NASA PDS GEOSCIENCES NODE STATUS UPDATE. Jennifer G. Ward, Edward A. Guinness, Daniel M. Scholes, Thomas C. Stein, June Wang, and Paul K. Byrne, Department of Earth and Planetary Sciences, McDonnell Center for the Space Sciences, Washington University in St. Louis, 1 Brookings Drive, Campus Box 1169, St. Louis, Missouri, 63130, jgward@wustl.edu.

Introduction: The Geosciences Node of NASA's Planetary Data System (PDS) archives and distributes science data related to the study of surfaces and interiors of terrestrial planets and their moons. These data, along with tools and expert advice on their use, are provided at no cost to scientists, educators, and the public.

Geosciences Node Overview: The Geosciences Node archives include data from past NASA planetary missions as far back as the Apollo, Viking, and Mariner programs in the 1960s and 1970s, current missions, and individual investigators. Our archives currently contain 390 terabytes of digital data and are expanding at a rate of about 20–25 terabytes per year.

The Geosciences Node works closely with NASA, several international planetary missions, and individual researchers to help them design high-quality, well-documented, peer-reviewed data archives. The Geosciences Node typically serves as the lead PDS Node for missions to Mercury, Venus, Mars, and the Moon in cases where the main objective is to study the surfaces and interiors of these bodies. As lead Node, we coordinate archiving among all PDS Nodes involved with a given mission, in addition to archiving data from relevant instruments. Table 1 lists the active and developing missions that deliver or will deliver data to the Geosciences Node.

The Geosciences Node's primary interface to the planetary science community is our website at pds-geosciences.wustl.edu, where all Node holdings are available for download. Other services include the Orbital Data Explorer (ode.rsl.wustl.edu) [1], the Analyst's Notebooks (an.rsl.wustl.edu) [2], the Spectral Library web interface (pds-speclib.rsl.wustl.edu), and the Community Forum (geoweb.rsl.wustl.edu/community). We also offer Digital Object Identifiers (DOIs) for our datasets (pds-geosciences.wustl.edu/dataserv/doi.htm). Questions about any of our data or services may be sent to geosci@wunder.wustl.edu.

Recent Activities:

Mars Sample Dossier. We provided guidance to the Mars 2020 science team on development of the Sample Dossier archive, including proper content and documentation. Initial reports for the first 21 collected samples are posted in the Node archive. In addition, related images and metadata are available in the Perseverance Analyst's Notebook.

Artemis. We began work with the Artemis program to discuss PDS support for Artemis III data management and archive plans. Efforts are focused on understanding anticipated data acquisition, detailing archive considerations for mission planning, and ensuring lunar science data are properly preserved and made accessible for the science community.

Mars Sample Return. We continued support of the Mars Sample Return (MSR) program's sample collection inventory archive planning and ongoing creation of the MSR Three Forks Depot archive. Efforts will continue in 2024 to help develop an archive plan for Phase E activities.

CLPS DASS. We are continuing to support the upcoming Commercial Lunar Payload Services (CLPS) missions through the Data Archive Support Service (DASS). This resource provides tools for teams delivering data from the numerous CLPS payloads. These resources are continually updated based on feedback from CLPS teams as they prepare their archives. The first launches are scheduled for early 2024.

Table 1. Geosciences Node Archives of Active and Developing Missions

Active Missions	**Science Experiments**
Mars 2020*	PIXL, RIMFAX, SHERLOC, SuperCam, Returned Sample Science
MSL*	APXS, ChemCam, CheMin, DAN, SAM
MRO*	CRISM, SHARAD, Radio Science
LRO*	Diviner, LEND, LOLA, Mini-RF, Radio Science
Mars Express*	ASPERA, HRSC, MaRS, PFS, MARSIS, OMEGA, SPICAM, VMC
Mars Odyssey*	HEND, NS, Radio Science
Developing Missions	**Science Experiments**
CLPS*	*Various*
VIPER*	MSolo, NIRVSS, NSS, TRIDENT, Rover Imaging
Lunar Trailblazer*	HVM3, LTM
Europa Clipper	MISE, REASON, Radio Science/Gravity
Dragonfly*	DraMS, DraGNS, DraGMet
EnVision VenSAR*	VenSAR
VERITAS*	*Under Discussion*
* Geosciences as Lead PDS Node	

Astromaterials. We are continuing support of community astromaterials planning, archiving, and discovery efforts. In addition to the Geosciences Node Spectral Library (pds-speclib.rsl.wustl.edu), we

provided archiving guidance to Astromaterials Data System personnel and joined the newly-formed Extraterrestrial Materials Analysis Group (ExMAG) Working Group on Astromaterials Data Management and Archiving.

PDS3 to PDS4 Migration. The Geosciences Node continues to work towards migrating all our legacy PDS3 holdings to PDS4. Table 2 shows our current status. In 2023 we completed migration of most of our Lunar Reconnaissance Orbiter (LRO) datasets, as well as three Magellan and four Clementine datasets. We expect to complete migration of all datasets from these three missions in 2024.

We continue to assist the Mars Science Laboratory (MSL), Mars Reconnaissance Orbiter (MRO), and Mars Odyssey missions in the conversions of their data processing pipelines to PDS4. Five of our MSL datasets are now being delivered in PDS4 and the rest will follow in early 2024. MRO teams expect to do the same by the end of FY24 and Odyssey by the end of FY25. Migration of older MSL, MRO, and Odyssey data will follow the schedules listed in Table 2.

Table 2. PDS3 to PDS4 Migration Status

PDS3 Completed Mission Archives at the Geosciences Node	**PDS4 Migration Status and Schedule**
MER	Complete
MESSENGER	Complete
Chandrayaan-1	Complete
Lunar Prospector	Complete
LCROSS	Complete
GRAIL	Complete
Magellan	In progress FY22–24
Clementine	In progress FY23–24
Apollo	FY25
Mars Phoenix Lander	FY25
Mars Global Surveyor	FY23–25
Mars Viking Lander	FY24
Mars Viking Orbiter	FY25–26
Mars Pathfinder	FY26
PDS3 Active Mission Archives at the Geosciences Node	**PDS4 Migration Status and Schedule**
LRO	In progress FY23–24
MRO	In progress FY23–25
MSL	FY24
Mars Odyssey	Best effort

Individual Investigators. The Geosciences Node continues to work with individual data providers to archive those datasets appropriate for PDS archiving, principally in support of mission operations and/or of regional or global scale and generated primarily through NASA data analysis programs. Currently there are 45 pending archives in the queue, with data submitted from multiple ROSES programs including CDAP, MDAP, LDAP, PDART, and SSW.

Application Program Interface (API). To support data accessibility, open science, and modern programming techniques, the PDS has developed an application programming interface (API) for accessing the PDS archives, which was released for public use in the summer of 2023. The API allows software developers, researchers, and automated processes to search archives, pull metadata, and download associated PDS archive documents and observation data. The Geosciences Node participates in the review and testing of the PDS API, which is actively developed and maintained by the PDS Engineering Node.

What to look for in 2024–2025: The Geosciences Node will continue to migrate most of our legacy PDS3 archives to PDS4 over the next several years, notably data from the Viking Lander, Magellan, and Clementine missions in FY24. Further, in parallel with our work supporting active and upcoming missions, the Geosciences Node will continue to advise instrument teams from the Europa Clipper, Dragonfly, and Lunar Trailblazer missions, as well as EnVision VenSAR and CLPS providers, to design, plan, and implement their archives. Archiving of data from the first CLPS mission will begin in summer 2024.

The Orbital Data Explorer (ODE) map search interface, related services, and map-processing pipeline are scheduled for an upgrade to the latest version of the ArcGIS map server. ODE will be updated with active mission data releases and migrated PDS3-to-PDS4 data, including future releases of PDS4 MRO HiRISE data and PDS4-migrated Magellan, Clementine, Odyssey GRS, and MGS MOLA and TES data.

Enhancements to map services and sol document search were added to the Analyst's Notebook (AN) in 2023 [2], and image measurement functions for the Perseverance rover will be added in early 2024. Additional updates related to PDS4 migration tasks will bring performance improvements to internal functions. Curiosity and Perseverance rover archive data and daily reports will be added commensurate with scheduled data releases. The Mars 2020 science target and sample dossier archives will be incorporated when released. Further, the development of ANs for the VIPER and Dragonfly missions will take place, and the legacy Apollo and LCROSS ANs will be updated to the latest framework.

References: [1] Wang, J. et al. (2024) LPS LV, this volume. [2] Stein, T. C. and F. Zhou (2024) LPS LV, abstract #1255.