LATE MIOCENE AND PLIOCENE EAST ASIAN MONSOON CIRCULATION INFERRED FROM MULTIPLE-ISOTOPOLOGUE SIGNATURES OF PALEOSOL CARBONATES FROM NORTHERN CHINA

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East Asian summer monsoon circulation is enhanced by the existence of the Himalaya and Tibetan Plateau, and East Asian summer monsoon precipitation is markedly depleted in $^{18}O$ compared to summer precipitation falling elsewhere globally at similar latitudes. This unique signature of monsoon circulation is thought to relate to precipitation ‘amount’ effects, including locally derived amount effects, as well as ‘imported’ amount effects resulting from prior partial rainout of atmospheric water masses. We combine carbonate clumped isotope thermometry of paleosol carbonates with paleosol carbonate $\delta^{18}O$ to back calculate $\delta^{18}O$ values of paleo soil water. Our record from the Chinese Loess Plateau extends from 7 to 3 Ma, and we find that soil water $\delta^{18}O$ values were indistinguishable from modern summer monsoon precipitation during this time interval. Since evaporation of soil water can lead to enrichment in $^{18}O$, our results place upper limits on meteoric water compositions, suggesting that late Miocene and Pliocene precipitation was as low or lower in $\delta^{18}O$ than present day precipitation. The carbonate clumped isotope temperatures are similar to or slightly lower than present day summer temperatures, suggesting that the soil carbonates formed primarily during the warm season. Carbon isotopes of paleosol carbonates from multiple localities in the Chinese Loess Plateau (CLP) resolve an environmental gradient from C$_3$ forests in the southern CLP to C$_3$ + C$_4$ steppe in the northern CLP, a pattern similar to the present day forest – steppe – desert transition marking the landward weakening of the summer monsoons. Taken together, these lines of evidence suggest active summer monsoon circulation in East Asia during the late Miocene and Pliocene. This may suggest that the late Miocene / Pliocene orographic configurations of the Himalaya and Tibetan Plateau had similar effects on regional circulation as they do today. Finally, our record of clumped isotope soil temperatures in a relatively stable and low elevation tectonic setting can serve as a useful baseline for future carbonate isotopologue studies in nearby regions that may have experienced changes in surface elevation.