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Sticking properties of TEP as a function of metal concentrations

Testing a simplified encountering model for TEP.

*Major aggregation processes occuring in the sea involve highly sticky transparent exopolymer particles (TEP). Therefore, the determination of the factors controlling the sticking properties of TEP is crucial to build up an accurate picture of the global Carbon cycling. The stickiness, **α**, is defined for two encountering particles and depends on the inner properties of the particles (concentration, size and sticking properties) but also on the turbulence of the medium that leads collision. Thus, the value of **α** is a probability to estimate. For this study the encountering parameters have been simplified as follows:*

- *only two groups of particles interact to form mixed aggregates: TEP and synthetic beads (6 μm)*
- *the beads have* $\alpha_{beads} = 0$
- *the shear rate is constant (10 m.s*$^{-1}$*) under an oscillating grid system*
- *the relationship between the number of beads attached to a TEP (**N**) and the corresponding size of the particle (**d**, equivalent spherical diameter) can be linearly regressed, The linear coefficient, **a**, is used as an indication of the variations of* α_{TEP} *.*

Can metals control TEP stickiness?

In the lagoon of New Caledonia, a major Nickel provider in the world, the sticking properties of TEP decrease along a coast-to-ocean transect.

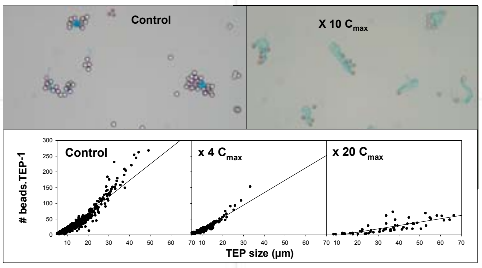
In this study we investigated metal concentrations as a key controlling factor of sticking properties of TEP. Therefore, a solution of TEP-precursors, i.e. a seawater filtrate (<1μm) with low concentration of metals, has been enriched with a metal-mix (Ag, Al, Co, Cr, Cu, Fe, Mn, Ni, Pb, Zn).

This metal enrichment has been performed proportionally to the highest dissolved concentration of each metal measured in the lagoon, C_{max}*. Thus, the final solution held a* C_{max} *enriched bulk of metals. We performed the following experiment with 2 to 20 times* C_{max} *metal enrichments:*

Protocol.

2 l filtrate < 1 μm + Metal-mix x Cmax + 5.10³ beads ml⁻¹ — 3h at 10m.s⁻¹ sampling every hour → 20 ml filtered onto 0,2 μm — TEP colored with Alcian blue + Filter Transfer Freeze to microscopic slide → Photographs of TEP — Image-analysis-software (ImageProPlus, MediaCybernetics) Sizing TEP: **d** — Counting beads Attached to TEP: **N**

Results and implications.



__Photos__ of TEP (x40) having the same size scale and sticking more beads in the control sample than with metal concentrations reaching 10 times C_{max} *.*

***Figure 1**: Linear regressions **N= a.d** for the Control, metal concentrations of 4 and 10 times* C_{max} *samples. Note the decrease in the TEP stickiness slope, **a**, as metal concentration increases.*

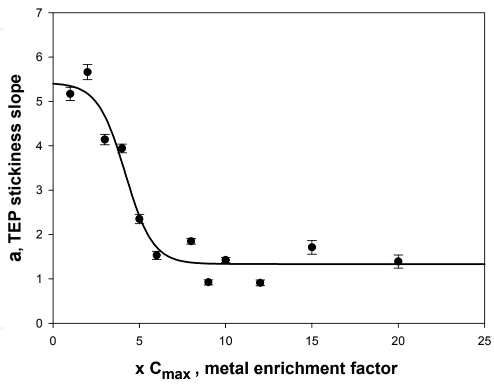


***Figure 2**: **The sticking properties of TEP decrease as metal concentrations increase.** Around 10 times* C_{max} *the treshold shows that subsequent metal enrichment doesn't lead to a decrease of the sticking properties of TEP anymore.*
An hypothesis would be that TEP own binding sites that are at this point "saturated" in metals. This process might be driven by electrostatic linkages.

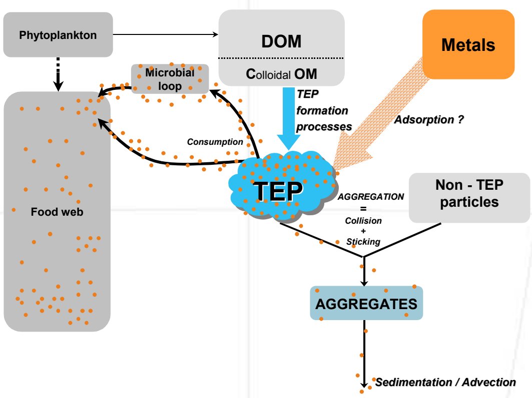


***Figure 3**:*
On one hand, reduced TEP stickiness should lower aggregation and therefore vertical fluxes as TEP is the cohesive matrix of aggregates. Subsequently,this would make the organic matter to remain longer in the water column because it needs more time to become dense enough to sink .

On the other hand,TEP can act as an adsorption matrix for metal but also as a feeding substrate. Thus, in metal-enriched seawater, microbial degradation of TEP may contribute much more to TEP pathway.

Actually, TEP could be a metal vector from a dissolved state to a particulate and easy assimilated state; in other words, a primary entry for metal in the marine food web.

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