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The tectonic setting and mineralization potential for nickel, scandium, chromium and cobalt of ultramafic complexes in NE Queensland

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North-eastern Queensland contains a series of mafic-ultramafic complexes that are highly prospective for numerous critical metals, but are poorly characterised and understood, and have received very little exploration attention despite their metallogenic potential. This project aims to investigate the ultramafic rocks from north-eastern Queensland, focussing on their tectonic setting, character, distribution, genesis and potential to host critical metals including nickel, scandium, chromium and cobalt. The ultramafic rocks occur as a series of variably sized bodies along major structural zones. The individual ultramafic bodies vary in size from a few hundred meters up fifteen kilometres in length whilst multiple lenses can occur in zones up to a few hundred kilometres long. The ultramafic complexes typically comprise serpentine-talc-carbonate schists, gabbros, pyroxenites, dunites and anthophyllite/cummingtonite schists bearing anomalously high chromium concentrations and up to 10% by volume chromite. At Greenvale, the weathering of the underlying ultramafic complexes has produced thick piles of nickel-laterite which constitutes the largest nickel-cobalt-scandium reserves in Queensland, whereas at the Running River Metamorphic complex, magnetite rich gabbro's contain up to 1300 ppm vanadium. At the Running River Metamorphics the ultramafic rocks occur as lenses within amphibolites intercalated with quartzite within a tectonic zone dominated by gneiss and intrusive tonalite. The amphibolites display geochemical characteristics typical of ocean island basalts indicating their oceanic character. Detrital zircon geochronology from the intercalated quartzite layers suggests a maximum sedimentation age of 470 Ma whereas the 456 Ma emplacement age of the tonalite suggests that the ultramafic rocks must have been emplaced in their current position during the Ordovician. The quartzite units contain garnet grains with oriented rutile needles and quartz inclusions displaying radial fracture patterns indicative of coesite to quartz transition. Preliminary PT calculations using garnet core isopleths indicate nucleation at ~24 Kbars and ~600 °C whereas garnet rim thermobarometry indicates equilibration at ~11 Kbars and ~800 °C. The occurrence of the ultramafic rocks together with eclogitic garnets along major structural zones indicates that these ultramafic complexes mark suture zones and delineate terrain boundaries.