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Mapping of FeNi-laterite outcrops through spectral unmixing on Sentinel-2 multispectral data: the case study of Tsouka excavation (Central Greece)

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Ni-laterites constitute a significant proportion of world nickel reserves. LARCO GMMSA exploits the domestic laterite deposits in Greece during the last 50 years, operating in Locris and Euboea island (Central Greece) as well as in Kastoria area (Northern Greece). Since the late 70's, the use of remote sensing technology in geological mapping has gained significant attention worldwide. In particular, multispectral/hyperspectral imagery is one of the most widespread and standard source of data for the recognition of spatial and/or spectral patterns in mineral/ore exploration. Towards this direction, the development of suitable state-of-the-art processing algorithms, either at pixel level or at sub-pixel level, is of crucial importance. Spectral unmixing (SU) is currently a very powerful method that allows sub-pixel level processing for assessing spectral information regarding different lithologies that co-exist within a single pixel. The aim of SU is the decomposition of the spectral signatures of mixed pixels onto a space spanned by a set of spectral signatures (represented as vectors) corresponding to pure physical materials (endmembers). The latter are retrieved either from spectral libraries or they are extracted from the image itself by detecting the relatively "purest" pixels via suitable algorithms. The resulting decomposition coefficients are indicative of the degree of each endmember's presence within each pixel. It should be noted here, that in contrast to other scalar-based approaches (e.g. spectral indices), SU is a vector-based processing that provides higher representational capabilities. The most widely used assumption in SU is that each pixel's spectral signature can be written as a linear combination of the spectral signatures of its endmembers (linear mixing hypothesis). In this study, we investigate the ability of SU to map FeNi laterite outcrops with high grade of reliability. The study area is the Tsouka laterite excavation in Central Greece, operated by LARCO GMMSA. More specifically, linear SU is applied on a Sentinel-2 satellite image. The dataset is atmospherically corrected, spatially resampled into 10m pixel size. For the needs of SU, two endmembers are used, namely a laterite endmember and a non-laterite endmember. The former corresponds to the average spectral signature of selected pixels of pure laterite composition. The latter represents both the other two existing lithologies, namely Cretaceous limestones and ophiolites. The SU resulting abundance maps show that Sentinel-2 succeeds to map the FeNi-laterite quite satisfactory. The proposed method is fast, low-cost and non-destructive and can contribute to the research of LARCO GMMSA for new exploitable ores