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APPLICATION OF GEOELECTRIC METHOD TO DETERMINE THE DISTRIBUTION OF LIYANGAN TEMPLE IN CENTRAL JAVA

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Abstract, Application of Geoelectric Method to Determine the Distribution of Liyangan Temple in Central Java. *The Liyangan Site was buried on the slopes of Mount Sindoro in a fairly complete condition, with the Liyangan Temple and a residential complex. Knowing the existence of the temple and residential complex is very important in helping to reveal the history of the complex. The geoelectric method aimed to obtain the distribution towards the lateral and depth of the temple. This method provides an overview of the distribution of the Liyangan Temple and settlement based on differences in the resistivity properties of igneous rocks (as temple materials) and the surrounding rocks (alluvial or pyroclastic rocks from the eruption of Mount Sindoro). There are nine geoelectric lines in dipole-dipole confguration, consists of fve parallel and four perpendicular lines, with a spacing of 10 meters and n = 1-8. Res2DInv was used to process the geoelectric data. The results show that the resistivity values below the surface are classifed into four criteria, which are low resistivity with a value of <100 Ω.m is interpreted as soil, medium (100-490 Ω.m) as pyroclastic breccia lithology, high (490-2100 Ω.m) as volcanic breccia lithology, and high resistivity value of 2100 Ω.m is interpreted as andesite lava at a depth of 20-40 meters below the surface. The results also show that six lines have very high resistivity value anomalies (>2100 Ω.m) and are located on the surface to a depth of 4 meters, which are interpreted to be the remains of the foundation of the Liyangan Temple.*

Keywords: *Liyangan Temple, Resistivity, Geoelectric, Dipole-Dipole*

Abstrak. Situs Liyangan yang terkubur di lereng Gunung Sindoro ditemukan dalam kondisi yang cukup lengkap, yaitu terdapat Candi Liyangan dan kompleks pemukiman. Mengetahui keberadaan candi dan kompleks permukiman menjadi permasalahan yang sangat penting dalam membantu upaya mengungkap sejarah kompleks tersebut. Upaya untuk memperoleh distribusi ke arah lateral maupun kedalaman candi dilakukan dengan metode geolistrik. Metode ini memberi gambaran persebaran Candi Liyangan dan pemukiman, berdasarkan perbedaan sifat resistivitas batuan beku (sebagai bahan candi) dan batuan sekelilingnya (aluvial atau batuan piroklastik produk letusan Gunung Sindoro). Sebanyak sembilan lintasan geolistrik konfigurasi dipole-dipole diambil untuk bisa memetakan kondisi bawah permukaan. Lima lintasan sejajar dan empat lintasan yang tegak lurus, dengan spasi 10 meter dan n=1-8. Res2DInv digunakan untuk mengolah data geolistrik. Hasil penelitian menunjukkan nilai resistivitas di bawah permukaan digolongkan menjadi resistivitas rendah dengan nilai <100 Ω.m diinterpretasikan sebagai soil, medium (100-490 Ω.m) sebagai litologi breksi piroklastik, tinggi (490-2100 Ω.m) sebagai litologi breksi vulkanik, dan sangat tinggi dengan nilai 2100 Ω.m diduga sebagai lava andesit pada kedalaman 20-40 meter di bawah permukaan. Hasil penelitian juga menunjukkan bahwa enam lintasan memiliki anomali nilai resistivitas yang sangat tinggi (>2100 Ω.m) dan terletak di permukaan tanah sampai kedalaman 4 meter yang diduga merupakan sisa bagian dari pondasi Candi Liyangan.

Kata kunci: Candi Liyangan, Resistivitas, Geolistrik, Dipole-Dipole

1. Introduction

In Indonesia, many archaeological sites show the local community's culture at that time. One of these archaeological sites is the Liyangan Site, located on the slopes of Mount Sindoro, 8 kilometers from its peak, in Liyangan Hamlet, Purbosari

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Village, Ngadirejo District, Temanggung Regency, Central Java (Riyanto 2018, 2). The Regional Agency for Archaeological Research D.I. Yogyakarta Province (Balai Arkeologi Provinsi D.I. Yogyakarta) has conducted several studies at this site since 2009 and found that the Liyangan Site was once an ancient settlement. Part of the settlement was found to be complete. Balai Arkeologi Provinsi D.I. Yogyakarta classifies ancient settlements at the Liyangan Site into 3 areas: residential, worship, and agricultural.

The complete and well-defined remains of the ancient Liyangan settlements are shown in Figure 1, some of which are almost intact and comparable to modern villages. The ancient settlement of Liyangan was covered by material from the eruption of Mount Sindoro about 1,000 years ago. It is suspected that the people there have inhabited the location since the second century AD. This means that the Liyangan Site was continuously occupied by people for hundreds of years, from the second century to about the eleventh century AD (Riyanto 2018, 2). Among the remains of the Liyangan Site, the most prominent part is the ones used for worship, which were made of andesite rock, such as temples, petitions, Batur, and statues, indicating a Hindu religious background.

The andesite rock, the primary material for the archaeological object, has physical properties different from those of the deposits around the temple, which are alluvial products of Mount Sindoro. The difference in the physical properties of rocks causes differences in resistivity values. Resistivity parameters can be measured using geophysical methods, namely geoelectric methods.

Non-destructive geophysical methods are widely used to delineate archaeological sites (Piro 2008; Linford 2006; Lowe 2012). A combination of Ground Penetrating Radar (GPR) and electrical resistivity tomography was used to delineate the biblical Pisidian Antioch city (Balkaya et al. 2018), and the resistivity tomography method was used to solve

Figure 1. A and B are the locations of the new findings from the 2018 research, while I, II, III, and IV are the order of the steps of the worship area. Hitherto, four terraces have been found, other terraces will likely be found later (Source: Riyanto, 2018)

archaeological problems (Tsokas, Tsourlos, and Papadopoulos 2008; Linford 2006). The use of magnetic and GPR methods to investigate the Karnak Temple in Egypt was carried out by Abbas et al. (2005).

The geoelectric method was used to determine the existence of the Alassumur Site in Bondowoso Regency, which is made of bricks buried below the surface (Rochman, Widodo, and Adausy 2022, 12). The results show that the lithology of the study area consists of breccia, sandy clay, and andesite rocks. Each interval has a value of 26-33 Ω.m as sandy clay, 34-101 Ω.m as breccia, and 102-143 Ω.m as andesite. Anomalies associated with bricks have a resistivity value range of 19-25 Ω.m. In addition, it was also used by Rifqi, Dewi, and Leihitu (2023, 1) to delineate the Menapo Sungai Melayu II structure in the Muarajambi Temple area.

The geoelectric method (tomography resistivity) is perfect for delineating the existence of temples buried below the ground surface. The research on the identification of temple foundation rocks (andesite) subsurface around Badut Temple using the geoelectric resistivity method was conducted by Luthfin, Kurniawan, and Jufri (2020, 10). The study results showed that the temple foundation rocks (andesite) were at a depth of 0.5-1.5 meters, with the highest resistivity values compared to other rocks with rock resistivity values ranging between 33.87-66.8 Ω.m.

This study uses the geoelectric tomography method to determine the continuity and parts of the Liyangan Temple, which are still partially buried below the ground surface. It studies the nature of electricity flow in the earth's subsurface rocks based on differences in rock resistivity and its measured value distribution. The results of this research are expected to be helpful for the development of the Liyangan Site based on tourism, geoarchaeological, and educational aspects.

2. Method

The resistivity geoelectric method is used to determine the nature of resistivity on earth. This resistivity method uses an electrode configuration by injecting direct current (DC) into the earth through current electrodes and measuring through potential electrodes. This method assumes that geoelectricity is a large resistor (Lowrie and Fichtner 2020, 217). The medium under the earth's surface is not homogeneous, so there is a notion of specific resistance (resistivity) that depends on the installation of current and potential electrodes or the geometry factor (k), in addition to the measured voltage (V) and the current delivered (I) as written in the equation.

$$\rho = k\frac{\Delta V}{I}$$

ρ	: Specific resistance (Ω.m)
k	: Geometry factor
ΔV	: Electric voltage (mV)
I	: Electric current (mA)

In field measurements, the apparent specific gravity value depends on the measured specific gravity of the rock layers and the measurement method (electrode configuration). The constituent rocks in the earth that function as resistors can be measured simply by assuming that the medium is an isotropic homogeneous medium(Lowrie and Fichtner 2020, 216).

Resistivity measurement dipole-dipole configuration, where the two current and potential electrodes are separated by a distance a (Figure 2). The current and inner potential electrodes are separated as far as (na), with n being an integer. The variation of n is used to obtain a specific depth range, and the greater the n, the greater the depth. The level of range sensitivity in the dipole-dipole configuration is influenced by the magnitude of a and the variation of n (Loke 2004; Seidel and Lange 2007). The geometry factor (k) of the dipole-dipole configuration is k $= n(n+1)(n+2)\pi a$.

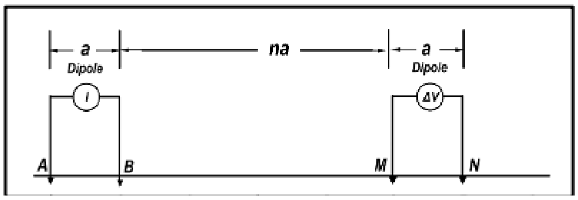

Figure 2. Dipole-dipole configuration
(Source: Seidel and Lange 2007, 217)

This research includes the stages of data collection, processing, and interpretation. This study uses a multi-channel Magusta Resistivity Meter and its equipment as a tool for quality control (QC) data. The Magusta has 24 channels that can be run simultaneously. Current delivery and measurement are automatically regulated. If the distance of the current electrode is close, then the current sent is slight, and the farther the distance, the greater the current sent. The data obtained from the measurement results are the distance of the current and potential electrodes, the datum points, the amount of current injected, the amount of potential measured, and the resistivity value. The data obtained in the field is still in the form of apparent resistivity. An inversion process is carried out to obtain the conditions in the subsurface using Res2DInv to obtain the actual resistivity distribution under the measurement path.

A literature review of this research is also conducted. After this data processing, the first step is to download the data file in DAT format. In the field data, there are values of A, B, M, N, n, V, I, SP, M, Q, and Rho. Then, open the Res2Dinv software and input field data to be processed. Several settings are made so that the data processing results are maximized. Next, three cross sections will be obtained: Measured Apparent Resistivity Pseudosection, Calculated Apparent Resistivity Pseudosection, and Inverse Model Resistivity Section. After the processing, the result is a subsurface resistivity cross-section of the research area. The resistivity cross-section of the processing results is then correlated with each other using Encom Discover software so that a cross-section correlation model will be obtained. In addition, a slicing model is carried out to obtain a horizontal slicing model so that the data results at a certain depth can be known later.

Furthermore, analysis and discussion are carried out on the results of data processing that has been obtained. Data interpretation stages are carried out through quantitative and qualitative interpretation. Quantitative interpretation aims to identify rock lithology in the research area based on resistivity classification and previous research. Qualitative interpretation is to identify each lithology obtained based on geological conditions in the research area.

Data collection was conducted at the Liyangan Site on June 18-20th, 2022. The research area covers about 10 hectares. Figure 3 is a survey design map, where the measurements were made with nine measurement passes with a line of 210 meters and 120 meters in length, with five southeast-northwest oriented measurement lines and four southwest-northeast oriented measurement lines. The perpendicular line design intends to obtain a more valid resistivity distribution map in the subsurface of archaeological objects in the area. Information on resistivity measurement data in the research area and the results of resistivity inversion on all lines are presented in Table 1.

3. Research Result and Discussion

3.1 Geology of Research Area

The research area is located on the flank of Mount Sindoro, Central Java. The Sindoro Volcano is included in the Solo Zone, as shown in Figure 4. The stratigraphy og the research area is divided into several rock units: the Volcanic Breccia Unit, the Pyroclastic Breccia Unit, and the Andesite Lava Unit (Van Bemmelen 1949, 14). The stratigraphic column at the Liyangan Site is shown in Table 2.

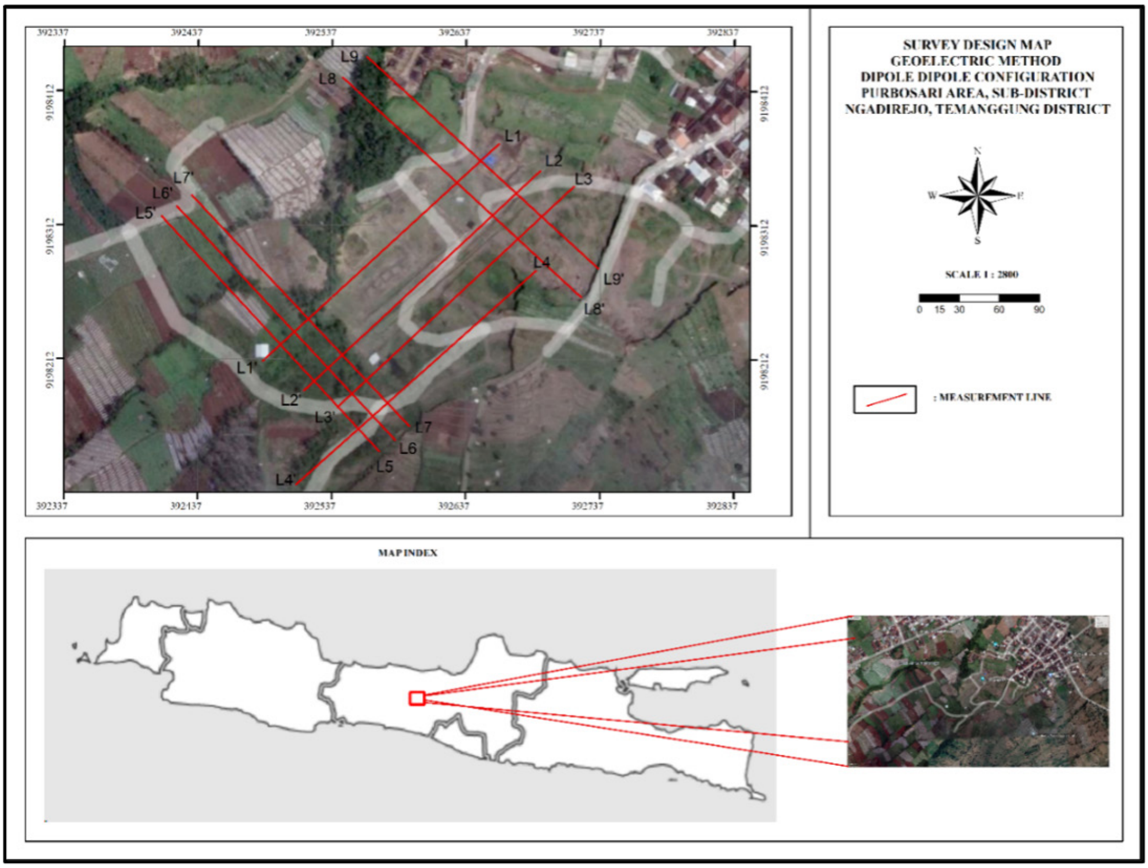

Figure 3. Survey design map, where there are nine intersecting lines (Source: Utama et al., 2022)

Table 1. Measurement line data and resistivity inversion results for all lines (Utama et al, 2022)

No	Line	Direction (N-E)	Length (m)	Minimum Resistivity Value (Ω.m)	Maximum Resistivity Value (Ω.m)
1	Line 1	230°	210	85.91	10049.24
2	Line 2	225°	210	40.46	6154.01
3	Line 3	225°	210	25.01	7977.10
4	Line 4	210°	210	65.71	10796.95
5	Line 5	315°	120	43.17	8051.20
6	Line 6	300°	120	105.6	9710.21
7	Line 7	300°	120	14.51	10887.21
8	Line 8	300°	120	40.07	11370
9	Line 9	295°	120	51.13	6445.73

The landscape and shape of the research area consist of upper (V1) and middle (V2) volcanic slope landform units (Figure 5). This landform unit was formed due to volcanic activity and occupies 37% of the landform area, including Tegalrejo Hamlet, Giripurno, and Katekan. It has a steep and deep valley shape, forming a "V" shape with lithology of lava, pyroclastic breccia, and volcanic breccia, which typically has a high resistivity. This landform is usually used for land for planting or cultivating trees, but it is also used for agricultural land. The middle volcanic slope landform unit occupies 63%, which includes Munggangsari, Banjarsari, Gunungsari, Banjarsari, and surrounding villages. This landform generally has a passive soil texture with a light brown to dark brown colour. It is sometimes covered with vegetation formed due to material from volcanic eruptions with the dominant lithology of pyroclastic breccia and volcanic breccia (Enggono and A.T. 2016, 23).

3.2 Resistivity of Inversion Result

Table 1 shows the inversion results of all lines. The data processing results on all lines show a resistivity range of 15 to 10.000 Ω.m. The resistivity value range is divided into four criteria: low, medium, high, and very high, as shown in Table 3. Table 3 also includes the results of the interpretation of subsurface lithology. The lithological interpretation results are based on the magnitude of the resistivity value and the rock outcrop data in the area.

The Liyangan Temple rock has the same

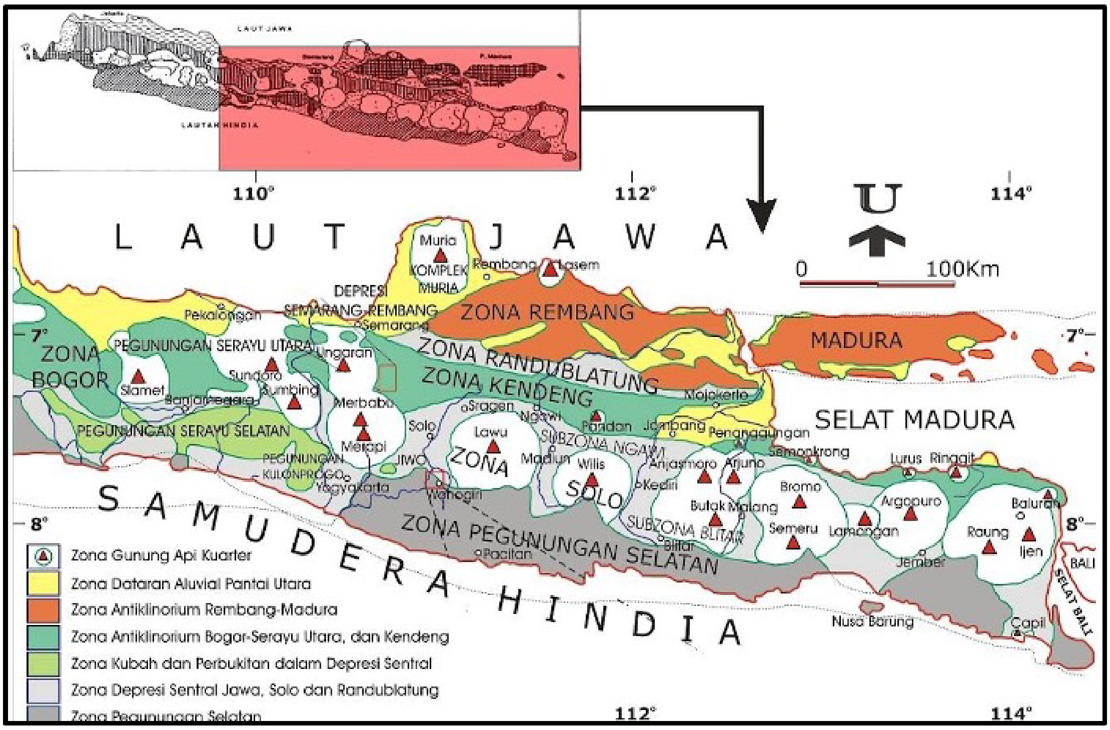

Figure 4. Physiography of Java Island (Source: Van Bemmelen 1949)

Table 2. Stratigraphic column of the research area (Source: Enggono and A.T. 2016)

Period	Epoch	Formation	Rock Unit Symbol	Lithostratigraphic Unit
Quaternary	Holocene	Alluvium Unit		Soil
		Sindoro Volcano Unit		Andesite Lava
				Pyroclastic Breccia
				Laharik Breccia

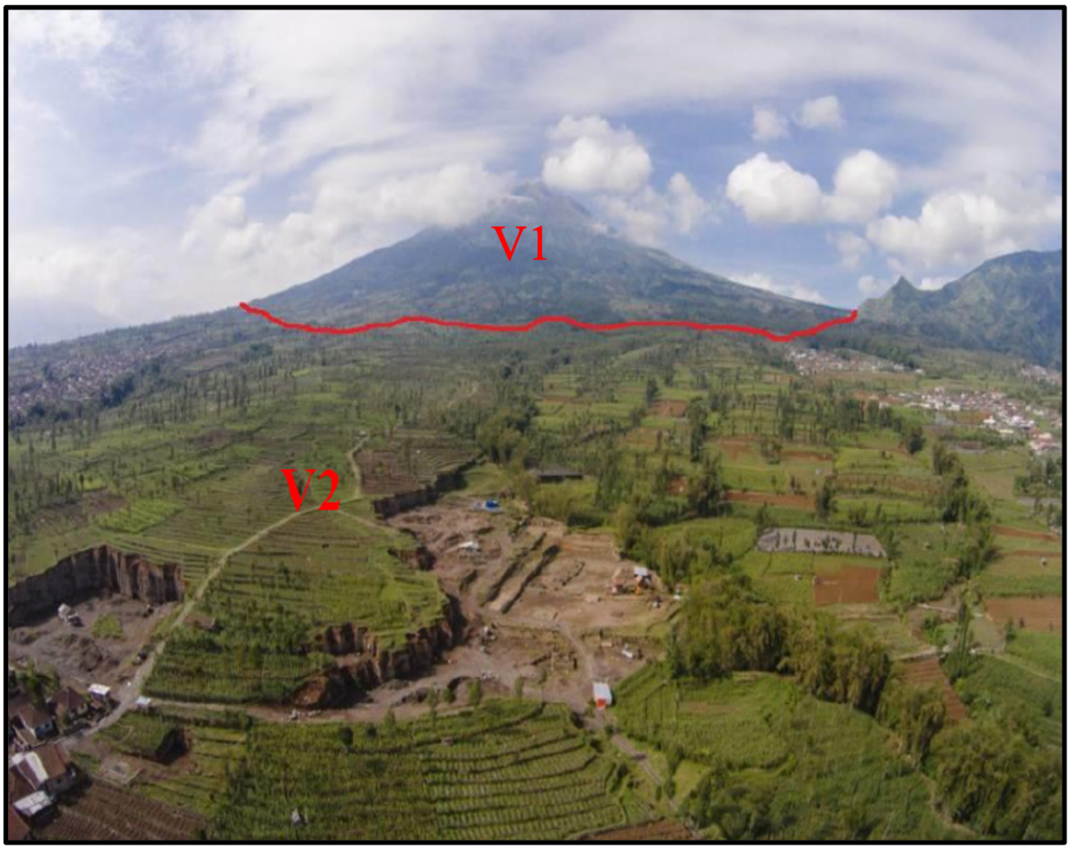

Figure 5. Landscape photo of the study area with the camera facing east, taken from Liyangan Village with camera direction N 232° E (Source: Enggono and A.T. 2016, 21)

Table 3. Resistivity value and interpretation of the lithology at research area (Source: Utama et al, 2022)

No	Classification	Value Range ρ (Ω.m)	Lithology
1	Low	< 100	Soil formation Alluvium Unit
2	Medium	100-490	Pyroclastic breccia formation of Sindoro Volcano Unit
3	High	490-2100	Volcanic breccia formation of Sindoro Volcano Unit
4	Very High	> 2100	Andesite lava and temple rock formation of Sindoro Volcano Unit

resistivity value as andesite lava rock. The difference between the materials of the Liyangan Temple and the underground andesite igneous rock can only be recognized by observing the presence at the location. The Liyangan Temple rock is found on the ground surface to a depth of 4 meters, while the andesite lava rock is more than 10 meters below the surface. In addition, the grouping of rock units in the research area is based on geological observations and previous research.

Soil lithology is seen to be associated with pyroclastic breccia and volcanic breccia lithologies. This phenomenon occurs due to exogenous processes. Exogenous is a force outside the earth's crust or interaction between the hydrosphere, lithosphere, and atmosphere. Weathering, erosion, and human activities are exogenous processes that play a role in its formation (Dearman 2013, 19). This pyroclastic breccia is thought to have originated from the fall deposits of the eruption of Mount Sindoro, which carried various materials that were transported to a place and lithified into breccia lithology with pyroclastic rock fragments. In addition, volcanic breccia lithology has a higher resistivity value than pyroclastic breccia because breccia rocks contain andesite and basalt rock fragments of medium sand-boulder sizes, which are then deposited and lithified in one place.

Furthermore, andesite lava lithology is found at an average depth of 10-450 meters. The andesite lava is thought to have been formed by lava flows that came out during the eruption of Mount Sindoro. This andesite lava has a massive structure and good rock compactness, so it tends to have a high resistivity value compared to lauric breccia and pyroclastic breccia. In addition, this andesite lava layer can be referred to as a bedrock layer because it underlies the volcanic breccia layer and pyroclastic breccia layer.

3.3 2D Resistivity and Lithology Cross-section

Only two of the nine geoelectric lines measured represent geoelectric measurements with geological conditions and archaeological evidence based on recent excavations, namely Line 2 and Line 5. Line 2 geoelectric dipole-dipole configuration has a length of 210 meters with electrode spacing of 10 meters. The azimuth of Line 2 is N 225° E with a direction of northeast to southwest. Not all line inversion results are shown in this paper because some lines are parallel and very similar to the discussed lines, and some have no outcrops.

The results of the lithology analysis based on the resistivity values obtained from the inversion of geoelectric data on Line 2 are shown in Figure 6. Figure 6A is the 2D resistivity inversion cross section model. Figure 6B is a 2D lithological distribution model based on the resistivity value, and Figure 6C is a photograph of Line 2 during data measurement. Figure 6A shows the range of resistivity values from 16 to 8292 Ω.m. Based on Table 3, low resistivity values have a range of <100 Ω.m shown in dark blue. Medium resistivity is 100-490 Ω.m, indicated by light blue to green colour clusters. High resistivity has a range of 490-2100 Ω.m indicated by yellow to brown colour outlines, and the very high is >2100 Ω.m indicated by red to dark red colour clusters. Figure 6B shows the difference in lithology based on the distribution of resistivity values. Based on Table 3, low resistivity as soil lithology, medium resistivity as pyroclastic breccia lithology, high resistivity as volcanic breccia lithology, and very high resistivity values at a depth of 20-45 meters are shown as andesite lava lithology.

The resistivity value >2100 Ω.m found on the surface to a depth of 2 meters is shown as an anomaly suspected of Liyangan Temple's remains. The Liyangan Temple rock has an andesite base material with a massive structure and good rock compactness; therefore, it has a high resistivity value. It can be concluded that the anomaly is suspected to be a remnant of Liyangan Temple in the form of an ancient road located from 30 meters to 190 meters. The community allegedly used this ancient road to connect residential, agricultural, and worship areas (Riyanto 2018). The condition of the ancient road of Liyangan Site is shown in Figure 6C.

Line 5 geoelectric dipole-dipole configuration has a length of 120 meters with a spacing distance between electrodes of 5 meters. The azimuth of Line 5 is N 315° E with a direction of southeast to northwest.

The results of the lithology analysis based on the resistivity values obtained from the inversion of geoelectric data on Line 5 are shown in Figure 7. Figure 7A is the 2D resistivity inversion cross section model, Figure 7B is a 2D lithological distribution model based on the resistivity value, and Figure 7C is a photograph

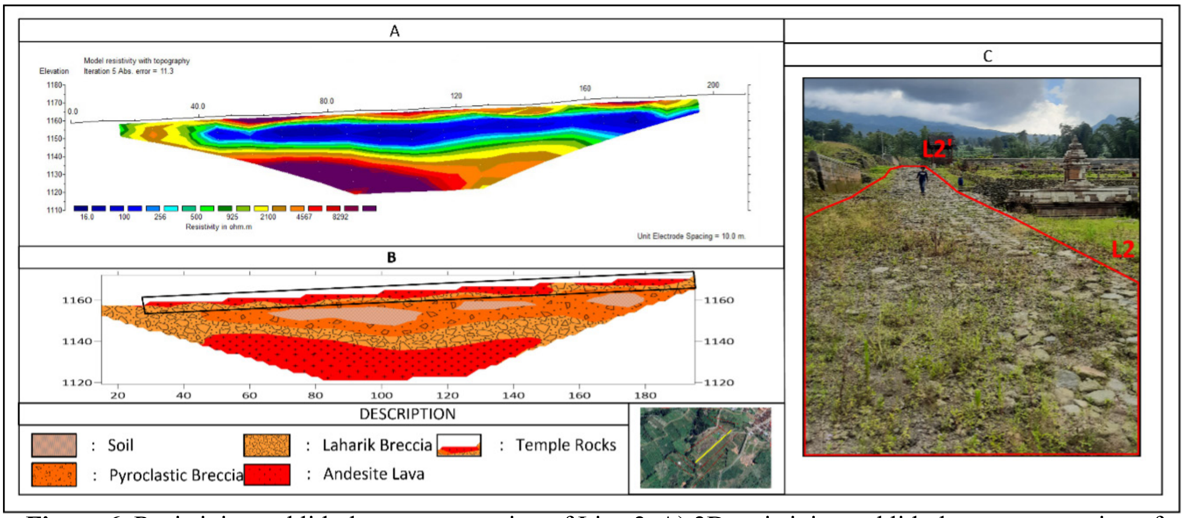

Figure 6. Resistivity and lithology cross-section of Line 2, A) 2D resistivity and lithology cross-section of the line, B) 2D lithology distribution model based on resistivity value, and C) Photo of Line 2 during data measurement (Source: Utama et al., 2022)

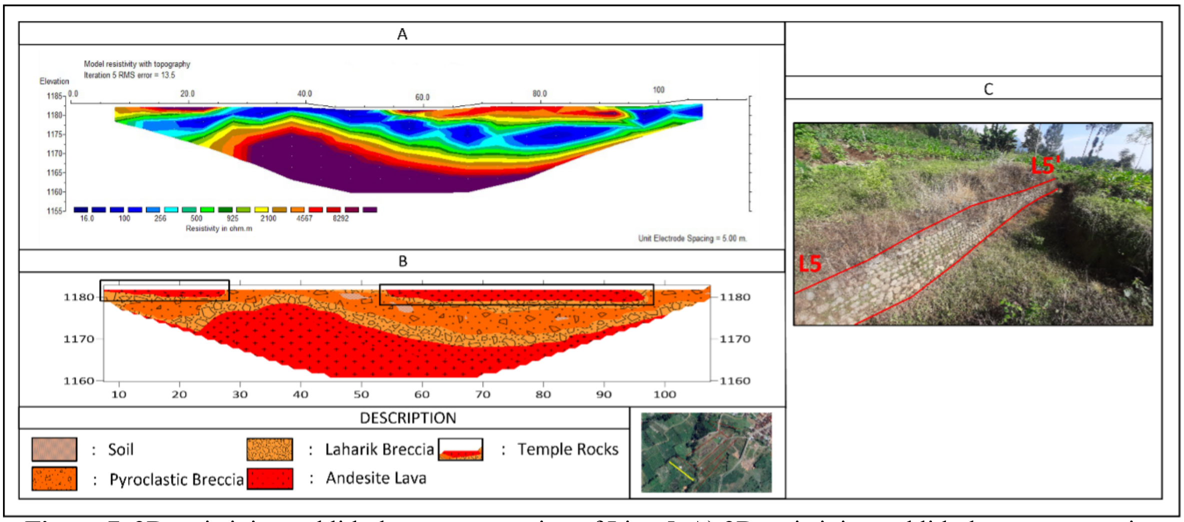

Figure 7. 2D resistivity and lithology cross-section of Line 5, A) 2D resistivity and lithology cross-section of the line, B) 2D lithology distribution model based on resistivity value, and C) photo of Line 5 during data measurement (Source: Utama et al., 2022)

of Line 5 during data measurement. Figure 7B shows the difference in lithology based on the distribution of resistivity values. The resistivity value >2100 Ω.m found on the surface to a depth of 4 meters is considered temple rock. The Liyangan Temple rock has an andesite base material with a massive structure and good rock compactness, so it has a high resistivity value. It can then be concluded that the anomaly is suspected to be a remnant of Liyangan Temple in the form of a landslide retaining dike located at a distance of 5-28 meters and 55-95 meters. This landslide retaining dike was allegedly used by the community at that time as a retaining layer of soil above to prevent landslides. The landslide retaining dike located at 55 to 95 meters is excavated (Riyanto 2018). In comparison, the anomaly located between 5 to 28 meters is considered a landslide retaining dike that is still in the ground or has not been excavated. The condition of the landslide retaining dike on Line 5 of Liyangan Site can be seen in Figure 7C.

3.4 2D Resistivity Cross-Section Correlation

Figure 8 shows the correlation between 2D resistivity cross sections overlaid with satellite images of the Liyangan Site area. Based on this, Figure 8 shows that each 2D resistivity cross section of each line has almost the same lithological layer pattern. The anomalous distribution of very high resistivity values, suspected of being the remains of the Liyangan Site, is distributed on the line's surface to a depth of 4 meters. As with Lines 2 and 5 described in Figures 6 and 7, the excavated remains of the Liyangan Site show very high resistivity values and have a suitable location for data collection so that they can be a reference in identifying anomalies suspected of being the remains of the Liyangan Site on other lines. Lines 1, 2, 4, 5, 6, and 8 have these anomalies, while Lines 3, 7, and 9 do not.

The pattern of lithological layers of each line from the top is soil, pyroclastic breccia, volcanic breccia, and andesite lava. In some passes, soil lithology is associated with pyroclastic breccia lithology. This indicates an endogenous process that affects both lithologies, resulting in the soil lithology having a low resistivity value. The pyroclastic breccia lithology comes from the fall deposits of the eruption of Mount Sindoro, which carried various pyroclastic materials that were transported and lithified into breccia lithology with pyroclastic rock fragments overlaying the layer below, namely volcanic breccia lithology. The volcanic breccia lithology has andesite and basalt rock fragments, so it has a high resistivity value and overlaps the andesite lava lithology as the oldest layer.

The Liyangan Temple is divided into three areas: the settlement area as the community's residence; the agricultural area to produce the staple food of the community at that time; and the worship area for the place of worship of the community. The location of the Liyangan Site is on the northeastern slope of Mount Sindoro at 1174 meters above sea level. Based on the lithostratigraphic review in Table 2, the Liyangan Site is located in the volcanic slope geomorphic unit (V2) and the medial facies of the volcano, it can be seen that in the area of the current Central volcanic slope geomorphological unit (V2), there are many villages. Subsequently, excavation activities conducted by Balai Arkeologi Provinsi D.I. Yogyakarta in 2013 yielded archaeological findings in the form of rice grains and corn

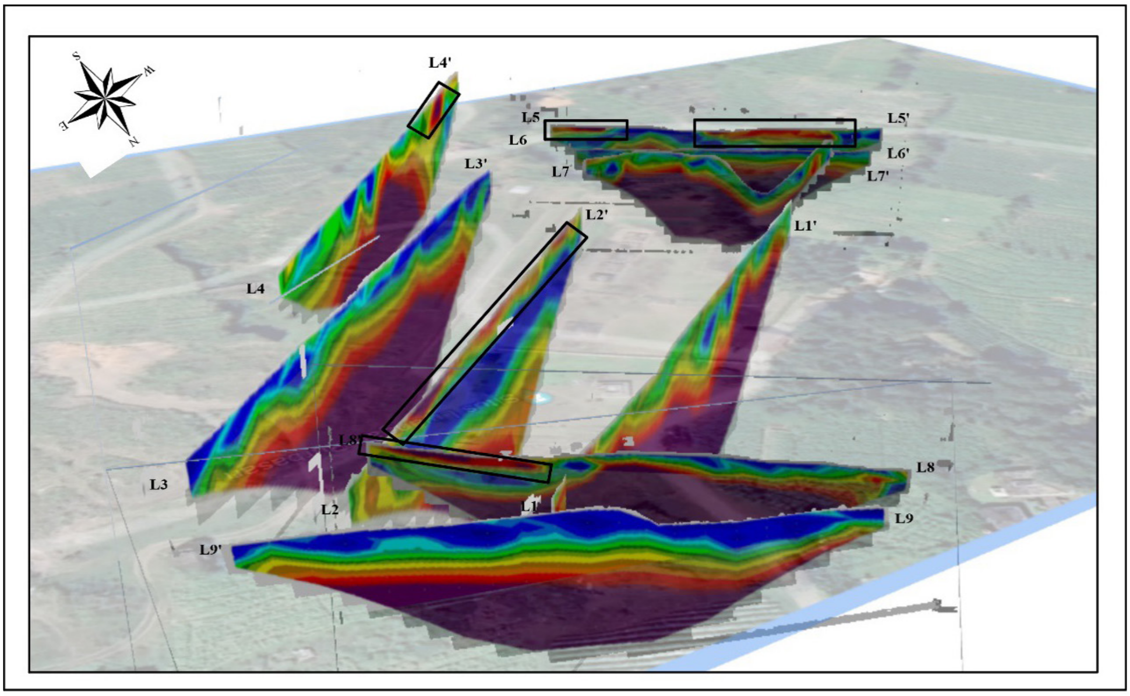

Figure 8. Correlation of 2D resistivity cross section of the Liyangan Site area (Source: Utama et al, 2022)

seeds, indicating agricultural activities during the ancient Liyangan community (Riyanto 2018, 10). The Liyangan community currently utilizes land in the area with the shape of the middle volcanic slope (V2) mainly for agricultural areas, especially tobacco farming and food crops such as rice. Based on this, soil fertility factors and the availability of abundant water resources were likely to be the main determinants for agricultural activities at that time.

Based on Soekmono's theory, a temple can be interpreted as a building erected by a person or group to worship something considered beneficial. Conceptually, a temple is the abode of the gods. In Hindu cosmology, the abode of the gods is at the top of a mountain known as Mount Meru, so a temple was built as a replica of the mountain to "facilitate" the worship of the gods. Because of the sacredness of this building, there are important components to the building of a temple, such as the selection of the land on which the temple will be built. The temple cannot be built in any place, but must be in a place favored by the gods (Soekmono 1995).

Besides the possibility that the temple was built as a fundamental element in a city, in addition to residential areas, agricultural areas, and mobilization areas in the form of roads, there are specific considerations underlying the choice of location on the volcano's slopes. About the geological conditions of the Liyangan Site, the temple was constructed of andesite rock, which is readily available around the temple area and has a quality that is not easily weathered by weather conditions. In contrast, the temple's base is made of pyroclastic breccia rock.

3.5 Horizontal Slicing of 2D Model of Liyangan Temple

The horizontal slicing map of the 2D model of the Liyangan Site is overlaid on the topographic map of the research area shown in Figure 9 at the surface depth shown in Figure 9A and at a depth of 2.5 meters shown in Figure 9B. This horizontal slicing model shows the distribution of very high rock resistivity values (>2100 Ω.m). Based on Table 2, these are the Liyangan Temple rocks based on andesite. Figure 9 shows that lines 1, 2, 4, 5, 6, and 8 have red colored outlines as anomalies suspected to be the remains of the Liyangan Site. There are no anomalies on the other lines, namely 3, 7, and 9.

Figure 9A and Figure 9B have almost similar closures and the same distribution pattern of resistivity values. The difference is that it is in line at a distance of 5-15 meters, with a red closure. The closures have anomalously high resistivity values, so they are thought to be relics of the Liyangan Site. Line 1 (L1-L1') has an anomaly at 140-150 meters at a depth of 20-40 meters. Line 2 (L2-L2') has a red outline that is strongly suspected to be an ancient road, as some parts have been excavated at a distance of 30-190 meters. Line 3 (L3-L3') has no red outline, as based on archaeological data, Line 3 is an ancient agricultural area. Based on archaeological data, Line 4 (L4-L4') belongs to an ancient agricultural area. However, a red-colored cloche was found at a distance of 175-185 meters, which is suspected to be the remains of the Liyangan Site. Line 5 (L5-L5') has a red outline that lasts at a distance of 5-28 meters and a distance of 55-95 meters. Interestingly, at a distance of 5-28 meters, the remains of the Liyangan Site have been excavated and are strongly suspected to be a landslide retaining dike. The red-colored closure at a distance of 55-95 meters is suspected to be a canal of the landslide retaining dike. On-Line 6 (L6-L6'), there is an anomaly at a distance of 35-40 meters. Line 7 (L7-L7') does not have a red border. Line 8 (L8-L8') has an anomaly at 75-105 meters. Line 9 (L9-L9') does not have a red border.

Figure 9 shows the distribution of Liyangan Temple rock remains in the research area. This can develop further excavation activities at the

Liyangan Site to learn about the history of the ancient Liyangan community. The identification of the archaeological site's remains can be used as a reference in the development of the Liyangan Site based on aspects of tourism, geoarchaeology, and education.

4. Conclusion

Based on the research results, the subsurface condition of the Liyangan Site has a diverse distribution of resistivity values and lithological types. Low resistivity with a value of <100 Ω.m is interpreted as soil and medium lithology with a value of 100-490 Ω.m as pyroclastic breccia

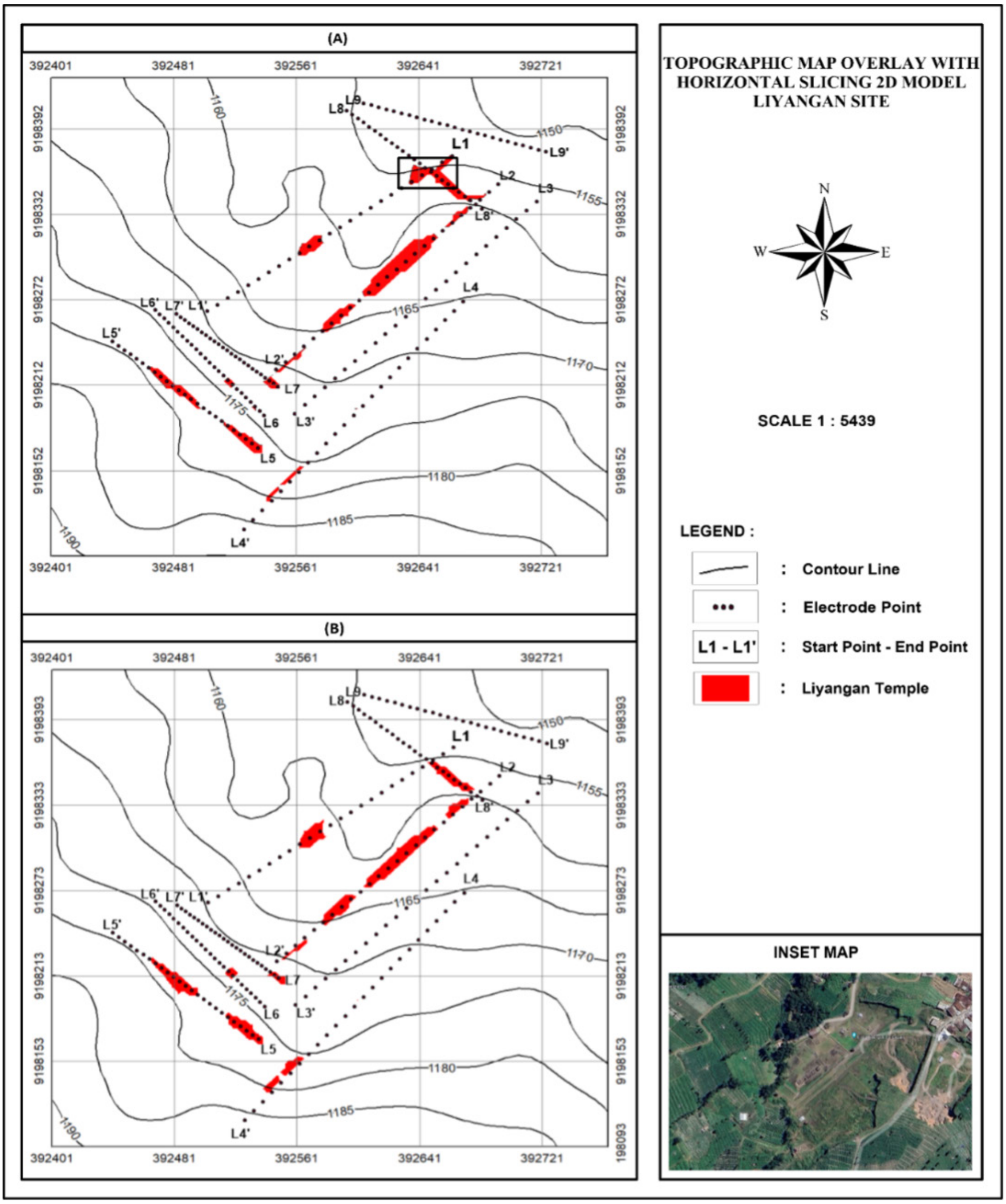

Figure 9. Horizontal slicing map of 2D model of the Liyangan Site, A) Surface level, B) 2.5-meter depth

lithology. High resistivity with a 490–2100 Ω.m value as volcanic breccia lithology. The very high resistivity value is >2100 Ω.m, interpreted as andesite lava lithology at 20–45 meters deep and as a rock remnant of Liyangan Temple. Based on the correlation of the 2D resistivity cross section and the horizontal slicing map of the Liyangan Site model, it shows that there is a distribution of high resistivity values as anomalies on the surface to a depth of 4 meters, which is thought to be the remains of the Liyangan Temple.

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