Understanding HiRISE Color Imaging of Mars – a potential new tool for assisting in mineral identification at the meter resolution W. Alan Delamere[1], Alfred S. McEwen[2], Kris Becker[3], Nathan T. Bridges[5], Eric M. Eliason[2], Kenneth E. Herkenhoff[3], Laszlo Kestay[3], Sarah Mattson[2], Moses Milazzo[3], Patrick S. Russell[4], Frank Seelos[5], Livio L. Tornabene[4] and James Wray[6].
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Introduction: The HiRISE team has produced many remarkable color images of Mars [1]. The three broad spectral bands, coupled with the highly sensitive 14 bit detectors and time delay integration, enable detection of subtle color differences, but are not designed to determine mineralogy. The very high resolution (~25 cm/pixel scale) of HiRISE can augment the mineralogic interpretations based on multispectral (THEMIS) and hyperspectral datasets (TES, OMEGA and CRISM) and thereby enable detailed morphologic and stratigraphic interpretations at meter-scales.

Color ratios: A study of HiRISE data demonstrates that potentially useful color ratio images aids the distinction of certain mineral classes [2]. In Fig. 1 laboratory mineral spectra were resampled to the HiRISE bandpasses and resulting I/F values ratioed. The minerals chosen for this plot were selected based on their likely detection within Martian spectral datasets, and/or identification within Martian meteorites. We do not claim to be able to distinguish the individual mineral phases plotted here (for a listing of the minerals used, see [2]), but can help distinguish classes of Fe-bearing

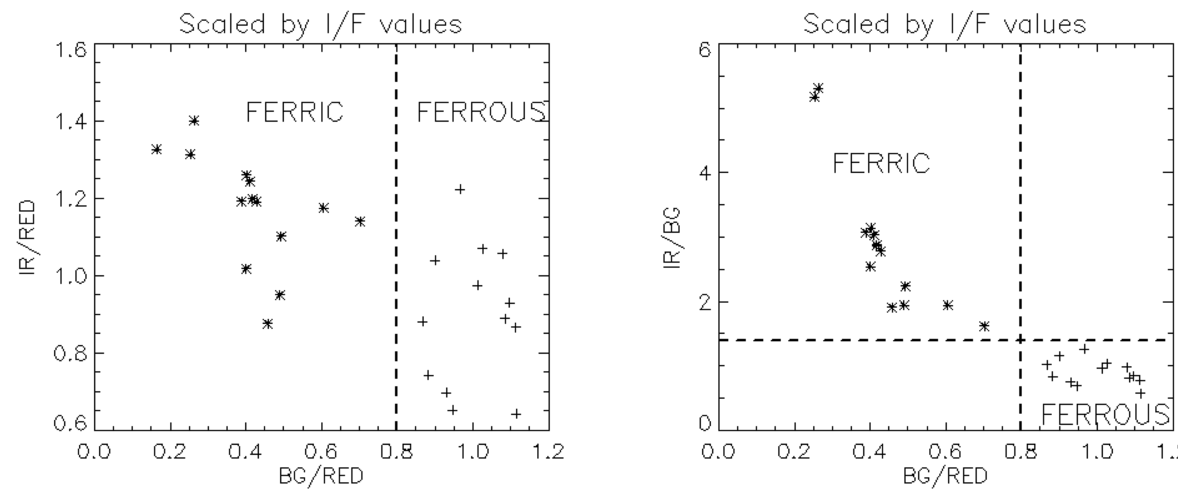

Fig. 1. Band ratio values derived from laboratory mineral, lithologic and surface spectra weighted by the HiRISE spectral response.

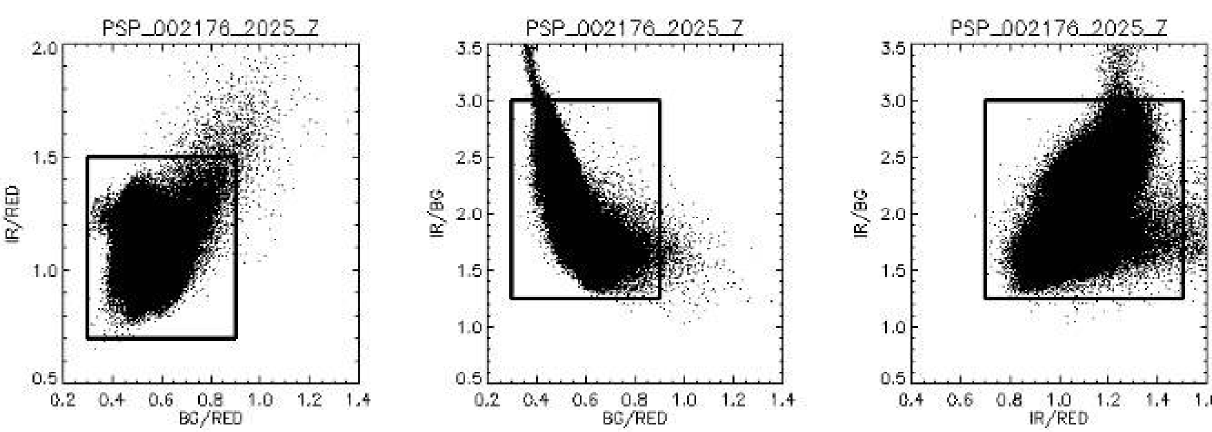

Fig. 2. Plots of all data points in the 1000x1000 subset from the HiRISE ratios from image PSP_002176_2025. The boxes are arbitrary limits for producing a color stretch for these images, used for figure 3.

minerals.. The position of the three HiRISE bandpasses are particularly sensitive to ferrous vs. ferric iron contents in these minerals, which can be seen here. The basic premise is that by making this distinction of ferrous and ferric minerals with HiRISE, it may be possible to further augment spectral units defined in lower spatial resolution spectral datasets. Examples of plotting the color ratios for all points in an area of a HiRISE observation are shown in fig.2.

Color ratio images: To produce meaningful color ratio images of surface features it is essential to first subtract the "haze" from atmospheric scattering. We do this by using the deepest shadows in each color image if deep shadows are available. We are currently investigating other techniques to use when deep shadows are absent, such as deriving haze estimates from CRISM emission phase function sequences [3]acquired along the same orbit as the HiRISE data.

From the ratio images a false color image can be produced that shows the spectral diversity of the area (fig 3). It consists of the IR/RED ratio, IR/BG ratio and BG/RED ratio, represented in Red-Green-Blue, respectively. All are byte scaled to the boxes shown in fig.2. This is a full resolution sub-image of 1000 by 1000 pixels (i.e., approximately 15 by 15 CRISM pixels) with a 28 cm./pixel scale.. In general, the blue color represents ferrous minerals and the yellow ferric. Identification of minerals by color in this image may be possible to a limited extent but the real value is in extending the CRISM results to smaller scales.

In order to deliver a consistent product, we found that the calibration of the HiRISE images needed to be improved. This work has been completed and we will be able to produce good color ratio images by the spring of 2011. Interpretation of such a product hinges on the comparison of the joint observations by CRISM and HiRISE.

References:

[1] McEwen, A. S. et al. (2010) *Icarus, 205,* 2–37.
[2] Delamere, W. A. et al. (2010) *Icarus, 205,* 38–52.
[3] Murchie S. et al. (2007) *JGR, 112,* E05S03.

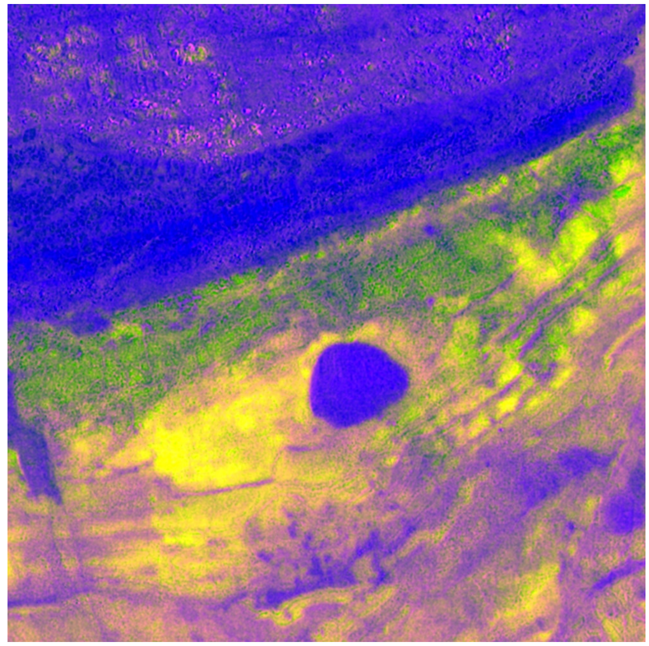

Fig. 3. HiRISE color band ratio image from PSP_002176_2025 in the Nili Fossae region of Mars, where CRISM data confirms both ferrous minerals.