Importance of geological aspects of karstic aquifer for vulnerability assessment: case study of Učja Valley, NW Slovenia

Petra Žvab Rožič
University of Ljubljana, Faculty of Natural Sciences and Engineering, Department of geology, Privoz 11, 1000 Ljubljana; petra.zvab@ntf.uni-lj.si

Učja aquifer represents a karstic aquifer, which may contain very large amounts of quality groundwater, and could in the future represent an important source for drinking water or commercial use as well as it could be used as a significant water resource for cross-border supply. Through the postdoctaral project the first comprehensive survey of Učja aquifer is carried out and thereby the base data for connection across border are prepared.

Location:
Učja Valley is located in north-western Slovenia, on the border with the Republic of Italy, and also extends across the border to Mount Musi on the Italian side. Due to many natural features, the valley is protected as a natural value of national importance.
The investigated area is bounded by mountain ridge on the southern and northern strains; the ridge of Kobariški stol with the highest peak of Stol (1673 m) in the south and the ridge with the peak Veliki Muzec (1721 m) as a part of the Kanin Mountains in the north. The western border defines the state border between Republic of Italy and Slovenia, and Soča Valley at the Žaga settlement in the east.

Conceptual hyadological model - idea (Figure 1):
The main aquifer of Učja Valley is structurally separated by the W-E oriented fault in the south and the trust in the north (Figure 1). These structures are probably not complete hydrological barriers therefore, the Učja Valley can supply water also from higher parts of the Kobariški stol and Kanin Mountains. In the east, the hydrological barrier represents the Idrija fault.

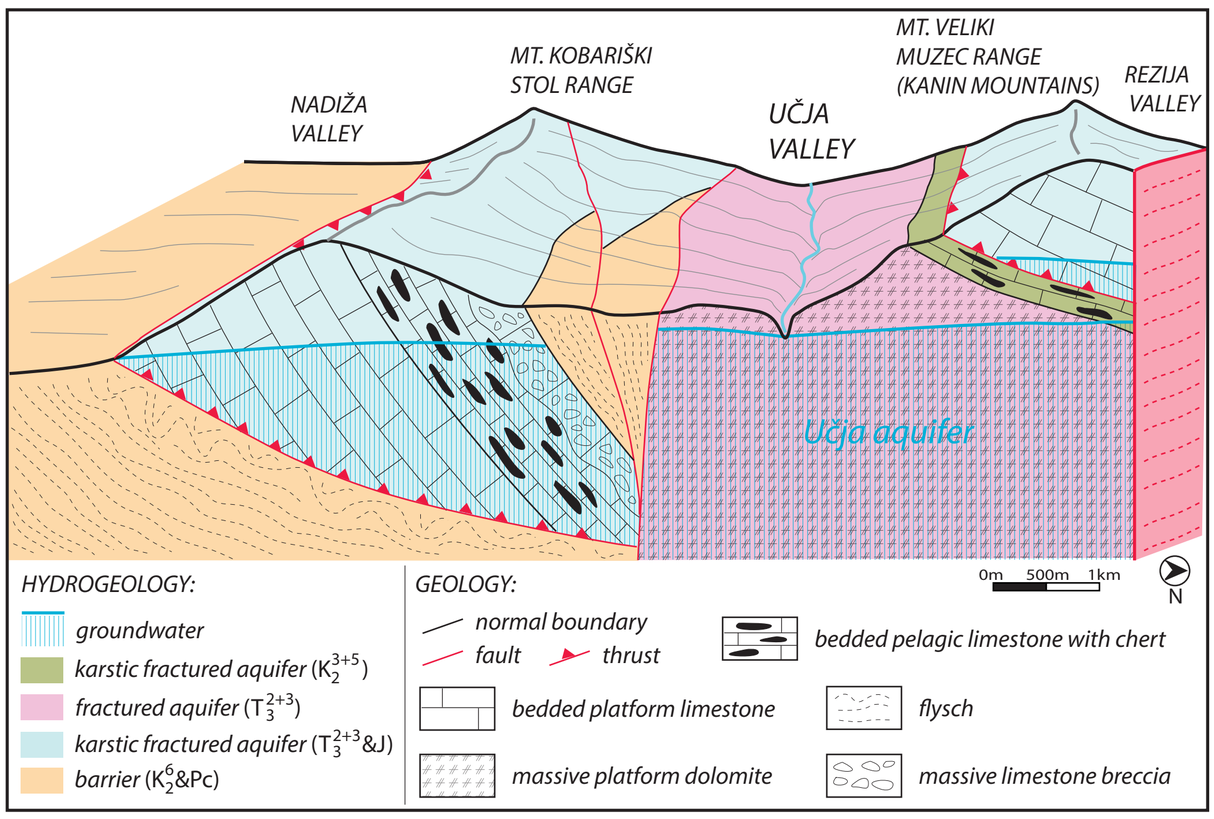

Figure 1: First idea of conceptual hydrogeological model

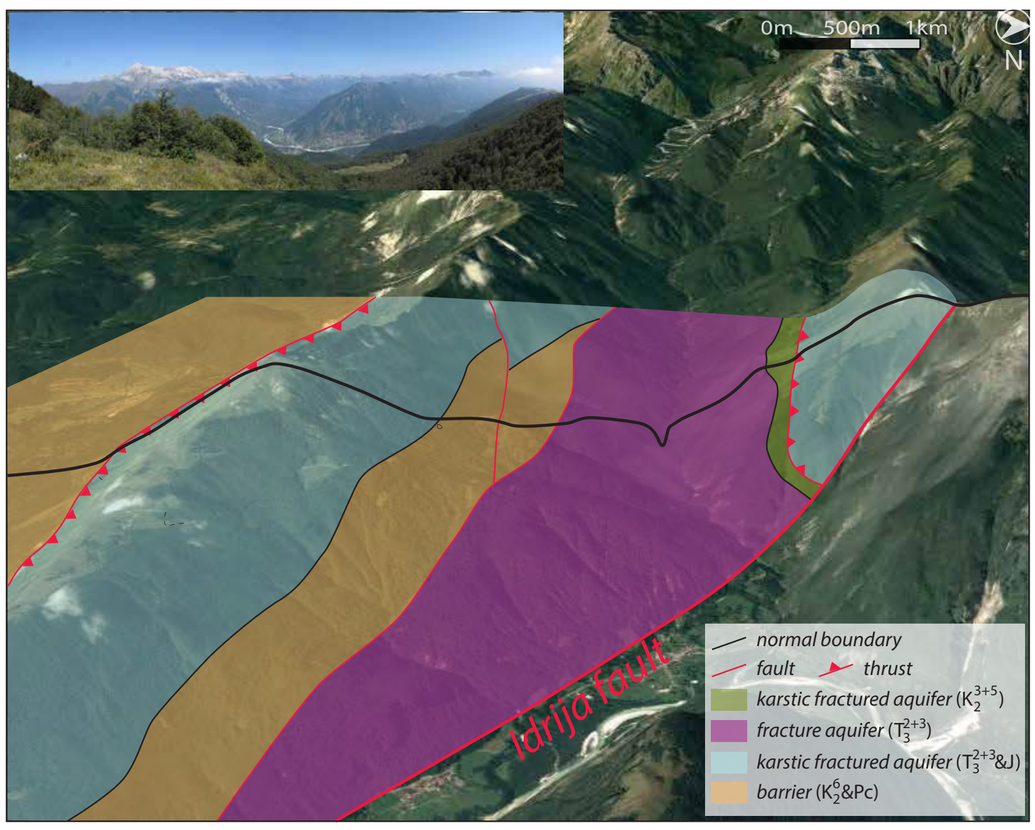

Figure 2: Simplified geological map of investigated area (compiled from Buser, 1986; Premru, in Brenčič et al., 2001; personal 1:5000 mapping)

Lithological aspect (Figure 2):
Potential aquifers of investigated area comprise Triassic dolomites (T_3^{2+3}) and the carbonate sequence of Triassic and Jurassic rocks, predominately limestones (T_3^{2+3}& J). Upper Cretaceous to Paleocene formation (K_2^6 & Pc) is composed of basal limestone breccias overlain by alternating carbonate and silicycliclastic turbidites and marls (flyshoid facies). While basal breccia is a part of a large karstic fractured aquifer, the succeeding part of formation represent a hydrological barrier and significantly influence to the groundwater flow.

Structural aspect:
The recognition of geological structure is based on the special mapping method adopted for the karstic realm. The methodology describes three degrees of tectonic fracturing in carbonates; crushed, broken, and fissured/fractured zones (Čar 1982; Čar & Pišljar 1993). These zones were found to be important factor for groundwater flow. Where the crushed zones are developed, the faults act as barriers, while fissured zones are significantly more permeable. An important hydrogeological role was proposed also for so-called deflector faults (Šušteršič et al. 2001, Šušteršič 2006) which solely hinder streaming through them and redirect water in the main channels (caves) along the faults. Such fault can be also W-E orientated fault on the southern slopes of the Učja Valley.

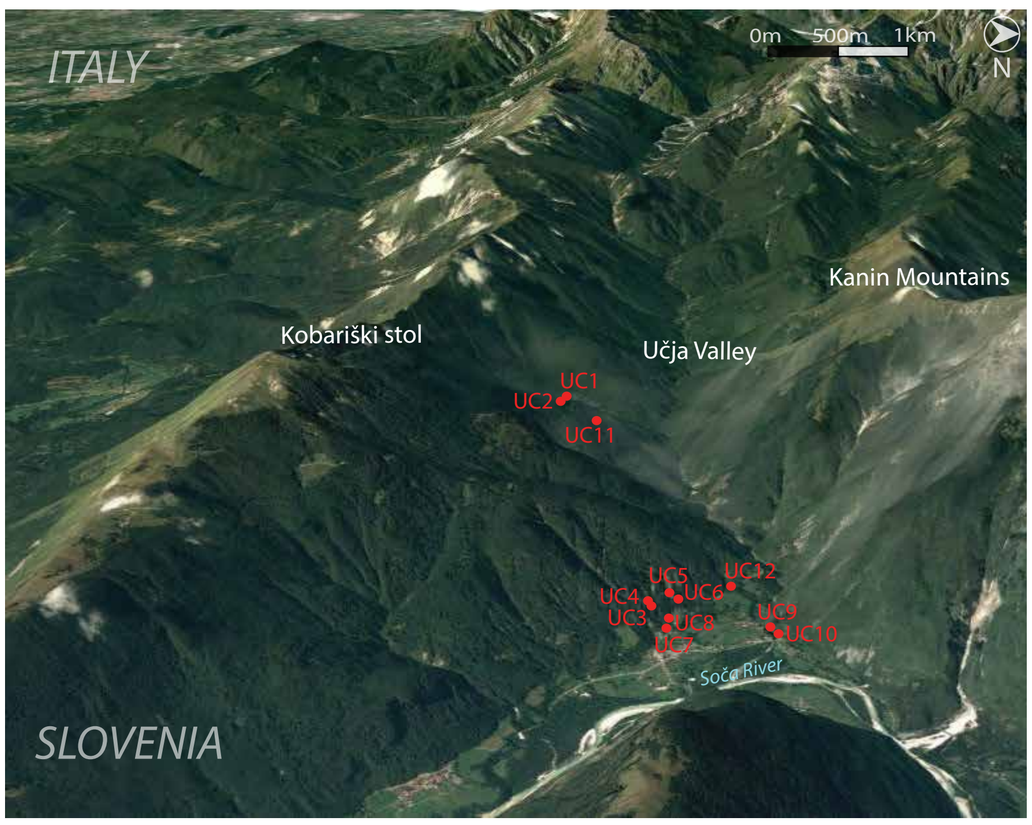

Figure 3: Positions of sampling locations of groundwater in selected sources in Učja Valley

Hydrogeochemical and isotopic analyses:
In order to determine the dynamics of groundwater in the area of the aquifer of Učja Valley, a polygon of sampling locations of groundwater was made (Figure 3 and 4), where the monitoring of physico-chemical parameters, geochemical and isotopic composition of water is carried out. Physico-chemical parameters (EC, T, pH) are measured monthly, while geochemical (anions, cations) and isotopic ($\delta^{18}O$, δD, $\delta^{13}C_{DIC}$) analyzes seasonally. Statistical analyzes and geochemical modeling of the results will give an information of geochemical composition of groundwater under different hydrological conditions.


Figure 4: Sampling locations of groundwater

This research is financially supported by the Slovenian Research Agency (Postdoctoral project Z1-8154: Evaluation of Učja valley karstic aquifer as a potential source of drinking water (NW Slovenia). I thank my colleagues Boštjan Rožič, Rok Brajković, Timotej Verbovšek and student Ana Grkman for help in the field.

Brenčič, M., et al., 2001: Raziskave ležišč pitne vode v območju Posočja. Zaključno poročilo o rezultatih opravljenega raziskovalnega dela na projektu v okviru ciljnih raziskovalnih programov (Research of drinking water resources in the Posočje area; in Slovene), pp. 72 / Buser, S., 1986: Tolmač k Osnovni geološki karti SFRJ 1: 100 000 lista Tolmin in Videm (Udine). Zvezni geološki zavod, Beograd,pp.103 / Buser, S., 1987: Osnovna geološka karta SFRJ 1: 100 000, list Tolmin. Zvezni geološki zavod, Beograd / Čar, J. 1986: Geološke osnove oblikovanja kraškega površja = Geological bases of karst surface forma¬tion (In Slovene, English Summary).- Acta Carsologica, 14/15 (1985/1986), 31–38 / Čar J. & M. Pišljar, 1993: Presek Idrijskega preloma in potek doline Učje glede na prelomne structure (In Slovene, English Summary).- Rudarsko-metalurški zbornik, 40, 1–2, 79–91 / Šušteršič, F., 2006: Relationships between deflector faults, collapse dolines and collector channel formation: some examples from Slovenia.- International Jour¬nal of Speleology, 35, 1–12 / Šušteršič F., Čar J. & S. Šebela, 2001: Zbirni kanali in zaporni prelomi – Collector channels and deflector faults (In Slovene, English Summary).- Naše jame, 43, 8–22.