Geophysical Research Abstracts, Vol. 9, 04869, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-04869

The Zicksee paradox revealed? Contradictory results of the water balance of a shallow lake in the Seewinkel region (Northern Burgenland, Austria)

H. Häusler (1), T. Payer (1), J. Scheibz (1), D. Rank (1), W. Papesch (2), K. Maracek (3)

1. Department of Environmental Geosciences, Vienna University, Austria,
2. ARC Seibersdorf research GmbH, Department of Environmental Sciences, Seibersdorf, Austria
3. Amt der Burgenländischen Landesregierung, Abteilung 9, Eisenstadt, Austria

The hydrogeology of the Zicksee was investigated by calculating the water balance, by subsurface geophysical and by isotope hydrology investigations. It is a shallow lake of approximately 1 km^2 in size and a depth of up to 1.5 m, situated within the Seewinkel region of the Northern Burgenland.

As the lake level of the Zicksee decreased during the last decade, the lake is donated by groundwater in order to attract tourism by water sports. For this purpose up to 170 l/s are pumped out periodically from two pumping wells, which are situated 500 m north of the lake in the first aquifer, the Quaternary Seewinkel gravel beds. In general, the groundwater is flowing in southern direction, from municipality Frauenkirchen in the north to the municipality St.Andrä/Zicksee in the south.

The hydrologic cycle of the Zicksee seems quite simple, about 500 to 600 mm precipitation nearly equals the evaporation from the lake, and at present there is no surface drainage in the surrounding of the Zicksee.

Basically the Zicksee seems to be a lake with groundwater contact because after regular total run out for fishery in the 1950s, the lake naturally filled again in autumn despite minor precipitation. In addition, the lake follows the yearly fluctuations of the surrounding groundwater body although the amplitudes of the water level are buffered somehow. Both observations natural refill by groundwater and yearly fluctuations of

the lake paralleling the groundwater table of neighbouring wells indicate that the Zicksee is embedded in the groundwater of the Seewinkel region.

In contrary, however, the variation of monthly ^{18}O- and tritium data during a time span of two years showed that the Zicksee comprises mainly precipitation water. As a consequence, we characterise the Zicksee as a paradox, as it is clearly filled up by the surrounding groundwater body when run out on the one hand although the lake is dominantly influenced by precipitation on the other.

In addition to this complex precipitation-groundwater situation, pumping and donating the Zicksee with groundwater from the north since 1991 induce an artificial hydrological cycle. As proved by the deuterium excess, the lake heavily evaporates during summer time and then lake water with a higher content of heavy oxygen discharges eastward into the neighbouring groundwater body. In the following this groundwater rich in lake water with high deuterium excess locally circulates to the north, where water is pumped out of the groundwater body for donating the Zicksee. Regarding the isotope ratio of the groundwater pumped out north of the lake, we estimate that the pumped water contains about 40% of evaporated lake water. This fact again pronounces the importance of local groundwater flow for the Zicksee regime at least since pumping has started.

A dense net of high resolution multi-electrode geoelectric sections allows for the general interpretation of fluvial sediments with more gravel north of the lake (where the pumping wells are situated) and in the east, where the lake water discharges in the neighbouring groundwater body, as proved by the isotope ratios. As the western part of the lake is made up by more sandy and silty beds and gravel is partly overlain by silty and clayey beds, these varying sedimentary conditions control direction of flow and transmissivity of the groundwater whereas the lake itself predominantly consists of precipitation water.

These subsurface conditions of the Zicksee catchment apparently enable both the loss of enormous amounts of pumped groundwater discharging immediately into the groundwater body (to the east), and buffering the 1.5 m yearly amplitude of neighbouring groundwater fluctuations down to 0.5 m of lake level changes. For future planning of technical measures reducing the loss of lake water in order to ensure summer tourism, the Zicksee groundwater regime will be quantified in more detail by numeric groundwater modelling.