***INTERNSHIP PROPOSAL:* Patterns generated by erosion by dissolution**

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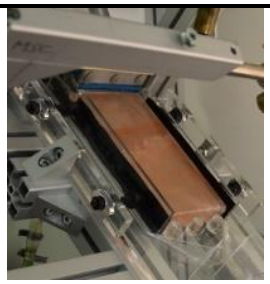
Thesis possibility after internship: YES
Funding: NO, Application to ED PIF PhD grants.

Patterns generated by erosion by dissolution

Landscapes are shaped under water flows and wind action, and the understanding of their morphodynamics requires the identification of the physical mechanisms at play. The processes of erosion of sediment composed of macroscopic grains have been extensively studied, which is not the case of the erosion by dissolution. However, this process plays a significant role in area covered by a soluble mineral like in Karst regions and is the cause of the formation of remarkable patterns [1] (limestone pavements, scallops, dissolution channels [2], dissolution pinnacles, limestone forests…) with characteristic length scales. We propose in this internship, by the mean of controlled laboratory experiments, to study the morphogenesis of dissolution patterns. The soluble media and the hydrodynamic flows will be tuned to downscale the characteristic size and time of the involved processes from geological values to "laboratory" values. Thanks to quantitative measurements of the flow and of the topography of eroded surfaces, we will identify the driving elementary physical mechanisms and thus develop mathematical models [3] and numerical simulations [4], with the aim to explain complex geological systems and to predict the long term evolution of landscapes. Field missions are performed to measure dissolution shapes in nature and to compare with models and experiments.

In this internship, the student will develop in the group, one or several model experiments, reproducing dissolution erosion phenomena. To decrease the timescales, fast dissolving materials like salt and plaster will be used. Hydrodynamic properties of the flows will be characterized and the 3D shape evolution of eroded surfaces will be recorded. A first project consists in investigating the case of soluble plates submitted to a run-off water flow, producing by dissolution a channel, i.e; dissolution river. This project will complement our previous study with a localize injection of water, to produce a dissolution channel. In that case, we reported the generation of parallel dissolution grooves created by a thin flowing water film [2].

Cave Saint Marcel, Ardèche



Study of patterns generated by run-off flows on a pink salt plate

Crests formed by dissolution of salt on water, when driven by the solutal convection

References:
[1] P. Meakin and B. Jamtveit, **Proc. Of the Royal Society A**, 466, 659 (**2010**)
Geological pattern formation by growth and dissolution in aqueous systems.
[2] A. Guérin, J. Derr and S. Courrech du Pont and M. Berhanu **Physical Review Letters**, 125, 194502 (**2020**)
Streamwise dissolution patterns created by a flowing water film. (Editor's choice).
[3] M. Chaigne, S. Carpy, M. Massé, J Derr, S. Courrech du Pont, & M. Berhanu. (**2023**).
Emergence of tip singularities in dissolution patterns. Accepted in **PNAS**. ArXiv preprint arXiv:2306.11676
[4] J. Philippi, M. Berhanu, J. Derr and S. Courrech du Pont **Physical Review Fluids**, 4, 103801 (**2019**)
Solutal convection induced by dissolution

Condensed Matter Physics: YES Soft Matter and Biological Physics: YES
Quantum Physics: NO Theoretical Physics: NO