Gold Source and Ore-Forming Process of the Linglong Gold Deposit, Jiaodong Gold Province, China

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The Linglong gold orefield, situated at the northwest of the Jiaodong gold province, China, comprises more than 10 gold mines with a total gold resource of ~1,000 t. Gold mineralization is in the form of gold-bearing quartz veins. In this study, pyrites from three main mineralization stages have been investigated for texures, in situ major and trace element concentrations, and sulfur isotope compositions. Pyrites in stage I (Py-I) show euhedral crystals with homogeneous brightness in the BSE, without mineral inclusions, porous microtextures, and oscillatory zones and have low contents of Au, Ag, As, Bi, Cu, Sb, Zn, Co, and Ni.. Pyrites in stage II (Py-II) are fine- to coarse-grained and euhedral-subhedral with little fracture, and have similar element contents but higher contents of As and Sb than those of Py-I. Pyrites in stage III (Py-III) were produced in the quartz-polymetallic sulfide veins and show subhedral to anhedral porous texture features. Py-III have significantly higher contents of metals elements, especially Au and As.The $\delta^{34}S$ values of Py-I, Py-II, and Py-III show 6.76~7.47‰, 6.11~7.27‰, and 6.07~8.33 ‰, respectively. The textures and geochemical compositions of pyrites have proved that invisible gold mainly occurred in pyrite in the form of solid solution (Au^{+}) with a few of nano-form of gold. Ore-forming materials were mainly derived from mantle-derived mafic magma. Decrease of fluid temperature, water-rock interactions, and fluid boiling would lead to the deposition of sulphide and gold. In the Late Mesozoic, lithospheric delamination of the eastern block of the NCC triggered decompression and melting of the upwelling asthenospheric mantle and partial melting of the lithospheric mantle. These lithospheric mantle-derived mafic magmas provided the ore-forming materials for the large-scale gold mineralization in the Jiaodong gold province.