I

Thysanotus xilicurus (Eichwald, 1840)
1 - incomplete ventral valve, internal mould (a), latex cast (b) and latex cast of exterior (c), MM 440, x3;
2 - incomplete ventral valve, internal mould (a) and latex cast (b), MM 404, x3;
3 - fragment of ventral valve, external mould, MR - No. 1,96/40, x3;
4 - incomplete dorsal valve, internal mould (a), latex cast (b) and latex cast of exterior, MM 369, x3;
5 - ventral valve, internal mould, MR - No. 1,96/28, x3;
6 - dorsal valve, latex cast of exterior, MR - No. 1,96/29, x3.
Age: Upper Tremadoc, Milina Formation, unit B (1-6), Localities: Horní Kvaři (field) (1-4,6), Olešná (5).

PI. II

Thysanotus xilicurus (Eichwald, 1840)
1 - dorsal valve, latex cast of exterior, MM 405, x3;
2 - ventral valve, latex cast of interior, MR - No. 1,96/30, x4;
3 - ventral valve, latex cast of exterior, MR - No. 1,96/32, x3;
4 - ventral valve, latex cast of interior, MR - No. 1,96/31, x4.
Thysanotus primus (Kolha, 1924)
5 - external moulds of incomplete ventral (?) valve, MR - No. 1,96/33, x3,5;
6 - external moulds of incomplete dorsal (?) valve, MR - No. 1,96/34, x3,5;
7 - external moulds of incomplete dorsal valve, MR - No. 1,96/35, x3,5;
8 - external moulds of ventral valve (a), latex cast of exterior (b), and internal mould (c), MR - No. 1,96/36, x3,5.
Age: Upper Tremadoc, Zbititska beds, chalcedonites (1-4); Upper Tremadoc, Trinicia Formation (5-8), Localities: Poland, the Holy Cross Mountains, Zalezie, outcrops above creek (1-4); Bohemia, Jivina (east quarry) (5-8).

PI. III

Thysanotus primus (Kolha, 1924)
1 - external mould of dorsal (?) valve, MN 1,31930, x3,5;
2 - internal mould of ventral valve, MR - No. 1,96/37, x3,0;
3 - dorsal valve, external mould (a) and latex cast of exterior (b), MR - No. 1,96/38, x3,5, x3,0;
4 - dorsal valve, internal mould, MR - No. 1,96/39, x3,0.
Hyperobolas sp.
5 - ventral beak, showing pedicle groove and pseudointerarea, deformed internal mould, NM 1,31932, x3;
6 - ventral valve, showing pedicle groove and pseudointerarea, deformed internal mould, NM 1,31931, x3;
7 - deformed external moulds of ventral (?) valve, NM 1,31933, x3;
Age: Upper Tremadoc (1-4), and Tremadoc (5-7), Localities: Eastern Barrandian area, sandstones in Březany (old quarry) (1-4); Železné hory, Brňoh (Višňovka) (5-7),

Bulletin of the Czech Geological Survey 72, 1, 1997