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Molybdenite Re–Os, zircon U–Pb dating, and Lu-Hf isotopic analysis of the Xiaerchulu Au deposit, Inner Mongolia Province, China

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The Xiaerchulu region is located in the Southern Orogenic Belt (SOB), which is an important component of the Xing'an-Mongolia orogenic belt (XMOB). The Xiaerchulu Au deposit is hosted in an Early Permian (271-261 Ma) volcanic-plutonic sequence of the SOB, and occurred in a transitional tectonic setting from compression to extension caused by subduction of the Paleo-Pacific oceanic plate. Mineralization took place in silicified biotite granites or along the contact zone between the Neoproterozoic Baiyinbaolage Group and the biotite granite [1].

We measured Re-Os isotopes of six molybdenite samples from the main ore body, of which yield model ages ranging from 260.1±3.6 to 263.7±3.7 Ma with a well constrained ^{187}Re-^{187}Os isochron age of 263.4±4.3 Ma, a MSWD of 1.2 and a weighted average model age of 261.7±1.5 Ma with a MSWD of 0.55. The ^{187}Re-^{187}Os isochron age is consistent with the weighted mean model age within error, indicating that the time of mineralization was at c. 262 Ma. Granites studied here, including biotite granites and granites, are peraluminous with A/CNK=1.11-1.12, which is consistent with the tectonic regime. High precision U-Pb dating for these granites (LA-ICP-MS) yields Permian $^{206}Pb/^{238}U$ ages ranging from 269 to 271 Ma. These age data confirm that both intrusion and related mineralization initiated at Early Permian. Re contents of molybdenite, εNd(t), zircon εHf(t), and $^{176}Hf/^{177}Hf$ values of the granites fall into the ranges from 1.153 to 2.740 μg/g, -11.1 to -9.3, -8.8 to -0.9, and 0.282358 to 0.282688, respectively. All these evidences suggest that the Xiaerchulu Au deposit located at an extensional rifting setting, the metals were derived from a predominantly crustal source and the rejuvenation of continental may play an important role during the ore-forming processes in early Permian.

The timing of magmatic hydrothermal events are crucial in understanding ore deposit formation from both academic and exploration viewpoints [2,3]. Thus, Re–Os dating of molybdenite and U–Pb dating of zircon have been used by many authors for linking mineralization to magmatic activity [4,5]. The molybdenite Re–Os average age of 261.7±1.5 Ma from the Xiaerchulu Au deposit is closely consistent with the zircon U–Pb ages (269.1 ± 2.5 Ma) of the biotite granite associated with the mineralization. Moreover, the model molybdenite Re–Os ages are strongly similar, ranging from 260.1 ± 3.6 Ma to 263.7 ± 3.7 Ma for the six samples. The strong agreements with these age constraints indicate that the ore formation event is genetically related with the biotite granite and there is little age gap between biotite granite crystallization and ore formation. As noted above, the zircon U–Pb dating results indicate that the emplacement timing of the biotite granite was ~269 Ma, whereas the age of molybdenite crystallization was ~262 Ma. Thus, the mineralization resulting in the Xiaerchulu Au deposit probably lasted ~7 Ma from the magmatism responsible for the biotite granite intrusion.

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