P-T history and zircon geochronology of a paragneiss hosting ultrahigh pressure metamorphic rocks from Tromsø Nappe, Caledonian orogenic belt

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The spatial extent of ultrahigh pressure (UHP) metamorphic rocks gives critical constraint to evaluate the exhumation process of the relevant area. Most of felsic gneisses hosting UHP rocks mainly consist of amphibolite facies minerals that harm to determine the exact spatial extent of the UHP terranes. However, UHP evidence such as coesite and jadeite have been found from orthogneiss in Dabie-Sulu terrane in early 90's (Tabata et al., 1998). Therefore, some of felsic gneisses are considered to be suffered UHP metamorphism along with the hosting UHP rocks, in spite of the missing of UHP evidence. The Scandinavian Caledonides are composed of a stuck of several nappes, subducting deeply during continental collision between Laurentia and Baltica from Ordovician to Devonian. The Tromsø Nappe is the uppermost nappe and consists of felsic schists and gneisses with minor amounts of mafic rocks such as eclogites and amphibolites. The UHP evidence is known from eclogites and diamond-bearing gneiss (Ravna and Roux, 2006; Janák et al., 2012, 2013). However, its spatial extent remains unknown. The comprehensive study on zircon is a powerful tool to unravel the spatial extent of UHP rocks and their formation timing especially in UHPM terrains suffered pervasive later stage overprint. To understand the extent of UHPM rocks, we examined a *P-T* history of a garnet-muscovite gneiss from Holmevaten in the Tromsø Nappe. The rock shows an augen structure characterized by plagioclase porphyroclasts in the gneissic matrix, mainly composed of micas, garnet and quartz. X-ray mapping of garnet suggests that some garnet grains are zoned, such as Ca-poor ($Grs_{9–15}$) and inclusion-rich inner-core (including kyanite), Ca- and inclusion-poor outer-core and Ca ($Grs_{16–26}$)-rich rim, although most of garnet grains are free from Ca-rich rim. Most plagioclase grains show Ca-rich ($An_{25–31}$) core and Ca-poor ($An_{15–22}$) rim. Zr-in-rutile thermometry, conventional geobarometry and the pseudosection modelling give 640–700 ^{o}C/1.5–1.7 GPa for the garnet-plagioclase cores and 550–590 ^{o}C/1.1–1.3 GPa for the rim pairs. Based on REE pattern of garnet, most domains of garnet grains show negative Eu anomaly, suggesting crystallization in plagioclase stability field, except for some domains (Grs_{15-18}). *P-T* conditions of the core pairs in this study are similar to those of pelitic schists (Krogh et al., 1990), but cooling path is different. Zircon grains show oscillatory-zoned core, dark mantle and bright rim in cathodoluminescence image. Quartz, muscovite, biotite and apatite are included in zircon core and mantle. The LA-ICPMS U-Pb zircon dating gives the concordant ages of 2800–950 Ma (core/mantle) and 480–430 Ma (rim). Older domains show high Th/U ratio (> 0.10), steep HREE pattern and positive Ce and negative Eu anomalies, suggesting the detrital domains of magmatic zircons. These age spectra are similar to those of the Seve Nappe Complex (the middle nappe of the Scandinavian Caledonides) and the Greenland Caledonides, suggesting that the studied felsic gneiss is a paragneiss derived from either Laurentia or Baltica continent (or both). Younger rims show low Th/U ratio (< 0.10), flat HREE pattern and negative Eu anomaly, suggesting the metamorphic recrystallization in plagioclase stability field. Some zircon grains showing metamorphic rim are included in garnet grains, therefore the rim ages (480-430 Ma) shows the metamorphic timing of the studied felsic gneiss. These ages overlap ID-TIMS U-Pb zircon and titanite/rutile ages from eclogites (452.1 +/- 1.7 Ma; Corfu et al., 2003). From the above, the studied paragneiss had been a sedimentary rock including detrital zircon grains derived from Laurentia/Baltica continent. The paragneiss formed at the alomost same timing as UHP rocks but in the different depth. However, the spatial extent of UHP rocks and the exhumation process of the Tromsø Nappe remain unknown.