Measuring the force exerted by confined growing crystals

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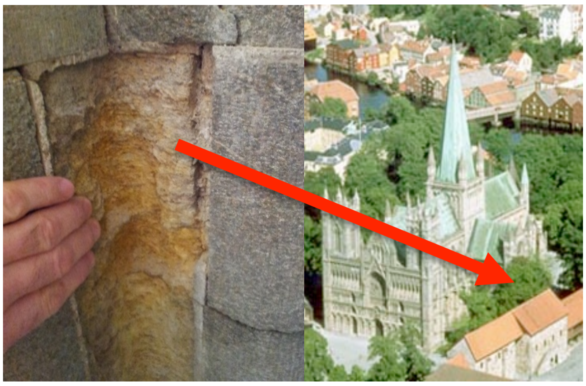
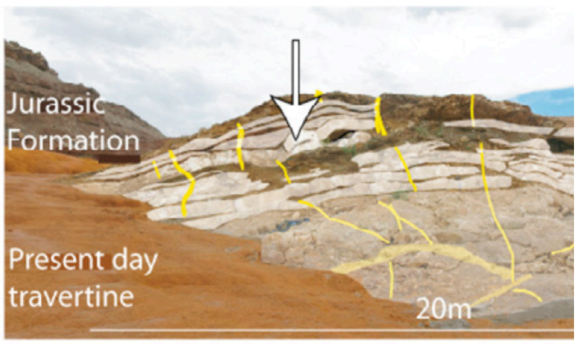
Since Sorby, Gibbs and Lord Kelvin discussed the "crystallization force" and the chemical potential of non-hydrostatically stressed solids, these fields have been full of confused theory and ill-controlled experiments. Meanwhile, geologists, engineers and built heritage conservators have shown the importance of fracture and damage induced by crystallization of ice and minerals in porous structures (see example in Figure (a)). The feedback between crystallization, fracture and transport also multiplies by orders of magnitude the rate of weathering and soil formation and controls the metamorphosis of rocks down to more than 100 km depth in the Earth's crust (see example in Figure (b)). Despite these important contexts, stresses induced by confined crystals are poorly understood and characterized.



(a) Crystallization-induced damage in Nidarosdomen, Trondheim (Norway)

This internship aims at measuring the force exerted by a single salt crystal growing in a supersaturated solution, with unprecedented control over the fundamental parameters (degree of supersaturation, contact area, transport kinetics, confining surface properties etc.) governing the physics at play. The results will help elucidate a long outstanding debate about the existence, magnitude, and physical origin of crystallization-induced stresses, with important implications in geology and civil engineering.



(b) Geological formation induced by crystallization pressure (from Gratier et al., Geology, 2012)

The internship can be extended into a PhD study, which will include a collaboration with the University of Oslo (Norway).