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# The origin of granular chert in the BARB3 drill core from the 3.4 Ga Buck Reef Chert, Onverwacht Group, Barberton Greenstone Belt, South Africa

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The 3.4 Ga Buck Reef Chert (BRC) of the Onverwacht Group was recently drilled as part of the ICDP-funded Barberton Drilling Project. The 900 m long BARB3 drill core consists of a variety of chert lithofacies. These include banded white chert, massive carbonaceous chert and a granular chert variety, which is most abundant in the stratigraphically lowermost part of the drilled succession. It is present, albeit much less abundant, in the top part of the BRC but rare to absent in the middle part of the BRC. The environment and processes of granular chert formation are not well-known. The origin of the carbonaceous matter present in the granular chert is also poorly understood. However, carbonaceous matter from the BRC locally constitutes possible microfossils and microbial biofilms. It is currently unresolved (1) whether the granular chert lithofacies formed as a result of sedimentary processes or hydrothermal processes or a combination of both, and (2) whether the carbonaceous matter present in granular chert is a result of biogenic process.

The granular chert is characterized by the presence of sand-sized (125 µm to 2 mm) particles of dark grey to black carbonaceous chert (most abundant), white chert and a variety of other clasts derived from adjacent rocks, ranging from sand to pebble size (commonly white chert fragments). Irregular domains (200 µm to 2 mm) resembling fenestrae in carbonate rocks are present in massive granular chert and they are typically filled with white chert, but can also be filled with fine-grained sediment. The granular chert often contains pebble-sized clasts of host rocks, which include massive white chert and, less commonly, crinkly laminated green chert. These clasts are angular to well-rounded and there is no evidence of transport observed, indicating that the roundness may be due to chemical abrasion rather than mechanical abrasion.

The granular chert can either form stratiform layers or fills stratiform as well as cross-cutting secondary veins. The stratiform layers of granular chert are typically planar and tabular with a thickness ranging between 1 mm and 50 mm, but can reach a thickness of up to 200 mm. Veins of granular chert are frequently infilled with chert sand grains, specifically white chert grains (200 µm to 2 mm), with black carbonaceous chert grains (100 µm to 200 µm) being less frequent. Detailed petrological and sedimentological studies together with field studies indicate that the granular chert is commonly massive but can also be laminated in which the laminations are defined by lamina concentrated in carbonaceous matter.

The interpretation of the palaeoenvironment of the BRC is a centre of debate. Granular chert consisting predominantly of silt- to fine sand-sized (20 µm to 150 µm) black carbonaceous chert particles that accumulated during transport to form ripple bedforms c. 6 m below the BRC provides evidence for granules to have been reworked, and possibly formed, in a shallow-water depositional environment. The

sand-sized carbonaceous chert grains could represent ripped up microbial mats [1] [2] and the sand-sized white chert grains could represent ripped up layers of white chert. Based on preliminary results, both sedimentary and hydrothermal processes could have influenced the formation of the granular chert.

*References:*

[1] Hofmann A and Bolhar R (2007) Astrobiology 7(2): 355-388
[2] Tice M and Lowe D (2006) Earth Science Reviews 76: 259-300