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Edscottite, Fe_5C_2, a new iron carbide mineral from the Ni-rich Wedderburn IAB iron meteorite

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Abstract

Edscottite (IMA 2018-086a), Fe_5C_2, is a new iron carbide mineral that occurs with low-Ni iron (kamacite), taenite, nickelphosphide (Ni-dominant schreibersite), and minor cohenite in the Wedderburn iron meteorite, a Ni-rich member of the group IAB complex. The mean chemical composition of edscottite determined by electron probe microanalysis, is (wt%) Fe 87.01, Ni 4.37, Co 0.82, C 7.90, total 100.10, yielding an empirical formula of $(Fe_{4.73}Ni_{0.23}Co_{0.04})C_{2.00}$. The end-member formula is Fe_5C_2. Electron backscatter diffraction shows that edscottite has the *C*2/*c* Pd_5B_2-type structure of the synthetic phase called Hägg-carbide, χ-Fe_5C_2, which has $a = 11.57$ Å, $b = 4.57$ Å, $c = 5.06$ Å, $\beta = 97.7°$, $V = 265.1$ Å^3, and $Z = 4$. The calculated density using the measured composition is 7.62 g/cm^3. Like the other two carbides found in iron meteorites, cohenite (Fe_3C) and haxonite ($Fe_{23}C_6$), edscottite forms in kamacite, but unlike these two carbides, it forms laths, possibly due to very rapid growth after supersaturation of carbon. Haxonite (which typically forms in carbide-bearing, Ni-rich members of the IAB complex) has not been observed in Wedderburn. Formation of edscottite rather than haxonite may have resulted from a lower C concentration in Wedderburn and hence a lower growth temperature. The new mineral is named in honor of Edward (Ed) R.D. Scott, a pioneering cosmochemist at the University of Hawai‘i at Manoa, for his seminal contributions to research on meteorites.

Keywords: Edscottite, Fe_5C_2, new mineral, iron carbide, Wedderburn iron meteorite