Regional Potential for Ti-V-Fe Ore in the Intrusive Complex of the 1.79 Ga Hart-Carson Large Igneous Province, Northern Western Australia

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The Hart Dolerite is the intrusive complex of the Hart–Carson Large Igneous Province (LIP, Hoatson et al., 2006; Tyler et al., 2006) in northern Western Australia. At 300,000 km^3, the volume of the tholeiitic Hart-Carson LIP is comparable to the Columbia River Basalts. A series of shallow (2-3 km depth) sills and some dikes intrude the lower Kimberley Basin and the underlying Speewah Basin and comprise 83% by volume of the Hart-Carson LIP. The mean U-Pb crystallization ages of zircon and baddeleyite of the Hart Dolerite is 1797 ± 11 Ma.

The sill complex around the margins of the Kimberley and Speewah Basins forms two exposed belts, each about 400 km in length. One trends northeast along the eastern margin of the basins and the other trends northwest along the southern margin of the basins. On the northeastern arm is Speewah Dome where the Hart Dolerite, folded by a doubly plunging fold, hosts a Ti–V deposit (Measured Resource of 322 Mt at 0.32% V_2O_5 and 2% Ti; King River Copper Ltd, 2014). A series of drill holes indicate that the mineralization is hosted within a 100-m-thick magnetite-rich gabbro, sandwiched between a 300 m thick lower sill and a 130-m-thick overlying series of mafic to felsic granophyric units (Alvin, 1993, 1998; Eves, 2010; Andrew et al, 2012). The hosting magnetite gabbro contains abundant feldspar-rich inclusions, exhibits elevated magnetic susceptibility (60×10^{-3} SI units). Ti and V are in titanomagnetite, which is most abundant in the lower 15–25 m of the disseminated magnetite gabbro.

In the Millie Windie valley 280 km SW of Speewah Dome, the Hart Dolerite displays internal sill architecture comparable to Speewah Dome. A dark, inclusion-rich, 100 m-thick magnetite gabbro is between a 450 m-thick lower sill and overlying 300 m-thick granophyric granite (syenogranite, monzogranite), quartz monzonite, and diorite. Even limited sampling suggests that the magnetite gabbro has elevated V, Ti and Fe when compared with the underlying and overlying units. The elevated magnetic susceptibility of the magnetite gabbro (40-90 x 10^{-3} SI units) facilitates its signature on magnetic datasets, where it can be followed for at least 65 km along strike. The highest V analyses from the Hart–Carson LIP geochemical dataset outside of Speewah Dome are coincident with this unit.

The similarity of the host of elevated Ti-V-Fe in the Millie Windie valley with the unit hosting Ti-V-Fe mineralisation at Speewah Dome, both in appearance and location in the sill architecture, combined with long strike lengths and ease of identification from magnetic data raises the potential for the discovery of new Ti-V-Fe resources in northern Western Australia.