Application of spatially resolved U-Pb rutile thermochronology to the exhumation history of the Alpine Fault, New Zealand

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Rutile is a common accessory mineral with a broad stability range. It incorporates measurable concentrations of U and Pb, allowing for its use as a high-temperature thermochronometer. At low temperatures, Pb is immobile and rutile geochronology can be used with confidence. However, there is less confidence in applying rutile geochronology at higher temperatures. For instance, the development of in-situ analysis capabilities for rutile is in its infancy, and the two prominent studies that have calculated Pb diffusion parameters in rutile conflict and result in differing Pb closure temperatures by 200°C for a 100 μm rutile grain[1,2]. We have developed a protocol for rutile U-Pb analyses via SHRIMP-RG that has a reproducibility error of 2%. To calculate Pb-in-rutile closure temperature, we analysed rutile from samples adjacent to the Alpine Fault, New Zealand, because of the well-constrained t-T history. Rutiles were analysed in-situ in thin sections. Rutile grains ranged from 250-1600 μm diameter and contained 4-22 ppm U. Pb ppm and U-Pb age gradients were measured from rim to core to create Pb diffusion profiles. Age gradients from rims to core range, respectively, from 2-9 Ma, 2-16 Ma, 5-19 Ma. Rutile ages are the first from high-temperature thermochronometers to record rapid Alpine Fault exhumation ~6 Ma. Modelled Pb diffusivity parameters from Pb diffusion gradients will reveal more detail about the exhumation and fault slip during the onset of exhumation on the Alpine Fault.

[1] Mezger et al. (1989), *EPSL* 96, 106-118. [2] Cherniak (2000), *Contrib. to Min. and Pet.* 139, 198-207.