A MODEL COMET MADE FROM MINERAL DUST AND H_2O-CO_2 ICE: SAMPLE PREPARATION DEVELOPMENT

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The task of the team was to prepare a model comet of approx. 10 kg for the KOSI III experiment in the Space Simulator of DLR-Köln, cf. (1-4). The sample should contain about 10 wt.% mineral dust (olivine, montmorillonite in the ratios 7:3 or 9:1), 12-25 wt.% CO_2 ice, and 65-78 wt.% H_2O ice. The preparation was achieved by spraying a mineral-water suspension (treated with ultrasound) into liquid nitrogen using CO_2 as a propellant gas. This technique already used in KOSI I and II experiments was maintained since it allowed the production of large quantities of material. New procedures via condensation from the gas phase are under development (KFA Jülich, DLR Köln, MPIK Heidelberg, Univ. Tel Aviv).

Several parameters were controlled during preparation: propellant gas pressure (1.5-3.5 bar), flow rate of suspension through spraying nozzle (1-4 ml s^{-1}), distance of nozzle to liquid N_2 surface (9-14 cm), and storage time. The "activity" of differently prepared samples was checked in small chamber experiments with artificial sun irradiation (1-3 SK). Here, the cooling device had to be improved with respect to previous studies (1-4) in view of the volatile CO_2. The CO_2 content measured via gas chromatography proved to be a characteristic indicator for sample homogeneity, cf. Fig. 1. It was determined as a function of the parameters cited above, irradiation intensity and duration, and layer depth (depth profiles).

Other methods to characterize the sample were optical inspection of morphology, X-ray diffraction, measurement of density and porosity, SEM of dry residues, measurements of isotopic abundances and test of material strength by drilling.

Two general types of materials were obtained: a "mud" like sample of very fine grains and a "snow" like, coarser crystalline one. The "snow" like character of the material and with it the "activity" increased with the content of phyllosilicate and the flow rate of the suspension, and decreased with propellant gas pressure. The mixture for KOSI III was finally prepared at 1.5 - 1.7 bar, a flow rate of 2 ml s^{-1}, and a nozzle eluation of 10 to 12 cm, and consisted of 8.3 wt.% mineral dust (9 olivine: 1 montmorillonite), 13.8 wt.% CO_2 ice and 77.9 wt.% water ice. The CO_2 loss during filling the KOSI III sample container was small (cf. Fig. 3, left side). After 41 h of artifical sun irradiation (1.3-2.7 SK) in the Space Simulator, the fine coherent material at the surface had changed to coarse dry residues, cf. Fig. 2. A some cm thick crust had been formed underneath the dust layer. The sample had lost almost all of its CO_2, except for layers near the cold back plate and a white H_2O-CO_2 ice layer on the back plate itself, cf. Fig. 3 (right side). This layer seemed to contain more CO_2 than the starting material.

These studies are funded by the Deutsche Forschungsgemeinschaft (DFG).

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3.) K. Roessler, A. Bischoff, G. Eich, et al., LPSC XIX (1988) 996
4.) A. Bischoff, and D. Stöffler, LPSC XIX (1988) 90

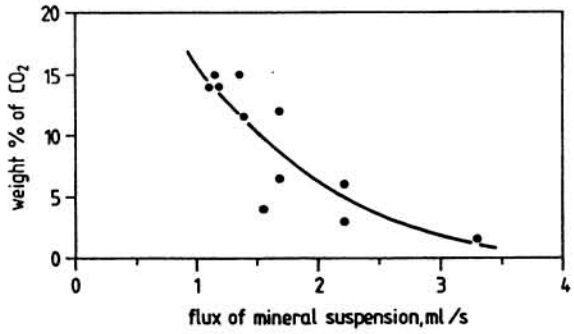

Fig. 1 Dependence of CO_2 content of the mixture on the flux rate of the water mineral suspension through the spraying nozzle, at a CO_2 propellant gas pressure of 0.8 bar.

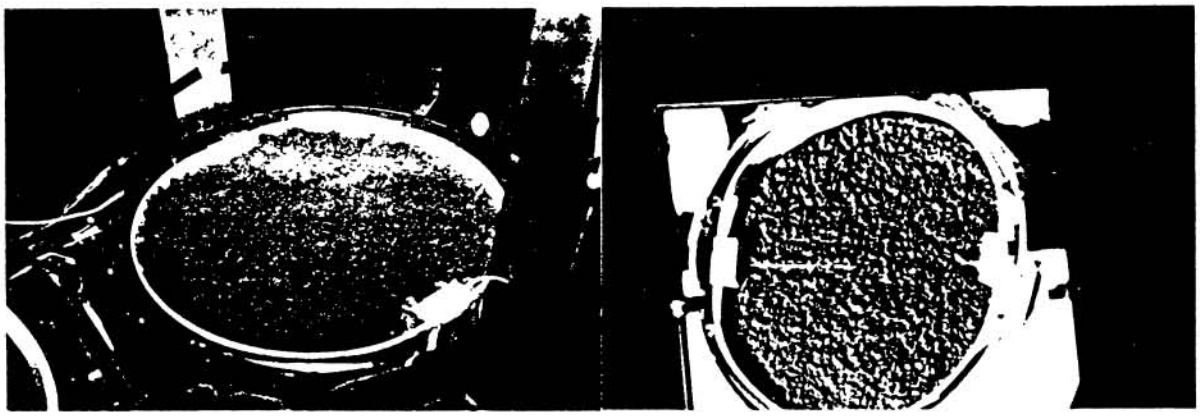

Fig. 2 KOSI III sample (Ø 30 cm) before (left side) and after (right side) 41 h artificial sun irradiation (1.3 - 2.7 SK).

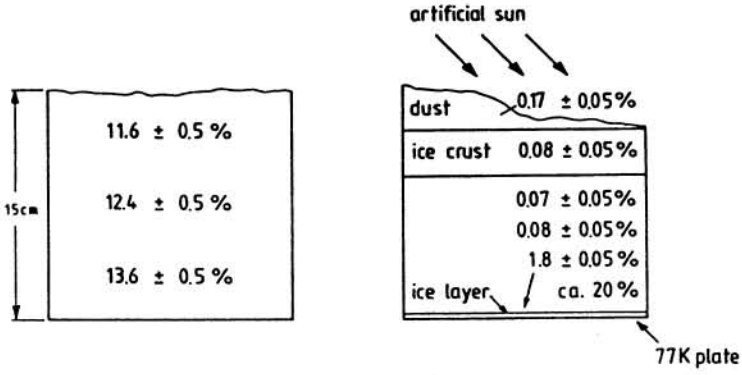

Fig. 3 CO_2 content (wt. %) of KOSI III sample before (left side) and after (right side) 41 h artificial sun irradiation (1.3 - 2.7 SK), depth profiles.