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Zircon U-Pb Age, Geochemistry and Geological Significance of Granite Porphyry from Xiagalaiaoyi Pb-Zn Deposit in the Great Xing'an Range

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Abstract: The Great Xing'an Range is an important part of the most eastern part of the central Asian orogenic belt. The geochronology data in recent years shows that the main ages of the formation for intrusions there is Mesozoic (Tang et al., 2016). Mineralization mainly occurred in the Late Mesozoic, reached its peak in the Early Cretaceous, and is closely related to the Mesozoic magmatic hydrothermal activity. Shu et al. (2016) believe that the tectonic setting and mineralization of the early and middle Jurassic igneous rocks in the northern part of the Great Xing'an Range are related to the subduction of the ancient Pacific plate in the early Jurassic, while Chen et al. (2017) believe it is related to the subduction of the Mongol-okhotsk oceanic plate. The Xiagalaiaoyi Pb-Zn deposit is located on the metallogenic belt of Cu, Pb, Zn, Au, Ag, Al and U in the Yanshanian period of Ergun block. The geotectonic location belongs to the Xing'an-Inner Mongolia geosynclinal fold region, and the western segment of the junction between the Emuer central uplift belt of the Ergun block and the Great Xing'an Range rift belt (volcanic rock belt). By studying the magmatism and lithogenesis of the rock mass in this area, we can better understand the changing rule of lithosphere structure with time, providing important clues for the geodynamical process. In this paper, the granite porphyry associated with mineralization of the Xiagalaiaoyi Pb-Zn deposit were chosen to analyze for LA-ICP-MS zircon U-Pb dating and whole rock geochemistry, discussing the lithogenesis, diagenetic age and the tectonic setting of magmatic rocks, which has laid a foundation for studying the metallogenic age, ore genesis and tectonic background evolution of the Xiagalaiaoyi Pb-Zn deposit. The sample is a granite porphyry and was collected from the Xiagalaiaoyi Pb-Zn deposit (N52°12′47″, E122°56′20″) for LA-ICP-MS zircon U-Pb dating. Zircons have a grain size of 100–150μm and is mostly colorless transparent (Fig. 1). Their Th/U ratios range from 0.56 to 1.65 (>0.1), indicating a magmatic origin. Nineteen analyzed spots fall on or close to the concordia curve and yield a weighted mean $^{206}Pb/U^{238}$ age of 168.9±2.1Ma (MSWD=0.16), indicative of the magmatic age of granite porphyry (Fig. 1). Rocks from the Xiagalaiaoyi Pb-Zn deposit have high Si, K and alkali (SiO_2=71.47%–71.91%; K_2O=5.63%–5.89%; K_2O+Na_2O=9.93% –9.98%), low Al (A/CNK=0.97–0.98) and negative Eu anomalies (δEu=0.25–0.27), relatively rich in light rare earth, loss at heavy rare earth, abundant in large-ion lithotropic elements (Rb, K) and high-field strength elements (Th, U, Zr, Hf) and deficient in high-field strength elements (P, Ti, Nb, Ta) (Fig. 1). This geochemical feature is similar to those of typical Quasi-aluminou A-type granites. The samples' Nb/Ta is 13.14-13.25, which is between the global lower crust (8.3) and the depleted mantle (17.7), La/Nb is 3.01–3.07(>1), indicating that mantle-derived material was added during the formation of granite porphyry. K, Rb and Th were enriched in the samples, while Nb, Ta and Ti were deficient, manifesting that crustal miscibility occurred in the process of magma rising. In the Rb-(Yb+Ta) diagram (Fig. 1), the samples fall into the post-collision tectonic environment. The samples' differentiation index, DI is 93.48-93.96, indicating that it has the characteristics of extensional granite and reflecting the extensional tectonic background of the magmatic evolution during the middle Jurassic in the study area, that is, the granite porphyry associated with mineralization formed from the extensional environment formed after the closure of the Mongols-Okhotsk Ocean in the middle Jurassic. The genesis may be related to the partial melting of the lower crust caused by mantle magma underplating.

Key words: A-type granite, granite porphyry, Middle Jurassic, extensional environment, Xiagalaiaoyi, Great Xing'an Range

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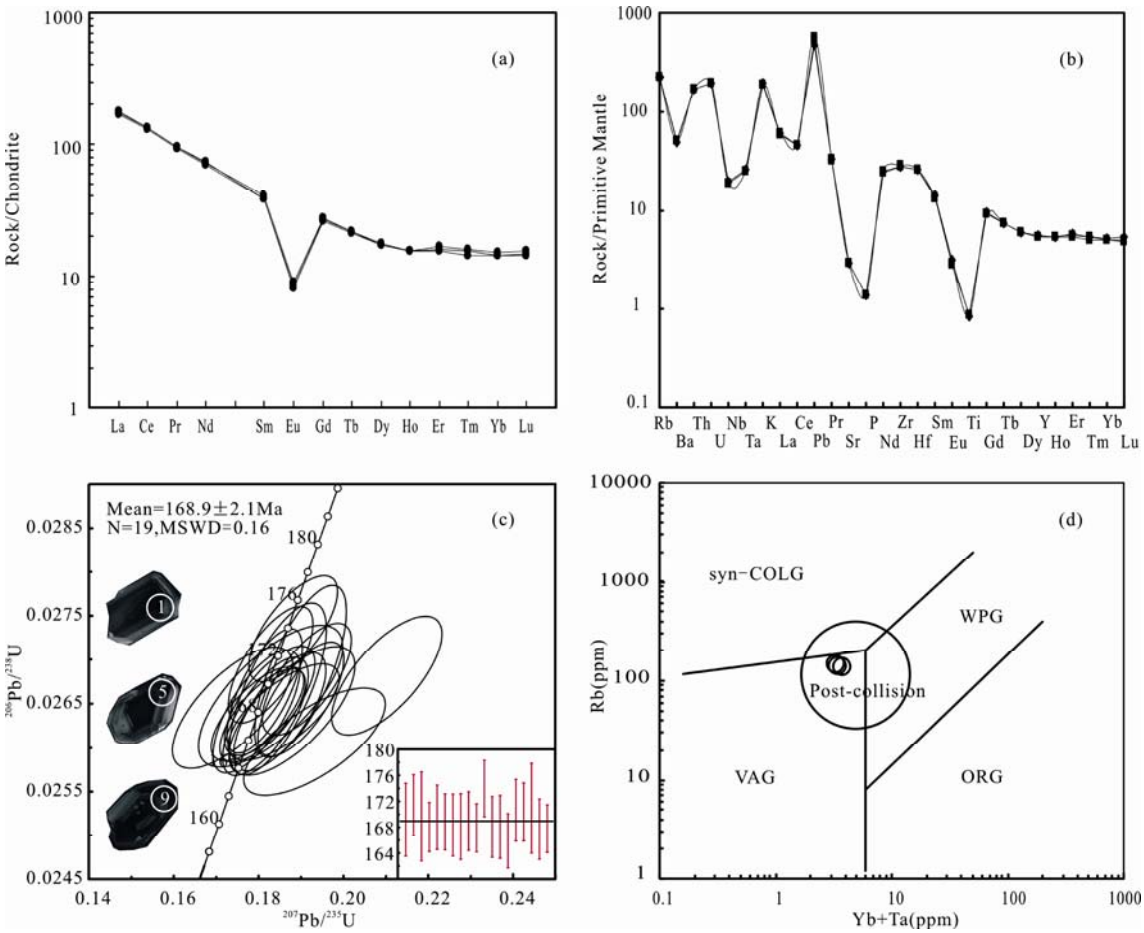

Fig. 1. (a) Chondrite-normalized REE patterns; (b) Primitive mantle-normalized trace element spidergrams; (Normalization values are from Sun and McDonough (1989)). (c) U-Pb harmonic diagram, distribution of ages diagram and CL images; (d) Rb-(Yb+Ta) discriminant diagram (Pearce, (1996)).

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