Stockpiled limonitic material as a novel source of readily bioleached cobalt

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Cobalt has unique properties highly valued for many applications essential to the green economy. Its use in rechargeable batteries for electric vehicles, so significant in the transition to a low-carbon economy, is particularly driving the high demand. Cobalt is rarely the primary target of a mine and is usually recovered as a by-product of base metal mining. Indeed, the nickel industry remains the major source of Co with Ni laterites supplying 20% of world's Co.

We have undertaken a mineralogical, chemical and atomistic-scale characterization of limonites from locations including Greece, New Caledonia, Brazil, Kazakhstan, Turkey, Philippines and Cameroon. Combining bulk and spatially resolved techniques, including synchrotron micro-analysis, we imaged the Co distribution, identified the Co-hosting phases and modelled its atomic scale residence. The main determinant of Co enrichment is its preferential association with Mn oxides, mineralogically identified using EMPA, μRaman, FTIR and μXRD. Most common were asbolane, lithiophorite and asbolane-lithiophorite intermediates. Co varies between 1 and 20 wt%, and is structurally incorporated in these minerals. The predominant Co-Mn association in limonites facilitates selective leaching of Co by microbially-mediated reductive dissolution.