

Stable isotope composition of surface and deep waters from Plitvice Lakes

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Within the project "The influence of climatic changes and environmental conditions on biologically induced precipitation of tufa and sedimentation process in the Plitvice Lakes", contracted between the Ruđer Bošković Institute and the National Park Plitvice Lakes, various isotopic data for water, tufa, lake sediments and atmosphere were collected in the period from April 2011 to April 2014. Here we present isotopic composition ($\delta^2\text{H}$ and $\delta^{18}\text{O}$) of surface and deep waters. The study area was the Plitvice Lakes system of 16 lakes separated by tuffa barriers and interconnected by waterfalls. Surface water was collected at 8 locations along the water course in length of ~ 10 km from Matica (the main stream feeding the lakes) to the Korana River (the outflow from the lake system), while the deep water was collected at 4 sediment traps in different lakes (IRB1 and IRB2 in Lake Kozjak at water depth 6 m and 8 – 10 m, respectively, IRB3 in Lake Prošće at 6 m, IRB4 in Gradinsko Lake at 2 m).

Both $\delta^2\text{H}$ and $\delta^{18}\text{O}$ of water show seasonal variations with higher values during summer, but the seasonal variations (<1.4 ‰ in $\delta^{18}\text{O}$, <9 ‰ in $\delta^2\text{H}$) are much smaller than in precipitation of the area ($\delta^{18}\text{O}$ values in precipitation varied from -16 ‰ to -2 ‰, and $\delta^2\text{H}$ from -120 ‰ to -10 ‰ [1] confirming that the waters of the system are well mixed. No difference between deep and surface waters is observed if the mean values are concerned. A slight increase in both mean $\delta^2\text{H}$ and $\delta^{18}\text{O}$ values and their seasonal variations is observed for locations along the water course, from -10.7 ± 0.1 ‰ at Matica to -10.3 ± 0.3 ‰ at the Korana River. Influence of heavy summer rains and snow melting was observed by slight increase and decrease, respectively, in $\delta^{18}\text{O}$ values compared to the average/"normal" values in both surface and deep waters.

The LMWL for the Plitvice Lakes precipitation is $\delta^2\text{H} = 7.8 \delta^{18}\text{O} + 11.7$ [1]. All surface waters in this study lie on the line $\delta^2\text{H} = (6.5 \pm 0.3) \delta^{18}\text{O} - (2.8 \pm 3.0)$, $R^2 = 0.88$, and the deep water on the line $\delta^2\text{H} = (5.8 \pm 0.3) \delta^{18}\text{O} - (9.5 \pm 3.0)$, $R^2 = 0.91$. Lower slopes and intercepts of both relations compared to the LMWL indicate influence of evaporation of surface waters that is more pronounced in big lakes, and also more pronounced in deep than in surface waters.

- [1] Babinka S, Obelić B, Krajcar Bronić I, Horvatinčić N, Barešić J, Kapelj S, Suckow A. In: Advances in Isotope Hydrology and its Role in Sustainable Water Resources Management (IHS-2007), Proceedings of a Symposium, Vol. 1, STI/PUB/1310. IAEA, 2007. 327-336.