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A Focused ca. 120 Ma Granite-hosted Orogenic Gold Mineralization Event in the Jiaodong Peninsula, China

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With more than 5,000 t of gold resources, Jiaodong ranks as one of the largest gold provinces in the world. The Jiaodong gold deposits are highly anomalous because Mesozoic mineralization formed ~1.8 billion years after high-grade metamorphism of the Precambrian basement rocks. The Jiaodong deposits are mainly controlled by regional faults that are sited along contacts between Upper Jurassic Linglong granites and Precambrian basement metamorphic rocks or Lower Cretaceous Guojialing granites. A critical overview of previously published isotope age data and new geochronological studies resolves the long-standing controversy concerning the temporal and genetic relationship between gold mineralization and gold-hosting (and other) granites. Most published reliable zircon U-Pb ages of the gold-hosting Linglong and Guojialing granites, representing the most voluminous magmatism, range from 166 ± 5.0 to 149 ± 2.0 Ma and 133 ± 3.0 to 126 ± 0.6 Ma, respectively. The Aishan granite, which is barren of gold-only deposits, yields zircon U-Pb ages of 120–108 Ma. The recent reliable hydrothermal muscovite $^{40}Ar/^{39}Ar$ and monazite U-Pb ages of ca. 120 Ma accord with previous age constraints of 123 ± 1–117 ± 3 Ma obtained mainly by robust $^{40}Ar/^{39}Ar$ dating of hydrothermal muscovite and U-Pb ages of hydrothermal zircon. These concordant ages constrain the timing of the major gold mineralization event across the Jiaodong province at 120 ± 2 Ma (arithmetic mean), although earlier or later insignificant gold mineralization events cannot be ruled out. This major ca. 120 Ma gold mineralization event is also consistent with constraints provided by crosscutting relationships between pre- and post-ore granitic and lamprophyric dikes and the gold deposits. A genetic relationship between the gold-hosting Linglong and Guojialing granites and mineralization is excluded because of the age gaps in their timing and by crosscutting relationships of auriferous quartz veins with the granites. The majority of Aishan granites are significantly younger than the gold mineralization event, and, although several of their U-Pb ages overlap the 120 ± 2 Ma age of gold mineralization, the fact that they show no spatial relationship to the gold deposits argues strongly against a genetic relationship. The Jiaodong gold deposits are structurally controlled, lack high-T alteration assemblages and metal zonation, and share geochemical and isotopic compositions with orogenic deposits, indicating that they are orogenic rather than intrusion-related deposits. Together with the reliable mineralization ages from robust isotope methods, cooling ages of gold-hosting granites demonstrate that these granites provided P-T conditions close to the ductile-brittle transition and fluid trap-sites for mesozonal orogenic gold mineralization. This enabled the effective ingress of fluids, leading to intensive brecciation, alteration, and formation of both vein-type and disseminated gold ores at ca. 120 Ma.