The BIF-hosted iron ore deposit is one of the most important iron ore deposits in China. In Anshan-Benxi area, iron deposits, known as Anshan-type iron ore deposits, are mainly distributed in the arcuate zone, composed of Archean BIF and Late Archean granitic complex in nearly E-W direction, covering an area of 6,000 km². On regional scale, there are two rock bodies, namely granite bodies of Tiejiashan and Gongchangling, and five iron ore belts, including Anshan (containing super large iron deposits of Xi'anshan, Donganshan and Dagushan), Qidashan (containing super large iron deposits of Qidashan and Hujiamiaozi), Gongchangling (containing Gongchangling high-grade iron deposit and super large iron deposits of Dumu and Hejia), Waitoushan (containing Waitoushan super large iron deposit, etc.) and Nanfen (containing super large iron deposits of Nanfen and Dataigou). Tiejiashan granite body, composed of biotite trondjemite, biotite granite and two-mica granite, with zircon age of about 3.0 Ga, was formed in the Middle Archean. Gongchangling granite body, which is more than 100km in longth, with Rb-Sr age of about 2.45Ga, was formed in the late Archean and mainly composed of moyite and adammellite. The iron-bearing rocks in Anshan-Benxi area are restricted between the two phases of granite. The Archean BIF in Anshan-Benxi area belongs to Algoma-type iron formation and can be divided into three iron-bearing layers from bottom to up. The lower iron-bearing rocks (Cigou Formation of Anshan Group), with a thickness of more than 2000 meters, mainly comprise biotite granulitite, amphibolites, schist and magnetite quartzite and can be divided into six iron-bearing layers, of which the thickness is in the range of 10-60 meters, up to 100 meters. The primary rock formation consists of basic volcanic rock, intermediate-acidic volcanic tuffs and argillaceous siltstone. The middle iron-bearing rocks (Dayugou Formation) have a thickness of about 2,400 meters and consist of gneiss, leptynite, quartz schist and magnetite quartzite, partly marble. Several iron-bearing layers in the rocks are stratiform with the thickness of 5-20 meters for each. Its primary rock formation comprises silico-ferric sedimentary rock and intermediate-acidic volcanic tuffs. The upper iron-bearing rocks (Yingtaoayaun Formation) with a thickness of more than 1,000 meters include sericite quartz, chlorite schist, muscovite-biotite schist, phylite and magnetite quartzite. Because of the large thickness (90–300 meters), stable extension (more than 5km) and deep extending, the iron-bearing layers are known as “iron wall”. Its primary rock formation consists of muddy-silty sediments and dacitic volcanic tuffs, locally interbedded with silico-ferric sedimentary rock and small amount of basic volcanic rock. Three iron-bearing rocks show evolving characteristics, from deep sea to continental block margin, that the less volcanic rocks, the more sedimentary rocks.

In Anshan-Benxi area, BIF-hosted high-grade iron ores with TFe more than 50% are mainly in Gongchangling large high-grade iron deposit, Yingtaoayaun high-grade iron deposit, Bapanling iron deposit and high-grade iron orebodies in iron deposits. In Gongchangling iron deposit, the largest BIF-hosted high-grade iron ore deposit in China, 138 high-grade iron orebodies, mainly composed of high-grade magnetite orebodies, bedded and vein, have been found. They are mainly distributed near striking faults with TFe grade of 64.62% on average. Wall rocks of high-grade orebodies are “altered rocks”, mainly consisting of chlorite schist, garnet chlorite schist and chlorite garnet. The Bapanling iron district which mainly consists of high-grade magnetite orebodies, with chlorite, garnet chlorite and actinolite chlorite as wall rocks, is located in the eastern extension of Gongchangling No.2 ore district. High-grade orebodies of the Qidashan iron ore deposit are mainly hosted in the broken fault zone, with chlorite schist and quartz chlorite as wall rocks. High-
grade orebodies of Nanfen iron ore deposit is controlled by the fold, in the core of which high-grade pillar-shape orebody forms, elliptical lenticle in the plane, with chlorite as wall rocks.

High-grade magnetite ore, which is most widely distributed, in large reserves and good quality, with TFe of 50~70%, can be divided into magnetite-type ore and hematite-magnetite-type ore in Anshan-Benxi area. Main minerals are magnetite, hematite, quartz, etc. Magnetite-type high-grade ore that has two generations is of euhedral to subhedral granular structure. Early magnetite is of fine type high-grade ore, the second generation is of euhedral minerals are magnetite, hematite, quartz, etc. Magnetite-hematite-magnetite-type ore in Anshan-Benxi area. Main 50~70%, can be divided into magnetite-type ore and distributed, in large reserves and good quality, with TFe of wall rocks.

Orebody forms, elliptical lenticle in the plane, with chlorite by the fold, in the core of which high-grade pillar-shape orebodies in the BIF-hosted iron deposits. High-grade magnetite deposits are closely related to high-grade iron deposits, are in close relationships with magnetite. They mainly occur as layered garnet chlorite, also as garnet veins and garnet chlorite veins interspersing high-grade iron orebodies. Garnet is dominated by almandine, with content of 89.9% ~93.6% at the roof and floor of high-grade orebodies. It is characterized by high content of FeO, low content of Fe₂O₃, CaO, MgO and MnO, and lower content of TiO₂, K₂O and Na₂O. The total iron content of almandine in wall rocks at roof and floor is 29.21% ~31.67%, some exceeding the total iron content of almandine with ideal formula (31.14%). CaO content of garnet in surrounding rocks ranges from 0.14% to 4.35%, 2.02% on average, far less than 6%. Chlorite, dominated by brunsvigite and rigidolite, is the main mineral of altered rocks: chlorite and garnet chlorite. Chlorite grows vertically the surface of magnetite, reflecting that it is the product of later hydrothermal fluid. Iron-bearing coefficient (f) of chlorite in high-grade iron orebodies is greater than 60. In contrast, the iron-bearing coefficient of chlorite, which is in low content in magnetite quartzite, is less than 40. Biotite, mainly Mg-Fe biotite, appears in biotite schist and biotite granulite, and its content increases with depth in the Gongchangling high-grade iron deposit.

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High-grade magnetite deposits are closely related to magnetite quartzite in space. High-grade orebodies occur in magnetite quartzite layers in the same occurrence, and...
their structure, texture and main minerals are similar to those of magnetite quartzite. The main minerals of magnetite quartzite are magnetite, quartz, etc., with total content of SiO₂, Fe₂O₃ and FeO up to 91.51% on average. Other components are mainly CaO and MgO, but in low content. High-grade magnetite, of which the primary chemical constituents are also Fe₂O₃, FeO and SiO₂, with content of Fe₂O₃ +FeO more than 70% and SiO₂ content apparently lower than that in magnetite quartzite, consists of magnetite and minor amounts of quartz, amphibole, chlorite, garnet, etc. There is a significant negative correlation between Fe content and Si content in magnetite quartzite and high-grade magnetite ore, which are both in lack of aluminum silicate, indicating no addition of aluminum-containing clastic rocks in the formation. As shown in the primitive mantle-normalized spidergran of trace elements, magnetite quartzite and high-grade magnetite ore both have enriched incompatible elements, with (Rb/Yb) N value of 1.27–22.26 (7.66 on average) and 1.83–9.06 (6.28 on average), respectively, and obviously enriched LILE of Rb and K, but Sr in weak loss, HFSE of Ti in great loss. In addition, the content of Ni, Cr, Sc and V is very low. The distribution pattern of trace elements in magnetite quartzite and high-grade magnetite ore is same. REE in magnetite quartzite are right dipping pattern with relatively low total content (ΣREE:7.88×10⁻⁶~36.39×10⁻⁶, 38.87×10⁻⁶ on average) and enrichment of LREE (LREE/HREE: 2.60–4.73, 3.83 on average; (La/Yb) N: 2.21–4.52, 3.38 on average). Magnetite quartzite in this area has positive anomaly of Y, with Y/Ho ranging from 33 to 43, much higher than the average value of 27 in the upper crust (Michael B. 1999; Yasuhiro k.,2006), indicating that the BIF in this area is formed by marine chemical deposition. REE pattern in high-grade magnetite quartzite are right dipping pattern or flat pattern with relatively low total content (ΣREE:7.88×10⁻⁶~36.39×10⁻⁶, 26.85×10⁻⁶ on average) and significant enrichment of LREE (LREE/HREE: 1.90–4.59, 2.93 on average; (La/ Yb) N: 0.88–3.31, 2.19 on average). Similarly to the magnetite quartzite, high-grade magnetite ore in this area also has positive anomaly of Y, with Y/Ho ranging from 33 to 43. They both have obvious positive Eu anomaly and negative Ce anomaly, reflecting its material source is related to seafloor hydrothermal fluid. δ³⁴S value of syngenetic sedimentary pyrite in magnetite quartzite is close to 0 ‰, indicating the sulfur comes from volcanic eruption. δ³⁴S value in high-grade iron ore, effected by metamorphic hydrothermal fluid, is higher and mostly positive. By the analysis above, the distribution pattern of REE in magnetite quartzite and high-grade magnetite ore is same. All above show the consistency and succession between magnetite quartzite and high-grade magnetite ore. It can be proposed that high-grade magnetite ore is transformed from magnetite quartzite combined with the relationship of output position between them.

Geological characteristics of BIF-hosted high-grade iron deposits in the Anshan-Benxi area include that deposits occur in thick or multiple BIF layers and are mostly magnetite-type. Main minerals of ores are magnetite, hematite and quartz. Chlorite, amphibole and garnet show the effect of hydrothermal activity. Altered rocks in high-grade iron deposits include chlorite and chlorite-garnet, belonging to alteration types of chlorite-garnet and chlorite-muscovite. The altered rock is the product of mineralization, also the important symbol for prospecting of high-grade iron deposits, which are controlled by folds. As shown by characteristics of chemical composition and REE, high-grade iron ore comes from iron-bearing series, formed by enrichment of hydrothermal fluid under regional metamorphism. On the one hand, hydrothermal fluid has the strong ability of leaching SiO₂ from rocks. On the other hand, ferruginous material in the iron-bearing rock series is active under high temperature gas-liquid interaction, forming metasomatic diffusion from iron-bearing layers to surrounding rocks. When the metasomatism, characterized by addition of iron and removal of silicon, acts on thick layers of magnetite quartzite, metasomatic high-grade magnetite ore forms, while on amphibolite and muddy-silty rock, altered rocks form, which result in strong metasomatism of iron around high-grade orebodies, forming altered rocks with extremely high content of iron, and in altered rocks with quite high content of iron in high-grade iron orebodies; and in the far distance from high-grade orebodies, metasomatism of iron gradually weakened, forming altered rocks with low content of iron. Aluminium-bearing muddy-silty material in the iron-bearing rock series plays the role of consuming silicon leached out from magnetite quartzite and forming garnet, chlorite and biotite. Obviously, based on thick or multiple layers of magnetite quartzite, the BIF-hosted high-graded magnetite deposits in the Anshan-Benxi area formed under favorable conditions such as the storage space formed by folds, continued hydrothermal fluid and migration dynamics formed by regional metamorphism and interbedded layers of muddy-silty sediments.

**Key words:** Anshan-Benxi area, magnetite quartzite, high-grade iron ore, regional metamorphism, altered rocks.