Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.29936

# The rise of the Himalaya recorded by O and H isotopes of fluid inclusions

**RAPHAËL MELIS**[1,2], GWELTAZ MAHÉO[1], VÉRONIQUE GARDIEN[1], PHILIPPE-HERVÉ LELOUP[1], STEPHANE SCAILLET[3], PATRICK JAME[4], ERIK BONJOUR[4], BASANT BHANDARI[5] AND ARNAUD PÊCHER[6]

[1]Laboratoire 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

[2]Senckenberg Biodiversity and Climate Research Centre (BiK-F), Senckenberg, 60325 Frankfurt/Main, Germany

[3]Institut des Sciences de la Terre d'Orléans (ISTO), CNRS, Univ. Orléans, BRGM

[4]Institute of Analytical Sciences (ISA), UMR 5280 CNRS, Lyon1, ENS-Lyon

[5]Tri-Chandra Campus, Tribhuvan University, Kathmandu, Nepal

[6]ISTerre, Université Grenoble Alpes, 38000 Grenoble, France

The Tibetan Plateau and the Himalaya, with an average altitude of 5 km and peak elevations above 8 km, are key sites for paleotopographic reconstructions. Numerous 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 Cenozoic global climate change as well as their influence on the development of the Asian monsoon system. However, reconstructing the history of surface elevation, whilst essential, is still elusive, particularly in the Himalaya where commonly applied paleoaltimetry proxy materials are rarely preserved.

Here, we use the oxygen ($\delta^{18}O$) and hydrogen ($\delta^{2}H$) isotopic compositions of paleoprecipitation trapped in fluid inclusions of hydrothermal quartz veins common in Himalayan shear zones. Samples originate from the Kali Gandaki Valley and the Manaslu massif, as well as the Jajarkot klippe (Central Nepal), a more frontal area of the Himalaya. The age of the quartz veins is estimated to be middle Miocene for the Kali Gandaki/Manaslu samples, and late Oligocene for the Jajarkot samples (24.7 ± 0.2 Ma) based on $^{40}Ar/^{39}Ar$ dating of hydrothermal muscovite. Isotopic analyses indicate a meteoric origin for the fluids with values ranging from $\delta^{18}O = -1.74$ to $-11.09$‰ and $\delta^{2}H = -55$ to $-111$‰ for the Kali Gandaki/Manaslu area and $\delta^{18}O = -3.69$ to $-9.01$‰ and $\delta^{2}H = -43$ to $-74$‰ for the Jajarkot klippe.

Our paleoaltimetry reconstruction incorporates assessment of climatic bias by integrating isotope lapse rates and low-elevation $\delta^{18}O$ values adapted to each period of time. The results suggest that the mean elevation of the Himalaya rose from around 2.7 km in the late Oligocene to over 5 km in the middle Miocene, which is in agreement with other paleotopographic reconstructions (e.g. [1]; [2]). This surface uplift between 25 and 16 Ma could be the response to the detaching Indian lithosphere.

[1] Ding et al., Nature *Reviews Earth & Environment* 3, 652–667 (2022)

[2] Gébelin et al., *Geology* 45, 215-218 (2013)