Dewatering and Environment—Problems of Dewatering in Hungary

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1. ABSTRACT

This report is going to point to that the effect of the mining dewatering on the area of Transdanubian Mountain Range has reached a phase when the cost of dewatering and providing damages can seriously jeopardize a profitable mining operation. Up to 60s the interest of mining had been dominant only, but since the begining of 80s the conceptions of industrial development and the value of envirorment protection have been changed. The natural karstwater balance of the TMR can be presented (Figure 1.and 2.) and the present situation of it points to that the descharge has exceeded the reacharge in 50 %. During the past 10 years the decreasing of the stored karstic water resourches was 1.1 km . The decreasing of the spring yields reached 80-82 % of the natural ones. (Figure 3-4.). Conservation of the present discharge may lead up to the totaly drain of the karstwater regime. A computer aid control system had been to develop by the bauxite mining and using of it the yield of dewatering decreased and a moderate rising of the water table has started since 1986.
A recunstruction was made at the biggest thermal-medicinal lake its springs have had their source in 40 meter depth inside a spring cave at the bottom of the lake. Earlier the spring yield decreased due to the dewatering activity of mines. As a result of using of the CAC system and the providing works at the thermal spring,the karstwater balance has got in the state of equilibrum, the first cost was decreased and spring yield was increased and the enviromental limits were adverted from the way of mining.

2. INTRODUCTION

Some papers of the previous International Mine Congreses delt with the dewatering activity of coal and bauxite mining of the Transdanubian Monutain Range (TMR) in Hungary and their effect caused on the enviroment. This paper is going to point to that the dewatering activities of mines on this area has reached a phase where the costs of dewatering and providing the damages, can seriously do jeopardize a profitable mining activity.

Bisedes the high costs, there are potential damages, not equivalent in money, on the enviroment of great importance (ie changes in the thermal karstwater system) which may cause irreversible changes on it. During the 50s and 60s years the interest of the mining had been dominat only, but in the 70s and since the begining of the 80s there has been a decisive change in the conceptions of industrual developmeent and in the value of enviroment protection too. Under the pressure of cirumstances the specialist of mining have started to deal with the problems of the enviroment protection with a great intenzity (ie. recultivation, considerate technology to enviroment) besides the exclusively mining and dewatering problems.

3. THE NATURAL KARSTWATER BALANCE OF THE TMR

The dewatering activity had started to be in life at the end of the last century, but the pumped yields were too limited comparing with the natural water circulation and the karstwater balance at the end of the 40s seems to be a natural one. The TMR consist of four separete mountains and date of their natural karstwater circulation can be seen on Figure 1. The 50 year average infiltration on the area of the TMR is 8700 l/s due to the calculations. The value of infiltration of a given year can be range between 3500 and 13400 l/s depending on the precipitation and its distribution during the year. The average yields of the karstwater circulation on the area of the TMR are as follows:

springs	7050 l/s
discharge for non karstic aquifers and springs in brook beds	2010 l/s
Total yield	9060 l/s

The difference between the reacharge and discharge is not more than 3-4 % which seems to be a good harmony in hydrological pont of view. The natural karstwater table can be found on the Figure 2 which represents the situation of the karstwater regime before the begining of hard mining dewatering. The annual change of the water table can be ± 7÷10 meters depending the annual infiltration during the natural conditions. On the places where the permeability of the rocks is a bad one this water level change may be reched the 40-50 meters per year.

4. THE PRESENT SITUATION OF THE KARSTWATER REGIME

Between the 1950 and 1960 the expanding activity of the mining demanded to open new mines. The drift and the operated stages in mines had gone step by step deeper level under the karstwater table and this activity resulted the pumped yields to be increased. The critical situation was developed at the midle of 80s in pont of view of mining and the enviromental protection too. The mines operated by dewatering and the dried springs, as well as the springs being yet in life can be seen on Figure 3. That was a fact the value of the inflituration during the last 10 years was less than the 50 year average in 7-10 %, however the averege discharge was as follows:

mine water		9900 l/s
springs		1230 l/s
water works		1870 l/s
	Total	13000 l/s

Under the intensive dewatering activity the flow direction inside the non karstic aquifers situated at the foot of hills turned back and the waters of this type of aquifers (sands, gravels etc) have fed the karstic water regime. The lack between the rearcharge and discharge of the karstwater balance has been 4300 l/s meaning that the discharge exceeded the reacharge in 50 %. The reacharge feeding the karstic water regime from the non karstic aquifers was about 800 l/s. The decreasing of the stored karstic water resourches had been 1.1. km (3500 l/s during the past 10 years and due to this fact the water level was reduced in 12 meter as an average reduction for the total unconfined area of the TMR. The differences and its areal distribution in the karstwater level developed from the begining of the intensive dewatering up to 1987 can be seen on the Figure 4. The greatest decreasing of the water level can be done in the centre of the depression cones and they have exceeded the 100 meters and in one place the 270 meters too. The spring yields decreased in 80-82 %, a lot of them went to be dried (see Figure 3.) and the thermal karstwater reservoirs found at western and easter ends of the TMR run into an especially damaged situation because of the yields of the thermal springs have decreased due to the water pressure loss in the karstic aquifers. The decreasing of the thermal water disharges have reached the 45-50 % of the natural yield of them. According to the outlined bad situation on the karstic water regime on the area of the TMR can not make the dicharge of the karstic aquifer be increased and what is more the present value of the discharge do not be conserved becuse that may lead up to the totaly drain of the karstwater regime.

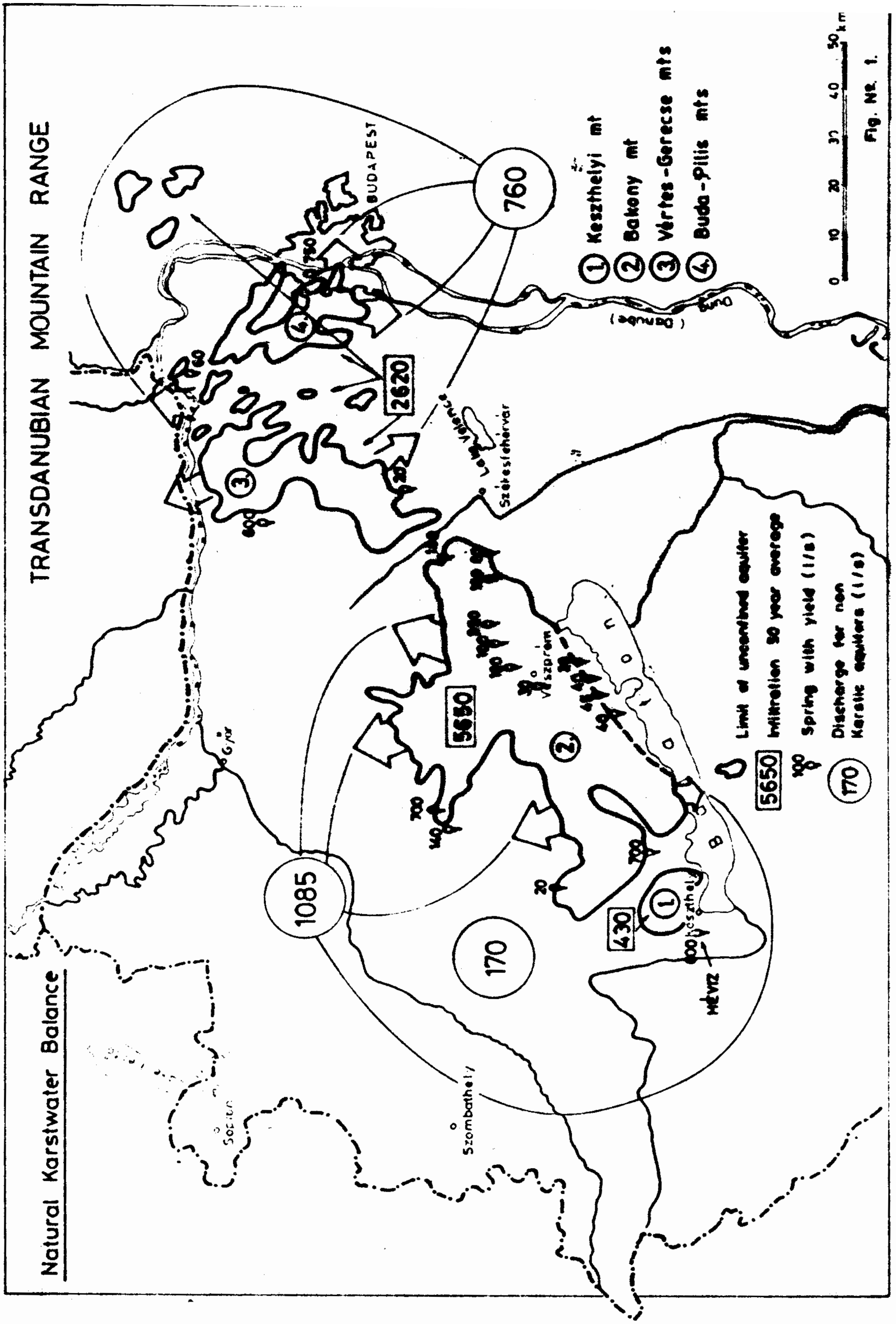
5. EFFORIS TO KEEP THE WATER BALANCE IN THE STATE OF EQUILIBRUM

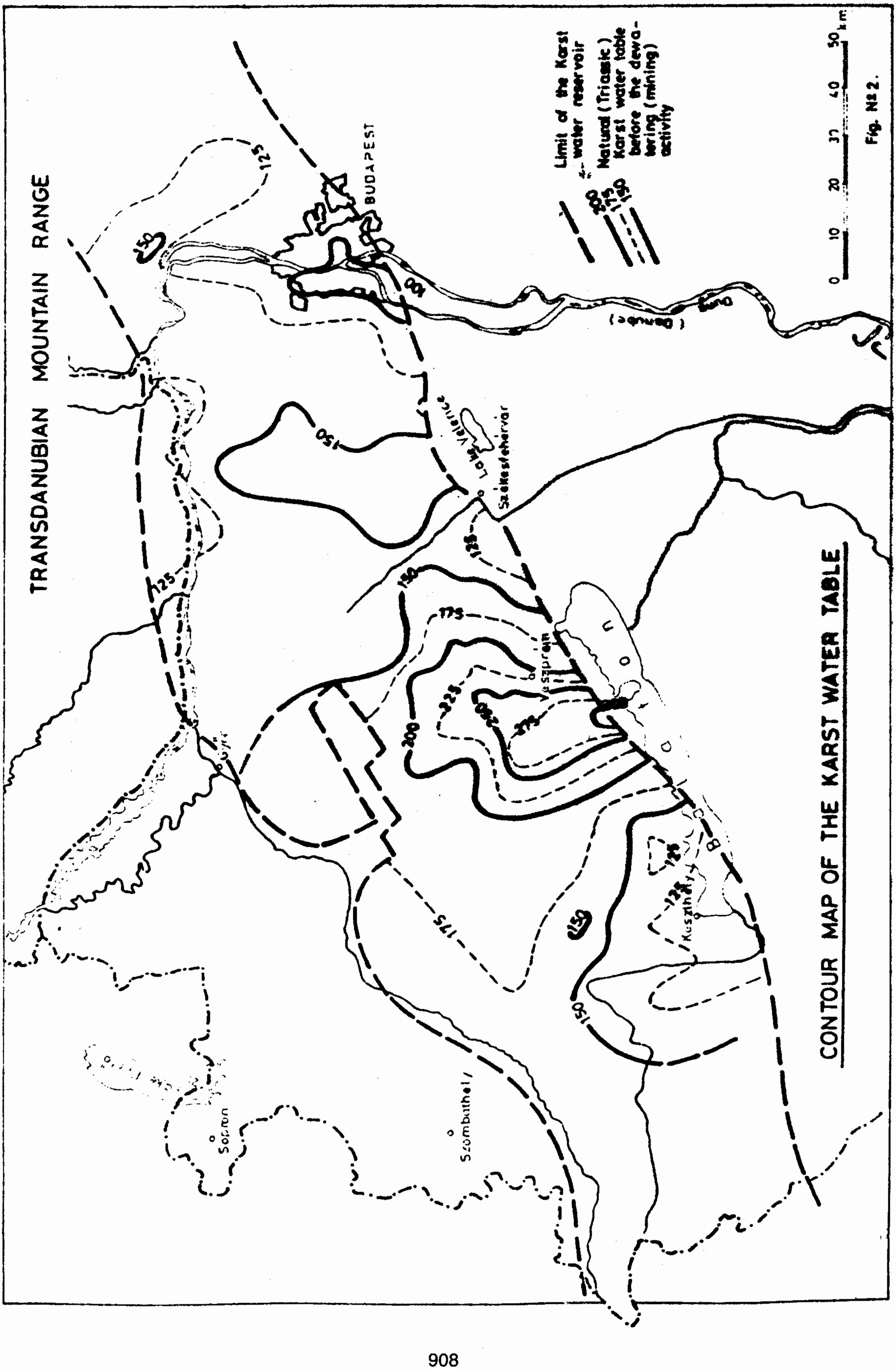
Due to the above mentioned situation the main task for the bauxite mining in Hungary since 1978 has been to develop an equilibrum in the karstwater balance which may lead to stop turning the thermalwater system into worse condition, however can make it regenerate and on the other side to continue the mining. The bauxite mining as the first in the line of mine dewatering production, seeing to total yield of pumped water, made a recognition there had not been sufficient to make a limit for the dewatering yield, but dealing with the reconstruction of thermalwater system had to be done. Frist step was to develop a computer aid control system on the dewatering which has been able to keep the water table in 0.5-1.0 meter under the actual mining floors. This CAC system can put the centres of dewatering in the different part of mining area if it seems to be required. Due to the operation of the CAC system the decreasing of the yeield of dewatering was 25-26 % during the last 10 years. The first cost of production has been decreased by using this CAC system and this activity has led to stop the process of karstwater balance to get worse.

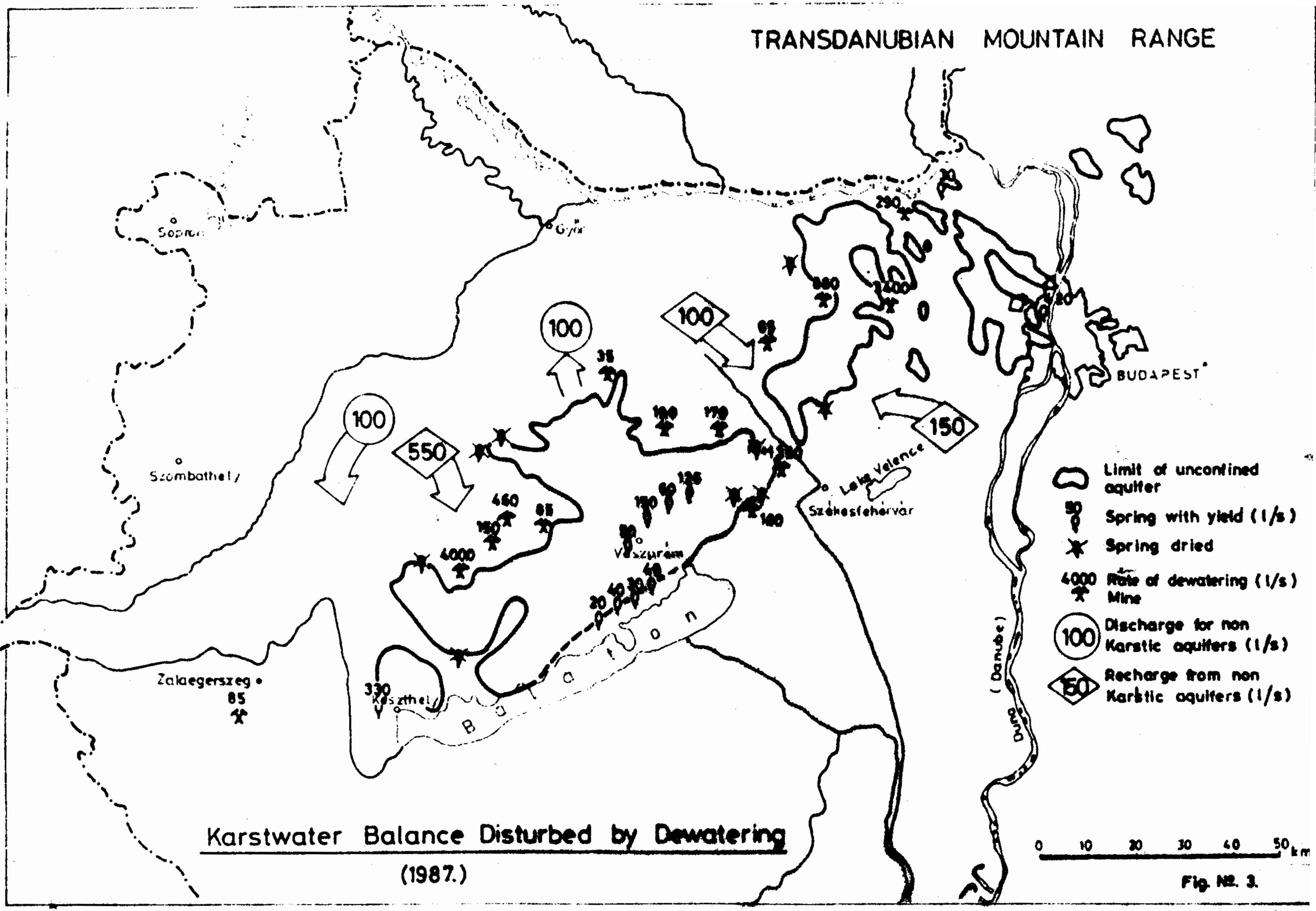
The decreasing in the karstwater table was made be stoped in 1986 and 87 and a moderate rising of the water table has started since 1986. 1987 was the first year when the infiltration exceeded the discharge of the total karstwater circulation. The investigation and weighing ot the biggest spring of the western thermal water regime was the second step. The Hévíz lake is the biggest medicinal lake all over the world and its spings have their source in 40 meter depth inside a spring-cave. The debris got into the bed of the lake during the past centuries had made the cross-section of the sping tunnel be decreased by step by step and the cross-section at the begining of the work was one third of the original one only (see Figure 5.). Due to the spring yields reduced by the minind dewatering the mud being in the lake started to go into the spring cave, and into the spring passes too. Taking into consideration the outlined situations, the local causes of the spring yield reduction could be found besides the water pressure loss caused by the mining dawatering in the surrounding. The cleaning of the lake from the debris and stop of the local hydraulic resistanves inside the spring tunel had been urged and the cost of these works was paid too by the bauxit mining. Due to the results of the prevention activity, the decreasing of the spring yield was stoped in 1983 an a moderate rising of it has been observed (from 290 l/s up to 330 l/s). Taking into consideration the interests of the mining on one side and the interests of the enviromental protection on the other side, the results of our activity on this field have been as follows:

- the decreasing of the first cost and
- the increasing of the spring yield.

According to the results, the enviromental limits were adverted from the way of miming of the bauxite resourches in the bes quality in Hungary.


Natural Karstwater Balance
TRANSDANUBIAN MOUNTAIN RANGE
BUDAPEST
Székesfehérvár
Veszprém
Győr
Szombathely
Keszthely
HÉVÍZ
Duna
(Danube)
760
2620
5650
1085
170
430
① Keszthelyi mt
② Bakony mt
③ Vértes-Gerecse mts
④ Buda-Pilis mts
Limit of unconfined aquifer
5650 Infiltration 30 year average
100 Spring with yield (l/s)
170 Discharge for non Karstic aquifers (l/s)
0 10 20 30 40 50 km
Fig. No. 1.

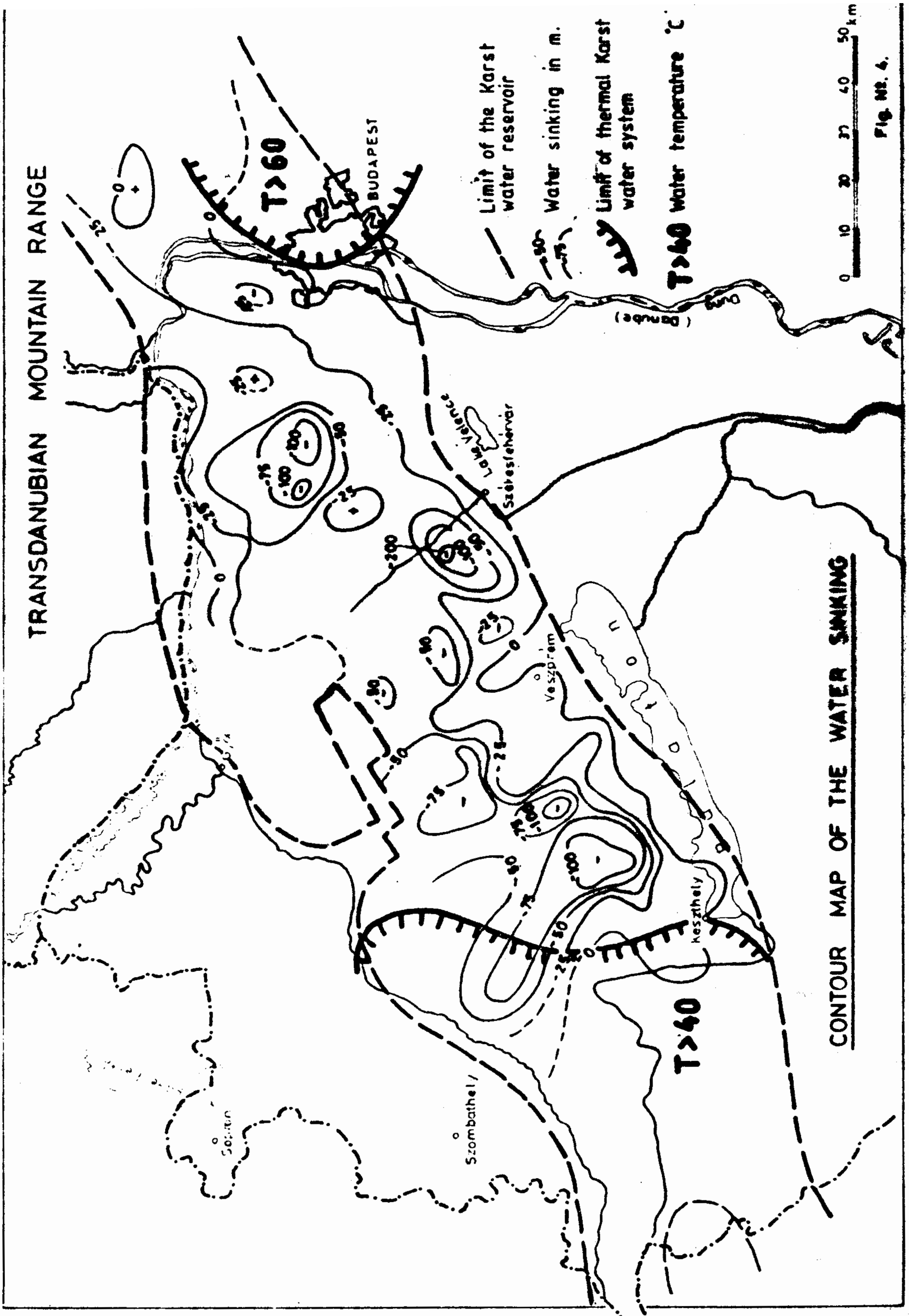

TRANSDANUBIAN MOUNTAIN RANGE
CONTOUR MAP OF THE KARST WATER TABLE
Limit of the Karst water reservoir
Natural (Triassic) Karst water table before the dewatering (mining) activity
200
175
150
0 10 20 30 40 50 km
Fig. N° 2.
BUDAPEST
Duna
(Danube)
Lake Velence
Székesfehérvár
Veszprém
Keszthely
Szombathely
Sopron
BALATON
125
150
175
200
225
250
275

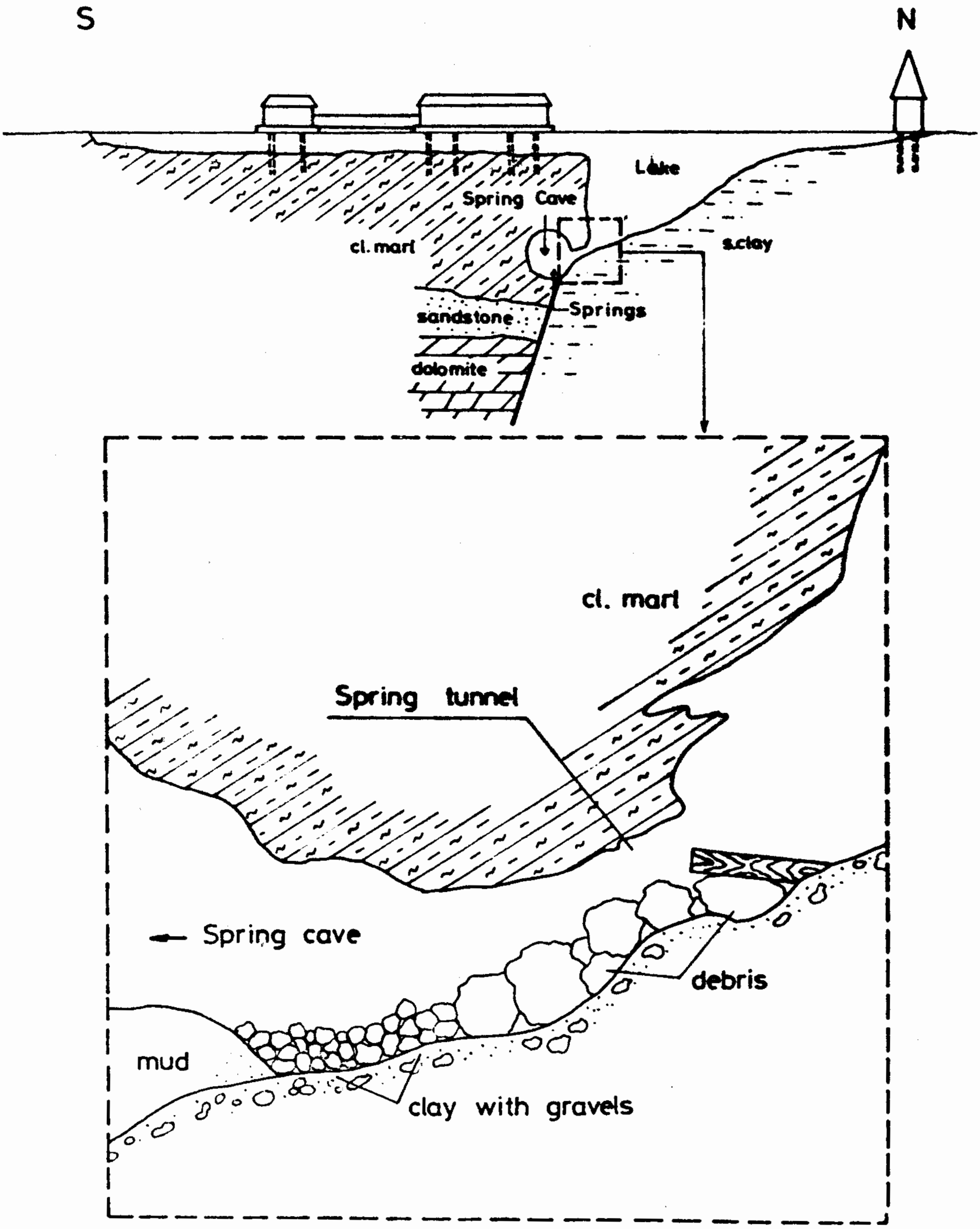


Karstwater Balance Disturbed by Dewatering

(1987.)

Fig. No. 3.


TRANSDANUBIAN MOUNTAIN RANGE
Limit of the Karst water reservoir
Water sinking in m.
Limit of thermal Karst water system
T>40 Water temperature °C
0 10 20 30 40 50 km
Fig. Nr. 4.
BUDAPEST
T>60
T>40
Duna (Danube)
Lake Velence
Székesfehérvár
Veszprém
Keszthely
Szombathely
CONTOUR MAP OF THE WATER SINKING



Héviz lake springs

Fig. Nº 5.