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Marine particle geochemistry: influence on biogeochemical cycles in the ocean - *Paul Gast Medal Lecture*

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Marine particles are a complex mixture of organic matter and biogenic, authigenic, and lithogenic minerals, and are important for the cycling of most elements in seawater. The production and destruction of organic matter through photosynthesis and respiration controls the distribution of carbon and nutrient elements in the ocean. Exogenous particles such as mineral dust can be a source of dissolved trace elements to seawater. And particles of all types provide surfaces onto which particle-reactive trace elements and isotopes (TEIs) are adsorbed and removed from seawater in a process marine geochemists call scavenging. The importance of authigenic oxides of iron and manganese for scavenging of TEIs from seawater was already recognized by Ed Goldberg almost 70 years ago based on studies of manganese nodules {Goldberg 1954}, but he didn't have access to clean seawater measurements of Fe and Mn oxides or trace elements to directly examine this in the water column. Thanks to the International GEOTRACES programme, we now have the benefit of simultaneous measurements of TEIs together with marine particle concentrations and their composition over a wide range of oceanographic settings. In this talk, I will describe the distribution of particle concentrations as well as their major components using a recent compilation of several decades of particle data collected from all major ocean biomes by in-situ filtration, including from the GEOTRACES Programme. I will review the results of several GEOTRACES studies that have showed the importance of particles for the removal of TEIs from seawater and have confirmed the outsized importance of Fe and Mn oxides in this scavenging. Finally, I will show how a molecular-scale consideration of the mineralogy of Fe and Mn oxides helps us to understand the large-scale patterns of TEI scavenging.