

The whole application can be mounted in existing measuring stations, without changing the existing collecting funnel (as shown in Fig.2). This is important for the continuity of the measurement at an existing station.

To avoid large changes of temperature of the sampled water, the containers can be isolated. The station must be heated in such a way, that the sample is not freezing. A simple funnel heating is not enough. The heating can be done with gas or electricity. Electrical heatings can be regulated by a thermostat. In stage of development are funnel-heatings with Peltier-elements. This devices are also able to cool the collecting funnel during hot periods.

The system (without the heating) can be supplied with solar panels and supplemented with remote data transfer systems like LEO-satellites, GSM or telephone.

## The $^{13}\text{C}/^{12}\text{C}$ fractionation Upon the Setting of Calcium Carbonate Mortars

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A number of sciences has become more and more concerned with the constituents of historical mortars. For example, in archaeology the objective is to deduce from the mineralogical and chemical compositions the provenance of material or even former recipes and methods for preparation, and environmental sciences are specially concerned with the carbon isotopes of the calcium carbonate of lime mortars in order to derive a former composition of atmospheric carbon dioxide. Under such auspices it has been shown that the sulfur isotopes of gypsum mortars may be used in order to trace the origin of the raw material. However, lime mortars represent a much more complicated case, because their calcium carbonate displays a rather wide range of compositions from  $\delta^{13}\text{C} \approx -25$  to  $-7$  ‰ (PDB) and from  $\delta^{18}\text{O} \approx 8$  to  $24$  ‰ (SMOW). Obviously, this range reflects various processes of isotopic fractionation which 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 set up. Surprisingly, the measurements show that, unlike to the sulfur isotopes of gypsum mortar, the 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 at a very good correlation to the oxygen isotopes. This zoning along a mortar layer is caused by a kinetic fractionation factor  $\alpha_{\text{CaCO}_3-\text{CO}_2(\text{g})} = 0.9960$  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. The variation of the oxygen isotopes follows the same principle. However, a reliable fractionation factor is difficult to assess.

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