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The geochronological evolution of subduction and exhumation of the Vaimok Lens, Seve Nappe Complex, Scandinavian Caledonides

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In-situ monazite Th-U-total Pb dating, zircon LA-ICP-MS depth-profile U-Pb dating and in-situ white mica 40Ar/39Ar geochronology were applied to metapsammitic and metapelitic rocks of the Vaimok Lens, Seve Nappe Complex, to reveal the timing of subduction and exhumation. The area comprises sedimentary and igneous rocks of the Baltica passive margin that were subducted to and metamorphosed at (ultra-)high pressure conditions. Partially decomposed monazite as well as detrital zircon comprise the accessory phases of the metasedimentary rocks. The predominant structure of the rocks is a pervasive, exhumation-related S2 foliation that is defined by an alignment of white mica and clinozoisite that surround partially decomposed monazite. The localized internal thrust faults and the bounding fault trace of the Vaimok Lens that formed during the final, collisional stage of the Scandinavian Caledonides are also defined by the same schistosity. Subduction of the Vaimok Lens occurred at 498 $\pm$ 10 Ma as recorded by monazite that formed via dissolution-reprecipitation of Neoproterozoic monazite. The reprecipitated monazite contains low $Y2O_3$ (mean: 0.18 wt%) and high SrO (mean: 0.35 wt%) with respect to the Neoproterozoic monazite (means: 0.70 $Y2O_3$ wt% and 0.18 SrO wt%), thereby tracking prograde garnet growth in high-pressure conditions. Subordinate monazite (mean $Y2O_3$ wt% of 3.03) grew at 479 $\pm$ 29 Ma in response to partial garnet dissolution during initial exhumation of the Vaimok Lens. As exhumation continued, Ca-rich fluids infiltrated the Vaimok Lens and catalyzed the breakdown of monazite, forming apatite, allanite and clinozoisite. The reaction products grew aligned with S2 foliation. The Ca-rich fluids also facilitated dissolution-reprecipitation of detrital zircon, forming thin (<10 μm) rims on the grains. These rims chemically record monazite breakdown as they are enriched in Light Rare Earth Elements, U, Th, and P. Subtle Eu anomalies in the rims (Eu/Eu* $\approx$ 0.6-1.2), with respect to the cores, indicates that dissolution-reprecipitation of zircon and coeval monazite breakdown operated under high-pressure conditions. The age of zircon rim formation was calculated from three samples at 480 $\pm$ 22 Ma, 479 $\pm$ 38 Ma and 475 $\pm$ 26 Ma. Cooling of the Vaimok Lens during exhumation occurred at 468 $\pm$ 8 Ma, as indicated by 40Ar/39Ar dates of tabular, undeformed mica defining the S2 foliation. High-strain samples of the S2 foliation exhibiting mica-fish and S-C structures record deformation of the metasediments at 447 $\pm$ 9 Ma, implying later-stage exhumation through shallower crustal conditions. The final phase of exhumation during continental collision is dated via high-strain white mica from an internal thrust (408 $\pm$ 4 Ma) and the floor thrust (414 $\pm$ 6 Ma) of the Vaimok Lens.

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