A study on mineralization of Cheonbo gold mine

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Abstract

The Cheonbo gold mine is located approximately 8km northeast of Cheonan in southern part of Korean peninsula. The Cheonbo gold deposits are composed of parallel-filling quartz veins that are associated with the Cheonan granite which intruded the surrounding Precombrian metamorphic country rocks. Rb/Sr date of the granitic intrusion is 170±0.3m.y.,suggesting a middle Jurassic age for gold mineralization.

1. Introduction

This paper is intended to research the studies on geologic environment and mineralization, one of the productive hydrothermal gold deposit in Precombrian metamorphic rocks in Korea.

The Cheonbo mines(latitude 36° 38'N, longitude 127° 13'E)are located within the Cheonan area of the Chungchung Province.

The complete geologic map and description of the studied region were conducted by Kim et al.(1980) Bezmen(1975) suggested that the experimental results on the formation temperature agree well with partition of cobalt and nickel in natural pyrite-pyrrhotite associations from different genetic types of ores. So et al.(1978) presented that the relationship of the major components to uranium can be expressed by the regression equatation in Ogcheon group.

The studied mine are the principle example of a group of deposits that have many geologic, mineralogic, and geochemical features in common. The deposits are of Jurassic age and are shallow seated. Each deposit is spatially related to strong normal faults, some of which are occupied by preore dikes; some of the normal faults served as conduits for hydrothermal fluid.

The major ore minerals, galena, sphalerite, and pyrite, together with minor amounts of chalcopyritem, arsenopyrite, pyrrhotite and electrum are contained within fissure-filling hydrothermal quartz veins. The gangue minerals consist of calcite. The average ore grades of the Cheonbo mine is 7.23g/metric ton gold.

2. Geologic environment

The geology of Cheonbo mine area consists of, in ascending order, the Precambrian Cheonan gneiss intruded Mesozoic igneous rocks. Cheonan gneiss locally consists of interbedded biotite gneiss, Onyang gneiss and in places dieplays augen gneiss.

The foliation is variable due to the deformations, and minor folds are observed in some places. The pegmatites intrude along and/or cut through the foliation surface in some places.

Mineral components of biotite gneiss are of quartz, feldspars and biotites with a small amount of muscovite, and the garnet and coarse feldspar occur as porphyroblast. The feldspars are of orthoclase, microcline and sodic plagioclase.

The accessary minerals are monazites, magnetites, limonites and leucoxenes. The Onyang gneiss has a lot of xenoliths of banded gneiss at several places, being intruded by genissose biotite granite. Augen gneisses are from medium to coarse grains. The main components of augen gneisses are quartz, feldspar and biotite. The foliation is well developed, and foliation surfaces are uneven and folded due to the deformations.

Foliation of the rock is well developed with general trend of the foliation striking NE to SW with a dip of 10 - 80 SE and has the superposed fold which has the synclinal axial trace of 30 to 40, 60° (Kim, 1980)

The granites, which intruded into the gneiss complex in Jurassic age, are classified into three types such as biotite granite, leucocratic granite and hornblende granite. Biotite granite shows partly gnessosity with granular texture and consists of feldspar, quartz, biotite and muscovite. Feldspar changed to sericite and muscovite, and biotite to chlorite. It has much sericite and inclusions of graphic grain. Leucocratic granite has a granular texture, quartz is anhedral and feldspars are partly sericitized, kaolinized and calcitized. Leucocratic granites irregularly intruded into the Cheonan gneiss, and the pegmatite and quartz veins intruded like the lit-par-lit along the foliation surface(Fig.1). Hornblende granite has a granular texture with gneissose structures. Quartz grains are intensely fractured, and feldspar are superior in number of plagioclase and partly changed to sericite, epidote and calcite. Biotite and hornblende are partly chloritized. Hornblende has inclusions of quartz and feldspars.

The granites occur mainly as sills, having many xenoliths of gneiss, and have the feature of gneissosity.

In the mining area, principal five Au-bearing quartz veins (Main, Doksa, Sajang and Omok vein in Cheonbo mine) typically were formed by narrow open space filling along the parallel or subparallel structures of banded gneiss and granitic rocks. The veins are developed within pegmatite, in contract with pegmatites and intermate dikes, intruding into wallrock structure. The ore vein decreases where the pegmatite is wider and divides into two veins upwards. Some veins exhibit evidence of post mineralization faulting(So, unpub. data)

The veins strike N50E to N65E. The veins have been traced for approximately 2km along the strike, dips from 60S to 80S and vary considerably from 0.1 to 1.2m in thickness along their strikes. The mineralized veins consist chiefly of two generation of clear to milky and green quartz and small amounts of sulfides are closely associated with electrum. Most vein quartz is massive and varies from cryptocrystalline to dense and show often orbicular rhythmic banding.

Brecciated fragments of the wallrock are frequently contained within the ore vein and they are highly silicified approching the gray quartz in appearance. Alteration of the wallrock adjacent to the ore vein consists of major amounts of introduced quartz and some disseminated fine grained pyrite. Ore shoots consist of fine electrum intergrown with quartz or sulfides. Most of the electrum occurs as the grain with the size of less than 1mm.

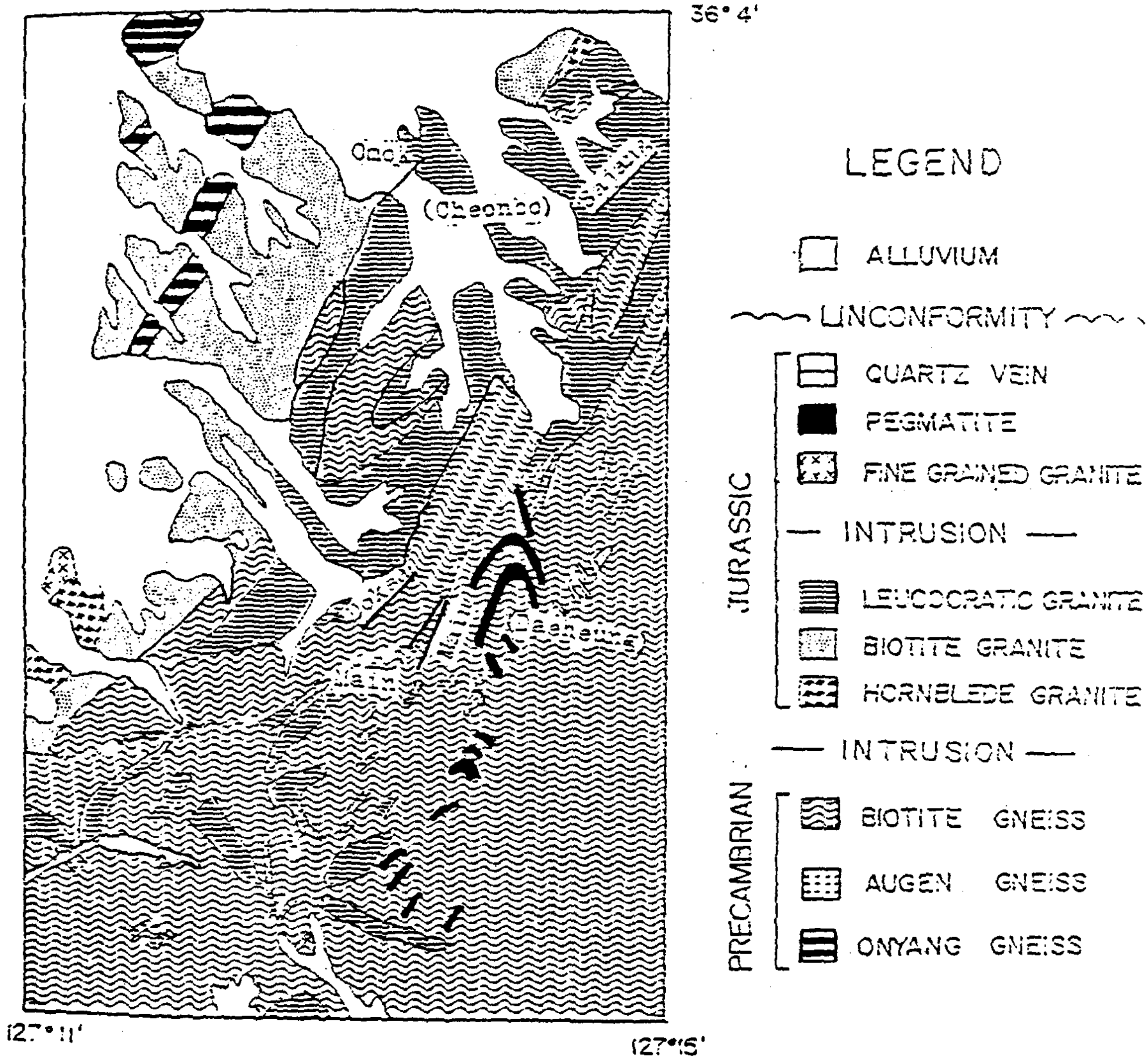

Fig. 1. **Geologic map of the studied area, showing gold-bearing quartz veins**

3. Age dating of mineralization

Rb/Sr dates were obtained for biotite from the host two mica granite in contact with ore veins. The procedures of the dating are as follows.

About 0.2g of powdered sample was weighted by a semi-micro chemical balance and spiked with both working spike solutions, ^{87}Rb(Ref. 190901) obtained from Oak Ridge National Lab., and ^{84}Sr(NBS. 988) from National Bureau of Standards. The spike sample in 100ml Pt dish was added with about 10ml $HClO_4$(Merck 571) and 30ml HF(Merck 335), and put on the temperature control-led hot plate. The sample was dissolved in a specially designed hood kept at an over pressure. After the sample was dissolved in a specially and dried out, 5ml of 2.2N HCL(Merck 318)was added. The dissolved and solution was transferred to a small quartz centrifuge tube. Supernatants liquid for the Sr ion separation was transferred into a quartz column in size of 1cmØ×25cm filled with Dowex 50-8x cation exchange resin. The residual precipitation was purified with alcohol and kept for a measurement of Rb isotopes by the mass spectrometer. Sr ion was eluted in the fraction between 135ml to 175ml of 2.2N HCL while the column condition for the separation of Sr was tested by 0.1 μCi ^{82}Sr tracer.

Table 1. Analyzing condition of mass spectrometer

Instrument	: mass spectrometer TH-5, Varian Matt(KIER)
Vacuum	: 2×10^{-8} torr
Dual rhenium filament	
Measuring isotopic ratio	: Faraday cup ion collector Kompendogrsph recoder
Standards	: ^{87}Rb(Ref. 190101) ^{84}Sr(NBS. 988)
$^{87}Sr/^{85}Sr$ ratio	: 8.3752
$^{87}Rb\lambda\beta$	: $1.42 \times 10^{-11}y^{-1}$

The elected Sr ion was dried in Pt dish, transferred into a quartz centrifuge tube with a few drops of HNO_3(Merck 441) and triple distilled water, and kept for a measurement of Sr isotopes by the mass spectrometer. Special care was taken to decontaminate the residual Sr in the column. The result tested by blank are normally less than 15mg of both strontium and rubidium elements. Analyzing condition of the mass spectrometer and results are given in Table 1 and 2.

Table 2. Rb/Sr Data of specimen from the mines studied

Sample No.	Description	Slope (10^{-3})	Intercept	Age (m.y.)
C-2	Fresh two mica granite	2.421± 0.004	0.7106	170.3±0.3

The result was 170.3±0.3m.y. This date is consistent with other observation from the gold mines in Korea(Park, 1981).

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