Curation

How?  What?  Why?

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Curation

Integral role in Mission

• Plan sample return containment and control contamination
• Monitor cleanliness of return containers
• Monitor transfer of return samples from reentry to curation facility

Returned Samples

• Inventory and catalog for Science community
• Subdivide samples for allocation
• Secure storage
• Preservation for now and for the future
How do we Curate

- Class 10K (1K) clean room
- Stainless Steel processing and storage cabinets
- Nitrogen atm in cabinets, <10ppm H₂O, O₂, Argon
- Keep samples in dedicated cabinets by mission
- Limit materials in contact with samples
  - Stainless Steel
  - Aluminum
  - Teflon
- Multiple layers of packaging
- Layer stripping during transfers
- Strict handling procedures
First Occupied in the summer of 1979, Now nearing 30th anniversary

Has preformed very well
State of the Lunar Facility after 28 years

Completed since 2002

- Upgrade Security system (2004, continues today)
- Resurface roof (2005, no penetrations)
- Replace Liquid Nitrogen Tank (2005/06)
- Lunar Database upgrade (Complete, Dec. 2007)

To be completed

- Air handling control system (Fy 2008/09)
- Laboratory clean room upgrade (Fy 2008/9)
Secure Clean Storage
Stainless Steel
Glove Boxes
Flowing Nitrogen
Processing to
class 10 cleanroom
standards
## Apollo Lunar Sample Collection

### NASA Custody

<table>
<thead>
<tr>
<th>Description</th>
<th>Kgs</th>
<th>Wt. %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pristine Sample Vault &amp; Laboratory</td>
<td>268</td>
<td>70.1</td>
</tr>
<tr>
<td>WSTF Remote Vault</td>
<td>52</td>
<td>13.5</td>
</tr>
<tr>
<td>Returned Sample Vault &amp; Lab.</td>
<td>29</td>
<td>7.6</td>
</tr>
<tr>
<td>Consumed</td>
<td>13</td>
<td>3.4</td>
</tr>
</tbody>
</table>

### Outside Custody

<table>
<thead>
<tr>
<th>Description</th>
<th>Kgs</th>
<th>Wt. %</th>
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</thead>
<tbody>
<tr>
<td>Principal Investigators</td>
<td>7</td>
<td>1.8</td>
</tr>
<tr>
<td>Long Term Loan</td>
<td>10</td>
<td>2.6</td>
</tr>
<tr>
<td>(75 samples; 55 locations)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rotating Loan &amp; Education</td>
<td>3</td>
<td>0.8</td>
</tr>
<tr>
<td>Gifts</td>
<td>0.26</td>
<td>0.1</td>
</tr>
<tr>
<td>(Presented by Nixon to Countries &amp; States)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Uniform, fine-grained basalts and impact melt rocks

High Ti basalt 10044

Vesicular high Ti basalt 10072

Impact Melt 76055
Anorthositic Highland Crust
15415

Troctolite 76535

These are The Gems
Some Pristine Clasts have been found
Rake Samples

> 1 cm rocks from regolith
Coarse Fines from Regolith

A-16
2-4 mm

A-12
4-10 mm

7 mm
It is a Question of Scale

Lunar meteorite
Y86032,133
0.529 g

Analysed for Nd
Sample: 0.0008g
Nd: 0.000000002g
$^{143}\text{Nd}/^{144}\text{Nd}=0.511942\pm0.000038$
Sample Return Containers

The whole box

A-14 SCR packed for travel

A-16 SCR prior to unloading

leak
Documented Sample bags

Al ring around top roll and twist seal
Special Environment Sample Container

Weight = \(~360\) grams
Length = 21 cm
O. D = 6.1 cm
Volume = 360 cm\(^3\)

Indium seal
Knife edge
Seal covers
Contamination Issues

- Indium (10%Ag) Seals, Rock Boxes, etc.
- A15 drill core, Ti alloy, threads canadized in Pb bath
- Core bit with WC cutters brazed to drill stem; W, Ni, Pb?
- MoS$_2$ grease used in LRL up to about 1972; organics
- Xylan: complex blend of organics with PTFE replaced
  MoS$_2$ about 1972; N, organics
- Band saw blade diamonds adhered in electroplated Ni;
  sawing is dry, causing heating
- Moisture & oxygen in N$_2$ usually ~5 ppm, but rises
  during processing, gloves leak; samples in containers are protected during storage.
Apollo lessons learned

- **ROCKS WILL ANSWER THE BIG QUESTIONS**
  - Rocks do not need to be brought back in vacuum, but need to be well sealed in appropriate bags.
  - Special containers work reasonably well, but can be improved, use only for special samples, **SOILS?**
  - Basalts and fine-grained melt rocks can be smaller
  - Collect all the **pristine crustal rocks** possible!
  - **Breccias** have variety and large samples are desirable, **may contain pristine crustal rocks**
  - Rake samples **may contain pristine crustal rocks**. Change tine width?; Collect Robotically?
  - Preventing contamination begins with initial design and requires diligent monitoring throughout manufacture, collection, and curation
Future Lunar Surface Sampling

- Curation begins with mission priorities and planning
- Well documented surface samples, fine-grained rocks can be smaller, clast rich breccias larger
- Field collected samples may be high graded later
- Rake samples more important? Variety
- Greater emphasis on outcrop or boulder samples; will give relationships between rock types. Use small drill for precise selection of samples
- Volatile rich samples especially regolith, use new sampling techniques and containers
Future Sample Return Containers

- **Rx Boxes**: limited use, special samples?
- **Teflon bags**: various sizes, improved seal, main container for returning Rxs & soils
- **Drive tubes (4 cm)**: may not want as many as during Apollo
- **SS cylinders**: Improve the seal design to hold vacuum; use for special samples
AND MOST IMPORTANT

Preventing contamination begins with initial design and requires diligent monitoring throughout manufacture, collection, and curation.

The community should reconsider the contamination issue after nearly 40 years of experience.