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MIOCENE HYDROCARBON RESERVOIRS AND POOLS IN EASTERN HUNGARY

by

M. SZENTGYÖRGYI

The location map shows the hydrocarbon fields where oil and gas accumulated in Miocene reservoirs (Fig. 1) of the fields 12 are located in Transdanubia and the rest in the Great Hungarian Plain. These fields represent nearly 10% of the proved hydrocarbon reserves. One fourth of Hungary's oil and gas resources can be found in multiple reservoirs hydrodynamically connected with Miocene rocks. This paper deals only with that part of the country which is east of the river Tisza (Fig. 2).

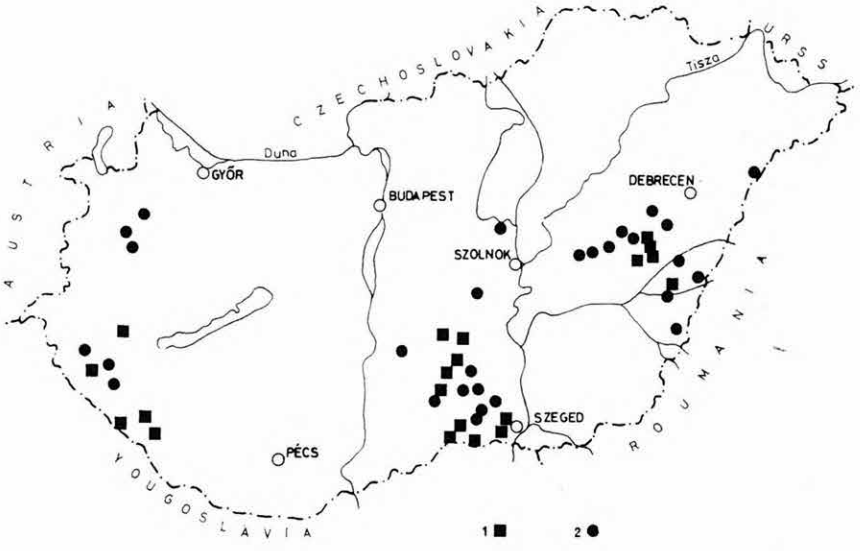

Fig. 1. Location map of Miocene reservoirs and pools in Hungary
1 Natural gas, *2* oil

On this territory there are five Neogene basins, the borders of which where drawn along the negative watersheds. In these basins out of 68 hydrocarbon occurrences 25 reservoirs consist of Miocene rocks or are hydrodynamically connected with Miocene formations. 22% of the discovered hydrocarbon resources can be found in them. The most significant occurrences are the pools at Hajdúszoboszló and Szeghalom.

The Miocene formations rest unconformably on the surface of the Paleozoic, Mesozoic and Paleogene basement, respectively. Hydrocarbon accumulated in multiple reservoirs and rarely bed reservoirs. The impermeable seal rocks are the Lower

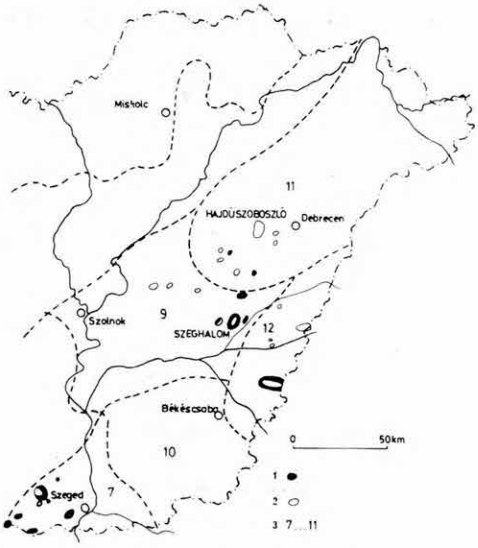

Fig. 2. Location map of the pools dealt with
1 Oil, *2* natural gas, *3* 7—11 area of Neogene partial basins

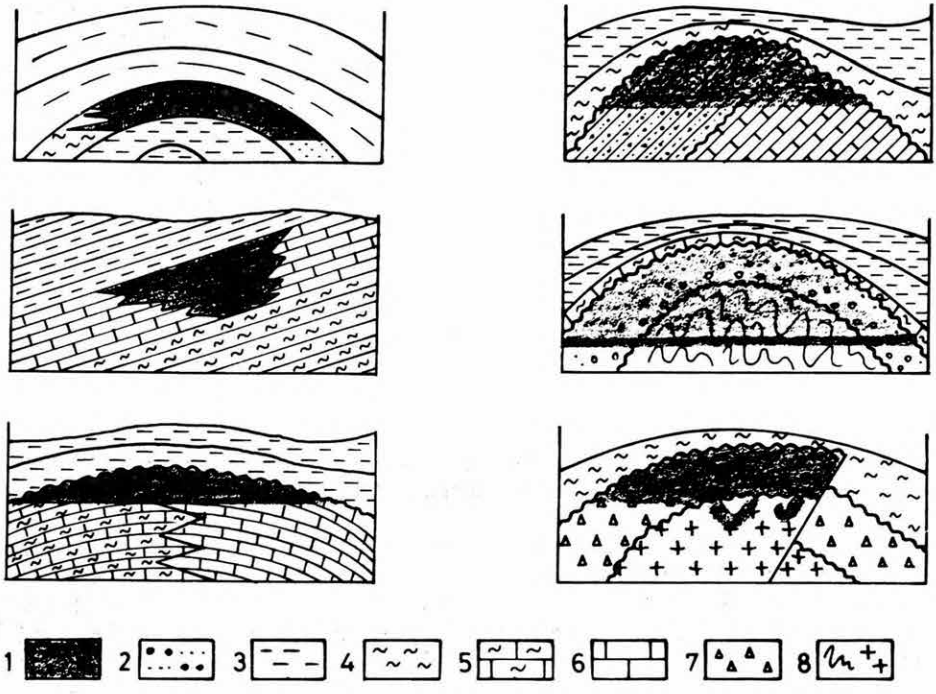

Fig. 3. Different types of traps
1 Fluid content (hydrocarbon), *2* sandstone, *3* clayey marl, *4* marl, *5* calcareous marl, *6* limestone, *7* breccia, *8* metamorphite

Pannonian calcareous marls and marls. The traps are due to either lithological or permeability changes or by truncation and sealing. However the combination of structural and stratigraphic features constitutes the most important type (Fig. 3).

Even the bed reservoirs are lithologically and petrophysically varied. This type of reservoirs can be found in 14 fields of the 39 beds of this pools 27 stone free gas (Fig. 4). Coarse-grained reservoirs (Miocene breccias, conglomerates, sandstones) are the most common. Another important reservoir type consists of heterogeneous sediments: alternation of fine to medium grained detrital sediments, with slightly marl-shale and limestone interbedding. The carbonate reservoir rocks are mostly lithothamnian or oolitic limestones and calcareous marls. The Neogene volcanic complex (agglomerates, tuffs) is not important as reservoir.

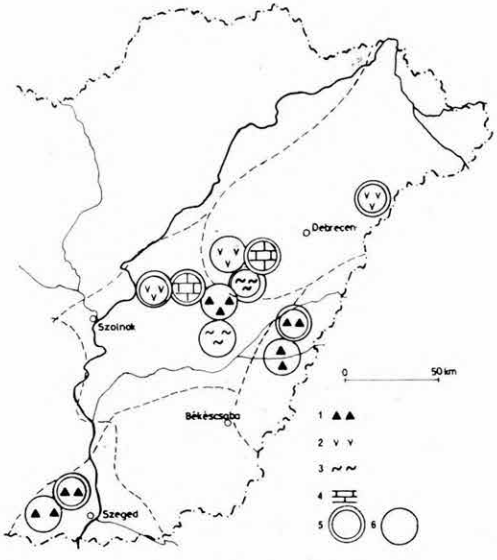

Fig. 4. Reservoir rocks of bed reservoirs

1 Coarse-grained sediments, *2* volcanic rocks, *3* heterogeneous sediments, *4* carbonate rocks, *5* natural gas, *6* oil

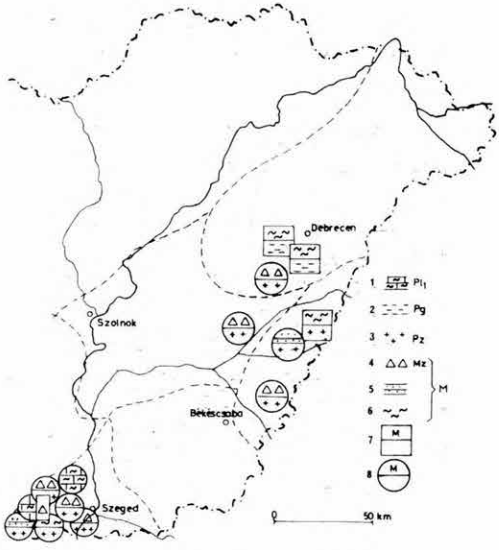

Fig. 5. Rocks of multiple reservoirs (with the age of rocks)

1 Calcareous marl, *2* flysch, *3* metamorphite, *4* breccia, *5* sandstone, *6* lithologically heterogeneous sequence, *7* natural gas, *8* oil

Oil and gas accumulated in 17 multiple reservoirs of 14 fields in the Great Hungarian Plain. In some cases the hydrocarbons come partly from fractured basement rocks (two-porosity system). Fig. 5 shows the dominant fluid content and the age of the storing rocks. Lower Pannonian and Miocene calcareous marls contain some oil only in one pool in the southern Great Hungarian Plain. The most significant free gas resources are stored in the sandstone matrix and narrow fractures of the Palaeogene flysch sequence and they are connected with the overlying Miocene carbonate formations.

At one place there is hydrodynamic connection between the Triassic fractured dolomite and the Miocene breccia. The most important is the combination of Miocene reservoir rocks with Precambrian metamorphites (gneis, amphibolite, granite). The basement rock stores in the fractures (Fig. 6).

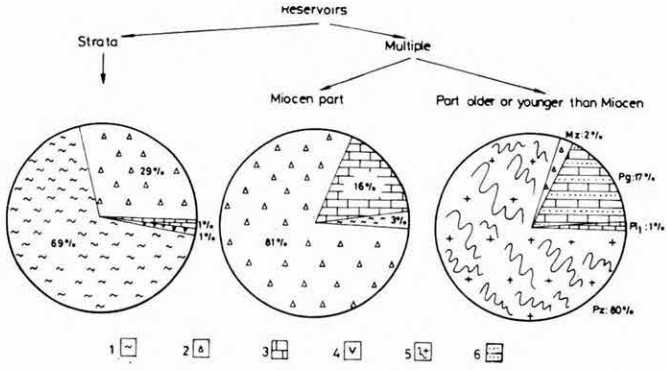

Fig. 6. Distribution of reserves in the study area

1 In heterogeneous rocks, *2* in coarse-grained rocks, *3* in carbonate rocks, *4* in volcanic rocks, *5* in metamorphites, *6* in sandstones

The petrophysical properties of Miocene reservoirs are rather varied. The average matrix porosity of the rocks is between 5.1—18.6%. The extreme porosity values measured on core samples are the following:

— coarse detrital sequence of reservoirs caracterized by 2.5—15.9%. The maximum is 29.6%.
— porosity of limestones is 5.0—19.3% (max. 29.6%),
— average porosity of volcanics 6.0% (max. 16.0%),
— shale porosity is 1.1—8.2% (average is 5.1%).

The Szeghalom pool developed mostly in Miocene reservoir rock is one of the most significant gas-cupped oil pools. The Miocene reservoir consists of sandstone and conglomerate (Fig. 7). Measured average porosity is 12.9% in reservoir part.

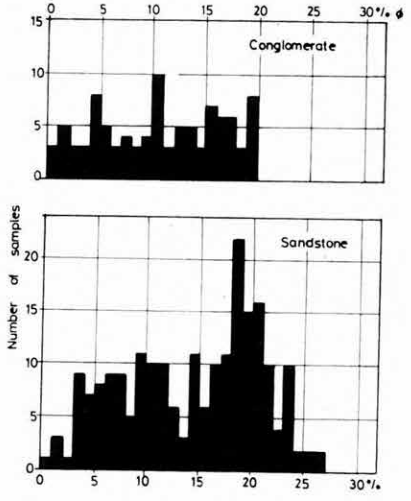

Fig. 7. Distribution of porosity in Miocene reservoir rocks pool of Szeghalom (data provided by the testing of core samples)

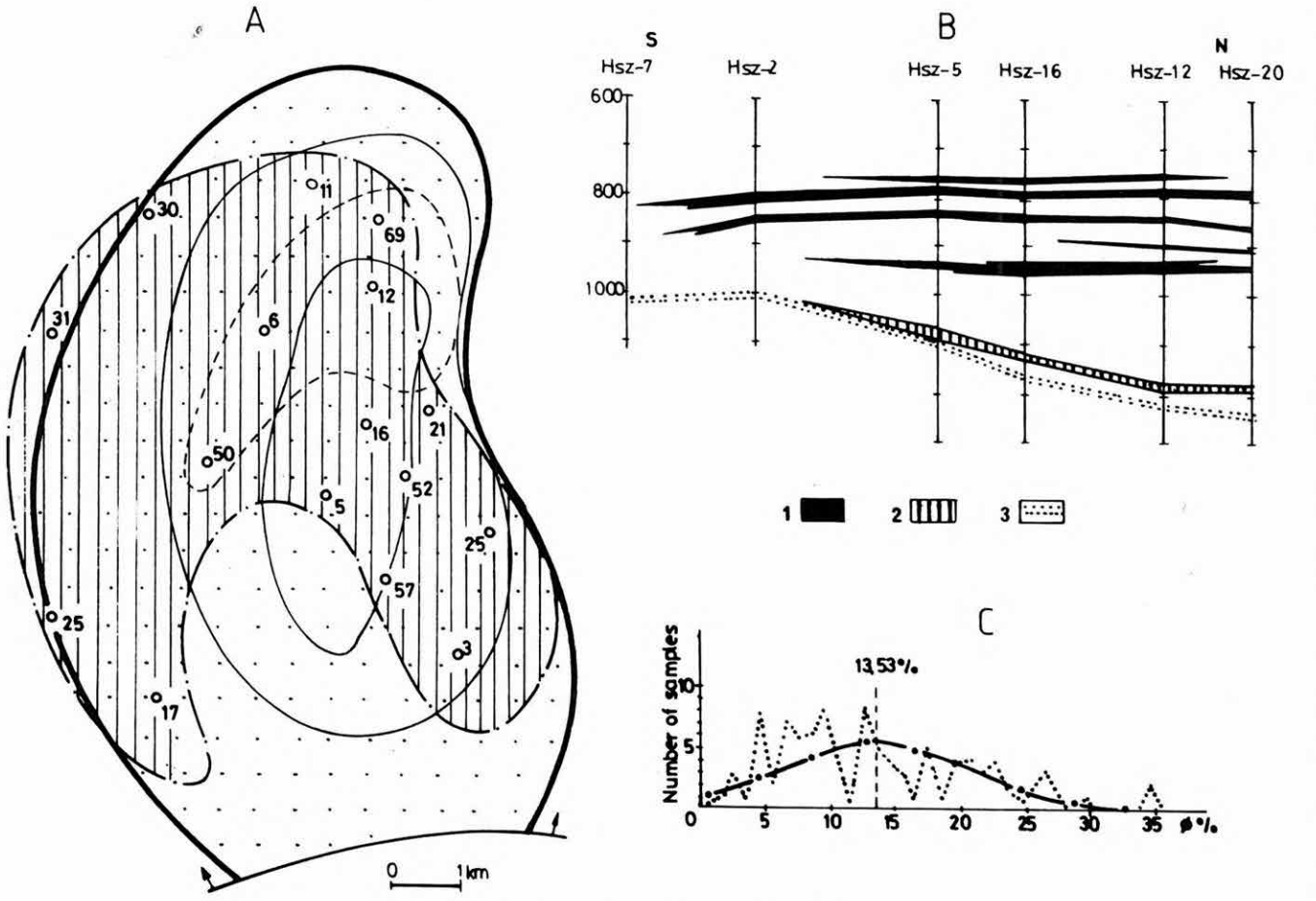

Fig. 8. Geological sketch of pool Hajdúszoboszló

A: Extension and position of Miocene carbonate reservoir rocks in the pool.—B: Position of natural gas reservoirs.—*1* Pannonian sandstone reservoirs, *2* Miocene oolitic limestone reservoir, *3* Paleogene flysch reservoir.—C: Distribution of porosities in Miocene oolitic limestones

An important free-gas pool can be found at Hajdúszoboszló in the Miocene limestone and the Paleogene flysch series (Fig. 8). The flysch complex is made up by alternating layers of sandstones, shales and siltstones; porosity is due to fracturing caused by faulting. The Miocene reservoir part is oolitic limestone; its porosity is due to oolitic texture with partially cemented interstices. Average porosity of the limestone is 13.5%. Calculated average permeability for the total reservoir range between: 10 and $843 \cdot 10^{-3}$ μm^2. Estimated values of connate water saturation are between 20—75%.

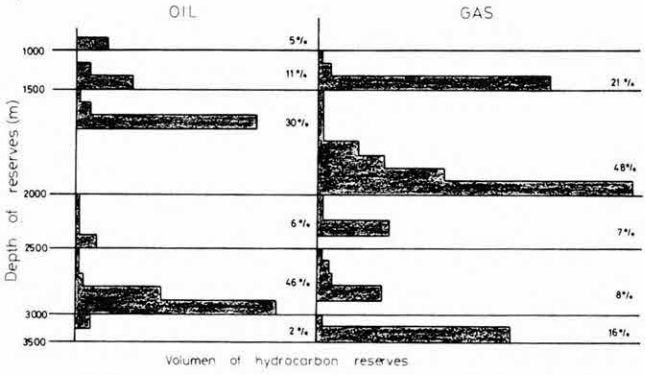

Fig. 9. Distribution of oil and gas reserves versus depth

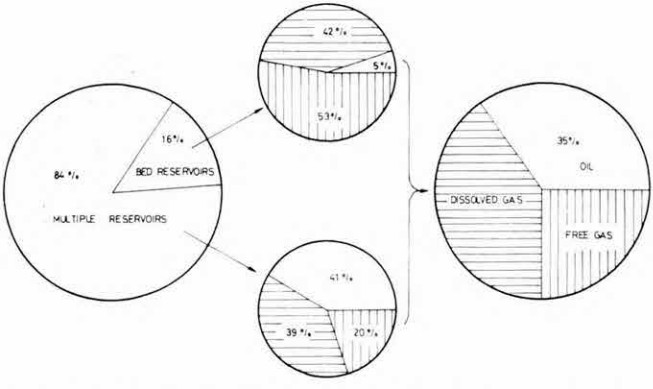

Fig. 10. Distribution of hydrocarbons in the two types of reservoirs

Approximately the half of oil resources in the Miocene reservoirs of the Great Plain area is to be found in the interval between 2500—3000 m and 30% between 1500—2000 m (Fig. 9). Half of the natural gas resources are also bound to the same intervals. Only 16% of resources of partly or totally Miocene reservoirs is contained in bed reservoirs. However, only 5% of their total hydrocarbon volume is oil. 41% of the resources stored in multiple reservoirs is oil combined. 35% of the hydrocarbons to be found in these two types of reservoirs is oil (Fig. 10). On the basis of

hydrocarbon prediction prospectivity of the combined Neogene and pre-Neogene structures has been increased. Accordingly, the importance of Miocene reservoirs and their contribution to the hydrocarbon reserves of Hungary has increased as well.

Mrs. MARIA SZENTGYÖRGYI
Oil Exploring Company
SZOLNOK P.O.B. 85.
H-5001. Hungary