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PEAT EXPLORATION FOR MEDICAL USE

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Abstract

An extended swamp was developed in the western foreland of Lake Balaton in the Holocene. The peat has already been explored for hundred years. The peat based product, the HUMET-R syrup became a medicine by the '90s. Its main component is humin acid that acts as a transporter of trace elements or as a reducer of the excess trace elements of the human body. The aim of the exploration was to delineate medical peat in Keszthely region. By the 84 core drillings of the 190 000 m^2 exploration area 367 000 m^3 of exploitable peat reserve was found. The peat is divided into three types: mature, fibrous peat (bull liver) and mixed types. The bulk of the reserve belongs to the mixed peat type. It has favourable properties such as 43 – 68 m % of humin acid and 12 – 16 m % of ash content.

The groundwater table is at 0.4 – 0.6 m thus it is necessary to drawdown during the periods of exploitation.

Keywords: peat, geochemistry, medicine.

1. Introduction

Although the peat was already used by German tribes A.D., the main peat exploration and utilisation only began in the 17th and 18th century. In Hungary the peat prospection began in the middle of the last century (POKORNY, 1863). Detailed surveys, explorations and reserve qualifications were only made after the turn of the century. Thickness map of peat reserves of Balaton region was published by LÁSZLÓ (1913).

Peat Exploration Institute was founded in 1948 that made a national survey. Geological and mining institutes also prepared studies on the physical and chemical properties of the peat occurrences. The National Peat Cadaster was completed in 1981 including reserves and quality data.

Chief veterinary of Keszthely E. Csucska has already begun the humin acid based medical tests for several tens of years. He used peat and paludal soil from the swamps of Keszthely-Alsópáhok valley that was considered as a non-exploitable reserve according to the former national surveys. For extracting humin acid that peat proved to be very excellent.

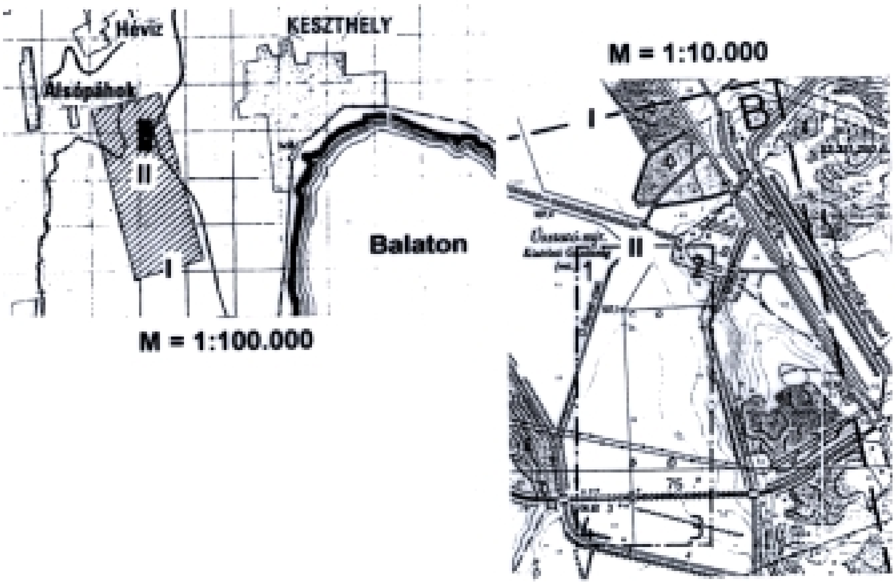

Fig. 1. The location of the study area and its exploration map. I – preprospecting area, II – exploration area

The HUMET-R syrup was qualified as a medical product (no. OGYI-430/1993). The producer HORIZON-MULTIPLAN Co. invited the Department of Engineering Geology for a preliminary and for a later detailed peat exploration.

2. Geography and Geology of Peat Deposits

2.1. Setting and Geography

The study area is located in the Keszthely–Hévíz bay *W* of the town of Keszthely, *N* of the main national road no. 75 near Úsztató major (Úsztató Manor) (*Fig. 1*).

The present area has a very low land-use value since it is a meadow with high weeds (*Fig. 2*). From geographical point of view the area belongs to the moors and fens of Kis-Balaton (Small Balaton) and Zala völgy (Zala valley) in the form of a $N - S$ oriented sub-basin. The 105 – 407 m a.s.l. area is bordered by two gentle humps of 110 – 120 m a.s.l. on each sides.

Fig. 2. Flat bog area with meadow

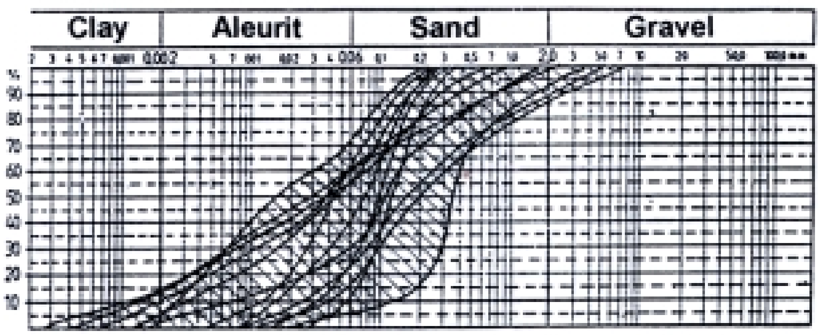

Fig. 3. Grain-size distribution of underlying beds

2.2. Geology

Young Tertiary and Quaternary loose sediments cover the area having relatively simple structural setting.

The *Triassic* Main Dolomite that gives the bulk of Keszthely Mountains has outcrops 3 km to the N in Hévíz. In the study area it is found at a depth of 100 – 150 m forming faulted step-like blocks.

The Triassic is covered by *Upper Pannonian* conglomerates, sandstones, clayey-sandstone, and thin bedded sandstones. The Upper Pannonian strata are exposed in the open pits of the elevated side humps.

The *Pleistocene* period was characterised by punctuated uplift and related erosion. Along the $NNW - SSE$ structural lines humps and gentle valleys were developed giving place to surface streams. The sediment accumulation was insignificant, only river deposits, slope debris and on the humps loess were formed.

The *Holocene* was the period of infilling. In the shallow subsided basins

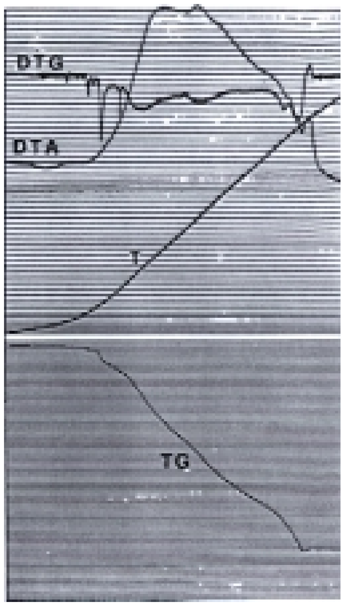

Fig. 4. Hand drilling of peat deposit with spiral bit sampling

above the Pannonian lacustrine deposits or on the top of the Pleistocene fluvial clays, sands, fine gravels Holocene swamps and fens were formed (*Fig. 3*). In the swamps of Balaton region mainly sedge and reed peats were formed (*Fig. 4*). Paludal carbonates are often found below the peat deposits. Peat can be exposed on the surface or frequently covered by paludal soil (*Fig. 5*).

The productive peat deposit is 3 – 5 m thick and it passes into muddy clayey sediments toward its margins (*Fig. 6*).

2.3. Hydrogeology

The surface water cover of the peat occurrence was eliminated by the regularisation of Lake Balaton and River Zala. The swampy area of Keszthely–Hévíz bay is now canalised and thus the water regimen and water table are controlled by locked channels.

As a consequence the average ground water table is at 0.4 – 0.6 m on the study area. Several years of drought resulted in a water table drop down to 1.1 m or after rainy periods surface waters were also observed (*Figs 6, 7*).

This condition led us to conclude that during the periods of main exploitation it is necessary to drawdown the groundwater. The surface waters and ground water were also tested for drinking water quality, toxicity and bacteriologically since the peat is used for medical purposes (*Table 1*).

Fig. 5. Large scale sampling of paludal soil and peat with well drilling method and concrete well ring emplacement

The tests have shown that the water quality is very different from the drinking standards. Toxic metals are below the standards, meanwhile the bacteriological tests showed significant pollution that is related to the cow farm. The bacteriological pollution is eliminated during the extraction of humin acid from peat.

3. Description of Peat Deposit

3.1. Peat Reserve

The detailed exploration only covered a small part of the legally allowed exploration area since there is only a limited need for peat (*Fig. 1*).

The study area is 645 m long and 292 m wide having a surface of 190 000 m^2. The exploration was performed by 84 drillings in a network of 50 $\times$ 50 m. The drilled depth was in between 3.5 and 70 m (*Fig. 9*).

According to the drillings the peat deposit can be divided into three types:

– paludal soil

– mature peat
– mixed peat
– fibrous peat (bull liver)

Table 2 shows the average thickness and the reserves of each type.

Fig. 6. Derivatogramme of peaty mud from the base of the deposit

Fig. 7. Groundwater in the monitoring well

3.2. Peat Quality

The analyses showed that there was a relation between the thickness of the peat deposit and its quality. The thickest deposits represent three different peat decay phase: mature, mixed, fibrous. The bulk of the deposit consists of mixed type of peat. The mature peat that occurs in the upper part of the deposit becomes thicker to the northern and eastern margins of the exploration area. The fibrous peat, characterising the lower part of the deposit is more significant in the central part of the study area.

The decay state also determines the ash, the organic matter and the humin acid content as well as the water absorption capacity of the peat. As a consequence the value of the reserve depends not only on the quantity but on the quality and

Table 1. Chemical and bacteriological composition of surface water and groundwater

Analysed components		Surface water	Groundwater	
		Channel of Úsztató-Manor	Dug well	Drilling no. 9.
Chemical components of water				
COD	mg/l	6	**46**	**229**
Cl^-	mg/l	74	50	**166**
NO_3^-	mg/l	6.6	0	0
NO_2^-	mg/l	0	0	0
SO_4^{2-}	mg/l	77	**540**	**2601**
NH_4^+	mg/l	0.15	**0.33**	**2.4**
Fe^{2+}	mg/l	0	0	0
Mn^{3+}	mg/l	0.02	**0.41**	**1**
Total hardness CaO	mg/l	224	**530**	**1820**
pH		7.16	**5.12**	**5.42**
Relative electric conductivity at 20°C	μS/m	696	**1420**	**3780**
Toxic heavy metals				
As	μg/l	1	6.1	6
Cd	μg/l	<0.5	<0.5	<0.5
Cr	μg/l	<3.0	<3.0	<3.0
Hg	μg/l	<0.2	<0.2	<0.2
Pb	μg/l	<10.0	<10.0	<10.0
Bacteriological tests				
no. of Coliforms/100 ml		300	600	0
Fekalias streptococcus/100 ml		250	40	6000
Number of colonies				
at 22°C-on/1 ml		3360	600	4200
at 37°C-on/1 ml		2400	180	2400
Clostridium/50 ml		32	8	50
ENDO no. /100 ml		15000	8000	20000

(the tests were performed in the laboratories of National Health Centre and Medical Survey)

potential usage of the peat.

The peat deposit is covered by 0.5 m of paludal soil that was formed by the oxidation peat and by the concentration of minerals. Its humin acid content is 25 –

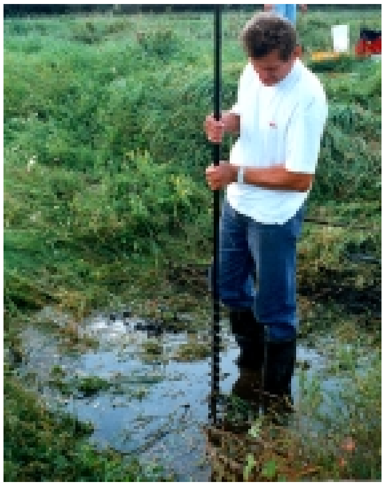

Fig. 8. Elevated groundwater table comes to the surface

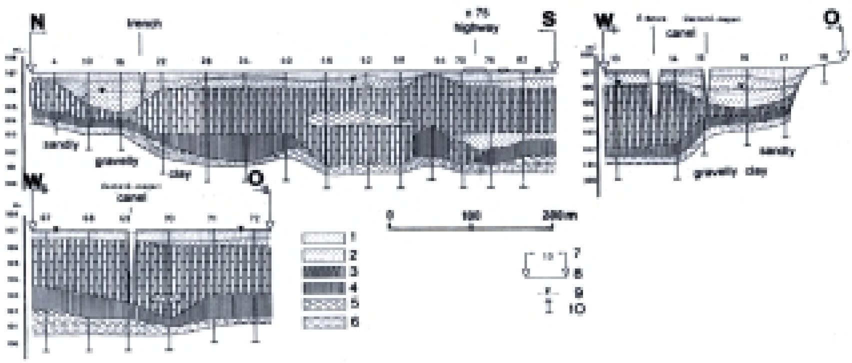

Fig. 9. Geological cross section of the peat deposit. 1 – paludal soil; 2 – mature peat; 3 – mixed peat; 4 – fibrous peat; 5 – peaty mud; 6 – sandy mud, mud; 7 – no. of drilling; 8 – limit of exploration area; 9 – groundwater table; 10 – drilled depth

30 m %, organic matter content is about 40 m %.

The main raw material is the mature, mixed and fibrous peat that has a general vertical pattern. The ash content decreases while the organic matter content increases from the mature to the fibrous peat.

The extractable humin acid, that has a primary importance in medical use, shows some variations between 43 and 68 m % in the productive unit. The highest humin acid content was found in the 0.5 – 2 m zone (*Fig. 10*). The significant decrease in humin acid and increase in ash content below 5 m is related to the

Table 2. Quantitative data of peat deposit, reserves (there is an overlap in peat types thus the given data cannot be simply summed up)

		Average thickness m	Payable reserve 1000 m^3	Exploitable reserve 1000 m^3
Paludal soil		0.45	81.9	**41.7**
Peat				
Peat	mature	0.70*	98.9	
	mixed	2.80*	493.6	
	fibrous	0.90*	148.0	
Total peat reserve		4.20	740.5	**367.8**

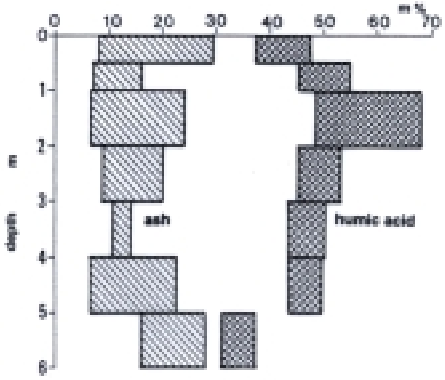

Fig. 10. Quality changes of the peat deposit by depth

appearance of muddy layers, intercalations.

It is very favourable from exploitation point of view that the zones of higher humin acid are found in shallow depth, since the groundwater table in the drillings was below 1 m while the piezometric water table is at 0.4 – 0.6 m.

As the outflow of Hévíz radioactive spa crosses the study area and because of the medical use of peat, analyses have to be considered. Consequently the natural radioactivity of stream side peat and the subsurface peat in the zone of groundwater were also analysed (*Table 3*). The tests showed the effect of radioactive waters, as well as the surface samples gave a K-40, Cs 137 peak due to the catastrophe of Tsernobil. The aggregate radioactivity is not harmful for human health.

Table 3. Natural radioactivity of peat deposit

Sampling site	Activity concentration [Bqr/kg]					
	U-238	U-235	Th-232	K-40	Cs-137	sum
Surface, side of Hévíz-stream	**3586**	275	140	**133**	**85**	4226
TK-1. drilling 1.0 - 2.0 m, below the groundwater table	**3213**	194	66	66	13	3553
TK-2. drilling 1.0 - 2.0 m, below the groundwater table	**3165**	260	55	75	5	3560
comparative data; IAEA soil	981	0	350	360	43	1734

(the tests were performed in the Nuclear Institute of Budapest Technical University

4. Conclusions

The detailed geological exploration has proved that there is a significant peat reserve on an area that was formerly considered as barren. The 367 000 m^3 exploitable reserve provides enough raw material for medical use for several tens of years. With the extension of the area further geological reserves are predicted.

The exploitation does not interfere with the environment but it establishes a valuable wet niche. Despite these positive effects it is necessary to get to an agreement with the local self-government and with the responsible authorities.

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