Experimental investigation of gravity effects on sediment sorting on Mars. Nikolaus J. Kuhn[1], Brigitte Kuhn[1], and Andres Gartmann[2], [1]University of Basel, Physical Geography, (Klingelbergstrasse 27, 4056 Basel, Switzerland, nikolaus.kuhn@unibas.ch), [2] University of Basel, MCR Lab (Klingelbergstrasse 27, 4056 Basel, Switzerland).

Introduction: Sorting of sedimentary rocks is a proxy for the environmental conditions at the time of deposition, in particular the runoff that moved and deposited the material forming the rocks. Settling of sediment in water is strongly influenced by the gravity of a planetary body. As a consequence, sorting of a sedimentary rock varies with gravity for a given depth and velocity of surface runoff. Theoretical considerations for spheres indicate that sorting is more uniform on Mars than on Earth for runoff of identical depth. In reality, such considerations have to be applied with great caution because the shape of a particle strongly influences drag. Drag itself can only be calculated directly for an irregularly shaped particle with great computational effort, if at all. Therefore, even for terrestrial applications, sediment settling velocities are often determined directly, e.g. by measurements using settling tubes.

Experiments: In this study the results of settling tube tests conducted under reduced gravity during three Mars Sedimentation Experiment (MarsSedEx I, II and III) flights, conducted between 2012 and 2015, are presented. Ten types of sediment, ranging in size, shape and density were tested in custom-designed settling tubes during parabolas of Martian gravity lasting 20 to 25 seconds.

Results: The experiments conducted during the MarsSedEx reduced gravity experiments showed that the violation of fluid dynamics caused by using empirical models and parameter values developed for sediment transport on Earth lead to significant miscalculations for Mars, specifically an underetsimation of settling velcoity because of an overestimation of turbulant drag. The error is caused by the flawed representation of particle drag on Mars. Drag coefficients are not a property of a sediment particle, but a property of the flow around the particle, and thus strongly affected by gravity.

Conlcusions: The observed errors in settling velocity when using terrestrial models and parameter values on Mars have implications for sediment movement and sorting, in particular for sandstones and conglomerates, and thus analogies drawn between Earth and Mars. Most significantly, sorting on Mars is less pronounced for given flow conditions than on Earth.

References: [1] Kuhn N. J. (2014) Experiments in Reduced Gravity – Sediment Settling on Mars, Elsevier.