CALCULATION OF UNCONFORMITY RELATED ERODED STRATAL THICKNESSES ALONG THE MID-HUNGARIAN MOBILE BELT IN THE DANUBE-TISZA INTERFLUVE AREA, HUNGARY

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1. Introduction

The Neogene Pannonian Basin is underlain and surrounded by tectonic units of the Alpine-Carpathian-Dinaridic system of orogens. Many tectonic units of the orogen systems underwent significant shortening during the Mesozoic to Cenozoic period. The Pannonian basin fill is regarded as post-tectonic, as it rest unconformably on large parts of the Alpine-Carpathian-Dinaridic tectonic units. These sediments were later deformed in several places by deformations related to basin formation and inversion. Stratigraphic and tectonic evolution of the basin fill is fairly well understood [1, 6, 10, 11], but location of tectonic boundaries is still rather uncertain.

Results of detailed seismic surveys and deep drilling indicate that potential hydrocarbon-bearing formations can be assigned to three tectono-stratigraphic mega-sequences [8]. The Upper Miocene-Quaternary mega-sequence, of 4-6 km maximum thickness, is represented by molasse formations deposited during the early Late Miocene. The Paleogene-Middle Miocene mega-sequence, consists of 3-4 km maximum thickness infill wrench basins, rifts, half grabens and flexural basins. The Mesozoic mega-sequence includes a rather heterogeneous group of tectonic units. The Mid-Hungarian Mobile Belt (MHMB) is situated above the Szolnok-Sava belt and above it shares boundaries with the ALCAPA and Tisza mega-unites [10]. It is the most significant neotectonic zone of the Pannonian Basin [9]. The faults of the Mid-Hungarian Mobile Belt were active through the complete Neogene period. MHMB recorded multiple deformations during Miocene–Quaternary, witnessing an inherited weakness zone [3, 5, 11].

2. Sedimentation and tectonic settings

The ALCAPA mega-unit, constituting the basement of the north-western part of the Neogene Pannonian Basin, consists of different continental and oceanic fragments which were welded together during the complex Late Jurassic-Cretaceous-Paleogene evolution [2].

The south-eastern part of the Pannonian Basin is underlain by the Tisza-Dacia mega-unit [4]. This mega-unit implies a series of nappes consisting of basement and its Mesozoic cover (Figure 1). The pre-Triassic basement of the Tisza-Dacia mega-unit consists of various Variscan high-grade metamorphic rocks. The Alpine nappe pile that forms the Tisza-Dacia mega-unit includes, from NW to SE, the Mecsek, Bihar and Codru nappe

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systems [4]. In principle, nappe emplacement direction is toward the NNW and consists of northward propagating sequence of Cretaceous thrusting events [12].

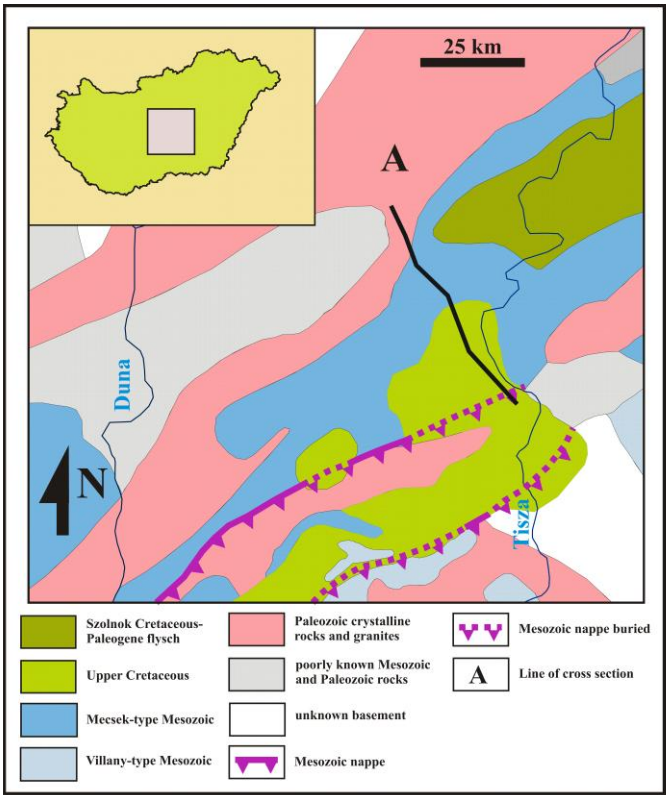

Figure 1. Simplified pre-Tertiary geological map of the Danube-Tisza Interfluve part of the Pannonian Basin with boundary of the nappes and the location of the different type of Mesozoic rocks (modified after [13]*)*

The basal members of the overlying Permian-Mesozoic succession are generally Late Permian continental red beds covered by Muschelkalk-type facies which grades into more massive Mid-Triassic carbonate build-ups overlain by Keuper facies. The Mecsek nappe system is characterised by Early Jurassic coal measures. Substantial Late Jurassic and Early Cretaceous facies variations were related to the different facies zones of the Tisza-Dacia mega-unit (Figure 2). Valanginian to Barremian volcanic activity in the Mecsek Mountains coincided with the opening of the Valais-Magura Ocean and with the departure of the Tisza microcontinent from the European continent. The Bihar nappe system is characterised by Lower Cretaceous reefal limestones. The most internal and structurally highest units, the Codru nappe system, generally contain Jurassic to Lower Cretaceous pelagic red limestones, dark shales and turbidites.

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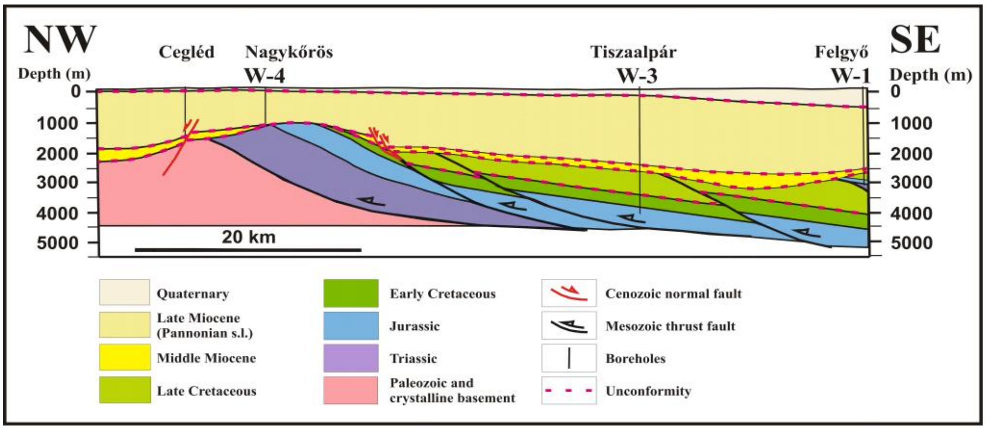

Figure 2. Idealized NW-SE profile through the Danube-Tisza Interfluve with thrust, normal faults and erosional horizons; for location, see Figure 1

The second, early Late Cretaceous deformation episode peaked during the Turonian. Structures are typically sealed by an erosional unconformity of Late Turonian to Coniacian age overlain by Upper Cretaceous foredeep deposits. The second Cretaceous compressional thrusting event, according to Haas [4], can be distinguished from the first one rather well in the area of the Tisza-Dacia mega-units. The early Late Cretaceous unconformity can be overlain by Late Cretaceous or Paleogene sediments. No Paleogene compressive events are known from the Tisza-Dacia mega-units.

The complex tectonic history of the Danube-Tisza Interfluve part of the “Mid Hungarian Line” as revealed by [1], includes intra-Oligocene–Early Miocene thrusting, Middle Miocene extension, local Late Miocene inversion, Late Miocene–Pliocene normal faulting and left-lateral wrenching.

In the Late Neogene sedimentary succession three tectonically driven unconformities were identified by Pogacsas et al. [10] in the central part of the Danube-Tisza Interfluve Area as follows:1) Base Late Miocene Unconformity 2) Top Late Miocene Unconformity, 3) Late Pliocene Unconformity. Age dating of horizons younger than 5.9 Ma is more uncertain because of the poor seismic resolution of the near-surface part of the sedimentary basin fill. Juhasz et al. [6] identified similar unconformities based on sedimentological analysis of the Kaskantyú-2 well. Here the expected duration of the hiatuses were from 6.2 Ma to 3.9 Ma in the case of the Top Late Miocene Unconformity and from 3.2 Ma to 1.8 Ma in the case of the Late Pliocene Unconformity. The succession bounded by the Top Late Miocene Unconformity and the Late Pliocene Unconformity was affected by nearly vertical wrench fault zones [7, 10].

3. Eroded strata thickness

Out of several unconformities related erosional events we chose two and calculated the eroded stratal thicknesses along these unconformities in the Danube-Tisza Interfluve Area. Reconstruction of eroded stratal thicknesses with graphic method was based on Ro%-depth data, and the scenarios were tested with 1D subsidence history analysis applying PetroMod software.

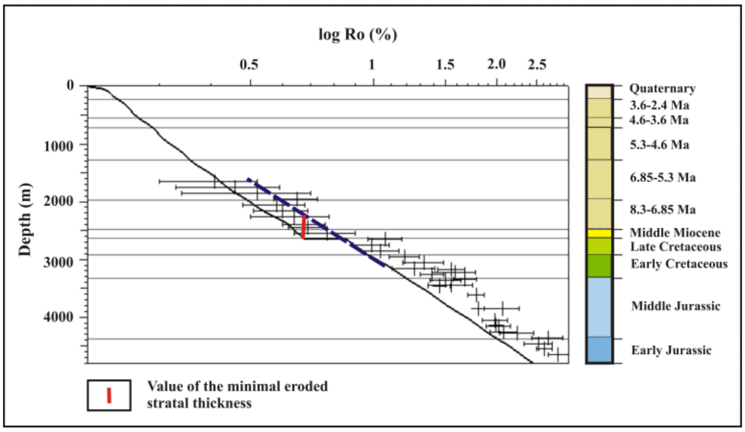

Figure 3.Thickness of stratigraphic units in the W-2 well, measured and calculated vitrinite reflection (R_0)

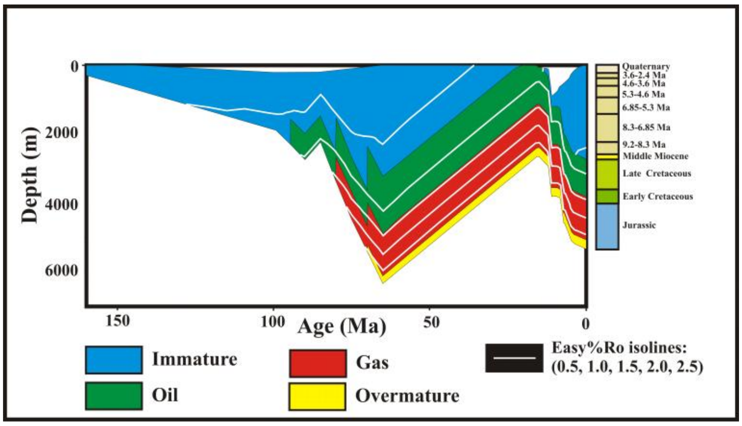

Figure 4. Time-space evolution of the W-3 well. The eroded stratal thickness value can be obtained directly from the depth versus time diagram.

3.1. Late Cretaceous to Miocene erosional event. The estimation of unconformity related eroded sediment thickness value was based on vitrinite reflection–depth profile with graphic method (Figures 3 and 4). A contour map was compiled on the basis of the eroded thickness value of nine wells. The magnitude of the erosion fluctuates within a wide range. The minimum and the maximum values were 1,000 and 3,800 metres (Figure 5).

3.2. Middle Miocene to Late Miocene erosional event. The magnitude of this erosional event was smaller than in the Late Cretaceous to Miocene. Because of that, it did not have as definite an impact on the thermal maturity as the Late Cretaceous to Miocene event had. According to our preliminary results, the magnitude of the Middle Miocene to Late Miocene erosion was between 50 and 300 metres in the study area (Figure 6). The range of the erosion decreased from north-east to south-west.

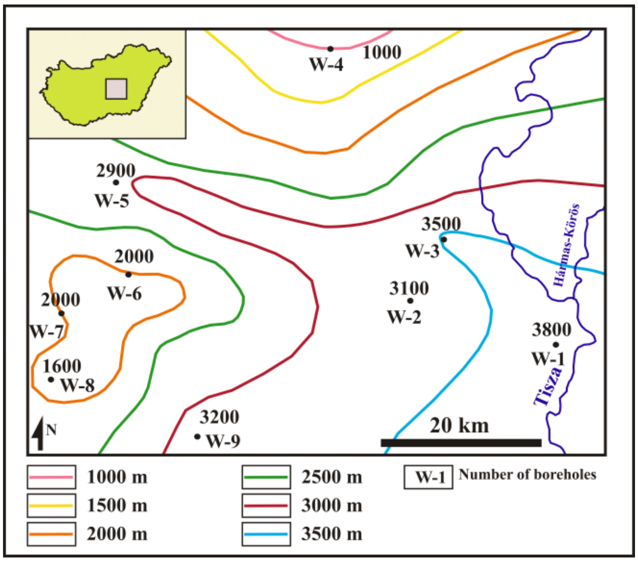

Figure 5. Contour map of the eroded sediment thicknesses (Latest Cretaceous- Middle Miocene) in the studied part of the Danube-Tisza Interfluve

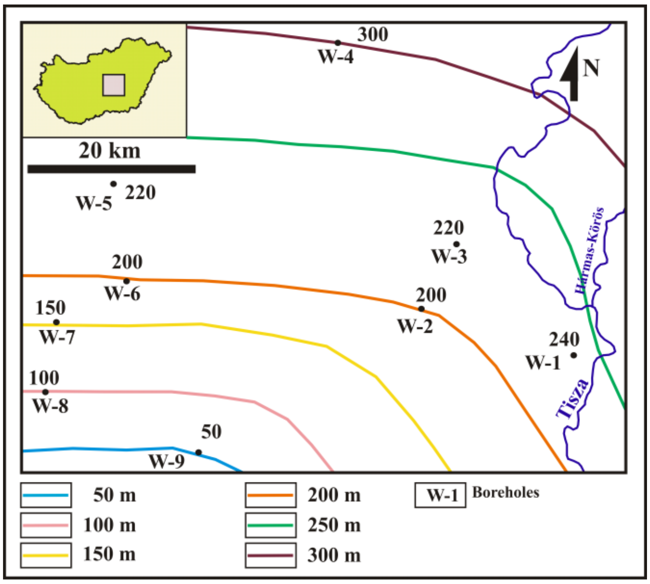

Figure 6. The contour map of the eroded sediment thicknesses (Early and Middle Miocene-Late Miocene) in the studied part of the Danube-Tisza Interfluve

4. Conclusion

The distribution and magnitudes of eroded thickness values are different in the case of the Late Cretaceous to Miocene and the Late Miocene to Pliocene-Quaternary erosional events. The Late Cretaceous to Miocene unconformity significantly affected the thermal maturity while the impact of the Middle Miocene to Late Miocene event was much weaker.

5. Acknowledgements

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