APPLICATION OF TIR SPECTROSCOPY TO UNDERGROUND MINING

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This work presents a fast and efficient method to discriminate sulfide containing rocks from their barren host, and to estimate ore grade using hyperspectral thermal infrared reflectance (TIR, 500 – 5000 cm-1) spectra. Spectra were collected from samples from Sudbury mines, Canada operated by Inco Ltd. and analyzed jointly with point count information obtained from thin section analysis to determine mineral abundance. Most of the host rock forming minerals (silicates) have spectral features occurring between 700 – 1300 cm-1 and 2000 – 3300 cm-1. In contrast massive sulfides display distinctly higher reflectance and lack contrast over this region. The largest spectral difference between silicates and sulphides is observed in the 1300 – 1500 cm-1 region. In this region the spectra of most known silicate minerals converge to a common reflectance of 1.5% eliminating the requirement to constrain the spectral characteristics of each silicate constituent of host rocks. The presence of disseminated sulfides increases the average reflectance of the rock but the correlation with abundance is not linear. In this spectral range a correlation of 0.90 (R2) between reflectance and sulfide concentration was obtained for measurement of dry surfaces. For an average of dry and wet surfaces an R2 of 0.87 was obtained demonstrating the feasibility to estimate total sulfide concentration from TIR reflectance data even when samples are wet. Ore-bearing samples can be confidently separated from host rocks when ore concentration exceeds 20%.