Particle flux processing in the deep ocean: Insights from the Oceanic Flux Program time series in the oligotrophic North Atlantic

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The 40+ year Oceanic Flux Program (OFP) time series of particle flux in the deep Sargasso Sea off Bermuda has helped to revolutionize our understanding of the connectivity between the surface and deep ocean environments. However, processes within the ocean interior that modify the flux as this material makes its way to the seafloor have received relatively less attention. This talk focuses on two major biologically-driven processes controlling flux and sedimentation patterns within the North Atlantic gyre: authigenic mineral precipitation and suspended particle aggregation. As labile organic matter (OM) within the mesopelagic zone degrades, easily-solubilized elements are released. This is accompanied by bacterially-mediated precipitation of barite and Mn-Fe (oxy)hydroxides. For example, at the OFP site the barite flux doubles and Mn-Fe oxide flux increases by an order or magnitude between 500 m and 1500 m depth. The coupling between OM remineralization, element solubilization and authigenic mineralization results in major reorganization of element associations with flux carrier phases in mesopelagic waters. The geochemical behaviour of P becomes increasingly independent of OM carriers, and authigenic Mn-Fe oxides become an increasingly important carrier phase for Co, Ni, Cu, V, and Pb. These element associations with authigenic mineral phases continue to evolve with depth.

The OFP also evidences the important role of suspended particle disaggregation/aggregation processes in the deep water column. For example, at the OFP site the lithogenic flux doubles between 500 m and 3200 m depth. Elemental ratios indicate primary source of lithogenic material is North American continental slope sediments that have been advected by Gulf Stream circulation into the western North Atlantic gyre. This finding underscores the critical role that particle aggregation processes play in removal of suspended materials from the deep ocean interior.