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EARTH SCIENCE

SPEAKERS CLUB

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Petrochronology in Zealandia:
Investigating continental breakup using Lu-Hf in garnet and depth profiling in zircon

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Zealandia is a hidden geological continent that is 94% submerged as a result of widespread lithospheric thinning during rifting from Gondwana in the Late Cretaceous. In the emergent portion of Zealandia, the Alpine Schist accretionary wedge complex records post-subduction processes occurring at the paleo-Pacific – Gondwana subduction margin. The metamorphic record preserved in the Alpine Schist offers a unique opportunity to investigate the drivers responsible for the crustal thinning preceding detachment of Zealandia.

To fully decipher the complex metamorphic history recorded in the Alpine Schist, we combine Lu-Hf garnet geochronology with depth profiling of U-Th/Pb and REE in zircon. Garnet geochronology records prograde to peak metamorphism occurring in a progressively trenchward direction in the fold-thrust accretionary complex. Garnet ages are corroborated by the relatively novel approach of depth profiling in zircon using laser-ablation split stream (LASS)-ICP-MS, which enables the analysis of thin and discontinuous metamorphic zircon overgrowths. Based on our knowledge of rare earth element partitioning between zircon and garnet, it is possible to link metamorphic rim dates to specific metamorphic events, and discern the timing of garnet growth versus garnet breakdown. In combination, garnet-zircon petrochronology resolves a prolonged history of metamorphism, with prograde conditions during 97 – 75 Ma and decompression and cooling during 84 – 45 Ma. The results imply that convergence throughout the accretionary wedge was contemporaneous with lithospheric thinning and rifting of Zealandia from East Gondwana, providing insight into the mechanisms responsible for widespread thinning and submergence of this 'new' geological continent.