ABSTRAK

IDENTIFIKASI SISTEM PANAS BUMI GUNUNG LAWU, JAWA TENGAH BERDASARKAN ANALISIS PEMODELAN DATA GAYABERAT

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Gunung Lawu merupakan salah satu kawasan yang memiliki potensi panas bumi di Pulau Jawa, ditandai kemunculan fumarol, mata air panas, dan alterasi hidrotermal. Tujuan penelitian untuk mengidentifikasi struktur geologi yang berperan dalam mengontrol sistem panas bumi, menganalisis distribusi densitas bawah permukaan, menyusun model sistem panas bumi Gunung Lawu berdasarkan interpretasi data gayaberat. Data gravitasi satelit GGMPlus diolah melalui serangkaian tahapan yang meliputi koreksi gayaberat, pemisahan anomali regional dan residual, analisis *First Horizontal Derivative* (FHD) dan *Second Vertical Derivative* (SVD), serta inversi tiga dimensi (3D) menggunakan perangkat lunak Grav3D. Hasil analisis FHD dan SVD menunjukkan keberadaan sejumlah struktur sesar yang didominasi oleh sesar normal, dan beberapa sesar naik dengan orientasi utama baratlaut–tenggara. Struktur tersebut berperan sebagai jalur permeabilitas yang mengontrol pergerakan fluida hidrotermal menuju permukaan. Pemodelan inversi 3D menghasilkan distribusi densitas batuan berkisar 1,8–2,9 gr/cc. Zona berdensitas rendah 1,8–2,0 gr/cc diidentifikasi sebagai *reservoir* panas bumi yang tersusun oleh batuan vulkanik berpori dan permeabel. Di atasnya berkembang lapisan batuan penudung (*caprock*) dengan densitas 2,1–2,3 gr/cc, sedangkan zona berdensitas tinggi >2,4 gr/cc pada kedalaman lebih dari ±3000 m diinterpretasikan sebagai sumber panas (*heat source*) berupa intrusi andesit dan sisa dapur magma Gunung Lawu. Model konseptual yang dihasilkan menunjukkan bahwa sistem panas bumi Gunung Lawu dikontrol oleh interaksi antara aktivitas magmatisme, struktur sesar, distribusi batuan vulkanik, dan proses alterasi hidrotermal.

Kata kunci: Panas bumi, Gunung Lawu, gayaberat, FHD, SVD, inversi 3D.

ABSTRACT

IDENTIFICATION OF THE GEOTHERMAL SYSTEM OF MOUNT LAWU, CENTRAL JAVA BASED ON GRAVITY DATA MODELING ANALYSIS

By

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Mount Lawu is one of the geothermal prospect areas in Java, characterized by the presence of fumaroles, hot springs, and hydrothermal alteration zones. This study aims to identify the geological structures controlling the geothermal system, analyze subsurface density distribution, and develop a conceptual model of the Mount Lawu geothermal system based on gravity data interpretation. GGMPlus satellite gravity data were processed through several stages, including gravity corrections, regional and residual anomaly separation, First Horizontal Derivative (FHD) and Second Vertical Derivative (SVD) analyses, and three-dimensional (3D) inversion modeling using Grav3D software. The FHD and SVD results reveal the presence of several fault structures dominated by normal faults, accompanied by a number of reverse faults trending predominantly northwest–southeast. These structures act as permeability pathways that facilitate the upward migration of hydrothermal fluids. The 3D inversion model indicates rock density values ranging from 1.8 to 2.9 g/cm³. Low-density zones of 1.8–2.0 g/cm³ are interpreted as geothermal reservoirs composed of porous and permeable volcanic rocks. Overlying these zones is a *caprock* layer with densities between 2.1 and 2.3 g/cm³, while high-density zones exceeding 2.4 g/cm³ at depths greater than approximately 3,000 m are interpreted as the heat source, represented by andesitic intrusions and remnants of the Mount Lawu magma chamber. The resulting conceptual model suggests that the Mount Lawu geothermal system is controlled by the interaction of magmatic activity, fault structures, volcanic rock distribution, and hydrothermal alteration processes.

Keywords: Geothermal, Mount Lawu, gravity, FHD, SVD, 3D inversion.