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# Potential of Hyperion (EO-1) Hyperspectral Remote Sensing for Detection and Mapping Mine-Iron Oxide Pollution

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**Abstract :** Acid Mine Drainage (AMD) from mine wastes and contaminations of soils and water with metals are considered as a major environmental problem in mining areas. It is produced by interactions of water, air, and sulphidic mine wastes. This environment problem results from a series of chemical and biochemical oxidation reactions of sulfide minerals e.g. pyrite and pyrrhotite. These reactions lead to acidity as well as the dissolution of toxic and heavy metals (Fe, Mn, Cu, etc.) from tailings waste rock piles, and open pits. Soil and aquatic ecosystems could be contaminated and, consequently, human health and wildlife will be affected. Furthermore, secondary minerals, typically formed during weathering of mine waste storage areas when the concentration of soluble constituents exceeds the corresponding solubility product, are also important. The most common secondary mineral compositions are hydrous iron oxide (goethite, etc.) and hydrated iron sulfate (jarosite, etc.). The objectives of this study focus on the detection and mapping of MIOP in the soil using Hyperion EO-1 (Earth Observing - 1) hyperspectral data and constrained linear spectral mixture analysis (CLSMA) algorithm. The abandoned Kettara mine, located approximately 35 km northwest of Marrakech city (Morocco) was chosen as study area. During 44 years (from 1938 to 1981) this mine was exploited for iron oxide and iron sulphide minerals. Previous studies have shown that Kettara surrounding soils are contaminated by heavy metals (Fe, Cu, etc.) as well as by secondary minerals. To achieve our objectives, several soil samples representing different MIOP classes have been resampled and located using accurate GPS (□ ≤ ± 30 cm). Then, endmembers spectra were acquired over each sample using an Analytical Spectral Device (ASD) covering the spectral domain from 350 to 2500 nm. Considering each soil sample separately, the average of forty spectra was resampled and convolved using Gaussian response profiles to match the bandwidths and the band centers of the Hyperion sensor. Moreover, the MIOP content in each sample was estimated by geochemical analyses in the laboratory, and a ground truth map was generated using simple Kriging in GIS environment for validation purposes. The acquired and used Hyperion data were corrected for a spatial shift between the VNIR and SWIR detectors, striping, dead column, noise, and gain and offset errors. Then, atmospherically corrected using the MODTRAN 4.2 radiative transfer code, and transformed to surface reflectance, corrected for sensor smile (1-3 nm shift in VNIR and SWIR), and post-processed to remove residual errors. Finally, geometric distortions and relief displacement effects were corrected using a digital elevation model. The MIOP fraction map was extracted using CLSMA considering the entire spectral range (427-2355 nm), and validated by reference to the ground truth map generated by Kriging. The obtained results show the promising potential of the proposed methodology for the detection and mapping of mine iron oxide pollution in the soil.

**Keywords :** hyperion eo-1, hyperspectral, mine iron oxide pollution, environmental impact, unmixing
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