Formation of Ni-bearing minerals during chemical weathering of ultramafic rocks in Myanmar

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Ni laterite deposit, an important resource for Ni, is formed by chemical weathering of ultramafic rocks under tropical climate conditions. Whereas many studies have aimed to understand the formation processes of Ni laterites in Indonesia and Philippines, few studies have investigated those in Myanmar, which also has a high potential of Ni laterite resources. The highest grade of Ni in a weathering profile is usually found in a saprolite zone, a weakly weathered section underlain by intensively-weathered laterite zone. Mobilization of Ni from the bedrock as well as laterite zone together with Fe has been proposed to be an important process for Ni enrichment in saprolite zone (e.g., Golightly, 2010). However, formation of various Ni-bearing minerals in saprolite zone (Tauler et al., 2017) may also govern the Ni enrichment though the common Ni-bearing mineral in saprolite zone is secondary-formed serpentine (Ser-II). It is important to understand the formation processes of Ni laterite deposits for efficient exploration and mine development. Therefore, in this study, we are focused on the formation of secondary minerals at different weathering degrees and its relationship to Ni enrichment during chemical weathering of ultramafic rocks in Myanmar by investigating 6 different weathering profiles in the Western and Central Ophiolite Belts.

The results of the bulk chemical analysis by XRF show that Ni is concentrated in saprolite zones up to 1.6 wt% as chemical weathering progresses as indicated by thickness of profiles and depletion of major elements (e.g., Mg). Ni is associated more closely with 0.2-2 μm fraction (e.g., clay minerals) of the samples as Ni concentration in this fraction was determined by acid digestion and ICP-AES. The results of mineralogical analysis by XRD and petrographic microscope show that minerals formed in saprolite zones varies depending on the degree of weathering regardless that all the bedrocks are serpentinite. Whereas smectite dominates in the saprolite zone of the least weathered profile, both smectite and Ser-II were present in the saprolite zone of the most weathered profile. This suggests that smectite is formed at the initial stage of chemical weathering of the ultramafic rocks in Myanmar. However, the results of SEM-EDS analysis show that Mn-oxide (e.g., asbolane) is the main mineral concentrating Ni in the least weathered profile whereas secondary silicate minerals (e.g., Ser-II, smectite, unidentified Fe-Ni silicates) are the main minerals in the most weathered profile. Therefore, Ni is preferentially associated with Mn-oxide possibly because of a strong electrostatic interaction. However, as weathering progresses and Mn-oxide dissolved away, Ni is enriched into secondary silicate minerals (e.g., Ser-II, smectite). No preferential incorporation of Ni was observed between Ser-II and smectite. Further progress in chemical weathering may result in the transformation of other silicate minerals into Ser-II, which would be then the main Ni-bearing mineral in Ni laterite deposit in Myanmar.

