

Short residence time and fast transport of fine-grain detritus – From ^7Be in settled dust in the Judean desert

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The short-lived cosmogenic isotope ^7Be ($t_{1/2}=53.3$ d) was measured in dust collected from dust traps placed in the Judean Desert. This enabled us to: (a) Determine the ^7Be dry deposition flux in the Dead Sea region; (b) Estimate the residence time of dust in the Dead Sea drainage basin and (c) Estimate the recycled component of the long-lived cosmogenic isotope ^{10}Be ($t_{1/2}=1.39\cdot 10^6$ y) of Judean desert dust. These estimations constrain the rate of transport of fine detritus material that is washed from the marginal terraces of the Dead Sea basin into the lakes that occupied the basin during the late Quaternary. The data show that: (a) the ^7Be flux in the Dead Sea regions is $2.0\pm 0.6\cdot 10^4$ atoms $\cdot\text{cm}^{-2}\cdot\text{y}^{-1}$ during summer and winter months and $5.3\pm 0.7\cdot 10^4$ atoms $\cdot\text{cm}^{-2}\cdot\text{y}^{-1}$ during fall months; (b) the residence time of dust in the drainage basin is less than one year and (c) the recycled ^{10}Be component in Judean desert dust is small. It appears that the inventory of ^7Be in dust settled in the Dead Sea drainage basin increases as a function of time and does not reach steady state. Thus, ^{10}Be may be used for reconstructing paleo-flood frequency and dust transport

Behaviour of dissolved silica (adsorption and coprecipitation) in the presence of calcite

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The replacement of carbonate minerals in sediments by silica is common during carbonate rock diagenesis. Silica, as well as organic material and clays, can be one of the inhibitors of chalk (>95% calcite) recrystallization process [1]. However, the mechanism of selective substitution of carbonate sediments by silica and the influence of different factors on silica uptake by adsorption and coprecipitation with calcite are still not clear. In this work, we studied the interaction between dissolved silica and calcite under a variety of experimental conditions to estimate the role of SiO_2 in chalk diagenesis.

The experiments were performed at 25 °C, different CO_2 partial pressures ($p\text{CO}_2=1$ atm, $p\text{CO}_2=10^{-3.5}$ atm and no access to CO_2) and various SiO_2 concentrations (≤ 2 mM). In monomeric silica solutions, no SiO_2 removal by adsorption was observed. The uptake of SiO_2 correlates with the amount of silica polymers and has its maximum value at basic pH, where some polysilicates are present.

Coprecipitation experiments were carried out by the constant addition method. The silica partition coefficient was calculated to be less than 1 and found to be dependent on calcite precipitation rate. The results of coprecipitation studies support that of adsorption experiments and also show that only insignificant amount of silica can be coprecipitated with calcite (maximum SiO_2 uptake is 4.8 $\mu\text{mol g}^{-1}$). This value increases with increasing dissolved silica concentration, increasing pH and the amount of silica polymers. Using the data from the adsorption study, namely, that polysilicic acid depolymerizes at the calcite surface, we can suggest two models for solid solution formation during coprecipitation.

We can conclude that interaction between dissolved SiO_2 at concentrations below the saturation with respect to amorphous silica and calcite is very weak and depends on adsorption of silica polymers.

[1] Baker *et al.* (1980) *Marine Geology* **38**, 185-203