

Supplementary Material

**Hydrochemical and stable isotopes ($\delta^2\text{H}$ and $\delta^{18}\text{O}$) changes of groundwater
induced by local earthquakes in a spring, Northwest China**

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Introduction

This Supplementary Material contains two main sections:

Section 1: Supplemental Figures;

Section 2: Supplemental Tables.

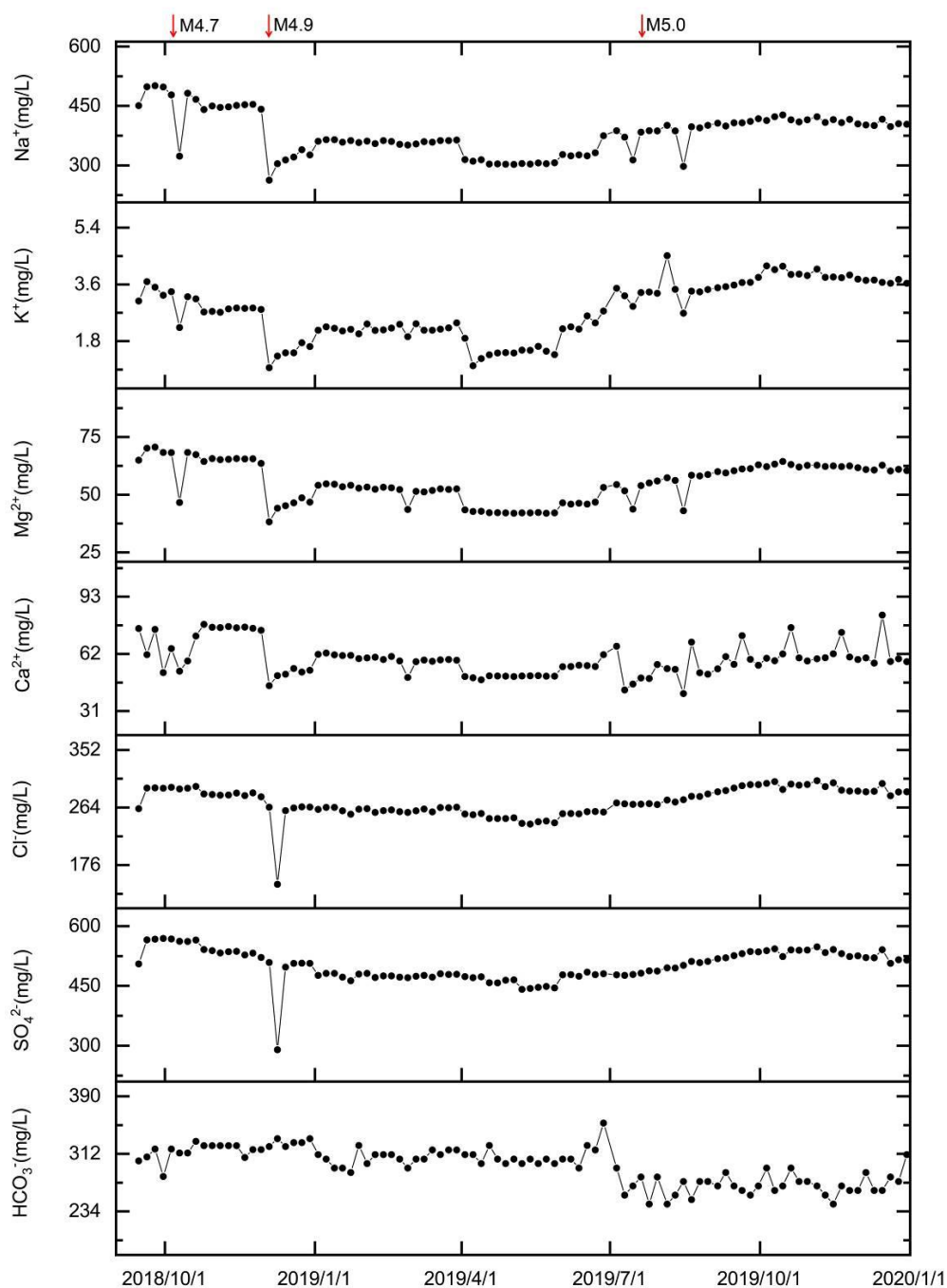


Fig. S1. Time series of hydrochemistry major ion concentration at X10 spring, from September 5, 2018 to January 1, 2020. The red arrows represent 3 earthquakes of over M4.5. The earthquakes are the October 7, 2018 Urumqi M4.7 earthquake, the December 8, 2018 Hutubi M4.9 earthquake, and the July 22, 2019 Heshuo M5.0 earthquake, respectively.

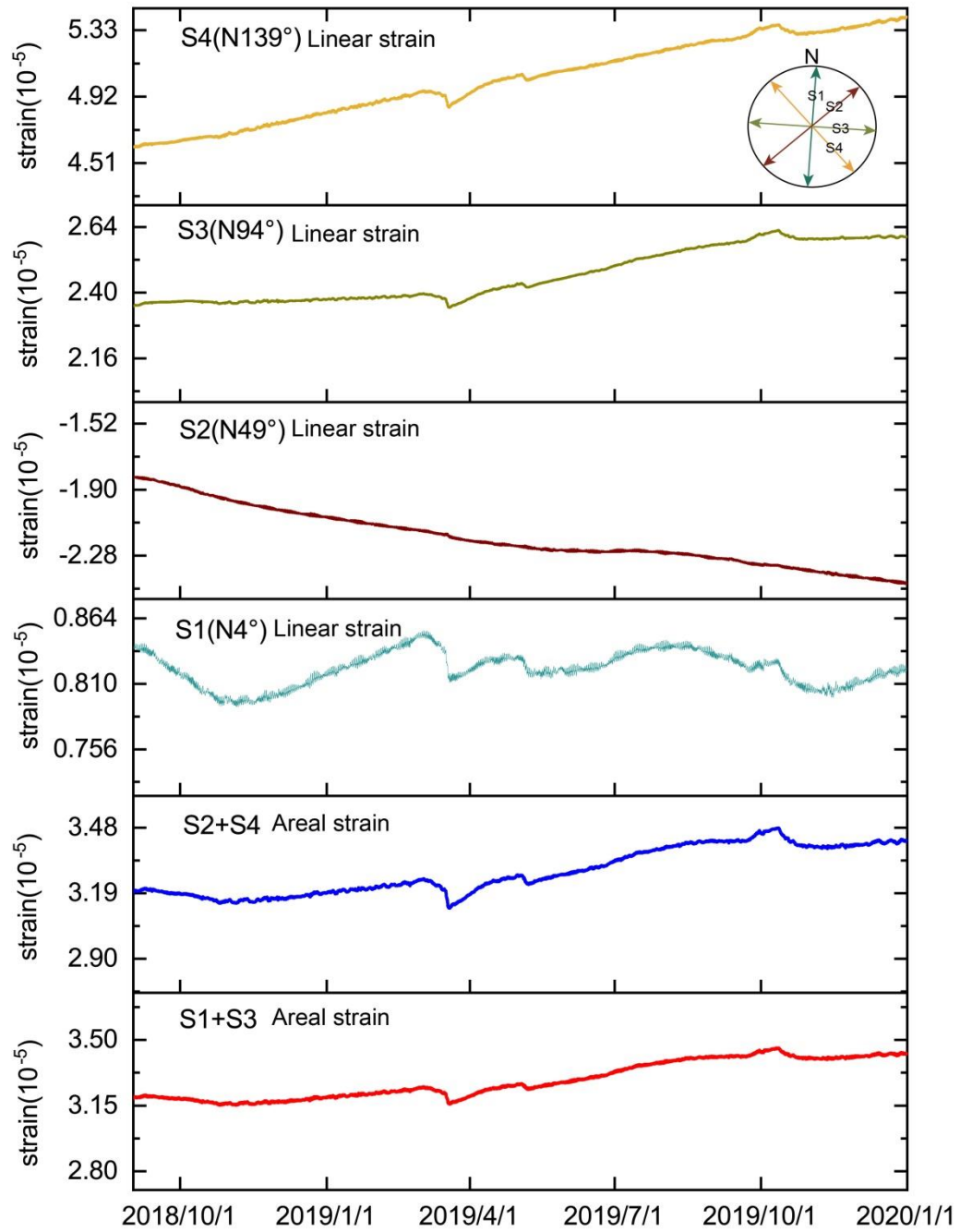


Fig. S2. The area strain near X10 spring (8km).

(S1, S2, S3 and S4 represent the linear strain components at the four orientations of N4°, N49°, N94° and N139°, respectively. S1+S3 and S2+S4 represent area strain, respectively.)

- **Table S1**

Earthquake information around X10 Spring during the study period (within 150km).

Date	Latitude	Longitude	Magnitude	Seismic Energy Density	Distance
	°N	(°E)	M_w	J/m ³	Km
2018/9/9	43.3	88.8	3.1	1.38E-06	105.27
2018/10/7	43.23	87.3	4.7	1.75E-03	58.29
2018/10/10	43.77	88.35	3.6	4.21E-05	59.32
2018/11/4	43.65	86.07	4.2	3.23E-05	125.12
2018/11/10	43.82	86.42	4.1	4.91E-05	97.55
2018/11/10	43.75	86.42	3.3	3.44E-06	96.85
2018/11/13	43.22	87.28	4.2	3.00E-04	60.01
2018/11/16	43.72	87.9	3.2	2.06E-04	22.68
2018/12/6	43.23	87.65	3.1	1.15E-05	52.27
2018/12/8	43.83	86.42	4.9	7.12E-04	97.70
2018/12/11	43.9	86.33	3	9.55E-07	106.16
2018/12/17	43.68	86.7	3.6	2.10E-05	74.21
2018/12/28	43.78	87.43	4.3	1.66E-02	17.70
2019/2/8	43.82	86.42	3.2	2.41E-06	97.55
2019/3/31	43.22	87.32	3.8	8.44E-05	58.60
2019/4/28	43.65	87.95	3.1	8.47E-05	27.19
2019/5/2	43.77	86.88	3	5.33E-06	60.12
2019/5/10	42.97	88	3.9	3.61E-05	86.76
2019/5/15	43.7	86.92	3.6	4.82E-05	56.43
2019/5/22	43.85	88.78	3.1	1.90E-06	94.86
2019/6/4	43.58	89.45	3.6	2.61E-06	148.26
2019/6/13	43.95	86.07	3	5.46E-07	127.74
2019/7/1	43.83	88.02	3.5	1.46E-04	35.30
2019/7/1	43.87	88.05	3.5	1.04E-04	39.43
2019/7/13	42.95	87.35	3.2	3.52E-06	86.15

2019/7/22	42.67	87.7	5.0	6.17E-04	114.61
2019/7/28	43.8	86.38	3	1.13E-06	100.49
2019/9/4	43.8	86.38	3	1.13E-06	100.49
2019/9/10	43.83	87.75	3.1	3.03E-04	17.84
2019/9/18	43.62	87.85	3	1.42E-04	20.57
2019/9/21	43.73	86.33	3.5	5.42E-06	104.01
2019/10/21	43.8	88.57	3	2.52E-06	77.32
2019/11/24	43.78	86.4	3.2	2.33E-06	98.68
2019/12/3	43.68	89.4	3.1	5.40E-07	143.52
2019/12/4	43.6	89.18	4.3	4.42E-05	126.34
2019/12/17	43.73	88.02	3	3.55E-05	32.41
2019/12/23	43.87	87.12	3.2	2.59E-05	44.46

- **Table S2**

The descriptive statistics of major ion concentration data in X10 spring (n=94).

	Na	K	Mg	Ca	Cl	SO ₄	NO ₃	HCO ₃	TDS	δD	δ ¹⁸ O
	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(‰)	(‰)
n ^a	94	94	94	94	94	94	94	94	94	94	94
Mean	379.87	2.76	55.14	58.96	272.32	501.31	3.58	295.71	1423.58	-89.06	-12.46
SD ^b	53.96	0.90	8.54	9.05	22.36	39.82	2.55	24.63	119.99	0.55	0.23
Minimum	262.94	0.96	38.29	40.54	146.83	290.06	0.01	244.07	1009.19	-90.60	-13.04
Median	385.74	2.78	54.65	58.32	269.89	503.95	3.87	300.81	1406.40	-89.03	-12.42
Maximum	501.20	4.52	70.63	83.09	305.01	569.21	10.54	353.90	1672.94	-87.87	-12.06
CV ^c	0.14	0.33	0.15	0.15	0.08	0.08	0.71	0.08	0.08	-0.01	-0.02

^a Number of spring samples.

^b Standard deviation.

^c Coefficient of variation.