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Assessing the Spectral Capability of the HiRISE Colour Channels: A Re-Visit to the CRISM Type-Locality Sites on Mars at Higher Resolution

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The High Resolution Imaging Science Experiment (HiRISE) onboard the Mars Reconnaissance orbiter has been acquiring images of the Martian surface at scales of ~25-50cm/px since 2006 [1]. The dataset has been instrumental in helping understand a variety of past and present geologic processes (e.g., [2,3]), and support landing site safety certification and science exploration for future missions (e.g., [4,5]). Apart from high-resolution panchromatic information provided by 10 overlapping CCDs with a broadband RED filter (~690nm), HiRISE also acquires colour infrared information along a central strip with two additional filters (BG: ~500 nm and IR: ~870 nm). While this colour swath is narrow and limited in coverage (and has recently become narrower still), it has provided crucial information for characterizing several colour-associated surface changes (e.g., [6,7]).

Most compositional information of Mars is provided at relatively medium-to-coarse resolution (10s to 100s of m/px) by Observatoire pour la Minéralogie, l'Eau, les Glaces et l'Activité (OMEGA) and the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM). With the loss of CRISM's L-detector in 2018, and subsequent decommissioning of the instrument in 2022 [8], it is important for us to understand the spectral capabilities of presently operational higher-resolution multispectral instruments in orbit like HiRISE and the Colour and Stereo Surface Imaging System (CaSSIS; ~4m/px). Recent studies (e.g., [7]) have demonstrated that HiRISE products available through the PDS, which are subject to cosmetic clipping of the values at extremes of the image histogram, may not be ideal for quantitative spectral analysis. Alternatively, generation of unfiltered data products, free from such cosmetic modifications, have been shown to be beneficial for spectral characterization of surface materials like pure water-ice [7,9].

We attempt to further explore this capability, to assess the spectral sensitivity of the three HiRISE

colour channels to help characterise a variety of surface minerals that have been identified on Mars. We have been acquiring dedicated HiRISE colour observations at all CRISM mineral/phase type-locality sites identified by [10]. In this work, we describe how the three HiRISE colour wavelengths resolve each mineral/phase, and the extent to which HiRISE colour may be able to discriminate between them. We also provide band ratios and spectral parameters that are useful for mitigating the effects of the variable atmospheric opacity and illumination. Altogether, HiRISE colour products will be useful for future surface characterization studies, and permit co-analysis with other operational multispectral datasets like CaSSIS [11] and the High Resolution Stereo Camera (HRSC) [12].

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