Research Advances

Diagenesis-Mineralization and Ore Prospecting of the Yangla Copper Deposit, Yunnan Province, Southwest China

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The large-scale Yangla copper deposit, located in the central part of the Sanjiang Tethys polymetallic belt, is structurally controlled by the Jinsha River Fault and Yangla Fault. This deposit consists of seven ore blocks, including the Beiwu, N lively, Jiangbian, Linong, Lunong, Tongjige and Jiaren. The Cu metal prospective reserves of the Yangla deposit are above 1 million tons. There are widely distributed Indosinian granodiorite and also many gabbro-diabase dikes and few quartz porphyries exposed in the Yangla ore district. The ore-hosting rocks are diopside-garnet skarn, sericite sandy slate and metamorphic quartz sandstone of the first member of the Devonian Linong Formation. Ore bodies occur as layered, stratoid, lenticular and veined shapes, and are strictly controlled by rocks, strata and structures. The main structures in the Yangla Cu deposit are SN-trending interlayer fracture zones, NE-trending faults and magmatic intrusive-contact structures. This study analyzed the diagenesis, mineralization, tectono-geochemistry and ore prospecting of the Yangla Cu deposit, which is jointly supported by the National Natural Science Foundation of China (41402072), Postdoctoral Science Foundation of China (2012MS10214) and Open Foundation of State Key Laboratory of Ore Deposit Geochemistry, Chinese Academy of Sciences (201108).

The zircon U-Pb dating of three gabbro-diabase dikes yielded three ages of 231.3±0.88 Ma, 229.5±1.4 Ma and 228.7±0.85 Ma, respectively. The results show that these gabbro-diabase dikes were formed in the Indosinian and were the products of the continent-continent collision. The diagenesis age of gabbro-diabase dikes was generally consistent with the granodiorite ages (231–239 Ma), but they may be derived from two independent magma chambers. The zircon U-Pb dating of three quartz porphyries obtained in this study yielded three ages of 234.0±2.9 Ma, 232.2±0.77 Ma and 228.8±0.69 Ma, respectively. These ages show that they were formed in the late Indosinian rather than the Yanshanian or Himalayan. The diagenesis ages of quartz porphyries were later than those of the granodiorite (231–239 Ma), but similar to the Re-Os ages of molybdenite (229.7±3.3 Ma to 233±3.4 Ma), indicating that the quartz porphyries have a closely relationship with the Cu mineralization. Studies of Ore deposit geochemistry and geochronology for the Yangla Cu deposit suggest that the main metallogenic ages range between 228 Ma and 233 Ma. The ore-forming fluids were derived from magmatic water and mixed with meteoric water in the late stage. The metallogenic metals were mainly sourced from the Indosinian granodiorite with parts of metals derived from the basic rocks, quartz porphyries and the hosting wall rocks. Tectonic analysis of more than 210 faults shows that the tectonic systems within the Yangla Cu deposit can be divided into three groups, i.e., near SN-trending, NE-trending and NW-trending tectonic belts. This indicates that the Yangla Cu deposit has experienced four tectonic movements, corresponding to the late Hercynian, Indosinian, Yanshanian and Himalayan, respectively. We also summarized two types of ore-controlling structural models, i.e., “contact structure between magmatic bodies and country rocks together with interlayer fault” and “X-type structure together with step-type structure”. Based on comprehensive analysis of ore deposit geology, geophysics, geochemistry and metallogenic model, this study used tectono-geochemical prospecting prediction to delineate three important ore prospecting target areas. Engineering verification has obtained 156863 tons of Cu (at an average grade of 1.03%), 2799 kilograms of Au (0.39 g/t) and 125.70 tons of Ag (9.35 g/t), indicating a new prospecting breakthrough in the Yangla Cu deposit.