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### 甘肃北山明舒井岩体形成年龄、地球化学特征及其地质意义

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#### 摘要:

北山明舒井岩体为一由辉长岩、闪长岩和花岗岩构成的岩浆杂岩体。LA-ICP-MS锆石U-Pb定年分别获得辉长岩 $442.9 \pm 1.2$  Ma、闪长岩 $437.0 \pm 2.3$  Ma、花岗岩 $435.9 \pm 2.2$  Ma的形成年龄。其中,辉长岩为富钙、高铁和镁的钙碱性岩,相对富集LREE和LILE、贫化HFSE,亏损Nb、Ta、Ti、Zr和P, Pb正异常,具中等偏高的( $^{87}\text{Sr}/^{86}\text{Sr}$ )<sub>i</sub>(0.705892)、高放射性成因Pb,低 $\epsilon_{\text{Nd}}(t)$ (0.1),锆石 $\epsilon_{\text{Hf}}(t)$ 变化大(-7.1~+8.3)。闪长岩和花岗岩富钠、低钙、铁和镁,为准铝质钙碱性岩;它们富集LREE和LILE、亏损HFSE、Nb、Ta及Sr、P、Ti明显负异常;也显示中等偏高的( $^{87}\text{Sr}/^{86}\text{Sr}$ )<sub>i</sub>(0.705951~0.706196)和高放射性成因Pb、低 $\epsilon_{\text{Nd}}(t)$ (-0.2~-0.1),但锆石 $\epsilon_{\text{Hf}}(t)$ 明显偏正(-1.1~+12.0)。不同岩类的地球化学特征及其相对一致的Sr-Nd-Pb同位素及明显不同的锆石Hf同位素,指示它们形成于板块消减带构造环境,为源自受流体交代和陆壳物质改造的幔源岩浆与新元古代陆壳物质部分熔融的岩浆混合和分离结晶演化的产物,代表北山南部早古生代晚奥陶世-早志留世晚期与大洋俯冲消减作用有关的构造岩浆事件。

#### 英文摘要:

Mingshujing pluton in Beishan area is a multiple intrusion composed of the gabbro, diorite and granite. LA-ICP-MS zircon U-Pb dating yields the  $^{206}\text{Pb}/^{238}\text{U}$  ages of  $442.9 \pm 1.2$  Ma for gabbro,  $437.0 \pm 2.3$  Ma for diorite and  $435.9 \pm 2.2$  Ma for granite, respectively, being interpreted as their formation ages. The gabbro is calc-alkaline and enriched in CaO,  $\text{FeO}^{\text{T}}$  and MgO, as well as the LREE and LILE, poor HFSE with a positive Pb and negative Nb, Ta, Ti, Zr and P anomalies. They have moderate ( $^{86}\text{Sr}/^{87}\text{Sr}$ )<sub>i</sub> (0.705892), high radioactive Pb and low  $\epsilon_{\text{Nd}}(t)$  (0.1). Their  $\epsilon_{\text{Hf}}(t)$  values range from -7.1 to +8.3. Both of the diorite and granite are the metaluminous calc-alkaline, and relatively enriched in  $\text{Na}_2\text{O}$ , low CaO,  $\text{FeO}^{\text{T}}$  and MgO. They also show an enrichment of LREE and LILE as well as poor HFSE with evident negative Nb, Ta, Sr, P and Ti and positive Pb anomalies. They have moderate to high ( $^{86}\text{Sr}/^{87}\text{Sr}$ )<sub>i</sub> (0.705951~0.706196), low  $\epsilon_{\text{Nd}}(t)$  (-0.2~-0.1), and positive  $\epsilon_{\text{Hf}}(t)$  (-1.1~+12.0), displaying a geochemical affinity of magmatic rocks formed in subduction zone. In addition, their variable Hf and much similar Sr-Nd-Pb isotopic compositions suggest that they were resulted from the mixing between crust- and mantle-derived magmas. In which, the crustal magma was formed by the partial melting of Neoproterozoic crust materials, whereas the mantle-derived magma was derived from a mantle modified by the continental crust and the fluids dehydrated from subducted oceanic crust. Subsequently, Mingshujing pluton was a complex intrusions composed of gabbros and granitoids evolved from crustal magma mixed by mantle-derived magmas by the fractional crystallization, representing an important tectono-magmatism related to oceanic slab subduction from the Upper Ordovician to the Late Middle-Silurian in the southern area of Beishan Mountain.

**关键词:** 锆石U-Pb年龄 岩石地球化学 Sr-Nd-Pb-Hf同位素 俯冲消减环境 北山

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