

A new UHP metamorphic complex in the ~1.8 Ga Nagssugtoqidian Orogen of West Greenland

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ABSTRACT

The Nagssugtoqidian Orogen is a ca. 1.8 Ga belt of east-west trending, highly deformed rocks that bisects central Greenland. Although a variety of data have suggested this belt marks the location of a continent-continent collision zone, evidence of subduction has been lacking. We report here mineralogical evidence from four samples within a well-defined lithologic unit of metabasic and metasedimentary ocean floor rocks of a previously unrecognized UHP metamorphic episode. The UHP episode is recorded by remnants of orthopyroxene exsolved from majoritic garnet, graphitized diamond, exsolution of rutile from garnet and pyroxenes, exsolution of magnetite from olivine, and complex exsolution textures in ortho- and clinopyroxenes (including omphacite). Associated with these mineralogical features is an unusual occurrence of quartz needles in Mn-rich fayalite. From textural characteristics, we infer that the quartz needles exsolved from the fayalite. To our knowledge, olivine with exsolved silica has not been reported. We note, however, that experimental studies have shown that β -spinel can incorporate excess silica. We therefore speculate these quartz needles may be silica that exsolved from Mn-rich ahrensite, the Fe analog of ringwoodite, upon decompression and inversion to fayalite. If correct, this occurrence would be the first reported sample of naturally occurring olivine (fayalite) that inverted from ahrensite. Corroborating an early UHP history are reaction relationships that delineate a path through high-pressure and high-temperature conditions during decompression. *P-T* conditions inferred for the UHP episode are ~7 GPa at ~975 °C. The unusually low *T* for this UHP system at ~1.8 Ga may reflect either very rapid subduction rates at that time, or unexpectedly cool mantle conditions. Preservation of the UHP assemblages probably is due, in large part, to the exceptionally low $a_{\text{H}_2\text{O}}$ during decompression and cooling. These UHP rocks establish that the location of the subduction and suture zones that must have existed prior to and during the collision of continents was along what is now the northern edge of the Nordre Strømfjord shear zone.

Keywords: UHP metamorphism, majorite, diamonds, Nagssugtoqidian, pigeonite, ahrensite, Paleoproterozoic, exsolution