

**PRIMARY HEMATITE IN NEOARCHEAN TO PALEOPROTEROZOIC BANDED IRON FORMATIONS.** S. Sun, Y. -L. Li, Department of Earth Sciences, University of Hong Kong, Pokfulam Road, Hong Kong ([sunsi.hku@hku.hk](mailto:sunsi.hku@hku.hk); [yiliang@hku.hk](mailto:yiliang@hku.hk)).

Banded iron formations (BIFs) are chemical sedimentary rocks formed throughout the first two billion years of Earth's life history. They are characterized by alternating iron- and silica-rich bands. Iron oxides (i.e., hematite and magnetite) and chert are major minerals of BIFs. It was extensively accepted that the chert was transformed from amorphous silica or silica colloids flocculated with ferric oxyhydroxides, whereas the hematite and magnetite were derived from Fe(III) oxyhydroxide precursors. Ferrous iron oxidation was supposed having occurred in the seawaters from which BIFs deposited, via anaerobic iron-oxidizing bacteria or photosynthesis-produced oxygen or both. The presence of Fe(III) and Fe(II) oxides (i.e., hematite and magnetite) gives BIF an average oxidation state of Fe<sup>2.4+</sup>. However, it was also suggested that iron silicates similar to smectite in composition might be the primary minerals of the BIF [1], and hematite might be a secondary product derived from silicates in a later-stage process mediated by external oxic fluids [2]. If this was the case, the Fe(II)-to-Fe(III) oxidation might not happen in the seawaters and the oxidation state of the ancient ocean might have been overestimated.

To provide new insights to understand the timing and formation of Fe(III) oxides, we carried out systematic petrographic observations and high resolution mineralogical characterization on two best-preserved BIFs: the 2.7 Ga Abitibi BIF from the upper most part of the Hunter Mine Group in Abitibi greenstone belt, Canada and the 2.46 Ga Kuruman BIF from the Transvaal Supergroup in South Africa [3]. Three types of hematite are identified in both BIFs: (1) 3-5 nano crystals aggregated in iron-oxide-rich bands, (2) submicrometer-sized euhedral crystals randomly scattered in chert matrix in the transitional zones between iron- and silica-rich bands (Fig. 1), (3) needle-like particles distributed along fractures or bandings. We interpret the first two types are primary hematite dehydrated from ferric oxyhydroxide precursors during diagenesis, whereas the third is a later-stage product possibly formed with the mediation of external fluids. The first type of hematite inherited its precursor's crystal size, while the second type of hematite has undergone a coarsening process with the aid of internal fluids released from the structure of the matrix chert. The existence of the primary hematite indicates that ferric oxyhydroxide are indeed one major primary mineral in BIFs. Moreover, photosynthetic Fe(II) oxidation, by

either direct or indirect biological mechanisms, had already emerged in Neoproterozoic to Paleoproterozoic.

[1] Rasmussen B. et al. (2013) *Geology*, 41, 435–438. [2] Rasmussen B. et al. (2014) *GSA Bulletin*, 126, 438–446. [3] Sun S. et al. (2015) *GSA Bulletin*, in press.

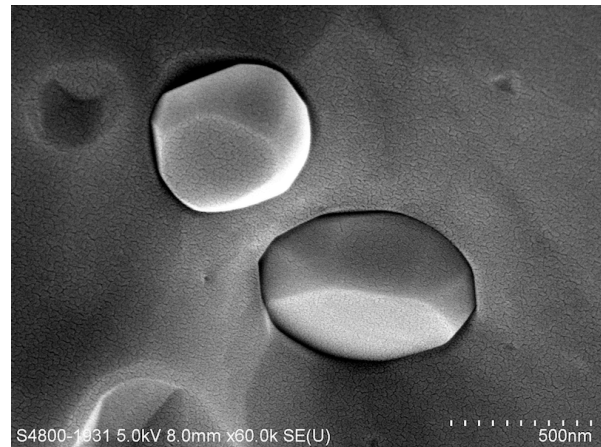


Fig. 1 Scanning electron microscopic image of submicrometer-sized euhedral hematite crystals in chert matrix from the Kuruman BIF.