

Influence of global temperature change on the geochemical processes in the Plitvice Lakes waters - a case study

Andreja Sironić (1), Jadranka Barešić (1), Nada Horvatinčić (1), Andrijana Brozinčević (2), Maja Vurnek (2), and Sanja Kapelj (3)

(1) Ruđer Bošković Institute, Zagreb, Croatia, (2) Scientific Research Center "Dr. Ivo Pevalek", Plitvice Lakes National Park, Croatia, (3) Faculty of Geotechnical Engineering, University of Zagreb, Varaždin, Croatia

One of the major reasons for the global air temperature increase, recorded as the highest in the last decade, is considered to be the increase of the atmospheric CO₂ concentration. However, in calculation of the global carbon budget a certain unknown carbon sink is identified, and karst relief is considered to be an important candidate for it, as well as being a source of carbon. Aquatic systems on karst enable carbon exchange between karst and atmosphere, often through groundwater geochemical carbonate rock dissolution (carbon sink) and in form of secondary calcium carbonate precipitation (carbon source).

Protected area of the Plitvice Lakes National Park, settled in the karst area of Croatia, was chosen as a case study of karst geochemical processes. The Lakes are also specific for its tufa precipitation in form of tufa barriers. Physical and chemical data of water collected on 8 locations (2 springs and 6 lakes) in the last 30 years were studied.

The data records were not systematic for all 30 years, so first the seasonal periodicity of all data was assessed and temporal change was investigated in each calendar month, and then the change was studied by comparing two distinct periods: 1981-1986 and 2010-2014.

On all selected locations we observed temporal increase of air and water temperature, Ca²⁺ and HCO₃⁻ concentrations, calcite saturation index (SI_{calc}) and of calcite dissolution ionic ratio (IR_{calc}) and a decrease in Mg/Ca ratio, though the intensity of this changes differ locally. No statistically significant change was observed for pH and CO₂(aq) and Mg²⁺ concentrations. Discharge rates did not show significant change in the last 30 years; however there is a change in their seasonal distribution and more extreme values were recorded in recent period.

Comparison of mean monthly air and water temperature for two periods implies more influence of groundwater inflow at all locations in recent period, which is probably a result of seasonal change in water discharge rates.

Significant increase in Ca²⁺ and HCO₃⁻ concentrations at lake locations were caused by their increase in springs. With Mg²⁺ concentration simultaneously being stagnant, this is an indication of stronger calcite than dolomite dissolution. One of the reasons for this could be increased air/soil temperature resulting in higher CO₂ soil production primarily dissolving calcite.

A temporal and spatial change in SI_{calc} and IR_{calc} values on surface waters were explained as being under influence of change in water temperature.