ORIGIN AND EVOLUTION OF LATE TRIASSIC BACKPLATFORM AND INTRAPLATFORM BASINS IN THE TRANSDANUBIAN RANGE

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Abstract: The evolution of the Late Triassic basins in the Transdanubian Range reflects the geodynamic trends of the area between the northwestern termination of the Neo-Tethys and site of incipient rifting of the Ligurian – Penninic ocean branch. Progressive Neo-Tethys rifting led to formation of narrow intraplatform basins roughly parallel to the platform margin from the Carnian onward. Initiation of opening of the Ligurian–Penninic ocean-branch resulted in formation of Kössen Basin-system behind the Dachstein platform.

Key words: Transdanubian Range, Upper Triassic, intraplatform basin, slope facies analysis.

The Upper Triassic of the Transdanubian Range (TR), Hungary is made up of platform carbonates and intraplatform basin deposits. Neo-Tethys rifting in the late Anisian–Ladinian resulted in the formation of relatively large basins in the central part of the TR. Increased terrigenous influx and shedding of carbonate mud led to filling up of these basins by the latest Carnian. The leveled topography made possible the formation of an extremely extensive carbonate platform system (Dachstein-type platform). At the same time new basins were formed in the northeastern part of the TR unit (Hármashatárhegy Basin -- Buda Mts, Csővár Basin – Mesozoic blocks east of the Danube; see Fig. 1 and Fig. 2) some of them persisted until the Jurassic. During the Norian new basins were formed both on the northeastern and southwestern side of the TR unit (Kössen Basin – SW part of the TR unit, Feketehegy Basin – Pilis Mts; see Fig.1 and Fig.2).

According to the recent palaeogeographic reconstructions the TR unit was a part of the Neo-Tethys passive margin in the Late Triassic (Dercourt et al.,

1993, Haas et al., 1995, Vörös, 2000). It may have been located between the South Alpine and the Upper Austroalpine realms (Fig. 3). In the Northern Calcareous Alps (Upper Austroalpine unit), backstepping of the platform margin and formation of narrow basins near the offshore margin were explained by thinning of the continental crust due to rifting of the Tethys (Lein, 1987) or Neo-Tethys according to the present-day nomenclature. In the Southern Alps, in Lombardy and also in the Carnian Fore-Alps, formation of intraplatform basins in the late Norian was attributed to incipient rifting of the Ligurian–Piedmont ocean branch (Jadoul et al., 1992; Carulli et al., 1998). Based on studies of the tensional features of the Late Triassic basins in the Carnian Fore-Alps, Cozzi (2000) emphasised the role of the westward propagation of the Neo-Tethys in the Southern Alps as well.

The TR unit has got good potential for the comparative study of various intraplatform basins and analysis of their original relationships because it represents an almost complete cross-section of the Neo-Tethys palaeomargin and it was affected only by relatively slight tectonic deformation during the Alpine orogeny. In the last decade, detailed studies have been carried out to detect the stratigraphy and sedimentological characteristics of the basins (Csővár Basin – Haas et al., 1997, Pálfy et al., 2001, Hármashatár-hegy Basin – Haas et al., 2000, Kössen Basin – Haas, 1993. The aim of the present paper is to summarise the characteristics and compare the evolutionary history of the Late Triassic intraplatform basins in the area of the TR and to consider their evolution within the structural frame of the region.

Conclusions

Due to Neo-Tethys rifting, extensional basins began forming in the central part of the TR during the Middle Triassic. Some of them persisted until the Late Carnian. A new rifting stage was initiated in the Early Carnian, which resulted in the formation of narrow intraplatform basins in the northeastern part of the TR unit.

In the late Norian, incipient rifting of the Ligurian–Penninic Ocean (Fig. 3) led to formation of the Kössen Basin in the external belt of the shelf i.e. in the southwestern part of the TR unit. Therefore, since that time a double rift system may have been in operation.

Although formation of the basins was tectonically controlled, their sedimentation pattern, facies characteristics, architecture and evolution were influenced by various factors. The most important of these are:

– palaeogeographic setting of the basins, i.e. their relation with the continental hinterland (source area of the siliciclastics) and the shallow marine (subtidal) carbonate factories.

– climate that basically controlled the siliciclastic input and also influenced the carbonate production and mode of diagenesis (e.g. dolomitization)

– sea-level changes which controlled the geometry of platform carbonates and also determined the size and restriction of the intraplatform basins. Signals of the 3rd-order relative sea-level changes are generally recognisable in the successions. Higher order cyclicity was recognised in the successions formed on the wide ramp between the Dachstein platform and the Kössen Basin.

Intraplatform basin successions akin to those in the TR are known also in the Central W Carpathians, Northern Calcareous Alps and Southern Alps, indicating a similar scenario of basin evolution.

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References

Carulli G.B., Cozzi A., Longo Salvador G., Ponton M. & Podda F., 1998: Evidence of synsedimentary tectonic activity during the Norian–Lias (Carnian Prealps, Northern Italy). *Mem. Soc. Geol. It.*, 53, 403–415.

Cozzi A., 2000: Synsedimentary tensional features in Upper Triassic shallow-water platform carbonates of the Carnian Prealps (northern Italy) and their importance as palaeostress indicators. *Basin Research*, 12, 133–146.

Dercourt J., Ricou L.E., Vrielynck B. (eds) 1993: Atlas Tethys Paleoenvironmental Maps. Gauthier-Villars, Paris, 307p., 13 maps, 1pl.

Haas J., 1993: Formation and evolution of the "Kössen Basin" in the Transdanubian Range. *Földt. Közl.*, 123, 1, 9–54 (in Hungarian).

Haas J., Kovács S., Krystyn L. & Lein R., 1995a: Significance of Late Permian–Triassic facies zones in terrane reconstructions in the Alpine–North Pannonian domain. *Tectonophysics*, 242, 19–40.

Haas J., Tardi-Filácz E., Oravecz-Scheffer A., Góczán F. & Dosztály L., 1997: Stratigraphy and sedimentology of an Upper Triassic toe-of-slope and basin succession at Csővár-1, North Hungary. *Acta. Geol. Hung.*, 40, 2, 111–177.

Haas J., Korpás L., Török Á., Dosztály L., Góczán F., Hámor-Vidó M., Oravecz-Scheffer A. & Tardi-Filácz E., 2000: Upper Triassic basin and slope facies in the Buda Mts. – based on study of core drilling Vérhalom tér, Budapest. *Földt. Közl.*, 130, 3, 371–421 (in Hungarian).

Jadoul F., Berra F. & Frisia S., 1992: Stratigraphic and paleontologic evolution of a carbonate platform in an extensional tectonic ragime: example of the Dolomia Principale in Lombardy (Italy). *Riv. It. Paleont. Strat.*, 98, 1, 29–44.

Lein R., 1987: Evolution of the Northern Calcareous Alps during Triassic times. In: Flügel W. & Faupl P. (Eds): *Geodynamics of the Eastern Alps*. *Deuticke*, 85–102, Wien.

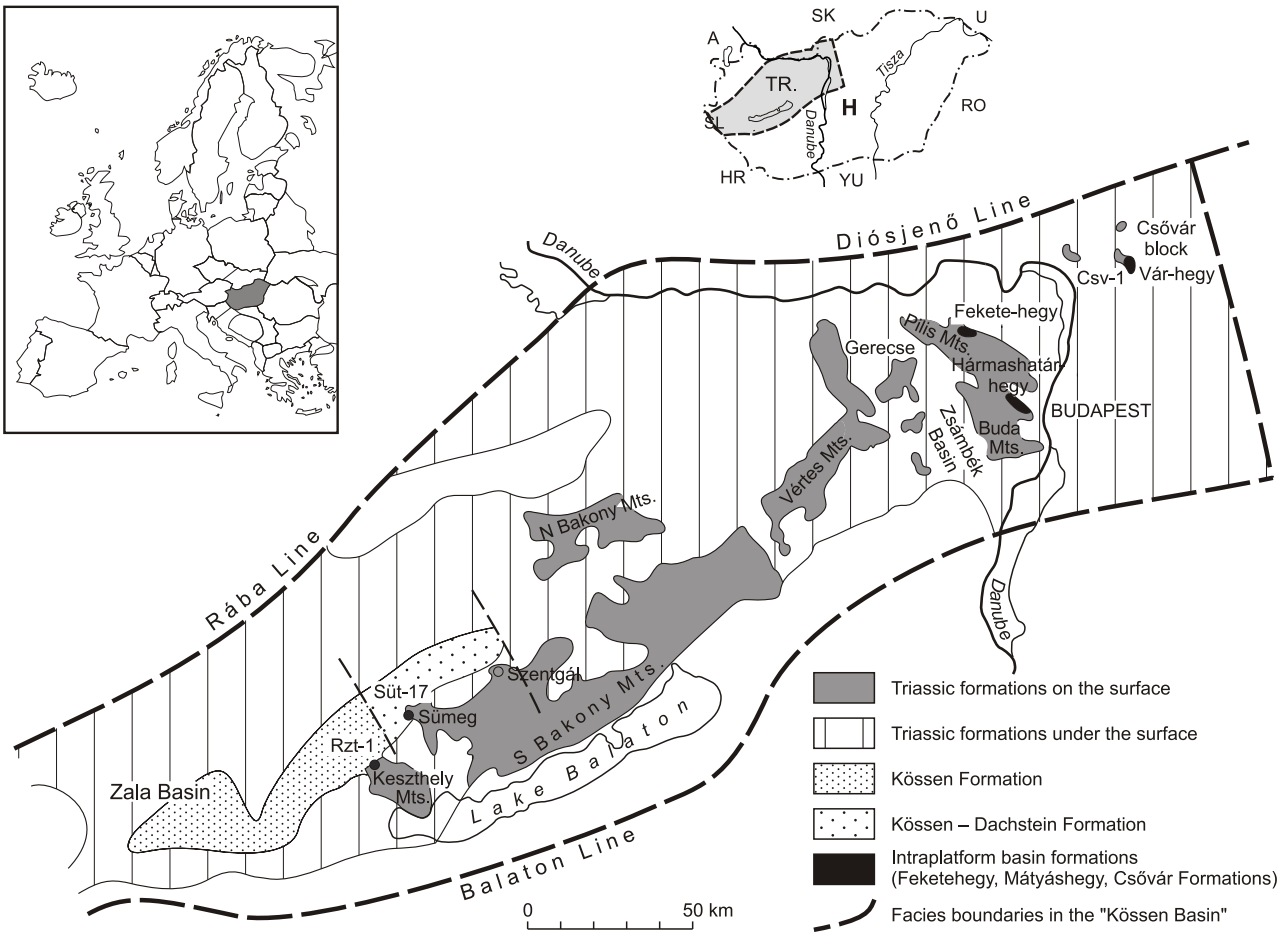
Pálfy J., Demény A., Haas J., Hetényi M., Orchard M.J. & Vető I., 2001: Carbon isotope anomaly and other geochemical changes at the Triassic-Jurassic boundary from a marine section in Hungary. *Geology*, 29, 11, 1047—1050.

Vörös A. 2000:The Triassic of the Alps and Charpathians and its interregional correlation. – In: Hongfu Yin, J.M. Dickins, G. Rshi & Jinnan Tong (Eds): Permian—Triassic Evolution of Tethys and Western Circum-Pacific, pp. 173—196. --Elsevier

Fig. 1 A/ Location of the study area in Europe and B/ within Hungary/. C/ Upper Triassic formations in the Transdanubian Range unit and location of the studied basins

Fig. 2 Stratigraphic chart for the Upper Triassic of the Transdanubian Range. Abbreviations: F – Feketehegy Formation, D – Dachstein Limestone, M – Mátyáshegy Formation, Cs – Csővár Formation

Fig. 3 Paleogeographic sketch-map of the western Neo-Tethys and reconstructed location of the Transdanubian Range unit in the Early Norian. Rifting axis of the Ligurian – Penninic ocean-branch is indicated by bold dash line.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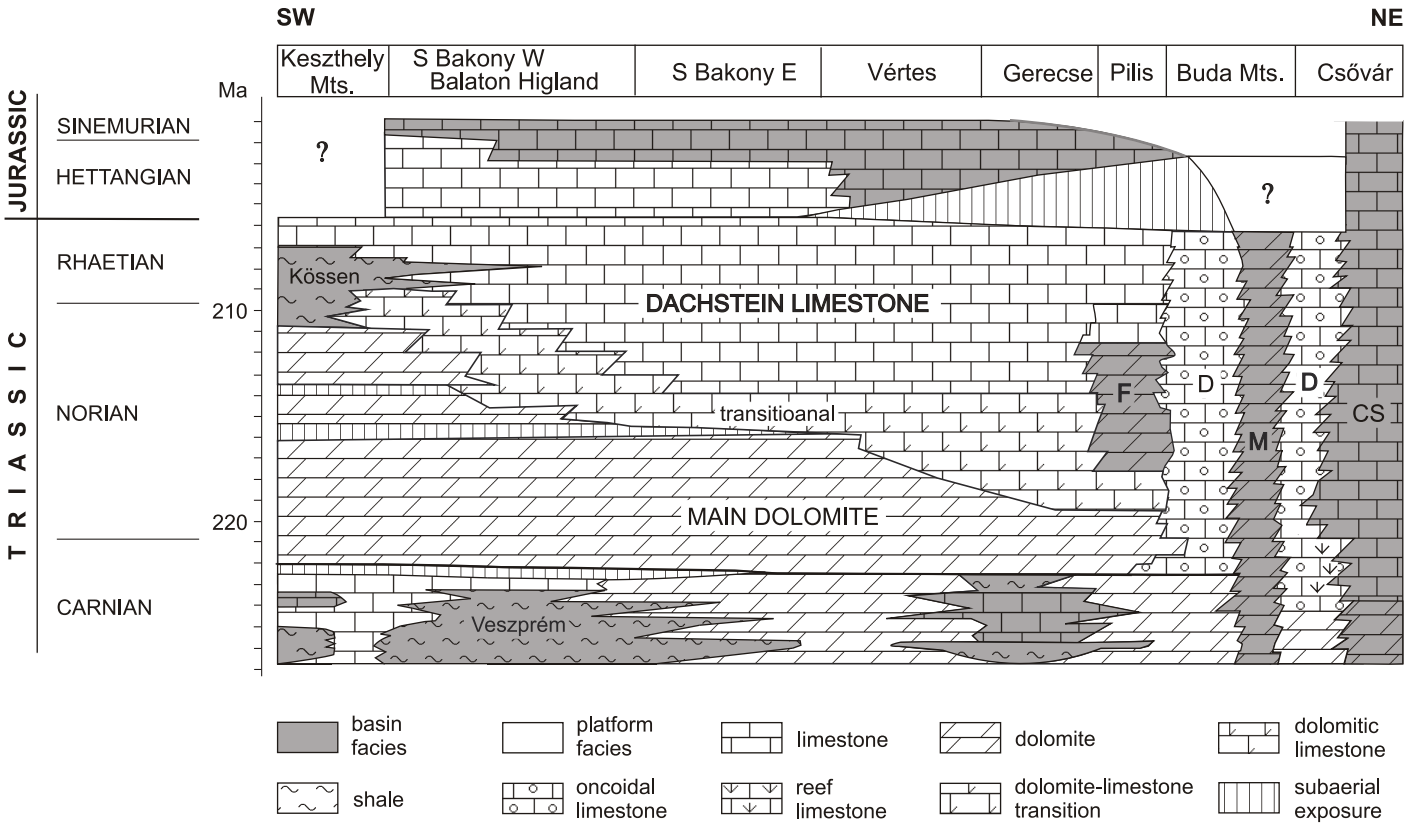
Vértes Mts.
N Bakony Mts.
Rába Line
Danube
Szentgál
Süt-17
Sümeg
Rzt-1
Keszthely Mts.
S Bakony Mts.
Lake Balaton
Zala Basin
Balaton Line
0
50 km
Triassic formations on the surface
Triassic formations under the surface
Kössen Formation
Kössen – Dachstein Formation
Intraplatform basin formations
(Feketehegy, Mátyáshegy, Csővár Formations)
Facies boundaries in the "Kössen Basin"

Haas Fig 1.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Buda Mts.
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TRIASSIC
SINEMURIAN
HETTANGIAN
RHAETIAN
NORIAN
CARNIAN
210
220
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Kössen
DACHSTEIN LIMESTONE
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MAIN DOLOMITE
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basin facies
platform facies
limestone
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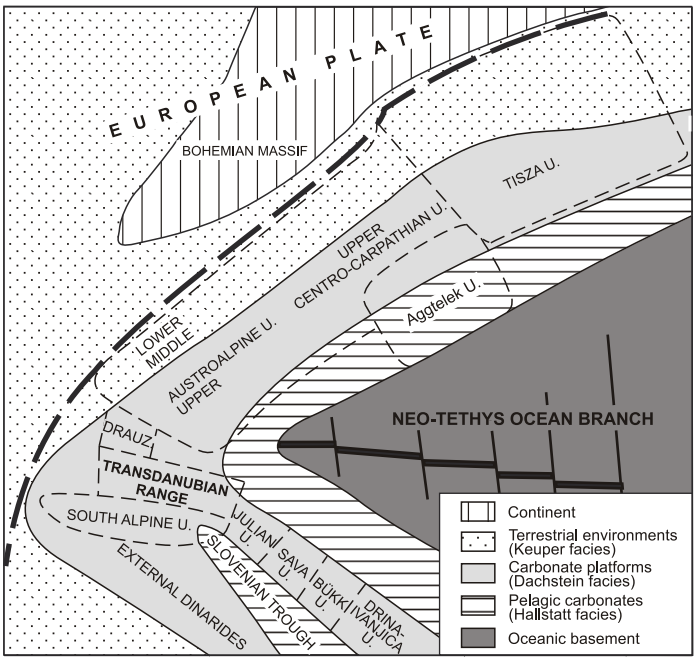
dolomite-limestone transition
subaerial exposure

Haas Fig 2.


EUROPEAN PLATE
BOHEMIAN MASSIF
TISZA U.
UPPER
CENTRO-CARPATHIAN U.
Aggtelek U.
LOWER
MIDDLE
AUSTROALPINE U.
UPPER
NEO-TETHYS OCEAN BRANCH
DRAUZ
TRANSDANUBIAN RANGE
SOUTH ALPINE U.
JULIANI SAVA U.
BÜKK U.
DRINA-IVANJICA U.
SLOVENIAN TROUGH
EXTERNAL DINARIDES
Continent
Terrestrial environments (Keuper facies)
Carbonate platforms (Dachstein facies)
Pelagic carbonates (Hallstatt facies)
Oceanic basement

Haas Fig 3.