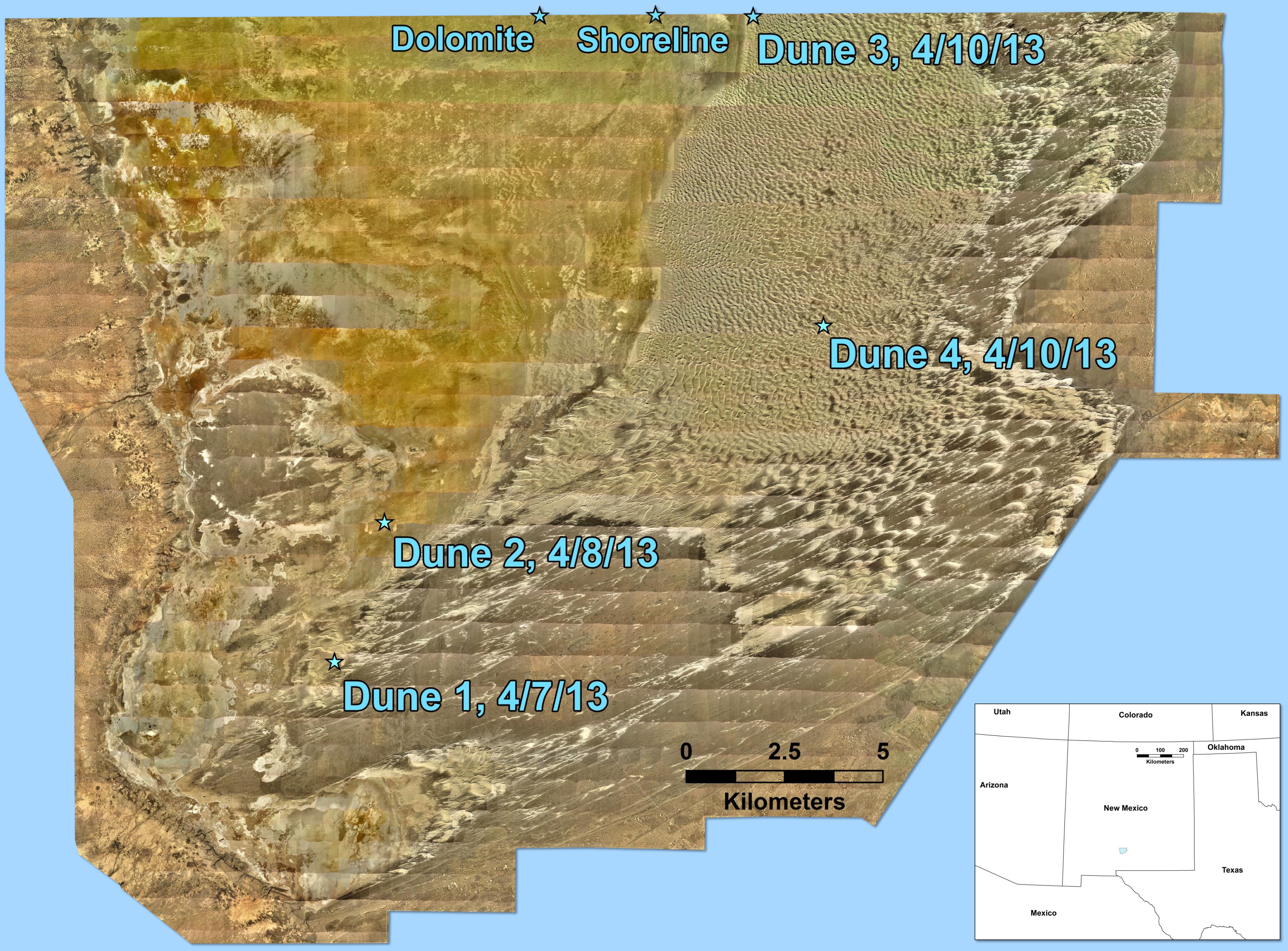
Preliminary results from a field study of the mineralogy of White Sands National Monument dune field

L. K Fenton[1], J. L. Bishop[1], B. Lafuente[2], B. H. Horgan[3], A. Szynkiewicz[4], D. Bustos[5], and S. J. King[6]

[1]SETI Institute, Mountain View, CA, lfenton@seti.org, jbishop@seti.org
[2]University of Arizona, Tucson, AZ
[3]Arizona State University, Tempe, AZ
[4]University of Tennessee, Knoxville, TN
[5]White Sands National Monument, Alamogordo, NM
[6]California State University, Sacramento, CA

White Sands National Monument



1 Background

In 2005, a large quantity of gypsum was unexpectedly identified on Mars in the high latitude dune sands of Olympia Undae [1]. Because gypsum is formed in the presence of liquid water, the discovery of this extensive deposit has import implications for the climatic and sedimentary history of the currently cold and dry north polar region of Mars. CRISM data indicate that gypsum sand grains concentrate at dune crests [2-4], but it is not clear whether aeolian processes alone could be responsible for this effect, nor what the significance of this pattern may be.

To investigate how aeolian processes distribute soft and hard sand grains (e.g., gypsum and quartz, resp.) across active dunes, we performed a field investigation of four barchan/barchanoid dunes at White Sands National Monument in New Mexico, USA.

10 SECOND TAKEAWAY:
Preliminary laboratory analyses of our field samples suggest a reduced preservation potential of harder aeolian-transported grains when in the presence of large quantities of gypsum sand.

2 Field Site

White Sands National Monument contains the largest known gypsum-dominated dune field on Earth (> 400 km^2), and it has long been the subject of aeolian studies [e.g., 5,6]. Four barchan/barchanoid dunes were sampled in a field study during April 7-10, 2013. Of the four sites, only Dune 3 contained a significant mixture of non-gypsum grains.

Dune 3 is a barchanoid dune on the western edge of the dune field (see Fig. 1). Its stoss is covered in coarse-grained ripples, with dolomite and other grains derived from lakebed strata exposed a few kilometers upwind. Samples were taken from 9 locations, separated by 10 m, down the dune stoss from the slip face brink (see Figs. 2 and 3). Additional samples were obtained from coarse-grained ripples upwind of the dune and on another dune.

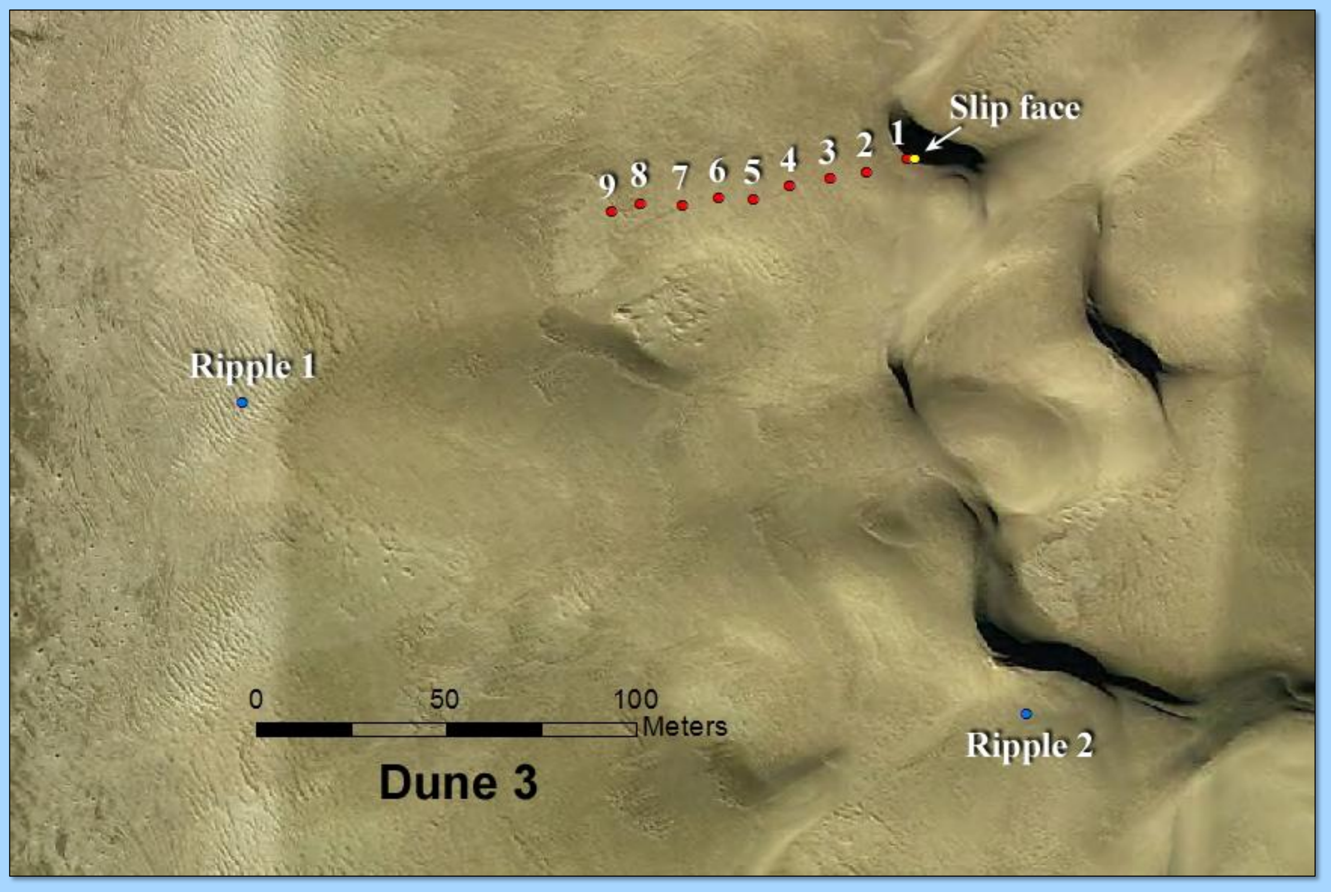


Fig. 1. Sample sites along the windward slope of Dune 3.

Fig. 2. Sample collection at Flag 7, Dune 3. Note the coarse and fine grains.

Fig. 3. Looking west down the traverse from the Dune 3 slip face brink (at Flag 1).

3 Lab analysis

- For XRD analysis of Flag 7 from Dune 3, as well as Dunes 1 and 2, see neighboring poster by Lafuente et al. (poster location #416).

- For VNIR analysis of Flag 7 from Dune 3, as well as Ripples 1 and 2, see neighboring poster by King et al. (poster location #417).

4 Preliminary Results

Dolomite and other minerals dominate the > 1 mm samples, taken from coarse-grained ripples on the stoss of Dune 3. Despite being derived from a similar location upwind, these grains are harder than gypsum and thus have not yet broken into smaller grains. As a result, harder grains dominate the surface of the ripples (and this could be reflected in spacecraft spectra). However, the dune sediments are dominated by finer-grained gypsum (see Fig. 4).

Thus, this close to a sediment source, dune cross-strata may not preserve the hardest minerals mobilized by the wind. This runs counter to current thinking, in which typically only the hardest minerals survive the rigors of transport. Proximity to source is likely a relevant factor.

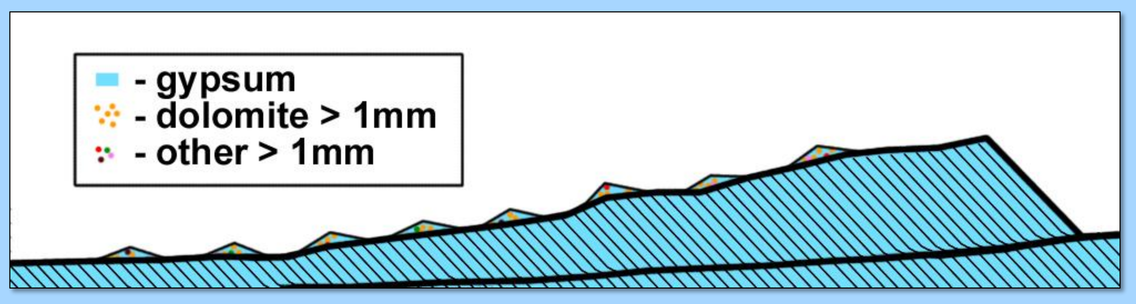


Fig 4. Proposed cross-section of Dune 3 showing depletion of hard minerals in dune cross-strata.

References:
[1] Langevin et al. (2005), *Science,* 307, doi:10.1126/science.1109091.
[2] Murchie et al., (2009), *JGR,* doi:10.1029/2009JE003342.
[3] Horgan et al. (2009), JGR, doi:10.1029/2008JE003187.
[4] Calvin et al. (2009), JGR, doi:10.1029/2009JE003348.

Blowing wind moves sand:
gypsum, carbonate, and quartz.
But which is preserved?