COMMENTS ON THE SPECTRAL EVIDENCE FOR HYDRATES SALTS IN RECURRING SLOPE LINEAE ON MARS. W. S. Gosset[1], [1]University of Dublin (Physics Department, College Green, Dublin 2, Ireland, william.sealy.gosset@mail.com).

Introduction: Recurring slope lineae are active features observed on Mars by the HiRISE instrument since McEwen et al., 2011 [1] and the possibility of transient brine flows was proposed since then. Direct and indirect perchlorate measurement at the Phoenix [2] and Mars Science Laboratory [3] landing sites indicate that the brines hypothesis is very probable. Laboratory measurements have shown that a significant concentration of brines cannot be traced by reflectance spectroscopy in the near-infrared [4]. Here I discuss the recent salts detection [5] and report a basic analysis of raw data, available publicly on the Planetary Data System archive.

Detector's saturation is a well known phenomenon that produces artifacts similar to absorption bands. As the detector is saturated, the maximum value recorded is below the true one. After calibration, the apparent energy recorded is below the true energy deposed, thus creating spurious local minima in the reflectance spectrum. If the calibration and treatment pipelines are mixing informations from contiguous pixels (element in the image) and/or spectels (element in the spectrum), the local minima can be extended to the neighboring spectels/pixels. Since the CRISM calibration pipeline is not provided, it is impossible to disentangle this potential confusion process. Moreover, in the publicly available calibrated data (trr3), the corrupted data are not flagged and instead a "calibrated value" is provided.

The systematic presence of a saturated pixel and spectel in the presented detections by [5] leads us to conclude that here are no evidence for any detection, contrarily to the initial interpretations. In addition, all wavelength spectels are presented in the viewgraphs of [5], including the saturated ones, in contradiction to the standard procedure consisting in the removal of corrupted data. This is an additional argument, indicating that the saturation artifacts were not considered by the authors.

Dataset and notation: Sample/Line: refers to the image element (pixel). Numbering from 1 to the end of the file. Usually, there are 640 samples and a few hundreds of lines.

Channel: refers to the wavelength channel (spectel). Numbering from the RAW data (from 1 to 438). For instance, No 1 is corrupted, No 2 corresponds to 3935.38 nm and No 438 to 1001.73 nm.

Correspondence between channel number and wavelength from ENVI_CAT software file: CDR6_1_0000000000_SW_L_0.TAB

The saturation occurs in many pixel/spectels, I only report here the saturation associated to the absorption bands proposed.

Example in Palikir crater: From [5] Supplementary Material table S1, RSL regions of observation FRT0002038F are (sample/line): 335/218, 335/226, 335/232, 336/218, 336/242, 336/247

From the analysis of frt0002038f_07_sc163l_edr0.img:

Sample 335 is saturated (DN=4095) in the following channels: 301 (1899.29 nm), 289 (1978.50 nm), 266 (2130.59 nm), 139 (3023.94 nm), 138 (3030.57 nm).

Sample 335 is close to saturation (DN>4000) in channel 303 (1886.09 nm).

Sample 336 is saturated (DN=4095) in the channel 369 (1452.23 nm).

The presence of saturated data records imply artificial absorption bands at 1.48 micron, 1.91 micron, 2.15 microns and ~3 microns (see figure 1). The temporal effect is more probably due to the non-saturation of the second CRISM image.

CRISM calibration and treatment pipelines: Unfortunately, the CRISM calibration and destriping pipelines are not public. Consequently, I could not check if this problem can be transmitted to neighboring wavelengths (spectels) or neighboring places (pixels). I nevertheless suspect that it is the case, like in every calibration/destriping/despiking pipelines. In addition, the behavior of the CRISM data compression on-board the Mars Reconnaissance Orbiter in the case of saturated data may be also a source of neighboring contamination. In order to verify this point, the community needs to have access to these pipelines.

Conclusion: I show that the detection locations presented in [5] are systematically associated to saturated data. In the present state of the analysis, the data analyzed by [5], cannot be considered as a proof of the brines hypothesis, but should be rejected. Potentially, other spurious detections using the CRISM dataset have been reported so far, since neither the calibration pipeline is available, nor the corrupted data is flagged.

References: [1] McEwen, A. S. et al. Science 333, 740–743 (2011). [2] Hecht, M. H. et al. Science 325, 64–67 (2009). [3] Glavin, D. P. et al. J. Geophys. Res. 118, 1955–1973 (2013). [4] Massé, M. et al. Planet. Space Sci. 92, 136–149 (2014). [5] Ojha, L. et al. Nature Geoscience, 8, 829-832 (2015)

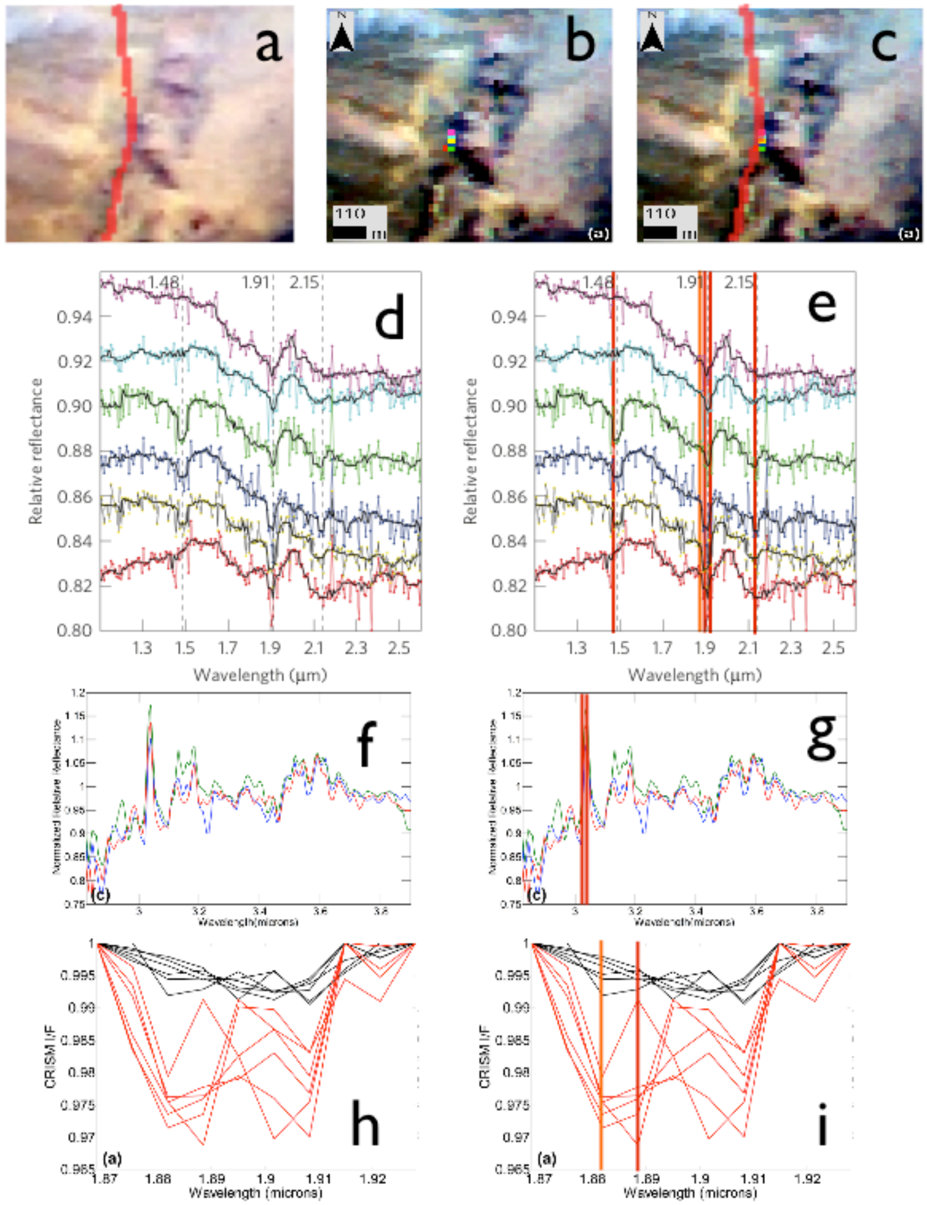

Figure 1: Saturation of CRISM image FRT0002038F in Palikir crater. (a) saturated sample 335 and 336 in red, in a background map (Red=channel 205, Green=channel 360, Blue=channel 436), in a cylindrical projection. (b) original detection map (fig 1.b and fig S3 from [5] with unknown projection). All detection pixels are in samples 335 and 336 (from [5], supplementary material table S1) (c) attempt to superpose both previous figures. (d) original detection in selected spectra (fig 1.c from [5]) (e) corresponding saturation elements in red and near saturation in orange (f) original detection in selected spectra (fig S1.a from [5]) (g) corresponding saturation elements in red and near saturation in orange (h) original detection in selected spectra (fig S1.c from [5]) (i) corresponding saturation elements in red and near saturation in orange.