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Geological characteristics of the Luohe iron deposit: The largest iron deposit in the Middle-Lower Yangtze River Valley metallogenic belt

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Luohe is the largest iron deposit in the Middle-Lower Yangtze River Valley Metallogenic Belt (approx. 1 Gt Fe ore resource with 35% grade); it is located in the northwestern part of the Lu-Zong volcanic basin. The stratiform and lensoidal orebodies were discovered in the 1970s at 400-700 depth. Deep (1350 - 1800 m deep) stratiform orebodies (approx. 1260-m-long, 840-m-wide, 76-m-thick on average) were discovered in 2013. Shallow orebodies consist of aggregations of irregular magnetite veins of variable width; at depth, the magnetite is disseminated. All orebodies occur in Cretaceous andesite. The main ore minerals are magnetite and pyrite; gangue minerals include diopside, phlogopite, anhydrite, epidote, apatite, and titanite. Widespread titanite is developed in the footwall of shallow orebodies, and in the hangingwall of the deep orebodies. Magnetite-anhydrite-diopside is the typical mineral assemblage in the deposit. Main ore textures include euhedral-subhedral granular, anhedral granular, and metasomatic pseudomorphic texture. Based on mineral crosscutting and replacement relationships, the Luohe alteration and mineralization can be divided into stage I alkali feldspar, stage II magnetite-diopside-anhydrite, stage III chlorite epidote-carbonate, stage IV anhydrite-pyrite, stage V quartz-sulfide, and stage VI carbonate-anhydrite veins. Alkali alteration includes both albite and K-feldspar, with albite alteration dominant. Stage II is the main ore-forming stage, in which magnetite commonly coexists with diopside and apatite. Quartz and kaolinite formed in stage V are mainly distributed in tuff. $^{40}Ar/^{39}Ar$ ages of phlogopite in the shallow and deep orebodies are about 132-131 Ma, consistent with the age of diorite intrusions in the region. Stage II pyrite and anhydrite have $\delta^{34}S$ values of 10‰ and 20‰, respectively. Middle Triassic evaporite beds in the basement to Luohe have anhydrite $\delta^{34}S$ values ~30‰. This suggests that sulfate from the underlying evaporites was involved in forming the deposit. We propose that the Luohe Fe mineralization was genetically related to deep-seated diorite intrusions (not observed near the orebody), and the orebodies formed by high temperature metasomatism (>600°C) in the volcanic rocks far from the genetically-related intrusions.