Once more on the age of the Andělská Hora Formation in the Nízký Jeseník Mts.

Znovu ke stáří andělskohorského souvrství v Nízkém Jeseníku (Czech summary)

(1 text-fig.)

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The discovery of a coral of the genus *Lithostrotion* in the pebbly mudstone present at the top of the Andělská Hora Formation merely points to the possibility that the uppermost of this formation may be of Viséan age. By contrast, the conodont fauna from Chabičov V-101 borehole unambiguously attests the Tournaisian age of the upper part of the Andělská Hora Formation. Its lower part, situated farther west, is most probably of Upper Devonian age.

Key words: Stratigraphy, Upper Devonian, Lower Carboniferous, Moravia

Introduction

The Andělská Hora Formation is the oldest Variscan flysch formation within the Jeseníky Mts (cf. the definition in Zapletal et al. 1989). Dark shales, siltstones and fine- to coarse-grained greywackes prevailingly alternate in rhythms with graded bedding and of varying size. Laminites have also frequently been found. Pebbly mudstones are a typical but quantitatively rather subordinate component. The maximum thickness of the formation exceeds 1500 m. Eastwards the grains are getting finer and the Andělská Hora Formation gradually passes into siliceous shales with silicites (Ponikev Formation). Their detailed characteristics is describet in the paper treating the flysch development in the Nízký Jeseník Mts. (Dvořák 1994). The contact with the underlying Vrbno Group is also considered in the review of the Moravian Paleozoic (Dvořák 1993). The equivalent in time Ponikev Formation, including the lateral transition into the Andělská Hora Formation, is discussed in the paper on the Šternberk-Horní Benešov Zone of the Nízký Jeseník Mts. (Dvořák 1995). The Andělská Hora Formation can be dated only indirectly (younger than Frasnian and Lowermost Famennian) or it can be dated in places where it passes into other facies. The formation mentioned is overlain by the tuffitic greywackes of the Horní Benešov Formation (Dvořák 1994).

The recent discovery of a coral of the genus *Lithostrotion* (Otava et al. 1994) in a limestone pebble from the pebbly mudstone present near Dětřichovice once more brought up the question about the age of the Andělská Hora Formation. Pebbly mudstone have been found in the uppermost part of the Andělská Hora Formation. It has been generally known that the pebbles and dark limestone fragments in these mudstone are essentially synchronous with the formation in which they occur at a secondary locality (for more details see Dvořák 1994). This fact has also gained acceptance by

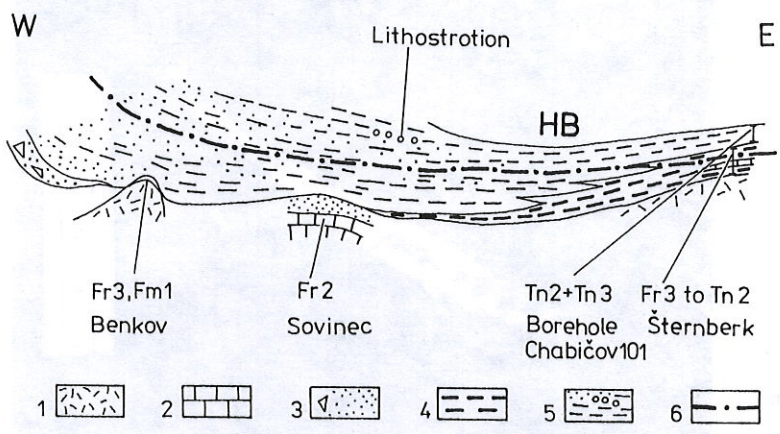

Fig. 1. Schematic stratigraphic section of the Andělská Hora Formation with biostratigraphic documentation. Not to scale!
1 - basic volcanic rocks; *2* - limestones; *3* - calcareous sandstones and limestone breccias (Moravský Beroun Formation); *4* - siliceous shales (Ponikev Formation); *5* - shales, siltstones, greywackes, pebbly conglomerates (Andělská Hora Formation); *6* - approximate boundary Famennian/Tournaisisan; HB - Horní Benešov Formation (Viséan)

the authors concerned. Corals are far from being a group of animals that developed, in time, at roughly the same speed as did conodonts, foraminifers or goniatites. They are also clearly associated with specific facies, which reduces their stratigraphical significance. There exists no convincing evidence of the fact that the genus *Lithostrotion* did appear worldwide as early as the Tournaisian/Viséan boundary. It was in Belgium that a significant facies change occurred at this boundary: a facies favourable to conodont evolution but adverse to the lives of foraminifers and corals prevailed in Belgium during the Upper Tournaisian. We should better state that the first discoveries of the coral of the genus mentioned above were made in limestones of Viséan age.

The discovery of a coral of a single genus cannot lead to the conclusion that the whole Andělská Hora Formation is of Viséan age. The Tournaisian age of the upper part of the Andělská Hora Formation was unambiguously evidenced by Chabičov V-101 borehole situated north of Chabičov near the town of Šternberk at the lithostratigraphic upper boundary with the Horní Benešov Formation which is a rather pronounced one at this place. In the middle interval of the borehole mentioned (cf. Fig. 6 in Dvořák et al. 1983), the typically developed Andělská Hora Formation comprises limestone intercalations containing conodont faunas placed into the Middle and, in the upper parts of this interval, into the Upper Tournaisian. It could clearly be demonstrated that stratigraphically upwards the fauna is gradually getting younger. The interval indicated by the presence of conodonts of Middle Tournaisian age is more than 40 m thick. Upper Tournaisian age is evidenced not only by *Scaliognathus anchoralis* but also by *Pseudopolygnathus triangulus pinatus*, described by Zikmundová (1967) from the Ponikev Formation south of Krnov. Redeposited conodont faunas of Upper Famennian age were found in a limestone breccia intercalation in which Tournaisian conodonts were missing. Between the uppermost sample, containing conodonts of the *anchoralis* Zone, and the base of the Horní Benešov Formation an undated interval of the Andělská Hora Formation is present that displays a thickness of about 100 m. Its age can be supposed to be Upper Tournaisian or Lowermost Viséan already (cf. Dvořák - Zapletal 1993).

It should be noted incidentally that the „Světlá greywackes" are a facies of the Horní Benešov Formation - by the heavy minerals contained they correspond to the base of this formation (including the sequence encountered by Dětřichov-1 borehole) sharing with it an identical ichnofauna (Zapletal - Pek 1987), typical of the Lower and Middle Viséan (Dvořák 1994) also in the Rheinisches Schiefergebirge.

From the regular W-E migration of flysch sedimentation in the Jeseníky Mts (Dvořák 1994) it follows beyond a doubt that flysch sedimentation started earlier in the zones situated farther to the west. The situation of the thin limestone intercalations at the top of a volcanic elevation near Benkov southwest of Uničov demonstrates that, at this place, limestone deposition was terminated as early as the lowermost Famennian (boundary between the *Palmatolepis triangularis/Palmatolepis crepida* Zones - last described in the paper by Dvořák 1994 that also reviews the older literature). West of this elevation, flysch sedimentation must have begun much earlier. The other sites near the margin of the Vrbno Group cannot be determined with certainty, particularly Růžová site, where, most probably, the samples were mistaken for one another.

Experience from the Rheinisches Schiefergebirge Mts. and from the Harz Mts. has taught us that not only greywackes, siltstones and shales but also siliceous shales with silicites have been assigned to the „Kulm", i.e. to a set of facies replacing each other. Their appearance in the basin demonstrates that flysch development had started somewhere at the basin margin. With the aid of conodonts from siliceous-shale intercalations in the Giessener Grauwacke of the Rheinisches Schiefergebirge Mts. Stibane (et al. 1984) could prove their Upper Frasnian age. For several places in Moravia, determinations of conodont faunas (by Zikmundová 1966, Zikmundová - Chlupáč 1962) at the Ponikev site near Konice and at the Moravský Beroun site have supplied evidence showing that the Ponikev Formation (siliceous shales) began to form as early as the Upper Frasnian. It is obvious not only from Moravia but also from the Rhenohercynicum that it took the fauna (particularly lamellibranchs and goniatites, but also animals leaving only crawling traces) several million years to get adapted to quite different living conditions in a completely unknown environment. This is the reason why fossils have been found rather sporadically in the oldest flysch sequences (regardless of their heavy folding and metamorphosis). „No capital can be made" out of this fact nor can the outdated hypotheses be resumed, according to which the lithostratigraphic units of the whole basin were thought to be isochronous. The hypotheses of former times believed the present time to be an atectonic stage of the Earth's evolution supposing, at first, undisturbed sedimentation over many millions of years in the mobile zone and, after that, the sudden folding of the entire mountain range in a catastrophically short time span (cf. Dvořák 1992).

Conclusion

The Tournaisian age of the upper part of the Andělská Hora Formation could be unambiguously proved for the eastern part of its occurrence near Šternberk, while the western part is, most probably, of Upper Devonian

age. The discovery of a coral of the genus *Lithostrotion* may point to the fact that the uppermost section (some 50 m) of the Andělská Hora Formation in the Šternberk area might be assigned to the lowermost Viséan. This supposition, however, cannot be accepted with any assurance.

Submitted November 9, 1994 *Translated by M. Radevová*

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Znovu ke stáří andělskohorského souvrství v Nízkém Jeseníku

Nález korála rodu *Lithostrotion* ve valounu vápence ve slepencové vložce nejvyšší části andělskohorského souvrství může být interpretován jen jako možný doklad spodnoviséského stáří nejvyšší části andělskohorského souvrství. Vrt Chabičov V-101 s. od Šternberka obsahoval konodontovou faunu středního a svrchního tournai. Tím je jednoznačně doloženo tournaiské stáří svrchní části andělskohorského souvrství. Na základě pozice v nadloží paleontologicky doložených vápenců s konodontovou faunou frasnského stáří je velmi pravděpodobné, že nižší část tohoto souvrství je famenského stáří - viz obr. 1.