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The relationships between the geological structure and hydrocarbon system in the Slovak part of the Danube Basin

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Abstract. The Danube Basin spreads on the territories of Austria, Hungary and Slovakia. This interpretation focuses on the large central part of the basin on Slovak territory. Until recently, little was known about the lower part of the Neogene fill. Re-processing of older reflection-seismic profiles and measurements of newer ones have led to a better understanding of the lower structure of the basin. Moreover, new significant features of the basin structure have been revealed in areas not covered by seismic survey before.

Keywords: Danube Basin, geological structure, tectonic evolution, hydrocarbon system

Study and Conclusions

An analysis of the tectonic-geological structure showed that the deepest part of the basin is the Győr-Meder pull-apart basin (Fig.1) with its base reaching the depths of 9.5 to 10 km (Hrušecký et al.,1993, 1996) . This basin is most probably filled with Karpatian and Lower Badenian sediments. However, even older (Paleogene? to Ottnangian?) sediments cannot be excluded. The pre-Tertiary basement surface of the central part of the basin is dissected and broken by a system of major faults into seven upper-crustal blocks (Fig.1). Moreover, an important part of the pre-Tertiary basement of the central part of the basin on Slovak territory is most probably built of (according to seismic profiles) metasediments of Paleozoic-Mesozoic cover and nappe sequences of the Alps and West Carpathians. In places, these sequences reach up to 2 000 - 3 000 m. It has also been found out that the pre-Tertiary basement in the western part of the basin, represented by Tatric crystalline rocks, is formed (according to reflection-seismic data) into one to three superimposed tectonic scales (Hrušecký, 1997, 1999).

Faults striking N-S (with slight deviations in both directions) and NE-SW predominate in the Slovak part of the basin. These faults are accompanied with significant transversal W-E and WSW-ENE oriented faults (Fig.1). Newer seismic profiles and newer gravity maps did not confirm any important faults of Sudetic direction (NW-SE). In the past, these NW-SE vergent faults were considered to have played a major role in the forming of the pre-Tertiary and Tertiary structure of the basin. Some major faults in the basin (e.g. the Čertovica-Mojmírovce fault system, the Hurbanovo line, etc.) are re-activated in places of old pre-Tertiary tectonic lines, some of them having been produced as late as during the basin evolution (e.g. the Cífer transversal fault, the Medveďov fault, the Kolárovo fault, etc.).

The different areal and time activity of the major faults in time and area lead to more or less significant reconstructions of the tectonic style in the basin evolution history. Therefore, different styles of sedimentation and tectonics occur in different internal levels of the basin. Four structural levels of the basin fill can be distinguished in the central part of the Danube Basin (from the oldest to the youngest):

a) **level 4** - lower extensional level represented by the fill of the *Győr -Meder pull-apart basin* (Paleogene?-Ottnangian?, Karpatian to Lower Badenian);

b) **level 3** - upper extensional level (Lower Badenian to Sarmatian);

c) **level 2**- transitive extensional-thermal (early thermal) level (Lower Pannonian);

d) **level 1** - thermal level (Middle Pannonian to Quaternary).

The tectonic evolution of the Slovak part of the Danube Basin has been controlled by two subsequent phases of tectonic formation:

1) **Crustal extension phase** - (Paleogene? - Ottnangian?), Karpatian to Lowest Pannonian (17.5-11.0 MA);

2) **Thermal collapse phase** - later Lower Pannonian to Recent (11.0-0.0 MA).

According to the main features of the geological structure and tectonic evolution, the Slovak part of the Danube Basin has been classified among polyhistoric, composed basins (global classification of basins after Shannon and Naylor, 1989). This classification of the basin is based on the fact that the Slovak part of the Danube Basin includes in its "basinal curve", according to which it has been de-

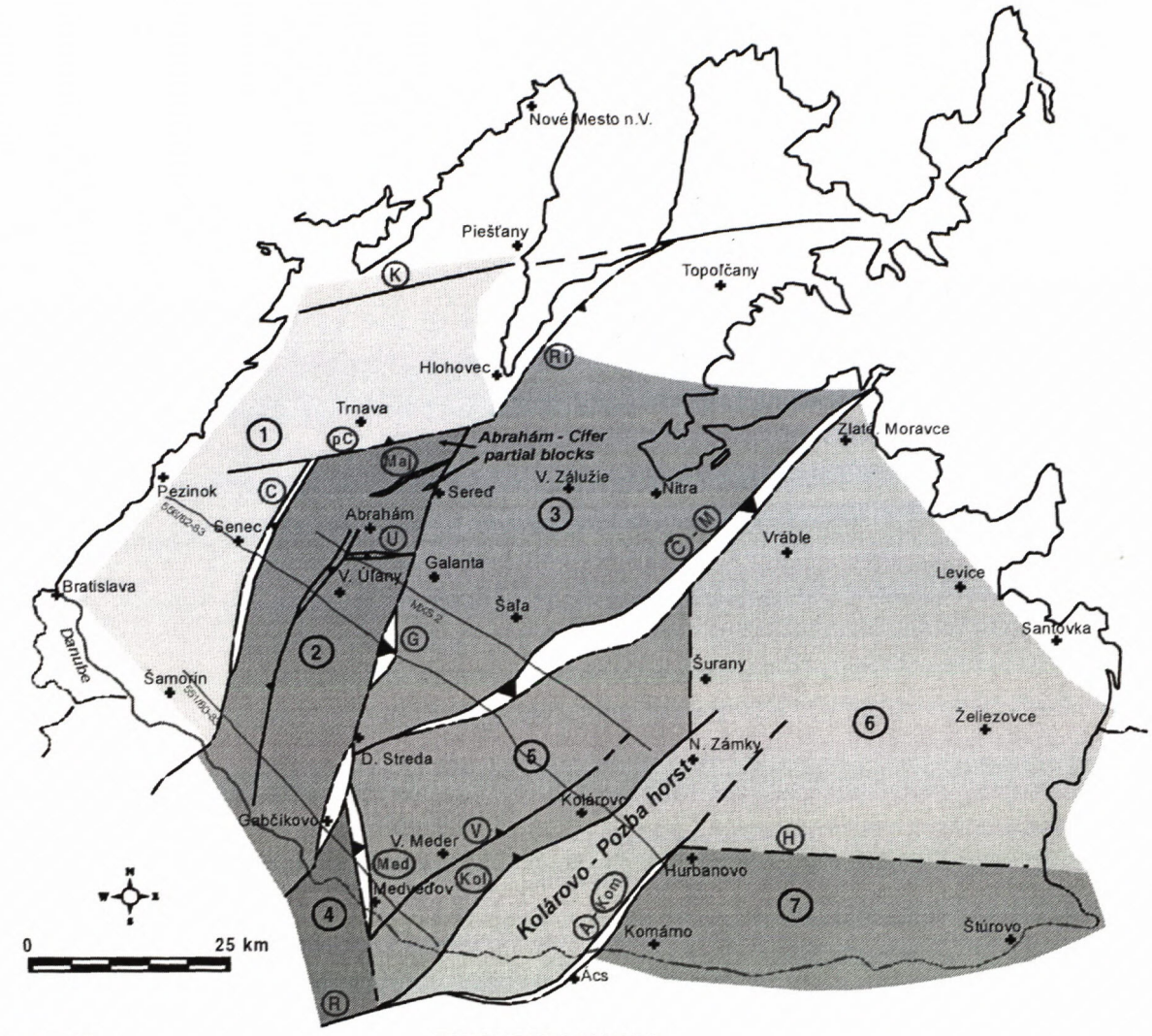

Fig. 1 Slovak part of the Danube Basin - significant upper crustal blocks and important faults (modified after Hrušecký et al., 1998)

veloping in time, at least two pure basin types (pull-apart and rift basins), and the final stage of its evolution is associated with thermal collapse (Hrušecký et al., 1998; Hrušecký and Pospíšil, 1999) The hydrocarbon prospection parameters of such polyhistoric, composed basins terminating with the thermal sag phase are very good. Even, on assumption of a small number of structural phases during the basin evolution, these basins are considered to be the most promising in regard to the generation and accumulation of hydrocarbons (Shannon and Naylor, 1989).

Evaluation of the hydrocarbon prospection parameters in the Slovak part of the Danube Basin shows that at least its central part has sufficiency of source rocks, potential

traps and reservoir rocks in the pre-Tertiary basement and within the Neogene fill. Until now, eight prospective exploration areas have been defined. The most promising strata for hydrocarbon prospection appear to be sands and sandstones of levels **2** and **3** (Badenian, Sarmatian and Lower Pannonian sediments) and the weathered surface of the pre-Tertiary basement in the shallower parts of the basin (Hrušecký, 1997, 1999). A favourable factor is the large number of direct and indirect indications of hydrocarbons in boreholes, but also within the reflection seismic profiles. Misgiving of high or dominant contents of non-hydrocarbon gases in the gas mixture in the basin need not be well-founded. World experience (e.g. Hunt, 1982) shows that hydrocarbon gases together with non-hydrocarbon gases (CO_2, N_2,, H_2S) in basins frequently display areal and also depth zonality. Gas quality maps (Hrušecký et al., 1996) of sediments of the level **2** (Lower Pannonian) confirm that there is a high-methane-content zone in the central part of the Danube Basin. Positive for hydrocarbon exploration is the existence of several prospective areas inside this Lower Pannonian high-methane-content zone or in its vicinity.

References

Hrušecký, I. (1997): Central part of the Danube Basin in Slovakia - geophysical-geological model of the structure and its influence on hydrocarbon perspectives of the region. PhD. thesis. Comenius University, Bratislava, pp. 1-159 (in Slovak).

Hrušecký, I. (1999): Central part of the Danube Basin in Slovakia: Geophysical and geological model in regard to hydrocarbon prospection. EGRSE Journal, Brno, Special issue, Vol VI., No 1, pp. 2-55.

Hrušecký, I., Pereszlényi, M., Šefara, J. & Vass, D. (1993): Structure of the Danube Basin in a view of the interpretation of new and reinterpretation of older geophysical data. In: Rakús, M. and Vozár, J. (Eds.): Geodynamic model and deep structure of the Western Carpathians. GÚDŠ, Bratislava, pp. 291-296 (in Slovak).

Hrušecký, I., Šefara, J., Masaryk, P. & Lintnerová, O. (1996): The structural-facies development and exploration potential of the Slovak part of the Danube basin. In: Wessely, G. and Liebl, W. (Eds.): Oil and Gas in Alpidic Thrustbelts and Basins of Central and Eastern Europe. EAGE Spec. Publ. No.5, Geol. Soc. of London, pp. 417-429.

Hrušecký, I., Bielik, M., Šefara, J. & Kúšik, D. (1998): Slovak part of the Danube Basin - From geological structure to lithospheric dynamics - defined from seismic profiles. Contribution to Geophysics and Geodesy, 28, 4, pp. 205-226.

Hrušecký, I. & Pospíšil, L. (1999): Slovak part of the Danube basin – from passive and active rifting to thermal collapse. Abstracts of the 3nd Conference of Slovak Geophysicits. Contributions to Geophysics and Geodesy, 29, 2, pp. 137-138. (Abstract and poster presentation), Bratislava.

Hunt, J. M. (1982): Petroleum geochemistry and geology. Mir, Moscow, pp. 1-703.

Shannon, P. M. & Naylor, D. (1989): Petroleum Basin Studies. Graham and Trotman, London, pp. 1-206.