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A GIS and Remote Sensing Based Approach for the Classification of Mine Tailings in South Africa

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Innovative technology developments are key to sustainable management of mineral deposits and the environment. This study seeks to create a GIS database cataloguing mine tailings (waste material produced when processing ore of mineral deposits) across South Africa, both active and closed mines. This groundbreaking initiative in South African literature will create a publicly available database, paving the way for future research. With the escalating costs of deep-level mining, rising commodity prices, and advancements in ore processing, stakeholders are increasingly interested in reworking mine tailings for their economic potential. This study intends to identify mine tailings in the Witwatersrand Basin, Barberton Greenstone Belt and Northern Cape with p interest in gold, manganese and iron using Aster and Sentinel 2 sensors. In the methodology, we apply band ratios, mineral Indices, Principal Component Analysis and other image enhancement techniques for identification of mine tailings to the Aster and Sentinel 2 free, atmospherically corrected and, minimal-to-no-cloud cover images. Our approach enables larger area coverage and analysis of mine tailings, overcoming the cost and logistical limitations of traditional methods. Preliminary findings show potential in our approach to catalogue tailings and variations in gold mine tailings identification between Witwatersrand Basin mines and those in the Barberton Greenstone Belt, possibly attributed to different processing methods, potentially biological in the latter. Our study stresses the importance of monitoring, including identifying abandoned tailings, crucial for future environmental sustainability efforts. This research aims to compile mine tailings data into a geospatial database, guiding policymakers in sustainable mineral resource management and setting the stage for future South African research. Ultimately, it seeks to transform mine tailings from a liability into an asset.