Ore Genesis and Tectonic Setting of Laojiagou Porphyry Mo Deposit, Inner Mongolia (Northern China): Evidence from Ore Geology, Fluid Inclusions, H-O Isotopes, Zircon U-Pb Age and Whole-rock Geochemistry

TANG Wenhao[1], LI Jian[1], WANG Keyong[1, 2, *], LI Shunda[1], CAI Wenyan[1], LIU Hanlun[1] and WANG Yicun[1]

[1] *College of Earth Sciences, Jilin University, Changchun 130061, Jilin, China*
[2] *Key laboratory of Mineral Resources Evaluation in Northeast Asia, Ministry of Land and Resources of China, Changchun 130061, Jilin, China*

Citation: Tang et al., 2019. Ore Genesis and Tectonic Setting of Laojiagou Porphyry Mo Deposit, Inner Mongolia (Northern China): Evidence from Ore Geology, Fluid Inclusions, H-O Isotopes, Zircon U-Pb Age and Whole-rock Geochemistry. *Acta Geologica Sinica* (English Edition), 93 (supp.2): 120.

Abstract: The Laojiagou is a Middle Triassic porphyry Mo deposit situated in the northern margin of the North China Craton. The Mo mineralization is associated with monzogranite porphyry, and mainly occurs as quartz veins in potassic-, silicic-, sericite-, and propylitic-altered wall-rocks (Zeng et al., 2012). The alteration/mineralization processes comprise three stages: (I) molybdenite+pyrite+quartz, (II) pyrite+chalcopyrite+ molybdenite+quartz, (III) sulfide-poor+quartz+fluorite. Three types of quartz-hosted fluid inclusions (FIs) were identified (Bodnar et al., 1993; Goldstein et al., 2003), i.e., aqueous–carbonic (C-type), liquid-rich two phase (L-type) and rare vapor-rich two phases (V-type) FIs. Microthermometric results indicate that the hydrothermal fluids evolved from high-temperature (> 350°C), low salinity (< 10 wt% NaCl equiv.) and CO_2-rich to low-temperature and CO_2-poor with major meteoric water input. Hydrogen and oxygen isotopes confirm that source of the hydrothermal fluids had gradually shifted from magmatic- to meteoric water-derived (Stage I: $\delta^{18}O_{H2O}$ (4.4‰ to 4.8‰) and δD_{H2O} (–105.8‰ to –101.5‰)). LA-ICP-MS zircon U-Pb dating indicates that monzogranite porphyry was emplaced in the early Late Triassic (233±2 Ma; MSWD =0.73). The monzogranite porphyry samples have high SiO_2, K_2O and Al_2O_3, and low MgO and CaO contents, and are high-K calc-alkaline and weakly peraluminous. The rocks are all enriched in light rare earth elements (LREEs) and large ion lithophile elements (LILEs), but depleted in high field strength elements (HFSEs). Placing the age and post-collisional geochemical signatures of the monzogranite porphyry into the regional tectonic context, we propose that the Laojiagou porphyry Mo deposit was formed in the early Late Triassic, associated with the post-orogenic extensional tectonics after the closure of the Paleo-Asian Ocean (Chen et al., 2003).

Key words: porphyry Mo deposit, fluid inclusions, H–O isotopes, zircon U–Pb geochronology, paleo-Asian Ocean, North China Craton.

Acknowledgements: We thank the Analytical Laboratory in the Beijing Research Institute of Uranium Geology, China National Nuclear Corporation (CNNC), China, for their assistance during isotopic analysis.

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About the first author

TANG Wenhao male, born in 1995 in Liaocheng City, Shandong Province; Master. Studied in Jilin University, majoring in mineralogy. E-mail: 78690 4094@qq.com; phone: 18243011375.

About the corresponding author

WANG Keyong, male, born in 1965 in Tangshan City, Hebei Province; Doctor, graduated from China University of Geosciences (Wuhan). He is engaged in mineralogy and fluid inclusions. Email: wangky@jlu.edu.cn; phone: 13069004095.

* Corresponding author. E-mail: wangky@jlu.edu.cn