Acta Geologica Sinica (English Edition), 2019, 93(6): 1983–1984

Research Advances

New Data on Lithium Isotopic Geochemistry of the No. X03 Lithium Vein in the Jiajika Super-Large Lithium Deposit, Sichuan, China

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Citation: Liu et al., 2019. New Data on Lithium Isotopic Geochemistry of the No. X03 Lithium Vein in the Jiajika Super-Large Lithium Deposit, Sichuan, China. Acta Geologica Sinica (English Edition), 93(6): 1983–1984. DOI: 10.1111/1755-6724.14312

Objective

The No. X03 lithium pegmatite vein in the Jiajika lithium deposit in western Sichuan is a newly discovered super-large vein which contains an identified reserves of 643, 100 tons Li_2O. Lithium has two stable isotopes (^6Li and ^7Li), and ^6Li is a key raw material for nuclear fusion. Significant fractionation of lithium isotopes is almost nonexistent during partial melting, crystallization differentiation and metamorphism, and lithium isotopes are thus often used as a tracer in geological studies of source areas and subduction zones. In this study, pegmatite engineering samples from the No. X03 vein were systematically determined for the first time. It is helpful to directly understand the distribution characteristics of lithium isotopes in the deposit and the source of pegmatite.

Methods

A total of fifteen pegmatite engineering samples were collected from top to bottom of two drill holes (ZK701 and ZK702) along the exploration line No. 07 of the No. X03 super-large lithium deposit. The samples were albite-spodumene pegmatites. The lithium content analysis was completed with ICP-MS methods in the National Research Center for Geoanalysis, and the chemical pretreatment and MC-ICP-MS analysis of the lithium isotopes was conducted at the MLR Key Laboratory of Metallogeny and Mineral Assessment, Ministry of Natural Resources of China. First, 10 mg samples were weighed and placed in a PFA sample bottle with acid (HNO_3:HF=1:5). Then, the bottle was placed in an ultrasonicator for 10 min. The bottle was transferred to a hotplate and heated at 100-120° C for 24 h until it steamed and the grain size decreased. After this, concentrated HNO_3 was added to the bottle. Then, the bottle was transferred to a hotplate and heated at 100–120°C for 24 h, during which concentrated HNO_3 was added two to four times. Then, 3 ml of concentrated HCl was added, and the sample was heated for 24 h until it was dry. Finally, 4 mol/L HCl was added to the samples. Three cationic exchange resins (AG 50W-X8) were used to separate and purify the resulting solution.

Results

The test results show that the whole rock lithium contents of 15 ablite-spodumene type pegmatite samples range from 283 ppm to 7942 ppm, with an average content of 5666 ppm; lithium isotopic compositions lie between −1.80‰ and +0.40‰, with an average δ^7Li value of −0.72‰ (Appendix 1). There is no obvious correlation between lithium content and lithium isotopes. Although there is no significant difference of lithium isotopic composition of the two drill holes, the samples from ZK701 (the average δ^7Li value is −0.39 ‰) are slightly larger than the samples from ZK702 (the average δ^7Li value is −0.94 ‰) in the composition of lithium isotope. The lithium isotopes of pegmatite change little with the depth and remain basically stable. The δ^7Li values of the bottom samples are generally higher than that of the upper part, showing slightly positive values (Fig. 1).

Studies show that the whole rock lithium isotopes of pegmatite in the No. X03 vein are basically the same as that of two-mica granite rock mass (the δ^7Li value range between −1.56‰ and +0.90‰) in Jiajika mine area, indicating that they have the same source. And they are close to the average upper crust value (0 ± −2‰), indicating that they are parent to the crust.

Conclusions

The new systematic data on lithium isotopes of the No. X03 lithium vein show that:

(1) The lithium composition of 15 ablite-spodumene pegmatite whole rock samples from the No. X03 super-large lithium deposit lie between −1.80‰ and +0.40‰, with an average δ^7Li value of −0.72‰. The lithium isotopic composition of pegmatite samples from ZK701 is slightly larger than that from ZK702.

(2) There is no correlation between lithium content and lithium isotopic composition of spodumene ores from the No.X03 lithium vein.

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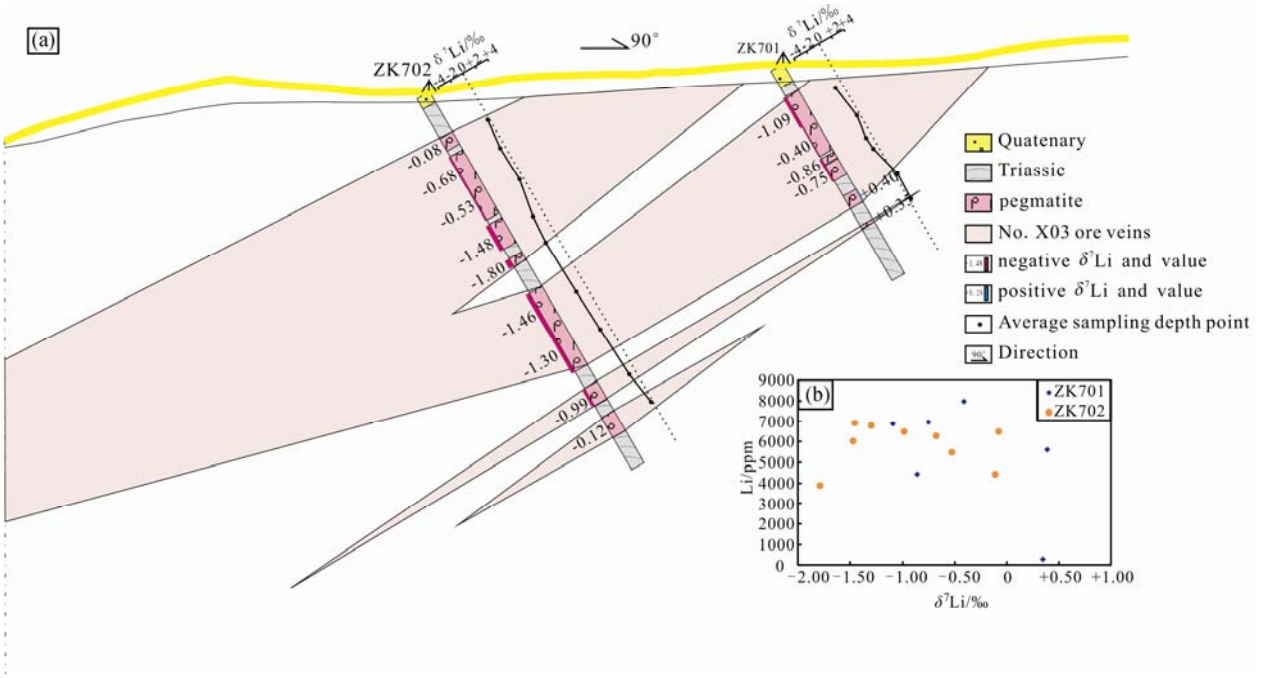

Fig. 1. (a) Section map showing distribution of lithium isotopic composition in the drill holes of No. X03 lithium vein along the exploration line 07 in the Jiajika lithium deposit; (b) diagram showing the correlation between the Li content and lithium isotopic composition.

(3) The δ^7Li values of pegmatite samples from the No. X03 lithium vein change slightly, showing stability of lithium isotope in the spodumene ores.

(4) The lithium isotopic composition of the No. X03 lithium vein is basically consistent with that of the two-mica granite rock mass in the mining area, indicating that they have a close genetic relationship and originated from crust remelting.

Acknowledgments

This research was financially supported by the National Key Research and Development Program of China (grant No. 2017YFC0602701) and the "Geology of Mineral Resources in China" from the China Geological Survey (grants No. DD20160346, DD20190379).

Appendix 1 Li and δ^7Li values of albite-spodumene pegmatites from the No. X03 vein along the exploration line No. 07 in the Jiajika lithium deposit

Number	Sample No.	Li (ppm)	δ^7Li (‰)	$\pm 2\delta$	Number	Sample No.	Li (ppm)	δ^7Li (‰)	$\pm 2\delta$
1	ZK701-L1	6840	−1.09	0.08	9	ZK702-L3	5493	−0.53	0.03
2	ZK701-L2	7942	−0.40	0.03	10	ZK702-L4	6055	−1.48	0.03
3	ZK701-L3	4418	−0.86	0.02	11	ZK702-L5	3894	−1.80	0.03
4	ZK701-L4	6923	−0.75	0.02	12	ZK702-L6	6935	−1.46	0.02
5	ZK701-L5	5572	+0.40	0.02	13	ZK702-L7	6795	−1.30	0.03
6	ZK701-L6	283	+0.35	0.03	14	ZK702-L8	6536	−0.99	0.03
7	ZK702-L1	6536	−0.08	0.03	15	ZK702-L9	4448	−0.12	0.03
8	ZK702-L2	6316	−0.68	0.03					