Detection of hydrothermal alteration zones distribution by applying linear unmixing method to hyperspectral satellite imagery for densely vegetated geothermal area

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For exploring geothermal resources in areas with surface manifestations, detection of alteration minerals by remote sensing technology is effective, because such minerals were generated by hydrothermal fluids (water and gas) that rose from geothermal reservoir in shallow depth to the ground surface. However, this detection is difficult in wide area by optical sensor remote sensing due to limited spatial resolution and mixture of several materials in an image pixel. Therefore, unmixing method that can separate correctly end members is indispensable. Band math method is traditional for mineral mapping using multispectral imagery. Accurate mineral mapping is expected to be possible by an application of hyperspectral imagery with high wavelength resolution.
Thus, a typical hyperspectral satellite imagery, Hyperion was used in this study by selecting the Wayang Windu geothermal field in West Java, Indonesia in which a large-scale geothermal power plant with 227 MW is operated. This field is covered by thick vegetation. To improve detection accuracy of hydrothermal alteration zone in such dense vegetation field, linear spectral unmixing was applied to the Hyperion data by focusing on the spectral reflection and absorption characteristics of alteration minerals. As the result, most pixels extracted as alteration mineral zones corresponded to known geothermal manifestations and fault traces and additionally, main minerals constituting the zones were identified. This research is supported by JST and JICA through a project of Science and Technology Research Partnership for Sustainable Development (SATREPS, Grant No. JPMJSA1401).

Keywords: remote sensing, Hyperion satellite imagery, geothermal manifestation, geothermal-resource exploration, Wayang Windu field (Indonesia)

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