National Aeronautics and Space Administration

The Apollo Legacy

AND NASA'S LEAP INTO THE FUTURE

Crewed Apollo Missions

Dates	1967 - 1972
Vehicles	• *Saturn IB* and *Saturn V* launch vehicles • *Apollo* Command/Service Module • Lunar Module
Number of People Flown	33
Number of Astronauts to Walk on the Moon	12
Highlights	• First humans to leave Earth orbit • First human landing on the Moon

Apollo Landing Sites

Apollo 1

- January 27, 1967
- Virgil I. “Gus” Grissom, Edward H. White II, Roger B. Chaffee
- Preflight test launch pad fire
  - Fatal accident led to major design & engineering changes to Apollo spacecraft

APOLLO 50 NEXT GIANT LEAP

Apollo 7

- October 11-22, 1968
- Donn F. Eisele, Walter “Wally” M. Schirra, Jr., Walter Cunningham
- Apollo’s first successful crewed launch into space
  - Earth orbiting mission
  - First live TV broadcast of Americans from space

APOLLO 50 NEXT GIANT LEAP

Apollo 7 Command Module

- Location:
  - Frontiers of Flight Museum
  - Dallas, TX

Apollo 8

- December 21-27, 1968
- Frank F. Borman II, William A. Anders, James A. Lovell, Jr.
- First crewed spacecraft to leave Earth, reach the Moon, orbit, and return to Earth

APOLLO 50 NEXT GIANT LEAP

Apollo 8

- Crew were first people to see lunar far side with own eyes
- Live Christmas Eve broadcast
- Earthrise photo

APOLLO 50 NEXT GIANT LEAP

Apollo 8 Command Module

- Location:
  - Museum of Science and Industry
  - Chicago, IL

Apollo 9

- March 3-13, 1969
- James A. McDivitt, David R. Scott, Russell “Rusty” L. Schweickart
- NASA’s first crewed mission of the lunar module
- Earth orbiting mission

APOLLO 50 NEXT GIANT LEAP

Apollo 9 Command Module

- Name: “Gumdrop”
- Location:
  - San Diego Air & Space Museum
  - San Diego, CA

Apollo 10

- May 18-26, 1969
- Eugene A. Cernan, Thomas P. Stafford, John W. Young
- NASA's final dress rehearsal for lunar landing
  - Encompassed all aspects of an actual crewed lunar landing (except the landing)

APOLLO 50 NEXT GIANT LEAP

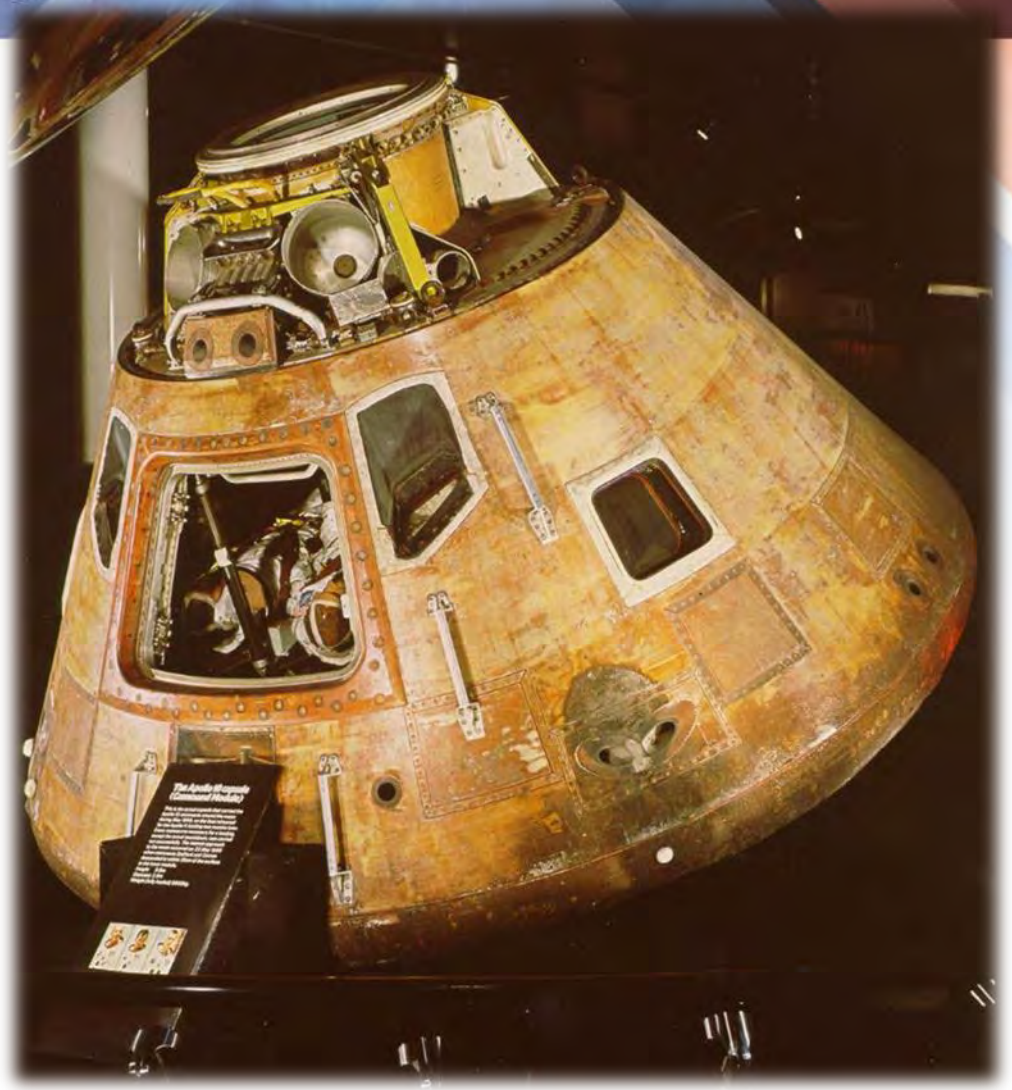
Apollo 10

- Peanuts & NASA
  - Snooping around the Apollo 11 landing site
  - Lunar module named “Snoopy”
  - Apollo command module named “Charlie Brown”

APOLLO 50 NEXT GIANT LEAP

Apollo 10 Command Module

- Name: “Charlie Brown”
- Location:
  - Science Museum
  - London, England



Apollo 11

- July 16-24, 1969
- Neil A. Armstrong, Michael Collins, Edwin E. “Buzz” Aldrin, Jr.
- First human Moon landing & Armstrong’s famous first step

APOLLO 50 NEXT GIANT LEAP

Apollo 11 Traverses

Apollo 11 Command Module

- Name: “Columbia”
- Location:
  - The Museum of Flight
  - Seattle, WA

Apollo 12

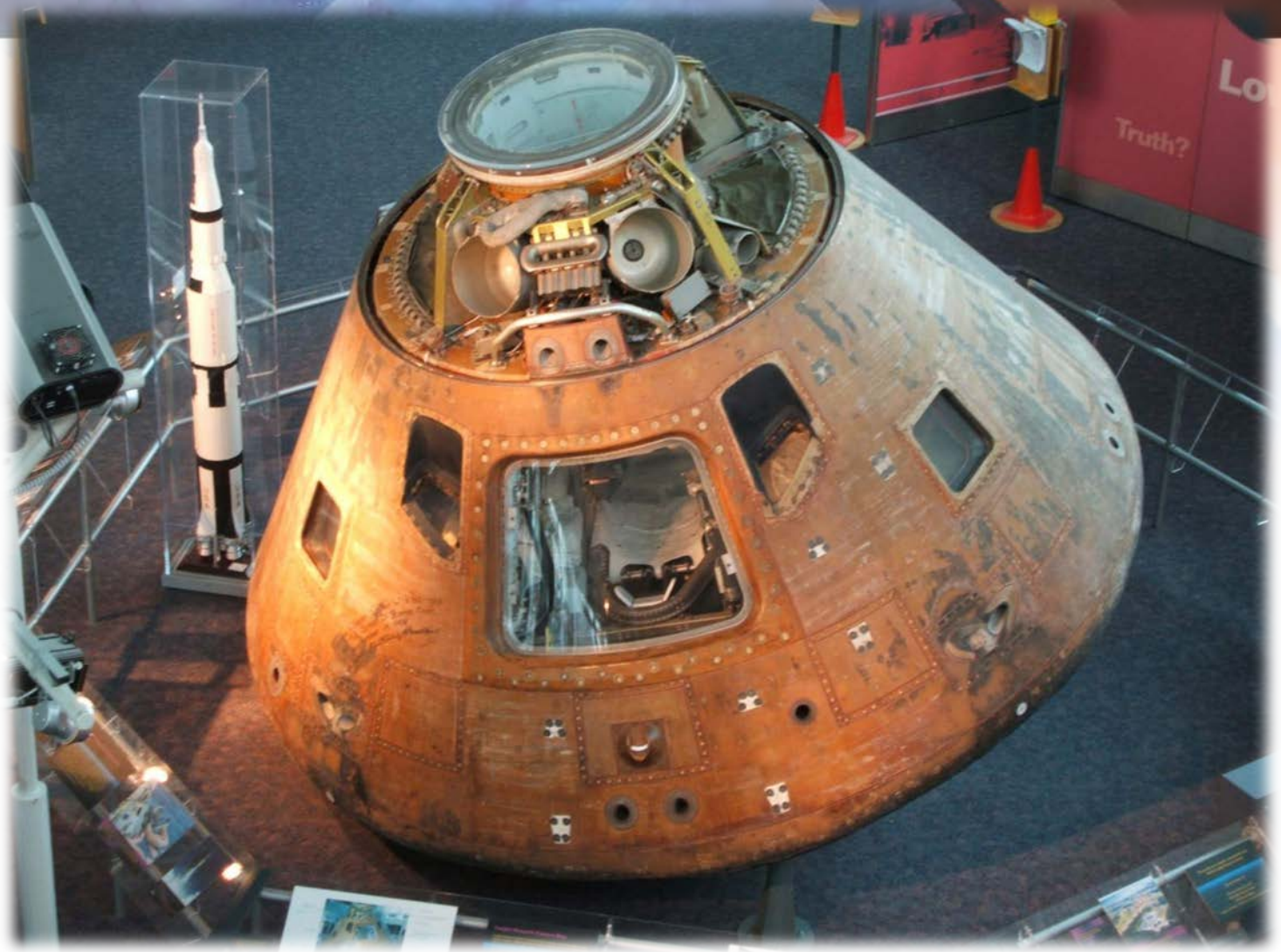
- November 14-24, 1969
- Charles “Pete” Conrad, Jr., Richard “Dick” F. Gordon, Jr., Alan L. Bean
- Astronauts use precision targeting w/use of Doppler effect radar to pinpoint landing

- Pieces of the *Surveyor 3* probe were collected & returned to Earth for analysis

APOLLO 50 NEXT GIANT LEAP

Apollo 12 Command Module

- Name: “Yankee Clipper”
- Location:
  - Virginia Air & Space Center
  - Hampton, VA



Apollo 13

- April 11-17, 1970
- Fred W. Haise, Jr., John “Jack” L. Swigert, Jr., James A. Lovell, Jr.
- Mission aborted after an explosion in one of oxygen tanks crippled spacecraft during flight
  - The crew returned safely to Earth

APOLLO 50 NEXT GIANT LEAP

Apollo 13 Command Module

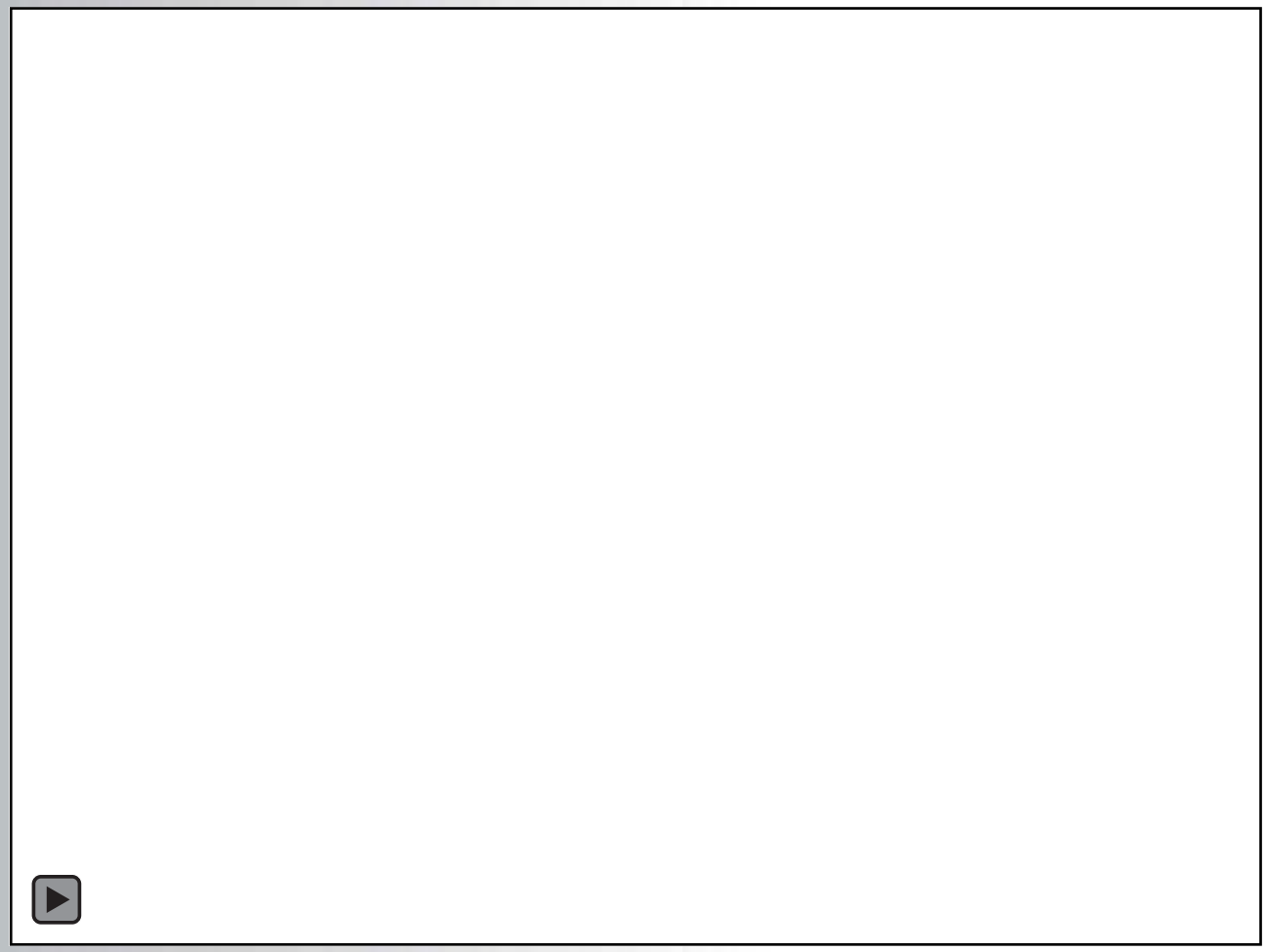
- Name: “Odyssey”
- Location:
  - Kansas Cosmosphere and Space Center
  - Hutchinson, KS

Apollo 14

- January 31-February 9, 1971
- Stuart A. Roosa, Alan B. Shepard, Jr., Edgar D. Mitchell
- Lunar module lands in the Moon's Fra Mauro formation (Apollo 13's original target)

APOLLO 50 NEXT GIANT LEAP

Apollo 14



- Alan Shepard – lunar golfer
  - Hit two golf balls on the Moon at end of last extravehicular activity

Apollo 14

- Stuart Roosa – Moon trees!
  - Brought hundreds of tree seeds with him → many now growing on Earth

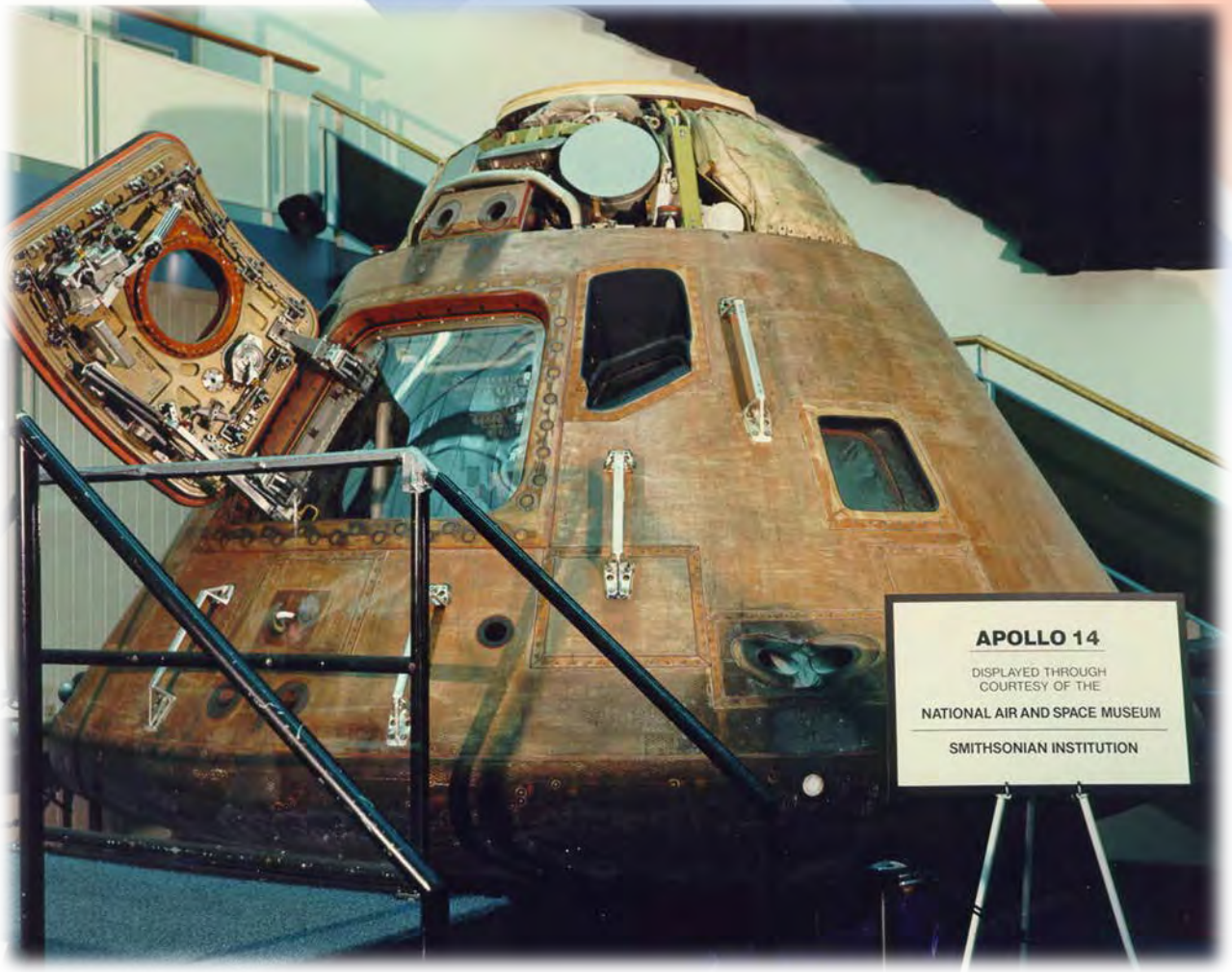
NASA Goddard Space Flight Center, Greenbelt, MD
Jay Friedlander

Jefferson County, OH
Bob Jankowski

APOLLO 50 NEXT GIANT LEAP

Apollo 14 Command Module

- Name: “Kitty Hawk”
- Location:
  - NASA Kennedy Space Center
  - Kennedy Space Center, FL



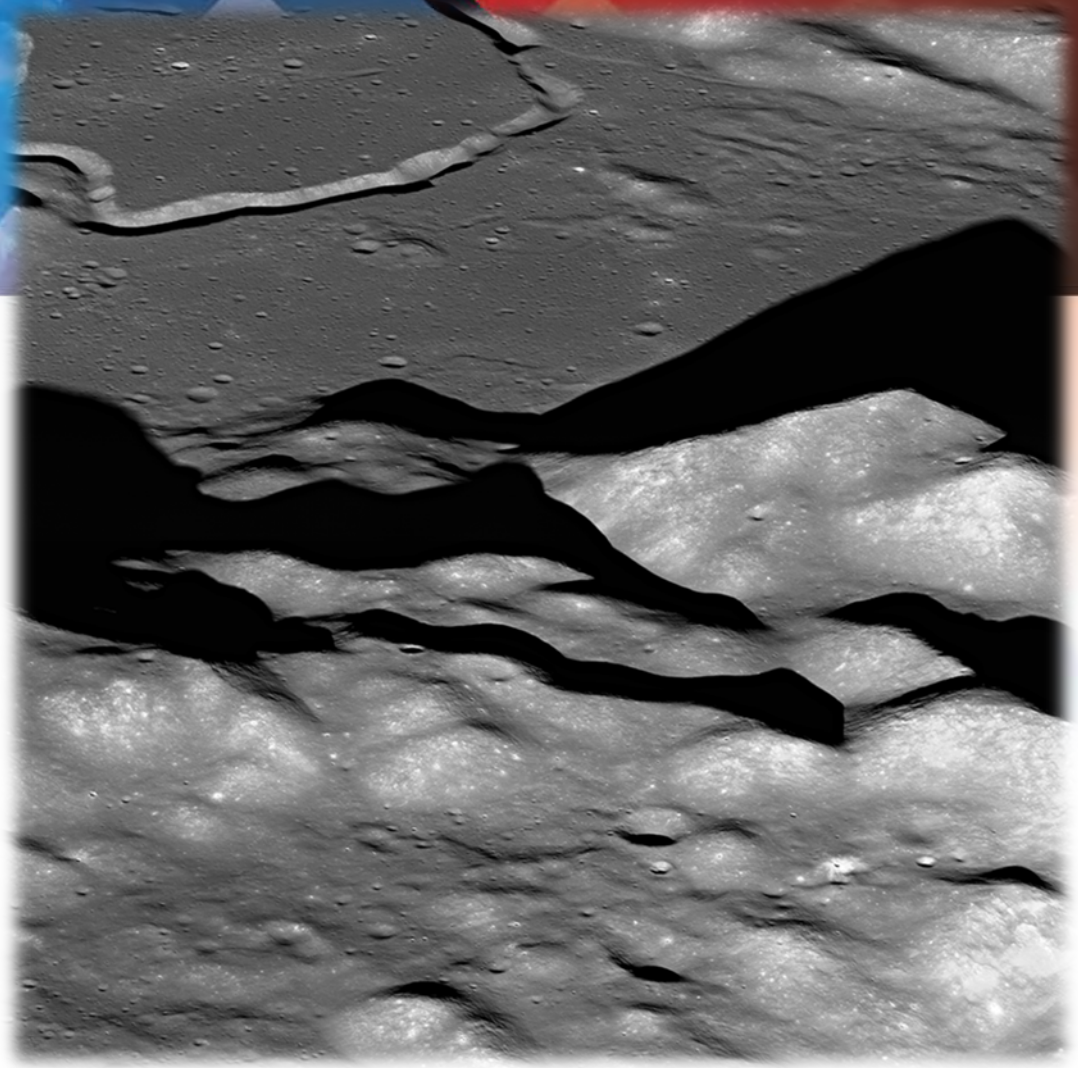
Apollo 15

- July 26-August 7, 1971
- David R. Scott, Alfred M. Worden, James B. Irwin
- Improved technology allowed astronauts longer stay on the Moon
  - Nearly 3 days!

APOLLO 50 NEXT GIANT LEAP

Apollo 15

- First flight of the Lunar Roving Vehicle (LRV)
  - Used to explore the geology of the Hadley Rille/Apennine region
  - Allowed Apollo 15, 16, & 17 astronauts to venture farther from the Lunar Module



APOLLO 50 NEXT GIANT LEAP

Apollo 15 Command Module

- Name: “Endeavour”
- Location:
  - National Museum of the United States Air Force
  - Wright-Patterson Air Force Base, Dayton, OH

Apollo 16

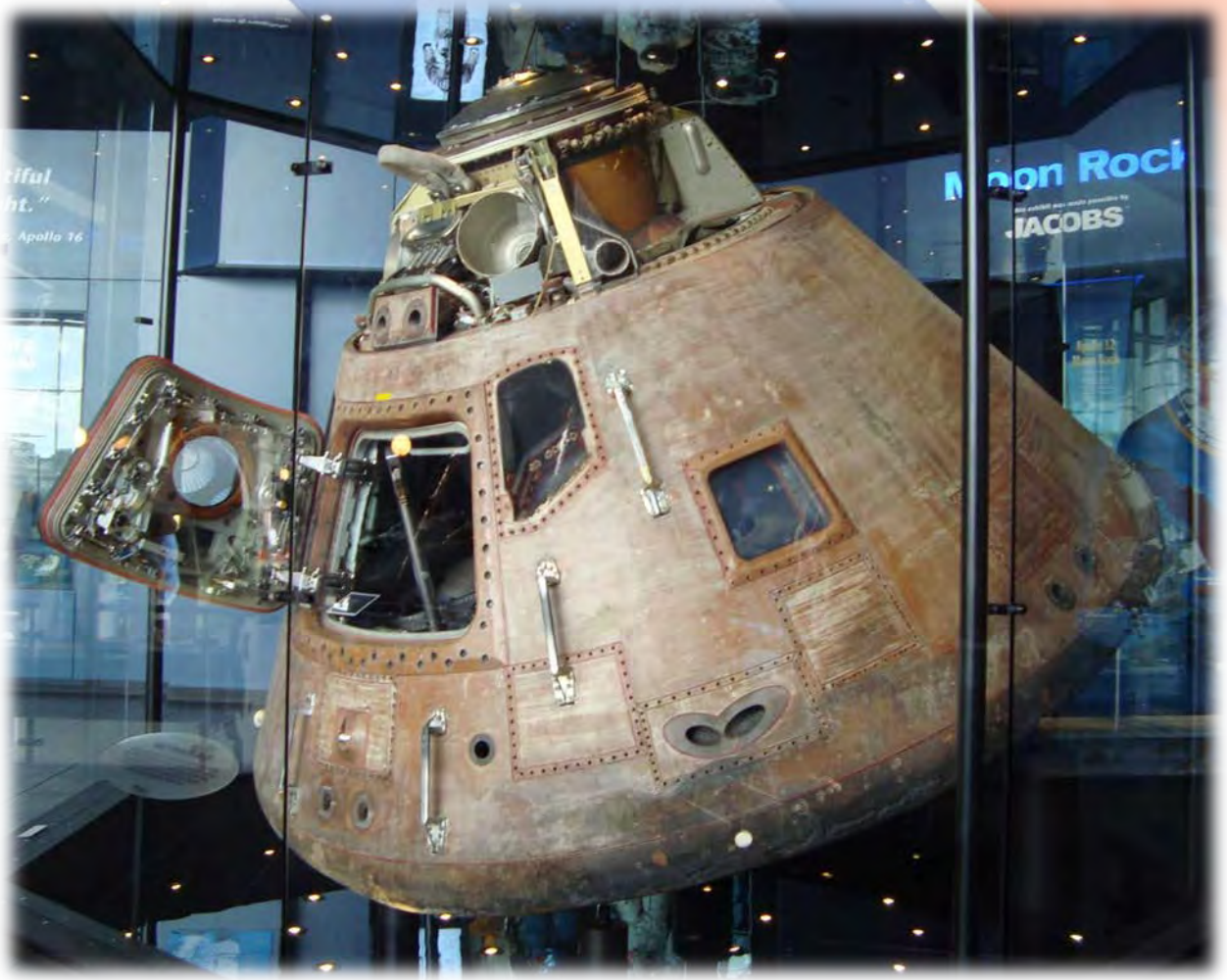
- April 16-27, 1972
- Thomas “Ken” K. Mattingly II, John W. Young, Charles M. Duke, Jr.
- Astronauts landed in and studied the Moon’s highlands area
  - They deployed and operated the first astronomical telescope on the Moon

APOLLO 16
YOUNG•MATTINGLY•DUKE

APOLLO 50 NEXT GIANT LEAP

Apollo 16 Command Module

- Name: “Casper”
- Location:
  - US Space & Rocket Center
  - Huntsville, AL



Apollo 17

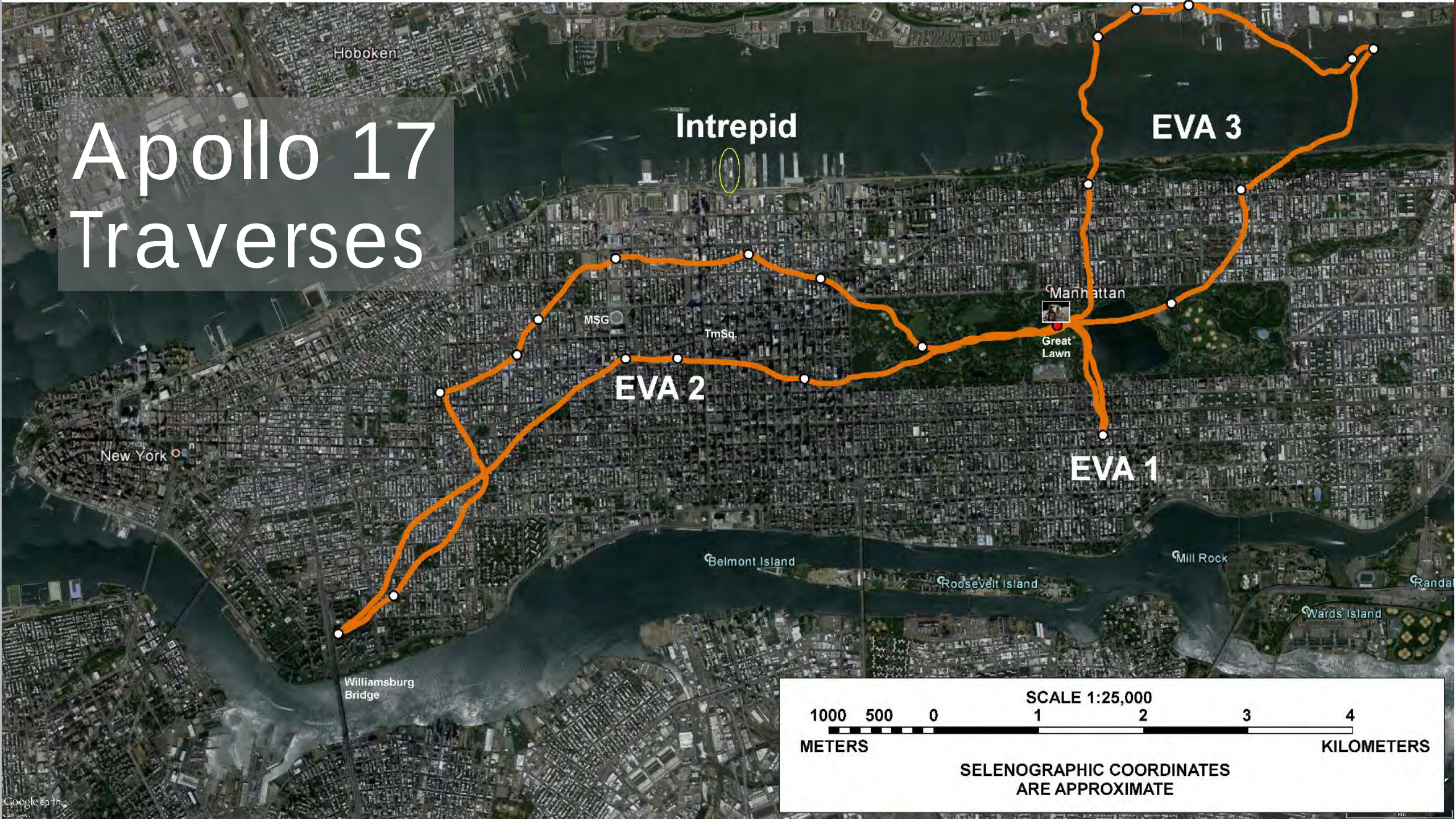
- December 7-19, 1972
- Harrison H. “Jack” Schmitt, Eugene A. Cernan, Ronald E. Evans
- Apollo’s final launch
- Only time a scientist walked on the Moon
  - Geologist Harrison H. “Jack” Schmitt

APOLLO 50 NEXT GIANT LEAP

Apollo 17

- First night launch of the Saturn V launch vehicle
- Longest Lunar Roving Vehicle traverse on a single extravehicular activity
- Greatest amount of lunar samples returned to Earth (242.5 lbs)

APOLLO 50 NEXT GIANT LEAP


Apollo 17
Traverses
Hoboken
Intrepid
EVA 3
MSG
TmSq.
Manhattan
Great
Lawn
EVA 2
EVA 1
New York
Belmont Island
Roosevelt Island
Mill Rock
Wards Island
Williamsburg
Bridge
SCALE 1:25,000
1000 500 0 1 2 3 4
METERS
KILOMETERS
SELENOGRAPHIC COORDINATES
ARE APPROXIMATE

Apollo 11 Traverses

Apollo 17 Command Module

- Name: “America”
- Location:
  - Space Center Houston, NASA Johnson Space Center
  - Houston, TX

PRESENT LUNAR EXPLORATION

Lunar Reconnaissance Orbiter

Lunar Reconnaissance Orbiter

- Launch: June 18, 2009
- 6 instruments + 1 technology demonstration

APOLLO 50 NEXT GIANT LEAP

Lunar Reconnaissance Orbiter

- Mission Goals:
  - Detailed characterization of the lunar surface and radiation environment
  - Identify resources (like water-ice deposits)
  - Identify landing hazards (like rough terrain)

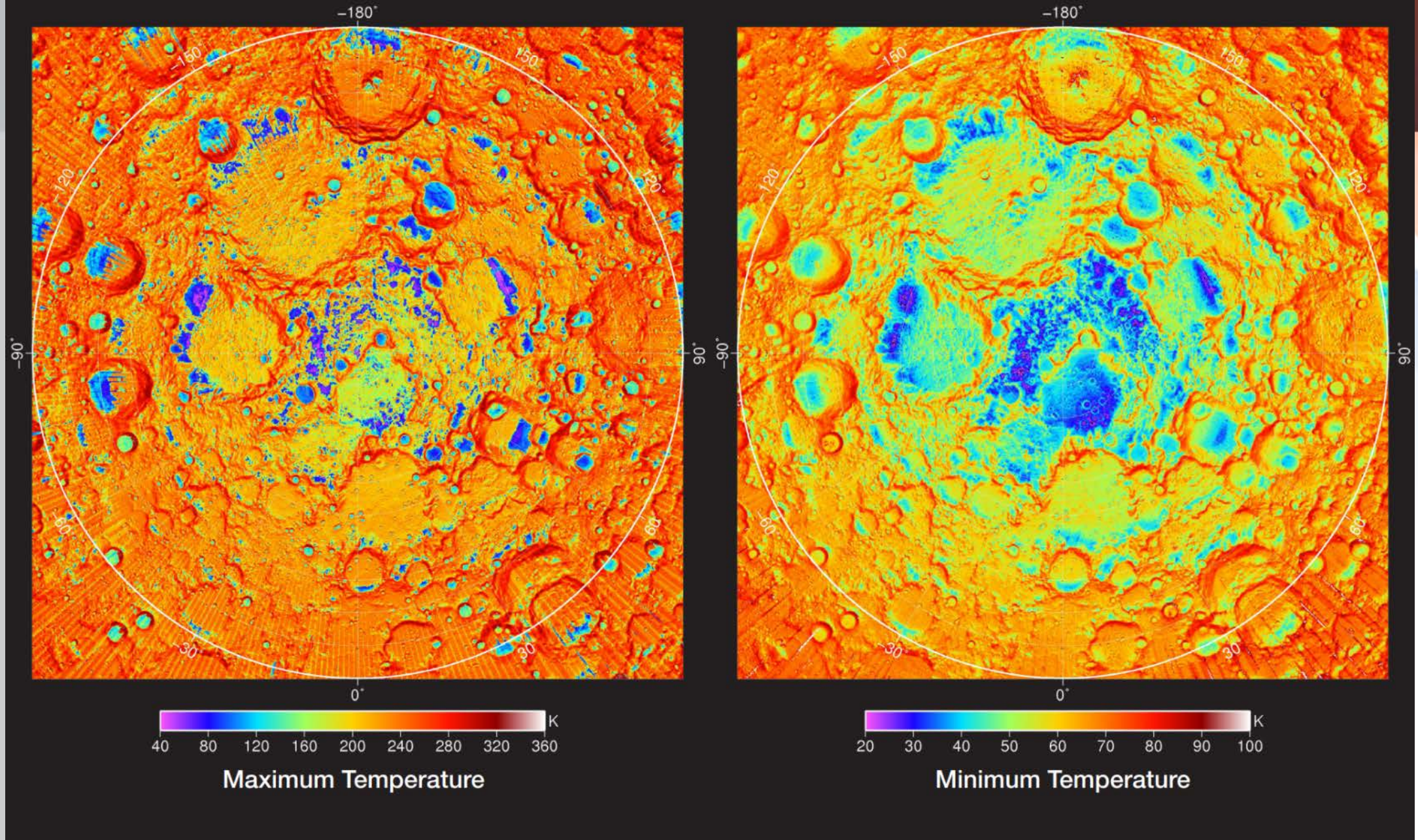
APOLLO 50 NEXT GIANT LEAP

Lunar Reconnaissance Orbiter

- Key Discoveries:
  - Some regions are *really* cold (-414.4°F)!
  - Water on the Moon
  - Shrinking Moon
  - Lunar pits

APOLLO 50 NEXT GIANT LEAP

North Pole


−180°
−150°
150°
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120°
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90°
−60°
60°
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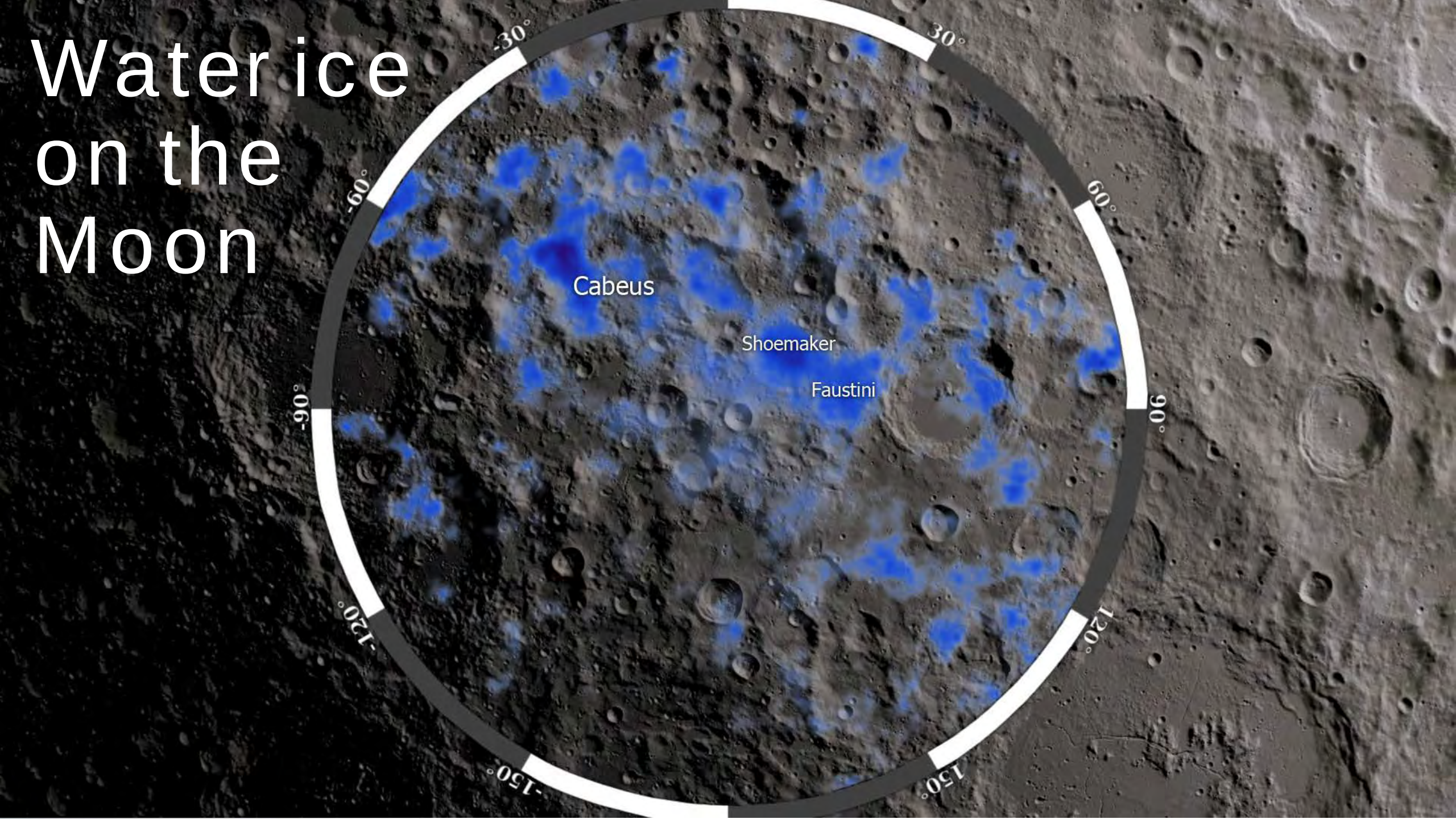
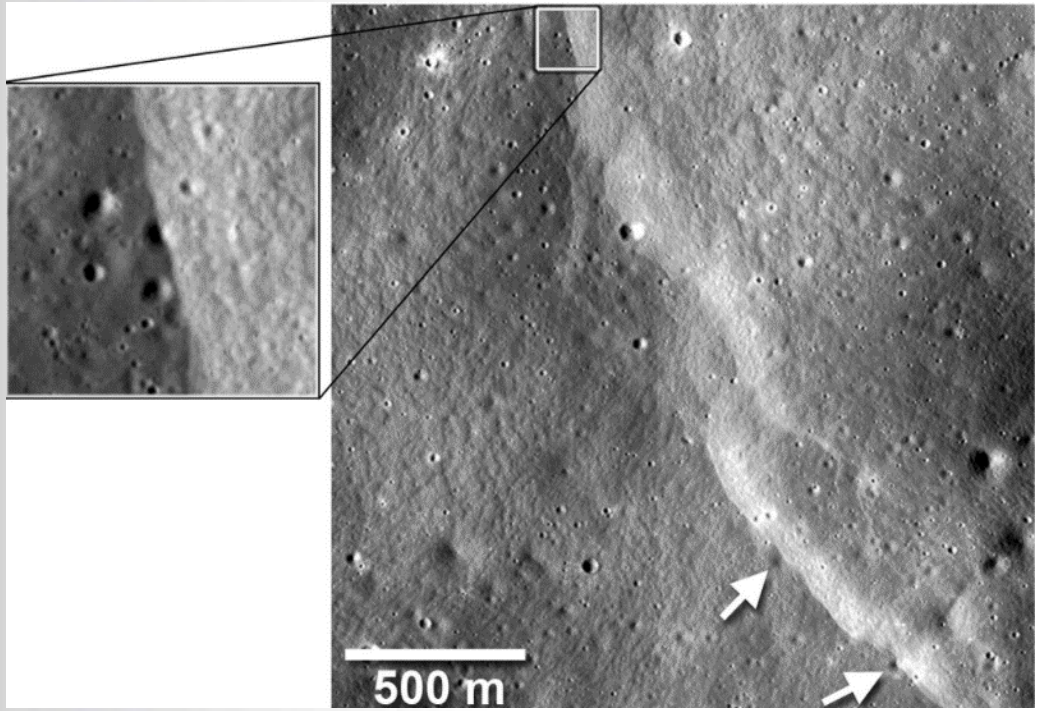
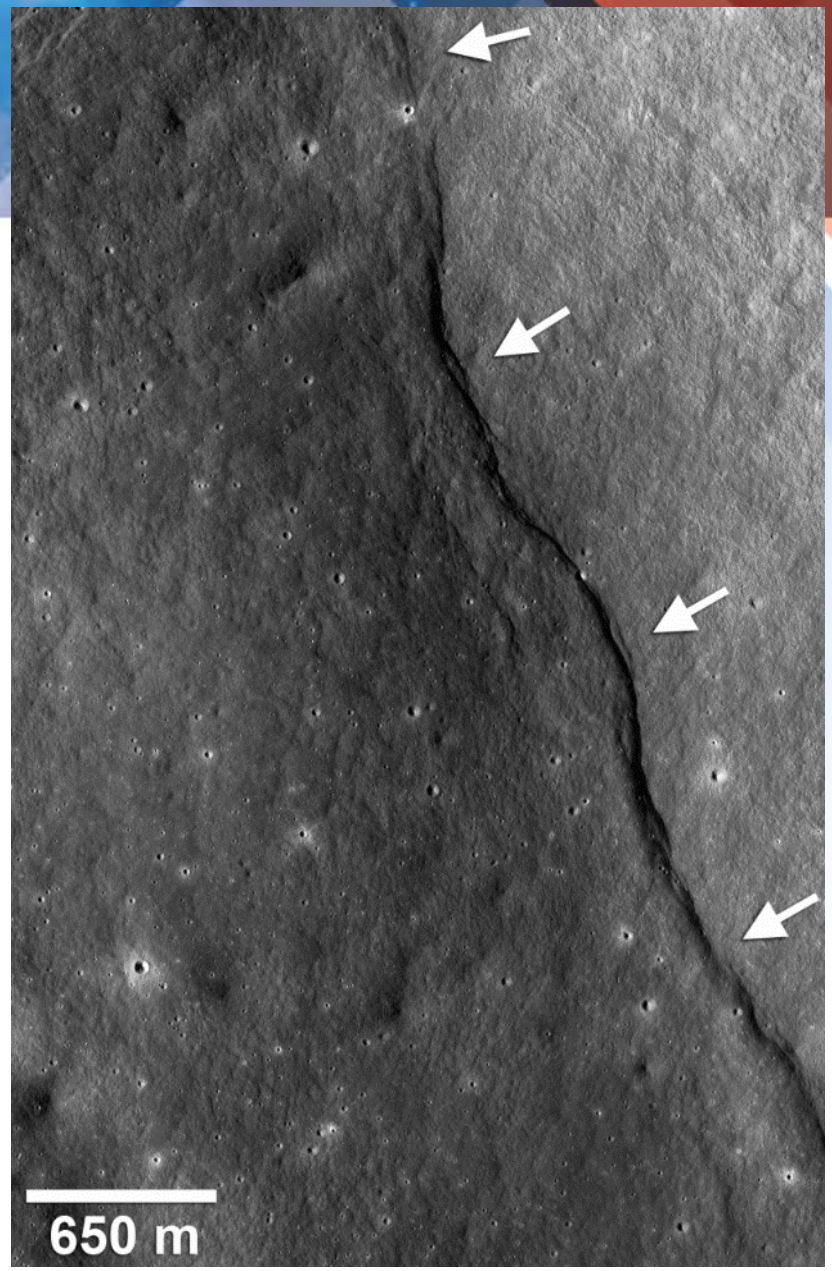
K
40 80 120 160 200 240 280 320 360
Maximum Temperature
−180°
−150°
150°
−120°
120°
−90°
90°
−60°
60°
−30°
30°
0°
K
20 30 40 50 60 70 80 90 100
Minimum Temperature

Water ice on the Moon



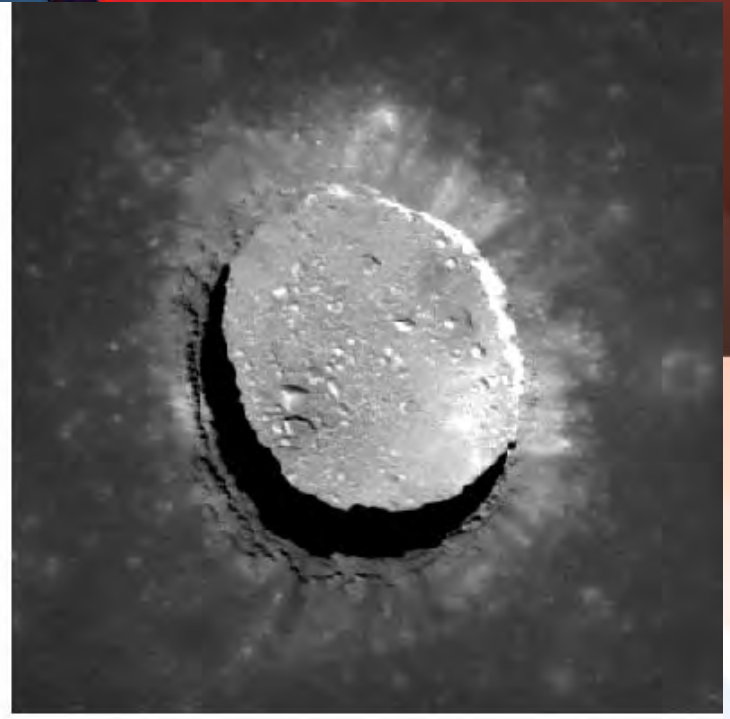
Shrinking Moon

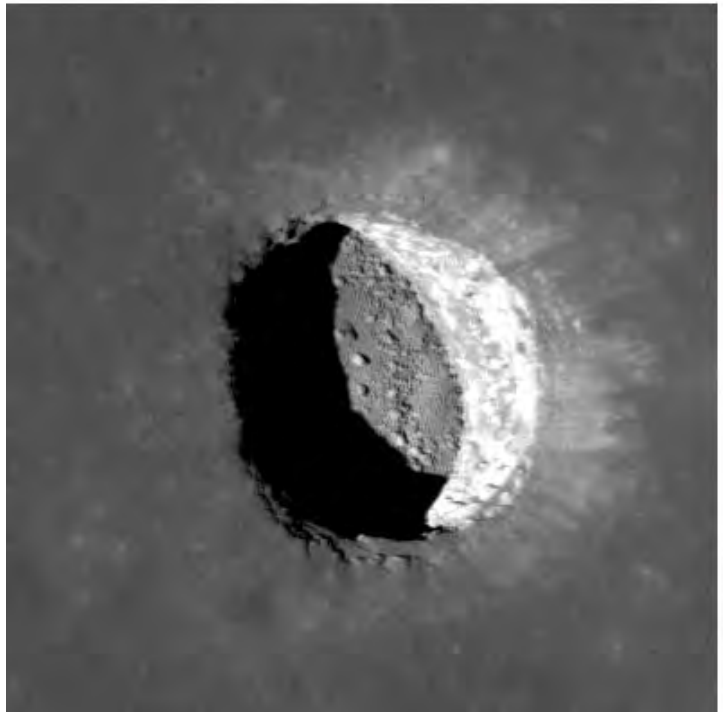


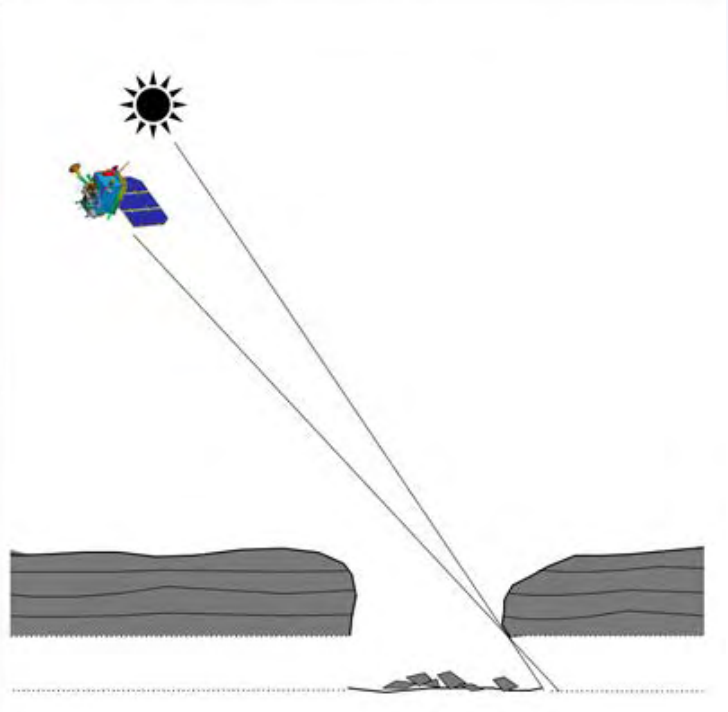


Lunar Pits

- Mare Tranquillitatis pit
- Pit diameter: 100 m
- Pit depth: 107 m



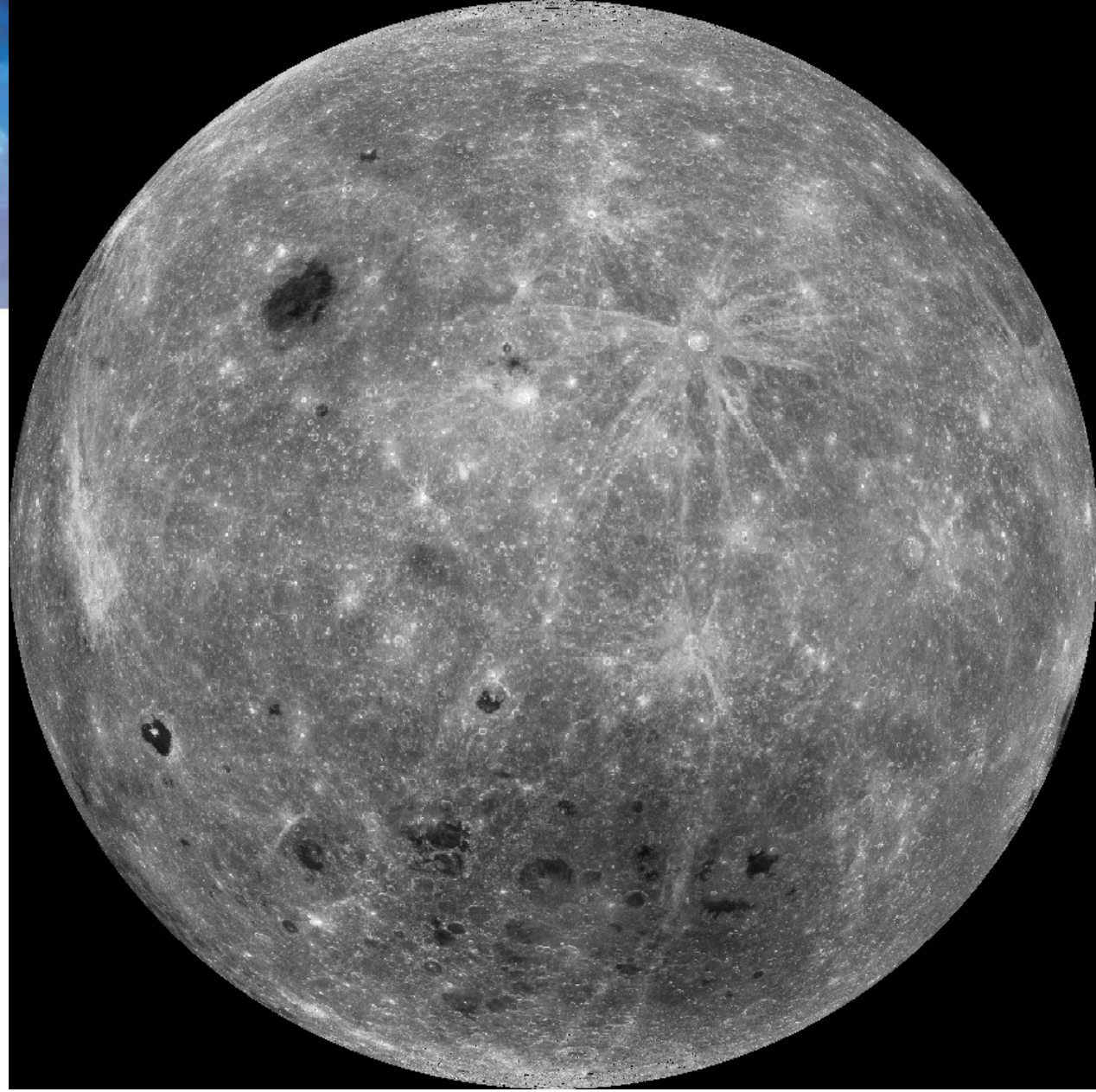




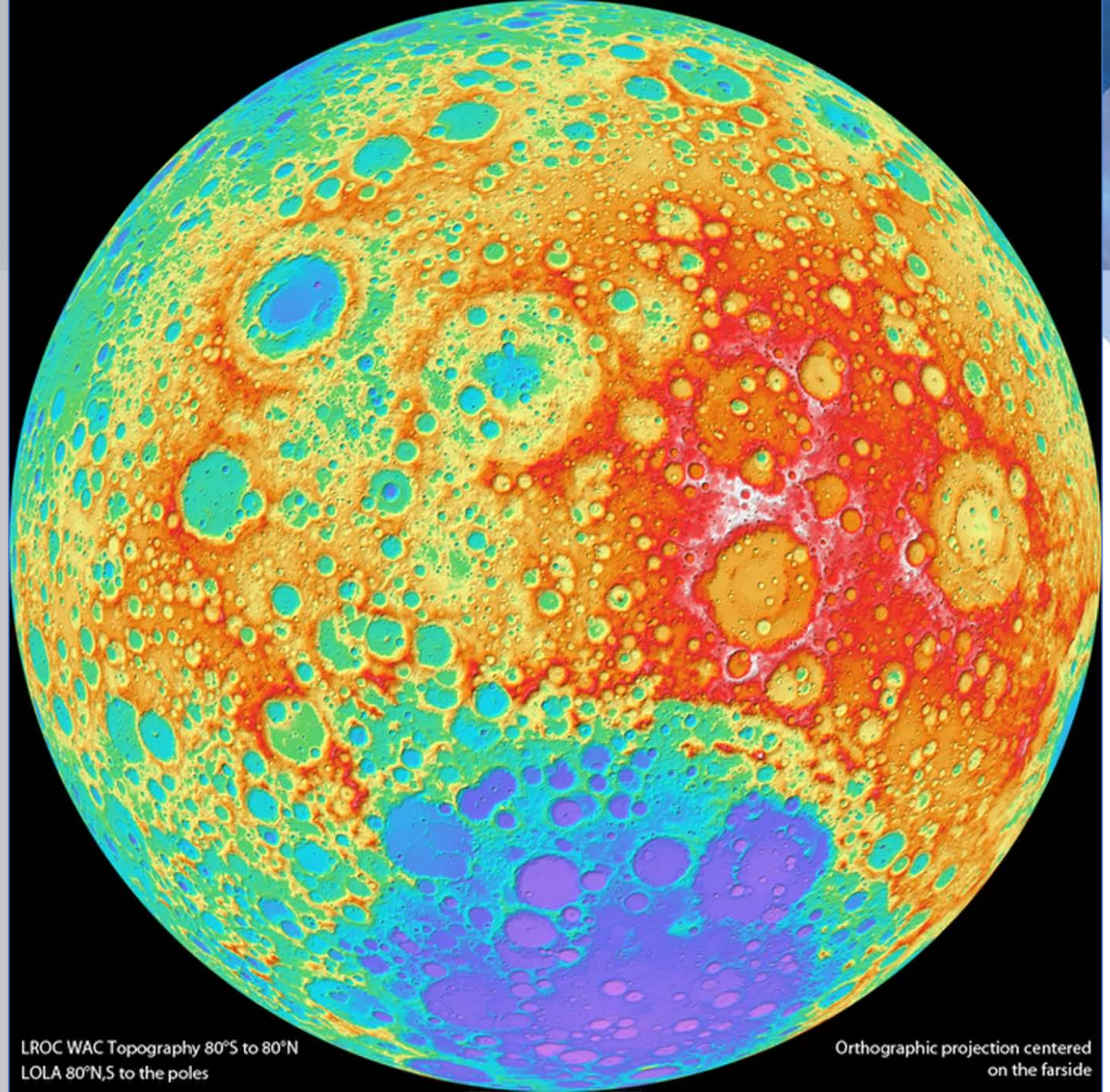
Lunar Pits

- Safe havens for astronauts?

Near Side



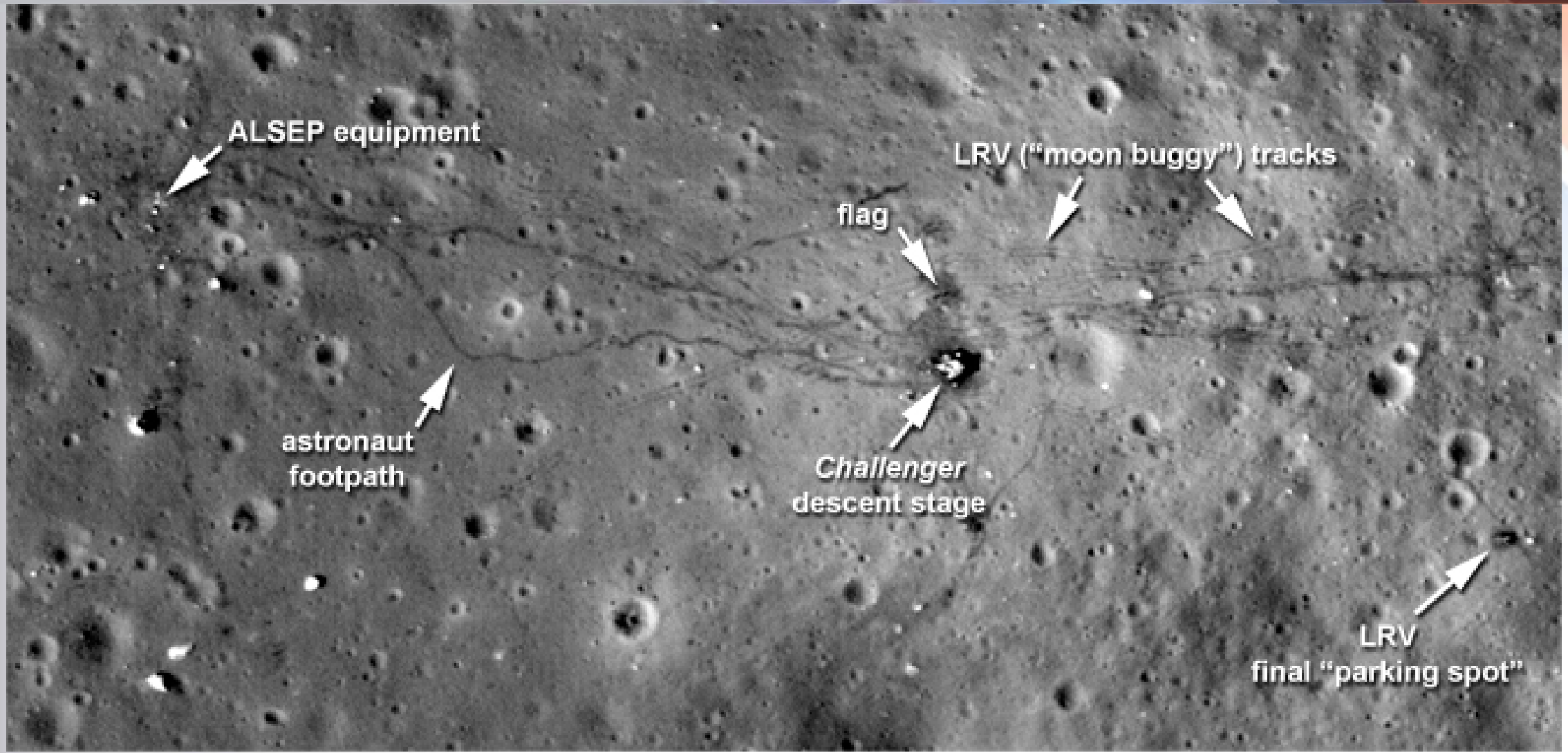
Far Side



Lunar Reconnaissance Orbiter Lunar Topographic Map

APOLLO 50 NEXT GIANT LEAP

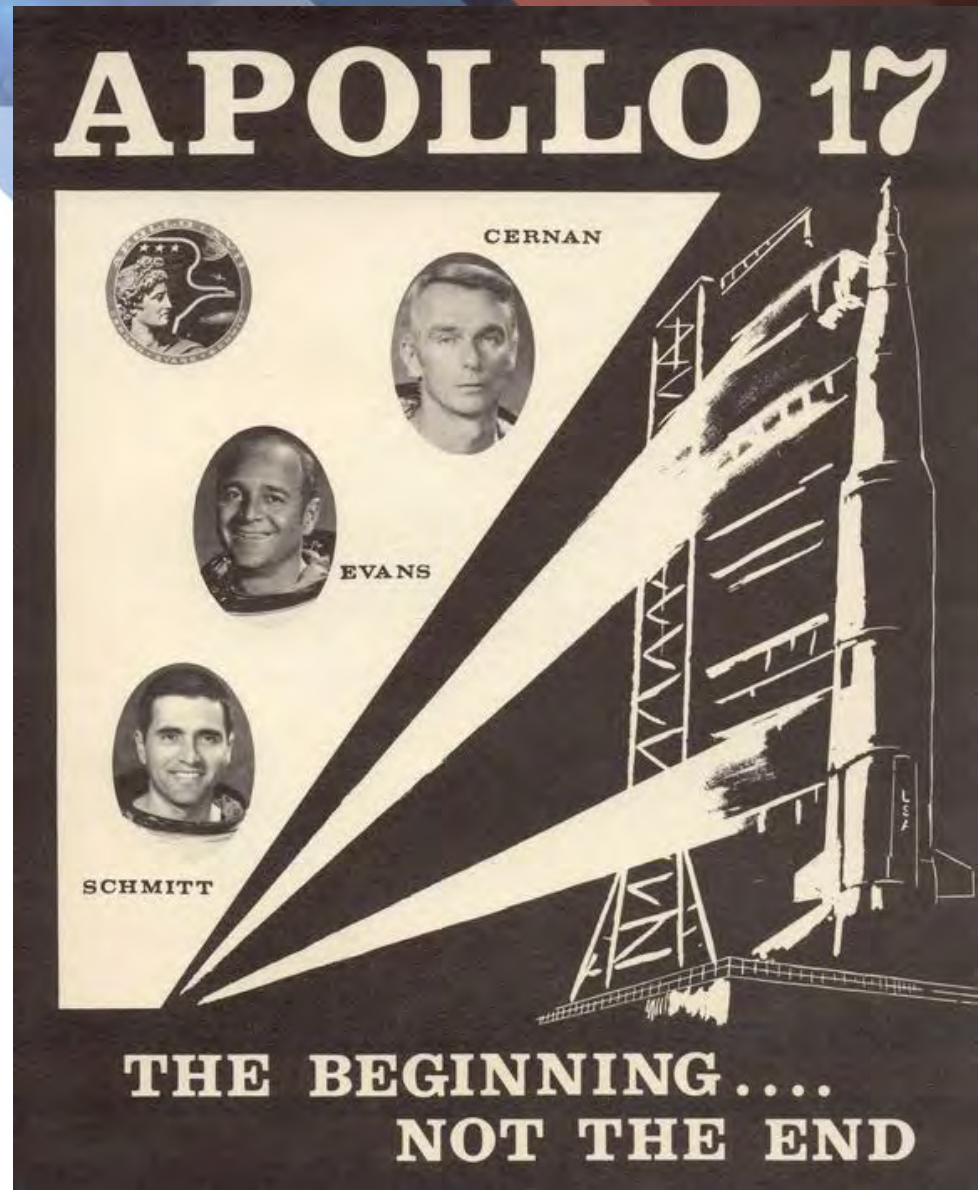
Traces from Apollo 17



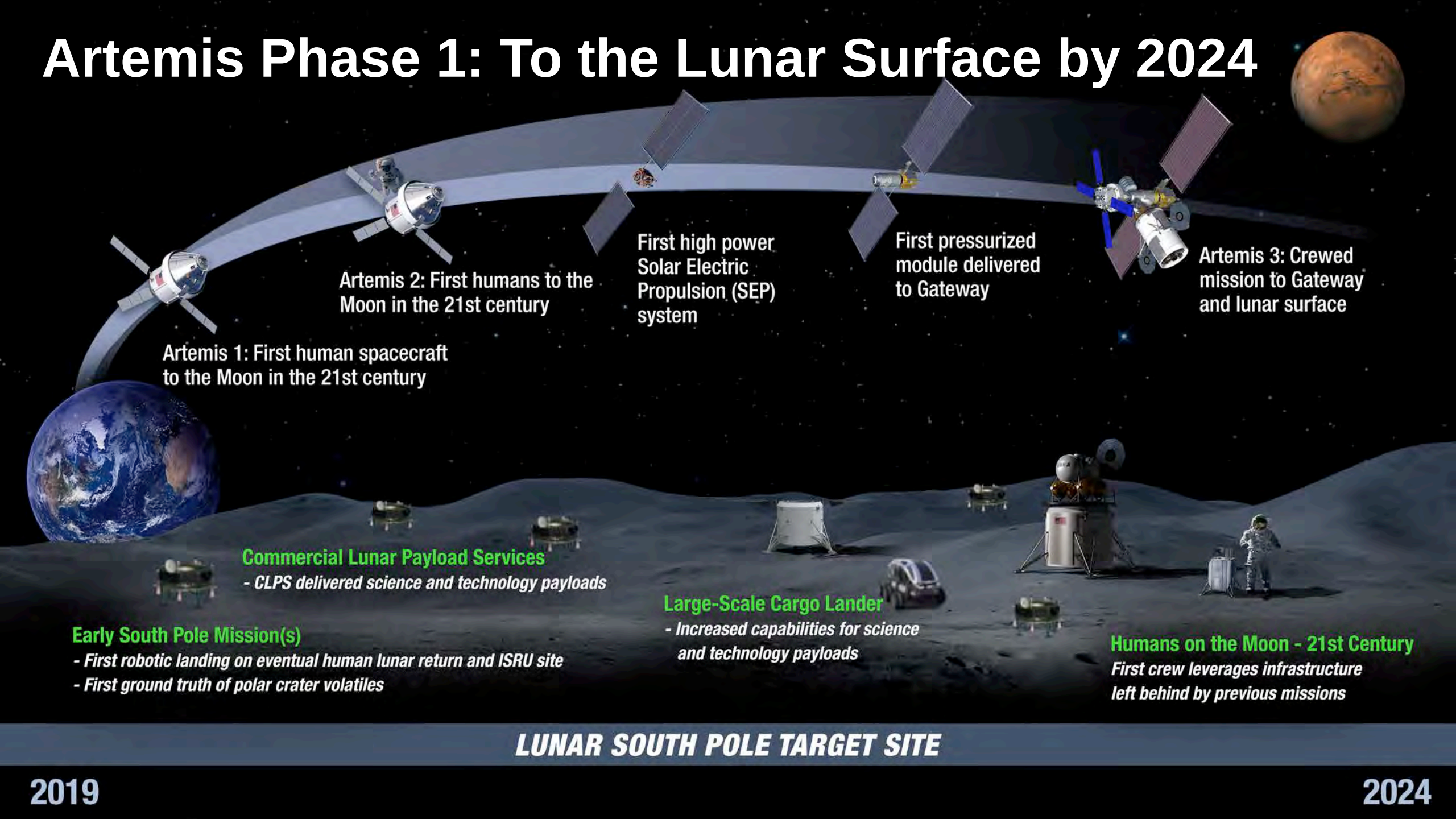
FUTURE LUNAR EXPLORATION

Future Lunar Exploration

- Apollo has left an incredible legacy that we are still learning from today
- The solar system is an amazing and diverse place
  - The Moon gives us an opportunity to understand the processes that have shaped the solid bodies within the solar system

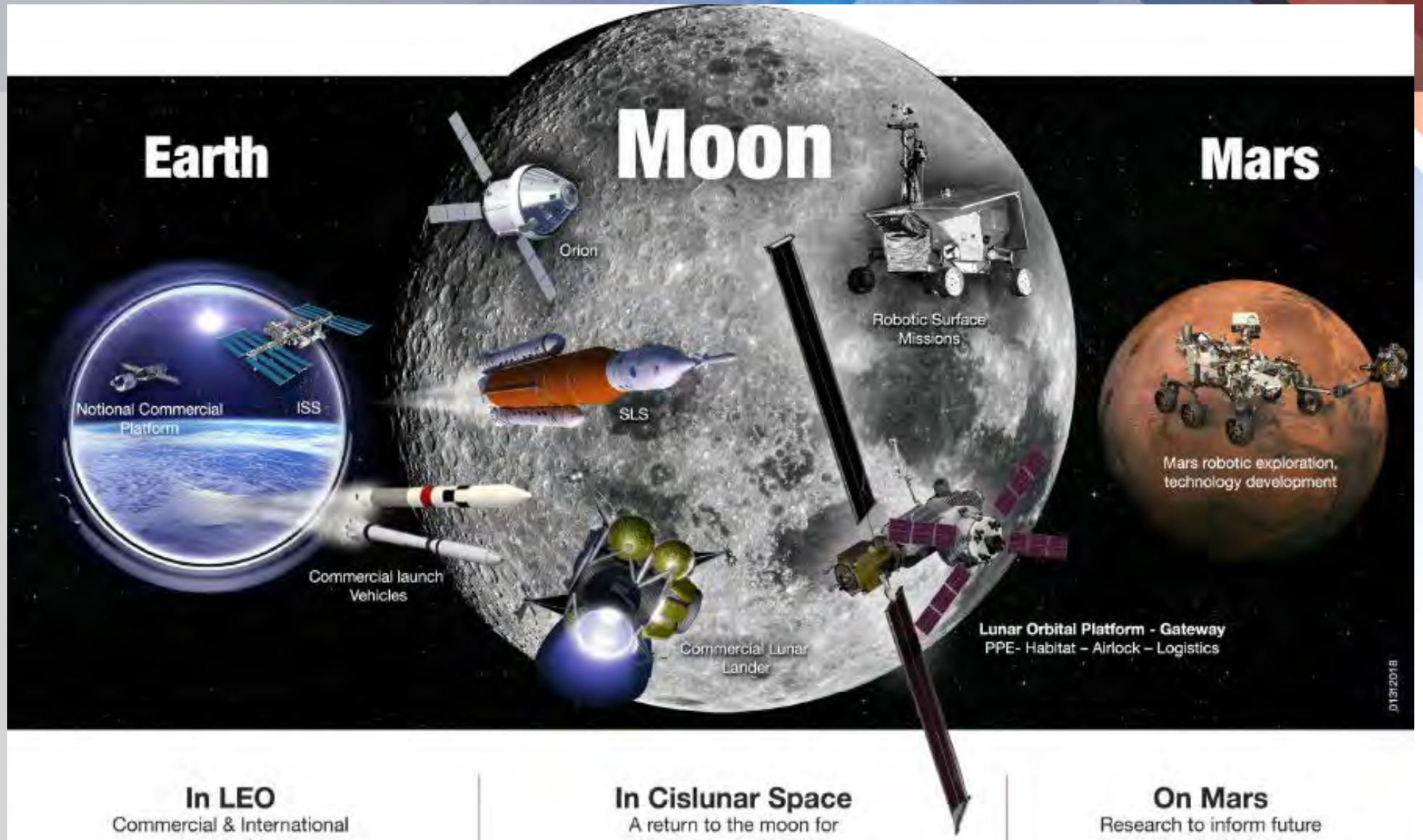


Artemis Phase 1: To the Lunar Surface by 2024



Moon to Mars

Exploration Campaign

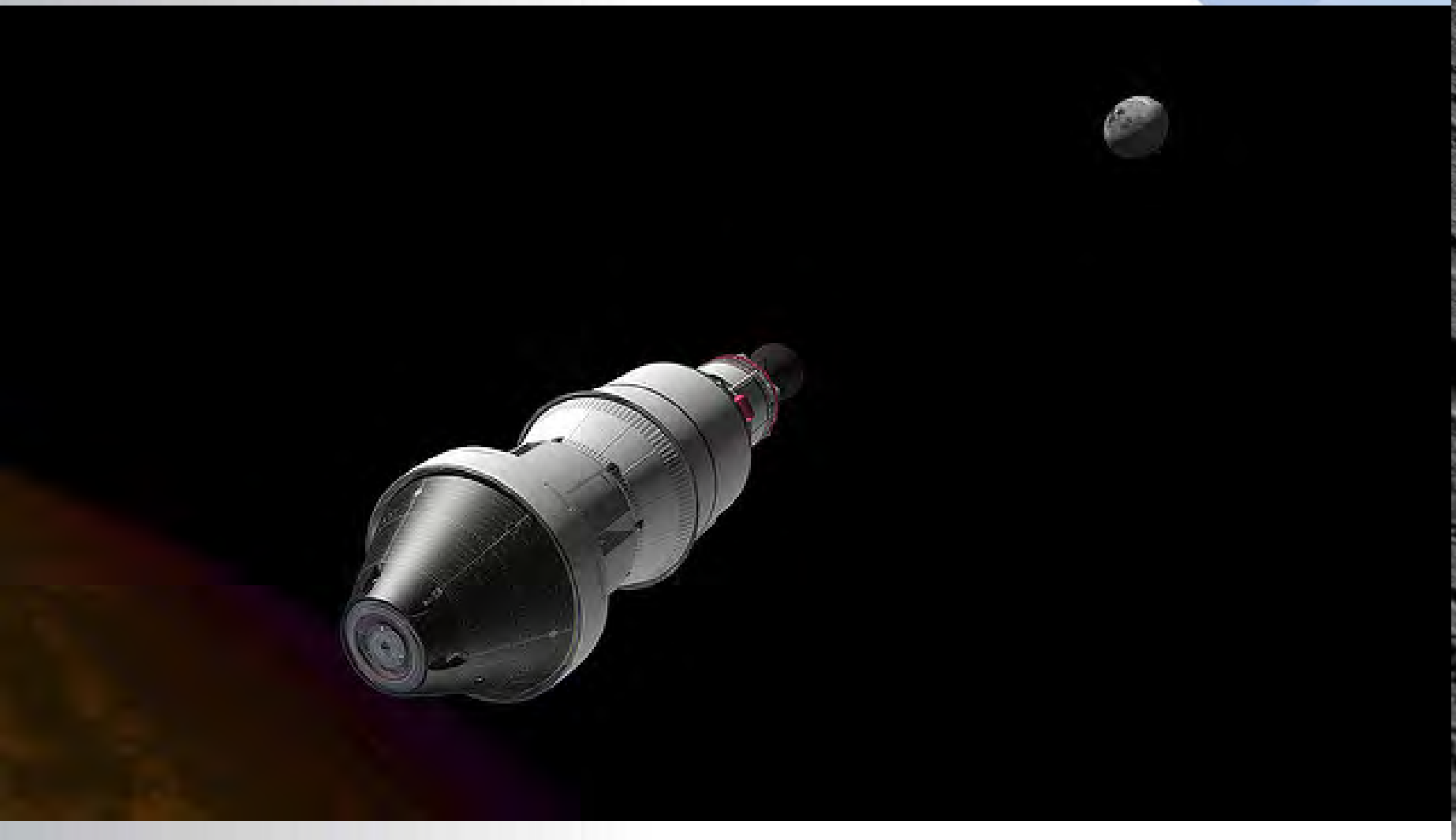


In LEO
Commercial & International partnerships

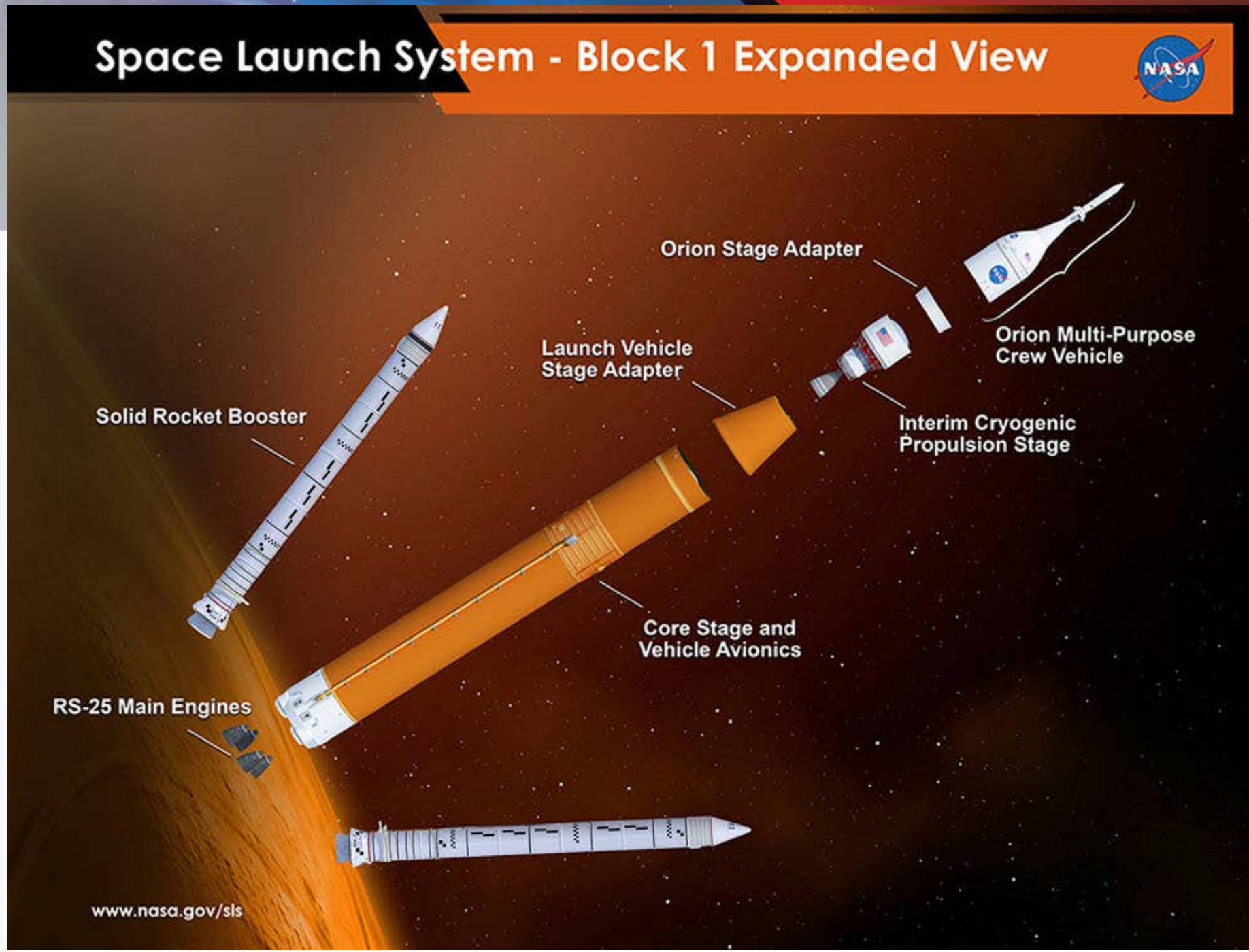
In Cislunar Space
A return to the moon for long-term exploration

On Mars
Research to inform future crewed missions

Orion Spacecraft



Space Launch System (SLS) Rocket



The Gateway

- Lunar orbiting platform to host astronauts farther from Earth than ever before

For More Information

- Apollo missions:
  - https://nssdc.gsfc.nasa.gov/planetary/lunar/apollo.html
  - https://history.nasa.gov/ap11-35ann/index.htm
  - https://history.nasa.gov/apollo.html#NASALinks
  - https://airandspace.si.edu/explore-and-learn/topics/apollo/apollo-program/landing-missions/
  - Press kits/releases: https://historydms.hq.nasa.gov/
- Current lunar exploration: https://lunar.gsfc.nasa.gov/
- Future lunar exploration: https://www.nasa.gov/specials/moon2mars/
- Moon Trek: https://trek.nasa.gov/moon/

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