



# The Moon: Science, exploration and colonization

Gabriella Stenberg Wieser

Trial lecture for appointment as docent at Umeå university

**This lecture is dedicated to Willi Wieser**





## Moon compared to Earth

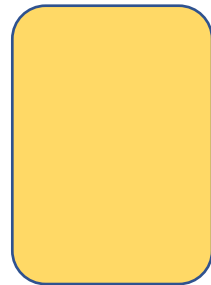
Radius:	1737 km	= 1/4 x Earth radius
Mass:	$7.342 \times 10^{22}$ kg	= 1/81 x Earth mass
Surface gravity:	1.622 m/s <sup>2</sup>	= 1/6 x Earth surface gravity
Surface pressure:	$10^{-12}$ bar	= no atmosphere

# How far away is the Moon?

Moon radius: 4.5 cm



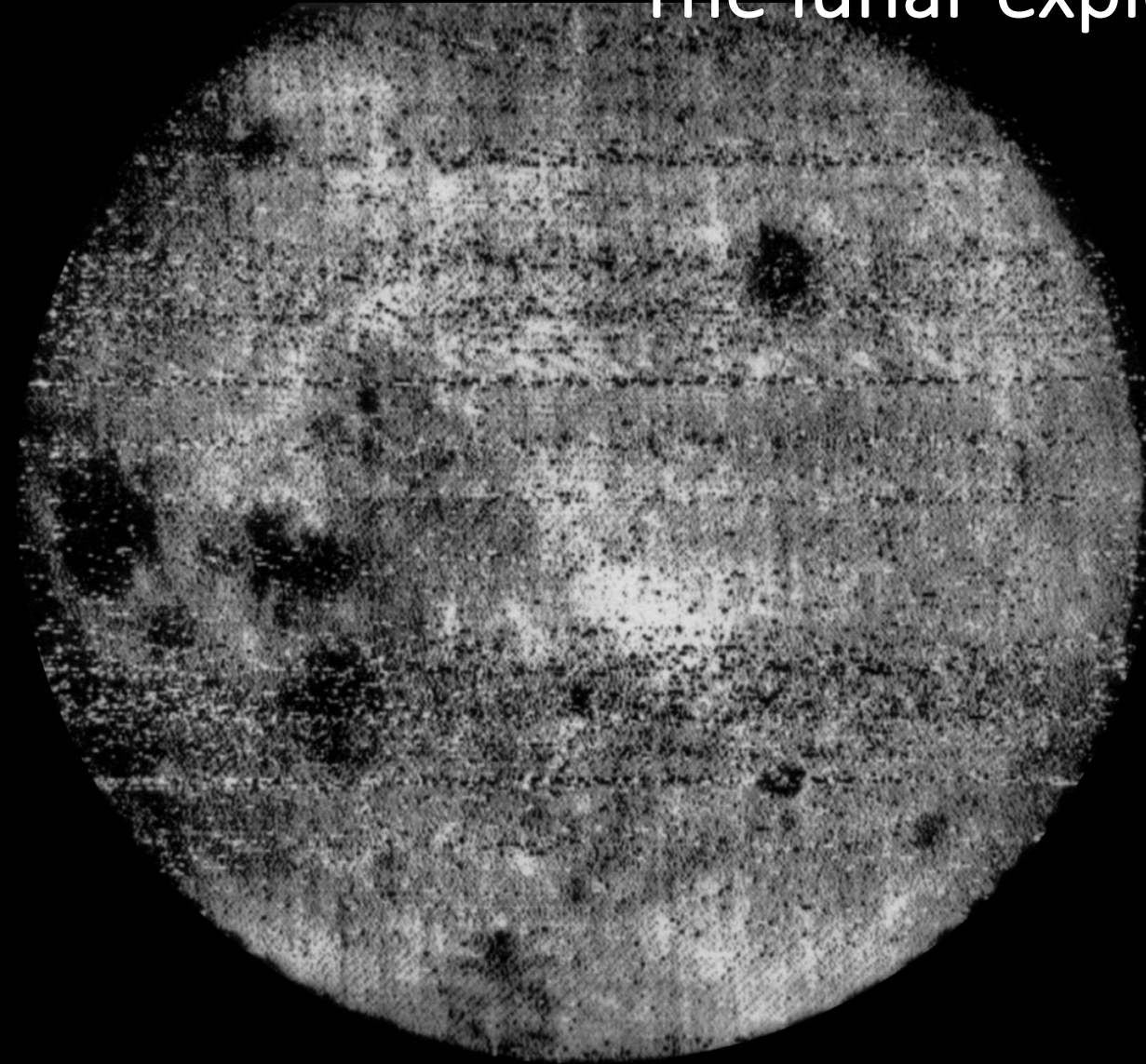
5 meter



10 meter



# The lunar exploration starts



**Luna 3**

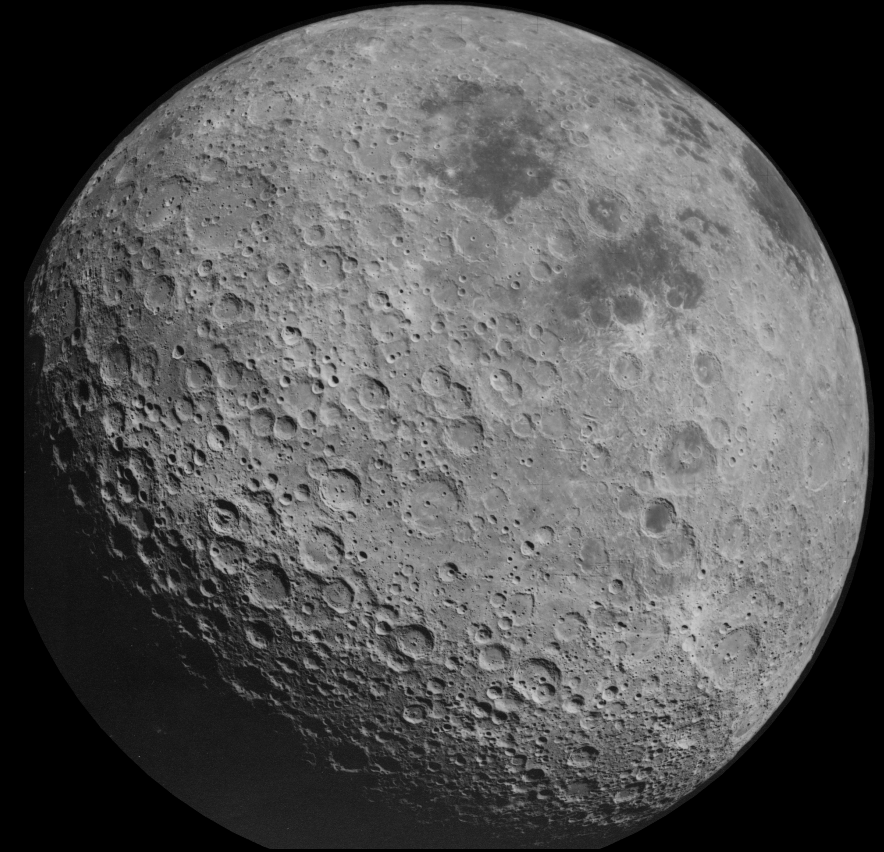
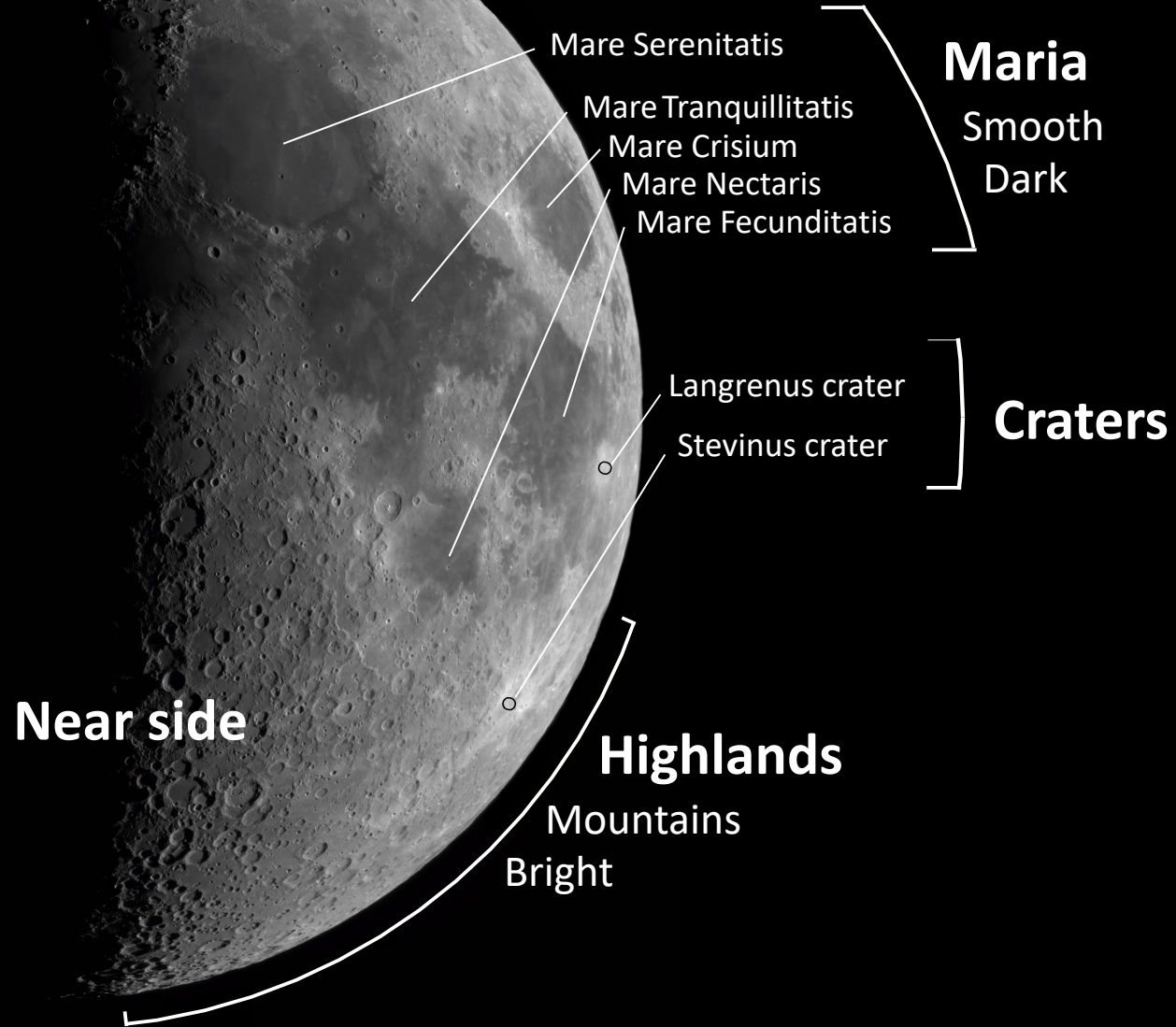
Launched in 1959



**Lunar Reconnaissance Orbiter**

Launched in 2009

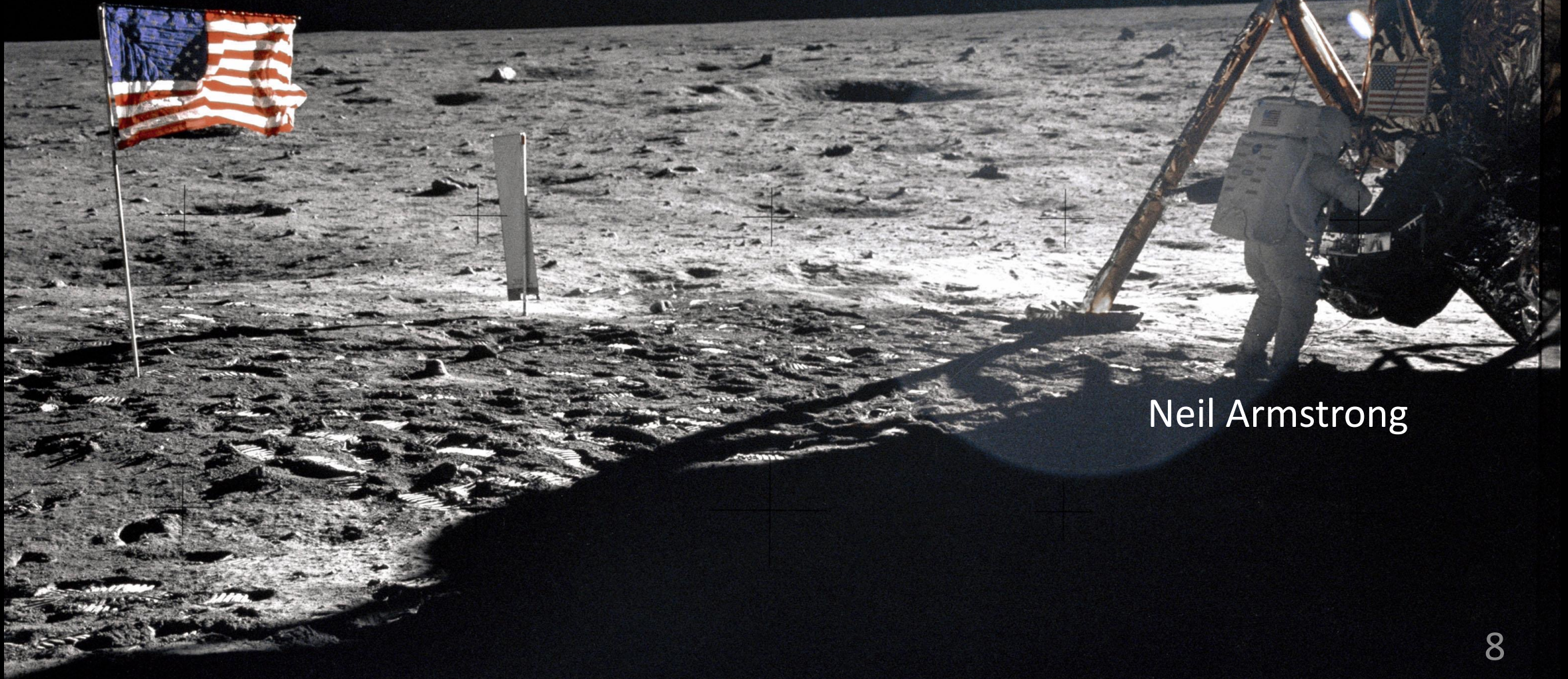
# The lunar landscape



**Far side**  
Almost no maria

# Apollo 11, July 1969

"That's one small step for [a] man, one giant leap for mankind"



Neil Armstrong



# Sweden on the surface of the Moon, part 1



Hasselblad camera, model 500C



# Sweden on the surface of the Moon, part 2

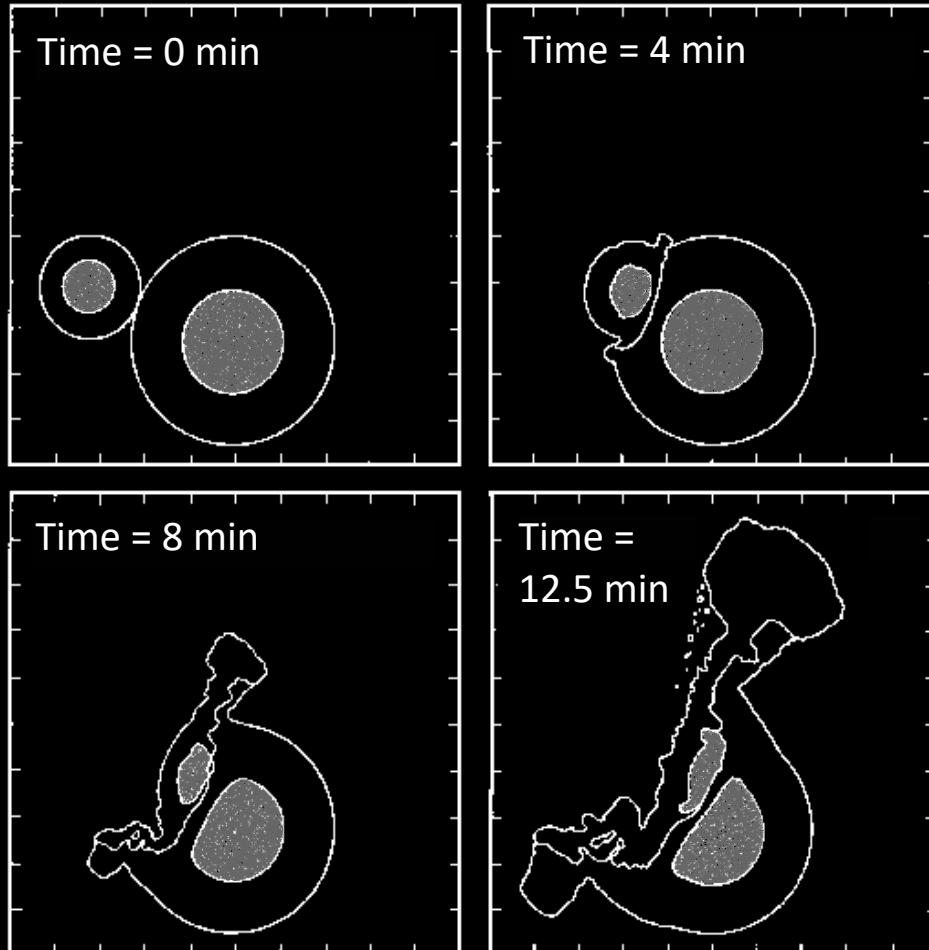
Edwin  
"Buzz"  
Aldrin



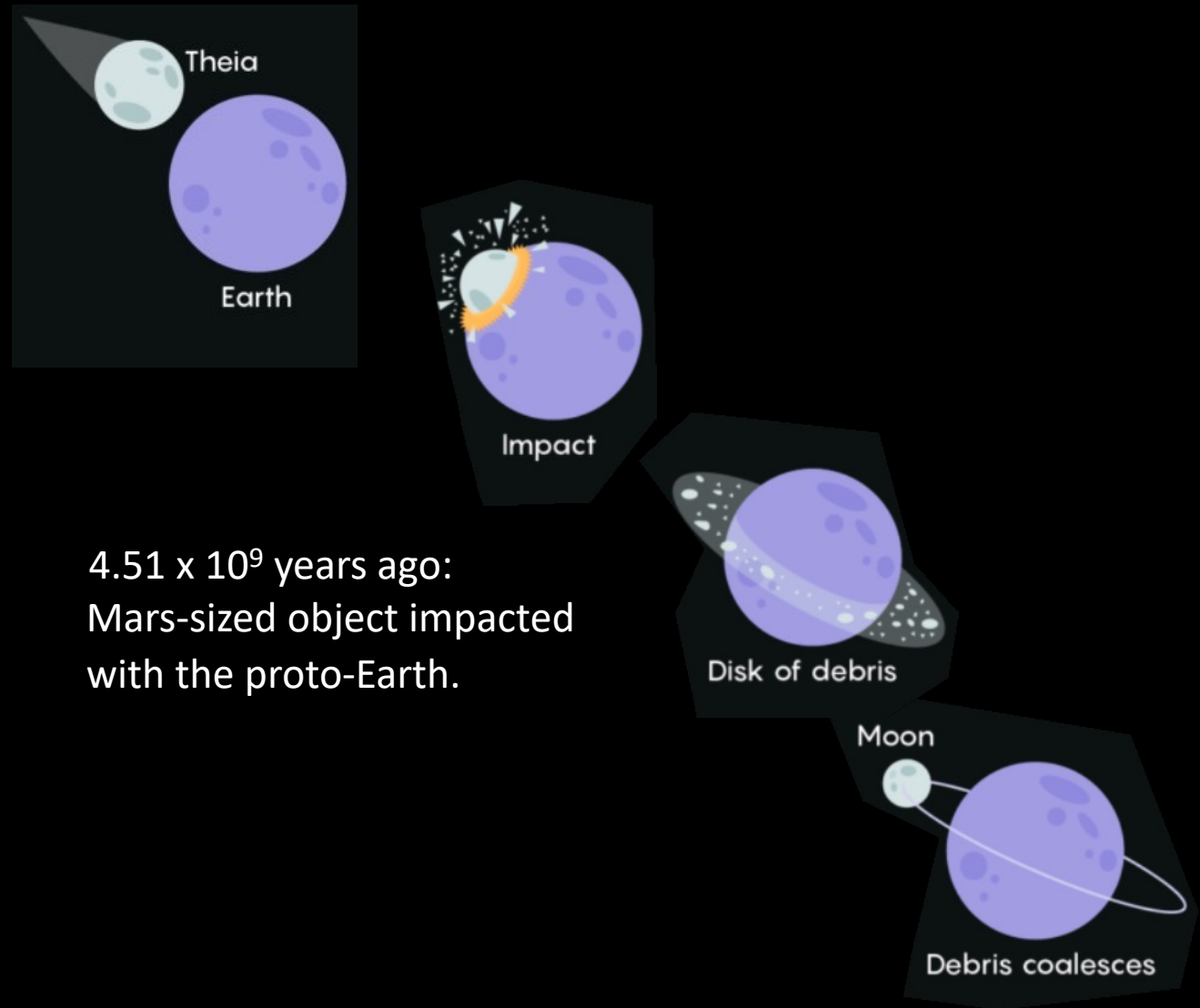
Grandparents Karl Johan and Anna  
emigrated 1892 from Stjärnsfors in  
Värmland

# Giant Impact Hypothesis

Simulation:



After Kipp and Melash, 1986

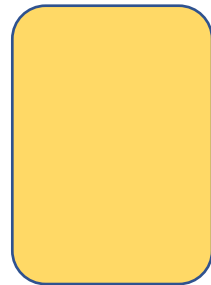


$4.51 \times 10^9$  years ago:  
Mars-sized object impacted  
with the proto-Earth.

Does the Moon have a magnetic field?

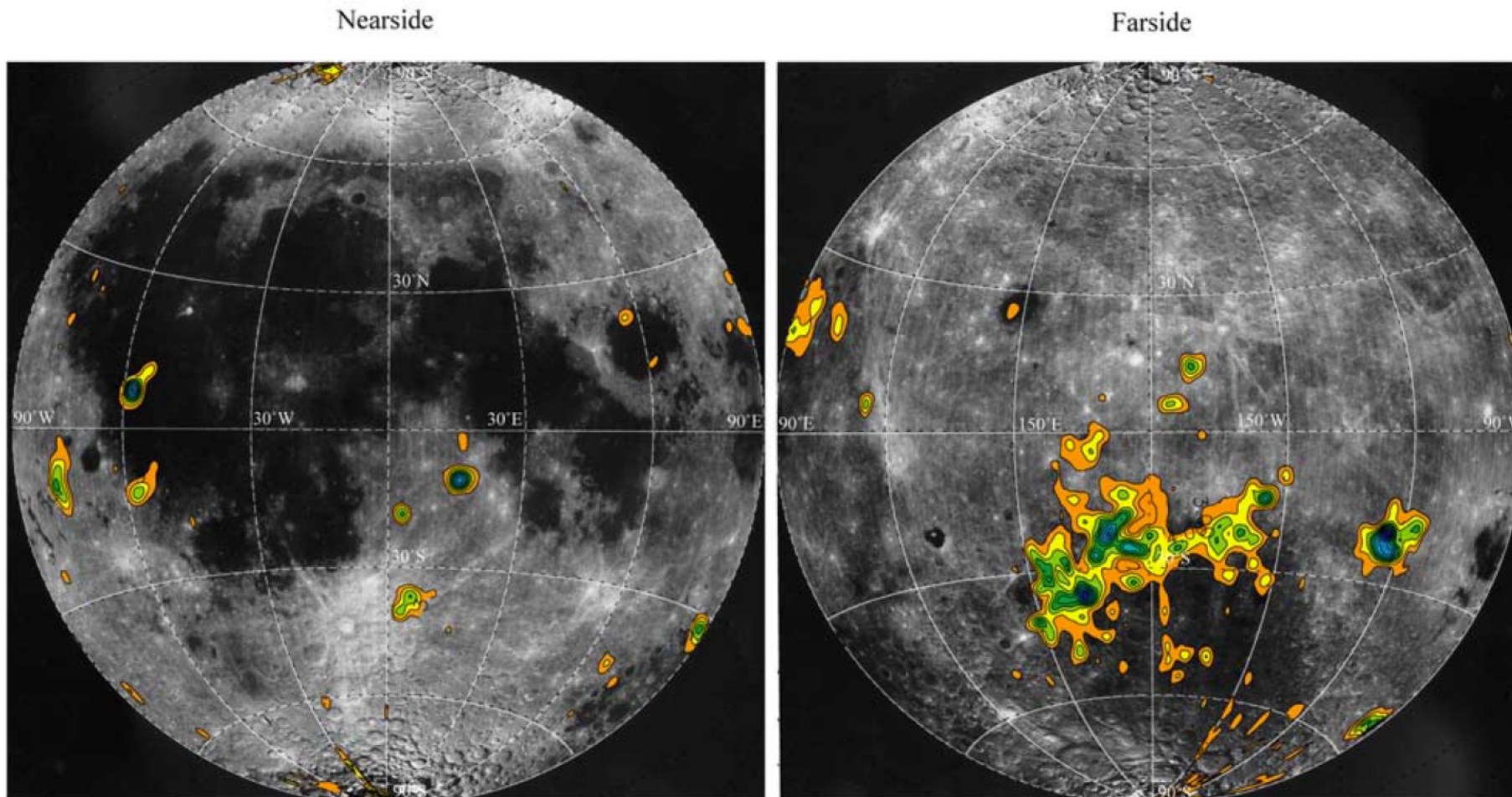


Yes



No

# The magnetic field of the Moon



Data from  
Lunar Prospector  
30 km altitude

Richmond and Hood, 2008



# More important findings

## **Not primordial**

complex geological history

## **Dry**

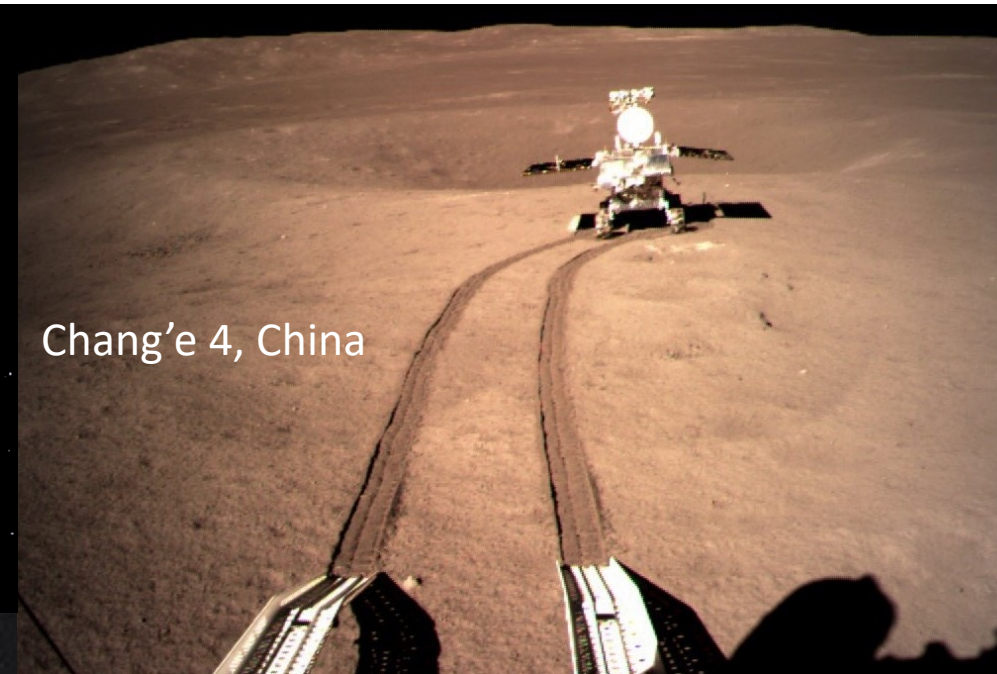
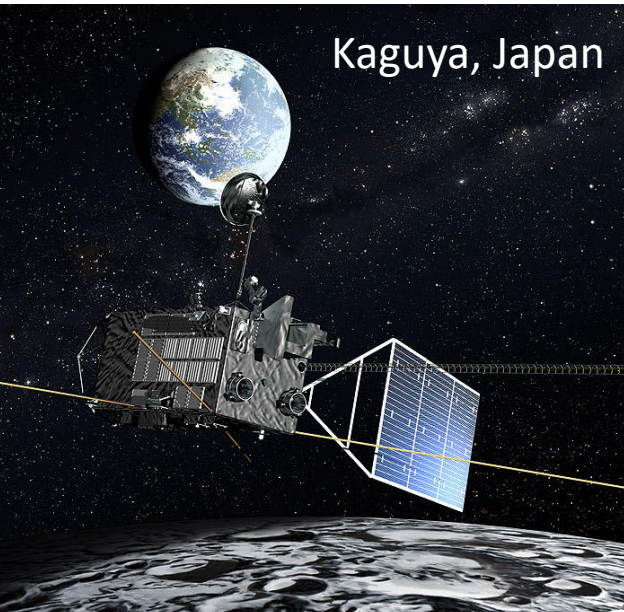
almost waterless

## **Lifeless**

no life, poor in key elements essential  
for life



# The second wave of Moon exploration 2003-now

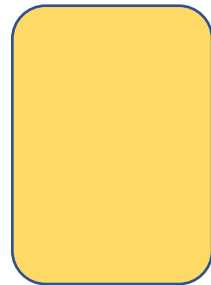


# How much water does this surface contain?

Surface area: 30 cm x 40 cm



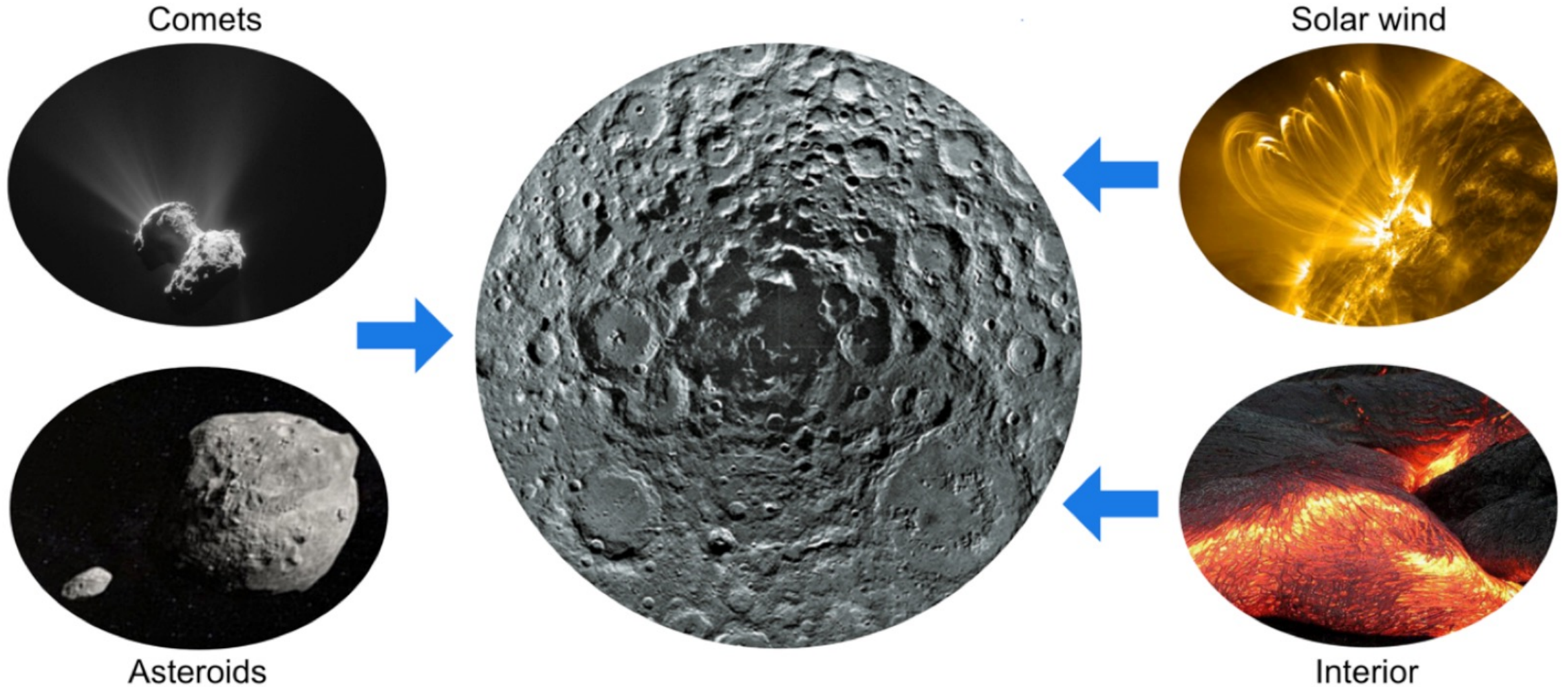
A single drop



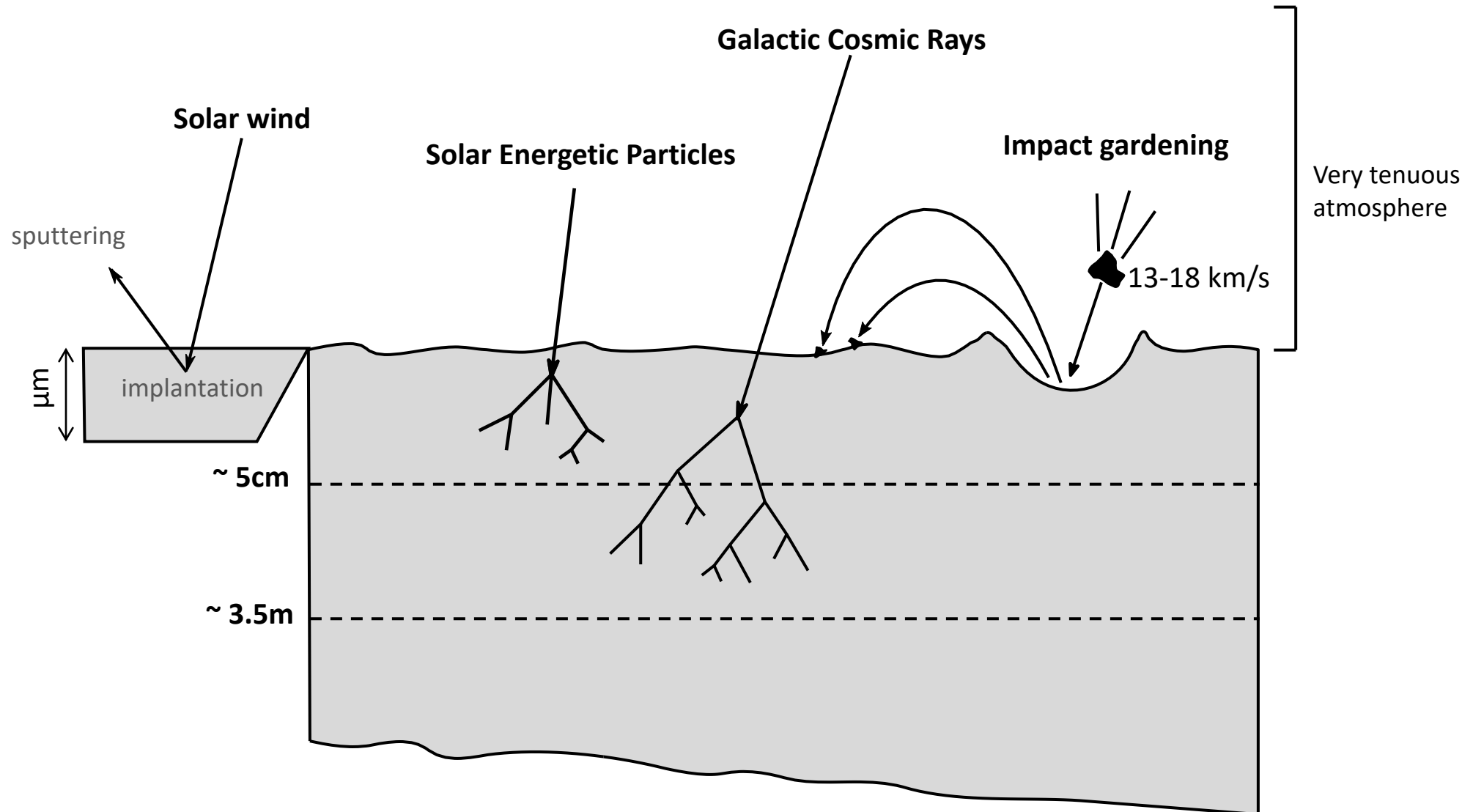
A tablespoon



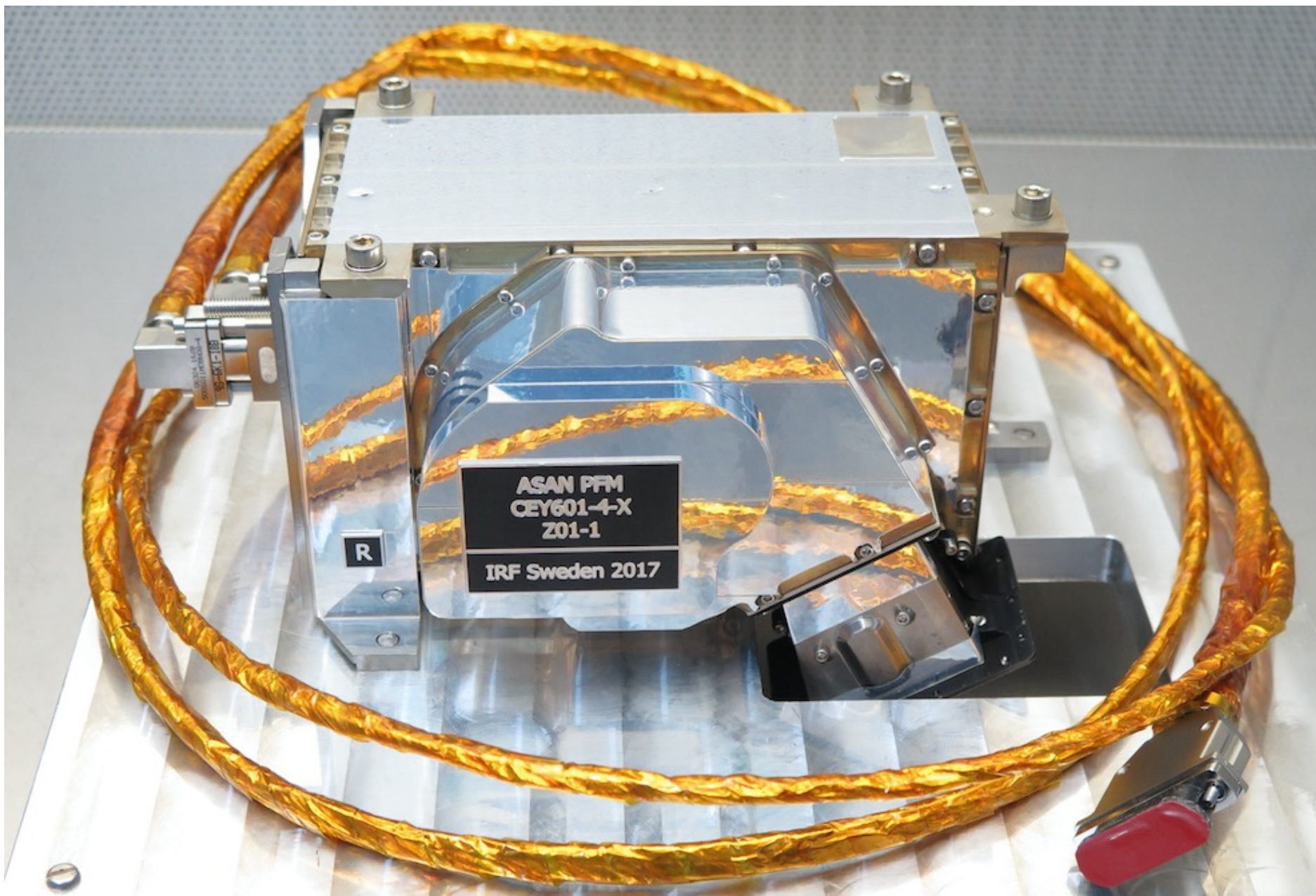
# What is the origin of lunar water?



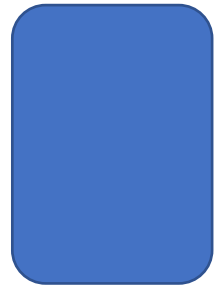
# Space weather effects



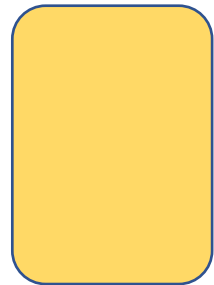
# Sweden on the surface of the Moon, part 3



# Can we build a lunar base and live there?

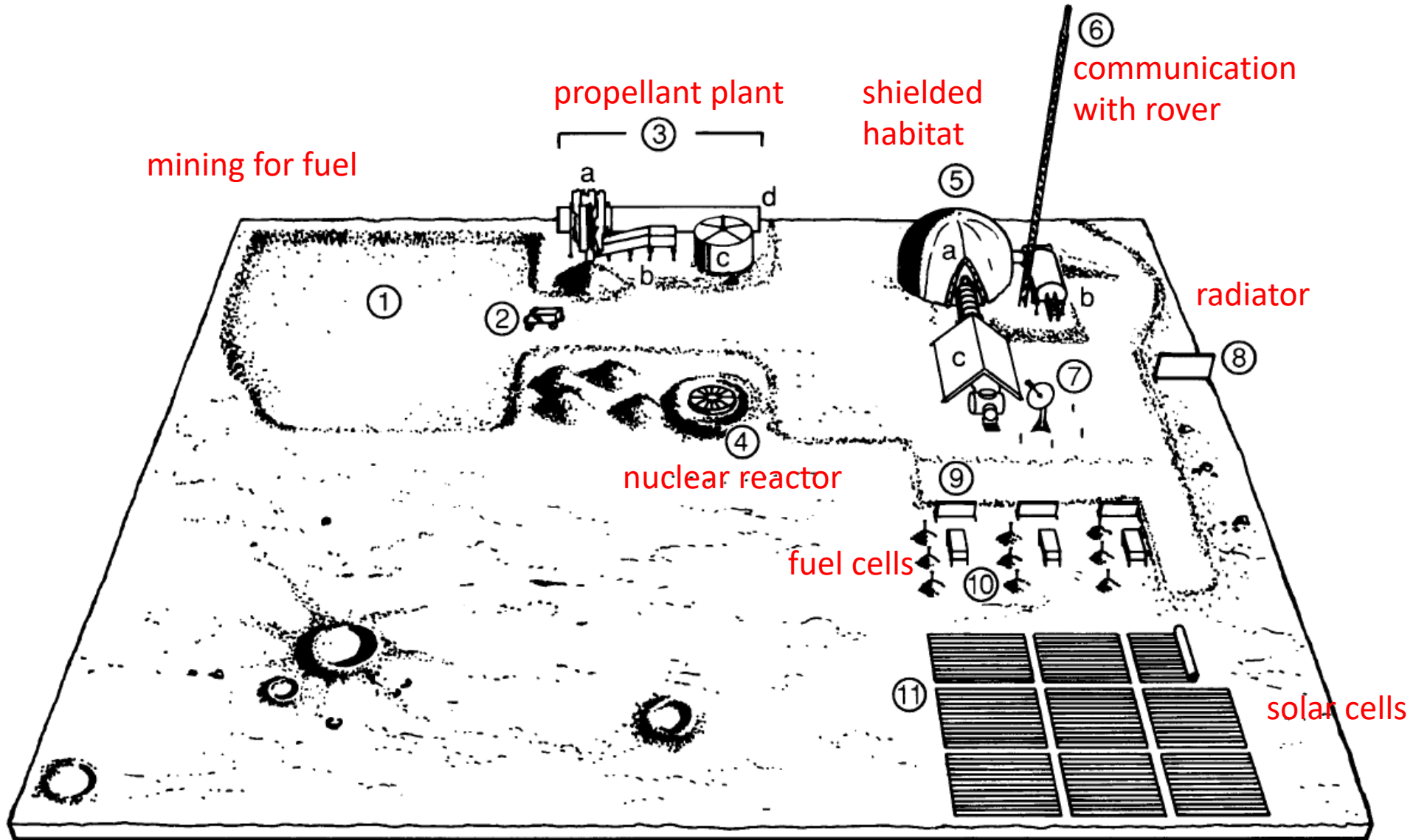


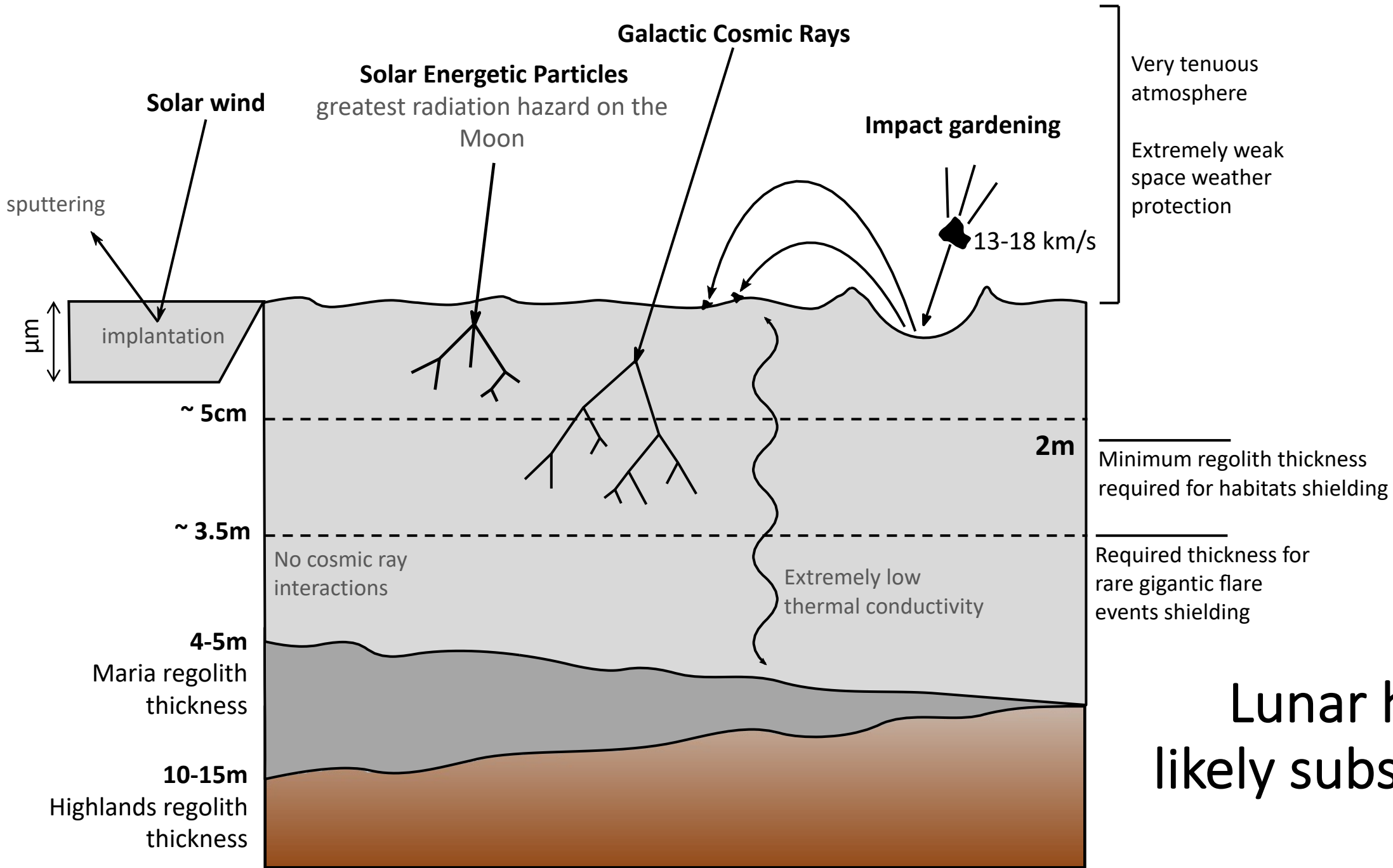
Yes



No

# A lunar base: NASA sketch from 1989





**Lunar habitat likely subsurface**



# Lunar Gateway