Constraining the Quaternary evolution of the Hida range of the Japanese Alps

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Japan is one of the most tectonically active locations on Earth, situated adjacent to two triple junctions between four tectonic plates. Within this convergent zone, the Hida, Kiso and Akaishi ranges of the Japanese Alps are thought to have been uplifted within the last 1 to 3 Myr. Whilst undoubtedly tectonically driven, this mountain-building may also have been coincident with the onset of the Quaternary period, and the associated global climatic transition to ice-house conditions. Extremely high rates of precipitation (>3,000 mm/yr) coupled with earthquake enhanced landsliding potentially make the Japanese Alps one of the most rapidly exhuming places on Earth. However the rate of exhumation and the topographic evolution of this significant tectono-climatic setting remain poorly constrained. Quantifying exhumation rates will provide insights into the tectonic evolution of the Japanese Alps as well as an improved understanding of the coupling between tectonics and climate through erosion processes.
Thermochronometry enables exhumation rates to be determined from the measurement of rates of rock cooling, and the newly developed multi-OSL-thermochronometry system is sensitive to temperatures of as low as ~25 ℃, enabling constraint of late-Quaternary exhumation histories at an unprecedented resolution. We collected 19 samples from the Hida range of the Japanese Alps for multi-OSL-thermochronometry analysis, including 4 samples from a high-temperature tunnel which has a present day temperature of ~40-50 ℃, but experienced temperatures of up to 166 ℃ prior to excavation in the 1930s. The high-temperature samples should have an apparent age of almost zero when measured using OSL-thermochronometry, providing a local control on the performance of this recently established technique. Measurement of the remaining 15 samples will complement previous (U-Th)/He in Apatite (Ahadi et al., In Prep.), Zircon fission track (Yamada and Harayama, 1999; Ito and Tanaka, 1999) and Zircon U-Pb (Ito et al., 2013) measurements which have been made on the same sample suite. Once measurements are complete, we will be able to invert the different thermochronometric data together, to determine the exhumation of the Hida range over the past 3 Myr.
In a second research phase, we plan to sample the Kiso and Akaishi ranges, applying a similar set of methods to constrain their recent exhumation histories. Temporally consistent changes in exhumation rates across all ranges may reveal the effects of global climatic changes.

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