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Compositions and structures of particulate and colloidal organic matter in aquatic environment by advanced analytical techniques

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Dissolved, colloidal and particulate organic matter (DOM, COM and POM) is important in the global carbon cycle and knowledge of their sources and structures can be critical to understanding their roles in biogeochemical cycles. This study explored the sources and chemical structures of COM and POM samples from the Pearl River Basin, China by elemental, chlorophyll a (Chl a), radiocarbon and stable carbon isotopic analyses, NMR techniques, and Fourier transform ion cyclotron resonance mass spectrometry (FT-ICR MS) analysis. The chemical and nano-sclae structures of two ultrafiltered dissolved organic matter (UDOM) samples from surface seawater of the Pacific and Atlantic Ocean were also studied by various advanced solid-state NMR techniques. The C/N ratios and δ13C values indicated that plankton and soil organic matter (SOM) were two major sources of COM and POM, whereas Chl a and radiocarbon analyses demonstrated the significant contribution of phytoplankton and ancient organic matter (OM) to COM and POM. The correlations among structural parameters, Chl a and Δ14C values suggested that phytoplankton significantly contribute to the COO/NC=O groups. The OCH3/NCH, nonpolar alkyl C and aromatic C-O groups could be derived from refractory and ancient OM, while O-alkyl C and di-O-alkyl C from labile and contemporary sources. FT-ICR MS analysis indicated that the main molecular composition of COM was CHO (56.44-62.83%), with the majority of the composition consisting of highly unsaturated compounds (more than 60%). This study for the first time provides the evidence that the chemical structures of COM and POM are influenced by trophic levels, and by their algal and ancient OM sources. We also discovered novel UDOM structures, which had wrongly been identifed before. It is interesting that sugar-bound COO groups are present in amounts similar to amino-acid residues and N-acetyl sugars, which has not been previously reported. Dissolved black carbon, polymethylene structure, and humified indices are estimated by the advanced techniques.