EPITHERMAL GOLD MINERALIZATION IN THE CINEAM SUB-REGENCY, TASIKMALAYA, WEST JAVA-INDONESIA

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CONTENT

- INTRODUCTION
- GEOLOGY
- MINERALIZATION FLUID INCLUSION.
- Exploration, Mining, Ore extraction and Tailing
Cineam deposit is gold deposit located ± 180 km Southeastern of Bandung, which altitude between 400-500 meters above sea level, it belongs to Sub-regency of Cineam, Tasikmalaya, West Java.

Historically, it was firstly found by local miners in the Citambal river and Cisarua 1968. Few years later, the searching was continued and discoveries the primary one, Citambal and Cengal (Cisarua) in 1970.

The potential area of mineralization; Cikondang, Citambal and Ciseel.

Metallic mineral present in the deposits: gold (electrum), and some base metals

The average grade of gold: around 6 to 15 g / ton Au.

The thickness of vein: few centimeters up to 60 cm. Local the thickness can reach until 1 m. Commonly the high grade one is is not more than 5 cm.

Even the deposit is not classified as a big scale deposit, however, genetically it has an interesting characteristic mainly by raising of tellurides minerals.

Mining system: sharing system.

The gold extraction: Amalgamation process with recovery 50 – 60%.

Some new problem raise, environment pollution caused by mining activity (amalgamation process).
The objective of this paper is to discuss about the genesis, development history and its problems.
Location of the deposits

Figure 1. Location map of Study area, West Java, Indonesia.
GEOLOGY

- **Regional:**
  Geologically, Cineam area was mainly composed of Oligo-Miocene series of Jampang Formation volcanic. Jampang Formation volcanic consist of andesitic to dacitic composition (Bemmelen Van, 1949). These volcanic groups were intruded by diorite, granodiorite, andesite and dacite intrusive.

- **Tectonically; twice orogenic event:**
  - First, in the middle Miocene uplifting followed by folding and faulting and a number of intrusion within the Jampang Formation.
  - The second, in the Pleistocene produce the formation of young volcanic.
  - According to Budhistira (1987), Cineam area is belong to Jampang Formation.
Geology of Cineam deposit:

- It was composed of 6 lithologic units:
- **Tuff unit**, the oldest unit, intercalated with dacitic lava and breccia, occupies the Cisarua, Cikurawet and Balekambang area.
- **Lava unit**, andesitic to basaltic occupies the Ciseel area.
- **Breccia-tuff and tuffaceous sandstone unit**: It is widely distributed from the north to the south of the area.
- **Diorite**, (porphyry andesite?) well exposed, at the head of Ciherang and Ciseel area.
- **Dacite**, is located in the northern area, particularly around Pangajar
- **Hornblende andesite**, are well developed in G. Kendeng.
- **Geological structure**: anticline and oblique fault. Anticline is located in the western area while oblique fault, located in the eastern area.
Geological map of Cineam area, Tasikmalaya District, West Java

Index:
- Andesite tuff - breccia and tuff
- Dacite
- Tuff intercalated with Dacite tuff
- Porphyr Andesite
- Andesite
- Hornblende Andesite
- Basaltic - Andesite Lava
- Gold bearing quartz vein
- Active mine
- Fault
- Fold

SCALE 1 : 50000
MINERALIZATION.

- Alteration and mineralization, indicated by the presence of quartz vein contains gold intruding lava, volcanic breccias in the lower part, tuff–tuff breccia in the upper part of Jampang Formation.
- Alteration type: propylite, argillic silification and locally phyropylite. It is a typical of low sulfidation type.
- Quartz veins direction: generally from N.330º to 350º E with the dip from 60º to 90º, the thickness are from few cm up to 60 cm, local it is reach till 1 meter.
- The nature of alteration: pervasive (Citambal) to selected pervasive (Cikondang area). In Ciseel (Nyalindung) sometime is difficult to recognized the original of the rocks. It is also classified as pervasive.
- Age of mineralization: 8 Ma little bit younger than Citambal ± 9,6 Ma.
Two main stages of mineralization:

Stage-1: Cikondang

Stage 2: (Citambal, Cikurawet and Ciseel).

Stage-1: electrum, pyrargyrite, realgar, stibnite, orpiment, marcasite, pyrite, and iron oxide. The electrum shape, platy like tissue or paper, associated with stibnite, pyrargyrite, realgar, marcasite, pyrite, orpiment and iron oxide.

Stage 2: pyrite, sphalerite, tetrahedrite-tennantite, galena, chalcopyrite, electrum. hessite, petzite, proustite, arsenopyrite and tetrahedrite-tennantite, iron oxide.

Quartz is developed well from sub-stage 1 to sub-stage 4 of stage 2. In sub-stage 5 quartz decreasing drastically to less than 5%, in this case carbonate (calcite) is dominant as gangue mineral.

Age of mineralization ± 8.5 Ma

Telluride is a specific minerals. It can be used for guiding to indicate the presence of visible gold.
Mineralization stage on the Cineam area,

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Au-Ag-Te diagram of the Cineam Mineralogy
Based on the Cabri (1965), Afifi et al (188)
Fluid Inclusion Studies

- The objective: $T_h$ (°C), & depth (m) related mineralization.
- Sample for fluid inclusion: quartz vein taken from Cikondang, Citambal, and Ciseel area.
- Kind of fluid inclusion: primary fluid inclusion; liquid-vapor rich and vapor-liquid rich
- Methods: Heating stage to get $T_h$ (°C), freezing stage to get salinity
- $T_h$ of Measurement result: 190 ~ 240°C from sub-stage 3. Some fluid inclusions homogenized over 240° up to 350°C (Citambal).
- The average of filling temperature: Ciseel, little bit higher than Citambal, it is around 230°C. Boiling occurs in 210°C.
- Saninity: Citambal 1.45 to 2.30 wt% NaCl, Ciseel, little higher with value of salinity up to 3.7 wt% NaCl equiv.
- Cikondang, the temperature cannot be measured due to fluid inclusion in quartz was very rare and tiny.
- Hass program (1971), the depth of mineralization formation of Cineam deposit was approximated around 200 – 400 meter.
The relation between type of fluid inclusion and temperature.
Exploration, Mining Ore Processing and Tailing

- Exploration: It was conducted unsystematically. In order to trace the source of gold (gold bearing vein) first, they usually do by panning to know whether gold present or not. Determination of the ore position is based on their own theory (experience). To know the gold content was also determined by panning (made of plate or wood). When the primary gold found they checked it for several times until they believe that the gold that want to be mined is visible. It is true, from that point the mining of gold is began following the direction of ore or vein.
• Mining was done by simple methods. First is started by tunnel building across and next following the ore vein. It is performed by using a simple tools like hammer, chisel, bucket and water pump. In KUD Mekarjaya is used jack hammer and trolley (to carry the ore).

• Mining system is underground. Shaft as entrance for the miners and air circulation (blower) in the tunnel, and water pump. Ore obtained by chisel and hammer from the ore body. Using bucket and wire, they begin to pull the to the surface, and carried out by trolley.

• The depth of shaft is vary, around 20 to 40 meters. At the depth more than 40 meters the water usually raising from the beneath. At such condition the water must be taken out to the surface using water pump, until the tunnel condition is free from flooding.

• In mine they also used blower to keep the air circulation condition in the tunnel constant (normal)
In the Cineam area there are some mining concession (Mining License)

- Mining License is given by the Government Regency (Bupati) to the four holders (applicant) bellows:

1. KUD Mekar Jaya, 36.58 Ha
2. Nanih T Sopandi, 5 Ha
3. Haji Karmudin, 3 Ha
4. Cucu Purwata, 5 Ha

b) Mining License (IUP) is given for 5 (five) years, and can be extended subsequently.

c) The license form does not require systematic of mining activity stages from upstream to downstream, but license holder can directly conduct mining, processing and trading of mine production.
• The gold ore extraction: Amalgamation method.
First, the ore that already crushed by hammer (Ø < 0.5 cm) put into the milling (we call it ‘tromol’) around 1/3 portion of the tromol volume. Put the water into the tromol and before the tromol closed, put also mercury (0.5 – 1 ounce) in it.

• The tromol is then rotated by flow of the river or generator with speed 60 RPM for 8–12 hours. In order to get good recovery the miners is usually uses a special leaves. After the miners involved in one mining group gained the ore, they process it personally in different place. In KUD Mekar Jaya the processing is conducted at one site, where each tromol is connected by belt each other, and the it rotated by generator machine. After the rotation is over mercury is taken out from the tromol, and put into a piece of cloth, then it is squeezed to get bullion. The last process to get gold, bullion is ignited to release the mercury content. After that the gold is ready to sell. In amalgamation the gold recovery is only reach around 50 to 60 %. Based on their experience, ratio of Au and Ag = 7: 3.

• Tailing, is usually flow out directly to the river. It is commonly done by the miners. In KUD Mekar Jaya tailing is not flow out directly, but they provide tailing dump with function in order that the mercury will precipitate first before flowed to the river. This method will reduce the impact of water pollution worse.
The negative impact of environment will be occurred due to amalgamation process. 

- Many of mining groups conducted amalgamation process without managed → Pollution environment.
- The last survey (2006) :
  - Mercury is widely distributed with higher concentration than normal.
  - Decreasing of water quality → water is dirty and muddy.
  - High mercury concentration specially around extraction site.
  - The Hg at Cineam at the moment have not changed to methyl mercury (as free ion or unstable compound).
Map distribution of mercury in the Cineam area
The Histogram of Hg element active sediment
The Histogram of Hg element in soil sample
The average content of element in ppb (Levinson, 1974)

<table>
<thead>
<tr>
<th>Element</th>
<th>Crust</th>
<th>Ultramafic</th>
<th>Basal</th>
<th>Granodiorite</th>
<th>granite</th>
<th>Limestone</th>
<th>Soil</th>
<th>River water</th>
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<td>0.08</td>
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<td>0.05</td>
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<td>Cu</td>
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<td>10</td>
<td>100</td>
<td>30</td>
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<td>2-100</td>
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<td>Pb</td>
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<td>0.1</td>
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<td>Zn</td>
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<td>Cd</td>
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The government role: To increase mining life better and health, the endowment from the government is needed. Tech-Mira and The Center for Geological Resource are the institution that begin to try in assisting their problems such as guidance and technical assistance, like how to find a new potential vein, making tunnel and shaft building, recovery in gold extraction increase, keep and save from the negative environment impact of the mining activity, etc.
• PHOTOS
Type of metallic minerals at Cineam
Variation of metallic minerals in red color

- Stibnite and realgar (Cikondang)
- Proustite (Citambal)
- Pyrargyrite (Cikondang)
Variation of base metal minerals of Cineam deposit
The typical of ore from Cikondang and Citambal
Tunnel and shaft condition, 1995
Tunnel condition in Citambal, 1995
The comparison of Tunnel condition at KUD Mekarjaya
Gold Extraction by Amalgamation Process

1. **Crushed / pounded stage**
   - Ore is pounded with hammer till get the size 0.5 to 1 cm

2. **Milling stage**
   - Ore put into ‘tromol’, add mercury + leaves in it then rotated around 50 RPM for 8-12 hour.

3. **Washing stage**
   - Water is separated from amalgam by panning amalgam is collected and put into piece of cloth then squeezed till get bullion

4. **Ignition stage**
   - Add at Bullion, borax and put into ceramic bowl then heated till 400°C

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**Legend**:
- Crushed / pounded stage
- Milling stage
- Washing stage
- Ignition stage
Gold processing at KUD and the local people

Gold processing at KUD

Gold processing local miner

Tromol
The waste derived from amalgamation process
Cineam mining area

- Water condition dirtied by tailing
- Direct exile of tailing to the river
- Tailing dump at KUD Mekarjaya
- Warning board of mercury dangerous
The condition of gold ore transaction at the Cineam area (Local market)
River condition contaminated by mercury
Thank You