DUST FROM MARS-ANALOG PLAINS (ICELAND): PHYSICO-COMPOSITIONAL PROPERTIES AS A FUNCTION OF GRAIN-SIZE FRACTION. Marion Nachon[1], R.C. Ewing[1], F. Marcantonio[1], L. Romero[1], D. Schimmenti[1], M. Tice[1], E.B. Rampe[2], B. Horgan[3], M. Lapotre[4], M.T. Thorpe[2], C. Bedford[5], K. Mason[1], P. Sinha[3], E. Champion[1], A.D. Harrington[2], and the SAND-E engineering Team[6]. [1]Texas A&M University, Department of Geology & Geophysics (mnachon@tamu.edu, marion.nach@gmail.com), [2] NASA JSC, [3]Purdue Univ., [4]Stanford Univ., [5]Lunar and Planetary Institute, USRA. [6]Mission Control Space Service.

Introduction: Dust is a key component of the geological and climatic systems of Earth and Mars. On Mars, dust is ubiquitous. It coats rocks and soils, and, in the atmosphere, it interacts strongly with solar and thermal radiation. Yet, key questions remain about the genesis and fate of martian dust, as well as its sources, composition, and properties **[1]**.

We collected wind-blown dust from basaltic plains in SW Iceland at Skjaldbreiðauhraun that represent a geologic Mars-analog environment **[2]**. Icelandic dust differs from the typical continental sources (e.g. Sahara, Asia) because of its basaltic volcanogenic origin **[3]**, which is similar to Mars **[**e.g. **4]**. Dust collection took place in July of 2019 as a complementary project to the SAND-E: Semi-Autonomous Navigation for Detrital Environments project **[5]**.

Here we report preliminary analyses of this Mars-analog dust material, with the goal of understanding the processes that control the physico-chemical properties of the different grain-size fractions.

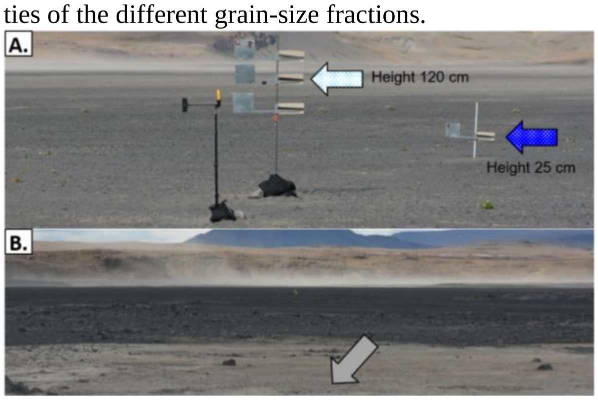

Figure 1: Wind-blown dust in field work area, Iceland. ***A.*** *Dust collectors (at 120 cm and 25 cm high) & anemometer.* ***B.*** *Arrow shows deposits sourcing the dust.*

Data and Methods:

Windblown dust was sampled with passive dust traps (BSNE **[6]**) at various heights (from 25 cm to 150 cm high, Fig. 1A). Simultaneously, measurements of wind speed, air temperature, and relative humidity were collected using a portable weather station (Fig. 1A). *S*ediment was also collected from the surface from areas sourcing the dust (Fig. 1B). Sediment was dry sieved into 5 size fractions: medium sand (x>250µm), fine sand (180<x<250µm), very fine sand (63<x<125µm), coarse silt (63<x<45µm), and below 45µm.

Concentrations in trace elements are determined via ICP-MS (from the Radiogenic Isotope Geochemistry Lab., at Texas A&M University). µXRF analyses were performed with a commercial benchtop Horiba XGT7000 (from M. Tice Lab., at Texas A&M University) to obtain geochemical maps of the samples.

Preliminary results:

Physical properties: The dust comprises grains ranging from below coarse silt up to fine sand for sample collected at h=120cm, and up to medium & coarse sand for sample at h=25cm (Fig. 2). The grain-size distribution of wind-blown samples varies as a function of the height. Dust collected at h=120cm is mainly composed of coarse silt (32%) and below (53%), and the amount of fraction decreases with the grain-size fraction. Dust collected at h=25cm has a lower proportion of the finest fraction and an increased proportion of very fine sand and coarser sediment. The distribution is more uniform, containing 17 to 25% of each of the 5 grain-size fractions shown in Fig. 2. The samples were collected during a ~2 hour window during which the average wind speed was 9m/s and gusted to 12m/s.

Sediment collected from deposits sourcing the dust (Fig. 1B) range from sizes below coarse silt (42%) to medium sand.

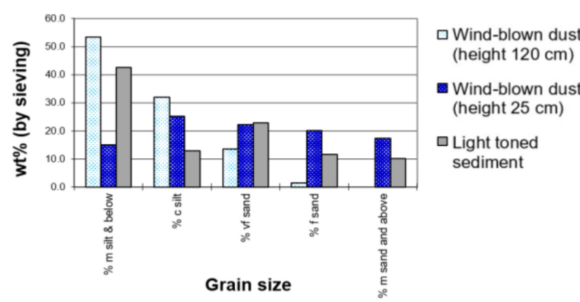

Figure 2: Grain-size distribution of two wind-blown dust samples and one sample of local ground sediment.

Among the physical properties of windblown particles, grain shape is, along with grain size, key in the processes of transport. Preliminary measurements using microscope images (Fig. 3) of light-toned-grains from 2 different grain-size fractions (between 90 and

125µm, and below 45µm) show that on average the finest fraction has relatively higher roundness. Preliminary analyses of the angularity of grains (which is a function of transport history and mineral hardness **[7]**) show that both light-toned-grain fractions have similar angularities.

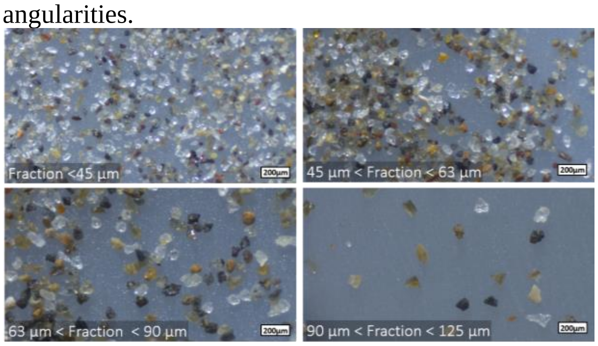

Figure 3: Microscope images of 4 grain-size separates, from wind-blown dust collected at height=120cm.

Geochemical properties: Preliminary ICP-MS analyses show that Ni, V, Cr, Zn, Cu, Co as well as Mo, Se, As, W and Cd are detected in dust and sediment samples.

µXRF (X-Ray Fluorescence) analyses provide geochemical maps that allow grain-size to be coupled to the grain chemistry. The technique presents the advantage of being non-destructive, and is analogous to the PIXL (Planetary Instrument for X-ray Lithochemistry) instrument that will be deployed on the Mars 2020 rover **[8]**. A µXRF map (Fig. 4A) of sediments sourcing the dust shows Fe-rich grains (two of them highlighted by gray arrows) and Ca-rich grains (blue color component) are prominent. Cr (red color component) here appears more scattered through the sample. This might represent Cr being is present as a coating on coarser grains, or concentrated in the finer fraction. µXRF analyses allow to identify individual grains bearing a specific minor or trace element, such as the Mn-rich grain highlighted by the green arrow.

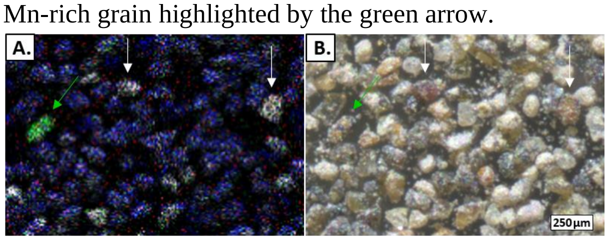

Figure 4: ***A.*** *Micro-XRF compositional map of sediment sample. Red=Cr, green=Mn, gray=Fe, blue=Ca.* ***B.*** *Corresponding microscope image.*

Future work: Our aim is to understand the processes that control the physico-chemical properties of the different grain-size fractions of Mars-analog dust. For the minor and trace chemical elements naturally present in basaltic rocks we will compare their content in the dust with their content as determined in regional source rocks as well as aeolian and fluvial sediments studied by the SAND-E team **[9-14]**. Particular focus will be given to the elements that have been detected on Mars (e.g. Ni, V, Cr, Zn, Cu, Mn). µXRF analyses (analog to the PIXL instrument onboard the NASA Mars 2020 rover) will help identify the co-occurrence of chemical elements in the different dust grain-size fractions, and identify the mineral phases bearing minor and trace elements, in order to extrapolate this finding to Mars.

Dust is also a challenge to human health on Earth and for the future manned exploration of Mars **[15]**. Specific focus on inhalable dust fractions, determining their properties (e.g. grain shape and composition in toxic chemical elements as a function of grain-size) would inform about martian dust properties that currently lack constraints.

References: **[1]** MEPAG (2018). **[2]** Mangold N. (2011) Segregation of olivine grains in volcanic sands in Iceland and implications for Mars, *EPSL*. **[3]** Dagsson-Waldhauserova P. (2014) Physical properties of suspended dust during moist and low wind conditions in Iceland, *Atm.* **[4]** Ming D.M. & Morris R.V. (2017) Chemical, mineralogical, and physical properties of Martian dust and soil, *abstract 6027 Dust workshop*. **[5]** Ewing R.C. (2019) SAND-E: Semi-Autonomous Navigation for Detrital Environments First Results, *AGU abstract*. **[6]** Fryrear D.W. (1986) A field dust sampler. *J. of Soil & Water Conserv*. **[7]** Weitz C.M. (2018) Sand grain sizes and shapes in eolian bedforms at Gale Crater, Mars, *Geophy. Res. Lett.* **[8]** Allwood A. (2015) Texture-specific elemental analysis of rocks and soils with PIXL: The Planetary Instrument for X-ray Lithochemistry on Mars 2020, *IEEE Aero.Conf.* **[9]** Bedford C. *this issue, abstract 2478*. **[10]** Rampe E. *this issue, abstract 2478*. **[11]** Thorpe M. *this issue*. **[12]** Champion E. *this issue*. **[13]** Mason K. *this issue*. **[14]** Sinha P. *this issue*. **[15]** Dust in the atmosphere of Mars and its impact on the human exploration of Mars (2018) *NESC workshop*.