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Mineralogy and Geochemistry of Ni-Co Laterites in Southern Oregon and Northern California

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Key elements for deposit formation are driver, source, transport, trap, and preservation. Ni-Co laterites in southern Oregon and northern California formed from pervasive chemical and mechanical weathering of large bodies of serpentinized harzburgite and dunite of ophiolites accreted to the North American margin. Petrology and microanalytical analysis of protolith, saprock, and limonite reveal that olivine sourced the Ni and Co while pyroxenes sourced Sc; lizardite, iron oxides, and manganese oxides concentrated these elements in the altered rims of the protolith and in saprocks. Limonite samples submitted for XRD analysis show that Fe-oxide is the dominant mineral from all sample sites – confirming previously reported observations that there is little hydrous-Mg silicate saprolite horizon preserved in the southern Oregon and northern California occurrences. In addition to Fe-oxides, there is also notable clay and remnant minerals from the protolith (olivine and clinopyroxene). Laser ablation-inductively coupled plasma-mass spectrometry analysis of limonite pressed pellets shows the concentrations of Ni, Co, and Sc are an order of magnitude higher in the limonite than in the alteration rims of the protolith and in saprocks.

Northeast of the Klamath Mountains, Nickel Mountain, the only producing Ni laterite in the U.S.A., developed from a portion of the Coast Range ophiolites that experienced significantly less uplift than the Klamath Mountain and adjacent northwestern Coast Range, as evidenced by previous studies of ¹⁰Be isotopes and geodetic surveys. While adequate surficial weathering occurred to concentrate Ni, Co, and Sc in comparable concentration (up to 1% Ni, 1000 ppm Co, 65 ppm Sc) to Nickel Mountain and other exploited deposits from around the world, the balance between development and preservation for the laterite occurrences in the Klamath Mountains and northwestern Coast Range fell short compared to the northeast of the region where Nickel Mountain hosts a more well preserved laterite profile.