

Influence of Serpentinization and Mass Balance Constraints on Ni-Co Enrichment in Laterite Profiles in Pomalaa, Sulawesi, Indonesia

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Indonesia hosts the world's largest lateritic nickel reserves, with Pomalaa, Southeast Sulawesi, being a major mining area developed on ultramafic rocks of the East Sulawesi Ophiolite Belt. These ultramafic rocks have undergone extensive serpentinization that provide a favorable protolith for lateritization. This study examines three representative laterite profiles (Everest, Hummer, and Fortuner) integrating geochemical, mineralogical, and physical property analyses to assess Ni-Co enrichment. The methods employed include X-Ray Diffraction (XRD) for mineralogical identification, X-Ray Fluorescence (XRF) for major and trace element chemical composition and SEM-EDX for chemical composition. Physical property measurements of density, porosity, and magnetic susceptibility also were conducted to analyze the degree of serpentinization along with Loss on Ignition (LOI) data in the bedrocks. Mineralogical results reveal a vertical transition from primary mineral (olivine, orthopyroxene) and serpentine in bedrock to goethite and hematite in limonite zone. physical property analysis indicates that the initial serpentinization process significantly altered the ultramafic bedrock. Analysis of physical properties and LOI indicates that the initial serpentinization significantly altered the ultramafic bedrock. The increasing trend in Loss on Ignition (LOI) from the Everest to Hummer to Fortuner sites suggests a higher degree of hydration associated with serpentinization. Geochemical profiles show pronounced Ni-Co enrichment in the saprolite zones. with Ni concentrations reaching 2.33 wt.% in Everest, 2.61 wt.% in Hummer, and 1.83 wt.% in Fortuner. Cobalt (Co) concentrations exhibit similar enrichment patterns. Furthermore, Mass balance calculations demonstrate that during lateritization, Ni and Co were immobilized and concentrated in the saprolite zone, while other elements like Mg and Si were mobilized and leached. This process leads to a decrease in density and an increase in magnetic susceptibility due to magnetite formation. These results highlight the mineralogical transformations, physical property changes and elemental mobilities that control the economic potential of lateritic Ni-Co deposits in Pomalaa.