

EGU24-426, updated on 15 Jul 2024

<https://doi.org/10.5194/egusphere-egu24-426>

EGU General Assembly 2024

© Author(s) 2024. This work is distributed under the Creative Commons Attribution 4.0 License.



Late oligocene elevation of the Himalaya recorded by O and H isotopes of fluid inclusions

Raphaël Melis¹, Gweltaz Mahéo¹, Véronique Gardien¹, Philippe-Hervé Leloup¹, Stéphane Scaillet², Patrick Jame³, and Erik Bonjour³

¹Laboratoire de Géologie de Lyon : Terre, Planète et Environnement, CNRS UMR 5276 - UCB Lyon1 - ENS Lyon 8 Campus de la Doua, Bâtiment Géode, 2 rue Raphaël Dubois, 69622 Villeurbanne, FRANCE

²Université Orléans, CNRS UMR 7327 - BRGM - Institut des Sciences de la Terre d'Orléans (ISTO), F-45071 Orléans, France

³Institut des Sciences Analytiques de Lyon (ISA Lyon), CNRS UMR 5280 - UCB Lyon 1, 69622 Villeurbanne, FRANCE

Since the Earth's topography is shaped by both tectonic and climatic processes, measuring land surface elevation variations through time is of critical importance for the investigation of the multiple interactions between mountain building (orogenic) processes and long-term climate change. With a total surface area of over 5 million km², an average elevation of 5000 m and 14 peaks over 8000 m, the Tibetan Plateau (TP) and adjacent Himalaya are particularly well suited to this research, as many models attempt to explain the growth of these high elevation regions in the context of the continental collision between India and Asia and their feedback on the Asian climate. However, the evolution of surface elevation (paleoaltimetry), whilst essential, is still elusive in the Himalaya. A number of published paleoaltimetric data hinges on the relationship between the stable isotopic composition of precipitation ($\delta^{18}\text{O}$ and δD) and altitude. However, these methods, based on the stable isotopic composition of carbonates and phyllosilicates, do not provide both $\delta^{18}\text{O}$ and δD values and involve the use of an isotope exchange equation to calculate the composition of paleoprecipitation. To avoid such calculation, we use a method developed at LGL-TPE, which directly measure the isotopic composition ($\delta^{18}\text{O}$ and δD) of paleoprecipitation trapped in fluid inclusions of hydrothermal quartz veins.

We measured the $\delta^{18}\text{O}$ and δD of fluid inclusions in quartz veins within the Main Central Thrust shear zone in the Jajarkot klippe (Central Himalaya, Nepal). The $\delta^{18}\text{O}$ of fluid inclusions varies between -3.69‰ and -9.01‰ and the δD between -43.11‰ and -74.24‰, which are consistent with meteoric water compositions. Stable isotope analysis were coupled with Ar-Ar geochronology on hydrothermal white micas that co-crystallized with quartz and indicates an age of 24.7 ± 0.2 Ma for vein formation. Taken together, these data allow us to calculate a mean elevation of the Central Himalaya of $2771 +286/-403$ m at the end of the Oligocene, a period for which no previous paleoaltimetric data are available. Although already significant 25 Myr ago, the mean elevation of the Central Himalaya was nevertheless lower than the average elevation of the present topography (~5000 m), which formed at least ~16 Myr ago (e.g., Gébelin et al., 2013, Melis et al., 2023). Collectively, our data as well as previous paleoaltimetric studies provide a valuable contribution to the assessment of deformation models for the Himalayan range.

