Integration Of Multiscale Hyperspectral Data, Geochemistry, and Mineralogy for Assisting Mineral Exploration: The Brownfield Punta Corna Co-Ni Vein-Type Deposit (Italy)

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This study aims to investigate how the integration of hyperspectral field-based to hyper- and multispectral satellite data with geochemistry and mineralogy can support in recognizing the signature of alteration potentially associated with Co-Ni–bearing mineralization. The test site is the Punta Corna brownfield exploration prospect, owned by AltaMin Ltd., located in the Servin Valley in the Western Alps of Italy, an area well-known for hosting several post-orogenic hydrothermal ore deposits exploited in the past. The Punta Corna deposit is characterized by “five element” hydrothermal polymetallic vein-type orebodies composed of zoned Fe^{2+}-rich carbonates and Co-Ni mineralization, hosted by metabasite in greenschist facies. Laboratory-based hyperspectral spectroscopy, mineralogical (XRPD), and micro- and bulk geochemical (FESEM-EDS and ICP-AES/MS) analyses were performed to define target alteration minerals and validate the results obtained from optical satellite image processing. The absorption features at 900, 2,200, and 2,250 nm were considered diagnostic for identifying and/or characterizing the compositional variation of the main alteration minerals detected (i.e., Fe-oxy-hydroxides, white mica, chlorite). The results show that the strongest hydrothermal alteration consists mainly of heavy sericitization in the immediate proximity of the ore occurrences, associated with Fe-oxy-hydroxides after weathering of hypogene Fe-bearing carbonates. Both were recognized with laboratory-based hyperspectral data and satellite remote sensing. By combining hyperspectral and geochemical data from hand specimens, instead, a more widespread chloritization was identified. Even though mineralogical and geochemical systematic patterns with regards to the Mg-rich chlorite and its relationship with the Co-Ni mineralization were observed, the background regional greenschist facies metamorphism and deformation must be considered for the formation of chlorite. The integration of distinct data sets allowed identifying distinct hydrothermal alteration types at different observation scales, including sericitization and secondary supergene alteration, as well as a possible chloritization, which can be useful to support exploration in the area.