ASSESSING SEDIMENT PROVENANCE ON EARTH AND MARS USING VISIBLE AND NEAR-INFRARED (VNIR) SPECTROSCOPY AND DECORRELATION STRETCHES (DCS) OF VISIBLE IMAGES. P. Sinha[1], B. Horgan[1], A. Rudolph[1], R.C. Ewing[2], E. Rampe[3], M.G.A. Lapôtre[4], M. Nachon[2], M.T. Thorpe[3], C.C. Bedford[5,3], K. Mason[2], E. Champion[2], P. Gray[6], E. Reid[7], M. Faragalli[7], [1]Purdue Univ. (sinha37@purdue.edu), [2]Texas A&M Univ., [3]NASA Johnson Space Center, [4]Stanford Univ., [5]Lunar and Planetary Institute, USRA [6]Duke Univ., [7]Mission Control Space Services.

Introduction: Deciphering paleoenvironments on Mars requires tracing of sediment sources and transport history [1,2]. However, it is not well know how different transport pathways cause physical fractionation and chemical alteration in sedimentary deposits. Semi-Autonomous Navigation for Detrital Environments (SAND-E), a NASA Planetary Science and Technology through Analog Research (PSTAR) project, aims to study glacio-fluvial-eolian landscapes of Iceland as a Mars analog to advance the science workflows during rover operations and maximize science returns. This study aims to test the predictive capability of color analysis on visible images to identify mineralogical variability to trace sediment and weathering processes from source to sink. Here, we compare sediment colors with visible and near-infrared (VNIR; 0.3-2.5 µm) spectra.

Methods: Field work was conducted at Skjaldbreidauhraun, characterized by eolian and fluvial ripples and dunes, wind-sculpted bedrock, wind-deflated rocky plains, and sand drifts similar to martian landscapes [3]. Source rocks were collected from exposed bedrocks and sediment samples were taken from proximal, medial, and distal zones in the outwash plains. VNIR spectra of rocks and grain-size sorted sediments were acquired using an ASD FieldSpec spectrometer. The grain-size segregated sediments and cobbles were imaged using a handheld cellphone camera [4] and DCS images were created using IDL ENVI.

Results and Discussion: DCS transforms the limited color differences of mafic sediments to expand and utilize the entire color space, thereby, maximizing the color information [5]. Among the source rocks, purple, blue and green colors indicate rocks spectrally dominated by primary minerals (pyroxenes and olivine). Red and yellow represent oxidized, altered glass, and smectite clays. Among the grain-size segregated samples coarser grains appear green/blue in color while the finer fraction is red/yellow. Both coarser and finer fractions display mafic signatures but the finer fractions show shows hydration and hydroxylation bands suggesting concentration of altered grains.

We see that the DCS of exposed bedrock surrounding the outwash plain shows all colors but the valley/outwash plain is dominated primarily by blue along with purple and green. Some of the color variability within the outwash plain is likely due to differences in the local surface density of coarser and finer particles. Based on our analysis of color variations with grain size this is because sediment color is dominated by coarser materials whose spectral properties are dominated by primary minerals, while red and yellow colors corresponding to altered materials (such as hyaloclastite tuff from inter-glacial volcanoes) are only apparent in the fine grained fraction as they are more friable and thus break down quickly and gets transported easily by river and winds.

The correlation between mineralogy and color has the potential to enhance mapping, analyzing, and targeting during mission tactical cycles. DCS images used in tandem with spectral and other data sets can be used to optimize rover's traverse to targets of higher scientific merit, thereby, enhancing the science returns. Also, DCS of high-resolution color data help extend mineralogical interpretations from coarser resolution or limited sampling hyperspectral datasets

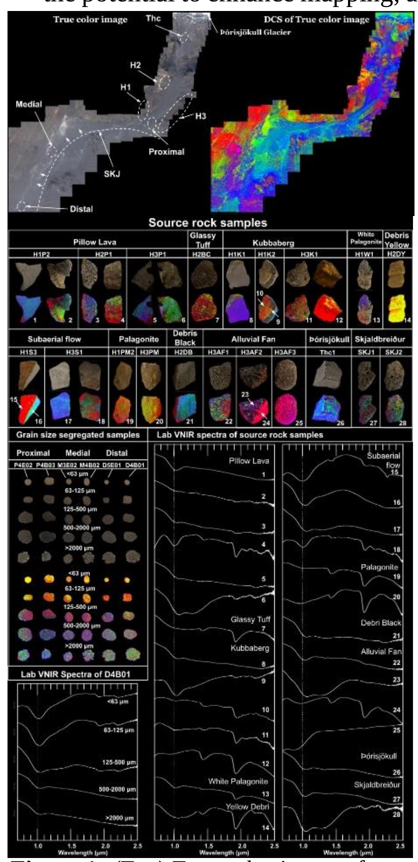

Figure 1: *(Top) True color image of catchment-scale mosaic showing a river originating from the Þórisjökull glacier, flowing across several alluvial fans and basaltic lavas and hyaloclastites (Source: Loftmynda ehf. [6]). (Middle) True color and DCS images of source rocks. (Bottom left) True color and DCS images of grain-size segregated sediment samples with its VNIR spectra. (Bottom right) VNIR spectra of source rocks.*

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