

POTENTIAL THERMAL WATER EXPLORATION IN THE TOKAJ AND SZERENC S AREA

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1. Introduction

The area around Szerencs lies in the border of many landscape contacts, so it is characterised by morphological diversity. The city of Tokaj lies on the southern part of the Tokaj Mountains. The region lies between the Bodrog River and the Nagy Kopasz Hill, built up from andesite, and is therefore a geologically complex unit. Both sides of Nagy Kopasz Hill are volcano tectonically and geomorphologically structured lines.

In the paper mainly Szerencs and Tokaj will be analyzed within their administrative boundaries, but also the wider environment will be mentioned. The area is bordered by Abaújvevceser to the north, Nyíregyháza to the east, Tiszaújváros to the south and Szikszó to the west (Figure 1).

In the wider environment hundreds of wells and geological exploration drilling units have been installed. The 74 wells in which effluent water is over 20°C provide the main information for thermal water research. We collected many parameters of the wells (code, EOV coordinates, depth, temperature, filtering, etc.). From these data we made the basic database. The major lukewarm and hot water wells are illustrated in Figure 1.

From the wider environment we located a narrower area, where we made detailed research for Szerencs and Tokaj. This area is bordered by Tállya to the north, Prügy to the south, Mád to the east and Megyaszó to the west. On this map we marked the preliminary results of geophysical investigations, including the structural and the tectonic lines.

Szerencs and Tokaj are in a hydrogeologically disadvantageous environment. In spite of this fact, we attempt to mark the places with hot water potential, which can be used for long-term hot water supply.

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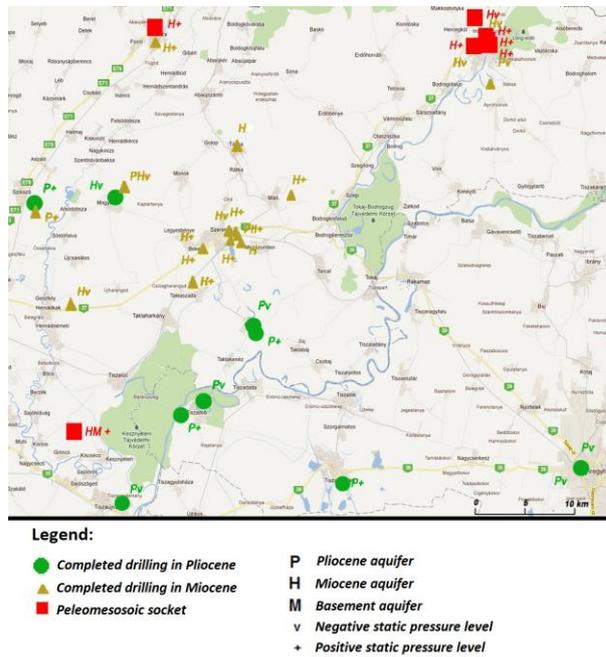


Figure 1. Map of the regional area with the warm and hot water wells

2. Geomorphological characterization of the Szerencs area

We have wide knowledge from the geological documentation, but precise depth parameters of the basement are insufficient. The depth and the material of the basement have not yet been identified (Table I).

The tectonic and structure lines of the basement maps are approximately parallel [2] [3] [4] [5] [6] [11]. The lines of three basement maps from the six we used coincide, and this line lies next to Szerencs in North-South direction. This line is probably the Hernád tectonic line, from which transverse fractures may permit hot water updraft.

Table I. Suspected materials of the basement under Szerencs

Year	Author(s)	Material of basement
1967	Viktor Dank, József Fülöp	Trias
1987	József Fülöp, Viktor Dank	Unknown material
1989	K. Brezsnayánszky, J. Haas	Unknown material
1990	Viktor Dank, József Fülöp	Unknown material
1990	János Tanács, R. Lászlóné	Unknown material
2010	János Haas	Unknown material

Different rocktypes are formed due to the updrafting solutes: hydrothermal quartz, geyserite and sweetwater quartz [8]. These rocktypes imply to postvolcanic activity. Mád and Szerencs are bounded by two faultlines: North-Southern and the East-Western direction. is the faultlines intersect at Aranka

Mountain. On higher levels the peaks are covered with hydrothermal quartz, while the valleys are covered with sweetwater quartz [1] [7].

We measured the potential temperature values of the depth from the effluent water's temperature to fill in the missing geothermal data of the depth. From this we defined the geothermal gradient, which is 7.1°C/100 m, which we then used as a constant in this area.

3. Summary of geothermal research activity in Szerencs

In Szerencs's surroundings there is a North-Eastern hydrothermal zone. It can be seen on the surface: Fekete Hill – Aranka Mountain – Árpád Mountain to the North and also to the South at the Bocskai church (Figure 2). Further to the South it tends to the deep and can only be traced in the drills' stratigraphical lines. The filtering of the transversing drills through the hydrothermal quartz is on this layer, because of its high permeability. (Table II).

Table II. Comparison of warm water anomalies in wells of Szerencs

Well name	Sign	Static water level [maB]	Outlet temp. [°C]	Yield [l/min]
Bakery	K-43	99.8	20	270
Chocolate factory-III	Cs-III	102	25	1,500
Motel Fridez	K-60	100	24.8	1,300

The Chocolate factory drill (Cs-III) has the highest static water level, effluent temperature and yield. With these conditions we can assume in the depth there is a plentiful yield of warm water from the aquifer layer, due to the drainage capacity of the hydrothermal quartz's zone.

Approaching the centre of the Taktaköz Basin the hydrothermal quartz formation's dip increases, so the temperature of the water increases. The tectonic breccia is intersected by disaggregated hydrothermal quartz and fractured siliceous rhyolitic tuff at a depth of approximately 220-230 m. Water with a temperature of approximately 28°C can potentially be found at this depth. If we assume 0.5°C /100 m updraft cooling, the fissure's temperature is still around at least 26.5°C. When further geophysical experiments show the hydrothermal quartz's continuation to the depth (around 360 m at the periphery border), the base temperature may be about 39°C. In this case the effluent water's temperature is around 37°C. Surface investigations should be carried out in Vince Tanya (a dairy farm) to the south of Szerencs, in the area of Mád and Ond.

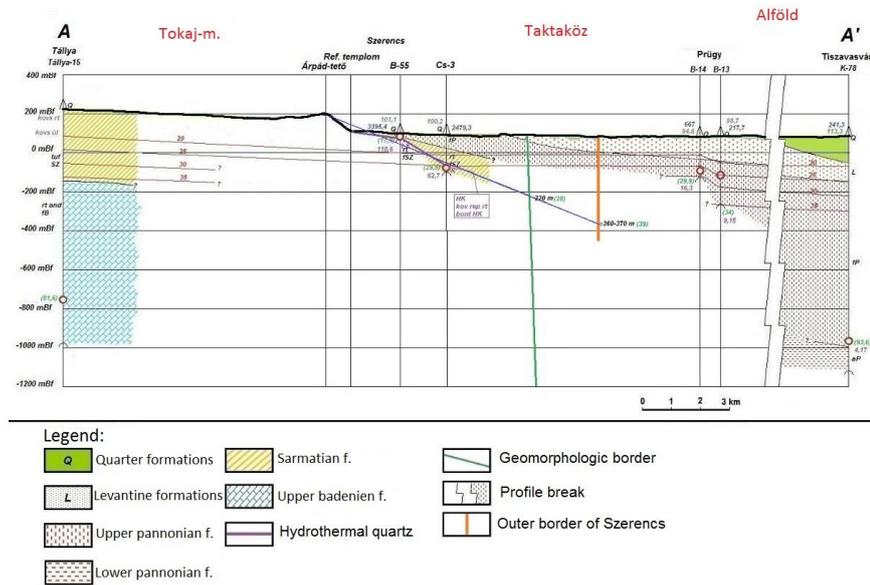


Figure 2. North-South hydrogeological profile

4. Geomorphological characterization of the Tokaj research area

In the environment of Tokaj there are many shallow drillings and wells, but these only tell us the near-surface geological structure and hydrogeological conditions. Without deep drillings, we do not have enough knowledge about the deeper layers. As far as thermal water research is concerned, only the environment of the Sárospatak-Véghardó Spa has been sufficiently examined, due to kaolin mining, uranium exploration and subsequent spa well drillings [9].

In Table III we can see the most likely rock material of the basement under Tokaj and its estimated depth according to several studies [2] [3] [4] [5] [6] [11].

Table III. Material and depth of basement under Tokaj

Year	Author(s)	Material of basement	Depth
1967	Viktor Dank, József Fülöp	Supposed Perm	-1500 m
1987	József Fülöp, Viktor Dank	Unknown basement	-900 m
1989	K. Brezsnýánszky, J. Haas	Unknown basement	-1000 m
1990	Viktor Dank, József Fülöp	Unknown basement	-900 m
1990	János Takács, R. Lászlóné	Badenien formations	-900 m
2010	János Haas	Unknown basement	-900 m

As can be seen from the table, our knowledge about the consistency of the basement and its depth is uncertain. On the southern part of the Tokaj Mountains there is an andesitic volcano-tectonic line and along this volcanic material erupted onto upper Tortonian and lower Sarmatian formations. After the end of

volcanic periods huge tensile stresses affected the solidified lava. On the edges of the mountain the taper volcanic matter became less resistant to the emerging tension, thus it was cut and dropped, made the pair of structural lines [10] (Figure 3).

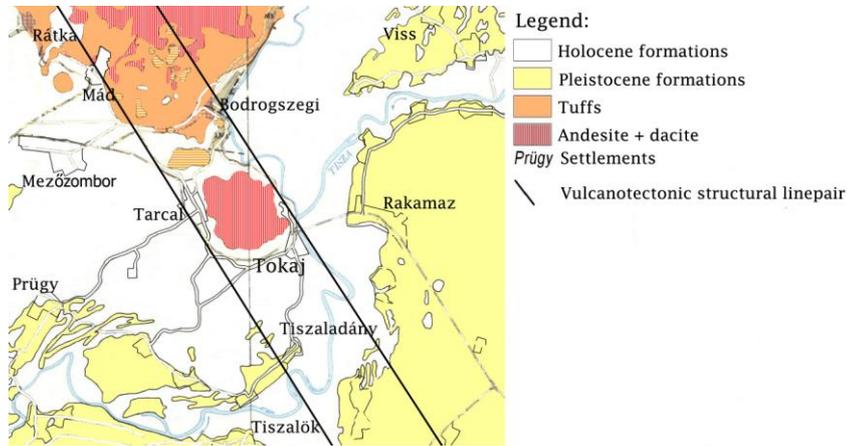


Figure 3. Pair of structural lines of Tokaj

A more detailed picture of the previously shown structural lines can be seen in Figure 4. It shows the depth's geological structure between the geothermal well at the Tokaj synagogue and the well in Viss settlement. Drilling into the structural line at sufficient depth results in inflowing hot water. Further geophysical experiments are needed to define the precise location and depth.

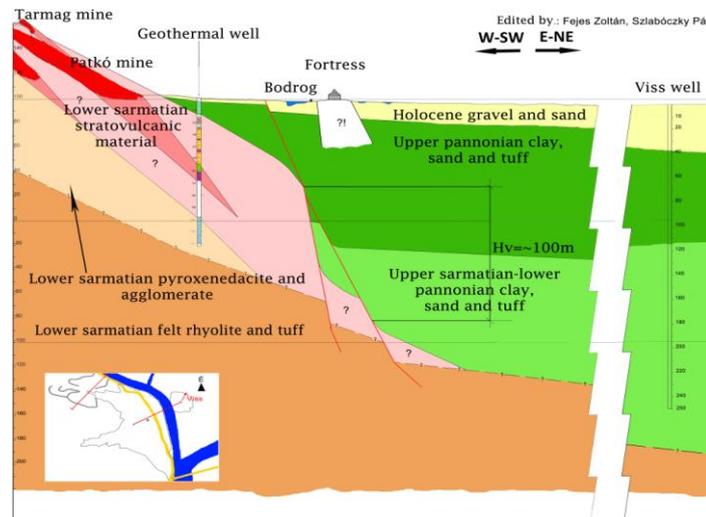


Figure 4. Conceptual hydrogeological profile

5. Conclusion

Recently the hot water supply of Szerencs and Tokaj has become more important. We used the previous research results, a thermal well database and the complex geology of the area for our exploration. In this territory the hot water providing basement is at a great depth, so it cannot be a target of thermal water research.

The highest chance of hot water updraft is in the occurrences of structural lines and layers formed by the post-volcanic activities that can be found in this area. To clarify these locations, further geophysical experiments are required in this region.

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