岩石学报
ACTA PETROLOGICA SINICA

李竞妍,郭锋,李超文,李红霞,赵亮. 2014. 东北地区晚古生代-中生代I型和A型花岗岩Nd同位素变化趋势及其构造意义. 岩石学报, 30(7): 1995-2008

东北地区晚古生代-中生代I型和A型花岗岩Nd同位素变化趋势及其构造意义

作者	单位	E-mail
李竞妍	中国科学院广州地球化学研究所, 同位素地球化学国家重点实验室, 广州 510640;中国科学院大学, 北京 100049	
郭锋	中国科学院广州地球化学研究所, 同位素地球化学国家重点实验室, 广州 510640	guofengt@263.net
李超文	中国科学院广州地球化学研究所, 同位素地球化学国家重点实验室, 广州 510640	
李红霞	中国科学院广州地球化学研究所, 同位素地球化学国家重点实验室, 广州 510640	
赵亮	中国科学院广州地球化学研究所, 同位素地球化学国家重点实验室, 广州 510640	

基金项目：本文受国家“973”项目（2013CB429804）和国家青年自然科学基金项目（40973024）联合资助.

摘要：

中国东北地区位于中亚造山带巨型增生陆缘的东段，分布着巨量的具有新生特征的显生宙花岗岩和火山岩。本文对东北地区晚古生代-中生代I和A型花岗岩年代学和Nd同位素组成开展了综合分析和研究。东北地区的I型花岗岩有两种Nd同位素变化趋势：一是以额尔古纳和兴安地块为代表，其$\varepsilon_{Nd}(t)$随着年龄变新而增大，与造山带垮塌、软流圈上涌的幔源熔体或蒙古-鄂霍茨克洋的俯冲交代地幔楔熔体加入引起的地壳增生作用相关。二是以松嫩地块西南区和张广才岭为代表，$\varepsilon_{Nd}(t)$随着年龄变新而下降，反映花岗岩的熔融源区有从早期的新生岛弧中、下地壳向晚期含更多再循环物质的中、上地壳迁移的趋势。A型花岗岩侵位时代主要有三期，总体上具有正的$\varepsilon_{Nd}(t)$值，绝大部分t_{DM2}<1.0Ga，反映了东北地区强烈的地壳增生作用。晚古生代A型花岗岩主要沿着贺根山-黑河断裂分布，可能与兴安和松嫩地块碰撞后伸展作用相关；早中生代A型花岗岩主体分布于张广才岭，与松嫩、佳木斯和兴凯地块的碰撞后伸展作用相关；早白垩世A型花岗岩遍布整个东北地区，可能与古太平洋板块俯冲、后撤导致的区域性伸展作用相关。晚古生代-中生代花岗岩的Nd二阶段模式年龄（t_{DM2}）与侵位年龄（t）的对比展示了东北各构造单元地壳增生作用的差异。与华北北缘中生代花岗岩的特征相似，额尔古纳和佳木斯地块的花岗岩表现出$t_{DM2} > t+1000$Ma的特征，表明这两个地块具有古老的结晶基底。兴安地块、松嫩地块西南区和张广才岭花岗岩的t_{DM2}和侵位年龄差值集中在300~1000Ma，反映不同属性（年轻vs.古老）的地壳物质对熔融源区的贡献。东北地区t_{DM2}和侵位年龄差值小于300Ma的花岗岩岩体极少，仅有乌兰浩特的查干岩体一例，可能由新近增生的新生地壳熔融形成。由Nd同位素特征显示，晚古生代-中生代东北地区显著的地壳增生作用主要发生在缝合带和岩石圈规模的断裂带，幔源岩浆沿断裂带上升到地壳不同深度并形成高$\varepsilon_{Nd}(t)$和低t_{DM2}的中酸性火成岩。除几个特殊岩体表现出过于亏损或富集Nd同位素的特征，早白垩世东北地区酸性火成岩的Nd同位素组成相近，$\varepsilon_{Nd}(t)$值集中在0~+3之间，可能暗示此时期东北地区的中、下地壳成分组成趋于一致并与同时期的古太平洋俯冲作用有关。我们的结果显示东北地区晚古生代-中生代花岗岩的起源与古亚洲洋、蒙古鄂霍茨克洋和古太平洋的构造演化相关。这三个古大洋的扩张和俯冲作用提供了大量新生地壳物质，而新生和再循环地壳物质的重熔形成了东北地区大规模的显生宙花岗岩及其对应成分的喷出岩。

英文摘要：

The northeastern China is located in the eastern segment of the gigantic accreting continental margin of the central-Asian orogenic belt, in which the subduction-accretion complexes added ~5.3Mkm^2 of material to Asia. In the NE China region distributes voluminous Phanerozoic granitoids and volcanic lavas, which were mostly of juvenile origin. A compilation of age spectrum and Nd isotopic compositions of the Late Paleozoic to Mesozoic I-and A-type granites in NE China is presented in this paper. There exist two contrasting Nd isotopic variation trends for the I-type granites. One is represented by those granites occurring in the Erguna and Xing'an Blocks, which show a progressive increase of $\varepsilon_{Nd}(t)$ following the youthening of the emplacement age. Such a Nd isotopic variation was likely resulted from crustal growth in response to either orogenic collapse and asthenospheric upwelling or the subduction-related accretion through coeval subduction of the Mongolia-Okhotsk Ocean. The other is represented by the I-type granites in SW Songnen Block and Zhangguangcai Range, which show a progressive decrease of $\varepsilon_{Nd}(t)$ value following the youthening of intrusive age. A likely explanation for such Nd isotopic change is that the melting source of the granitic magmas migrated from lower-middle subarc-type juvenile crust to the middle-upper crust, where the protolith components comprise higher proportion of recycled crustal materials. By contrast, the majority of the Late Paleozoic to Mesozoic A-type granitoids have positive $\varepsilon_{Nd}(t)$ values with two-stage Nd model age below 1.0Ga, also indicating the role of Phanerozoic crustal growth in NE China. They can be roughly grouped into three emplacement peroids, which were conrresponding to three stages of lithospheric extension events. The Late Paleozoic A-type granites distribute roughly along the Hegenshan-Heihe fault, so their origin was likely related to the post-collisional extension after the collsion between Xing'an and Songnen Blocks. The Early Mesozoic A-type granites distributing along the Zhangguangcai Range were genetically related to the post-collisional extension after the collision between the Jiamusi-Khanka and Songnen Blocks. The Earl

y Createous A-type granites occurring all over the NE China were likely formed under lithospheric extension related to subduction and rollback of the paleo-Pacific Ocean. A comparison between the t_{DM2} (two-stage Nd model age) and e mplacement age of Late Paleozoic to Mesozoic granitoids shows the differences of crust growth among different tecto nic units in NE China. Similar to the Mesozoic granitoids occurring in northern margin of North China Craton, the granit oids occurring in the Erguna and Jiamusi Blocks have t_{DM2} 1000Ma more than their intrusive ages, suggesting that be neath these two blocks may exist ancient basement rocks. The granitoids outcropping in the Xing'an Block, SW Songn en Block and Zhangguangcai Range have the difference between t_{DM2} and formation age ranging from 300Ma to 100 0Ma, implying different proportional mixing of crustal components (juvenile and recycled crustal materials) in their melt ing sources. By contrast, the granitoids with difference between t_{DM2} and intrusive age less than 300Ma are very rar e, except for the sample from the Chagan pluton from the Wulanhaote area, the origin of which was likely derived fro m the melting of newly accreted juvenile crust. In terms of Nd isotopic compositions, the crustal growth during the Lat e Paleozoic to Mesozoic time mainly occured around or along the previsous collisional sutures and lithosphere-scale fa ults, in which depleted mantle-derived magmas ascended along these faults to different crustal levels to produce the intermediate to felsic igneous rocks that have relative higher $\varepsilon_{Nd}(t)$ and lower t_{DM2}. Except for several special plutons (e.g., Suolunzhen, Luoguhe and Xiaochengzi plutons) have excessively depleted or enriched Nd isotopic composition s, most of the Early Cretaceous felsic igneous rocks in NE China have an $\varepsilon_{Nd}(t)$ range from 0 to +3. This implies that t he Nd isotopic compositions of the lower-middle crustal source components for the granitoids throughout the NE Chin a became similar, possibly related to contemporaneous subduction of the paleo-Pacific Ocean. Our results suggest th at the origins of the Late Paleozoic to Mesozoic granitoids in NE China were tectonically linked with the evolution of th e paleo-Asian, Mongolia-Okhotsk and paleo-Pacific Ocean. Spreading and subduction of these three oceans added vol uminous juvenile crustal materials into the crust and remelting of both the juvenile and recycled crustal protoliths for med the large-scale Phanerozoic granitoids and their eruptive counterparts across the NE China.

关键词：Nd同位素 构造演化 花岗岩 晚古生代-中生代 东北地区

投稿时间： 2013-08-10 最后修改时间： 2013-12-19

黔ICP备07002071号-2
主办单位：中国矿物岩石地球化学学会
印刷版(Print)：ISSN 1000-0569 网络版（Online）：ISSN 2095-8927
单位地址：北京9825信箱/北京朝阳区北土城西路19号
本系统由北京勤云科技发展有限公司设计