Abstract # 2001

Shocked Phyllosilicates at Mawrth Vallis by Factor Analysis and Target Transformation

Lonia Friedlander*[1] and Timothy Glotch[1]

[1]Department of Geosciences, Stony Brook University, *lonia.friedlander@stonybrook.edu

INTRODUCTION

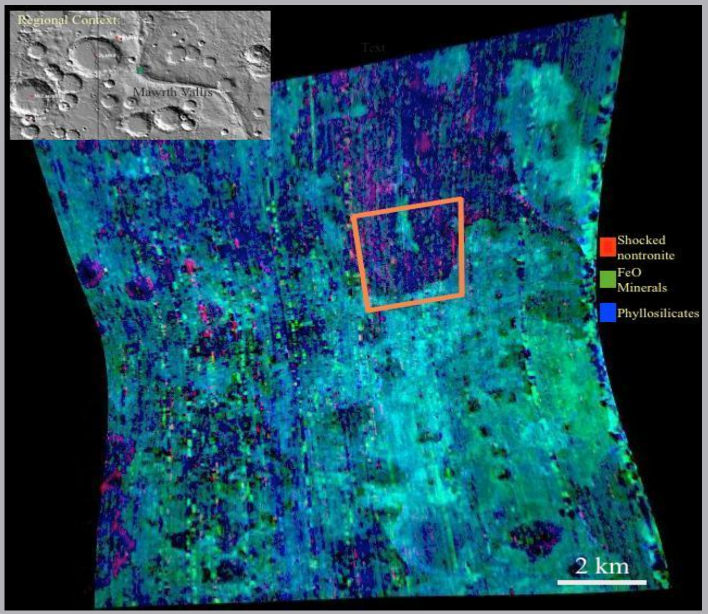
Phyllosilicates on the martian surface have been identified by visible near infrared (VNIR) reflectance spectroscopy in several locations, many in old and heavily bombarded terrains [1-4]. This suggests that phyllosilicates may have experienced impact related structural and spectral change [5, 6]. The most commonly identified phyllosilicate mineral assemblage on Mars is an Fe-Mg bearing interstratified smectite/chlorite, closely followed by an iron-bearing smectite similar to nontronite [7]. Previous work has shown that nontronite is susceptible to structural and spectral change after exposure to laboratory impacts [5, 6, 8]. In addition, impact shock produces spectral change that differs from that produced by other processes, such as thermal alteration [8]. Thus, we hypothesized that impact-altered nontronite can be specifically identified on the martian surface by remote sensing.

MATERIALS AND METHODS

We used factor analysis and target transformation (FATT) [9-11] to analyze a 130x130 pixel region of the CRISM image FRT00013E49_07 (Mawrth Vallis). We then compared these results to a spectral library containing impact and thermally altered spectra for both nontronite and kaolinite, as well as smectite standards from the RELAB database.

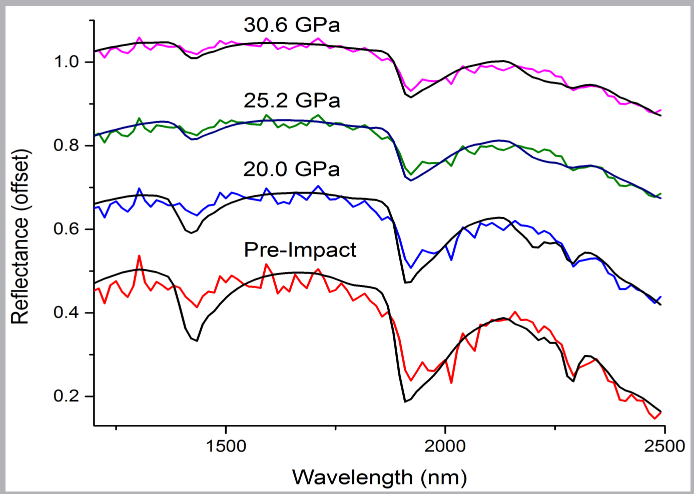
WHAT IS FATT?

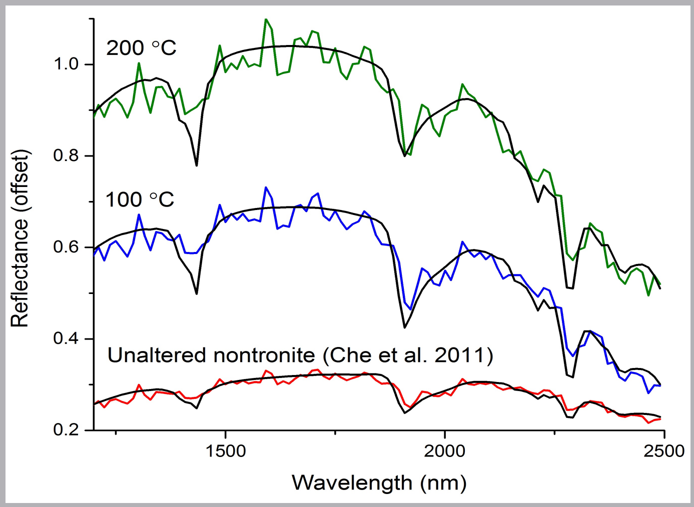
FATT is a principle components-based analysis that analyzes large, mixed spectral datasets by deriving a series of orthogonal eigenvectors and associated eigenvalues [8, 11]. Although these have no physical meaning, they can be used to recreate the spectra of potential end-members in a spectral mixture (assuming linear mixing). If the laboratory spectrum of a given material can be reproduced by combinations of FATT eigenvectors, that material may be a component of the analyzed spectral mixture [11].

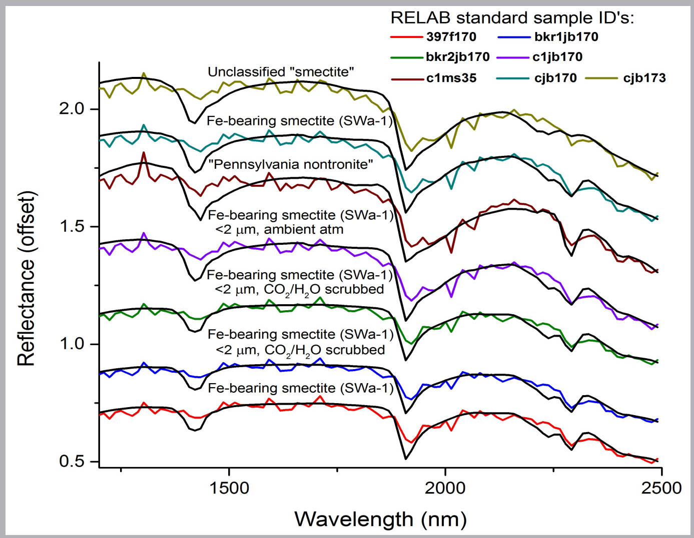


CRISM image FRT00013E49_07 showing the distribution of impact altered nontronite. The 130x130 analyzed area of interest [285:415, 190:320] is outlined in orange. Iron oxide and phyllosilicate indices were taken from [12] and produced using the process_crism command in Davinci. The impact altered nontronite index was produced by shifting the band center of the phyllosilicate index described in [12] from 2.3 to 2.2 μm and broadening the tie-points.

RESULTS





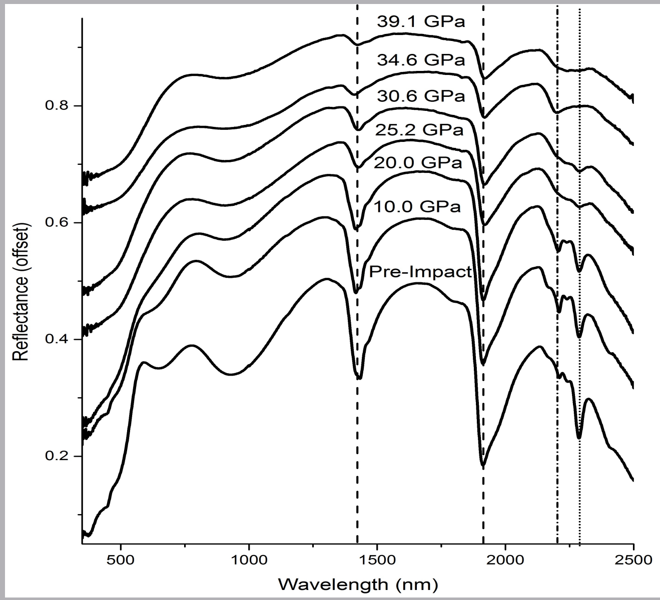


KEY OBSERVATIONS

1. Shocked nontronite spectra from samples after impacts up to 20.0, 25.2, and 30.6 GPa peak pressure were reasonably reproduced by the FATT analysis.
2. Thermally altered nontronite spectra were less well reproduced and the best matches were low temperature samples, reflecting the presence of unaltered nontronite.
3. The best RELAB database matches were similarly unaltered nontronite or related smectite species.
4. None of our kaolinite spectra were well reproduced, suggesting that phyllosilicates in the region of interest are dominated by iron-bearing clays (e.g., nontronite).

CONCLUSIONS

Shocked phyllosilicates may be a component of the spectral mixture in our region of interest. The specific identification of impact altered nontronite suggests that impact altered mineral spectra should be included in spectral libraries for the analysis of remote sensing data from Mars. This complicates potential mineral identifications, but supports impact induced spectral alteration as a possible explanation for conflicting results among different remote sensing techniques, as suggested in [6] and [8].



REFERENCES

[1] Bibring J.-P. et al. (2005) *Science, 307,* 1576-1581. [2] Loizeau D. et al. (2007) *JGR, 112,* E08S08-E08S27. [3] Bibring J.-P. et al. (2006) *Science, 312,* 400-404. [4] Che C. and Glotch T. (2014) *GRL, in press*. [5] Gavin P. et al. (2013) *JGR:Planets, 118,* 1-16. [6] Friedlander L.R. et al. (2012) *LPSC XLIII,* Abstract #2520. [7] Carter, et al. (2013) *JGR: Planets, 118*, 831-858. [8] Friedlander L.R. et al. (2013) *JGR: Planets,*in prep. [9] Malinowski E. (1991) *Factor Analysis in Chemistry*, 2nd Ed., John Wiley, New York, NY. [10] Glotch T.D. and Bandfield J.L. (2006) *JGR, 111,* E12S06-E12S17. [11] Thomas N.H. and Bandfield J.L. (2013) *LPSC XLIV,* Abstract #1325. [12] Pelkey, S.M. et al. (2007) *JGR, 112,* E08S14.

This work is partially funded by NASA MFRP