

Pemodelan sistem geotermal menggunakan integrasi metode magnetotellurik dan gravitasi di Daerah Prospek Geotermal Pusuk Buhit, Kabupaten Samosir = Geothermal system modeling using the integration of magnetotelluric and gravitational methods in the Prospective Geothermal Area of Pusuk Buhit, Samosir

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Abstrak

Pusuk Buhit adalah salah satu lapangan di Indonesia dengan potensi geotermal, dibuktikan oleh keberadaan fumarole, hot spring, dan cold spring. Penelitian bertujuan membangun model konseptual yang menggambarkan komponen-komponen sistem geotermal fokus wilayah penelitian yang belum ada sebelumnya, menggunakan data primer geofisika dan data sekunder geologi dan geokimia. Inversi 3-dimensi magnetotellurik mampu menggambarkan komponen sistem geotermal dari variasi resistivitas. Claycap memiliki resistivitas 0-16 m, reservoir 16-80 m, dan basement 80-300 m, dengan pola updoming di antara basement diduga sebagai sumber panas. Model gravitasi 2-dimensi digunakan untuk mengkonfirmasi jalur fluida ke zona reservoir dan nilai densitas dari komponen sistem geotermal, dengan lapisan piroklastik densitas 1.92 gr/cc, batuan gamping 2.3-2.4 gr/cc, dan batuan dasar metamorf 2.7 gr/cc, yang menunjukkan korelasi dengan model magnetotellurik. Kedua metode didukung data geologi yang menunjukkan korelasi antara struktur dengan manifestasi permukaan, serta data geokimia yang menunjukkan fluida reservoir bertipe bikarbonat, suhu di reservoir 240-270°C, dan pergerakan fluida lateral ke arah manifestasi air, serta upflow menuju fumarole. Integrasi data menunjukkan area prospek geotermal berada di bawah lapisan batuan teralterasi konduktif di antara struktur graben wilayah penelitian.

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Pusuk Buhit is one of the fields in Indonesia with geothermal potential, evidenced by the presence of fumaroles, hot springs, and cold springs. The research aims to build a conceptual model depicting the components of the geothermal system in the focus area, which has not been previously studied, using primary geophysical data and secondary geological and geochemical data. The 3-dimensional magnetotelluric inversion can illustrate the geothermal system components based on resistivity variations. The clay cap has a resistivity of 0-16 m, the reservoir 16-80 m, and the basement 80-300 m, with an updoming pattern within the basement suspected to be the heat source. A 2- dimensional gravity model is used to confirm fluid pathways to the reservoir zone and the density values of the geothermal system components, with pyroclastic layers having a density of 1.92 gr/cc, limestone 2.3-2.4 gr/cc, and metamorphic basement rocks 2.7 gr/cc, which show correlation with the magnetotelluric model. Both methods are supported by geological data showing a correlation between structures and surface manifestations, as well as geochemical data indicating bicarbonate-type reservoir fluids, reservoir temperatures of 240-270°C, lateral fluid movement towards water manifestations, and upflow towards fumaroles. Data integration indicates that the geothermal prospect area is located beneath the conductive altered rock layer within the graben structures of the study area.