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Blocks dissolving or melting into aqueous solutions. Receding rate and pattern formation.

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Patterns in nature are shaped under fluid flows. Understanding their morphodynamics demands to identify the physical mechanisms at play. When a dissoluble body is exposed to a water flow, patterns with scallop-like shapes may appear [1, 2]. These shapes are observed on the walls of caves or icebergs. Here, we experimentally study the dissolution of rectangular blocks of either caramel, salt (NaCl) or plaster (gypsum) and the melting of ice blocks immersed in quiescent aqueous solution. We systematically vary the inclination of the blocks and the solute concentration of the solutions and, in the melting case, the temperature of the solutions.

The dissolving (resp. melted) mixture, which is created at the bottom (resp. top) interface of the immersed block undergoes a buoyancy-driven instability and the dissolving (resp. melting) front destabilizes into filaments. This mechanism yields to spatial variations of solute concentration (resp. temperature) and to differential dissolution (resp. melting) of the immersed block. We first observe periodic longitudinal stripes, which evolve towards chevrons and scallops that interact and propagate against the dissolving/melting current.

In the dissolution case, the flow instability is analogous to a Rayleigh-Bénard instability [3, 4]. In the melting case, both transports of mass and heat have to be taken into account to model the characteristic melting rate and the pattern wavelength [5].

We will discuss the dissolution and melting rates of the blocks as the pattern morphodynamics.

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