

The controlled exploitation ceasing of an unprofitable and destabilised salt deposit in a water saturated massif

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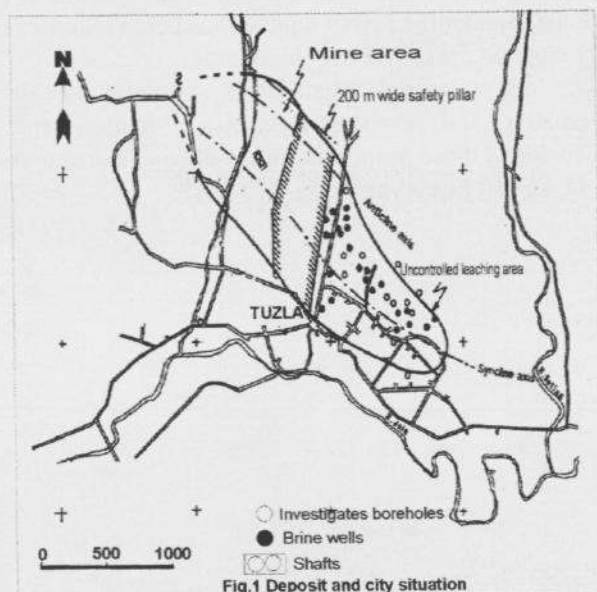
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Under the city of Tuzla (Bosnia and Herzegovina), dipping partly under urban area, a Miocene rock salt deposit is located, featuring humble reserves, low salt quality, complex tectonics, quite unfavourable hydrogeological conditions and questionable economic efficiency (Fig. 1)



The exploitation concept of this deposit neglected the importance of the presence of water, water tightening and massif stability, causing large technical, economical and ecological problems.

The deposit was exploited using uncontrolled leaching in the southeast part of deposit. The salt was leached by infiltration of unmineralized waters in deposit, moving across uncontrolled paths in deposit area, leaving a cavern with unknown spatial distribution. The consumption of large amount of water, used for leaching, followed by limited natural renewal conditions of aquifer into "fissurekarstic" media, resulted in a drastic lowering of underground water level in the deposit. The surface subsidence caused by this extraction method, effected the

destruction of urban complex ranging ecological disaster in salt deposit area (Fig. 1 and 2.).

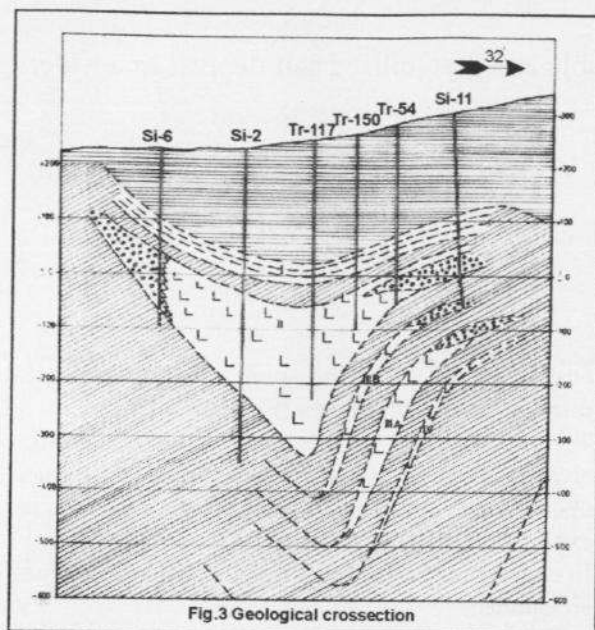
To the Northwest of the uncontrolled exploitation area, a deep underground salt mine is located, opened with shafts that during construction and exploitation stage have been repeatedly flooded.

In underground mine there the following techniques are applied:

- the classic room and pillar rock salt exploitation method
- controlled leaching (under the lowest pit level) over the "lost control" part.

From all stated above, it is clear that here particularly distracted and damaged deposit is concerned, without possibilities to enable rational, safe and ecologically sustained production. The decision was therefore made to cease exploitation and move to new deposit "Tetima", now under construction. This means that existing deposit exploitation should be ended, a controlled way and without ecological negative consequences. Furthermore, the costs for the cessation of exploitation should be acceptable with the economical boundary conditions imposed in country that is entering a transition process.

Suspension of the uncontrolled exploitation should be carried out in programmed and planned way, especially regarding the substantial groundwater level increase, which will change the physical equilibrium state of massif, which if disturbed could lead to unacceptable consequences. The consequences could not be forecasted because geotechnical model of massif in disturbed state is yet not fully determined. Especially the form, character, spatial position of leached vacancies and the hydrodynamic state in secondary create "fissure-karstic" aquifer are unknown.



The answers to some of these questions could be given in Project "Controlling the problem of subsidence in Tuzla", that will be realised as a part of the "Dutch cities to Tuzla" cooperation. The basis of the project is the application seismic tomography

for the determination of the structure and porosity of the massif, its character and spatial distribution.

Finding ways to cease the existing exploitation, immobilise the massif and protect the is a quite serious and technically complicated problem. It anticipated to realise this in several steps (phases):

- 1) To make the necessary prophylactic protection measurements and prevention of uncontrolled mine flood.
- 2) To immobilise the mine with the saturated brine overflow.
- 3) To cease uncontrolled leaching exploitation in a controlled way (by a groundwater level increase).
- 4) To keep up production by developing the exploitation at new locality, until full planned capacity.
- 5) To monitor the massif and surface behaviour after production ceasing at the old locality.

The Mining Institute Tuzla itself, supported by salt research and extraction experts, created and developed those proposals for production ceasing at old deposit locality.

