

CAPTEM Minutes

Minutes of the Fifty-fourth Meeting of the Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM)

Held at the Lunar and Planetary Institute in Houston, Texas on Saturday, March 24th,
2018

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1. Agenda for Spring 2018 CAPTEM Meeting, March 24th

Attending:

CAPTEM: Kevin McKeegan (Chair), Liz Rampe (Secretary), Carolyn Crow (Lunar), James Day (Lunar), Vinciane Debaille (MWG), Juliane Gross (Lunar), Justin Hagerty (Informatics), Munir Humayun (Asteroids), Hope Ishii (Cosmic Dust), Jim Karner (MWG/ANSMET), Noriko Kita (MWG), Sam Lawrence (Informatics), Larry Nittler (Genesis), Devin Schrader (MWG), Gary Huss (representing Rhonda Stroud, Stardust), Jeff Taylor (Lunar, Informatics, Space Exposed Hardware), Arya Udry (MWG), Thomas Zega (MWG)

Others: Judy Allton (Genesis Curator), Jessica Barnes (new Lunar member), Michael Callahan (MWG), Michael Calaway (JSC Curation), Nicholas Castle (meeting organizer, LPI postdoc), Cari Corrigan (Smithsonian Representative), Dave Draper (NASA ARES Research Office Manager), Cindy Evans (JSC ARES Division Chief), Ken Farley (Caltech, Mars 2020 Project Scientist, attending remotely), Marc Fries (Cosmic Dust Curator), Rachel Funk (JSC Meteorite Processor), Jeff Grossman (HQ Program/Discipline Scientist), Andrea Harrington (Mars Sample Curator), Richard Herd (interested international partner), Julie Hoskin (Smithsonian Collection Manager), Jeremy Kent (JSC Curation), Francis McCubbin (JSC Head Astromaterials Curator), Julie Mitchell (JSC Advanced Curation), Andrea Mosie (JSC Lunar sample collection), Keiko Nakamura-Messenger (Hayabusa2), Sarah Noble (HQ Program/Discipline Scientist), Lisa Pace (JSC ARES Division Deputy Chief), Aaron Regberg (JSC Advanced Curation), Kevin Righter (JSC, Meteorite and OSIRIS-REx Curator), Cecilia Satterwhite (JSC meteorite collection), Carol Schwarz (JSC sample allocation), Christopher Snead (JSC Advanced Curation), Eileen Stansbery (JSC EISD deputy director, JSC chief scientist), Linda Welzenbach, Kim Willis (JSC sample allocation), Ryan Zeigler (Apollo Sample Curator, ARES curation office manager), Mike Zolensky (Curator of Stardust, Hayabusa, microparticle impact lab)

Saturday, March 24, 2018 8:00AM CDT, Hess room

8:00 am

Gather with coffee & donuts

8:10 am

Welcome and introductions (McKeegan)

Approval of minutes from Fall 2017 online meeting

Action items from Fall 2017 meeting (Rampe, McKeegan)

Approval of/changes to agenda for Spring 2018 meeting

8:30 am

STARDUST review & report (Huss, Zolensky)

9:00 am

ASTEROID curatorial/allocation report (Zolensky, Humayun)

9:10 am

NASA HQ briefing (Grossman)

9:40 am

JSC organizational report (Evans)

9:55 am

JSC facilities report (Pace)

10:10 am

Break

10:30 am

Astromaterials Curation report (McCubbin)

10:50 am

Advanced Curation - Small particle handling (Snead)

11:00 am

*MWG curatorial/allocation report (Righter)
(Group dismissed for allocation meetings)*

11:25 am

COSMIC DUST curatorial/allocation report (Fries/Ishii)

11:40 am

GENESIS curatorial/allocation report (Allton/Nittler)

11:50 am

Report of NAS, PAC meetings (McKeegan)

NOON

Break for lunch

1:30 pm

Mars 2020 sample caching and Mars Sample Return (Farley)

2:15 pm

Mars 2020 ATLO Curation updates (Harrington)

2:30 pm

Break

2:50 pm

LUNAR samples curatorial/allocation report (Zeigler/Gross)

3:35 pm

INFORMATICS report (Zeigler/Lawrence)

3:55 pm

Other activities:

- *CAPTEM vice chair election*
- *New CAPTEM members*
- *Science bullets*
- *Discussion of any CAPTEM findings to be brought to PAC*

4:30 pm

New business:

- *Schedules for Fall (online) and subcommittee meetings*
- *Sub-committee for review of OSIRIS-Rex and Hayabusa-2 curation plans*
- *Action items summary (McKeegan, Rampe)*

5:00 pm

Adjourn

Attachments:

Minutes from Fall 2017 meeting

2. New action items from this meeting

- 1) Review OSIRIS-REx curation plan (Asteroids Subcommittee).
- 2) Assemble a CAPTEM subcommittee to review Hayabusa2 curation plan (McKeegan, Asteroids).
- 3) Review subcommittee membership and send list of members to K. McKeegan and L. Rampe (all subcommittee chairs).
- 4) Review new implementation strategy for addressing Stardust requests. Discuss whether a similar implementation strategy would make sense for other collections.
- 5) Consider a motion to relax former CAPTEM finding (from 2007) that would discourage Curation from allocating the largest and highest grade science samples, and vote on this motion at the Fall 2018 CAPTEM Meeting.
- 6) Review the Cosmic Dust collection strategy and its effects on curation in the Spring 2019 CAPTEM Meeting (Fries, Cosmic Dust Subcommittee)
- 7) Identify samples with high science priority in each collection; consider how long-term storage may affect curation, conservation, and science; and write special allocation rules that would allow new CAPTEM members to evaluate future proposals to study these samples with high scientific value (all subcommittees).
- 8) Provide <1 page of text to F. McCubbin detailing what each subcommittee would like to include in a future Astromaterials newsletter to advertise sample availability and advocate for certain analyses.
- 9) Send science bullets to K. McKeegan.
- 10) Compile new PI information from proposals (e.g., how many new PIs proposed, are they international?) (all subcommittees, except Lunar and MWG, who have already compiled this information)
- 11) Schedule CAPTEM Fall Meeting (McKeegan)

3. Welcome and roll call (McKeegan)

Approval of the Spring 2017 Meeting Minutes: Motion approved unanimously by show of hands, but some spelling errors need to be fixed.

Disposition of action items from last meeting:

Action item 1: Create a small committee to think of ways to improve the Stardust catalog and feedback between Curation, PIs, CAPTEM (Stroud, McCubbin).

Resolution: The Stardust Subcommittee convened a review committee to evaluate the status of the collection and allocation. They distributed a survey to the community to solicit ideas for improving the catalog and allocation process. The survey participants suggested that the catalog could be improved by categorizing tracks by type, adding optical images, and linking samples in the catalog to published results.

Action item 2: Update the Cosmic Dust webpage so that PIs can specify whether the analyses will be destructive or not in the request.

Resolution: Updates to the Cosmic Dust webpage are in progress.

Action item 3: Assemble a CAPTEM subcommittee to review the OSIRIS-REx and Hayabusa2 curation plans.

Resolution: This will be discussed during the meeting today.

Action item 4: Review draft of Mars Curation plan from Andrea Harrington.

Resolution: This will be discussed during the meeting today.

Action item 5: Each subcommittee should draft and review policies on sample preservation and conservation and circulate to CAPTEM prior to Spring 2018 Meeting.

Resolution: This action item will be tabled for now, but the committee will revisit this.

Action item 6: Subcommittee chairs should review the membership spreadsheet, send corrections to Kevin, and put forward names for new members.

Resolution: This will be discussed during the meeting today.

Action item 7: Arrange a time for each subcommittee to meet prior to Spring 2018 Meeting, if feasible.

Resolution: Lunar and MWG met before the Spring 2018 Meeting.

Action item 8: Elect a CAPTEM Vice Chair.

Resolution: The Vice Chair is an appointment, not an election. Hope Ishii is the CAPTEM Vice Chair.

Action item 9: Investigate costs and logistics associated with changing the spring 2019 CAPTEM meeting to the Saturday before LPSC (McKeegan).

Resolution: This will be discussed during the meeting today.

4. STARDUST review & report (Huss, Zolensky)

Subcommittee members include Rhonda Stroud (Chair), Philipp Heck, George Flynn, Andrew Westphal, Ryan Ogliore, and Thomas Stephan (replacing Scott Sandford). The plan is to rotate 1-2 new members onto the subcommittee yearly.

One request was received since the Fall Meeting. A review committee was established to investigate why there are so few requests for allocation and to evaluate the status of the collection and allocation. A community survey was sent to 80 researchers that have previously worked on Stardust samples. The survey included eight questions to figure out who is currently working on samples, if they like the allocation process, and to ask for suggestions to improve the request/allocation process. The committee spent 1.5 days at JSC looking at the curation facility, evaluating the online catalog, and meeting with the Stardust curators.

There was a bimodal response to a few survey questions. There were initially many participants in PE, but now there are not many. Those in PE thought the process worked well. Those who still work on samples were less satisfied with the process and in particular thought it was difficult to identify the request. The survey elucidated a variety of perceptions of what goes into a request. Some experienced long delays or got samples that were not like what they requested. The survey also asked if requests should be a biannual process, but most thought it should remain a rolling process. Some respondents had concerns about the review process; they wanted more transparency in the review and thought there was a high technical bar for sample allocation. The greatest frustration was navigating Stardust catalog. The subcommittee recommends the following for improving the catalog: categorize tracks by type (carrot, bulk, etc.), add optical images if available (i.e., do not take new images for the catalog), and links to published results, and add information on sample status and history.

The site visit showed that facilities and staffing are in good shape. The review committee recommended aerogel tiles be pulled from the tray so that can be removed while there are curators who still know how. The review committee was concerned over shut down for air handling upgrades and Hayabusa2 lab construction. The review committee recommended that the internal catalog ("De Gregorio catalog") that curation maintains be incorporated into the public catalog. To further improve the request process, the subcommittee recommends setting up an email alias that is connected to the CAPTEM Stardust chair, the Stardust Curator, and the Head Curator. After the request is processed, the request would go to the Stardust allocation review committee. The allocation approval would be sent to the same email alias attached to the curators and Stardust chair. The PI who made the request would be cc'd on the emails so he/she would know the status of the request.

Comments from CAPTEM and curators: One problem with this new email alias is that after the CAPTEM committee makes a recommendation, it goes to NASA for a decision. CAPTEM does not make the ultimate decision. The current process of request and allocation is not very different; the main change is that Francis McCubbin and Mike Zolensky would get a notification, which would add more transparency. CAPTEM suggests writing an implementation strategy for

CAPTEM to approve, set up an email alias, and create new instructions so the community knows about the change). Should this be done for other subcommittees and collections? It may not work well for collections with many allocations (e.g., Lunar and MWG) because hundreds of emails would be generated and sent to the curators.

The Stardust subcommittee recommends preparing a few tracks for advertising to new or previous PIs (~5 keystones at 6 month intervals for a year) and taking photos of the tracks. This may reduce activation energy to request a track. The Stardust subcommittee also recommends trying to attract different communities (e.g., the Rosetta community may be interested). The success of creating new tracks should be reevaluated after a year to keep from preparing unusable tracks. The subcommittee also suggests harvesting terminal particles or preparing new TEM grids for researchers who can't work with the whole track, so PIs don't have to be as technically skilled.

Comments from CAPTEM and curators: JSC/LPI has held two training sessions on handling challenging samples (microsample handling). Should groups outside of JSC be encouraged to hold similar training sessions? There are analog keystone samples that PIs can request so they can learn how to work microsamples. The curators should advertise the availability of analog keystones. The Curator Zolensky disagreed with preparing new keystones because curators already help researchers prepare samples on a case-by-case basis. Curators at JSC will talk about this more and will respond to recommendation. Keiko Nakamura-Messenger volunteered to give a talk at the Rosetta team meeting to attract that community to Stardust sample analysis.

The subcommittee recommends importing the De Gregorio database into public catalog, reviewing existing descriptions and removing jargon, entering high level information about tracks and crater, and developing a better keyword search so PIs can check for availability (an improved key word search is the primary recommendation).

Comments: The Stardust subcommittee should iterate on improvements to the catalog with curators as they continue to update the catalog. One problem identified is that the catalog includes a lot of melt debris. Is it possible to advertise other particles? There was a suggestion to announce to the community when catalog is updated in an email through the LPI.

5. ASTEROID curatorial/allocation report (M. Zolensky/ M. Humayun)

The Asteroids Subcommittee had no new requests for Hayabusa samples. There was one outstanding allocation awaiting confirmation by PI that he could pass sample handling test, which he did this at LPSC. 45-50 total Hayabusa samples have been received from JAXA, and six samples have been allocated. The Hayabusa catalog is updated as particles are received.

A finding from CAPTEM in 2007 stated that curators are not allowed to allocate largest particles or tracks in any collection. There was discussion about whether CAPTEM should rescind that finding. CAPTEM members generally agree that the highest grade samples should not be arbitrarily saved for the future because there are no guidelines on when those samples would be studied (if ever). CAPTEM subcommittees should start advertising which samples are available (including those with high science priority). Advertising the high priority samples could attract more PIs. A motion to relax the former CAPTEM finding from 2007 that would discourage

Curation from investigating allocation largest and highest grade science samples will be put forward at the Fall Meeting. Before the Fall Meeting, K. McKeegan and L. Rampe will circulate the text of that 2007 CAPTEM finding to CAPTEM and the associated curators.

6. NASA HQ Update (Grossman)

According to the newly enacted FY18 Omnibus Appropriation, NASA's Planetary Science Division budget will increase from \$1.8 to \$2.2B. There are no details on the final budget numbers for individual programs relevant to CAPTEM, but selections will likely be consistent with previous years. There are big increases for lunar exploration in the budget.

In ROSES17, for Emerging Worlds, 30 of 128 proposals were selected (23%), and for Laboratory Analysis of Returned Samples (LARS), six of 18 proposals were selected (33%). The number of proposals and selection rates were lower than in previous years, but availability of funding was not the cause. ROSES18 was released on Feb 14th. Emerging Worlds and LARS have similar scopes and due dates. The Solar System Workings due date was moved up a month (Jan 2019).

The scope of LARS includes all sample return missions and readiness for future sample return (except for lunar sample return). Stardust has the lowest investments because there is not a lot of proposal pressure. The question was again raised: How do we get the best return out of our mission dollars? CAPTEM should devise a strategy to get the most out of the collections.

Planetary Major Equipment and Facilities (PMEF) has changed. For proposals to PMEF, the attached equipment proposal can only be for equipment to do the proposed research. Stand-alone proposals can still be submitted for facility instruments. There is a single deadline for all proposals (Step 1: July 17, 2018; Step 2: September 17, 2018). There are two different lengths for standalone proposals, depending on whether the instrument would constitute a facility. Proposers don't need to be a PI on another proposal to submit proposals to PMEF, but the proposed instruments must align to previous research. PMEF is open to same programs as in 2017, in addition to the Internal Scientist Funding Model (ISFM) and Exoplanets Research Program (XRP), which are two NASA directed research programs.

The Data Management Plan (DMP) must now cover any astromaterials planned to be collected or purchased over the course of the research. These include meteorites, micrometeorites, and cosmic dust. The DMP must demonstrate any such astromaterials with scientific value not consumed during the proposed research would be made publicly available after the proposed research ends (e.g., if the PI purchases a meteorite with NASA money, any sample not consumed must be made available to the community). There is no expectation to transfer samples to JSC (e.g., if meteorites are purchased, they would be more appropriate for the Smithsonian).

There are many Sample Return Missions coming up or in development (OSIRIS-REx; Hayabusa2; Martian Moons eXploration, which is an ISAS/JAXA mission; CAESAR is in Phase A in New Frontiers, which would launch 2024, and return samples from comet 67P/Churyumov-Gerasimenko in 2038; Mars 2020 is first phase of a Mars Sample Return campaign; and there are upcoming lunar opportunities).

The NAS study on extraterrestrial sample analysis facilities is ongoing. The committee has met several times and has solicited community contributions. The committee is meeting again in early April. The final report is expected soon.

Sarah Noble gave an update on the lunar discovery and exploration program. SMD and HEO are working on lunar missions together. There will be a ROSES call for opening sealed drive tubes and other specially curated samples. HQ is in discussions with curation to develop this call, but there is no timeline on its release. A CAPTEM review could be incorporated into ROSES proposal reviews to expedite the process for allocating new samples. How will the availability of new samples be advertised? HQ asked curation to start thinking about this. The new samples have not yet been identified by curation. The Development and Advancement of Lunar Instrumentation (DALI) program was created to develop lunar instrumentation that would be launched on commercial landers. Language was added to ROSES calls to encourage lunar studies, anticipating extra funding for lunar research. With the additional funding for lunar research, HQ plans to develop an archive system for lunar and other sample data. This should not be thought of as a PDS for samples. It will build off of MoonDB to fulfill DMP requirements.

NASA will be soliciting instruments to fly on small commercial landers (the third Stand Alone Missions of Opportunity Notice-Program Element Appendix, SALMON-PEA, will be released soon). A commercial lander may be available as soon as next year. Bigger, more capable landers are expected in the future, with sample return as soon as 2025. Commercial entities are also talking about sample return. CAPTEM discussed whether it should interface with these companies and who would curate samples if they were collected by commercial entities. If the mission is developed with NASA, then NASA would likely curate the samples.

7. JSC organizational/lab report (Evans/Pace)

Cindy Evans briefed CAPTEM on activities in the JSC Astromaterials Research and Exploration Science (ARES) Division. Since the Fall CAPTEM Meeting, ARES hosted the National Academy's Sample Analysis Review Panel site visit and participated in a conference on the Lunar Orbiting Platform Gateway Utilization, which included many sample return ideas, like installing collectors outside the Gateway (the results of the conference are being compiled by Ben Bussey). ARES also conducted training for the new class of astronauts, including on the importance of planetary samples.

Lisa Pace gave a report on ARES curation facilities. The strategic plan for ARES includes adding an annex to Bldg. 31, renovating 31E, and demolishing the Bldg. 31 hi-bay (31W) while continuing to use 31N (lunar curation facility). ARES has started to occupy a portion of Bldg. 29, which was renovated five years ago. ARES is currently sharing Bldg. 29 with the Engineering Directorate. ARES is requesting \$15M to build the annex, which will provide 20,000 ft² of lab space. A facility assessment in 2016-2017 devised the cost and concept of the annex. It will be designed to withstand a category 3 hurricane, and construction is expected to begin in 2021-2022. Curation facilities will not be housed in the annex; they will be in 31E and 31N.

Updates on advanced curation and cleaning facilities:

- The first floor conference room in Bldg. 31E will be turned into an advanced cleaning lab. The design will be finished in April 2018. The bid and award will take ~six months, and construction is expected from January 2019-June 2020.
- The second floor OSIRIS-REx and Hayabusa2 curation facilities 100% design delivery is due April 2018. The bid and award will take ~six months, and construction is expected from January 2019-June 2020.
- A new separate exhaust for the Stardust curation facility is in progress. The N plumbing is currently being isolated, and the security door is being relocated ahead of construction.
- A new ultrapure water heater was installed for the lunar curation labs. The 100% design for a new ultrapure water loop for advanced curation and cleaning labs is due in April 2018.

Bldg. 37 was the original Lunar Receiving Lab and will be demolished, but a National Historic Landmark will be dedicated in its place. JSC Center Operations is working with historic preservation people to build a memorial park. Sidewalks in the park will represent hallways in the buildings, different vegetation will represent the different zones in the building, and historical objects will be present in the park.

8. JSC Astromaterials Curation Report (McCubbin)

Updates to the Office

There were no changes to the ARES org chart. Dr. Julie Mitchell is working full time in advanced curation as the lead on cold curation and Curator of planetary ices and organics. Marc Fries has taken over as Cosmic Dust Curator for Mike Zolensky. Anne Kascak will be retiring in a few weeks. Darren Locke (Jacobs) is the project lead for advanced curation on the contract side. Jacobs is advertising a new position for lab support in advanced curation in the area of geomicrobiology/medical geology.

Curation Support to New Missions

Construction in OSIRIS-REx and Hayabusa2 labs will begin in FY19. Hayabusa2 has reported visual on Ryugu and will reach Ryugu in July 2018. O-REx expects a visual on Bennu in August 2018.

Andrea Harrington is the Mars Sample Curator and has drafted a curation plan for archiving witness materials and coupons. Advanced curation is awaiting direction from NASA HQ on how Curation and Mars 2020 Project interactions shall proceed. Once decided, Curation will ask CAPTEM to review the curation plan.

Advanced curation has obtained a -80 °C freezer that will be used to store biological contamination knowledge (CK) coupons for Mars 2020.

Francis McCubbin continues as ex-officio member of the Mars 2020 Return Sample Science (RSS) Board and the chair of the Contamination Control and Planetary Protection Working Group (CCPPWG) for Mars 2020.

Allocation highlights since November 8th 2017

One Stardust allocation was partially worked and two keystones were allocated. Nine Genesis flown samples and four non-flight reference samples were allocated. 233 Apollo samples were allocated. 361 Apollo samples have been returned. 348 meteorite samples were allocated to 51 PIs. 234 new meteorites were announced in the Spring 2018 newsletter. 263 samples were received from the 2017-2018 ANSMET season in mid-March 2018. No Hayabusa, Cosmic Dust, or MIC samples have been allocated since the Fall 2017 CAPTEM Meeting.

Status of pending allocations approved in Fall 2017 or earlier:

- There are five pending requests for meteorites (three for thick slices, one for extensive sawing/cutting of OCs, and one lunar meteorite chip awaiting photo-documentation before chip allocation).
- There are 12 pending requests for lunar samples (eight awaiting additional PI requirements for information, two awaiting completion of thin sections, and two were old pending requests for which Curation recently received PI input).
- Two Stardust allocations are in process.
- One Cosmic Dust request is pending results of PI sample inventories.
- One partial allocation of a Genesis sample from 2016 is pending initial results from the PI.
- There are no pending requests for Hayabusa and Space Exposed Hardware.

Outreach highlights

Educational disk and outreach programs have reached 10,000s of people. For FY17, 27 sample disk certification workshops were held. NASA Science Day events reached 1,383 participants. Since October 2016, 266 disks (148 lunar, 118 meteorite), 25 thin section packages (15 lunar, 10 meteorite), and 89 lunar and Mars soil simulant sample packs (47 lunar, 42 martian) were loaned to educators, museums, and students.

27 public outreach events using displays reached >4,700 students, teachers, or the general public.

Social media sites featuring Astromaterials include blogs (myares.wordpress.com), Facebook (NASA ARES), Twitter, and Instagram.

Updates on Advanced Curation

Advanced Curation is developing a Hamburg meteorite consortium study. A meteorite fell on a frozen lake in Hamburg, MI on 17 January 2018. It was collected in clean Al foil, kept frozen, and a portion of the meteorite was supplied to Curation. Advanced Curation is treating like a returned sample Preliminary Examination. This will be the first trial of cold curation sample processing under the purview of Dr. Julie Mitchell. It will test the PE process and allow current curators to gain practice ahead of upcoming sample return missions. It will allow a thorough Contamination Knowledge (CK) description at each step of the process and will ultimately help understand how to mitigate contamination (microbial, inorganic, and organic). CAPTEM members suggested testing the O isotopes of the frozen lake water to compare to the meteorite.

Advanced Curation is investigating dry collection of Cosmic Dust. Previous work by Messenger et al. (2015) demonstrated that IDPs can be collected using foam instead of oil-coated collectors. Oil can be problematic because it is a contaminant that affects studies of organics, O isotopes, etc. This method of collection is proven, but removing particles from the foam is difficult. CD team

and Christopher Snead have brainstormed nine methods of removing particles from dry foam and narrowed them to six: vacuum wand, particles trapped on filter; vacuum glass probe tip for individual particles; adhesive probe using carbon tape; cut the foam, distribute as mounted sample; update existing system with stage articulation; glass needle probe.

Advanced Curation has experimented with storing small particles (<20 um) in Si wells produced via FIB by Zia Rahman. Semiconductive Si storage receptacle reduced static charging effects and may be suitable for e-beam analyses and characterization. Similar wells may be produced on other substrates (e.g., beryllium).

Dr. Julie Mitchell is scoping testing (experiments, modeling, etc.) needed to support comet sample return. For cold meteorite processing, upgrades to make hardware cold-tolerant are ongoing. Practice runs with witness materials and positive controls will be conducted prior to sample preparation of Hamburg meteorite. Long-term cold curation studies will begin once materials are collected. Samples will be stored at -20 and -80 °C for predefined time intervals. GC-MS, SEM, and FTIR will be used to assess sample alteration.

Microbial ecology studies of samples from the meteorite lab by Aaron Burton show that fungal isolates are not producing exotic amino acids. Therefore, if rare amino acids were identified, they would be assumed to be extraterrestrial and not produced by fungi in the laboratory.

9. Advanced Curation – Small Particle Handling (Snead)

Christopher Snead is investigating methods of handling small particles in preparation for O-REx and Hayabusa2 sample return. Microparticles are defined as those with diameters 1-100 um. Christopher is identifying and solving microparticle handling challenges (e.g., mitigation of triboelectric charging effects, handling in N-purged sample cabinets, complex surface morphology). Handling includes removal of particles from the collection substrate, a storage container (e.g., glass concavity slide), or analysis substrate (e.g., SEM mount, epoxy bullet). The goal is to reduce microparticle loss. Forces that affect micro particles include van der Waals forces (causing the particles to stick to the needle) and triboelectric charging (causing the particles to be repelled by the needle).

The tests were done in the microsample handling clean lab in Bldg. 31 (room 2024) with a Nikon SMZ-18, a Nikon SMZ-1500, a mechanical micromanipulator, and a MicroSupport AxisPro. The following methods were tested for mitigating triboelectric charging effects: Po-210 ionizing sources, increased humidity, conductive/semi-conductive manipulation tools, high surface area tools, and wet epoxy-coated needle (if putting sample in epoxy). A tungsten carbide needle has high surface area (short taper, as opposed to glass needle) and can mitigate triboelectric charging. Po-210 alpha sources work well <1” from samples. Christopher is keeping track of particles lost with each method and estimates a ~95% success rate, but will better quantify that value in the future.

Christopher is evaluating the use of a FIB to mill wells into Si for small particle (<20 um) storage. The Si is a semi-conductive receptacle, so it reduces triboelectric charging. Particles in the receptacles can be imaged in SEM. Wells could also be milled in other substrates (Ge, Be, Au,

diamond). This could be advertised as an option for PIs. Particles could sit in the well or could be welded in place. It takes relatively little time to make these wells.

Working with small particles in N-purged cabinets is challenging because the use of rubber gloves results in loss of dexterity and the cabinets have very low humidity. Christopher is going to Japan to learn to manipulate small particles in N-purged cabinets from Hayabusa team because there is desire to curate OSIRIS-REx samples in N. The MicroSupport AxisPro is a digital microscope with an automated stage and dual micromanipulation system that could operate in the glove box. Manipulators are restricted to 3-4 axes of motion, and removal of particles will require tilt and rotation degrees of freedom. The MK1 3D Pantograph Micromanipulator simulates the motion of a hand, so Christopher is investigating the tool. He is also investigating robotic arm manipulation with Texas State San Marcos interns. The interns are using open-source 3D-printed 4-axis robot arms to characterize how these could augment human operation in a glove box.

Christopher is testing removal of particles from complex collection surfaces, like OSIRIS-REx contact pads (3D metallic hook and loop, stainless spring steel; some of it is archived – composition will be determined by mission). Christopher is also investigating the removal of CD from 3D foam surfaces.

10. MWG curatorial/allocation report (Righter)

348 samples were allocated to 51 PIs in the last six months. 234 meteorites were published in the Spring 2018 newsletter. ~263 new specimens were collected by the 2017-2018 ANSMET team (from WSG, PRE, and GRO). Jim Karner reported that the ANSMET volunteers were split into two teams of four people. One team went to the Grosvenor Mountains and collected 211 meteorites. The other team went to six different ice fields and collected 50 meteorites, but found no significant concentrations in any of the ice fields. McMurdo renovation is expected in ~2020, with potential impacts to many programs, including ANSMET.

40 requests were received since the CAPTEM Fall 2017 Meeting. MWG will be evaluating 28 later today.

The 2017 inventory was initiated 31 October 2017. 278 samples were sent, 204 of which have been received, 52 are outstanding, and 22 are pending.

Since the CAPTEM Fall 2017 Meeting, 493 meteorite samples have been returned or consumed.

Noriko Kita is the new MWG Chair.

Of the 40 requests since Fall 2017, nine were curatorial requests and five new PIs have requested samples.

118 K-12 program meteorite disks have been sent out from November 2017-March 2018, reaching ~29,000 people. Meteorite hand samples were shown at seven events, meteorite display samples were shown at seven events, and college disks and thin sections were sent out nine times. A CAPTEM member asked if new meteorite and lunar disks have been created recently. MWG has

10 thin section sets, but these have not been added to since the mid-1990s. Should these kits be updated? Lunar has enough sets, but they are near capacity. 200 disks have been created, and ~120 are used. Lunar Curation is ready to increase disks for schools. The problem is that only one person ships them, so there are limitations on how many can be shipped and how quickly they can be shipped. Lunar Curation may need to increase distribution as the moon comes back into favor. Some CAPTEM members who are professors remarked that there is a long waiting line for meteorite thin sections and they may wait from three months up to a year. They suggested making more thin section sets and advertising them to educators. Curation will look into problem of availability of thin section sets. Is this isolated or pervasive? Curation will report back at the Fall 2018 Meeting.

The Meteorite Lab is working on ANSMET samples from 2015, 2016, 2017. The last of the 2014 samples were sent to the Smithsonian for characterization.

Based on the number of requests from previous years, Kevin Righter predicts 80 requests in FY18.

Cari Corrigan reported that the new probe has been installed at the Smithsonian and is working well. They classify ordinary chondrites by SEM-EDS, not immersion oils (this method is less reliable). Every ordinary chondrite has data associated with it for classification (e.g., Fa#, Fs#) in the newsletter. Terrestrial age information for meteorites in the entire collection is in a spreadsheet on the website.

Jeff Grossman asked about the domestic vs. foreign requests for meteorite samples. Kevin Righter estimated ~25% international, and thinks that number has increased over time. He will quantify this number for the Fall 2018 CAPTEM Meeting or will email Jeff Grossman directly with these numbers.

MWG released to discuss allocations.

11. COSMIC DUST curatorial/allocation report (Fries/Ishii)

Marc Fries, the new CD Curator thanked Mike Zolensky for his many years of service.

No allocation requests were received since the Fall 2017 CAPTEM Meeting. Two new requests are being processed and a third request requires inventories from the PI before moving forward.

CD database upgrades are needed after information polling of the community. CD processors and IT have been meeting monthly on updating the database. Sub-sample tracking capability (like used in the meteorites database) has been added. Loan requests are now stored in the CD database as pdfs. Automatic generation of emails to request loan agreement renewals was also added.

The CD subcommittee reviewed 3 new requests, for a total of 34 particles. One was recommended for full allocation (11 CS IDPs). One was recommended for partial allocation with revise and resubmit (20 cosmic and possible cosmic particles). No allocation was recommended for the third request with revise and resubmit (two GC IDPs).

The current CD subcommittee members include Hope Ishii, George Flynn, Scott Messenger, Penny Wozniakiewicz, Susan Taylor, and Zahia Djouaii-Bouali. Brad De Gregorio will replace George Flynn (>15 years of service). Henner Busemann will replace Scott Messenger.

There was discussion of how to name parent cluster particles. Going forward, parents will be given a designated name and individual particles from that parent will be given a number after a comma (similar to the process in Lunar Curation). Should cluster particle parents be retroactively re-named if pieces of the cluster particle were removed and studied? This is not planned because the cluster particles already have a designated name in publications. This is only the plan going forward. Images will be added to the database for each particle. If a PI divides cluster, would he/she assign comma numbers? No.

One ER-2 set of collectors was exposed on a short flight (8 hours) at the beginning of February 2018. No WB-57 flights occurred since the Fall 2017 CAPTEM Meeting. An ER-2 flight was requested to sample a massive meteorite fall off the Washington State coast (8 March 2018), but this request could not be fulfilled.

Particle picking continues at steady pace (by Kathleen McBride). A Freon replacement is needed because the Freon supply is running short. Freon is used to thin the oil coating the collectors. Marc is testing the use of spinners to thin the oil (centrifugal force would help coat the collector with oil, rather than Freon).

For the future of CD:

- Whole cluster particles will not be issued to individual PIs without a compelling reason. The preferred method for the study of CPs is through consortium studies and a combination of methods. There were many questions about this (e.g., how many people make a consortium? How many institutions must be involved? Are consortium studies preferred when requesting an entire Stardust track? Stardust subcommittee says yes). There was concern that being too conservative could temper demands for materials and the people that CAPTEM wants to see work together may not want to work together. Subcommittees need criteria with which to judge proposals, so it was recommended that each subcommittee update criteria for allocation requests and make the community aware of these updates (both curators and CAPTEM should weigh in on the criteria). More scrutiny will be placed on the samples with the highest scientific value. Curation solicitation criteria should be clear. PIs must return unconsumed material after analyses and must state in his/her proposal how destructive the planned analyses would be.
- Add whole-collector imaging prior to picking (in as-received condition) because this is good curation practice and could result in basic science, like particle size distribution. CD Curator is assessing the existing microscope and may need to buy new microscope or re-assign existing equipment to scan entire collector.
- Marc is investigating dry collection of CD with foam (i.e., the Messenger method). Contamination from oil is a problem because it is a contaminant, which is driving this investigation of dry collection. A mix of dry foam and oil-coated collectors will be flown in the near term to compare the two methods of collection. Previously used foam was not available, so a replacement is needed. There are many types of foam (Teflon foam, electrically conductive foam, etc.). Issues to address include removing particles from the

foam (which is optically opaque; Christopher Snead is testing six methods to remove particles from foam), degradation of particles from acidic aerosols if oil is not present, and loss of particles by airflow removal. There is no intent to replace oil; the dry foam method would supplement the oil-coated collectors.

- Balloon-borne collection will be investigated to supplement (not replace) aircraft collection. The collection would occur over longer durations (100s of hours of collection). Off the shelf hardware is available for collecting airborne particulates. Balloon collection would reduce long-term risk of aircraft flight programs being descoped. A CAPTEM member noted that the balloon could produce terrestrial dust. Marc suggested a 2 km long string to hang collectors off of could mitigate this.
- Ground-based high volume air sampling with large area filters is on-going. Antarctic South Pole collection by Dr Susan Taylor will be incorporated into JSC CD collection. Mauna Loa collection by Ishii and Bradley may be incorporated.

CAPTEM suggested Marc review the CD collection protocol/strategy and how the strategy will affect curation. This review should be done after Marc has had time to test these new methods (which could be a year from now).

Two small particle sample handling training sessions have been held (hosted by LPI and JSC). There is a lot of demand for trainings (only four out of 12-20 applicants have been allowed to take the trainings). Should trainings be held at other places? The Brownley and Westphal labs may be appropriate places to hold trainings and would put a dent in the demand. CAPTEM unanimously finds that it would be useful to pursue small particle training sessions at other sites. The trainings at JSC have been funded by the LPI (a feature of the most recent LPI CAN). This requires a lot of time from Curation scientists (and with O-REx coming up, Curation scientists may be unavailable for training sessions), so it would be beneficial to distribute training sessions to other institutions. CAPTEM could advise HQ to make funding available to further develop small particle training sessions. How are these advertised? Is there media coverage/publicity? JSC creates a NASA feature and LPI publicizes it. Previous trainings were picked up by news media.

12. GENESIS curatorial/allocation report (Allton/Nittler)

The Genesis Subcommittee members include Larry Nittler, Mike Pellin, Roger Wiens, Dimitri Papanastassiou, and Sarah Crowther.

Two manuscripts using Genesis samples were published by Jurewicz et al. and Leming et al. There were 11 posters with Genesis results presented at LPSC on Tuesday night. The Genesis Sample Users Meeting was held March 18th.

There were two allocations since the Fall 2017 CAPTEM Meeting; one for ellipsometry and another to Evan Groopman for testing Fe and Ni isotopes on a new instrument.

The subcommittee is vetting the idea of making fragments <2 mm (too small for full cleaning) available to PIs as test samples to test new techniques.

Genesis curators are working to use ellipsometry to measure the effects of cleaning fluids on Genesis collectors. Ellipsometry is non-destructive and fast and is an optical technique in which changes in polarized light reflected off of a surface are observed.

There is a need for compendium to capture Genesis information and attract new researchers. Judy Allton would divide the compendium into three separate topics: science results, collector material and characterization, and cleaning techniques and cleanliness assessment. The science results could be organized by element, solar wind regime, analysis technique, collector materials, or broad science objective. Results from collector materials and characterization could be organized by fabrication method and batch, bulk composition, or surface cleanliness assessment. There are still questions about who would organize the compendium and what the final product would be.

13. Report of NAS, PAC meetings (McKeegan)

It was decided that we were running behind and we already touched on the NAS report earlier, so we did not further discuss the NAS and PAC meetings.

14. Mars 2020 sample caching and Mars Sample Return (Farley)

Ken Farley gave CAPTEM an update (via Web connection) on the Mars 2020 mission because it will potentially produce samples that would be allocated by CAPTEM. Mars 2020 is looking for further participation in the mission who are interested in the samples and analyzing them.

Two mission goals are related to the in-situ portion of the mission A) Characterize geologic history of landing site, and B) do in-situ astrobiology (find and characterize ancient habitable environments, look for past life, rather than extant). Two mission goals are related to the future: C) Sample return (rigorously documented and returnable cached samples for possible return to Earth), and D) human exploration (facilitate future human exploration by making significant progress toward filling major strategic knowledge gaps) and technology (demonstrate technology required for future Mars exploration).

Mars 2020 has been officially deemed the first element of a Mars Sample Return effort. NASA is still not committed to MSR, but Mars 2020 is taking steps by preparing samples for possible future return. Mars 2020 will investigate an astrobiologically relevant ancient environment with geologic diversity and will select the most scientifically interesting samples for collection. Samples will be acquired, sealed, and cached on the surface. Mars 2020 will satisfy scientific goals for sample cleanliness/integrity, will meet all technical requirements to allow MSR by a potential future mission, and will generate detailed documentation (“field notes”) about samples for use by future scientists.

The 2nd International MSR Conference will be 25-27 April 2018 in Berlin. The conference will focus on how to return the samples collected by Mars 2020. Some NASA funding will be allocated to figure this out. Return is not expected before 2026, with arrival no sooner than 2030.

Mars 2020 is a mission of high heritage. It uses the *Curiosity* platform, with a new suite of science instruments: Mastcam-Z, MEDA (weather), MOXIE (converts atmospheric CO₂ to O₂), PIXL

(imaging XRF, ~100 um over 1 cm², co-registered with information from SHERLOC), SuperCam (LIBS, VNIR, Raman, RMI – chemistry, mineralogy), RIMFAX (ground-penetrating radar), SHERLOC (microscopic imager, Raman and fluorescence mapping spectrometers – map organic matter, some mineralogy), new wheels, new cameras (engineering cameras will be high-res color, so it will be challenging to return the data because images will be larger than collected with *Curiosity*), enhanced autonomy capabilities (samples will be acquired without ground in the loop and stored on rover), 5 hour operations timeline, EDL cameras and microphone, strengthened parachute, terrain relative navigation and range trigger, and a drone (the drone is still being assessed – budget directs continued assessment of drone).

There are currently ~250 science team members on Mars 2020. The current Returned Sample Science (RSS) Board will be disbanded and returned sample science participating scientists will be added to the team.

The team will select a diversity of samples. The rover must be capable of collecting >37 samples total and 20 samples in prime mission (1.5 Mars years, motivates efficiency and increased autonomous operations), consisting of rock, regolith, and blanks. ~15 g samples will be collected in cylinders. Regolith samples will be mixed (i.e., stratigraphy will not be preserved). Five witness tubes and a drillable blank will be flown. 42 sample tubes will be available (including five for engineering margin). Rock and regolith tubes are identical.

Each tube must contain <1 viable terrestrial organism, <10 total terrestrial (non-viable) organisms per tube, <10 ppb total organic carbon, and <1 ppb key marker compounds. There is a requirement that samples should not exceed 60 °C (the temperature the samples experience is landing site dependent, some sites' max T <20 °C). Fragmentation/fracture/powdering of rock samples will be limited. Samples will be hermetically sealed after drilling. There are limitations on allowable contamination of key geochemical species. The tungsten drill bit may be problematic for W isotopic measurements.

The Adaptive Caching Assembly (ACA) is located inside of the rover and includes stowage for sample tubes (silos). Sample acquisition will occur in <6 hours (without ground in the loop). The drill core is ~5 cm long x ~1 cm diameter. Drilled rocks may be intact or may break into multiple disks. A combination of rotary and percussive drilling will minimize rock breakage.

Witness tubes are identical to normal sample tubes and will be handled the same, but they have a series of elements in them that allow them to sequester contamination. The outer part of the witness tubes are made of meshes of TiN and Al designed to immobilize particulate and vapor phase contaminants. The tubes will be open throughout exposure time of tube. Inside, there are additional witness materials (Al and Au foil), activated at a specific time by forcing a puncture mechanism (to measure the contaminants present at moment of sampling and evaluate how the contamination environment evolves over time).

Mars 2020 will utilize a depot caching strategy, where samples will be stored on the ground (a depot), and the rover can return to the depot to deposit more samples or create another depot. The samples will not be stored in the rover because if the rover somehow became incapacitated, the sample tubes would be trapped inside the rover.

There are three landing sites under consideration: Jezero (open system lake), Northeast Syrtis (carbonation of olivine, subsurface fluid flow), and Columbia Hills (possible hot spring environment). The final community landing site workshop will be on 15 October 2018 in Monrovia, CA.

The system integration review was just completed. Assembly, test, and launch operations have begun. The team is fine-tuning their Contamination Knowledge Plan.

The launch window opens in July 2020. The nominal surface mission will last 1.5 Mars years, with 20 km traverse capability.

CAPTEM asked about how sample tubes will be located by a future mission. Ken said that they will be located with imagery, and the depot location will be known within 10s of cm. Samples will be left in locations that won't accumulate dust, but we shouldn't expect that the samples will be covered with dust quickly because HiRISE can still see all rover tracks.

CAPTEM also asked how many drop spots (depots) are planned. Ken said they expect one or two depots, but the team is not committed to this. Ken said that he personally thinks this decision may be revisited if we find out more about a follow on mission to collect the samples.

CAPTEM asked about the hermetic sealing and how it works. It is a deformable metal seal. Testing shows that when sealing surfaces are dusty, there is still a good seal. The seals are built to withstand 50 years of diurnal thermal cycles.

CAPTEM asked about the requirements for the Contamination Knowledge (CK) Plan. There is a requirement to acquire CK. There is a document that describes the CK Plan that Ken will send to Marc Fries.

The next landing site workshop is the last time the community gets to provide input about where the rover should go. The vast majority of scientists are interested in in-situ work. Farley and McKeegan implored noted the desirability of having good representation from the sample community to participate in landing site workshop.

15. Mars 2020 ATLO Curation Updates (Harrington)

The Mars Sample Curator, Andrea (Andi) Harrington, presented the draft plan for Contamination Knowledge (CK). CK includes information from samples saved for analysis upon return or on mission inception. Flight and non-flight reference materials and witness items will be curated. The focus is on curating flight reference materials from the Sampling and Caching Subsystem (SCS) with the Adaptive Caching Assembly, the Sample Handling Assembly, and Sample Intimate Hardware. Andi asked for the master equipment and material list to determine CK curation needs. She is using a CAD model JPL provided to determine where line-of-sight materials may be. She emphasized that she is in negotiations to acquire materials and is trying not to go over budget or time. Andi created an ideal list of CK samples, but the numbers of materials she can reasonably acquire have already decreased (e.g., she asked for a complete flight spare of the SCS, which will

not happen; she asked for 20 sample tubes, but is now getting 7; she asked for five regolith drill bits, but is now getting one; and she asked for five witness blank tubes, but is now getting two). She will also curate seals, oils, and paints and asked for non-flight hardware materials used during fabrication and processing (e.g., gloves). She is asking for replicates of any hardware or coupon, flight or non-flight measuring 100 g or 0.2 m² in area or 0.2 m in length and for an additional six samples of smaller sizes for allocation. She is asking for gas samples in duplicate or triplicate and may cold weld these samples into Cu tubes.

Samples will be stored in Teflon bags (samples will be double bagged and sealed with a Teflon clamp). Nylon and Si tapes will not be used. The third bag for shipment will be polyethylene or Teflon. Bags will be purged with N_{2(g)} before closure. Liquids will be packaged in sealable Pyrex glass with Teflon lids and placed in Teflon bags. Three inorganic flight and non-flight reference materials/coupons for CK will be packaged as following: two samples will hermetically sealed in a rigid stainless steel container and triple bagged in Teflon, and the third sample will be triple bagged in Teflon. Three organic flight and non-flight reference materials/coupons for CK will be packaged as following: two samples will be triple wrapped in organically baked-out Al foil, placed into rigid, baked-out glass jar with a Teflon screw top, then triple bagged in Teflon, and the third sample will be placed in a baked-out rigid stainless steel container, hermetically sealed, and triple bagged in Teflon.

Currently, JSC Mars Curation has three N cabinets for final cleaning, one large N cabinet in the Return Sample Vault for larger CK items, and two -80 °C freezers (one for 2020, one backup). The database is up and running, but is currently for internal use only. Advanced curation research is focused on cryogenic storage and how it will affect allocation and preservation in the future. Mars Curation currently has no CK samples, but is expecting to start receiving solvents next week.

The current state of the collection (which are in negotiations with JPL) include:

- Reference materials (two witness tubes (to be baked out separately from flight items), seven sample tubes, and one volume probe) with ETA at the end of ATLO
- Cleaning solvents and materials for Sample Intimate Hardware/Sample Handling Assembly SIH/SHH (isopropyl alcohol rinses from instrument hardware, wipes, foils, storage bags, and gloves from final cleaning process; pristine materials for blanks also collected) with ETA starting at the end of March 2018
- Witness items (environmental witness plates to examine biological contamination and unprocessed swab and wipe samples from flight-like material after ultra-precision clean, to be stored in -80 °C freezer; quantities are still in negotiation)
- Inorganic and organic reference samples of flight items after final clean (quantities are still in negotiation)

There were questions from CAPTEM about the -80 °C freezers, cryostorage, and whether some samples will be stored under a gas other than nitrogen (because this could affect N isotope measurements). The freezers are on LN₂ backup. Cryostorage uses vapor phase LN₂ storage, which is riskier than liquid phase. Andi will look into storing some samples under a gas other than N. There is a He cabinet Mars curation could use. They could also use Ar.

Another comment was that colder temperatures are not necessarily better for storing organic materials. There is no consensus in the community on how to preserve DNA. Curation will do more research on this (Regberg).

A concern about the samples returned from Mars 2020 is the change in relative humidity and temperature and how this might change the mineralogy. The TiN coating in tubes could also get scored and contaminate the samples.

16. LUNAR samples curatorial/allocation report (Zeigler/Gross)

The Lunar Subcommittee includes Juliane Gross, Jessica Barnes, Carolyn Crow, James Day, Katie Joy (new), Jeff Taylor, and Allan Treiman. Two will be rotating off next year.

30 new sample requests were received since the Fall 2017 CAPTEM Meeting. The subcommittee reviewed 18 requests and one resubmission. It recommended passing six as is, passing five with modifications, and denying two. Five requests were tabled because there was not enough info to make recommendation (asking for more information from the PIs).

There was discussion about the requests for high-demand samples with low mass (e.g., KREEP basalts 15382/6 (10.2 g)). Although sample masses are low, the science gained from the analysis of high-demand samples could be illuminating. There is a desire for more consortia where each PI asks for ~10-20% of sample and multiple analyses are done on one sample. Can CAPTEM recommend this or would it be incorporated this into ROSES? The CAPTEM allocation committees are review panels, so CAPTEM cannot advocate for this, but language could be added to a call to emphasize the study of these high-demand samples. CAPTEM subcommittees should identify and write down the samples in each collection that fall into this category and what science they have to offer. MWG has a similar list, and so does Lunar, but it's incomplete. There was a request for data from the last five years about how many times one of these high-demand samples has been requested but denied because there was not enough material available. Are there certain samples whose analysis should be expedited? Jeff Grossman and Sarah Noble need to know about these samples.

CAPTEM discussed whether there should be special allocation rules or criteria for studying high-impact samples (e.g., consortium studies only; multiple isotopic measurements from one column to conserve sample and get the most out of each measurement)? CAPTEM or NASA could announce the availability of certain samples and describe which measurements are needed. This could be incorporated into an Astromaterials newsletter. The target publication date for the newsletter is the Fall 2018 CAPTEM Meeting. By August 1st, each subcommittee should provide <1 page on what they would like to incorporate into newsletter. A draft of the newsletter will be circulated before the Fall CAPTEM meeting.

There have been requests from museums for long-term displays. Touchstone and pristine samples are in pyramid displays. The idea is to offer a third type of display, like the Apollo Ambassador Awards (1-2 g chip). Since these samples would be smaller, they would be easier to secure because would not be as fragile.

There have been 242 allocations since the Fall 2018 Meeting. There has been a steady decrease in % of new lunar PIs, and about half of all PIs are foreign (the % foreign requests has been increasing over time). There are nine open requests (four are waiting on feedback from PI, feedback from PI was recently received for two, and two are waiting on recalls from PIs). 361 samples have been returned from PIs. The average allocation time is 50-70 days after the required HQ approval.

James Day has been investigating whether materials (e.g., steels) in the lunar curation procedure could cause contamination. There must be significant contamination (e.g., > few mg/g) to have a major effect on the composition of highly siderophile elements, Mo, Mn, and Cu. One problem is that he cannot account for contamination in individual PIs' labs, so it's important to make PIs aware of protocols.

Lunar curation outreach since the Fall CAPTEM Meeting includes 38 viewing area tours (for a total of 337 people) and 44 pristine vault tours (for a total of 167 people). 15 thin section sets were allocated to university classes, and 148 disks were distributed to institutions (reaching >47K students). Lunar curation has been involved in local, regional, and national outreach (e.g., at LPSC).

Lunar curation is currently working on thin section reorganization and is making efforts to characterize thin sections to make these samples available to the community. There are 20,000 thin sections and they have not been well characterized in systematic way (e.g., there aren't photos for all of them). The thin section reorg is currently on a delayed schedule, but Juliane Gross helps for a week each summer to keep it moving.

The new XCT scanner has been up and running for a year now. Its main use is for imaging polymict breccias to find new material. It has a minimum resolution of 1 um voxels.

Inventory on the ~110,000 lunar samples was performed in November, which involves JSC security. All went well.

Lunar PIs will be getting lunar inventory in early April. 60 loan agreements are expiring, and it will require some paperwork on behalf of Curation and the PIs to reinstate the loan agreements.

17. INFORMATICS report (Zeigler/Lawrence)

Collection Databases (Zeigler)

Stardust, OSIRIS-REx, Hayabusa, and Data Center databases are in production. Most curation databases are accessible through a common dashboard (except Lunar and Genesis). The Data Center database went in production in Jan 2018, with over 16,000 line items added.

MoonDB is an interactive database preserving, digitizing, and curating lunar geochemical and petrological data and their associated sample metadata and analytical metadata. It was built off of the PetDB architecture and is funded through the NASA PDART program. There are ~800 references on MoonDB and the beta version for searching is available. The plan is to put all lunar data in MoonDB, including lunar meteorites. It includes primarily geochemical data now and not

as much geochronology, spectroscopy, or microscopy. Those data are being added currently. MoonDB could serve as a template for other astromaterial collection databases. MoonDB is completely independent of the PDS (e.g., individual analyses of pyroxenes won't fit well in PDS).

CAPTEM asked about the lunar compendium. All compendia need to be updated or made to exist for all collections.

Is there a mini tutorial for MoonDB? There is a help function for PetDB. Kirsten Leonard gave classes on MoonDB at AGU, and MoonDB will be advertised at Goldschmidt in Boston. It is housed at the Lamont-Doherty Earth Observatory at Columbia University. The plan is for databases to be available in perpetuity.

Informatics (Lawrence)

The Subcommittee members include Sam Lawrence, Larry Taylor, Andrew Westphal, Dave Joswiak, Larry Nittler, Justin Hagerty, and Tim McCoy.

The proposed community survey was put on hold because at the Fall CAPTEM Meeting, PSD requested that ARES perform a study to define the requirements for a notional Astromaterials submission-based data repository. This is essentially a supersized MoonDB effort. Sam will turn to the Informatics subpanel to seek input and will report back to CAPTEM at the Fall virtual meeting.

Kevin asked if Sam has all of the expertise he needs on the subcommittee. Sam has enough for a first pass, but if more input is needed, he will consult with McKeegan, and they then will solicit input from the community.

18. Other Activities

McKeegan reminded subpanel chairs to send him and Liz the current list of subcommittee members and to look for new members. No CAPTEM vote is needed to approve subcommittee members. Vote are only needed for voting members of CAPTEM.

Send science bullets to Kevin McKeegan or Jeff Grossman.

There was a brief discussion about organizing a lunar sample return workshop.

Kevin asked the subcommittee chairs for new PI information from all of the subcommittees. If new PIs are declining across the board, this could be a concern for the science that is being returned from the sample collections.

19. New Business

There was a discussion about whether the Spring CAPTEM Meeting in 2019 should be the Saturday before LPSC. It may not work out, since next year is the 50th anniversary of the Apollo samples and there may be a celebration the weekend before. There was a vote by show of hands

of when to have the meeting. Prior to LPSC: 15, After LPSC: 8. The majority was in favor of moving it to the weekend before LPSC. If it occurred the Saturday before, people would miss the interesting events that are regularly scheduled on the Saturday before LPSC.

Kevin will send out an email to schedule the virtual Fall Meeting.

Subcommittees are needed to review the OSIRIS-REx and Hayabusa2 JSC curation plans. Kevin asked Munir if the current Asteroid subcommittee is sufficient to perform reviews of both curation plans. It was decided that the same group should not look at both plans because that would be too much work for one group, so a second review committee must be organized. Keiko is currently working on the Hayabusa2 curation document, but the OSIRIS-REx plan can be reviewed now. The Hayabusa2 curation document will be completed by the Fall CAPTEM Meeting. The review will not involve a site visit. The subcommittee will look at lab plans (though lab plans are set and cannot be changed) and review CK. Multiple iterations of the plans will be reviewed (e.g., in its current state, after samples are cached, and when samples are returned). Jeff Grossman will discuss this review with the OSIRIS-REx project. Munir may select people inside or outside of CAPTEM to help with the review and will select a mix of small and large sample people.

Subcommittees must consider requirements for preservation. The Stardust report addressed the motivation for this (i.e., aerogel may not keep forever and it may be difficult to pull tiles in the future). Each subcommittee should look at samples under their purview to identify issues with long term storage and how that might impact curation, conservation, and science. The MWG and Lunar subcommittees each have rules on saving material for the future. Policies for other subcommittees should be reviewed. Subcommittee should discuss a prioritized set of science to be done on samples. Genesis has been circulating a draft for 2-3 years. The subcommittee will look at the current draft and work through it.

Richard Herd commented that there is no Canadian national committee looking at what samples come to Canada from OSIRIS-REx. Should CAPTEM contact other space agencies and communicate its plans? This will be done formally for JAXA.

Andrea Harrington suggested that a CAPTEM member who understands human health (toxicology, biology, medical geology) should be nominated to help evaluate proposals related to human health. Subcommittees can access experts from elsewhere to help evaluate proposals, so there is no immediate need to identify a CAPTEM member who specializes in human health. This may become more important as human exploration ramps up.

CAPTEM voted affirmatively to ask Jessica Barnes to serve as a voting member of the Lunar subcommittee.

20. Summary of action items (Rampe)

Review OSIRIS-REx curation plan (ASTEROIDS Subcommittee).

Assemble a CAPTEM subcommittee to review Hayabusa2 curation plan (McKeegan, ASTEROIDS Subcommittee).

Review subcommittee membership and send list of members to K. McKeegan and L. Rampe (all subcommittee chairs).

Review new implementation strategy for addressing Stardust requests. Discuss whether a similar implementation strategy would make sense for other collections.

Consider a motion to relax former CAPTEM finding (from 2007) that would discourage Curation from allocating the largest and highest grade science samples, and vote on this motion at the Fall 2018 CAPTEM Meeting.

Review the Cosmic Dust collection strategy and its effects on curation in the Spring 2019 CAPTEM Meeting (Fries, COSMIC DUST Subcommittee)

Identify samples with high science priority in each collection; consider how long-term storage may affect curation, conservation, and science; and write special allocation rules that would allow new CAPTEM members to evaluate future proposals to study these samples with high scientific value (all subcommittees).

Provide <1 page of text to F. McCubbin detailing what each subcommittee would like to include in a future Astromaterials newsletter to advertise sample availability and advocate for certain analyses (all subcommittees).

Send science bullets to K. McKeegan.

Compile new PI information from proposals (e.g., how many new PIs proposed, are they international?) (all subcommittees, except Lunar and MWG, who have already compiled this information)

Schedule CAPTEM Fall Meeting (McKeegan).

Adjourn.