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A Spectroscopic Approach to Assess Heavy Metals Contents of the Mine Waste of Jalta and Bougrine in the North of Tunisia

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ABSTRACT

Near InfraRed Spectroscopy (NIRS) has become an extremely important analytical technique in recent years and been applied in various geoscience areas such as mineral exploration and environmental studies. It is used for studying the physico-chemical properties of earth materials by enabling the interpretation of mineral composition and the study of its variability based on the diagnostic of spectral features. In this research, the application of laboratory reflectance spectroscopy in assessing heavy metals pollution is investigated. The potential use of reflectance spectroscopy in detecting Fe-related and clay minerals as well as the quantitative characterization of pollutants is studied for the mine waste of Jalta and Bougrine in the North of Tunisia. Mining activities of lead/Zn, have led to extensive pollution. The analysis of geochemical results outlined the level and spatial pattern of pollutants concentration. Results of the study showed that a relationship exists between reflectance spectra and geochemical measures of pollutants. The Spectral interpretation of Fe-related minerals and clay minerals showed that they are related to the pollutants and can be used as indirect spectral indicators of the pollution. The Fe-minerals include: jarosite, goethite, hematite/goethite, and hematite; clay minerals and feature-less (aspectral) materials. A direct quantitative relationship between pollutants and spectral parameters shows that Pb-Zn-Mn are the best correlated with a ratio of 610/500 nm range while Ni-Cr have a best correlation with a slope around 980 nm. Outputs from Partial Least Square Regression (PLSR) confirmed these relationships and also indicated that spectral parameters and reflectance values within 400 - 2500 nm range can better predict the contamination for Mn, Pb and Zn than for Ni and Cr but not for Fe, Cu, Cd, EC and pH.

KEYWORDS

Acid Mine Drainage; Metals Leaching; Geochemical Properties; Spectral Properties; Spectral Parameters; PLSR (Partial Least Square Regression)

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