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REBUILDING OF ORIGINAL WATER BALANCE IN KARSTIC RESERVOIRS

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ABSTRACT

Distortion has occured in karst water balance of Transdanubian Mountains /Hungary/ because of precipitation shortage and a great volume of artificial water discharges. The rebuilding of the original water balance requires new, effective measures i.e. reducing of mine water pumping /by grouting/; reinjection of mine water; utilization of mine water as drinking water in water supply systems and direct protection of thermal springs.

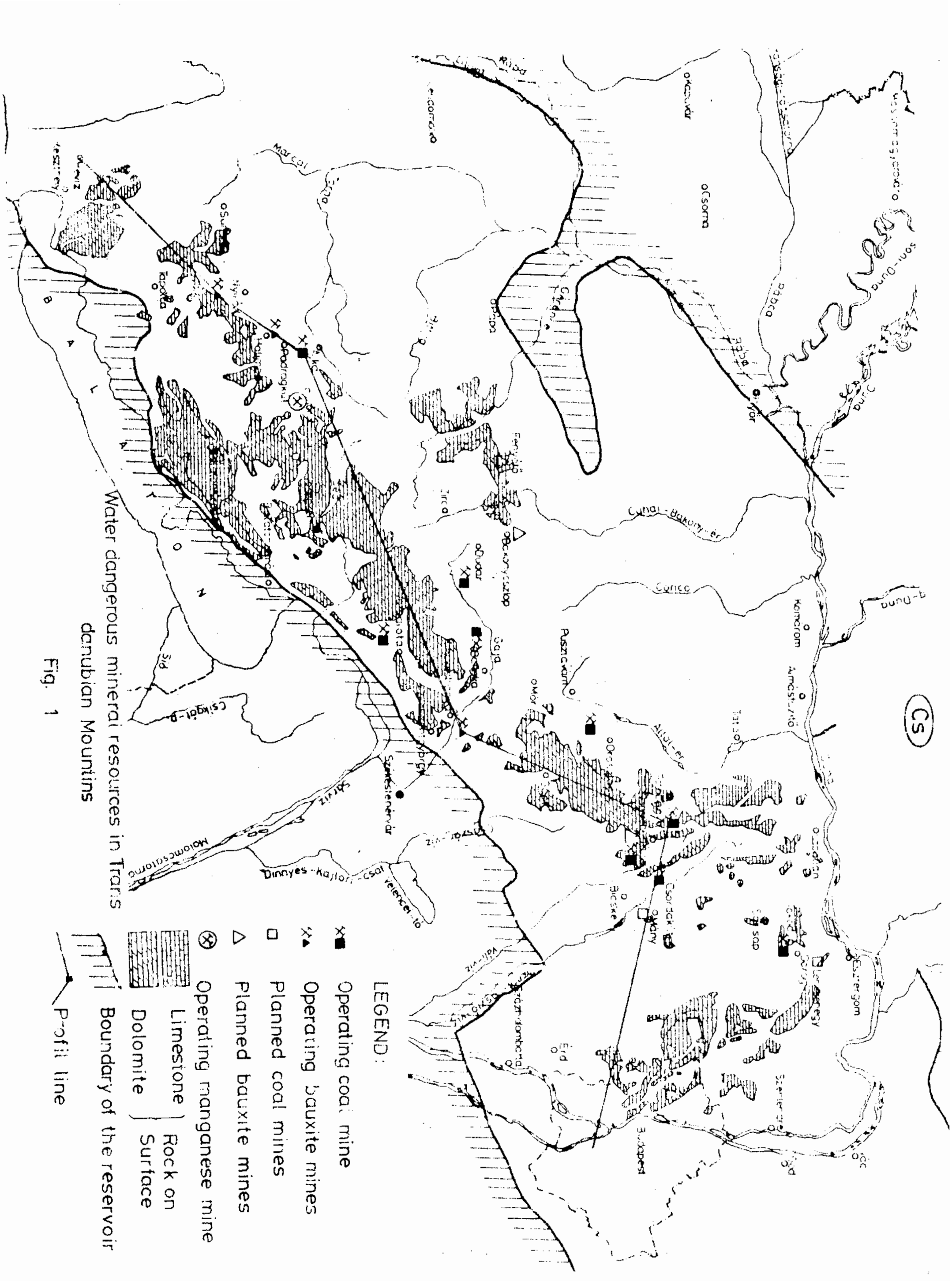
1. LOADING OF KARSTIC WATER RESOURCES IN TRANSDANUBIAN MOUNTAINS

The average water recharge infiltrating from precipitation can be approximated as 680 m³/min. Under undisturbed, original state this dynamic water resource was flown out of the system via cold and thermal springs and out of the communications with other water bearing strata and the Danube river.

The load of the reservoir is of three-purpose:

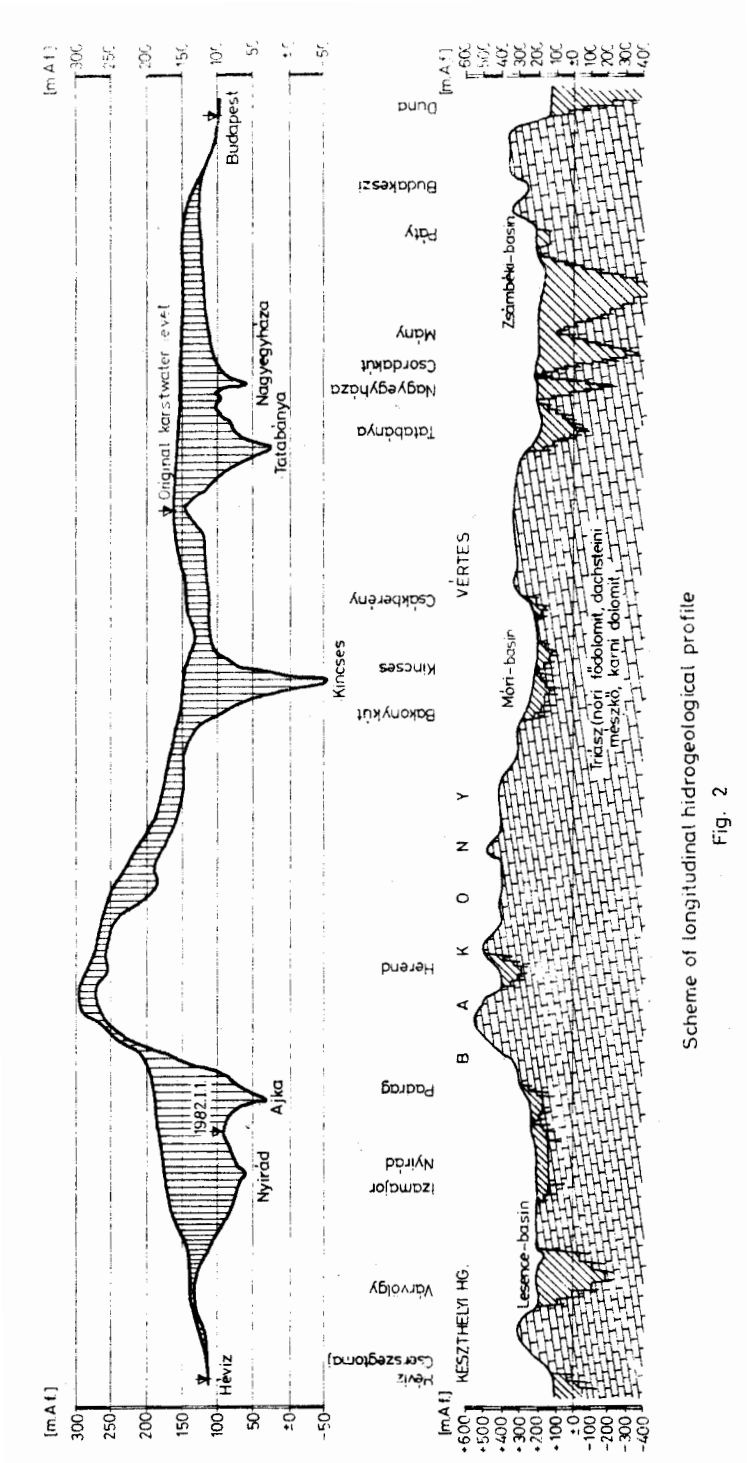
- The mine is forced to pump the water because of the safety of operations.
- Water works for municipal purposes produce karstic water from zones being close to the surface.
- Traditional spa and resort culture are existing based on the thermal springs at the foot of the mountains. /See Fig. 1 and 2 /

The above mentioned factors caused overloading of the system. To reduce the shortage of karstic water balance the mine water pumped out in drink water quality has become the basis of the regional water supply systems and it caused advantages for the surface waters during the mining activity.



Water dangerous mineral resources in Transdanubian Mountins

Fig. 1



Scheme of longitudinal hidrogeological profile

Fig. 2

2. ENVIRONMENTAL EFFECTS OF MINE WATER PRODUCTION

Complicated changes were caused by the artificial water outputs in the reservoir:

- Water table sinking was formed regionally because of decreasing trends of the stored water volume.

- Partial ground water sinking appeared in the surrounding neogen strata and consequently the direction of ground water recharge was reversed in the connection zones i.e. the karstic reservoir is fed by ground water.

- Springs of big water yield decreased or ran dry.

- Geothermical water systems of balneological importance became dangered.

The above listed environmental changes were followed by ecological consequences.

The direct effects of karstic water sinking appeared mainly on the edges of the reservoir in the zones of the erosion basis and in the areas of hydraulic communications with neogen porous strata.

The measurable water yield changing of springs is well defined but the rate of lateral and vertical communications with other water bearing strata is estimated both by their yield and locations.

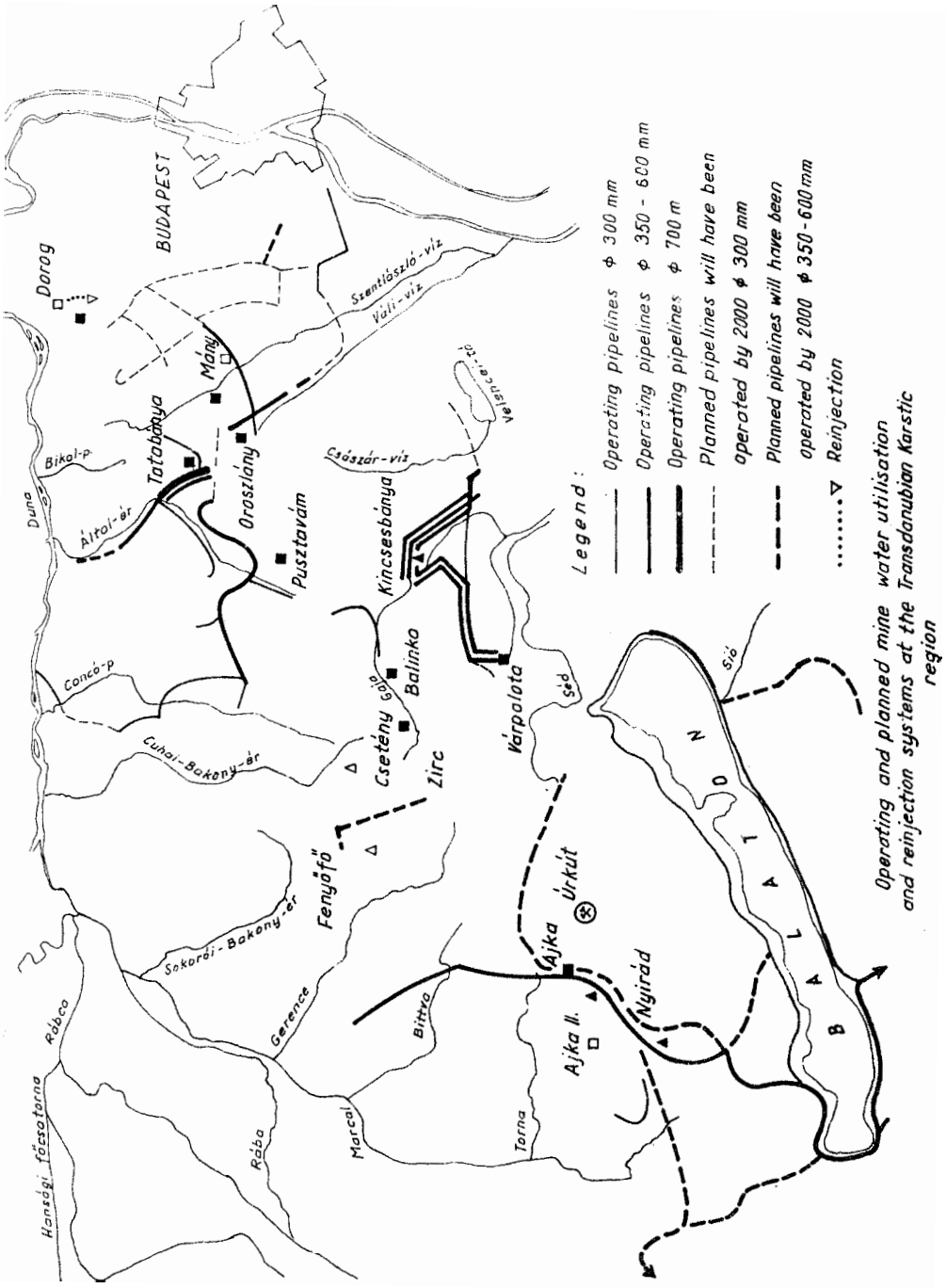
3. THE PLANNED METHOD OF WATER BALANCE REBUILDING

The reduction of karstic water withdrawal neither for mining purpose nor for other purposes is allowed and consequently the necessity of preparation for urgent measures is required.

In order to have better information on character of the reservoir about 4oo water level observation wells were drilled and the water yield change of springs was measured periodically.

Complex evaluation of the data of this regional monitoring system is carried on once a year. New data bank system for collecting, storing and evaluating each of the important data /i.e. water level, water yield, etc./ was developed and completed with numerical program of the checking system. Electronic instruments were built for water level observations into the wells. The registered data stored on tape are suitable for direct computer evaluation. /Futó 1983/

For reliable forecasting of the expected pressure changing in the reservoir two finite-difference simulation models were developed. The verified regional models are suitable for simulating either the mass transport /Szilágyi 1978/ or mass and heat transport simultaneously /Mavasy 1985/. The longterm program of rebuilding the environmental damages can be elaborated on the basis of these simulation modelling



Plans to improve the recent conditions in the reservoir are based on reducing the mine water output and on the utilization of mine water for regional water supply systems.

Three methods are existing to reduce mine water pumping:

- Operation of local water drainage systems which results in smaller specific water yield /applicable prevention mainly in bauxit mining/ /Böcker 1983/.

- Combined mine water control based on the preventive effect of grouting for reducing water inrush yield /proposed for coal\ mining/ /Szentirmai 1985/.

- Reinjection of mine water pumped out over limit with using well-system.

The secondary way of the improvement of water balance is to replace the single-wells or smaller water works for water supply systems based on mine water. For its realisation the preservation of the drinking water quality is supposed. The drainage systems in mines are needed to be separated from mining operations in order to exclude contaminations.

The scheme of methods and facilities for water balance re-building is presented in Fig.3.

4. THE EXPECTED EFFECTS OF MEASURES

By the early 1990-s the overloading of reservoir will be eliminated and the rebuilding is supposed to be started in return for the effective measures.

To preserve the rebuilt water balance of this reservoir for a longer period a multiobjective approach is necessary, where the preservation of the karstic water balance will also be one of the main goals together with the goals of meeting the bauxite and energy demands, although these goals are not equivalent in many cases. This multiobjective decision making approach surely will not disturb the mining activity which is necessary from the viewpoint of the national economy, but the time sequence of opening new mines may change and those mine water control methods will be preferred, which methods will not strongly impact the environment /e.g. the karstic reservoir/.

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