Does dredged material dumping effect pelagic (pico-) phytoplankton?

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Dumping of dredged material into the marine environment is a common threat to the marine ecosystem. Effects on bentic organisms are widely observed. But what about pelagic organisms? Every change in chemical or environmental ecosystem effects phytoplankton. And thus dumping of dredged sediment does, too.

Aims:

1) What is transported into seawater via dumping of dredged material
2) Effects on (pico-) phytoplankton

3) Guideline for environment friendlier dumping

Methods:

- River influenced Samandağ and human influenced Mersin harbor sediments were examined and exposed to seawater
- Different concentrations of exposed water was added into natural coastal and off-shore phytoplankton communities (Samandağ high=4.5g, low=0.75 and Mersin high=9, low=1.5 gram sediment per liter)
- Chlorophyll-, nutrient and species developments (via flow-cytometry) were observed

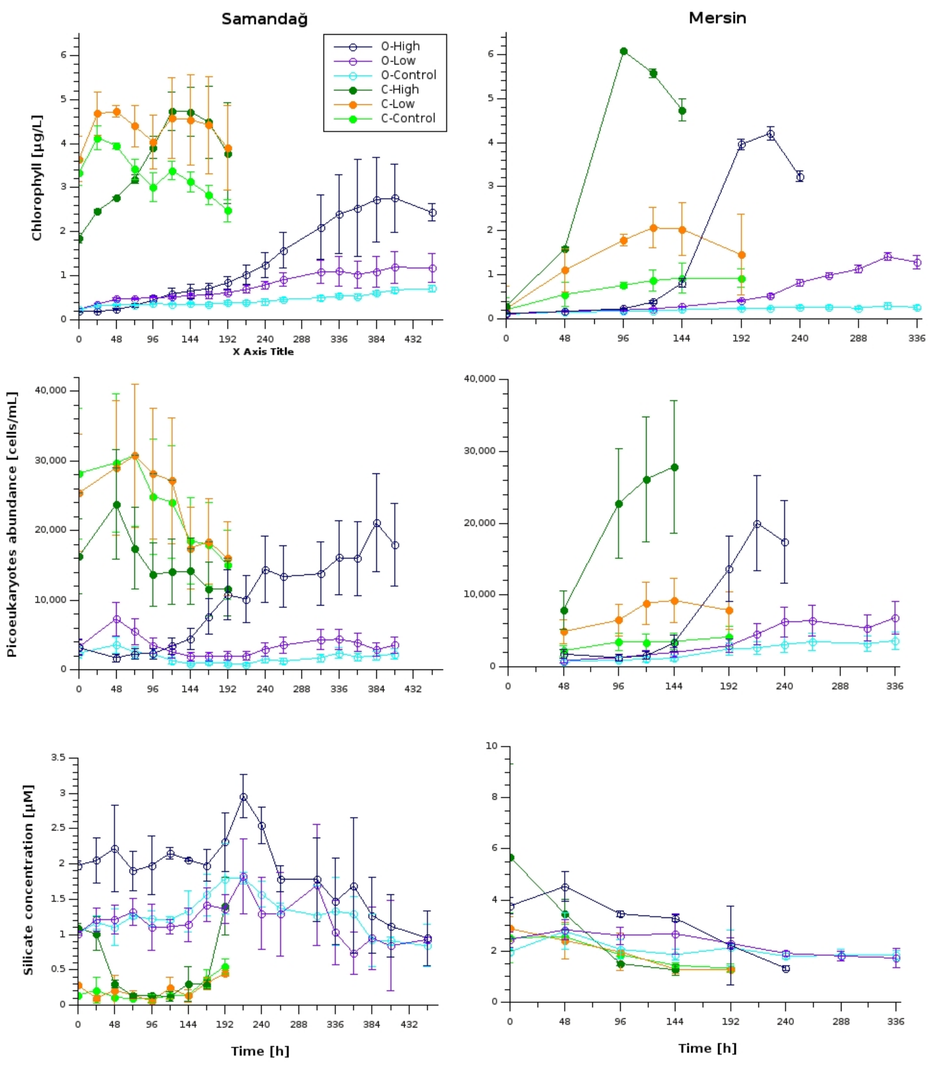

Fig. 1: Time-dependent development of chlorophyll-a and silica concentrations, Picoeukaryotes abundances in the Samandağ (left) and Mersin (right) sediment added communities, taken from off-shore (O and blueish open circles) and coastal zone (C and green/orange colored circles)

Results:

- Some metal concentrations reach lethal value for phytoplankton in both sediments [1], e.g. copper (table 1)
- Mersin harbor sediment had higher concentration in soluble silicate
- Coastal community reacts in shorter time to sediment addition
- Dumped material concentration dependent biomass production (here chlorophyll a)
- Silicate decrease with chlorophyll increase → increase driven by diatoms
- Less diatoms present in off-shore waters → longer lag phases for chl-a increase
- Picoeukaryotes increase with higher concentration and time
- *Prochlorococcus* and *Synechococcus* were not influenced consistently

Table 1: Metal components, total carbon, organic carbon and nitrogen concentrations in the sediments and initial seawater soluble concentrations of nutrients of all treatments

Parameter per unit sediment	Cr [mg/kg]	Mn [mg/kg]	Fe [g/kg]	Co [mg/kg]	Ni [mg/kg]	Cu [mg/kg]	Zn [mg/kg]	Cd [mg/kg]	Pb [mg/kg]	Al [g/kg]
Samandağ	297	577	30.7	32.6	384	17.4	40.8	0.194	4.98	17.7
Mersin	372	644	45.7	35.2	683	24.7	76.7	0.38	22.8	38.8

Parameter per unit sediment	TC [mmol/g]	TOC [mmol/g]	TON [mmol/g]
Samandağ	3.48	1.01	0.09
Mersin	4.52	0.37	0.03

Initial nutrient concentrations [µM] coastal / off-shore		NO2 + NO3 [µM]	Ammonium [µM]	Phosphate [µM]	Silicate [µM]
Samandağ	Control	1.58 / 0.25	1.10 / 0.58	0.04 / 0.03	0.14 / 1.01
	Low	1.45 / 0.43	1.30 / 1.75	0.03 / 0.04	0.28 / 1.01
	High	1.73 / 0.53	1.81 / 1.51	0.04 / 0.11	1.09 / 1.98
Mersin	Control	0.49 / 0.39	0.68 / 0.33	0.05 / 0.03	2.52 / 1.97
	Low	0.20 / 0.22	0.42 / 0.40	0.04 / 0.03	2.88 / 2.46
	High	0.54 / 0.33	1.09 / 1.39	0.25 / 0.30	5.68 / 3.77

Dilution plays a crucial role

One time dumping will not effect the pelagic community much
Therefore, dumping of large volumes to shallow and enclosed bays appears to modify biochemical properties of pelagic community.
However, impact of dumping material to off-shore communities is limited

[1] S. Nayar, P.B.L. Goh, L.M. Chou, 2004. Environmental impact of heavy metals from dredged and resuspended sediments on phytoplankton and bacteria assessed in in situ experiments. Ecotoxicology and Environmental Safety, 59: 349-369

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