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Stepwise metamorphic and anatectic reactions in high-grade metamorphic terrains

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High-grade metamorphic terrains are commonly characterized by extensive metamorphic and anatectic reactions associated with episodic exhumation. How the metamorphic and anatectic reactions respond to the changing P–T–X conditions during the tectonic evolution of orogenic belts is one of many poorly constrained problems. Young metamorphism and partial melting of intermediate to deep crustal rocks is widespread along the Himalayan orogenic belt, which provides an unparalleled opportunity to address such an outstanding problem.

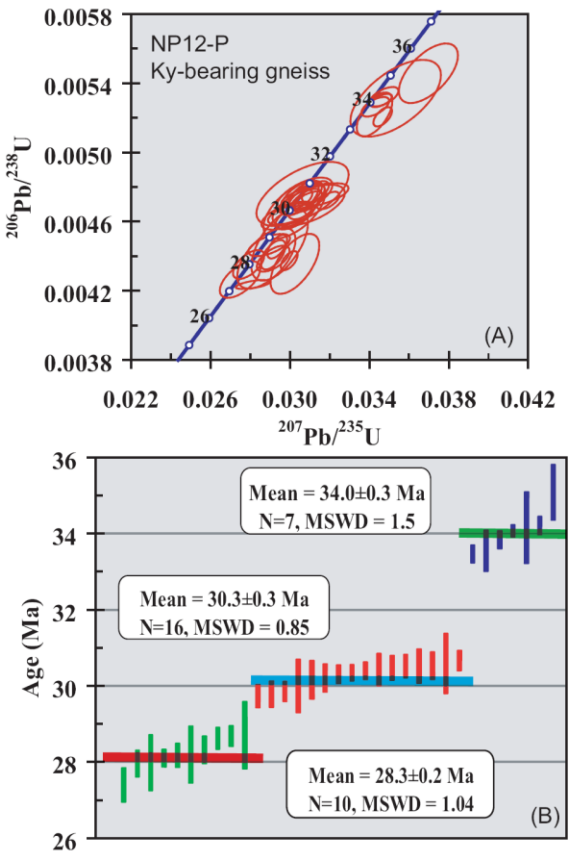

Figure 1: Zircon U-Pb results for the metamorphism in the Kyanite-bearing gneiss, Central Nepal, Himalaya

Zircon grains from kyanite-bearing gneiss within the High Himalayan Crystalline Sequence registered at least three episodes of metamorphic overgrowth at 34.0 ± 0.3 Ma, 30.3 ± 0.3 Ma, and 28.3 ± 0.2 Ma, respectively (Figure 1). Garnet-bearing leucogranites from the Namche Barwa massif also show similar patterns in zircon overgrowth from anatectic melts at 9.2 ± 0.2 Ma, 8.1 ± 0.2 Ma, 7.1 ± 0.1 Ma, 6.6 ± 0.1 Ma, down to ~4.0 Ma, which is corroborated with metamorphic ages of nearby high-grade marble formation. In addition, relatively large leucogranite complexes (e.g., Mabja and Malashan) again display similar patterns. These observations indicate that metamorphism as well as partial melting in deep crustal levels proceed in a stepwise fashion, which is highly similar to the fault-valve behavior of shear zones.

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