Petrological Characteristics of the Altered Rock in No. 2 Mining Area of the Gongchangling Iron Deposit

ZHANG Jianmin, FU Jianfei, JIA Sanshi, WU Zhongjian

School of Resources and Civil Engineering, Northeastern University, Shenyang, Liaoning, 110819, China

The No.2 mining area of the Gongchangling iron deposit is the most important producer of high-grade Fe ores in Anshan-type diagenetic-metamorphic banded iron formation, which located in the north pterygoid of Gongchangling anticline between Hanling fracture and Laoling fracture. Mining area stratum is mainly Archean Anshan group Cigou formation, as a big residual body produced in large mixed granite, which consists of a set of metamorphosed volcano sedimentary rock series including lower iron rock series, K strata and upper iron rock series. The layer’s strike 20°~60°, tendency towards north-east direction, dip 60°~85°. The tectonic and magmatite distribute widely. Meanwhile, in the middle of the mining area, there exists a wide range of developmental hydrothermal (gas) altered rock which has close genetic relationship with the rich iron ore. In order to investigate the mineralization of high-grade ore, this study presents the petrological, mineralogical and geochemistry characteristics of the altered rock.

1 Spatial Distribution and Rock Types of Altered Rocks in the No. 2 Mining area

The altered rock mainly distributes along the strike of fault near the Fe6 rich layer, layered or lenticular, and consistent with the seam, presenting a positive correlation in size. In the experimental section altered rock has zoning characteristics, by the rich outwards respectively mafic amphibole rock, mafic amphibole garnet rock, garnet chlorite rock, chlorite rock and actinolite rock. The altered rock was divided into four types, including garnet-rich type, chlorite-rich type, garnet chlorite-rich type and magnetite-actinolite-rich type, which are described as follows.

1.1 Magnetite-actinolite-rich type
The rock is vein, stratoid in the roof and floor of bonanza, and has clear boundaries with the ore body, but also gradual transition trend of local. On the section, containing magnetite actinolite rock shows thickness of about 20cm, yellow green, massive structure, fine structure, composed of actinolite, carbonate minerals, magnetite and garnet.

1.2 Garnet chlorite-rich type
The rock shows stratoid in the greenschist belt at the top and bottom plate of ore body, or in the surrounding rock, and can also be veinlike in structural collapse locations of rich layer. In addition, the rock has clear boundaries contacting with rich iron ore. Garnet chlorite-rich rock has magnetite mineralization, zoning is not obvious. Besides, the rock is seized of greenish - brown, massive structure, coarse grain structure, mainly composed of coarse garnet, tremolite, chlorite, quartz, magnetite, actinolite.

1.3 Garnet-rich type
The rock is stratoid in roof and floor of the rich ore bodies and ore body boundaries obviously, part of a gradual transition, garnet rock shows mineralization obviously. Garnet rock is brown, red brown, massive structure, coarse grain structure, mainly consisting of a coarse garnet and a small amount of quartz, magnetite. Quartz, magnetite ore mainly distribute in the gap of the garnet rock, intact and coarse grain.

1.4 Chlorite-rich type
The rock is vein in banded iron, ore mineralization and ore body boundaries, obviously, later than poor iron ore formation. In contacting area, magnetite bands became rich, removing silicon phenomenon clearly. Chlorite shows deep green, banded structure, fine structure, mainly composed of chloride and magnetite.
2 The Main Characteristics of the Mineral Composition of Altered Rocks

Two altered rock is complex in the study area, containing many types of minerals, mafic amphibole, almandine, chlorite, and magnetite, biotite, calcite, etc. This article only describes chlorite, garnet, biotite briefly.

2.1 Chlorite

The chlorites are mainly iron magnesium chlorite, creep chlorite, and there may be a small amount of dense chlorite, which is an important indicator of iron minerals. Generally, the chlorites presents higher iron depleted silicon, aluminum-rich, FeO content up to 31.08% with an average 22.52%. Fe₂O₃ content is higher, ranging from 1.22 to 6.77%, with an average of 3.001 percent, called oxidation chlorite. The iron coefficient of chlorite is closely related to ore-grade space, in general, the higher the closer the coefficient of iron ore.

2.2 Garnet

Garnet is characterized by higher FeO content, lower Fe₂O₃, CaO, MgO and MnO content, and its TiO₂, K₂O, Na₂O content is lower, the almandine total iron content in bonanza roof and floor rock is 29.21% ~ 31.67 % some over ideal formula (31.14%). The garnet in studying area is rich of almandine, up to 93.6%, the minimum is 71.9%, in the roof and floor bonanza almandine content is 89.9% ~ 93.6%.When the full iron coefficient closing to their lower limit, appears depleted iron ore, and closing to their upper limit appears rich iron ore.

2.3 Biotite

This biotite contains generally Na₂O, CaO, Na₂O in 0.07 ~ 1.47, CaO in 0.01 ~ 0.06, and biotite is rich of Na, which is favorable for the formation of iron ore. For example in Fe₆, iron ore is richer in southeast area with high content biotite, while the iron is poor in northwest with low content biotite, and the CaO content in northwest is higher content than southeast, also showing differences between different partitions medium conditions. Biotite iron factor f, varies with the rich ore. With iron ore from the northwest to the southeast region becoming rich and thick, biotite’s f value increases with iron concentration increasing.

3 The Geochemical Characteristic of Altered Rocks

In order to explore the relationship between the altered rock and the rich ore body further more, in this paper, detailed research on the altered rock about major elements, trace and rare earth elements has been done. In the altered rock, the average content of SiO₂ is 29%; the Al₂O₃ content is 14.82%; the Iron oxide content is14.82%; the content of MgO style significantly lower than the iron oxide, the average content of 8.64%; CaO content range of 0.14% ~ 4.35%, an average of 2.02%, far less than 6%, this Indicates that its original rock is not amphibolite, but shows argillaceous rock characteristics. Through the A-C-FM protolith restoration, the altered rock projection points fall in between siltstone and ferrosilicon sedimentary rock. The major elements’ data analysis results show that the altered rock has similar component, the main difference is SiO₂ and iron oxide, this difference is consistent with the difference between magnetite quartzite and magnet rich ore.

The trace elements test results shows that in the altered rock all kinds of trace elements are very low, indicating the chemical composition is consistent, which is the characteristic of sedimentary origin. After the primitive mantle normalizing, the altered rock is found rich in Rb, Ta, defective in Sr, the morphology is similar to the magnetite quartzite’s.

The REE content is low with the slightly enriched LREE and slightly right characteristics. The δCe values range from 0.73 to 0.76, with an average of 0.75, showing negative anomaly, this suggests that altered rock formed in reducing environment; smaller Th/U values in the range of 0.95 to 3.37, average 2, also shows altered rocks formed in a reducing environment. Eu value is negative, suggesting an involvement with no hydrothermal in its forming process, the numerical range of Y/Ho from 22.83 to 27.65, the average was 25.49, the ratio is slightly less than the upper crust with an average value of 27, indicating that it is not formed by the marine chemical deposition. All REE values except Eu show moderate REE losses, which is similar to the magnetite quartzite’s.

4 Conclusion:

Based on the field investigation, the petrological, mineralogical and geochemistry characteristics of the altered rock were investigated, results showed that the altered rock was divided into four types, including garnet-rich type, chlorite-rich type, garnet chlorite-rich type and magnetite-actinolite-rich type; the iron content of chlorite, garnet and biotite has a close relationship with the iron ore grade, generally speaking, the closer to the magnetite rich ore, the iron content is higher, and vice versa, away from the rich iron ore, iron content decreased. From the major element, trace element and REE data analysis results, altered rock formed in a reducing environment, the original rock is pelite, and has close genetic relationship...
with the rich iron ore.

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References