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Meteoric fluids in the South Tibetan Detachment and palaeoaltimetry of Central Himalaya

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The South Tibetan Detachment (STD) is one of the most fundamental structures within the Himalayan orogenic belt. It exposes a mylonite zone over a distance of > 1500 km along strike that is hundreds of metres thick and separates Paleozoic sedimentary units from high-grade metamorphic rocks and syntectonic leucogranites. In this study, we document the infiltration of meteoric fluids in the STD footwall at ∼15 Ma when recrystallized hydrous minerals equilibrated with evolved meteoric water and therefore recorded the hydrogen isotope composition of water present during mylonitic deformation. Although these minerals deformed and recrystallized at significant depth (∼10 km), they can be used as palaeoelevation proxies if they can be temporally and kinematically linked to the evolution of the STD. Stable isotope palaeoaltimetry uses the systematic relationship between the oxygen (d18O) and hydrogen (dD) isotope ratios of rainfall that scale with elevation in a predictable fashion (∼2.8 per mil in d18O or ∼22 per mil in dD per km). Here, we present palaeoaltimetry estimates based on the hydrogen isotope composition of synkinematic micas and amphiboles collected over 200 m of structural section from the STD into the underlying mylonitic footwall at Rongbuk Valley (Mount Everest region). Biotites reveal a very constant pattern of mid-Miocene 40Ar/39Ar plateau ages and exchanged isotopically at high temperature with D-depleted water (dDwater ∼ -150 ±5 per mil) that originated from high-elevation precipitation and infiltrated the crustal hydrologic system at that time.

To eliminate a climate impact on our palaeoelevation estimates, the hydrogen isotope record from the high elevation STD is compared to time-equivalent low-elevation foreland d18O records. Our palaeoaltimetry results indicate that the mean elevation of Mount Everest region during the mid-Miocene was similar to today (∼5200 m). This has two main implications: (1) Strengthening of the Asian Summer Monsoon may have started earlier than previously thought; (2) a strong Himalayan rain shadow characterized the Tibetan plateau already at 15 Ma, inducing a strong aridity on the Tibetan plateau over most of the Neogene.

These results are further supported by very low dD values of synkinematic minerals that formed in the high strain STD footwall along a N-S transect in central Himalaya between Kodari and Nyalam.