



## Geochemical Characteristics of Alkali-rich Intrusive and its Prospecting Significance in the Laojiezi Pb-Ag Deposit, Central Yunnan, SW China

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**Abstract:** Alkali-rich intrusive rocks are widely concerned because of their special tectonic environment, rock types and close relationship with endogenous polymetallic minerals. The Jinshajiang—Ailaoshan alkaline porphyry metallogenic belt is an important part of the Sanjiang metallogenic belt in southwest China. A large number of alkali-rich porphyry-related Cu-Au-Mo deposits, porphyry-skarn Au polymetallic deposits and hydrothermal Pb-Ag deposits have been found in the belt. The Laojiezi Pb-Ag deposit is an important part of the Jinshajiang—Ailaoshan alkaline porphyry metallogenic belt, and its formation has a closely time-space-source contact with the alkali-rich intrusive rocks. The geochemical characteristics of alkali-rich intrusive rocks and their relationship with Pb-Ag mineralization needs further study in this deposit. Three types of alkali-rich intrusive rocks were identified from the large-scale tunnel profile survey in the deposit. There are syenite porphyry, biotitesyenite porphyry dike and pseudoleucite porphyry dike. This paper selected the alkali-rich intrusive rocks as the research object, compared their chemical composition, explores their relationship with mineralization, and provided evidence for resource accumulation and prospecting prediction. Several conclusions were drawn as follows:

(1) distribution characteristics: The syenite porphyry is the main rock in the deposit, which is mainly yellow-brown, dark gray and fleshy red in color. The gray purple biotitesyenite porphyry dike and the gray green pseudoleucite porphyry dike are the later dikes after syenite porphyry;

(2) Geochemical characteristics: ① Major elements: Syenite porphyry samples showed high SiO<sub>2</sub> contents of 52.41–67.96 w%, with Na<sub>2</sub>O+K<sub>2</sub>O contents of 7.51–14.35 w%, K<sub>2</sub>O/Na<sub>2</sub>O values of 6.12 to 8.65 and Rittman index ( $\sigma$ ) ratios of 3.58 to 10.57 and aluminum index (ASI) values that were characterized by A/CNK ratios of 1.24–1.66; The biotitesyenite porphyry samples also showed high SiO<sub>2</sub> contents of 61.46–65.04 w%, with Na<sub>2</sub>O + K<sub>2</sub>O contents of 12.56–14.35 w%, K<sub>2</sub>O/Na<sub>2</sub>O values of 2.06 to 22.92 and Rittman index ( $\sigma$ ) ratios of 7.65 to 9.70 and A/CNK ratios of 1.14–1.39; And the pseudoleucite porphyry samples showed SiO<sub>2</sub> contents of 45.07–58.60 w%, with Na<sub>2</sub>O + K<sub>2</sub>O contents of 5.77–12.44 w%, K<sub>2</sub>O/Na<sub>2</sub>O values of 7.26 to 85.5 and Rittman index ( $\sigma$ ) ratios of 5.26 to 16.08 and A/CNK ratios of 1.26–3.65; The major elements showed that the syenite porphyry and biotitesyenite porphyry dike were mid-acid, but the

pseudoleucite porphyry dike were mid-subsiliceous. The total alkali contents of most samples in the three types of intrusive rocks (dikes) were greater than 8%, Rittman index ( $\sigma$ ) ratios were greater than 3.3, K<sub>2</sub>O/Na<sub>2</sub>O values were greater than 2 and A/CNK ratios were greater than 1.1. All these characteristics suggest that three types of intrusive rocks (dikes) belonged to alkali-rich, high-K and high-Al series; ② Trace elements: They were enriched in large-ion lithophile elements, such as Rb, Th, K, Ba etc, and depleted in high field strength elements such as Ta, Nb, P, Ti etc, and with strongly negative Ta, Nb, and Ti (TNT), anomalies—all characteristics of subduction-zone mantle-derived rock; ③ REE: The content of rare earth elements in the deposit is generally high, and the syenite porphyry and pseudoleucite porphyry dike has higher REE content than the biotitesyenite porphyry dike, which may be related to the higher degree of crystallization differentiation and evolution of magma at the time of formation. All rocks have high values of LREE/HREE and (La/Yb)<sub>N</sub>, which indicated that they have light and heavy REE fractionation significantly and negative Eu anomalies slightly. Samples of all intrusive rocks showed right deviation of smooth curves in the chondrite-normalized REE patterns map; ④ Trace elements and REE characteristics showed that they are partially melted from EMII with character of crust and mantle;

(3) Prospecting significance: Syenite porphyry is more abundant in Pb, Zn, Ag, Cu, Mo and other metallic mineralized elements than the other two types of alkali-rich intrusive rocks. On the spatial distribution of ore bodies, the Pb-Ag orebody was identified primarily within the syenite porphyry and its outer contact zones, and the upper of the biotitesyenite porphyry dike. The metallogenic age of Pb-Ag is close to or a little later than the intrusion time of syenite porphyry. The pseudoleucite porphyry dike has no direct genetic relationship with Pb-Ag ore (mineralized) body, but both of them formed under the dynamics background of the collision of the Eurasian and Indian Plates and Ailaoshan–Jinshajiang fracture.

This report provided not only a new idea for ore prediction in deep and peripheral of the Laojiezi Pb-Ag deposit, but also a reference for the theoretical research and prospecting practice of similar deposits in the region.

**Key words:** alkali-rich intrusive, geochemical characteristics, prospecting significance, Laojiezi Pb-Ag deposit, central Yunnan

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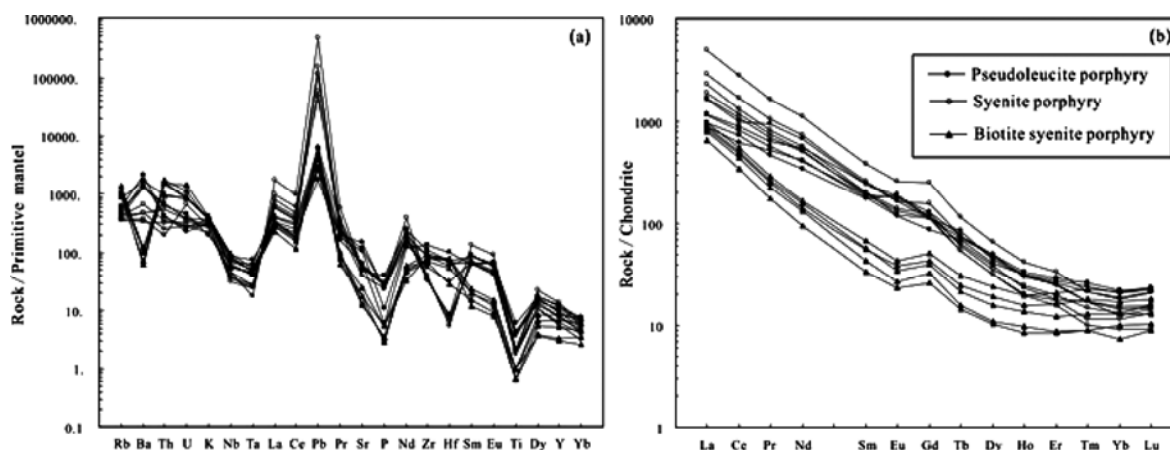


Fig.1. Primitive mantle-normalized diagram (a) and Chondrite-normalized REE patterns (b) of Laojiezi alkali-rich intrusive rocks (normalization values from Sun and McDonough, 1989).

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