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Recrystallization of zircon rims facilitated by LREE-rich, high-pressure metamorphic fluids during continental subduction of the Seve Nappe Complex, Scandinavian Caledonides

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The eclogite-bearing Seve Nappe Complex (SNC) of the Scandinavian Caledonides represents continental crust subducted to high-pressure (HP) conditions. Sixty-two zircon grains were hand-picked from a quartzite, with metapelitic laminae, obtained from the SNC. Unpolished zircon grains were analyzed via LA-ICP-MS depth-profiling technique, examining both trace element geochemistry and U-Pb geochronology. Zircon grains exhibit euhedral morphology with minor surface abrasion. Results of depth-profiling revealed zircon cores with rare earth element (REE) patterns typical for primary igneous zircon. Integrations of 207Pb/206Pb dates for zircon cores yielded a dominant c. 1000-1100 Ma detrital signature with dispersed ages at c. 1200-1500 Ma. Geochronological investigation of the zircon rims revealed 206Pb- and 207Pb-loss from the rims of 21 zircon grains. Discordance regression (via Wetherill Concordia) produced a Concordia lower-intercept of 487 $\pm$ 22 Ma (n = 21, MSWD = 1.05), interpreted to be the age of rim recrystallization. Trace elements in zircon rims revealed that more than half of the analyzed grains are enriched in light-REEs (LREEs) with relatively undisturbed primary heavy-REE (HREE) patterns. We interpret LREE-enriched rims to be the result of dissolution-reprecipitation (recrystallization) of zircon in the presence of LREE-rich fluid. These rims exhibit weak Eu anomalies (Eu/Eu* $\approx$ 0.6-1.2) indicating that recrystallization occurred in the absence of plagioclase (i.e. HP conditions). LREE enrichment is not matched by an enrichment of P, suggesting that P was not available to charge balance the incorporation of LREEs in the zircon crystal structure during recrystallization. We hypothesize that LREE-rich fluids which facilitated zircon recrystallization are linked to monazite-forming metamorphic reactions for which P was a limiting element and LREE was in excess. Monazite is preserved both in HP garnet porphyroblasts and in the matrix, commonly rimmed by secondary allanite. Th-U-total Pb dating of monazite yielded a date of 494 $\pm$ 4 (n = 73, MSWD = 0.99), interpreted to be the age of primary crystallization. Monazite grains contain elevated-Sr ($\sim$1000-4500 ppm) and weak Eu anomalies (Eu/Eu* $\approx$ 0.35-0.60), indicating crystallization in plagioclase-free HP conditions. Therefore, both primary crystallization of monazite and recrystallization of zircon rims occurred under HP metamorphic conditions, providing strong evidence for an intimate link of these two processes. The results provide significant insight into fluid-driven recrystallization processes of zircon and LREE mobilization under HP conditions in subduction zones.

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