The application of ASTER remote sensing data to porphyry copper and epithermal gold deposits

Abstract:

This paper reviews the performance characteristics of the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) remote sensor, the standard data products, and applications of the most recently developed image processing methods applied to ASTER data as a tool for mapping hydrothermal alteration mineral zones associated with porphyry copper and epithermal gold mineralization and related host-rock lithology. Hydrothermal alteration zones associated with porphyry copper deposit such as phyllic, argillic, and propylitic mineral assemblages can be discriminated from one another by virtue of their spectral absorption features, which are detectable by ASTER SWIR spectral bands. The identification of the phyllic zone is important in the initial stages of porphyry copper exploration as an indicator of high economic-potential for copper mineralization.Two new crosstalk-corrected ASTER SWIR reflectance products including AST-07XT and RefL1b are more reliable than previous ASTER data products for regional mineral mapping without use of additional spectral data from the site for calibration. Four types of algorithms were used to extract spectral information of ASTER data: 1) band-ratio, indices and logical operator based methods; 2) principal components and enhancement based methods such as Principal Component Analysis (PCA) and Minimum Noise Fraction (MNF); 3) shape-fitting based algorithms such as Spectral Angle Mapper (SAM), Matched-Filtering (MF), and Mixture-Tuned Matched-Filtering (MTMF); and 4) partial unmixing methods such as Linear Spectral Unmixing (LSU) and Constrained Energy Minimization (CEM).This review emphasizes that the logical operator algorithms can be best suited for hydrothermal alteration mineral mapping, including phyllic and argillic zones associated with porphyry copper mineralization in a regional scale. Shape-fitting based and partial unmixing algorithms are robust and reliable for detecting particular mineral and mineral assemblages in hydrothermal alteration zones in a district scale. Consequently, the integration of the results derived from the logical operator, shape-fitting based, and partial unmixing algorithms can produce comprehensive and accurate information for the reconnaissance stages of copper and gold exploration at both regional and district scales. All of the methods and applications reviewed in this paper demonstrate the utility of ASTER data for exploration of the porphyry copper and epithermal gold deposits around the world.