The effect of swarm seismicity on the Schönbrunn hydrothermal system - a natural long-distance gas tracer experiment

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The spatial and temporary long-distance effect of swarm quake events onto the hydrodynamic and hydrochemistry in seismo-tectonic regions is one of the aim of our complex isotope and gasgeochemical investigations in the Eger rift and was verified for mineral springs in Vogtland (Germany) and NW-Bohemia (Czech Republic) (Bräuer et al., 2003, Weise et al., 2001). In the light of these results the gas monitoring carried out at the 453m level of the Schönbrunn fluorite mine have to be evaluated as an example of a boundary location of the western Eger rift affected by swarm earth quakes.

The hydrothermal system of Schönbrunn, Vogtland, is located at the north-western rim of the seismically active western Eger rift area, coinciding with a currently active CO_2 mantle degassing field at Bublak characterised by He isotope signatures >5 R_a (Bräuer et al., 2003). Its lower R/Ra of 0.7 is obviously due to mixing of He from both a deep-seated magmatic and a crustal source. The area is not far from the swarm seismic zone of Novy Kostel, connected with the NNW-SSE striking fault, and belongs to the Marianske Lazne fault system. Directly at the top of the hydrothermal system, the Schönbrunn fluorite mine was operating for several decades. Therefore, a long-term depression down to about 450m below ground was caused by water processing for mining operations. Kuschka (1998) described the groundwater depression affecting a surface area of 5.5 km^2 (5 km long, 1.1 km width, about 450 m deep). In total, 3.23 m^3 water/min was discharged from the whole mining area up to 1998.

We used a multidimensional isotope gasgeochemical and hydrochemical methodology to study this very sensitive versus seismic disturbances system. For this aim, gas and water samples were taken in the fluorite mine Schönbrunn in a depth of 453 m between April 1994 and August 1996. Isotopic analyses of water ($^2H/^{18}O$, T) and gas (^{13}C, ^{15}N, $^3He/^4He$, $^{40}Ar/^{36}Ar$) as well as gasgeochemical and hydrochemical analyses were carried out. The geochemical data were correlated to seismic data. The monitoring period has included the strong earthquake swarm period lasting from December 4/5, 1994.

The results indicate a release of gas components stored in the rock near the sampling location by stress/strain field changes during and after seismic events. While

the $^{13}C_{CO2}$ signature at the Bublak Mofette already changed about 30 days after the swarm quake event, the monitored $\delta^{13}C_{CO2}$ of the Schönbrunn hydrothermal system decreased for three month 150 days after the event. The isotope data of CO_2 and He from the hydrothermal system support the model (Weise et al., 2001) that a mixture of crustal fluids having their source in the environment of the hypocentre, and gas derived from the upper mantle, supplies the thermal water of Schönbrunn. Therefore, we can assume a long-distance connection between the hydrothermal system and the degassing centre of the western Eger rift fed by magmatic CO_2 and mantle derived He. From the variations of the gas isotope tracers the transport velocity and the spatial distribution of the magmatic gases (CO_2 and He) and their crustal components can be evaluated along the large degassing province of the western Eger rift.

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