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Characteristic Solutes in Geothermal Water from the Rehai Hydrothermal System, Southwestern China

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Rehai, a high-temperature hydrothermal system located in the southern part of the Tengchong volcanic geothermal area of Yunnan province, is characterized by the wide distribution of boiling and hot springs. The geothermal waters discharged from Rehai are basically HCO_3-Cl-Na and SO_4-Cl-Na types. As typical characteristic solution constituents in high-temperature hydrothermal systems with magma as heat source, Cl, B and As in the Rehai geothermal waters originate mainly from magma degassing. However, besides the mixing of magmatic water, the concentrations of fluoride in the geothermal waters from Rehai are also affected by the anion exchange between OH^- in water and F^- in some fluoride-bearing minerals of the hostrocks, as indicated by a good linear relation between solution fluoride concentration and pH value. The much higher concentration of SO_4^{2-} in the Diretiyanqu spring as compared to the other springs outcropping at Rehai implies that it has a quite different geochemical genesis. The H_2S separated from the boiling (i.e. adiabatic cooling) of the deep geothermal fluid could ascend to the shallow aquifers where it was mixed with cold groundwaters and oxidized. In this way was the geothermal water with low pH value and high SO_4^{2-} concentration formed.

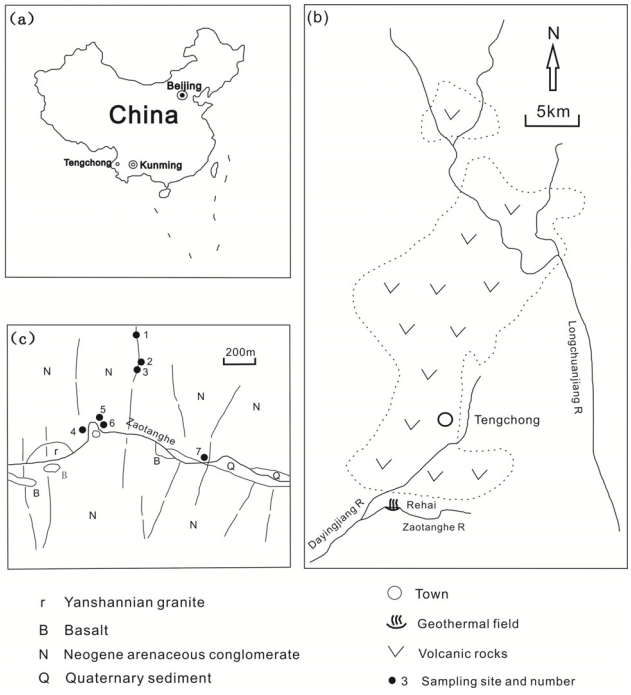

Fig. 1. Geographic location of the Rehai geothermal field (a and b) and sampling sites for the Rehai geothermal waters (c) (modified after Zhang et al., 2008).

1, Laogunguo; 2, Diretiyanqu; 3, Dagunguo; 4, Gumingquan; 5, Huaitaijing L; 6, Huaitaijing R; 7, Nameless.

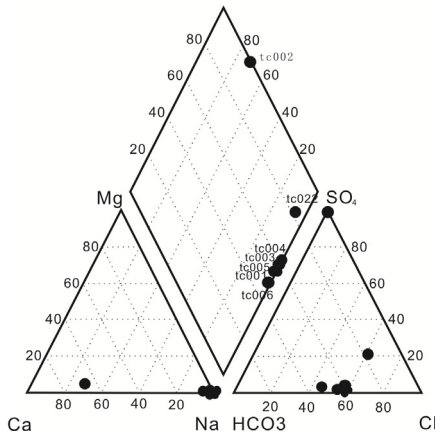

Fig. 2 Piper diagram of the Rehai geothermal water samples

Key words: Boiling spring; Hot spring; Characteristic constituent; Magma degassing; Fluid-host rock interaction; Rehai

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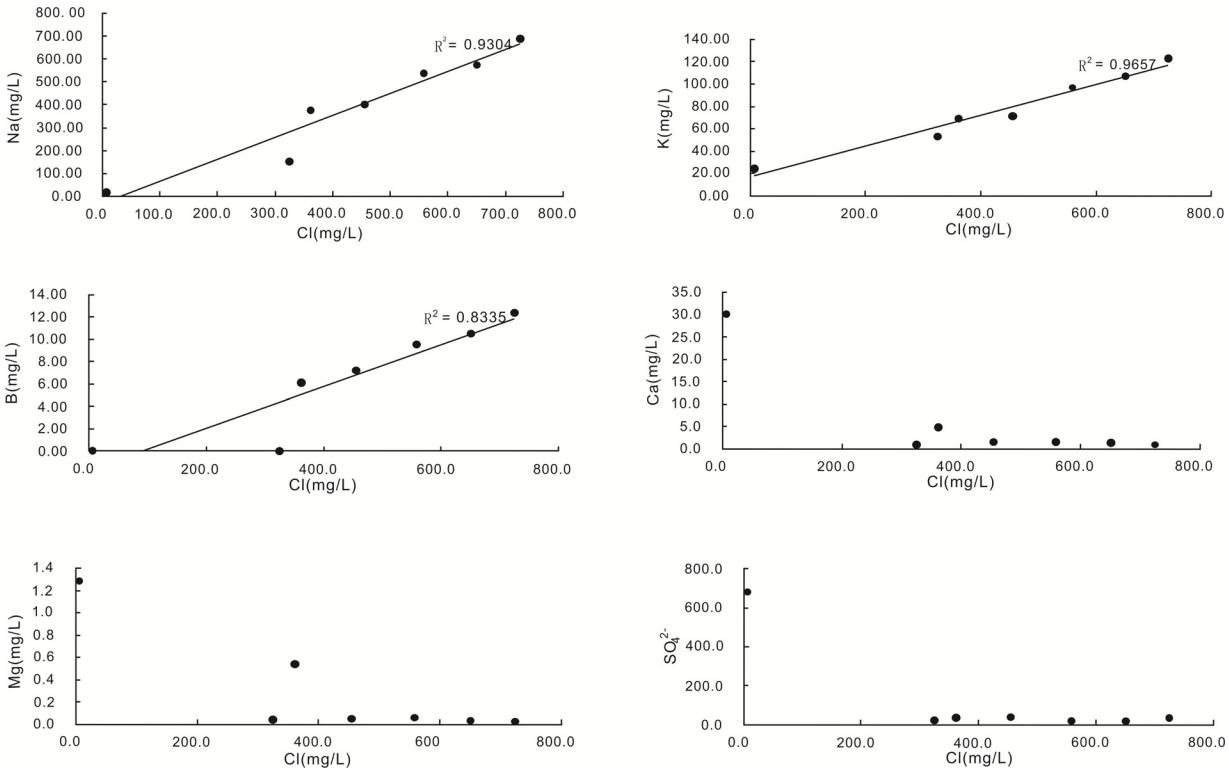

Fig. 3. Plots of Na vs. Cl, K vs. Cl, B vs. Cl, Ca vs. Cl, Mg vs. Cl, and SO_4^{2-} vs. Cl of Rehai geothermal water samples

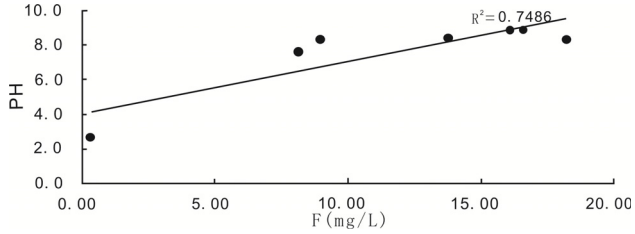

Fig. 4 Plot of F^- vs. pH of Rehai geothermal water samples

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Table 1 Major geochemical characteristics of geothermal water samples collected from the Rehai field

Name of spring	T	pH	EC (μs/cm)	DO (mg/)	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	B (mg/L)	SO_4^{2-} (mg/L)	Cl^- (mg/L)	F^- (mg/L)	NO_3^- (mg/L)	HCO_3^- (mg/L)	CO_3^{2-} (mg/L)
dagunguo	96.6	8.3	4210.00	12.49	1.0	0.0	689.00	122.80	12.37	35.2	725.0	18.22	92.53	1131.9	35.6
diretiyanqu	88.0	2.7	2012.00	0.01	30.2	1.3	14.77	24.07	0.05	682.0	5.9	0.32	2.48	0.0	0.0
huaitaijin-left	88.0	8.4	3350.00	0.98	1.5	0.1	538.30	96.80	9.56	20.1	558.6	13.77	19.62	857.3	40.8
huaitaijin-right	88.0	7.6	2464.00	0.75	1.6	0.0	400.40	71.06	7.23	38.3	454.6	8.14	15.39	628.5	0.0
gumingquan	96.0	8.9	3560.00	1.28	1.4	0.0	573.20	107.10	10.52	18.6	651.0	16.08	5.55	759.7	122.3
nameless	70.0	8.3	2269.00	0.24	4.9	0.5	375.40	68.94	6.12	34.0	361.9	8.97	5.81	701.7	63.0
laogunguo	91.0	8.9	1949.00	0.00	0.9	0.0	152.00	53.10	0.00	23.9	325.0	16.60	0.00	561.0	36.0

Table 2 Concentrations of trace elements in geothermal water samples

Name of spring	Sr (μg/L)	Se (μg/L)	Fe (μg/L)	As (μg/L)	Ba (μg/L)	Mn (μg/L)	Pb (μg/L)	Zn (μg/L)	Cd (μg/L)	Cu (μg/L)	Sn (μg/L)
dagunguo	92.20	n.d	21.10	1100.00	467.30	5.20	693.60	53.50	9.80	5.70	2.60
diretiyanqu	100.00	n.d	750.00	99.60	31.80	548.90	13.40	100.00	0.12	2.18	0.12
huaitajin-left	54.60	n.d	31.20	382.30	582.40	28.60	489.00	96.00	6.00	4.40	4.40
huaitaijin-right	32.90	n.d	21.60	591.00	17.50	16.50	394.20	217.50	5.90	5.70	1.10
gumingquan	81.00	n.d	13.90	508.40	532.90	10.40	540.20	172.60	5.70	5.30	2.10
nameless	61.30	0.0004	146.10	310.20	306.70	35.50	281.50	143.90	6.50	5.20	n.d
laogunguo	20.00	n.d	150.00	40.00	109	311.00	309.00	n.d	7.94	3.70	n.d

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