

GEOTHERMAL AND MINERAL WATERS IN VALLIS AUREA

TERMALNE I MINERALNE VODE VALLIS AUREA

KOLBAH, Slobodan; SCURIC, Svjetlana; KULENOVIC, Ismet; SKRLEC, Mladen & GRIVIC, Franjo

Abstract: *Geothermal potential is important for the development. It is indicated by thermal springs and proved and developed by INA Naftaplin. Based on previous activities and experience, geothermal potential in Pontian and Miocene sediments is indicated and more is expected. In our standard but highly integrated approach, with understanding of the geological objects, we can project geothermal water production with necessary techniques and technologies, supported by information systems, and controlled by the economical criteria in an environment friendly way, as well as in agreement with national legislation and international standards, as a basis for acceptable solutions and financing for geothermal consumption.*

Key words: *geothermal energy, deepwater bodies, exploration-production*

Sažetak: *Geotermalni potencijal je važan za razvoj. Na njega nas upućuju termalni izvori dok je u dubini dokazan i dostupan zahvaljujući radovima INA Naftaplin-a. Prema iskustvima naših prethodnih radova radi se o potencijalu u panonskim i miocenskim sedimentima, ali očekuje se i drugdje. Za prihvatljivo rješenje i dobivanje fondova za razvoj korištenja geotermalnih resursa predlažemo korištenje našeg uobičajenog više disciplinarnog pristupa. Zahvaljujući kritičkom geološkom rješenju, moguće je projektiranje proizvodnje s odgovarajućom tehnikom i tehnologijom, podržanom informacijskim sistemom, sagledane ekonomskim kriterijima, na prihvatljiv način za okoliš, u skladu s nacionalnom legislativom i međunarodnim standardima*

Ključne riječi: *geotermalna energija, Duboka vodna tijela, istraživanje i pridobivanje*



Authors' data: Slobodan Kolbah, mr., INA, Zagreb, slobodan.kolbah@ina.hr; Svjetlana Šćuric, dipl ing, INA, Zagreb, svjetlana.scuric@ina.hr; Ismet Kulenović, dipl ing, INA, Zagreb, ismet.kulenovic@ina.hr; Mladen Škrlec, dipl ing, INA, Zagreb, mladen.skrlec@ina.hr; Franjo Grivić, dipl ing, INA, Zagreb, franjo.grivic@ina.hr

1. Geothermal and Mineral Waters in Vallis Aurea

Regional development of Vallis Aurea, beside the human potential and other advantages, should be supported by the geothermal water resources.

These resources are needed in an outstanding agricultural and industry province, with high quality of products, natural beauties, mild climate and great history and cultural objects. On the basis of oil, gas and geothermal exploration and production experiences we can show the way for sustainable use of geothermal energy of more or less mineralized waters bodies. Basic information can be seen on figure 1.

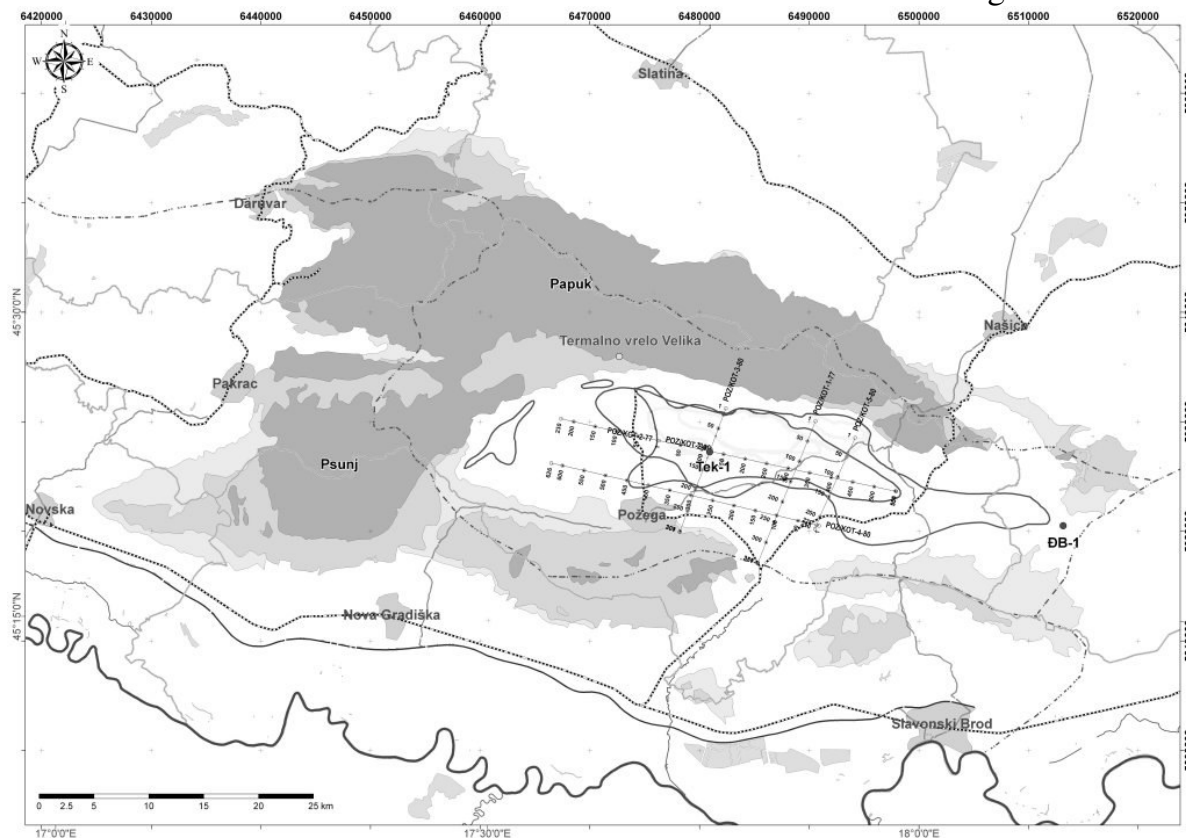


Figure 1.

On the index map Vallis Aurea is surrounded by Slavonian Mountains. Termal water springs at Velika and Đakovačka breznica (Miholić, 1935) was early indicators of potential. Extensive geological studies and mapping was undertaken, the spectra of geophysical measurements including gravimetric and seismic lines. Important are POŽ/KOT-1 to 5 shot in 1977 and 1988, One dry oil well Tek – 1 (T.D. 2.575 m, drilled and tested in 1980) and one geothermal well ĐB – 1 (T.D. 950 m, drilled and put in production in 1985). According to our preliminary study, two geothermal water bodies in tertiary sediments are marked on the map; with additional reservoirs in fractured basement nearly the whole valley has some potential for geothermal water. Further exploration and geothermal water production should be undertaken.

Results of “Oil exploration” studies (Naidenovski, 1986) and others such as INA Naftaplin’s data base, have been used as a starting point to define geothermal

potential of the area. From the deep data mostly obtained by drilling we learnt a lot (See Figure 2).

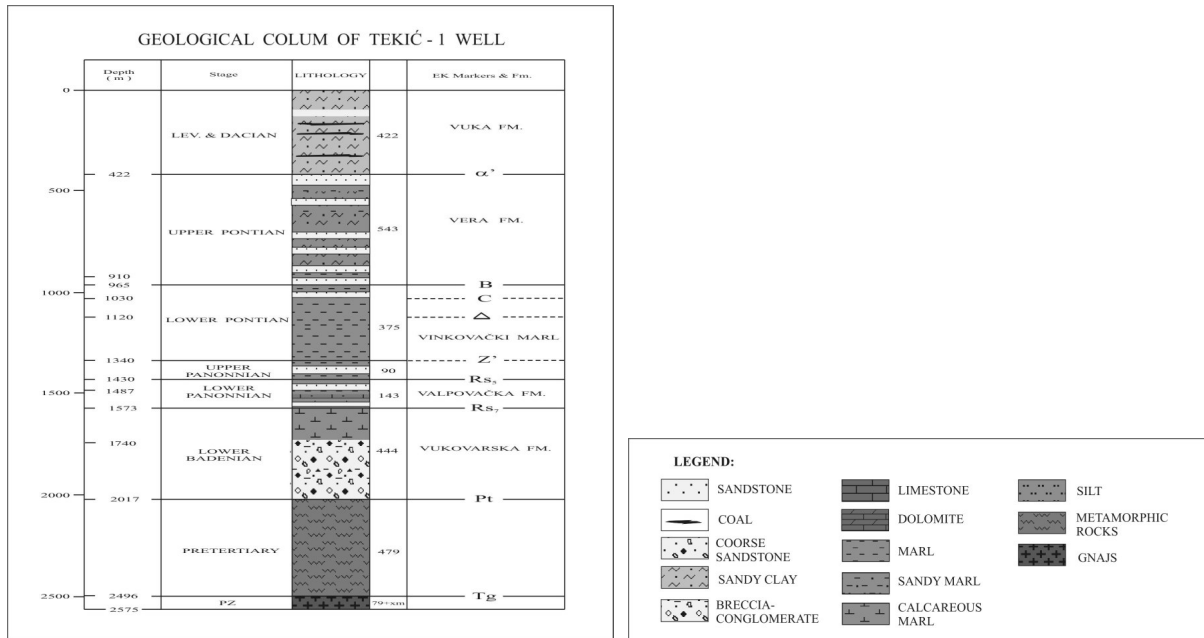


Figure 2.

At Tek-1 well, a potential sandstone reservoir was detected at the 422 m, in the top of Pontian stage / Vera formation, below the alfa EK Marker. Even more important, but deeper at the 1.740 m in the lower Badenian stage / Vukovarska formation in the breccias reservoir. Water temperatures, due to the high geothermal gradient, 55°C/km are higher than 33 °C in sandstone and 110 °C in the breccias reservoirs. A similar situation is encountered at the ĐB-1 well, where lower Badenian breccias reservoir at the 650 m depth and the deeper fractured Palaeozoic Basement. At the Velika thermal spa geothermal water body is in the fractured middle Triassic dolomites. Such first class geothermal water bodies are not yet recognise. To delineate these indicated geothermal water bodies in that region and appraise their geothermal potential, we use the experience from other Pannonian basins (Kolbah, et al, 2002 and 2004) and local information (See Figure 3).

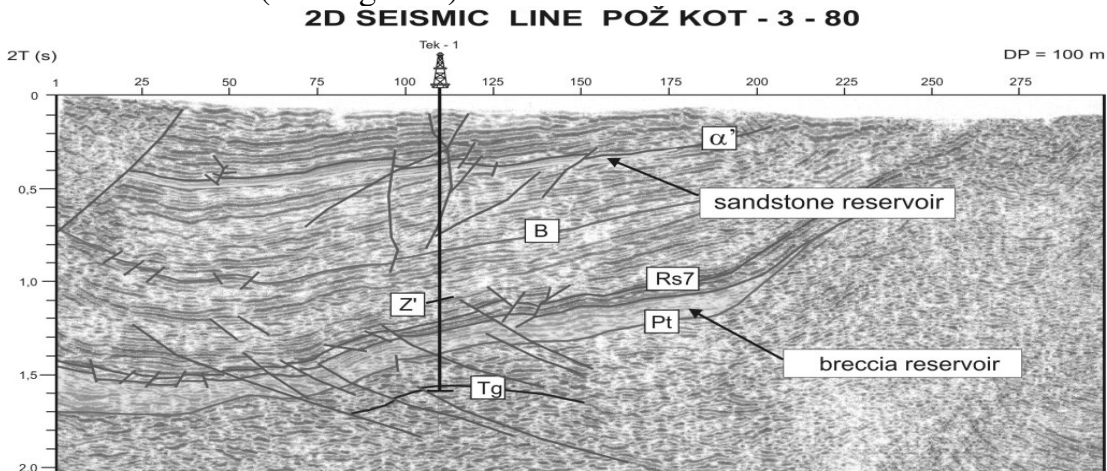


Figure 3.

Recent interpretation of the 2D seismic line puts more light to the understanding of the geothermal water bodies of Vallis Aurea.

In the complex approach to delineate geothermal water bodies we apply standard geological, reservoir engineering subsurface and surface producing technologies, and solutions to the environmental issues, controlled by economical viability and supported by GIS and other information technologies (Hitrec, et al, 2008). It could seem to be sophisticate but it is a minimum to meet national and international standards. In such projects the quality and the motivation of the expert staff is crucial. In this preliminary stage we have created a spatial idea of the two distinguished geothermal water bodies and the basic parameters for estimating energy production. As already mentioned, the whole project is determined by economical prospect, so although the shallow sandstone reservoirs are poor in temperature and productivity, they are relatively inexpensive to drill and develop, and most importantly they are expected to be widespread. Further technological solutions for the use of very low enthalpy energetic sources or another application for these low mineralised waters can be established. The Deeper reservoirs in breccias reservoir are quite the opposite. They have higher temperature and productivity but they are relatively expensive to drill and develop. Finding the first class fractured and really hot water reservoirs in this area is still a challenge.

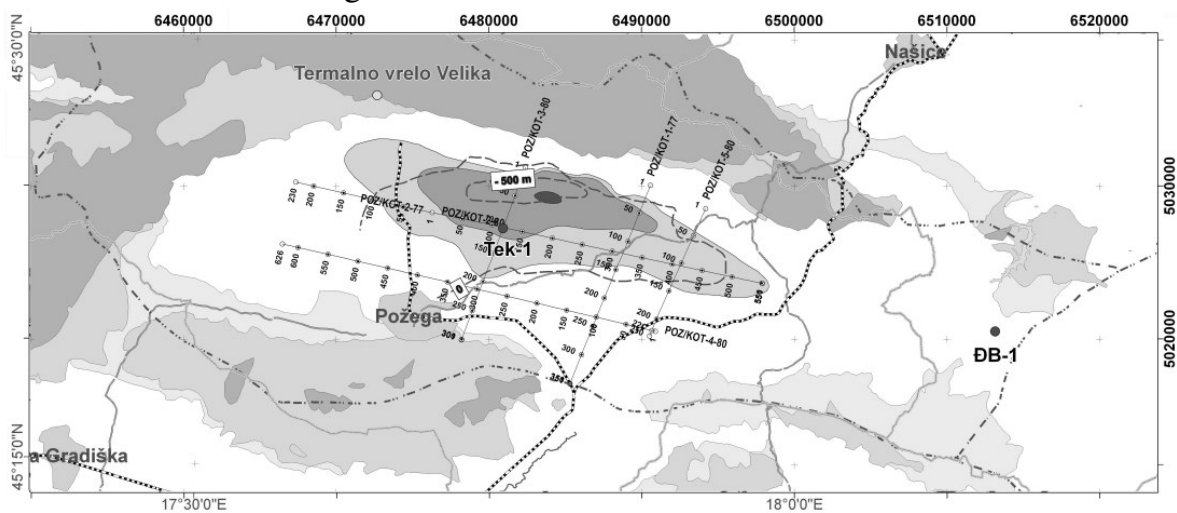


Figure 4.

Shallower geothermal water body is well recognised on the Well Tek-1 and the 2D seismic lines on the NE side of the valley, a cover over 1.500 km², where it can be reached from +/-0 to -500 m below sea level, to which we should add the local topographic altitude. As we know on well Tek-1 top reservoir was reached at the 422 m depth of the well.

In short, the definite geothermal water potential is proved and initially defined. While developing the area, it is necessary to develop the natural resources, especially now and in the near future. Prices of conventional and mostly imported fuels are rising and their consumption is prohibited because of their negative impact to the environment. The use of geothermal energy is not instantly financially rewarded, but in the long run and accordance with the regional development it could be an important issue, as a

starting point in encouraging other resources: human, agricultural, industrial, cultural and tourist. Future research should be lead by dedicated experts with sound references in researching and implementing geothermal production.

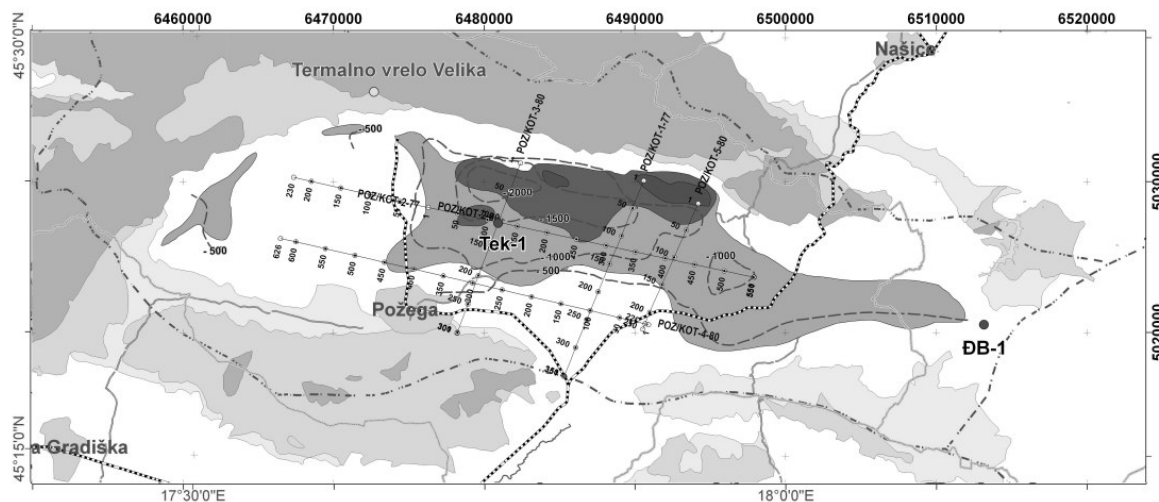


Figure 5.

So far, the best recognised geothermal water body in the breccias reservoir are tested with Drill Steam Test on the Well Tek-1. The spread of the reservoir in the Vukovarska formation, obtained from the interpretation of the 2D seismic lines, seems to be developed in the entire valley, except north of Pleternica and NE from Požeška, where other important geothermal water body in the fractured basement can occur. They are much deeper, from -500 to over -1.000 m below sea level, to which we should add local topographic altitude. As we know on well Tek-1 the top reservoir was reached at the 1740 m depth of the well.

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