Coccolithophore ballasting effect on marine microplastic export and accumulation

Michaël Grelaud

Institut de Ciència i Tecnologia Ambientals, Universitat Autònoma de Barcelona, Bellaterra, Spain. michael.grelaud@uab.cat

Laura Simon-Sánchez

Institut de Ciència i Tecnologia Ambientals, Universitat Autònoma de Barcelona, Bellaterra, Spain

Patrizia Ziveri

Institut de Ciència i Tecnologia Ambientals, Universitat Autònoma de Barcelona, Bellaterra, Spain

Since the early 1950s, the annual global plastic production has increased exponentially to reach 367 million tons in 2020. Through waste mismanagement, illegal dumping, shipping or fishery activities, as some examples, a large portion (~8-10 million tons) ends up in the marine system every year (Boucher et al., 2017). Once in the environment, the plastic waste will undergo fragmentation, through various processes, leading to the formation of the notorious microplastics (1-5000 μm) and nanoplastics (<1 μm). However, this floating contamination, which concentrates within the 5 subtropical gyres (i.e. garbage patches), represents only 1% of the total budget (Koelmans et al., 2017), pointing the seabed sediments as the ultimate destination of this pollution.

It is hypothesized that in the ocean, the floating microplastics can form aggregates embedded in marine snow and faecal pellets. The coupling of this biotic and abiotic removal is suspected to be the main pathway for microplastics to reach the seafloor, although the mechanisms behind this removal remains poorly understood. In order to test this hypothesis, we measured the accumulation of coccolithophores over the last ~60 years in a well preserved and dated sediment core retrieved in the prodelta of the Ebro River (northwestern Mediterranean Sea). These data are compared to the accumulation of small microplastics (10-1000 μm) measured in the same core (Simon-Sánchez et al., in review).

The results show that the microplastic mass accumulating in these sediments mimics the exponential increase of the global plastic production over the last 70 years, making the comparison with the coccolithophore record irrelevant, unless the exponential trend is removed from the microplastic record. In this case, the detrended microplastic record parallels the absolute abundances of coccolithophores since the mid-1960s, showing for the first time the direct relation between the surface export production and the removal of microplastic from the surface to the seafloor.

References:

Boucher, J. & Friot, D. 2017. Primary microplastics in the oceans: A Global Evaluation of Sources. *IUCN*, Gland, Switzerland: 43 pp.

Koelmans, A.A., Kooi, M., Law, K.L. & van Sebille, E. 2017. All is not lost: Deriving a top-down mass budget of plastic at sea. *Environmental Research Letters* **12**(11): 1–9.

Simon-Sánchez, L., Grelaud, M., Lorenz, C., Garcia-Orellana, J., Vianello, A., Liu, F., Vollersten, J. & Ziveri, P. In review. Sediment cores revealing the plastic age? – Microplastic preservation in coastal sedimentary records.