DISTRIBUTION OF WINDBLOWN SEDIMENT IN SMALL CRATERS ON MARS: PRELIMINARY FIELD ANALOG STUDIES AT AMBOY CRATER, CALIFORNIA. R. L. Kienenberger and R. Greeley, 1School of Earth and Space Exploration, Arizona State University, Tempe, AZ 85287 (Rebekah.Kienenberger@asu.edu).

Introduction: Shallow craters (<200 meters in diameter) or “hollows” [1] are prevalent near the Spirit rover landing site (Gusev Crater) and are thought to be mostly eroded secondary impact craters [2]. These craters contain asymmetric distributions of aeolian (windblown) sediments on the northwest side of the crater floor (Figure 1) indicating a prevailing wind direction either toward the northwest (depositing against the downwind side) or southeast (depositing on the upwind side). The study of wind streaks and bedforms (ripples, dunes) can lead to a determination of local wind regimes on Mars [3]. However, the bedforms which are common on the plains of Gusev Crater are small (<50 meters) and cannot be used to infer wind direction because they have ambiguous shapes [4]. Therefore, a study of the location and characteristics of these asymmetric deposits with respect to crater morphology is being conducted to determine the predominant local wind direction during deposition. We present the preliminary results of field work at a terrestrial analog site for comparison to HiRISE images and topographic data from a digital elevation model [5] in Gusev Crater.

Terrestrial Analog Background: A field area in the Mojave Desert of California provides an analog for this area of Mars. The Amboy lava field (Figure 2) consists of ~70 km² of vesicular pahoehoe basalt with an estimated age of 6,000 years [6]. A dark wind streak in the lee of a cinder cone extends ~4 km to the southeast. Alluvial deposits located upwind of the Amboy lava field provide a source for sand particles which are transported by wind to the lava field and provide a contrast to the basalt flow [7]. The predominant wind direction at Amboy is from northwest to southeast, consistent with the wind streak in the lee of the cinder cone [8]. Several endogenic craters are located on the flow which provide a good analog for secondary impact craters on Mars because they have similar morphometric properties (depth, diameter, circularity) and contain aeolian material.

Methodology: Morphometric data (depths, diameters and circularities) for a total of 20 craters in the Amboy lava field were collected in the field and from aerial photographs. The rim-to-rim diameters of the craters were obtained by tracing the crater rim from an aerial photograph and overlaying circles of different sizes to obtain a best-fit circle for each crater following the method of [10]. The rim-to-floor depths were measured in the field using a laser level on the crater rim and a measuring rod located in the deepest part of the crater.

Real-time wind measurements using suspended weighted styrofoam balls were collected at ~35 locations in and around the two largest craters (Craters 6 and 7). The wind direction (azimuth) was collected downwind to ensure the flow was not disrupted. All measurements were taken within 30 minutes to obtain
a “snapshot” of the wind flow around the crater.

Sediment drift observations were made via dyed sand placed within four craters in the plateau area (Figure 2). Small conical piles of #30 sand (~300-600 μm) were placed in seven locations within each crater. During subsequent visits to the field area, measurements were taken to document the change in each pile over time. The lengths and orientations of all sediment drift patterns associated with dyed sand piles were measured from the location of a numbered flag which was originally placed in the center of the pile.

Each crater was mapped to illustrate the locations of different zones and prominent features within the crater floor. Important areas included the active sand deposits, lag deposits, transitional zones (from sandy to lag surfaces), and desert pavement (Figure 3). Additionally, topographic profiles for Craters 6 and 7 were completed with a laser, measuring rod and measuring tape. These profiles were extended past the crater rims to account for the slope of the surrounding terrain. An azimuth of 130° was used for Crater 6 (Figure 3) to correspond to the inferred predominant wind direction with respect to the crater center. Measurement of crater models with known depths, diameters and rim heights (including a model of one analog crater from Crater 20). Crater 20 had nearly three times as many northwest-trending deposits (throughout the entire crater floor) than the other two craters during the same one month interval. The fourth crater, Crater 11, exhibited nearly all southeast-trending deposits with a d/D ratio of 0.019. Results of crater mapping indicate Craters 6, 7 and 20 contain asymmetric deposits of active aeolian material on the northwest sides of the craters (Figure 3) while Crater 11 contains active aeolian material throughout the entire crater floor.

**Conclusions:** The results of real-time wind measurements and assessments of active sediment deposition with respect to the predominant wind direction (Figure 3) indicate reverse or stagnant wind flow occurs in three of the four craters with d/D ≥0.05. However, reverse flow did not occur in the shallowest crater (d/D <0.02). Therefore, reverse wind flow is expected to cease within a d/D range of 0.02 to 0.05, resulting in wind movement directly over the crater floor in the downwind direction. Craters with asymmetric aeolian deposits near the Spirit landing site have d/D ratios of 0.034 to 0.076, indicating reverse flow may occur in these craters.

**Future Work:** Wind tunnel experiments using crater models with known depths, diameters and rim heights (including a model of one analog crater from Amboy) will be completed to determine the areas of deposition within the craters and at what d/D ratio reverse flow ceases. Finally, all results will be compared with HiRISE images and morphometric properties of craters on Mars to determine how wind patterns and the resulting aeolian deposition in and around small craters vary as a function of crater morphometry.

**Acknowledgments:** This research was funded by the NASA Planetary Geology and Geophysics Program and the JPL Mars Exploration Rover project.

**References:**