

Banded iron-formation carbonates: Diagenetic proxies or records of primary water-column processes?

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Iron carbonates (siderite, ankerite) in banded iron-formation (BIF) are widely thought to represent the products of diagenetic reactions involving organic matter and Fe(III) oxy-hydroxide precursors (e.g. ferri-hydrate). This is chiefly based on the low $\delta^{13}\text{C}$ carbonate values that BIF typically record, which range between -5‰ and -13‰ [1]. Such low values are interpreted as a result of organic C oxidation *via* microbial dissimilatory iron reduction (DIR) within the precursor BIF sediment [2]: also observed in modern anaerobic diagenetic environments. Variations in the relative abundance of organic C and Fe(III) oxy-hydroxide in the initial sediment would therefore dictate the degree of modal carbonate abundance and bulk iron oxidation state of individual BIF samples [2].

We have embarked on a re-assessment of the C-isotope composition and origin of siderite and ankerite in BIF, through the study of several continuous drill-core sections of the ~2.45Ga Kuruman and Griquatown BIF of the Transvaal Supergroup in South Africa. Samples of microbanded to mesobanded and occasionally granular BIF, were collected across all cores at random stratigraphic positions every 10-15m on average, and examined texturally, chemically and isotopically. Total organic carbon analyses across one core revealed very low TOC abundances in all samples (<0.1 wt%). Bulk carbonate C isotope data ($\delta^{13}\text{C}_{\text{carb}}$) for all cores fall within the expected range of -5 to -13‰, and record consistently reproducible profiles, irrespective of carbonate modal abundance or bulk mineralogy in general. The profiles are characterized by a broad plateau of high ($-6.5 \pm 1.5\%$) $\delta^{13}\text{C}_{\text{carb}}$ values across the Kuruman-Griquatown transition, and at the stratigraphic top of the succession; lower $\delta^{13}\text{C}$ values ($-11 \pm 2\%$) prevail over the remaining part of the cores. Siderite- and ankerite-specific $\delta^{13}\text{C}$ data from selected samples are also consistently within 1-2‰ between one-another and bulk $\delta^{13}\text{C}_{\text{carb}}$. The curious chemo-stratigraphic reproducibility in bulk $\delta^{13}\text{C}_{\text{carb}}$ between individual cores is hard to interpret as a result of diagenetic C and Fe cycling alone, and calls for water-column processes as partly responsible for the observed signals.

[1] Klein (2005) *American Mineralogist* **90**, 1473-1499.[2] Heimann *et al* (2010) *EPSL* **294**, 8-18.