Mineralogical Analysis of ExoMars Rover Landing Sites using CRISM  
Stuart M. R. Turner and John C. Bridges*.  
Space Research Centre, Leicester Institute for Space and Earth Observation, University of Leicester, Leicester, LE1 7RH, UK (*j.bridges@leicester.ac.uk).

Introduction  
The ExoMars 2020 rover currently has three candidate landing sites: Oxia Planum, Aram Dorsum and Mawrth Vallis [1]. The purpose of this study is to highlight the mineralogical diversity of the proposed ExoMars landing sites with false-color hyperspectral imagery overlain on high-resolution imagery to amplify morphological context.

Oxia Planum  
Oxia Planum (Fig. 1) has been described as a clay-rich layered Noachian deposit that has subsequently undergone long-lived aqueous alteration as exhibited by a Hesperian-aged delta to the south-east, with remnants of an Amazonian-aged capping unit also identified [6,7,8]. The region includes an ancient, but recently exhumed clay-bearing unit (Fig. 2) with some phyllosilicate exposures as young as 100 Myr based on crater counts [7]. 

At the resolution of CRISM, Fe,Mg clay is mixed with olivine and pyroxene throughout the scene (Figs. 2 – 4). Most notable spectral mixtures in Fig. 3 are located at the base of the delta to the south-east where the Fe,Mg clay and olivine are mixed resulting in an orange color, and also in the centre of the landing ellipses where Fe,Mg clay. Spectral analysis has shown that the widespread Fe,Mg clay closely resembles vermiculite (Fig. 4), which is consistent with other work [8].

Aram Dorsum  
The landing site proposed in Aram Dorsum contains an inverted channel system thought to be part of a regional alluvial system, which may represent a wider alluvial landscape [12,13,14]. This location has been shown to have potential for biogenic preservation [15]. As shown in Fig. 5, due to dust cover-age the CRISM hyperspectral images within the landing ellipses there is no direct mineralogical information however, nearby dust-free regions have shown sulfates, Fe,Mg- and Al-phyllosilicates [14].

Mawrth Vallis  
The landing ellipses proposed for Mawrth Vallis are located adjacent to an excised channel. Previous studies have shown Fe,Mg and Al phyllosilicates, hydrated silica and sulfates to be present on the margins of the ellipses [10,11].

Analysis Techniques  
Hyperspectral images <40 m/pixel resolution taken by the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) [2] were obtained from the NASA Planetary Data Sciences Geosciences Node and processed using the CRISM Analysis Toolkit (CAT) [3] extension to ENVI. Map-project flattened Viviano-Beck et al [4] summary parameters were ex-ported into ArcMap and overlaid onto 25 cm/pixel imagery from the High-Resolution Imaging Science Experiment (HiRISE) and a 100 m/pixel Thermal Emission Imaging System (THEMIS) daytime infrared global mosaic, with landing ellipses taken from [1]. The summary parameters selected for this work were R2529, R1506 and R1080 in an RGB configuration to give enhanced false-color images, as outlined in [4]. Red usually represent olivines, blue may indicate pyroxene, blue/green mixtures often indicate clay, and blue/grey/brown often indicate basaltic material [4]. Due to mineral mixtures the RGB configuration was only treated as a guide, with firm mineral identification being undertaken using spectral extraction and library comparison techniques, like those used in other studies [e.g., 5].

Summary  
Analysis of CRISM coverage of the three ExoMars rover candidate landing sites showed that Oxia Planum and Mawrth Vallis have spectral signatures consistent with phyllosilicates, whereas dust cover-age in Aram Dorsum prohibits mineralogical analysis. Further CRISM coverage of Mawrth Vallis to highlight areas of interest within the landing ellipses would be advantageous in preparation for the ExoMars rover mission, should this site be chosen. Additional CRISM coverage of the proposed delta in Oxia Planum would also be advantageous. Due to dust masking spectral signatures in Aram Dorsum, analysis and future CRISM observations should focus on nearby dust-free areas where interpretation of spectral signatures can be extrapolated for comparative analysis.