

WE

eur  **PLANET 2024**  
Research Infrastructure





Geology & Planetary Mapping

# Winter School

## Welcome and Introduction

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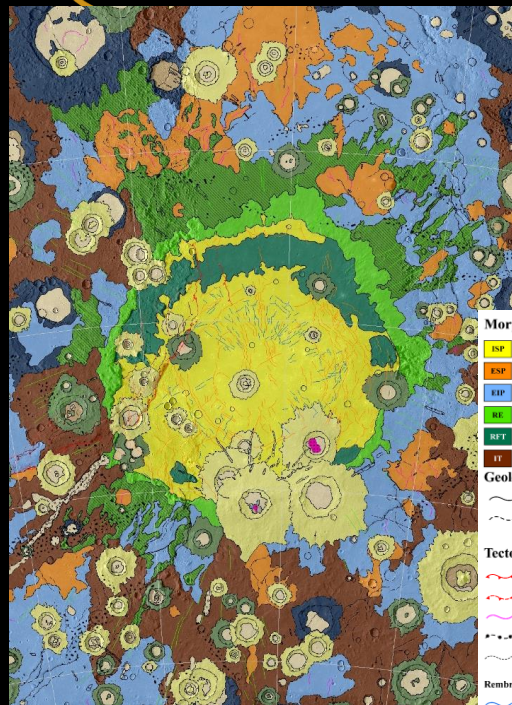


An artistic illustration of a Mars rover on the left and a child in a blue space suit on the right, both positioned on a colorful, stylized map of a planet's surface. The map features various colors like green, blue, brown, and yellow, representing different geological features. The rover has six wheels and a camera. The child is lying on their back, looking up. The text "Welcome to the 3rd Geology and Planetary Mapping Winter School" is overlaid in white on the map.

# Welcome to the 3<sup>rd</sup> Geology and Planetary Mapping Winter School

# The Geological Drama

A geological map is a representation on a topographic base of a territory, showing rocks and deposits distribution and ages. From geological maps it is inferable the territory geological evolution and the subsurface geometry of rock bodies.



Morpho-stratigraphic units	Crater materials
<b>ISP</b> Interior smooth plains	<b>SCF</b> Smooth crater floor
<b>ESP</b> Exterior smooth plains	<b>HCF</b> Hummocky crater floor
<b>EIP</b> Exterior intermediate smooth plains	<b>C3</b> Crater material - well preserved
<b>BE</b> Rembrandt ejecta deposits	<b>C2</b> Crater material - degraded
<b>RET</b> Rembrandt Rough Floor Terrain	<b>C1</b> Crater material - heavily degraded
<b>IT</b> Intercrater plains	

Geologic contacts	Linear features
Certain	Crest of crater rim (diam. >20km)
Approximate	Crest of small crater rim (diam. >10km)
	Crest of subdued or buried crater
	Striped basin-related features
	Irregular pit

Tectonic features	Surface features
Thrust - certain	Hollow cluster
Thrust - uncertain	Pyroclastic deposit
Wrinkle ridges	Secondary crater chain/cluster
Graben - uncertain	
Uncertain structure	
<b>Rembrandt basin tectonics</b>	
Extensional feature	
Contractural feature	

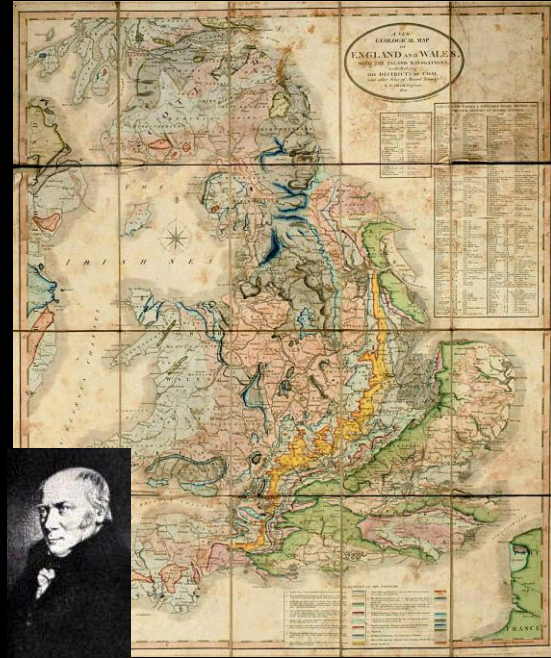


Staff: 5 horizontal lines and 4 spaces	Half Note: half the space equal to two to full note	Full duration of note or rest should be extended	<b>f</b> Forte: loud, powerful
G Clef or Treble Clef	Quarter Note: quarter note of whole note	Tie: to be played on one note	<b>ff</b> Fortissimo: very loud
Measure: space between 2 vertical bars	Detailed Quarter Note: dot over note	Triplet: played in time of two notes of same value	<b>mf</b> Mezzo-forte: moderately loud
Letters of spaces of Treble Clef	Quarter Note: quarter note of whole note	Slur: bracket should be smooth	<b>mf</b> Mezzo-forte: moderately loud
F Clef or Bass Clef	Eighth Note: one eighth of whole note	Accented: distinct, accentuated	<b>ff</b> Forte: loud, powerful
Letters of spaces of Bass Clef	Eighth Note: one eighth of whole note	Legato: very smooth and connected	<b>rit.</b> Ritardando: gradually slower
Double bar: end of a section or piece	Sixteenth Note: one sixteenth of whole note	Accent: emphasis to stress or highlight	<b>rit.</b> Ritardando: gradually slower
Repeat: section to be repeated	Sixteenth Note: one sixteenth of whole note	Ferocious: from force to be measured	<b>rit.</b> Ritardando: gradually slower
Whole Note: longest note in use	Chord: three notes into one full note	Crescendo: Time: some on last four notes	<b>rit.</b> Ritardando: gradually slower
Whole Note: longest note in use	Chord: three notes into one full note	Diminuendo: diminishing gradually to less than the first 1/2	<b>rit.</b> Ritardando: gradually slower
Half Note: half the time of whole note	Chord: three notes into one full note	Grand Staff: Treble and Bass Clefs	<b>rit.</b> Ritardando: gradually slower
	Chord: three notes into one full note	Phrasing: very soft	<b>rit.</b> Ritardando: gradually slower
	Chord: three notes into one full note	Phrasing: very soft	<b>rit.</b> Ritardando: gradually slower
	Chord: three notes into one full note	Phrasing: very soft	<b>rit.</b> Ritardando: gradually slower



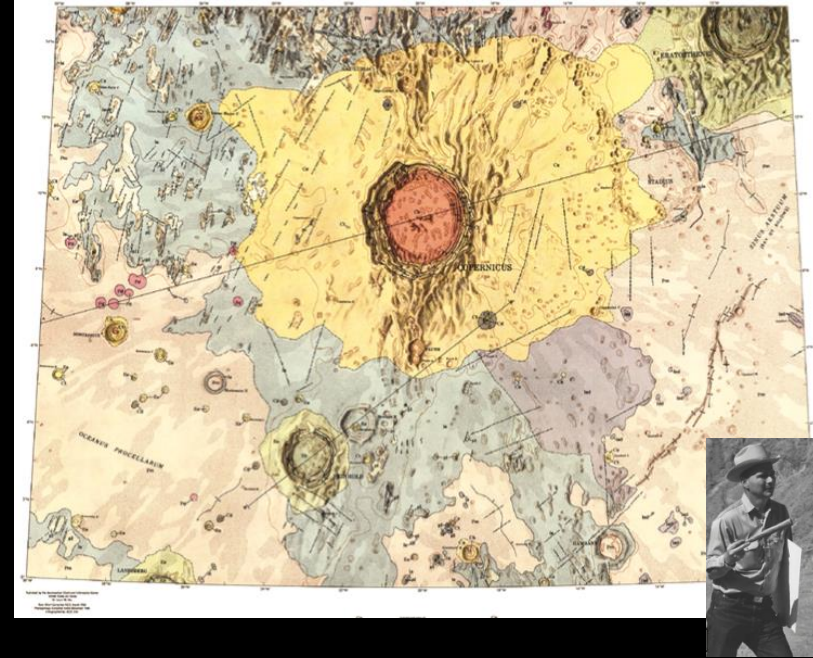
# Why Geological Maps

Smith 1815



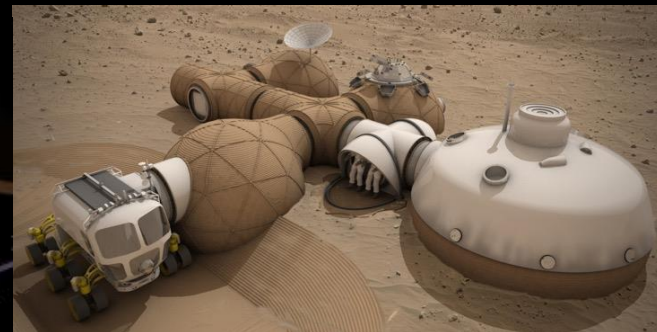
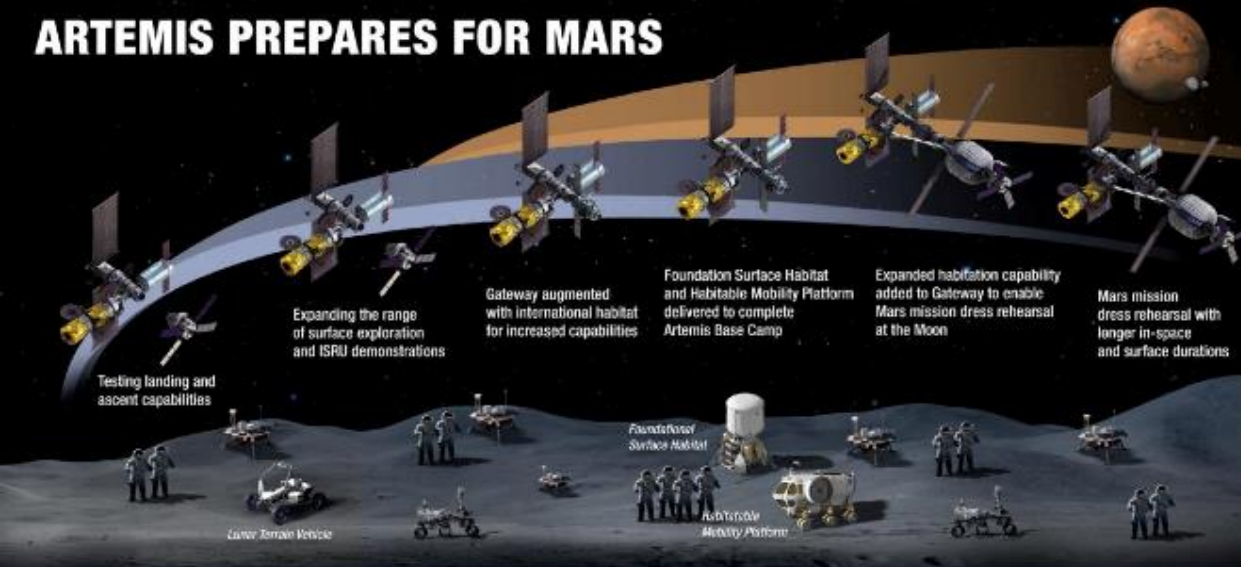
- ➔ Science investigation
- ➔ Resource exploration
- ➔ Resources evaluation, exploitation and management
- ➔ Hazard and Risk assessment
- ➔ Land use and Infrastructure planning
- ➔ Environment protection

Shoemaker 1960



# Future in situ Exploration: From the Moon to Mars

## ARTEMIS PREPARES FOR MARS



### SUSTAINABLE LUNAR ORBIT STAGING CAPABILITY AND SURFACE EXPLORATION

MULTIPLE SCIENCE AND CARGO PAYLOADS | INTERNATIONAL PARTNERSHIP OPPORTUNITIES | TECHNOLOGY AND OPERATIONS DEMONSTRATIONS FOR MARS

*Artemis Plan 2020*



# We need to land !



# What we are going to learn

## Lectures and Practicals

### How to produce Planetary Geological Maps

- Base data extraction and handling
- Reference Systems
- Mapping in GIS environment
- Geological mapping of Lunar and Martian surfaces
- Compositional data handling

### How to enable landing and traverses

- Trafficability and landing site safety
- Landing site characterization on Moon and Mars
- How to define science and in situ resource targets

### Tools and resources

- Mapping tools
- GMAP Jupiter Lab functionalities
- Gmap portal





# Seminars and Special Events

## The state of the Art

- Earth vs Planetary Geological maps
- Landing sites mapping on Moon and Mars
- Venus geological maps
- Titan Geological maps
- Geostructural mapping on Planets

## Perspectives

- Machine learning
- Digital Outcrop geomodelling
- Virtual Reality
- Human exploration on Moon and Mars

.....and GMAP community lightening on geological mapping of Mars in different contexts



# General logistics and schedule

- Schedule is flexible for asynchronous use, but tight → Not much time for speaker introductions
- No audio questions, in general
- Q&A = OK (next slide)



# How to ask questions

- If questions come up **during a talk**, please **write** them down on the **Q&A of Zoom**
- If questions come up **earlier/later**, please **write** them **clearly** and **concisely** on **Discord**



- Data available from:

<https://www.planetarymapping.eu/414/info-for-participants.html>

- Info & references on:

<https://github.com/europlanet-gmap/winter-school-2023>

## 3 options:

- A. Acceptance of participation → No strings attached (but no certificate)
- B. **Attendance & quizzes** (no grading, only >50% correct =OK) → **Basic certificate**
- C. Mapping tasks completed (=map produced) → **Advanced certificate**