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Geodynamic setting of fluxoturbidites in West Carpathian Upper Jurassic and Lower Cretaceous sedimentary basins

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Abstract. Eustatic and hydrodynamic regime on Tethyan shelves and microcontinents changed during Late Jurassic and Early Cretaceous. These changes are well recognizable by study of the allodapic fluxoturbidite intercalations in pelagic basinal infillings.

Tithonian (lithohoriyon Ti.6) Barmstein fluxoturbidites with platform carbonate clasts are restricted to S of the Alpine - Carpathian lithosphaeric block. No biohermal rims supplying allodapic beds have been developed around contemporaneous Jasenina Basin of northernmore Fatric Zone. Nozdrovica Breccia (litohorizon Be-7) accumulated along active faults: its composition changed from place to place.

Valanginian (Oravice, Va-4) siliciturbidites inserted in hemipelagites (equivalent to East Alpine Rossfeld Beds) originated during eustatic sea level drop by river transport bringing terrigeneous clastic material from SE. Chromian spinel grains were derived from eroded ultrabasic rocks of elevated segments of fundament.

The maximum development of fluxoturbidites has been attained during Hauterivian (Ha-3). The Strážovce Turbidite consists of bioherm rim debris, transported by channel system cutting fault slope.

Barremian (Ba-2) and Aptian (Ap-2) fluxoturbidites were associated with prograding Urgonian carbonate platforms in southern Tatric area. Other allodapes were derived from eroded elevated substrate.

Albian siliciturbidites accumulated in turbidite fan rim arising during extensive paleogeographic re-building of Central Western Carpathians. The quartzose admixture was derived from erode fundament and, partially, it was also produced by syngenetic volcanism.

Key words: calciturbidites, siliciturbidites, pelagic carbonate basins, Upper Jurassic, Lower Cretaceous, Western Carpathians.

The intercalation of allodapic sediments in pelagic Upper Jurassic and Lower Cretaceous sequences was associated with an eustatic drop of the sea-level and with the effects of tectonic sea bottom denivelisation. Although the Neo-Cimmerian collision zone running meridionally south of Asian Cimmerides terminates in Crimea and Dobrogea, traces (both compressive and tensional) of Neo-Cimmerian deformations are recognizable in the Carpathians (mainly in their southernmost zones: MICHALÍK 1990) and in the Eastern Alps: (TOLLMANN 1987), as well.

The deformation of outer Tethyan shelves changed the eustatic and hydrodynamic regime of the basins. During the Berriasian, global transgression (VAIL et al. 1977) and the successive change of current regime led to paleogeografic reorganisation of the broader area of the Mediterrannean Tethys (MICHALÍK et al. 1991, SOTÁK 1989). Reef growth on the Outer Carpathian border finished, the extent of carbonate platforms diminished substantionally: their products have been preserved only rarely, mostly in fragments in allodapic sediments. Microplankton remnants became an important constituent of pelagic sediments (VAŠÍČEK et al. 1994). Nannocone biomicrites sedimented in aerated eupelagic environment, while radiolarites and silicites were deposited below the CCD level. Turbidite beds and other allodapic members are inserted in Upper Jurassic and Lower Cretaceous pelagic carbonate successions of Central and Outer Western Carpathian basinal infillings. A wide range of facies types in the sections of Zliechov, Bobrovec, Vysoká, Belá, Havran and Humenné units of the Krížna Nappe, in the Butkov development of the Manín Unit (all in Central Carpathians), as well as in the Rača Unit of the Magura Basin (Outer Carpathians) allows to follow lateral transitions from distal through proximal calciturbidite deposits to deep sea fans, slope lithofacies and infillings of submarine channels.

Oxfordian to Berriasian allodapes were formed of the detritus of platform carbonates (REHÁKOVÁ 1995) transported down the slopes of elevated fundament blocks (MICHALÍK 1994). Fluxoturbidites (Barmstein Limestone) are restricted to the basin bottom in southern zones of the Alpine - Carpathian lithospheric block (MIŠÍK & SÝKORA 1982). Fluxoturbidite beds are accompanied by intercalations of contourite character.

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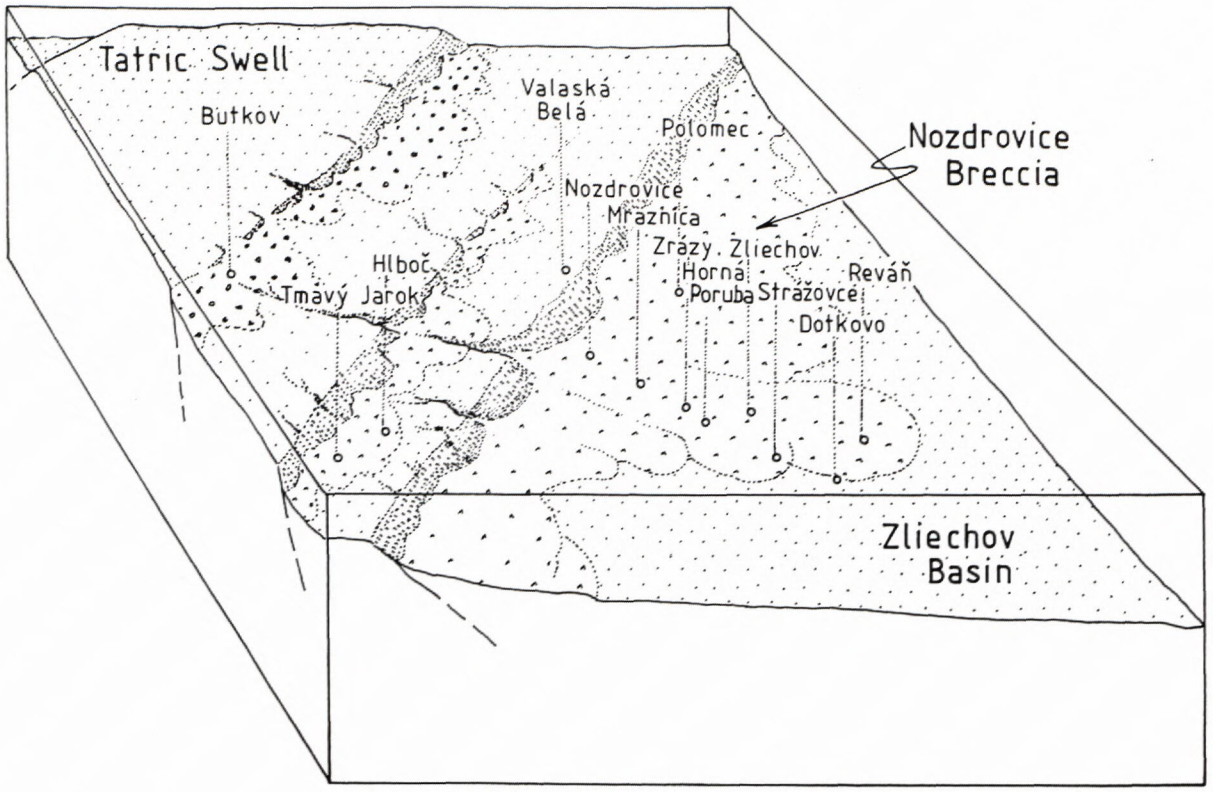

Fig. 1. Model of origin of the Nozdrovice Breccia Beds in NW part of the Fatric Zliechov Basin during Berriasian time.

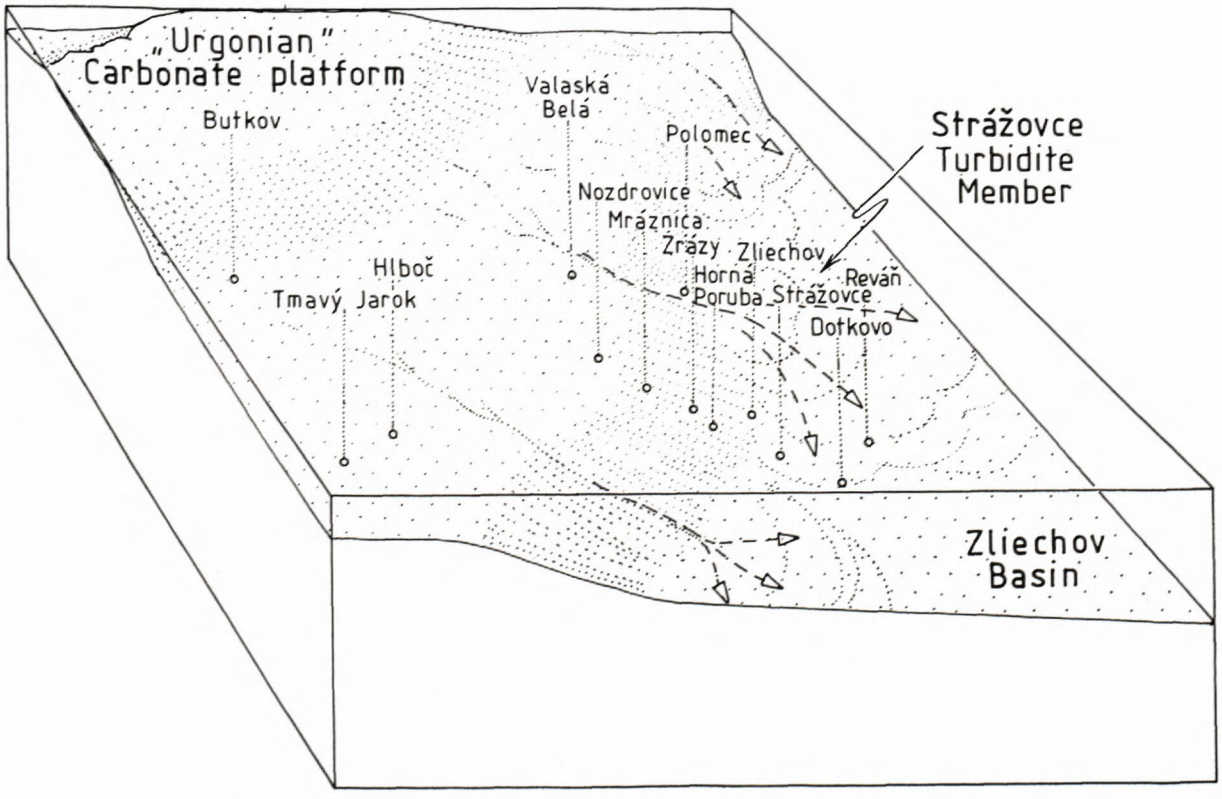

Fig. 2. Model of origin of the Strážovce Turbidite Member in NW part of the Fatric Zliechov Basin during Hauterivian time.

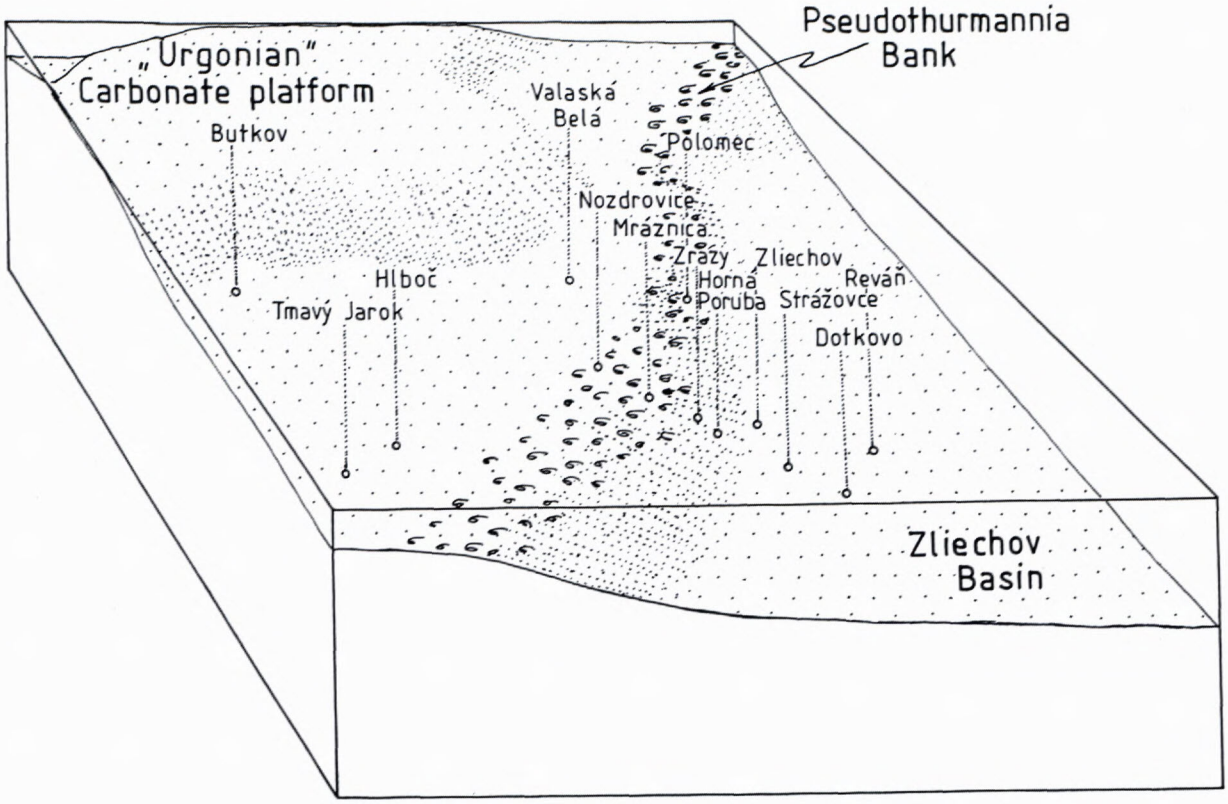

Fig. 3. Model of origin of the Pseudothurmannia Bed in NW part of the Fatric Zliechov Basin during latest Hauterivian time.

On the other hand, the contemporaneous filling of the Zliechov Basin (Jasenina Formation) in the Fatricum does not contain any allodapic beds. Apparently, this basin was not rimmed by bioherms at that time. Bodies of the Nozdrovica Breccia composed of basemental pelagic Upper Jurassic/ Berriasian limestone clasts accumulated along active faults (Fig.1; MICHALÍK & REHÁKOVÁ, 1995). Proximal developments (Butkov, Hlboč, Nozdrovice localities) have more variegated composition of clasts, while the breccia along the axis of the assumed submarine fan (Mráznica, Zrázy, Poruba, Zliechov, Strážovce, Reváň localities) is composed of Upper Tithonian Crassicollaria and Lower Berriasian Calpionella limestone clasts.

Upper Berriasian and Valanginian pelagic sequence contains allodapic intercalations as well. However, the maximum development of these facies was attained during Hauterivian. Calciturbidite intercalations are preserved in Magura Basin infilling in Outer Carpathians (VAŠÍČEK & REHÁKOVÁ 1994). Lower Cretaceous resediments in Pieniny Klippen Zone units occur rather exceptionally (AUBRECHT (1994).

BORZA et al.(1980) defined a Hauterivian organodetrital limestone complex inserted in the Mráznica Formation as the Strážovce Turbidite Member. It consists of limy detritus of the bioherm rim, transported into basin by a channel system cutting the fault slope along its border (Fig.2.). During the topmost Hauterivian shallowing and Tatric carbonate platform progradation, this border was the place of accumulation of fossiliferous Pseudothurmannia Beds (Fig.3).

The Strážovce Member is well exposed by the Polomec quarries near Lietavská Lúčka (BORZA et al., 1984). Probably the thickest body of allodapes (Muráň Limestone Formation) forming a big deep sea fan lens transported southwards into basinal carbonates of the Koscieliska and Muránska Lúka Formations builds the Belianske Tatry Mountains Ridge (MICHALÍK & SOTÁK 1990).

On the other hand, siliciturbidite beds contain material derived from different sources. Cimmerian deformed Inner Carpathian zones on the SE of the Alpine - Carpathian microcontinent could be regarded as a possible source area. Several siliciturbidite beds are inserted in the Valanginian hemipelagic Fatric sequence in the Juráňova Valley near Oravice (JABLONSKÝ in AUBRECHT et al., 1992). They are genetically equivalent to the clastic Rossfeld Beds in the Eastern Alps (FAUPL & TOLLMANN 1979). Their origin was connected with an eustatic drop of sea level, with the activity of rivers bringing terrigeneous clastic material into carbonate basins at that time, as well as with tectonic activity of individual segments of the

fundament. The presence of chromium spinel grains derived from eroded ultrabasic rocks is remarkable (MIŠÍK et al., 1980, MIŠÍK & SÝKORA, 1981, FAUPL & WAGREICH 1992, WAGREICH et al., 1995).

The rising proporsion of radiolarians and sponge spicules in Valanginian rocks could culminate in local concentrations of these remnants. Although some of them were caused by environmental fluctuations, others could be accumulated by distal turbidity or countour currents. Similar thin paralell bedded calcisiltites with radiolarian bands were described from the Lombardian Basin of the Southern Alps (WEISSERT, 1981; BERSEZIO, 1993).

Barremian and Aptian fluxoturbidites were frequently associated with prograding biogenic sedimentation on Urgonian carbonate platforms (MICHALÍK & SOTÁK 1990; MICHALÍK 1994) in southern Tatric area. Other allodapic deposits were derived from eroded elevated parts of the substrate (JABLONSKÝ et al. 1993).

Allodapic beds of siliciturbidite character occur more frequently in Aptian and Albian sequences. JABLONSKÝ & MARSCHALKO (1992) suggested extensive paleogeographic re-building of the area of Central Western Carpathians during the middle Albian. It was connected with basin subsidence and with the uplift of northwestern marginal zones. This process led to the accumulation of a turbidite fan rim. The quartzose admixture was derived from the eroded fundament and, partially, it was also produced by syngenetic volcanism.

References

AUBRECHT R.,1994: Hauterivian turbidites in the Kysuca Unit (Pieniny Klippen Belt, W Carpathians).- Min.Slov. 26., 250-254.

AUBRECHT R., JABLONSKÝ J., MICHALÍK J., MIŠÍK M., REHÁKOVÁ D., SOTÁK J. & VAŠÍČEK Z. (eds.), 1992: Lower Cretaceous deposits of the Central Western Carpathians. Cretaceous and Paleogene paleogeography and geodynamics of the Alpine- Carpathian- Pannonian region. Field guide.- Bratislava, 67 p.

BERSEZIO R., 1993: Sedimentary events and rhythms in an Early Cretaceous pelagic environment: the Maiolica Formation of the Lombardy Basin (S Alps).- Giorn. Geol. 3A, 55, 1., 5-20.

BORZA K., GAŠPARÍKOVÁ V., MICHALÍK J. & VAŠÍČEK Z., 1980: Upper Jurassic/Lower Cretaceous sequence of the Krížna Nappe (Fatric) in the Strážovce section, Strážovské Vrchy Mts. (Western Carpathians). - Geol.zb.Geol.Carpathica 31, 4., 541-562.

BORZA K., MICHALÍK J., GAŠPARÍKOVÁ V., & VAŠÍČEK Z., 1984: The biostratigraphy of the Hauterivian/Barremian Boundary Beds in the Krížna Nappe, Western Carpathians (Czechoslovakia).- Cret. Research 5., 349-356.

FAUPL P. & TOLLMANN A., 1979: Die Rossfeldschichten: Ein Beispiel für Sedimentation im Bereich einer tektonisch aktiven Tiefseerinne aus der kalkalpinen Unterkreide.- Geol. Rundschau 68., 93-120.

FAUPL P. & WAGREICH M., 1992: Cretaceous flysch and pelagic sequences of the Eastern Alps: Correlations heavy minerals and paleogeographic implications.- Cret. Research 13., 387-403.

JABLONSKÝ J. & MARSCHALKO R., 1992: Pre - flysch olistrostromes in Central Western Carpathians, Barremian - Aptian of the Krížna Nappe, Slovakia.- Geologica Carpathica 43,1., 15-20.

JABLONSKÝ J., MICHALÍK J. & PLAŠIENKA D. & SOTÁK J., 1993: Sedimentary environment and correlation of the Solírov Formation with Lower Cretaceous turbidites in central Western Carpathians, Slovakia.- Cret. Research 14., 6013-621.

MICHALÍK J., 1990: Paleogeographic changes in the West Carpathian region during Kimmerian tectonic movements.- Acta geol. geogr. Univ. Comen., Geologica 45., 43-54.

MICHALÍK J., 1994: Notes to paleogeography and paleotectonics of the West Carpathians.- Mitt. Öst. Geol. Ges. 86., 101-110.

MICHALÍK J. & REHÁKOVÁ D., 1995: Sedimentary records of Early Cretaceous tectonic aktivity in the Alpine - Carpathian Region.- Slovak Geol. Magazine 2., 159-164.

MICHALÍK J., REHÁKOVÁ D., & HALÁSOVÁ E., 1990: Stratigraphy of the Jurassic/Cretaceous boundary beds in the Hlboč Valley (Vysoká Unit of the Krížna Nappe, Malé Karpaty Mts.).- Knihov. Zem. Plyn Nafta 9 (a): 183-204.

MICHALÍK J. & SOTÁK J., 1990: Lower Cretaceous shallow marine buildups in the Western Carpathians and their relationship to pelagic facies.- Cretaceous Research 11: 211-227.

MICHALÍK J., SOTÁK J., HALÁSOVÁ E., OŽVOLDOVÁ L., ONDREJÍČKOVÁ A., PETERČÁKOVÁ M., REHÁKOVÁ D. & BORZA V., 1991: Environmental-, sedimentary-, and life changes during the Jurasic/Cretaceous boundary. Min. Slov. 23, 3., 277-282.

MICHALÍK J. & VAŠÍČEK Z., 1987: Geology and stratigraphy of the environs of the Lower Cretaceous limestone deposit of Mt Butkov (Manín U., middle Váh V.).- Min. Slovaca 19, 2., 115-134.

MICHALÍK J., VAŠÍČEK Z., PETERČÁKOVÁ M. & SOTÁK J., 1990: Ku spodnokriedovej bio- a litostratigrafii tatrickej spodnokriedovej sekvencie v Zázrivskej doline (Bralo pri Párnici, Malá Fatra).- Knih. Zem. plynu a nafty 9 (a), 7-22.

MIŠÍK M. & SÝKORA M., 1981: Pieninský exotický chrbát rekonštruovaný z valúnov karbonátových hornín kriedových zlepencov bradlového pásma a manínskej jednotky. - Západné Karpaty, Geológia 7., 7-111.

MIŠÍK M. & SÝKORA M., 1982: Allodapische Barmsteinkalke im Malm des Gebirges Čachtické Karpaty.- Geol. zborn. Geol. Carpathica 33,1., 51-78.

REHÁKOVÁ D., 1995: Upper Jurassic / Lower Cretaceous carbonate microfacies and environmental models from W Carpathians and adjacent paleogeographic units.- Cret. Research 16.,283-297.

REHÁKOVÁ D. & MICHALÍK J., 1994: Abundance and distribution of Late Jurassic and Early Cretaceous microplankton in Western Carpathians. - Geobios 27,2., 135-156.

SOTÁK J., 1989: A contribution to research of Mesozoic facies in externide flysch zones, with implication on microfacies, paleogeography and paleotectonics of the Western Carpathians. In: Sedimentological problems of Western Carpathians. Dionýz Štúr's Geological Institute, Bratislava, 43-65.

TOLLMANN A., 1987: Late Jurassic/Neocomian gravitational tectonics in the N. Calcareous Alps in Austria.- In: Flügel H.W. & Faupl P. (eds.): Geodynamics of the Eastern Alps. Deuticke Verl., Vienna, 112-125.

VAIL P. R., MITCHUM R. M. JR. & THOMPSON S. III, 1977: Seismic stratigraphy and global changes of sea level, Part 3. Relative changes of sea level from coastal onlap.- In: PAYTON C. E. (ed.): Seismic Stratigraphy-Applications to Hydrocarbon Exploration. AAPG Mem., 26., 63-81.

VAŠÍČEK Z. & MICHALÍK J. & BORZA K., 1983: To the "Neocomian" biostratigraphy in the Krížna-Nappe of the Strážovské Vrchy Mts (NW Central Carpathians).- Zitteliana 10: 467-483.

VAŠÍČEK Z. & MICHALÍK J. & REHÁKOVÁ D., 1994: Early Cretaceous stratigraphy, paleogeography and life in Western Carpathians.- Beringeria 10.,1-170.

VAŠÍČEK Z. & REHÁKOVÁ D., 1994: Biostratigrafické výzkumy na lokalitě Kurovice v r. 1993 (vnější Karpaty, titon - spodní valangin).- Geol. výzk. Mor. Slezska 1994, 28.

WAGREICH M. & FAUPL P. & SCHLAGINTWEIT F., 1995: Heavy minerals from Urgonian limestone pebbles of the Northern Calcareous Alps Austria, Bavaria): Further evidence for an intra - Austroalpine suture zone. - Geol.Carpathica 46, 4., 197-204.

WEISSERT H., 1981: Depositional processes in an ancient pelagic environment: The Lower Cretaceous Maiolica of the Southern Alps.- Eclogae Geol. Helv. 74, 2., 339-352.