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Stable Carbon Isotopic Composition of Black Carbon in Surface Soil as a Proxy for Reconstructing Vegetation in the Northern China

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Black carbon (BC) is produced by the incomplete combustion of vegetation and fossil fuels, and is good proxy recording wildfires and palaeovegetation information. Whether it's stable carbon isotopic composition ($\delta^{13}C_{BC}$) can be used directly for palaeovegetation reconstruction in different climate and vegetation zones is still in debate. We systematically investigated surface soil from the Chinese Loess Plateau (CLP) and the Qinling Mountains (QL), and surface sand from the deserts and dune fields (DD) (including the Mu Us dune field, the Tengger Desert, and the Badain Jaran Desert) in the Northern China. We analyzed the stable carbon isotopic composition of BC ($\delta^{13}C_{BC}$) and organic carbon ($\delta^{13}C_{SOC}$). For surface soil in CLP [1], the $\delta^{13}C_{BC}$ values ranged from −27.9‰ to −21.9‰, and the $\delta^{13}C_{SOC}$ values ranged from −26.8‰ to −20.9‰. For surface soil in QL [2], the $\delta^{13}C_{BC}$ values ranged from −26.7‰ to −21.7‰, and the $\delta^{13}C_{SOC}$ values ranged from −26.5‰ to −21.0‰. For surface sand in DD [3], the$\delta^{13}C_{BC}$ and $\delta^{13}C_{SOC}$ values ranged from −28.2‰ to −23.0‰, −27.4‰ to −22.5‰, respectively. Positive correlations were observed between $\delta^{13}C_{BC}$ and $\delta^{13}C_{SOC}$ in these three areas, suggesting that local vegetation mainly controls $\delta^{13}C_{BC}$. The difference between $\delta^{13}C_{BC}$ and $\delta^{13}C_{SOC}$ in these three areas were all in small ranges (−1.5‰ to +1.3‰ in CLP, −2.1‰ to +1.5‰ in QL, −0.2‰ to +3.5‰ in DD), and the difference should be due to isotope fractionation occurring during burning and/or SOC decomposition. The characteristics of vegetation on the CLP, QL, and DD, indicated by $\delta^{13}C_{BC}$ and $\delta^{13}C_{SOC}$ values, were consistent with those of the modern plants. All these suggest that $\delta^{13}C_{BC}$ values for surface soil are controlled mainly by surface plants, and therefore $\delta^{13}C_{BC}$ can indicate the palaeovegetation effectively in the Northern China.

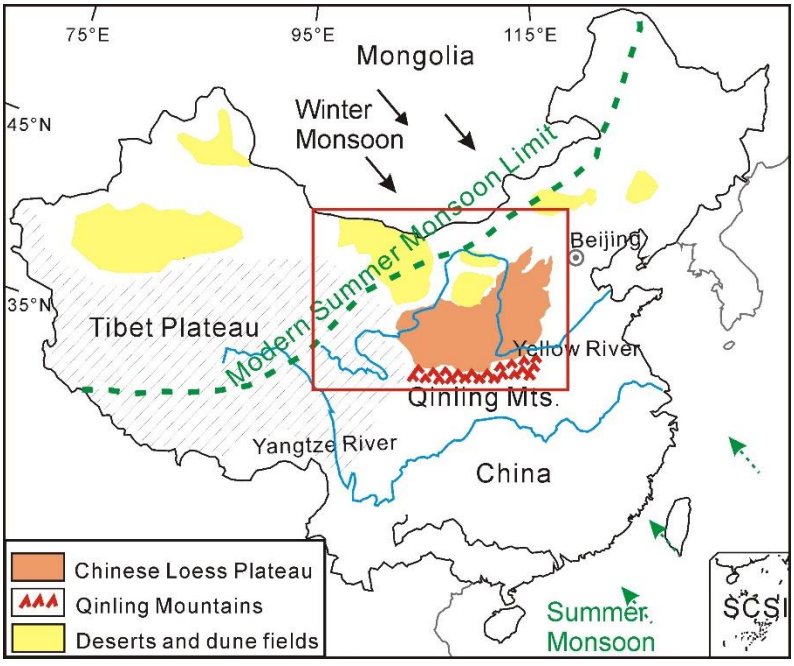

Figure 1: Schematic map showing the position of research areas.
The red rectangle in figure shows the locality of the Chinese Loess Plateau, the Qinling Mountains, and the deserts and dune fields in the Northern China.

References:

[1] Liu L (2013) Palaeogeogr. Palaeoclimatol. Palaeoecol. 388: 109-114
[2] Liu L and Huang M (2016) ACTA GEOL SIN-ENGL 90 (accepted)
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