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Lithological Mapping and Iron Deposits Identification in El-Bahariya Depression, Western Desert, Egypt, Using Remote Sensing Data Analysis

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Abstract : This study is proposed for the lithological and iron oxides detection in the old mine areas of El-Bahariya Depression, Western Desert, using ASTER and Landsat-8 remote sensing data. Four old iron ore occurrences, namely; El-Gedida, El-Haraa, Ghurabi, and Nasir mine areas found in the El-Bahariya area. This study aims to find new high potential areas for iron mineralization around El-Baharyia depression. Image processing methods such as principle component analysis (PCA) and band ratios (b4/b5, b5/b6, b6/b7, and 4/2, 6/7, band 6) images were used for lithological identification/mapping that includes the iron content in the investigated area. ASTER and Landsat-8 visible and short-wave infrared data found to help mapping the ferruginous sandstones, iron oxides as well as the clay minerals in and around the old mines area of El-Bahariya depression. Landsat-8 band ratio and the principle component of this study showed well distribution of the lithological units, especially ferruginous sandstones and iron zones (hematite and limonite) along with detection of probable high potential areas for iron mineralization which can be used in the future and proved the ability of Landsat-8 and ASTER data in mapping these features. Minimum Noise Fraction (MNF), Mixture Tuned Matched Filtering (MTMF), pixel purity index methods as well as Spectral Ange Mapper classifier algorithm have been successfully discriminated the hematite and limonite content within the iron zones in the study area. Various ASTER image spectra and ASD field spectra of hematite and limonite and the surrounding rocks are compared and found to be consistent in terms of the presence of absorption features at range from 1.95 to 2.3 µm for hematite and limonite. Pixel purity index algorithm and two sub-pixel spectral methods, namely Mixture Tuned Matched Filtering (MTMF) and matched filtering (MF) methods, are applied to ASTER bands to delineate iron oxides (hematite and limonite) rich zones within the rock units. The results are validated in the field by comparing image spectra of spectrally anomalous zone with the USGS resampled laboratory spectra of hematite and limonite samples using ASD measurements. A number of iron oxides rich zones in addition to the main surface exposures of the El-Gadidah Mine, are confirmed in the field. The proposed method is a successful application of spectral mapping of iron oxides deposits in the exposed rock units (i.e., ferruginous sandstone) and present approach of both ASTER and ASD hyperspectral data processing can be used to delineate iron-rich zones occurring within similar geological provinces in any parts of the world.

Keywords : Landsat-8, ASTER, lithological mapping, iron exploration, western desert
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