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Ore-Controlling Structures of the Heishan Iron Deposit, Damiao Anorthosite Complex in North China Craton and Ore-Prospecting

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1 Introduction

Damiao anorthosite complex, located at the northern edge of the North China Craton, Chengde county Hebei province (Fig.1), contains typical anorthosite–norite–mangerite association, and hosts abundant Fe–Ti–P oxide ores, and numerous geological, petrological and geochemical studies are available (Xie et al., 1988; Chen, et al., 2008;Sun et al., 2009; Zhao et al., 2004,2009; Li et al., 2010). However, ore-controlling structures analyses, tectonic stress field study and ore-forecasting model are poorly constrained, which are useful and critical to guide to further ore-prospecting.

2 Tectonic Setting of the Damiao Iron Deposit and Characteristics of the Heishan Iron Deposit

Field observation showed that the emplacement of the Damiao complex was controlled by EW-trending Damiao-Hongshilazi in the south and Longhua-Pingquan fault zones in the north (Fig.1). Iron ore-areas and ore-bodies within the Damiao complex were control by NE and NW-trending faults. While, nearly NS-trending fault formed and activated later than the mineralization, which cut and moved ore bodies.

Heishan area, located in the southern edge of the complex, is a typical and unique sulfide-bearing magma-type deposit in Damiao complex, with large-scale ore reservoir (Ye et al., 1996). Two types of ore-bodies, Fe-Ti-P and Fe-P ore-body, are symbiotic developed (Sun et al.,2009; Li et al., 2010), but Fe-P ore-body usually developed in upper part of the Fe-Ti-P ore-body. Ore-bearing norite veins with density massive Fe-Ti-P or Fe-P ore-bodies intruded into anorthosite, forming a clear boundary. Disseminated Fe-Ti-P and Fe-P ore-body gradually transited to the norite, or just as a component of the norite, showing typical characteristics of the differentiation to injection magma-type iron deposit.

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3 Ore-Controlling Structures in Heishan Deposit

Fracture zones and joints are widelyspread in Heishan area, which controlled the development of iron-ore bodies. EW-trending structures, parallel to the Damiao fault zone, are characterized by lens-type breccia, showing a type of compressional deformation. No iron bodies developed inside EW-trending fracture zones. NE- and NW- trending joints developed in the anorthosite, were filled by ore-bearing norite veins, forming mainly ore-bearing structures. High grade and large-scale iron ore-bodies usually developed at intersected areas of NE- and NW-trending joints.

The occurance of joints and ore-bearing norite veins were detailed measured in the field and statistical results showed that the injection of ore-bearing norites during the metallogenic stage was mainly controlled by regional NS-trending compressional stress (Fig.1).

4 Uplift-Exhumation Process and the Tectono -Graphy of the Complex

Apatite was chosen out from iron-ores from Damiao anorthosite complex and surrounding areas and was dated by fission tracking dating method, revealing ages ranging from 80Ma to 46Ma, indicating that the tectono-geomorphic feature of the complex formed later than the Late Cretaceous.

Regional data showed that the present triangle-type of the complex (Ye et al., 1996), original probably EW-trending and controlled by EW-trending fault zones, formed later than the Cretaceous in time, because of the regional uplifting and exhumation, the development of unconformity between the Jurassic-Cretaceous volcanic-

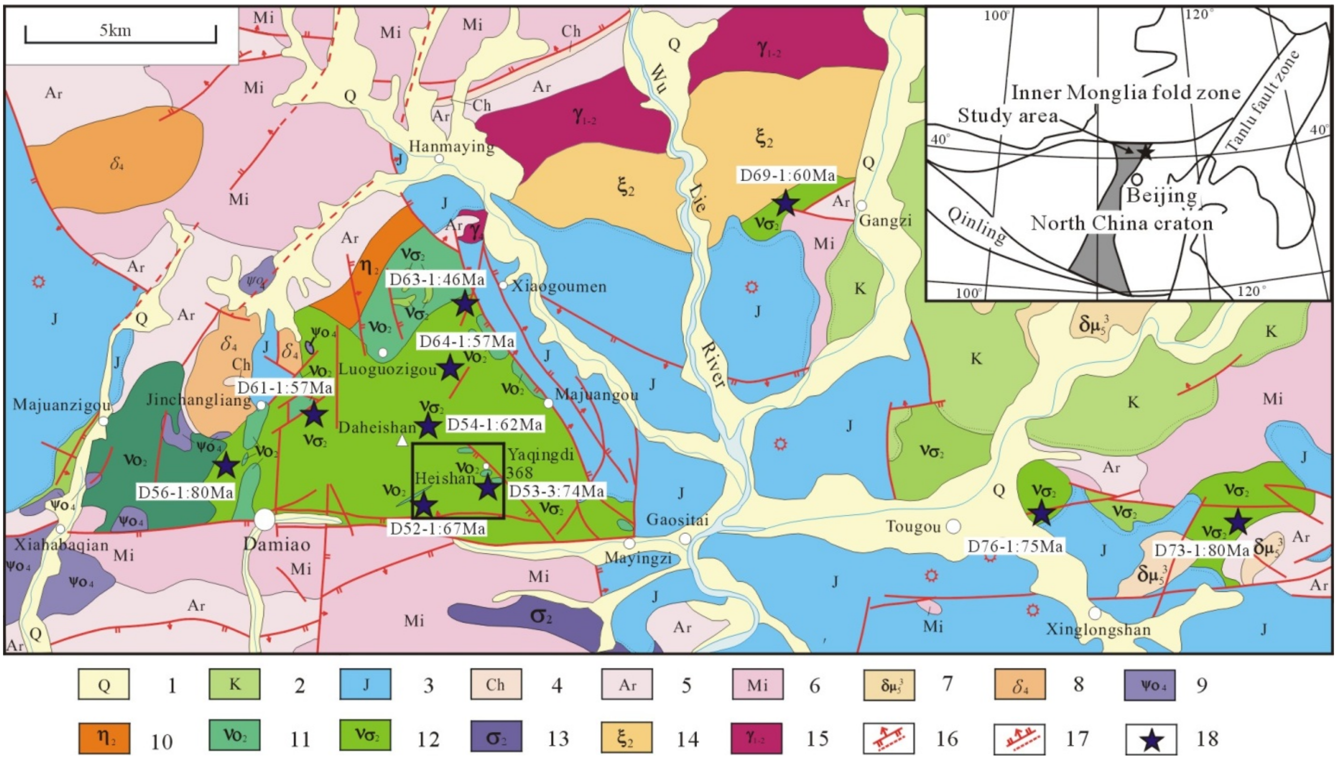

Fig.1. Simplified geological map and sample location for fission track dating of the Damiao complex (modified from Ye et al., 1996)
Quaternary; 2-Cretaceous; 3-Jurassic; 4-Middle Proterozoic; 5-Archean; 6-migmatite gneiss; 7-Mesozoic diorite; 8-Paleozoic diorite; 9-Paleozoic supper-basic rock; 10-mangerite; 11-norite; 12-anorthosite; 13-Proterozoic supper-basic rock; 14-Proterozoic diorite;15-Proterozoic granite; 16- normal fault; 17-thrusting fault; 18-sample location for fission track dating

sedimentary rocks and the complex, and latterly thrusting along the NE-trending Habaqian-Hangmaying and NW-trending Mayingzi-Hangmaying fault zones.

5 Ore-Forecasting Model and Ore-Prospecting

The magma evolution (Zhang et al,2007), ore-controlling structures and ore-forming mechanics (Zhao et al., 2009) suggested that the injection of norite magma into anothorite in the Heishan area was accompanied with the Fe-Ti-P mineralization (Chen et al.,2007), and present location of ore-bodies inside the complex probably was controlled by the uplifting and exhumation and thrusting movement since 80Ma. The ore-forecasting model was finally established, and favorable ore-prospecting areas at the depth of the Heishan deposit and surrounding areas were also pointed out, indicating that the ore-reservoir should be very large.

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