

Spectral Mapping of Hydrothermal Alteration Minerals for Geothermal Exploration Using Advanced Spaceborne Thermal Emission and Reflection Radiometer Short Wave Infrared Data

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Abstract : Exploiting geothermal resources for either power, home heating, Spa, greenhouses, industrial or tourism requires an initial identification of suitable areas. This can be done cost-effectively using remote sensing satellite imagery which has synoptic capabilities of covering large areas in real time and by identifying possible areas of hydrothermal alteration and minerals related to Geothermal systems. Earth features and minerals are known to have unique diagnostic spectral reflectance characteristics that can be used to discriminate them. The focus of this paper is to investigate the applicability of mapping hydrothermal alteration in relation to geothermal systems (thermal springs) at Yankari Park Northeastern Nigeria, using Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) satellite data for resource exploration. The ASTER Short Wave Infrared (SWIR) bands are used to highlight and discriminate alteration areas by employing sophisticated digital image processing techniques including image transformations and spectral mapping methods. Field verifications are conducted at the Yankari Park using hand held Global Positioning System (GPS) monterra to identify locations of hydrothermal alteration and rock samples obtained at the vicinity and surrounding areas of the 'Mawulgo' and 'Wikki' thermal springs. X-Ray Diffraction (XRD) results of rock samples obtained from the field validated hydrothermal alteration by the presence of indicator minerals including; Dickite, Kaolinite, Hematite and Quart. The study indicated the applicability of mapping geothermal anomalies for resource exploration in unmapped sparsely vegetated savanna environment characterized by subtle surface manifestations such as thermal springs. The results could have implication for geothermal resource exploration especially at the prefeasibility stages by narrowing targets for comprehensive surveys and in unexplored savanna regions where expensive airborne surveys are unaffordable.

Keywords : geothermal exploration, image enhancement, minerals, spectral mapping

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