

**THE FUTURE OF INFORMATION SERVICES IN ASTROGEOLOGY.** A. E. Zink<sup>1</sup>, M. A. Hunter<sup>1</sup> and J. J. Hagerty, USGS Astrogeology Science Center (2255 N Gemini Drive, Flagstaff, AZ, 86001 (azink@usgs.gov)).

**Introduction** The USGS Astrogeology Science Center (ASC) in Flagstaff, Arizona serves as a repository, access point, and distribution facility for planetary data and products, as well as an archive for the ASC and historic mission information. In this role, the ASC is tasked with preserving the history of astrogeological research and exploration while providing useful services and products to assist in the continued exploration of the Solar System. As planetary spacecraft and their resulting data products evolve, it is important to keep pace with evolving user needs while also making sure that a historical foundation is continuously maintained. The following information details how this challenge will be addressed.

**Assessing Planetary Science Community Needs:** Historically, providing access to hard copies of planetary geologic maps, photographic images, mission reports, and other mission information has been a large part of the ASC's service to the planetary science community; however in today's digital world, many of these resources and services are not in such high demand. Re-evaluating the products and services needed by the planetary community is essential to maintaining an active and useful role in facilitating planetary research.



**Figure 1.** USGS ASC planetary image, document, and map storage.

Similar to other recent efforts by the ASC [e.g., 1,2], we are developing a web-based survey for determining the information needs of the planetary science community that will be available at this conference. The survey covers a range of topics related to planetary information and services, including access, preferred formats, and training. Generalized, anonymous

survey results will be made available in a short abstract or white paper later this year.

**Digitization and Remote Access:** Recognizing that the vast majority of the planetary community does not have direct access to and may not be able to visit the ASC, making resources digitally findable and accessible to remote users is necessary.

A selection of unique historical documents has been identified by NASA and the ASC for priority digitizing during the 2020 fiscal year, and additional items from the ASC archive collections will be digitized soon thereafter. Selected items that may be of particular interest given the current NASA directive to return humans to Earth's Moon include documents, schedules, and reports relating to the Apollo astronaut trainings conducted by ASC. Additionally, Astrogeology Center Monthly Reports dating back to 1960 that detail research, publications and presentations, visitors, and mapping progress will be digitized and made available to the community. Although the goal is to eventually make much of the collections available digitally, it is important to note that digitization does not mean hard copies will be disposed of, but instead will be made available to a greater audience.

**Metadata and Standards.** In order to make ASC archive collection items and newly digitized information easily findable, ASC will employ the use of standardized metadata in an online searchable and browsable archive database and item records will be updated to include Federal Geographic Data Committee (FGDC) created Content Standard for Digital Geospatial Metadata (CSDGM) descriptor fields. ASC researchers have proposed a planetary geology extension to the FGDC CSDGM which will allow for more complete descriptions of the diverse item types in ASC collections [3]. These metadata records will be used to establish a catalog using the Open Geospatial Consortium (OGC) Catalog Service on the Web (CSW) standard for geospatial search.

**On-site Facility Usage:** In addition to reworking remote access to ASC data and products, it is important to reassess use of physical space. An ongoing project to reorganize and refine the archive and physical product collections will bring collections that have been split into different storage areas together into one climate-controlled, publicly accessible archive and research space. This ensures that items will be correctly stored for preservation while still being accessible to researchers. Refining collections by identifying items that are better served by other institutions ensures that

those items have the specialized conservation efforts they require and frees up space for continued reorganization. As a part of this effort, in 2019 ASC transferred nine pallets of Lunar Orbiter and Apollo film to the National Archives and Records Administration (NARA) and more films are expected to be transferred in 2020. This thoughtful reorganization of space allows for the creation of multi-use collaborative spaces that can change to meet community needs.

1:11,000,000-SCALE MAPPING  
REPORT FOR MONTH OF February, 1971

x - Stage complete  
p - in progress  
90 - Percent complete

		Revision of preliminary (R)	on new start (N)	Author's draft-map	Author's draft-explanation and text	Consultant's first review	Author's revision	First technical review	Author's revision	Second technical review	Author's revision	Third technical review	Author's revision	Consultant's second review	Branch Chief's approval	Editorial review (ED)	Author's revision	Director's approval; in drafting (DD)	In press (IM)	Published
Equatorial Belt																				
	ARISTARCHUS LAC 39	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	BYGIUS LAC 74	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	CLEMENS LAC 44	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	COLUMBO LAC 73	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	COPERNICUS LAC 58	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	FRAGASTORTIS LAC 97	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	GEMINI LAC 74	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	HEVELIUS LAC 56	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	JULIUS CAESAR LAC 60	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	KEPLER LAC 37	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	LANGRENS LAC 80	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	LEYBOND LAC 95	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	MACGREGOR LAC 43	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	MARE RIMORIUM LAC 93	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	MARE SERENITATIS LAC 42	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	MARE UNDARUM LAC 62	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	MARE VAPORUM LAC 59	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	MONTES APENNINUS LAC 41	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	MONTES RIFRAGUS LAC 74	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	PIETAVIUS LAC 98	R	100	60																
	PITAVIUS LAC 94	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	PROLARIUS LAC 77	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	PURBACH LAC 95	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	RIESES ALTA LAC 96	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	SILESIUS LAC 38	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	SARITIVUS LAC 61	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	SHOPLISS LAC 78	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	TIMCHARIS LAC 40	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Northern Hemisphere (32°N - 64°N)																				
	ARISTOTELIS LAC 13	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	CASERTI LAC 25	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	EURODUS LAC 28	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	GEMINUS LAC 27	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	L'HERICHEL LAC 11	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	PLATO LAC 12	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	RUMER LAC 23	R	100	50																
	ELINE TRIPON LAC 24	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Southern Hemisphere (32°S - 64°S)																				
	CLAUDIUS LAC 176	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	HORNEL LAC 127	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	MAURITIUS LAC 113	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	SHIFIA LAC 118	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	SCHICKARD LAC 110	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	SCHILLER LAC 125	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	SYDNEY LAC 112	R	100	100	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	WILHELM LAC 111	R	100	90																

Figure 2. Table showing Lunar mapping progress from the February 1971 Astrogeology Center Monthly Report.

**Community Outreach:** Adopting a practice of reaching out through involvement in the various aspects of planetary research is an essential part of continued support of the planetary science community. Such involvement will be essential to leverage new ideas, technology and collaborative opportunities as the community continues to grow and mature.

As part of a larger effort to support the realization of a robust planetary spatial data infrastructure (PSDI), ASC is well-positioned to serve as a model for organizations across the community that hold collections of valuable historical material [4]. This includes the promotion of best practices for handling, digitizing, cataloging and describing historical records and derived data products. In addition to the planetary metadata

extension under development, ASC also released a JavaScript library for handling planetary coordinates in the OpenLayers web map viewer. When coupled with open data technology such as OGC cataloging and data exchange services, small groups with limited funding will be able to make their holdings discoverable and usable in science-ready formats. Further, ASC is able to advocate for the planetary science community at standards and technology workshops, and be responsive to changes in community needs.

**Moving into the Future:** The USGS ASC is coordinating multiple efforts across the center to ensure we provide the best, most consistent, and useful products and services to the planetary science community. We are exploring the production, archival, and dissemination of derived data products that will ultimately be made available to people around the world. We will also be investigating new technologies and services associated with the visualization and multi-dimensional manipulation of spatial data products in an effort to maximize scientific return from planetary spacecraft missions.

**References:** [1] Skinner, L. A., et al. (2019) *LPSC L*, Abstract #2132. [2] Skinner, J. A., et al. (2019) USGS Open-File Report 2019-1012. [3] Hunter, M. A., et al. (2020) *LPSC LI*, Abstract #1157. [4] Laura, J. R. et al. (2017) *ISPRS*: 181.