

THE NASA REFLECTANCE EXPERIMENT LABORATORY (RELAB) FACILITY: AN ONLINE SPECTRAL DATABASE FOR PLANETARY EXPLORATION. R.E. Milliken¹, T. Hiroi¹, D. Scholes², S. Slavney², & R. Arvidson², ¹Dept. Earth, Environmental & Planetary Sciences, Brown University, Providence, RI 02912 (ralph_milliken@brown.edu), ²Washington University in St. Louis, St. Louis, MO 63130

Overview: The Reflectance Experiment LABORatory (RELAB) is a NASA-supported multi-user spectroscopy facility that has been housed and operated at Brown University for 30+ years [1]. The RELAB facility provides services to acquire and distribute high quality spectral data to members of the NASA, planetary science, and broader remote sensing communities. A primary goal of the facility is to archive and make publicly available all spectral data that are acquired [2].

Over the past several years, funding through the NASA PDART program has (1) allowed for this extensive database to be made PDS4-compliant and archived at the NASA PDS Geosciences node hosted at Washington Univ. in St. Louis, and (2) enabled the development of a user-friendly [online search tool](#) to increase accessibility of this rich dataset. In addition, the database and structure allow for ancillary data (e.g., sample photos, chemical data, X-ray diffraction data, etc.) to be archived and linked to specimens and their spectral products. General procedures for archiving of spectral data with the PDS Geosciences node (e.g., PDS Spectral Library Data Dictionary) were developed, with the goal that this would streamline future submission of spectral data generated by other laboratories, including spectra of extraterrestrial samples returned by past, present and future missions (e.g., Hayabusa2, OSIRIS-REx, Mars Sample Return).

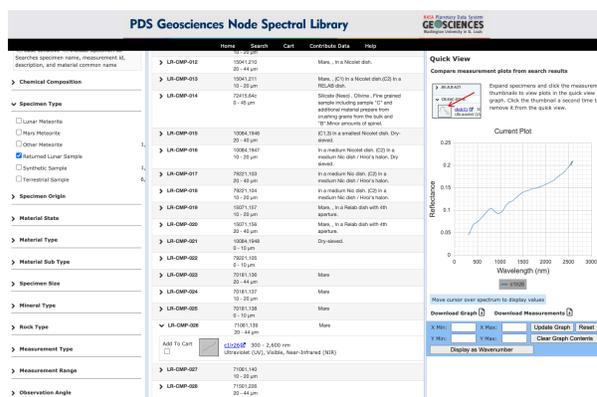
RELAB Spectral Database: The full RELAB database currently contains >24,000 spectra that represent >12,000 unique samples (including some data that are still within the maximum 3-year embargo period). This includes a wide variety of terrestrial and extraterrestrial materials in a variety of physical forms (e.g., powders, chips, slabs). The vast majority of RELAB data are reflectance spectra, but transmission, thermal emission, and Raman spectra are also compatible with the database structure. Over 300 peer-reviewed journals have used RELAB data in the past 10 years alone, with the use of these data increasing as new missions acquire more spectral data and as researchers seek to compare those data with high quality laboratory spectra of relevant materials. It is anticipated that the new online search tool and shopping cart-style download method will further enhance the accessibility and usefulness of this extensive database within the science community. Importantly, the database allows for the inclusion of literature references to (1) promote proper citation of studies associated with the original acquisition of spectra in the database and (2) allow users to understand how various spectra have been used for scientific research and interpretation.

An important aspect of the RELAB database is that it contains spectral data for a significant number of extraterrestrial samples, including lunar samples (Apollo,

Luna, meteorite) and hundreds of non-lunar meteorite samples. The former provide an important foundation for comparison with spectra of newly returned lunar materials (e.g., Chang'e 5 samples and future Artemis program samples), and the latter includes spectra of dozens of carbonaceous chondrites relevant to current and upcoming analyses of samples returned from the asteroids Ryugu and Bennu.

The new archive, detailed database, and online search tool allow users to quickly access and download spectral data of any samples returned by current and future missions that have been measured in RELAB. Currently, RELAB data are 1D point measurements, but methods for similar archiving of spectral image cubes (e.g., μ FTIR spectral maps) are being developed. Other advantages of the RELAB facility and database include:

- Long history (30+ years) of acquiring high precision and well-calibrated *absolute* visible-near IR reflectance spectra for use in radiative transfer models.
- Ability to acquire spectra over a wide range of incidence and emergence angles for photometric characterization of materials.
- Provides a single source for spectra of lunar and meteorite samples that were prepared and measured in a consistent manner using similar instrumentation.
- Detailed metadata (sample and spectral acquisition conditions) for each spectrum; photos of sample as mounted for measurement is now standard



Example of RELAB online search tool interface showing result for returned lunar sample. The blue link in the bottom center of the window opens a new window with detailed metadata for sample, spectral acquisition conditions, and ancillary data (e.g., photo of sample as mounted for measurement).

Personnel: R.E. Milliken is Science Manager, T. Hiroi is Operations Manager, W. Patterson III is RELAB Engineer **References:** [1] Pieters, C.M. (1983) *JGR*, 88, 9534-9544; [2] RELAB user manual and archive documentation: <https://pds-geosciences.wustl.edu/speclib/urn-nasa-pds-relab/document/>