Identification of Potential Distribution of Gold Mineralization Zone of High Sulfidation Epithermal System using Time-Domain Induced Polarization (TDIP) and Magnetic Method at "N" Mountain Qrea

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Abstract. The high gold commodity as well as the Pongkor production field that has existed since decades ago made it necessary to find a new potential zone for gold mining production. To find out the zone of gold mineralization and its continuity, geophysical studies then conducted by using the methods of Time-Domain Induced Polarization (TDIP) and magnetic. TDIP data consisting of resistivity and chargeability data are interpreted to determine alteration zones and subsurface mineralization that are correlated with magnetic data that has been inversed in 3D to obtain susceptibility parameters. Based on the value of resistivity in the study area, the argillic alteration zones are thought to have a value of < 50 Ohm.m. Silicification alteration zones supposedly have the value > 50 Ohm.m. The value of the chargeability at the mineralized zone indicated has a value of 100-810 msec. Also, study in the area of the mineralized zone have a susceptibility value in the range of -0.073 to -0.021 cgs. From that parameter of the mineralized zone, it is assumed that the mineralization zone is in the eastern part of the study area and oriented North-South direction with the orientation of the main fault.

1. Introduction
Pongkor Field has been operating to produce gold since 1994 [1], so development is needed to find new reserves. Mount "N" is located close to the mining site that produces in Antam Pongkor. It is thought to have new reserve potential. Geological mapping shows the texture of vuggy quartz rocks on Mount “N”, which indicates high sulfide epithermal deposits [2]. These deposits have unique characteristics that distinguish them from other deposits. High sulfide epithermal deposits have more acidic properties than low sulfide, this is because the constituent fluid is dominated by magmatic fluid and only a few meteoric fluids. The process of deposition of gold minerals occurs in the cavity of the rock structure that causes the presence of this mineral is not concentrated in one place but spread[3]. Geophysics methods are needed to solve this problem. This study is used to determine the presence of mineralized zones with characters spread and also the relation with geological conditions of Mount “N” Area.
2. Geological Setting
Based on Geological observation, Rocks in the study area are dominated by pink tuff crystal and red andesite igneous rocks and also dacitic rocks at the edges of the study area. The volcanic rocks indicate there used to be a magmatism process which is closely related to the hydrothermal process [4]. Based on geological data, there are 4 faults that cut all units of existing rock [5]. Three of the faults are shown in Figure 1. From the existing structural patterns in the study area, there are 2 different deformation stages. The first stage causes a north-south oriented right fault, then the second phase of the fault is left-aligned which intersects the main fault and is oriented southwest-northeast. These two structures are thought to be the pathways for the release of several andesitic intrusions which are located following the distribution of the fault pattern.

3. Method
The data used in this study consists of resistivity, chargeability, and magnetic data. Resistivity and chargeability data are obtained from the measurement of the TDIP method using a dipole-dipole configuration because this configuration is very good at mapping the distribution of vertical and horizontal subsurface layers [6]. There are 3 measurement lines that have a distance of 100 meters for each line. The data was then processed by using software to create the resistivity and chargeability profile.

Meanwhile, the magnetic method is used by using the base-rover technique with a space between the measurement points is 25 meters and north-south oriented. The data is processed to get the 3D inversion and forward modeling display. In addition, the inversion will produce susceptibility parameters that will be classified as a gold mineralization zone.

4. Results and Discussion
In this study, the TDIP method is used to determine the presence of metal sulfide minerals carrying elements of gold (Au) and non-sulfide minerals in high epithermal systems. Gold deposits in the epithermal system can be identified by the presence of argillic and silicification alterations. The maps of Figure 1 shows that the study area is dominated by alteration of argillic silicification and alteration. Based on the value of resistivity and chargeability, the study area is divided into two alteration zones, namely alteration silicification, advanced argillic alteration and argillic alters which the authors combine into one argillic alteration unit. The division of alteration values can be seen in Table 1.
Table 1. The physical parameter's value for TDIP interpretation.

|                              | Resistivity (Ohm.m) | Chargeability (m.sec) | Metal Factor (ms/ohm.meter) |
|------------------------------|---------------------|-----------------------|-----------------------------|
| Silisification Zone          | > 50                | > 100                 | > 2500                      |
| Argillic Zone                | < 50                | > 100                 | > 2500                      |

The section of the 2D model shows the mineralized zone has a high value of chargeability and magnetic response, whereas the value of resistivity is low. The mineralization zone seems in a small area only (see Figure 2). The mineralization can occur in rocks that experience silicified and argillic alteration [7]. On-Line N-1 the mineralized zone is expected to occur in alteration silicification (which is marked in the red box of Figure 2) and argillic alteration (which is marked in black ones). The changeability value for path 1 has a value of 100 msec to 810 msec, the magnetic susceptibility has a low to moderate value in the range of -0.073 to -0.005 cgs.

In-Line N-2 (Figure 3) there is a body with resistive, presumably the presence of Vuggy Quartz with alteration silicification which causes a very high resistivity value. The Vuggy Quartz texture contained iron oxide ore minerals such as hematite minerals and gold-bearing sulfide minerals (Au) namely alunite minerals which have a high chargeability value. This alteration occurs in a range of 600-900 m and with a height of 400-500 m. Whereas in the East the dominant argillic alteration occurs with a low resistivity value. The value of metal factors on this track ranges from 500 to 10000 mohs/meter. Also in Line N-2 shows, that argillic alteration patterns have susceptibility.
values which tend to be low and alteration silicification as well. Silicified alteration with low susceptibility at a distance of 600 to 900 m is thought to have quartz content and become an association mineral from the presence of gold minerals.

![Figure 3](image_url)

Figure 3. Mineralization zone from interpretation of TDIP and magnetic data in Line N-2.

The Line N-3 (Figure 4) has a high resistivity value of above 50 to 100 ohm.m, which are located at a distance of 600-900 meters with a height of 400-500 meters with chargeability worth 100 to 500 ms. Whereas argillic alteration is on the East surface with a resistivity value of less than 50 ohm.m and with chargeability around 100 ms. The value of the metal factor on this track is 2000 to 10000 mho/meter.
Figure 4. Interpretation of TDIP and magnetic methods Line N-3.

The values of these three parameters are thought to be mineralized zones. Mineralized zone if seen in Figure 4. In two alteration zones, namely argillic alteration and silicification zone, this zone is thought to contain sulfide ore minerals such as enargite, hematite, magnetite, and pyrite minerals and hydrothermal clay minerals such as alunite, kaolinite, dickite illite which is dominant and is thought to have gold content [2].

Figure 5. Correlation each line

The 3D model in figure 5 can provide geometry and relation between parameter values that indicate mineralized zones. In 3D models using isosurface models from the results of magnetic 3D inversion and a cross-section of changeability. Also, High susceptibility indicates levels of iron content[8]. This is done because these two parameters are considered dominant in determining the mineralized zone. High susceptibility also shows If plotted into the structure map in the study area, it will show continuity from North to South in the same direction as the right-hand fault, the pattern can be seen in figure 5.
5. Conclusion

There is indicated a mineralized zone in the study area. The mineralized zone with a high sulfide deposit is characterized to have a low susceptibility value (-0.073 to -0.005 cgs), high chargeability (more than 100 ms) and low to high resistivity (less than 50 Ohm.m is the argillic alteration and resistivity more than 50 Ohm.m for silicified alteration). The subsurface model shows the suspected mineralized zone in the study area which is thought to be in the east of the measurement and is thought to be controlled by a horizontal fault oriented North-South.

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