SIMULATION OF DUST SEDIMENTATION ON THE CALIBRATION TARGETS FOR THE SURFACE STEREO IMAGER ONBOARD THE PHOENIX MARS LANDER 2007, L. Drube[1], M. B. Madsen[1], M. Olsen[1], J. Jørgensen[1], D. Britt[2], M. Lemmon[3], C. Shinohara[4] and P. Smith[4], [1] University of Copenhagen, Denmark (line@fys.ku.dk), [2]The University of Central Florida, USA, [3]Texas A&M University, USA, [4]University of Arizona, USA

Introduction: The Phoenix Mars Lander 2007 mission will carry three identical calibration targets to verify and validate the preflight calibration of the Surface Stereo Imager (SSI) and to monitor the stability of this calibration during the mission.

The specially designed calibration targets ('the caltargets') each consist of an aluminum plate with six different color chips each in two sizes and four experimental color chips. The pigments for the first set of chips consist of inorganic pigment material dispersed in silicone RTV material and they are green (chromium oxide), yellow (goethite), blue (cobalt aluminate). The second set of chips is three shades of gray (mixture of titanium dioxide and carbon black, reflectivity: 60%, 40%, 20%).

Fig. 1: The caltarget

Underneath each of the six large color chips a 7 mm tall ring-magnet with an inner diameter of 5 mm and an outer diameter of 11mm is embedded. These ring-magnets will protect roughly the central 3 mm from magnetic dust settling onto the surface. The design of each individual magnet is almost identical to that of the sweep magnets flown on MER [1]. On MER, using such a sweep magnet it has been possible to maintain a relatively clean surface in the dusty Martian environment (see fig. 2). From the results it seems that almost any airborne particle contains at least a small amount of a strongly paramagnetic phase or a ferrimagnetic phase [1]. We have recognized later that the ferrimagnetic phase is predominantly magnetite [2]. This remarkable property of the Martian dust is the basis of the idea to have selected chips of pigmented material placed at the centers of the ring-magnets. These color chips constitute a color calibration target. These color chips will almost not be obscured by reddish dust accumulation during the mission.

Fig. 2: Sweep magnet on MER [1]

The six small color chips are exposed to the natural Martian dust environment to allow a comparison with the protected ones. Each of the four experimental color chips has a different surface coating (Au, Pd, Cu and RTV).

In addition to serving as calibration targets for the SSI, these targets serve at the same time as an improved and more sensitive sweep magnet experiments. On the MERs the sweep magnets were embedded in gray aluminum (fig. 2). For Phoenix the sweep magnets in the caltarget will have differently colored chips to enhance the sensitivity for detection of any dust that might be able to enter and settle there. In this way the caltargets will also serve as a repetition of the sweep magnet experiments on another location on the surface of Mars – and with improved sensitivity compared to MER.

Simulation experiments: To test the performance of the caltarget these will be exposed to wind and dust in a simulated Martian atmosphere and pressure in the Mars Simulation Chamber at the University of Aarhus, Denmark. In this facility it has not been possible to observe slow sedimentation of dust from the atmosphere and consequently a less sophisticated 'Dust Sedimentation Chamber' was built at the Niels Bohr Institute, Denmark. It is non-pressurized and has earth atmospheric composition.

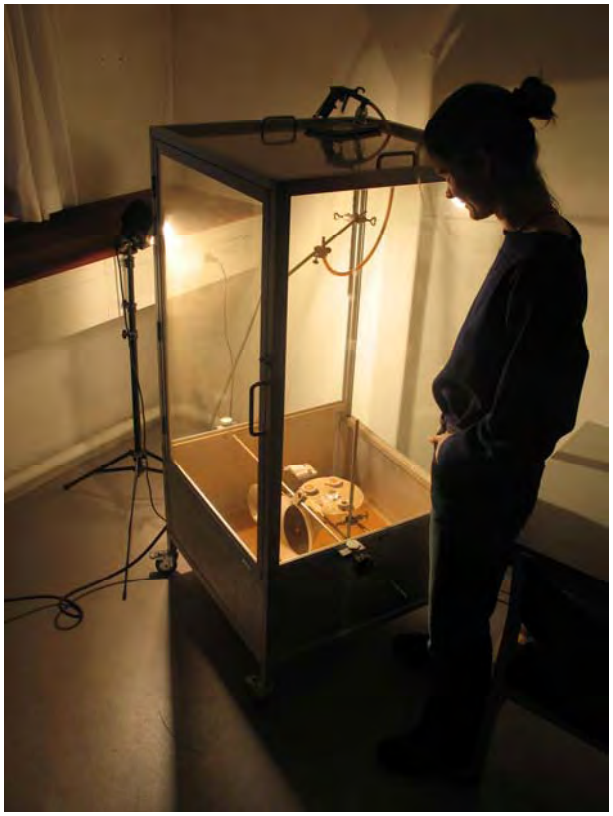

Fig. 3: Dust Sedimentation Chamber

Dust will be injected into the chamber near the top by pressurized air (see fig. 4).

Several types of dust have been used in these experiments. The most important dust sample used is from Salten Forest in Denmark, as this material is so far the best magnetic analog to mimic the observed magnetic properties of the dust on Mars. This sample contains hematite, maghemite, goethite and silicates, has a suitable saturation magnetization and a reddish color [3].

Fig. 4: Dust injection outlet

For the caltarget to get exposed only to 'slow' sedimentation we have covered it by protective caps during the dust injection and for a while thereafter. (See fig. 5).

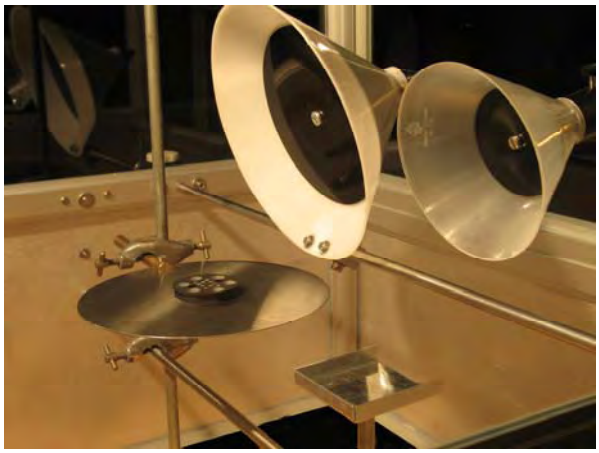

Fig. 5: Protection caps being lifted off the caltarget and a calibration plate for the experiment

For one series of testing we investigated the distribution of minerals and dust particle sizes along a cross section on top of a single magnet. This was done by positioning several 3 mm diameter transmission electron microscope grids (TEM-grids) along the cross section of a magnet. This allows a detailed investigation of material on the calibration surface and for the Salten Forest sample, and the distribution of the different crystal structures across the magnet color chip has been studied.

Results:

A preliminary report of these experiments will be offered at the conference.

References: [1] Bertelsen, P. et al., (2004) /Science/ *305, 827-829. [2] Goetz, W. et al., (2005) /Nature/ *436*, 62-65. [3] Bertelsen, P., (2001), Ph.D. Thesis, Denmark.