GRANULAR CONVECTION IN MICROGRAVITY. N. Murdoch, B. Rozitis, P. Michel, W. Losert, T-L. de Lophem and S. F. Green. 1University of Nice-Sophia Antipolis, Observatoire de la Côte d’Azur, CNRS (Laboratoire Lagrange, BP 4229, 06304 Nice Cedex 4, France) 2The Open University, Department of Physical Sciences (Walton Hall, Milton Keynes, MK7 6AA, UK) 3Institute for Physical Science and Technology, and Department of Physics (University of Maryland, College Park, Maryland 20742, USA)

Introduction: Granular convection is a process often invoked by the community of small-body scientists to interpret the surface geology of asteroids. For example, Miyamoto et al. [1] suggest that the arrangements of the gravels on Itokawa's surface are largely due to granular convective processes. It has also been suggested that, “all other considerations aside, granular convective processing is favored by microgravity” [2]. The convective flow in granular matter that is the subject of most research is the vibration-induced type (e.g. [3],[4],[5]). Convective-like flows in a granular material have also been seen using the Taylor-Couette geometry (e.g. [6],[7]). However, in all of these experiments a pressure gradient occurs within the medium due to the Earth's gravitational field.

Experiment: We use a modified Taylor-Couette shear cell (Fig. 1) to investigate, for the first time, convective-like flows in a granular material under the conditions of parabolic flight microgravity. The experiment consists of two concentric cylinders. The outer cylinder is fixed and its inner surface is rough with a layer of glued on particles; the outer surface of the inner cylinder is also rough but it is free to rotate, and the floor between the two cylinders is smooth and fixed in place. The gap between the two cylinders is filled with granular material on which the rotating inner cylinder applies shear stresses.

Results: The radial velocity profiles of particles on the top surface of the cell in ground-based experiments exhibit a large dip close to the inner cylinder, which is indicative of convective-like motion (Fig. 2). However, this dip is not present in the radial velocity profiles of microgravity experiments. This indicates that there is a mechanism causing the inward motion of particles on the top surface in the presence of an external gravitational field. This mechanism does not seem to be active in microgravity. This finding is further confirmed when we examine how the mean particle radial velocities vary in time over the course of a parabola as the simulated gravity changes.


Acknowledgments: Thanks to: the OU, TAS, STFC, RAS and the French PNP for financial support; ESA for the opportunity to be part of the 51st ESA microgravity research campaign, and for their financial support; OU workshop staff for constructing our experimental hardware. This work benefited from fruitful discussion at ISSI (Bern).