

MAP-A-PLANET 2 MOSAIC PROJECTION WEB SERVICE: S.W. Akins, T.M. Hare, R.M. Sucharski, J. Shute, L. Gaddis, T. Gaither, J. Richie. U. S. Geological Survey, Astrogeology Science Center, 2255 N. Gemini Drive, Flagstaff, AZ, 86001 (sakins@usgs.gov).

Introduction: The USGS Astrogeology Science Center has developed Map-A-Planet 2 (MAP2), an update to the existing Map-A-Planet [1] of the Planetary Data System (PDS), an on-line tool for extracting science-ready, map-projected images from global mosaics. MAP2 stores the mosaics in a searchable document management system or data portal called Astropedia (<http://astropedia.astrogeology.usgs.gov>) [2]. The user enters a mosaic selection and processing options that are executed on a local processing cluster using tools in Astrogeology's "freeware" image processing package Integrated Software for Imagers and Spectrometers (version 3 or "ISIS3" [3]) and the Geospatial Data Abstraction Library (GDAL, <http://www.gdal.org>) [4]. When the processing is complete, the user is notified by email to collect the product from the web site.

Background: The current version of PDS Map-a-Planet (MAP) is heavily relied on by planetary scientists, educators, and students at all levels. The site receives an average of 620,000 hits and a download average of 447 GB per month. MAP allows users to explore digital, global mosaics of the planets and satellites created from PDS data obtained from a wide variety of planetary missions through a web interface. Users can customize and download map-projected image maps of the Moon, Mars, Venus, and other planets and moons. The MAP image processing engine, called Mapmaker, was an innovative tool created 14 years ago (in 1997) to locate and load the tiles required to produce a requested digital mosaic, scale the tiles to the desired resolution, knit the tiles together, then apply a density stretch and projection to finalize the product requested.

Several limitations in the current MAP implementation have led to this update of the service with the development of MAP2. Currently, the steps required to prepare a new map base are lengthy and time-consuming. The base image must be tiled, pyramided and processed for use as both a web browseable map and for processing by the MapMaker engine. The software implementation does not support hardware which scales on demand and this can result in long wait times when there is heavy use. Finally, the current MAP uses ISIS2 [5] as its underlying processing engine, which is no longer under support or maintenance in Astrogeology. These aspects of MAP, and the growing popularity of web-based map services

supported by higher internet bandwidths, necessitated the modernization of map delivery services realized in MAP2. In addition, MAP2 products are enhanced by more descriptive metadata and a wider variety of delivery format options.

Implementation: The first step for a new MAP2 user is to request an Astrogeology cloud services account (<http://astrocloud.wr.usgs.gov>). This account will be used as a point of contact to keep the user informed about when their processing requests are complete and to help tailor their web experience. MAP2 extends and reuses the web interface recently developed for the Map Projection on the Web (POW, [6]) service. The MAP2 interface includes the account system, notifications to send e-mail when a job is completed, and job tracking tools to monitor which jobs are running, which products are ready for download, and to review job processing options.

A user will select an image either through a link on a product description page in Astropedia or by browsing the MAP2 eligible products page (http://astrogeology.usgs.gov/search/results?k1=processing_function&v1=MAP2), or by selecting a result from an Astropedia search. The mosaics stored in the Astropedia system are supplemented with detailed FGDC-based (Federal Geographic Data Committee) geospatial metadata [7, 8] about the heritage and quality of each product. The FGDC metadata standard is commonly used to document Earth-based data and includes the scientific rationale for the image, authorship, accuracy, known errors, and other key details. These data help to identify which mosaic images meet the user's scientific requirements. Associated with each mosaic product the user sees detailed information, including the source data, date of creation, geographic extent, coordinate system and map projection used, bit type, digital dimensions, spatial resolution, and (for multispectral products) number of bands, their wavelengths, resolution, and any band math functions used to derive the image. The user can use any or all of these data properties to identify the desired product and to enter a MAP2 processing request to extract a full or portion of a mosaic and/or to calculate a derived product.

MAP2 will provide all of the layers currently available for processing in the existing MAP software and will feature new products as they are released such as the latest mosaics of Mercury from the MESSENGER Team, Lunar Orbiter Laser Altimeter

topography and Lunar Reconnaissance Orbiter Camera wide angle mosaic from the LRO Team, and the newly released Vesta global products from the Dawn Team. Once the user identifies a product in Astropedia for processing with MAP2, they are sent to the MAP2 web interface. The MAP2 web interface prompts them to download the entire product or to identify the processing options supported for that product. These processing options include:

- Setting a bounding box to extract a desired sub-scene or a smaller, more manageable product,
- Selecting an output map projection (i.e., Polar Stereographic, Sinusoidal),
- Selecting which band(s) from a multi-band image to use for grayscale or an RGB image,
- Selecting from a defined set of band math functions,
- File format for the finished product including GeoTIFF, GeoJPEG2000, ISIS3 cube, PDS image, or simple graphic formats like Jpeg and PNG with GIS headers.

The availability of these published functions for creating derived products that are selectable by the user supports straightforward science analysis with the MAP2 data. For example, for multispectral images such as those of the Clementine Ultraviolet/Visible (UVVIS) mosaic [9], a list of published band math functions (implemented using the ISIS3 function fx) is provided for user selection. The derived iron content (FeO wt. %) function of Lucey et al. [10] was used to create **Figure 1** (where f1 is mapped to band 2 and f2 is mapped to band 4):

$$17.427 * \left(-\operatorname{atan}\left(\frac{f2}{f1}\right) - 1.19 \right) - 7.565$$

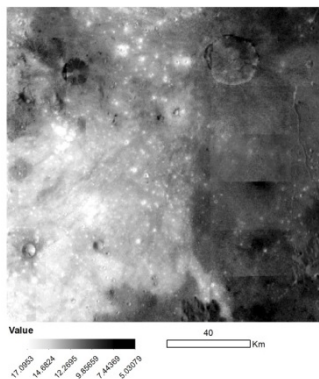


Figure 1. Derived FeO wt % map created in MAP2 from the Clementine UV/VIS mosaic after the Lucey 2000. Legend and scale bar added in ArcMap.

When a user's processing job is finished, they will be notified by e-mail that their MAP2 products are ready. In addition to the requested image product, supporting files are included in a .zip archive from the processing results web page. Supporting files include a text document listing the ISIS3 commands that were used to create the product. This documents the steps needed to create the product and allows the user to duplicate the process as needed and to become more familiar with ISIS3.

Summary and Future Plans: The MAP2 service provides a simple way to create map-projected, usable science or publication-ready products. In the future, we will be improving the MAP2 user interface to provide a web map for navigating and selecting the clipping boundary. There will be more help and guidance for users selecting their processing options to ensure the user understands the impact of choices they are making. We will be adding the ability to re-use previous job processing requests, thus allowing users to take advantage of new products with confidence the products are consistent with previous versions.

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References: [1] Garcia, P. A., et al., 2010, LPSC 41, abstract 2669 and references therein. [2] Bailen, M.S., et al., 2012, LPSC 43, abstract 2478 and this volume. [3] Keszthelyi, L., et al., 2013, LPSC 44, abstract 2546 and this volume. [4] Hare, T.M., et al., 2007, LPSC XXXVIII, abs #2364. [5] Gaddis et al., 1997, LPSC 38, p. 387, 1997. [6] Hare, T.M., et al., 2013, LPSC 44, abstract 2068. [7] see <http://www.fgdc.gov/>. [8] Hare, T.M., et al., 2011, LPSC 42, Abstract 2154. [9] Eliason, E.M., 1997, LPS XXVIII, 331-332. [10] Lucey, P.G. et al., 2000, Journal of Geophysical Research, 105(E8), pp. 20297-20305.