# Exploring the Limits of Material Discrimination with CaSSIS Multiband Imaging

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## Key Points

We present ongoing investigations of the spectral sampling space of the ESA Trace Gas Orbiter CaSSIS multiband imager, using our Supervised Spectral Parameters Learning technique, that we apply to CaSSIS images of Jezero Crater, Mars, for cross-referencing of CaSSIS-derived material classes against the extensive literature on this region.

## Abstract

Visible-to-near-infrared multispectral images of Mars are vital for correlating compositional and morphological interpretations of the surface, but from first principles this spectral domain contains limited information for discriminating mineral species. However, a new supervised learning method for exploring multispectral dimension reductions (Supervised Spectral Parameters Learning), that considers prior knowledge of the context of an observation, implies that richer information can be extracted. The method learns linear combinations of spectral parameters, that reduce the number of spectral 'dimensions' of a multispectral image (dimension reduction), by analysing large datasets of mineral reflectance spectra obtained under laboratory conditions that are labelled by mineral type. The method leverages these labels as part of the learning process (supervised learning), providing novel multispectral dimension reduction (spectral parameter) data products applicable to a diverse range of scenes. We report on the application of this method to the dataset of 4-band multispectral images captured by the Colour and Stereo Surface Imaging System (CaSSIS) of the ExoMars Trace Gas Orbiter (TGO), and describe developments to the host software of the method, the open-source Spectral Parameters Toolkit. CaSSIS has imaged the surface of Mars extensively, including Jezero Crater, the landing site of the NASA Perseverance rover, a terrain hosting a diversity of minerals and morphologies indicative of past water activity. We assess the enhancement of contrast in CaSSIS through the application of newly learned dimension reduction data products, by comparison against the compositional units established in the literature in the context of the on-going exploration of Jezero Crater.