Sediments incorporated into sea ice: Implications for phytoplankton growth

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Impacts of sediments in sea ice on Arctic marine ecosystems

Sediment-laden sea ice is a ubiquitous feature in the Arctic Ocean. This study presents implications of unique roles of sediments incorporated into sea ice on phytoplankton growth.

Capturing sediment-associated features of sea ice

Field measurement: Light transmittance of 10-cm sectioned ice cores and sediment loads of each subsection.
Incubation experiment: Time series of chlorophyll-a fluorescence in seawaters with several sediment levels.

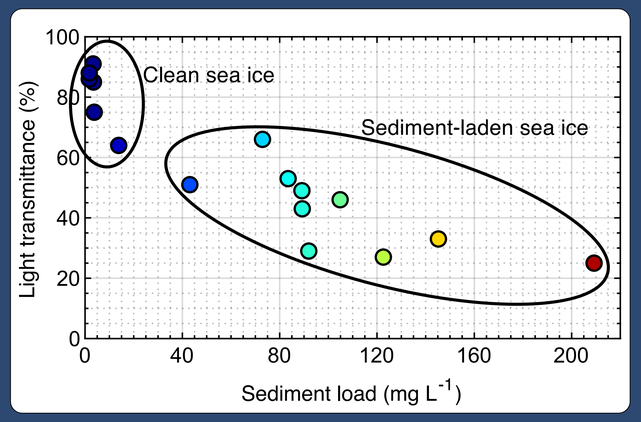
Light transmittance and chlorophyll-a fluorescence

We found a clear relationship between light transmittance and sediment loads. Chlorophyll-a time series showed sharp increases in samples with sediments, presumably suggesting positive impacts of sediments on phytoplankton growth.

Biogeochemical consequences on phytoplankton growth

Sediments incorporated into sea ice have both **positive**/**negative** impacts on phytoplankton growth in the Arctic; nutrients, vegetative/resting cells, and light attenuation.

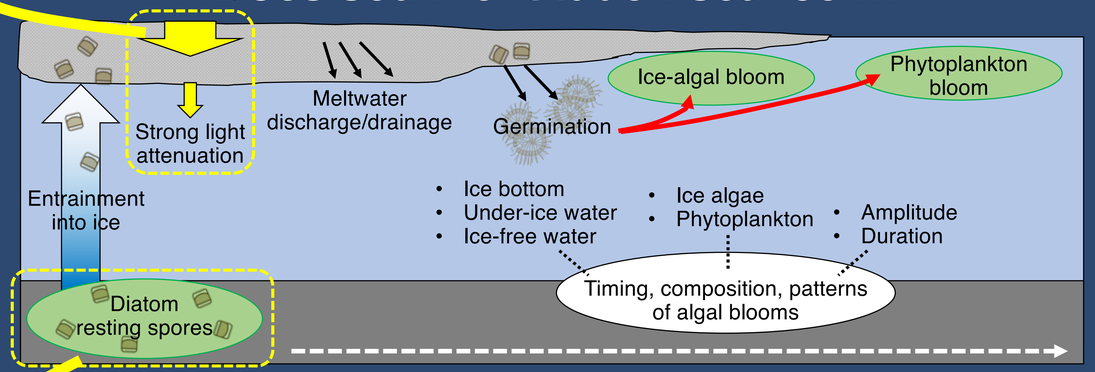
Sediment-laden sea ice is likely to have unique roles distinct from what we see in sediment-free clean sea ice

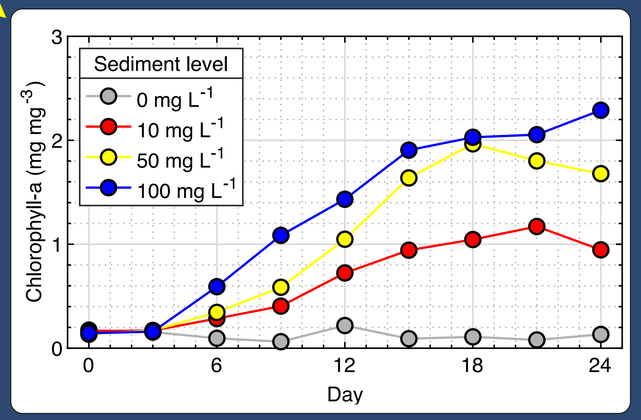


Light transmittance

Ice-core samples collected on landfast sea ice near Point Barrow exhibited sediment loads ranging from1.7 mg L^{-1} to 209.2 mg L^{-1}. Sediments incorporated into sea ice showed a significant impact on light transmittance of sea ice, suggesting a potential impact of sediment-laden sea ice on ice algal and phytoplankton growth in the Arctic.

Does sediment-laden sea ice …



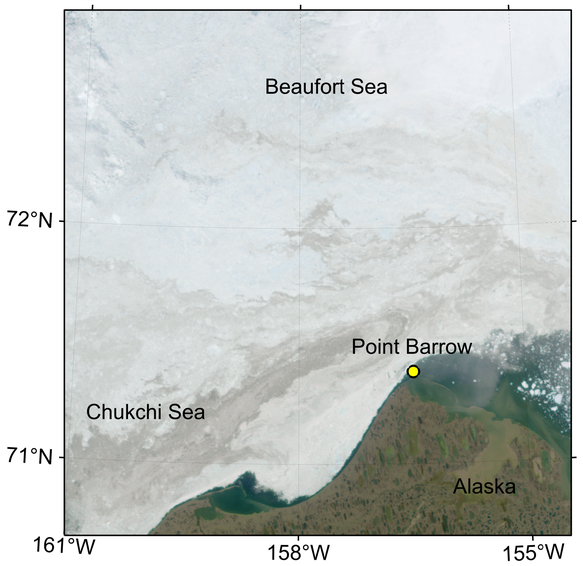


Phytoplankton resting stages

Sediments collected from ice cores were incubated in artificial seawater. Since artificial seawater contains no organic materials, phytoplankton we observed would have originated in sediments. One reasonable explanation is that resting stages of phytoplankton stored in sediments germinated and resumed growth in response to environmental cues.

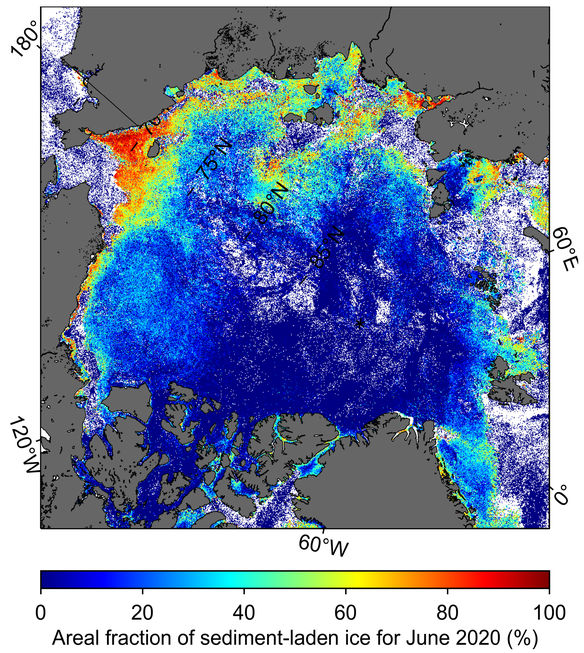
How sediment-laden ice looks like

MODIS/Aqua true-color image around Point Barrow on July 24, 2006. Sediment-laden ice (grayish ice) is advected toward the east along the Alaska coast.



Satellite mapping of sediment-laden ice

According to Waga et al. (2022), sediment-laden ice widely distributes across the Arctic Ocean, with maximum areal fractions of >80% on the shallow continental shelves.



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