EGU21-223
https://doi.org/10.5194/egusphere-egu21-223
EGU General Assembly 2021

Timescales of continental subduction: Constraints from ultrahigh-pressure metapelites in the Western Gneiss Region, Norway

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The Western Gneiss Region (WGR), Norway is an archetypal continental ultrahigh-pressure (U)HP terrane with an extensive metamorphic history, recording the subduction and subsequent exhumation of continental crust to depths exceeding 120 km. The vast bulk of past work within the WGR has focused on mafic eclogites. In this study, data from rare garnet-kyanite metapelites in (UHP) domains of the WGR is presented. U–Pb geochronology and trace element compositions in zircon, monazite, apatite, rutile and garnet were acquired, and P–T conditions were calculated by mineral equilibria forward modelling and Zr-in-rutile thermometry. The Ulsteinvik metapelite defines a prograde path that traverses through ~600–710 °C and ~11–14 kbar. Minimum peak conditions are ~750 °C and ~2.9 GPa in an inferred garnet-kyanite-coesite-omphacite-muscovite-rutile-quartz-H_2O assemblage. Plagioclase-biotite-quartz intergrowths developed after omphacite-phengite-rutile breakdown on the early retrograde path, followed by cordierite-spinel-plagioclase symplectites after garnet-kyanite-biotite, defining a retrograde P–T point at ~740 °C and ~7 kbar. Late Ordovician-Early Silurian (~470–440 Ma) zircon and rutile age data in Ulsteinvik pre-dates the major Scandian UHP subduction episode in the WGR, interpreted as recording early Caledonian subduction within the Blåhø nappe. Monazite and apatite U-Pb geochronology and trace element data suggest exhumation occurred at ~400 Ma. The Fjørtoft metapelite is a constituent of the Blåhø nappe. Minimum peak P–T conditions are ~1.8 GPa and ~750 °C, with poor peak mineral fidelity attributed to extensive retrograde deformation. Negative Eu anomalies in ~423 Ma monazite suggest retrograde conditions were reached [RJT1] by ~423 Ma. Ulsteinvik and Fjørtoft may have experienced pre-Scandian subduction together within the Blåhø nappe, but record dissimilar histories after this. Two potential scenarios are presented: (1) Ulsteinvik resided within the mantle for 20 million-years longer than Fjørtoft during Scandian subduction, or (2), the samples were exhumed at different times during pre-Scandian subduction of the Blåhø nappe. The preservation of prograde zoning within Ulsteinvik garnets precludes a long-term residence within the mantle and suggests the latter option. In this scenario, the subducting Blåhø nappe experienced a degree of slab tear and partial underplating of the upper plate during the early stages of continental underthrusting. Discrete pieces may have later reattached to the lower plate at different times, partially exhumed, and then subducted to mantle-depths during the Scandian.