AN ASSESSMENT OF THE RELIABILITY OF MINERAL ABUNDANCE ESTIMATES DERIVED FROM TES DATA OVER DUNE SITES. C. J. Ahrens[1] and T. N. Titus[2], [1]West Virginia University, Morgantown, WV 26506 (cahrens@mix.wvu.edu), [2]U.S.G.S. Astrogeology Science Center, 2255 N. Gemini Dr., Flagstaff, AZ 86001.

Introduction: Dune fields are abundant on the Martian surface, and their mineralogical composition can reveal much about their origin and history, as well as planetary processes. Here, we use Mars Global Surveyor Thermal Emission Spectrometer (TES) [1] data to examine multiple Orbital Counter Keeper (OCK) observations over two dune fields. Only one is shown in this abstract as an example. In this study, we compared mineral-abundance estimates derived from atmospherically-corrected TES emissivity spectra [2] and evaluated the repeatability of those results from multiple and overlapping tracks over the same area. Determining the repeatability of mineral-abundance estimates will enable us to evaluate the reliability of the analysis technique when studying dune fields where few tracks are available, and to test the robustness of the atmospheric correction.

Dataset: We selected a dune field with overlapping TES observations for analysis using the Java Mission-planning and Analysis for Remote Sensing (JMARS) software [3] and the added Mars Global Digital Dune Database [4] plug-in. JMARS also allowed us to download TES observations where the spectra had already been converted to emissivity. The TES emissivity spectra were then atmospherically corrected by spectrally separating the atmospheric and surface components [5] using the Spectral Mixing Analysis (SMA) function within the Davinci programming environment [6]. We used the SMA function a second time on the surface spectra to estimate mineral abundance from each orbital track. Our mineral library consists of 44 lab-documented minerals that have been observed on Mars (Table 1) [7].

Table 1: List of the mineral groups and respective end-members for this study [7].

MINERAL GROUP	ENDMEMBER	MINERAL GROUP	ENDMEMBER
QUARTZ	Quartz	HEMATITE	Martian Hematite
FELDSPAR	Microcline Albite Oligoclase Andesine Labradorite Bytownite Anorthite Shocked Anorthite (17, 21, 25.5, 27, 38.2, 56.3 GPa)	PYROXENE	Bronzite Enstatite Hypersthene Lindsley Pigeonite Diopside Augite (2 types) Hedenbergite
SULFATE	Anhydrate Gypsum Kieserite	CARBONATE	Calcite Dolomite
OLIVINE	Forsterite Fayalite KI (Fo 10, 35, 60, 68)	HIGH-PHASE SILICA	Illite Montmorillonite Saponite Na-Montmorillonite K-rich glass SiO2 glass Opal A Aluminous Opal Heulandite Stilbite

Data Analysis: A preliminary study was conducted using dune field #2938-497 (Figure 1).

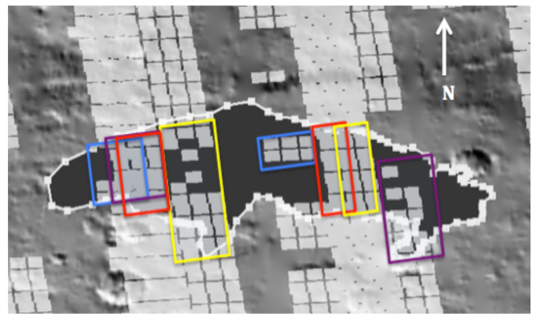

Figure 1: Dune field 2938-497 on JMARS interface. Colored boxes correspond to orbital tracks used in this study and match the colors used in Fig. 2.

Individual orbital tracks are segmented with Incremental Counter Keepers (ICK), and have at most 6 detectors apiece. Each ICK (and detector), within its respective orbital track, was carefully chosen to include only those detectors where the Fields-Of-View (FOV) were within the dune field parameter (Table 2).

Table 2: List of each orbital track researched with respective ICK and specific sensors used for this study and location relative to the dune field.

OCK	ICK	SENSORS	LOCATION	OCK	ICK	SENSORS	LOCATION
3615	1260	ALL	WEST	3703	1259 1262	1; 2; 4; 5; 6 ALL	EAST
4030	1259 1260 1261 1262	1; 4; 5; 6 ALL ALL ALL	WEST	5602	1259 1260 1261 1262	ALL ALL ALL ALL	EAST
5187	1273 1274 1275 1276 1277 1278	1; 2; 4; 5 ALL ALL ALL ALL ALL	WEST	5929	1258 1259 1260 1261 1262	ALL ALL ALL ALL 1; 2; 3; 6	EAST
5514	1258 1259 1260 1261	1; 2; 4; 5; 6 ALL ALL ALL	WEST	5275	1257 1259 1260 1261	1; 2; 4; 5 ALL ALL ALL	EAST

We analyzed orbital tracks in the western and eastern regions of the dune field and compared their individual mineral abundance percentages (Figure 2) to test repeatability for all orbital track data. With the atmospheric correction applied, the mineral abundances in overlapping orbital tracks should not vary greatly.

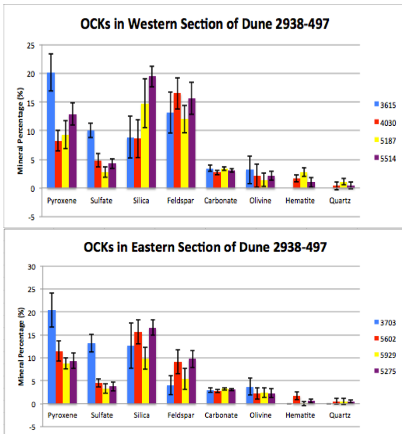

Figure 2: Mineral-abundance comparisons of the orbital track data on the dune site, categorized by different minerals detected. Each orbital track's mineral abundance has RMS error bars derived from Davinci. Colors of each orbital track correspond to Figure 1.

Error Analysis: Output from the SMA function shows the RMS percentage value for each mineral abundance detected and for each orbital track (Table 3). We evaluated the consistency of the overlapping orbital track mineral abundances derived from the TES data analysis.

Table 3: Orbital tracks and respective total track RMS percentage values calculated using Davinci. Note that the RMS values are only for the detectors contained within the dune site.

OCK	RMS	OCK	RMS
3615	0.310187	**3703**	0.305976
4030	0.210948	**5187**	0.164218
5275	0.153475	**5514**	0.151725
5602	0.19889	**5929**	0.196254

Repeatability analysis was applied to the eastern and western orbital tracks separately. The analysis was done by using the ANalysis Of VAriance (ANOVA) technique. The purpose of this technique is to find variation between overlapping and adjacent orbital track mineral data.

This technique calculates the P-value and the r-value using the individual mineral abundance percentages from each orbital track. The high P-value indicates the level of consistency between overlapping and adjacent orbital track mineral percentages. It was noted that a P-value of 5% or less is statistically significant, suggesting variation [8] between the orbital tracks. The lower r-value is defined as the smaller margin of error, indicating repeatability (Table 4, 5).

Table 4: Eastern and western orbital track mineral data with respective P-value and r-value for error analysis. The eastern orbital tracks have a high P-value and low r-value, which is ideal for repeatability. In contrast, the western orbital tracks have a lower P-value and higher r-value.

	EAST	WEST
r-Value	5.15%	21.776%
P-Value	23.55%	7.73%

In the first error analysis, we examined all of the orbital tracks and mineral groups. The result of the r-value for the western orbital tracks was significantly higher in error margin than the eastern tracks. This also showed lower consistency in the western orbital tracks.

In the next analysis, we evaluated each orbital track and mineral groups that may have caused the larger error in the western tracks. We found that excluding the feldspar mineral group from both the eastern and western orbital tracks lowered the statistical difference between the two regions of the dune site (Table 5). This may suggest that the feldspar mineral group is not homogenous across the dune site or concentrated on the crest or trough of the dune structure.

Table 5: Eastern and western orbital track mineral data with respective P-value and r-value for error analysis. The r-values for the western and eastern orbital tracks have a repeatability margin of error with a difference of 2.05% points. The P-values for the western and eastern orbital tracks are consistent with a 2.2% point difference.

	EAST	WEST
r-Value	10.68%	8.63%
P-Value	18.09%	20.29%

This abstract shows preliminary results for a single dune field. More dune sites will be evaluated by using the same techniques described in this abstract, and to better understand of the reliability of the data and statistical robustness. We will also expand the investigation to examine mineral groups that may cause statistical errors.

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