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# Compound-specific radiocarbon analysis (CSRA) as a tool for tracking the atmospheric fate of carbonaceous aerosols

**GAN ZHANG**[1], BUQING XU[2], TIANGANG TANG[2], XIN YI[2], GUANGCAI ZHONG[2], ZHINENG CHENG[2], SANYUAN ZHU[2] AND JUN LI[2]

[1]Guangzhou Institute of Geochemistry, Chinese Academy of Sciences

[2]Guangzhou Institute of Geochemistry, Chinese Academy of Sciences

Presenting Author: zhanggan@gig.ac.cn

Radiocarbon ($^{14}C$) is a unique tool to unambiguously distinguish the relative contributions of biomass-derived and fossil fuel sources. Compound-specific radiocarbon analysis (CSRA) offers more precise information on the sources and atmospheric processes of various carbonaceous species/compounds of concern. In this presentation, we will report on the CSRA methodology development in the environmental radiocarbon laboratory, targeting atmospheric carbonaceous species of specific interests. (i) CSRA of naphthalene (NAP), as a surrogate of intermediate-volatility organic compounds (IVOCs), indicated that 95.1 ± 1.8 % of NAP was emitted from fossil sources in the North China Plain cities of China. (ii) Compound-specific dual-carbon isotopic fingerprints ($\delta^{13}C$ and $\Delta^{14}C$) of dominant aqueous secondary organic aerosol (aqSOA) molecules, such as oxalic acid, to track the precursor sources and formation mechanisms of aqSOA. Contrary to the paradigm that these aqSOA compounds are largely biogenic, radiocarbon-based source apportionments show that fossil precursors produced over one-half of the aqSOA molecules. (iii) A new method was developed for the CSRA of benzene polycarboxylic acids (BPCAs), which are artificial breakdown products of polyaromatic organic matter (POM), as a short-life climate pollutant (SLCP) atmosphere. Of interest, the BPCA Fm values (0.443 ± 0.005) of the bulk POM, in an ambient PM2.5 sample, were found to be significantly lower than those of methanol-extractable POM (0.618 ± 0.007) and water-extractable POM (0.618 ± 0.008), confirming a greater contribution of fossil fuel combustion to the non-extractable POM (including black carbon, BC) in the aerosol.

Key References

1. Large contribution of fossil-derived components to aqueous secondary organic aerosols in China. 2022. *Nature Communications*, 13: 5115.

2. Compound-specific radiocarbon analysis of low molecular weight dicarboxylic acids in ambient aerosols using preparative gas chromatography: method development. 2021. *Environmental Science & Technology Letters* 8:135-141.

3. Triple isotopes ($\delta^{13}C$, $\delta^{2}H$, and $\Delta^{14}C$) compositions and source apportionment of atmospheric naphthalene: a key surrogate of intermediate-volatility organic compounds (IVOCs).