LUNAR *NEWS*

No. 71 February 2012

In This Issue:

Next CAPTEM Meeting – March 24-25, 2012
Website - http://curator.jsc.nasa.gov

This issue of the Lunar *News* dedicated In Memory of the 'Lunatics' and to the 'Lunatic' Retiree

Lunar *News* Mission

The purpose of "Lunar *News*" is to provide a newsletter forum for facts and opinions about lunar sample studies, lunar geoscience, and the significance of the Moon in solar system exploration.

Editor's Notes

"Lunar *News*" is published by the Astromaterials Acquisition and Curation Office, Lyndon B. Johnson Space Center (JSC) of the National Aeronautics and Space Administration (NASA). It is sent free to all interested individuals. To be included on the mailing list, write to the address below. Please send to the same address any comments on "Lunar *News*" or suggestions for new articles.

Astromaterials Curation
Phone Numbers

Lunar *News* Editor
Andrea Mosie 281-483-5769
Roger Harrington- SARD Mentorship Protégé......... 281-483-3792
Newsletter Design, Production, and Printing
Andrea Mosie, Technical Publication 281-483-5769
Nancy Todd, Website Publication 281-483-5911
Astromaterials Curator
Carlton Allen 281-483-5126
Lunar Sample Curator
Gary Lofgren 281-483-6187
Ryan Zeigler..........281-244-6923
Messages and General Information
Suzanne Summers 281-483-5033
Antarctic Meteorites
Kevin Righter 281-483-5125
Cosmic Dust, LDEF, Stardust and Hayabusa
Mike Zolensky 281-483-5128
Genesis Curator
Judy Allton 281-483-5766
Loan Agreements and Records
Mary Luckey 281-483-3154
Contamination Control
Lindsay Keller 281-483-6090
Education and Public Outreach
Mary Luckey 281-483-3154
Special Projects
Charles Meyer 281-483-3133
Karen McNamara..........281-483-5058

Mailing Address: KT/Lunar Sample Curator
NASA Johnson Space Center, Houston, Texas 77058-3696 USA

Electronic Mail: gary.e.lofgren@nasa.gov or JSC-ARES-LunarRequest@mail.nasa.gov
Fax: 281-483-5347

43rd Lunar and Planetary Science Conference

On March 19–23, 2012, the 43rd Lunar and Planetary Science Conference will be held at The Woodlands Waterway Marriott Hotel and Convention Center in The Woodlands, TX. This conference brings together international specialists in petrology, geology, astronomy, geophysics, and geochemistry to present the latest results of research in planetary science. The five-day conference will be organized by topical symposia and problem-oriented sessions. The sponsors are the Lunar and Planetary Institute (LPI) and National Aeronautics and Space Administration (NASA). Participants may indicate a preference for oral, poster, or print-only presentation. The Program Committee will make all decisions on the mode of presentation to ensure a balance of as many important new research results as possible. Selection criteria will be based on the relevance of the subject matter to the conference and the quality of the science. For further information regarding conference, contact http://www.lpi.usra.edu/meetings

NETS 2012

held in conjunction with the
43rd Lunar and Planetary Science Conference

Cont'd on page 6

Curator's Comments

Gary Lofgren
Lunar Sample Curator
NASA JSC

Many years have passed since the last publication of the Lunar News and many changes have taken place in ARES and here at JSC. See the related article by Carlton Allen in this issue about the Astromaterials Acquisition and Curation at JSC.

Again Lunar samples made the news in a way we all probably hoped it wouldn't happen. The Office of the Inspector General (OIG) report of missing and stolen lunar samples fueled a flurry of speculation. The report stated that JSC's Astromaterials Acquisition and Curation Office, which maintain NASA's collection of 163,000 Astromaterials samples, lacked sufficient control over its loans of moon rocks and other items for research, education and public display.

Although such losses at any time are regrettable, NASA agrees with the OIG. Report that continuing to improve accounting procedures could reduce losses. The benefits to science of making these samples available for study, however, vastly outweighed the tiny risk of loss, NASA spokesman William P. Jeffs, said in a statement. NASA officials said they were implementing the recommendations in the report, which called for the space agency to require loan agreements for all types of materials and strengthen the inventory verification process, among other steps. Mr. Jeffs said that although several researchers involved in losing samples were reprimanded by NASA, their research privileges were not revoked. *(JSC Media Services)*

The truth is that the losses reported by the inspector general represent only a small fraction of the tens of thousands of Astromaterials samples that were allocated to scientists around the world for more than 40 years. In particular, the lost samples from the moon amounted to less than one-hundredth of 1 percent of the samples that were safely returned in the past four decades. One significant result of the OIG audit will be the request of all Lunar PIs that they return lunar samples that are not the subject of current or planned research. We will be contacting PIs this year to facilitate the return of these lunar samples. We do have newly revised procedures for sample accounting that are detailed elsewhere in this newsletter.

The samples that American and foreign dignitaries received as gifts were not included in the report, because the space agency does not track them. Moon-rock experts say NASA should keep an inventory of those as well, and they estimate that of nearly 400 moon rocks given to state and world leaders after the Apollo 11 and 17 missions, almost 200 have been lost, destroyed or stolen. Joseph R. Gutheinz Jr., a Texas lawyer and former OIG agent has been credited, along with his students for locating many lost or misplaced lunar sample gifts to states and countries. See related article in this issue about the 'Children of the World' rock.

Astromaterials Acquisition and Curation at JSC

by Carlton Allen
Astromaterials Curator
Manager, Astromaterials Acquisition and Curation Office
NASA JSC

The summer of 2012 will mark 43 years since the first lunar rocks and soils were brought to Earth by the astronauts of Apollo 11. The Apollo expeditions in all collected 2,196 individual rock, soil and core samples with a total mass of 381.69 kg. These have now been subdivided into over 140,000 subsamples – and we continue to curate them all for NASA and distribute them to a worldwide research community. What an awesome privilege and responsibility!

We have recently honored the career of Jack Warren – retiring after an amazing 45 years, mainly in the Curation organization. In 1969 Jack opened the first container of Apollo samples in the Lunar Receiving Laboratory. He went on to help design or operate every one of our Curation labs, and lead the Curation of cosmic dust and space-exposed hardware. Every scientist who studies samples from space owes a debt of gratitude to the professionalism of Jack Warren.

We welcome Angela Green Garcia and Roger Harrington to the Lunar Curation Team. They represent part of the new generation who will build on the work of today's curators and take lunar sample processing into the 21st century.

Within the next year we will also honor the retirement of Dr. Gary Lofgren, current Lunar Curator and a key member of the lunar science community. Gary has built a distinguished career as a NASA scientist, concentrating for over four decades on the geologic history of the Moon. He has trained Apollo astronauts, conducted high-quality research, led the ongoing lunar Curation effort, and helped plan the future of human exploration. His career in lunar science is unique, and an inspiration for a worldwide community of space scientists and explorers.

Finally we welcome Dr. Ryan Zeigler, who will take over as Lunar Curator with Gary's retirement. Ryan built his own record as a researcher at Washington University in St. Louis, studying the detailed geochemistry of lunar rocks. He applied for the Lunar Curator job from Antarctica, where he was a member of last year's ANSMET team!

A 2011 Addition to Curation

Future Lunar Sample Curator

Ryan A. Zeigler comes to us from Washington University in St. Louis, where he worked on lunar and meteorite samples as a research scientist in the Department and Earth and Planetary Sciences and a member of the McDonnell Center for Space Sciences. Over the past 12 years, Ryan has utilized electron-microprobe, neutron-activation, and ion-microprobe analyses to study the characteristics and origins of lunar meteorites and Apollo glass particles. His experience with lunar samples is extensive, as he has studied samples from all six Apollo missions and nearly every know lunar meteorite.

Ryan Zeigler

Ryan received his Bachelor of Arts degree in geology and history from State University of New York, Potsdam in 1998. He went on to graduate school at Washington University in St. Louis where he received his Master of Arts (2000) and Doctor of Philosophy (2004) degrees in Earth and Planetary Sciences under the tutelage of Drs. Larry Haskin, Randy Korotev, and Brad Jolliff. His PhD Thesis was a study of basalts and basaltic glass from the Apollo 16 site and of the basaltic lunar meteorite stones recovered in the LaPaz Icefield, Antarctica.

Ryan loves to travel for fun, and has been to six of the seven continents, with only South America still to go. Most recently, he was able to travel to Antarctica as a member of the 2010-2011 ANSMET field team where he and twelve other colleagues were able to collect over 1240 meteorites during a six-week field season in the Davis-Ward Nunataks region of the Dominion Range, the LaPaz Icefield, and the Patuxent Range.

The United States National Park system is of special interest to Ryan, and over the years he has traveled to more than 25 of the National Parks and at least a dozen of the National Monuments, mostly in the western United States. During his time at Washington University he helped to plan and lead several departmental field trips to parks all around the country to study the geology and natural features preserved within these parks.

A big ARES welcome to Ryan and we are looking to many great years of working together in ARES!

NETS 2012

NUCLEAR AND EMERGING TECHNOLOGIES FOR SPACE

March 21-23, 2012 – The Woodlands, TX

held in conjunction with the

43rd Lunar and Planetary Science Conference

March 19-23, 2012

The year 2012 will mark completion of the first 50 years of nuclear-powered spaceflight, which began with launch of the Transit 4A satellite in June 1961. In honor of this occasion, the LPI is pleased to announce that the 43rd LPSC will be held in conjunction with the Nuclear and Emerging Technologies for Space (NETS) topical meeting, which will take place March 21–23, 2012.

Nuclear power has been an enabling technology for the most ambitious planetary missions in history. Holding the meetings together, with a joint plenary session on Wednesday, will allow the planetary science community to learn more about the latest developments in nuclear power and propulsion, and see how new technologies could help their exploration efforts in the future.

Roger Harrington

Roger Harrington began working in Astromaterials Curation as a Sample Collection Processor in August 2007. He is a Jacobs/ ESCG teammate with Hamilton Sundstrand. Roger works primarily in the ANSMET Meteorite Processing Lab and the Meteorite Thin Section Laboratory. As a Curation sample processor, he prepares sample chips and\or sections for allocations to Principle Investigators, interact with PIs for accuracy in sample research and sample documentation (lunar). Roger continues to help out as needed in the Lunar Sample Laboratory and the Lunar Thin Section Lab as well as with JSC Media Services promoting ARES and assisting in activities with the general public. Roger has prepared several lunar and meteorite samples for displays including the AP-11 display that was flown on the International Space Station (ISS). He participates in ARES and ESCG Educational Outreach programs by disseminating motivational and scientific information to students, faculty and communities in the Houston and surrounding area.

Roger's previous career experience includes laboratory rock core analysis for oil and gas exploration, geotechnical engineering field and laboratory operations, and working for the Environmental Stormwater Management Division of the City of Norfolk, VA Public Works Department. He taught geology and oceanography laboratory courses at Tidewater Community College in Virginia Beach, Virginia. While at TCC, Roger worked aboard the college oceanographic research vessel R/V Matthew F. Maury in every capacity from engineer to instructor. He also spent eight years as an Aviation Electronics Technician in the U.S. Naval Reserve working on F/A-18 Hornet aircraft. Roger received his Bachelor of Science degree in geology from Old Dominion University in 1996. He has continued his training by taking Managerial, Ethics, and Motivational as well as Service trainings. He is a part of the SARD Mentorship Program in the Lunar Sample Facility.

Roger and his wife Kim moved from Chesapeake, Virginia to Sugar Land, Texas in January of 2007. They still reside there today with sons Alex and Ethan.

Roger is a great addition to the ARES team and Sample Curation!

Angela Green Garcia was born on September 4, 1978 (Labor Day) in Idabel, Oklahoma, but has called Houston her home since she was 3 months old. Her hero is Popeye and says she would take Batman over Superman. Angela holds a Master's Degree in Geology from Louisiana State University; GEAUX TIGERS!! As a young child she was fortunate enough to have a father who loved science. He spent a lot of time taking her and her brothers to free science events around town, including every NASA event that was offered (especially the open houses). She notes that this was when people were allowed to enter into most of the buildings. As a result Angela has loved science since she was a young girl. One of her fondest memories was watching the Space Shuttle piggy-back to Ellington. Much like her father, she has always had a love for NASA. It was her dream to grow up and become a NASA scientist.

When Angela was in college, she was an intern with an education outreach group, NASA Space Science Ambassadors, a collaborative between several minority universities and NASA. It was through this program that she was first introduced to the Pristine Sample Laboratory at Johnson Space Center. As part of the training, the ambassadors were brought to JSC to interact with "real" NASA scientists. One of the laboratories visited was the Lunar Sample Laboratory. Her first visit to the Lunar Laboratory left her with a strong desire to one day work in the Pristine Sample Laboratory. She also found that she had a passion for sharing science with others and remained with the Space Science Ambassadors program as the coordinator until leaving to attend graduate school.

Angela Green Garcia

After receiving her Master's of Science from LSU, Angela returned to Houston and taught Geology at the University of Houston-Downtown as an adjunct professor. She was notified about the job opening for a lunar sample processor, applied and landed her dream job at JSC! Currently, she works in the Lunar Lab as well as the Lunar Thin Section Lab. She enjoys applying her skills as a geologist to Space Science; more specifically to lunar geology. "In addition to getting to work with rocks from the moon as if that wasn't cool enough, I am also very fortunate to get to spend a large portion of my time doing outreach and education." Angela has not forgotten the impact it had on her life and hopes to impact others in the same manner.

Angela is a great asset to ARES and Lunar Sample Curation!

Kelsey E. Young

Kelsey Young graduated from the University of Notre Dame in 2009 with a B.S. in Environmental Geosciences. She then came to Arizona State University and is currently pursuing a Ph.D. in Geology with Dr. Kip Hodges. Her primary research interests involve the utilization of terrestrial analog sites, or sites on Earth that resemble locations on other planets. She is working on thermochronologic studies of both Haughton and Mistastin Impact Structures and has conducted fieldwork at both Canadian craters. She is also interested in the use of analog sites as testing grounds for the advancement of planetary field geology. She works on developing the technology needed for astronauts to gather geologic observations as well as establishing protocols and procedures for collecting scientific data on other planetary surfaces, whether it is the Moon, Mars or asteroids. Kelsey has participated in several NASA Desert RATS field tests as both a crewmember and a member of the science backroom. These tests are designed to develop technology and protocols for conducting planetary field geology from habitat rovers and laboratories on other planetary surfaces. In addition to this, Kelsey was awarded a NASA Graduate Student Researchers Program (GSRP) Fellowship, which funds her research for three years and enables her to spend three months a year working at NASA JSC. She is working with Dr. Cindy Evans on developing handheld X-ray fluorescence (XRF) technology, which will enable astronauts to obtain real-time geochemical data in the field. (The abstract below was presented at the poster session at the 42th LPSC in March 2011).

IN-SITU XRF MEASUREMENTS IN LUNAR SURFACE EXPLORATION USING APOLLO SAMPLES AS A STANDARD. K. E. Young[1], C. Evans[2], C. Allen[2], A. Mosie[2], and K.V. Hodges[1]. [1]Arizona State University, School of Earth and Space Exploration, Tempe, AZ, 85287-1404 (Kelsey.E.Young@asu.edu), [2]NASA Johnson Space Center, Astromaterials Research & Exploration Sciences Directorate, Houston, TX, 77058.

Introduction: Samples collected during the Apollo lunar surface missions were sampled and returned to Earth by astronauts with varying degrees of geological experience. The technology used in these EVAs, or extravehicular activities, included nothing more advanced than traditional terrestrial field instruments: rock hammer, scoop, claw tool, and sample bags. 40 years after Apollo, technology is being developed that will allow for a high-resolution geochemical map to be created in the field real-time. Handheld x-ray fluorescence (XRF) technology is one such technology. We use handheld XRF to enable a broad in-situ characterization of a geologic site of interest based on fairly rapid techniques that can be implemented by either an astronaut or a robotic explorer. The handheld XRF instrument we used for this study was the Innov-X Systems Delta XRF spectrometer.

Handheld XRF Technology: The handheld XRF spectrometer was originally developed for use in a range of industries and recently, field geologic mapping. Our goal is to evaluate this technology as a possible field/lab instrument that can be used during planetary surface exploration missions. We are developing techniques with current models of commercially-available handheld XRF spectrometer for rapid, in-situ geochemical characterization of geologic outcrops and samples.

The current handheld XRF technology is portable, robust, and simple to operate; it holds promise as a versatile field tool. In just 60 seconds, the user can obtain a rough look at the elemental abundances of a sample, for major elements that are heavier than magnesium (existing handheld XRF models cannot accurately detect and measure elements lighter than magnesium).

Using XRF on Apollo samples: Our handheld XRF instrument provides a way to quickly and roughly quantify key elements in order to differentiate between and possibly high-grade samples on the lunar surface. By testing the handheld XRF on previously characterized lunar samples, we can evaluate how effective the instrument would have been if the Apollo astronauts had been able to use this instrument while on EVA. In this way we can determine the importance of taking geochemical instruments on future planetary surface exploration missions, whether they be to the Moon, Mars, or an asteroid.

The lunar samples returned from the six Apollo surface missions were geochemically characterized using a number of instruments, including a laboratory XRF spectrometer. Samples were sent out to a number of labs around the country, and have since been returned to the lunar Curation facilities at NASA's Johnson Space Center (JSC). 22 of these returned samples have been set aside in a collection for non-destructive tests by interested parties [1]. For this study, we use these 22 samples to compare the effectiveness and utility of handheld XRF technology. By testing the handheld XRF and comparing it to the previously obtained XRF data for these samples, we can evaluate how effective the handheld instrument is in the geochemical characterization of lunar samples. Combining this with tests in the field on Earth, we will investigate the instrument's utility in a field mapping capacity.

Methods: We collected data on a suite of well-characterized terrestrial samples to build calibration files for the major elements ([1], [3]). After the collection of the calibration data, we tested three different setups for collecting handheld XRF data from the lunar samples, all of which were done in the Returned Lunar Sample laboratory located at Johnson Space Center in Houston, TX. The first setup was established to test rock samples in the Innov-X Delta XRF testing stand which we placed on top of a lab bench. Each of the 18 rock samples was individually placed in the testing stand in an orientation that we determined to be representative of the whole sample. Measurements were taken of every face large enough to yield data (faces $\leq$ 8mm across could not be accurately measured). In the case of samples with large phenocrysts or other heterogeneities, we took several measurements of different surfaces of the sample to make sure that we acquired all possible data. Each of the 18 hardrock samples therefore had at least 2-3 measurements taken and some had as many 6 measurements on one sample.

Four lunar soils were tested from Apollo 11, 14, 16, and 17. The methodologies for testing these with the handheld XRF had to be modified from the setup used for the hardrock samples. Two Teflon sheets were separated by approximately one inch. A hole was cut in the middle of the top Teflon sheet and a small plastic cylinder was placed in this hole. We filled the cylinder with soil so the soil was packed down. The packed soil formed the surface where data was collected with the handheld XRF.

The third setup we used to collect data was a pressurized glovebox in the Returned Lunar Sample laboratory located at Johnson Space Center, in Houston, TX. We reran three hardrock samples tested in the first lab bench setup to evaluate the difficulties of using the handheld XRF in a glovebox.

Results: At the time that this abstract was written we have not yet completed a full data reduction and comparison of the handheld XRF data to the previously published literature on this suite of Apollo data. However, we have begun to process the XRF data, with special focus on the effect of different orientations and surface characteristics in an effort to constrain sampling techniques for the instrument. Figure 1 shows data collected from the rock samples with sawed surfaces compared with values reported in the literature and the Lunar Sample Compendium [2]. Using curves built from the calibration files, we calculated TiO_2 and FeO abundances from the spectra collected on the lunar samples (Figure 1).

Other comparisons between different faces of the same sample (representing different surface roughnesses and sample heterogeneity) are ongoing. In this way we can use the XRF data to draw parallels between rocks found at each of the Apollo landing sites.

Effects of Sample and Sampling Heterogeneities on XRF Data: Due to the early stage of development of the handheld XRF technology, we are still evaluating effects of surface and other bulk sample characteristics on the data. We have found that surface roughness, vesicularity, sample homogeneity, and distance from the sample to the detector all have an effect on the data returned from the instrument [4]. Keeping these effects in mind, we put forth methods of data collection that help to mitigate these effects.

Surface roughness had the largest effect on data returned. We collected data on smooth, sawed surfaces whenever possible as well as fresh but rough and broken surfaces. Sample homogeneity is also important to think about in data collection. Vesiculated basalts yield different results than massive basalts. Due to the 8 mm spot size of the instrument, breccias (like several of the Apollo samples we worked on) could cause inconsistencies in the data if one spot measures a different clast than a second spot. Distance from the sample to the instrument detector can also have an effect on the data because of the dispersive nature of the energy coming back to the detector from the sample [4].

All of these effects have implications for possible sample preparation procedures in the field. Depending on what deployment mode (ie robotic, human, or habitat laboratory) is being utilized, sample surfaces should be prepared with these considerations in mind. For example, the Pressurized Excursion Module (PEM), tested in the 2010 NASA Desert Research and Technology Field Studies field test, has a sample splitter for the astronaut crewmembers to use to create fresh surfaces, helping to eliminate the effects of surface roughness.

Future Work: We are continuing our work on the Apollo XRF data, and seek to better integrate the previous laboratory results with our handheld XRF results. Comparison of major elements between all 22 samples (including soils) will play a major role in this study and further assessments of the instrument response and operational constraints are ongoing. As with all technical instruments, understanding response under different conditions is critical for interpreting data. We will continue to characterize the effect of surface characteristics on the XRF data and work to incorporate our findings into effective instrument testing procedures for future field deployment.

We will also continue to deploy the XRF in a variety of terrestrial analog modes, including both robotic and human exploration in order to better evaluate the value the instrument provides in the field, in the lab, or as part of a robotic field assistant.

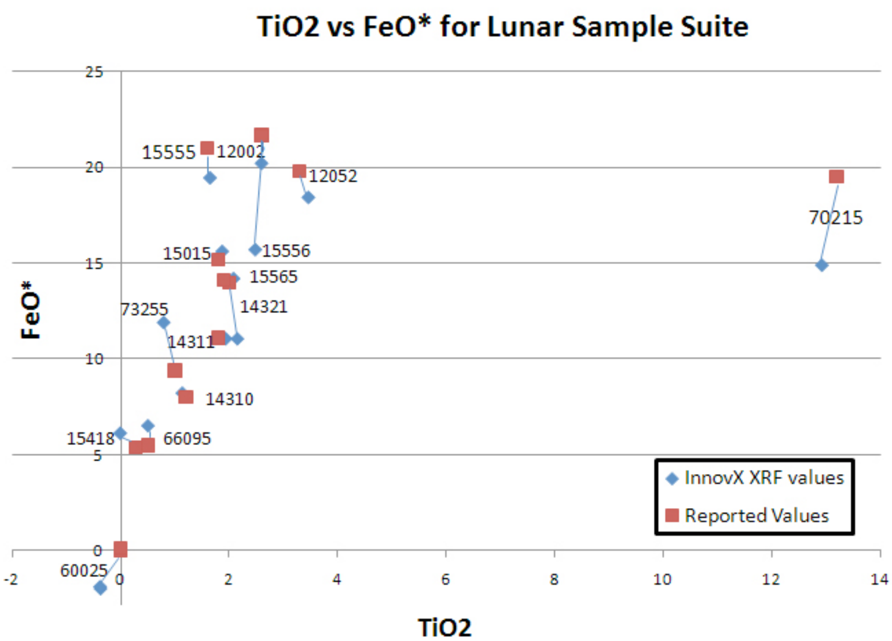


Figure 1: Preliminary TiO_2 vs FeO results from XRF data collected on the lunar sample suite (sawed surfaces), compared to representative values reported in the literature.

References: [1] Allen et al (2010) LPSC 2010, Abstract 1457. [2] Meyer, Charles for the Astromaterials Research & Exploration Science Office at NASA JSC (2010), The Lunar Sample Compendium. [3] Morris, Richard, Personal Communication. [4] Young et al (2010) GSA 2010, Abstract 19-10.

Dava Sobel Visits the Lunar Sample Facility

Dava Sobel

Dava Sobel is an award-winning writer and former *New York Times* science reporter who have contributed articles to *Audubon, Discover, Life* and *The New Yorker*. She has also been a contributing editor to *Harvard* Magazine, writing about scientific research and the history of science.

Ms. Sobel has maintained an interest in Galileo since childhood and her latest book, *Galileo's Daughter,* fulfills her ambition to plumb the renaissance scientist's life and times, and to reveal his relationship with his daughter, Suor Maria Celeste, a Poor Clare nun. In researching this book, she traveled to Italy four times and translated original documents, including more than 120 letters from Suor Maria Celeste to her famed father.

Ms. Sobel's book *Longitude* (published by Walker & Company) became an international best-seller, and has been translated into more than twenty foreign languages. *Longitude* has won several awards, including the "Harold D. Vursell Memorial Award" from the American Academy of Arts and Letters, "Book of the Year" in England, "Le Prix Faubert du Coton" in France, and "Il Premio del Mare Circeo" in Italy. Also in recognition of *Longitude,* Ms. Sobel was made a fellow of the American Geographical Society. The PBS program NOVA produced "Lost At Sea--The Search for Longitude," a television documentary adaptation of *Longitude,* which aired in fall 1998, *Galileo's Daughter.* In summer 2000 the A&E Network will broadcast a four-hour miniseries dramatization of *Longitude* produced as a joint production of Granada Films and A&E and starring, among others, Jeremy Irons.

Lecture engagements have taken Ms. Sobel to speak at The Smithsonian Institution, The Explorers Club, the NASA Goddard Space Flight Center, The Folger Shakespeare Library, The Los Angeles Public Library, The New York Public Library, The Royal Geographical Society (London), and BookExpo America 1998. She has appeared on numerous radio and television programs, including NPR's "All Things Considered," "Fresh Air," and "The Connection" with Christopher Lydon, as well as C-SPAN's "Booknotes", "The Today Show," and "ABC World News Tonight".

(Article from www. galileosdaughter.com/home)

Relics from the Moon, still good as new

by Dava on September 27, 2011

While in Houston last week to lecture for the Lunar and Planetary Institute's "Cosmic Explorations" series, my hosts took me to the nearby Johnson Space Center on a thrill ride — a tour of the Lunar Curatorial Lab, where the rocks the Apollo astronauts collected on the Moon now reside.

By coincidence, I'd received a message immediately upon arrival in Houston from my friend Carolyn, the only person of my acquaintance ever to have eaten real Moon dust. The memory of that incident had been on my mind the whole day, and now here she was in a rare communication, writing to say she'd just located the astronomer who gave her that Moon dust as a love token four decades ago.

There was no Moon dust lying around the Lunar Curatorial Lab. It was a clean room in the technical sense — so clean that I had to remove my jewelry before entering lest stray atoms of gold contaminate the environment. Obeying regulations, I put on a protective cap and suit (for the protection of the lunar samples) and stood several minutes in an air shower designed to relieve me of Earthly dust particles.

Cont'd on page 13

Big Muley 61016

Bill Muehlberger, Longtime UT Geology Professor, dies

Bill Muehlberger, a longtime University of Texas geology professor who also taught geology to astronauts, died in September of natural causes. He was 87. Born in New York, Muehlberger grew up in Hollywood, Calif., and received bachelor's, master's and doctoral degrees in geology from the California Institute of Technology. He taught at the University of Texas for nearly 40 years before retiring in 1992, but continued to serve as professor emeritus and keep an office there.

NASA first asked Muehlberger in the mid-1960s to train Apollo astronauts in geology, so they could identify and understand features on the moon. As a NASA consultant, Muehlberger led a staff that helped determine where astronauts would land to collect rock samples that might provide insight into the history and composition of the moon. Muehlberger trained the last four men to walk on the moon - Charles Duke and John Young on Apollo 16, Gene Cernan and Jack Schmitt on Apollo 17 - as well as the backup crew on Apollo 15. NASA even named a moon rock after him. At nearly 26 pounds, "Big Muley" is the largest piece of the moon ever brought back to earth.

"First and foremost, he was a teacher. He loved to teach and had a motivated and captivating audience" in the astronauts, his son Eric said.

Muehlberger spent 15 years on another ambitious project: mapping the geologic and tectonic structures of North America. Sharon Mosher, dean of the Jackson School of Geosciences at UT, called it "an award-winning map that hangs in probably every geoscience building in the country."

Michael J. Drake 1946–2011

Michael J. Drake, Regents' Professor, Director of the University of Arizona's (UA) Lunar and Planetary Laboratory (LPL), and head of the Department of Planetary Sciences, died September 21 at The University of Arizona Medical Center–University Campus in Tucson, Arizona. He was 65.

Drake, who joined UA in 1973 and headed LPL and the planetary sciences department since 1994, was the principal investigator of the most ambitious UA project to date, OSIRIS-REx, an $800 million mission designed to retrieve a sample of an asteroid and return it to Earth. OSIRIS-REx is due to launch in 2016.

Under Drake's leadership, the LPL grew from a small group of geologists and astronomers into an international powerhouse of research into the solar system. Drake played a key role in a succession of ever more high-profile space projects that garnered international attention for LPL and the university. Those include the Cassini mission to explore Saturn, the Gamma-Ray Spectrometer onboard NASA's Mars Odyssey Orbiter, the HiRISE camera onboard NASA's Mars Reconnaissance Orbiter, and the Phoenix Mars Lander.

A native of Bristol, England, Drake graduated with a degree in geology from Victoria University in Manchester, and then he left for a doctoral program in geology from the University of Oregon, graduating in 1972. After a postdoctoral program at the Smithsonian Astrophysical Observatory, Drake moved to, and immediately fell in love with, Arizona.

Timothy Swindle, the assistant director at LPL, summed it up, saying, "Not only was he a world-class scientist, but he was a tireless advocate for the Lunar and Planetary Laboratory and all the people who have worked here.

(Articles from Lunar List Server/C. Neal)

Dava Sobel (Cont'd from page 10)

Dava with Gary Lofgren, Andrea Mosie and pieces of the Moon

Within the facility's work area, Moon rocks lay untouchable inside glass cabinets giving them temporary shelter plus an atmosphere of pure nitrogen gas. Even Andrea Mosie, who has worked here for thirty-six years, handling Moon rocks on a daily basis, has never felt the Moon on her skin. She must put her hands in white fabric gloves first, then into the bulky black appendages of the glove boxes, then don clear Teflon gloves as a third barrier before picking up a hammer or chisel to break off small samples for the scientists who request them.

Only half a dozen rocks occupied the various cabinets. The rest — approximately 800 pounds' worth — hid in the adjacent vault, protected by a system of combination locks worthy of the secret service.

Cosmochemist Gary Lofgren, who holds the singular title of "Lunar Curator," gave me a glimpse of a Moon rock through a modified microscope set atop one of the glass cases. The rock sparkled at me, flashing tiny beams from a hundred shiny inclusions. I must have gasped, startled by the unexpected show of beauty. "They're still fresh," Dr. Lofgren explained, with an equally fresh enthusiasm for the specimens. "Ancient as they are, they never weathered on the Moon's surface, and they're protected from weathering here."

Thanks to all my new friends in Houston for this privilege. *(Article from Lunar List Server/C. Neal)*

Retired Lunatic, Jack Warren

Jack Warren, one of the unsung heroes of the space program, will retired from the Johnson Space Center Curation Office on Friday January 27. Jack opened the first rock box containing Apollo samples and has been deeply involved in every aspect of Curation during a 45 year career. Jack began his career at the Manned Spacecraft Center, now JSC, in June, 1966 working for Brown & Root-Northrop. His first assignment was working in Building 32 supporting the large vacuum chambers (he was hired because he had been working derricks on a drilling rig and didn't mind heights). Jack supported testing in Chamber A for the Apollo Service and Command Modules and Chamber B for the Lunar Excursion Module.

In 1968 Jack transferred to the Lunar Sample Processing Group. His duties included reviewing blueprints and operation maintenance manuals. He designed a mock-up F201 vacuum chamber out of a wood crate.

Jack Warren

Retired Lunatic (Cont'd from pg 13)

Jack Warren in 1969 (1003 ALSRC)

Jack drew the shortest straw from a group of about 12 technicians so he was given the task of opening the first rock box from the Moon in 1969. He continued working with the Lunar Sample Processing Group from Apollo 11 through Apollo 17.

In 1981 Jack began working on the Cosmic Dust Project and in April of 1982 processed the first samples using Don Brownlee's Lab in Washington University, since the JSC Cosmic Dust lab wasn't finished yet. By 1984 he started the Facility for the Optical Inspection of Large Surfaces (FOILS) lab which supported studies of space-exposed hardware including Solar Max, Long Duration Exposure Facility (LDEF), Orbital Debris Collector (ODC), PALAPA Blanket and the EURECA Blanket.

In 1998 Jack helped with the Genesis Project Team by assisting in finding a location to build a Class 10 Clean Room for spacecraft preparation and Curation. He was also a key member of the team that went to Utah to receive the Genesis capsule. Following Genesis, Jack became a member of the Stardust Project Team, where he helped to retrieve the capsule and then returned to JSC to process the samples.

From 2006 to the present Jack has worked primarily in the Cosmic Dust and Stardust labs, but every other lab and facility has called on his expert knowledge and skills. Jack's total career at JSC has spanned 45 years and 3 months.

Article from the Lunar Server List-Clive Neal

APOLLO SAMPLE COLLECTION DATA LAYERS FOR GOOGLE MOON

By Nancy Todd

Nancy Todd

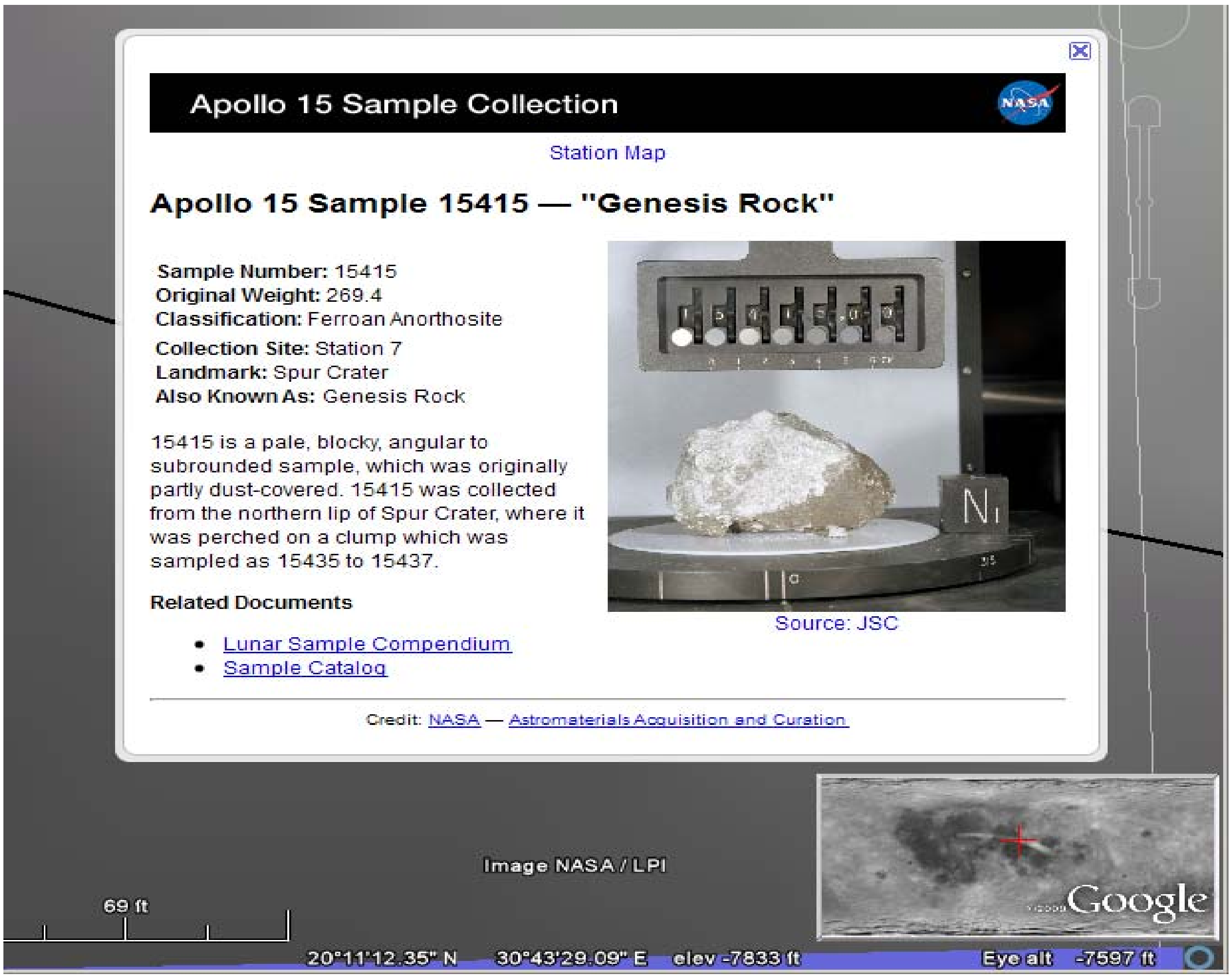
Last year, we reported the completion of the Apollo 15 and 16 data layer and were in the process of developing data layers for Apollo 17 Lunar samples. Since March of 2011, data layers for selected lunar rocks from Apollo missions 15 and 16 were made available to the public as KMZ files for use within the Google Earth/Moon application. Data layers are comprised of the following: station media galleries, annotated panoramas, sample information windows, interactive station maps, and surface graphical overlays of station maps showing sample collection areas. The KMZ files

Google Moon (Cont'd from pg 14)

are available for download from the Curation website at:
http://curator.jsc.nasa.gov/lunar/moon/index.cfm

The Apollo 17 mission data layer is almost complete. All the data and galleries have been created. The remaining activity for Apollo 17 is setting the spatial coordinates of samples within mission EVA collection stations to enable their display within Google Moon. This has been delayed by the lack of high-resolution images that show features near the size of prominent features found on each station. In the future, as more photos become available, we will also be creating data layers for the remaining missions.

Apollo Sample View in Google Moon



LUNAR SAMPLE AND PHOTO CATALOG DATABASE

by *Nancy Todd*

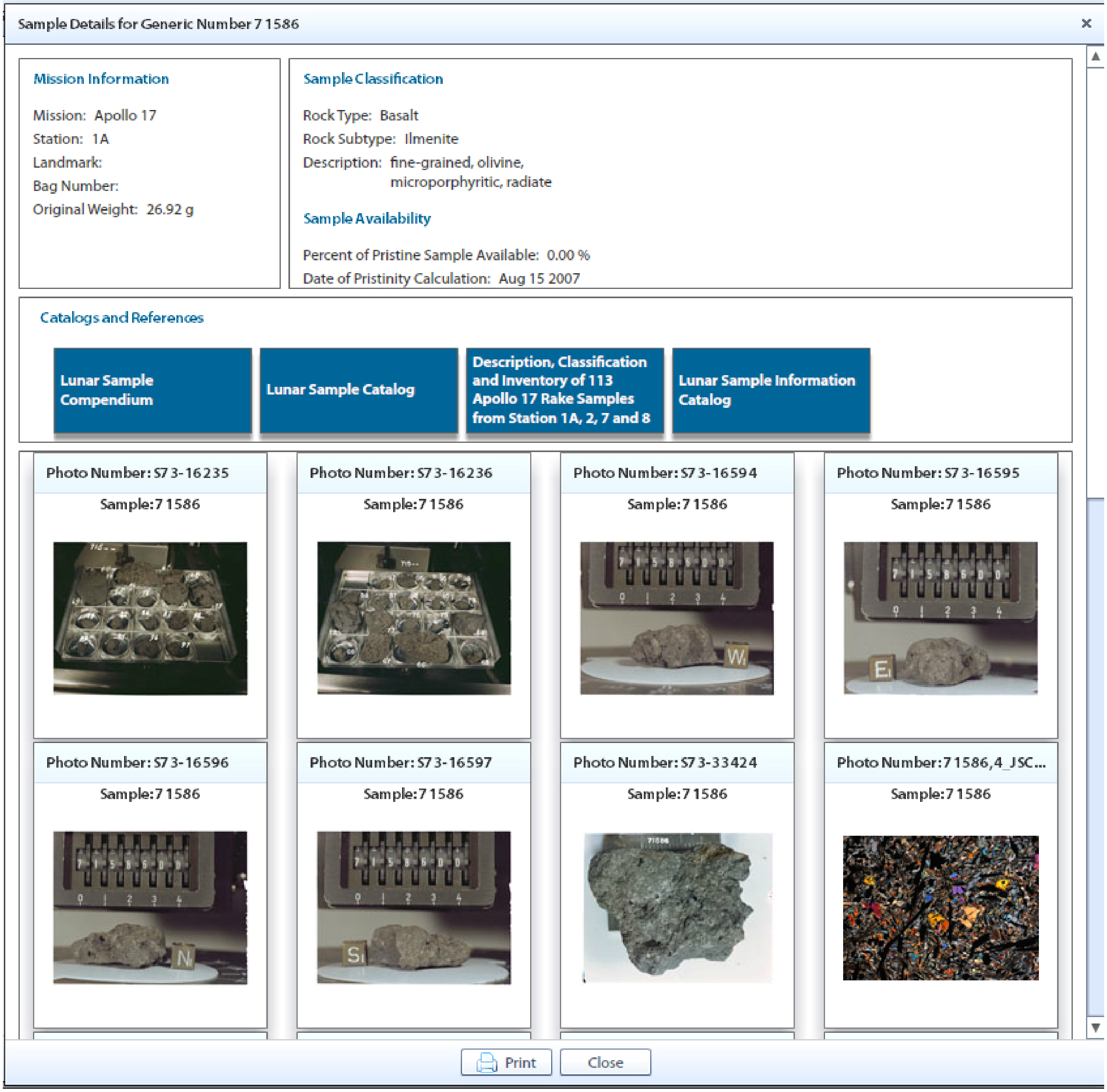
The Lunar Sample Catalog database was deployed to the Lunar website in November 2010. Since its deployment, the online catalog has been reworked to add the ability to search photos by photo number, as well as, provide for advanced photo search capability based on photo characteristics and

Database (Cont'd from pg 15)

related sample information. Other changes include the ability to display photo search results as a table or as a photo gallery. Photos are printable and downloadable.

Another enhancement made to the catalog, based on user feedback, is the ability to bookmark search lists, sample details, and photo details and access them later directly through a specific URL without having to redo searches. This also allows users to navigate back and forth through the browser interface. This enhanced interface will be made available to the public by Spring 2012.

Sample Details View in Lunar Sample Catalog and Photo Database



Lunar Sample Inventories, Loan Agreements, and Sample Return

The NASA Johnson Space Center Curation Office is instituting new procedures to better account for lunar samples allocated for research. There are currently over 10,500 lunar samples allocated to Principal Investigators. The Curation Office needs to reduce this very large inventory for several reasons. Most importantly, returned samples are needed for new allocations when pristine samples are not required. It's important to remember that these samples are national treasures, and must be safeguarded. The return of samples to the Lunar Collection in the Curation Office at JSC ensures that they are available for reallocation. This concept has been emphasized by a recent NASA Inspector General audit and reinforced by the Science Mission Directorate at NASA Headquarters.

Lunar Inventory and Loan Agreements

Lunar inventory are an important part of maintaining control of lunar samples. The inventory is an annual requirement and is so stated in the Loan Agreement. We will be more diligent in our efforts to fulfill that requirement on an annual basis. The new stipulation within Curation is that a PI cannot be allocated samples from any of the Curation collections if they are delinquent with any of the required inventories. A current loan agreement will also be required for the allocation of samples. The duration of the loan agreement will be increased to cover the usual length of time for the study of the samples allocated, usually 5 years.

Return of Samples No Longer in Use

All samples that are not part of an active research project recently approved by the Curation Analysis Team for Extraterrestrial Materials (CAPTEM) must be returned to the JSC Curation Office. If there are future plans for research with these samples, a request must be submitted to the Curation Office for CAPTEM approval. The approved samples, or any new samples requested, will be allocated for a designated period of time (typically 5 years). It will be possible to request an extended loan period. New samples will not be allocated from any Curation collection until samples no longer the subjects of active research are returned.

The Curation Office will assist in the return process in every way possible. The most important part of the process is to document the history of the samples while they were in your possession. This information must be recorded on the Curatorial Form F-75, (Return Sample Accountability & History). A Microsoft Word version of the F-75 form can be down loaded from the Curation Website:

http://curator.jsc.nasa.gov/lunar/samretins.cfm

If requested, electronic versions of the form including sample numbers and original weights can be sent to assist you in this process.

Transferring Samples to a Colleague

If you plan to retire and transfer samples to a colleague, CAPTEM has recently defined steps that must be followed. Although this will be a significant effort, these steps must be taken to assure the integrity of the lunar collection. We want you to work closely with us to accomplish the mission of returning the samples to the Curation Office.

A PI-to-PI transfer requires that the recipient of samples must have a CAPTEM-approved lunar request that identifies the desired samples to be transferred to the new PI. In

Lunar Inventories (Cont'd from pg 17)

addition both individuals must be approved

PI's with current Loan Agreements. The current PI must document the status of the samples to be transferred (including the current weight) on Curatorial Form F-75, Return Sample Accountability & History. All samples not reassigned to the new PI must be returned to the Curation Office. Each sample must be reconciled with the F-75 form to document the existing weight and condition, potential contamination issues, or whether it has been consumed and no longer exists.

Samples currently larger than 10 grams must be hand carried when they are returned to the Curation Office. No single shipment of lunar samples can exceed 10 grams. The procedures for returning samples can be found on the Curation website–

http://curator.jsc.nasa.gov/lunar/samretins.cfm

The Curation Office and the Science Mission Directorate appreciate your attention to these procedures and our efforts to preserve the integrity of the Apollo Lunar Collection. Your assistance can assure the science community that these samples will be available for continuing research well into the future.

'Children of the World' Rock
By Angela Green Garcia

"Joseph R. Gutheinz Jr., a Texas lawyer and former OIG agent has been credited, along with his students for locating many lost or misplaced lunar sample gifts to states and countries." *(NewYorkTimes.com, January 21, 2012)* He visited the Lunar Sample Facility in the fall 2011 to view the 'Children of the World' rock and tour our facility.

Lunar sample 70215 is a dense, fine-grained porphyritic mare basalt that has been used to create "touchstones" for public display. It was collected about 60 m from the Lunar Module and is one of the largest stones returned from the Moon. *(From the Lunar Sample Compendium; C. Meyer 2008).* Its original sample weight is 8110 grams.

Close-up of surface of 70125,261 showing zap pits, and apparent vugs. Sample is about 12 cm long. NASA # S89-34498.

Gutheinz was extremely excited to have the opportunity to view this special rock. While he was not allowed to touch the rock which he expressed he was 'dying' to hold, he was extremely impressed with the Sample Curation process and delighted with his visit.

Gutheinz stated that, "If someone hands a governor a Moon rock, and he keeps it or loses it, if you can't protect something like that, maybe they're not that vigilant ,and if they're not that careful, and they bring it home with them, what else have they brought home with them?: *(NewYorkTimes.com, January 21, 2012)*

In 1998, Gutheinz blocked the attempted sale of a nugget of lunar rock in Miami by a man who had acquired it in Honduras.

Instructions for the Return of Lunar Planetary Samples to NASA Johnson Space Center

ACCOUNTABILITY & HISTORY

1. Use Curatorial Form F-75. Complete one "Curatorial Form F-75, Return Sample Accountability & History" (Part A only) for the return of each sample which appears on your inventory listing. You do not need to complete the form to return samples which were issued to you as thin sections or probe mounts unless they were used in analysis by ion probe, proton probe, or other destructive technique. Use "Form F-75, Continuation Sheet" to list any subsamples that you have derived from the samples that you were assigned. If you have not made any splits, only the first page of the form need be used. If you have made more than 5 splits of any sample, you may either reproduce the "Continuation Sheet"' yourself, or you may obtain additional copies from the Curator by contacting the Sample Control Center.
2. Use Official Sample Numbers According to Your Sample Inventory. You may obtain a current listing of your samples by contacting the Sample Control Center at 281-483-2254 or FAX 281-483-5347.
3. Document Sample Utilization According to Mass. Enter the appropriate mass for each item in the spaces provided in Part A, lines 1-8. The masses should refer to the entire sample which appears on your inventory listing. Note that the masses which appear on the inventory reflect the amounts for which you are currently accountable, and may differ from the original masses which you were issued. Such differences reflect transfers of portions of the samples which were authorized by the Sample Curator, any amounts consumed which you reported as the result of an annual inventory, or parts of the samples which you previously returned.
4. Document Sample History with Regard to Contamination or Modification. Document the contamination history for each sample in the spaces provided as block 9 of Part A. The following questions should be used as guidelines:
    1. Has the sample been chemically degraded by exposure to or admixture with major or trace elements, organic or inorganic liquids, or heavy metals?
    2. Has the sample been exposed to an electromagnetic field?
    3. Has the sample been separated based on mineralogical or petrological properties, grain size, density, or magnetic properties?
    4. Has the sample been exposed to gases other than dry nitrogen, such as air, inert gases, or halogens?
    5. Has the sample been heated, fused or dissolved, or otherwise undergone any thermodynamic change in state?
    6. Has the sample been irradiated or undergone neutron activation?
    7. Has the sample been affixed to or imbedded in a substrate such as glass or epoxy? Samples degraded in this manner will include thin sections, probe mounts, potted butts, grain mounts, etc. Please be specific as to the current state of the sample.
    8. If the sample is a thin section or probe mount, has it been subjected to ion-probe analysis, proton-probe analysis, or other destructive method?

PACKAGING

5. Use Double Containers for Samples. As a minimum, provide two layers of protection against contamination, such as a sample vial within a plastic bag. Contact the Curator's office regarding special requirements; cleaned containers can be provided on request (allow one month for delivery).
6. Package for U.S. Registered Mail or the Equivalent. Prepare packages so that they are strongly resistant to damage. Container strength and sealing provisions should be compatible with requirements of registered mail with the U.S. Postal Service.

TRANSMITTAL BY INVESTIGATORS IN THE UNITED STATES

7. Hand-Carry Large Samples. Samples that weigh more than 10 grams, individually or in total, must be hand-carried to the Sample Curator unless the Curator provides a written exemption in advance.
8. Send Small Samples by Registered Mail. Samples weighing less than 10 grams may be mailed from points within the U.S. You may request NASA official business return mailing labels from the Curator's office; you must add your name clearly to the labels. (In the event that the Post Office will not accept these labels, you are required to pay the postage.) Send the samples by REGISTERED MAIL, RETURN RECEIPT REQUESTED to the following addresses:

Dr. Gary E. Lofgren
National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Mail Code KT
2101 NASA Parkway
Houston, Texas 77058-3696 USA

The U.S. Government acts as a self-insurer. Do not obtain postal insurance for planetary materials samples transmitted by the U.S. Postal Service.

TRANSMITTAL BY INVESTIGATORS OUTSIDE THE UNITED STATES

9. Hand-Carry Large Samples. Samples that weigh more than 10 grams, individually or in total, must be hand-carried to the Sample Curator unless the Curator provides a written exemption in advance.
10. Use International Courier Service e.g. FedEx. Return samples to the Lunar Curator via international courier service when samples weight less than 10 grams singly or in the aggregate. Samples packaged separately can be placed in different packages to keep the weight under 10 grams. Address package to:

Dr. Gary E. Lofgren
National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Mail Code KT
2101 NASA Parkway
Houston, Texas 77058-3696 USA
Telephone: 281-483-6187
FAX: 281-483-5347

INFORMATION

If you require help in any aspect of your sample return, please use one of the following points of contact:

	For Lunar:	For Meteorite:
Telephone:	281-483-3274	281-483-5125
FAX:	281-483-5347	281-483-5347
E-mail:	gary.e.lofgren@nasa.gov	kevin.righter-1@nasa.gov

Revised 10-Jan-2009