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Research Advances

Newly Discovered Euxenite and Polycrase in the Jiada Pegmatite-Type Lithium Deposit, Ke'eryin Lithium Ore Field, and its Geological Significance

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Objective

The Ke'eryin lithium ore field is one of the most typical concentrated distribution areas for lithium (Li) polymetallic pegmatite veins in the Songpan–Garzê metallogenic belt, western Sichuan (Li et al., 2015). A series of Li deposits are around the Ke'eryin complex rock mass (Fig. 1), represented by Dangba, Lijiagou and Yelonggou, etc. These granitic intrusions and pegmatite veins intruded into the Triassic epimetamorphic rock series. The occurrence of pegmatite viens are controlled by the NE and NW trending tensile shear fractures formed by the nearly N-S compression, which can match with the Ke'eryin complex anticline and substructures. Since 2019, a breakthrough in Li exploration had been made in the northeast of Ke'eryin, represented by the new discovery of Jiada deposit with large-super large scale through the geological survey project "Comprehensive investigation and evaluation of the large Li-beryllium (Be) polymetallic resource base in the Songpan-Garzê lithium belt". By detailed microscope and EMPA study on drill core samples, we found that the deep of the Jiada Li deposit contain certain amounts of euxenite and polycrase (Fig. 2).

In this paper, we report on the newly discovered polycrase and euxenite in the Jiada Li deposit, study their mineragraphic and geochemical characteristics, and discuss the geological significance of the formation of euxenite and polycrase in the Ke'eryin Li ore field.

Methods

Samples were collected from the drill hole ZK001 of the No. 36 pegmatite vein in the Jiada Li deposit, at elevations ranging from 3800 m to 4200 m and vertical height difference exceeding 200 m. The samples were first polished and observed under reflecting and scanning electron microscopes. Observations and analysis were completed in the MNR Key Laboratory of Metallogeny and Mineral Assessment, Institute of Mineral Resources, Chinese Academy of Geological Sciences, Beijing. Major and trace elements were analyzed using a JEOLJXA-8100 electron probe under accelerating voltage 15 kV and current 20 nA; both analytical precision and accuracy for major elements were generally better than 100×10^{-6}, and for most of the trace elements are between 100×10^{-6} and 300×10^{-6}, respectively.

Results

In the Jiada Li deposit, euxenite and polycrase crystals are too small to be found both in the field and hand specimens. They usually occur as plate-shaped or columnar grains with a size ranging from 10–50 μm (Figs. 2c–e). So far, the classifications of euxenite and polycrase are not uniform; according to the chemical compositions with $(Nb, Ta)_2O_5 > TiO_2$, (Nb, Ta) < Ti and (Nb, Ta):Ti = 1:1.4, most of our specimens can be identified as euxenite except for one sample, which is closer to the end member of polycrase (Table 1).

Although euxenite had previously been found in the heavy sand from western Ke'eryin (Lai et al., 2019), the source is still unclear. The primary euxenite and polycrase were found in the deep part of the pegmatite vein at the Jiada Li deposit from the northwestern Ke'eryin. In addition, both euxenite and polycrase are closely associated with apatite and epidote (Fig. 2). This might be due to the relative enrichment of volatile components and rare elements in the residual magma melt with the crystallization of some rock-forming minerals in the late stage of magmatic crystallization, reflecting that the granitic melts with lower initial rare element contents that can also produce local enrichments of rare element minerals under certain physical and chemical conditions. These granitic pegmatite veins are characterized by Li, Be, Nb, Ta and REEs polymetallic mineralization. For most of the pegmatite type deposits in the Ke'eryin area, including the Jiada deposit, we speculate that the metallogenic process might be closely related to the deep differentiation and multiple intrusion of homologous magma in the same tectonic magmatic cycle.

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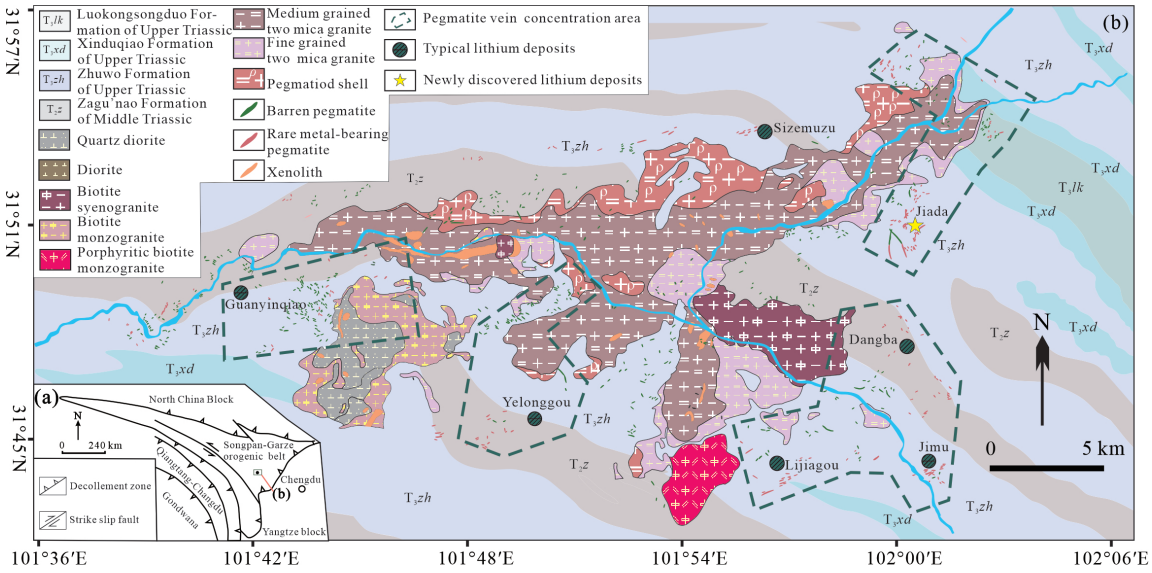

Fig. 1. Geological map of the Ke'eryin ore field in Western Sichuan.
Yellow star–location of the Jiada Li deposit.

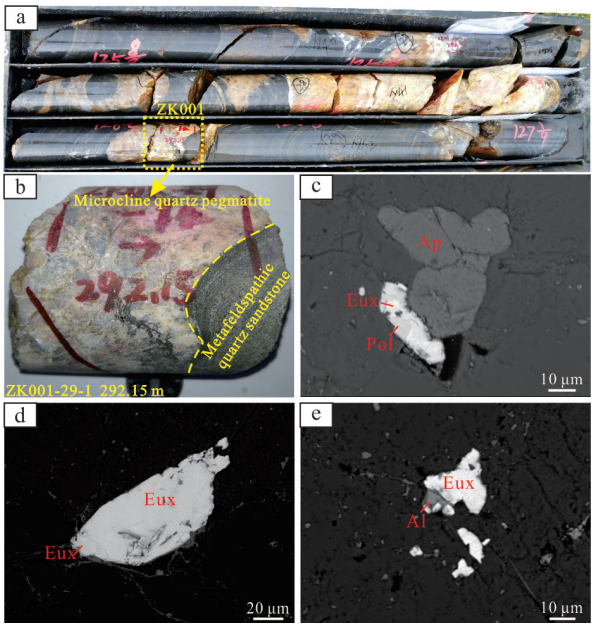

Fig. 2. Hand-specimen and BSE images of ore samples from the Jiada lithium deposit in the Ke'eryin ore field.
(a) Core samples from the drill zk001 at a depth of about 290 meters; (b) the micro plagioclase quartz pegmatite vein intruded into the metafeldspathic quartz sandstone of the Triassic Zhuwo Formation (T_3zw); (c–e) BSE images of euxenite and polycrase in the Jiada lithium deposit. Abbreviations: Al–allanite; Ap–apatite; Eux–euxenite; Pol–polycrase.

Conclusions

(1) The Jiada Li deposit contains certain amounts of euxenite and polycrase, which are closely associated with apatite and epidote, reflecting granitic melts with lower initial rare element contents that can also produce local enrichment of rare element minerals under certain physical and chemical conditions.

(2) Most of pegmatite type deposits in the Ke'eryin Li ore field, including the Jiada deposit, are characterized by Li, Be, Nb, Ta and REEs polymetallic mineralization. The metallogenic process might be closed, related to deep differentiation and multiple intrusion of homologous magma in the same tectonic magmatic cycle.

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Table 1 Contents of euxenite and polycrase (wt%) by EMPA analysis in the Jiada lithium deposit, western Sichuan

Sample no.	TiO_2	Nb_2O_5	Ta_2O_5	UO_2	CaO	SiO_2	ThO_2	WO_3	FeO	TR_2O_3	Total	Mineral
ZK001-29-1-02	24.91	18.07	15.64	10.64	0.36	0.04	1.04	0.74	0.18	30.11	101.73	euxenite
ZK001-29-1-03	28.30	24.07	4.72	0.35	0.22	0.02	0.05	4.36	0.36	38.85	101.30	polycrase
ZK001-29-1-04	23.62	20.50	18.04	3.76	0.41	0.15	0.38	0.89	0.61	33.43	101.79	euxenite
ZK001-29-1-05	20.65	15.65	30.86	0.46	0.64	0	0.27	1.23	0.25	30.29	100.31	euxenite
ZK001-29-1-06	23.52	19.45	20.10	1.19	0.20	0.02	0.11	1.32	0.23	33.36	99.47	euxenite