XING Shuwen, ZHANG Yong, SUN Jinggui, ZHANG Zengjie and MA Yubo, 2014. Studies on Metallogenic Models of Au-Nonferrous Metals Deposits in Eastern Liaoning-Jilin-Heilongjiang District. *Acta Geologica Sinica* (English Edition), 88(supp. 2): 1697-1698.

Studies on Metallogenic Models of Au-Nonferrous Metals Deposits in Eastern Liaoning-Jilin-Heilongjiang District

XING Shuwen[1], ZHANG Yong[1], SUN Jinggui[2], ZHANG Zengjie[1] and MA Yubo[1]

1MLR Key Laboratory of Metallogeny and Mineral Assessment, Institute of Mineral Resources, Chinese Academy of Geological Sciences, Beijing 100037, P.R. China
2College of Earth Sciences, Jilin University, Changchun 130061, P.R. China

The Eastern Liaoning- Jilin- Heilongjiang district, referring to the east parts of Liaoning, Jilin, and Heilongjiang provinces along the line of Dalian- Shenyang- Changchun- Haerbin- Jiamusi, situates adjacently to the Northern Korea in the south and Russia in the north, respectively. The study area, tectonicly located at the eastern part of the northern margin of North China Craton and Central Asian Orogenic Belt, is a complex structural area, which is composed of different blocks and tectonic belts and has experienced multiple stages of teconization. Due to different ages, tectonic environment and degrees of superposition, different sub-districts present different geological characteristics and diverse metallogeneses.

1 Metallogenic Model of Archean Cu, Zn Massive Sulfide Deposits

Archean metallogenesis is represented by Hongtoushan Cu-Zn deposit. The metallogenic process can be described as the following: in the interim period of the eruptions of base metal-enriched mafic-intermediate-acid calc-alkaline volcanics in about 2500 Ma, the ore-bearing fluids erupted and formed the massive sulfide deposits around the jet orifice and formed the mesh-vein ore bodies in the volcanic vent; after the formation of the initial ore bodies, accompanied by the cratonization process, the ore bodies underwent the deformation and metamorphism of amphibolite facies, and partly turned into plastic flow to be enriched in the turning ends and the cores of folds, and the extensional space of the interlayer as well; because of the tectonism after Archean, parts of ore bodies were reactivated and remold, or formed sparsely disseminated ones.

* Corresponding author. E-mail: xxx8844@163.com.

2 Metallogenic Model of Proterozoic Sedimentary Pb, Zn, Ag, Au, Cu and Co Deposits

The Pb, Zn, Ag, Au, Co and Cu deposits in the study area are hosted in the assemblages of marine carbonates and clastic rocks of Paleoproterozoic Liaohe Group (Laoling Group in Jilin province). Of these, in basins of the shallow sea, juvenile Pb, Zn, Ag and Au deposits were formed by sedimentation, while in depression belts in deep water, Co, Cu, and Ni deposits were developed by biochemical sedimentation. Subsequently, the formed ore bodies were relocated by the metamorphic solution from the regional metamorphism. In the epoch of Indo- Yanshanian, lots of magmatic water and heat provided by the magmatism, joined by ground water, constantly leached and dissolved the metal minerals from country strata, and changed into ore-bearing hydrothermal water, which activated, migrated and accumulated the metallogenic materials to form the deposits again.

3 Model of Paleozoic Metallogeneses of Sedimentary Exhalation and Hydrothermal Alteration

Partial gold, iron and copper deposits in the region occurred in the sedimentary environment of marine volcanic-continental carbonate and clastic rocks. Among them, the mineralization of Dongfengshan, and Dongfenglinchang iron-gold deposits was submarine volcanic exhalation and chemical sedimentation; while Hongtaiping copper deposit, and etc., are massive sulfide deposit in the submarine volcanic exhalation and sedimentation system; the gold, copper, lead and zinc deposits, related to the Permian magmatism, were skarn-type deposits, such as Laozuoshan gold deposit and

Hengren Pb-Zn deposit, which were developed by the metasomatism between the host carbonates and the magma formed from the partial melting of the enriched mantle, which was formed by the metasomatism of the fluids and melts carried by the Paleo Asia oceanic slab during the course of the subduction.

4 Mesozoic Metallogenic Model

4.1 Meallogenic model of the Mesozoic mantle- derived magamatic Cu-Ni sulfide deposits

The formation of typical Cu-Ni sulfide deposits, like Hongqiling, Chajianling, Piaohechuan, postdated the vertical thickening of the lithosphere as the results of the collision between the North China Craton and Jiamusi block. Due to the gravitational instability, the subsequent extension of lower crust and the delamination of lithospheric mantle, the overlying depleted lithosopheric mantle produced the primitive magma because of partial melting. The crystallization of olivine and orthopyroxene and other minerals took place and formed the deposits during the ascenting process of the primitive magma, with no significantly contamination by crustal materials.

Chibaisong Cu-Ni sulfide deposit formed in the N-E trending deep faulting system in the continental margin of the subduction of Paleo-pacific plate to Paleo-Asia continent. Since late Jurassic, this region gradually turned into continental back-arc extensional environment with widespread plutonic magmatism and volcanic eruption. The initial basaltic magma derived from the partial melting of the E-MORB type mantle underplated lower crust and crustal the, and strongly contaminated by Archean materials, formed Chibaisong deposit.

4.2 Metallogenic model of the Jurassic porphyry-metasomatic hydrothermal Mo-Pb-Zn deposits

The metallogenesis of this stage was closely related to the subduction of the Pacific plate, but different deposits have different evolutional processes of the provenances. Mantle-derived basaltic magma underplated and mixed with the magma which was formed by partial melting of the lower crust triggered by the underplating, to form the magma chamber. The mixed magma from the chamber formed the granitic complex by fractional crystallization and produced the deposits (Daheishan Mo deposit, Liushengdian Mo deposit). When there was no crustal contamination during the rising of the magma from the chamber, the deposits such as Tianbaoshan Cu-Pb-Zn- Mo deposit, and Shuangshan Mo deposit, and the accompanied granitic complex were developed.

4.3 Metallogenic model of the Jurassic-Cretaceous mesothermal gold deposits

The digenetic and metallogenic geodynamics were related to the subduction of the Pacific plate in the east. In the course of the subduction, the granitic magma, as the result of partial melting of the crust triggered by the dehydration of subducted oceanic plate (Izanaqi), ascended and heated the lower crust, produced lots of ore-forming fluid，and developed into gold deposit in suitable structural location.

4.4 Metallogenic model of the Cretaceous porphyry copper -epithermal gold deposits

The adakitic magma, formed by partial melting from the secondary enriched lithospheric mantle, mixed with lower crust remelting magma and form magma chamber. The granitic complex and related deposits were developed by fractional crystallization; In other case, the enriched mantle caused the remlting of the lower crust and forming the potassium calc-alkaline magma, then the granitic complex, volcanic rocks and the accompanied deposits were formed.

Acknowledgements

This research was supported by China Geological Survey Projects (Grant No.1212011085530, 12120113090100, 1212011220806, 12120114004001).

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