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Potential magnetofossils in ∼3.4 billion-year-old cherts from the Barberton Greenstone Belt of South Africa

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Previous reported paleointensity data from ∼3.45 Ga dacites of the Barberton Greenstone Belt indicate the presence of a relatively strong geomagnetic field requiring the presence of a dynamo (Tarduno et al., Science, 2010). The ∼3.40 Ga Buck Reef Chert from the same belt includes shallow water environments that may have been conducive for magnetotactic bacteria, if such forms were present in the Paleoarchean, as might be expected given the presence of the field. Here we use rock magnetism, electron microscopy, and ferromagnetic resonance to test for the presence of bacterial magnetite particles. Magnetic hysteresis properties of bulk samples show a variety of rock magnetic behaviors, including multi-domain, pseudo-single domain, single domain, and wasp-waisted curves; the latter indicate grain and/or compositional mixtures. Electron microscopy of magnetic separates and in-situ particles from the Buck Reef Chert show cubo-octahedral to quasi-rectangular and hexagonally shaped grains that fall within a stable single domain range typical of biogenic magnetite. Ferromagnetic resonance (FMR) spectra from bulk samples appear asymmetrical and skew towards low fields, suggesting a magnetic anisotropy that is similar to the spectra seen from some strains of modern magnetotactic bacteria. Thus, while there is clearly a mixture of magnetic particles within the Buck Reef Chert, these data suggest one component could be ancient bacterial magnetite.