

Geological exploration in the area of Zeleni vir (Green Whirlpool) and Vražji prolaz (Devil's Passage) (Skrad, Croatia)

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In the area of Gorski Kotar (Croatia), within Skrad municipality, the protected landscape Zeleni vir/Vražji prolaz (Green Whirlpool/Devil's Passage) is located. Since 1962 this area is protected and classified as a geomorphological reserve and since 2011 it is protected and classified as a protected landscape.

Specific geological characteristics of the protected landscape Zeleni vir/Vražji prolaz area were the main reasons for starting a *Geological educational trail project*, which was initiated by the tourist office of Skrad municipality. The main goal of the project is to display the geological features of the area to the numerous visitors of this protected landscape and to explain them geological processes and events involved in its formation.

Zeleni vir/Vražji prolaz area belongs to the mountain range of the Outer Dinarides, which is built mainly of Mesozoic and Palaeogene carbonate rocks. According to the basic geological map (1:100 000), Delnice sheet (Savić *et al.*, 1983), clastic rocks of Permian and Triassic age are also present in the Zeleni vir/Vražji prolaz area. However, lithostratigraphical and structural relationships are not clearly visible within the scale of the map. Therefore, construction of the more detailed geological map of the area is the main goal of the project, together with a geological reconstruction and a lithostratigraphical and structural revolution.

Research started in the summer of 2013, as an independent student project, logistically supported by Skrad municipality. Initial field work resulted with definition of the research area and with the main lithological and stratigraphical description of rocks outcropping within the area (Lower- and Middle Jurassic dolomite and limestone, Upper Triassic dolomite and clastic rocks of still questionable age - Triassic and/or Permian). Therefore, representative samples of these clastic rocks (mainly sandstone, but also siltstone/mudstone and fine conglomerate occur) were taken for petrographic microscopic analysis and analytical procedures aimed to define the lithological and stratigraphical characteristics. Carbonates (dolomite and limestone) are also systematically sampled throughout the research area and submitted to micropetrographical and palaeontological analysis.

Furthermore, structural relationships of grandiously-folded Jurassic carbonates were investigated. Main problems of folding mechanisms and the timing of structural deformations are questioned and they are still under discussion. Several structural models and scenarios are proposed. Some stratigraphical determinations are missing (because of the lack of fossils within some of the sampled rock packages), which further complicates the proposed structural model and the exact timing of the geological events.

Vražji prolaz (Devil's Passage) is actually the canyon insisted by Jasel Stream within Jurassic carbonates. According to our results of the geological field-observations and structural measurements, development of the canyon is initiated by faulting of carbonates, followed by spreading the fault zone and accelerating dissolution and weathering of carbonates. Differences in the lithology and

structural relationships in the two opposite canyon walls are clearly visible, indicating major faulting movements.

Additional geological and morphological features, which are also valuable components of the protected landscape Zeleni vir/Vražji prolaz (Green Whirlpool/Devil's Passage), are the small (cca. 200 m long) cave called „Muževa hišica”, with a constant air-temperature of 8°C throughout the whole year and the karst spring called Curak, situated at the contact of folded Jurassic carbonates (Fig. 1) and underlying carbonates. High discharge at the spring and its high hidropotential is used for a power plant called „Munjara” built already in the year 1922.

The results of the *Geological educational trail project* will be submitted to compete for University of Zagreb Rector's Award and this research will also result in two MSc thesis works:

1., I. Gudac will describe and interpret petrological and lithostratigraphical characteristics of clastic and carbonate rocks within the research area (under the supervision of prof. U. Barudžija).

2., M. Sečanj will describe and interpret structural relationships within the research area (under the supervision of prof. B. Tomljenović).

Also, they will help to better understand the hidrogeological and geomorphological open questions within the area of Zeleni vir/Vražji prolaz (Green Whirlpool/Devil's Passage).



Fig. 1. Folded Jurassic carbonates

Savić, D., Dozet, S. (1980): Basic geological map of SFR Yugoslavia (1:100 000), Delnice sheet