



## **CO<sub>2</sub> hydrates and terraforming processes on Mars - a myth??**

**A. Falenty**, G. Genov, W. F. Kuhs

Geowissenschaftliches Zentrum, Abteilung Kristallographie, Universität Göttingen,  
Goldschmidtstr.1, 37077 Göttingen, Germany (afalenty@gwdg.de / Fax: +49-551-39-9521 /  
Phone: +49-551-2137)

Throughout the recent history of Mars exploration, CO<sub>2</sub> hydrates were often considered as one of the constituents in the Martian regolith. Moreover, some authors suggested the existence of CO<sub>2</sub> clathrate hydrates in Martian polar caps. Due to their low thermal conductivity, they would reduce the heat flow and modify the speed of basal melting. Clearly, CO<sub>2</sub> and H<sub>2</sub>O are abundant in the Martian regolith, mostly as water ice and CO<sub>2</sub>-gas. Under p-T conditions, possibly exist in the Martian sub-surface, the formation of CO<sub>2</sub> clathrates should occur whenever the constituents get into contact. Laboratory experiments, performed by us, have shown that under these conditions the formation could be almost instantaneous [1]. However, the experiments indicate that the time for formation critically depends on the accessible surface area of the ice grains. Although the CO<sub>2</sub> clathrate stability field reaches the surface at the Martian poles the kinetics of hydrates formation may be too slow to create significant amount of hydrates. Indeed, any orbital detection methods have been successful in confirming their presence on the surface yet.

In number of publications, the rapid decomposition of CO<sub>2</sub> hydrates, previously formed in the regolith, was considered as one of the possible ways to explain the formation of peculiar morphological features, i.e., outflow channels, gullies, chaotic terrains or pancake domes. Adding to these attempts, a further explanation is worthwhile considering, the so-called self-preservation of gas hydrates [2]. In a temperature interval from ~ 240 to 273 K the decomposition is anomalously slowed down leading to a stabilization of CO<sub>2</sub> hydrate outside the thermodynamic stability field for geological time-scales. Formed at different climatic conditions, hydrates may enter this metastable state upon temperature change. Large amount of gas hydrates may subse-

quently decompose in a catastrophic manner upon some external triggers like impacts or volcanic activity. To provide a better basis for these ideas, experiments for CO<sub>2</sub> hydrate formation and decomposition were performed in the laboratory mimicking Martian surface and sub-surface conditions. They provide us with better insights of formation and decomposition processes including the p-T region of self-preservation. Additionally, we are able to estimate the involved time-scales.

Based on these results a critical examination of the suggested role of the CO<sub>2</sub> hydrates will be given.

[1] G. Genov, W. F. Kuhs, D. K. Staykova, E. Goreshnik, and A. N. Salamatin (2004), Experimental studies on the formation of porous gas hydrates  
*Am. Miner.* **89**, 1228-1239

[2] W. F. Kuhs, G. Genov, D. K. Staykova, and T. Hansen (2004), Ice perfection and onset of anomalous preservation of gas hydrates  
*Phys. Chem. Chem. Phys.* **6**, 4917-4920