REMARKS TO DIFFERENTIATION OF TETHYS IN THE CRETACEOUS AND PALEOGENE ON THE BASIS OF PALEOCLIMATE AND MICROBIOSTRATIGRAPHY (NORTH AFRICA, WESTERN CARPATHIANS)

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Abstract: An analysis of probable paleoclimate development in the time section of the Creataceous and Paelogene of the Tethys Realm is presented. The basis for this study is biofacial analysis and paleobathymetric development of marine and continental sediments, relations and representation of benthic and planktic microfauna in various types of paleobioassociations in space and time.

Key words: Cretaceous, Paleogene, paleoenvironment, paleogeography, foraminifers Tunisia and Western Carpathians of Slovakia.

Differentiat*on* of theTethyan realm, more or less homogeneous to the end of the Jurassic, into a southern and northern part started to be manifested in the Cretaceous. The humid paleoclimate resulted in formation of ten passages of detrital, prevailingly flyschoid types of sediments in the course of carbonate sedimentation in Tunisia. There deposited in the Lower and Middle Cretaceous. Whereas in the Western Carpathians sedimentation of flyschoid deposits took place in the Middle and Upper Cretaceous only.

Inundation-turbidity supplies of continental detrital material in Tunisia were from the Saharian platform to the north on the one hand and in the archipelago zone in the Berriasian, in the areas of Dj. Oust and Dj. Zaghouan on the other hand. Shallow-water organo-detrital sediments with agglutinated foraminifers and partly also redeposited calpionel microfauna formed.

The rate of supply of detrital sediments throught the Late Valanginian, Late Hauterivian, Late Barremian and Gargasian as well as the depth of sea distinctly influenced formation of foraminifer paleobioassociations. The presence of abundant representatives of the genus *Epistomina* with aragonite test, which were not affected by dissolution, testifies to a shallow-water platform environment. These are also present in Albian-Cenomananian flysch sediments in the Western Carpathians, mainly of the Klape unit (Šebeš□anova sequence).

Rapid flysch sedimentation in the Late Valanginian (Dj. Oust and Dj. Zaghouan areas) did not make the presence of benthic calcareous as well as agglutinated foraminifers possible. On the contrary, their rapid development in the Hauterivian to Aptian testifies to a distinctly slow

sedimentation. This is stressed by a rich development not only of planktonic foraminifers, but also of cephalopods and by the presence of rich benthic macrofauna.

A distinctly rapid inundation-turbidity sedimentation as a consequence of humid paleoclimate in the Western Carpathians, besides the already mentioned Albian-Cenomanian sediments, also took place in the course of sedimentation of Turonian-Santonian and Late Campanian-Maastrichtian deposits.

Mutual ratio of individual microfauna types is various. Cenomanian-Turonian planktic foraminifers and/or radiolarians are mainly accompanied by rich associations of agglutinated foraminifers.Calcareous benthic foraminifers are mostly missing. These are, however, relatively abundant in Coniacian sediments of the Manin unit and in Campanian-Maastrichtian sediments of the Klape (Šebeš□anová sequencee) and Drietoma (Hoštinna sequence) units. Richest is, however, the benthos together with planktic foraminifers, also represented in Senonian sediments of the Gosau type Cretaceous.

In Tunisia a typical Southern Tethyan Upper Cretaceou, also proposed for hypostratotypes and/or stratotypes of Upper Cretaceous stages (Salaj 1973), is represented by carbonate sediments, rich in macrofauna and microfauna. Obviously the humide paleoclimate, besides sporadical exceptions(layers of detrital sediments are in the Campanian-Maastrichtian Abiod Formation in Central Tunisia), was practically not manifested in their sedimentation. This paleoclimate was shown during sedimentation of Late Senonian and Paleogene sediments in the Northern Tethyan - Western Carpathian region.

Upper Senonian and Paleogene flysch sediments of the Biele Karpaty and Javorníky Mts.

The Upper Campanian-Maastrichtian flysch Jarmuta Formation (Czorstyn and Biele Karpaty Units) is characterized by the agglutinated foraminifers of the Karpatiella ovulum gigantea Zone. The Paleocene-Lower Eocene red shales of the Beloveža Formation are characterized by agglutinated foraminifers of the Karpatiella ovulum ovulum Zone. The calcareous benthic and planctic foraminifers are lacking in these shallow water sediments (only reworked species are present).

Most shallowing was in the Lower Eocene of the Javorníky Mts. (formation of bony coals and coal parting in marshy environment) connected with rain periods.

The rain periods practically throughout the Eocene caused distinct and rapid outwashed as well as transport of pebble material at short distance into a large intermontane lake (f. ex. the Súľov area) in its connection also into a sea lagoon with normal salinity or into the open sea.

In coal salty marshes to shallow-lagoon with normal salinity primitive turbular types of agglutinated foraminifers were living (*Nothia, Rhizammina, Rhabdammina* and *Bathysiphon*), in the structure (cement) of which scarttered coal substance and pyrite took part. In deeper lagoonal paleoenvironment species of the genera *Ammodiscus* div. sp. and *Glomospira* div. sp. are mainly represented. In the Ypresian, bedides the above mentioned types of agglutinated foraminifers, specimens of the species *Saccamminoides carpathicus* Geroch are found. besides light coloured types of agglutinated species of normal lagoonal paleoenvironment also dark types bound to a shallow reductional paleoenvironment are present. These obviously could have been redeposited from coal lagoon and marsches in connection with short-term rise of the water table and transgression.

This is in the first place proved by abundance of glauconite from the base of the bystrica and/ or Zlín Formation corresponding to the Upper part of the Lower Lutetian.

At the floor of the middle-Upper Eocene seas (Biele Karpaty, Javorníky and Súľov areas) in that time distinctly Fe-oxidation paleoenvironment with ferric concretion often of microscopis dimension mostly preserved as ooids was forming. These originally formed as secondary envelope of dead planctonic foraminifers fallen to the sea floor. The planctic foraminifers of the Middle and Upper Eocene were completly destructed except scarce finds. Obviously the Fe-oxidation of the paleoenvironment was completely unfavourable for development of benthic foraminifers (Salaj 1998).

The anoxic (reduction) events were in the time of the Globigerinatheka semiinvoluta Zone and of sedimentation of the Lower Oligocene Menilite Shales . The paleoenvironment on the sea flor was reductional with abundance of pyrite and manganese without condition for development of benthic foraminifers. Planctic foraminifers were pyritized after death and deposition.

Tropical elements of planktic foraminifers in the Upper Eocene and Oligocene are lacking. In this time, although there was a significant deepening of the sedimentary paleoenvironment, there was also evidently coaling, chiefly in the Middle Oligocene . The present planktic as well as calcareous benthic foraminifers are of very nannic dimensions. Agglutinated foraminifers, besides sporadical finds of nannic representatives of the genera *Rhizammina, Hyperammina* and *Rhabdammina* , are more or less absent.

In Tunisia, the Paleocene and Middle-Upper Eocene sediments are represented by the pelagic marly facies (Castany 1951) with tropical pelagic foraminifers. The Early-Lower part of Middle Eocene sediment, are represented by the pelagic facies of Globigerina Limestones of the Bou Dabbous Formation (Fournie 1978), futher on the Nummulitic Limestones facies of the El Garia Formation, equivalent in age. These both facies are practically everywhere separated from underlying claystones and marly of the El Haria Formation by regressive or lagoonal or freshwater (influence of the humid paleoclimate) horizons of phosphates of the Chouabine Formation.

The Oligocene is formed by the lagoonal Sannoisian (Lower Stampian) transgressive cycle of gypsum, brownish claystones, max. 100 m thick. They are overlain by 5-25 m thick desintegrating clayey light-yellowish silstones and by the Stampian organo-detrital

Nummulite Limestones.

In Tunisia as well as in Libya development of larger Foraminifers in the Upper Paleocene-Lower Eocene was unfavourably influenced by the distintly heated shallow-water and hypersaline regime of sea water masse. This was also the main reason why the many paleobiotopes of larger foraminifers (besides nummulites), known from the Northern Tethyan realm, are missing in the Southern Tethyan realm.

In the Northern Tethyan realm (for instance the Alps, Carpathians) marine sedimentation took place under humid paleoclimate, accompanied by monsoon rains. A huge complex of flysch inumdation-turbidity sediments were deposited.

It was a period unfovourable not only for development of larger foraminirers, but also for formation of primary oil and gas deposits. So far as these are found in flysch sediments, they are of secondary migrated from older, mainly Triassic sediments, rich in evaporites. Primary Cretaceous and Paleogene oil and gas deposits, as to their volume, are negligible importance in the North Tethys realm.

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