METHODOLOGY OF WIND TUNNEL EXPERIMENTS APPLIED TO GRAVEL MEGARIPPLE FORMATION ON EARTH AND MARS. E. M. Neely[1], M. G. Spagnuolo[2], S. L. de Silva [3], N. T. Bridges [4], J. R. Zimbelman[5], [1]Department of Geology, Portland State University, 1825 SW Broadway, Portland, OR 97201 (emneeson@pdx.edu), [2], IDEAN, UBA-CONICET Ciudad de Bs. As., Argentina, [3]College of Earth, Ocean, and Atmospheric Sciences, Oregon State University, Corvallis, OR 97331, [4]JHUAPL, Laurel, MD 20723, [5]CEPS/NASM MRC 315, Smithsonian Institution, Washington D.C. 20013-7012.

Introduction: Aeolian transport is the most active geomorphic agent on Mars today. Transverse Aeolian Ridges (TARs) are a landform intermediate in morphology between dunes and megaripples [1,2]. The origin and evolution of TARs has been debated in the literature [1-5], in large part because, until recently, suitable terrestrial analogs were lacking. However, recent work shows that the gravel megaripples in the Argentine Puna have many morphologic similarities [6], making the study of this region critical for understanding TARs. Part of this investigation is to quantify the wind speeds needed to move the megaripple material. These gravel bedforms are built on a local substrate of ignimbrites and composed of a bimodal association of dense (>2 g/cm^3) lava and metamorphic clasts up to 2.5 cm in diameter (here called “lithics”), and pumice clasts (<1.5 g/cm^3) up to 5 cm in diameter.

Samples of megaripple materials were used in wind tunnel experiments at the Arizona State University Wind Tunnel (ASUWIT). The objective was to determine threshold wind velocities for movement of these clasts. Once threshold velocities are established, they can be applied to similar landforms on Earth and ultimately on Mars (TARs) by scaling to Martian gravitational and atmospheric density conditions [1]. Several experiments were made, changing environment conditions: (1) Fluid, where the only lateral force was the wind (2) Quartz Impact, in which sand where dropped from the upwind hopper and (3) Scoria Impact, in which scoria material where dropped from the upwind hopper. The experiments were recorded in oblique view to be able to see the type of movement of the clasts (e.g. saltation). The results of this work is also described in [6] and [7]. The focus of this abstract is on the methodology.

Methods: In order to quantify the movement of clasts and the threshold velocities we used Kinovea software, which allows precise video measurements. Before the data could be analyzed, the wind tunnel data were calibrated to get proper measurements of clast size, migration direction, and speed.

In order to determine the diameter of moving clasts, accurate reference dimensions of the wind tunnel experiment floor were measured. Because the camera views of the experiments were oblique, obtaining an accurate scale for each clast required consideration of camera angles and distances.

Diameters measured in pixels from images taken from the experiment videos were most accurately obtained with rounded, spherical clasts. In cases where the moving clast was elongated and/or angular, the diameter could not be measured in the same way, as it provided a skewed measurement in one direction.

Once a clast was observed as moving, the diameter was measured in pixels parallel to the width of the wind tunnel. The width of the wind tunnel was also measured at the location of the clast and a conversion measurement was then determined (Fig. 1).

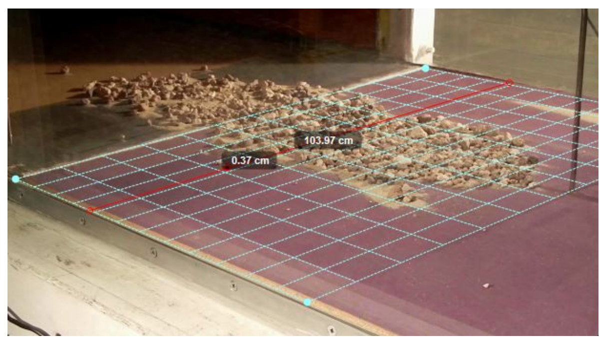

Fig. 1. Perspective view of ASUWIT experiment showing one clast and tunnel width measurement.

The clast was then classified according to movement type (vibrating, sliding, rolling, or saltating), composition (pumice or lithic), and location (patch or edge and up- or down-wind). Freestream wind velocities were obtained at the time of beginning of clast movement (Fig. 2).

These data estimate wind threshold velocity for different types of grains. The same sets of measurements were completed for one of the experiment videos by two people separately and measurement sets were compared to each other. The coefficient of determination showed the regression line fit the data well and the comparison showed sufficient method reliability (Fig. 3). These data are the first (that we are aware of) of threshold speeds for large clasts that compose megaripples in the Puna, and possibly Mars.

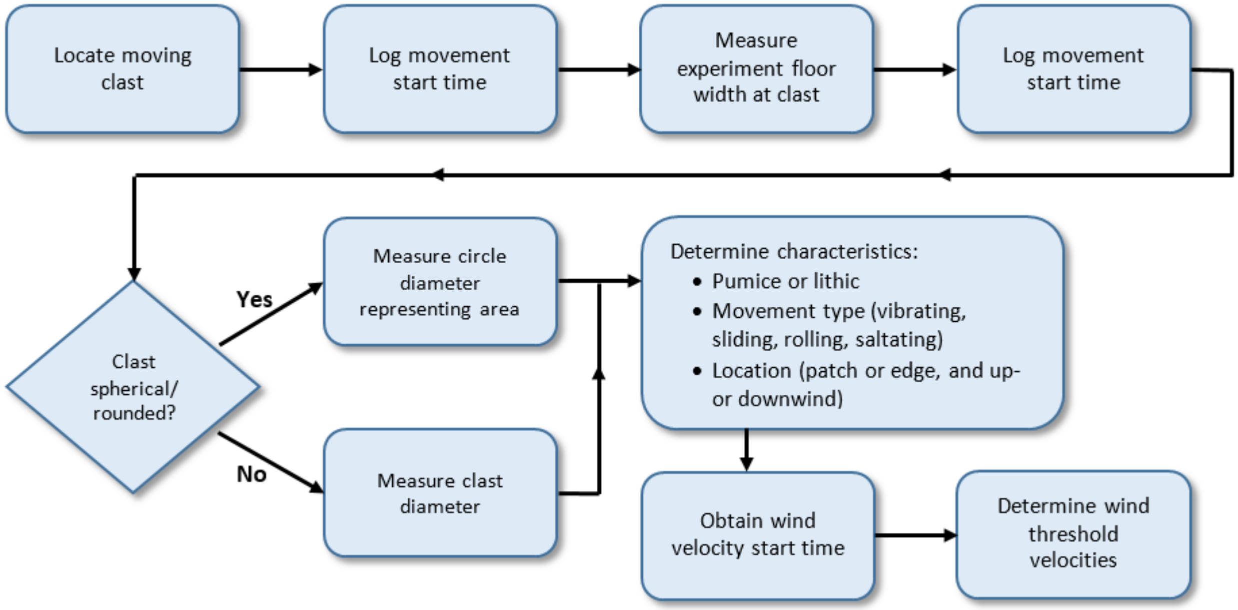

Fig. 2. Flow chart showing the methodological steps for clast analysis within the Kinovea software.

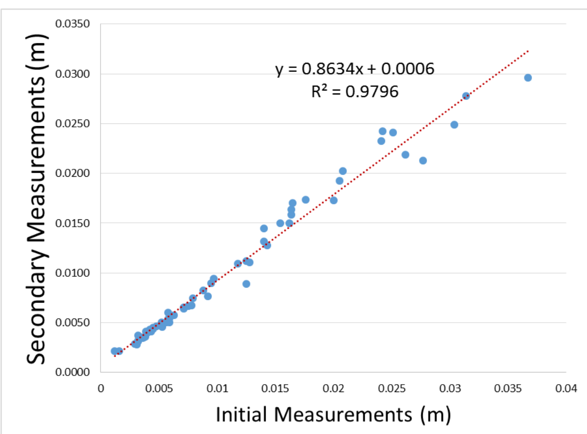

Fig. 3. Two measurements of the same clast diameters by different people using the same experiment video.

Results: A table was constructed with all of the computed values for each clast, providing a semi-quantitative analysis of the experiments. Preliminary results show a correlation between the clast diameter and saltation threshold wind speed. Some dispersion is caused by clasts shapes and the fact that only one direction of the clast was measured. Nevertheless this technique allows comparison of data between different experiments and even with field data (An abstract describing extended results is presented at this conference [7]).

References: [1] Zimbelman, J.R [2010], *Geomorph, 121*, 22-29. [2] Shockey, K.M. and J.R. Zimbelman [2013], *Earth Surf. Proc. Landforms, 38*, 179-182. [3] Balme, M. et al. [2013], *Geomorph, 101*, 703-720. [4] Kerber, L, and J.W. Head [2011], *Earth Surf. Proc. Landforms*, http://dx.doi.org/10.1002/esp. 2259. [5] Berman, D.C. et al. [2011], *Icarus, 213*, 116-130. [6] de Silva, S., Spagnuolo, M. G., Bridges, N., Zimbelman, J. R. (2013) *GSA Bulletin, 125*, 1912-1929. [7] Bridges, N.T. et al., *Lun. Planet. Sci, XLV*.