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The deterioration of building stones by salt crystallization

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Building stones are naturally altered along the time due to weathering which is currently accelerated by polluted atmospheres, aggressive climatic conditions, or unsatisfactory construction or maintenance procedures. These processes, usually related to the interaction of the intrinsic petrographical, physical and mechanical characteristics of the rock with external agents named above, commonly result in the alteration of the stone surface, ranging from aesthetical modification (loss of brightness, staining and others) up to the loss of mechanical strength.

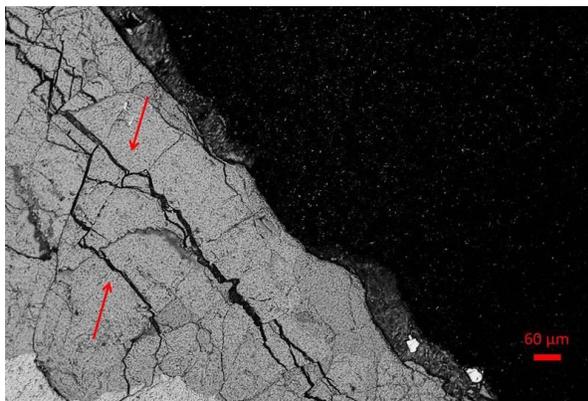
Among the weathering agents, the crystallization of salts is one of the most powerful since it is the main cause of rock weathering in marine environments, humid climates and, in special, polluted environments.

The action of salt crystallization in porous media depends on the degree of saturation of the saline solution and the pore system of the rock [1]; and results in the loss of grain cohesion and the main degradation mechanism is the pressure resulting from the crystallization of salts in the pores, microcracks and other discontinuities.



In general, it takes place close to the soil, in the lower parts of a building (Figure 1) or in floors, due to the rising of a saline solution through the rock by capillary action. In this capillary zone, it happens the evaporation and consequent crystallization of salts, either in the surface, which is called efflorescence, or the below the surface of the rock, as sub-efflorescence, and is characterized by the loss of material. The saline solution may come from saline components in the soil or it can rise from mortar components during drying and curing processes.

Figure 1: Example of loss of rocky material, in



building stone, due to salt crystallization.

In granitic rocks, the salt crystallization in microcracks disposed few nanometres underneath the stone surface (Figure 2) exposed to the atmosphere is the most effective mechanism [3]. Scaling is the first deterioration form to appear and the progression of the weathering processes will lead to granular disaggregation, exfoliation and others forms [4].

Figure 2: Microcracks underneath the rock surface filled with gypsum.

References:

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