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Supplementary Material

Rare earth elements as tracers of active colloidal organic matter composition

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Concentrations of REE as determined by ICP-MS

The ICP-MS used in the study was 7700x from Agilent. The operating conditions used during the measurements are presented in Table S1.

Table S1: Instrument operating conditions

Plasma conditions	
RF Power	1450-1550W
Carrier Gas	15 L/min
Auxiliary argon flow	1 L/min
Nebulizer micromist- argon flow	0.9- 1.0 L/min
CeO^+/Ce^+	1%
Ce^{2+}/Ce^+	<2 %

Calibrations were performed using synthetic multi-elemental solutions prepared in 2% HNO_3. Instrument drift was monitored and corrected by spiking each sample with an internal standard (Re, Rh) introduced on-line using a peristaltic pump. In order to suppress some spectroscopic interferences, mathematical corrections were required and calculated as a function of the oxide level. The choice of the measured isotopes and interferences applied is summarized in Table S2. The oxide production level was around 1 %.

Table S2. Preferred isotopes for REE analysis, isotopic abundance in %, oxides and hydroxides interference on analyte.

Element	**Isotope Mass**	**Abundance (%)**	**(Hy)Oxide interferences**	**Interferences corrections applied**
La	139	99.91		
Ce	140	88.48		
Pr	141	100		
Nd	146	17.19		
Sm	147-149	15	^{130}BaOH	
Eu	151-153	47.8-52.2	^{135}BaO, ^{137}BaO, ^{136} BaOH,	Eu (153) corrected from ^{137}BaO Eu (151) corrected from ^{135}BaO
Gd	157-158	15.65-24.84	^{142}CeO,^{142}NdO,^{141}PrO, ^{141}PrOH	Gd (157) corrected from ^{140}CeO and ^{141}PrO
Tb	159	100	^{143}NdO	Tb(159) corrected from ^{143}NdO
Dy	163	24.9	^{147}SmO, ^{146}NdOH,	Dy(163) corrected from ^{147}Sm
Ho	165	100	^{149}SmO	Ho(165) corrected from ^{149} SmO
Er	166	33.6	^{151}EuO	Er(166) corrected from ^{150} SmO
Tm	169	100		
Yb	172-174	21.9-31.8	^{157}GdOH	Yb(174) corrected from^{158}GdO
Lu	175	97.41	^{159}TbO	Lu(175) corrected from ^{159}TbO

The detection limits for all the REE are presented in Table S3.

Table S3. Detection limits obtained on HP 7700x ICP-MS, calculated from the AFNOR standards and based on the blank measurement

Element	Isotope	Detection limit (ppt)	Detection limit (mol L^{-1})
La	139	0.15	1.1 X 10^{-12}
Ce	140	0.14	1.0 X 10^{-13}
Pr	141	0.06	4.3 X 10^{-13}
Nd	146	0.16	1.1 X 10^{-12}
Sm	147	0.23	1.5 X 10^{-12}
Eu	153	0.10	6.6 X 10^{-13}
Gd	157	0.22	1.4 X 10^{-12}
Gd	158	0.13	8.3 X 10^{-13}
Tb	159	0.04	2.5 X 10^{-13}
Dy	163	0.17	1.0 X 10^{-12}
Ho	165	0.05	3.0 X 10^{-13}
Er	166	0.15	9.0 X 10^{-13}
Tm	169	0.04	2.4 X 10^{-13}
Yb	174	0.17	9.8 X 10^{-13}

ICP-MS analysis included three consecutive replicate measurements, producing a repeatability error less than 2%. To control the quality of the REE element measurements, the certificated reference material SLRS-6 standards (National Research Council –CNRC Canada) was used.

Concentrations of REE added and present naturally in the HS.

Table S4. Average concentrations of the REE added in the different experiments in mol L^{-1}.

	PLFA (mol L^{-1})	AHA (mol L^{-1})	LHA (mol L^{-1})
La	4.5E-09	4.4E-09	9.6E-10
Ce	4.4E-09	4.4E-09	9.5E-10
Pr	4.4E-09	4.3E-09	9.4E-10
Nd	4.3E-09	4.2E-09	9.2E-10
Sm	4.1E-09	4.1E-09	8.8E-10
Eu	4.1E-09	4.0E-09	8.8E-10
Gd	3.9E-09	3.9E-09	8.5E-10
Tb	3.9E-09	3.8E-09	8.4E-10
Dy	3.8E-09	3.8E-09	8.2E-10
Ho	3.8E-09	3.7E-09	8.1E-10
Er	3.7E-09	3.6E-09	8.0E-10
Tm	3.7E-09	3.6E-09	7.9E-10
Yb	3.6E-09	3.5E-09	7.7E-10
Lu	3.5E-09	3.5E-09	7.6E-10

Table S5. Average REE concentrations present naturally in PLFA, AHA and LHA (detection limit = DL).

	PLFA (mol L^{-1})	AHA (µmol L^{-1})	LHA (mol L^{-1}
La	7.5E-10	2.0E-11	3.9E-10
Ce	2.7E-10	5.7E-11	7.4E-10
Pr	3.4E-11	4.8E-12	7.3E-11
Nd	1.3E-10	1.9E-11	3.1E-10
Sm	2.2E-11	3.6E-12	4.5E-11
Eu	8.4E-12	1.0E-12	1.1E-11
Gd	1.8E-11	3.4E-12	5.2E-11
Tb	4.8E-12	5.0E-13	7.6E-12
Dy	9.7E-12	2.7E-12	4.6E-11
Ho	3.4E-12	5.2E-13	3.0E-12
Er	7.8E-12	1.4E-12	2.5E-11
Tm	2.4E-12	2.0E-13	<DL
Yb	9.1E-12	1.1E-12	2.0E-11
Lu	2.4E-12	1.7E-13	<DL