Evaluating ASTER SWIR data for lithological discrimination and mapping in Kurram-Waziristan, Northwestern Himalayas, Pakistan

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This research work provides novel approaches for lithological mapping in Kurram-Waziristan, in the Northwestern Himalayan orogenic belt using data from the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER). Reflectance data from visible near-infrared (VNIR), and shortwave infrared (SWIR) were processed and interpreted for mapping sedimentary units. Various methods i.e., Minimum Noise Fraction (MNF), Independent Component Analysis (ICA), Principal Component Analysis (PCA) and Band Rationing (BR) can be used for lithological mapping. This study involves calibrated ASTER (SWIR) data using the PCA and BR techniques. The area under study hosted numerous rock types, including limestone, shales, sandstone, dolomites, and siltstone, as well as continuous geological sequences. The efficiency of the proposed Band Combination (BC) for lithological mapping was demonstrated by its derivation from PCA (R: PC2, G: PC1, B: PC3) and BR for different minerals. In comparison to PCA the BR (R: B4/B7, G: B4/B1, B: (B2/B3)*(B4/B3)) performs well in discrimination of different lithological units. Lithological map derived from BR and PCA shows strong correlation between the published lithological map and results obtained from the field investigation. As a result, ASTER SWIR data combined with advanced image enhancement approaches i.e., PCA and Band Ratio are recommended as an efficient and cost-effective tool for lithological discrimination and mapping.

Keywords: Principal Component Analysis; Band Ratio; lithological mapping; ASTER