



Geomorphology of the lakebed and sediment deposition during the Holocene in Lake Visovac

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Lake Visovac is a tufa barrier lake on the Krka River between Roški slap (60 m asl) and Skradinski buk (46 m absl) waterfalls, included in the Krka national park as primarily unaltered area of exceptional natural value. Paleolimnological research was conceived to address a lake evolution and depositional environments through the geophysical survey and collection of the lake sediment cores. A high-resolution bathymetric map was obtained using a multibeam sonar. The average lake depth varies between 20 and 25 m. Sediment cores were investigated to extract physical properties, sedimentological, mineralogical, geochemical and paleoecological records constrained by the radiocarbon chronology, to understand what was happening to both the landscapes and lakescapes of Lake Visovac during the last 2.000 cal yr.

Significant findings of the project are geomorphological features on the lake bottom: submerged sinkholes of various sizes (up to 40 m deep); submerged tufa barriers in the area of Kalički kuk (southern part of Lake Visovac) at the depths of 15 and 17 m, followed by a series of buried cascade tufa barriers at the depth of 25 m covered with up to 10 m of Holocene lake sediments; submerged vertical tufa barrier up to 32 m-high near the mouth of Čikola River; submerged landslides, small (river) fan structures characterized by sediment waves. Ground-penetrating-radar (GPR) data have been acquired due to the presence of gas-saturated sediments over a large area of the lake, that limited the use of high-resolution acoustic profiling. A total thickness of sediments is up to 40 m. High resolution paleoenvironmental record through the Late Holocene gives evidence of high sedimentation rates in Lake Visovac, variable soil erosion impact on lake sediment composition and carbonate authigenic sedimentation. Higher organic carbon is observed in the last 50 years due to changes in land cover and reforestation. Pleistocene lake sediment outcrops occur up to 20 m above the present lake levels indicating higher lake levels as a consequence of higher elevation of tuffa barriers. Kalički kuk, which lies up to 20 m above present lake level, is a remnant of these barriers which have been dated to MIS5. Results allow us to interpret the environmental and evolutionary dynamics of Lake Visovac in the following way: lake level more than 20 m higher than today in mid-Pleistocene with significantly larger lake volume in Lake Visovac, with active Kalički kuk and Skradinski buk waterfalls; lower lake-level at the beginning of the Holocene when several small lakes existed in isolated basins in the area of Lake Visovac.

The tufa barrier at Skradinski buk started to grow faster than the Kalički kuk barriers and waterfalls resulting in their flooding and submergence during the Holocene. The tufa barrier at Skradinski buk has grown 15 m since then. This study demonstrates the role of geomorphological lakebed characteristics in reshaping our understanding of the environmental changes and the future of Lake Visovac.

The research was conducted as part of the project funded by the Krka National Park and CSF funded QMAD project (IP-04-2019-8505).