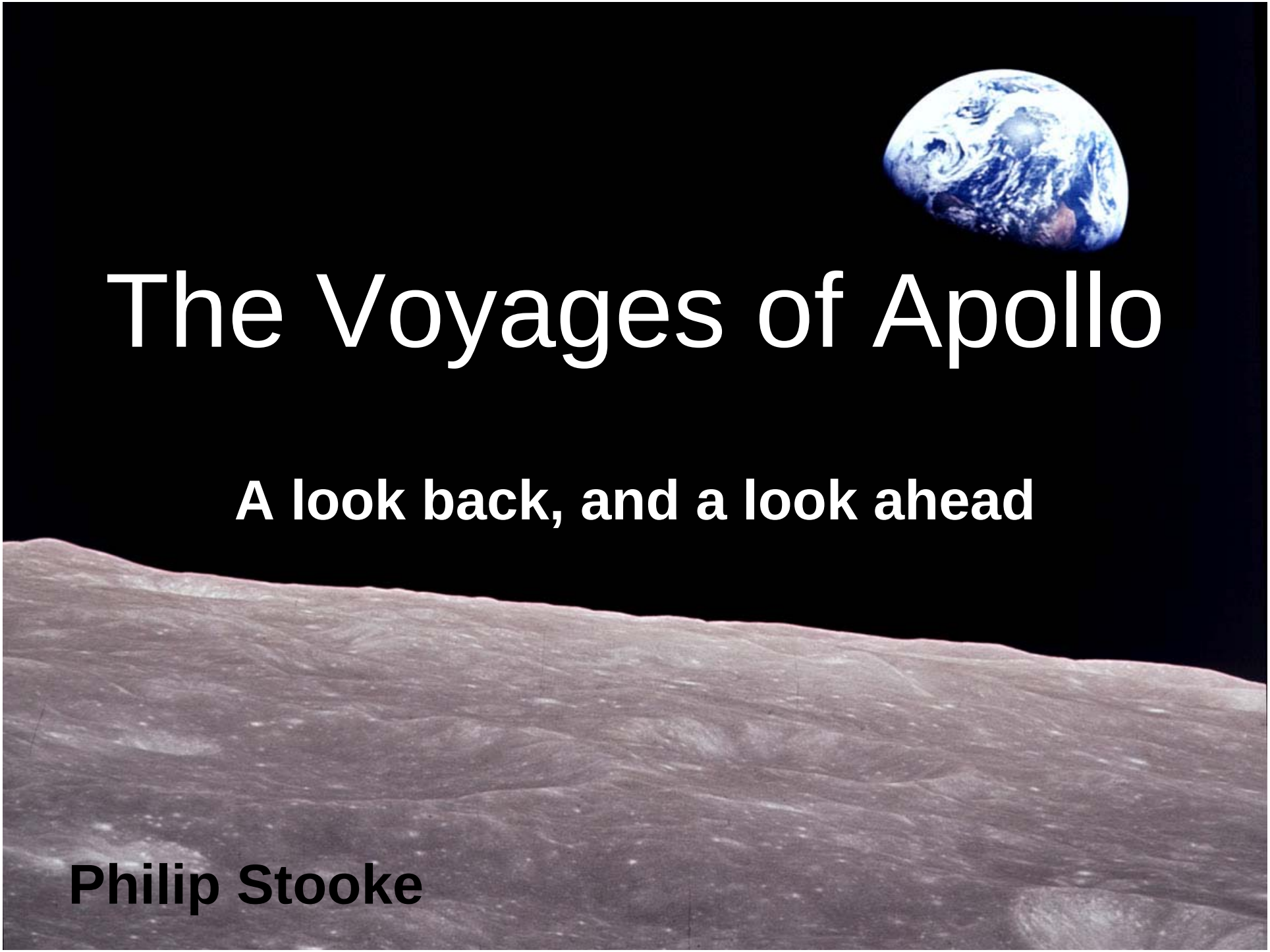


The Voyages of Apollo

A look back, and a look ahead

Philip Stooke

Kennedy's challenge

"I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to the earth.

No single space project in this period will be more impressive to mankind, or more important for the long-range exploration of space; and none will be so difficult or expensive to accomplish.

... it will not be one man going to the moon ... it will be an entire nation. For all of us must work to put him there."

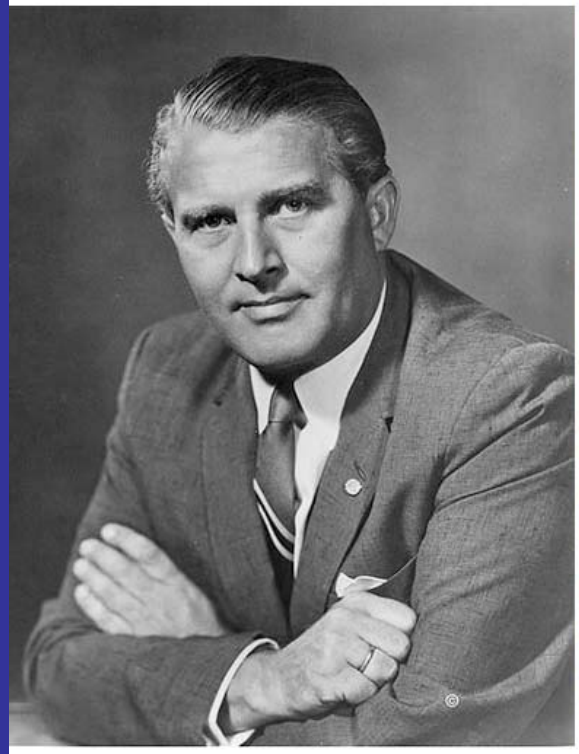
Why? - Military power of the Soviet Union, and its big lead in space

Yuri Gagarin and Sergei Korolev (lower right)

Mercury and Gemini – the first steps

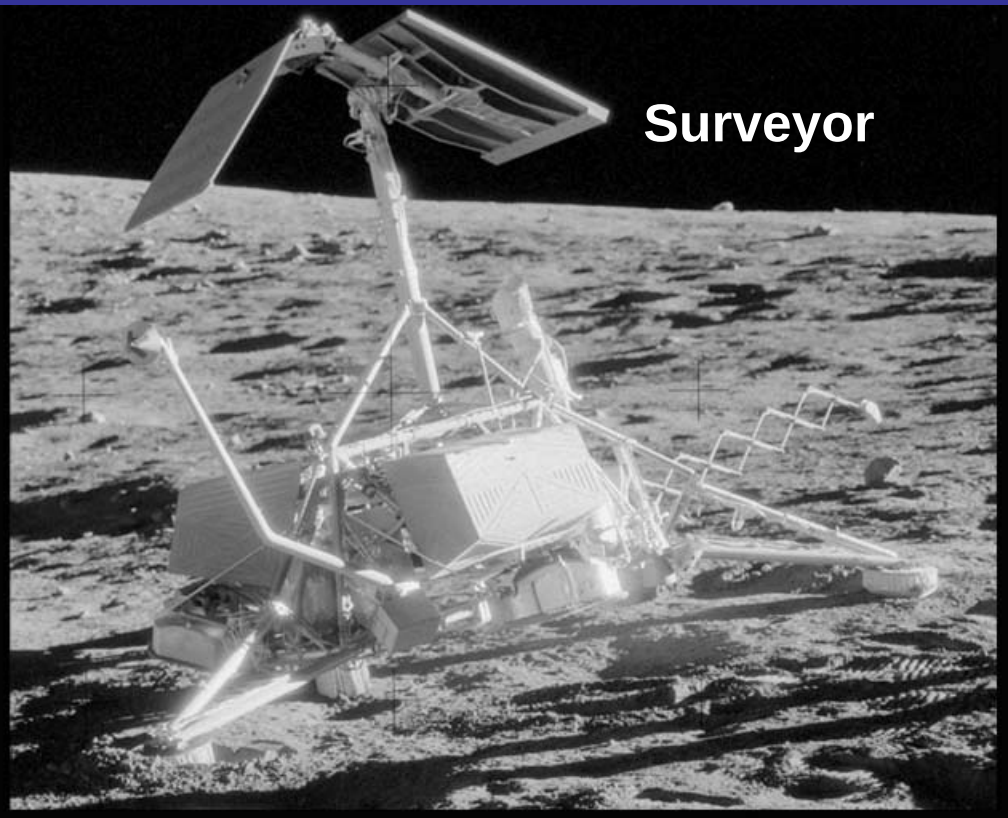
Saturn – the greatest rocket of all

Wernher von Braun

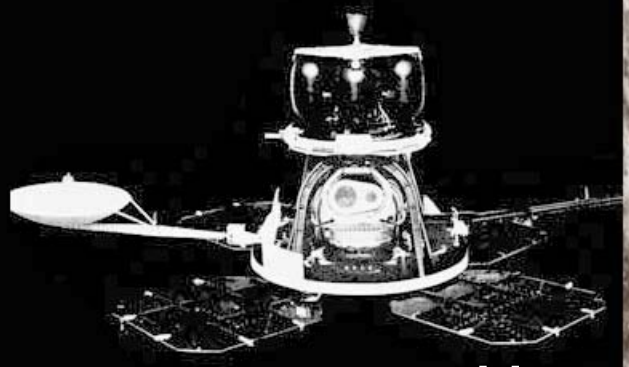


Robotic precursors

Ranger



Surveyor



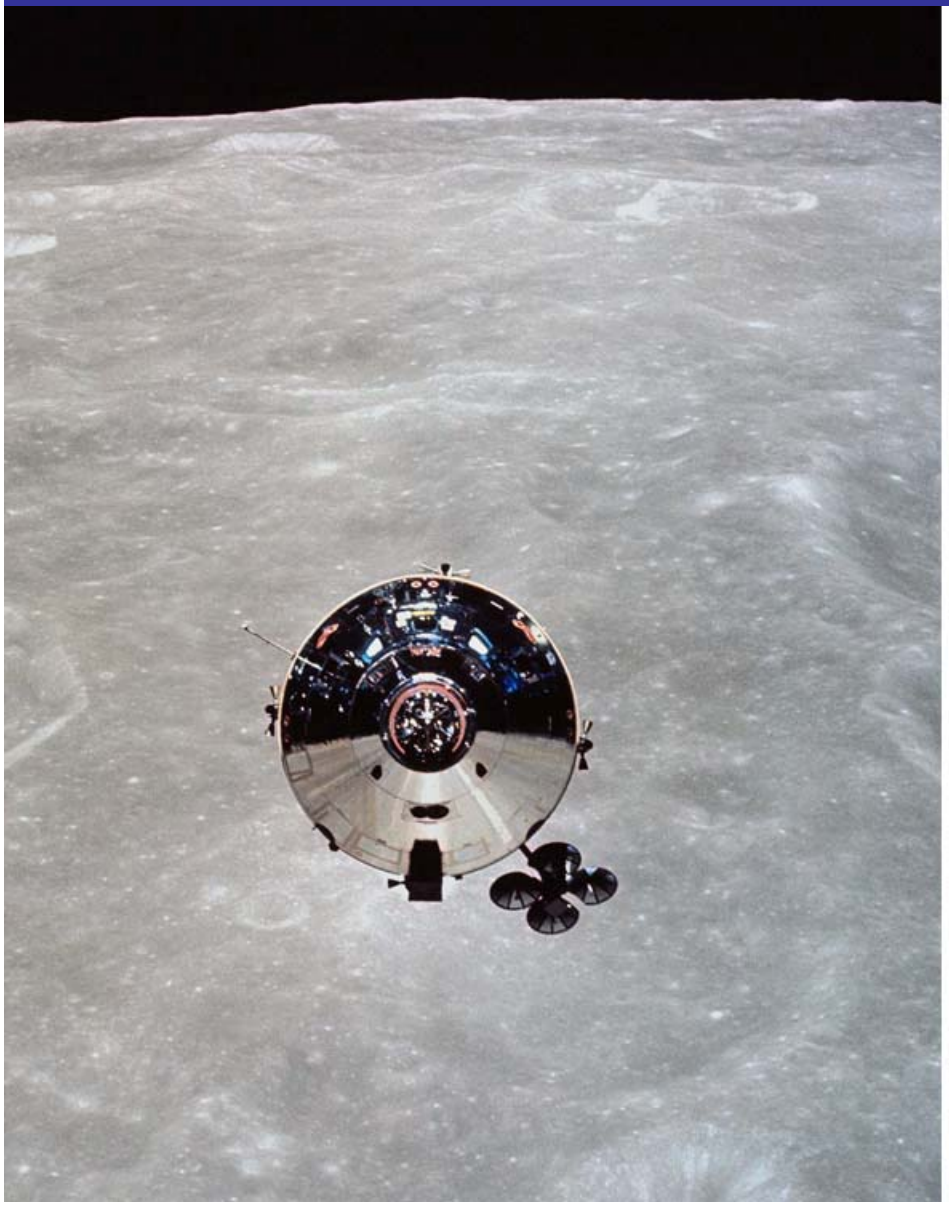
Lunar Orbiter

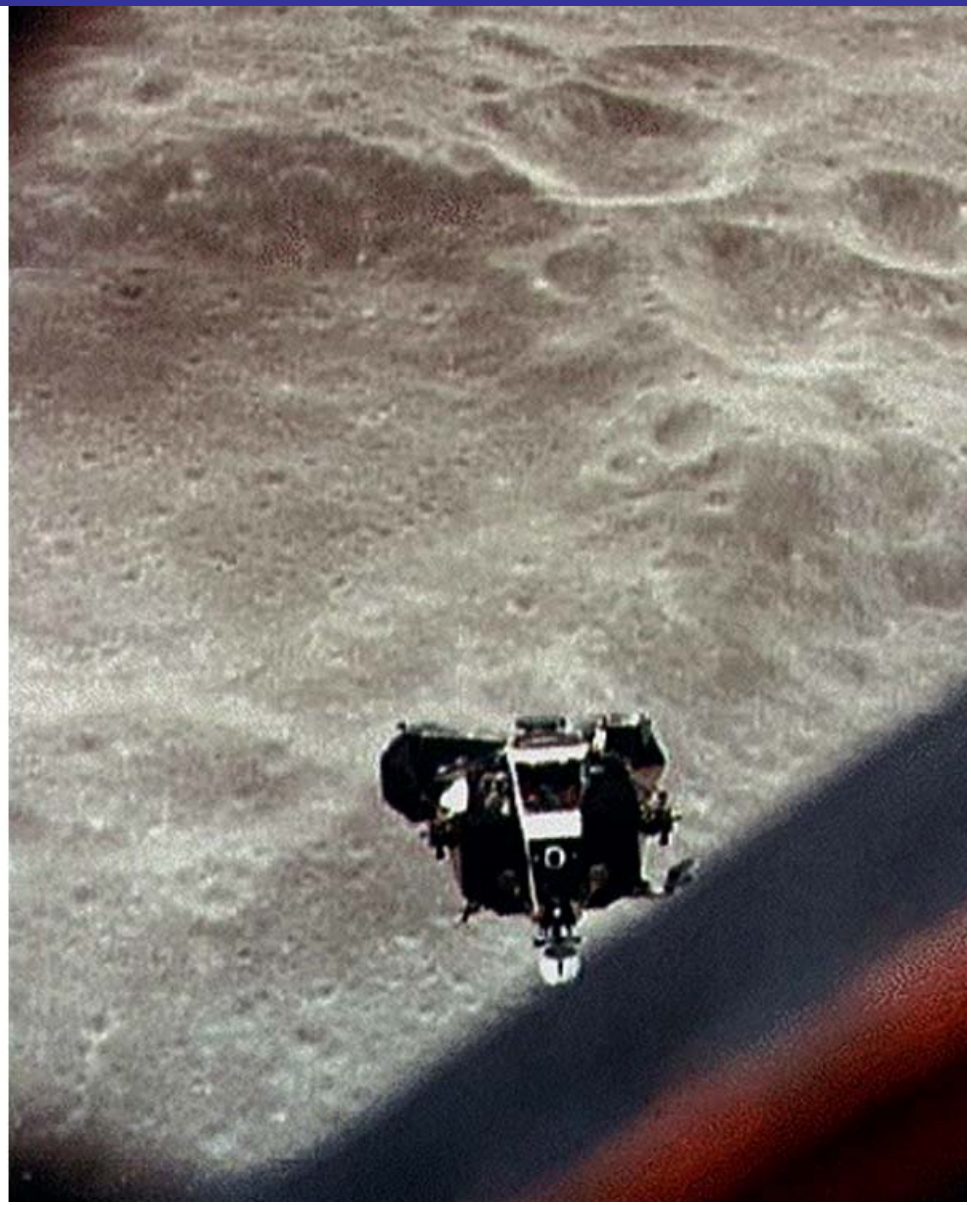
First to the Moon - Apollo 8 earthrise

Test navigation and communications - December 1968

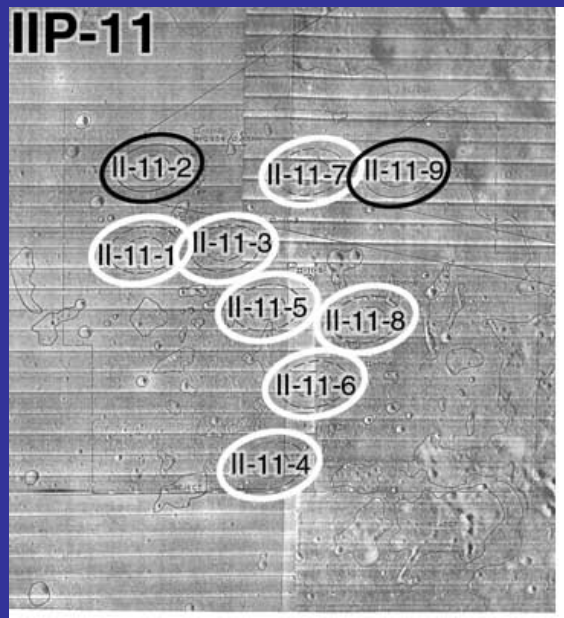
Apollo 10 – full dress rehearsal

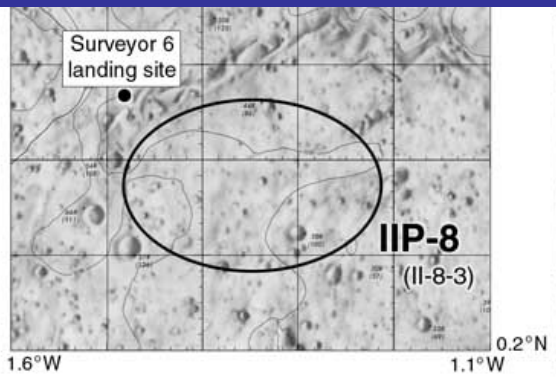
Fly the Lunar Module down to 50,000 feet

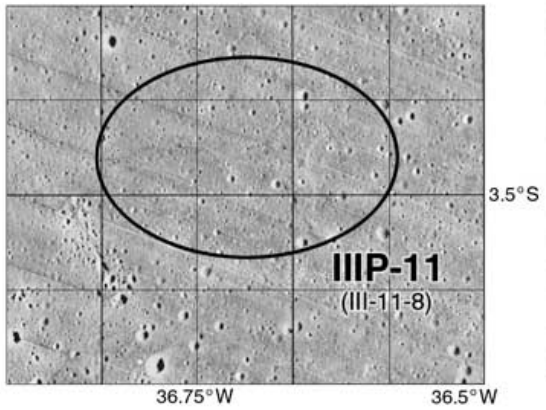


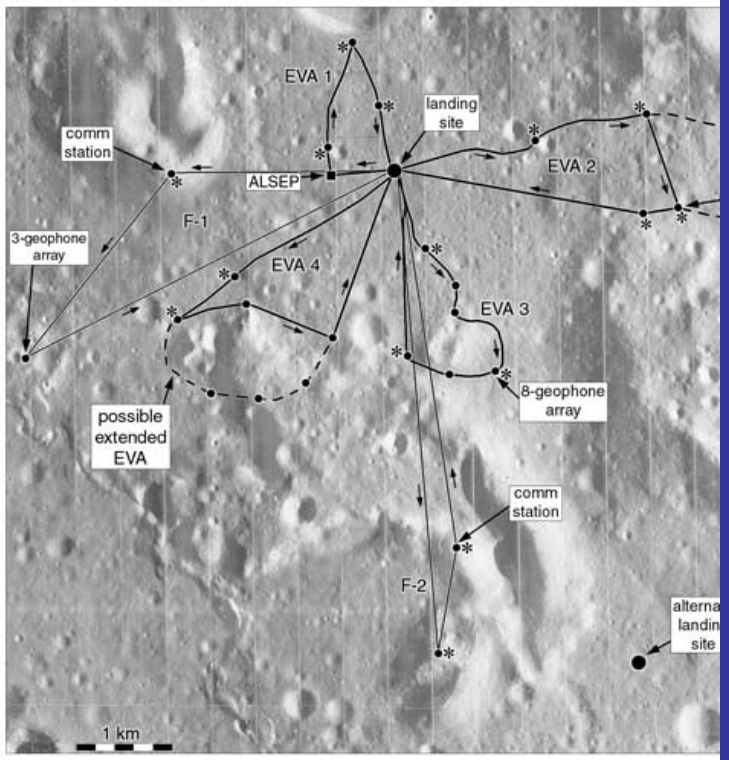


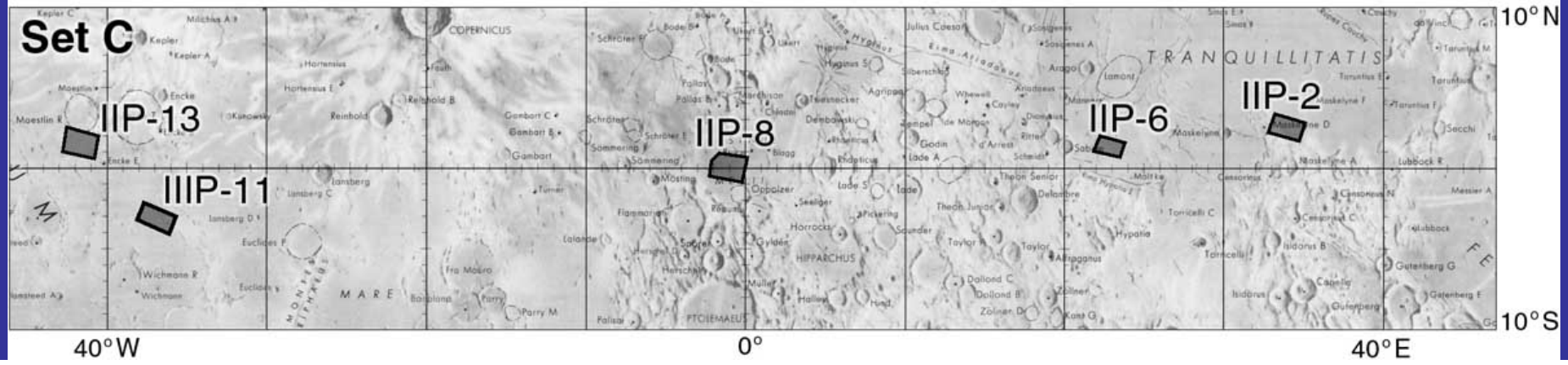
Landing site selection – safety first, then science







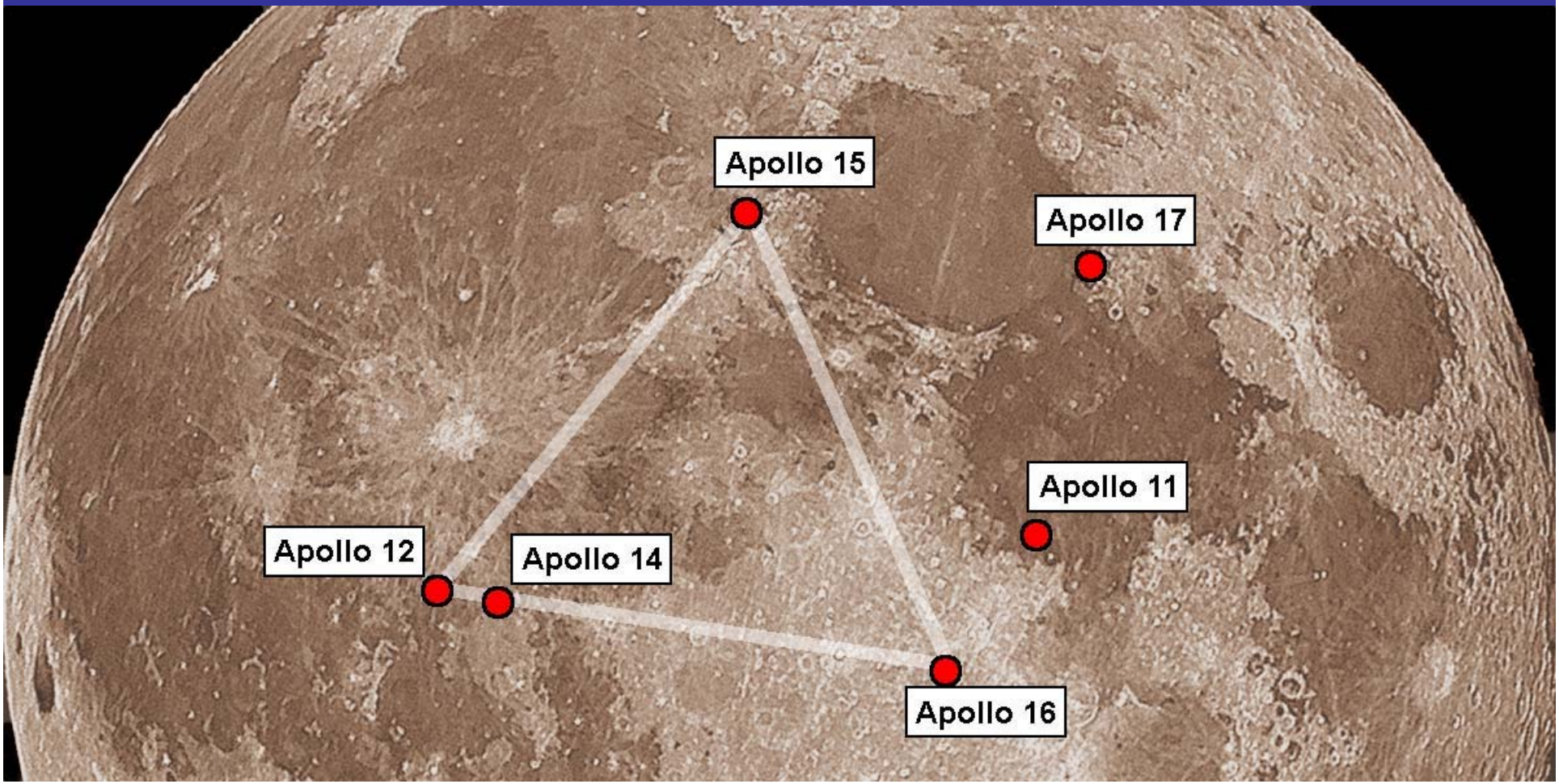




Landing site strategy:

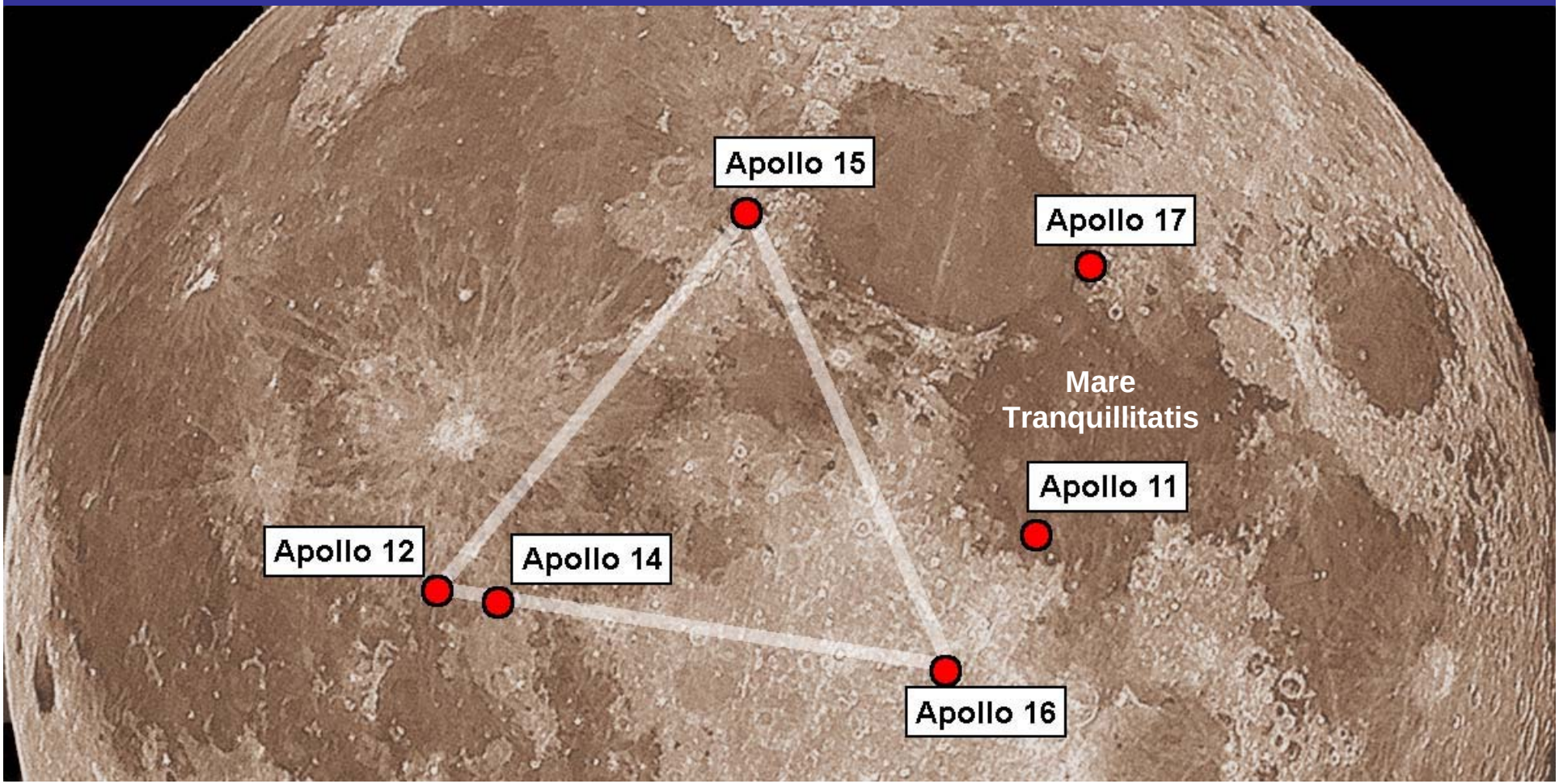
- Sample many different kinds of rock

- Set up a network of geophysical instruments

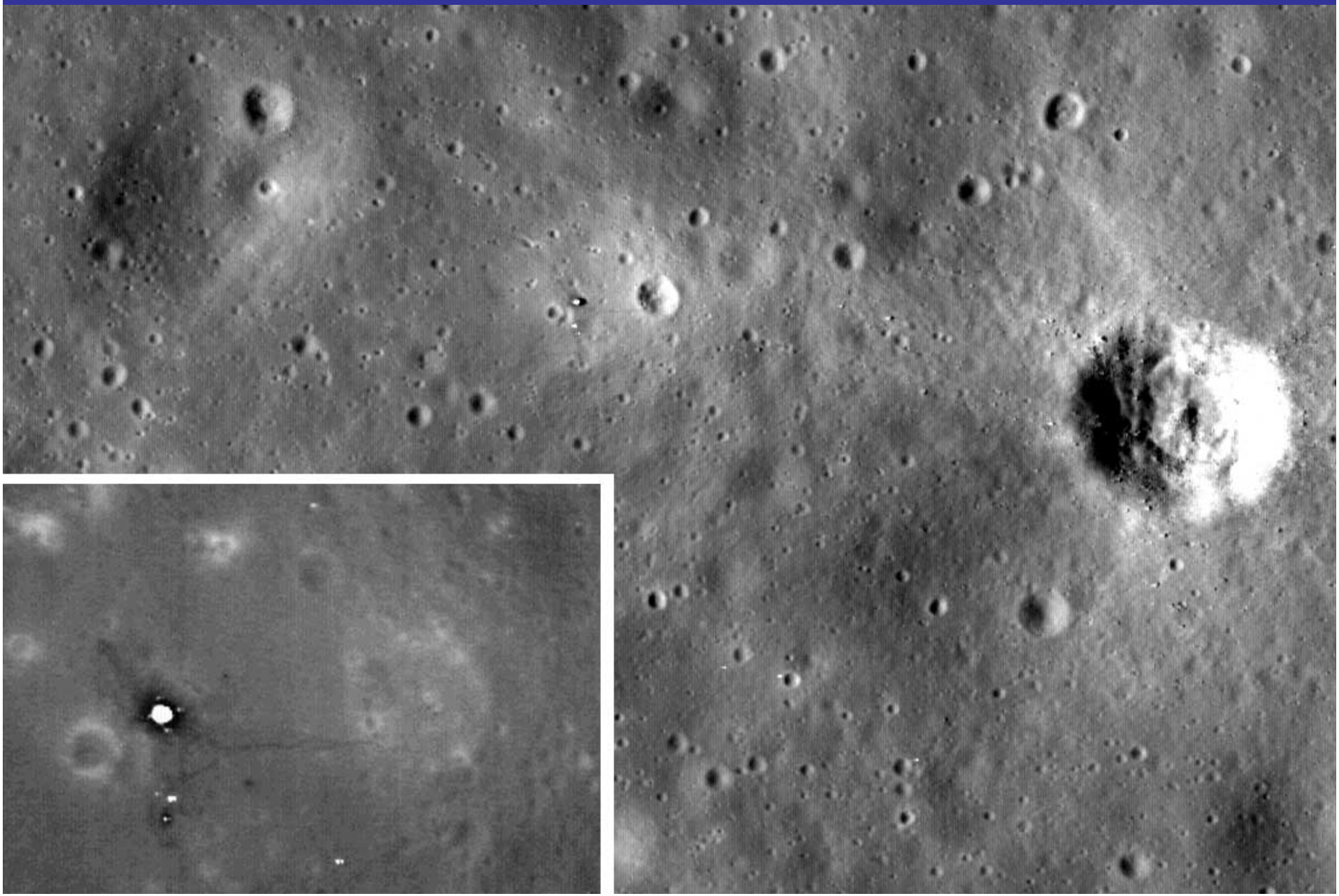


Apollo 11

- Land and get back safely
- Sample dark lava flows in the Sea of Tranquility



Apollo 11 landing site - safety above all, a very smooth plain

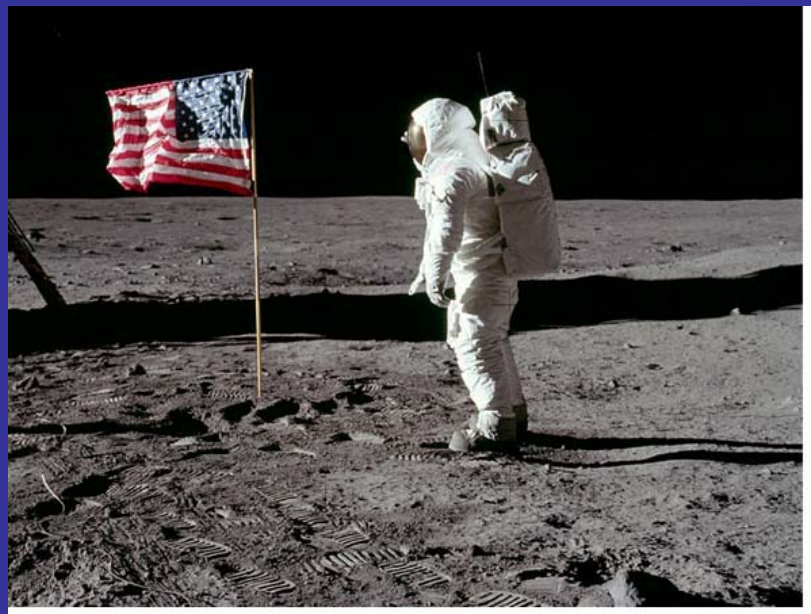


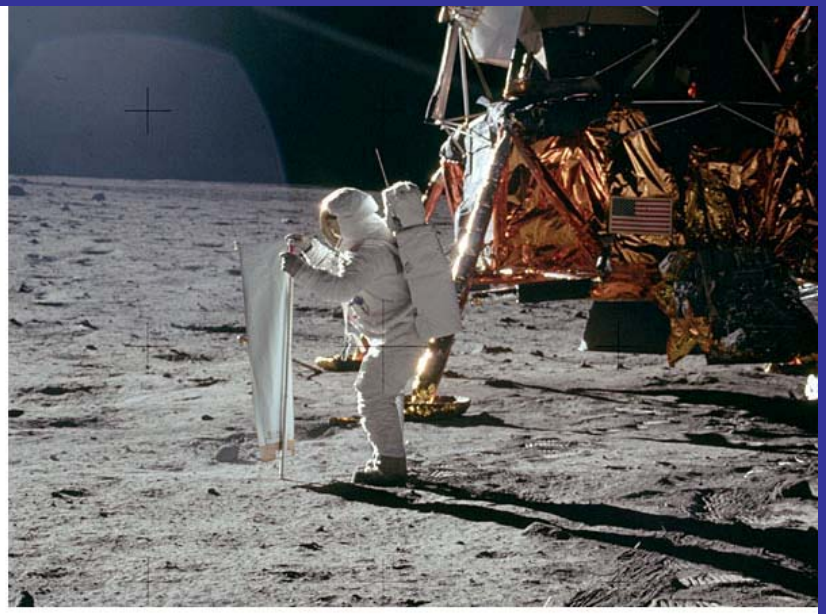
Apollo 11 - view from the LM window

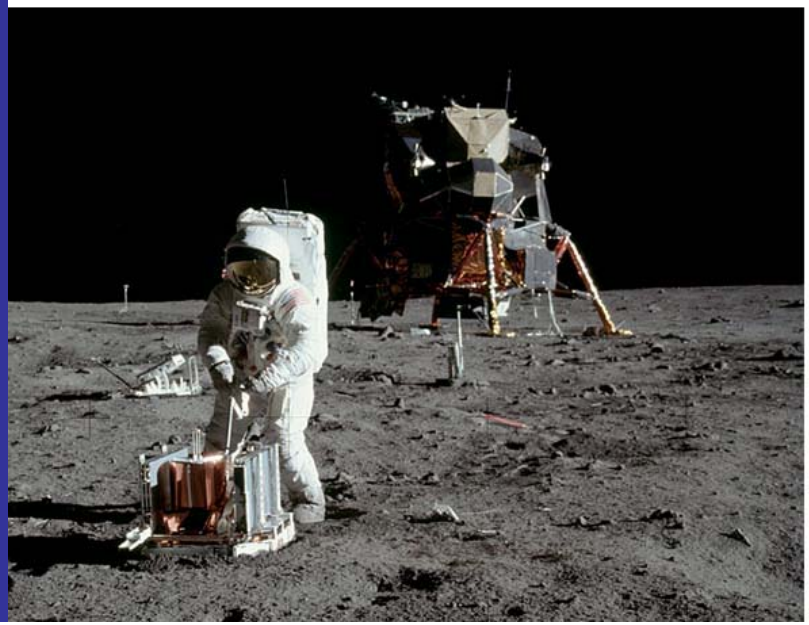
This site is one of the dark lava flow plains called ‘maria’ (seas), smooth and safe to land on, but Apollo would visit more dramatic areas later

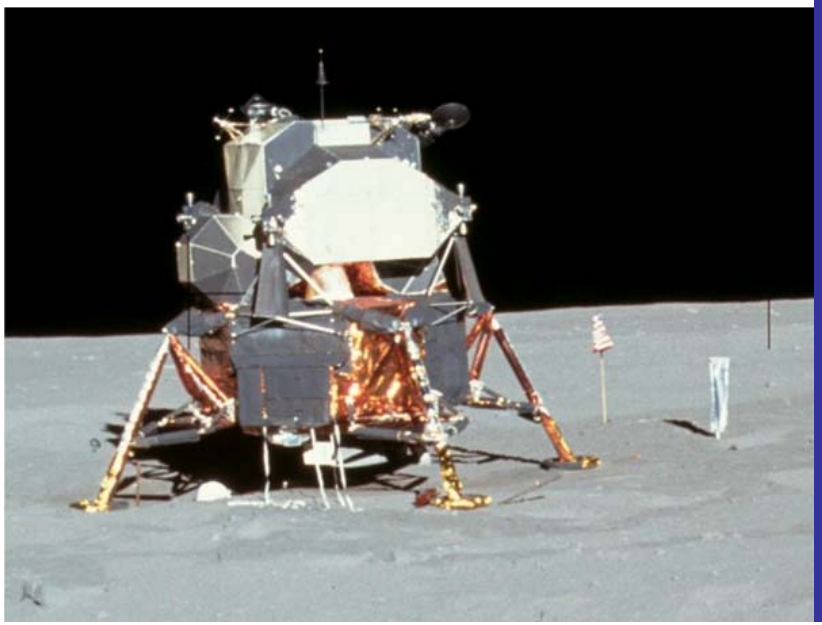
Apollo 11 - a short visit, but it fulfills Kennedy's challenge

Astronauts collect rocks, set up a seismometer and a laser reflector



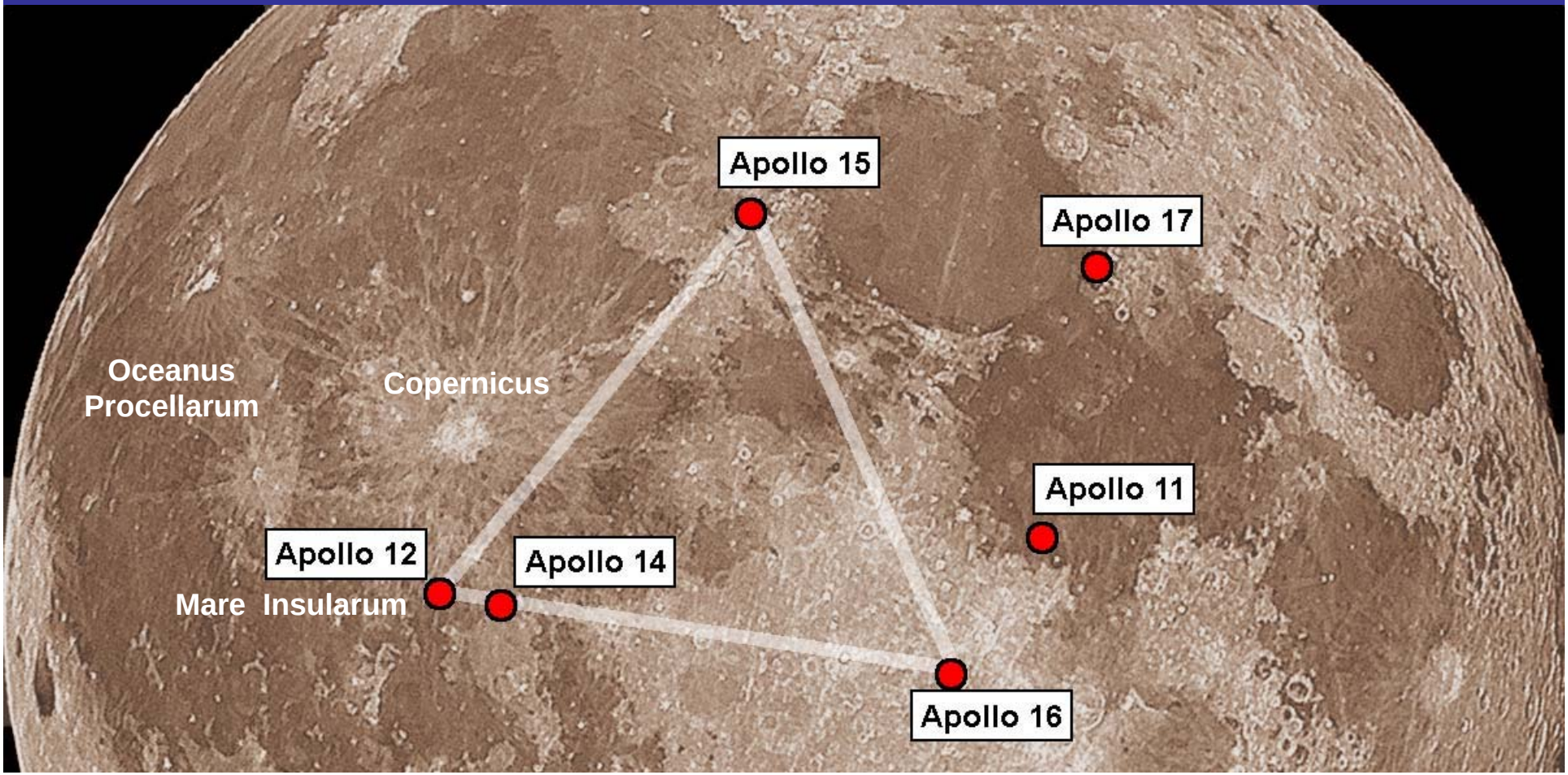




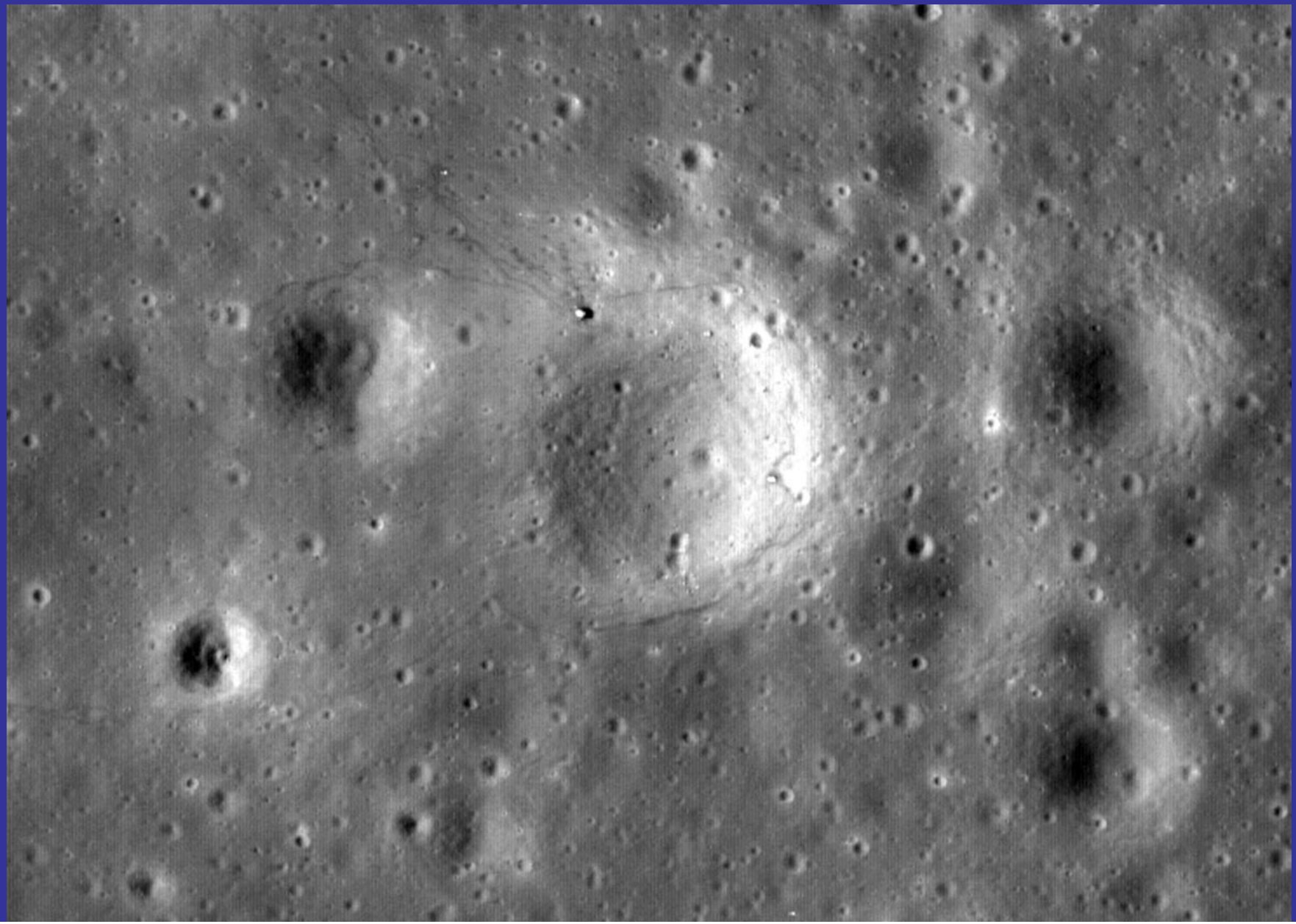


Apollo 12

- Make a pinpoint landing, return pieces of Surveyor 3
- Sample different lava flows in the Sea of Islands
- Collect fragments thrown out of Copernicus crater



Apollo 12 landing site - another lava plain, but half a billion years younger – and a pinpoint landing beside a Surveyor



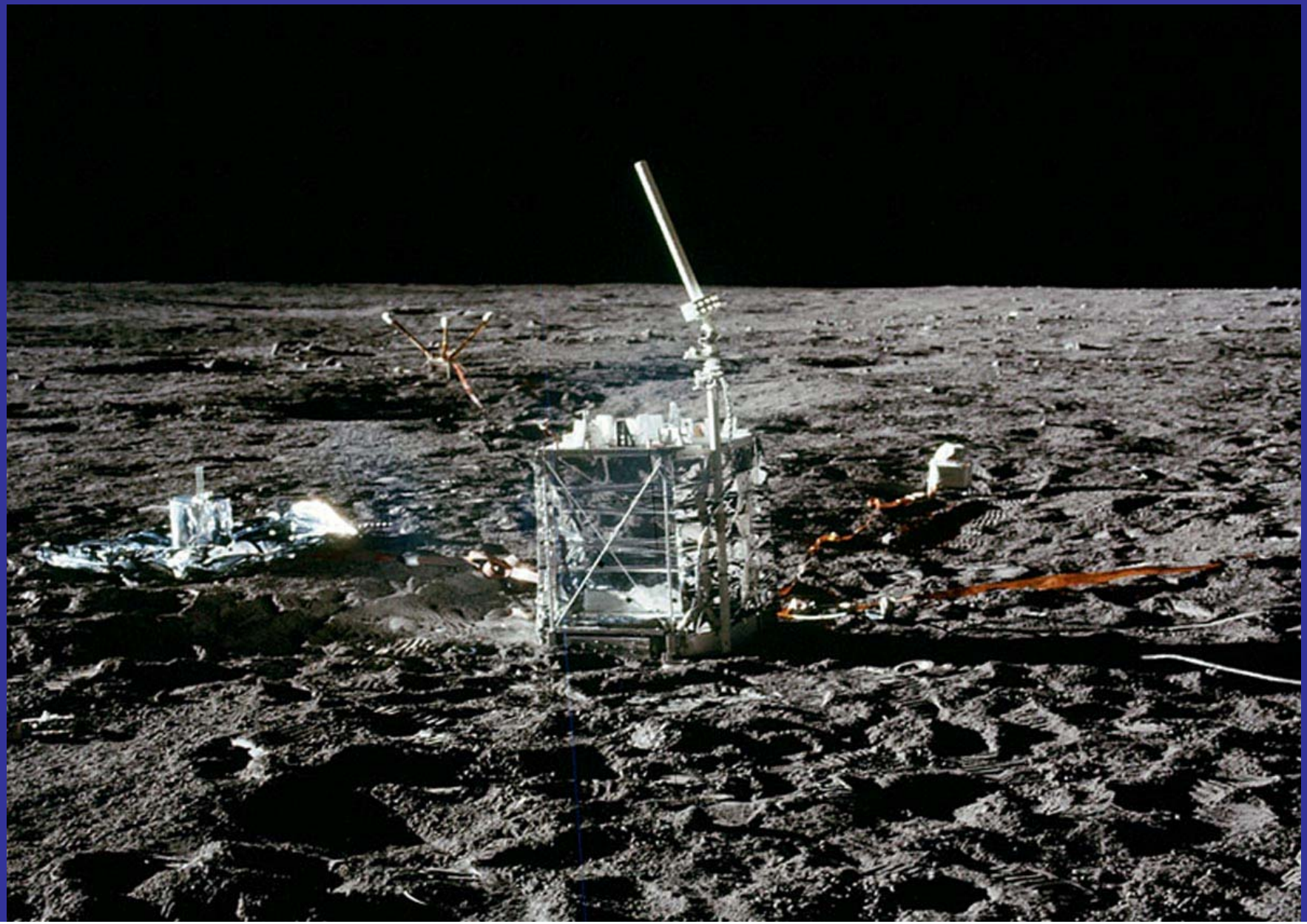
Apollo 12 - a longer stay:

two days, two excursions, more samples, more experiments

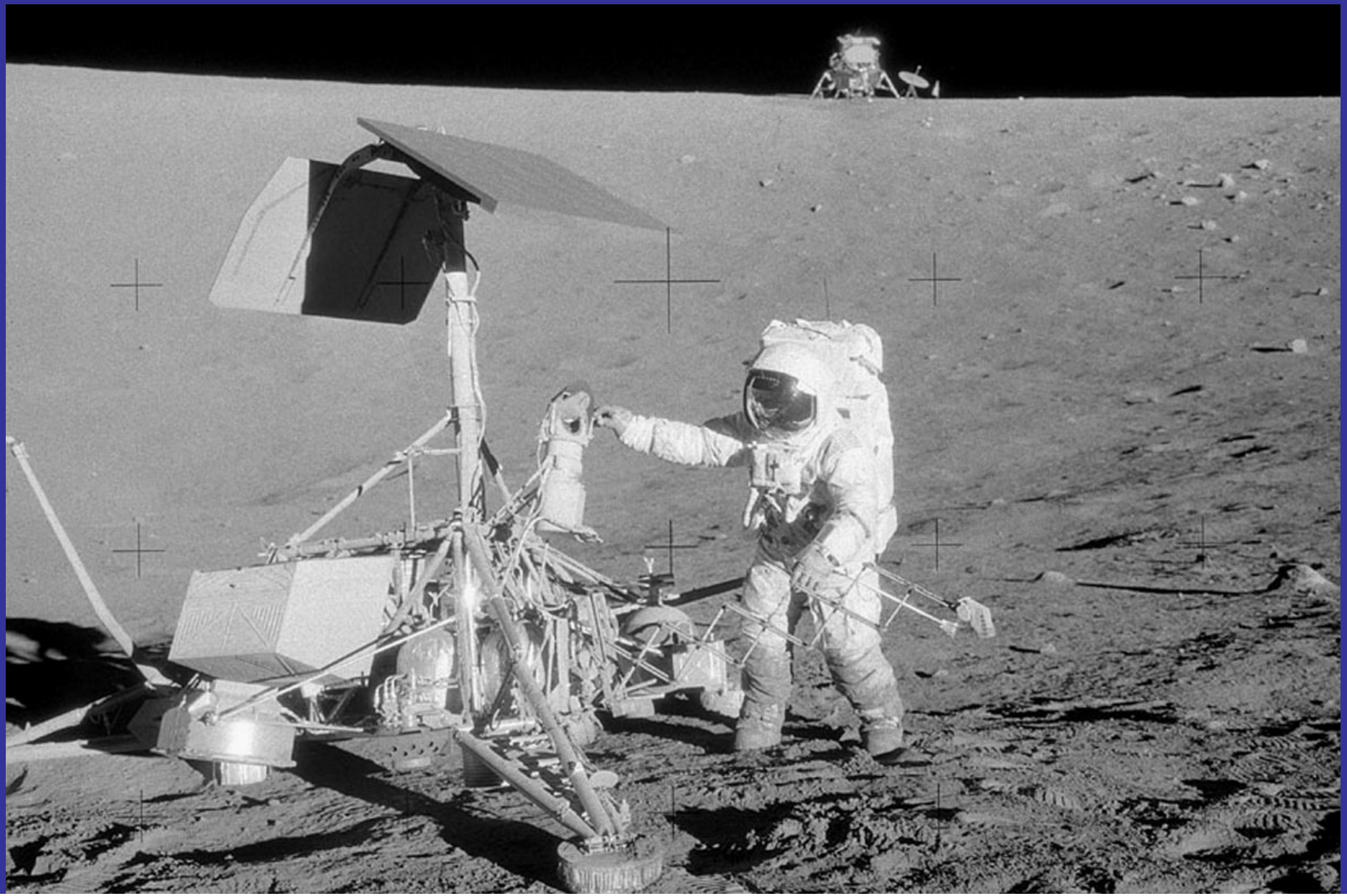
Apollo 12 – carrying the scientific instruments out from the LM

ALSEP - Apollo Lunar Surface Experiment Package

Apollo 12 – the experiments measured gas, dust, magnetic fields and moonquakes - and kept on working until 1977



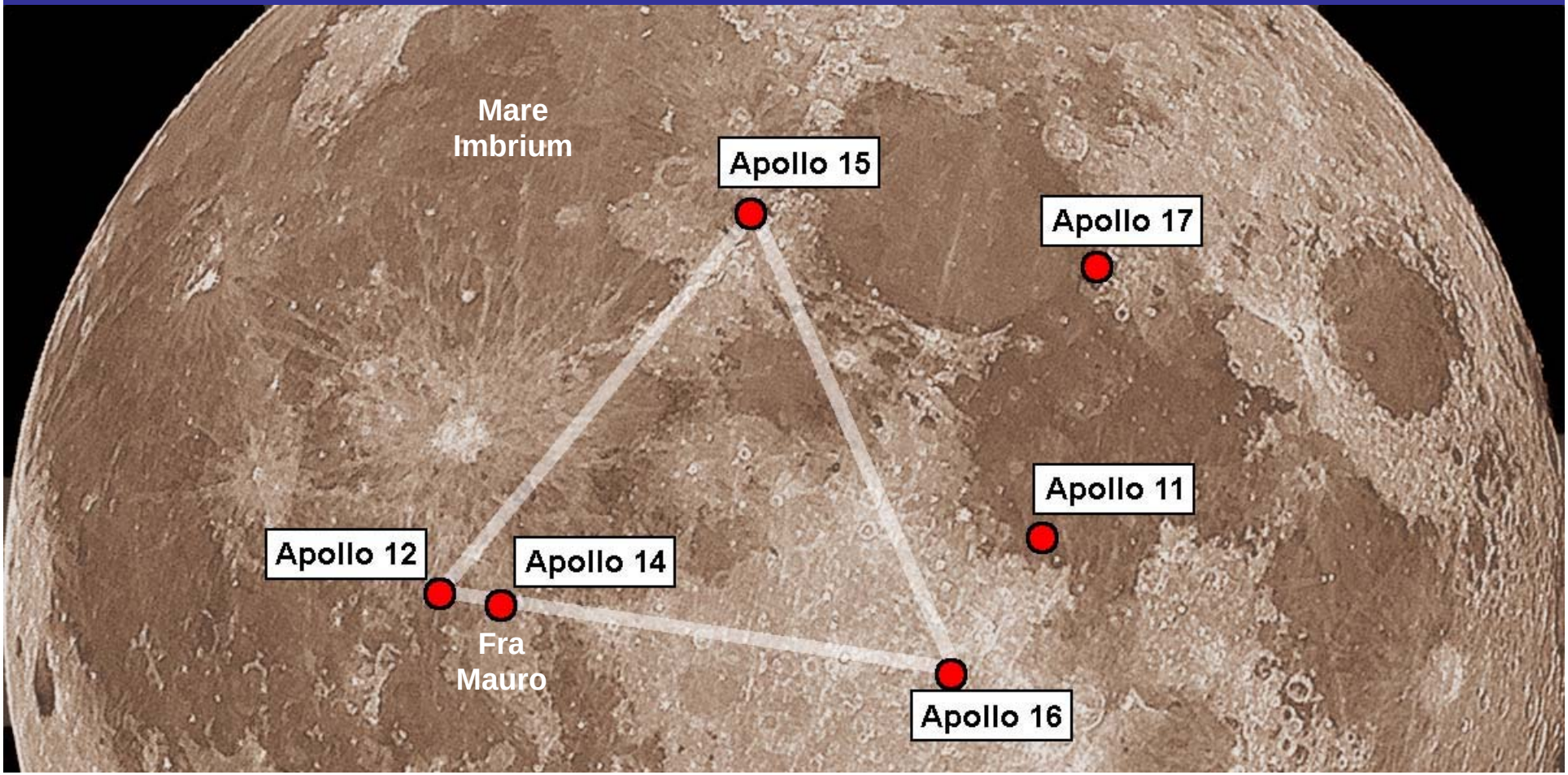
Apollo 12 – parts removed from Surveyor 3 to see how they withstood the lunar environment for three years – now in the NASM



Apollo 13

- Land in a rough hilly area - Fra Mauro

- Sample ejecta thrown out of the Imbrium Basin before the lava flows formed

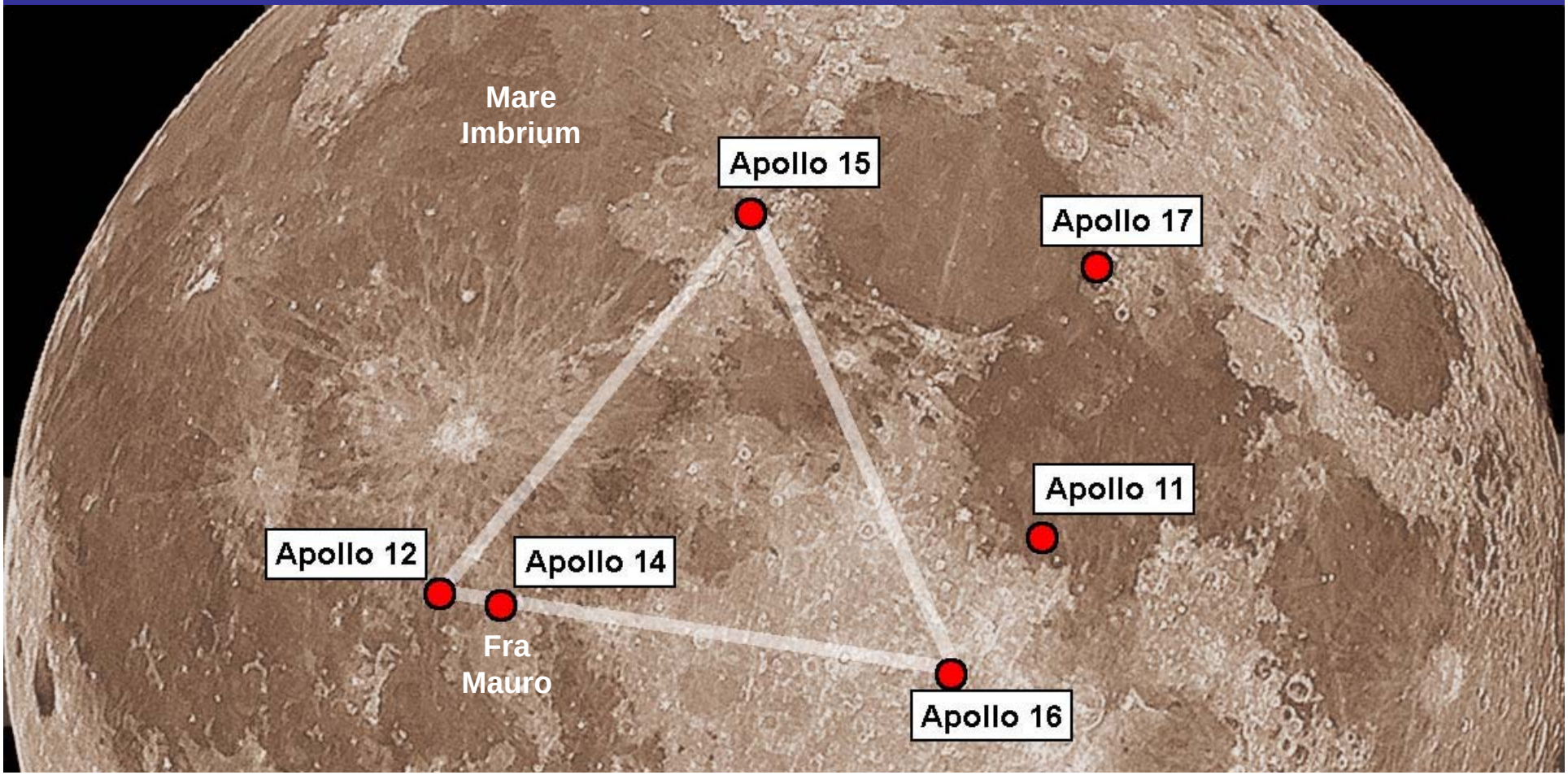


Apollo 13 accident – an explosion on the way to the Moon prevents a landing, but the crew return safely (now a major motion picture)

Apollo 14

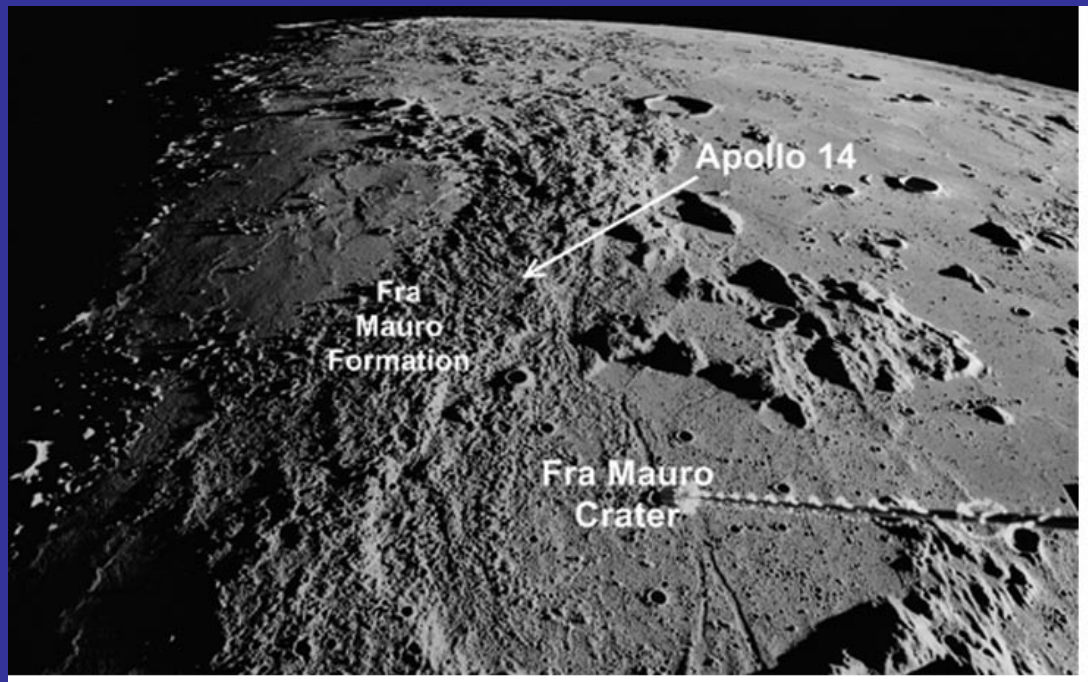
- Land in a rough hilly area - Fra Mauro

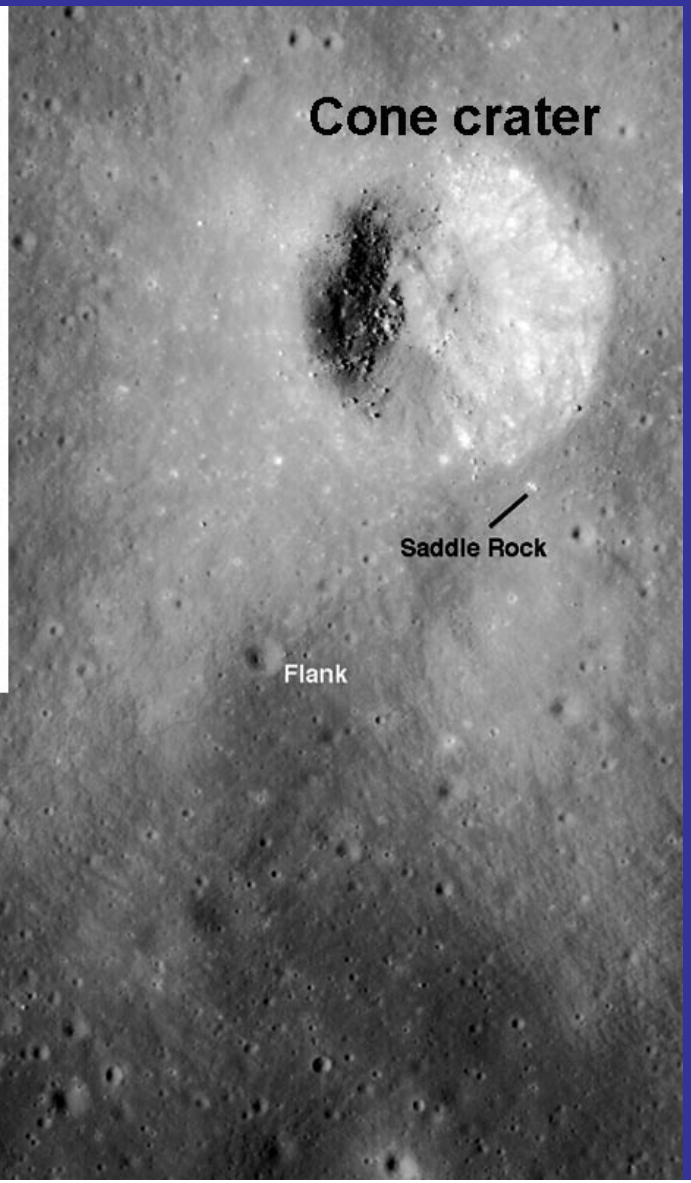
- Sample ejecta thrown out of the Imbrium Basin before the lava flows formed

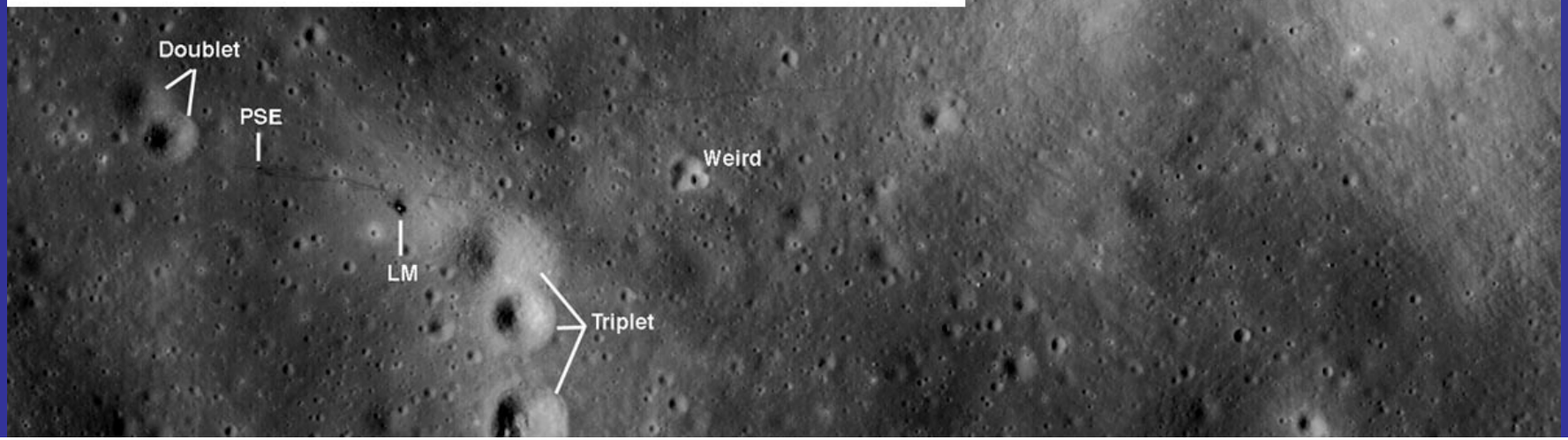


Apollo 14 landing site – rough hill country.

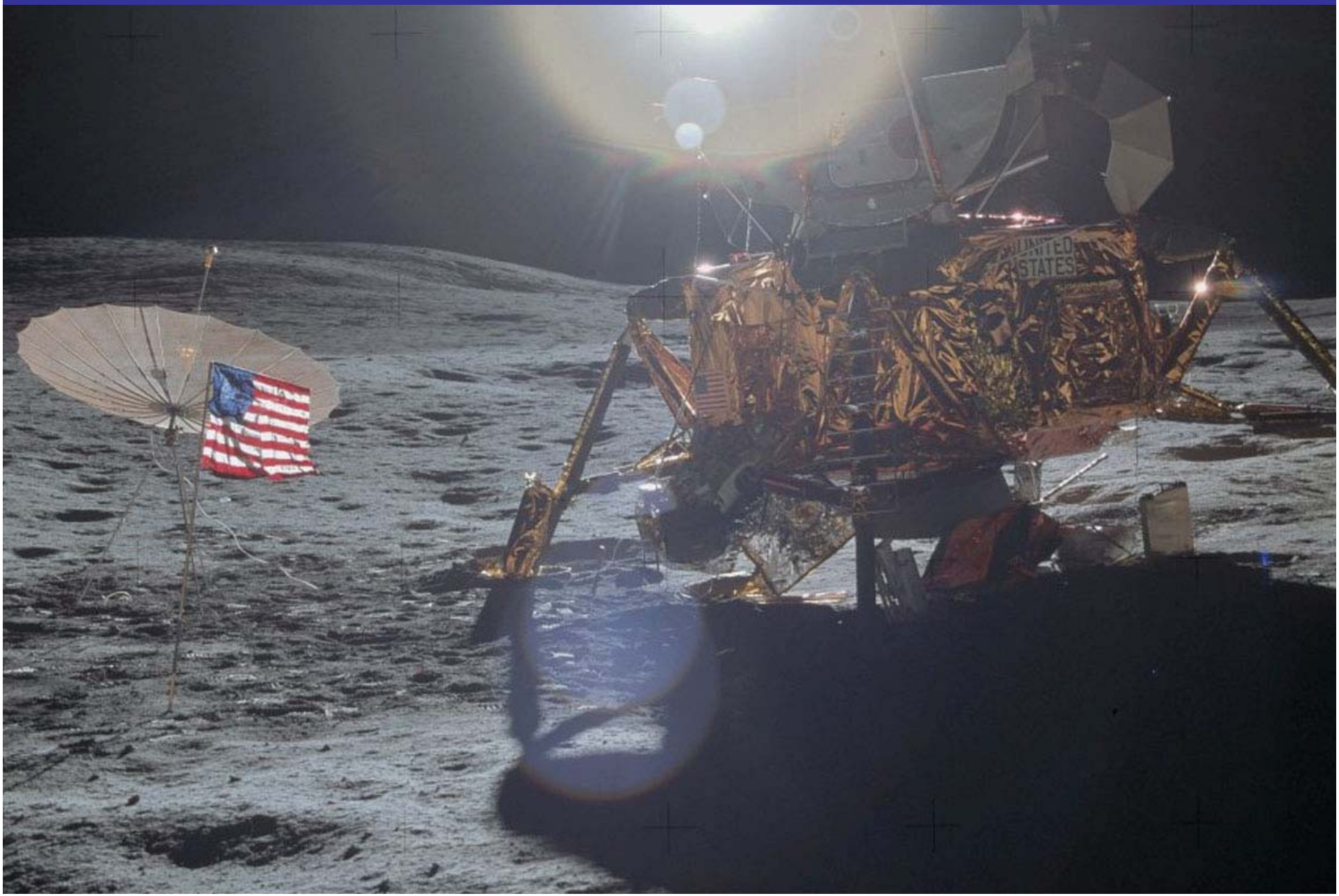
Rocks thrown out by a giant impact 3850 million years ago



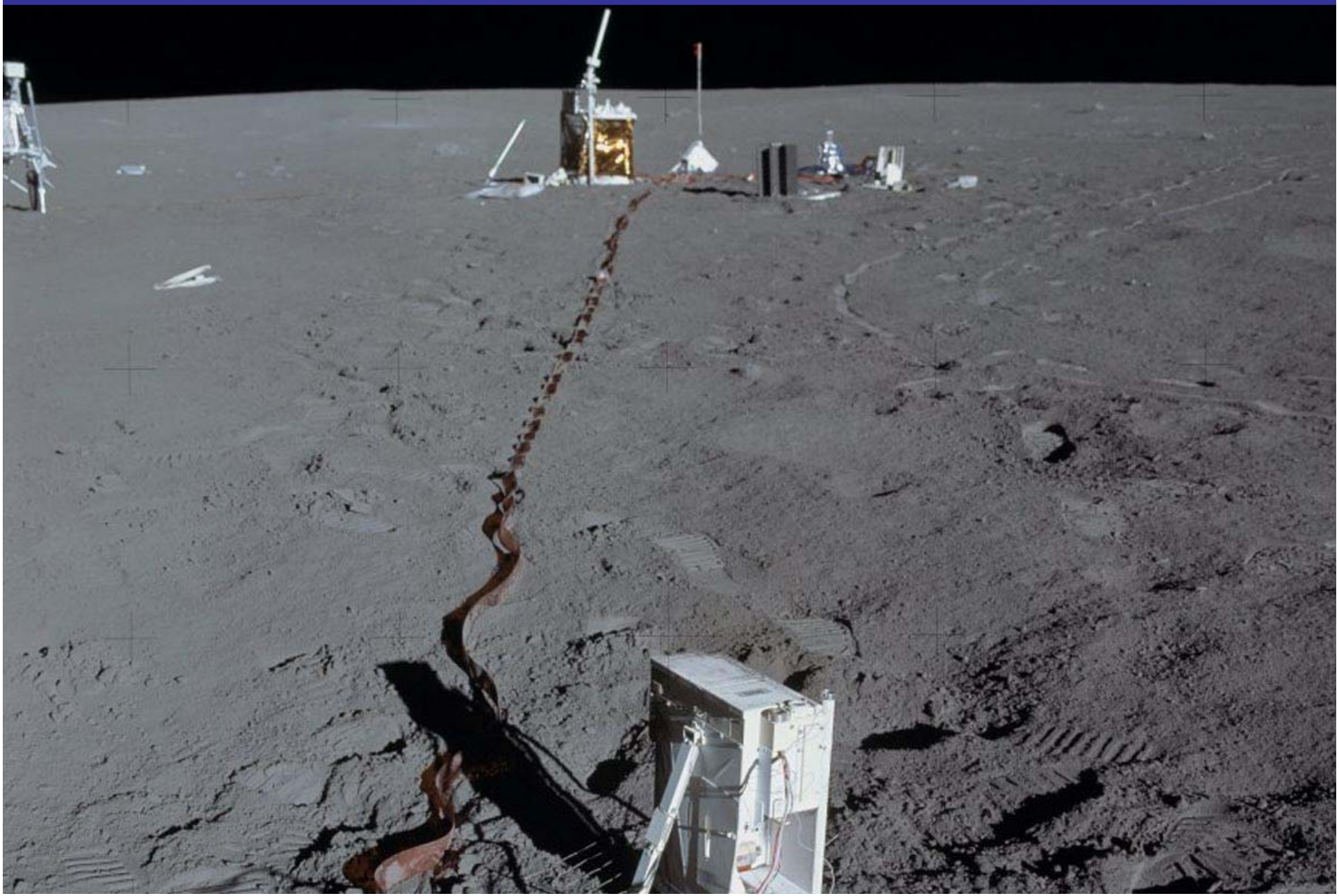




Apollo 14 at Fra Mauro – a more rugged landscape

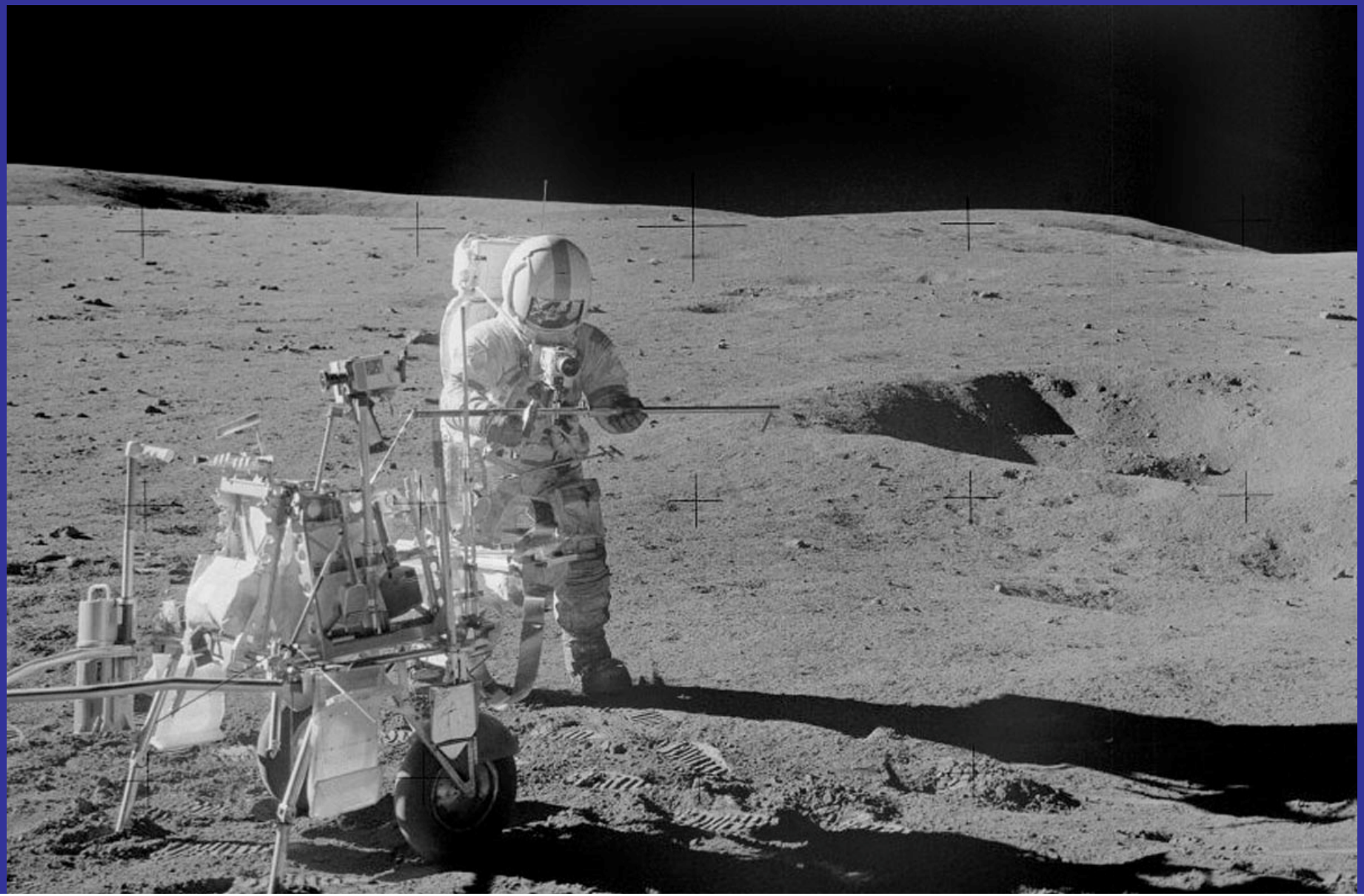


Apollo 14 – another experiment package set up



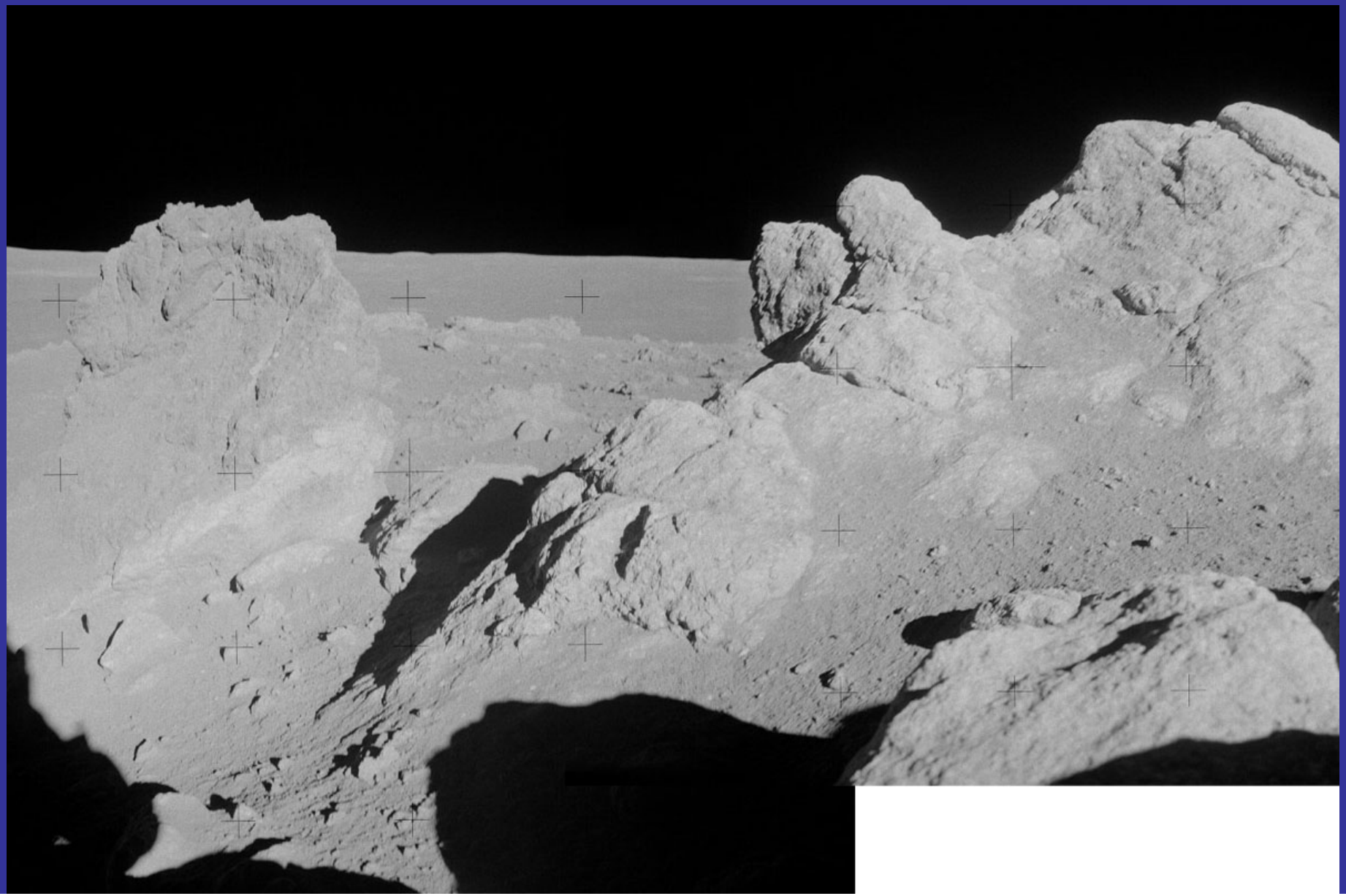
Apollo 14 – exploring the hills

The astronaut is holding a core tube for sampling deep in the soil



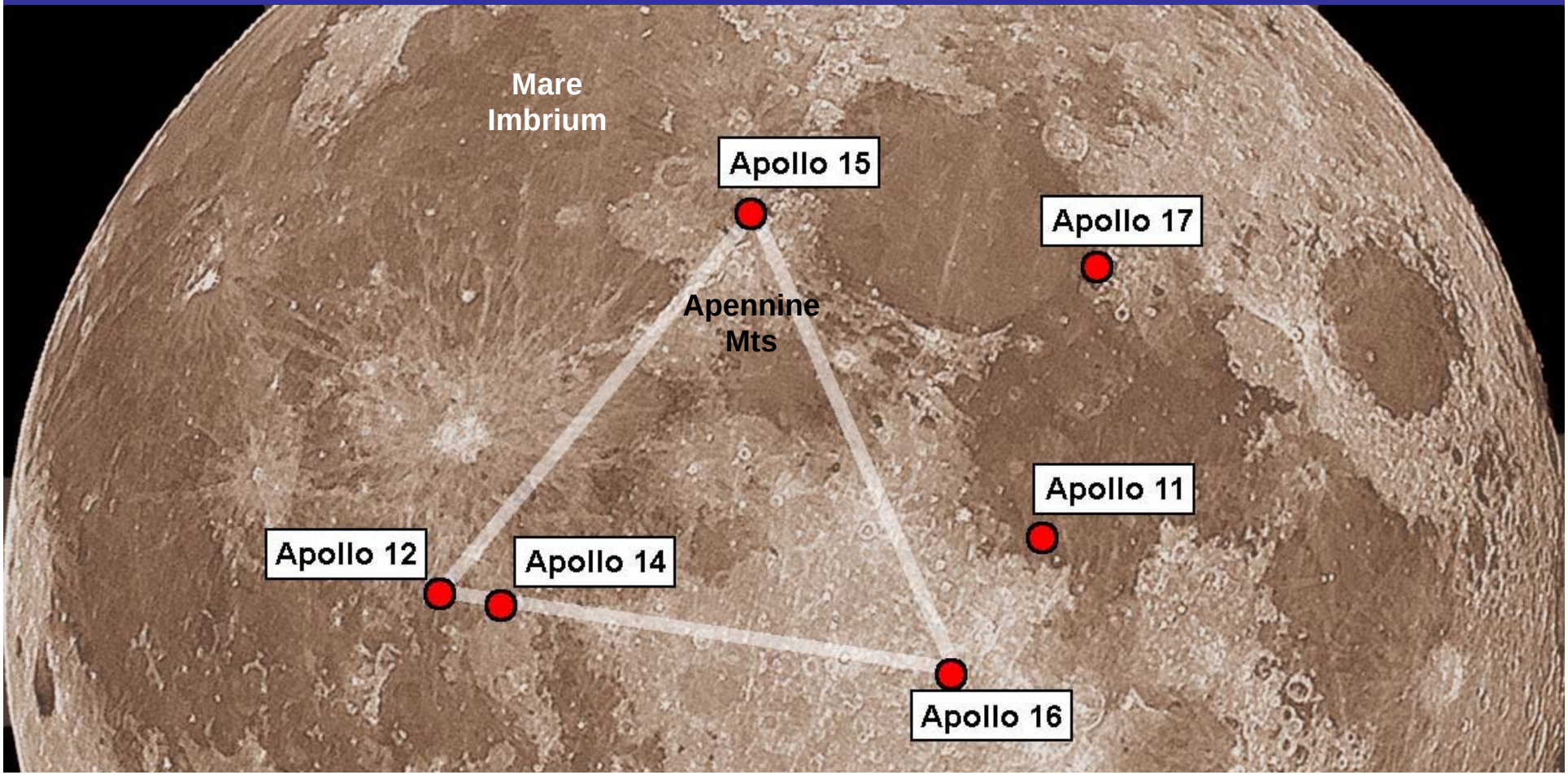
Apollo 14 – Saddle Rock on the rim of Cone Crater

(Rocks on the rim come from the deepest part of the crater)



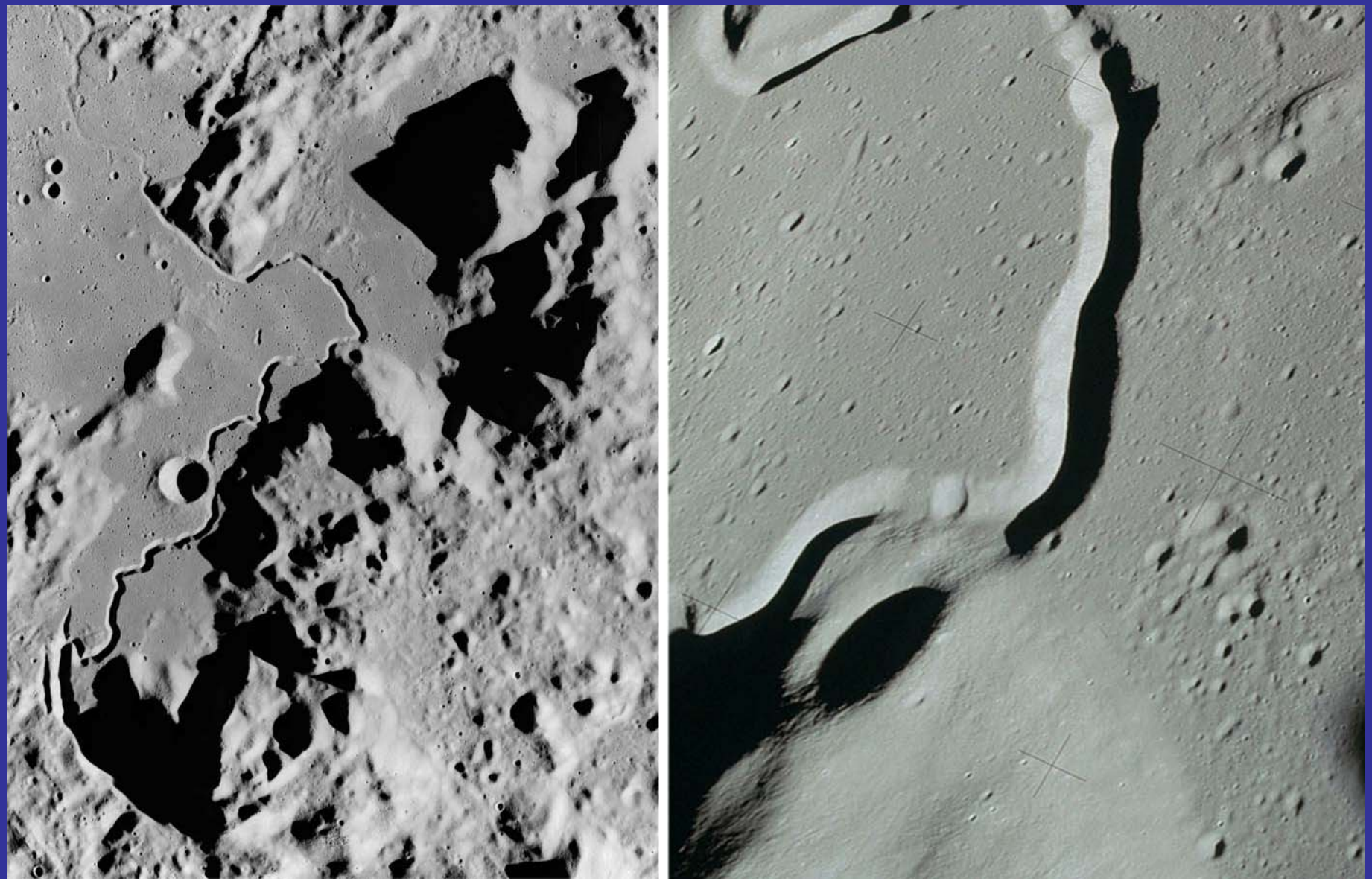
Apollo 15

- Land in lava plains at Hadley-Apennine
- Sample the mountainous rim of the Imbrium Basin
- Examine a lava channel, the Hadley Rille



Apollo 15 landing site – the mountains of the Moon.

Lava plains, mountains and an old winding lava channel.



Apollo 15 - a very different landscape.

The last three Apollo flights were truly great voyages of exploration.

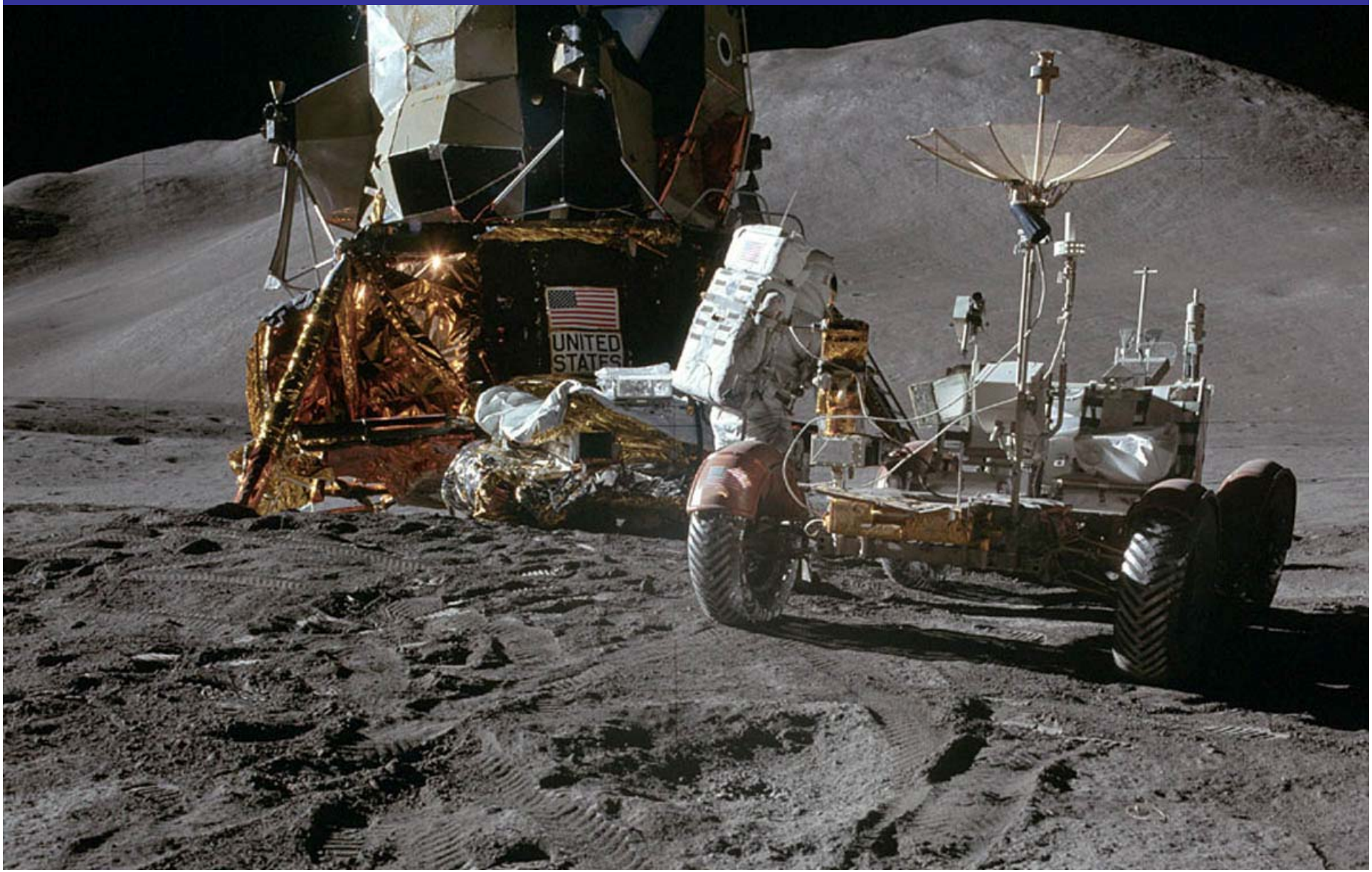
Three days on the surface with a rover for long distance travel.

Apollo 15 – Hadley Rille – a lava channel 3 billion years old.

Lava flowed through this valley into the plains to the west.

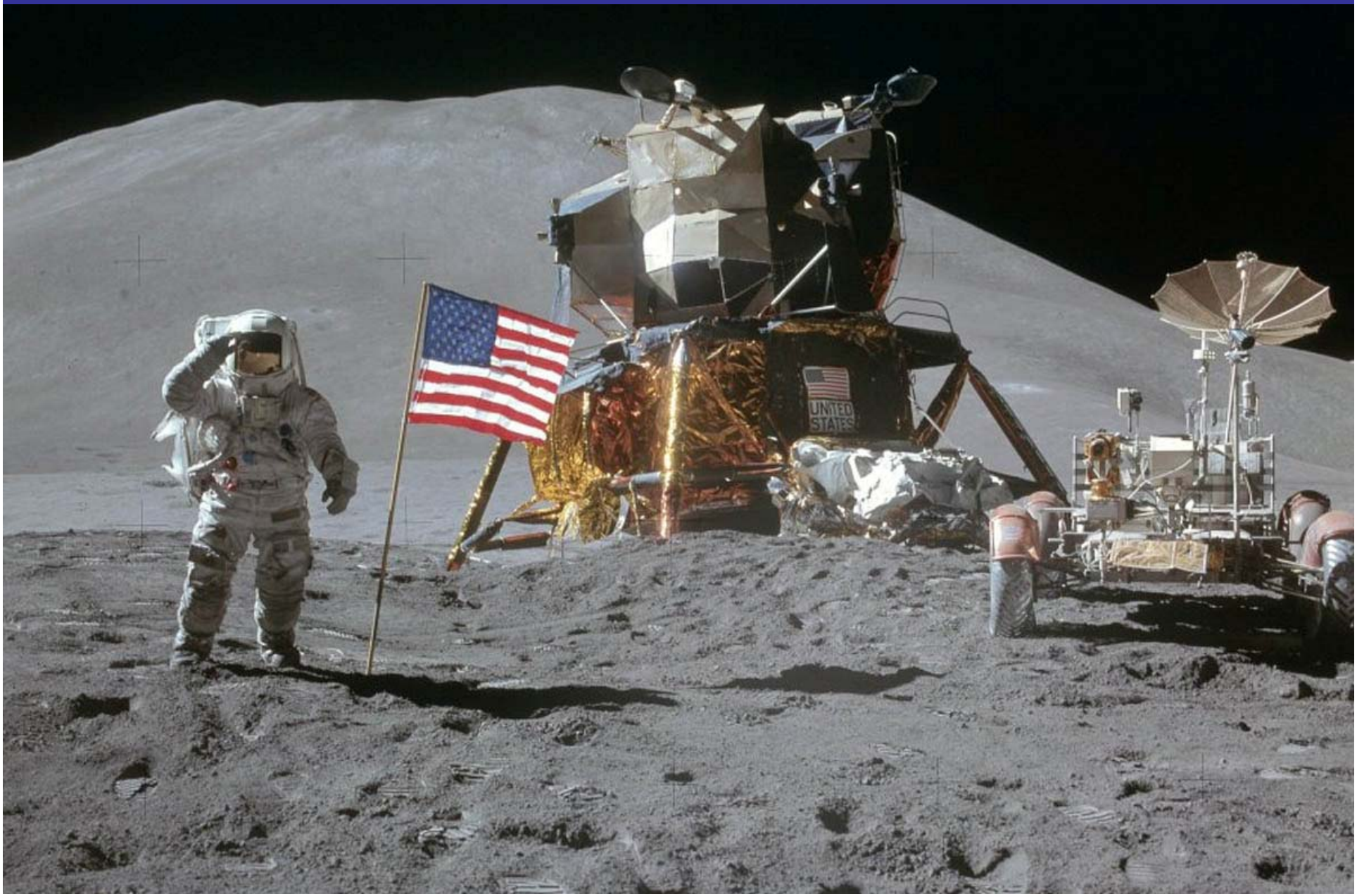
Apollo 15

Having a rover greatly increased the area that could be explored

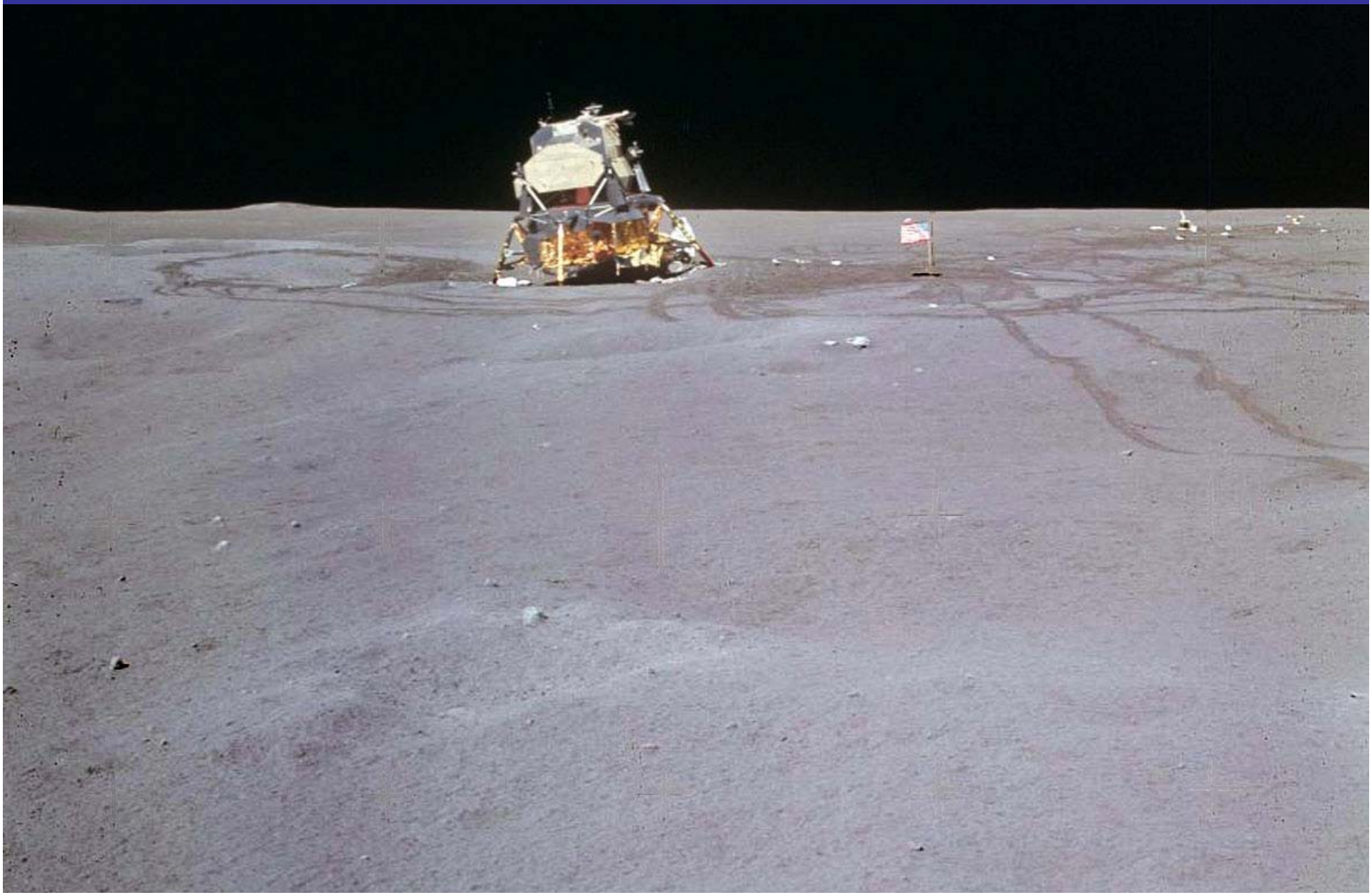


Apollo 15 - The Apennine Mountains form the rim of a vast crater called the Imbrium Basin, 500 miles across

Apollo 15 – there's always time for a photo with the flag

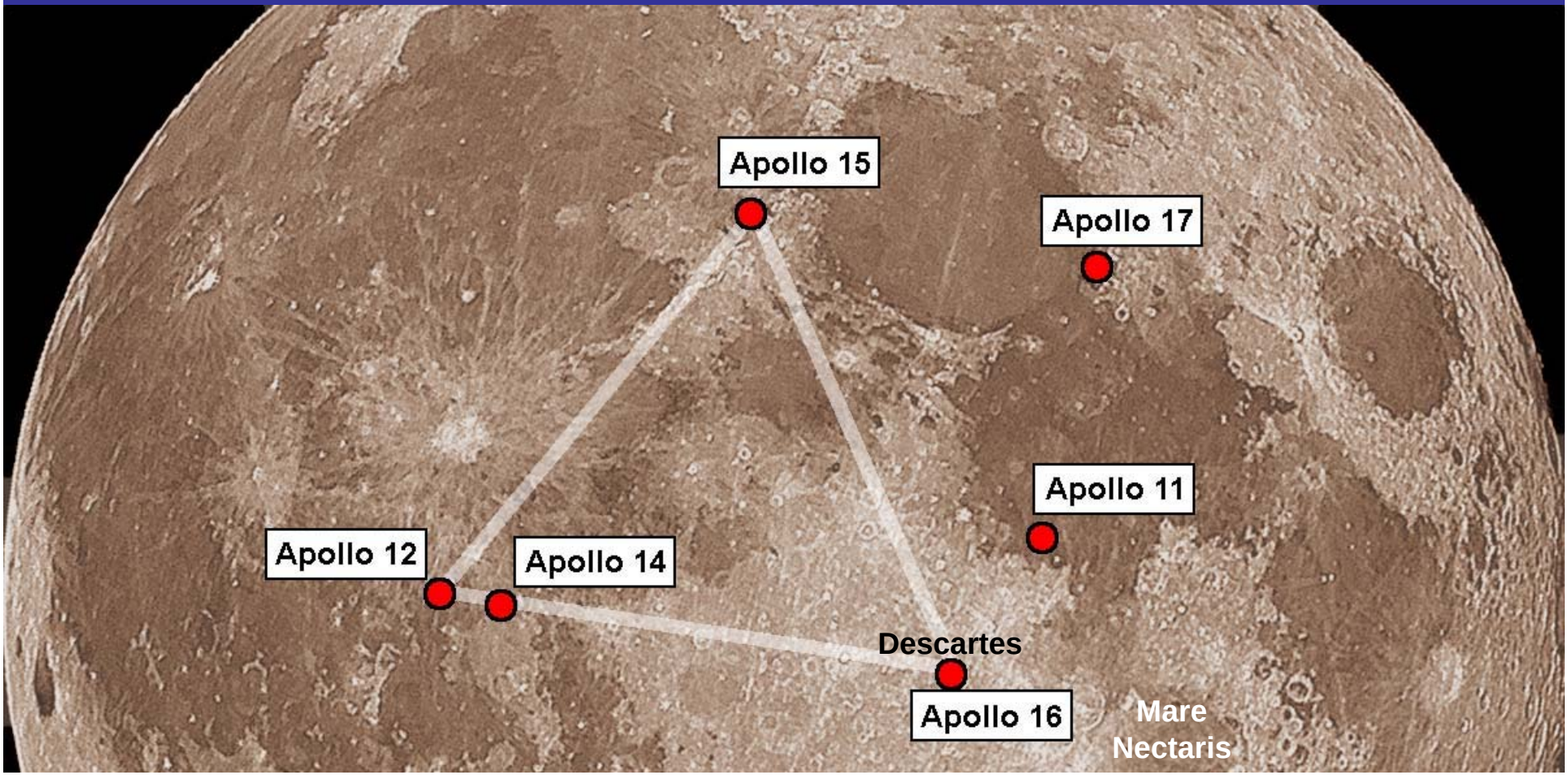


Apollo 15 – the Lunar Module landed with a leg down in a crater, perhaps the closest any Apollo mission came to a dangerous landing.



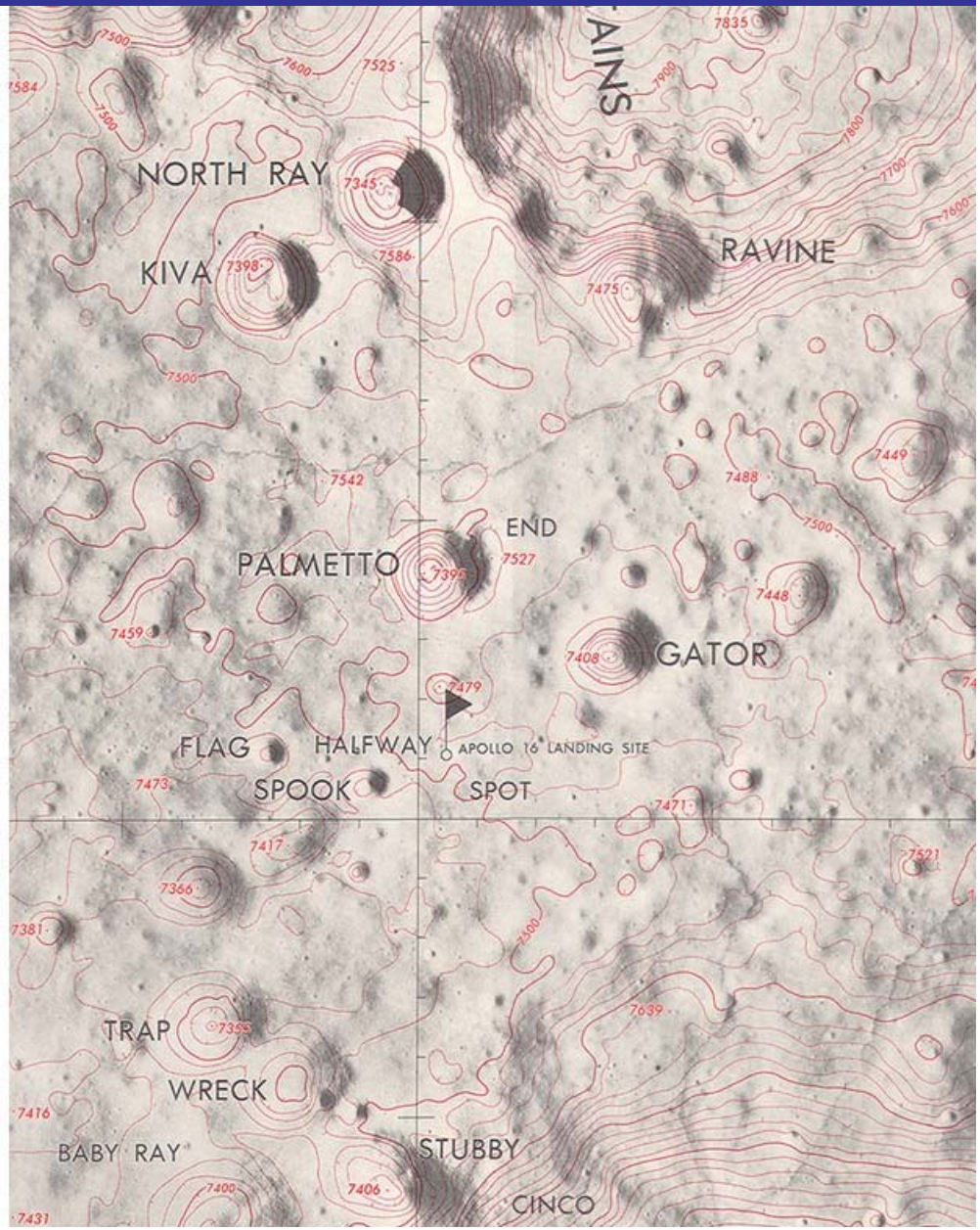
Apollo 16

- Land in the bright lunar highlands
- Sample ejecta from the Nectaris Basin
- Are nearby hills small volcanoes?



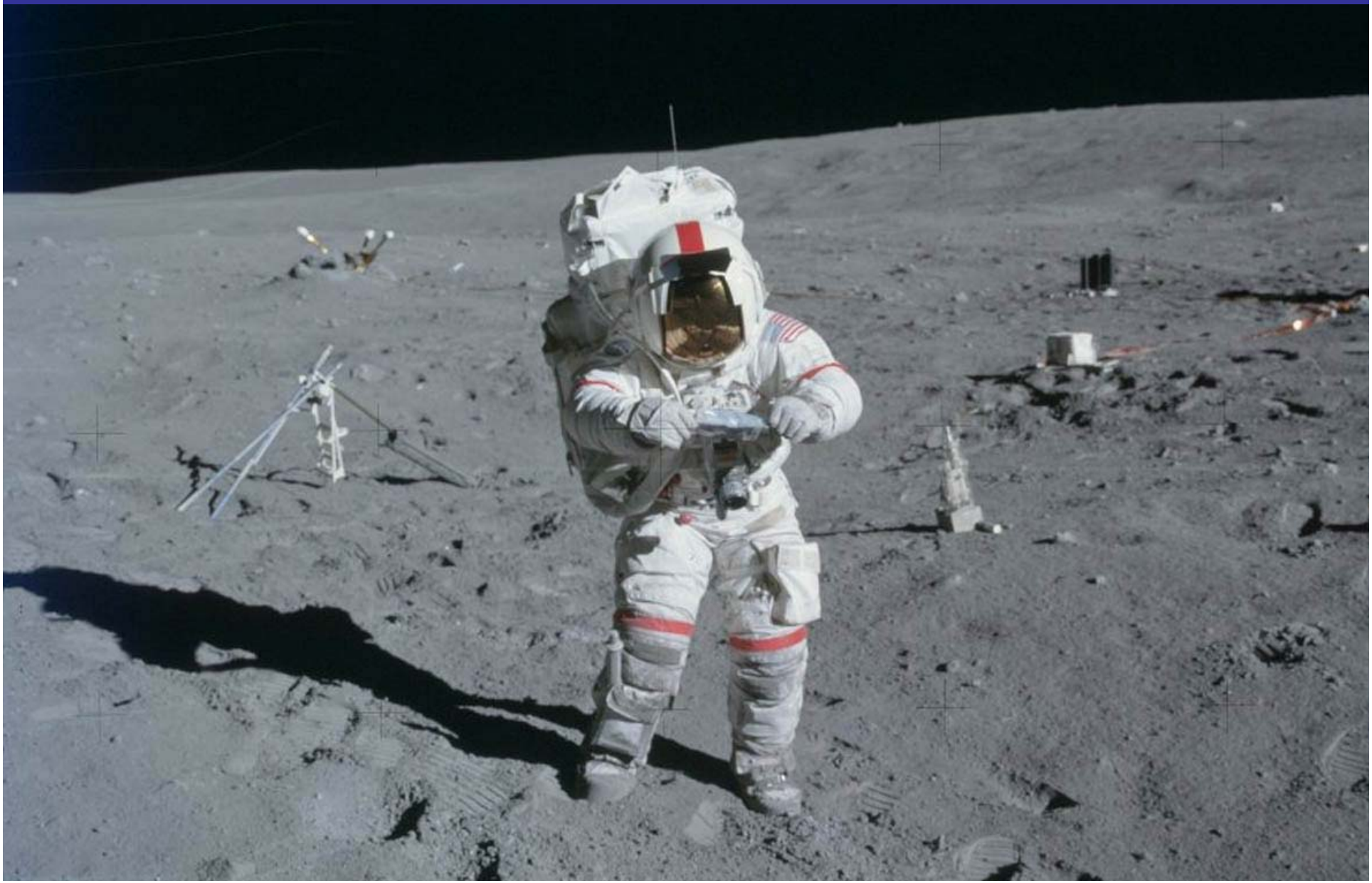
Apollo 16 landing site – the first site in the Moon's highlands.

The hills were thought to be volcanic, but they were just impact debris.

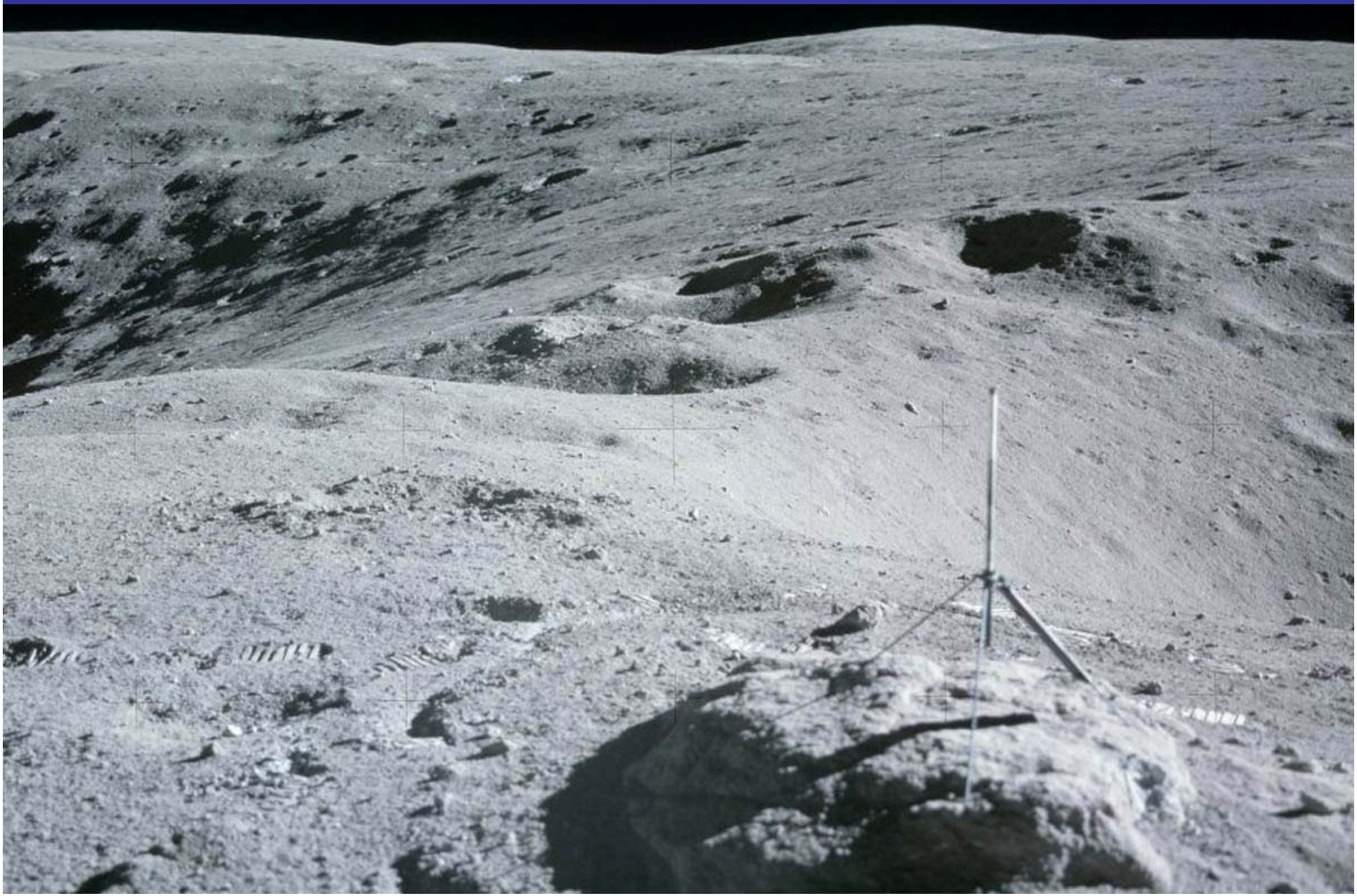


Apollo 16 – ALSEP

By now a whole network of instruments had been set up on the Moon

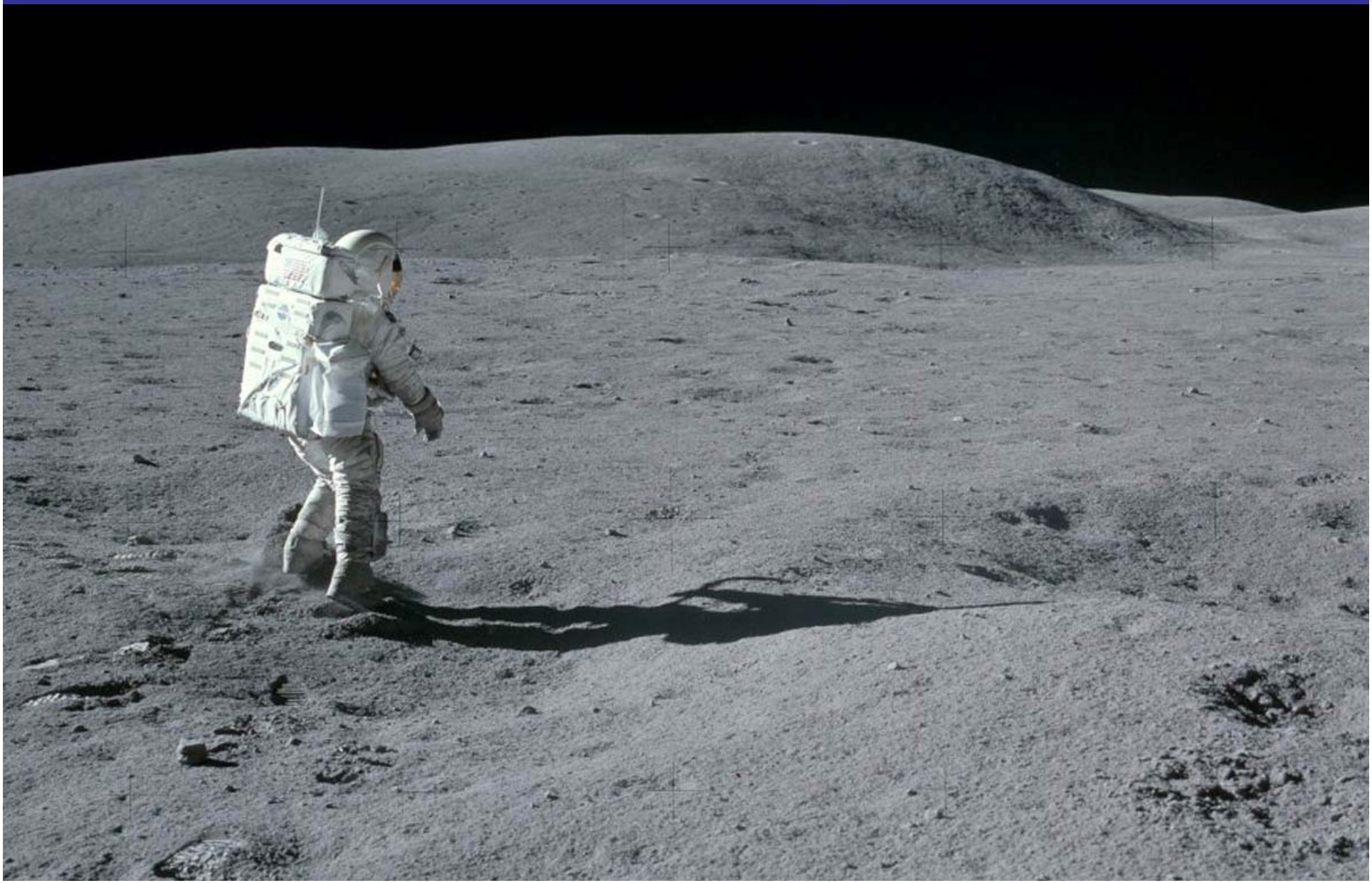


Apollo 16 – you have to watch your step here



Apollo 16 – Stone Mountain

Not as dramatic as Apollo 15's site, but different types of rock



Apollo 16 – the astronauts rode part way up the mountain.

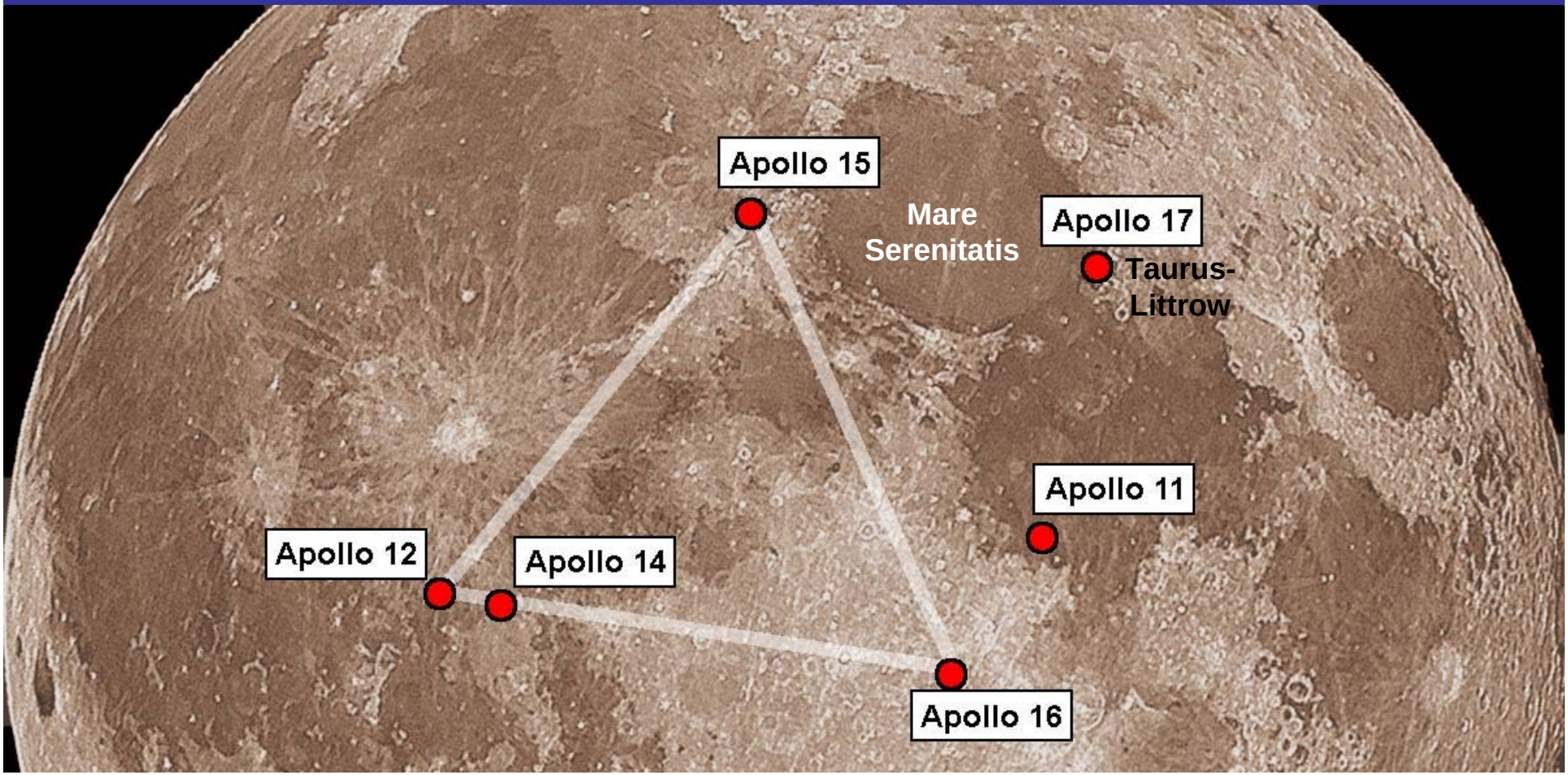
Looking back – the LM is out there somewhere

Apollo 16 – the astronauts set up a small telescope

The first observatory on the Moon

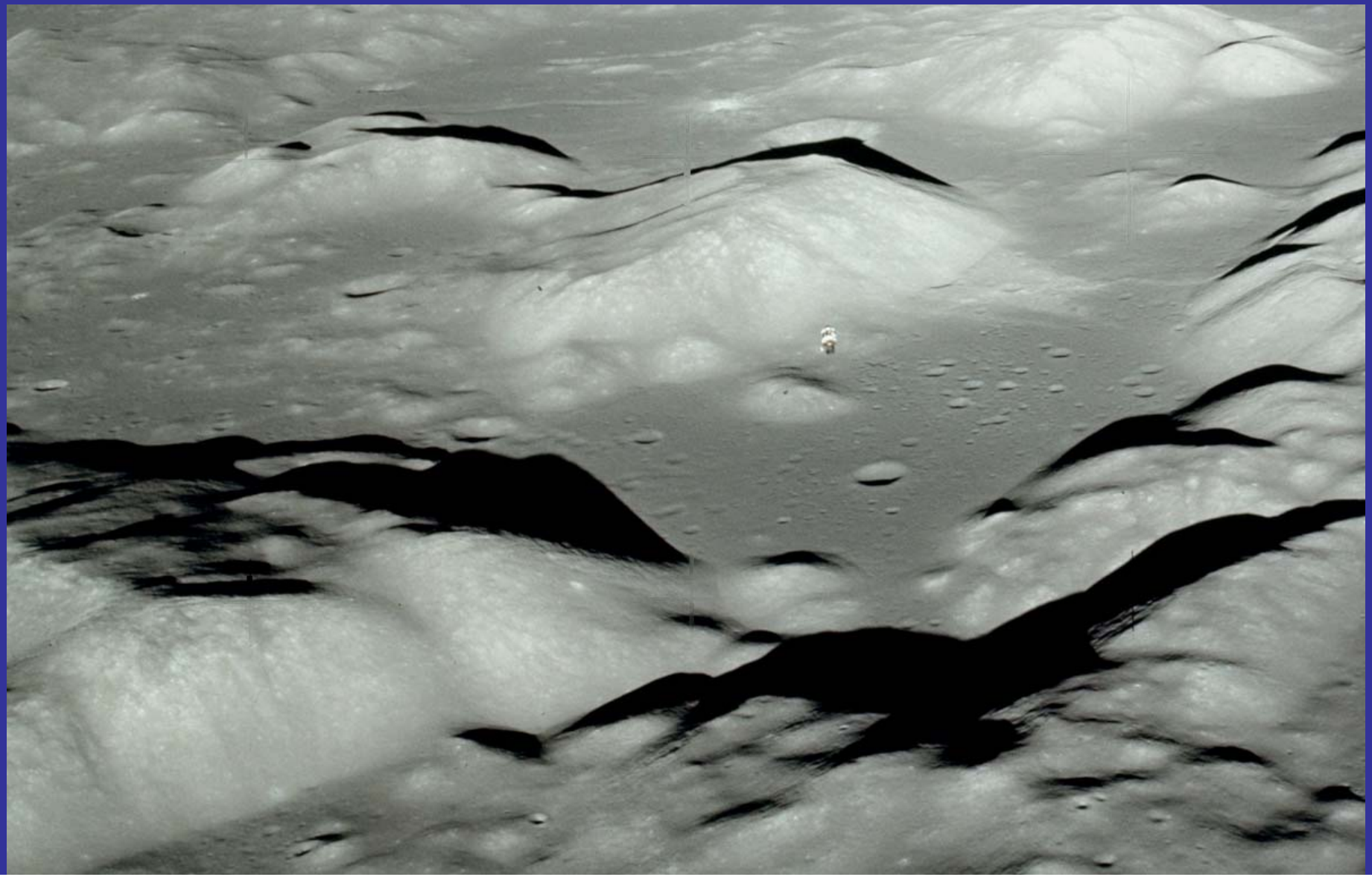
Apollo 17

- Land in a dark-floored valley
- Sample the rim of the Serenitatis Basin
- Is a small dark crater a little volcano?

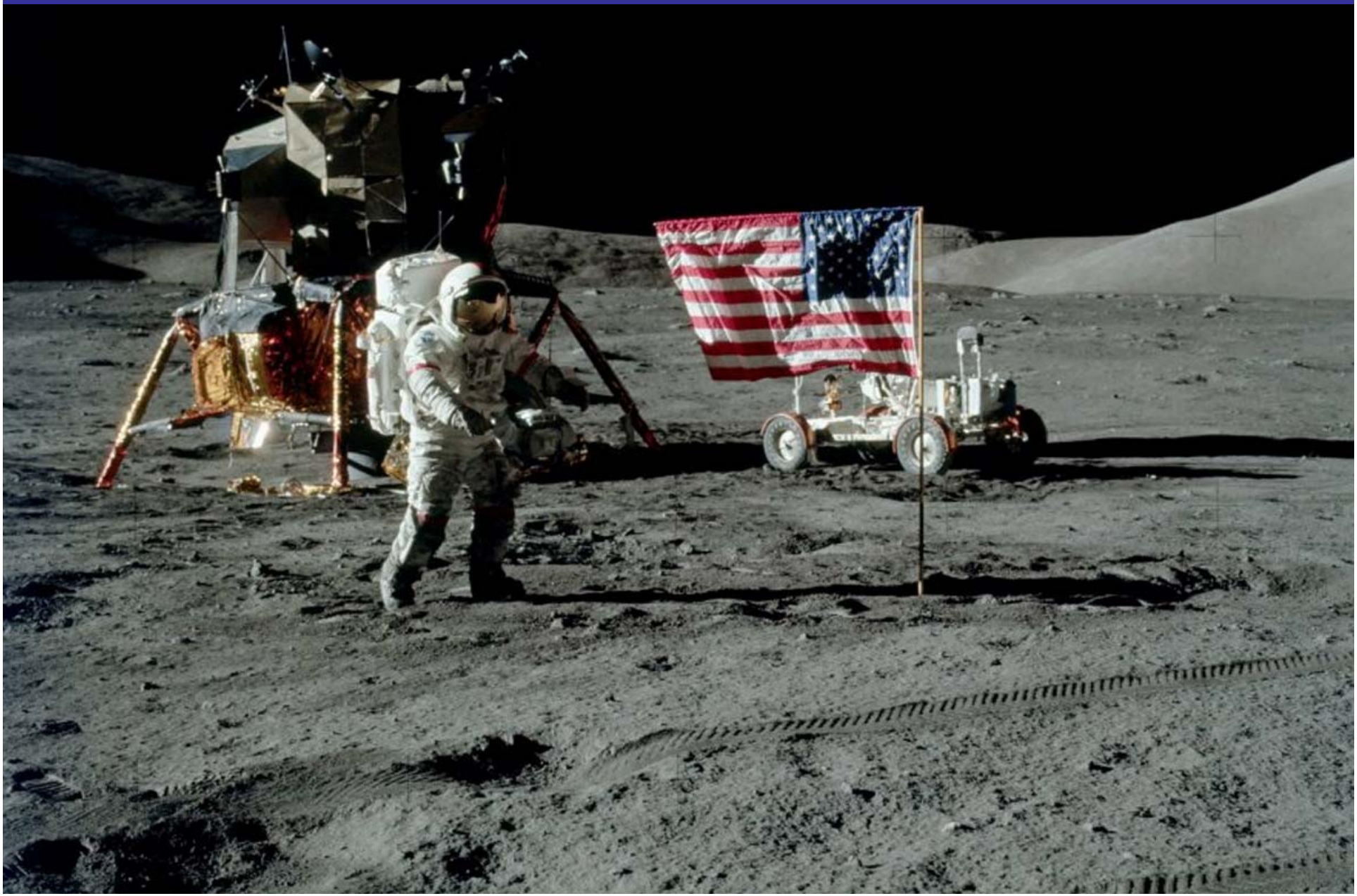


Apollo 17 landing site

Mountains on the rim of a different impact basin, dark lava flows, small volcanic cones and a large landslide.



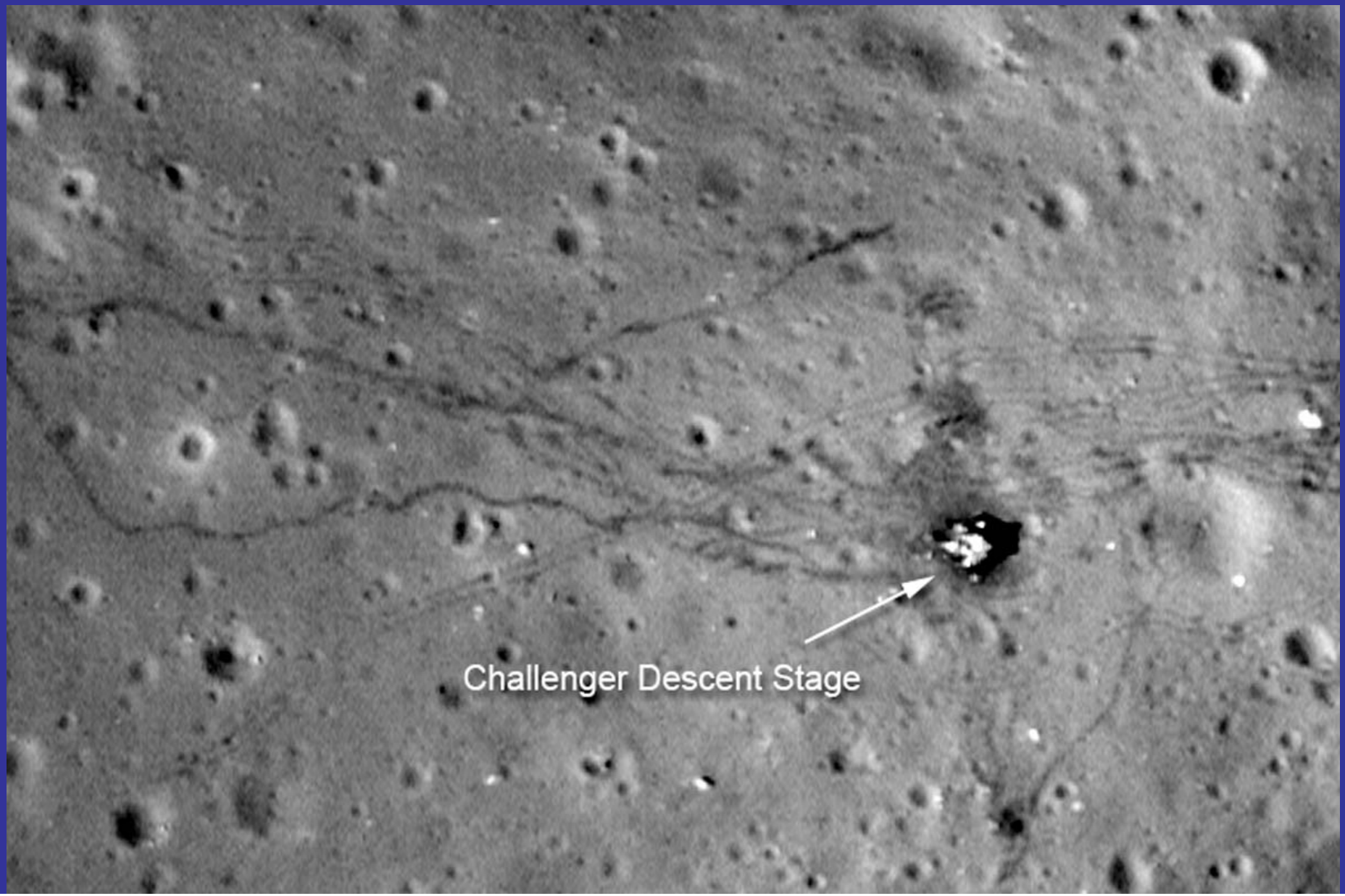
Apollo 17 – the valley floor is made of lava and volcanic ash



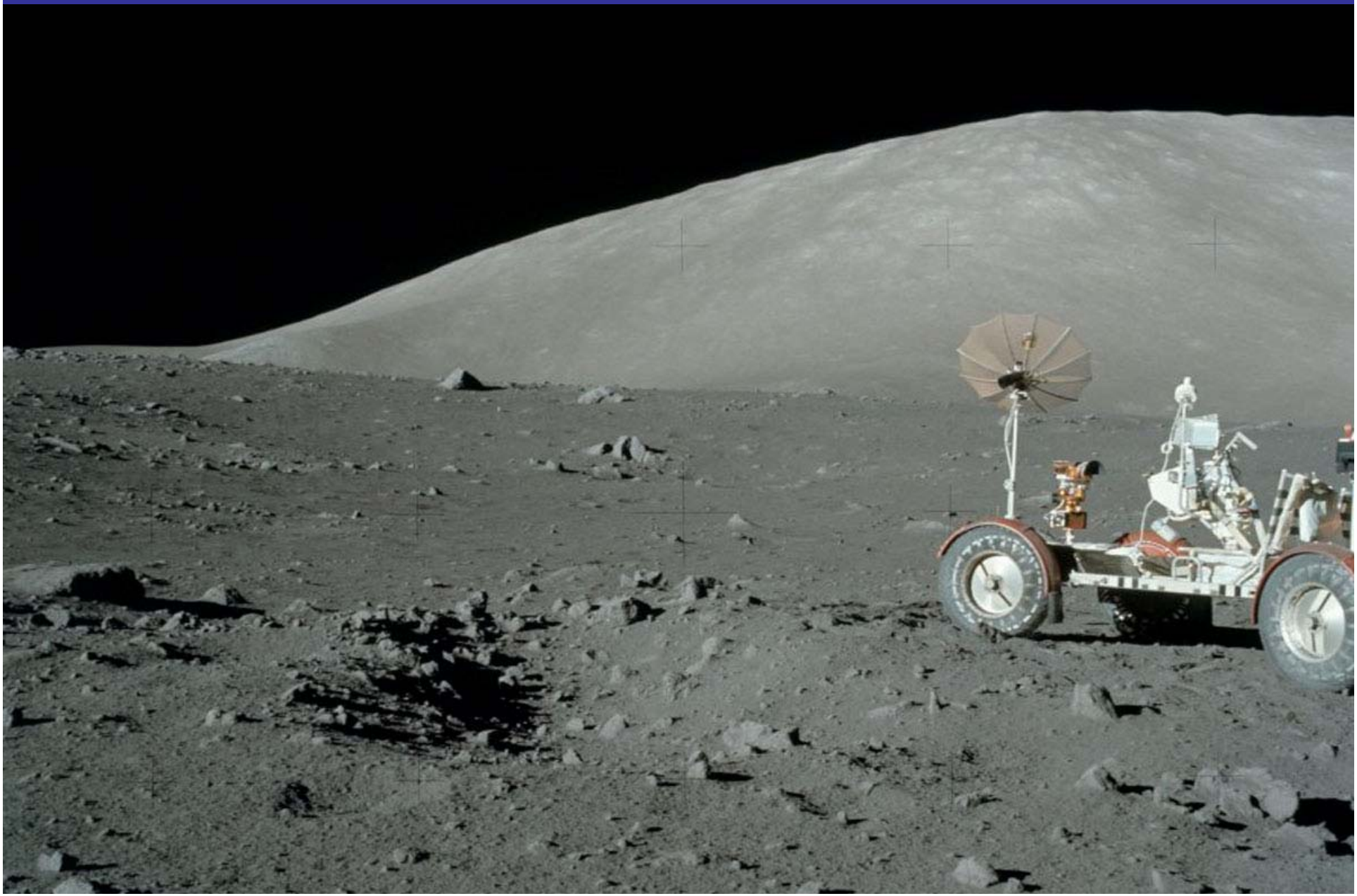
Apollo 17 – the crew left a lot of tracks on the surface

Apollo 17 – now we can see them in new images from orbit

(Lunar Reconnaissance Orbiter)



Apollo 17 – a rugged landscape



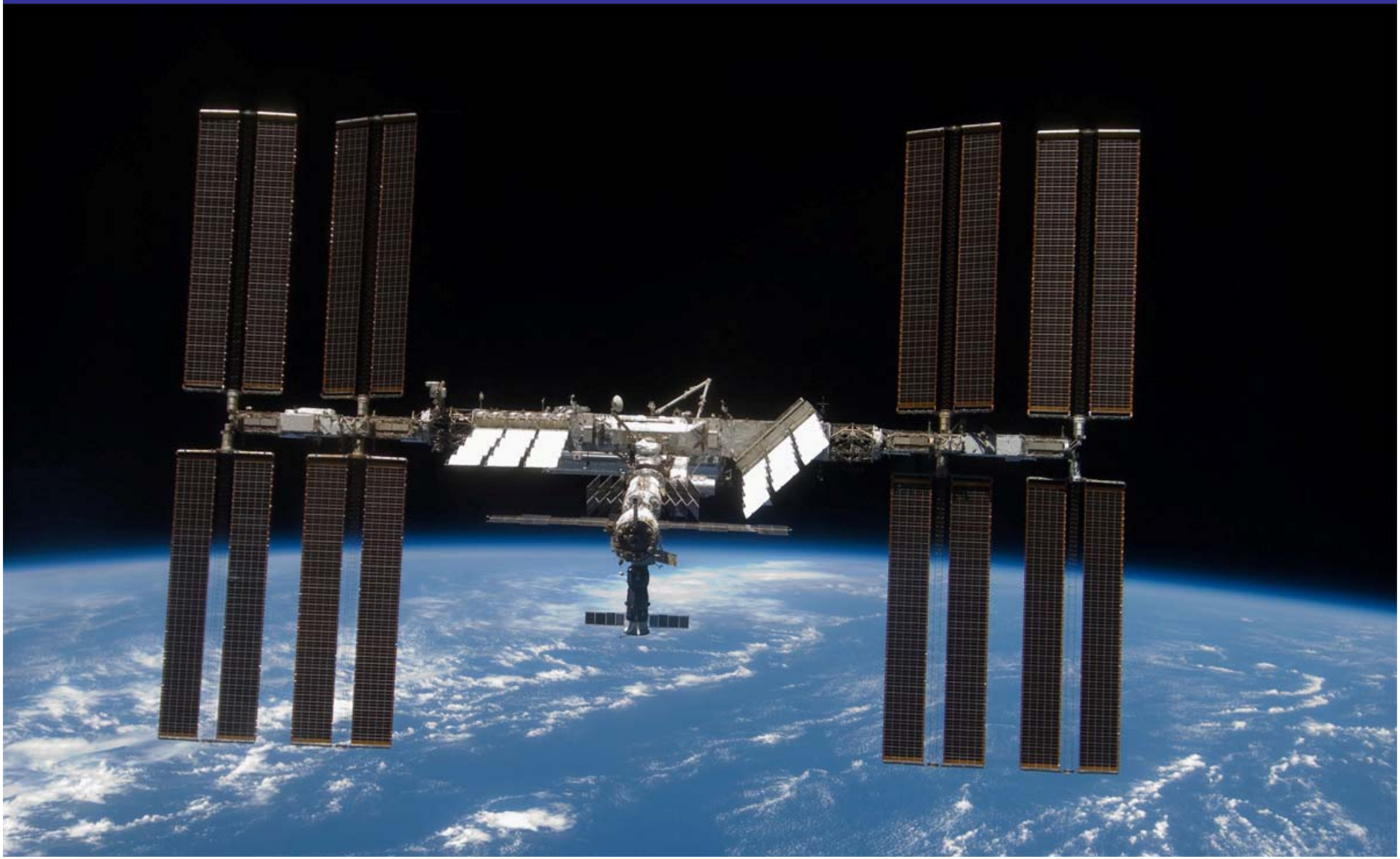
Apollo 17 – spectacular site and great science. The most dramatic finding – orange soil produced in violent volcanic eruptions.

After Apollo – how can you follow that?

NASA had great plans for a long program of lunar exploration, trips to Mars and large space stations.

The only part that was approved was Skylab, a small space station.

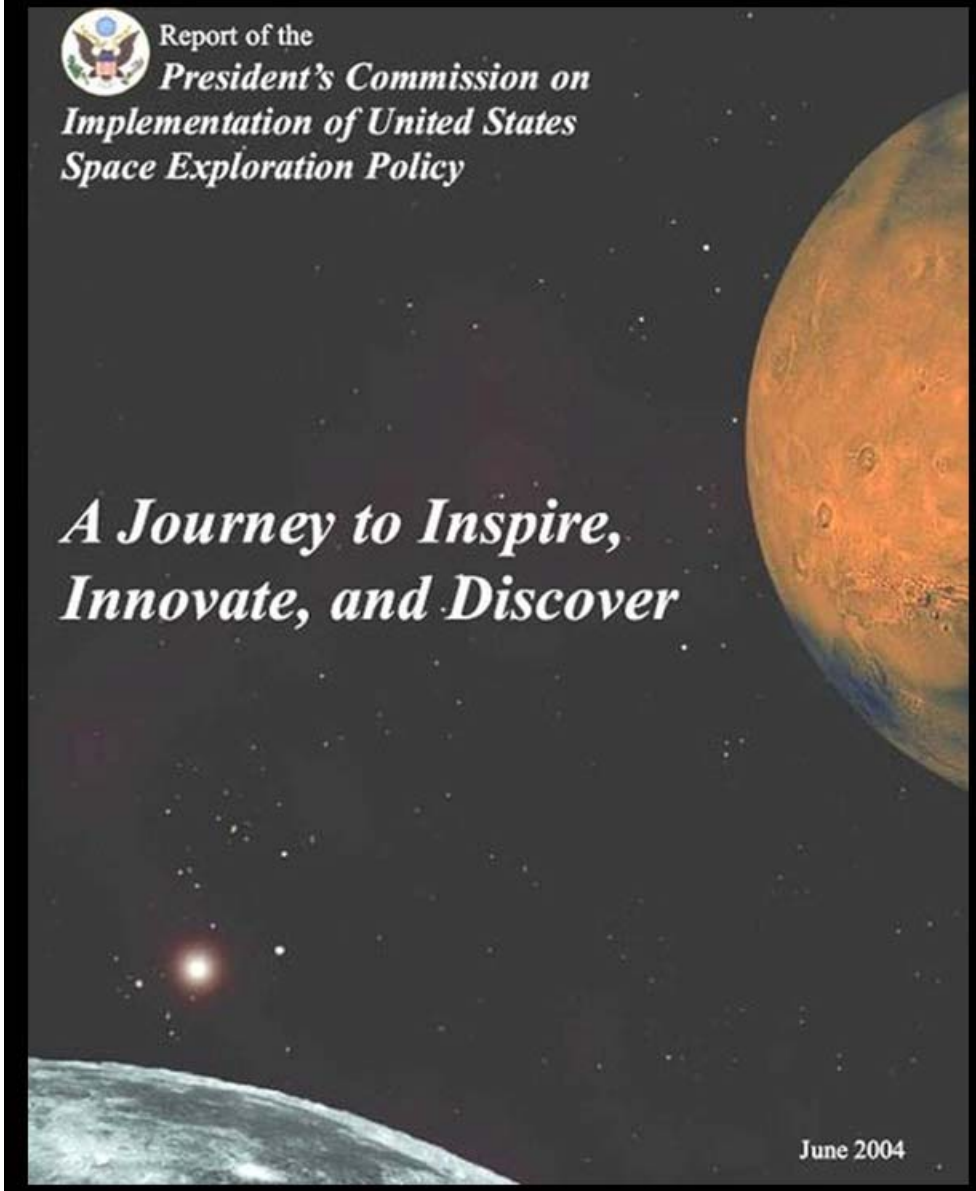
Shuttle and Station – after Apollo NASA was directed to build a reusable Space Shuttle and an orbiting laboratory



Challenger and Columbia accidents

These tragedies caused a reappraisal of NASA's goals

The Vision for Space Exploration



President Bush's *Vision*:

Fix the Shuttle

Finish the Station

Retire the Shuttle

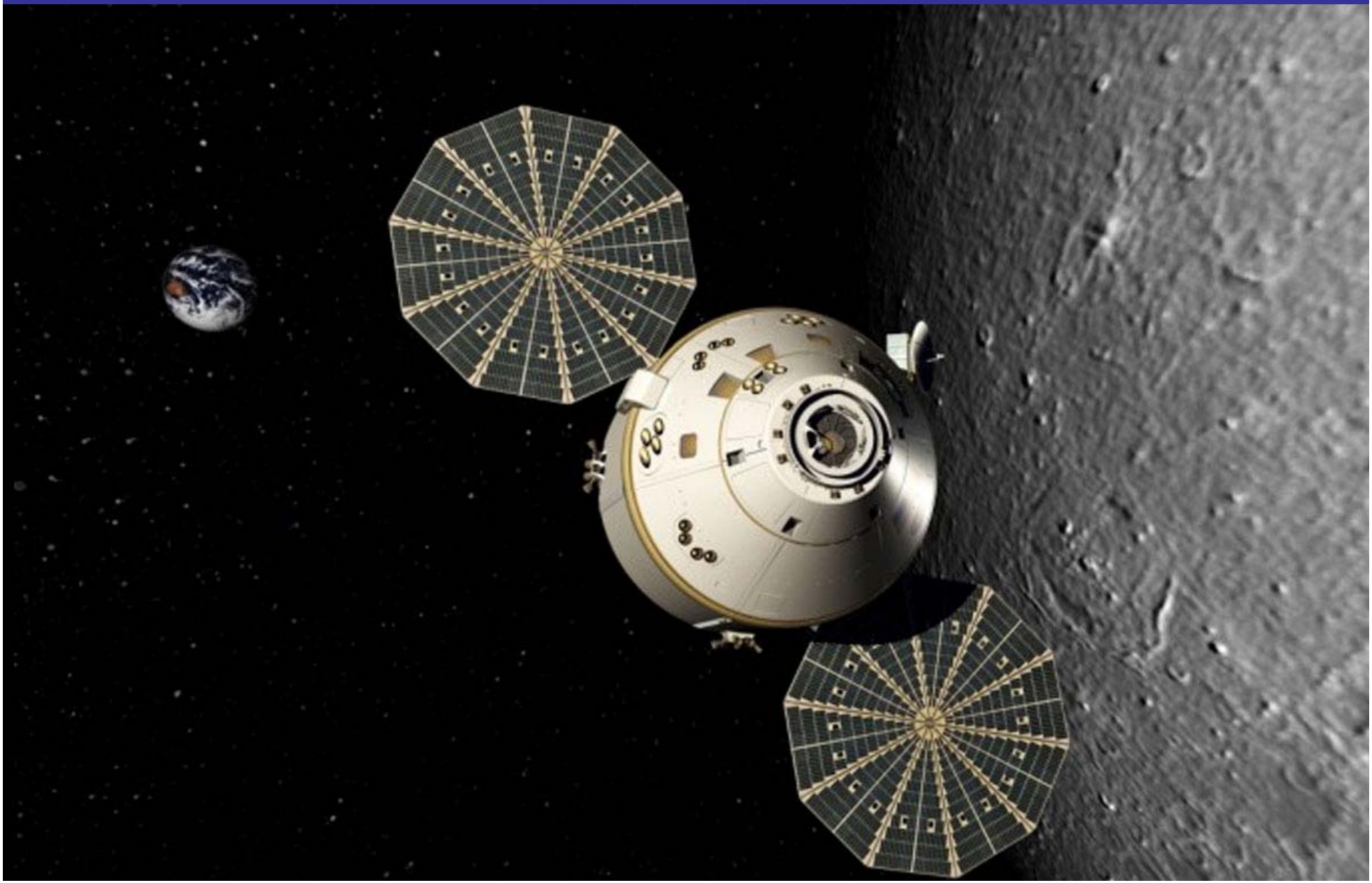
Build new rockets and spacecraft

Return to the Moon by 2020

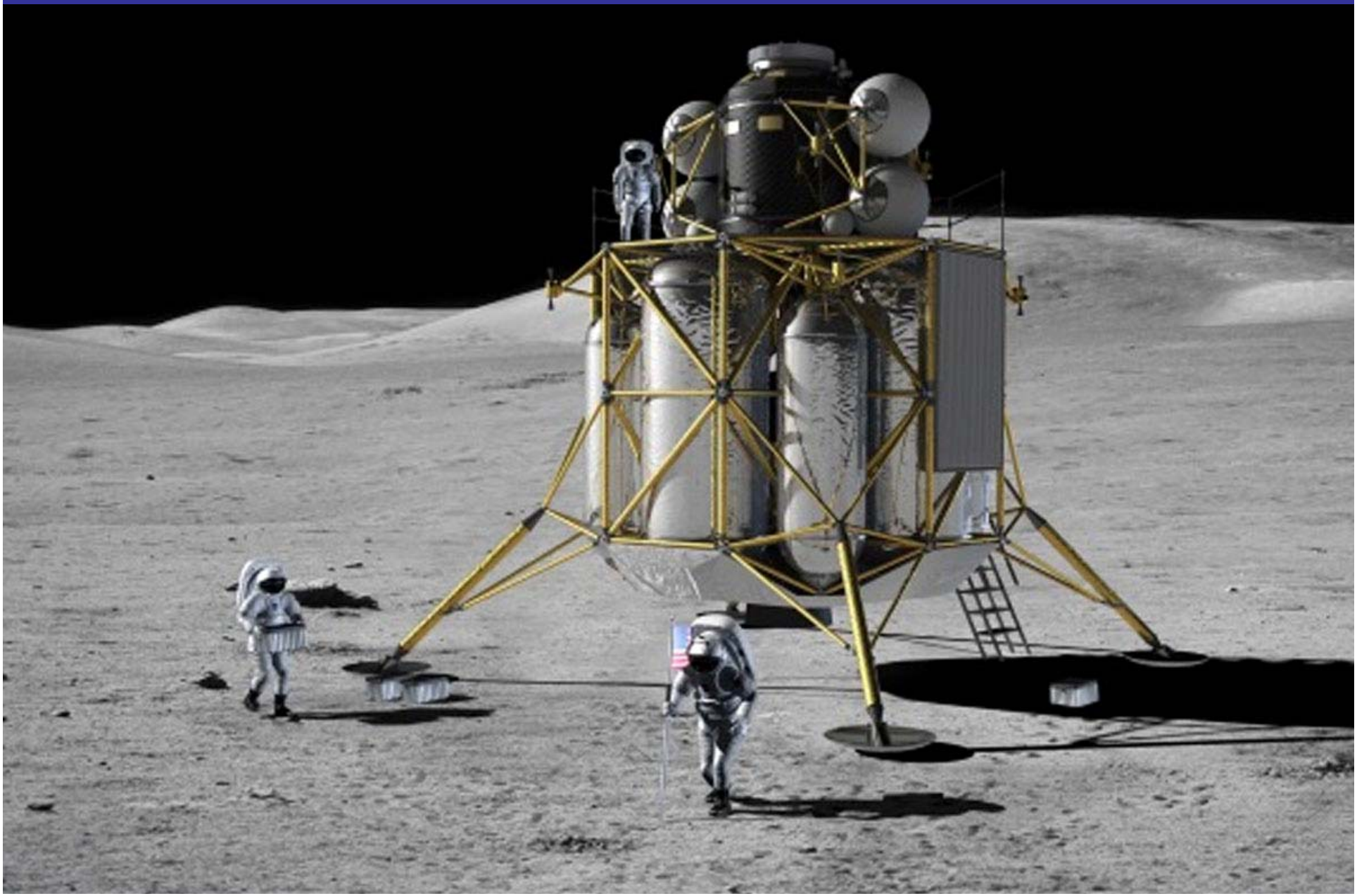
Prepare for other destinations (asteroids and Mars)

Orion – the new Crew Exploration Vehicle

Six crew to the Station, four to the Moon



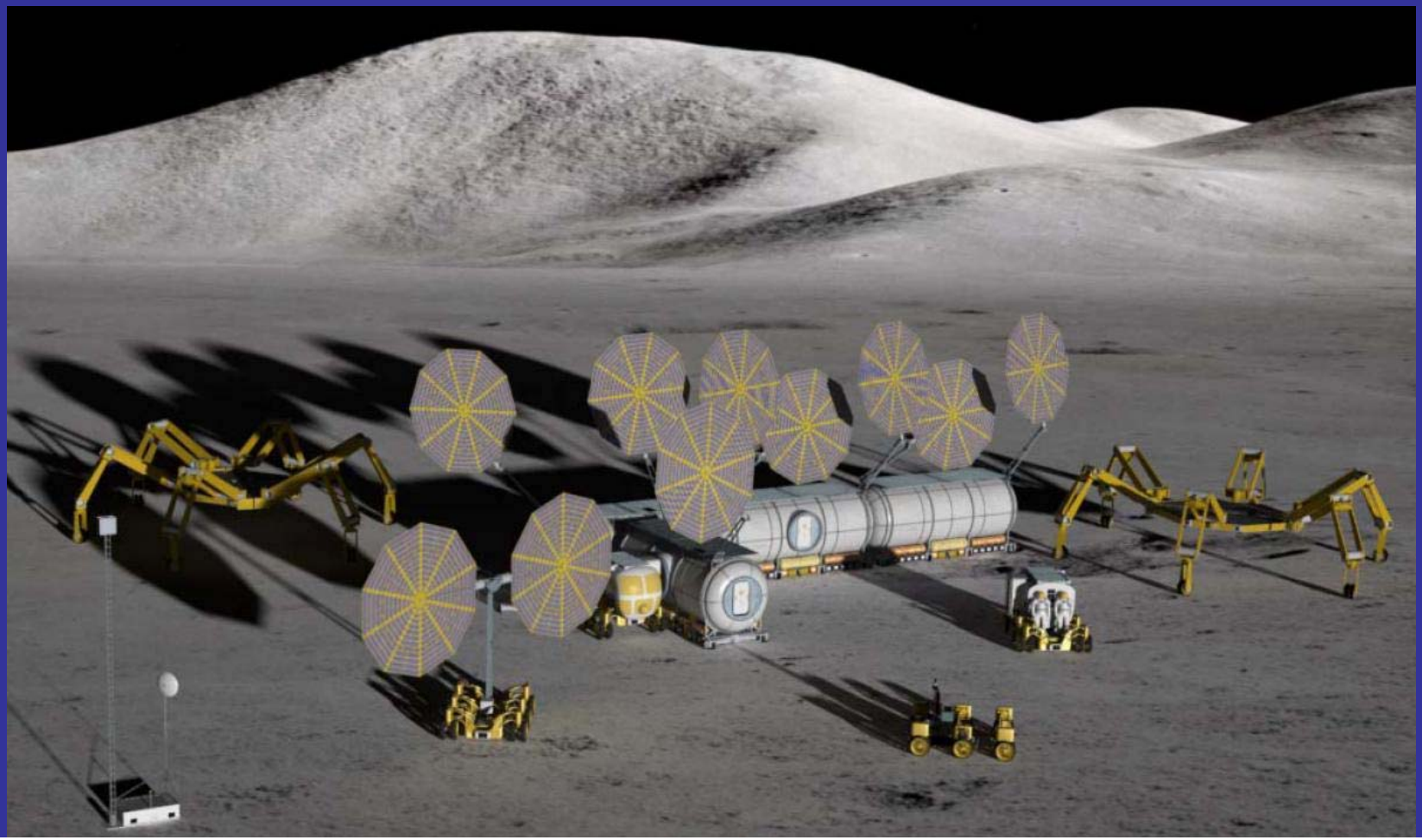
Altair – a new lunar lander, an outpost at the south pole



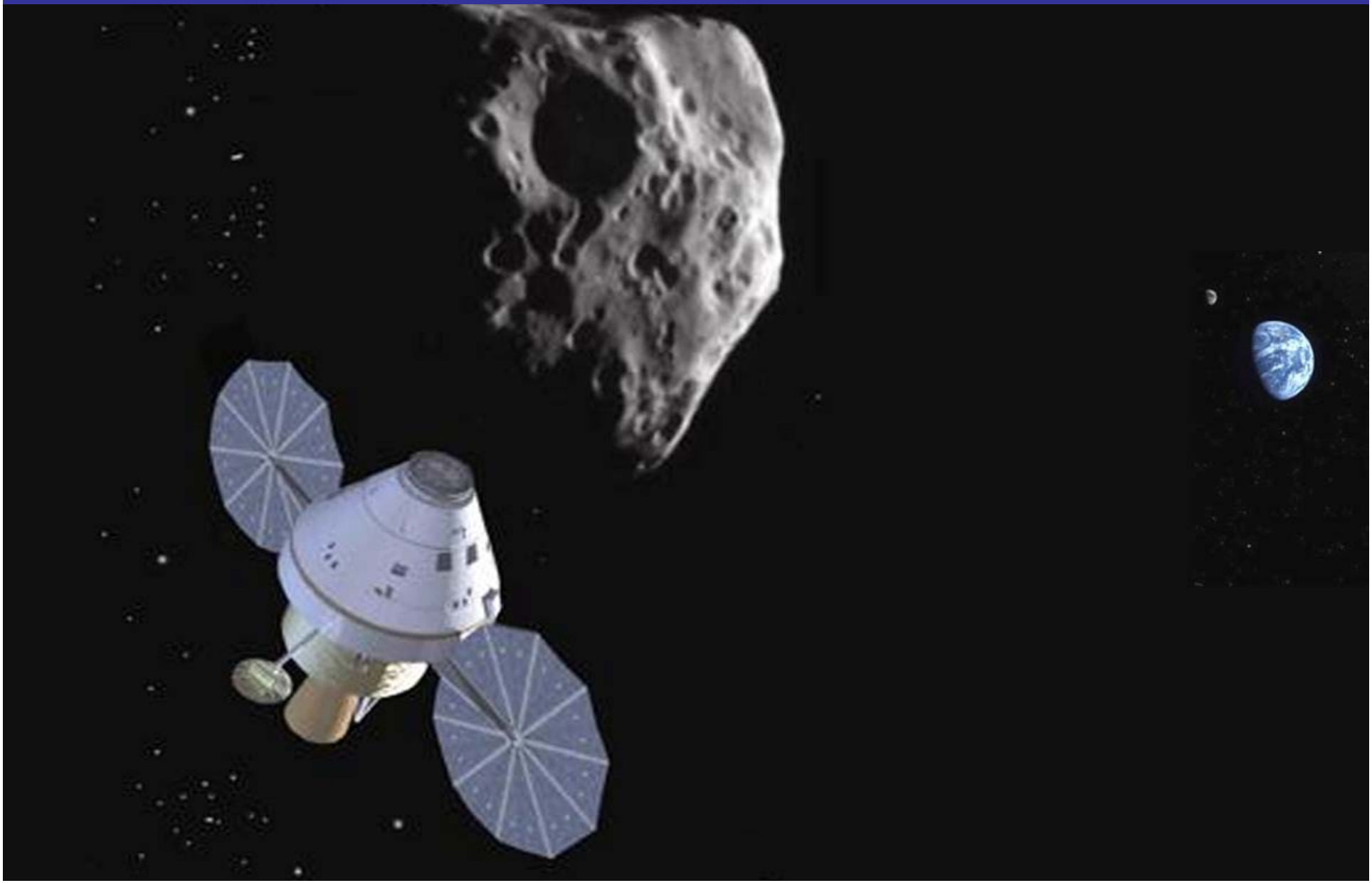
NASA's new direction

Constellation – NASA's plan to accomplish the *Vision* – changed by President Obama.

The Moon will be bypassed.
Mars, its moons, and asteroids will be the new targets.



Asteroid mission - in about 2025



Mars and its moons – about 2035

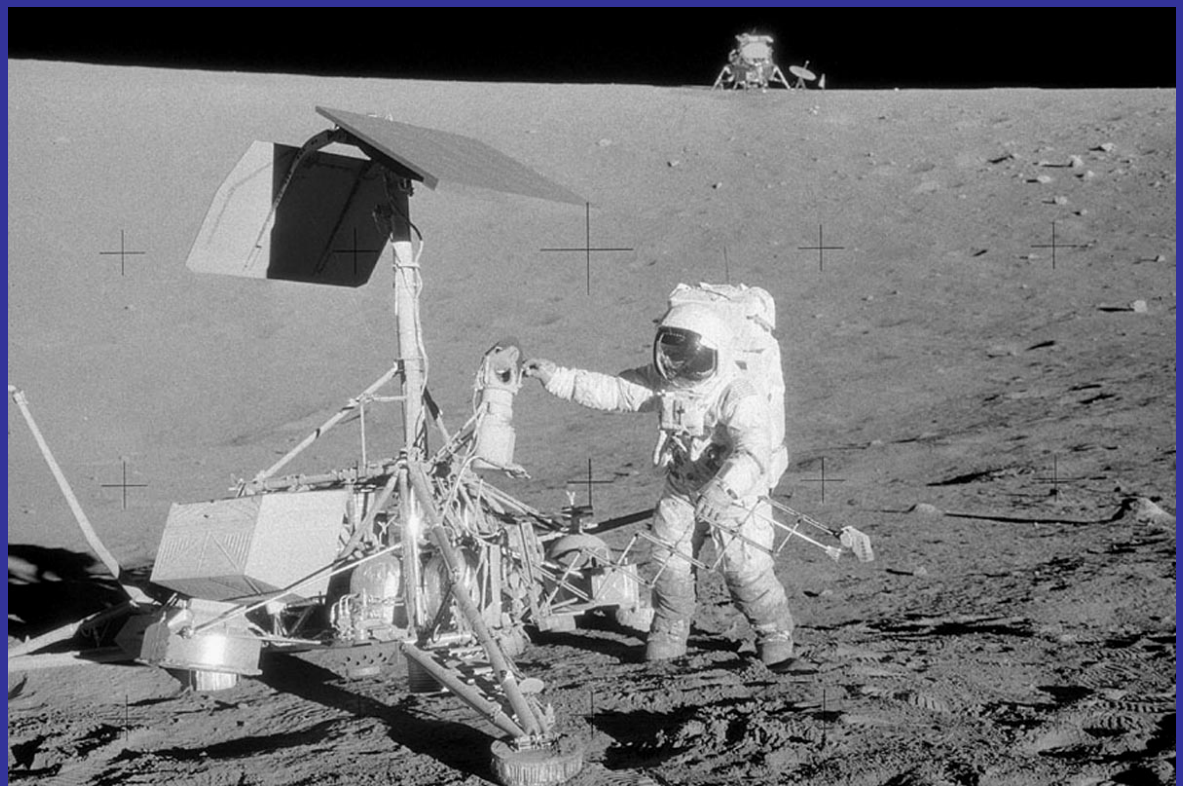
Apollo 8 and Apollo 10 were rehearsals for the first Moon landing.

A Phobos/Deimos mission might help prepare for the first Mars landing

End

Thanks for your interest in Apollo.

Philip Stooke



Apollo 15

Landing video

Apollo 15

Landing video

Apollo 11

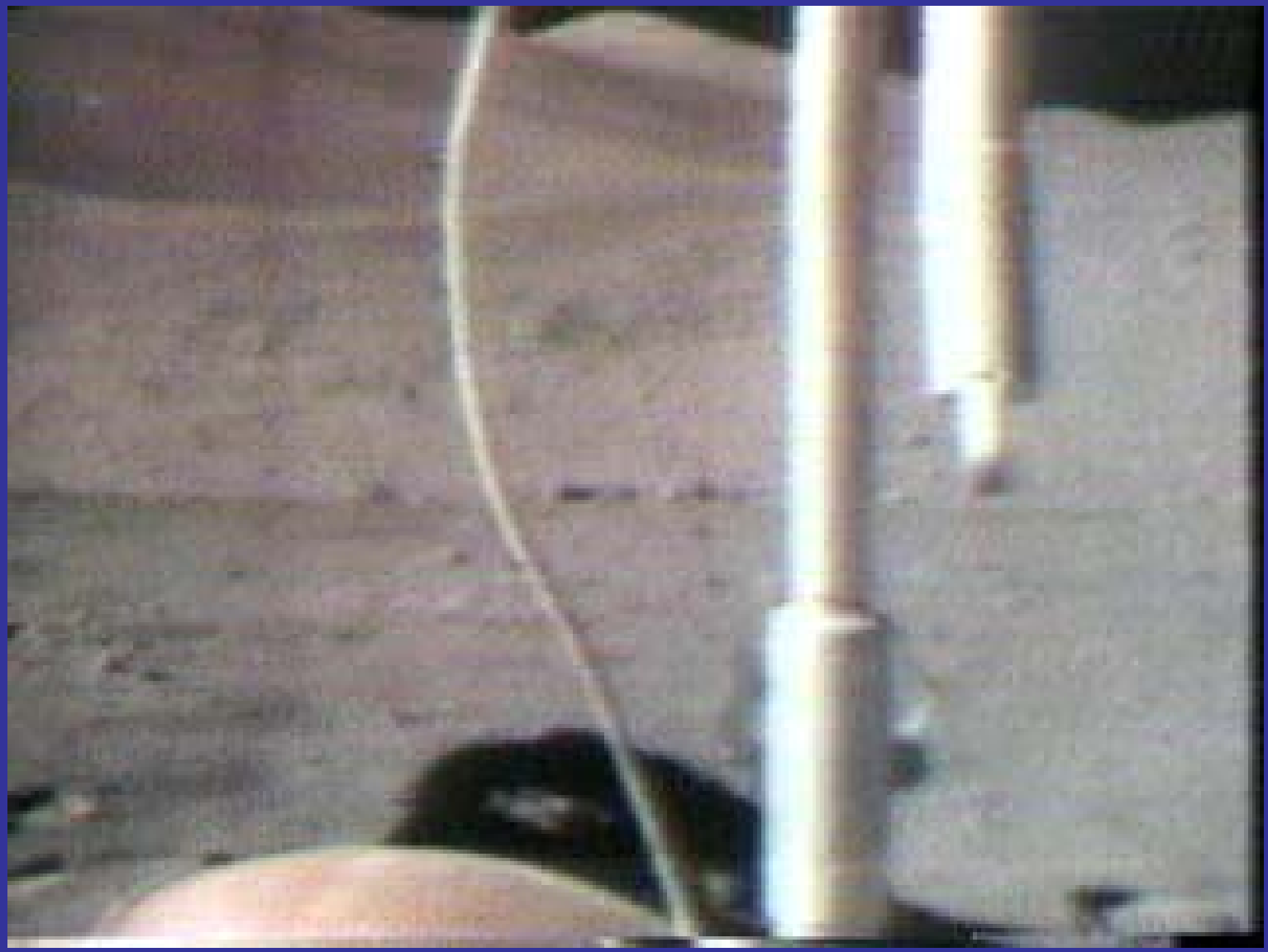
Buzz Aldrin climbs down the ladder

Apollo 11

Buzz Aldrin climbs down the ladder

Apollo 15 at Hadley Rille

Apollo 15 at Hadley Rille



Apollo 15

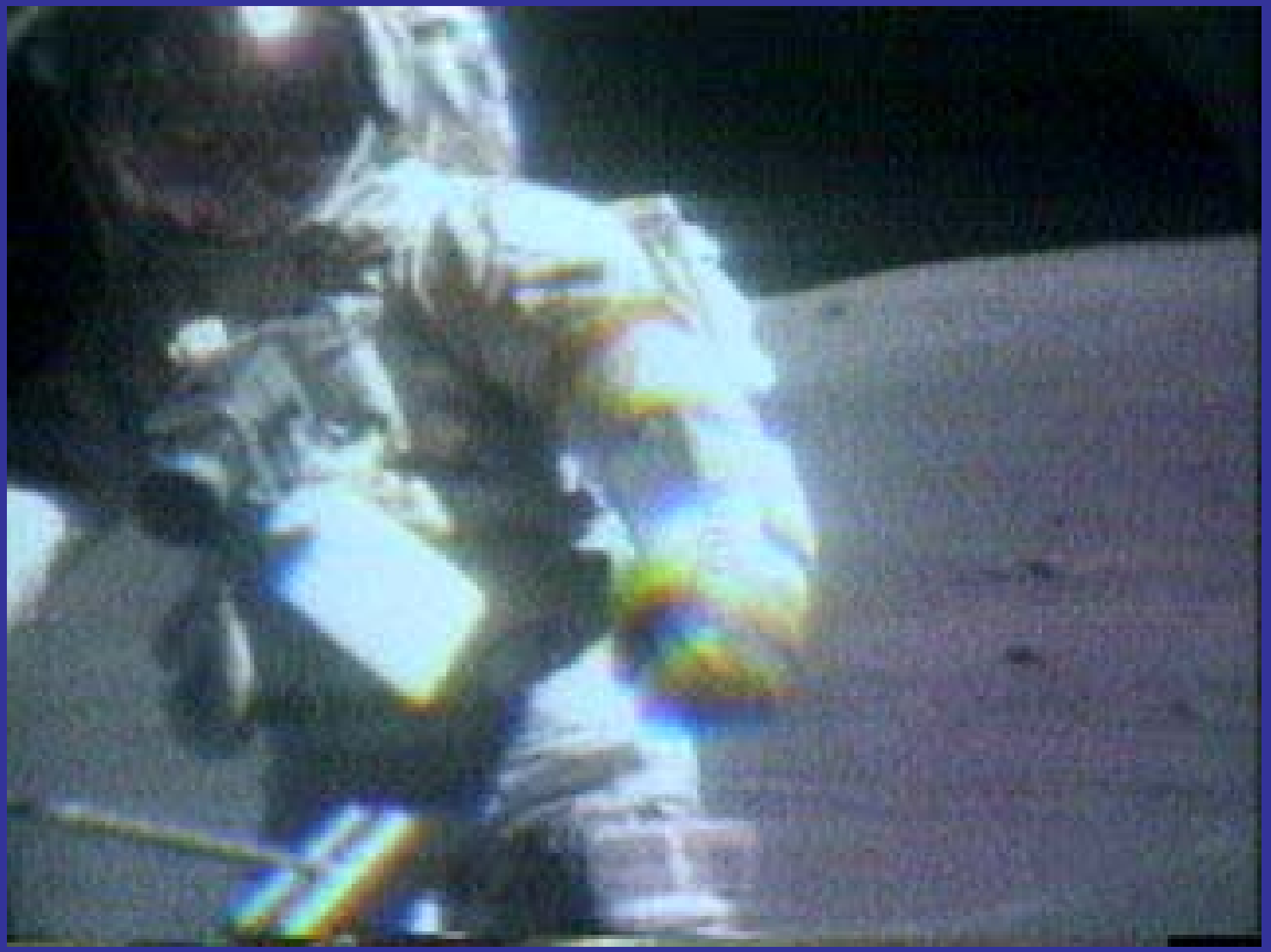
High resolution photography and a fall

Apollo 15

High resolution photography and a fall

Apollo 17 – lunar geological fieldwork

Apollo 17 – lunar geological fieldwork



The final takeoff – Apollo 17

Apollo astronauts leave the Moon for the last time, December 14th 1972

The final takeoff – Apollo 17

Apollo astronauts leave the Moon for the last time, December 14th 1972

End

Thanks for your interest in Apollo.

Philip Stooke