PRECISE MAPPING OF GEOTHERMAL POTENTIAL OVER SEMBALUN PROSPECT USING GEOMAGNETICS AND REMOTE SENSING

Teti Zubaidah*[1, 2], Rosmaliati[1], Bulkis Kanata[1] and Cipta Ramadhani[1]

[1] Dept. of Electrical Engineering, University of Mataram, Mataram, INDONESIA.
[2] Magister of Disaster Mitigation, University of Mataram, Mataram, INDONESIA.
(E-mail: tetizubaidah@unram.ac.id)

The urgency of providing renewable energy has escalated due to the depletion of fossil fuel resources. Lombok Island exhibits significant geothermal energy potential, particularly in the vicinity of Mount Rinjani, known as the Sembalun prospect. Despite previous research efforts indicating this potential, detailed mapping necessary for exploration has been lacking. This study employs geomagnetic surveys conducted by the University of Mataram since 2004, complemented by remote sensing techniques, to precisely identify geothermal hotspots in the Sembalun prospect. Geomagnetic ground measurements were taken at 138 points, while Landsat 8 satellite imagery was utilized to determine land surface temperature and vegetation indices. The results reveal three negative geomagnetic anomaly closures coinciding with areas of sparse vegetation and high surface temperatures, covering approximately 6.5 km^2 in Sembalun Bumbung, Sembalun Lawang, and Sajang villages. These findings suggest substantial geothermal potential suitable for direct use, particularly in supporting agricultural and tourism sectors. Further refinement through integration with gravity data is recommended for a comprehensive subsurface interpretation.

Key words: Geomagnetic, Geothermal, Remote Sensing, Sembalun

INTRODUCTION

Providing renewable energy has become a basic need to support human life, since scarcity of fossil energy resources. Previous studies show that the Lombok island has huge geothermal energy potentials [1-3]. However, these potentials could not been exploited up today, due to unavailable detailed mapping that can be used as a convincing basis for explorations. Geomagnetic surveys have been carried out by a research team from the University of Mataram since 2004, to obtain a comprehensive picture of geomagnetic anomalies over the Lombok island [4]. Furthermore, [5, 6] have created integrated modelling based on new magnetic data and gravity anomalies over the Lombok island and surrounding areas, which interpretations shows huge geothermal potential in the area around Mount Rinjani, namely Sembalun prospect. In order to exploit this potential, further research has to be carried out towards geothermal exploration activities.

METHODS

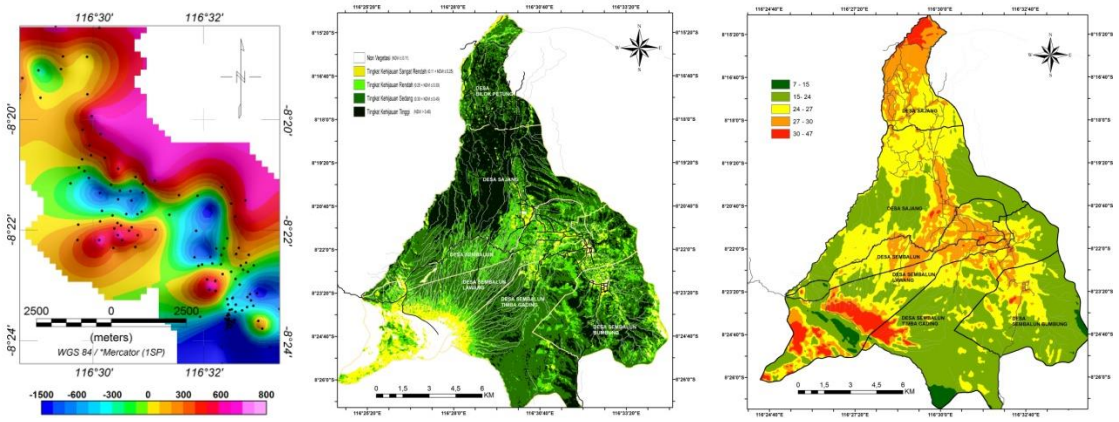
Geomagnetics method was chosen based on the results of previous researches, which have been able to map the potentials based on geomagnetic anomaly patterns in some parts of Sembalun prospect [7, 8, 9]. While remote sensing method was chosen to reconfirm the results of previous researches. An integrated combination of the two methods will produce more precise estimations of geothermal potentials with a higher level of confidence, therefore more convincing to proceed to the exploration stages.

Geomagnetic ground measurements were carried out at 138 points, spreading almost evently over Sembalun prospect. For each point, one-minute data were taken for at least one hour, to obtain 60 data with good qualities. The results measurements are in the form of geomagnetic intensity data, which are then carried out by data processing, namely diurnal correction for daily variations, IGRF correction, and upward continuations.
Remote sensing method refers to the standard of satellite imagery processing to determine land surface temperature [10]. Landsat 8 satellite imageries and Digital Elevation Model were obtained from USGS-EROS. At the pre-processing stage, radiometric corrections were carried out to correct and minimize atmospheric disturbances (such as fog and smoke) in satellite imagery recording. At the processing stage, image processings were carried out to obtain the distribution of Normalized Difference Vegetation Index (NDVI) and Land Surface Temperature (LST) values. The results of LST are the land surface temperature in degrees Celsius. Areas with high LST values can be associated as areas with geothermal potentials.

RESULTS AND DISCUSSION

The results of the geomagnetic surveys are as shown in Figure 1 (a), and the results of remote sensing image processings are as shown in Figures 1 (b) and (c). Areas with geothermal potential are represented by three negative geomagnetic anomaly closures, which coincide with areas with very sparse vegetation (very low NDVI) and high surface temperature anomalies (very high LST). This region covers an area of approximately 6.5 km^2 in the villages of Sembalun Bumbung, Sembalun Lawang, and Sajang.

The surveys carried out in this research targeted areas with moderate temperature enthaphi. In such areas, geothermal energy is not intended for generating electrical power, but for direct use. This is also the basic consideration for the feasibility of exploration in Sembalun prospect, where the utility of geothermal energy will greatly support the agricultural and tourism sectors in the villages.



(a) (b) (c)

Figure 1. Precise mapping of the geothermal potentials over Sembalun prospect, showing the areas with (a) geomagnetic negative anomalies (b) very low Normalized Difference Vegetation Index (NDVI) and (c) very high Land Surface Temperature (LST).

CONCLUSION

Geomagnetics and remote sensing methods have been carried out over Sembalun prospect to precisely highlight areas with geothermal potentials. The results show three negative geomagnetic anomaly closures, which coincide with areas with very sparse vegetation (very low NDVI) and high surface temperature anomalies (very high LST). These areas can be associated as areas with highest geothermal potential, in the villages of Sembalun Bumbung, Sembalun Lawang, and Sajang. These results should be further refined by integrating gravity data. Integration of gravity and magnetic data can be modeled to produce a more detailed subsurface interpretation.

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