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A long way to run: the Paleozoic-Mesozoic evolution of magmatism, mineralization, and deformation at the Duobaoshan Au-rich porphyry Cu deposit, eastern CAOB

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The Duobaoshan Au-rich porphyry Cu deposit which contains a proven reserve of 2.37 Mt Cu@0.52%, 73 tons Au@0.16~0.35g/t and 80, 000 tons Mo@0.016% is located in the eastern part of CAOB. It is tectonically located in the superposition area of Paleo-Asian Ocean tectonic domain and the Mongolia-Okhotsk ocean tectonic domain. As the oldest (~477Ma bymolybdenum Re-Os isotopic method) porphyry deposit in the eastern part of CAOB, the Duobaoshan deposit exhibits obvious deformation characteristics and multiple-stage volcanic eruption-magmatic intrusion cycles which were ignored in previous work. So, re-building magmatic sequence, tracing magma source and deciphering the relationship between multi-stage structures and mineralizations are very crucial for a better understanding of ore genesis, the temporal evolution of porphyry deposit, and regional tectonic evolutions.

Zircon SIMS U-Pb dating indicates that five epochs of magmatism occurred in the Duobaoshan deposit, including: (1) pre-mineralization magmatism consists of Middle-Cambrian high-Mg basaltic-andesite (506Ma) and Lower-Ordovician basaltic andesite-andesite association (485Ma); (2) syn-mineralization intrusions are composed of Lower-Ordovician granodiorite and fine-grained granite (477Ma), mineralization-related granodiorite porphyry (476Ma), intruded by high-Mg monzodiorite and monzonite (475Ma), diorite porphyry and non-mineralization dacite porphyry (473Ma); (3) post-mineralization magmatism contains Upper-Ordovician basaltic andesite-andesite association (445Ma), Mesozoic diorite pegmatite (224Ma) with weak disseminated chalcopyrite and pyrite mineralization, quartz syenite (223Ma) and granite porphyry (223Ma).

Schistose basaltic andesite (485Ma) xenoliths in granodiorite porphyry and the occurrence of spindle-shape porphyry stocks in the plane, suggest the existence of a pre-mineralization NW shear deformation (D1) which occurred at least 485Ma ago through the center of Duobaoshan district. Abundant ductile deformation of pre-mineralization volcanic rocks, granodiorite and granodiorite porphyry and hydrothermal veins imply a post-mineralization reactivate (D2) of the previous NW shear zone. This reactivation can be bracketed between 445Ma (deformed post-mineralization volcanic rocks) and 223Ma (non-deformed Mesozoic intrusions).

All the igneous rocks belong to medium-K to high-K calc-alkaline series and show an adakitic affinity. Moreover, both basaltic rocks and intermediate granitoids have very high zircon εHf(t) and whole-rock εNd(t) values, and young Hf and Nd model ages. They are generally enriched in large ion lithophile elements (LILEs) and depleted in high field strength elements (HFSEs). The high-Mg basaltic-andesite, andesite, monzodiorite and monzonite show similarity characteristic features with Bajaitic high-Mg andesite. Geochemical and isotopic compositions of all the rock types in Duobaoshan deposit suggest that, the pre-mineralization high-Mg volcanisms, syn-mineralization monzodiorite-monzonite, and post-mineralization basaltic andesite-andesite were

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formed by partial melting of mantle wedge metasomatized by subducted slab fluids, and the granitoids were formed by partial melting of the subduction-modified sub-arc lithosphere material (juvenile lower crust).

Finally, a Paleozoic-Mesozoic composite tectonic-magmatism model has been proposed. The Duobaoshan deposit formed in a subduction setting from Mid-Cambrian (506Ma) to late Ordovician (445Ma). The pre-mineralization NW-trend shear deformation (D1) was a response to the collision of Xing'an and Erguna block, and the post-mineralization reactivatiton (D2) might be related with the collision of Erguna-Xing'an and Songliao block. Mesozoic magmatism with weak mineralization was derived from the Early-Paleozoic subduction-modified thickened juvenile lower crust, triggered by the collision of Erguna-Xing'an and Songliao block.