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### 新疆东昆仑于沟子地区与铁-稀有多金属成矿有关的碱性花岗岩地球化学、年代学及Hf同位素研究

作者	单位	E-mail
钱兵	<a href="#">西安地质矿产研究所, 国土资源部岩浆作用成矿与找矿重点实验室, 西安 710054</a>	
高永宝	<a href="#">西安地质矿产研究所, 国土资源部岩浆作用成矿与找矿重点实验室, 西安 710054</a>	<a href="mailto:gaoyongbao2006@126.com">gaoyongbao2006@126.com</a>
李侃	<a href="#">西安地质矿产研究所, 国土资源部岩浆作用成矿与找矿重点实验室, 西安 710054</a>	
张照伟	<a href="#">西安地质矿产研究所, 国土资源部岩浆作用成矿与找矿重点实验室, 西安 710054</a>	
周安顺	<a href="#">吉林省地质调查院, 长春 130061</a>	
吴玉诗	<a href="#">吉林省通化地质矿产勘查开发院, 通化 134001</a>	

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#### 摘要:

东昆仑祁漫塔格地区是近年来发现的具有优越多金属成矿条件的地区,区内中-酸性侵入岩广泛发育且与成矿关系密切。于沟子铁-稀有多金属矿床位于祁漫塔格地区西部,矿床主要由产于钾长花岗岩外接触带矽卡岩内的铁-铜(钼)多金属矿化体及产于花岗岩体内部的铌、钽等稀有元素矿化体组成。锆石LA-MC-ICP-MS定年测得钾长花岗岩U-Pb年龄为 $210.0 \pm 0.6$  Ma,属晚三叠世末期岩浆活动的产物。岩体主要由条纹长石(60%~65%)、斜长石(10%~15%)、石英(20%~22%)、钠闪石(4%~5%)和少量黑云母(1%~2%)等组成,为典型的碱性花岗岩。地球化学特征上,该岩体具有高硅、高钾、准铝、钙碱性特点,富Nb、Zr、Rb、Th、U,贫Ba、Sr、P、Ti等元素,稀土元素总量较高,富集轻稀土,具强烈的负Eu异常( $\delta Eu = 0.09 \sim 0.26$ ),属于A型花岗岩。锆石 $\epsilon_{Hf}(t)$ 值为-6.71~2.25,平均为-1.15,二阶段Hf模式年龄( $t_{DM2}$ )为1102~1674 Ma,显示在成岩过程中有地幔物质的参与。综合研究认为,于沟子岩体形成于晚三叠世末后造山板内伸展阶段,该碱性花岗岩的确定,标志着东昆仑祁漫塔格地区在晚三叠世末(212~210 Ma)已逐步演化为伸展构造背景下的后造山构造阶段。同时矿床的成矿时代、氧同位素及电子探针结果均显示花岗岩与铁-稀有多金属成矿有关,指示出该类型碱性花岗岩具有良好的铁-稀有多金属成矿潜力。

#### 英文摘要:

In recent years, Eastern Kunlun Qimantage area widely developed mineralization closely related intermediate to felsic intrusive rocks, regarded as a polymetallic mineralization prospect area. The Yugouzi iron-REE deposit is located in the western part of Qimantage area, the ore bodies composed of iron-copper (molybdenum) polymetallic exo-skarn ore bodies and niobium, r ubidium and other rare metal ore bodies situated in granite. Zircon LA-MC-ICP-MS U-Pb dating of K-feldspar granite yield an age of  $210.0 \pm 0.6$  Ma, suggesting a Late Triassic magmatic activity. The K-feldspar granite intrusion is a typical alkali granite, it consist dominantly of perthite (60%~65%), plagioclase (10%~15%), quartz (20%~22%), riebeckite (4%~5%) and minor biotite (1%~2%). Geochemically, the K-feldspar granite shows Si-rich, K-rich, metaluminous and calc-alkaline features. Trace elements composition shows this K-feldspar granite enriched Nb, Zr, Rb, Th, U and LREEs, and depleted in Ba, Sr, P, Ti, and strong negative europium anomalies ( $\delta Eu = 0.09 \sim 0.26$ ), suggesting affinity with A-type granites. The zircon  $\epsilon_{Hf}(t)$  values and two-staged Hf model ages ( $t_{DM2}$ ) are -6.71~2.25 and 1102~1674 Ma respectively, which indicated a significant involvement of mantle components in petrogenesis. Based on the comprehensive studies, we suggested that the Yugouzi rock formed in the post-orogenesis extensional environment, the age of the alkaline K-feldspar granite indicating the post-orogenesis in Qimantage area has basically been gradually evolved by the Late Triassic (about 212~210 Ma). The age of mineralization, O isotope and electron microprobe results all show closely relationship between the granite and the iron-rare metal mineralization, also indicating a good potential of iron-rare metal mineralization in this type granite in the Qimantage area, eastern Kunlun Mountains.

**关键词:** 碱性花岗岩 年代学 Hf同位素 于沟子地区 东昆仑

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单位地址：北京9825信箱/北京朝阳区北土城西路19号

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