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晚古生代古亚洲洋俯冲作用: 来自珲春前山镁铁质侵入岩的年代学和地球化学记录

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摘要:

珲春地区前山镁铁质侵入岩主要由橄榄辉长岩、苏长岩和辉长闪长岩组成,形成年龄 $273 \pm 2\text{Ma}$,为早二叠世侵入岩。该岩体显示出岛弧拉斑玄武岩的元素地球化学特征,弱富集LREE且正Eu ($\text{Eu}/\text{Eu}^* = 1.05 \sim 1.44$)异常的REE配分模式,在不相容元素中富集大离子亲石元素(LILE)如Ba和Sr,亏损高场强元素(HFSE) ($\text{La}/\text{Nb} = 2.8 \sim 4.8$; $\text{Zr}/\text{Sm} = 8.0 \sim 22.5$),与起源于流体交代地幔楔部分熔融的岛弧低钾拉斑玄武岩类似。在同位素特征上低放射成因Sr,高放射成因Nd和Hf ($^{87}\text{Sr}/^{86}\text{Sr}(i) = 0.70295 \sim 0.70375$; $\epsilon_{\text{Nd}}(t) = +4.5 \sim +6.4$; $\epsilon_{\text{Hf}}(t) = +9.6 \sim +14.6$),反映其来源于同位素组成亏损的交代地幔。结合区域地质背景,我们认为前山镁铁质岩形成于晚古生代期间古亚洲洋向华北板块的俯冲作用背景,其亏损Nb-Ta、Zr-Hf及Hf-Nd同位素解耦特点说明该岩体最有可能来源于俯冲流体交代的地幔楔。

英文摘要:

Mafic magmatism occurring at Qianshan in the Hunchun area of eastern Jilin Province, NE China, comprises a wide spectrum of rock types from olivine gabbro, norite to gabbroic diorite. Zircon U-Pb dating results on a gabbroic diorite indicate an Early Permian emplacement age ($273 \pm 2\text{Ma}$, $n=12$, $\text{MSWD}=1.6$). These rocks show typical geochemical characteristics to arc tholeiitic basalt, e.g., enrichments in LILEs (Ba and Sr) and LREEs but depletion in HFSEs (Nb, Ta, Zr and Hf), with La/Nb range of 2.8~4.8 and Zr/Sm range of 8.0~22.5. They also have depleted Sr-Nd-Hf isotopic features, spanning an $^{87}\text{Sr}/^{86}\text{Sr}(i)$ range of 0.70295~0.70375, an $\epsilon_{\text{Nd}}(t)$ range of +4.5~+6.4, and an $\epsilon_{\text{Hf}}(t)$ range of +9.6~+14.6, suggesting their derivation from an isotopically depleted mantle reservoir. Combined major, trace element and Sr-Nd-Hf isotope data suggest that the primary magma was derived from a metasomatized mantle wedge, predominantly modified by fluid released from the subducted sediments. This magma then experienced fractional crystallization of olivine and clinopyroxene to form the wide spectrum of rock types. Generation of Qianshan mafic intrusions was genetically associated with subduction of the Paleo-Asian oceanic slab. Our new results indicate that the existence of the Paleo-Asian Ocean lasted even to the end of Paleozoic in the eastern segment of the Central Asian Orogenic belt.

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