COMPOSITION DETERMINED BY LINEAR MIXTURE MODELING VARIES WITH THE LAB SPECTRA USED. N. Rodricks[1], B. Greenhagen[2], L. Kirkland[1,3], and K. C. Herr[3], [1]Lunar and Planetary Institute, Houston, TX, rodricks@lpi.usra.edu; Washington University at St. Louis, beng@levee.wustl.edu; The Aerospace Corporation, kirkland@lpi.usra.edu, kenneth.c.herr@aero.org.

Introduction: Linear mixture modeling is an analytical technique often used to determine the composition of materials measured using infrared spectroscopy. Concentrations of pure minerals can be estimated by comparing the observed spectral signature band depth to that of laboratory spectra of the same mineral.

The method as used for Mars typically uses spectra measured of coarse particles. The abundance modeling then uses the assumption that the band depth measured of the field sample will be the same as the laboratory sample if the field target fills the field of view (100% coverage of the pixel).

However, abundance is not the only variable in observed band depth: (1) abundance, (2) surface roughness, and (3) particle size all cause spectral band contrast variation.

Here we illustrate the impact of ignoring effects 2 and 3 above on abundance models that are currently used for Mars. We use MiniTES analog data measured in the field at Mars spectral analog test sites.

Sites: We selected two Mars spectral analog location: Bristol Lake, a dry lake in the Mojave desert near Amboy, CA; and Alunite, an alunite rich outcrop ~15 miles SE of Las Vegas, NV.

At Bristol Lake, gypsum precipitated from saturated surface water. The gypsum bearing rocks form a compositional "bathtub ring" around dry lake, as different materials saturated and precipitated as the lake dried and shrank. The gypsum deposits that we examined here are mixed with silt and clay.

At Alunite has gypsum precipitated from saturated hydrothermal fluid. Gypsum veins cut through the host rock. We measured thermal infrared field spectra of this unit exposed in a small railroad cut (~5 m tall). *Heavens et al*. investigates the spectral identifications of the materials present, using both infrared spectroscopy and energy-dispersive X-ray spectroscopy (EDXS).

Data: The 2003 rover MiniTES (~6-25 µm) measures thermal infrared, hyperspectral images similar to the instruments RamVan and Tonka (~7.5-12.5 µm, 181 bands). RamVan and Tonka are van platforms, and measure spectra using a raster-scanning spectrometer that images with similar spatial resolution as the MiniTES. Figure 1 shows the Tonka spectrometer and the Alunite outcrop.

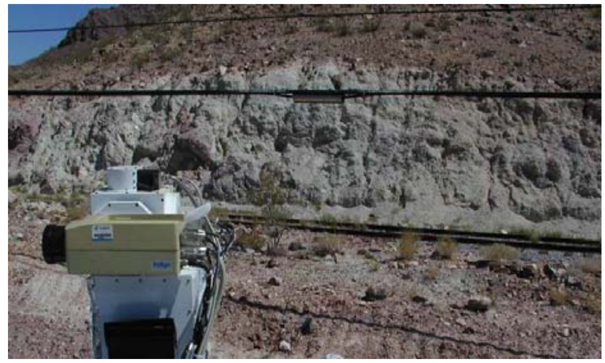

Figure 1: Tonka at the Alunite site. This shows the Tonka spectrometer head. The head is raised above the roof so the spectrometer can view the scene.

Figure 1: Tonka at the Bristol Lake gypcrete site. Tonka measured the gypsum-bearing rock that is visible in front of the 1 x 1 m targets.

Model: Linear mixture models used three different laboratory gypsum spectra. The difference between each was the particle size: (1) 0-45 µm; (2) 45-125 µm; and (3) 125-500 µm. The only other spectra used were quartz and a flat line. The flat line allows the spectral contrast to vary for the laboratory spectra.

Results. Table 1 shows the results for each model. The abundance estimate for the gypsum at Alunite is actually ~5-10%, based on on-site inspection. However, the model abundance ranged from 170% (physically impossible) based on the 0-45 µm gypsum laboratory spectra; to 36% for the coarse gypsum.

The abundance estimate for the gypsum as measured at Bristol Lake is actually ~80-90% exposure, based on on-site inspection. However, the model abundance ranged from 205% (physically impossible) based on the 0-45 µm gypsum laboratory spectra; to 34% for the coarse gypsum.

Conclusions. The abundance derived from the linear mixture model varied widely, depending on the particle size used. The result illustrates why abundance mapping using this method has error bars in Mars models that are unconstrained, and potentially large. The only route to direct abundance mapping would require knowing the true spectral contrast of the surfaces on Mars, and how surface roughness and particle size causes those contrasts to vary.

Table 1: Linear model results.

	Bristol Lake	Alunite Site
abundance from very fine gypsum	205%	170%
abundance from fine gypsum	44%	46%
abundance from coarse gypsum	34%	36%
approximate true abundance exposed	~80-90%	~5-10%

The laboratory spectra are from the ASTER on-line spectral library. Field spectra were measured by Tonka.

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