What Governed Au-Cu Mineralization Fertility of Magmatic Systems?: an Example from Yinan Au-Cu Skarn Deposits in Luxi District, North China Craton

Si-Yuan Li[1, 2], Si-Shen Li[3, 4], Zhuang Duan[5], Jian-Wei Li[1, 2]
1. School of Earth Resources, China University of Geosciences, Wuhan, China, 2. State Key Laboratory of Geological Processes and Mineral Resources, China University of Geosciences, Wuhan, China, 3. College of Automobile Engineering, Jilin University, Changchun, China, 4. State Key Laboratory of Automobile Simulation and Control, Jilin University, Changchun, China, 5. Institute of Geophysical and Geochemical Exploration, Chinese Academy of Geological Sciences, Langfang, China

Au-Cu ore-forming magmas are commonly thought to have been enriched in metal and/or volatile. An intensive study of whole rock samples, zircon, and apatite from magmatic systems associated with Yinan Au-Cu skarn deposits was undertaken to test these assumptions. Combined, in-situ Hf isotope analyses in zircon and bulk rock composition and Sr-Nd isotope imply that the Yinan ore-related intrusions were derived from an enriched lithospheric mantle metasomatized by subducted derived fluids and/or melts. The geochemical signatures of whole rock samples, zircon, and apatite unanimously indicate ore-related intrusions are characterized by high oxygen fugacity with volatile (H_2O, S, and Cl) enriched, most likely from the source inheritance. Petrographic, petrological and geochemical evidence reveal substantial sulphides were coprecipitated with pyroxene and amphibole during the magma evolution and trapped in cumulates, which may resulting in much lower Au and Cu content of magmas. These results implies that the formation of metal-rich cumulates at depth was not detrimental to their fertility, although likely loss of metal. Observed magmatic sulphides are tiny and are mostly found in non-fractured silicate minerals, making them inefficient for accumulating Au and Cu and difficult to be subsequently remobilized. High oxygen fugacity and high Sr/Y values of Yinan Au-Cu associated intrusions could not be produced by partial melting of those sulfide-bearing cumulates. These facts imply limitted contribution of sulfide-bearing cumulates to later Au-Cu mineralization. Given that such Au, Cu-depleted melts were nonetheless able to generate Au-Cu deposits, our results highlight magma volatile concentrations, not Au or Cu concentration, is the most important factor in governing Au-Cu mineralization potential.