PRISMA hyperspectral remote sensing satellite data for mineralogical mapping in Antarctica

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The hyperspectral sensor PRecursore IperSpettrale della Missione Applicativa (PRISMA), which was launched by the Italian Space Agency (ASI), represents a significant advance in Earth observation technology. This sensor records hyperspectral images in 239 spectral bands from 0.4 to 2.5 μm. PRISMA provides hyperspectral images for mineral exploration to map alteration minerals in remote and inaccessible regions such as Antarctica. The Dry Valleys (DVs) region on South Victoria Land in Antarctica, located in the Transantarctic Mountains along the coast of the Ross Sea, was selected as a case study. In the PRISMA hyperspectral images, the bands that are sensitive to water vapor were excluded. The spectral smile, also known as spectral curvature or shadow effect, was attenuated using the Minimum Noise Fraction (MNF). Hyperspectral analysis methods developed by Analytical Imaging and Geophysics (AIG) were applied to the PRISMA datasets to determine unique spectral endmembers and their spatial distribution and abundance to produce detailed mineral maps. A comparative analysis of the image spectra with the United States Geological Survey (USGS) standard laboratory spectra of specific minerals was performed to identify alteration minerals. The Linear Spectral Unmixing (LSU) algorithm was used for mapping subpixels and determining the relative abundance of end minerals within a pixel based on the spectral characteristics of the end minerals. A variety of alteration minerals such as illite, hematite, chlorite, calcite, fassaite, nontronite, vermiculite and montmorillonite were identified in the exposed lithologic zones of the DVs region. The results show that the PRISMA hyperspectral images are able to provide mineralogical information in isolated and inaccessible regions of Antarctica.