Post-collisional porphyry-related mineralization systems in the Hongshan deposit, southern Yidun arc, SW China

Zu, Bo[1]; Xue, Chunji[2*]; Chi, Guoxiang[3]; Zhao, Xiaobo[2]

[1]*Faculty of Earth Resources, China University of Geosciences, Wuhan 4330074, China;*

[2] *State Key Laboratory of Geological Processes and Mineral Resources, Faculty of Earth Sciences and Resources, China University of Geosciences, Beijing 100083, China*

[3]*Department of Geology, University of Regina, S4S 0A2 Regina, Canada*

（*corresponding author: chunji.xue@cugb.edu.cn）

The Hongshan Cu-polymetallic deposit (1.4 Mt Cu, 40,000 t Mo, 11,000 t Pb, 14,000 t, Zn, and 333 t Ag) is located in the southern Yidun arc in southwestern China, where both subduction-related (Late Triassic) and post-collisional (Late Cretaceous) porphyry-skarn mineralization systems have been previously recognized. It is, therefore, an ideal place to investigate the genetic linkage between the subduction related porphyry deposits and post-subduction porphyry deposits. In this study, two distinct magmatic events, represented by diorite porphyry and quartz monzonite porphyry, have been revealed in the Hongshan deposit, with zircon SHRIMP U-Pb ages of 214 ± 2 Ma and 73.4 ± 0.7 Ma, respectively. The 73 Ma age is comparable to the Re-Os ages of 77 to 80 Ma of molybdenite and pyrrhotite from the Hongshan deposit, indicating that the mineralization is related to the Late Cretaceous quartz monzonite porphyries rather than Late Triassic diorite porphyries.

The Late Triassic diorite porphyries belong to the high-K calc-alkaline series and show arc magmatic geochemical characteristics such as enrichment in Rb, Ba, Th and U and depletion in HFSEs, indicating that they were formed during the westward subduction of the Garzê -Litang Ocean. In contrast, the Late Cretaceous quartz monzonite porphyries show shoshonitic I-type geochemical characteristics, with high SiO_2, K_2O, LILE, low HREE, Y and Yb contents, and high LREE/HREE and La/Yb ratios. These geochemical characteristics, together with the Sr-Nd-Pb isotopic compositions (average $(^{87}Sr/^{86}Sr)_i$ = 0.7085; εNd(t) = - 6.0; $^{206}Pb/^{204}Pb$ = 19.064, $^{207}Pb/^{204}Pb$ = 15.738, $^{208}Pb/^{204}Pb$ = 39.733) suggest that the quartz monzonite porphyries originated from the partial melting of the ancient lower crust in response to underplating of mafic magma from subduction metasomatized mantle lithosphere, possibly triggered by regional extension in the post-collisional tectonic stage. The S isotopic compositions ($\delta^{34}S_{V\text{-}CDT}$ = 3.81 ‰

to 5.80 ‰) and Pb isotopic compositions ($^{206}Pb/^{204}Pb$ = 18.014 to 18.809, $^{207}Pb/^{204}Pb$ = 15.550 to 15.785, and $^{208}Pb/^{204}Pb$ = 38.057 to 39.468) of ore sulfides indicate that the sulfur and metals were derived from mixed mantle and crustal sources.

It is proposed that although the Late Triassic magmatic event is not directly related to mineralization in the Hongshan deposit, it contributed to the Late Cretaceous mineralization system through the storage of large amounts of sulfur and metals as well as water in the cumulate zone in the mantle lithosphere through subduction metasomatism. Re-melting of the mantle lithosphere including the hydrous cumulate zone and ancient lower crust during the post-collisional stage produced fertile magmas, which ascended to shallow depths to form quartz monzonite porphyries. Hydrothermal fluids released from the intrusions resulted in porphyry-type Mo-Cu ores in and near the intrusions, skarn-type Cu ores in the country rocks above the intrusions, and hydrothermal Pb-Zn ores in the periphery.