

Historical and recent carbonate binders – Application of stable C and O isotopes as environmental proxies

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Carbonate binders are used for mortar and plaster processing, which are typical man-made materials. The composition of these materials comprises information about their (trans)formation. In the present study an overview about the progress in the application of stable carbon and oxygen isotopes of carbonate binders as environmental proxies is given.

This multi isotope proxy approach is based on coupled isotope fractionation mechanisms at the boundaries between gaseous-liquid-solid phases as well as within the solution. ¹³C/¹²C- and ¹⁸O/¹⁶O-signatures of the carbonate binder reflect the setting behaviour of the primary carbonate cement. Initially CO₂ from the Earth's atmosphere is fixed within the precipitated carbonate, which is accompanied with kinetic isotope fractionations mostly due to the hydroxylation of CO₂. Thus carbonate binder or in general carbonate sinter in alkaline surroundings can be used to trace trapped gaseous CO₂. As calcite formation continued in a closed system the remaining gaseous CO₂ is subsequently enriched in ¹³C and ¹⁸O, which causes isotopic heavier carbonate, e.g. along a cement setting part. Deviations from such ideal isotope behaviour can be caused by evaporation events, variability in CO₂, e.g. from biogenic origin, relicts of primary limestone, recrystallization etc.. Implications of the use of stable C and O isotopes for material and environmental research as well as ¹⁴C dating are discussed.