Application of Remote Sensing for Delineating Area of Interest (AoI) in Parakasak Geothermal Potential Area, Banten

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ABSTRACT

Remote sensing can contribute to icrease survey's effectiveness and efficiencies in geothermal exploration. By using remote sensing, geophisical survey in geothermal exploration can be focused on Area of interest (AoI). Parakasak is a geothermal potential area in Banten, Java with appearance several surface manifestations such as kaipohan, hot springs, warm springs and cold springs. This research uses free Landsat 8 OLI imagery that free downloaded from www.earthexplorer.usgs.gov. The landsat is processed with some software such as global mapper, ER mapper and surfer. Interpretation of remote sensing data for mapping linements and geological structure is conducted by manual observation. The result finds geological structure that identified as rim caldera and appearance of several surface manifestations is correlated to the lineaments. The result also shows that the main direction of the lineaments developed in Parakasak geothermal prospect area is Northwest-Southeast. Area of Interest (AoI) as recommendation geophisical survey of Parakasak geothermal protential area is located on northern area of the Mt. Parakasak peak.

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I. INTRODUCTION

Geothermal energy is renewable and sustainable energy that can used as alternative energy to produce electricity. Geothermal system is a general term that describes natural heat transfer within a confined volume of the Earth's crust where heat is transported from a heat source to a heat sink, usually the free surface [1]. The advantages of geothermal energy compared with other energy sources are clean and safe, where geothermal energy has the lowest CO2 emission level. The ideal geothermal system consists of heat source, reservoir rock, altered clay cap, and recharge water.

Location of Indonesia, which is among the three Indo-Australian tectonic plates, the Eurasian, Pacific and Philippine plate made Indonesia become the country with the largest geothermal energy resources in the world. To develop and utilize adventages of geothermal energy is needed exploration survey that consist of geological, geochemical and geophisical survey. The surveys must be focused on Area of Interest (AoI).

Remote sensing can contribute to icrease survey's effectiveness and efficiencies in geothermal exploration. Remote sensing can be used to identify and delineate area of interest especially for geophisical survey in the geothermal potential area. Before make direct geophisical survey such as Magnetotelluric (MT) and Gravity in the field, creat survey design is important activity. Parakasak is a geothermal potential area in Banten, Java with appearance several surface manifestations such as kaipohan, hot springs, warm springs and cold springs. The location of Mt. Parakasak is about 35 kms from Banten city.

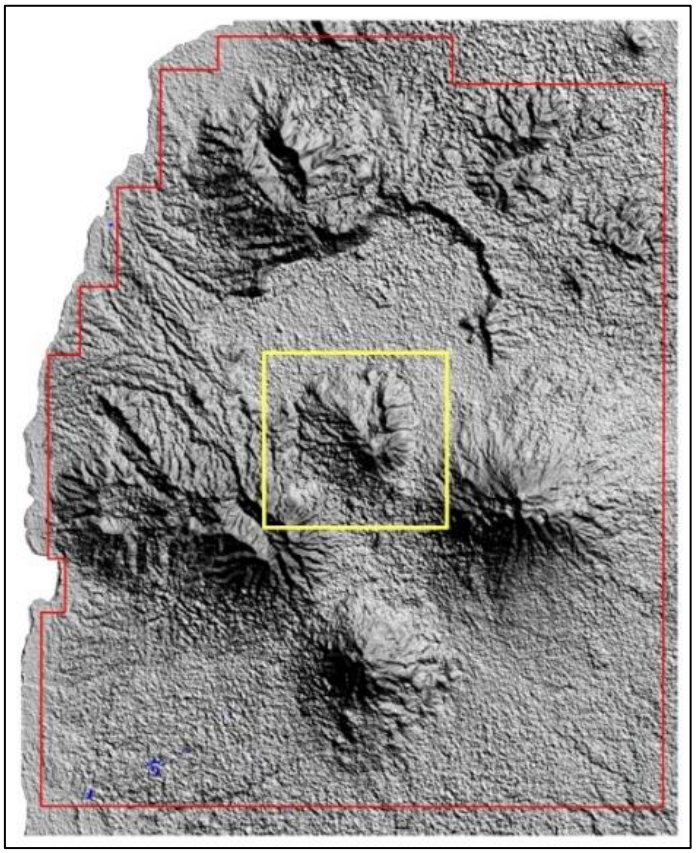


Figure 1. Location of Parakasak, Banten (Google Map, 2017)

Table 1. Surface Manifestations in Parakasak Geothermal Prospect Area (SBG, 2012)

NO	MANIFESTATION	TYPE	TEMPERATURE
1	PRK-1	Kaipohan- wellbore	-
2	PRK-2	Kaipohan	-
3	BTK	Hot Spring	52 ºC
4	KR-5	Hot Spring	61.1 ºC
5	KR-6	Hot Spring	54.6 ºC
6	KR-7	Hot Spring	53.9 ºC
7	KR-8	Hot Spring	55.5 ºC
8	KR-9	Warm Spring	42 ºC
9	KR-10	Hot Spring	51.6 ºC
10	KR-37	Cold Spring	32.2 ºC
11	KR-43	Hot Spring	50.3 ºC
12	KR-45	Hot Spring	45 ºC

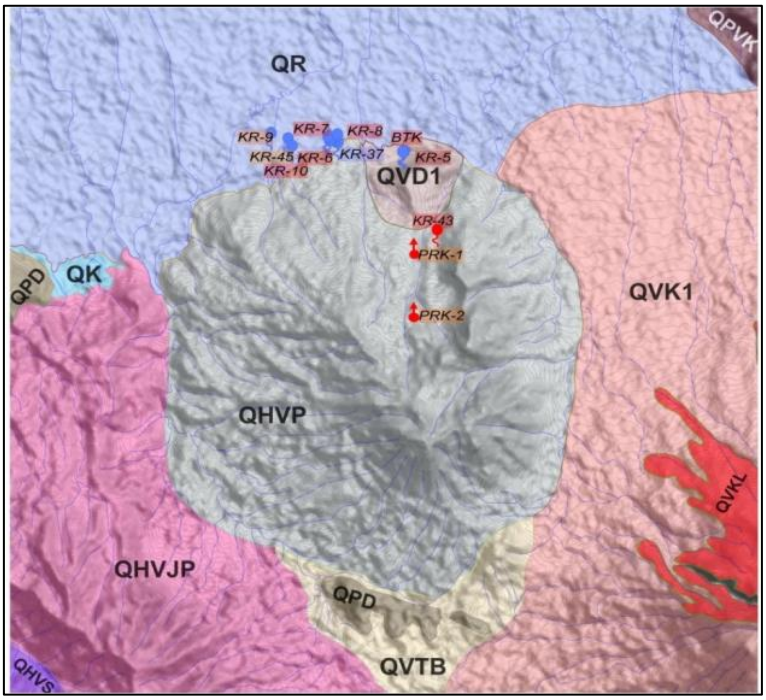


Figure 2. Location of Surface Manifestations in Parakasak Geothermal Potential Area

THE COMPREHENSIVE THEORETICAL BASIS

This research aims to delineate Area of Interest (AoI) in Parakasak geothermal potential area. Lineaments and geological structure are indicator of interesting area. Lineaments and geological structure can give some information related to geothermal system type and delineation of up/ out flow zone from a geothermal field.

This research follows some previous studies that using remote sensing to identify lineaments and geological structure in geothermal field. Remote sensing for geothermal applications have been conducted by Yamaguchi., et al [2]. The geology analysis using integration of Radarsat and Landsat ETM7 have been conducted by Awwab, et al [3]. Optimizing remote sensing data for guiding geothermal exploration have been conducted by Martasari, R. D [4]. The concept of automatic mapping of lineaments using shaded relief images derived from Digital Elevation Model have been conducted by Abdullah, et al [5]. The concept of observation and feature lineament extraction in remote sensing that are correlated to surface structure have been conducted by Siagian, H [6]. Methods to enhancing imagery quality has been conducted by Yuhendra, H., and Sumantyo, J. [7]. The Application of feature lineament extraction used PCI Geomatica of LINE module software from landsat remote sensing have been conducted by Novranza, K [8].

2. RESEARCH METHOD

This research used a multispectral image Landsat-8 OLI/TIRS data, free downloaded on the site www.earthexplorer.usgs.gov on January 15, 2017. The data consists of digital data and is processed by some softwares such as Global Mapper, ER Mapper and Surfer. Interpretation of remote sensing data for mapping lineamenst and alteration zones is conducted by manual observation. The analysis is conducted with focusing on some tone, texture, pattern, shape, size, and topographic of of landsat imagery.

a. Tone : variations in relative brightness or colour.
b. Texture : areas of an image with varying degrees of ‘smoothness’ or ‘roughness’.
c. Pattern: the arrangement of different tones and textures; may indicate certain types of geology or land use.
d. Shape: distinct patterns may be due to natural landforms or human shaping of the land.
e. Size: recognition of familiar objects allows size estimation of other features.
f. Topography: contours of the ground and existing features on the surface.

Figure 3. Raw Data Citra Landsat 8 OLI of Parakasak Geothermal Potential Area

3. RESULTS AND ANALYSIS

The remote sensing data that downloaded must be calibrate before futher process. Principal Component Analysis (PCA) and Pan-Sharpening techniques are used to enhance resolution imagery can make an imagery in good quality and representative. By using Pan-Sharpening and PCA, the spatial resolution at low-band can enhance from 30 m to 15 m (panchromatic Band-8).

Figure 4. Landsat 8 imagery before Atmospheric Correction

Figure 5. Landsat 8 imagery High Resolution Using Pan-Sharpening and Principal Component Analysis (PCA)

Topography as support data is needed to help to identify lineaments and geological structure. Topographic data can give contour information. This research used and processed DEM (Digital Elevation Model). Aster DEM is a digital file consisting of terrain elevations for ground positions at regularly spaced horizontal intervals (USGS).

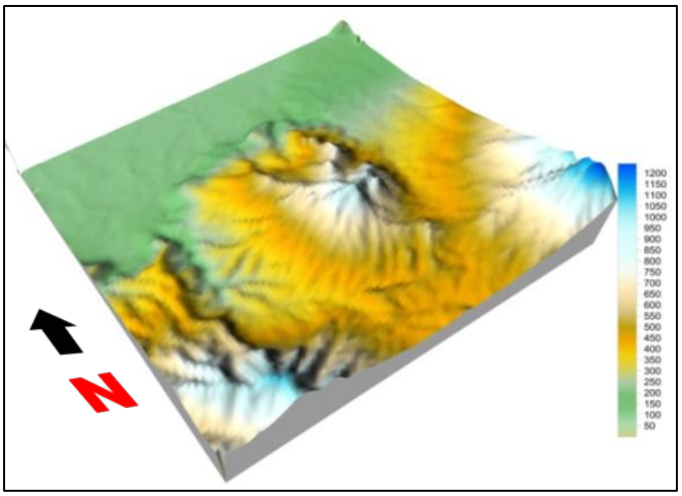
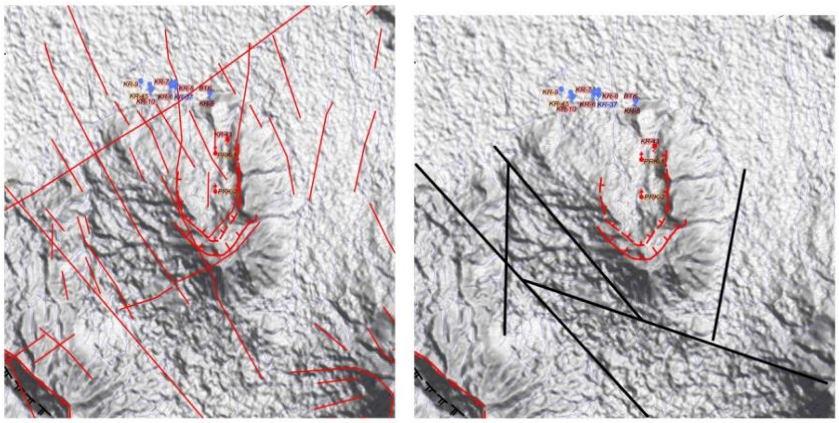


Figure 6. Topography 3D of Parakasak Geothermal Area (Aster DEM)

After calibration, enhancement and considering topography of the landsat image, manual/ visual interpretation enabled us to highlight the lineaments and geological structure. The result finds geological structure that identified as rim caldera and appearance of several surface manifestations is correlated to the lineaments. The result also shows that the main direction of the lineaments developed in Parakasak geothermal prospect area is Northwest-Southeast. Area of Interest (AoI) as recommendation geophisical survey of Parakasak geothermal protential area is located on northern area of the Mt. Parakasak peak.



(a) (b)

Figure 7. Interpretation of (a) Lineament and (b) Geological Structures Manually in Parakasak Geothermal Prospect Area

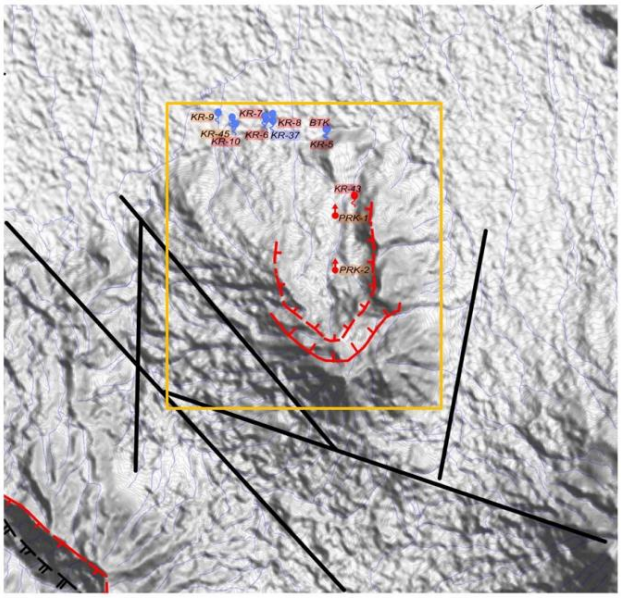


Figure 8. Interesting Area of Geophysical Survey Design

4. CONCLUSION

[1] The result finds geological structure that identified as rim caldera.
[2] The main direction of lineaments developed in Parakasak geothermal area is Northwest-Southeast and correlated to the appearance of surface manifestations.
[3] The recommendation geophisical survey of Parakasak geothermal protential area is located on northern area of the Mt. Parakasak peak.

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