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THE ROLE OF NEOGENE DEPOSITS AMONG THE MINERAL RESOURCES IN HUNGARY

by
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The successful exploration of Neogene mineral resources in Hungary required the knowledge of geodynamics, palaeogeography and basin development. This knowledge could be obtained by the combined use of the evidence provided by biostratigraphy, geophysics, geochemistry, magnetostratigraphy, radiometry, volcanology and other disciplines.

The present paper deals with the final results of this joint effort.

Hydrocarbon geology

In the central part of the Pannonian basin Neogene deposits overlie Palaeo-Mesozoic and Paleogene sediments. They play an important role in hydrocarbon exploration and production in Hungary.

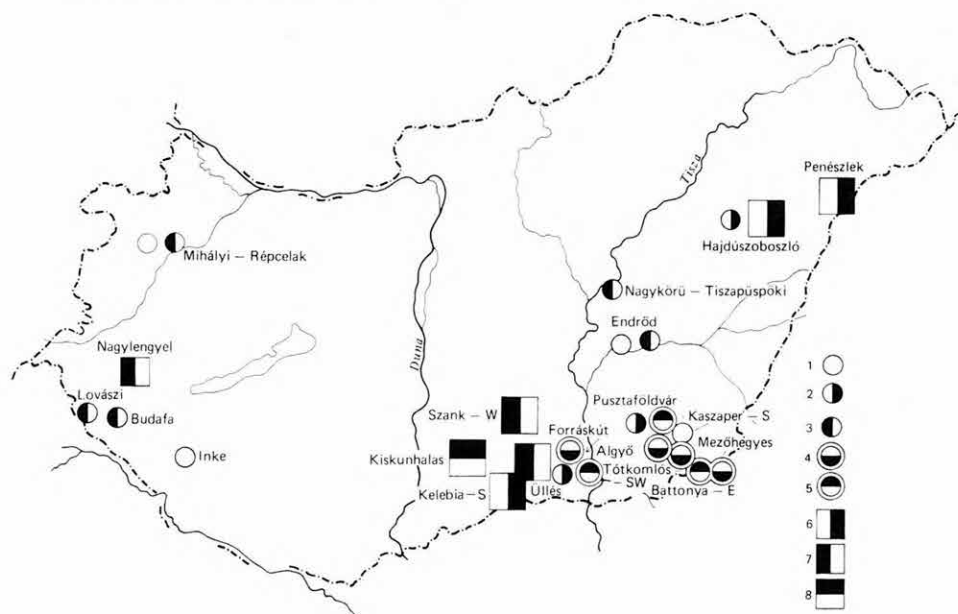


Fig. 1. Regional oil and gas bearing horizons in Neogene beds in Hungary

1 Middle part of Pliocene—Upper Pannonian, 2 lower part of Pliocene—Upper Pannonian, 3 middle part of Pliocene—Lower Pannonian, 4 basal limy marl of Pliocene—Lower Pannonian, 5 basal conglomerate of Pliocene—Lower Pannonian.
—Miocene: 6 Sarmatian beds, 7 Badenian beds, 8 Karpatian beds

Several oil and natural gas bearing horizons could be identified in the Neogene sequences (from top to bottom):

- in the middle third of the Pliocene—Upper Pannonian sequence the horizon of gas pools (Fig. 1, 1);
- in the lower third of the Pliocene—Upper Pannonian sequence and at the top of the Lower Pannonian the horizon of the oil and gas pools, mostly sandstone (Fig. 1, 2);
- in the middle third of the Pliocene—Lower Pannonian the horizon of oil and gas pools in sandstone layers (Fig. 1, 3);
- Pliocene fissured calcareous marl—oil bearing horizon (Fig. 1, 4);
- Pliocene basal conglomerate horizon of gas and oil pools (Fig. 1, 5);
- Sarmatian conglomerate—limestone—calcareous marl, horizon of oil (Fig. 1, 6);
- Badenian sandstone—conglomerate—breccia horizon of gas and oil pools (Fig. 1, 7);
- Karpatian clastic sequence horizon of gas pools (Fig. 1, 8).

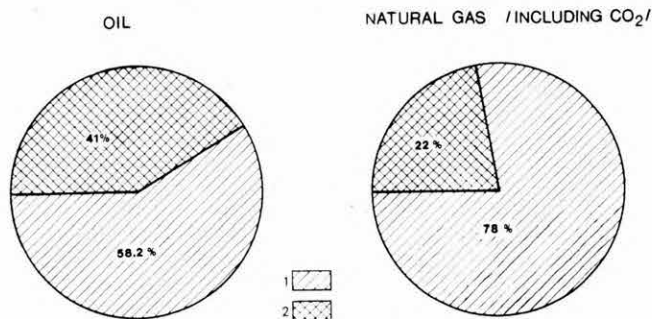


Fig. 2. Distribution of HC-reserves on the basis of their geological age
1 Neogene, 2 pre-Neogene

The pelitic sediments of the Neogene sequence can be considered, in most cases, the source rocks of the hydrocarbon pools. The total initial hydrocarbon resources of the country, can be put to 538 million ton (Mt), 41.8 per cent of which is oil, while 58.2 per cent is natural gas.

In the basin regions 77% of the country's territory, altogether 12 Neogene and one Paleogene subbasins can be distinguished. In the decreasing order of the known initial hydrocarbon resources these are the Fig. 3. Further Hungarian possibilities are shown on the Table 1—3.

Finally, the hypothetical-speculative resources of the previous Neogene basins will be shown, with respect to the oil—natural gas ratio, in function of the age of the possible hydrocarbon bearing sequences (Table 4).

The distribution of the hypothetical-speculative hydrocarbon resources between the Neogene and Pre-Neogene reserves, without the Paleogene and undiscovered Neogene reserves, in the function of depth is the Table 5 (in per cent).

The basins, according to their hypothetical-speculative resources can be arranged according to the following order:

1 Nagykovács 15.2%, 2 Kiskovács 13.2%, 3 Békés 11.6%, 4 Paleogene 10.7%, 5 Zala—S Balaton 8.8%, 6 Bihar 7.6%, 7 N Great Hungarian Plain 7.5%, 8 Hajdúszás

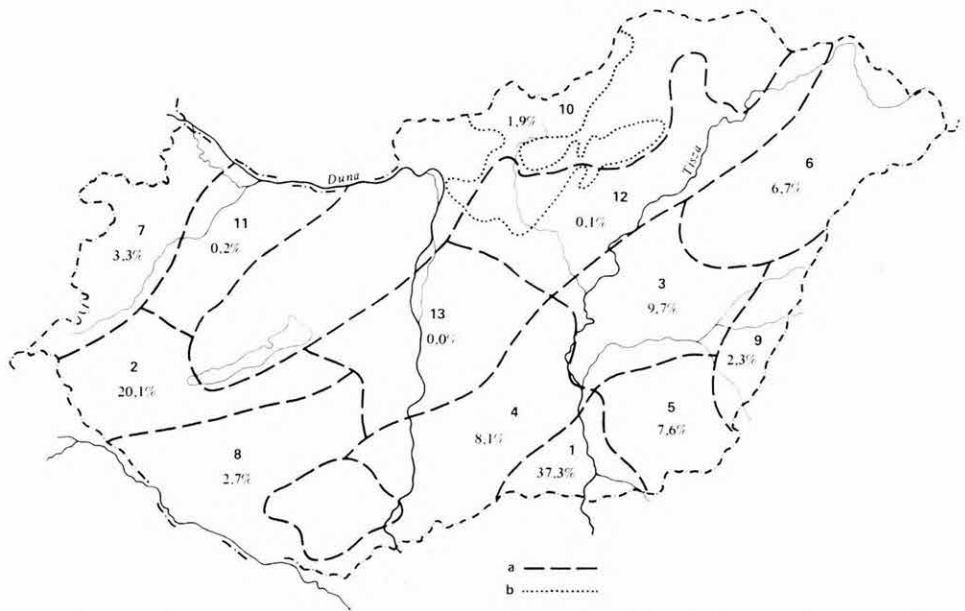


Fig. 3. Ranking of Hungarian subbasins on the basis of their original oil and gas in place reserves
 Subbasins: 1 Szeged, 2 Zala—S Balaton, 3 Nagykunság, 4 Kiskunság, 5 Békés, 6 Hajdúság, 7 W Little Hungarian Plain, 8 Somogy—Dráva valley, 9 Bihar, 10 Paleogene, 11 E Little Hungarian Plain, 12 N Great Hungarian Plain, 13 Duna.—
 a Boundary of Neogene subbasin, b boundary of Paleogene subbasin

6.3%, 9 E Little Hungarian Plain 4.6%, 10 Somogy—Dráva valley 4.4%, 11 Neogene (subtile) 4.4%, 12 Szeged 3.0%, 13 Danube 1.3%, 14 W Little Hungarian Plain 1.2%.

The majority of the oil and natural gas produced in Hungary comes from Neogene sequences.

In 1984 2.0 Mt of oil and 7.1 Gm³ of natural gas was produced in Hungary. 79.74% of the oil and 80.33% of the natural gas came from Neogene hydrocarbon bearing sequences. Since the starting of the industrial scale production in 1937 altogether 60.1 Mt oil and 102.6 Gm³ natural gas was exploited (1st January 1985) (Fig. 4).

Distribution of the known and hypothetical speculative hydrocarbon resources according to stratigraphic units

Table 1

Stratigraphic unit	Initial potential resources (%)	Known reserves (%)	Hypothetical-speculative resources (%)
Neogene	100	67.3	32.7
Pre-Neogene (Mz + Pz)	100	45.7	54.3
Paleogene	100	31.6	68.4
Neogene (subtile traps)	100	—	100.0
Hungary's total	100	66.5	33.5

Distribution of the different types of hydrocarbon reserves according to geological ages

Table 2

Stratigraphic unit	Initial potential resources (%)	Known reserves (%)	Hypothetical-speculative resources (%)
Neogene	58.6	69.8	44.1
Pre-Neogene (Mz+Pz)	32.6	26.4	40.7
Paleogene	6.8	3.8	10.8
Neogene (subtile traps)	2.0	—	4.4
Hungary's total	100.0	100.0	100.0

Distribution of the quality of hydrocarbon reserves to be discovered

Table 3

Stratigraphic unit	Initial potential resources (%)	Known reserves (%)	Hypothetical-speculative resources (%)
Neogene	32.1	54.0	43.3
Pre-Neogene (Mz+Pz)	3.3	5.5	1.9
Paleogene	23.6	1.5	3.1
Neogene (subtile traps)	41.0	39.0	51.7
Hungary's total	100.0	100.0	100.0

Hypothetic-speculative hydrocarbon resources of Neogene basins according to stratigraphic units

Table 4

Name of the Neogene basin	OIL		NATURAL GAS (incl. CO ₂)	
	NG-series %	PRENG-series %	NG-series %	PRENG-series %
1 W Little Hungarian Plain	2.6	97.4	2.7	97.3
2 E Little Hungarian Plain	7.4	92.6	23.7	76.3
3 Zala—S Balaton	18.0	82.0	85.9	14.1
4 Somogy—Dráva valley	52.5	47.5	43.6	56.4
5 Danube	42.4	57.6	34.1	65.9
6 Kiskunság	21.5	78.5	48.5	51.5
7 Szeged	74.9	25.1	72.2	27.8
8 N Great Hungarian Plain	64.3	35.7	61.0	39.0
9 Nagykunság	72.4	27.6	69.5	30.5
10 Békés	82.0	18.0	79.8	20.2
11 Hajdúság	81.1	18.9	78.8	21.2
12 Bihar	25.4	74.6	22.8	77

Hypothetic—speculative hydrocarbon resources in function of the depth of occurrence

Table 5

Depth range	Neogene %	Pre-Neogene %	Total %
0—1500 m	11.1	16.0	13.4
1500—3000 m	52.0	52.8	52.4
Deeper than 3000 m	36.9	31.2	34.2
	100.0	100.0	100.0

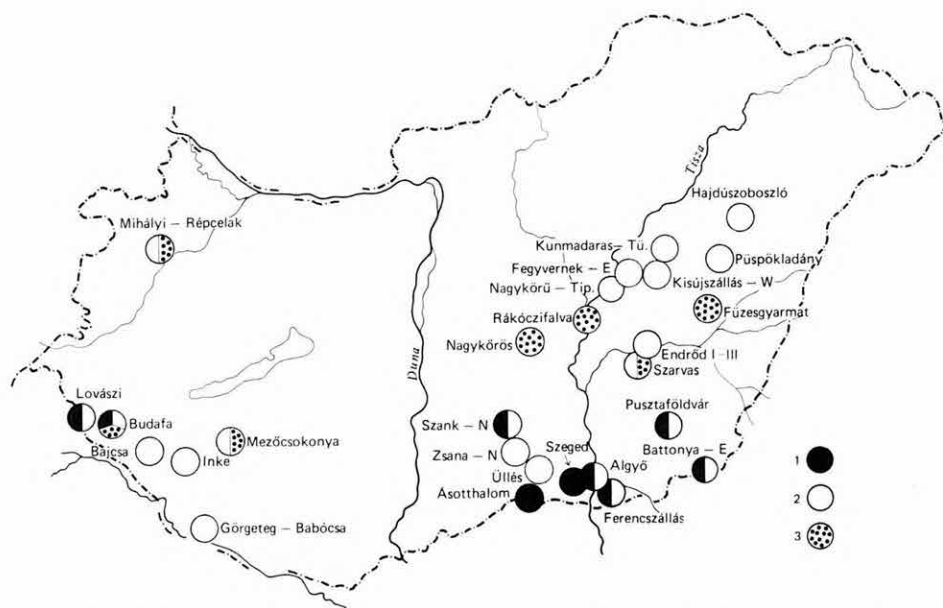


Fig. 4. Oil, gas and carbon dioxide fields of Hungary [with reserves more than 1 Mt (Gm^3)] in Neogene beds

1 Oil, 2 natural gas, 3 carbon dioxide

During this period the oil production from Neogene sequences was 63.34%, while that of the natural gas reached the 95.40%.

In the next section the occurrences are enumerated where the Neogene hydrocarbon resources of the deposits exceed the 1 Mt (Gm^3) initial reserves (according to the data of 1st January 1984).

Oil: Szank (Szank-W), Lovászi, Budafa—Kiscsehi, Ferencszállás, Szeged, Ásotthalom, Pusztaföldvár, Battonya, Battonya-E, Algyő. — **Natural gas:** Inke, Mihályi—Répcelak, Zsana-N, Görgeteg—Babócsa, Szank (Szank-W), Mezőcsokonya, Bajcsa, Lovászi, Budafa—Kiscsehi, Püspökladány, Szarvas, Kisújszállás-W, Fegyvernek—Fegyvernek-E, Nagykovács—Tiszapüspöki, Endrőd I—III, Ferencszállás, Hajdúszoboszló, Pusztaföldvár, Battonya, Úllés-basement, Tatarülés-E, Battonya-E. — **CO₂:** Mezőcsokonya, Nagykovács, Budafa-basement, Mihályi—Répcelak, Füzessyarmat, Rákóczi-falva, Szarvas.

Geology of brown coal and lignite

The Hungarian Neogene brown coals and lignites occur in five basins (Fig. 5):

- the Borsod–Ózd (Ottningian brown coal, ca 425 km²);
- the Nógrád (Ottningian brown coal, ca 335 km²);
- the Várpalota–Herend (Badenian brown coal, ca 60 km²);
- the Cserhát–Mátra–Bükkalja (Upper Pannonian lignite, ca 485 km²);
- The Torony (Upper Pannonian lignite, ca 117 km²).

There are some more smaller Miocene brown coal occurrences that already have no registered coal reserves or the reserves of which are insignificant:

- the Brennberg deposits (Ottningian);
- the Hidas deposits (Badenian).

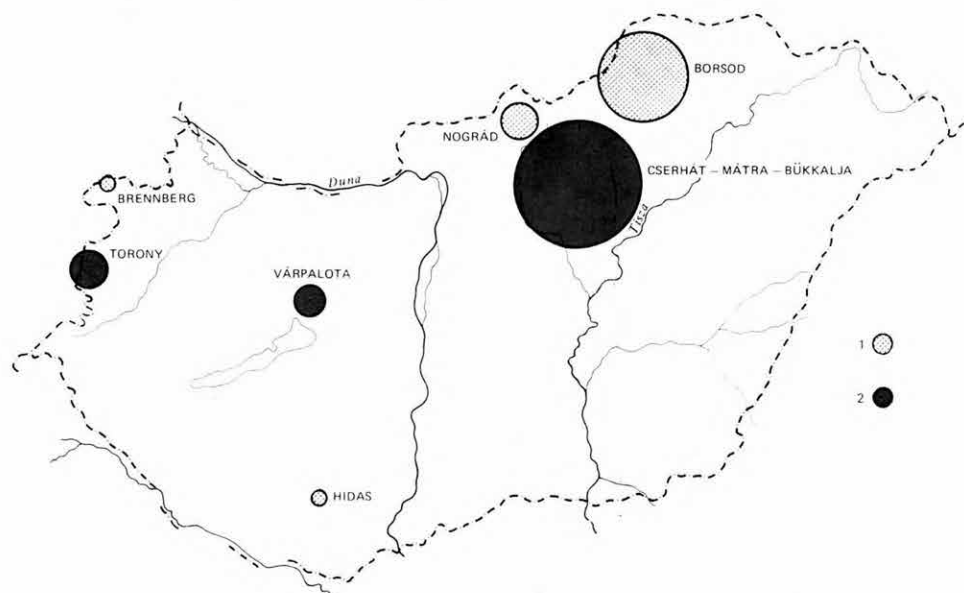


Fig. 5. Coal deposits of Neogene age in Hungary

1 Brown coal, 2 lignite

The quantity of the Neogene coal reserves, and the extent of their exploitation, as compared to the total amount of the coal reserves in Hungary, is shown on Fig. 6.

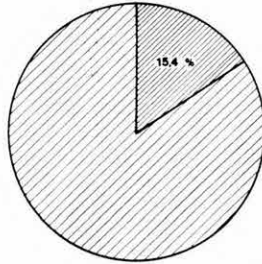
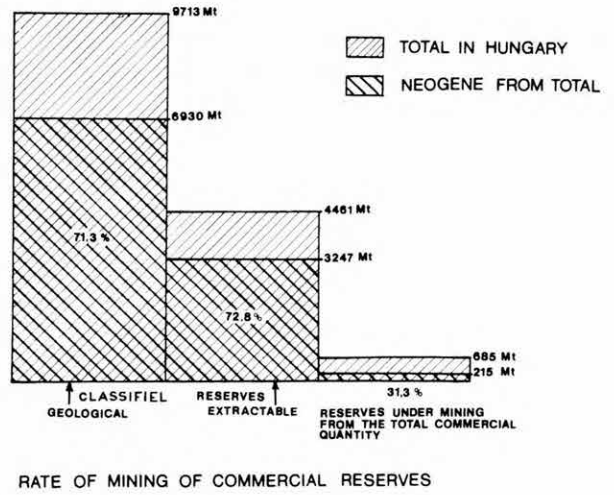
The following conclusions can be drawn:

- almost three fourth (71–72%) of both the coal reserves and that of the industrial coal reserves can be found in the Neogene sequences;
- the prognostic possibilities of the Neogene coals are very significant (71.7%).

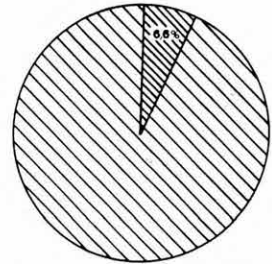
Within the annual 25 Mt coal production in Hungary the share of the Neogene coals is important (Fig. 7).

Accordingly,

- more than half of the coal produced in Hungary is of Neogene age (54.7%);
- 43.6% of the heat value is supplied by Neogene coals;
- the majority of the Neogene coals is exploited by open pit methods.



FROM TOTAL IN HUNGARY: 686 Mt



FROM TOTAL OF NEOGENE AGE IN HUNGARY: 215 Mt

Fig. 6.
The quantity of Neogene coal deposits in Hungary and rate of their mining

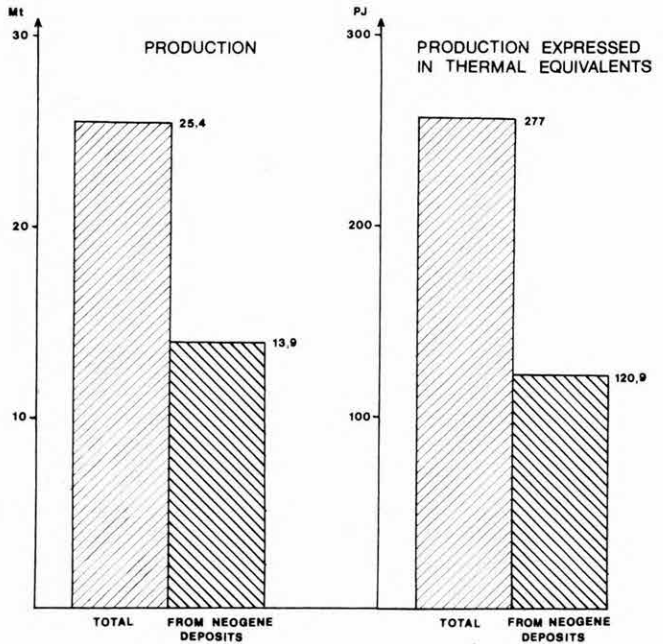


Fig. 7.
Coal production in 1984

Non-metallic mineral resources

Hungary is comparatively rich in non-metallic mineral resources (Fig. 8). The most valuable group of these resources occur in the *Tokaj* Mountains: noble clays (kaolinite, bentonite, illite, alunite), potassium tuff, perlites (perlite, pumicite), and tuffs containing zeolite, that are ever increasingly utilized in agriculture and food industry.

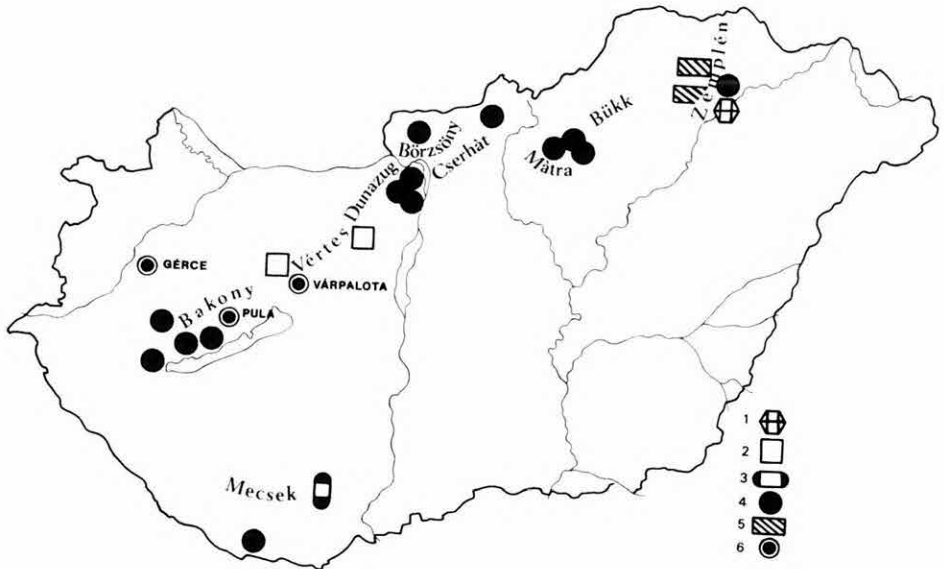


Fig. 8. Important mining sites of industrial minerals in beds of Neogene age in Hungary

1 Rare clays, 2 siliceous sand, glass sand, foundry sand, 3 feldspar-bearing sand, 4 building and decorative stones, 5 ceramic clay, 6 amelioration material

In the *Bakony* and *Vértes* Mountains different siliceous sands (glass sands, soulding sands, and polishing sands (quartz sandstone, soft limestone for preparing coloured earth, etc. are exploited.

In the foreground of the *Mecsek* Mountains feldspar rich sand is stripped.

The Neogene ornamental and building stones occur mainly the volcanic mountain (Balatonfelvidék, Dunazug Mts, Börzsöny Mts, Cserhát Mts, Mátra Mts, Tokaj Mts). The reserves of andesite, dacite, basalt, and rhyolite rocks and their tuffs are at the disposal of the building industry in a quantity of milliard tons. A special ornamental-building stone is the Pannonian "card-type stratified" sandstone and the pearl gravel (Hévíz, Tapolca basin). Pannonian clay for coarse ceramic purposes (brick, construction ceramics, tiles) is available. Northern Hungary the Miocene (Eggenburgian and Karpatian) schlier is also suitable for brick making.

The bulk of the Neogene mineral raw materials for a melioration purposes are offered by the unconsolidated Leithakalk (ca 43%) and by the recently discovered Pannonian oil shale, the alginite. The occurrences of the latter at Gércé, Pula, Várpalota and in the Cserhát Mts provide an exploitable reserve of 100 Mt, and the prospective reserves are estimated to the order of magnitude of milliard tons.

The share of the Neogene resources among the explored and registered non-metallic mineral resources in Hungary amounts to a total of 30.4% (3.3 Mrd t). Of these, 47.4% can be exploited by open-cast mining.

The economic significance of Neogene ore mineralization

Ore mineralization is bound to Neogene volcanites:

- in the Börzsöny Mts (Badenian andesites),
- in the Mátra Mts (Badenian andesites),
- in the Tokaj Mts (Sarmatian andesites).

Classified polymetallic ore reserves, can be found only at one site, in the GyöngyöSOROSZI region. Here a smaller ore mine and ore dressing plant was operated. Unfortunately, however, for economic reasons the operation was suspended period in 1985.

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