Isotope composition of precipitation, groundwater, surface and lake waters from Plitvice Lakes, Croatia : supplementary material

Krajcar Bronić, Ines

Supplement / Prilog

Permanent link / Trajna poveznica: https://urn.nsk.hr/urn:nbn:hr:169:642231

Rights / Prava: Attribution 4.0 International/Imenovanje 4.0 međunarodna

Download date / Datum preuzimanja: **2024-03-28**



Repository / Repozitorij:

Faculty of Mining, Geology and Petroleum Engineering Repository, University of Zagreb





water

MDPI

Supplementary material

Isotope composition of precipitation, groundwater, surface and lake waters from Plitvice Lakes, Croatia

Ines Krajcar Bronić [1,*], Jadranka Barešić [1], Andreja Sironić [1], Ivanka Lovrenčić Mikelić [1], Damir Borković [1], Nada Horvatinčić [1] and Zoran Kovač [2]

[1] Laboratory for Low-level Radioactivities, Division of Experimental Physics, Ruđer Bošković Institute, 10000 Zagreb, Croatia; jbaresic@irb.hr (J.B.); asironic@irb.hr (A.S.); ivanka.lovrencic@irb.hr (I.L.M.); damir.borkovic@irb.hr (D.B.); horvatin@irb.hr (N.H.)

[2] Faculty of Mining, Geology and Petroleum Engineering, University of Zagreb, 10 000 Zagreb, Croatia; zoran.kovac@rgn.hr

* Correspondence: krajcar@irb.hr

Received: date; Accepted: date; Published: date

Table S1. Number of isotope data for precipitation, groundwater, surface water and lake waters from the Plitvice Lakes area.

Sample type	*n* (*A*)	*n* (δ^2H, δ^{18}O)	Period	Reference[2]
Precipitation	27	5	1978 – 1984	[36]
	37	38	2003 – 2006	-
Groundwater	95	17	1979 – 1984	[7,8]
	31	3	1985 – 1990	-
	17	-	2000 – 2015	-
		56	2003 - 2006	[10]
	-	9	2015 – 2018	-
Surface water	-	95 (δ^2H), 38 (δ^{18}O) [1]	2003 – 2006	[10]
	-	88	2011 – 2014	-
	9	-	2015	-
Lake water	-	44	2011 – 2014	-

[1] Number of δ^2H and δ^{18}O data is not equal.

[2] References given in the main text.

Table S2. Monthly precipitation amount *P*, mean monthly temperature *T* and isotope composition of precipitation ($\delta^{18}O$, $\delta^{2}H$, deuterium excess, tritium activity concentration *A*) at the Plitvice Lakes. Data from [7,10,36,45]. Shadowed rows indicate years with no data. Red fonts indicate extreme values of parameters in 2003 – 2006 period.

year	month	*P* (mm)	*T* (°C)	$\delta^{18}O$ (‰)	$\delta^{2}H$ (‰)	*d*-excess (‰)	*A* (^{3}H) (TU)
1978	1						
1978	2						
1978	3						
1978	4						
1978	5						
1978	6						
1978	7						101.6
1978	8						108.2
1978	9						
1978	10						
1978	11						
1978	12						
1980	1						
1980	2						
1980	3						
1980	4						
1980	5						
1980	6						
1980	7						33.9
1980	8						46.3
1980	9						32.6
1980	10						7.6
1980	11						10.4
1980	12						20.1
1981	1						20.8
1981	2						28.4
1981	3						41.3
1981	4						57.7
1981	5						44.3
1981	6						67.2
1981	7						60.5
1981	8						50.8
1981	9						40.1
1981	10						23
1981	11						20.4
1981	12						13.9
1982	1						18.2
1982	2						20.2
1982	3						32.6

year	month	*P* (mm)	*T* (°C)	$\delta^{18}O$ (‰)	$\delta^{2}H$ (‰)	*d*-excess (‰)	*A* (^{3}H) (TU)
1982	4						
1982	5						
1982	6						34.8
1982	7						
1982	8						
1982	9						
1982	10						
1982	11						
1982	12						
1983	1						
1983	2						
1983	3						
1983	4						
1983	5						
1983	6			-9.11	-61.7	11.18	
1983	7						
1983	8						
1983	9			-7.19	-46	11.52	
1983	10						
1983	11						
1983	12						
1984	1			-11.29	-80.4	9.92	18.8
1984	2			-13.14	-94.4	10.72	17.1
1984	3			-11.19	-80.6	8.92	17.9
1984	4						
1984	5						
1984	6						
1984	7						
1984	8						
1984	9						
1984	10						
1984	11						
1984	12						
2003	1	190.1	-1.6				
2003	2	72.6	-4.3				
2003	3	65.5	3.9				
2003	4	90.3	8.1				
2003	5	77.5	15.8				
2003	6	58.8	19.9				
2003	7	17.5	20.1	-5.31	-32.80	9.68	7.5
2003	8	32.6	21.7	-4.13	-22.30	10.74	7.2
2003	9	186.4	12.2	-9.30	-56.90	17.5	4.1
2003	10	251.5	7.8	-10.69	-72.60	12.92	1.9
2003	11	101.9	6.6	-8.52	-53.50	14.66	1.8

year	month	*P* (mm)	*T* (°C)	$\delta^{18}O$ (‰)	$\delta^{2}H$ (‰)	*d*-excess (‰)	*A* (^{3}H) (TU)
2003	12	61.1	0.7	-11.88	-80.20	14.84	1.9
2004	1	141.6	-2.0	-13.46	-100.00	7.68	1.8
2004	2	196.4	0.9	-13.60	-95.40	13.4	2.5
2004	3	154.5	1.8	-14.81	-106.50	11.98	3.7
2004	4	210.1		-10.08	-69.40	11.24	8.2
2004	5	147.3	11.1	-7.05	-44.40	12	6.3
2004	6	158.9	15.7	-7.82	-50.80	11.76	11.9
2004	7	71.9	17.9	-7.07	-45.40	11.16	
2004	8	61.6	18.2	-6.36	-38.00	12.88	17.2
2004	9	170.7	12.8	-8.33	-51.20	15.44	5.5
2004	10	153.5	12.7	-7.54	-45.20	15.12	4.2
2004	11	184.9	4.5	-11.33	-76.50	14.14	4.3
2004	12	183.6	0.5	-8.76	-53.10	16.98	3.4
2005	1	146.5	-0.8	-16.35	-112.90	17.9	6.6
2005	2	160.5	-4.1	-18.32	-132.40	14.16	8.2
2005	3	130.6	1.5	-13.76	-94.20	15.88	7.2
2005	4	197.8	8.5	-9.24	-57.60	16.28	8.9
2005	5	138.3	13.0	-7.48	-46.60	13.2	9.4
2005	6	114.2	16.3	-7.52	-47.40	12.76	10.5
2005	7	165.4	18.3	-8.66	-55.88	13.4	14.3
2005	8	335.6	15.7	-7.80	-48.01	14.39	12.5
2005	9	222.1	14.0	-10.42	-69.28	14.08	11.3
2005	10	103.2	9.7	-8.25	-49.63	16.37	9.8
2005	11	136.8	4.3	-11.39	-73.3	17.82	3.7
2005	12	221.3		-13.80	-97.27	13.13	5.2
2006	1						
2006	2			-14.06	-98.3	14.18	6.8
2006	3	170.3		-11.96	-81.11	14.57	4.6
2006	4			-9.68	-62.98	14.46	8.5
2006	5	147.3	12.8	-10.00	-66.46	13.54	6.0
2006	6	128.3	16.6	-11.62	-76.52	16.44	18.4
2006	7	96.4	19.0	-5.75	-33.32	12.68	18.8
2006	8	198.0	15.8	-8.62	-54.24	14.72	7.3
2006	9	51.0	14.6	-5.79	-30.72	15.6	3.1
2006	10	9.2	11.9				
2006	11	121.6	7.6				
2006	12	69.0	3.4				

Table S3. Basic statistics (mean values and standard deviations, minimum, median and maximum values) for $\delta^{18}O$ (shadowed rows) and $\delta^{2}H$ in lake waters (IRB1, IRB2, IRB3, IRB4) and surface waters (Ma, LP, LC, LB, BW, KzB, KoS, KoB), 2011 – 2014 period. *n* – number of data, *SD* – standard deviation.

Location / Code	Isotope	*n*	Mean	*SD*	Minimum	Median	Maximum
IRB3	$\delta^{18}O$	11	-10.48	0.34	-10.87	-10.53	-9.64
IRB3	$\delta^{2}H$	11	-70.42	2.41	-73.3	-70.57	-64.47
IRB4	$\delta^{18}O$	10	-10.48	0.27	-10.84	-10.51	-10.06
IRB4	$\delta^{2}H$	10	-70.62	1.70	-73.20	-70.58	-67.79
IRB1	$\delta^{18}O$	13	-10.39	0.30	-10.87	-10.36	-9.95
IRB1	$\delta^{2}H$	13	-70.12	1.94	-73.30	-69.75	-67.11
IRB2	$\delta^{18}O$	8	-10.27	0.41	-10.84	-10.36	-9.66
IRB2	$\delta^{2}H$	8	-69.26	1.89	-72.77	-69.21	-66.57
Matica	$\delta^{18}O$	12	-10.67	0.10	-10.86	-10.69	-10.53
Ma	$\delta^{2}H$	12	-71.40	1.10	-73.52	-71.55	-70.0
Lake Prošćansko	$\delta^{18}O$	12	-10.53	0.21	-10.82	-10.54	-10.11
LP	$\delta^{2}H$	12	-70.57	1.68	-73.49	-70.34	-67.77
Lake Ciginovac	$\delta^{18}O$	11	-10.45	0.31	-10.89	-10.5	-9.9
LC	$\delta^{2}H$	11	-70.45	2.07	-73.52	-70.73	-66.76
Lake Burget	$\delta^{18}O$	11	-10.44	0.27	-10.83	-10.48	-9.91
LB	$\delta^{2}H$	11	-70.37	1.95	-73.24	-70.31	-66.7
Burget - waterfall	$\delta^{18}O$	12	-10.41	0.29	-10.82	-10.46	-9.86
BW	$\delta^{2}H$	12	-70.25	2.08	-73.72	-70.64	-66.73
Lake Kozjak - bridges	$\delta^{18}O$	12	-10.34	0.32	-10.81	-10.37	-9.76
KzB	$\delta^{2}H$	12	-69.98	1.95	-72.95	-70.06	-66.49
Korana R. Sastavci	$\delta^{18}O$	7	-10.33	0.24	-10.67	-10.44	-9.98
KoS	$\delta^{2}H$	7	-69.04	1.71	-70.61	-69.87	-66.64
Korana R. - bridge	$\delta^{18}O$	10	-10.41	0.31	-10.94	-10.43	-10.01
KoB	$\delta^{2}H$	10	-70.34	2.21	-74.42	-70.09	-67.38

Table S4. Slopes and intercepts of relations δ^2H *vs.* $\delta^{18}O$ at individual sampling locations of lake waters from traps (IRB1, IRB2, IRB3, IRB4) and surface waters (Ma, LP, LC, LB, BW, KzB, KoS, KoB), 2011 – 2014 period.

Location Code	Slope	Intercept	*n*	*r*
IRB3	6.94 ± 0.42	2.3 ± 4.4	11	0.98
IRB4	5.86 ± 0.73	-9.2 ± 7.6	10	0.94
IRB1	6.22 ± 0.55	-5.4 ± 5.7	13	0.96
IRB2	4.42 ± 0.55	-23.9 ± 5.6	8	0.96
Ma	7.14 ± 2.5	4.8 ± 2.7	12	0.66
LP	7.70 ± 0.76	10.5 ± 8.0	12	0.96
LC	6.56 ± 0.38	-1.9 ± 4.0	11	0.98
LB	6.76 ± 0.75	0.3 ± 7.8	11	0.94
BW	7.31 ± 0.75	5.9 ± 7.8	12	0.95
KzB	6.02 ± 0.41	-7.7 ± 4.3	12	0.98
KoS	6.78 ± 1.1	1.1 ± 11.4	7	0.94
KoB	6.78 ± 0.7	0.3 ± 7.4	10	0.96

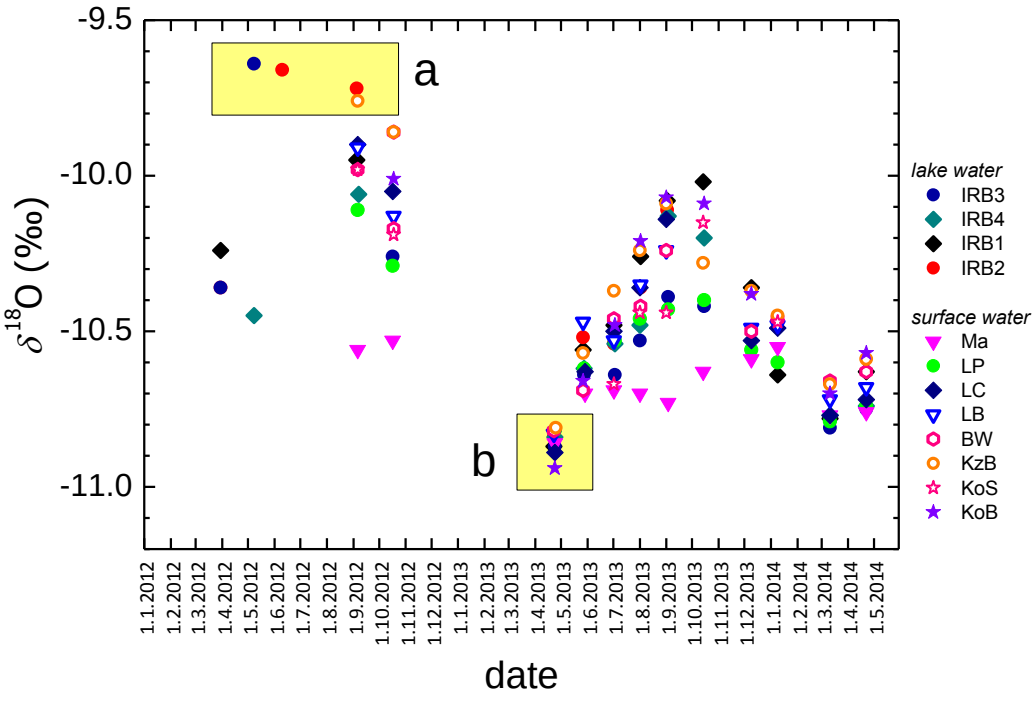


Figure S1. Seasonal variation in δ^2H of surface and lake waters, 2012 – 2014 period. Group **a**: after heavy summer rains; group **b**: after abundant winter precipitation and snow melting. For explanation of groups **a** and **b**, see text related to Figure 16.

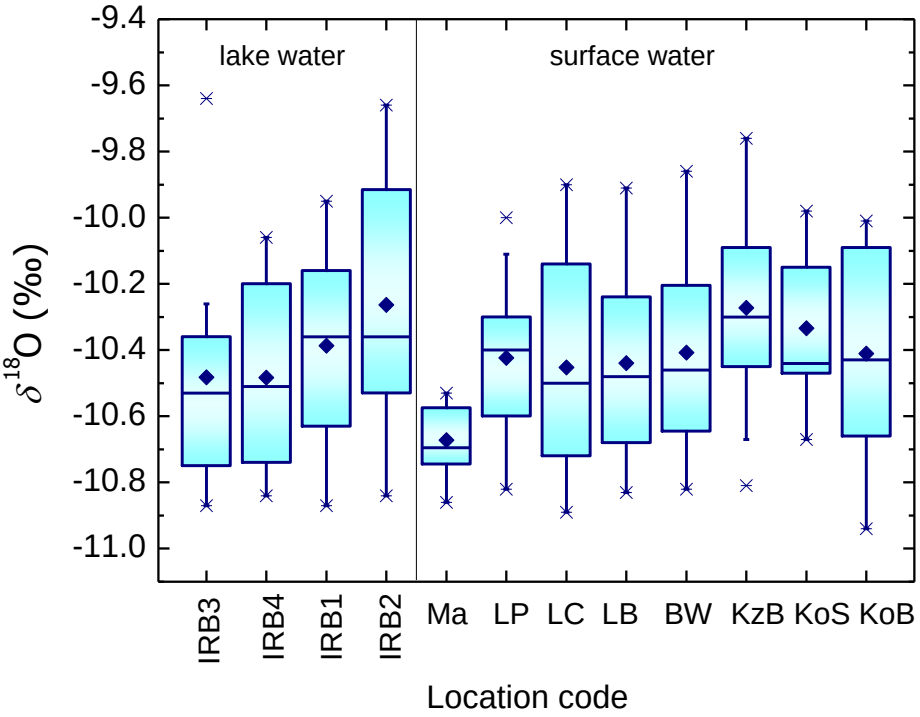


Figure S2. Box-plot of $\delta^{18}O$ values in lake and surface waters, sorted in downstream direction. Data from 2011 – 2014.

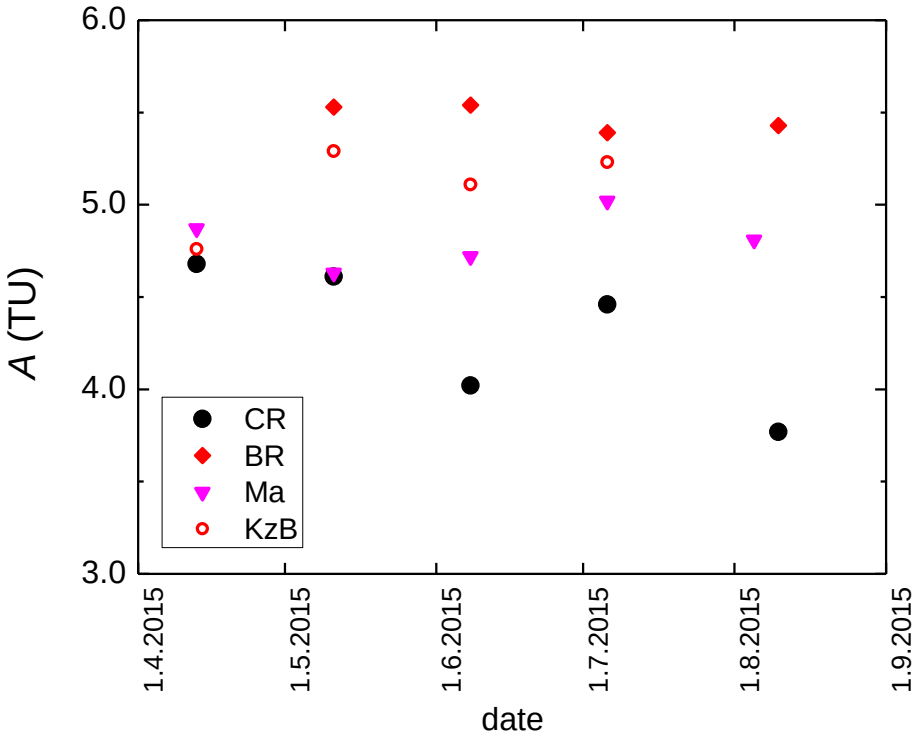


Figure S3. Tritium activity concentration in CR and BR springs and in surface water at locations Ma and KzB in 2015.

© 2020 by the authors. Submitted for possible open access publication under the terms and conditions of the Creative Commons Attribution (CC BY) license (http://creativecommons.org/licenses/by/4.0/).