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Investigating the depositional environment of banded iron formations from the Isua Supracrustal Belt, Southwest Greenland

CLAIRE I O NICHOLS[1], STEPHANIE HALWA[1] AND STUART A ROBINSON[2]

[1]University of Oxford

[2]Department of Earth Sciences, University of Oxford

Presenting Author: claire.nichols@earth.ox.ac.uk

Eoarchean (3.7 Ga [1]) banded iron formations (BIFs) from the Isua Supracrustal Belt, Southwest Greenland have been variably metamorphosed and deformed. At the top of the northeastern extent of the belt, the lowest degree of metamorphism is observed with a maximum pressure and temperature of 1.5 – 4 kbar and 360 – 400 °C, respectively [2]. Previously, the banding in these BIFs has been interpreted as entirely tectono-metamorphic in origin [3]. However, in the best preserved regions in the northeastern part of the belt the BIFs are exceptionally well preserved, and exhibit potentially sedimentary features including possible way-up indicators.

A particularly striking features of the BIFs in the northernmost region are repetitive bands of brecciated material which are approximately 30 cm wide and occur every 1 – 2 m. Similar brecciation textures are observed in dolomites in the area which have previously been interpreted as tempestites (storm-wave breccias) and evidence for a shallow marine environment [3,4]. The occurrence of similar breccias in the BIFs is at odds with the interpretation that these deposits formed in relatively deep water. The aim of this study is to interrogate the origin of the brecciated layers in the BIF, and whether these layers represent primary depositional 'beds' or were formed by later metamorphism and fluid alteration.

Petrographic observations show that the brecciated layers contain extensive carbonates, while the surrounding BIF is dominated by alternating layers of magnetite and chert. This is consistent with the contrast in weathering between the brecciated layers and banded layers from field observations. The origin of the carbonates is investigated by examining their $\delta^{13}C$ and $\delta^{18}O$ isotope and rare-earth element compositions. Preliminary results indicate that the breccias are hydrothermal in origin. We use these observations, in combination with paleomagnetic field tests to argue for some degree of preservation of primary depositional features in the Isua BIF.

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