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Shifts in the Intertropical Convergence Zone and the tectonics and climate of the India-Eurasia collision

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The Early Miocene (∼23 – 16 Ma) was the time of peak Himalayan exhumation and postulated mid-crustal channel flow in the High Himalayas – a tectonic configuration not recognized before or after in the range. Previous models have correlated this rapid exhumation with the onset of the Asian monsoon, and/or suggested that it contributed ultimately to mid-Miocene global cooling, via silicate weathering and/or organic carbon burial, and consequent atmospheric CO2 drawdown. Based on published Pacific Ocean sedimentation records and India-Eurasia plate reconstructions, we compare the position of the Intertropical Convergence Zone (ITCZ) with the palaeolatitude of the Himalayas, and show these converged in the Early Miocene. As the ITCZ is a zone of high precipitation, we suggest that this convergence was an important driver of Early Miocene High Himalayan exhumation and erosion. Continued northwards motion of the Indian plate took the Himalayas north of the ITCZ, which migrated south through the remainder of the Miocene. High Himalayan exhumation and ductile shearing correspondingly decreased after the Early Miocene. This mechanism for increased Himalayan erosion is independent of the timing of the onset or enhancement of the Asian monsoon, which is debated.

A variety of climate proxies from across Central, South and East Asia have yielded different ages for the start or intensification of a monsoon climate system. Common estimates include the early part of the Early Miocene (∼23-20 Ma) and the Late Miocene (∼11-8 Ma). We propose that increased seasonality in the Late Miocene in the Himalayas and neighbouring regions was a response to an increase in the distance between the ITCZ and the Himalayas/Tibet, such that the ITCZ was only brought northwards during the northern hemisphere summer each year. This is essentially the pattern of the modern South Asian monsoon system. These climatic changes coincide with a switch from north-south extensional shear on the northern side of the High Himalayas and thrusting on the Main Central Thrust, to thrusts further south in the Himalayas (Main Boundary Thrust). We speculate that the tectonic changes were at least in part a response to a reduction in precipitation over the High Himalayas: the Himalayan thrust belt re-organised to maintain a critical taper appropriate to a drier orogen.

Ref: Armstrong, H.A. & Allen, M.B. (2011) Shifts in the Intertropical Convergence Zone, Himalayan exhumation, and late Cenozoic climate. Geology, 39, 11–14, doi: 10.1130/G31005.1