Trapped-charge thermochronometry: novel methods to study the tectonics of the Himalayas

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Résumé

The Quaternary tectonic evolution of the central Nepal Himalayas remains a subject of debate, particularly regarding the relative contribution of frontal thrust propagation, and the role of mid-crustal duplexing or out-of-sequence thrusting in the exhumation of the High Himalayas.
This study presents over 100 new OSL and ESR thermochronometric measurements from across the central Himalayas, providing high-resolution constraints on exhumation rates and near-surface fault activity during the Quaternary. Results confirm that the Main Frontal Thrust has accommodated most of the India-Eurasia convergence, highlighting the significant seismic hazard posed by this active fault system. Additionally, trapped-charge data indicate potential out-of-sequence faulting around the topographic transition zone near the Main Central Thrust, challenging interpretations derived from higher-temperature systems. Indeed, traditional medium- to low-temperature thermochronometers (e.g., Ar-Ar, ZFT, ZHe, AFT, AHe) have supported a duplexing model, attributing rapid exhumation of the High Himalayas to thrusting over a mid-crustal ramp and the development of a Lesser Himalayan duplex.
These findings emphasize the value of trapped-charge thermochronometry in resolving late-stage deformation histories and offer critical insights into the spatial and temporal dynamics of Himalayan tectonics. By integrating field observations, laboratory analysis, and numerical modelling, this research enhances our understanding of the coupling between tectonics, erosion, and surface processes in orogenic landscapes, and contributes to improved assessments of seismic risk in active mountain belts.

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Mots-Clés: thermochronometry, tectonics, Himalaya, Quaternary