Origin and geodynamic significance of fault-hosted sulfide-rich gold deposits from the Jiaodong gold province, China: Rb–Sr dating and H–O–S–Pb isotopic constraints

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The Jiaodong region is the largest gold province in China and has proven reserves exceeding 3000 t Au. The gold deposits are traditionally grouped into three main types, namely, the auriferous quartz vein type (Linglong type), the altered rock type (Jiaojia type), and the interstratified breccia type (Pengjiakuang type). More recent exploration (from 2009 to 2014) indicate a minimum of 27 tonnes Au of additional resources in the Guocheng–Liaoshang gold belt, Jiaodong gold province. The ores are hosted in faults/ fractures in Paleoproterozoic metamorphic and later granitic rocks and are characterized as sulfide-rich type with sulfides of up to 40 to 95 vol.%. Rb–Sr isotopic dating of mineralized quartz yielded an isochron age of 116.2 ± 2.4 Ma (MSWD = 0.36). The ore-related quartz samples have δD values of −86 to −69‰ (mean −78‰), with calculated $\delta^{18}O_{H2O}$ values of 0.6 to 7.7‰ (average 3.6‰). The $\delta^{34}S$ values of ore sulfides vary from 8.5 to 12.7‰ with an average of 9.9‰. Lead isotope signatures recorded in sulfides are much less radiogenic ($^{206}Pb/^{204}Pb$ = 17.039–17.862) relative to that of Phanerozoic asthenosheric mantle ($^{206}Pb/^{204}Pb$ = 18.179–18.384). These results show that the gold mineralization style in this belt is different from the traditionally identified three types of gold deposits in the Jiaodong Peninsula. They also suggest deep-seated, mantle-derived magmatic sources for the ore fluids, most likely mafic dykes, with sulfur and metals in the hydrothermal system, despite the fact that wall rocks might provide some sulfur reflected in the enriched ^{34}S signature. The inferred mantle reservoir was probably formed by subduction-related fluid metasomatism during the assembly of the Paleoproterozoic (ca. 1.85 Ga) Jiao-Liao-Ji mobile belt (suture within Columbia supercontinent). Extensional tectonic inversion during the early Cretaceous, caused by subduction of the Kula–Pacific plate rather than post-collisional process of the Qinling–Dabie–Sulu orogen, triggered partial melting of this mantle domain, subsequent magma mixing and emplacement with final exsolution of ore-forming fluids.

Atlantic Geology, 2018, Volume 54
Atlantic Geoscience Society Abstracts – 44th Colloquium & Annual General Meeting 2018
doi: 10.4138/atlgeol.2018.003