

**ASSESSING THE ACCURACY OF DECONVOLVED PLAGIOCLASE COMPOSITIONS FROM TES DATA** Keith A. Milam<sup>1</sup>, Harry Y. McSween, Jr.<sup>1</sup>, Victoria E. Hamilton<sup>2</sup>, and Phil R. Christensen<sup>2</sup>, <sup>1</sup>Planetary Geosciences Institute, Department of Geological Sciences, University of Tennessee, Knoxville, TN 37996-1410 (kmilam@utk.edu), <sup>2</sup>Department of Geology, Arizona State University, Tempe, AZ 85287-1404.

**Introduction.** Spectra collected from the Thermal Emission Spectrometer (TES) instrument on board Mars Global Surveyor provide insight into Martian surface compositions. Previous workers [1,2] have identified regions on the surface of Mars dominated by basalt, andesite, and hematite. Deconvolution of a rock spectrum provides mineral composition data within a certain margin of error and provides clues to petrogenetic processes. The ability to refine the precision of modeled mineral compositions in mafic igneous rocks is crucial to understanding igneous processes on Mars. Here we explore the accuracy with which plagioclase compositions can be modeled from thermal emission spectra.

**Previous work.** Previous research [3,4] revealed that, during linear deconvolutions of mafic-intermediate volcanic rocks (basalt to dacite), modeled plagioclase compositions were more Na-rich than median measured values. Some modeled An# values plotted outside of measured ranges altogether [4]. It was suggested that this bias could be due to compositional zoning in plagioclase and/or the volumetric (areal) contribution of more sodic grain types (groundmass vs. megacrysts) in samples. Additional work [5] demonstrated that modeled An#'s were actually within measured compositional ranges for the sample and biased toward the volumetrically (areally) more abundant grain type. This study supported earlier work [3,4] by showing that linear deconvolution produces plagioclase compositions up to 15 An # more sodic than weighted average compositions. The question remained as to whether zoning in plagioclase leads to sodic biasing in modeled plagioclase compositions. This study evaluates the potential effects of zoning on plagioclase spectra.

**Procedure.** Samples of homogenous plagioclase were collected and ground into sediment to simulate the dominant grain size component (coarse sand: 500-850 $\mu$ m) of the Martian surface. Mixtures of homogeneous plagioclase were produced to mimic crushed zoned plagioclase sand grains. Twenty-one individual mixtures ranging compositionally from (An<sub>75</sub>+An<sub>2</sub>) to a more constrained (An<sub>76</sub>+An<sub>67</sub>) were mixed in 75-25%, 50-50%, 25-75% proportions. Spectra were collected using a Nicolet Nexus 670 spectrometer over a 4000 to 200 cm<sup>-1</sup> wavenumber range and deconvolved (over 1300-300cm<sup>-1</sup> wavenumbers) using spectra from only plagioclase used in the mixtures, endmember spectra from [4], and all available plagioclase (Table 1) end-

member spectra from this study and the ASU spectral library [6]. All deconvolutions in this study were obtained at both laboratory and TES resolutions.

**Results.** Modeled plagioclase compositions (at both laboratory and TES resolutions- Figure 1) from coarse sand mixtures showed  $\sim \Delta$ An<sub>0</sub>-An<sub>9</sub> (avg.:  $\Delta$ An<sub>3</sub>) difference from modeled compositions (variance). Deconvolutions using all available plagioclase endmembers showed a more constrained variance ( $<\Delta$ An<sub>6</sub>). Variances between modeled and measured An#'s showed no systematic bias toward sodic compositions (Figure 1).

**Discussion.** Deconvolutions of plagioclase sand spectra at both laboratory and TES resolution suggest that the accuracy of the technique is improved by using the endmember set containing all available plagioclase spectra in the deconvolution. In addition, variance between measured and modeled An values, for *sand* mixtures in the laboratory, are more constrained compared to previously reported variances of 10-15 An# [5,7] for *rocks* (mixtures of minerals). When mixtures of plagioclase involving the more structurally-disordered albite are excluded (Figure 2), An#'s can be modeled within  $\Delta$ An<sub>6</sub>. This is consistent with previous work [8] noting crystal structure effects in albite deconvolutions.

**Conclusions.** Plagioclase of different compositions linearly mix together to produce a composite spectra representative of the average An# for *sand* mixtures. With modeled An values showing no systematic sodic bias in laboratory spectra and with the high variability of plagioclase zoning patterns among and within *rock* samples, it is not likely that zoning systematically biases modeled plagioclase compositions in terrestrial volcanic rocks. Additional preliminary deconvolutions (using the expanded plagioclase endmember set) of volcanic rocks used in [4,5] produce similar modeled An values with no systematically sodic bias. Thus, plagioclase zoning is unlikely to be the cause of the sodic bias in deconvolved *rock* spectra.

**Future Work.** Although plagioclase zoning and volumetric contributions of more sodic groundmass plagioclase have been excluded as viable causes for the apparent sodic bias, other phases may be responsible. Currently, we are investigating the effects of over- / under-estimation of other phases common in volcanic rocks. Future work may provide insight into the cause and may provide a correction factor that would lead to

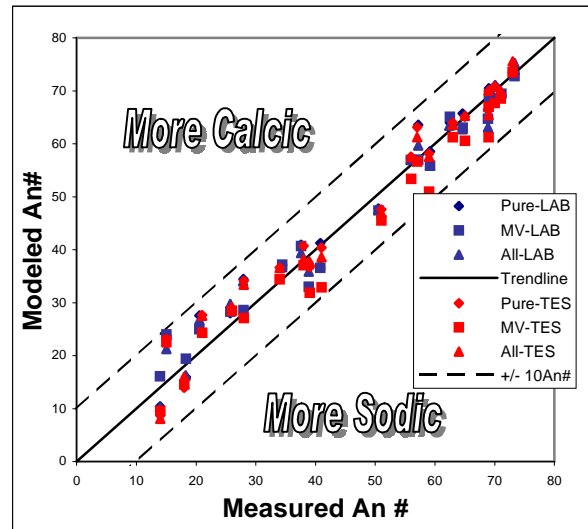
increased precision in modeling plagioclase compositions.

**References.** [1] Bandfield, J. L. et al., (2000), *Science*, 287, 1626-1630. [2] Christensen, P. R., et al., (2000), *JGR*, 105, 9623-9642. [3] Hamilton, V. E. et al., (2000), *Proc. LPSC XXXI* #1899. [4] Wyatt et al., (2001), *JGR*, 106, 14711-14732. [5] Milam et al., (2001) *Meteoritics*, 36, 9, A135 [6] Christensen, P. R. et al., (2000), *JGR*, 105, 9735-9739. [7] Hamilton, V. E. and P.R. Christensen, (2000), *JGR*, 105, 9717-9734 [8] Ruff, S., (1998), PhD diss., 234 pp., ASU.

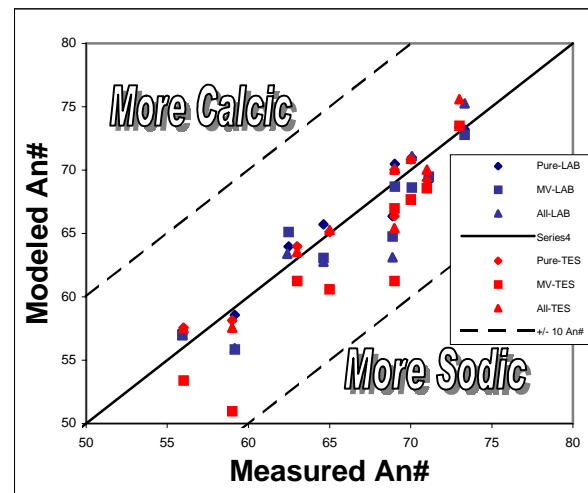
**Table 1.** Total available plagioclase endmembers used in deconvolutions.

Sample	Description	An#
WAR-0235	Albite (174)	<1
WAR-0244	Albite (5)	2
WAR-0612	Albite (26)	2
WAR-5851	Albite (220)	8
5851	Albite*	2
BUR-060D	Oligoclase (69)	15
BUR-060	Oligoclase (52)	16
5802a	Oligoclase*	22
WAR-5804	Oligoclase (70)	22
WAR-3680	Oligoclase (48)	25
WAR-0234	Oligoclase (22)	29
BUR-240	Andesine (1)	48
WAR-3080A	Andesine (176)	48
0022b	Andesine*	49
WAR-0024	Labradorite (175)	+50
WAR -4524	Labradorite (63)	53
4512A-L	Labradorite*	54
WAR-1384	Labradorite (177)	63
RGAND01	Labradorite (222)	67
SS	Labradorite*	67
WAR-5859	Bytownite	73
1382a	Bytownite*	76
WAR-5759	Bytownite (221)	88
BUR-340	Anorthite (123)	92

\* = new endmembers developed for this study



**Figure 1.** Diagram showing measured vs. modeled plagioclase compositions for deconvolutions of plagioclase mixtures at lab (blue symbols) and TES resolutions (red symbols). Dashed lines show  $\pm 10$  An# from the predicted linear trend. (Deconvolutions with: Pure= only plag used in mixtures, MV= endmember spectra from [4], All=all available plagioclase (Table 1); LAB=laboratory resolution, TES=TES resolution)



**Figure 2.** Diagram showing measured vs. modeled plagioclase compositions for deconvolutions of plagioclase mixtures (minus ones containing albite) at lab (blue symbols) and TES resolutions (red symbols). Dashed lines show  $\pm 10$  An# from the predicted linear trend. (Legend codes are the same as for Figure 1)