BAD SCHINZNACH, AN ONGOING GEOTHERMAL SUCCESS STORY

EMISSION-FREE ENERGY AT A HISTORICAL BUT INNOVATIVE HEALTH RESORT SAVES 1,400 TONNES OF CO_2 ANNUALLY

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In northern Switzerland, where the Aare River cuts across the Jura Mountains, people have known about the warm upwelling waters in the banks of the Aare River for ages (Figure 1). However natural changes of the braided river bed made locating the upwelling source of warm water difficult and the source was lost over various periods of time. Since the 17th century, the Schniznach spa has been used commercially and became a well known resort for health treatment, and a resort for social and political conventions.

Only at the beginning of the 20th century was a proper well sunk to a depth below the river bed to capture the thermal water. There the thermal water could be tapped directly from the underlying karst aquifer of Triassic limestones, the so-called Upper Muschelkalk. The shallow well served the Schniznach spa for over 80 years. The temperature and the chemistry of the thermal water was, however, diluted with cold and weakly mineralized groundwater from the Aare River. In 1980, in the course of a systematic regional study of the geothermal potential, an exploratory well was drilled at the Bad Schiznach site. The well produced about 10 l/s with an initial temperature of around 34ºC from karstic limestones at a depth of 72-78 m. The well produced reliably over the next 15 years. In the course of time, near surface groundwater increasingly seeped into the aquifer and cooled the source down to a mere 26ºC. The regional study revealed a mixed origin o the thermal water. Current interpretations from geochemical fingerprinting point to three sources: a distant transport from underneath the Molassse Basin fed by an alpine intake area, an upward flow along the Permocarboniferous trough margin and some surface inflow from the Jura Mountains (Figure 2).

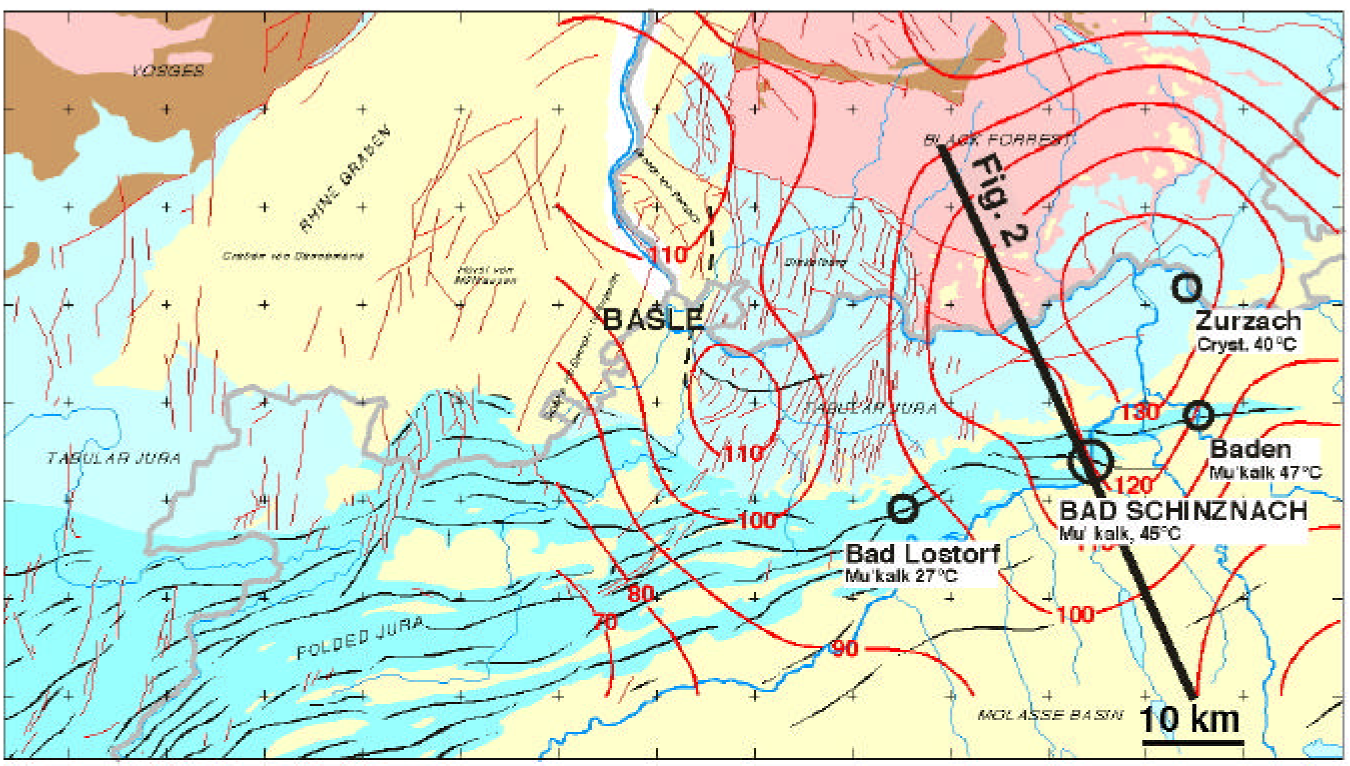

Figure 1. Regional geology and heat flow contours (mW/m²).

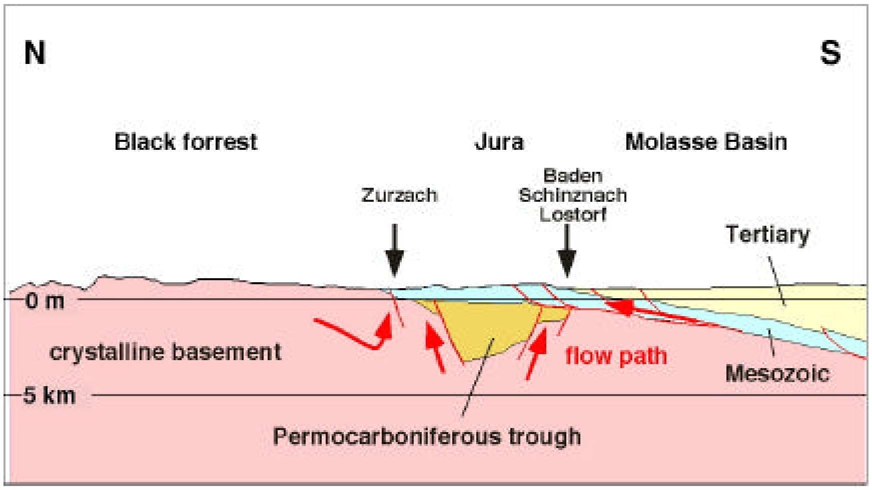

Figure 2. N-S cross section northern Switzerland and situation of thermal springs.

The newly built "Aquarena"–an attractive in- and outdoor pool area–required an increased and continuous supply of warm water as well as thermal energy for heating and air conditioning. According to its owner, the spa area–situated in a pleasant green surrounding–ought to be supplied with sustainable and emission-free energy. So the target was set to develop a geothermal well with a source capacity of 1 MW. The idea was to tap the known aquifer in a downdip position in order to produce water at higher temperatures and protected from the influx of cold surface water. It was further intended to produce the water not only for balneological purposes, but also as a heating source. In contrast to the previous utilization, this demand required a reinjection scheme.

The structural situation was investigated by a small seismic survey. The survey revealed that the outcropping Upper Muschelkalk is the top limb in a complex overthrust, overlying a detached silver of upper Muschelkalk and its autochthonuous part. The drilling location was selected under the criteria of minimal distance to the spa and maximum depth of the aquifer. At the selected well location, the aquifer could be tested at three different levels (Figure 3).

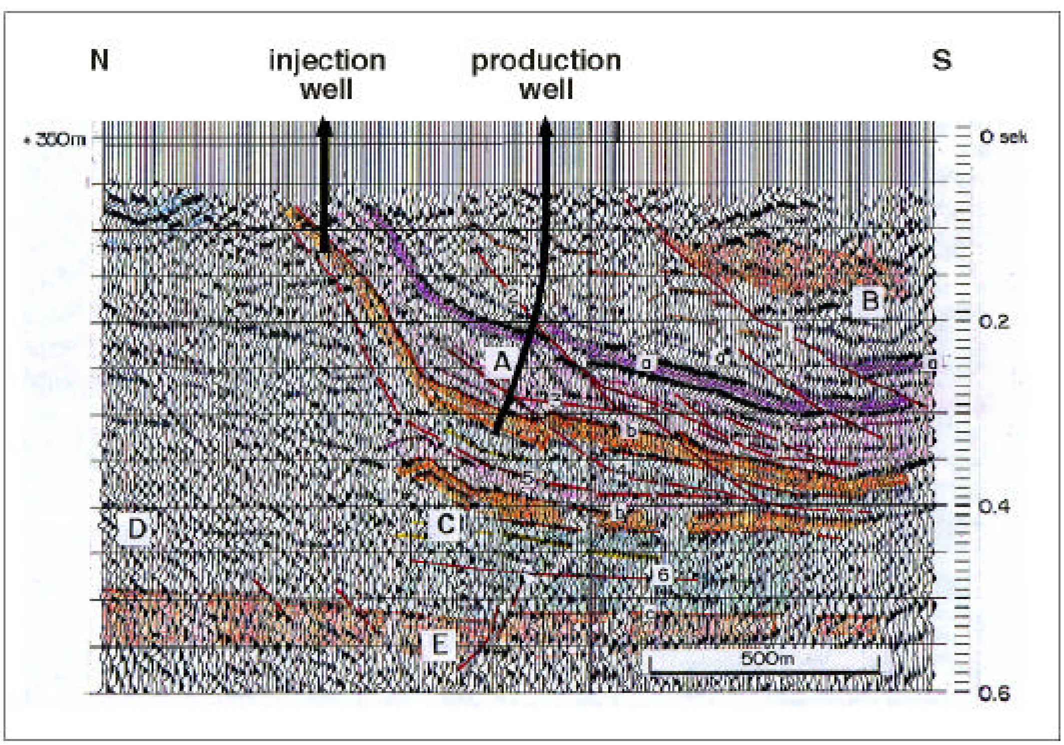

Figure 3. Migrated time-section with well traces (seismic interpretation by P. Diebold).

The well encountered the Upper Muschelkalk as expected at three levels, however, with very different hydrological characteristics. The uppermost limb produced thermal water with a temperature of 45ºC and the characteristic Calcium-Sodium-Sulfate-Chloride mineralization of the old Schniznach wells. The characteristic hydrogen sulphide concentration does not exceed 56 mg/l which is slightly less than in the old wells. In order to increse the initial flow rate, the well was acidized resulting in a sustainable production of 8.5 l/s with minimal drawdown and a peak production of up to 21 l/s. The deeper limbs of the Upper Muschelkalk produced much less water, but with temperatures of up to 64ºC. However, the mineralization–mainly sodium chloride–exceeded 20 g/l which renders these flow levels commercially unattractive. The different mineralization suggests that the deeper levels of the upper Muschelkalk are detached from the upwelling aquifer. But with the production from the top level, the target of a geothermal source of 1 MW was already clearly achieved. In a next step, reinjection into the old well was tested successfully. The reinjection scheme serves the double purpose of maintaining the hydrological balance and shielding the aquifer from the influx of cold near surface groundwater (Figure 4).

A 500-kW heat pump extracts 17ºK from the geothermal cycle and produces 4.5 GWh of emission-free thermal energy annually (Figures 5 and 6). The system substitutes now more than 450 tonnes of heating oil and reduces CO_2 emissions by 1,400 tonnes annually; a considerable environmental contribution to an attractive location dedicated to health and wellness. An oil peaking system provides 1.5 GWh annually. The oil heating system is utilized when the outside temperatures drops below about 15ºC and is used extensively when the temperature is below about -8ºC.

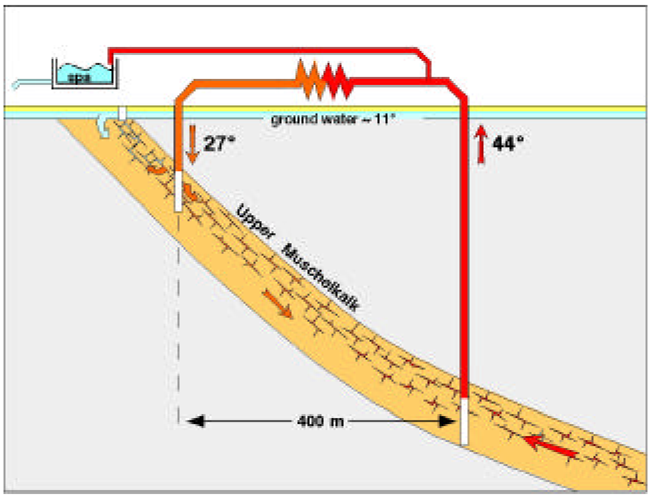

Figure 4. Geothermal doublette at Bad Schniznach.

Figure 6. Heat pump equipment room.

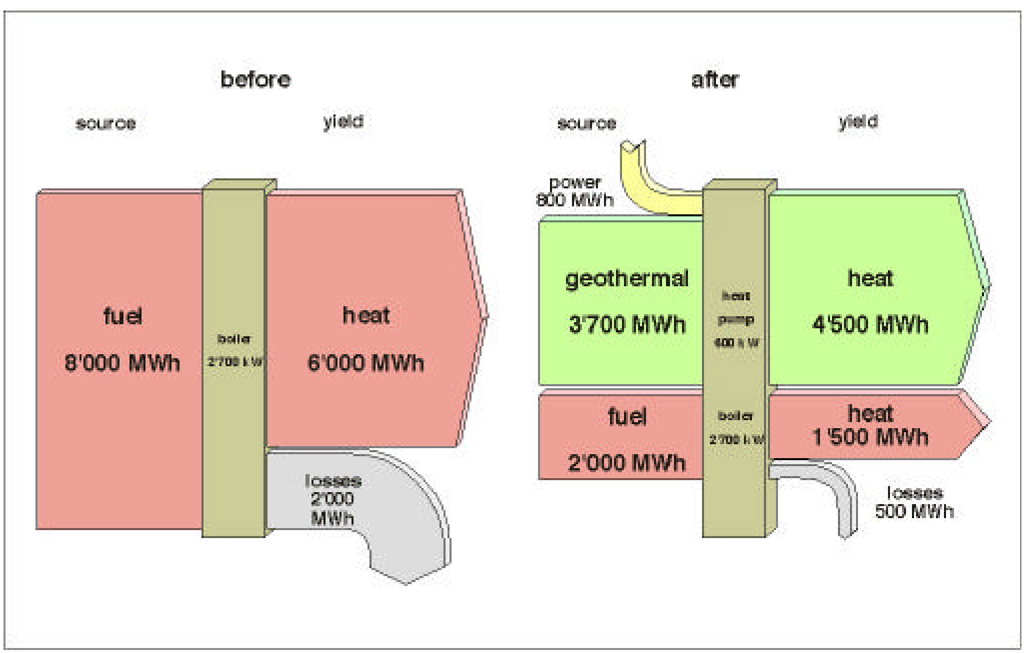

Figure 5. Heat supply at Bad Schniznach: old conventional vs. new combined geothermal.

The Bad Schniznach area has a number of facilities devoted to health and fitness. These can all be accessed on the Internet at: www.bad-schniznach.ch. The main pools heated by the geothermal waters are call Aquarena and consist of an outdoor pool of 600 m^2 at 35ºC supplied by a waterfall (Figures 7 and 8), an indoor pool at 35ºC and a soaking pool at 37ºC. The facility also has a sauna, a solarium, restaurant, and offers massages. A private bath, Thermi, located in a large building was built in 1760. This facility has a 200 m^2 outdoor swimming pool with massage jets located around the perimeter. The private clinic (Private-Klinik im Park) for physical therapy and a Kurhotel for the treatment of rheumatism are also located in the community. To add to the enjoyment of the area, a wooded area with many hiking trails are also available. Some of the trails are called "Geo-Weg" describing the geology of the area. As in most European countries, the trails distances are given in time rather than kilometers (Figure 9).

Figure 7. Aquarena–outside pool.

Figure 8. Aquarena–inside pool.

Figure 9. Sign post in hours (std.) and minutes (min).