Geosciences Contribution in Kidang Cave Archeological Site Blora, Central Java - Indonesia

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Introduction

(Fig.1)

Kidang Cave is a karst area located in Rembang Hills, part of the anticlinorium zone in the northeast of Java Island which extends east-west. Kidang Cave lithology is dominantly calcarenite and fragmental limestone which is Middle Miocene-late Miocene age (10 to 5 ma) as a component of Bulu Formation (fig.3).

Cave Kidang (fig.1) located under the ground, formed as dolina (fig.2a). There are two caves (fig.2b) facing each other with a distance of about 50 m, which are Cave Kidang A (western cave) and Cave Kidang AA (northeastern cave).

(Fig.2a)

Kidang Cave section (seen from side).

(Fig.2b)

Kidang Cave section (seen from above).

(Fig.3)

Geophysical Methods for Investigation

Geophysical surveys conducted in Kidang Cave area, including Ground Penetrating Radar (GPR), Geoelectrical and Geomagnetic.

Ground Penetrating Radar (GPR)

GPR consist of two antennas, the transmitting antenna (Transmitter) and the receiving antenna (Receiver). Reflection of electromagnetic waves (EM) emitted by the transmitter is received by the receiver, both are on the ground (fig.4 and fig.5). EM emitted waves pass through the interface (boundary plane) between two mediums (rock, concrete, water, metal, etc.) that have a dielectric permittivity value or contrast different dielectric constants. These EM wave reflections are imaged as radargrams (fig.6) which can be directly observed on the monitor screen of the GPR digital control unit when data retrieval takes place in general.

(Fig.4)

(Fig.5)

(Fig.6)

(Fig.7)

Sediment layers and hidden artifact objects have a unique physical and chemical composition that can affect the speed of electromagnetic waves (electrical conductivity and magnetic permeability).

Differences or variations in the received waves produce sub-surface image patterns that indicate the existence of objects, cavities, changes in the physical properties of the layers, etc. as an indication of archeological features plotted on the map (fig.7), interpreted as artifacts object (fig.8).

(Fig.8)

Geoelectrical

Geoelectrical survey is carried out by recording the electrical potential (V) arising from current (I) injected into the ground (fig.9). Geoelectric survey result is the resistivity value (ρ) of the subsurface material. Acquisition of geoelectric data can be seen at (fig.10)

(Fig.9)

(Fig.10)

Changing the distance of electrodes A and B results in an image of the distribution of resistivity values to depth, the greater the distance between electrodes A and B, the deeper the penetration will be. To obtain a variation in resistivity distribution laterally using multi electrode laterally array (fig.10) and additional instrument is used, namely automatic switching box that adjusts the change of the electrode position laterally.

(Fig.11)

The western part of the Kidang Cave has a thicker soft sedimentary layer compared to the central, eastern, and northeastern parts. The soft sediment thickness in the west is about 6 meters (fig.11 top) and in 2 meters in the center, east, and northeast.

(Fig.12)

Geomagnetic

(Fig.13)

(Fig.14)

Geomagnetic method is one of the geophysical methods that can be used to identify subsurface structures. Geomagnetic data is based on the rock magnetic susceptibility. Therefore, the effectiveness of this method depends on the magnetic susceptibility contrast of rocks below the surface. Geomagnetic investigations are carried out using two (2) sets of magnetometers, one tool is used to record magnetic station variations (fig.13), while the other one used for measurements on the field (fig.14). Readings at the base station are set every 1 minute because the survey area is not too wide. This data is then used to make diurnal correction. Each point is measured twice in order to maintain data quality during data acquisition.

(Fig.15)

Conclusion

GPR

Effective investigation of GPR is carried out on the surface of the dry media. The hyperbole pattern detected has a different amplitude, this can be seen from the brightness of the hyperbolic anomaly that is seen. The clearer the anomaly detected, means the contrast between the object sought and the surrounding environment (soil) is very high, for example hard rock. The width of a large hyperbole can indicate the diameter of an object below the surface is also relatively larger. Anomalies that are detected need to be clarified / verified in the form of manual excavation.

Geoelectric

Geoelectricity can map the Geomorphological conditions of the Kidang Cave, but cannot find the remaining archeological material that has small anomalies. In general, soft rocks are on the KDG01 path which may consist of sediments from water that pass through Kidang Cave when the rain inundates the cave in the rainy season. From the paths of KDG02, KDG03, and KDG04 it can be concluded that sediments have a thickness of 2-4 meters which can be seen from the value of low rock resistivity (blue). While the high resistivity value under the sediment is interpreted as limestone, and debris from the cave.

Geomagnetic

Yellow to red is a magnetic anomaly that has a high value, a high value in (fig.15 Kidang Cave Magnetic Signal Analysis Map) can be interpreted as artifacts of limestone buried under sediment or can also be interpreted as a archeology object that are buried by the sedimentary deposit.