

## Metamorphic conditions controlling the trace element characteristics of metamorphic zircons

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Comparison of trace element compositions of zircons from six metamorphic mafic rocks (one granulite and five amphibolites) and their host rocks is used to evaluate the major effect factors on the trace element characteristics of zircons in metamorphic rocks. All zircons listed Table 1 formed at 390-440 Ma. Table 1 shows large variations of trace elements in the zircons from all six samples, and no correlation of total REE, (La/Yb)<sub>n</sub>, Eu/Eu\*, Th/U and Zr/Hf between the zircons and their host rocks, implying that the chemical characteristics of zircons are dominantly controlled by metamorphic environments, rather than rock compositions.

**Table 1:** Chemical parameters of zircons and host rocks

rock	jx06-2	fj-38	zj06-10-1	zj06-6	zj-7-1	zj25-2			
REE	55	106	29	88	24	84			
(La/Yb) <sub>n</sub>	1.25	1.88	1.22	1.91	1.86	2.87			
Eu/Eu*	1.17	0.91	1.15	1.01	1.41	0.95			
Zr/Hf	33	32	27	31	29	31			
Th/U	3.0	4.7	4.7	2.2	3.0	0.9			
Zr	137	177	31	124	19	84			
Hf	4.19	5.48	1.17	4.02	0.65	2.73			
Th	1.24	1.34	0.64	1.65	0.32	0.54			
U	0.41	0.28	0.13	0.75	0.11	0.59			
zircon	c	r	early	late	early	late			
No.	6	4	4	5	9	5	1	7	20
Sm/Lu	0.041	0.086	0.019	0.013	0.061	0.021	0.075	0.016	0.018
Eu/Eu*	0.22	0.18	0.60	0.96	0.11	0.84	0.02	0.33	0.76
Ce/Ce*	63	150	178		117	22	11	17	171
REE	1958	162	476	153	764	145	1083	231	262
Th	174	26	306	22	458	29	85	201	75
U	388	348	713	94	620	348	312	811	206
Th/U	0.45	0.08	0.43	0.23	0.74	0.08	0.27	0.25	0.36
Zr/Hf	52	40	39	60	47	43	40	51	58
εHf(t)	3.7	5.6	15.8	3.0	-0.71		6.9	5.0	

The rims of zircons from a granulite (jx06-2) have significantly lower REE and higher Sm/Lu than the cores, suggesting that the zircon rims were in equilibrium with the garnet during granulite facies metamorphism. Late zircons in the sample zj06-10-1 have higher REE and obvious Eu negative anomaly, probably suggesting REE input of crustal fluids during late metamorphism, which is consistent with their significant decrease of εHf (Table 1).

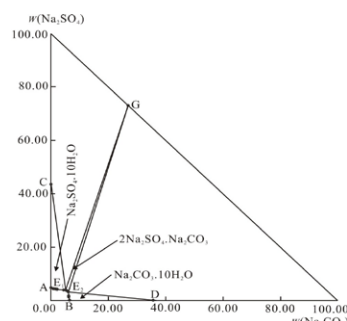
## Metastable phase equilibria for the aqueous system containing sodium, carbonate and sulfate at 273 K

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Zabuye Salt Lake, located in Tibet, is one of the carbonate alkaline lakes famous for its high concentrations of sodium, potassium, lithium and borate. The system containing sodium, carbonate and sulfate is one of the subsystem of Zabuye Salt Lake brine and its phase equilibria at 273 K has not been reported yet. In this paper, the metastable equilibria of this system were studied at 273 K using an isothermal evaporation method.

Figure 1 is the metastable phase diagram of the system at 273 K. The diagram consists of two invariant points, three univariant curves and three crystallization fields corresponding to single salt Na<sub>2</sub>SO<sub>4</sub>·10H<sub>2</sub>O, Na<sub>2</sub>CO<sub>3</sub>·10H<sub>2</sub>O and the double salt 2Na<sub>2</sub>SO<sub>4</sub>·Na<sub>2</sub>CO<sub>3</sub>, respectively. One invariant point is saturated with salts Na<sub>2</sub>SO<sub>4</sub>·10H<sub>2</sub>O and 2Na<sub>2</sub>SO<sub>4</sub>·Na<sub>2</sub>CO<sub>3</sub>, and the mass fraction of its equilibrium solution is w (Na<sub>2</sub>CO<sub>3</sub>) 5.15% and w (Na<sub>2</sub>SO<sub>4</sub>) 3.92%. The other invariant point is saturated with salts Na<sub>2</sub>CO<sub>3</sub>·10H<sub>2</sub>O and 2Na<sub>2</sub>SO<sub>4</sub>·Na<sub>2</sub>CO<sub>3</sub>, the mass fraction of equilibrium solution is w (Na<sub>2</sub>CO<sub>3</sub>) 6.03% and w (Na<sub>2</sub>SO<sub>4</sub>) 3.30%. Na<sub>2</sub>CO<sub>3</sub>·10H<sub>2</sub>O is the only crystallization form of sodium carbonate at 273 K.



**Figure 1:** Metastable phase diagram of the system containing sodium, carbonate and sulfate at 273 K

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