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Implication of temperature-independent boron isotope proxy to variations of EASM in NE China over the past 800 kyr

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The variations and driving mechanism of the East Asian summer monsoon (EASM) climate have attracted broad scientific attention and numerous paleo-monsoon records from archives (e.g., loess, stalagmites, and marine and lake sediments) have been explored to reveal the variability of the EASM on orbital timescales and its linkage with changes in solar insolation and boundary conditions (e.g., An et al., 1991 [1]; Sun et al., 2019 [2]).

As boron isotope fractionation during precipitation is dominated by the Rayleigh process, the variation of boron isotope in precipitation ($\delta^{11}B$) can be interpreted as a consequence of the level resulting from the rainout of air masses after multi-step fractionation processes along the moisture transport path. As a result, $\delta^{11}B$ of paleo-rainfall ($\delta^{11}B_{pr}$) has been proposed to be a robust proxy of the intensity of the EASM, which takes advantages of being directly correlated with the process of precipitation and is independent of temperature. On the basis of a systematic study of boron isotope geochemistry in the loess-paleosol sequence of the Niuyangzigou section (NYZG) in Northeast (NE) China, a mathematical inversion calculation is used to quantify the proportion of boron accumulation from three distinct sources (i.e., atmospheric precipitation, carbonate, silicate), and to capture the original $\delta^{11}B_{pr}$ signatures. A monsoon record based on$\delta^{11}B_{pr}$ shows a significant shift at ca. 430 ka, implying an abrupt weakening of the EASM after the Mid-Brunhes Event (MBE), which provides evidence of regional disparities in monsoon evolution in response to the MBE. Northern Hemisphere ice volume may have been responsible for changes in the EASM in NE China over the past 800 kyr.

[1] An Z., Kukla G.J., Porter S.C., Xiao J. (1991). Quat. Res. 36, 29-36.

[2] Sun Y., Yin Q., Crucifix M., Clemens S.C., Araya-Melo P., Liu W., Qiang X., Liu Q., Zhao H., Liang L. (2019). Nat. Commun. 10, 1-11.δ