Garnet U-Pb geochronometer for lode gold deposit: insights from the Dongping Te-Au deposit, North China Craton

GAOHUA FAN[1*], JIANWEI LI[1] , XIAODONG DENG[1]

[1]State Key Laboratory of Geological Process and Mineral Resources, China University of Geosciences, Wuhan 430074, China([*]correspondence: geologyfgh@163.com)

Garnet U-Pb geochronology remains in its infancy, but shows a great potential in precisely dating hydrothermal processes and associated mineralization. Here, we present the first garnet U-Pb dating of lode gold deposit and highlight its application to this very important deposit type.

The Dongping Te-Au deposit (~120 t Au) is hosted in the Shuiquangou alkaline complex that has a zircon U-Pb age of 392 ± 2 Ma and a garnet U-Pb age of 395 ± 6 Ma. Mineralization is dominated by quartz-sulfide-telluride lodes cutting through the syenite in the upper zones and auriferous alteration assemblages in the lower zone. The Te-Au lodes cut or displace quartz-potassic feldspar veins and are intersected by quartz-carbonate veins. Hydrothermal garnets widely occur both in the auriferous lodes and alteration assemblages, display well-developed oscillatory zoning and contain abundant fluid inclusions. They are andraditic or grossular in compositions, and display LREE-enriched and HREE-depleted or HREE-enriched and LREE-depleted chrondrite-normalized REE pattern. LA-ICPMS spot analysis and mapping results suggest that hydrothermal garnets contain 0.80-13.89 ppm U, mainly bounded in garnet structure. One garnet sample from Te-Au lodes has a U-Pb date of 140 ± 4 Ma, whereas three samples from the auriferous alteration assemblages yield U-Pb dates of 142 ± 5 Ma to 141 ± 4 Ma. Similarly, garnet grains from quartz-feldspar and quartz-carbonate veins have U-Pb dates of 140 ± 6 Ma and 139 ± 6 Ma, respectively. The crosscutting relations and garnet U-Pb dates suggest the Dongping gold deposit formed at ca. 140 Ma. This age is broadly consistent with a zircon U-Pb date (143 ± 1 Ma) of the granite stock intruding the Dongping alkaline complex, but significantly younger than the emplacement age of the latter. Results presented here preclude a possible genetic relationship between the Te-Au mineralization and the alkaline magmatism as previously suggested. Rather, the new garnet age data indicate a temporal and likely genetic link between the Te-Au mineralization and late Mesozoic magmatism induced by significant thinning of lithospheric mantle beneath the North China craton.