Hydrochemical Signatures of Groundwaters in Upper Austria – Contributions to a revision of the existing thermal aquifer model

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The North Alpine Foreland Basin (NAFB) forms an intensively used area for hydrocarbon production and for gas storage. Deep groundwaters in the Upper Jurassic (Malm) aquifer and in deeper sections of the Oligocene Linz-Melk Formation are utilized for energetic and balneological use. Furthermore, deep groundwaters tapped by wells with a depth of up to 500 m are used for drinking water purposes in municipal and private supplies. Hydrocarbons have been recovered (partly from the same formations) in the NAFB for decades. In order to allow a juxtaposition of the individual interests and to secure a sustainable usage of the basin´s resources, detailed knowledge of the basin structure, its hydrogeological units and the interactions of the different systems within, is essential.

In a joint effort of Upper Austrian and Bavarian experts and authorities, a hydrodynamic model of the Malm has been established. According to this model, thermal waters migrate from the main recharge area in the Bavarian Forest eastwards to Upper Austria and drain into the Linz-Melk Formation before they reach the discharge in Eferding Basin. However, recent projects have shown that the hydrodynamic model needs a general adaption.

In order to broaden the data base, water samples from private and municipal water suppliers, as well as deep (1521-2060 m) geothermal wells, all producing groundwater from the Malmian aquifer were sampled and analysed regarding their chemical and isotopic composition. Moreover, gases associated with the water were investigated. The objective of this study is to distinguish hydrostratigraphic units based on hydrochemistry and the composition of dissolved and free gases and to identify mixing processes.

Waters of the Malmian aquifer are of the Na-HCO_3-Cl-type with total mineralization ranging between 961 mg/l and 1409 mg/l, whereas groundwaters from younger aquifers are mainly Ca-HCO_3-type waters with average total mineralization of 385 mg/l and 134 mg/l for Innviertel Group and Bohemian Massif, respectively. However, preliminary results indicate mixing of different water types in shallower formations in the Innviertel and Hausruck area. For instance, water samples taken from wells located north and north-west from the city of Wels and south from Sauwald show a chemical composition which is a result of mixing deep Malmian groundwater with younger groundwater. Interestingly, one water sample taken in Andorf shows a composition similar to that of the Malmian aquifer – a Na-HCO_3-Cl-type water with increased mineralisation.

The isotopic signature of the gas taken together with the water samples suggests a microbial origin of the methane in samples from shallower ground water horizons (e.g. Linz-Melk Formation, Innviertel Group), whereas gas from geothermal wells (Malm) shows a mixture of thermogenic and microbial methane. Higher hydrocarbons within these samples support the mixing. It is assumed, that the hydrocarbons partly originate from thermogenic hydrocarbon deposits, either located in Bavaria or Upper Austria.

Dissolved and free methane in these wells support the ascension of deep groundwater. Adjacent faults could serve as possible migration paths for thermal waters. These new findings propose that the existing groundwater model in this region has to be refined due to the observed discharge of Malmian waters.

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