Supplementary Material

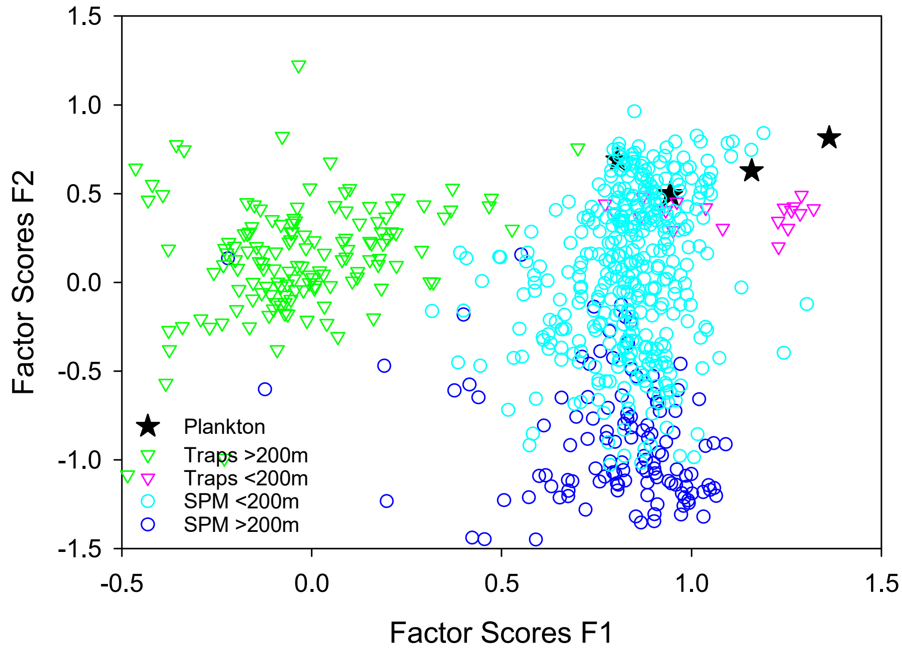

Figure S1: Factor scores (F1=SDI and F2=RTI) for plankton (star), trap samples from water depths <200m (green triangles) and >200m (magenta triangles), SPM samples from water depths <200m (cyan circles) and >200m (dark blue circles). Kara Sea samples are not plotted because they are mixed with resuspended sediments. Shallow trap samples comprise SDI of 0.7-1.5 and deep trap samples between -0.5 and 0.5 while RTI of trap samples are between -0.5 and 0.5. Shallow SPM samples have RTI values between -1 and 1 and deep SPM samples have RTI values between -1.5 and 0 while SDI values are between 0.5 and 1 for all SPM samples. While there is some overlap between shallow and deep SPM samples the shallow and deep trap samples are clearly separated by their SDI. Note that deep SPM and deep trap samples are separated by both, their SDI and RTI.

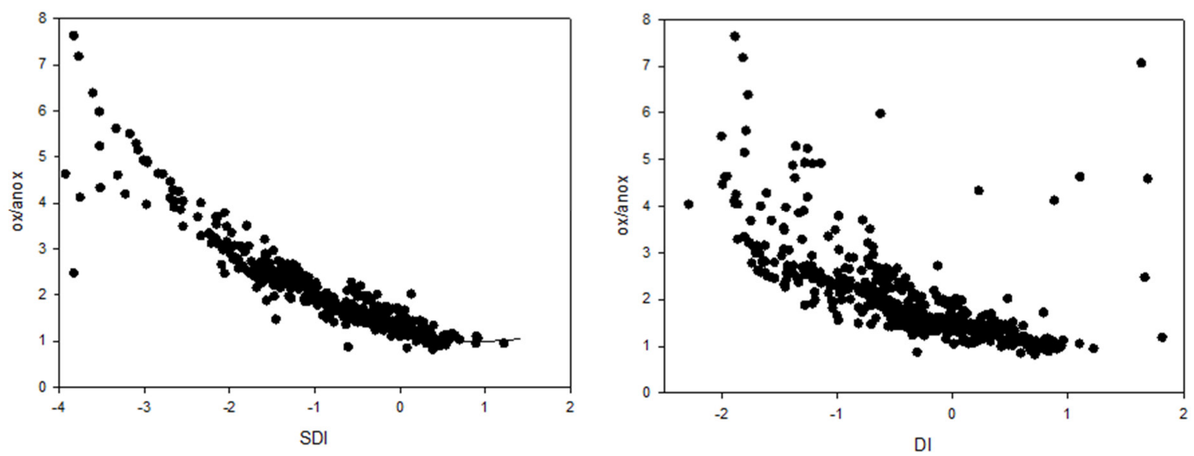

Figure S2: Correlation of the SDI with the ox/anox indicator (a) and of the DI with the ox/anox indicator (b) in sediment trap and sediment samples.

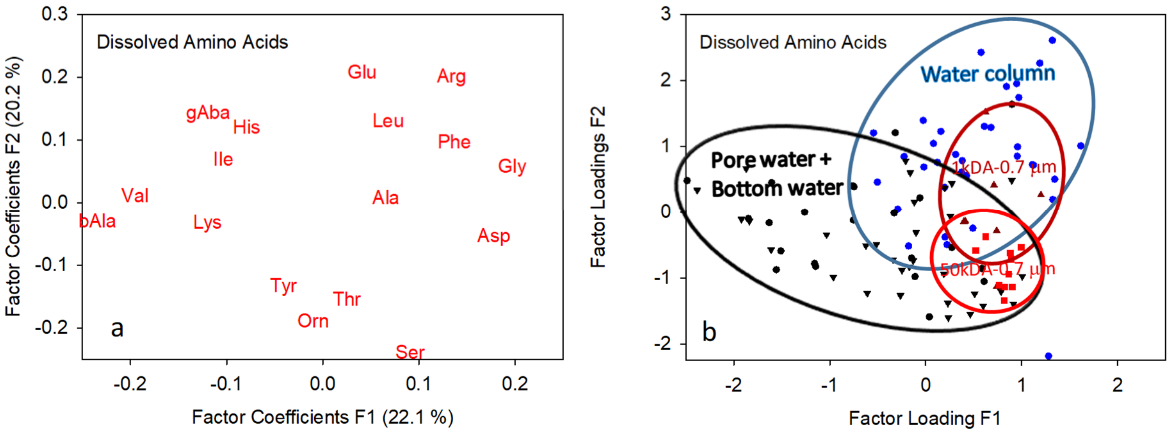

Figure S3: Factor coefficients of a PCA of TDAA (a) and factor loadings of samples (b). Encircled areas comprise samples from the water column (blue), size fractions of 1 kDA-0.7 µm (dark red), 50 kDa-0.7 µm (red) and pore (black triangles) and bottom water (black circles) samples.

This PCA of all TDAA samples corroborates that the enrichment of Ser is an indicator of increasing residence time. The already long residence time of DOM of up to 4000 years (Carlson and Hansell, 2015) is exceeded by several orders of magnitude in pore waters of deep-sea sediments. A PCA of TDAA samples shows no depth dependent clustering of samples from the water column but bottom waters and pore waters have higher contents of Ser, Orn, Thr and Tyr. In addition, the fraction of smaller molecular weight (1 kDa-0.7 µm) obtained from ultrafiltration of water samples plots within the range of samples from the water column while the higher molecular weight fraction plots within the range of pore water samples (50 kDa-0.7 µm). This suggests that the high molecular weight fraction is more enriched in aged organic matter than the small molecular weight fraction. This is in accordance with findings that the high molecular weight fraction (>1kDa), comprising about 25 % of oceanic DOC, is more resistant to degradation than the fraction of lower molecular weight (Orellana and Leck, 2015; Rosenstock et al., 2005).

References

Carlson, C.A. and Hansell, D.A. (2015) DOM sources, sinks, reactivity, and budgets. Academic Press Ltd-Elsevier Science Ltd, London.

Orellana, M.V. and Leck, C. (2015) Marine Microgels. Academic Press Ltd-Elsevier Science Ltd, London.

Rosenstock, B., Zwisler, W. and Simon, M. (2005) Bacterial consumption of humic and non-humic low and high molecular weight DOM and the effect of solar irradiation on the turnover of labile DOM in the Southern Ocean. Microb. Ecol. 50, 90-101.

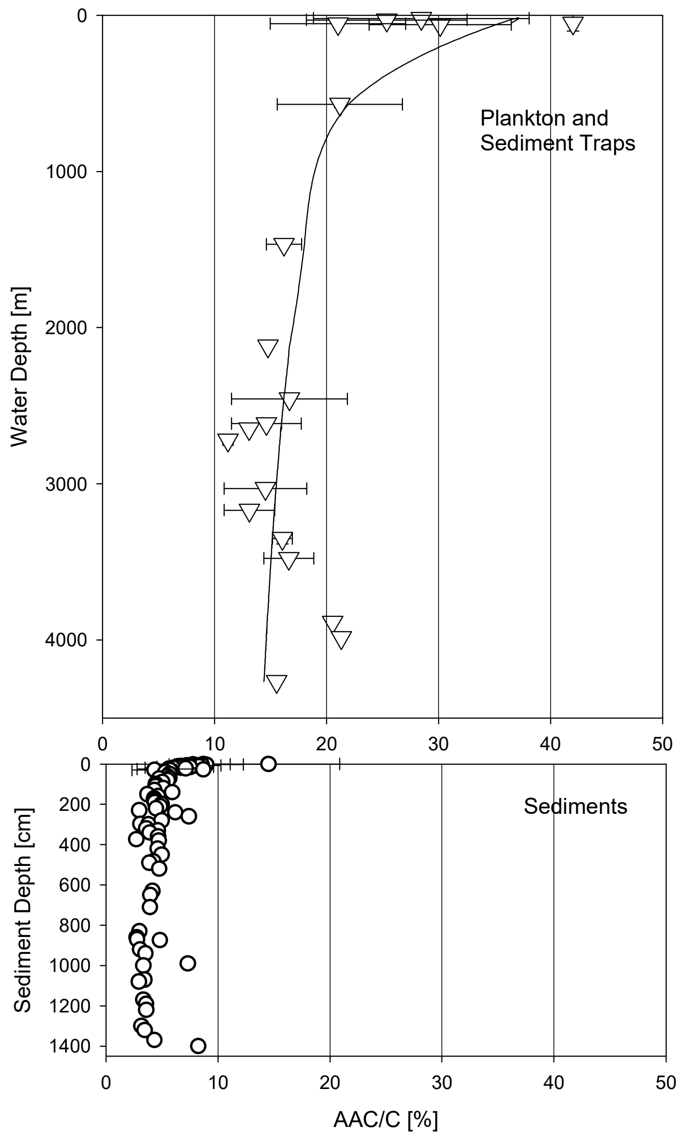

Figure S4: AA carbon as percentage of total carbon (AAC/C %) in plankton and sinking particles with increasing water depth (in m; upper panel) and in sediments with increasing sediment depths (in cm; lower panel).

Table S5: Calculation of oceanic POC, DOC, N and AA, AAC and AAN inventories using average trap fluxes (g m^{-2} d^{-1}) in sediment traps from water depths <2000 m and >2000 m, average concentrations in SPM (g m^{-3}) at water depth <200 m and >200 m, and average concentrations in sea water (dissolved; g m^{-3}). Sediment trap fluxes are calculated in g a^{-1} using oceanic areas while SPM and dissolved organic matter fluxes are calculated in g using ocean volume of Costello et al. (2010).

Trap fluxes	Total Ocean Area [m^2]	Ocean Area <2000m [m^2]	Ocean Area >2000 m [m^2]	g m^{-2} a^{-1}	<2000m	>2000m	Flux		Near Shore	off shore	add	% <2000m
	3.61E+14	5.09E+13	3.10E+14	POC	106.127	3.055	in g a^{-1}	POC	5.40E+15	9.46E+14	6.34E+15	8.51E+01
	3.61E+14	5.09E+13	3.10E+14	AA	62.247	1.128		AA	3.17E+15	3.49E+14	3.52E+15	9.01E+01
	3.61E+14	5.09E+13	3.10E+14	AAC	26.766	0.485		AAC	1.36E+15	1.50E+14	1.51E+15	9.01E+01
	3.61E+14	5.09E+13	3.10E+14	N	17.991	0.420		N	9.15E+14	1.30E+14	1.05E+15	8.76E+01
	3.61E+14	5.09E+13	3.10E+14	AAN	8.715	0.158		AAN	4.43E+14	4.89E+13	4.92E+14	9.01E+01
	Total Ocean	Volume	Volume									
SPM	Volume [m^3]	<200m [m^3]	>200 m [m^3]	g m^{-3}	<200m	>200m	Total in SPM		<200m	>200m	add	% <200 m
	1.34E+18	1.59E+15	1.33E+18	POC	0.272	0.036	in g	POC	4.33E+14	4.79E+16	4.83E+16	8.96E-01
	1.34E+18	1.59E+15	1.33E+18	AA	0.204	0.026		AA	3.25E+14	3.43E+16	3.46E+16	9.39E-01
	1.34E+18	1.59E+15	1.33E+18	AAC	0.088	0.011		AAC	1.40E+14	1.47E+16	1.49E+16	9.39E-01
	1.34E+18	1.59E+15	1.33E+18	N	0.040	0.005		N	6.33E+13	6.03E+15	6.10E+15	1.04E+00
	1.34E+18	1.59E+15	1.33E+18	AAN	0.029	0.004		AAN	4.55E+13	4.80E+15	4.84E+15	9.39E-01
	1.34E+18	1.59E+15	1.33E+18	SPM	1.750	0.330		SPM	2.79E+15	4.40E+17	4.43E+17	6.30E-01
	Total Ocean											
	Volume [m^3]			g m^{-3}			Total dissolved					
Dissolved	1.34E+18			DOC	1.300		in g	DOC	1.74E+18			
	1.34E+18			TDAA min	0.100			TDAA	1.34E+17			
	1.34E+18			TDAA max	0.200			TDAA	2.67E+17			
	1.34E+18			TDAA mean	0.160			TDAA	2.14E+17			
	1.34E+18			AAC	0.067			AAC	8.95E+16			
	1.34E+18			AAN	0.026			AAN	3.47E+16			

Reference

Costello, M. J., Cheung, A., and De Hauwere, N.: Surface Area and the Seabed Area, Volume, Depth, Slope, and Topographic Variation for the World's Seas, Oceans, and Countries, Environ. Sci. Technol., 44, 8821-8828, 10.1021/es1012752, 2010.