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LIBS Spectral Comparison with XRF Assays for Elemental Characterization of Iron Ore Samples

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Introduction

LIBS is a rapid multi-elemental technique supporting mineral exploration, ore characterization, and geometallurgical modelling. The correlation between spectral intensity and elemental concentration requires validation with geochemical reference data to ensure calibration.

Method and/or Theory

This study compares LIBS spectra and X-ray fluorescence (XRF) assays for 76 pressed-pellet samples of friable and compact itabirites and hematitites. LIBS spectra were collected in the UV–VIS range and cross-referenced with emission lines from the NIST Atomic Spectra Database. The LIBS is part of the corescaning facility from Geotek at Vale (LEEAP).

Results and Conclusions

Spectral intensities between 200–300 nm and 370–450 nm — linked to Fe and Si — align with the sample's dominant elements. Fe-rich samples showed higher Fe I and Fe II emissions (248 and 259 nm), while Si-rich ones displayed strong Si I signals (288.14 nm). Despite spectral consistency, LIBS-XRF correlations ranged from poor to moderate, likely due to matrix effects, mineralogical variation, and line overlaps. Al and Mn, though less abundant, showed better correlations with XRF ($R^2 = 0.81$ and 0.67 , respectively). These findings highlight LIBS as a fast, complementary tool to XRF in mining workflows. Further research is advised to improve Fe and Si quantification, using certified reference materials and broader concentration ranges.