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Study on The Genesis of The Chedu Gold Deposit in Bikou Block

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Abstract. The Chedu gold deposit is located in the south rim of bikou terrane. It is the first BIF-type gold deposit in shaanxi province. Experiment with electronic probes and scanning electron microscopy, we first discovered silver gold mine and calaverite wrapped in single-grain magnetite. According to the results of hydrogen and oxygen isotope analysis of quartz in gold ore, the value of $\delta^{18}\text{O}$ is from 16.4 ‰ to 16.6 ‰ and δD is from 16.4 ‰ to 16.6 ‰. This value is similar to the hydrogen and oxygen isotope values of quartz in BIF type iron ore. The discovery of wrapped gold and non-visible gold in magnetite suggests that gold is formed earlier or at the same time as the magnetite crystallizes. It is of great significance to study the genesis mechanism of BIF type gold deposit.

1. Introduction

More than 20 gold deposits have been found in Bikou Block, of which the Jiufangliang and Jinchanggou are medium-sized gold deposits, and Lijiagou and Huodiya are small-sized gold deposits. The main types of gold ore are carbonate type, quartz vein type and tectonic altered rock type. The formation of the Bikou gold deposit is closely related to the thrust of the North China plate from the north to the south in Mesozoic [1]. In addition, a small amount of magnetite quartzite type gold ores have been found in Chedu gold deposit, Xiaoyanzigou gold deposit and Jinchanggou gold deposit on the southern margin of Bikou block. The genesis mechanism of magnetite quartzite type gold ore needs further study.

2. Geological characteristics of gold deposit

Magnetite quartzite type gold deposit is located in the north of Yangpingguan fault about 30-100m. Gold grade is 1.50-9.82g/t. Alteration zones generally spread in NE direction. The total length of the gold ore body is 2800m and the width is 10-50m (Figure 1). Based on the data of geological survey and electrical sounding, the mineralization belt inclines steeply to the north and slowly wavy to the downward direction [2].

Magnetite quartzite gold ore: gray-black, fine-grained structure, banded structure (Fig. 3a). Magnetite is distributed in strips, with a high degree of self-formation and a square shape. The particle size is less than 0.40 mm. The content is about 35%. Quartz is distributed in strips and recrystallized by post-metamorphism. The particle size of quartz is 0.05-0.1 mm and the content is about 50% (Fig.



3b).The particle size of secondary limonite is 0.1-0.2 mm, and the content of secondary limonite is about 8%.Occasionally, silver minerals are found in limonite(Fig. 3c).

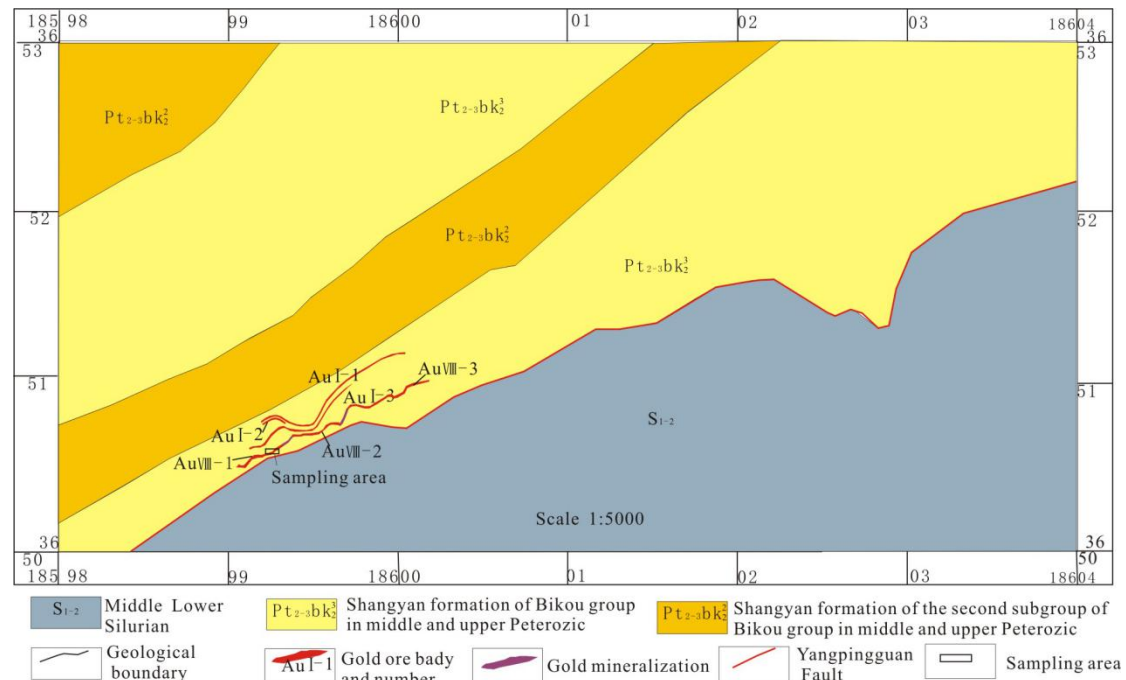


Figure 1. Geological map of the Chedu gold deposit

The main gold - bearing minerals are quartz and magnetite in magnetite quartzite. Gold occurs in silver-gold and tellurium-gold minerals(Fig.3d,e,f,g,h,i).Through scanning electron microscopy, we observed silver-gold minerals wrapped in quartz, silver-gold minerals and gold-plated minerals encased in magnetite.

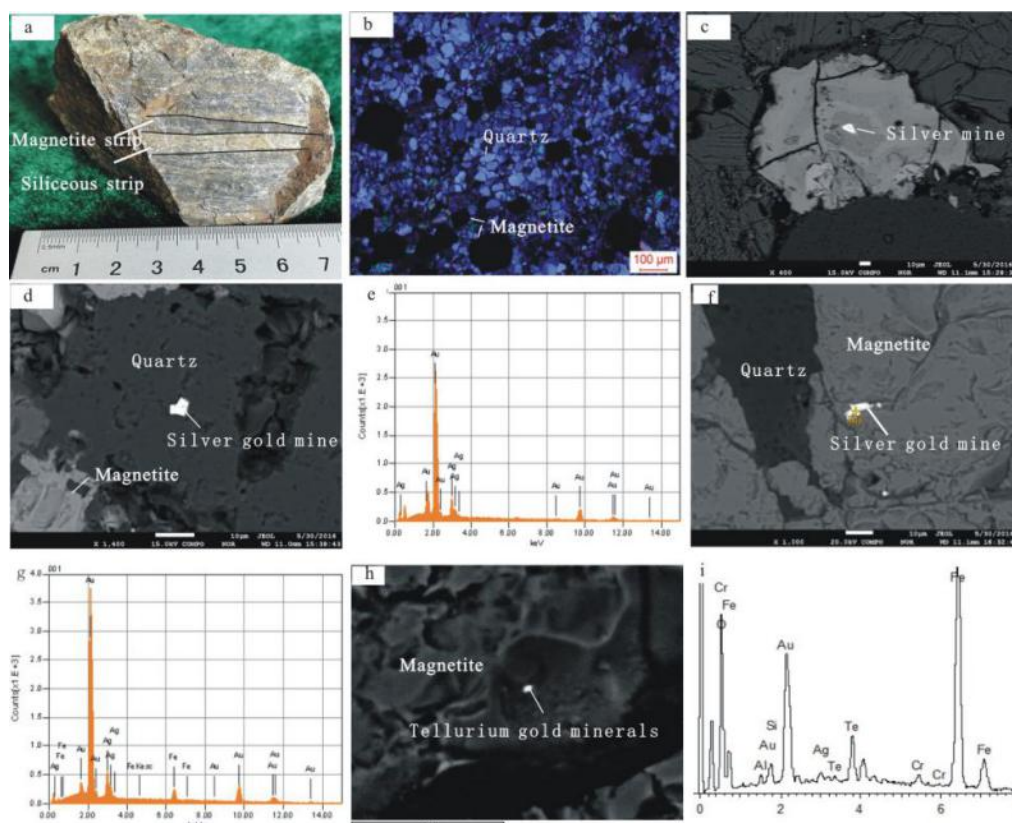


Figure 2. The figure of occurrence of microscopic gold grains and energy spectrum analysis

A, banded magnetite quartzite type gold ore; B, microscopic photographs of banded magnetite quartzite gold mineral; c, ring-banded limonite encloses silver mineral; d, quartz wrapped silver gold mineral; e, energy spectrum of silver-gold minerals; f, silver gold mine in magnetite; g, energy spectrum of silver gold mine; h, tellurium gold minerals in magnetite; i, energy spectrum of tellurium gold minerals.

3. The analysis of hydrogen and oxygen isotope

Two representative samples of magnetite quartzite gold ore were collected for hydrogen and oxygen isotope testing. The sampling position is shown in Figure 1. Selection of quartz single minerals was completed in Langfang Geological Service Co., Ltd. The hydrogen and oxygen isotope analysis and testing were completed in the Stable Isotope Laboratory of Beijing Institute of Geology.

3.1. Analytical method

Two gold ore samples were crushed to 40-60 meshes. After screening, cleaning, drying and magnetic separation, the single quartz mineral sample with 99% purity was finally obtained. The instrument for hydrogen and oxygen isotope analysis is MAT253EM mass spectrometer. The accuracy of the analysis is $\pm 0.2\%$. The results of hydrogen and oxygen isotope analysis of quartz single mineral are shown in table 1.

Table 1. The Value of Hydrogen and Oxygen Isotopes in Single Quartz Minerals

Sample number	Single mineral	$\delta D(\%)$	$\delta^{18}O_{\text{quartz}}(\%)$	Temperature ($^{\circ}C$)	$\delta^{18}O_{\text{water}}(\%)$
CD001-8-1	quartz	-112.6	16.6	396	12.45
CD001-8-2	quartz	-103.5	16.4	400	12.34

Article I. notes: $\delta^{18}\text{O}_{\text{water}} = \delta^{18}\text{O}_{\text{quartz}} - 1000 \ln \alpha_{\text{Q-W}}$, $1000 \ln \alpha_{\text{Q-W}} = 3.38 \times 10^6 T^{-2} - 3.4$

3.2. Characteristics of hydrogen and oxygen isotopes

The value of $\delta^{18}\text{O}$ ranges is from 16.4‰-16.6‰, with an average of 16.5‰. The value of $\delta^{18}\text{O}$ is more concentrated. It can be proved that its material source is single. It is similar to the oxygen isotope values of BIF type iron deposits in Anshan-Benxi area [3]. It shows the characteristics of hot water genesis siliceous rocks [4].

Application formula: $\delta^{18}\text{O}_{\text{water}} = \delta^{18}\text{O}_{\text{quartz}} - 1000 \ln \alpha_{\text{Q-W}}$, $1000 \ln \alpha_{\text{Q-W}} = 3.38 \times 10^6 T^{-2} - 3.4$

The $\delta^{18}\text{O}_{\text{water}}$ value was from 12.34 ‰ to 12.45 ‰, and the average value was 12.40 ‰. The δD value was from -112.6‰ to -103.5 ‰, and the average value was -108.05‰.

The δD variation of BIF type iron ore is from -129‰ to -75‰ in Anshan-Benxi area [5]. The scope of the two is the same. It is believed that quartz minerals in the magnetite quartzite of Chedu Gold Mine have BIF characteristics.

4. conclusion

4.1. The cause of the deposit

From the ore structure, the ore has obvious characteristics of banded cherty iron formation. Therefore, it is preliminarily considered that the deposit is BIF type gold deposit.

In terms of mineral characteristics, magnetite and quartz are the main gold-bearing minerals. From the isotope characteristics, the hydrogen and oxygen isotope values of the deposit are similar to those of the BIF type iron deposit in Anshan-Benxi area. Based on the above analysis, we believe that Chedu gold deposit is BIF type gold deposit.

4.2. The significance of discovering gold in magnetite

The gold-bearing minerals can reflect the geological background, mineralization, metallogenic mechanism and other information about the genesis of the deposit. BIF-type gold deposits, gold generally occurs in sulfides in oxide-phase iron formations. Gold-bearing minerals are mainly pyrite, quartz carbonate and chlorite. Gold minerals occur in magnetite in the form of fissure gold and intergranular gold. The discovery of gold encapsulated in magnetite in Chedu gold deposit proves that gold was formed earlier or at the same time as magnetite crystallization. The discovery of gold encapsulated in magnetite is of great significance to the study of genetic mechanism of BIF type gold deposit. It is suggested that gold can be deposited and enriched in the hypoxic and anoxic environment of BIF type iron deposits.

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