Fracture and mineral distribution analysis using hyper-resolution DEM and hyperspectral satellite imagery for detecting geothermal fluids paths

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From criteria of power output and temporal stability, geothermal is the most promising renewable energy for electrical generation. However, high introduction cost for geothermal power generation, in particular the cost for exploration to identify the geothermal reservoir is a main issue against the plan. Development of more accurate geothermal-resource exploration is necessary for enhancement of geothermal energy use. Detection of geothermal fluids paths including water and steam from geothermal reservoir is a major target in the exploration stage. Topographic analysis is one of the effective methods for the detection. Thus, we have generated a hyper-resolution DEM (HR-DEM) of the Wayang Windu Geothermal Field (WWGF), situated in West Java, Indonesia using UAV. HR-DEM with high spatial resolution (0.5 m) covers an area of 5 km (E–W) by 10 km (N–S) in WWGF. The lineament density map of WWGF was produced by a topographic analysis through HR-DEM. Moreover, spatial distributions of geothermal alteration minerals such as alunite, calcite, and kaolinite were mapped from an image processing of hyperspectral satellite image, Hyperion. A combination of the lineament and mineral distributions specified highly permeable zones in which the fractures and geothermal alteration minerals were concentrated. The location of high igh radon concentration by in-situ measurements correspond well with these estimated permeable zones. Therefore, the integrated analysis is expected to increase the identification accuracy of fluid paths and clarify the geothermal system in WWGF. This research is supported by JST and JICA through Science and Technology Research Partnership for Sustainable Development (SATREPS).

Keywords: alteration mineral, digital elevation model, geothermal reservoir, hyperspectral satellite image, lineament

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