



Sedimentary records of polycyclic aromatic hydrocarbons (PAHs) in Ngoring Lake at the source region of the Yellow River, Tibetan Plateau

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Polycyclic aromatic hydrocarbons (PAHs) are a sub-group of persistent organic pollutants (POPs), and originated from both natural processes and anthropogenic activities. Owing to their persistence and semi-volatile properties, these substances can undergo long-range atmospheric transport (LRAT) and finally reach remote areas. PAHs are of global concern due to their ubiquitous presence and toxicity. The source region of the Yellow River (SRYR) is situated in the hinterland of Tibetan Plateau, with the average elevation exceeding 4200 m. LRAT may be the major input pathway of PAHs transporting from warm and contaminated areas. SRYR is an important natural reserve for its unique and fragile ecological communities, but scarce research focused on POPs in this region. The undisturbed dated sediment core is useful for the assessment of long-term temporal trends and provenance of PAHs. In our study, a sediment core was collected in Ngoring Lake in SRYR, to reconstruct the deposition history and to evaluate PAHs contamination via LRAT.

The sediment was dated by the total ^{210}Pb activities, determined by the analysis of ^{210}Po activities via alpha-particle spectrometry (ORTEC, USA) and ^{226}Ra activities via high-purity germanium gamma-ray spectrometer (ORTEC, USA). Sixteen US-EPA priority PAHs were measured by gas chromatography-triple quadrupole tandem mass spectrometry (GC-MS/MS, Agilent 7890B/7000C, USA). Total organic carbon (TOC) in the sediment was analyzed using Elementar vario TOC cube (Germany). Air mass backward trajectories of the Ngoring Lake were calculated using HYSPLIT 4 model (Hybrid Single Particle Lagrangian Integrated Trajectory, Version 4), developed by US National Oceanic and Atmospheric Administration/Air Resources Laboratory (NOAA/ARL).

The concentrations of the total PAHs in the sediment core from Ngoring Lake ranged from 11 to 47 ng/g, which fell within a low level compared with other remote sites of the world, suggesting unobvious cold-trapping effect in SRYR. The total PAHs showed a significant correlation with TOC content ($p < 0.05$), indicating that PAHs in Ngoring Lake might be approaching steady state with sediment properties. Most air masses arriving at the SRYR were from the west including Central Asia and North India. The mean values of isomer ratios were 0.43 for Fla/(Fla+Pyr) and 0.37 for IcdP/(IcdP+BghiP), respectively, both showing the petrogenic source. Low molecular weight PAHs (2–3 rings) were dominant in the sediment with an average of 63%, which indicated that the profiles were affected by LRAT.

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