OPTIMIZING EXOMARS PANCAM MULTISPECTRAL SCIENCE: CROSS-ROVER MISSION COMPARISON. P. M. Grindrod[1], R. B. Stabbins[1], S. Motaghian[1], E. J. Allender[2], and C. R. Cousins[2], [1]1Natural History Museum, London, UK (p.grindrod@nhm.ac.uk), [2]University of St Andrews, UK.

Introduction: The ESA/Roscosmos ExoMars Rosalind Franklin rover is due to launch in 2022, and land in the Oxia Planum region of Mars in June 2023. The rover is designed to retrieve a sample from a depth of up to 2 m, to fulfil its primary objective of searching for signs of life [1]. Here we outline one of several studies focused on optimizing the multispectral science that can be achieved with PanCam, one of the remote sensing context instruments on the rover.

PanCam: The PanCam instrument is mounted on the mast of the rover, at approximately 2 m above the ground. The main objective of this instrument is to establish the geological and morphological context for the mission, and supporting the choice of sampling location [2]. PanCam will measure the visible/near-infrared (VNIR) reflectance of the surface through a multispectral suite of 12 narrowband filters, the wavelengths of which were optimized for identifying a broad selection of minerals expected to be encountered on Mars [3]. The goal of this study is to measure the performance of these filters across a wide range of mineral compositions, in order to refine and optimize the choice of spectral parameters, and to also compare the theoretical spectral response to that of other similar instruments, Mastcam on the Mars Science Laboratory Curiosity rover, and Mastcam-Z on the Perseverance Rover.

Method: We used the Western Washington University (WWU) VNIR Spectroscopy Database to acquire relevant mineral laboratory spectra.

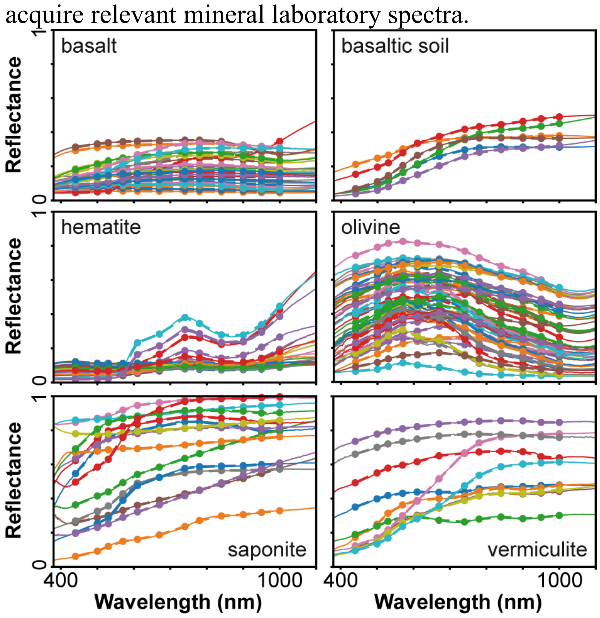

Figure 1. *(Below Left) The 163 spectra from the WWU database used in this study, split into rock or mineral type. Shown in each case is the resampled PanCam reflectance (circles and thick dashed lines) and the full laboratory spectra (thin sold line).*

We resampled spectra using the wavelength and bandwidth of the PanCam filters, to predict the response of the instrument to different mineral groups (Figure 1). We then linearly interpolated the PanCam and WWU spectra to a 1 nm spectral interval, before calculating the Root Mean Square Error (RMSE) between spectra. We used the RMSE as a measure of the ability of PanCam to accurately record the true spectral response of a mineral in the VNIR. We then carried out similar procedures for both Mastcam and Mastcam-Z.

Results: RMSE values vary within and across mineral and rock groups (Figure 2), which are largely reflective of the filter wavelength optimization process that performed best with ferric oxide compositions.

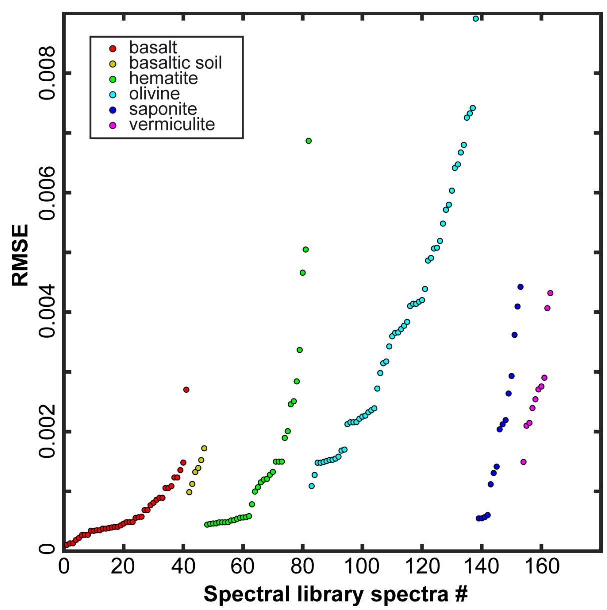

Figure 2. *RMSE between PanCam and WWU spectral database reflectance values.*

PanCam has low RMSE values for most basaltic compositions, with hematite also having some low RMSE values. However there is a wide range of RMSE values for hematite, in addition to olivine, saponite, and vermiculite.

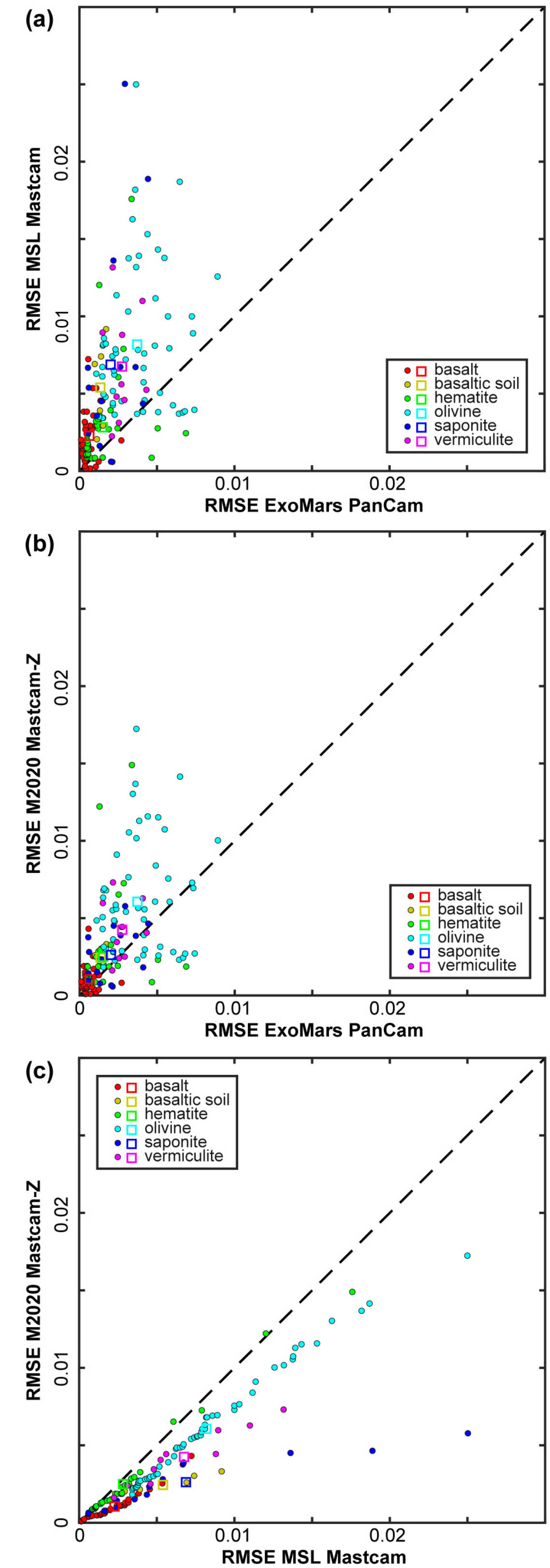

Figure 3. *Comparison of RMSE values for PanCam, Mastcam, and Mastcam-Z for the 163 WWU spectra used in this study.*

Overall, PanCam had lower RMSE values than Mastcam and Mastcam-Z for some spectra, but individual results suggest important variation within mineral groups that needs to be investigated further due to implications for interpretation (Figure 3).

Future Work: More detailed analysis of RMSE results across compositions and instruments is ongoing. We are also investigating the likely instrument response on Mars, using CRISM data from Gale Crater, and in particular hematite compositions at Vera Rubin Ridge (VRR) (Figure 4). Future comparison of predicted Mastcam performance using resampled CRISM data, compared with in situ Mastcam data acquired at VRR [4], will allow us to make stronger predictions of the spectral performance of PanCam and Mastcam-Z at the Oxia and Jezero landing sites respectively.

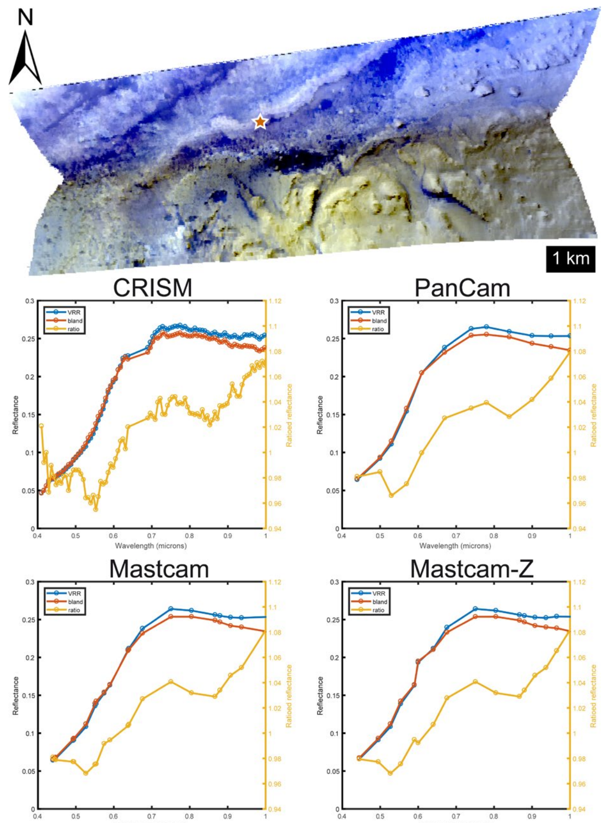

Figure 4. *Example of using CRISM data of Vera Rubin Ridge, Gale Crater. (TOP) CRISM VNIR RGB image FRT00021C92. (BOTTOM) Comparison of predicted spectra from different instruments (location = star).*

References: [1] Vago JL et al. (2017) *Astrobiology* 17, 471-510. [2] Coates AJ et al. (2017) *Astrobiology* **17,** 511-541. [3] Cousins CR et al. (2012) *PSS* 71, 80-100. [4] Fraeman AA et al. (2020) *JGR* 125, e2019JE006294.