Lineament Analysis and Fault Fracture Density (FFD) to Investigate High Permeable Zone in Non-Volcanic Geothermal System: A Study Case in Northern Konawe Regency, Indonesia

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Abstract

Around 40 % of the global potential geothermal energy is located in Indonesia for volcanic and non-volcanic systems. More explorations were performed in volcanic systems than in non-volcanic systems, even though some locations show the high potential of non-volcanic geothermal systems, and the northern part of Konawe in Southeast Sulawesi is one of them. Some research were performed to identify surface temperature anomaly (high temperature) and some surface manifestations for this area, specifically in the northeast part of Wawolesea. However, the source of surface manifestations and permeable zones as an implication of a good reservoir are still unknown. Therefore, investigating the permeable zones and geothermal potential in the non-volcanic geothermal system of north Wawolesea is the main objective of this study. Lineaments analysis and the Fault Fracture Density (FFD) method were applied to accomplish the objectives. In total, 1694 major and minor lineaments were manually delineated using ArcGIS based on Digital Elevation Model Nasional (DEMNAS). The orientation of all lineaments and structures were shown on the FFD map and rose diagrams, with the major lineaments trending NNE-SSW while the trend of minor lineaments is in uneven distribution and orientation. Field measurements also showed the same azimuth orientation for the mapped fractures. Five zones were characterized by high FFD values (2.81 - 4.54 km/km^2). One of the extensively fractured zones (Zone C) is located between Meluhu and Lembo, covering an area of around 19.39 km^2. This region is believed to be highly permeable and suggestive of a recharge location that contributes to the Wawolesea's surface manifestation. Therefore, the area between Meluhu and Lembo in the northern part of Konawe shows high geothermal reservoir potential due to the largest planar permeable area and exact location for the SSW direction of surface manifestations. This study allows an improved understanding of how fracture geometry, distribution and density control the permeability in geothermal reservoirs.