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MECHANISMS AND RATES OF CARBONATES DISSOLUTION BY ENDOLITHIC LICHENS

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Calcareous outcrops represent c. 70% of the exposed stone surfaces of the Earth. In Europe c. 60% of them are colonised by organisms, the most common being the so-called endolithic lichens, that live embedded in the substratum, and actively dissolve the carbonates by means of an unknown metabolic mechanism. This bio-dissolution might be related to the respiratory activity or the secretion of organic acids, e.g. oxalic acid. However, in the literature contradictory experimental evidences are given, suggesting that other, more sophisticated mechanisms are involved.

Here we discuss the first results of a multi-disciplinary research aimed at:

1. the description of the most typical bioweathering phenomena caused by endolithic lichens, and related biomineralisation products;
2. the identification of the dissolution mechanisms used by these organisms to penetrate into the substratum;
3. the quantification of surface lowering in rocks free of, colonised by, or set free

of endolithic lichens.

Nine species, selected among the most common endolithic lichens of north-eastern Italy, were studied in detail. FT-IR analyses demonstrated that none of them accumulate Ca oxalates in detectable quantity, although Ca oxalates were confirmed in a single species from North America studied for comparison. Calcite is the most common biomineralisation product: dissolved near the most active parts of the lichen thallus, it re- precipitates in the lithocortex, the exposed outer layer.

Histological, biochemical and biomolecular techniques applied to thalli still immersed in the substratum, or free from it showed that all the species produce specific carbonic anhydrases (CA), that are thus reported for the first time from lichenised ascomycetes. These enzymes are important for several fundamental metabolic processes, from CO_2transport to acid-base balance, because they catalyse the reversible hydration of CO_2. CA might play a significant role in the substratum dissolution, because their secretion in the sites of active growth would significantly intensify the chemical activity of respiratory CO_2. To verify this hypothesis, experiments are now extended to axenic cultures of selected apomycobionts. In this way it is possible to study *in vitro* the interactions between the fungal hyphae and the calcite crystals.

To quantify the lowering of limestone surfaces, *in situ* measurements are being carried out with a traversing-microerosion meter (t-MEM; estimated precision: 1 μm). Eighteen sites were distributed along two elevation gradients from 0 to 2500 m, along the line Trieste Karst – Mt. Canin (south-eastern Alps), and in the Maiella Massive (Central Italy). In each site 6 measuring stations were selected on horizontal, smooth limestone surfaces colonised by endolithic lichens. Two further stations consisted of not colonised, rock surfaces exposed by mechanical break or by cutting, and re-exposed horizontally. A sample of the lichens colonising each measuring station was taken for identification, and thin and polished sections were prepared to describe petrography and bioweathering of each measuring station. The first results of this part of the research will be thoroughly discussed on the basis of a 20-years-old series of similar observations carried out in the calcareous areas of north-eastern Italy.