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扬子地块西南缘大红山群变质基性岩的地球化学研究及构造意义

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摘要:

扬子地块西缘近年报道了大量古元古代晚期的地层和侵入岩体, 这些地层和岩体的构造环境多数被认为与大陆裂谷相关, 而位于扬子西缘的~1.7Ga大红山群一直缺少相关的地球化学证据。本研究对大红山群两种变质基性岩——石榴(斜长)角闪岩(A组)和绿帘斜长角闪岩(B组)的主微量元素进行了地球化学分析, 并对其构造环境进行了判别。A、B两组变质基性岩基本具有相似的地球化学性质: 主量元素SiO₂含量集中于46%~50%, MgO含量较低(5%~6%), 但A组FeO^T(平均14.28%)远高于B组FeO^T(平均3.26%), 可能与A组后期发生铁矿化作用有关; 两组角闪岩的REE配分模式较一致: A组(La/Yb)_N=1.52~4.67和B组(La/Yb)_N=1.34~4.50, 显示LREE轻微富集, Eu异常、Ce异常均不明显: Eu/Eu^{*}=0.82~1.24, Ce/Ce^{*}=0.93~1.05, 两组样品稀土元素特征均具有类似富集型洋中脊玄武岩(E-MORB)的特征; 二者的微量元素配分模式也基本一致: 相容元素Cr、Co、Ni含量变化较大, 不相容元素相对富集, Nb、Ta、Ti异常不明显, Zr、Hf轻微负异常, 其微量元素配分模式区别于岛弧玄武岩和OIB, 而与E-MORB较一致。大红山群变质基性岩的地球化学性质可与东川群的基性侵入岩进行类比。A、B两组变质基性岩的原岩为拉斑玄武岩, 通过不活动元素构造判别图解推断其构造属性为与富集地幔有关的大陆裂谷环境。变质基性岩中未受陆壳混染样品(Nb/La≈1)的微量、稀土元素地球化学特征显示其岩浆源区可能为富集地幔, 结合前人发表的相关ε_{Nd}(t)推测大红山群变质基性岩的岩浆源区为不均匀的岩石圈地幔。同样, 据扬子西缘相关火山岩的ε_{Nd}(t)、ε_{Hf}(t)值推测, 扬子西缘1.8~1.5Ga变质火成岩的岩浆源区可能为不均匀的岩石圈地幔。本研究为扬子西缘1.8~1.5Ga大陆裂谷环境的构造岩浆活动提供了新的地球化学证据, 大红山群与其同时代火成岩及地层的存在, 共同表明了扬子西缘曾在古-中元古代发生了一系列与大陆裂解有关的构造岩浆事件, 这期事件是哥伦比亚大陆裂解在扬子西缘的响应。

英文摘要:

A quantity of strata and intrusions aged in Late Paleoproterozoic were reported recently, tectonic settings of which were mostly interpreted to be continental rifting. There has been a long lack of geochemical evidence for the related tectonic environments in the Dahongshan Group in 1.7Ga. This study focused on geochemical characteristics of major elements, trace elements and REE of two groups of metabasite in the Dahongshan Group, including garnet bearing amphibolites and hornblendite (Group A) and epidote amphibolites (Group B). Group A and B have similar geochemical properties. They have similar major components with SiO₂ ranging from 46% to 50% and low MgO content of 5%~6%. While FeO^T content of Group A (14.28% in average) is much higher than that of Group B (3.26% in average), which may be attributed to the late iron-mineralization of Group A. They have similar flat chondrite-normalized REE patterns with slightly LREE enrichment [(La/Yb)_N=1.52~4.67 of Group A and (La/Yb)_N=1.34~4.50 of Group B], and no apparent Ce and Eu anomalies (Eu/Eu^{*}=0.82~1.24, Ce/Ce^{*}=0.93~1.05), which resemble the E-MORB pattern but are different from the OIB pattern. The two groups also have similar primitive-mantle normalized spidergrams with enrichment of incompatible elements, not obviously Nb, Ta and Ti anomalies and slightly negative Zr and Hf anomalies, which also resemble the E-MORB pattern but are different from the IAB or OIB pattern. Geochemical characteristics of the Dahongshan Group are similar to those of the mafic dykes intruded into the Dongchuan Group. Protolith of the two groups of metabasite were tholeiite. Through the discrimination diagram with immobile elements, a tectonic setting of continental rift related to enriched mantle was obtained. Geochemical characteristics of the samples without continental crust contamination (Nb/La≈1) and the published involved ε_{Nd}(t) show that the magma source of metabasite in Dahongshan Group may be the uneven lithospheric mantle. In addition, the published involved ε_{Nd}(t) and ε_{Hf}(t) were used to infer that the magma source of the 1.8~1.5Ga metavolcanics in the western Yangtze block may be the uneven lithospheric mantle. This study presents new geochemical evidence for the continental-rift related tectonic magmatism in 1.8~1.5Ga in western Yangtze block. Metabasite of the Dahongshan Group together with other meta-volcanics in the same age in western Yangtze block certify a series of tectonic magmatism related to rifting events in Meso- to Paleoproterozoic, which is in the same period of global Columbia supercontinent cracking event.

关键词: 变质基性岩 地球化学 大陆裂谷 大红山群 扬子地块

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