Iron-silicate nanoparticles in Archean chert: proxies for ferruginous, silica-enriched oceans

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High-resolution electron microscopy of cherts in banded iron formations (BIFs), shales and carbonates of the 2.63-2.45 billion-year-old Hamersley Group, Australia, reveals the presence of vast quantities of nanometer-sized, iron-silicate particles in laminated chert (Figure 1). The nanoparticles locally define sedimentary lamination, indicating that they represent relicts of the original sediments.

Based on low-temperature synthesis experiments, we suggest the iron-silicate nanoparticles precipitated from anoxic seawater enriched in silica and iron. The abundance and widespread distribution of the nanoparticles implies they were pervasive background precipitates in ferruginous, silica-enriched oceans, forming the primary sediments of BIFs during periods of enhanced submarine mafic volcanism.

Our findings imply that silicate precipitation was a major sink of seawater iron and silica before the Great Oxidation Event (betwen 2.45-2.2 billion years ago) and, because of the reactivity of nanoparticle surfaces, may also have influenced the transport and geochemical cycling of trace metals and nutrients.

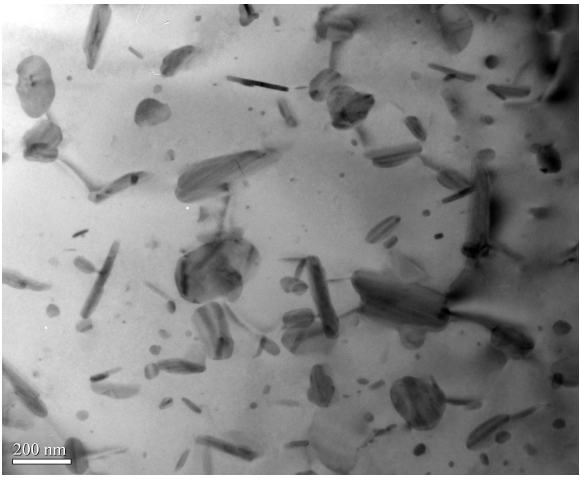

Figure 1: TEM image of randomly oriented, iron-silicate plates “floating” in chert cement. Scale bar is 200 nm.