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Carrying capacity of organic aggregates for different types of ballast minerals

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Recently it has been observed that the POC content of sinking matter in the deep ocean ranges between a fairly constant 3 and 7% of dry weight (DW), independent of the POC flux out of the euphotic zone. The mechanism behind this striking correlation is unclear, and the hypothesis has been put forward, that the amount of POC leaving the euphotic zone may determine the amount of ballast material which sediment. The underlying assumption to this hypothesis is, that small ballast particles with negligible sinking velocities ($<$ 1 m / day) are so abundant in the deep sea that an organic aggregate sinking through the water column will on average encounter more of these particles than it is able to scavenge. As the percent contribution of POC to DW differs with ballast material (3% for opal, 7% for calcium carbonate and 3-7% clays) the carrying capacity, e.g. the binding capacity of organic aggregates, would need to depend on the type of ballast material.

This hypothesis was tested by incubating organic aggregates for 48 hours in artificial seawater containing different concentrations (0.01, 0.05, 0.1, 0.5, 2.0, 10.0, 50.0 mg/L) of fine particles of opal, calcium carbonate, or clay (illite). The resulting POC/DW ratios were monitored as a function of ballast concentration and ballast type. In experiments with calcium carbonate, the POC/DW ratio remained constant at 14% for concentrations $\leq$ 0.5 mg/L, but decreased to 4% at concentrations $\geq$ 7.0 mg/L. POC/DW ratio remained constant at about 15% at illite concentrations $<$ 100 μg/L, and decreased continuously with increasing illite concentrations to 1% at 50 mg/L. A very different dynamic was observed for opal, where the POC/DW increased from 12% at 1 mg/L to 22% at 10 mg/L.