Research Advances

Structural Origin of the Red-Ribbon Style Iron Ores in the Xinyu Iron Deposit, Central Jiangxi Province

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The Xinyu iron deposit, located in central Jiangxi Province, is one of the most important BIF-type deposits in China. It is hosted in the Late Proterozoic volcanic-sedimentary rocks, which are composed of sericite-chlorite pyhllite, magnetite-bearing chlorite phyllite or schist, magnetite quartzite, and schist (Yu et al., 1989; Zeng et al., 2011).

The Xinyu iron orefield lies on the eastern side of the Wugong Shan uplift, to the north of the South China Caledonian fold belt, and the iron districts are distributed along the southern limb of the Shenshan anticlinorium (Fig. 1). The iron-bearing strata are gently dipping to the SW in the west of the Jingtou area; in the east of the Jingtou area, the strata generally trend NW-NNW, and are mainly overturned. In the Jinxi-Pitou joint area, the attitude of the ore beds is relative complex (Zeng et al., 2011). For example, strata in the southwestern section of the Changxi area (Fig. 1-A), usually trend NW, generally overturned; however, they trend SE in northeastern part, with a normal stratigraphical sequence.

The structural pattern of ore-hosted layers is characterized by folded bands and strips. In the northwestern Xinyu orefield, the structure is relatively simple. However, ore-hosting layers, especially quartz veins or bands in hosting rocks, are strongly deformed in most mining areas, showing complex Z-, S-type folds, and hook folds in dipping and striking directions (Tang, 1983; Dai, 1986). As a result, the “red-ribbon” style folded iron-

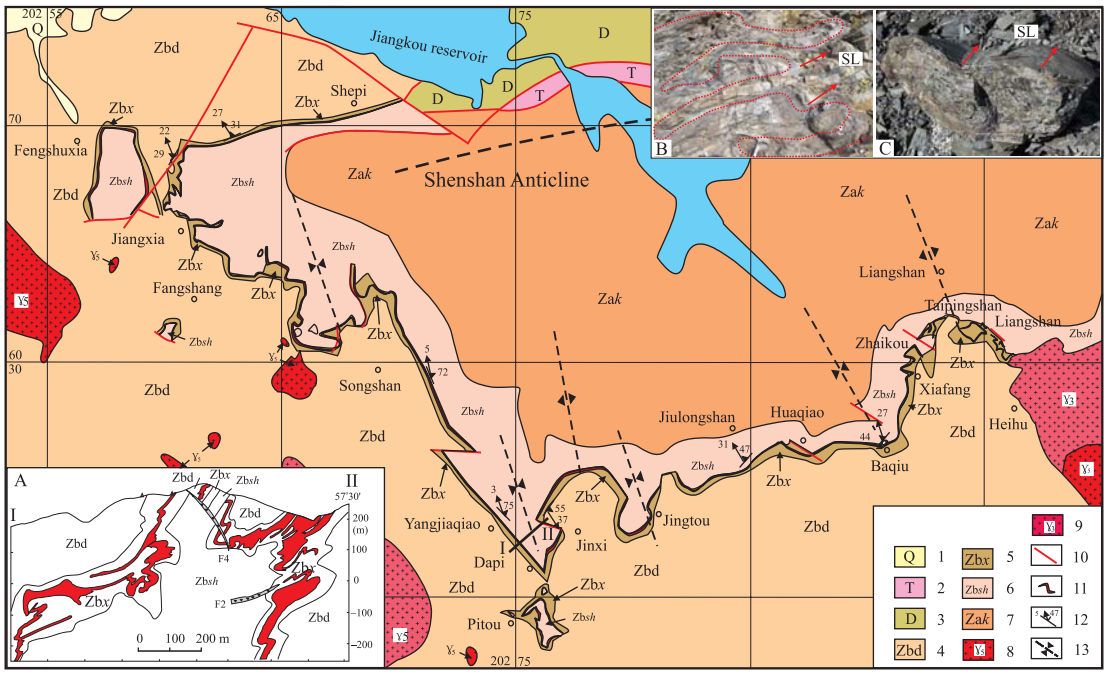

Fig. 1 Simplified geological map of the Xinyu iron deposit in central Jiangxi Province
1, Quaternary; 2, Triassic; 3, Devonian; 4, Late Proterozoic Dashajiang Formation; 5, Late Proterozoic Xiafang Formation; 6, Late Proterozoic Shangshi Formation; 7, Late Proterozoic Kuli Formation; 8, Yanshanian granite; 9, Caledonian granite; 10, fault; 11, iron orebody; 12, occurrence of the plane and stretching lineation; 13, fold hinge line; SL, Stretching lineation

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bodies are well developed in outcrops (Fig. 1-B) and also in most cross-sections (Fig. 1-A).

Multi-deformation and fold superimposition were proposed to interpret the origin of the "red-ribbon" style iron ore bodies. At least three phases of folding were determined based on fold geometry (Tang, 1983; Dai, 1986; Zeng et al.,2011; Xiao et al., 2013), which claimed that the "red-ribbon" style of iron-ore-bodies was produced by fold superimposition through different deformation phases (Xiao et al., 2013).

Our field investigation revealed that regional penetrative mineral stretching lineation and A-type folds (figure 1-B) were well developed throughout the entire Xinyu iron deposit. Sheath folds were identified abundantly in Yangjiaqiao, Pitou mining areas south of Xinyu (Fig. 1-C). Systematic measurements indicate that the mineral stretching lineation and hinge lines of A-type fold vary from NW 295° to NW 320°, with their plunging angles less than 25°. The quartz-feldspar pebble, the so-called pseudo-pebble (Dai, 1986; Ji, 1995) in metamorphic pebble-bearing siltstones underlying the magnetite-quartz layer, was strongly elongated in the lineation direction. The axial ratio of pebbles can reach 6 to 10 (Ji, 1995). B-type folds were rarely observed in ore-bearing layers.

Thus, it is indicated that the Xinyu iron deposits have experienced strongly regional plastic deformation after the sedimentation and metamorphism of BIFs. The ductile fabrics such as regional mineral stretching lineation, A-type folds and sheath folds, as well as the 'red-ribbon' style of folded iron-ore-bodies, are regarded as the products of plastic deformation, probably in the Caledonian Orogenises (Faure et al.,1996; Shu 1998). Different lithologic units behaved differently during the deformation. Ore-bearing unit, the magnetite and quartzite layer, behaved as the competent layer that highlighted the regional ductile deformation in the shape of the 'red-ribbon' style folding. Sheath folds were generated via differential viscous flow, and the iron-ore-bodies were thicken and enriched at the hinges and the noses of the sheath folds when material flowed towards those portions. The host rocks such as phyllite and schist (mostly metamorphosed siltstone and sandstone), on the other hand, behaved relatively homogeneously to accommodate the bulk deformation. Lineations are observed when clay minerals enriched locally and the quartz-feldspar pebbles developed that forms elongated rods. It was also suggested that the original form of the Xinyu iron-ore deposit area, known as Shenshan anticlinorium could be a giant sheath fold, generated from differential south toward viscous flow.

In summary, field observations and detailed measurements suggest that the red-ribbon style iron-ore bodies in Xinyu iron deposit result from regional plastic flow and sausage bending, rather than fold superimposition.

Acknowledgements

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