GRAIN SIZE AND SHAPE ANALYSIS OF BASALTIC AEOLIAN AND FLUVIAL SEDIMENT IN A VOLCANIC CATCHMENT: ÞÓRISJÖKULL GLACIER, ICELAND . K.G. Mason[1], R.C. Ewing[1], M. Nachon[1], E.B.Rampe[2], B. Horgan[5], M.G.A. Lapotre[4], M.T. Thorpe[2], C.C. Bedford[3,2], P. Sinha[5], E. Champion[1], P. Gray[6], [1]Texas A&M University, [2]NASA Johnson Space Center, [3]Lunar and Planetary Institute, USRA [4]Stanford University, [5]Purdue University, [6] Duke University. (kgmason@tamu.edu)

Introduction: Sediments and sedimentary rocks preserve a rich history of environment and climate. Identifying these signals requires an understanding of the physical and chemical processes that have affected sedimentary deposits [1]. Although these processes have long been studied in quartz-dominated sedimentary systems [2], the relative paucity of studies of basaltic sedimentary systems limits our interpretations of the environment and climate where basaltic source rocks dominate, such as on Mars [3,4].

This study is part of the SAND-E: Semi-Autonomous Navigation for Detrital Environments Mars analogue project [5], which uses robotic operations to examine physical and chemical changes to sediments in basaltic glacio-fluvial-aeolian environments in Iceland. This research studies changes in shape and size of fluvial-aeolian sediments along a glacier-proximal-to-glacier-distal transect in the outwash plain of Þórisjökull glacier in South-west Iceland.

Methodology: To this end, we mapped the source rocks in the catchment and analyzed particle size and shape for silt-to-cobble grain size fractions at 9 stops from near the glacier to ~12.5 km from the glacier. We used the Wolman Cobble Count method for pebble- and cobble-sized grains and a particle analyzer for sand-sized grains. Grain size was then used to calculate shear velocity to mobilize the grains by wind following Shao and Lu [6].

Results and Discussion: A diversity of source rocks exist at the field site. Most of the sediments can be attributed to lava flows and volcanic units such as tuff, kubbaberg, and pillow lava exist. These highlight potential differences in sorting and abrasion of particles downstream by both water and wind.

Minor variations in sediment size exists across the transect. The cobble count data show a decrease in the length of the intermediate axis from proximal to distal. The decrease is most prominent in the first 2 km of the transect and varies less across the last 6km. Downstream changes in the size of the smaller size fractions are not evident in either the fluvial or aeolian sediments. This matches expectations that the coarser fractions are sorted due to loss of river competence with a downstream decrease in slope [7].

Scatter plots comparing aspect ratio and grain size of the bulk sediment show an increase in aspect ratio with grain size (Fig. 1). Finer grains (~less than 1 mm) have lower aspect ratios than coarser grains. For all samples, a maximum aspect ratio is reached at an intermediate axis of ~2 mm, followed by a decrease or plateau of the aspect ratio for coarser grains (~2- 3mm) (Fig. 1). For grains larger than 3mm the data appears more scattered. The trends seen in the aspect ratio of different grain sizes are consistent with the tendency of smaller grain sizes to resist rounding through abrasion due to viscously damped impacts, and for coarser grains that experience infrequent transport or travel closer to the bed to also round at a slower pace [8].

The lack of significant variation in size and shape between fluvial and aeolian samples may be due to the relatively short length of transect, and fluvial and wind transport capacity.

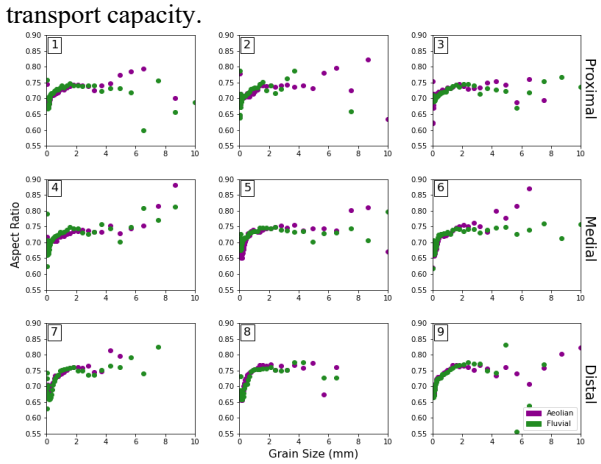

Figure 1: Aspect ratio versus grain diameter of aeolian (purple) and fluvial (green) samples from Stops 1 to 9 from particle analyzer.

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