USING THE PDS PLANETARY IMAGE LOCATOR TOOL (PILOT) TO INVESTIGATE SMALL BODIES.

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Introduction: The Planetary Image Locator Tool (PILOT) is a web-based search interface (http://pilot.wr.usgs.gov) that accesses numerous NASA Planetary Data System (PDS) image catalogs [1]. PILOT was developed and is maintained by the Cartography and Imaging Sciences ("Imaging") Node to complement other node delivery services such as the Planetary Image Atlas (http://pds-imaging.jpl.nasa.gov/search/). Functionality was recently added to PILOT to access PDS image data catalogs for Dawn Framing Camera images and metadata for the asteroids Vesta and Ceres. The Dawn data archives are managed for PDS by the PDS Small Bodies node.
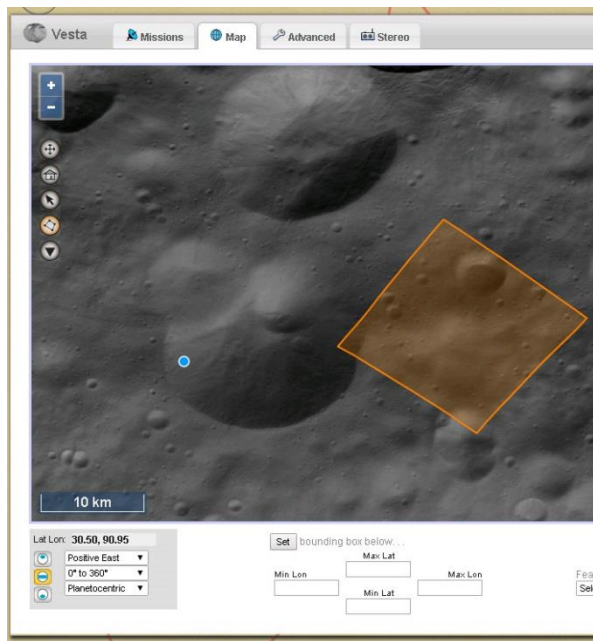

Figure 1: Screenshot from PILOT showing Map Tab with Vesta base map and an image footprint.

Background: PILOT (*Figure 1*) is part of the online data services suite that USGS provides for NASA planetary programs [2]. This suite also includes infrastructure services such as the Unified Planetary Coordinates (UPC) database [3], planetary nomenclature [4], and data services such as map Projection on the Web (POW) [5], Map-a-Planet 2 [6], and the Imaging Node Annex [7]. All of these services rely on Astrogeology's powerful data processing cluster and Integrated Software for Imagers and Spectrometers (ISIS 3, [8]) to provide camera models, accurate image geometry and map projection capabilities. POW allows users to convert raw PDS images to science-ready, map-projected products. MAP2 allows global, map-projected image products to be reprojected, stretched, clipped and delivered in a variety of useful image formats. The Annex supports PDS archiving and delivery of geospatial products derived from PDS data.

Scientific and Cartographic Advantages of Using PILOT: PILOT provides numerous benefits to the planetary scientist or cartographer seeking imaging data of a small body:

- *Metadata:* PILOT has direct access to the metadata accrued and stored in the UPC database [3] maintained by the Imaging Node. The UPC is a database containing improved geometric, photometric, and positional information about planetary image data, computed using a uniform coordinate system and projected onto the most current digital elevation model [9]. These improvements result in planetary image footprint accuracies increased by up to 12 km for a given planet, they enhance the user's ability to identify desired images, and they extend beyond those provided by the PDS. Precise searches can be performed within PILOT on individual metadata fields stored in the UPC database. In addition, PILOT has access to browse images, links to the raw images, and label information that can help scientists and cartographers perform further investigations on the images.

- *Completeness:* Although all data in the UPC and PILOT must be supported by an ISIS camera model that describes detailed instrument and target geometric behavior during image acquisition, together these services address ~90% of the image data for which Imaging node is responsible to the PDS. PILOT searches all image data released to the PDS by each mission and instrument supported. Every image is processed and "mapped" onto a target body. For images that cannot be accurately mapped (such as star calibrations or limb views), the data are still available and included in PILOT through the "unmapped" data. When data and coordinate

pointing are improved, new data are loaded into the UPC and becomes available to PILOT users.

- *Download and Processing Options:* PILOT not only allows users to download select images either individually or through provided scripts to pull large sets of images, it also provides direct access to the POW online mapping tool [5]. POW allows users to prepare the imagery for analysis by radiometrically calibrating and map projecting the products using ISIS 3. Using POW, users need not learn how to use the complex and sophisticated ISIS 3 software system to support their science data needs. POW provides users with science-ready calibrated cartographic images and map projection and processing to create derived data products that can be used readily for applications such as geologic mapping, change detection, merging of dissimilar instrument images, analysis in a Geographic Image System (GIS) and use in a host of other scientific applications (e.g., ArcMAP, ENVI, Matlab, JMARS, QGIS, Opticks, etc.). POW users also benefit from several mission data processing pipelines in ISIS 3 (e.g., HiRISE, LROC). Finally, the POW service can be used as a learning tool or an introduction to ISIS 3 because a detailed log of the ISIS 3 commands and their settings is provided along with processed data products.

- *Stereo Matching:* PILOT contains the functionality to compute potential stereo pairs [10] for selected areas of interest on any target body. Stereo pairs are useful for scientists or cartographers needing to create a topographic model to perform such research as slope and roughness analysis; landing site determination; wind, water, landslide and lava flow modelling; orthorectification for cartographic products, anaglyph creation, simulated 3D flyovers, and more. PILOT simplifies the task of finding stereo pairs by allowing real-time culling of stereo matches and visualizing the areas of interest on actual base maps.

Accessing Dawn FC Data: To access Dawn Framing Camera image data through PILOT, find the "Small Bodies" subheading on the home page and select the body you wish to investigate (example: Vesta). Once the target is selected, PILOT switches to the mission select panel, allowing you to choose the mapped or unmapped data from the Dawn mission. Choose the mapped data and then use the Map tab (*Figure 1*) or Advanced tab to limit your search. Results are presented on the right panel in PILOT (*Figure 2*). Users can view the thumbnail images, view the PDS image label or an enhanced label, then select and download single or multiple image collections.

For more information on PILOT and other USGS Astrogeology online tools and services, visit the Frequently Asked Questions data (see https://pilot.wr.usgs.gov/index.php?view=faq) or submit a question at the contact center (https://astrogeology.usgs.gov/contact).
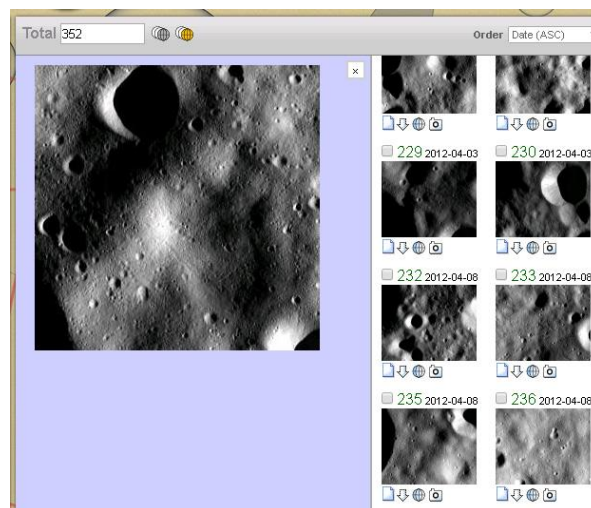
Figure 2: PILOT screenshot showing right panel for browsing Dawn FC images within the footprint designated in Figure 1.

References: [1] Bailen, M. et al. (2013) LPSC 44, abs. # 2246. [2] Hare, T. et al. (2014) LPSC 45, abs. # 2487. [3] Akins, S. et. al. (2009) LPSC 40, abs. # 2002. [4] Blue, J. et al. (2013) LPSC 45, abs. #2178. [5] Hare, T.M. et al. (2013) LPSC XLIV, abs #2068. [6] Akins, S.W. et al. (2014) LPSC 45, abs. #2047. [7] Hare, T. et al. (2015) 2nd Planetary Data Workshop, abs. #7060. [8] Keszthelyi, L. et al. (2014), LPSC 45, abs. #1686. [9] Archinal, B. et. al. (2010) LPSC XLI, abs. # 2609. [10] Bailen, M. S. et al. (2015) LPSC XLVI, abs #1074.