EROSION PATTERNS ON DISSOLVING BLOCKS

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Patterns in nature are shaped under water flows and wind action, and the understanding of their morphodynamics goes through the identification of the physical mechanisms at play. When a dissoluble body is exposed to a water flow, typical patterns with scallop-like shapes may appear [1, 2]. These shapes are observed on the walls of underground rivers or icebergs.

We experimentally study the erosion of dissolving bodies made of salt, caramel or ice into water solutions without external flow. The dissolving mixture, which is created at the solid/liquid interface, undergoes a buoyancy-driven instability comparable to a Rayleigh-Bénard instability so that the dissolving front destabilizes into filaments. This mechanism yields to spatial variations of solute concentration and to differential dissolution of the dissolving block. We first observe longitudinal stripes with a well defined wavelength, which evolve towards chevrons and scallops that interact and move again the dissolving current.

Thanks to a careful analysis of the competing physical mechanisms, we propose scaling laws, which account for the characteristic lengths and times of the early regime in experiments. The long-term evolution of patterns is understood qualitatively.

A close related mechanism has been proposed to explain structures observed on the basal boundary of ice cover on brakish lakes [3] and we suggest that our experiments are analogous and explain the scallop-like patterns on iceberg walls.

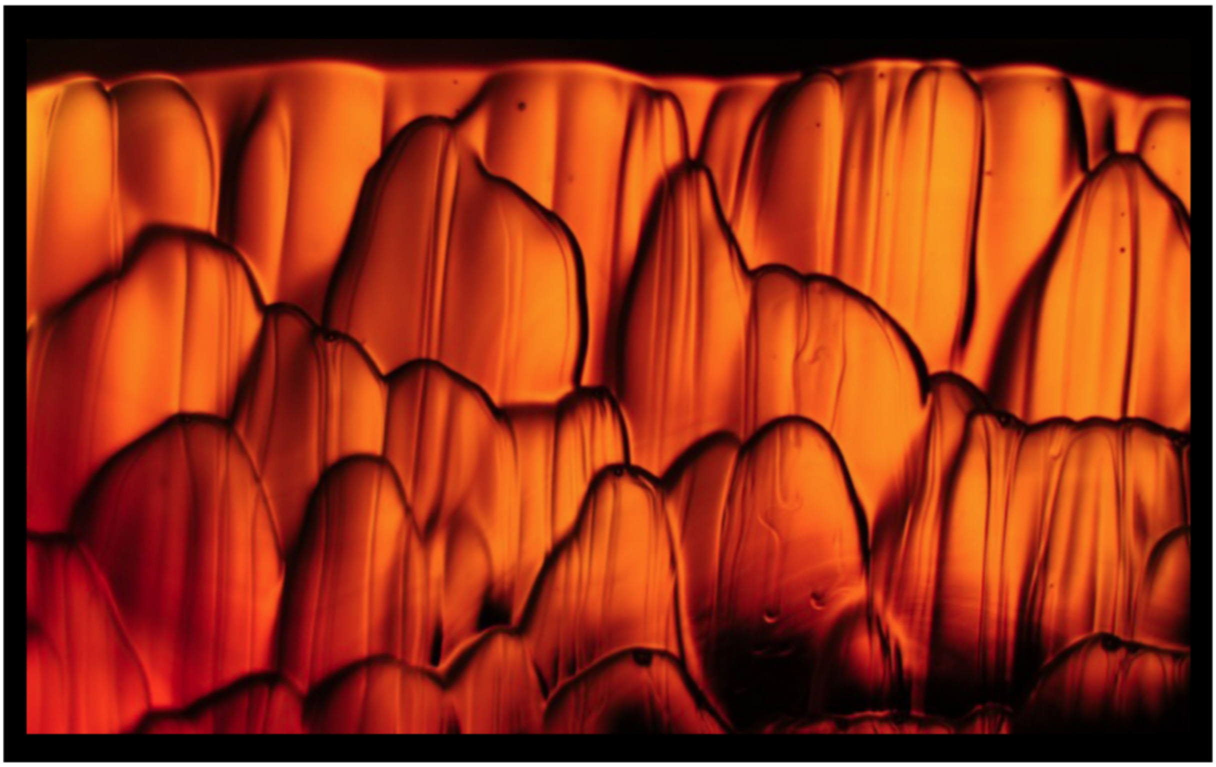

Figure 1. Centimeter scale patterns on a caramel block dissolving into water.

References

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