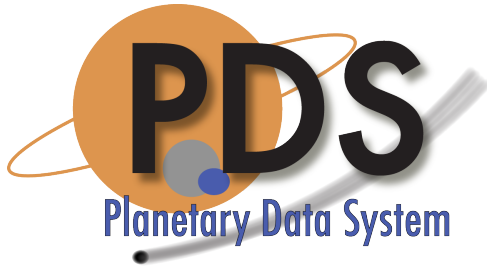# PDS Cartography & Imaging Sciences Node

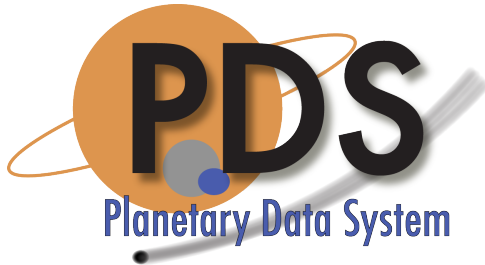## AKA "Imaging" or "PDS-IMG"

Lisa Gaddis & Sue LaVoie

PDSMC Face-to-Face Meeting

JPL, Pasadena, CA

28, 29 September 2015

Imaging Node

- **Team & New Node Members**

- **Science Disciplines**

- **Data Migration**

- **Status & Initiatives**

- **Support for Data Management Plans**
  - **Challenge:** Wide variety of research products proposed

- **Mission Challenges and Issues**
 - InSight: Lots of work, no issues

Imaging Node

Team

- **PI:** Lisa Gaddis (USGS)

- **Co-I, Institutional PI:** Sue LaVoie (JPL)

- **Co-Is:** Trent Hare (USGS), Moses Milazzo (USGS), Sam Lawrence (ASU)

- **Collaborators:**
  - Phil Christensen (ASU), Alfred McEwen (UA), Mark Robinson (ASU), Kerstin Lehnert (Columbia U.), Paul Ramirez (JPL), Kiri Wagstaff (JPL)

Imaging Node

- ## Science disciplines
  - ### Cartography and imaging sciences support
    - Planetary geometric & geodetic data characterization, calibration, geometric & physical camera and instrument modeling and characterization, geographic information system support, global & regional mosaicking and basemap creation (framing, line-scan, push-broom cameras; multi- & hyperspectral imagers, UVVIS, NIR, thermal, radar wavelengths), metadata harvesting and analysis, etc.
  - ### Digital image data served
    - Terrestrial planets, icy satellites, some asteroids
      - Mercury, Venus, Earth, Moon, Mars (Phobos, Deimos); Asteroids Gaspra, Ida, Vesta
      - Outer Solar System satellites (moons of Jupiter, Saturn, Neptune, Uranus)
    - Gas Giant planets
      - Jupiter, Saturn, Uranus, Neptune
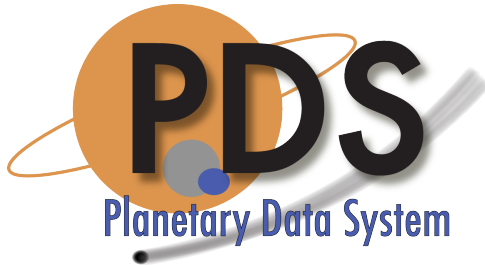
Imaging Node

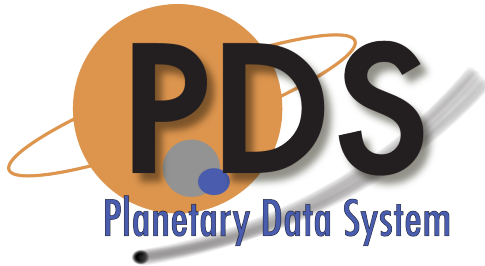- **New Node Members - USGS**
  - **Dr. Moses Milazzo**
    - HiRISE calibration, image processing and analysis software, CubeSat mission design
    - **PDS tasks:** Calibration dictionary, mission interface, others TBD
  - **Dr. Sam Lawrence**
    - LROC science team, lunar sample analysis, Apollo image archive lead, Lunaserv data server team
    - **PDS tasks:** Cartography, MoonDB lunar sample archive support, others TBD

Imaging Node

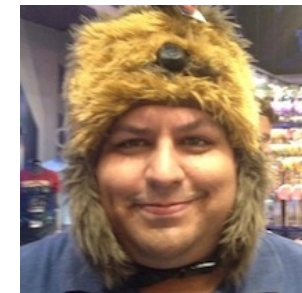- **New Node Members - JPL**
  - **Dr. Kiri Wagstaff**
    - Machine Learning researcher focused on methods for analysis of data; tactical uplink lead for MER.
    - **PDS tasks:** Application of Machine Learning and Data Mining technologies to enable smarter search and science discovery across massive datasets

  - **Mr. Paul Ramirez**
    - Software architect for large-scale data systems (distributed and cloud-based); search engines, information retrieval, data analytics and processing
    - **PDS tasks:** Application of architectures and technologies to improve validation, storage, search and data analytics

Imaging Node

- ## New Node Members – JPL

  - ### Dr. Cynthia Phillips

    - Europa mission science applications and communications coordinator; planetary geologist & image processing expert

    - **PDS tasks:** Mission Interface, Imaging & Geometry dictionaries, user interface testing
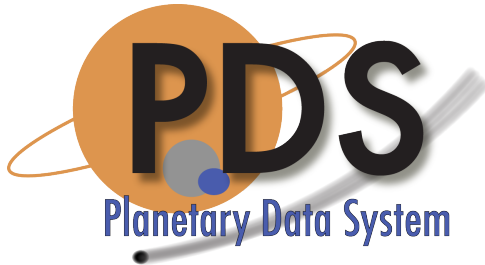
Imaging Node

- **Data Migration**
  - **Majority (~75%) of data require label transformations**
    - Requires additional data dictionaries (calibration, mosaic, telemetry, command, spectral cube, etc.)
  - **Remaining 25% require data manipulation**
  - **Approach (next 5 years)**
    - Perform migration of past mission data requiring only label manipulation (39 data sets)
    - Provide 'on-the-fly' processing for data requiring straightforward manipulation (5 data sets)
    - Provide PDS4 labels and metadata for mission requiring complex manipulation (5 data sets)
  - Migrated data will have both PDS3 and PDS4 labels and metadata to enable searches across all holdings using the PDS4 data registry
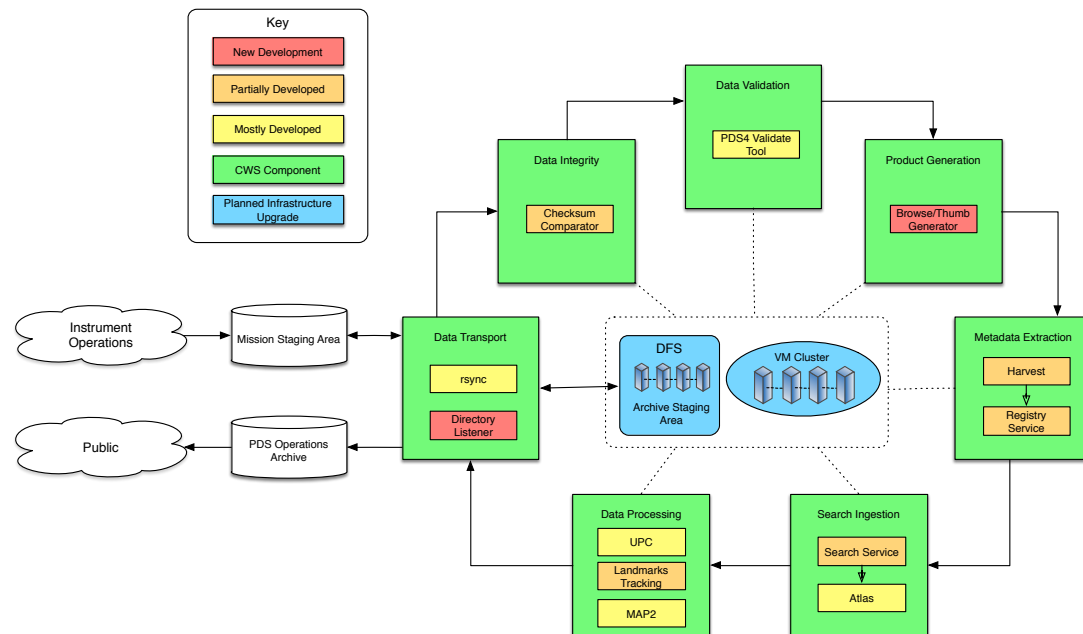
Imaging Node

- **Status & Initiatives (1 of 4)**
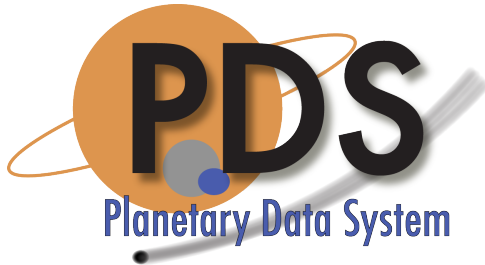 - **Automated Data Archiving Pipeline**
    - Process management system automates processing steps across distributed systems - quick turnaround from data receipt to release for missions and small research projects
    - Leverages AMMOS-developed Common Workflow Service (CWS), EN & IMG tools

Imaging Node

- ## Status & Initiatives (2 of 4)

  - ### Cartographic Searches, On-the-Fly Data Processing
    - PILOT recently added ability to search for stereo image coverage
    - Map Projection on the Web (POW) uses ISIS to create calibrated, map-projected frames for further processing
      - Planned upgrades: Use of backplane data, tonal matching, photometric correction, mosaicking
    - MAP2 delivers 70 regional/global mosaics, more added ~weekly (e.g., Dawn FC image, elevation, shaded relief mosaics recently added)

  - ### Informatics: Content-Based Data Searches
    - Landmark Classification (Wagstaff): automated, content-based search through large volumes of orbital image data
    - Prototype: HiRISE slope-streaks
      - Initial manual image review and algorithm training, detection of desired landmarks (>90% confidence), results database integrated into AtlasIII

Imaging Node

- **Status & Initiatives (3 of 4)**
  - **Informatics: Coordinated Imaging Viewing for In-Situ Missions**
    - Marsviewer tool
      - JAVA application to view EDRs, RDRs (XYZ maps, slope, reachability, mosaics), uses the Webification protocol (w10n) and can run locally on any computer to access data on IMG server
      - Currently supports MER, MSL & PHX; adaptable to other Mars and non-Mars future in-situ missions
  - **Digital Object Identifiers (DOIs)**
    - Unique online product information
      - Metadata that points directly to online products, fixed over product lifetime, registered (e.g., CrossRef, free DOI registration)
   - Propose working with EN as early adopter

Imaging Node

- ## Status & Initiatives (4 of 4)
    - ### MoonDB
        - PDART PI: Dr. Kerstin Lehnert (Columbia Univ.)
        - Database of Apollo lunar sample information from "legacy" and new research, publications, NASA sample compendia
        - Based on existing, widely used EarthChem infrastructure, PetDB architecture, terrestrial sample petrology (mineralogy, geochemistry) database
            - NSF-funded Interdisciplinary Earth Data Alliance (IEDA)
        - Open accessibility, extensive metadata based on terrestrial research and experience, integrated with historical sample and image data
    - IMG and GEO to assist with data formatting, addition of metadata and documentation (e.g., quality), integration with curation and PDS4 data & services, accessibility from lunar geospatial mosaics and maps
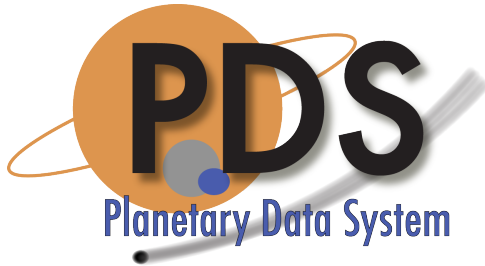
Imaging Node

- **Support for Data Management Plans**
  - **Letter of support**
    - Reviewed by many in MC (many thanks!), vetted for current use (MDAP, LDAP, etc.)
  - **Advice & review**
    - Offer advice & sometimes review of archive plan
    - Mostly we're not asked to do this, because of time pressure
  - **Online materials**
    - PDS4 pointers and information, archive plan template, guidance for proposers, preparers
    - http://pds-imaging.jpl.nasa.gov/help/PDS4.html
    - http://pds-imaging.jpl.nasa.gov/help/proposals.html

Imaging Node

- ## Challenges and Issues
    - ### Missions
        - InSight: Lots of work, but no issues
    - ### New products from research proposals
        - ROSES 2015 requires Data Management Plans for research proposals
            - C1 Planetary Overview (amended)
            - Text box (cover pages) or in proposal text
            - DMP must cover an data needed to validate research conclusions in publications (e.g., figures, maps, tables) as well as data needed to enable replication of results
            - Excludes preliminary or unpublished data, private communications (see SARA: http://science.nasa.gov/researchers/sara/faqs/dmp-faq-roses/)
        - Proposers to PDART, LDAP, MDAP, etc. are requesting support for a wide variety of products (*next slide*)

Research Products	PDS4 IM
Digital Terrain/Elevation Models (DTMs, DEMs)	Array_2D_Image (or _3D for multi-bands)
Reflectance Spectra	Array_2D_Spectrum (or _3D)
Light curves	Table_Binary, Table_Character, Table_Delimited
Image mosaics (regional, global)	Array_2D_Image (or _3D for multi-bands)
GeoTiff images	
- Interleaved tags, discontinuous byte stream	Non-compliant
- Continuous byte stream (image object)	Array_2D_Image (or _3D for multi-bands)
GIS Maps and GIS "Projects" (Vector Layers)	Non-compliant
- Drawn shapes (shapefiles), Coverages	
- Feature class, Point databases	How do we accommodate these for NASA funded mapping and research projects?
- Geologic units, contacts, structure, etc.	
Images (GIF, J2C, JPEG, PDF, PDF/A, PNG)	
- Data products	Non-compliant
- Browse	Product_Browse, Product_Document
PDS3 labeled image cube	Array_2D_Image (or _3D for multi-bands)
ISIS cube	
- Interleaved "tiles" (ISIS default)	Non-compliant
- BSQ (ISIS option)	Array_2D_Image (or _3D for multi-bands)
Software	
- Used for processing (referenced)	Product_Software (Software_Binary, Software_Script, Software_Source)
- Archive product	NASA GitHub (https://github.com/nasa)

Most commonly requested products

Discouraged (non-compliant in PDS4, not likely to change)

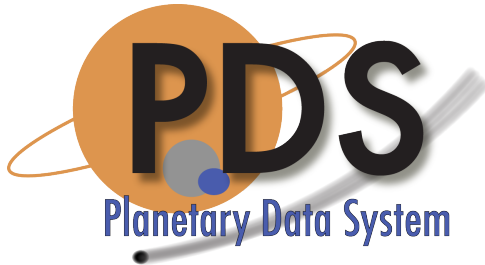Need SCR, discussion and review, etc.

ROSES 2015:

The DMP should contain the following elements, as appropriate to the project, in adequate detail for review.

1. A description of data types, volume, formats, and (where relevant) standards.
2. A description of the schedule for data archiving and sharing.
3. A description of the intended repositories for archived data, including mechanisms for public access and distribution.
4. A discussion of how the plan enables long-term preservation of data.
5. A discussion of roles and responsibilities of team members in accomplishing the DMP. (If funds are required for data management activities, these should be covered in the normal budget and budget justification sections of the proposal.)

Typical DMPs will describe plans for the publication of data in scientific papers, in online supplemental material to scientific papers, in the Planetary Data System (PDS) or equivalent public archives, or on websites that serve as accepted community repositories for specific types of data.

DMPs will be reviewed as part of the overall NASA research proposal review process. NASA reserves the right to require the revision of the DMP prior to selection or funding. Funded researchers, research institutions, and NASA centers are responsible for ensuring and demonstrating compliance with the DMPs approved as part of their awards. Awardees who do not fulfill the intent of their DMPs may have continuing funds withheld and this may be considered in the evaluation of future proposals.

Planetary Data Workshops

- ## 1st Planetary Data Workshop
  - 2012 meeting report (USGS Open-File Report):
    - http://pubs.usgs.gov/of/2014/1056/

- ## 2nd Planetary Data Workshop
  - 110 attendees
  - High Country Conference Center, Flagstaff, AZ
    - Resounding support for same time (of year), same place in 2017
  - USGS site, agenda, abstracts, presentations:
    - http://astrogeology.usgs.gov/groups/Planetary-Data-Workshop
    - https://docs.google.com/spreadsheets/d/13gPNXS-W-jxhaZg-_l5UbP4WWlCcjNJncOBlEa-dgz0/pubhtml
  - LPI site, abstracts:
    - http://www.hou.usra.edu/meetings/planetdata2015/