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Using environmental isotopes to estimate recharge area of the Zagreb aquifer

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The Zagreb aquifer is the most important source of water supply of the town Zagreb, where from about 5,5 m^3/s of groundwater is pumped. It is a part of hydrogeological system situated within the Sava basin and it is made of Quaternary sediments – Pleistocene and Holocene gravel-sand sediments with the prevailing limestone and dolomite pebbles and grains and silt-clay interbeds. Groundwater samples have been taken in various hydrological conditions at 15 piezometric wells at various depths (Fig. 1).

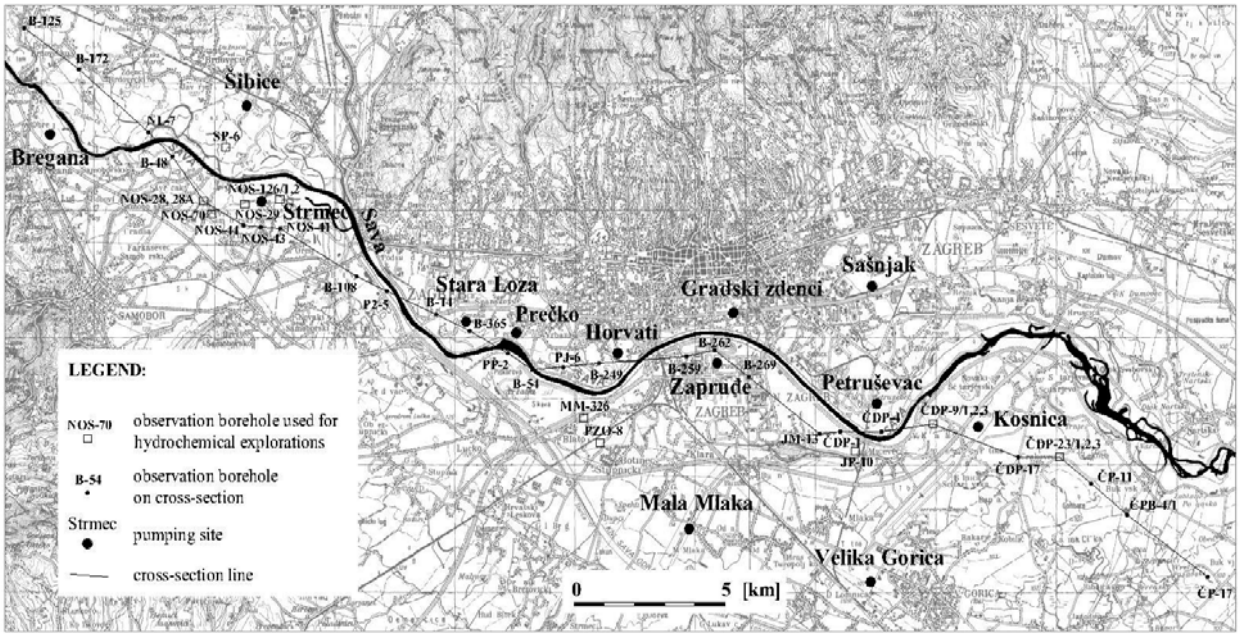

Fig. 1 The position map of piezometric wells

Main ions, stabile isotope of oxygen ($\delta^{18}O$) and hydrogen ($\delta^{2}H$), radioactive isotope of carbon (^{14}C) and tritium (^{3}H) were analysed in water samples. According to chemical composition, the groundwater belongs to CaMg-HCO_3 and CaNaMg-HCO_3 to CaMgNa-HCO_3 type (deeper parts of the aquifer in the Strmec area). The increase amount of sodium in the Strmac area is because of hydrolysis of alumosilicates in clayey silt deposits. The

groundwater temperature varies from 10 to 16°C. In the shallow parts of the aquifer were observed seasonally temperature changes and in deeper parts of the aquifer temperature changes were slow. Conductivity varies between 400 to 1000 µS/cm, and greater values than this have been measured at the individual piezometric wells downstream from groundwater pollutant. Groundwater from Zagreb aquifer is, according to pH values, slightly acid, neutral to slightly basic. Ratio of δ^2H and $\delta^{18}O$ indicate that the upper part of the Zagreb aquifer is under influence of water from lower altitude and warmer Holocene climate, but the deeper parts of the aquifer are under influence of regional flow (colder climate and a little bit higher altitude). Measured values on piezometric well JP-10 are like one in the Sava River and values on piezometric well CDP-9 (the Črnkovec area) are more positive, but measured values on piezometric well CDP-23 (the Črnkovec area) are negative and that indicate the influence of the regional flow (Fig. 2). Also, in the deeper parts of piezometric well PP-18 (the Pertuševec area), measured values of δ^2H and $\delta^{18}O$ are similar to one from piezometric well CDP-23. Measured values of δ^2H and $\delta^{18}O$ in samples of piezometric well NOS-28 indicate the recharge of that part of the aquifer in the colder period. The activity of tritium and ^{14}C are decreasing on locations CDP-23 and NOS-28 with the depth but their activity is reverse on the location CDP-9 (lower ^{14}C activity in the upper part and higher in the deeper part). Activity distribution of ^{14}C and ^3H along the aquifer depth on CDP-23 and CDP-9 locations shows that the whole quantity of water is the result of present recharge, so in its prevailing part, it is the result of precipitation infiltration in the last 50 years (IAEA, 1983, UNESCO/IAEA, 2001). Also, the lower part of the aquifer on the location NOS-28 is under the present recharge but in the deeper part of the aquifer the water is old (typical example of slow water exchange).

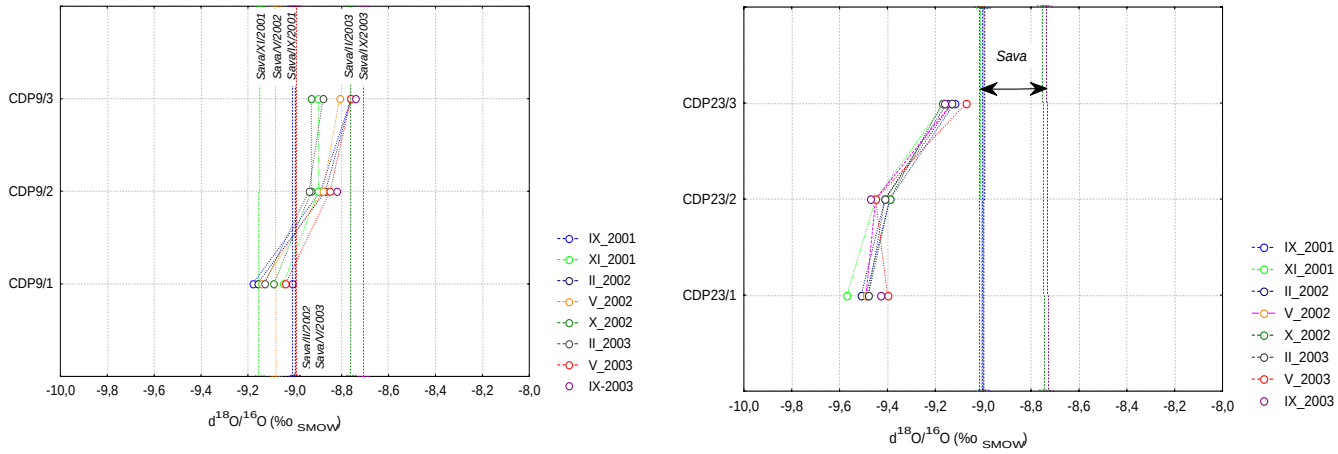

Fig. 2 The distribution of $\delta^{18}O$ on locations CDP-9 and CDP-23 along the depth

The Zagreb aquifer in the hydrochemic and isotopic sense is layered, especially in parts, which are far away from the Sava River. The shallow parts of the aquifer are under the present recharge and water in the deep parts of the aquifer has long residence time. Also, the deep parts of the aquifer in the Črnkovec and Petruševec area, which are situated at the opposite side of the Sava River, are unique hydrogeological system.

References:

IAEA, 1983. Guidebook on Nuclear Techniques in Hydrology, Technical report series No.91, International Atomic Energy Agency, Vienna.

UNESCO/IAEA 2001. Environmental Isotopes in the Hydrological Cycle. Principles and Applications. Book series edited by W.G. Mook, Vienna.