Geology and Geochemistry of Nikolauz Mafic-Ultramafic Intrusions, Peru: A Gondwanide Ni-Cu Sulfide Mineralized Conduit System in an Andean Orogenic Environment

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The demand of Ni and Co as critical metals renewed the interest in the exploration of deposits associated with mafic-ultramafic magmas. Orogenic environments underexplored for Ni-Cu-PGE deposits provide important opportunities for exploration. The Nikolauz intrusion, located in the Eastern Cordillera of Peru, is the first Ni-Cu sulfide mineralized conduit system reported within an Andean orogenic setting. It occurs as elongated bodies up to 4 km long, consisting of gabbroic rocks crosscut by ultramafic pulses emplaced into metamorphic schists of the Marañon Complex. Despite pervasive alteration of igneous olivine-pyroxene-plagioclase, magmatic textures are largely preserved, revealing tubular bodies with well-developed zoning consisting of adcumulus dunites at the core, which grade into peridotites, pyroxenites and gabbros toward the margins. Ni-Cu mineralization hosted within the ultramafic rocks consists of sulfide disseminations, blebby textures, and net-textured aggregates. Whole-rock geochemistry and petrography indicate that the Nikolauz intrusion consists mainly of variably altered olivine, pyroxene and plagioclase cumulates, with dunite as the principal ultramafic rock, evidenced by high MgO (>35wt.%) and Cr (>2500ppm) contents. Ultramafic rocks enriched in chalcophile elements (Ni: 2500–6000 ppm; Pd+Pt: 20–150 ppb) consistently exhibit elevated Cu/Zr (>100) and Ni/MgO (>50) ratios. Trace element systematics reveal high LREE/MREE ratios in the ultramafic rocks (La/Sm > 5) and a calc-alkaline affinity in the mafic-ultramafic suite (MgO/FeOt = 0.5–0.8; La > Nb; Th/Yb = 0.1–10; [Nb/Th]PM < 1). U-Pb zircon geochronology yields crystallization ages between 312 and 323 Ma, linking the Nikolauz magmatism to post-compressional processes related to the late Gondwanide event. Geological and geochemical evidence suggest an origin by partial melting of a pyroxenitic mantle source during lithospheric decompression triggered by slab break-off from Gondwanide orogenic. The recognition of a Ni-Cu sulfide mineralized dynamic conduit system in the orogenic environments of the Peruvian Andes highlight the potential for Ni-Cu deposits along the Eastern Cordillera.