Hematite dust in banded iron formations: Paleoenvironmental proxy or red herring?

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A fundamental tenet of conventional models for the deposition of banded iron formations (BIFs) is that fine-grained hematite (so-called dusty hematite) represents relict ferric oxide/hydroxide precipitates. However, this premise has never been proven. In a study of BIFs of the 2.63-2.45 Ga Hamersley Group, Australia, we find BIFs show progressive stages of *in situ* alteration from green chert, containing iron-silicate nanoparticles, to red chert with abundant hematite dust. Transmission electron microscopy in the transition zone between green and red chert reveals that dusty hematite formed after partial dissolution of iron-silicate nanoparticles and precipitation of iron oxides in resulting cavities (Fig. 1). These observations suggest that hematite dust in these samples is not the dehydration product of the original seawater precipitate but the end-product of post-depositional oxidation. If these results are corroborated in BIFs elsewhere, it follows that hematite dust is not a reliable proxy for palaeoenvironmental conditions or biological processes in early Precambrian seawater. Our results support a hypothesis for the origin of BIFs involving iron-silicate precipitation followed by post-depositional growth of iron oxides.

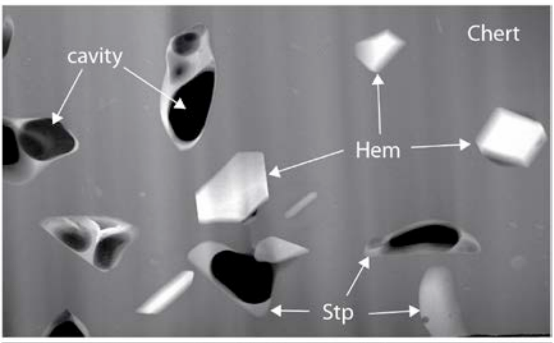

Figure 1. TEM image of randomly oriented stilpnomelane nano-particles (Stp) with abundant cavities (black). Note the presence of euhedral hematite (Hem) crystals in some of the cavities.