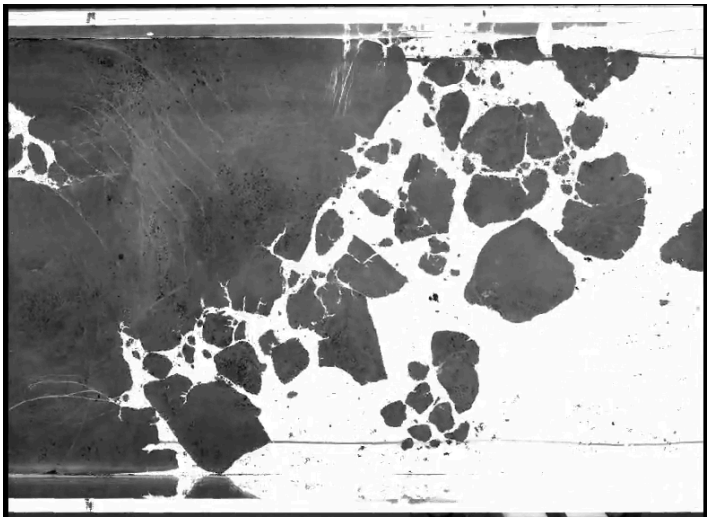
Water Waves Break Up Floating Film

A lab-scale model provides a testing ground for studying the breakup of ice sheets or of other thin solids floating on the surface of a fluid.

By **David Ehrenstein**

"Tea scum" is a thin film of minerals and organic molecules that can develop on the surface of a cup of tea. As it breaks up, this film becomes riddled with fissures in a pattern that resembles the cracks in sea ice. Michael Berhanu of Paris City University and his colleagues developed a physical model that may provide insights into these situations and other cases—such as biofilms—where a thin, flexible solid floats on top of a fluid [**1**].

The researchers sprinkled a powder of 10-µm-wide graphite particles onto the water surface in a wave tank to create a "raft," a film of particles held together by capillary forces. Then they generated 3-Hz-frequency (17-cm-wavelength) waves at one end of the tank and sent them propagating toward the roughly 10-cm-wide raft. The raft gradually broke apart into pieces that looked similar to the polygon-shaped fragments observed in arctic ice sheets.



A 20-cm-wide film made of graphite particles floating on water is broken apart by 3-Hz surface waves. In this case they are standing waves, and the breakup begins at one of the antinodes (locations where the wave amplitude is at a maximum).
Credit: L. Saddier *et al.* [**1**]

Ice tea. The film that forms on tea can develop cracks that resemble those observed in oceanic ice sheets.
Credit: L. Saddier *et al.* [**1**]**; IzzetNoyan/stock.adobe.com**

But Berhanu and his colleagues found that the break-up mechanisms for the raft were different from those of an ice sheet. Analyzing videos of the wave tank, the researchers developed a model in which the waves push and pull on the raft horizontally, causing it to crack and separate. However, these push–pull forces are negligible in the sea-ice environment, where previous research has shown that the dominant breaking mechanism is vertical bending of an ice sheet caused by the up-and-down motion of water waves. Still, the researchers say that the raft model can potentially provide useful information on ice floes. For example, the size distribution of raft pieces over a certain range followed a power-law relationship with

exponent −1, which is compatible with some ice floe observations.

David Ehrenstein is a Senior Editor for *Physics Magazine*.

REFERENCES

1. L. Saddier *et al.*, "Breaking of a floating particle raft by water waves," **Phys. Rev. Fluids 9, 094302 (2024).**