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title: Hydrogeological and geophysical research of the brackish groundwater lens on the small karst island of Ilovik in Croatia

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The island of Ilovik is situated in Kvarner region, in the northern part of the eastern (Croatian) Adriatic Sea coast. It is one of the smallest inhabited islands in the Adriatic Sea (5.88 km^2), built of karstified Cretaceous and Paleogene limestones. It is a part of the well-known Dinaric karst region, with very deep and irregular tectonics and karstification, which causes the possibility of seawater intrusions under the freshwater lenses or aquifers, with very irregular shape and wide transition zone. This transition or mixing zone spreads practically within the whole island's aquifer, making its water brackish. In such an environment, establishment of an extraction site (with as low salinity as possible) would be quite a big success.

Although the island is very small, in the years 2002–2004, it was subjected to a bulk research program with the main aim of developing a groundwater extraction site with 1.0 L/s of the brackish groundwater (chloride concentration should not exceed 5000 mg/L). The number of permanent inhabitants is quite low — less than a 100, but during the summer season it is usually much higher (few hundreds, or even more). Every year, more and more people, especially nautical tourists, come to this beautiful island to enjoy their summer vacations.

The research program was carried out within three phases and it contained (and combined) many different methods, such as: geological and hydrogeological mapping, geophysical researches (electrical tomography and seismic refraction), investigatory core drilling, designing of the test wells construction, pumping tests, groundwater level monitoring, and hydrogeochemical researches (*in situ* and laboratory). Because of these researches, more than the needed water quantity and quality was found and could be extracted with three boreholes (BIL-1, BIL-2, and BIL-3).

Achieved results and conclusions showed that parametric estimation of hydrogeological properties is useful even in such heterogeneous karst environment. Numerous and very different parameters were proven as useful tools for the hydrogeological description of such a complex environment. Accomplished results have been scientifically analyzed and compared with the results of similar studies from other Adriatic islands (Terzić, 2006). A very similar research case study — the island of Dugi Otok, has already been published (Terzić et al., 2007). Numerous experiences from other carbonate islands were used in planning and executing our research (Vacher, Quinn, 2004). The island's karstified rock mass is very permeable, and using Thiem's method of pumping test interpretation, hydraulic conductivity in Eocene limestone was 5.2×10^{-6} m/s, and in Cretaceous limestone from 2.0×10^{-5} to 2.6×10^{-4} m/s. The most permeable is rock mass around the borehole BIL-2, where there was only negligible drawdown during the pumping with 0.9 L/s (maximal quantity for the borehole diameter).

Considering the scale of research, which is closest to the so-called subregional scale (Sauter, 1992), where pumping test calculations are applicable to a certain extent and considering the results of geological and hydrogeological mapping and geophysical research, the groundwater flow in the island of Ilovik's underground happens dominantly within the fractures, fracture zones, fissures, and small connected caverns, and not that much through big karst conduits. Tidal efficiency was also noted in the groundwater level (as well as in chemical) fluctuations. Around the BIL-2 borehole, electrical tomography showed some 4000 Ωm in a dry rock mass above the groundwater level. Around the first few meters of fresh/slightly brackish water saturated rock mass it immediately dropped from 1200 to bellow 300 Ωm, and deeper in the transition zone, it was bellow 100 Ωm. Hydraulic and geophysical parameters should be used just as an orientation or order of magnitude and not as exact values that could be used for modeling.

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