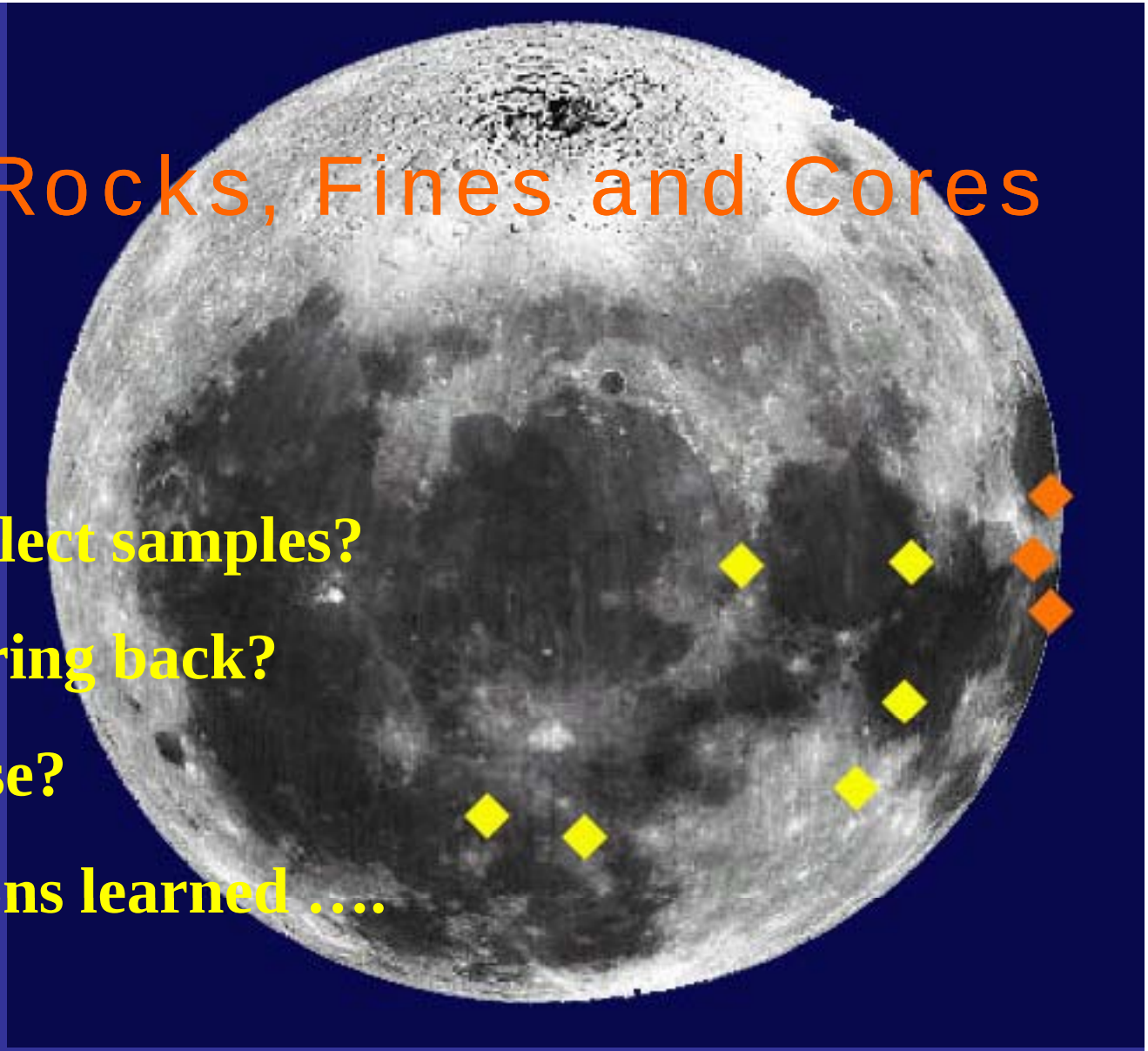
APOLLO Rocks, Fines and Cores



How did we collect samples?

What did we bring back?

What did we use?

And other lessons learned ….

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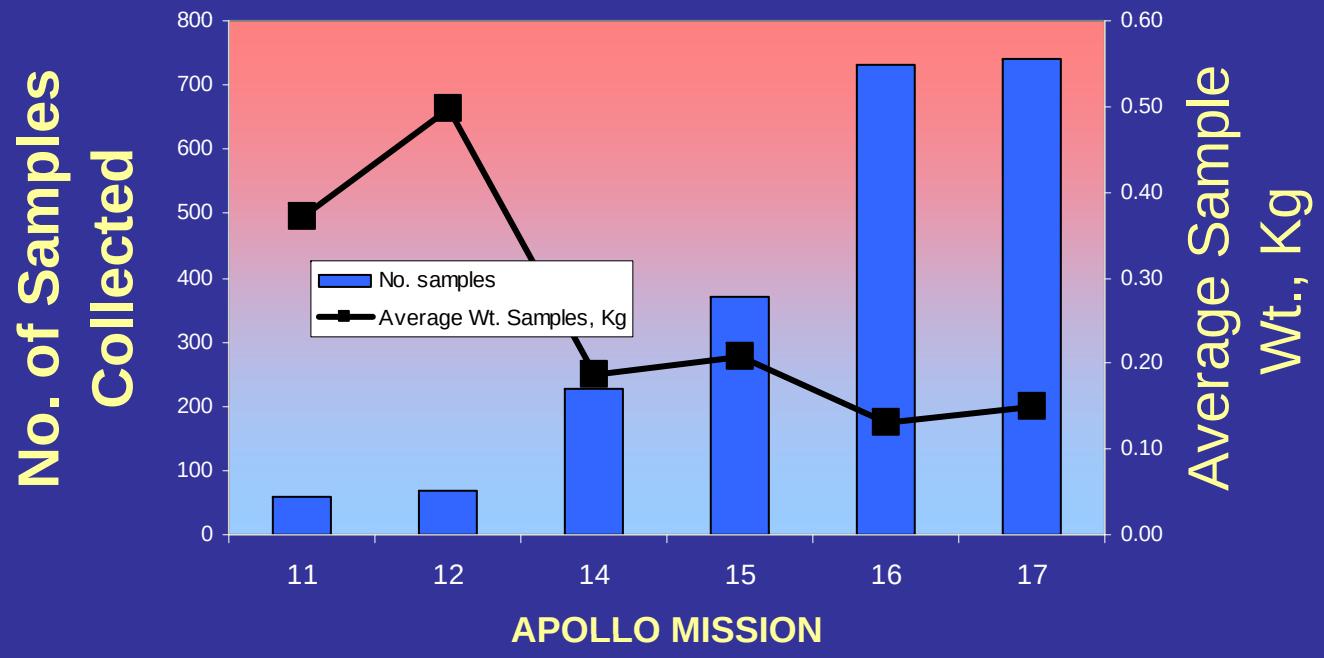
APOLLO Rocks, Fines and Cores

2196 SAMPLES

382 KG



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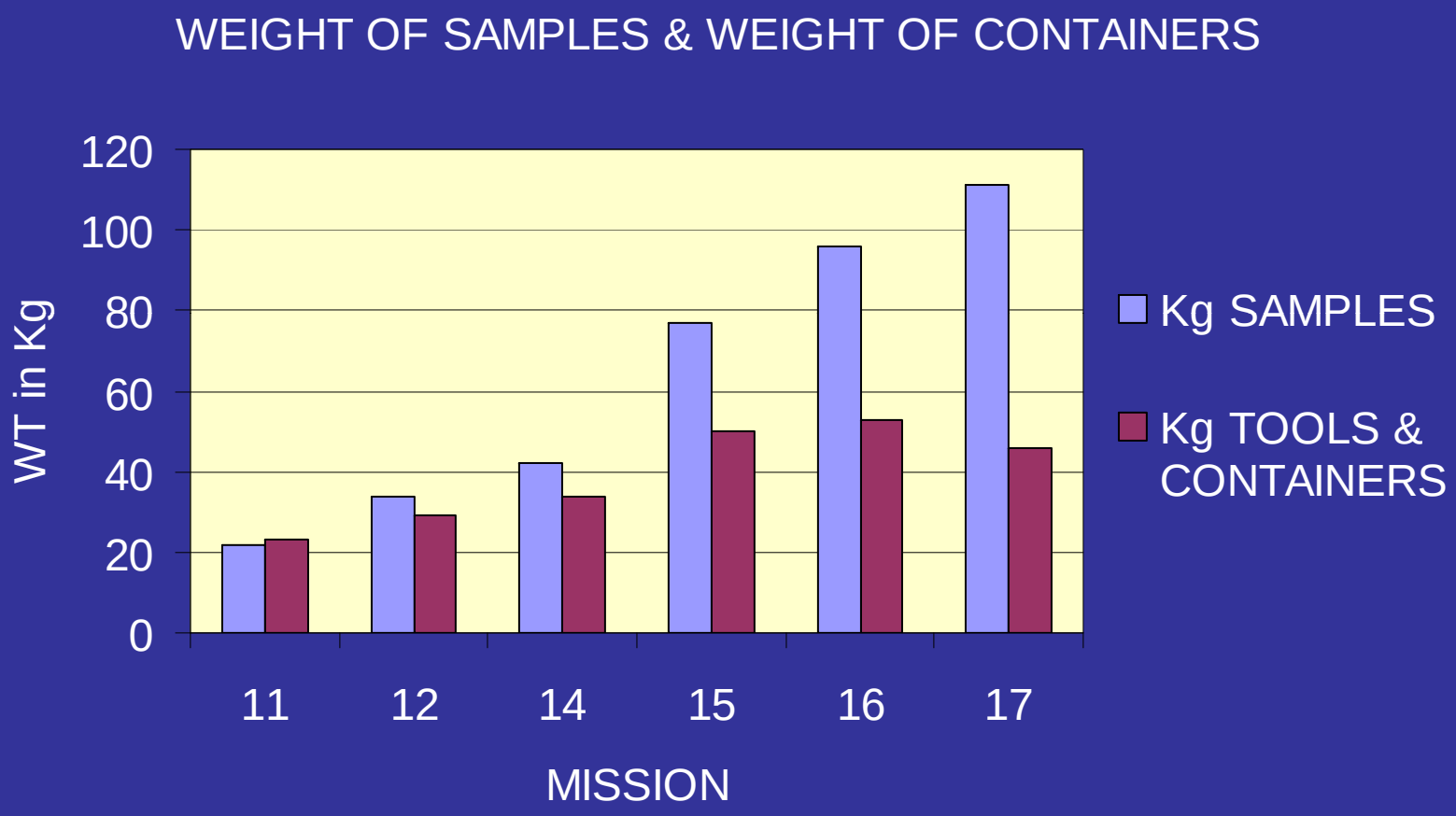

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Evolution of Sampling Tools

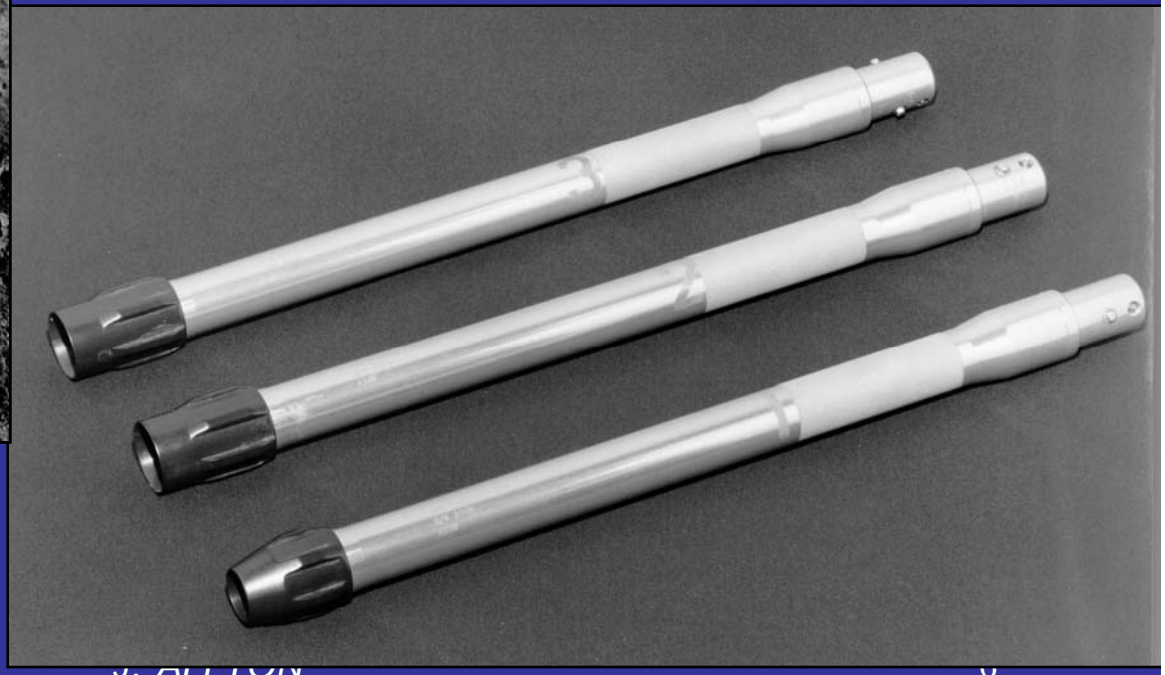
- Apollo 11, 12, 14, 15, 16, 17 landed 12 people between 1969 and 1972
- Tools evolved, both as planned and in response to new knowledge

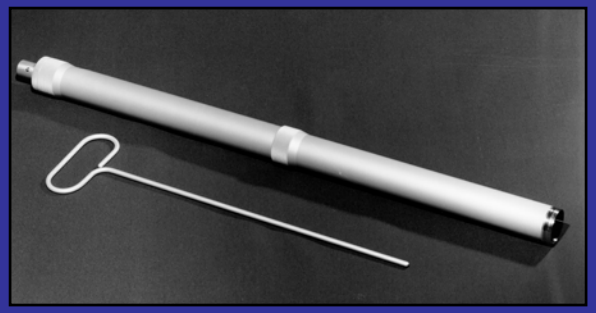
From Apollo 11 to Apollo 17…

- Evolution of:
  - Coring devices
  - Scoops
  - Tongs
  - Hammers
  - Sample bags
  - Tool carriers
- A quick peek at:
  - Rake
  - Contact Soil Sampling Device
  - Rock box
  - Gas-tight can

DRIVE TUBE CORE

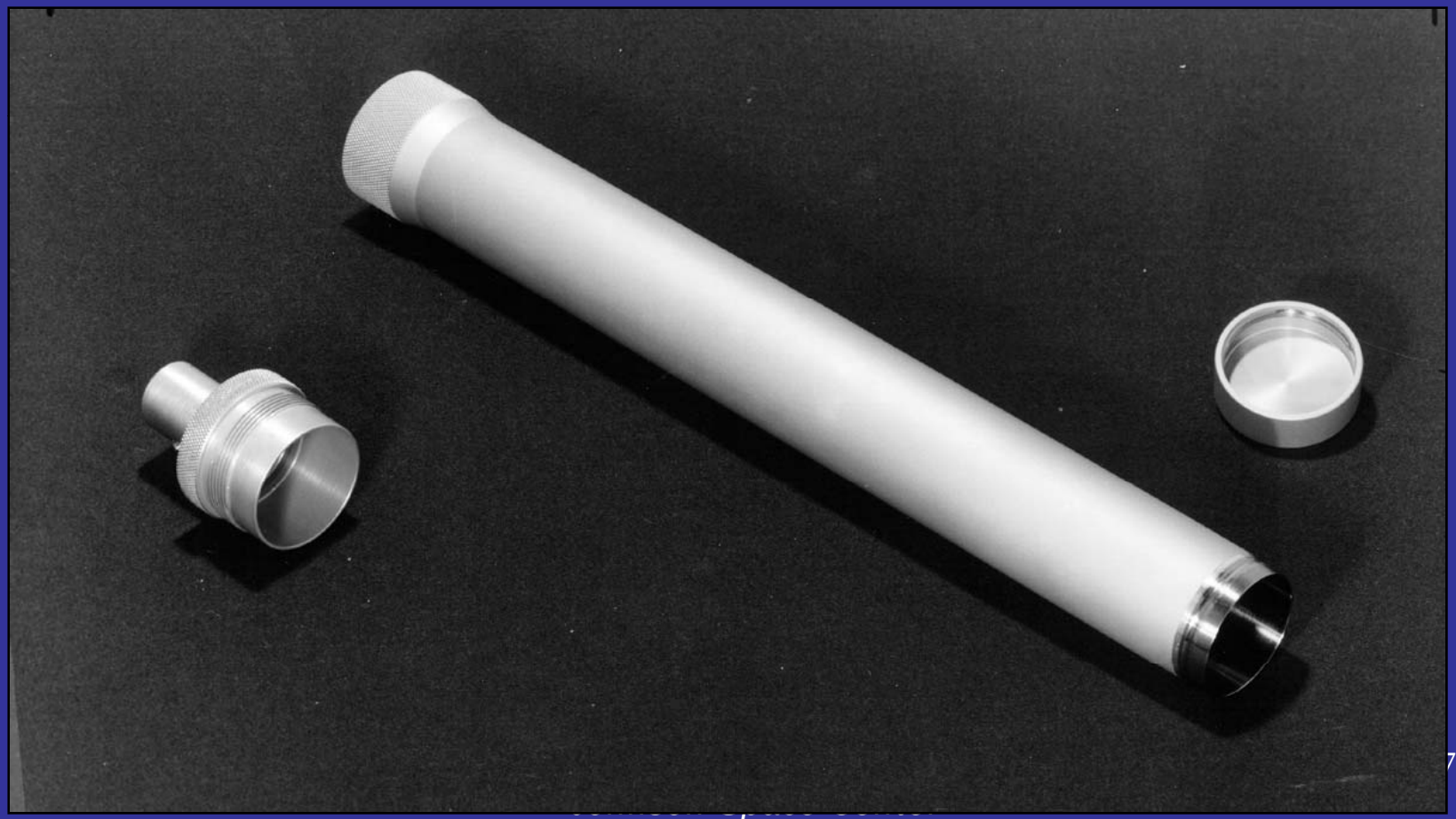
Apollo 11-14





DRIVE TUBE CORE

Apollo 15-17



DRILL CORE

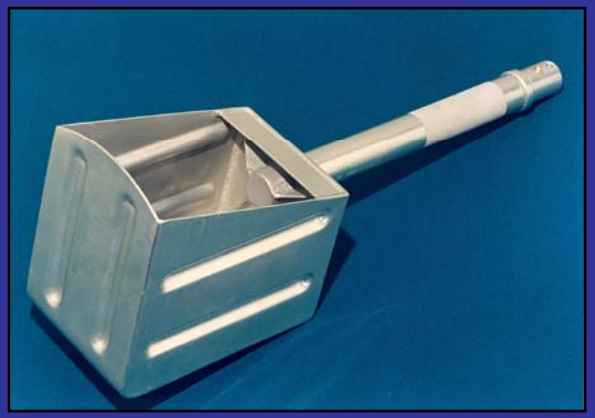
Apollo 15-17

Johnson Space Center

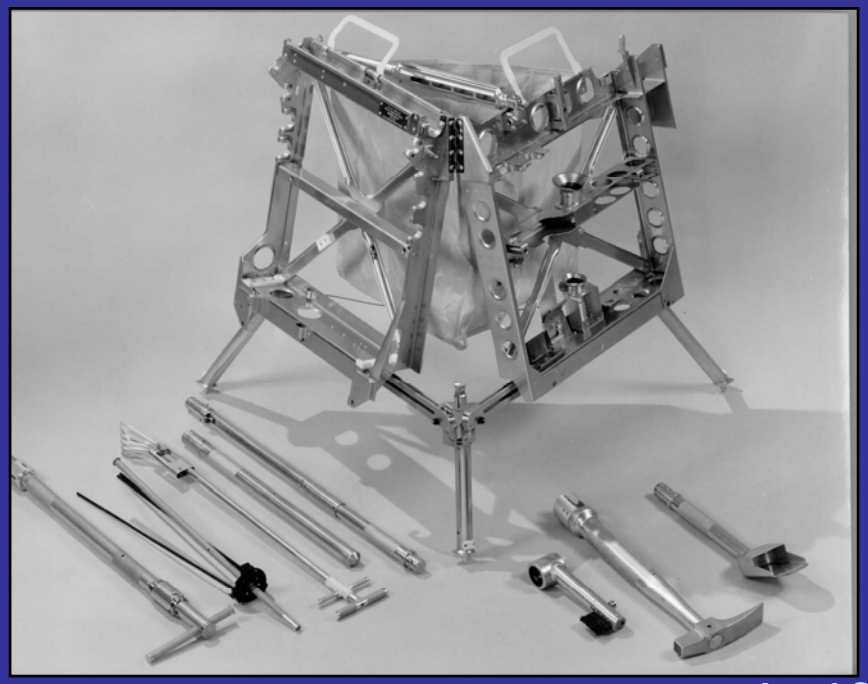
MSFC 2009

BOX SCOOP

APOLLO 11



Ap 11



Ap 12

Ap 15-17

TRENCHING TOOL

APOLLO 14

TONGS

Early, smaller

Later, larger

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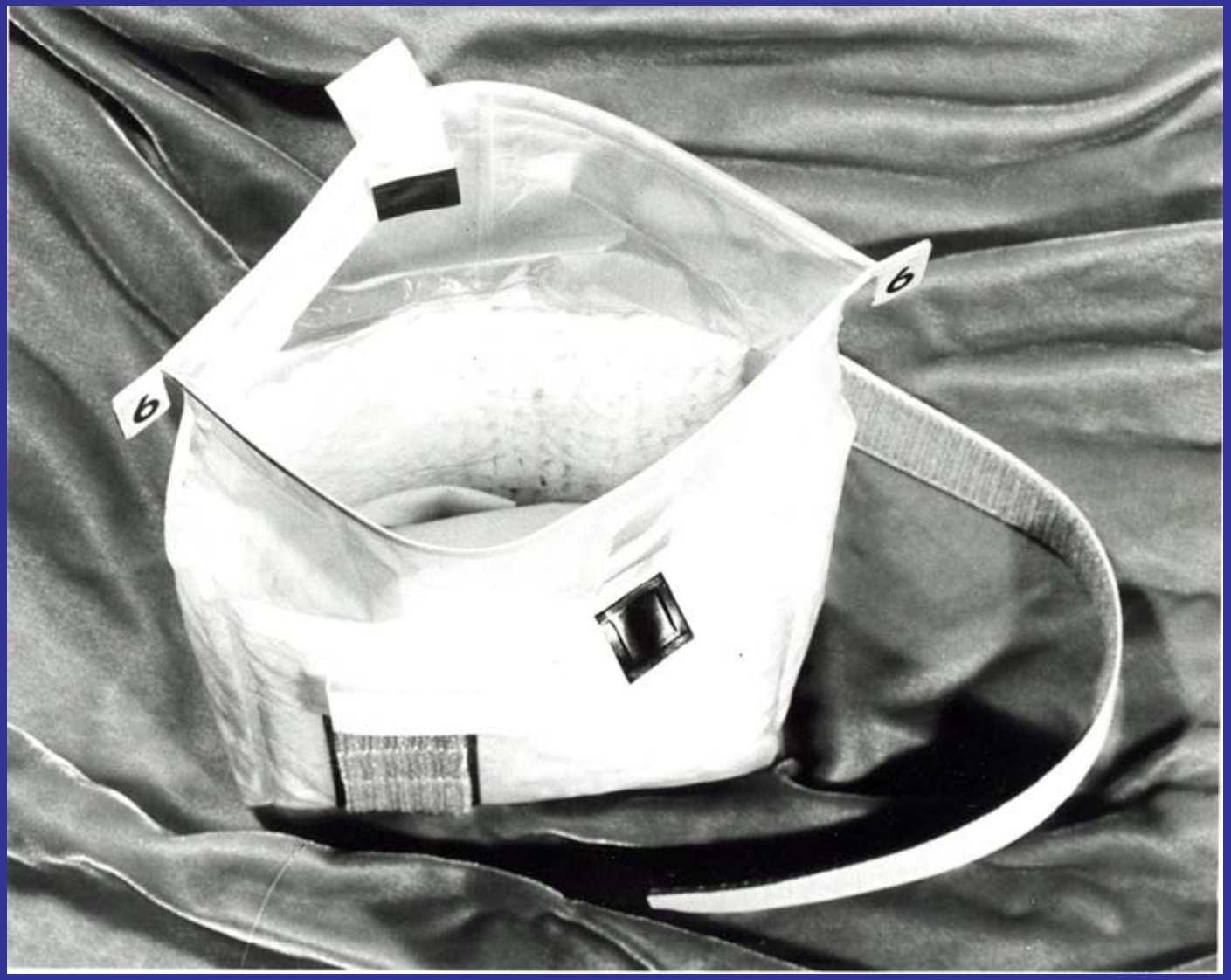
SAMPLE BAGS



PADDED SAMPLE BAG

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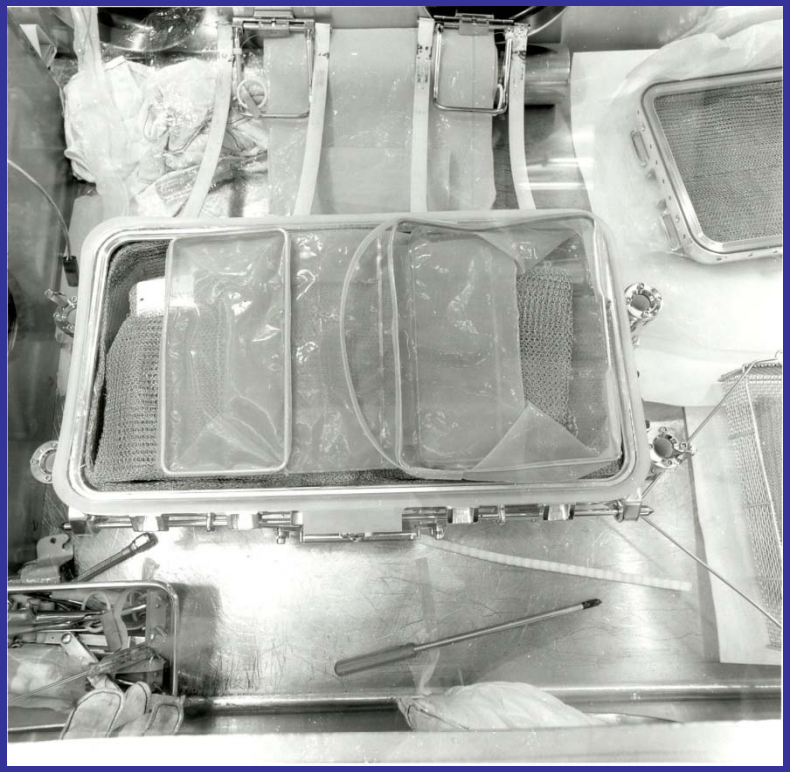

WEIGH BAG

Precursor to Sample Collection Bag

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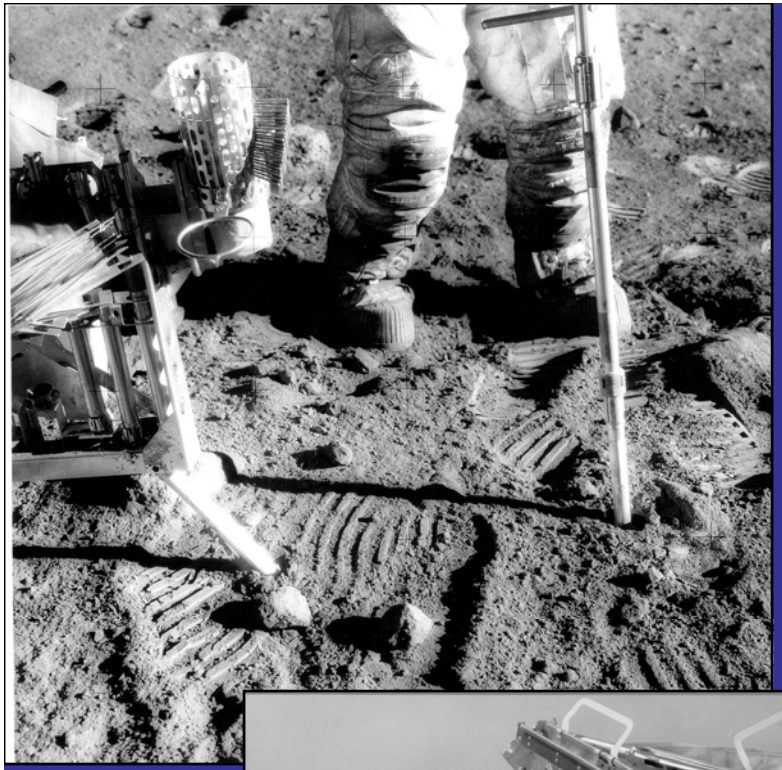
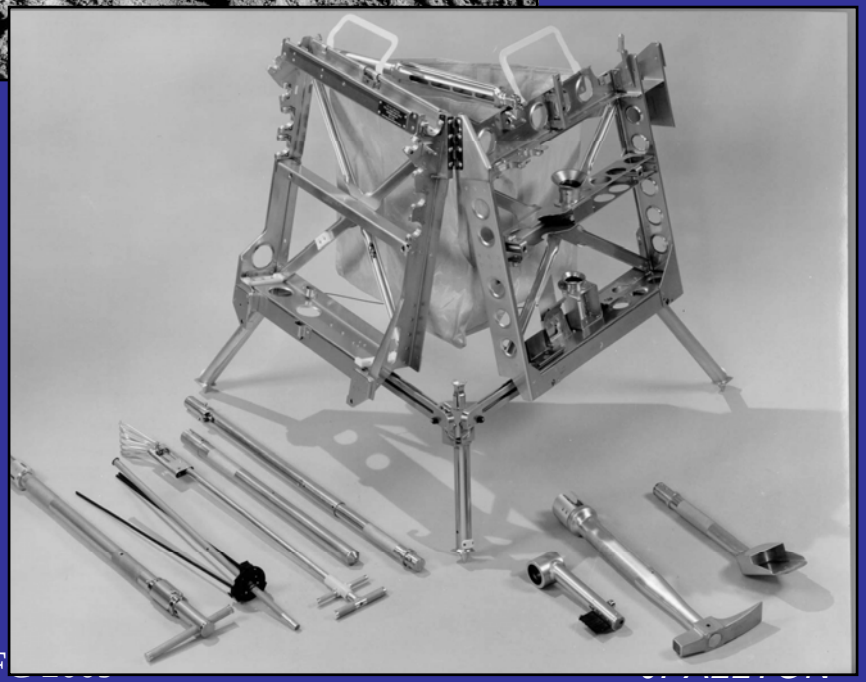
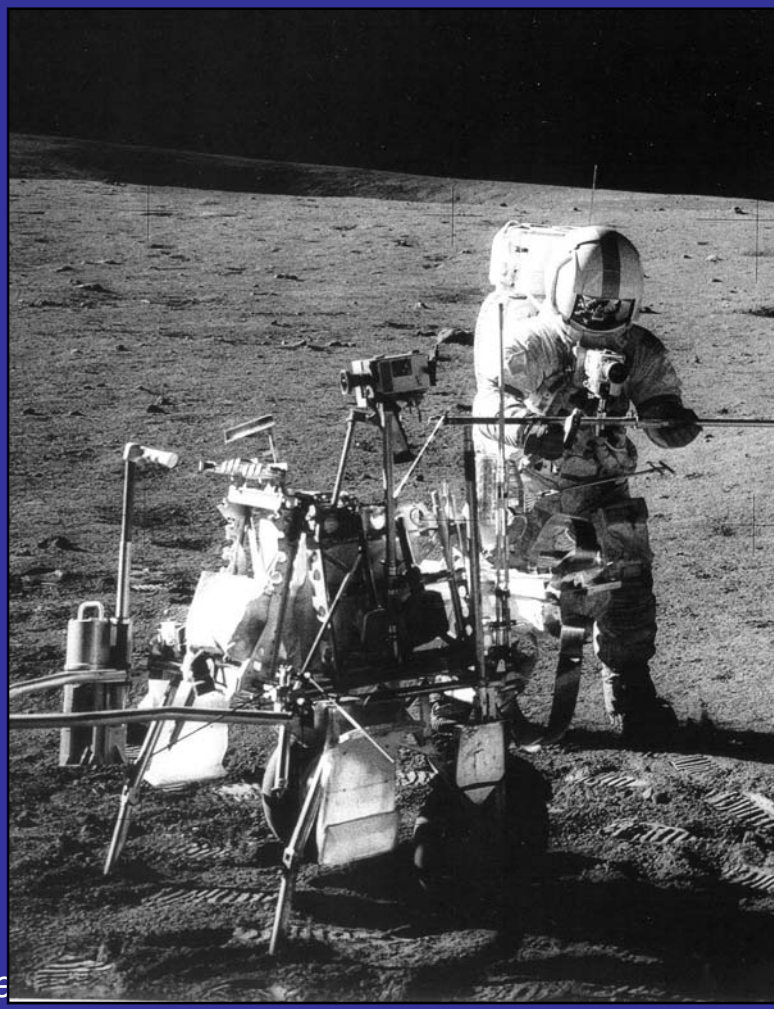
Tool Carrier



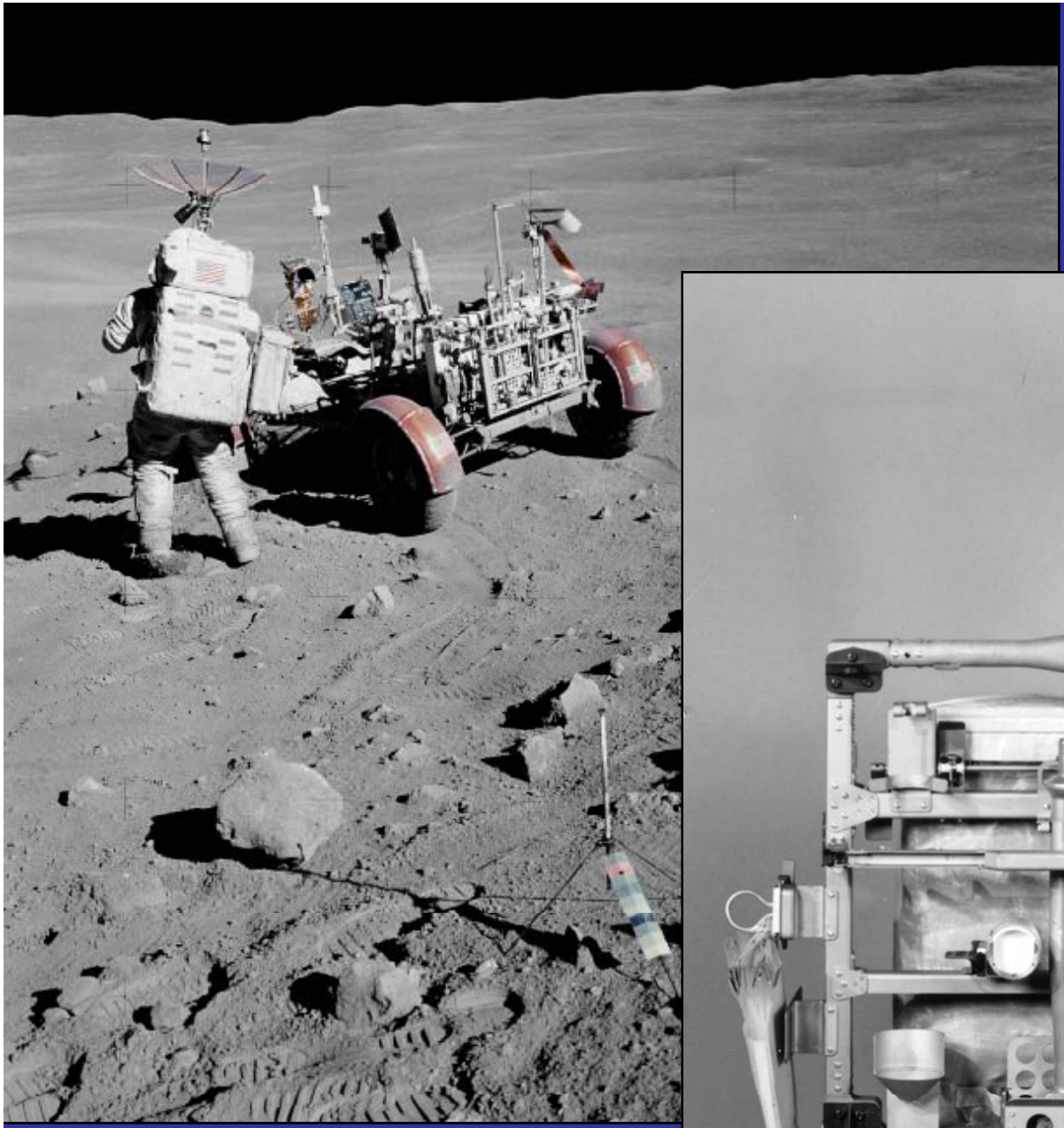
Apollo 12

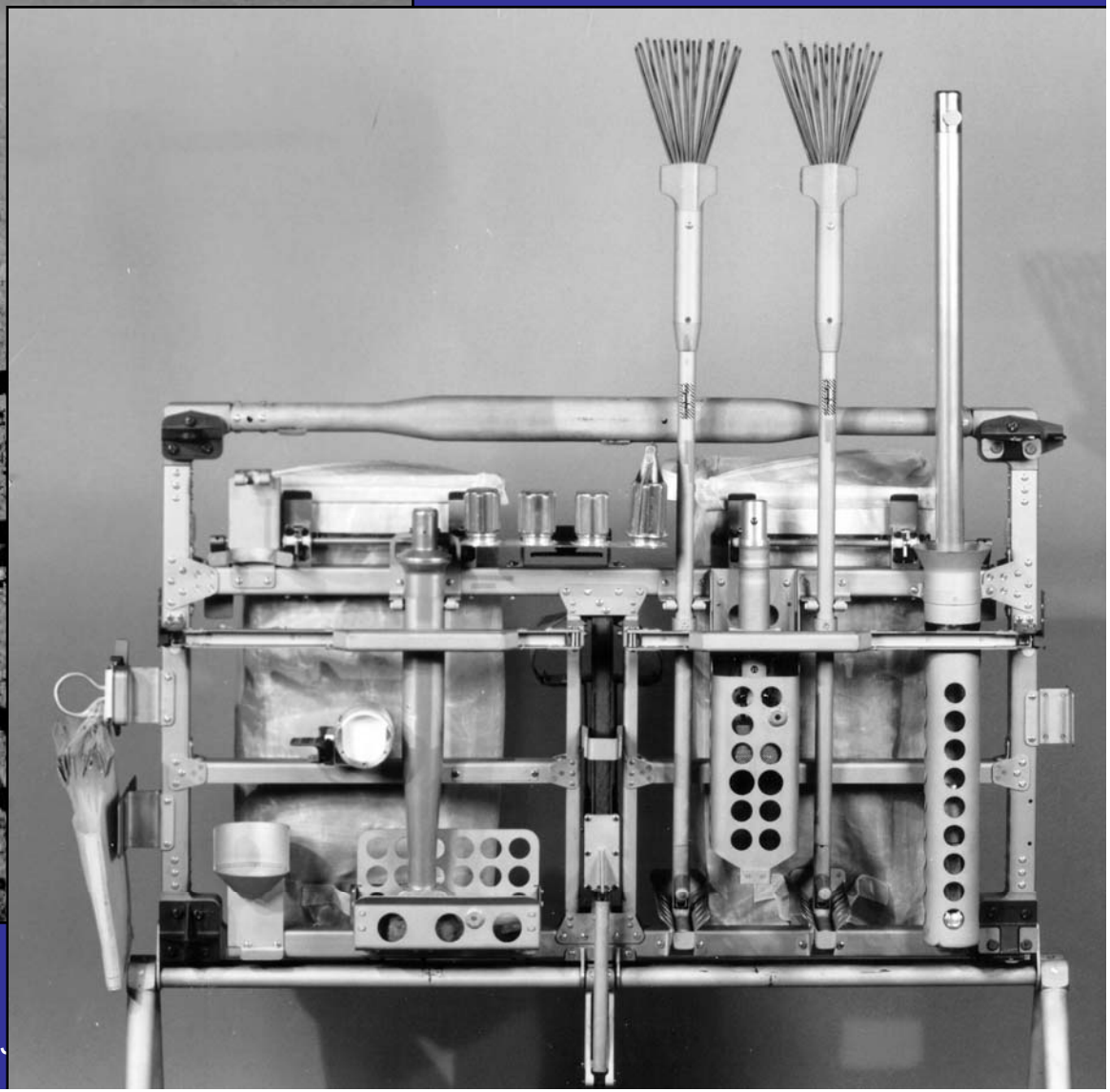


Apollo 14



Tool Carrier





Apollo 16

MSFC 2009

RAKE
APOLLO 15-17

GAS-TIGHT CAN

GAS ANALYSIS SAMPLE CONTAINER

ROCK BOX PACKED FOR LAUNCH

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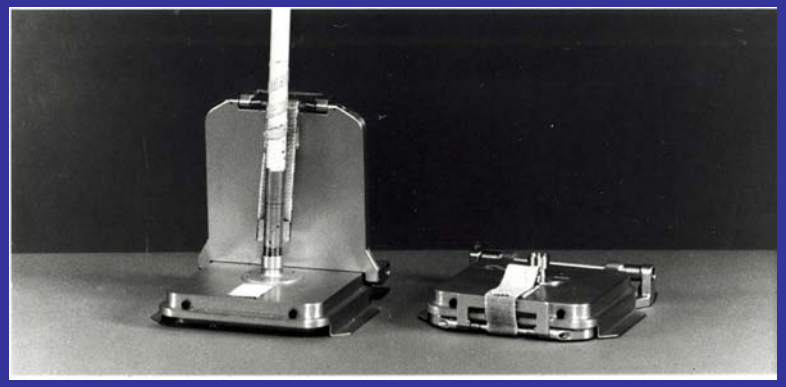
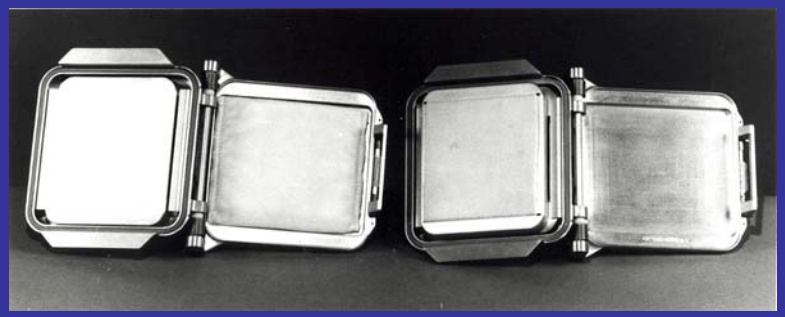


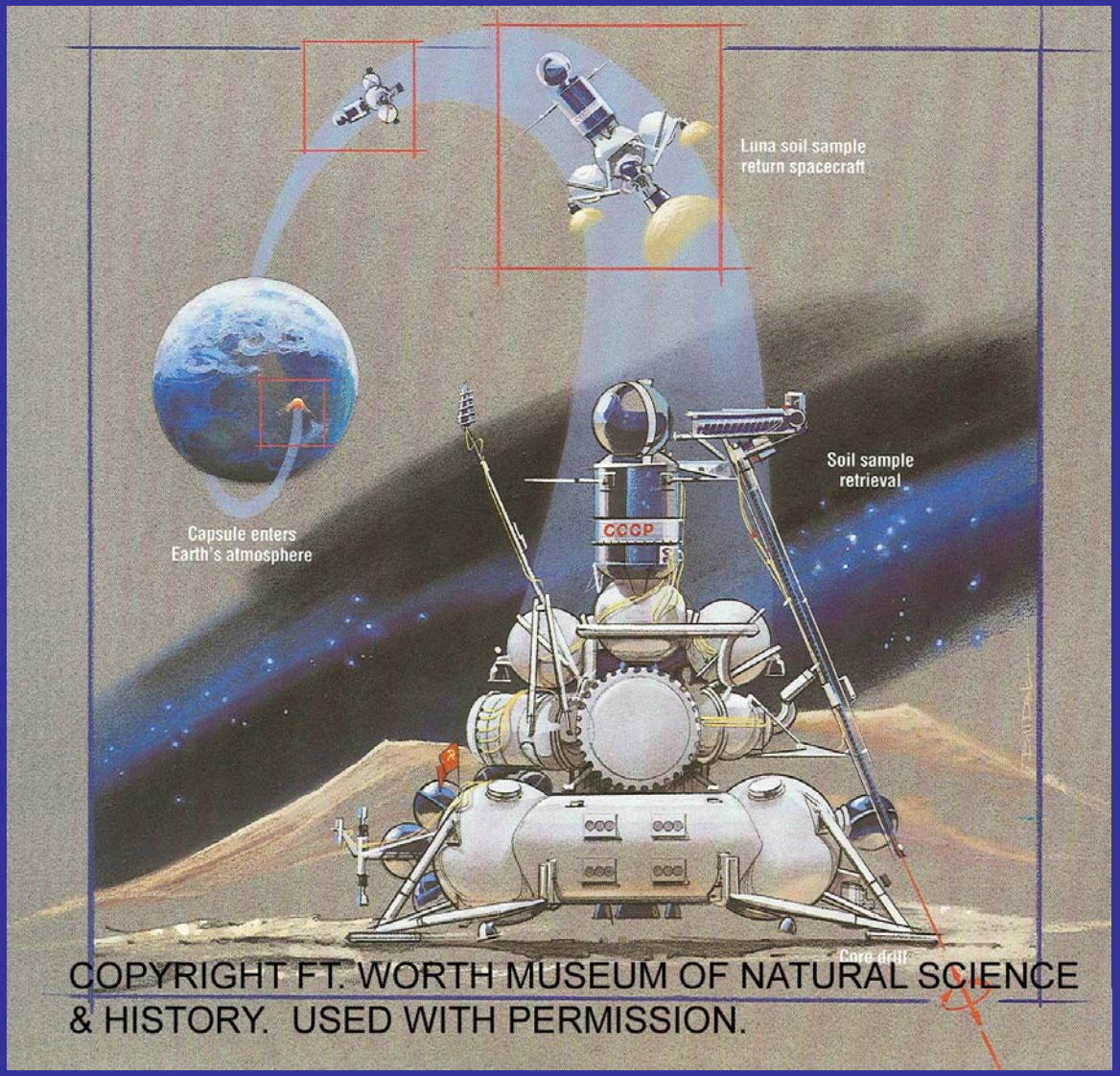


CONTACT SOIL SAMPLING DEVICE

APOLLO 12 & SURVEYOR III

Luna & Lunakhod

- First automated core sample return
- Luna 16, 20, 24
- Soviet rover features



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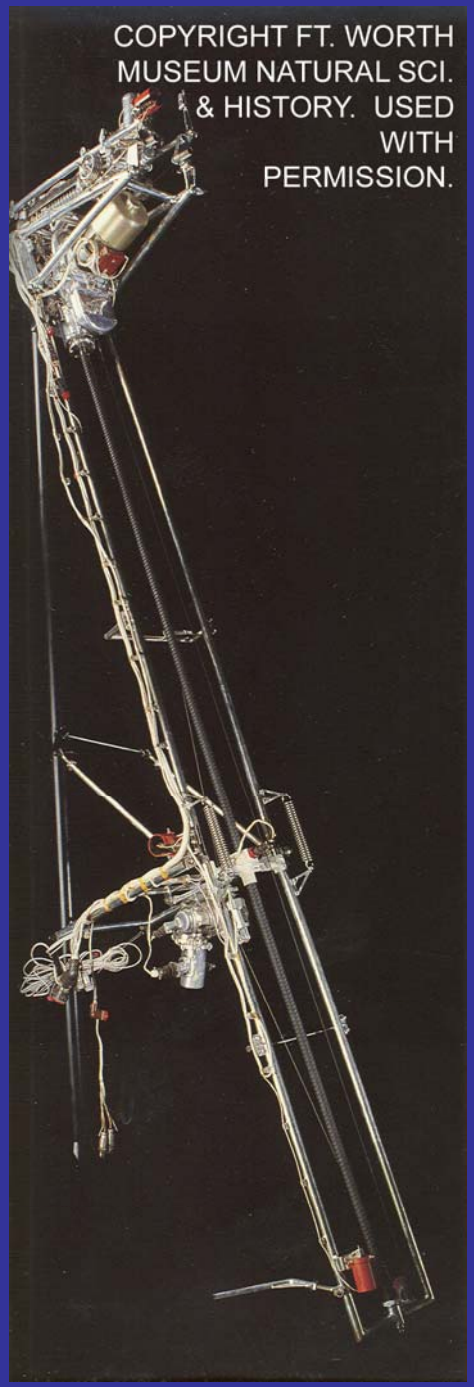
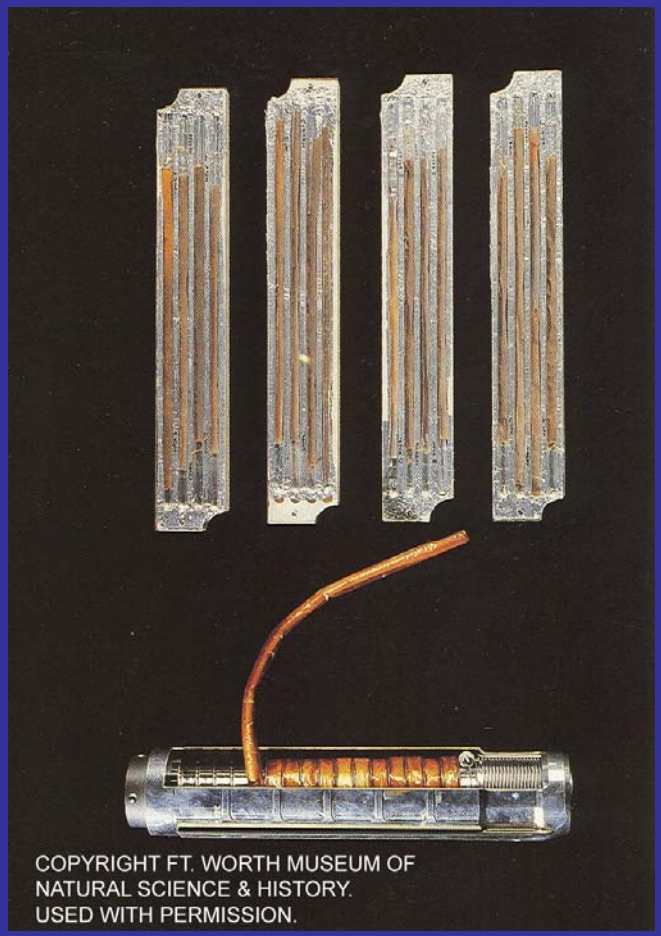


Luna Core



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Lunakhod

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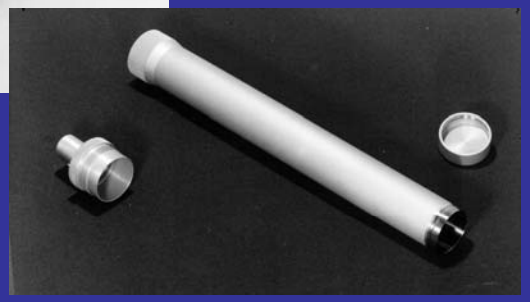
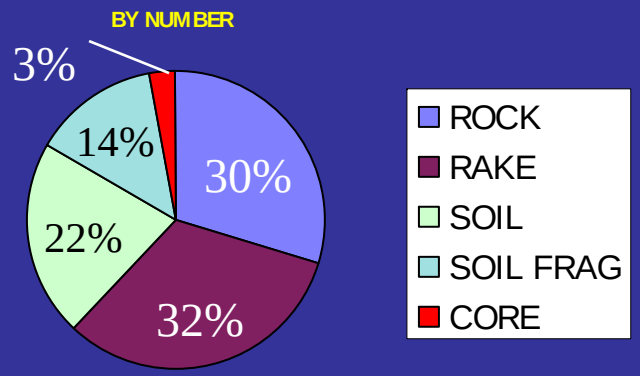
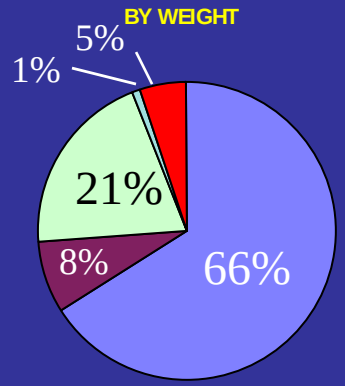
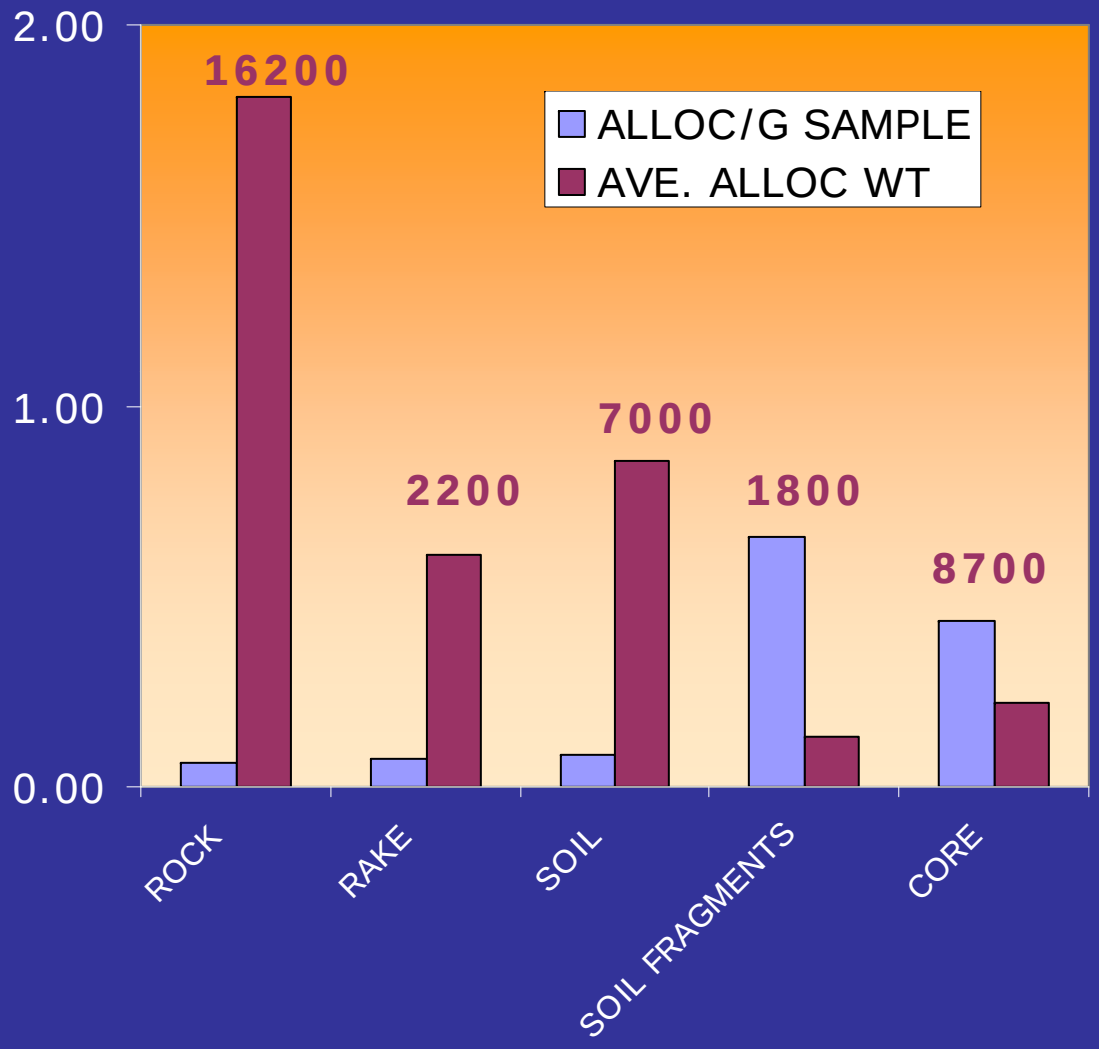
What did we bring back?







How did we use it?



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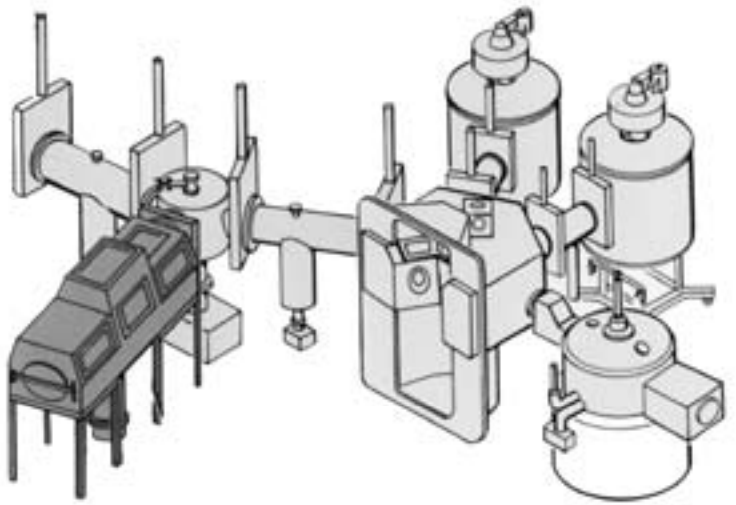
EVOLUTION OF SAMPLE HANDLING

FROM VACUUM TO POSITIVE PRESSURE NITROGEN



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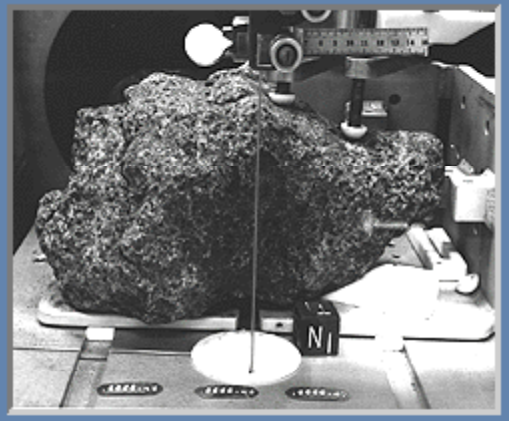
ROCKS

SAWING

The processor is photographing the sample in the bandsaw cabinet.



This Apollo 15 basalt, 15555, is ready for its first saw cut.

SOIL PROCESSING

SIEVING

1-2 mm

2-4 mm

4-10 mm

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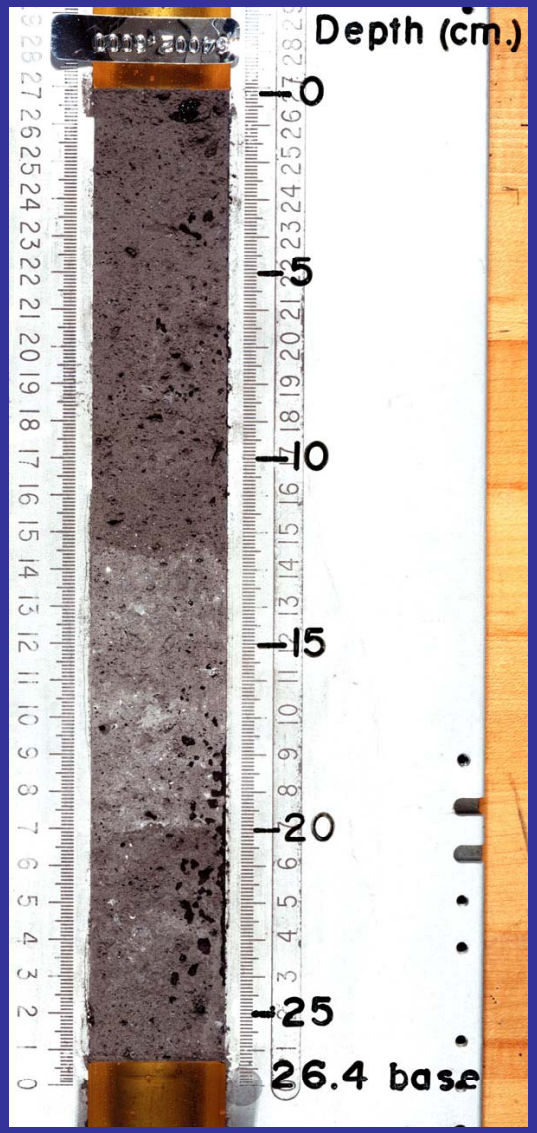
SOIL CORES



Apollo 16 core 64002 is being dissected. Soil from each millimeter interval is removed and sieved to remove particles greater than 1 mm. Then the two sieve fractions are weighed and any interesting particles are photographed.

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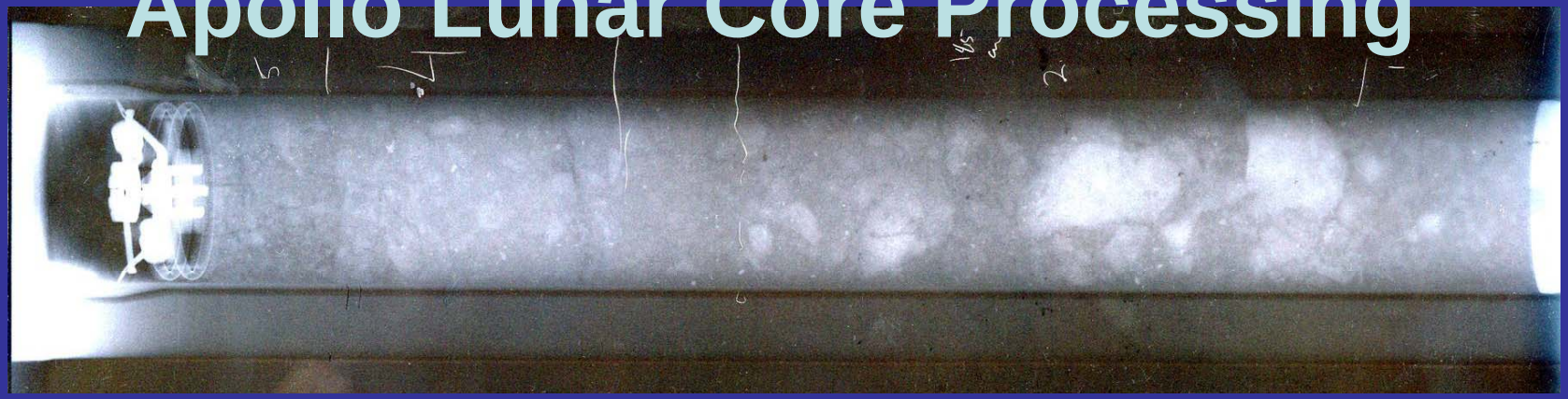
Apollo Lunar Core Processing



60009

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Apollo Lunar Core Processing

FINAL STEPS:

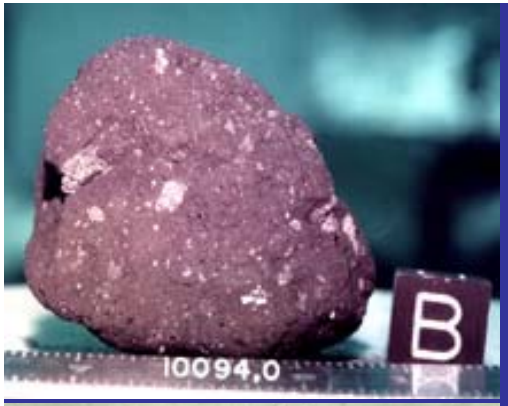
EPOXY IMPREGNATION

LENGTHWISE CUTTING

PREPARATION OF THIN SECTIONS

“CHEERS TO THE NEW EXPLORERS”

BACK-UP SLIDES



Within the allocation record, are there lessons on usefulness of RAKE vs SOIL FRAGMENTS?

Maximum diversity vs adequate mass for collaborative studies

Future science goals (Shearer et al, 2002) include:

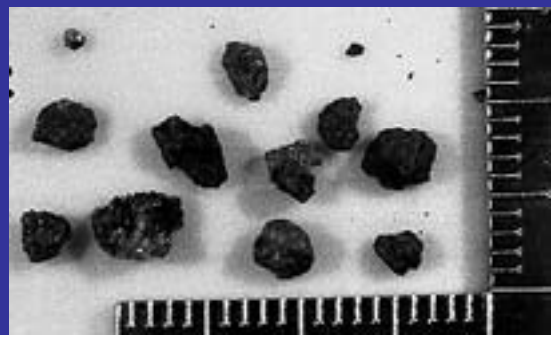
Calibrating the late impact history

Deciphering effects of catastrophic impacts

Understanding late stage thermal & magmatic evolution

Exploring the interior

Examining volatile reservoirs



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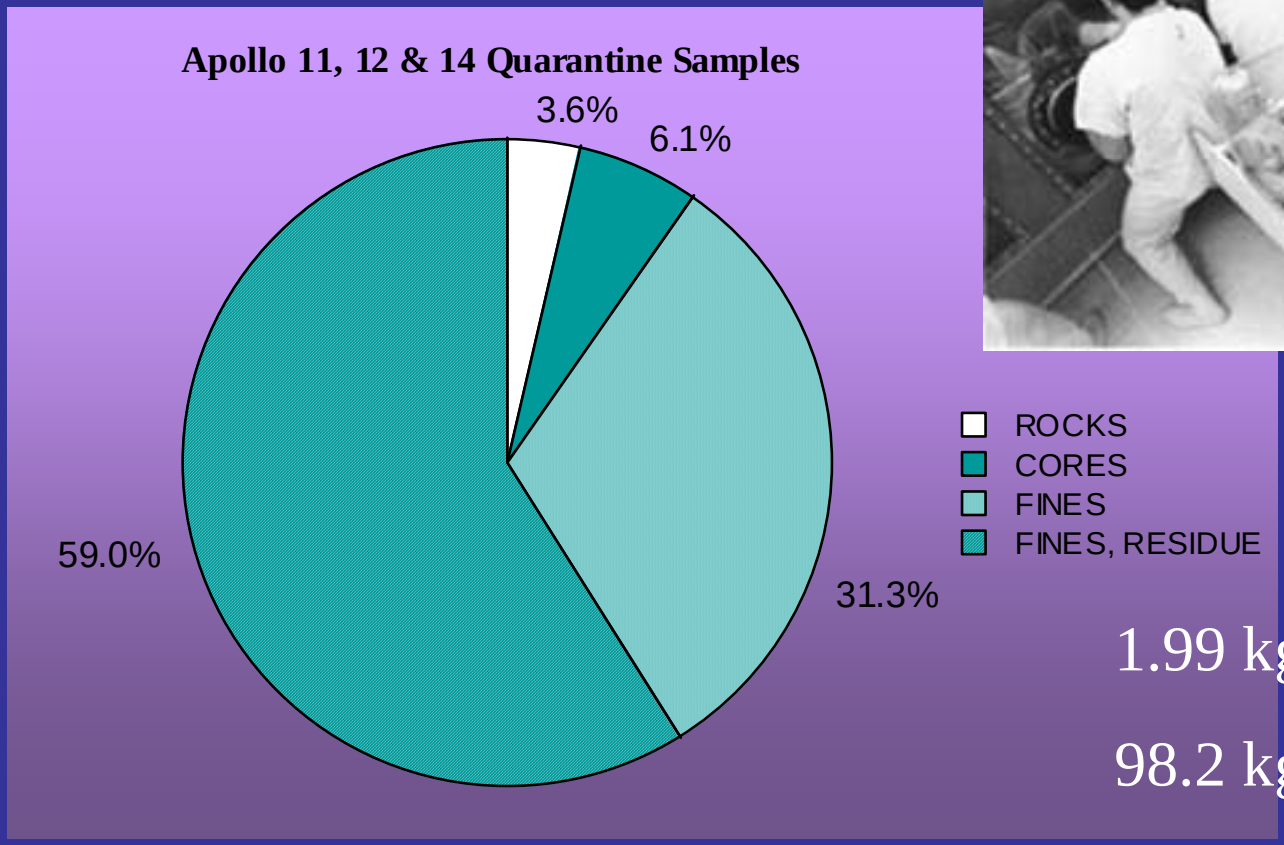
SCIENCE SAMPLES: Numerous aliquots of small size
HAZARD TESTING: Fewer, larger samples - BIOPOOL



1.99 kg from

98.2 kg = 2%

- Combining CLEAN, STERILE and CONTAINED is difficult technically
- Minimum sample to be used for hazard testing
- Minimum sample handling reduces contamination
- Reserve sample for future studies

Sources~
From Simoneit & Flory, 1970

1. Surface contamination of lunar-bound rock box
2. Surface contamination of collection tools
3. Descent engine exhaust products
4. Lunar module outgassing
5. Spacesuit leakage
6. Particulates abraded from suits, etc.
7. Venting of LM fuel, oxidizer, cabin and waste systems
8. Venting of spacesuit backpack
9. Exposure to LRL vacuum and nitrogen chambers
10. Surface contamination of sample processing tools
11. Surface contamination of containers sent to PIs

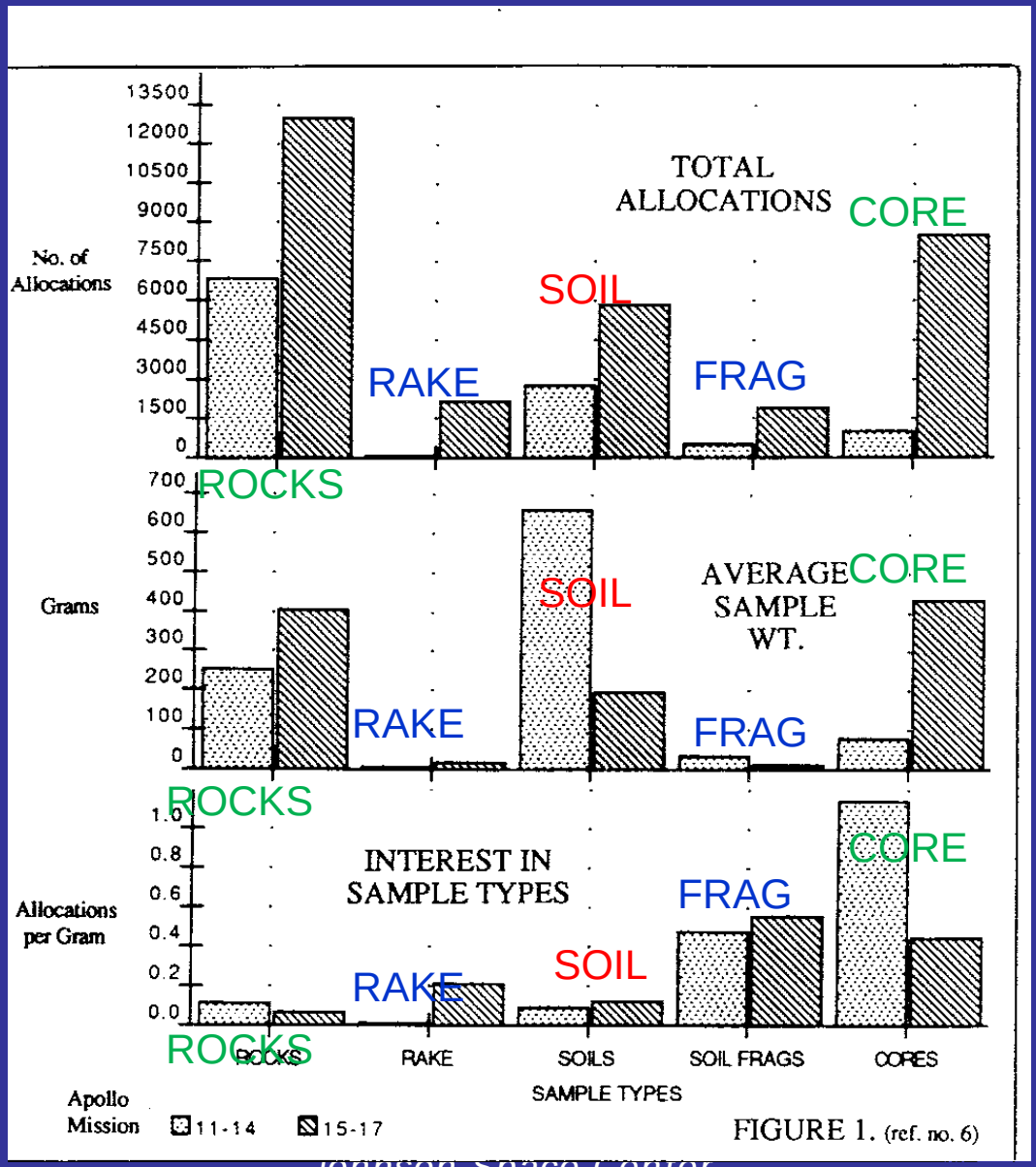
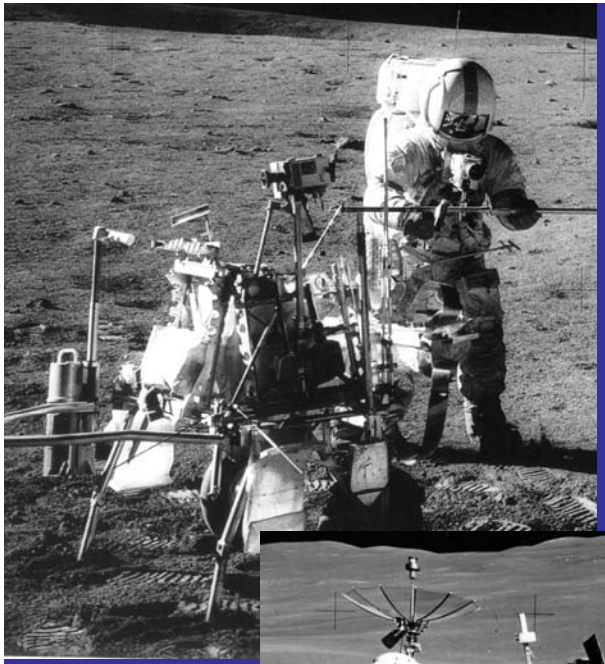
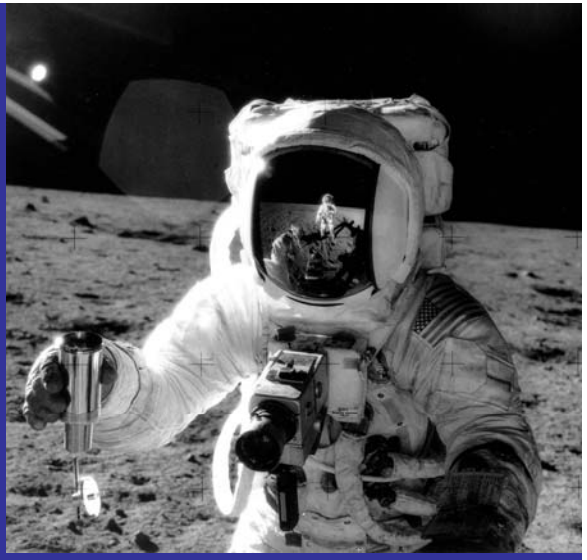
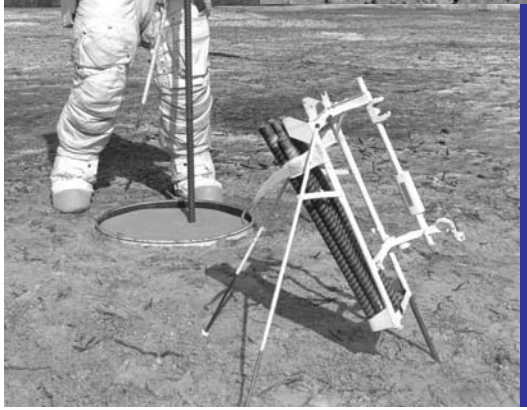
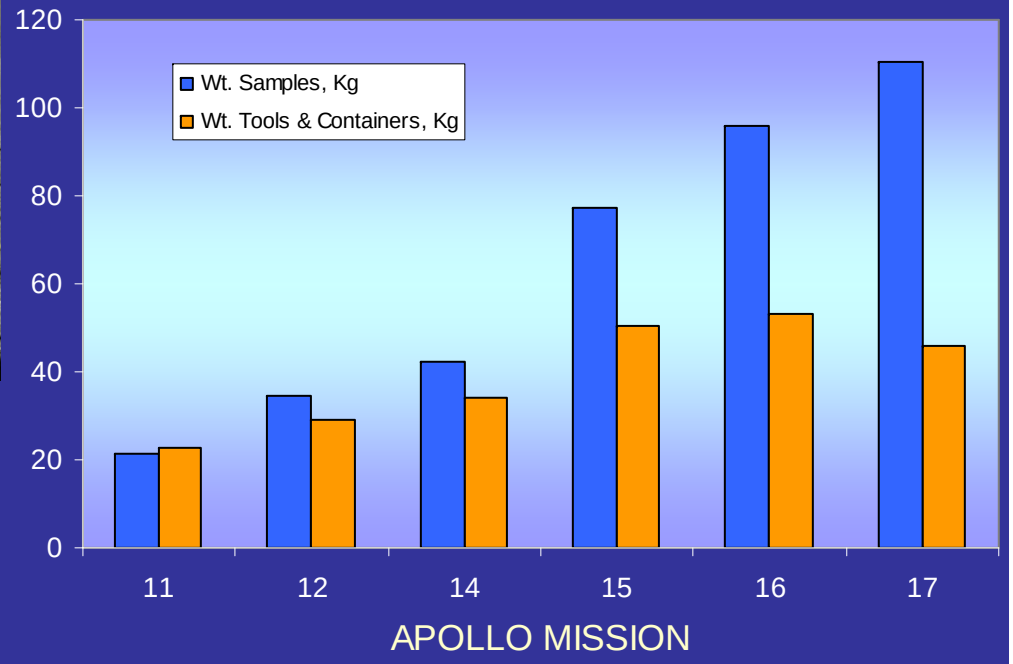


FIGURE 1. (ref. no. 6)









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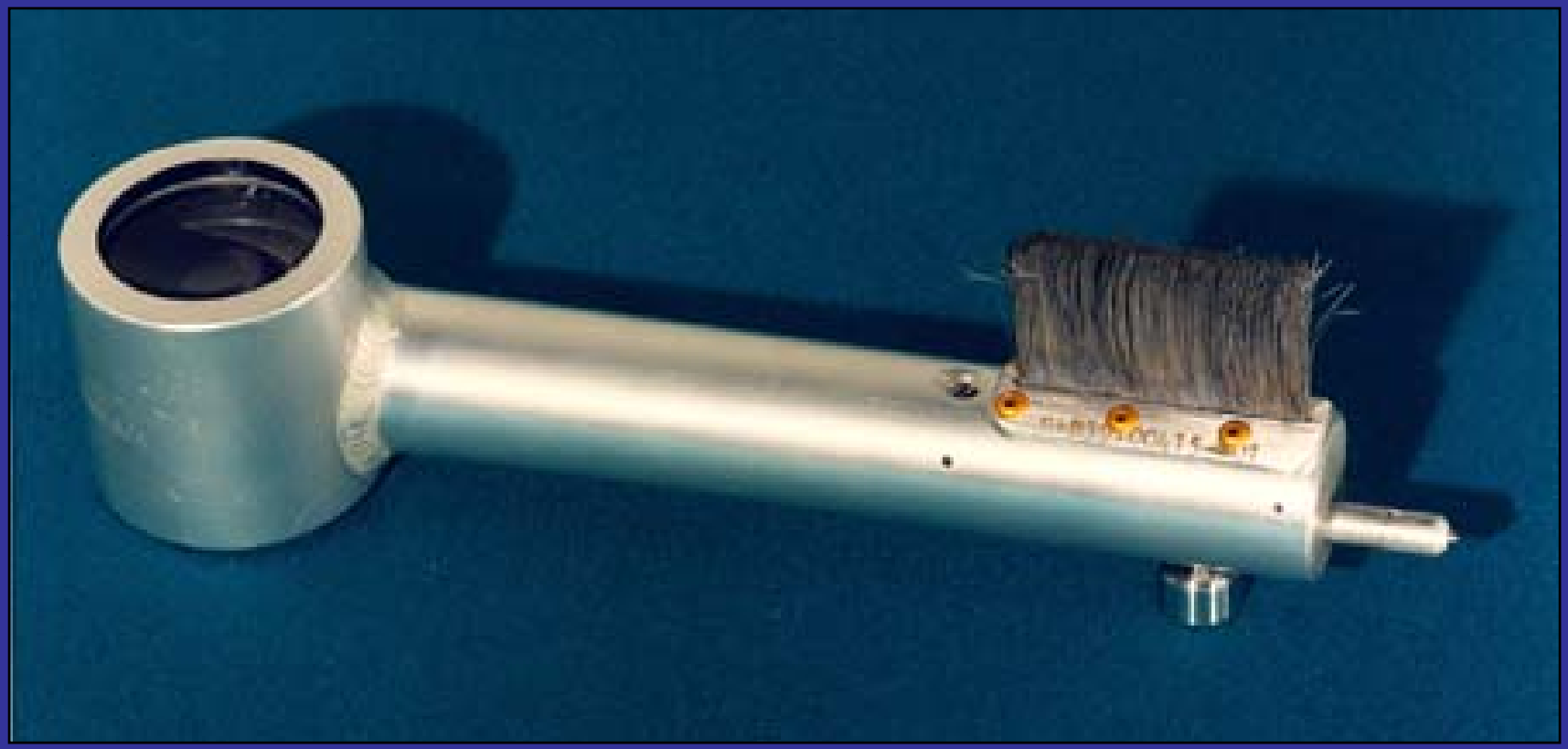
CONTINGENCY SAMPLER



LENS SCRIBER BRUSH

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