Planetary surface mineralogical characterization using PlanetServer.

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Introduction: The mineralogical characterization of planetary surfaces is of great importance for geologic mapping purposes. The analysis of RGB combinations of bands or parameters extracted from hyperspectral imagery is widely used. In this study we use the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) [1] TRDR L observations, with a spectral range of 1 to 3.92 μm. A solution comprising a web client [2] and a Python API [3] is presented allowing to pursue spectral analysis as well as band math, and RGB combinations.

Service Description: PlanetServer [4] comprises a server, a web client and a Python client/API. In the server side data are stored using the Array DataBase Management System (DBMS) Raster Data Manager (Rasdaman) [5]. Rasdaman offers features such as query languages, query optimization and parallelization on n-D arrays. Open Geospatial Consortium (OGC) standards such as the Web Coverage Processing Service (WCPS) [6], are implemented in the PetaScope component [7], a set of geospatial and geometry libraries, data access libraries and relational database access components. The web client is based on the JavaScript version of NASA's World Wind [8] a general-purpose 3D/4D client used as a virtual globe to interactively analyze and visualize data. The Python client API provides the user the possibility to create RGB combinations within Python and embed the results in existing data analysis pipelines.

Web client: Planetserver's web client is developed in a very minimalistic and non invasive way (Figure 1). It provides an easy and intuitive way to visualize and analyze hyperspectral imagery. It contains a 3D/2D globe where all available cubes are deployed. The left panel contains the projections, base map selector and the RGB combinator. The RGB combinator is pre-populated with CRISM products [9] translated into WCPS. In the right menu, the plot docks for single spectra retrieval and for spectral ratio calculations are located. Both plot docks can load the splib06a [10] spectral library in order to pursue a first study of the CRISM spectra vs. laboratory spectra. PlanetServer provides access to two planetary bodies with one dataset each: CRISM TRDR on Mars and M3 Level2 on the Moon (beta version), both retrieved from the PDS. Access to different planetary bodies is provided through separate clients with Solar System target-specific features.

Results: The web client gives a first impression of the results which can be further developed using the Python API. As an example of an analysis completed using the API, figure 2 shows the output of the image FRT0000C202 with the RGB combination R: BD1900_2; G: MIN2200; B:D2300 from [9]. The results can be compared to previous studies [11] where kaolinite and Fe/Mg smectite have been detected.

Discussion: Results using PlanetServer correlate with previous studies [9], [11], [12]. The creation and population of a library of WPCS queries with summary products and hyperspectrally derived indices allows reproducible analysis and workflow. All components of PlanetServer (server engine, web client and Python API) are open source and suitable for customization for specific purposes, as well as using additional datasets.

Ongoing work: Currently, we are finishing the preprocessing of M3 data for the Moon. A beta version with few coverages is already available and can be accessed by clicking the Moon icon in the web client. Future plans cover the inclusion of topographic data (MEX HRSC) and MEX OMEGA data.

References

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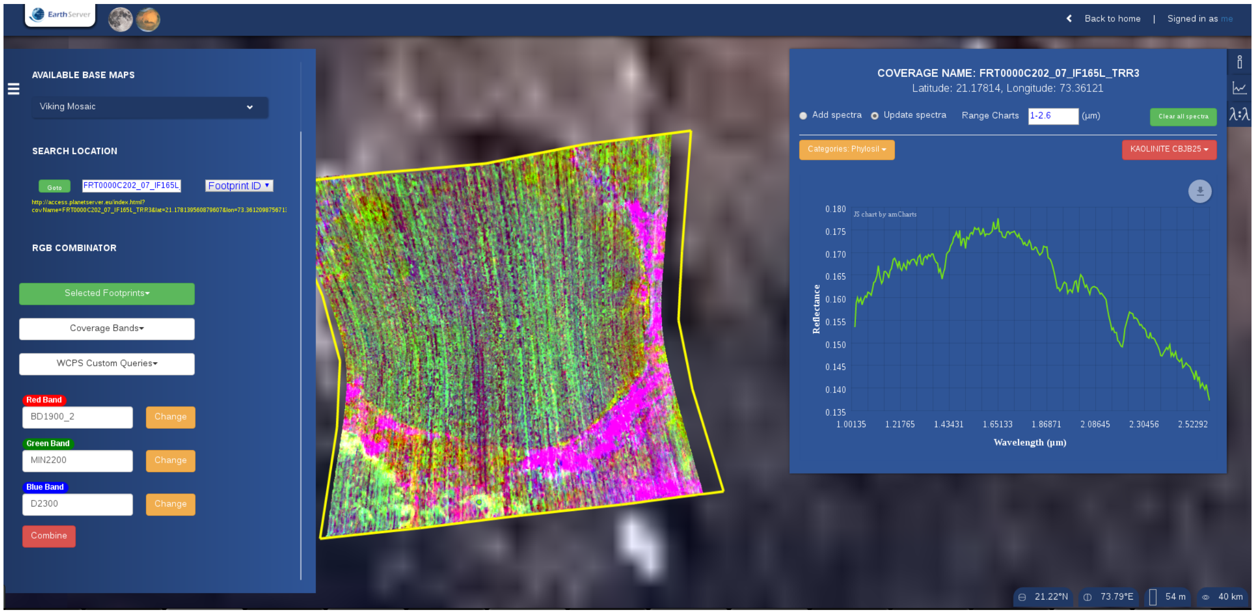

Figure 1: PlanetServer web client outlook showing an RGB combination (R:BD1900_2, G:MIN2200, B:D2300)for Kaolinite and Fe/Mg smectites detections. The plotting dock shows the spectrum at a location 21.17814°N, 73.36121°E where kaolinites are visible.

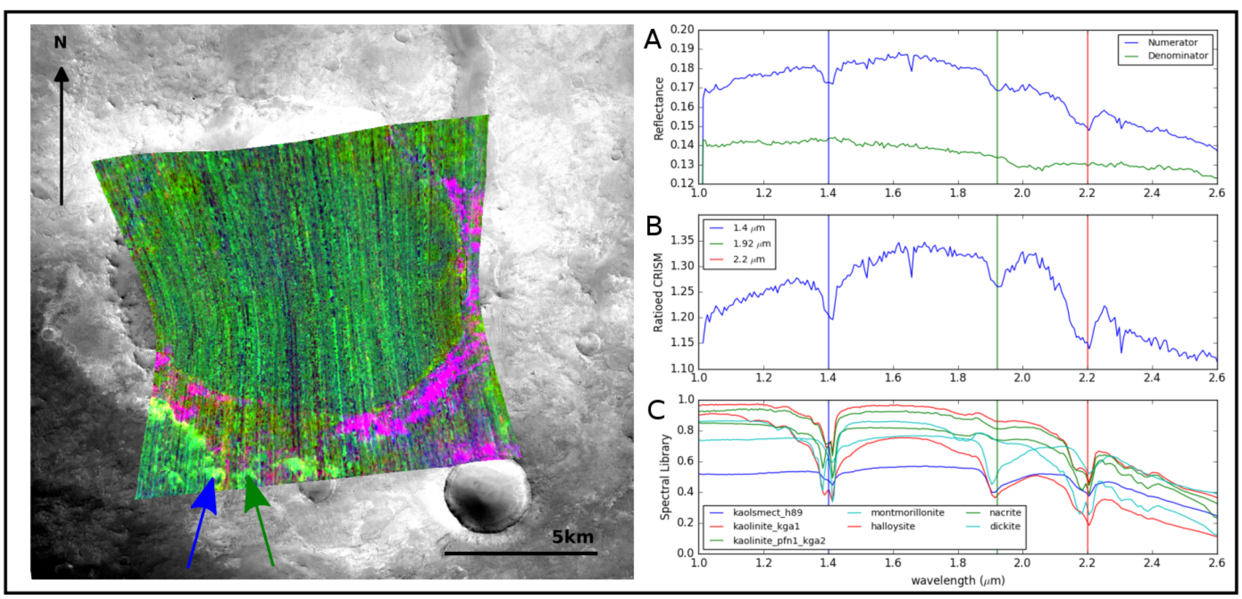

Figure 2: Kaolinite found in the image FRT0000C202 located in Nili Fossae. The RGB combination has been calculated using R: BD1900_ 2; G: MIN2200; B:D2300. A) Spectra collected at 21.17468°N, 73.31922°E (numerator) and 21.16931°N, 73.33749°E (denominator) are shown. The ratioed (B) spectrum of the numerator and denominator in A is presented. The vertical lines at 1.4, 1.92, and 2.2 mm correspond to absorption bands related with kaolinite, halloysite or kaolinite smectite clays. As seen in C the CRISM spectra has a better fit to kaolinite rather than montmorillonite as it coincides with the characteristic 2.16 µm absorption band found in kaolinites.