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THE IMPORTANCE AND CHARACTERISTICS OF KARST AQUIFERS

Due to their specific characteristics, karst aquifers are extremely vulnerable to various sources of pollution. High permeability of karst rocks enables fast infiltration of water from surface to the underground, and from there on a very rapid flow over long distances and through usually unknown paths. Together with water also the pollution spreads quickly and endangers water resources. Due to a heterogeneous structure of karst aquifers it is very difficult to simulate the groundwater flow and transport of harmful substances. This is additionally complicated by a great variability of the characteristics of aquifers at different hydrological conditions. The reaction to various negative factors is therefore specific and significantly different than in other environments. For the assessment of the impact of human activities on karst waters these specific properties have to be properly considered. A good understanding of the characteristics of karst aquifers is essential for their efficient protection.

In Slovenia almost half of the population drinks water from karst water resources, and in dry periods almost two thirds of our water reserves are stored in karst aquifers. This is especially true for the Goriška, Gorenjska, and Obalno-kraška statistical regions, which are included in the GEP project at the Slovenian side. The main water sources are the Mrzlek, Hubelj, Vipava, Rižana and some other springs. Their advantage is in sufficient water quantity, however due to large extents of their recharge areas it is difficult to protect their quality. Additional problem can occur when an area is supplied from only one water source in the vicinity. In the case of a drought or pollution accident this area can remain without drinking water or this water can be of low quality and its distribution disturbed.

Karst aquifers are areas composed of carbonate rocks (mostly limestone and dolomite), which were influenced by the processes of karstification. Karst channels and fissures in these rocks store relatively large quantities of groundwater. They differ from other types of aquifers in high solubility of rocks. This results in formation of specific surface and underground features, and in specific characteristics of groundwater flow.

Karst aquifers are usually areas with the extent of more tens to more hundreds of km^2 and are often intersected by highly karstified zones of fissures and faults. Due to their karstification, the precipitation water quickly infiltrates through bare surface or thin soil cover into the underground. At the contact with karst also surface streams from non-karst areas sink (Figure 1).

Projekt GEP Sofinanciran v okviru Programa čezmejnega sodelovanja Slovenija-Italija 2007-2013 iz sredstev Evropskega sklada za regionalni razvoj in nacionalnih sredstev
Progetto GEP finanziato nell'ambito del Programma per la Cooperazione Transfrontaliera Italia-Slovenia 2007-2013, dal Fondo europeo di sviluppo regionale e dai fondi nazionali.

REPUBLIKA SLOVENIJA
MINISTRSTVO ZA GOSPODARSKI RAZVOJ IN TEHNOLOGIJO

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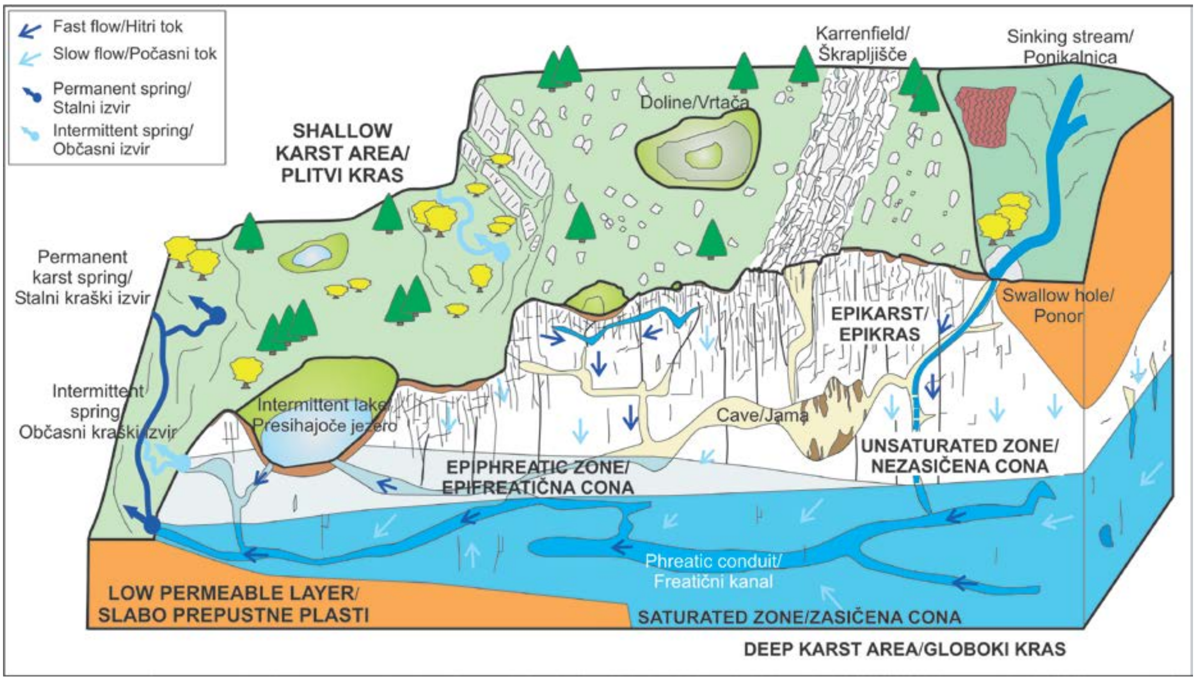

Figure 1: Schematic model of a karst aquifer (Ravbar, 2007).

In the underground, infiltrated water flows mostly vertically toward the water table. On its way it enlarges the fissures by corrosion and creates a system of interconnected flow paths of various sizes. Therefore the structure and functioning of karst aquifers differ significantly from non-karstic aquifers (e.g. intergranular). For karst aquifers very high permeability and high groundwater flow velocities, various types of flows and usually unknown flow paths are characteristic. Often water from different recharge areas is mixed.

Due to all described characteristics, the karst aquifers are extremely vulnerable to pollution. The processes of self-purification in karst are usually less efficient due to fast infiltration, low filtration capacity, high flow velocities (up to several hundreds of meters per hour) and therefore rapid transport of pollution far away from the point of injection. The time of water transfer from the surface to a spring depends on karstification of the flow paths. Through some karst channels the water flows rapidly, and in others it can be retained for longer time. Therefore pollutants can reach a spring in only several hours or days, or they can be stored in the underground for several days, weeks or months.

Different hydrological conditions have a significant influence on flow directions and transport times, as well as on the ability of dilution and storage of pollutants in the underground. In the cases of point spills of fluids in dry periods (e.g. at some accident), these fluids can flow very quickly along well permeable conduits and are temporarily stored in less permeable parts of the vadose zone. Also at diffuse and less intensive infiltration of substances these are stored in the vadose zone. However, when the vadose zone is due to some intensive or long lasting previous precipitation temporarily well saturated, the differences in flow velocities between well permeable and less permeable conduits are significantly lower.