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Tracing formation and durability of calcite in a Punic-Roman cistern mortar (Pantelleria Island, Italy)

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Ancient hydraulic lime mortar is preserved for millennia and its composition provides clues about historical processing. The distribution and isotopic composition of calcite in a mortar profile of a well-preserved Punic-Roman cistern at Pantelleria Island (Italy) was successfully used to trace its origin, formation conditions, durability and individual processing periods of the mortar. Four individual mortar horizons from the top to the bottom of the cistern floor coring are distinguished based on stable carbon and oxygen isotope ratios. All these horizons comprise of hydraulic lime mortar with a mean cementation index CI = 1.5 ±1, and constant binder to aggregate ratio of 0.31 ±0.01, which indicates standardized processing of the studied mortar.

The high durability of calcite formed during carbonation of slaked lime within the matrix of the ancient mortar and thus the excellent resistance of the used hydraulic lime mortar against cistern water, was documented by (i) a distinct positive correlation of $\delta^{18}O_{calcite}$ and $\delta^{13}C_{calcite}$ values, which typically occurs for calcite formed by carbonation through a mortar horizon, (ii) the characteristic evolution of $\delta^{18}O_{calcite}$ and $\delta^{13}C_{calcite}$ values through each of the four mortar horizons, where lighter follow heavier isotope values from upper to the deeper part of the cistern floor, and (iii) by $\delta^{18}O_{calcite}$ values, which cannot be originated from recrystallization and/or new formation of calcite through chemical attack by cistern water.