Molecular Characterization of Dissolved Organic Matter at the Mariana Trench

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Dissolved organic matter (DOM) is the largest reduced carbon reservoir in the ocean and plays a vital role in global biogeochemical cycles. However, due to its complexity and low concentration, the exact composition of DOM in the ocean is largely unknown. Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FTICR-MS) with ultrahigh resolving power has been increasingly used to elucidate the molecular composition of DOM. In this study, we utilized FT-ICR MS to study DOM collected from different depths at the Mariana Trench.

Results of multivariate analysis showed that samples from different depths are well separated: samples from 5 m and 75 m group together while samples from 500 m, 1000 m and 2000 m are assembled to another group, indicating distinct molecular compositions between surface layer and deep ocean. Samples from 200 m depth lie between these two groups, suggesting DOM from this layer could be in a transition between surface and deep waters. Molecular indices were calculated based on FT-ICR MS data, which all showed consistent changes with increasing depth. The degradation index (I_{DEG}) indicated that the DOM in deep layer is much more refractory than surface layer, which is consistent with the modified aromaticity index (AI_{mod}), corroborating that aromatic molecules are more refractory. The increase in terrestrial index (I_{terr}) with depth indicates enriched terrestrial signal in deep DOM, which may be explained by the recalcitrance of terrestrial DOM from global meridional overturning circulation.

Our results demonstrated that composition of DOM is stratified along the ocean depth, which may be related to stratification of water chemistry, microbial community structures, or physical processes in the ocean.