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Diagenesis of marine dissolved organic matter: a molecular approach

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The total amount of dissolved organic matter (DOM) in the world's oceans is similar to the amount of carbon stored in atmospheric CO_2. In order to understand global biogeochemical cycles, it is crucial to identify sources and transformation processes of DOM. However, tools for the characterisation of DOM in the ocean are extremely limited and thus, the molecular structure of marine DOM is largely unknown. Hitherto, persistent properties and complex composition prevented detailed molecular characterisation by standard analytical methods. The objective of our research is to establish new molecular tracers and signatures for the origin and fate of DOM. Recent progress in Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FTICR-MS) opened an analytical window to retrieve extensive new molecular information on intact marine DOM compounds. To cover the wide range of possible DOM compositions we analysed samples from very contrasting environments, algal-derived DOM of pure marine origin from water and sea ice of the Weddell Sea (Antarctica), experimentally produced DOM and terrigenous DOM from porewater of a tropical mangrove area. Several thousand molecular formulae and potential biomarkers were identified. Approximately one third of the molecular formulae was present in all marine water and mangrove porewater samples. Most of these substances were photo-stable and probably represent a refractory background. A significant proportion of the deep-sea DOM was identified as thermogenic polyaromatic hydrocarbons. A long-term microbial experiment was performed to produce refractory DOM by marine bacteria from different substrates. The amount of microbial-formed DOM was dependent on the composition and concentration of the substrate. Experimental results also showed the relation between DOM and other carbon pools: transparent exopolymer particles (TEP) were

formed by bacteria and largely degraded after a short period of time.