Slovak Geol. Mag., 6, 2-3(2000), 223–228

Tethyan - Boreal connection during the Pliensbachian (Western Carpathians): an evidence from ammonite fauna.

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Abstract: A distribution of Liassic ammonites provides an important tool for correlation between the Tethyan and Euroboreal realms in the Central Western Carpathians. Liassic ammonites described herein come from the Adnet Formation in the Veľká Fatra Mts. (Frčkov and Rovné valleys). Adnet limestones with ammonites occur in Jurassic sequence of the Zliechov Succession, belonging to the Krížna Nappe. The study of the Frčkov section allows to distinguish a set of 12 ammonite biozones within the Adnet Fm. The ammonites of the Adnet Fm. belong to the Raricostatum Zone (Sinemurian) - Jamesoni, Ibex, Davoei, Margaritatus and Spinatum zones (Pliensbachian) - and Tenuicostatum, Falcifer, Bifrons, Variabilis, Thouarsense, Levesquei zones (Toarcian). The results of this study indicate a mixing of the Boreal and Tethyan ammonite fauna during Pliensbachian, whereas the Tethyan ammonite fauna became dominant during the Toarcian.

Key words: Central Western Carpathians, Zliechov Succession, Lias, ammonites, biostratigraphy, paleobiogeography

Introduction

Liassic Adnet Formation was introduced by Hauer (1853) in the Eastern Alps. The type locality of these sediments occur in a quarry near Adnet in the Salzburg area. Hohenegger (1867) used this name for red limestones in the saddle of the Veľký Šturec Hill in the Veľká Fatra Mts. This locality was also mentioned by Štúr (1860).

The Adnet formation occur within the Liassic successions of the Krížna Nappe in the Central Western Carpathians (CWC) and in the Silica Nappe near the Gemerská Kováčová in the Miglinc river (Kollárová & Andrusovová, 1966). Mišík & Rakús (1964) described a microfacies character and faunal composition of the Upper Triassic - Liassic sediments of the Krížna Nappe from the Veľká Fatra Mts. Short reports resulted from geological mapping of this area of Polák et al. (1996).

The CWC were part of the Tethyan Realm. In spite of this, the Adnet Lms. in the Frčkov quarry contain a frequent ammonites of boreal fauna. Paleobiogeography of the Tethyan - Boreal realms has been evaluated by Enay (1980) and Enay & Mangold (1982). Early Jurassic fauna with Tethyan and Boreal ammonites has been described by Dommergues et al. (1983), Dommergues & Meister (1987, 1991), Blau & Meister (1991), Géczy & Meister (1994, 1998), Alkaya & Meister (1995) and Blau (1998).

Similar distribution of ammonite fauna in the Northern Calcareous Alps has been recorded by Meister & Böhm (1993) and Dommergues et al. (1995). Ammonite collection obtained from the Frčkov and Rovné localities comprises 54 specimens with very different degree of preservation (suture lines are possible to study only in rare cases).

Lithological description

The Frčkov and Rovné localities are situated in SW part of the Veľká Fatra Mts., between the Krížna hill (1574 m) and Ostredok hill (1592 m). First locality occurs on the right slope of the Rovné Valley and second one in higher part of the valley. The localities were studied by Rakús (in Mišík & Rakús, 1964) and Peržel (1967), acquiring the Liassic - Cretaceous fauna of ammonites. The thickness of whole sequence in outcrops is about 570 m, comprising of Upper Triassic to Early Cretaceous sediments.

The lower part of the Frčkov section is formed by the Keuper Formation with red, grey and green marls intercalated by yellow sandstones. Upper part of the Keuper Fm. consists of white - grey dolomites. This formation reaches a thickness of about 130 m.

The sequence grades up to the Rhaetian sediments of the Fatra Formation. This formation comprises massive beds of organogenic, organodetritic, brachiopod-rich and crinoidal limestones with layers of dolomites. This section has been described for the first time by Michalík (1974, 1976).

Higher up in the section, the Sinemurian – Middle Hettangian sediments of the Kopienec Formation follows. They comprise brown, grey and red marls with intercalations of yellow sandstones (3 - 5 cm) and massive crinoidal limestones (up to 5 m). In the top of this formation, gray – green and pink oncoidal massive limestones with chlorite occur. New information about deep-water chlorite oncoides from the Toarcian sediments has been given by Mišík & Šucha (1997).

The Adnet Formation is developed in thickness of about 14 m (Fig. 1). The study of this formation allows to

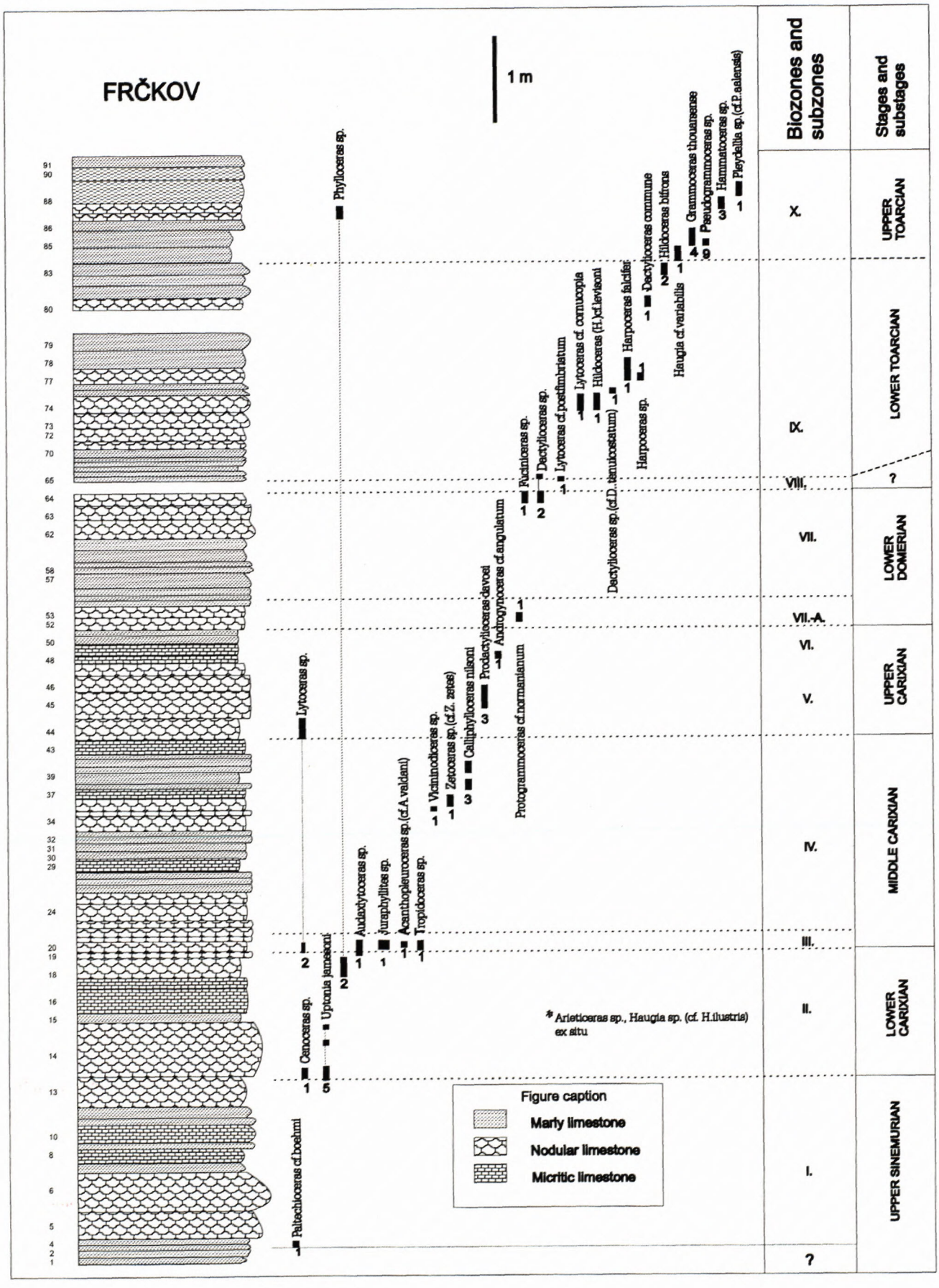

Fig. 1 Lithological profile of the Frčkov section

distinguish two lithological parts. The lower part consists of pink or reddish thin-bedded limestones (10 – 30 cm) with intercalations of dark red marls. This part is characterized by the frequent appearance of nodules. The upper part of the formation comprises of dark red marly limestones and marls with layers of green – light red nodular limestones. Nodules have a pink – light red colours and size between 3 – 15 cm. They disappear in the uppermost part of the Adnet Fm. Nodules frequently contain a autoclasts and rock cores of ammonites. The rostra of belemnites are frequent as well, showing a chaotic distribution due to semiplastic deformation of unlitified sediments on submarine slopes. In the lower part of section, the belemnites form a relatively large rostra (10 – 13 cm long and 0,8 – 1,5 cm in diameter), and higher up their size decreases (5 – 7 cm). Ammonite fauna have been collected by bed by bed study (Bendík, 1999, Fig. 1) and using of Peržel´s collection (unstratified and publicated).

General microfacial character of the Adnet limestones and marls corresponds to biomicrite (Folk 1959, 1962), in lower part observed as wackstone and in upper part as wackstone – packstone and packstone.

Limestones in upper part of the Adnet Fm. are grey, thin-bedded and rich in crinoidal detritus. They are supposed to be calciturbidite.

Successive sediments are red, grey or green and thin-bedded radiolarite limestones and radiolarites. The green colour indicates diagenetic fluid alteration in redox conditions. Radiolarites consists of numerous green or red cherts. The thickness of radiolarite section is about 70 m.

The uppermost part of sequence is composed of grey marly limestones with aptychi, light-grey thin-bedded marly limestones and marls with deformyted rock cores of ammonites. The thickness of this section is about 300 m.

Biostratigraphical framework

17 ammonite subzones, which have been recognized in the Frčkov section, are correlable with two standard zonations known from the NW Europe (Dean et al., 1961) and for the Tethyan realm (Ferretti, 1990).

Late Sinemurian

Raricostatum Zone

Raricostatum Subzone

From this zone following ammonites were found: *Echioceras raricostatum, Echioceras raricostatoides, Paltechioceras favrei and Paltechioceras cf. boehmi.* They belong to the Boehmi Horizon of Raricostatum Subzone in NW Europe (Meister, 1991, Dommergues, Meister & Böhm, 1995, Blau, 1998).

Macdonnelli Subzone

This subzone is defined by occurrence of *Paltechioceras cf. charpentieri* (Blau, 1998) and *Leptechioceras cf. meigeni*, representing a typical ammonites of Macdonnelli Subzone.

Early Pliensbachian (Carixian)

Jamesoni Zone

Jamesoni Subzone

Characteric ammonites of this horizon are represented by following species: *Uptonia jamesoni, Coeloceras sp. (cf. C. pettos), Phylloceras sp., Audaxlytoceras sp. and Lytoceras sp..*

Ibex Zone

Masseanum Subzone

Horizon is associated by *Juraphyllites sp., Lytoceras sp., Tropidoceras sp.* and *Tropidoceras cf. masseanum.* Last mentioned species is characteristic for lowermost part of Ibex Zone – Masseanum Subzone

Valdani Subzone

This horizon contains a poor ammonite fauna. In fragments there was observed these speciec: *Acanthopleuroceras sp. (cf. A. valdani), Acanthopleuroceras binotatum, Lytoceras sp. Vicininodiceras sp.*

Davoei Zone

Maculatum Subzone

Ammonite fauna from this subzone is very well preserved, representing by *Androgynoceras maculatum.*

Capricornus Subzone

From this zone, only one ammonite species of *Androgynoceras capricornus* has been found.

Capricornus - Figulinum Subzones

The boundary of Capricornus and Figulinum subzones is presented by *Prodactylioceras davoei.* This horizon is represented by *Calliphyloceras nilsoni, Zetoceras sp. (cf. Z. zetes)* and *Lytoceras sp.* Upper part of the Davoei Zone, which corresponds to Angulatum Horizon in NW Europe, is indicated by *Angulaticeras cf. angulatum.*

Late Pliensbachian (Domerian)

Margaritatus Zone

Amaltheus margaritatus known from Peržel´s collection and *Arieticeras algovianum* is typical ammonite of this zone.

Stokesi Subzone

This subzone represented *Protogrammoceras cf. normanianum* and belongs to NW European Celebratum Horizon (Blau & Meister, 1991).

Fuciniceras compressum, *Fuciniceras sp.* and *Arieticeras sp.* belong in widely extent to the Margaritatus Zone.

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Spinatum Zone

Apyrenum Subzone

Pleuroceras cf. solare is only one of ammonite species, finding in this subzone.

Hawskerense Subzone

This subzone is represented by *Pleuroceras cf. hawskerense* and *Pleuroceras cf. spinatum.*

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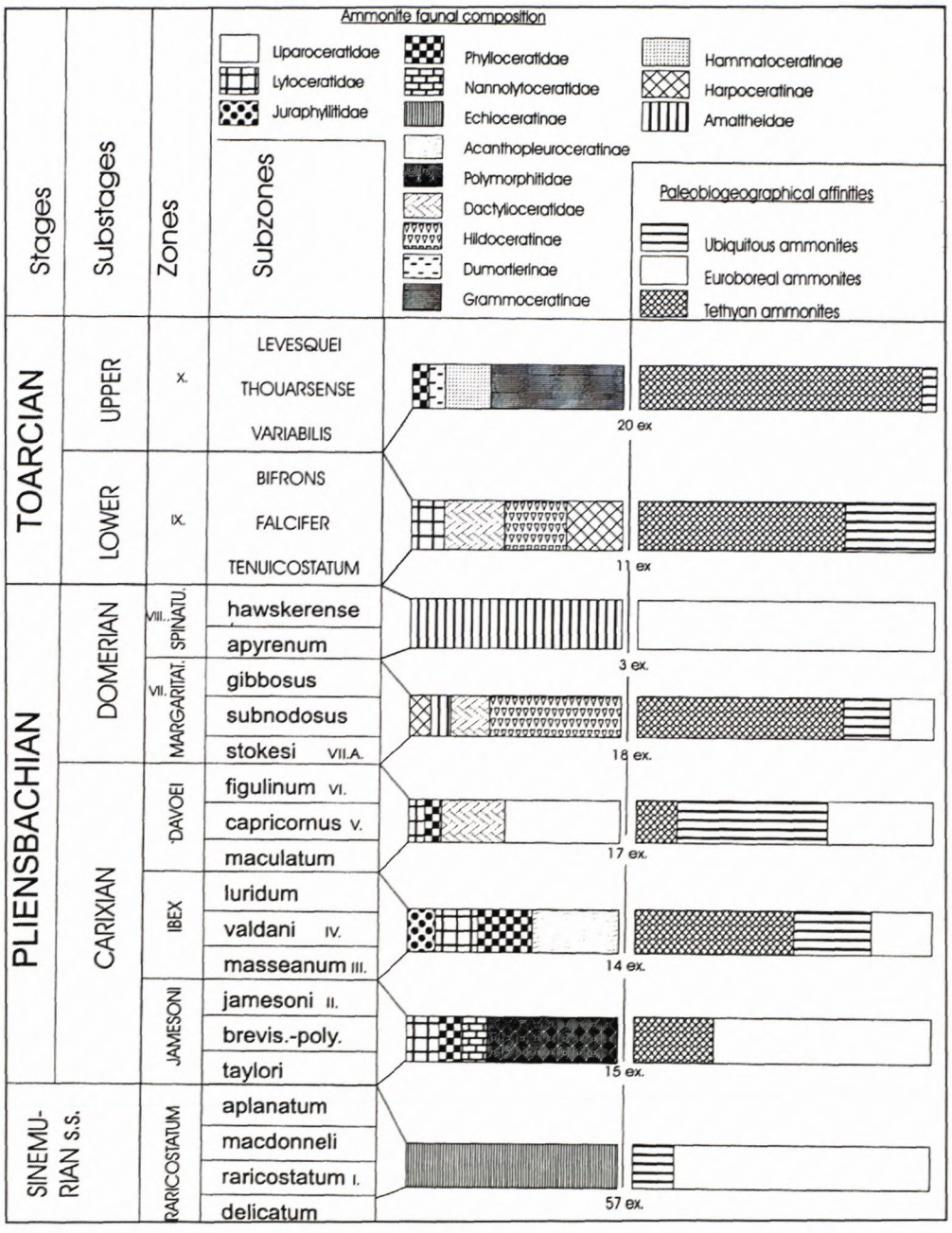

Fig. 2 Ammonite faunal composition and paleobiogeographical affinites.

Lower Toarcian

Tenuicostatum Zone

This zone is presented by *Dactyliceras sp.* and *Lytoceras cf. postfimbriatum.*

Tenuicostatum Subzone

Diagnostic species of this zone are represented by *Dactilioceras sp. (cf. D. tenuicostatum)* and *Lytoceras cf. cornucopia*, which defined the Tenuicostatum Zone.

Falcifer Zone

Falcifer Subzone

For this subzone, there is characteristic ammonites of *Harpoceras falcifer* and *Harpoceras sp.* (Dean, Donovan & Howarth, 1961).

Bifrons Zone

Commune Subzone

Only one ammonite *Dactyliceras commune* indicates this subzone, which is considered to be a characteristic species for NW European province. *Hildoceras bifrons* corresponds to the complete Bifrons Zone.

Upper Toarcian

Variabilis Zone

Variabilis Subzone

This subzone is limited by characteristic ammonites, belonging to *Haugia sp. (cf. H. ilustris)* ex situ, and *Haugia cf. variabilis*..

This zone comprises of *Pseudogrammoceras sp., Phylloceras sp.* and *Grammoceras thouarsense.* The latter of these ammonites is typical for the Striatulum Subzone which is correlated with the Thouarsense Subzone.

Levesquei Zone

Dispansum Subzone

Hammatoceras sp. is only one ammonite, that belongs to the Dispansum Subzone *sensu lato.*

Aalensis Subzone

This zone is reliable for *Pleydellia sp. (cf P. aalensis)*, known for Toarcian sediments of NW Europe and Helvetic Alps (Meister, 1991).

This biostratigraphical study is based on both Tethyan and Euroboreal fauna. From this point of view, the correlation between two different realms in CWC remain problematic.

Faunal composition and paleogeographical remarks

Faunal composition of the Adnet Lms., as has been recognized in successive horizons (Fig. 2), allows a following paleobiogeographic comparisons.

Carixian fauna of Adnet Lms. dominate in Lytoceratina and Phylloceratina. In upper part these ammonites are rare. Echioceratidae occur in raricostatum horizon, containing of Echioceras raricostatum, Echioceras raricostatoides, Paltechioceras cf. boehmi, Paltechioceras charpentieri and Paltechioceras favrei. In rare case they are accompanied by Acanthopleuroceratinae. Reachest ammonite fauna is represented by Polymorphytidae (Uptonia jamesoni). The boundary between Carixian – Domerian is well defined by Carixian fauna of Dactilioceratidae with Prodactylioceras davoei and Amaltheidae (Amaltheus margaritatus, Pleuroceras cf. spinatum, Pleuroceras cf. solare, Pleuroceras cf. hawskerense), Liparoceratidae and Domerian fauna of Grammoceratinae with Protogrammoceras cf. normanianum. Hildoceratinae became more rich during the Domerian and Upper Toarcian, where the Harpoceratinae are also present. Upper Toarcian ammonite fauna is represented by some subfamilies, where the Hammatoceratinaea are rare, Dumortierinae more frequent and Grammoceratinae common.

From paleobiogeographic point of view, the Tethyan ammonite fauna became dominant during the Toarcian stage. On the contrary, the Pliensbachian fauna comprise of rich boreal specimens. Tethyan affinity shows following ammonites: Juraphyllites sp., Lytoceratina, Phylloceratina, Tropidoceras sp., Dactylioceratidae. Boreal affinity represent: Echioceratidae, Uptonia jamesoni, Acanthopleuroceras sp. (cf. A. valdani), Acanthopleuroceras binotatum, Prodactylioceras davoei, L. (Liparoceras) bechei, Amaltheidae, Protogrammoceras cf. normanianum. The ammonites with ubiquitous Tethyan-Boreal affinity are represented by Paltechioceras cf. boehmi, Paltechioceras favrei, Paltechioceras cf. charpentieri, Tropidoceras cf. masseanum, Vicininodiceras sp., Androgynoceras cf. angulatum, Fuciniceras compressum, Harpoceratinae, Hildoceratinae, Hammatoceratinae and Dumortierinae.

Conclusion

The paper provides a detail biostratigraphy of the Adnet Fm from Frčkov and Rovné Valley localities in the Veľká Fatra Mts., the Upper Sinemurian to the Upper Toarcian comprising strata. Adnet Fm. of this area belongs to the Zliechov Sucession, which represents a deep-water sediments of the Tethyan region, but its faunal composition indicates an intermediate position in some stratigraphical horizons. Main diffrences between Tethyan and Boreal fauna have been identified during the Upper Sinemurian – Upper Pliensbachian within the Raricostatum, Jamesoni, Davoei and Spinatum ammonite zones, which recorded maximal influence of Boreal sea. In these zones we are able to identify an invasion of the Boreal ammonite fauna to the nothern parts of the Paleotethys. The Boreal incursions could be forced by paleoclimatic changes, tectonic activity, eustatic sea-level fluctuations and other effects.

These results appear to be important for correlation between Tethyan and Boreal provinces in the Alpian – Carpathian region during the Liassic period.

Acknowledgements

Author thanks to rangers from CHKO Veľká Fatra for accommodation, Dr. M. Rakús for helping with systematic determination, Dr. V. Andrusovova for lending of Peržel´s collection and Dr. J. Soták for providing of friendly review. The paper is a contribution to VEGA grants 7215 and 7068.

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