Cenozoic uplift and climate in Asia: Insights from stable carbon and oxygen isotopes

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Abstract

Modern climate in Asia is characterized by large-scale monsoonal circulation over India and southern China and vast, exceptionally arid deserts across much of Central Asia. Across this same area stand some of the largest mountain ranges in the world, including the Himalayas, Tibetan Plateau, Tian Shan, and Altai. How, when, and if these ranges influenced climate in Asia remains highly contentious. In this talk, I will use the stable isotopes of oxygen ($\delta^{18}O$) and carbon ($\delta^{13}C$)—as recorded in paleosols and lacustrine sediments—to explore the interaction between uplift and climate in Asia during the Cenozoic. Oxygen isotopes record large-scale atmospheric circulation and the interaction of air masses with topography; in contrast, carbon isotopes record primary productivity. Together, these isotopic systems demonstrate that *(1)* large-scale atmospheric circulation over Asia has remained largely unchanged over the Cenozoic, and *(2)* primary productivity has declined in Central Asia during the Neogene. Given the invariance of atmospheric circulation, I hypothesize that this decline in productivity is due to the interaction of the mid-latitude westerlies with high topography in northern Central Asia and a reduction in CO_2 fertilization of vegetation. As a test of this hypothesis, I will present new data from eastern Kazakhstan and western Mongolia demonstrating that the Tian Shan and Altai reached sufficient elevations by the late Miocene to dramatically impact climate in Central Asia. I conclude that paleoclimatic changes in Central Asia are more tightly controlled by the mid-latitude westerlies and their interaction with high topography in northern Central Asia than by changes in the height or extent of the Tibetan Plateau.