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Characteristics and distribution of gold in intermediete sulfidation deposit at Cipanggleseran, Banten, Indonesia

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Characteristics and distribution of gold in intermediete sulfidation deposit at Cipanggleseran, Banten, Indonesia

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Abstract. Cipanggleseran area is located within the Sunda-Banda magmatic arc. Physiographically, it is included into the Bayah Mountain Zone. This zone is a potential complex of gold-silver mineral hydrothermal properties that is divided into 3 complexes, namely Cibaliung Complex, Bayah Dome Complex, and Ciemas Complex. And the research area which is in the Bayah Dome Complex has the intermediate sulfidation type of gold deposit. There are 2 steps in this research. The first step is mapping and sampling vein which indicated as a place of accumulation of this gold. The second step is studio analysis for example mineragrafi analysis on microscope and SEM EDX analysis. The gold and silver mineralization of the Cipangleseran area is found in quartz vein that have a rich composition of shulpide minerals for instance, pyrite, chalcopyrite, galena, sphalerit, in sompe places found covellit, chalcosite, and azurite, with characteristic of the texture such as, crustiform-colloform, cockade, and banded. Vein with this characteristic produce numerous gold and silver. Mineral carrier of gold in the form of electrum and native gold which present as visible gold and invisble gold. Invisible gold is present in minerals quartz, sphalerite, chalcopyrite and pyrite. Generally, visible gold is associated with sulphide minerals that act as a host mineral. The gold ore is distributed as free gold in quartz, inclusion in sphalerite, pyrite, chalcopyrite, and coexist on sulphide minerals such as sphalerite, pyrite and chalcopyrite with gold grain size of 4.5-52.22 μm.

Keywords: Cipanggleseran, epithermal,vein, gold, distribution.

1. Introduction

The research location is in Cipanggleseran area, Citorek Village, Lebak District, Banten. Located in the south with a distance of approximately ± 5 hours using the land route from the Jakarta, capital city of Indonesia. The study focused on the subsurface area of a horizontal tunnel that is currently managed by a company with a small-scale mining area. This tunnel is formerly used by PT.Antam Tbk as production tunnel. Geographically the tunnel is in the 48 S zone of UTM with the coordinates X: 647847 mE, Y: 9254889 mN.

Physiography the research area is included into the Bayah Mountains with morphology forming a dome. The Bayah Dome is located in the western part of Java Island. Where the complex is one of the host rock from some gold deposits in West Java that comes from the Sunda-Banda magmatic arc [7].

Potential gold deposits generally appear in the North-South relative direction (Figure 1). This direction is a regional fault direction that occurs due to the Sunda-Banda plate shift [2].

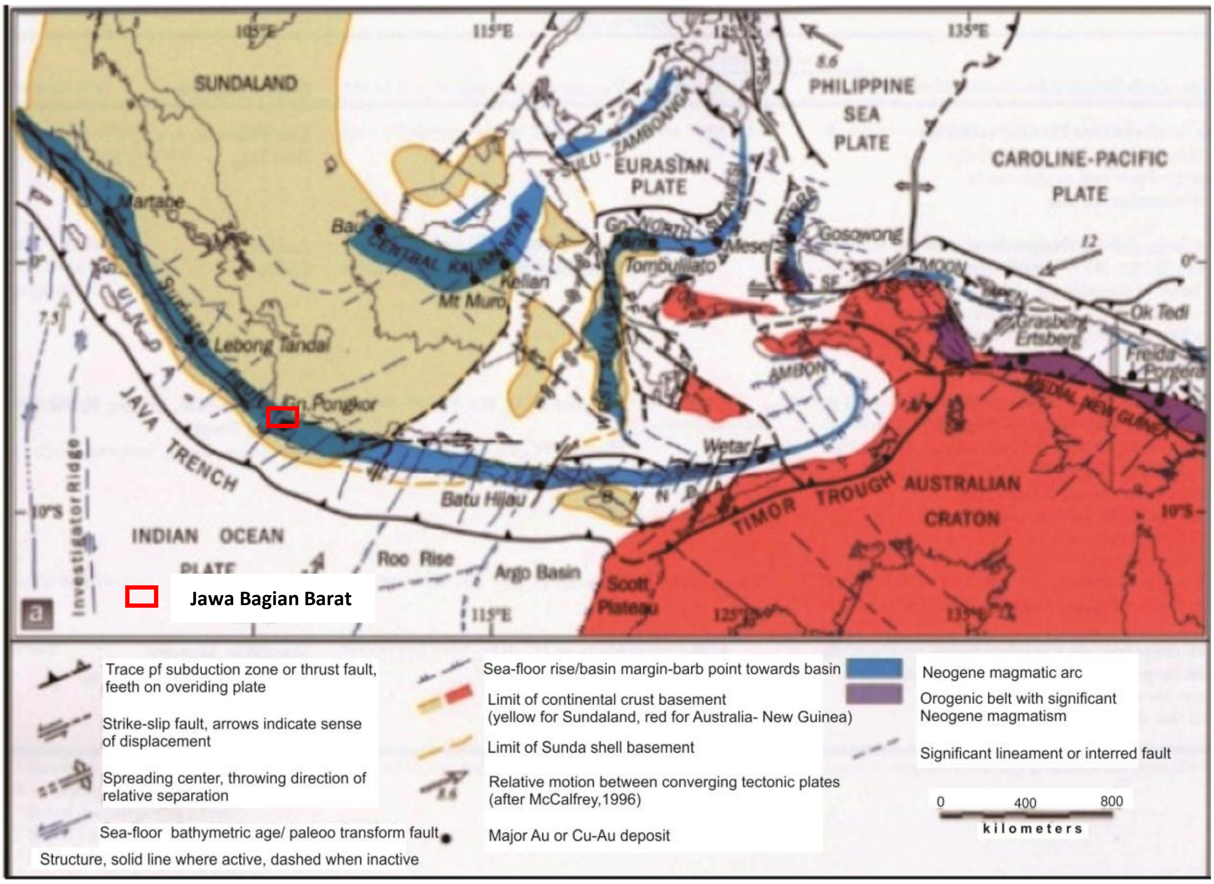

Figure 1. Interpretation of tectonic elements and the distribution of precipitate Au or Cu-Au in Indonesia [5]

The study area is an epithermal precipitate with intermediete sulphide type characterized by the presence of banded texture, crustiform-colloform, cockade. The types of alterations present are, phyllic, argillic, advance argillic, and propylitic. The vein present in the phyllic alteration type is a vein with a high gold content. Mineralization is present in the vein. Ore minerals present abundantly in vein such as chalcopyrite, pyrite, galena, sphalerite [3].

The distribution and presence of gold is closely related to the hydrothermal fluid that acts as a means of transportation. Gold is generally associated with ore minerals. There are two important types of groups in the process of transporting ore metal to hydrothermal solutions, namely: sulphides (HS- and H2S) and chloride (Cl). Both groups are capable of transporting large amounts of metals in natural fluid systems [4]. The gold distribution and characteristics can be a reference at the time of exploration and exploitation of gold processing. Factors affecting gold procurement in gold processing is include gold carrier minerals, The mineral gold mains, gold mineral carrier associations, and gold mineral grain size.

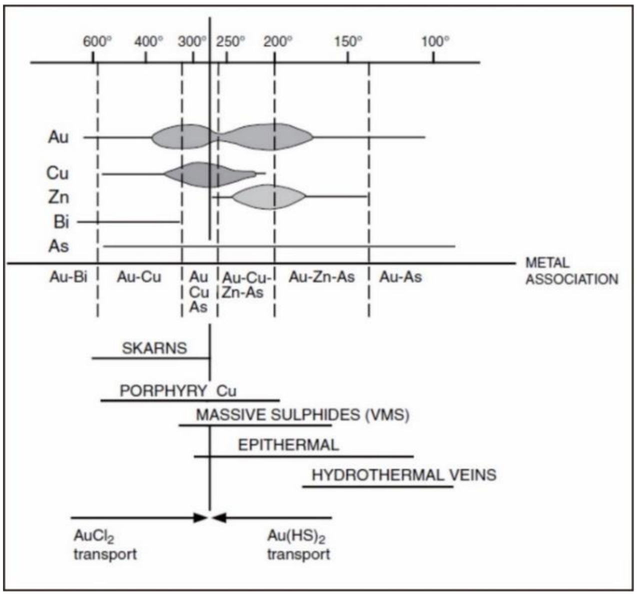

Figure 2. Diagram of the temperature range of metal transport of AuCl and AuHs as well as their mineral associations [4].

2. Method

The study focused on 3 veins indicated to contain large amounts of gold based on the presence of ore minerals, and quartz vein textures which are L400-50, L400-185, L400 EK cab1. The research method is divided into two steps. The first step is field observation including vein description, vein sampling, and documentation. The second step is laboratory analysis including microscopic analysis of ore (mineragraphy) conducted at Petrografi Laboratory of Pembangunan Nasional University (UPN) Veteran Yogyakarta and Puslitbang Tekmira, SEM EDX analysis conducted in Puslitbang Tekmira, and AAS analysis at Pusat Survei Geologi (PSG).

The microscopic analysis of the ore begins with the preparation of the vein sample into a polished thin section, then an analysis is performed using a reflected-light microscope. This analysis aims to determine the presence and distribution of gold, gold carriers, gold mineral carrier associations, and gold grain size. SEM EDX analysis is used to identify gold that cannot be seen by microscope (invisible gold). This analysis works by firing X-rays onto minerals which indicated to contain gold in the veins sample that prepared into a polished thin section. The analytic results in founding the elements contained in a mineral in percentage form. Analysis of AAS is to determine the level of the economical metal contained in the vein sample.

3. Results

Of the 3 veins taken, the mineragraphy analysis was performed on 64 samples of polished incision, 8 polished incisions analyzed by SEM-EDX. Then the AAS analysis is tested on these 3 veins. Sampling was done randomly on 3 of these veins. All the observed veins are in the type of phyllic alteration. These 3 veins have varying gold content (Table 1).

Table 1. The result of gold and element of economical metal content in the vein

Vein	Au (ppm)	Ag (ppm)	Cu (ppm)	Pb (ppm)	Zn (ppm)
L400-50	33.99	119	21,170	3,446	36,600
L400-185	0.27	140	27,510	2,626	64,600
	0.33	67	42,300	13,850	9,780
L400-185 EK Cab 1	5.08	77	13,490	1,064	39,800

L400-50

It has a direction of N 024° E/ 56°. Direction of the veins follow the direction of Fault Cipanggleseran ie horizontal fault with the direction of N-S. The product of this fault is indicated as the pathway where mineralization traps in the study area. The direction of this veins is a product of a tension joint.

Based on the results of mineragraphy 20 polished thin section on the L400-50, was found gold in 3 gold polished thin section. Gold is found in the form of native gold which has bright yellow and bright yellow electrum color but more dull than native gold with the size 13.3-51.30 μm. The mineral gold mains are predominantly sulphide minerals such as pyrite and chalcopyrite as well as quartz gangue minerals. Gold is distributed in the form of inclusions inside pyrite and chalcopyrite, free gold in quartz, and coexist between pyrite and chalcopyrite grains, pyrite and quartz grains (Fig.3).

To know the gold that cannot be seen on the microscope (invisible gold), we do SEM EDX analysis. This analysis was performed on 3 samples of polished thin section representing this vein. Minerals studied in this analysis are minerals, chalcopyrite, pyrite, and quartz in the vicinity of gold. This mineral is chosen because gold is generally present based on the results of mineragraphy analysis. Based on the results of SEM EDX gold found in chalcopyrite, pyrite, and quartz. However, the percentage of gold is very minimum, <0.01%. Meanwhile the limit of detection from SEM EDX analysis is 0.01%. But we can see in the curve that Au is present in the mineral although in a very low percentage (Fig.4)

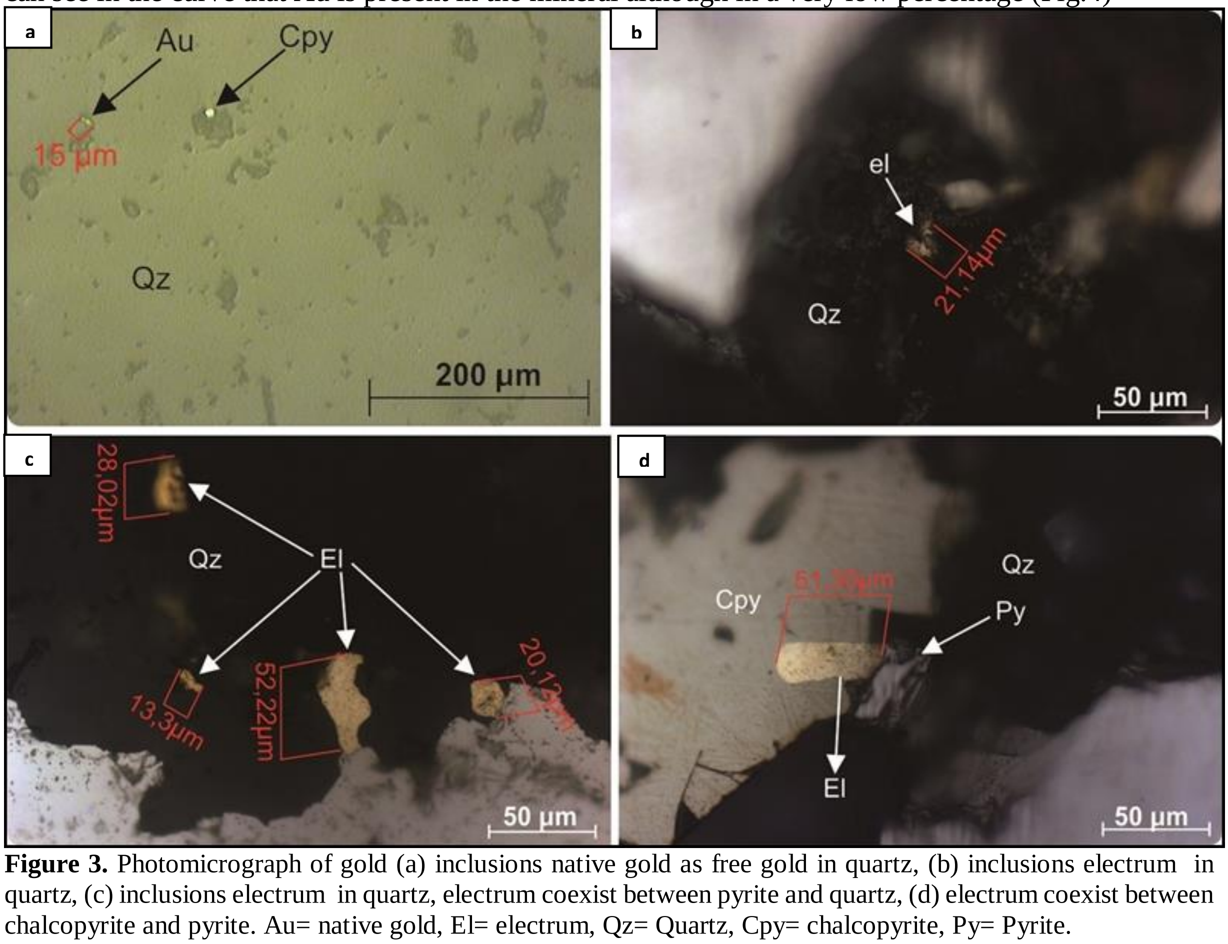

Figure 3. Photomicrograph of gold (a) inclusions native gold as free gold in quartz, (b) inclusions electrum in quartz, (c) inclusions electrum in quartz, electrum coexist between pyrite and quartz, (d) electrum coexist between chalcopyrite and pyrite. Au= native gold, El= electrum, Qz= Quartz, Cpy= chalcopyrite, Py= Pyrite.

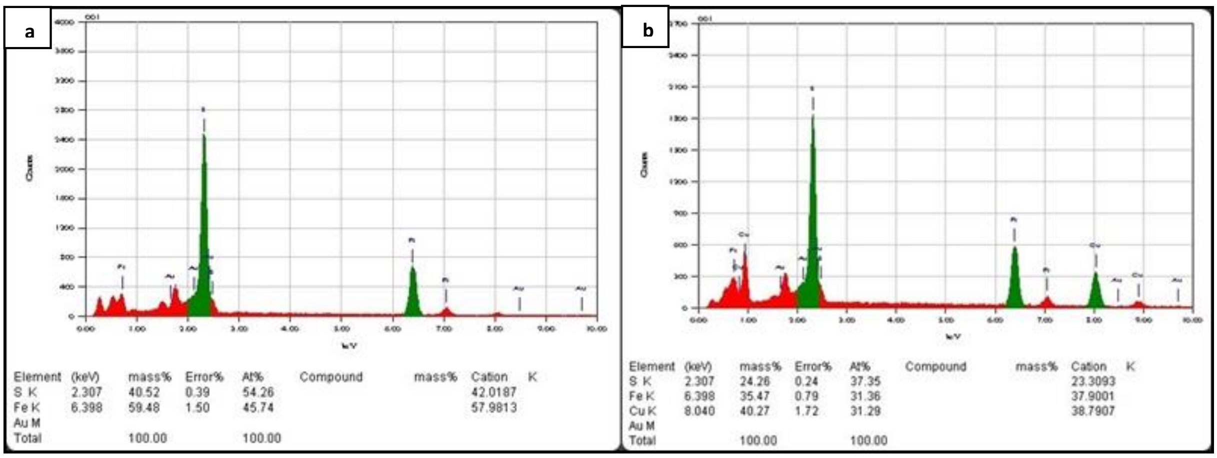

Figure 4. SEM EDX analysis graph (a) elements contained in pyrite, (b) elements contained in chalcopyrite.

L400-185

It has a direction of N 034° E/ 82°. Direction of the veins follow the direction of Fault Cipanggleseran ie horizontal fault with the direction of N-S. The product of this fault is indicated as the pathway where mineralization traps in the study area. The direction of this veins is a product of a tension joint.

Based on the results of mineragraphy 22 polished thin section on the vein L400-185, found gold on polished thin section. Gold is found in the form of native gold, which is bright yellow and bright yellow electrum but more dull than native gold with size 6.8-25.91 μm. Gold mineral minerals are dominated by sulphide minerals such as chalcopyrite and sphalerite and gangue minerals quartz. Gold is distributed in the form of inclusion in chalcopyrite and sphalerite, free gold in quartz (Fig.5).

To know the gold that can not be seen on the microscope (invisble gold) is done SEM EDX analysis. This analysis was performed on 2 samples of polished thin section that represented from this vein. Minerals studied in this analysis were chalcopyrite, sphalerite and quartz minerals in the vicinity of gold. This mineral is chosen because gold is generally present based on the results of mineragraphy analysis. Based on SEM EDX gold results found on chalcopyrite, sphalerite and quartz. However, the percentage of gold attendance is very small, <0.01%. While the detection limit of SEM EDX analysis is 0.01%. But on the curve comes Au as a marker that Au is present in the minerals studied despite having a very small percentage (Fig.6)

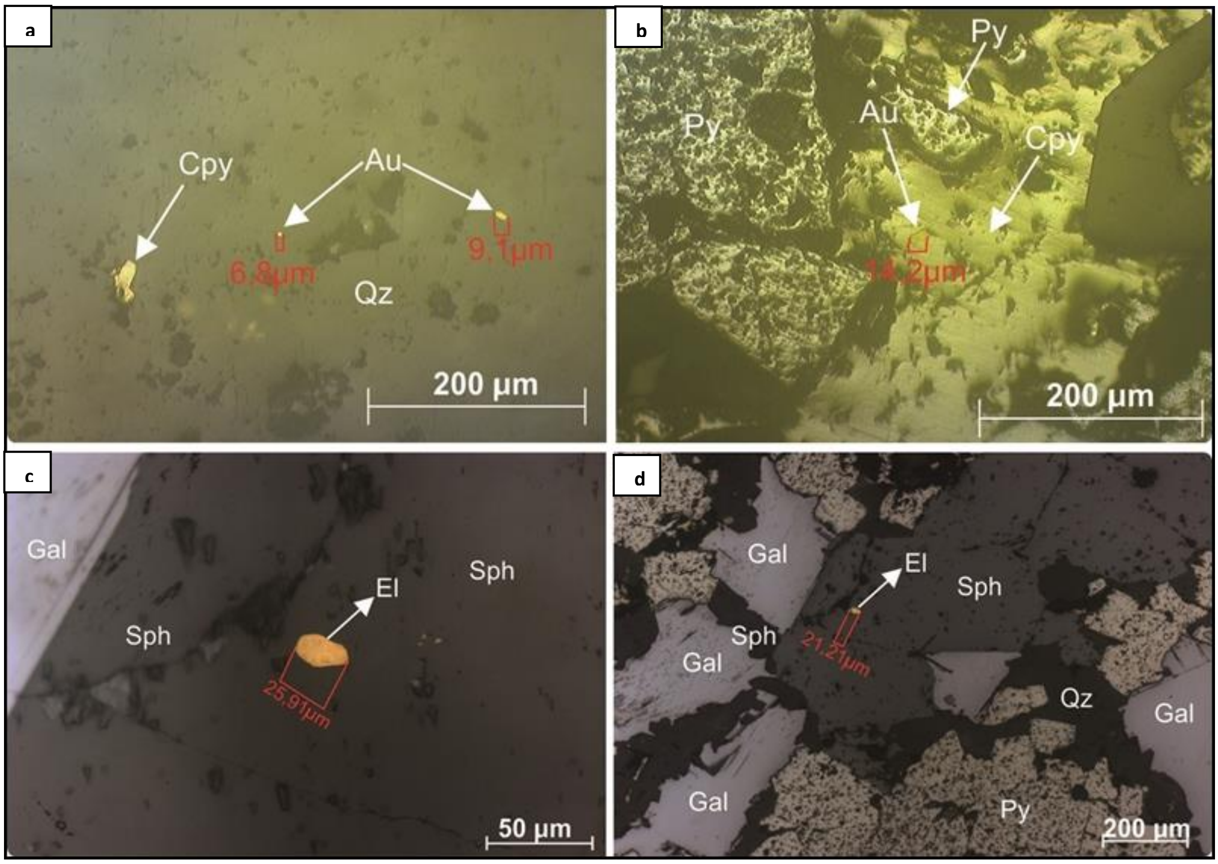

Figure 5. Photomicrograph of gold (a) inclusions native gold as free gold in quartz, (b) inclusions native gold in chalcopyrite, (c,d) inclusions electrum in sphalerite. Au= native gold, El= electrum, Qz= quartz, Cpy= chalcopyrite, Py= pyrite, Gal= galena, Sph= sphalerite.

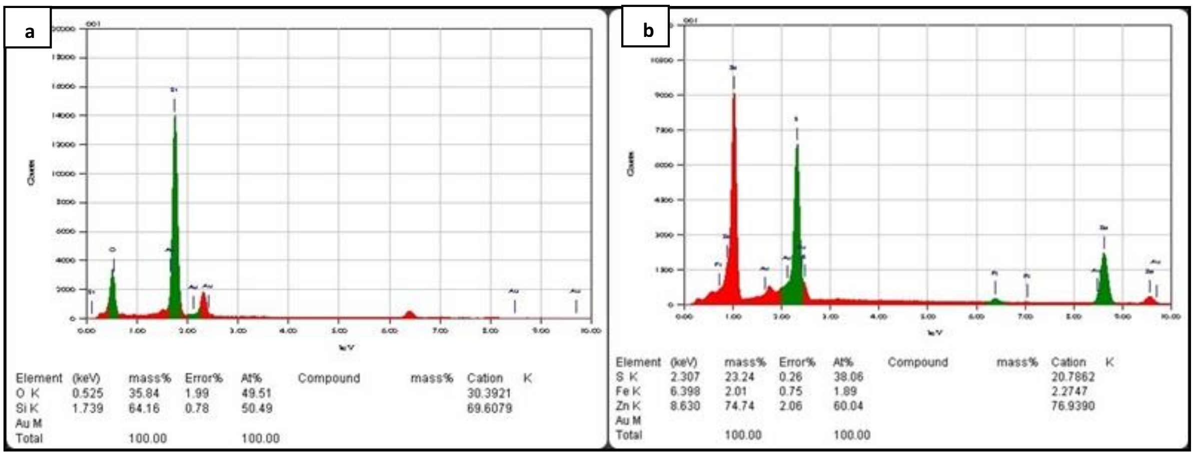

Figure 6. SEM EDX analysis graph (a) elements contained in quartz, (b) elements contained in sphalerite

L400-185 EK Cab 1

It has a direction of N 030° E/ 80°. Direction of the veins follow the direction of Fault Cipanggleseran ie horizontal fault with the direction of N-S. The product of this fault is indicated as the pathway where mineralization traps in the study area. The direction of this veins is a product of a tension joint.

Based on the results of mineragrafi 7 polished thin section on the vein L400 EK Cab 1, found gold on 2 polished thin section. Gold is found in the form of native gold that is bright yellow and bright yellow electrum but more dull than native gold with the size of 4.5-45 µm. Gold mineral minerals are dominated by sulphide minerals such as chalcopyrite, pyrite, sphalerite and quartz gangue minerals.

Gold is distributed in inclusions in chalcopyrite, pyrite, and sphalerite, free gold in quartz, and coexist between chalcopyrite and pyrite grains, chalcopyrite and sphalerite grains (Fig. 8).

To know the gold that cannot be seen on the microscope (invisible gold) is done SEM EDX analysis. This analysis was performed on 2 samples of polished thin section that represented from this vein. Minerals studied in this analysis are minerals, chalcopyrite, pyrite, and quartz in the vicinity of gold. This mineral is chosen because gold is generally present based on the results of mineragraphy analysis. Based on the results of SEM EDX gold found in chalcopyrite, pyrite with a very low percentage of gold presence, <0.01%. While the detection limit of SEM EDX analysis is 0.01%. But on the curve comes Au as a marker that Au is present in the minerals studied despite having a very small percentage. In quartz minerals gold present in on its elemental set with a percentage of 2.20%. (Fig.7)

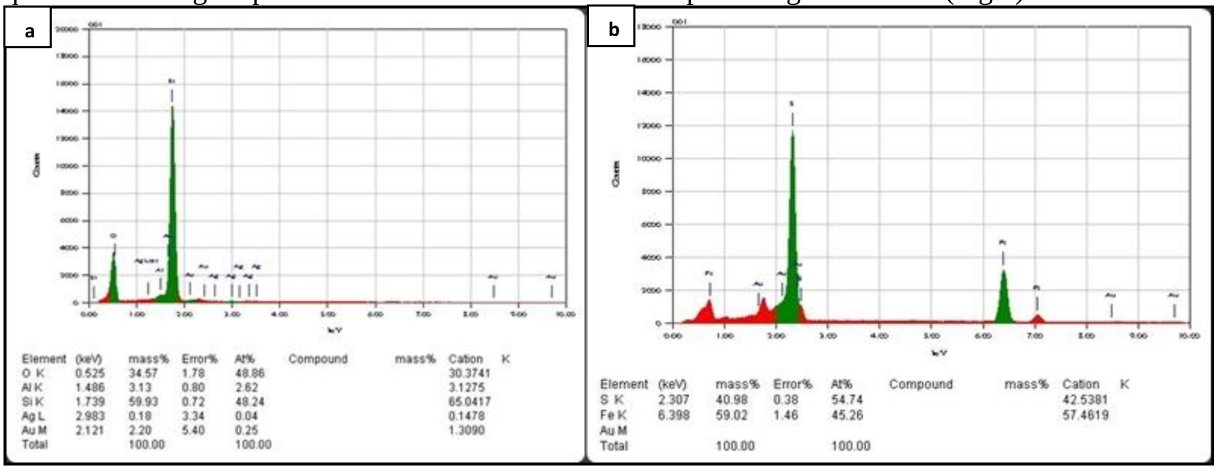

Figure 7. SEM EDX analysis graph (a) elements contained mineral quartz, (b) elements contained pyrite.

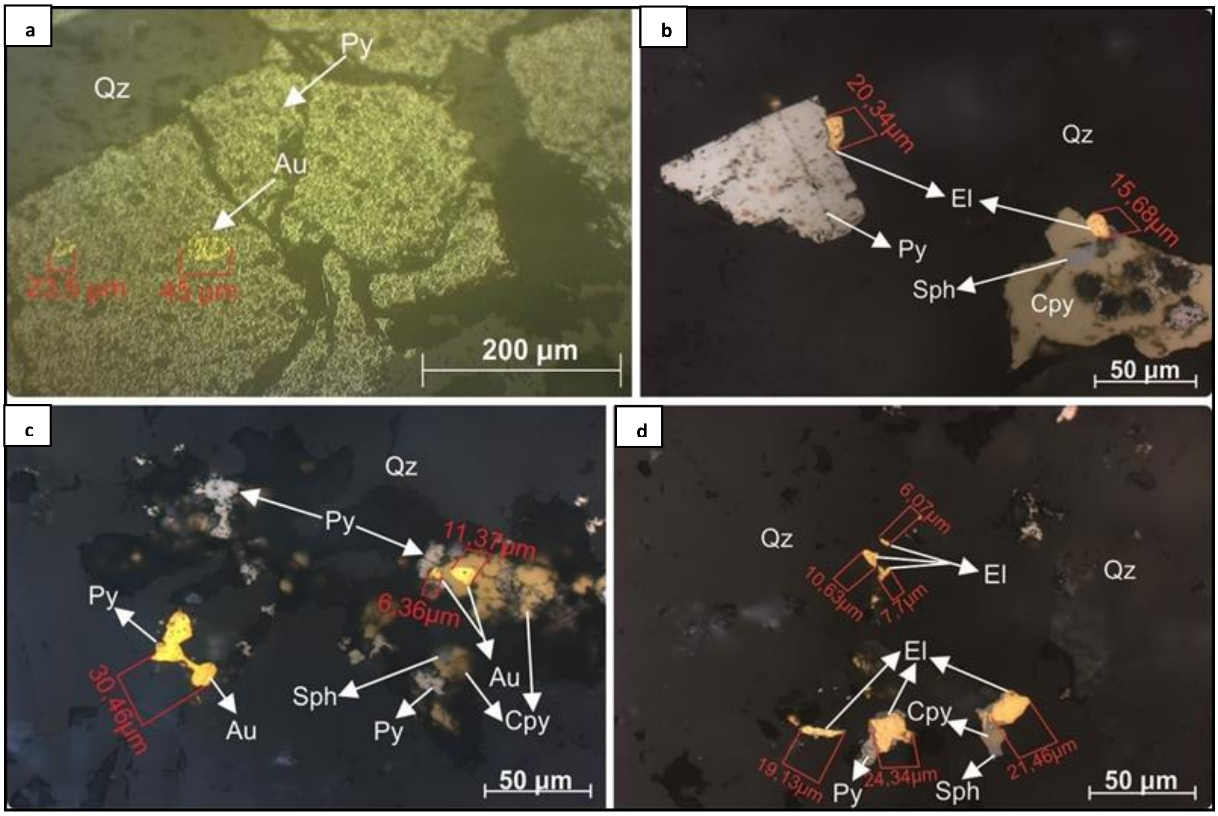

Figure 8. Photomicrograph of gold (a) inclusions native gold in pyrite, (b) electrum coexist in pyrite and quartz, coexist in chalcopyrite and sphalerite, (c) inclusions native gold in pyrite and chalcopyrite, (d) inclusion electrum in quartz “free gold”, inclusion in pyrite, electrum coexist in chalcopyrite and sphalerite. Au= native gold, El= electrum, Qz= Quartz, Cpy= chalcopyrite, Py= Pyrite, Sph= sphalerite.

4. Discussion

Based on the analysis and literature study, gold in the research area is presented as mineral native gold and electrum. In Indonesia, gold is generally formed as native gold and electrum. Visible gold is distributed in the form of inclusions and is coexist among sulphide minerals such as chalcopyrite, pyrite, and sphalerite, inclusion as free gold in quartz. Invisible gold is found only in quartz which has a percentage >0.01%, that is 2.2%. In L400-50 vein, many Au is distributed in the free form on quartz minerals in the form of inclusion and coexist gangue minerals quartz. In L400-185 vein, the Au is distributed on mineral sulfide and quartz almost evenly. Where as a whole is an inclusion. In L400-185 EK Cab 1 vein, gold is mainly distributed on sulphide minerals such as sphalerite, chalcopyrite and pyrite rather than quartz. Gold is also more widely distributed in the form of inclusions than among coexist of mineral grains. As for invisible gold only found in L400 EK Cab 1 vein on quartz mineral with gold content is 2.2% (Table 2). Large gold grain sizes generally reside in veins L400-50, while the small size is generally located in the vein L400 EK Cab 1.

Hydrothermal solutions containing H_2S (complex bisulfides) that cause an abundance of ore minerals, especially sulphide minerals, and the presence of inclusive gold as well as which coexist between the minerals sulphide on the vein in the study area that is a type of epithermal deposits. Bisulfide complexes are suitable ligands in solutions that having low salinity with reduced. The gold is then deposited when the bisulfide complex ion is distorted as a result of the boiling process, so the solubility of gold in the hydrothermal solution will decrease causing the gold to settle. The abundance of gold and metallic minerals in these three veins indicate that the study area is located in the vicinity and bottom of the boiling zone. Where boiling is the main process that produces gold in high epithermal deposits.

Gold is generally insulated and coexisted in mineral sulfide such as pyrite, chalcopyrite, and sphalerite which causes gold to be difficult to extract during gold processing. Unlike gold that is in the quartz has free characteristic. Special treatment is required for the separation of gold from these sulphide minerals

Table 2. Distribution the mineral gold mains in veins.

Vein	Visible Gold							Invisible Gold in qz (%)
	Au inclusion in qz	Au inclusion in py	Au inclusion in cpy	Au inclusion in sph	Au coexist in py and qz	Au coexist in py and cpy	Au coexist in cpy and sph	
L400-50	4	2	-	-	2	1	-	< 0.01%
L400-185	2	-	1	2	-	-	-	< 0.01%
L400 EK cab 1	4	8	3	9	1	-	1	2.2 %
Total	9	9	4	11	3	2	1	

Conclusion

Gold in the study area varies from 4.5-52.22 µm. Gold carrier mineral is native gold and electrum. In visible gold, gold is distributed in the form of inclusions and falls within the grain boundaries of the two minerals. The main gold minerals are mineral sulphides such as mineral pyrite, chalcopyrite and sphalerite, and quartz nonmetallic minerals. Invisible gold obtained only on the L400 EK Cab 1 vein in quartz minerals which has a gold presence percentage of 2.2%.

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