Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.31832

Magnesium isotope fractionation related to the weathering process during lateritization in Ni-laterite deposit

YURI CHOI[1], JIWON EOM[2], JUNG HUN SEO[1], TOSHIHIRO YOSHIMURA[3] AND DAISUKE ARAOKA[4]

[1]Seoul National University
[2]Korea Polar Research Institute (KOPRI)
[3]Japan Agency for Marine-Earth Science and Technology
[4]National Institute of Advanced Industrial Science and Technology (AIST)

Indonesia is the world's leading producer of Ni resources in laterite-type deposits. The Morowali Ni-laterite deposit, located in the East Sulawesi Ophiolite (ESO), features a well-developed laterite profile with three main horizons: saprolite, limonite, and ferruginous cap. The primary Ni ore mineral, garnierite, occurs in the saprolite horizon and comprises a mixed phase of serpentine, talc, and sepiolite, forming through Mg substitution by Ni during lateritization.This study investigates Mg isotopic fractionation during lateritization and garnierite formation, exploring Mg isotopes as indicators of weathering intensity and as proxies for Ni exploration.

X-ray diffraction (XRD) analysis shows that the bedrock is primarily composed of orthopyroxene and lizardite, with minor amounts of clinopyroxene, forsterite, and brucite. The saprolite horizon consists mainly of lizardite and garnierite, while the limonite horizon is composed of goethite and hematite. Garnierite can be distinguished by color and is classified into serpentine-like (lizardite and chrysotile) and talc-like garnierite (talc and sepiolite). Notably, talc-like garnierite often forms as a coating over serpentine-like garnierite.

The concentrations of major and trace elements vary significantly among the bedrock, saprolite, and limonite horizons. In the saprolite horizon, substantial Mg loss occurs, particularly during the transition from saprolite to limonite, whereas Ni becomes enriched during garnierite formation. The Mg concentration in saprolite ranges from 13.0 to 24.0 wt.%, decreasing to 0.3 wt.% in limonite. In contrast, the Ni concentration ranges from 0.3 to 2.7 wt.% in saprolite, with the highest Ni content observed in talc-like garnierite, reaching up to 15.0 wt.%. In the limonite horizon, the Ni concentration is 1.6 wt.%.

Despite the decrease in Mg concentration, δ^{26}Mg values increase progressively during lateritization from bedrock to limonite. Excluding garnierite, δ^{26}Mg values increase from bedrock (-0.33 to -0.11‰) through saprolite (-0.03 to 0.14‰) to limonite (0.47‰). The talc-like garnierite exhibits higher δ^{26}Mg values (0.54 to 0.63‰) compared to serpentine-like garnierite (-0.10 to 0.12‰). The relationship between δ^{26}Mg values and Ni/Mg ratios is positive, indicating that Ni enrichment is associated with increasing weathering intensity. This correlation suggests that Mg isotope could serve as useful geochemical indicator for identifying zones of Ni enrichment in laterite deposits.