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Nitrogen isotope proxy in clay ammonium as an indicator of wildfire activity over Indian Himalaya

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Wildfire is a seasonal phenomenon, the evidence of this preserved in the geological record since the advent of terrestrial vegetation [1]. Wildfire generates tropospheric ozone, which adversely affects plant productivity and is a cause for an increment in soil temperature and humidity, which produce excess soil ammonium having more lighter nitrogen(^{14}N) isotope due to microbial activities [2]. The soil ammonium replaces K^+ in the crystallographic structure of clay with minimal isotopic fractionation and behaves as a refractory with no major effect due to nitrification, denitrification, and diagenesis until pH approaches above 9.25 [3]. This makes the stable nitrogen isotope composition of fixed NH_4^+ ($\delta^{15}N_{fixed\ NH4+)}$ a unique proxy for wildfire intensity. To substantiate this novel proxy, we measured $\delta^{15}N_{fixed\ NH4+}$ from clay extract from Late Miocene to Pleistocene Ocean sediment from IODP362 site U1480 Nicobar fan, where primary sediment source is from Eastern Himalaya and Indo-Burma range [4]. The lower $\delta^{15}N_{fixed\ NH4+}$ value and a drop in ammonium concentration were detected for intervals 6 to 4.9 Ma and 2.6 to 1.8 Ma. It suggests an unequivocal index for wildfire activities, which is supported by the independent record of wildfire events from Himalayan foreland basin sediments from Sylhet succession [5] and Bengal fan ODP leg 11 [6] analyzed for the presence of sedimentary Polycyclic Aromatic hydrocarbon (PAHs).

References:

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