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Exploring the Composition of Ghana's Manganese through Geochemical, Mineralogical, and Particle Size Analysis

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1. Introduction

This study presents a detailed chemical and mineralogical analysis of manganese ore from the Nsuta deposit in Ghana. We employed an integrated multi-technique approach to address gaps in the comprehensive characterisation of this strategic resource, particularly concerning valuable elements of economic value. Subsurface samples were prepared and separated into distinct particle size fractions. Elemental concentrations were determined using X-ray Fluorescence (XRF) and Neutron Activation Analysis (NAA), while mineral phases and textures were identified via X-ray Diffraction (XRD) and petrographic microscopy. This combined methodology provides a more robust assessment of the ores' quality and economic potential than single-technique studies [1, 2].

2. Results

The Nsuta manganese ore was found to be rich in the medium-sized particle range and was composed mainly of rhodochrosite (72.2 wt%), with minor sphalerite and graphite. A key finding was the clear relationship between particle size and chemical content. Finer fractions (<150 µm) showed a 20–35% enrichment in valuable metals compared to the weighted average of the bulk ore. Statistical comparison confirmed that NAA provided consistently lower detection limits for trace and rare earth elements, underlining its superior sensitivity for comprehensive geochemical characterisation [3].

3. Conclusion

The integrated use of XRF, NAA, XRD, and petrography proved highly effective for the thorough evaluation of Ghana's manganese ores. The findings confirm substantial economic potential, not only for primary metal extraction but also for the future valorisation of Critical Raw Materials concentrated in specific particle size fractions. The marked enrichment of valuable metals in finer particles highlights a clear opportunity to optimise metal recovery by targeting these fractions during processing. This study provides a critical dataset and a reliable analytical framework to guide future resource management, process optimisation, and policy development for Ghana's mining sector [4].

4. References

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