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A conceptual hydrotectonic model of water level fluctuation in a cave at the Vienna Basin (Austria)

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Eisensteinhöhle is a hydrothermally overprinted cave at the south-western margin of the Miocene Vienna pull-apart Basin. The basin has been formed by a still active NE-SW trending sinistral strike slip fault associated with NNE-SSW striking normal faults. These faults create pathways for thermal water to rise from the central basin and emerge in several lukewarm thermal springs along the basin margin.

The cave was opened during quarrying in 1855 and is developed in a Miocene marine carbonate breccia. It has a crevice-shape while the morphology in most parts is coined by hydrothermal karstification. It is about 2 km long and has a vertical extend of 87 m. At the deepest point, there is a small pond filled with 14.5 °C warm water. This is about 5 °C above the annual average and it shows that there is some connection to a nearby subthermal spring with similar temperature. The water level fluctuates within a range of 3 m and at a certain level the water drains through a hole into a nearby slightly deeper gallery. This pond has attracted considerable attention because sporadic records of water level and discharge measurements since 1992 did not show any correlation with regional precipitation.

Within the framework of the SPELEOTECT project (Austrian Science Fund # P25884-N29), the current tectonic activity of two faults along the margin of the Vienna Basin as well as the fault controlling the orientation of the cave are monitored by means of high-resolution moiré extensometers. Since October 2015, data loggers measure water level and temperature in the pond as well as CO_2 in the air.

A pumping test during medium water level, where the whole pond was emptied showed a volume of only 2800 l and a discharge of 4.5 l/h. Water temperature and hydrochemistry hint towards a mix of old thermal components and young meteoric components. However, water level and temperature change abruptly with no obvious relation to precipitation. Within the first year of the continuous monitoring, the water level was almost stable with two periods of high level (almost at overflow) that lasted for about three weeks each. At the beginning of the first event, a minor fault activity was measured in the nearby Emmerberghöhle and a local earthquake (M 2.5) occurred one week later about 10 km from the caves. The water temperature increased by 0.1 °C during both water high stands. CO_2 concentration rose up to 1.3 % in the summer, but seems to be controlled by external air temperature and air pressure. After the first year of monitoring we suggest a hydrotectonic model, which correlates the water level changes with fault activities in the Vienna Basin.