



## **Kinetics of carbon isotope fractionation and $\text{CaCO}_3$ crystallisation upon the setting of lime mortar**

E. Usdowski

GZG Goettingen, Sedimentologie/Umweltgeologie. Goettingen, Germany. eusdows@gwdg.de

An examination of historical lime mortars has shown that their calcium carbonate cement displays a rather wide range of carbon isotope compositions from  $\delta^{13}\text{C} \approx -25$  to  $-7$  ‰ (PDB). Obviously, this range reflects various processes of isotopic fractionation which have occurred during the history of an individual cement. But it is not clear which of the data may represent a primary composition. In order to establish this composition experimental brickwork has been carried out. Surprisingly, the measurements show that calcite of lime mortar does not have a unique carbon isotope composition. The  $\delta^{13}\text{C}$  values change systematically from  $-11$  ‰ at the outside of the brickwork to  $-2$  ‰ (PDB) within the interior. This zoning along a mortar layer is caused by a kinetic fractionation factor  $\alpha_{\text{CaCO}_3-\text{CO}_2(g)} = 0.9960$  which is given by the absorption of atmospheric carbon dioxide into a strong alkaline slurry of portlandite, sand and water and its subsequent reaction to calcite within a liquid boundary layer surrounding the  $\text{Ca}(\text{OH})_2$  particles. Thus, the diffusion and the reaction of carbon dioxide leads to an enrichment of  $^{13}\text{C}$  over  $^{12}\text{C}$  at the gas-side of a reaction front so that the calcite becomes continuously “heavier” from the exterior to the interior along a mortar layer. The overall process may be described by a fractionation according to zone melting.