Development of a Mars Web-GIS for viewing multiple kinds of spectral data from orbiters

*Yuya Matsubara[1], Hironori Fukuchi[1], Yoshiko Ogawa[1], Yohei Hayashi[2]

1. The University of Aizu, 2. National Astronomical Observatory of Japan

The VIS-NIR reflectance spectra observed during latest Mars orbiter missions are of high quality and cover the whole globe. Such data sets are very informative for understanding the materials and their distribution on the surface. Each mineral has unique absorption bands in the spectra. We can identify which minerals are present by comparing the absorption bands of the observed spectra with the known absorption bands in the spectra measured in laboratories. In the case of Mars, we can estimate the type and distribution of hydrous minerals which leads to important clues to understand the water environment.

However, the VIS-NIR spectral data observed on Mars are not well utilized among the community. There are huge volume of accumulated data due to an increasing number of missions and various kinds of instruments with higher accuracy. It is not easy to process huge data and understand the relevance of them visually and intuitively.

We develop a new Mars web-GIS application, "Red Ace", to view and download the Mars observation data, especially the VIS-NIR spectra (image cube data format), easily and intuitively. The Red Ace handles multiple kinds of observation data: the Compact Reconnaissance Imaging Spectrometers for Mars (CRISM) data, the Thermal Emission Imaging System (THEMIS) data and DEM (Digital Elevation Model) data at the same time. Additionally, we use the DEM data from the Mars Orbiter Laser Altimeter (MOLA) to display 3D map of Mars with the Red Ace.

The Red Ace is developed based on CesiumJS that is an open source JavaScript library for 2D/3D maps. The user can choose the dimension of the map. In the Red Ace, the spectral observation points are displayed on the surface image layers. When the user clicks any point on the footprint of the layer, the color of the selected footprint changes and the thumbnail image appears. When the user selects any pixel on the thumbnail image, the Red Ace provides reflectance spectral data and ancillary data as graphs and tables. In response to user operation, multiple kinds of spectral data are displayed on the same window. The Red Ace also provides band- ratio images of THEMIS. The user can download band-ratio images, spectral data and ancillary data as files of PNG, CSV, JSON, XLSX and PVL formats. The user can move the windows displaying thumbnail image and graph freely. In addition, the Red Ace provides the function to control the Mars base map changing the exaggeration of height of the Mars globe. The user can change the order of layers and transparency of layers arbitrarily. The user can also jump to the region of interest directly by setting the coordinates and the zoom level. The user can handle these functions smoothly.

In the case of THEMIS, published data from the mission data archive are not reflectance data but radiance data. Therefore, the Red Ace derives reflectance data from radiance data and ancillary data, in order to compare them with CRISM spectra observed in the same spot.
In this study, considering the portability and extension of the application, the Docker was used for the development environment. Docker is an open source software platform that allow the user to develop applications quickly using containers. JSON format is adopted for data handling to make it easier to add new observation data from new observation equipments in the future. In the JSON format, it is unnecessary to associate item order and item meaning. Hence, it has high reusability and freedom. In the

Red Ace, by standardizing the structure of JSON format data in advance, it is possible to store and handle diverse data by using the same data structure.

Keywords: Mars, Spectral data, Web-GIS

