

A FEASIBLE TECTONIC MODEL FOR UHP METAMORPHISM AT THE END OF THE CALEDONIAN COLLISION

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New U-Pb SHRIMP dating and trace element analysis of coesite-bearing zircon (McCLELLAND et al., this volume) confirms that UHP metamorphism along the Laurentian margin of the North-East Greenland Caledonides occurred at 360 Ma, and likely persisted through 350 Ma. The hot (> 900 °C) UHP rocks were exhumed through the Sm - Nd closure temperature at 342 ± 6 Ma. These results push the duration of Caledonian collision between Laurentia and Baltica well into the Carboniferous, and beg the question: What tectonic scenario can produce UHP metamorphism near the end of the Caledonian orogeny?

The eclogite-bearing Laurentian continental basement exposed in Greenland generally lacks mantle peridotites, and therefore, is taken to be the upper, over-riding plate in a collision with Baltica as the down-going slab. Continental subduction of the Baltic margin at ca. 400 Ma, inferred from UHP metamorphism of the peridotite-rich Western Gneiss Region in Norway, marks the closure of the Iapetus ocean. Rapid exhumation of the Western Gneiss Region at 395 Ma is most likely caused by slab break-off. This event may trigger synorogenic extension at the surface and formation of the Old Red Sandstone Devonian basins in Greenland and Norway. HP granulites and eclogites were also forming in the overriding plate around 400 Ma due to crustal thickening by imbricate thrusting and / or vertical stretching processes. Once slab break-off occurs, continental subduction is likely to stop, and continued convergence will lead to the formation of an overthickened orogenic welt. Plate convergence, perhaps in a transpressional setting, must have continued into the Carboniferous in order to form UHP assemblages in the hinterland of the orogen in North - East Greenland. A "drip" model, whereby parts of the overthickened Laurentian crust are pulled down to mantle depths of 100 - 120 km, may explain the high temperatures as well as the young age of UHP metamorphism in North-East Greenland. The difficulty then comes in trying to exhume UHP rocks from the bottom of the pile. We suggest that a change in plate motion resulting in decreased convergence is needed to exhume the Greenland UHP rocks. This occurred between 350 - 340 Ma, perhaps in a transpressional or transtensional setting. Gneisses in the UHP terrane are cut by undeformed pegmatites dated by U-Pb zircon at ca. 330 Ma, demonstrating that amphibolite facies exhumation and deformation were waning. Pennsylvanian (i.e. Late Carboniferous) terrestrial conglomerates, sandstones and siltstones were deposited directly on eclogite-bearing basement in Germania Land, approximately 50 km south of the UHP locality and mark the final exhumation of the Laurentian margin.