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A cumulate origin of Eoarchean peridotite enclaves from the Narssaq ultramafic body, southern West Greenland

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Some ultramafic enclaves found within the Itsaq Gneiss Complex (IGC) in southern West Greenland have previously been interpreted as Eoarchean mantle relicts [1][2]. However, given that such ultramafic rocks are highly susceptible to metasomatism during their long residence time within mid-crustal levels, they could equally well represent cumulates [3]. Therefore, individual evaluation of such peridotite occurrences from different areas are required. Here, we present new petrological observations and geochemical data for the >3.8 Ga Narssaq ultramafic body (NUB), south of Nuuk, in order to better constrain its origin. The ultramafic rocks have high FeOt and Cr contents with coherent flat trace element patterns and positive Cr-MgO correlations, which are distinct from mantle rocks. In addition, the compositions of olivine and spinel follow a fractional crystallization trend. Those features do not support the interpretation that they are mantle residues, but are instead consistent with a cumulate origin. Furthermore, thermodynamic (MELTS) modeling shows that the observed compositional trends can be produced via fractional crystallization of the associated tholeiitic parental magma under anhydrous conditions, involving the accumulation of olivine + spinel ± cpx ± opx. The fact that identical ultramafic rocks can form as a natural consequence of fractional crystallization of the most common Archean mafic melt composition, makes a cumulate origin the simplest explanation for the origin of Archean peridotites. This has important implications for understanding Eoarchean geodynamic processes, because the cumulate model is consistent with a vertical tectonic setting involving dry tholeiitic magmas similar to those found in modern oceanic plateaus.

[1] Friend & Nutman (2011), *Geology* 39, 663–666.

[2] van de Löcht, Hoffmann, Li, Wang, Becker, Rosing, Kleinschrodt & Münker (2018), *Geology* 46, 199–202.

[3] Rollinson (2007), *Contrib. Mineral. Petrol*. 154, 241–252.