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华北克拉通东北缘岩石圈深部物质组成的不均一性: 来自吉林南部中生代火山岩元素及Sr-Nd同位素地球化学的证据

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摘要：

本文报导了吉林南部果松组和三棵榆树组火山岩的全岩K-Ar和角闪石$^{40}Ar/^{39}Ar$定年结果和岩石地球化学资料,并讨论了吉林南部早白垩世火山岩岩浆源区性质以及空间变异。定年结果显示,果松组和三棵榆树组火山岩的形成时代分别为130.2±0.3Ma和118.3±1.9Ma。果松组火山岩主要由玄武岩-玄武质粗面安山岩-粗面安山岩-英安岩组成; 它们的SiO_2含量介于46%~64%,$Mg^{\#}$介于31~50之间,Al_2O_3含量介于14.9%~18.9%之间,全碱含量(Na_2O+K_2O)介于4.61%~9.23%之间,属于亚碱性系列,具钙碱性演化趋势; 并以富集大离子亲石元素(LILEs)和轻稀土元素(LREEs),亏损重稀土元素(HREEs)和Nb、Ta、Ti等高场强元素(HFSEs)为特征; $(^{87}Sr/^{86}Sr)_i$值和$\varepsilon_{Nd}(t)$值分别介于0.7065~0.7077和-2.67~-19.71之间。果松组火山岩的成分具有较好的空间变异趋势,由东向西,火山岩的基性程度增高,东部果松组火山岩具有较高的$(^{87}Sr/^{86}Sr)_i$值,而西部具有较低的$\varepsilon_{Nd}(t)$值。三棵榆树组火山岩由粗面安山岩和粗面英安岩组成; 三棵榆树组火山岩的SiO_2含量介于55.5%~65.8%之间,$Mg^{\#}$介于42~50,Al_2O_3含量介于15.0%~15.7%,全碱含量偏高(Na_2O+K_2O=6.93%~9.24%),主体属于亚碱性系列,具钙碱性系列的演化趋势; 并以较高的Th/U (5.36~5.82)、Ba/Nb(50.2~120.0)、$(La/Yb)_N$(32.9~47.9)和Sr/Y(50.0~72.4)比值为特征; 它们的$(^{87}Sr/^{86}Sr)_i$值和$\varepsilon_{Nd}(t)$值分别变化于0.7056~0.7057和-8.99~-19.71之间。上述特征揭示,果松组火山岩(130Ma)的形成主要与古太平洋板块的俯冲作用有关,岩浆来源于受流体/熔体交代的地幔楔,东西部受到不同程度陆壳物质的混染。与果松组火山岩相比,三棵榆树组火山岩(118Ma)形成于俯冲背景下的相对引张环境,岩浆来源于受交代的岩石圈地幔,但受到深部陆壳物质的混染。

英文摘要：

This paper reports the whole-rock K-Ar and amphibole $^{40}Ar/^{39}Ar$ dating results and the geochemical data of the volcanic rocks from the Guosong and Sankeyushu formations, and discusses the nature of magma sources and its spatial variation. The dating results indicate the Guosong and Sankeyushu formations formed in the Early Cretaceous, i.e., 130.2±0.3Ma and 118.3±1.9Ma, respectively. The Guosong Formation is composed of basalt, basaltic trchyandesite, trchyandesite, and dacite with SiO_2=46%~64%, $Mg^{\#}$=31~50, Al_2O_3 =14.9%~18.9%, and (Na_2O+K_2O)=4.61%~9.23%, belonging to subalkaline series and displaying a calc-alkaline evolutionary trend on TAS diagram. They are characterized by enrichment in large ion lithophile elements (LILEs) and light rare earth elements (LREEs), depletion in heavy rare earth elements (HREEs) and high field strength elements (HFSEs) (e.g., Nb, Ta, Ti). Their $(^{87}Sr/^{86}Sr)_i$ ratios and $\varepsilon_{Nd}(t)$ values range from 0.7041 to 0.7057 and from -2.67 to -19.71, respectively. Chemically, the Guosong Formation volcanic rocks display a good spatial variation, i.e., the volcanic rocks from western part of southern Jilin having lower SiO_2 abundance and lower $\varepsilon_{Nd}(t)$ values than those from eastern part, whereas the latter having higher $(^{87}Sr/^{86}Sr)_i$ ratios. The Sankeyushu Formation consists of trchyandesite and trchydacite with SiO_2=55.5%~65.8%, $Mg^{\#}$=42~50, Al_2O_3 =15.0%~15.7%, and (Na_2O+K_2O)=4.61%~9.23%. Most of them belong to subalkaline series and show a calc-alkaline evolutionary trend on TAS diagram. They are characterized by high Th/U (5.36~5.82), Ba/Nb (50.2~120.0), $(La/Yb)_N$ (32.9~47.9), and Sr/Y(50.0~72.4) ratios and have $(^{87}Sr/^{86}Sr)_i$ ratios of 0.7056~0.7057 and $\varepsilon_{Nd}(t)$ values of -8.99~-19.71. Taken together, it is suggested that the primary magma of the Gousong Formation volcanic rocks could be derived from partial melting of the mantle wedge metasomatized by fluids or hydrous siliceous melts from subducted slab under a tectonic setting of active continental margin, and contaminated by the lower crustal materials during its ascending, and that the primary magma of the Sankeyushu Formation could be originated from partial melting of the metasomatized lithospheric mantle under an extensional setting, and be subjected to contamination of deep crustal material.

关键词：华北克拉通 吉林南部 中生代火山岩 年代学 地球化学

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