

WEATHERING EXPERIMENTS ON DIFFERENT MARBLES UNDER REALISTIC POLLUTION CONDITIONS

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Climate chamber experiments pursue the simulation of alteration processes by corrosives. Usually, weathering experiments on calcareous stone types are based on pronouncedly higher concentrations of SO₂ and NO₂ gases (1 to 5 ppm), e.g. MANGIO (1991). The conditions raise the question of comparability with real conditions.

In our study realistic average values of SO₂, NO₂ (0.150 to 0.200 ppm each), and O₃ (0.100 ppm) have been used corresponding to the mean half hour value for urban areas in Austria.

Cubes of about 15 cm² surface of two alpine marbles (calcitic Laas marbl, Italy; dolomitic Wattenberg marble, Tyrol), and a Jurassic limestone (Hagau "marble", Tyrol) have been exposed under this gas atmosphere in a chamber for 1, 2, 3 and 4 weeks, respectively at 30°C. Three campaigns have been conducted at different relative humidities (rh.) of 30%, 70% and 98%.

After each run the mineral phases on the sample surface were determined by XRD first. Then, the deposition of sulphate and nitrate on the receptor surface have been correlated to the amount of ions as determined by chromatography of water elutes.

The results of the ion chromatography show that these realistic concentrations of pollution gases at 70 % rh. lead to the formation of Ca-sulphate and Ca-nitrate already after one week. The amount of products increased linearly with time over the run-time of four weeks. There is a clear difference in product formation with a Ca-sulphate Ca-nitrate ratio of 10. Little difference is found for the different stone materials.

The production of sulphate and nitrate are much smaller at 30% rh., but they are already detectable even after a run-time of one week. However, the products' ratio is close to one, and a clear difference in reaction behaviour between the different stone types is observed. Obviously, the relevant mechanisms for the deposition of the damaging compounds and the following reactions depend on the receptor surfaces and given relative humidities.

The experiments at 98 % rh. posed considerable problems in data reproducibility. This may be related to the almost exponential increase of the sorption parameters. XRD measurements revealed gypsum formation on the Laas marble exposed to 70 % rh already after two weeks and after four weeks for the other stone types. At 30 % rh. no formation of new mineral phases was detectable. The results are encouraging for further simulation experiments at realistic conditions.

References

MANGIO (1991) PhD thesis. Univ. Göteborg.