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Dolomitic lime mortar - burning, slaking and setting

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Mortars are the binding material, which is responsible for the cohesion of brick and stone work of constructions. In Western Austria, parts of Italy and Germany as well as in other European countries, dolomitic or magnesian lime mortar is much more common at historic buildings than generally assumed.
The processes of burning, slaking and setting of dolomitic or magnesian lime is more complex compared to the known "lime cycle" of pure lime.
High Temperature Powder XRD for simulating the burning process of a dolomitic lime stone and a magnesian lime stone show that the decomposition of dolomite under atmospheric conditions takes place in two steps: i) CaMg(CO3)2 decomposes to CaCO3 + MgO + CO2 and further ii) CaCO3 decomposes to CaO + CO2.
Slaking leads to the formation of portlandite [Ca(OH)2] and brucite [Mg(OH)2]. While hydration of calcium oxide occurs readily at atmospheric pressure, the hydration of magnesium oxide requires a longer period of soak and/or a treatment at high pressure.
The setting process is characterized by a separate carbonation of portlandite and brucite. In contrast to portlandite that reacts comparatively quick to calcite [CaCO3] provided a sufficient CO2-supply, the formation of magnesite [MgCO3] is delayed or may be even inhibited in favor of the formation of hydrous magnesiumcarbonate phases.

These experimental findings have been compared with observations obtained from the examination of 200 samples of historic dolomitic or magnesian lime mortars taken from monuments in the Alpine region, which partly date back to Romanesque times. Most of the mortars are strikingly well preserved. Besides calcite, magnesite, hydromagnesite [4Mg(CO3) · Mg(OH)2 · 4H2O] and brucite have been identified in variable amounts as crystalline Mg-phases in the binder matrix. The detailed investigations also indicate the additional occurrence of further amorphous or poorly crystalline Mg-phases. However, nesquehonite [MgCO3 · 3H2O], which has been found in mortars of a young age, could not be confirmed in the binder of historic mortars.

The study shows that the dolomitic lime mortars represent a fairly complex mineralogical system. The comparison between experimental results and observation on historic sample material indicates that the latter represent a mineralogical system of which the reactions have come almost to completion with the times and seem to be close to equilibrium. This, presumably, is the cause for their striking durability.