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中国东北中生代构造体制与区域成矿背景: 来自中生代火山岩组合时空变化的制约

作者	单位
许文良	吉林大学地球科学学院, 长春 130061
王枫	吉林大学地球科学学院, 长春 130061
裴福萍	吉林大学地球科学学院, 长春 130061
孟恩	中国地质科学院地质研究所, 北京 100037
唐杰	吉林大学地球科学学院, 长春 130061
徐美君	吉林大学地球科学学院, 长春 130061
王伟	吉林大学地球科学学院, 长春 130061

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摘要:

本文系统总结了东北地区中生代火山岩的年代学、岩石组合及其时空分布规律,以便对环太平洋构造体系和蒙古-鄂霍茨克构造体系中中生代的演化历史及其东北地区中生代区域成矿背景给出制约。基于火山岩中锆石U-Pb定年结果,东北地区中生代火山作用可划分成六期:晚三叠世(200~228Ma)、早-中侏罗世(173~190Ma)、中-晚侏罗世(158~166Ma)、早白垩世早期(138~145Ma)、早白垩世晚期(106~133Ma)和晚白垩世(88~97Ma)。晚三叠世火山作用主要分布在吉黑东部和小兴安岭-张广才岭地区,前者为A型流纹岩,后者为双峰式火山岩组合,它们共同揭示了古亚洲洋最终闭合后的伸展环境;早-中侏罗世火山岩主要分布在吉黑东部、小兴安岭-张广才岭和额尔古纳地区,吉黑东部和额尔古纳地区早-中侏罗世钙碱性火山岩的存在分别标志着古太平洋板块和蒙古-鄂霍茨克洋板块俯冲作用的发生,而小兴安岭-张广才岭早-中侏罗世火山岩则以双峰式火成岩组合为特征,反映了双向俯冲的弧后伸展环境;中-晚侏罗世和早白垩世早期火山岩主要分布在松辽盆地以西和冀北-辽西地区,前者为碱性-亚碱性的过渡系列,主要由玄武粗安岩、粗安岩和少量粗面岩组成,后者为A型流纹岩或碱性流纹岩组成,这些火山岩形成于加厚陆壳的坍塌或拆沉阶段;早白垩世晚期火山岩广泛分布于东北地区,吉黑东部为钙碱性火山岩组合,而松辽盆地和大兴安岭地区则主要为双峰式火山岩组合,前者标志着古太平洋板块的俯冲,后者与早期加厚陆壳的拆沉和/或类似弧后的伸展环境有关;晚白垩世火山岩主要分布在吉黑东部和陆内,前者为钙碱性火山岩组合,后者为碱性玄武岩,反映了来自东部环太平洋构造体系的俯冲作用。综合上述中生代火山岩的岩石组合及时空分布特征,可以判定:1)环太平洋构造体系对东亚大陆下的俯冲始于早侏罗世,中生代期间存在早侏罗世、早白垩世晚期和晚白垩世三次俯冲事件,其影响的空间范围主要在松辽盆地及其以东地区,陆缘和古俯冲带是寻找斑岩型矿床的有利场所,而陆内的伸展区域主要与浅成低温热液矿床有关;2)蒙古-鄂霍茨克构造体系经历了中生代早期的俯冲事件和中侏罗世及早白垩世早期两次陆内推覆事件,其影响的空间范围主要在松辽盆地以西地区和华北地块北缘,中生代早期的俯冲事件主要与活动陆缘背景下的斑岩型矿床关系密切,而晚侏罗世和早白垩世两次与加厚陆壳拆沉有关的伸展背景有利于多金属矿床的形成。

英文摘要:

This paper summarizes geochronology and association of Mesozoic volcanic rocks and their spatial and temporal variations, with the aim of constraining evolutionary history, and ore-forming background of the circum Pacific and Mongol-Okhotsk tectonic systems in NE China. Zircon U-Pb dating results indicate that Mesozoic volcanisms in NE China can be subdivided into six stages, i.e., Late Triassic (200~228Ma), Early-Middle Jurassic (173~190Ma), Middle-Late Jurassic (158~166Ma), early Early Cretaceous (138~145Ma), late Early Cretaceous (106~133Ma), and Late Cretaceous (88~97Ma). Late Triassic volcanic rocks in NE China mainly distribute in the eastern Jilin-Heilongjiang provinces and the Lesser Xing'an-Zhangguangcai Ranges. The former consists of A-type rhyolite, the latter is composed of bimodal volcanic rocks, implying that they formed under an extensional environment after the final closure of the Paleo-Asian Ocean. Early-Middle Jurassic volcanic rocks occur in the eastern Jilin-Heilongjiang provinces, the Lesser Xing'an-Zhangguangcai Ranges, and the Erguna district. Those in the eastern Jilin-Heilongjiang provinces and the Erguna district are composed of calc-alkaline volcanic rocks, suggesting that they formed under the subductions of the Paleo-Pacific plate beneath the Eurasian continent and of the Mongol-Okhotsk oceanic plate beneath the Erguna Massif, respectively. However, those in the Lesser Xing'an-Zhangguangcai Ranges are a set of bimodal volcanic rocks, implying that they formed under an extensional environment similar to a back-arc setting of double-direction subduction. Middle-Late Jurassic and early Early Cretaceous volcanic rocks only distribute to the west of the Songliao basin, including the Great Xing'an Range and northern Hebei-western Liaoning provinces. Middle-Late Jurassic volcanic rocks consist of basaltic trachy-andesite, trachy-andesite, and trachyte, whereas early Early Cretaceous volcanic rocks are composed of A-type

rhyolite and alkali rhyolite, which formed under an extensional environment related to the collapse or delamination of the thickened lower crust. The late Early Cretaceous volcanic rocks are widespread in NE China, those in the eastern Jilin-Heilongjiang provinces belong chemically to a set of calc-alkaline series, whereas those from the Songliao basin and the Great Xing' an Range are a bimodal volcanic rocks. The former marks the subduction of the Paleo-Pacific plate beneath the Eurasian continent, the latter could form under an extensional environment related to the delamination of the thickened lower crust and/or a back-arc setting. Late Cretaceous volcanic rocks mainly occur in the eastern margin of the Eurasian continent, and consist of calc-alkaline series in the continental margin and alkali basalts in intracontinent, suggesting that they formed under the subduction of the Paleo-Pacific plate. Taken together, we conclude: 1) that the subduction of the circum Pacific tectonic system beneath the Eurasian continent began in the Early Jurassic and took place in three times (Early Jurassic, late Early Cretaceous, and Late Cretaceous) during Mesozoic; the influencing spatial extent of the circum Pacific tectonic system mainly include the Songliao basin and its to east; the active continental margin and Paleo-subduction zone are favorable sites in search of porphyry ore deposits, whereas an extensional regions within intracontinent are favorable for the formation of the epithermal hydrothermal ore deposits in the eastern Jilin-Heilongjiang provinces; 2) that the Mongol-Okhotsk tectonic system experienced Early Mesozoic subduction beneath the Erguna Massif, and Middle Jurassic and early Early Cretaceous thrusting events; the influencing spatial extent of the Mongol-Okhotsk tectonic system include to west of the Songliao basin and northern margin of the North China Craton; the Early Mesozoic subduction of the Mongol-Okhotsk oceanic plate beneath the Erguna Massif is favorable for the formation of porphyry deposits, whereas the extensional environment related to the collapse or delamination of the thickened lower crust in Late Jurassic and Early Cretaceous are favorable for formation of polymetallic deposits.

关键词: [东北地区](#) [中生代火山岩](#) [时空变化](#) [环太平洋构造体系](#) [蒙古-鄂霍茨克构造体系](#) [成矿背景](#)

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主办单位: 中国矿物岩石地球化学学会

单位地址: 北京9825信箱/北京朝阳区北土城西路19号

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