Metamorphic evolution of the Petersen Bay assemblage, Ellesmere Island: What can we learn about Pearya - Laurentia accretion?

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The accretion of the Pearya terrane to the northern margin of Laurentia plays an important role in the paleogeographic reconstructions for the Arctic region. Earlier workers proposed a timing of its juxtaposition spanning from Late Silurian (Trettin, 1998) to Late Ordovician (Klaper 1992). In this study, we focus on the pressure-temperature-time (P-T-t) evolution of the Petersen Bay assemblage. This subduction related unit crops out between the crystalline basement of Pearya and volcano-sedimentary sequence of Clements Markham fold belt. The highest grade rocks, garnet-kyanite-bearing schist (sample 17-66) and garnet-kyanite-staurolite gärbenschiefer (sample 17-64) were selected for P-T studies and in-situ monazite U-Pb dating by sensitive high resolution ion microprobe.

Thermodynamic modelling of sample 17-66 gives a P-T condition of 7.8-8.1 kbar and 590-610°C for garnet core formation, whereas a pseudosection calculated for the effective bulk composition indicates garnet rim growth at 8-9 kbar and 650-660°C. The QuiG Raman barometry coupled with Ti-in-biotite thermometry yield conditions of 6.5-7.5 kbar and 540-600°C for the garnet growth. The combination of QuiG barometry and Ti-in-biotite thermometry indicate garnet growth at 7.5-8 kbar and 500-550°C for the gärbenschiefer sample.

Monazite shows distinctive zonation and 2, up to 3, domains were recognized based on textures and X-ray microprobe maps. For the sample 17-66, Monazite-I forms inclusions within garnet rims or cores of bigger matrix grains. It defines a weighted mean $^{206}\text{Pb}/^{238}\text{U}$ age of 397±2 Ma (n=18, MSWD=1.6). Monazite-II occurs in the matrix and gives an age of 385±2 Ma (n=19, MSWD=1.5). Monazite-I from sample 17-64 yields a weighted mean $^{206}\text{Pb}/^{238}\text{U}$ age of 394±2 Ma (n=11, MSWD=0.6). Monazite-II defines the age of 388±2 Ma (n=7, MSWD=0.8). Monazite-III was distinct only in gärbenschiefer. It yields a younger age of 374±6 Ma (n=6, MSWD=3.1).

The P-T data coupled with monazite dating suggest a Middle Devonian metamorphism of the Petersen Bay assemblage under amphibolite facies conditions. These new results suggest that the juxtaposition of the Pearya terrane, Petersen Bay assemblage and the Clemens Markham fold belt is Middle Devonian or younger, i.e. much younger than previously thought.
References

