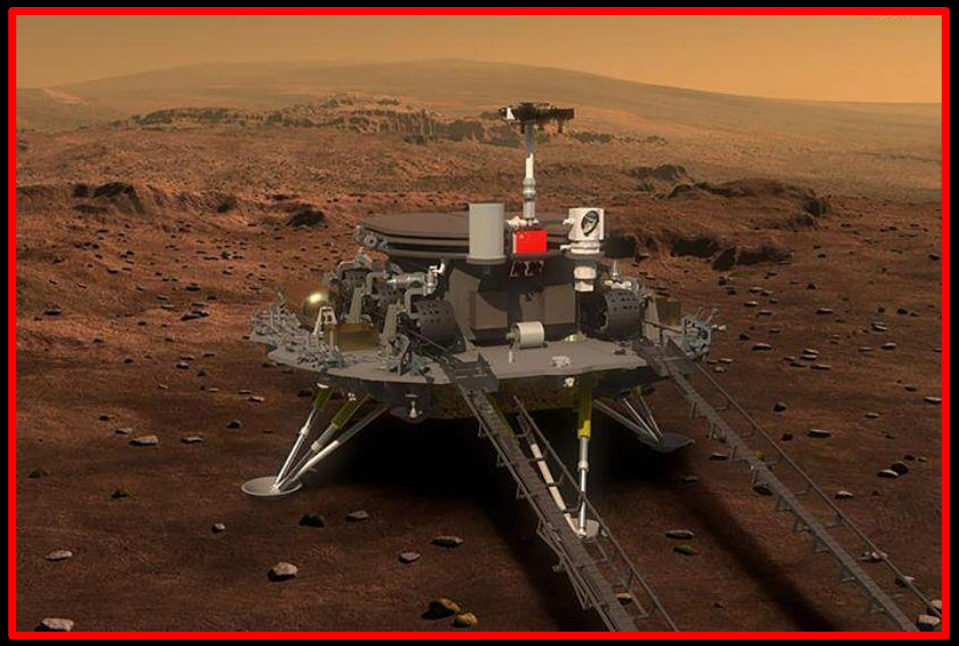
Space Exploration in China: The Rise of the Chinese Space Science and Exploration Community



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Caveat Emptor: Things to be careful about:

- **The Wolf Amendment:** It is against US Federal Law to expend NASA funds to undertake US-PRC bilateral cooperation.
  - Multilateral activities are permitted.
  - Attendance at international meetings in the PRC and elsewhere is permitted.
  - When in doubt, ask your NASA POC or Program Manager.
  - It is NOT "better to ask forgiveness than to ask permission".
  - For more guidance, read the very helpful NASA FAQs.
- -**National Security:** Space exploration and technology are dual use: Civilian/Economic and Military.
  - There are efforts by ALL countries to penetrate confidential and secret data sources and illegally procure information for economic, strategic and military use.
  - For more information about threats to the US and ways to recognize these, read the FBI Document online.

Role of National Space Programs.

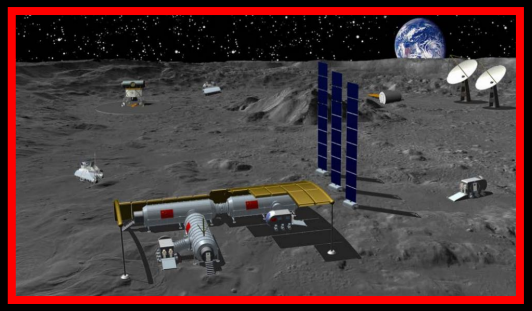
- Space is a scientific, technological and organizational frontier.
- Accomplishments in space demonstrate national power: *Sputnik, Apollo 11*.
- Accomplishments in space provide pride, prestige, inspiration to youth for science/technical careers.
- Accomplishments in space involve dual-use military-civilian technology.
- Accomplishments in space enhance national security and provide vertical and horizontal projections of power.
- Accomplishments in space provide international leadership and national legitimacy: Soviet *Interkosmos* Program.

The Current Chinese National Space Program:

- **PRC National Priorities and Space Exploration:** Communist Party Congress.
- **Implementation Timeline:** The long view: The "Peaceful Rise of China" the "Belt and Road Initiative" and the "Silk Road to Space".
- **International Cooperation and Competition:**
- **USA and China: A new "Space Race"?**
- **The PRC Space Program:** History, organization and the difference between the human and robotic space programs:

History of the Chinese Space Program

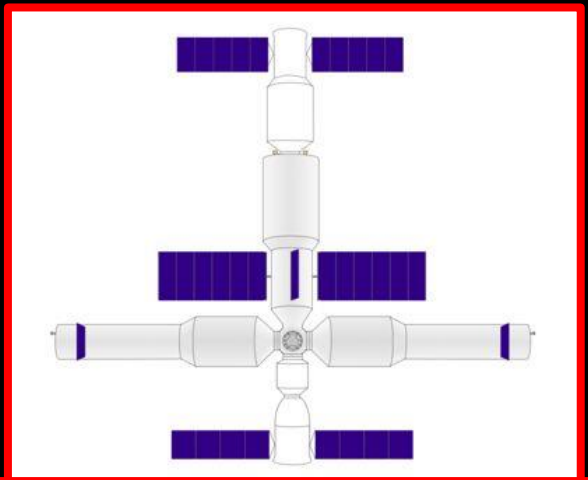
- Project 714 (1967): *Shuguang*: 2 person capsule.
- (1970) First Satellite *DongFangHong One* (The East is Red).
- Project 863 (1986): State Council extra-budgetary source of funding for technology; make China independent. 7th 5YP.
- Project 921 (1992): (*Shenzhou*) Phase I: To launch a human mission by 2002. Phase II: Temporary space laboratory by 2007. Phase III: Permanent space station.
- Project Lunar Exploration (2004): Three phases: orbiting the Moon; landing and roving; and returning samples. Preparation for human exploration.



中国探月
CLEP

Human and Robotic Chinese Exploration Programs

People’s Liberation Army GAD (General Armaments Department) (CMSEO) (CMCEDD)



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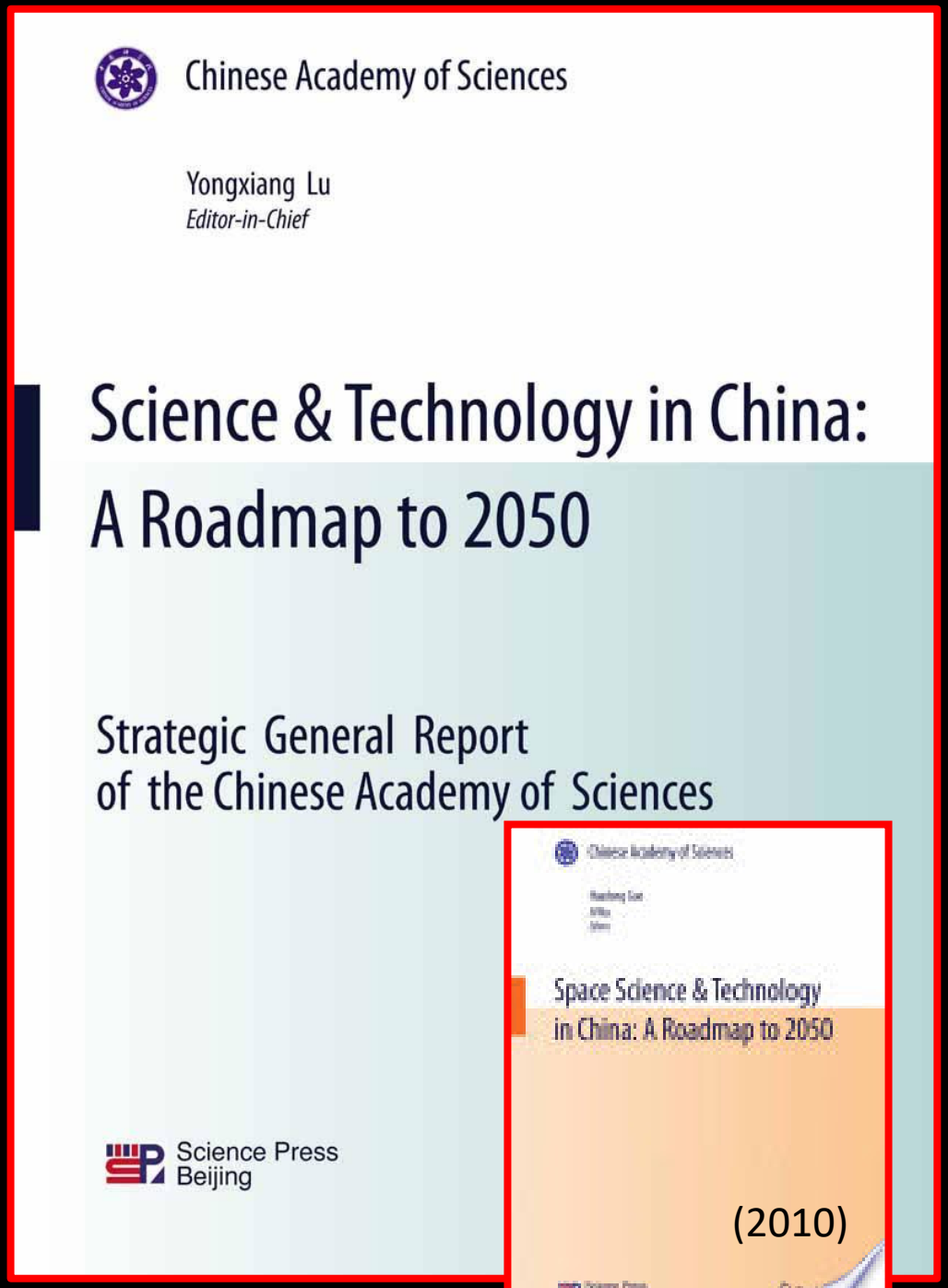
Human and Robotic Chinese Exploration Programs



Strategic Planning

- Defines set of key Strategic Goals.
- 1: Strategic Goal of Space Science.
- 2: Strategic Goal of Space Applications.
- 3: Strategic Goal of Space Technology.

Strategic Planning

- Outlines scientific questions.
- Presents strategic goals through 2030.
- Very broad space science.
- Names missions and required technologies.
- Provides future national funding estimates.
- Describes Jupiter System Exploration Mission.

国家航天局
China National Space Administration

CALT

中国航天科技集团公司
China Aerospace Science and Technology Corporation

NAOC

中华人民共和国工业和信息化部
Ministry of Industry and Information Technology of the People's Republic of China

中国探月
CLEP

中国科学院
CHINESE ACADEMY OF SCIENCES

中国地质大学
CHINA UNIVERSITY OF GEOSCIENCES

澳門科技大學
MACAU UNIVERSITY OF SCIENCE AND TECHNOLOGY
格意物誠

CASC

中国航天科技集团公司
China Aerospace Science and Technology Corporation

中国航天

中国长城工业集团有限公司
China Great Wall Industry Corporation

CALT

Chinese Lunar Exploration Program

中国探月

CLEP

国家航天局

China National Space Administration

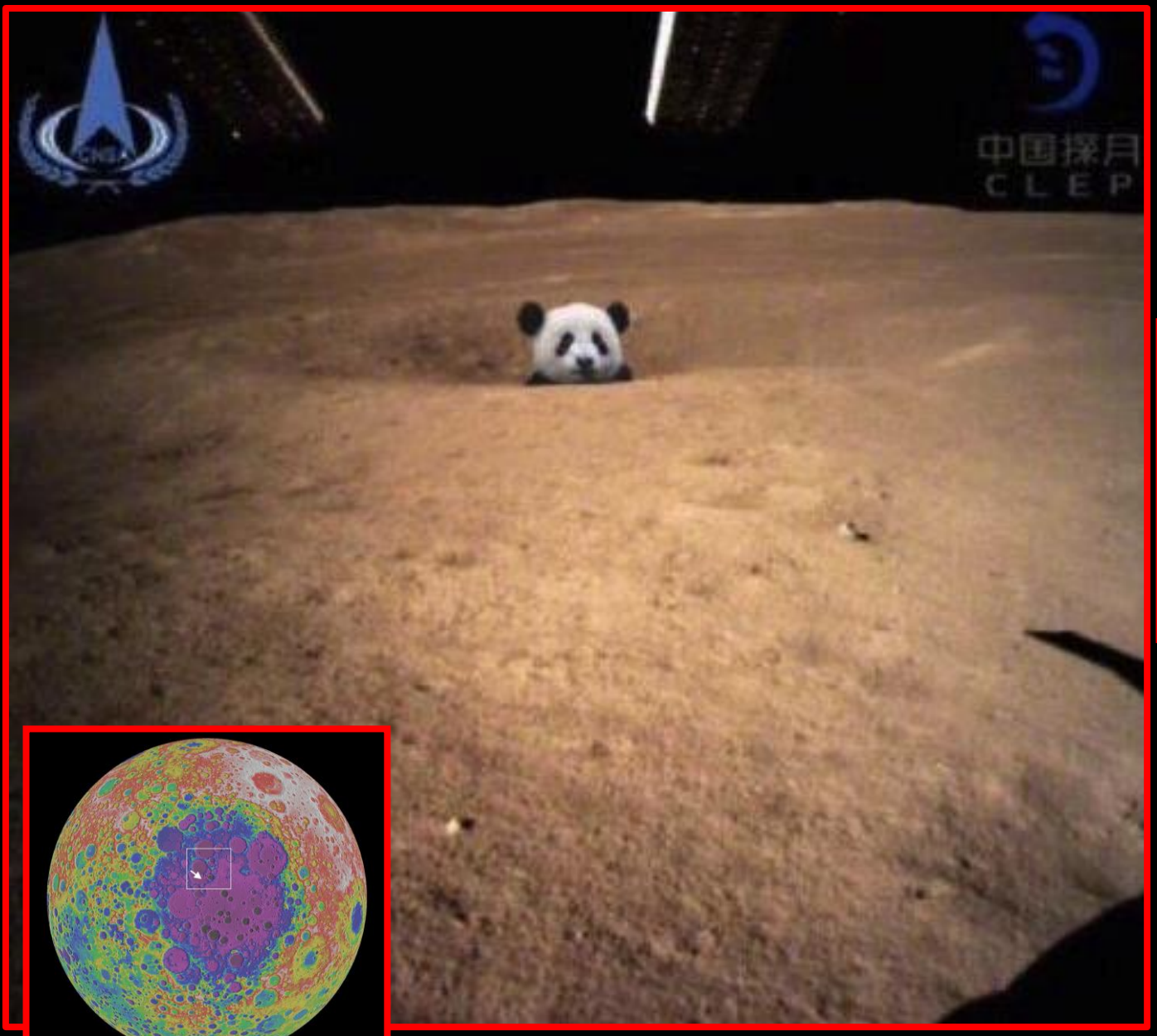
Chinese Lunar Exploration Program (CLEP) (中国探月)

Academician
Ouyang Ziyuan

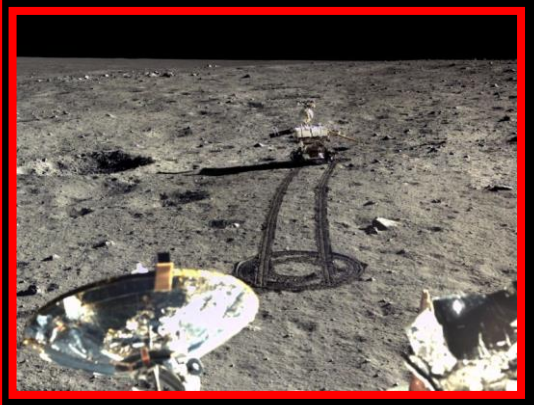
Institute of Geochemistry
Chinese Academy of Sciences

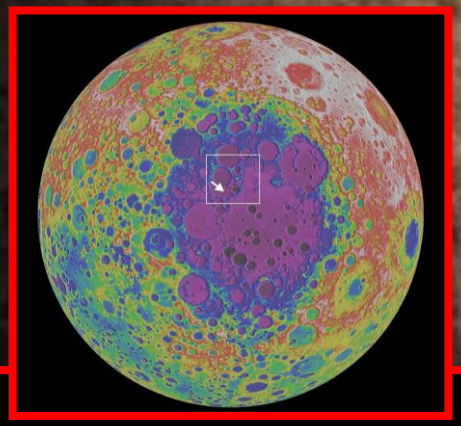
- Prominent Chinese geologist, chemical cosmologist.
- Among the first to advocate exploitation of known lunar metals reserves (titanium).
- Served as Chief Scientist of CLEP.

Chang'e 4 - Lunar Farside Von Kármán Crater - South Pole-Aitken Basin



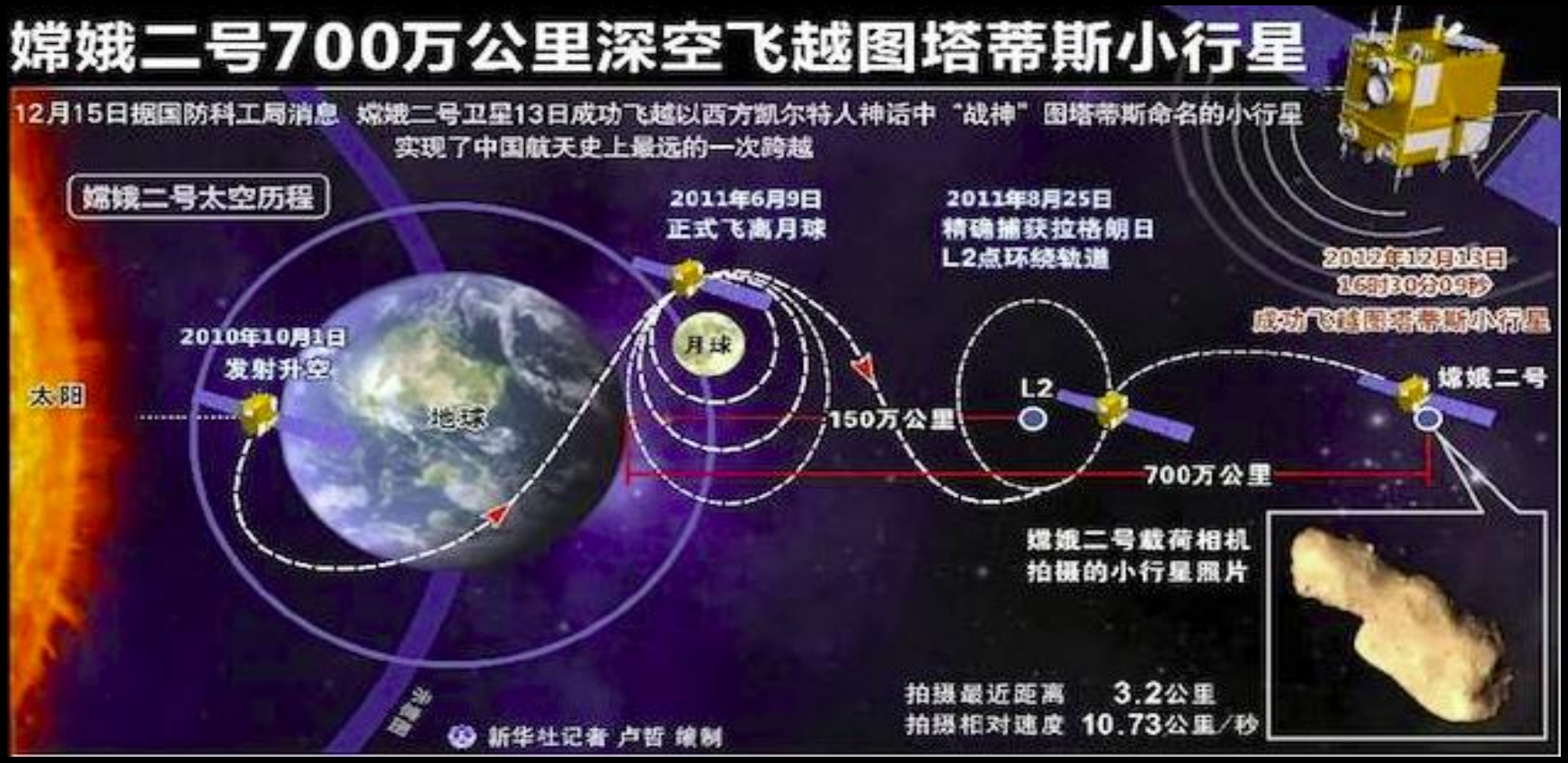
Yutu-2





Chang'e 5-
Lunar Sample Return-
Young Mare Basalts in
NW Procellarum.

President Xi Jinping Greets Chang'E 4 Engineers and Scientists
Great Hall of the People – February 20, 2019

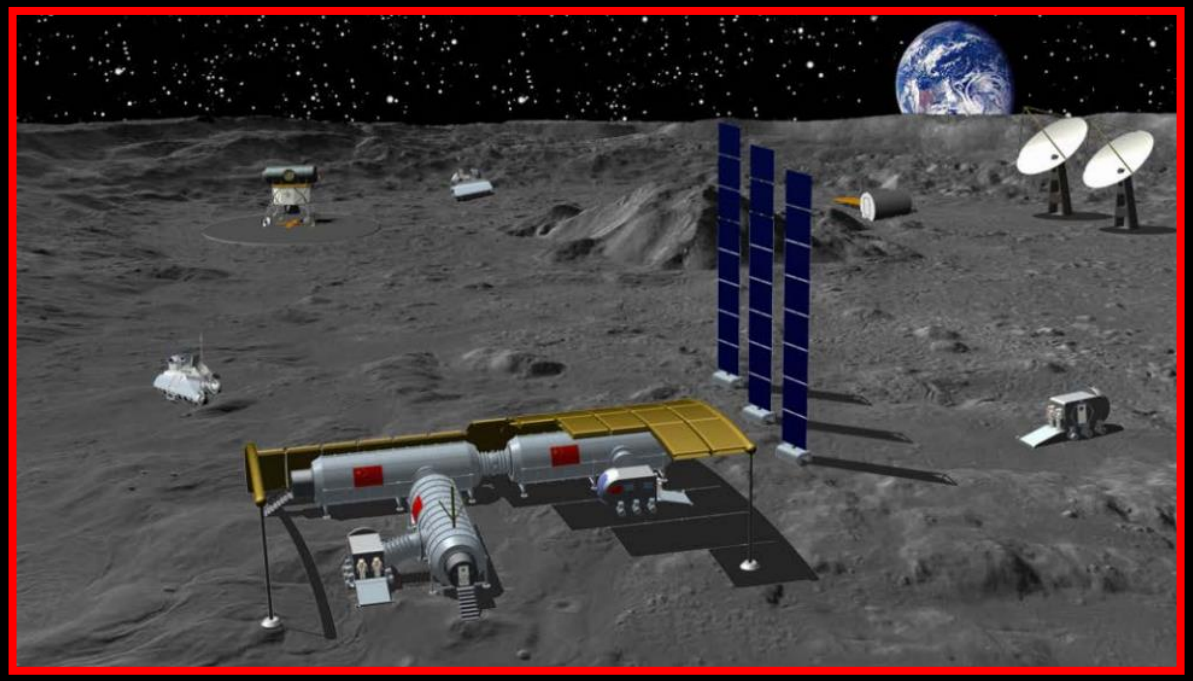


- Chang'e 2, launched on 1 October 2010 aboard a Long March 3C rocket, reached the Moon in under 5 days, compared to 12 days for Chang'e 1, and mapped the Moon in even greater detail. It then left lunar orbit and headed for the Earth–Sun L2 Lagrangian point in order to test the TT&C network. Having done that it completed a flyby of asteroid 4179 Toutatis on 13 December 2012, before heading into deep space to further test the TT&C network.

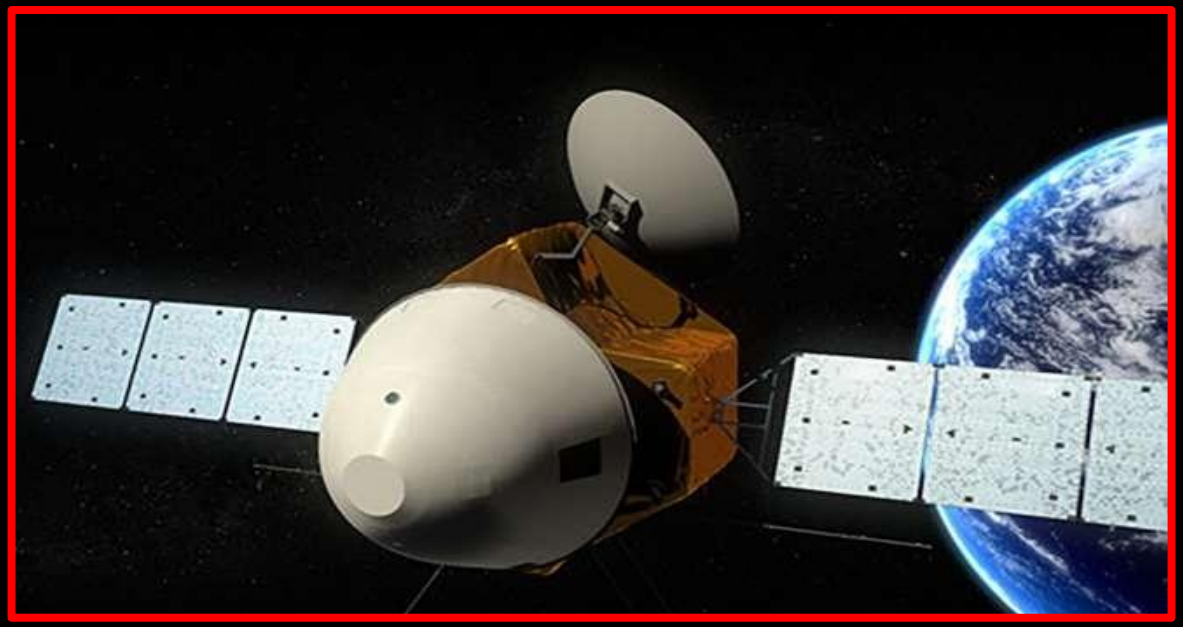
Ultimate Goal of the CLEP

The ultimate objective of the program is to pave the way for a human mission to the Moon. Such a mission may occur in the 2020s-2030s.

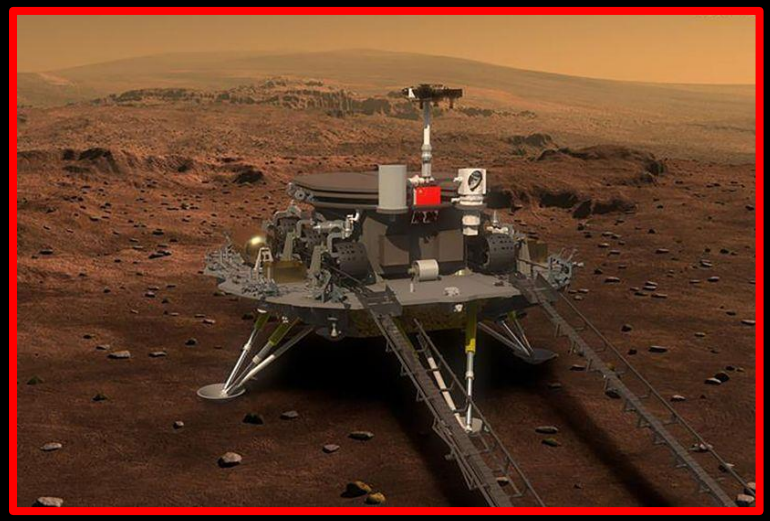
中国探月
CLEP



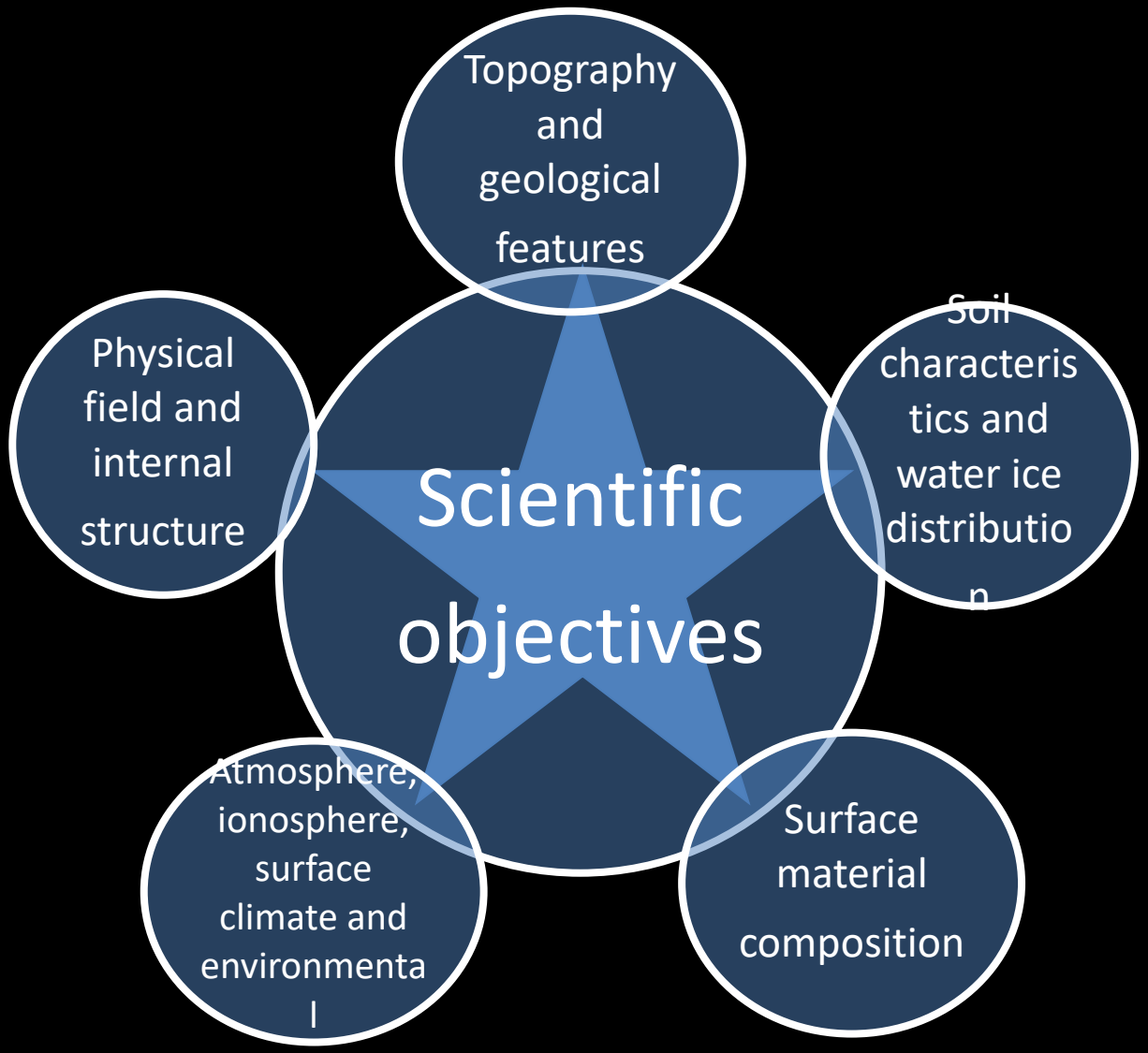
Mars 2020 Mission (Orbiter-Lander-Rover)



Mars Simulation and Training Base: Proposed base covers 95,000 km^2 in the Qaidam Basin, a Mars-like arid desert region on the Qinghai-Tibet plateau.



Scientific objectives of China's first Mars exploration

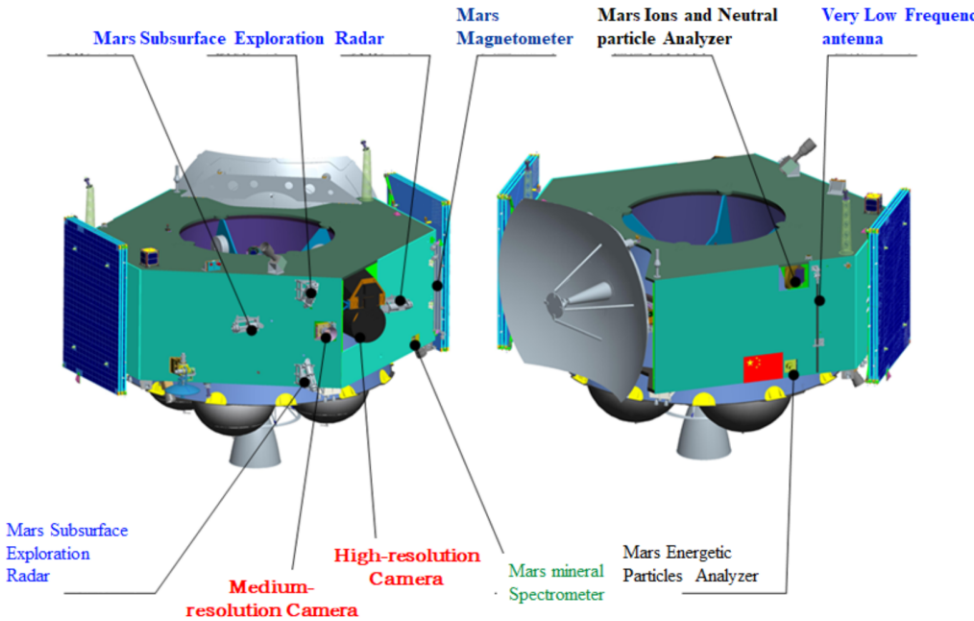


Scientific Mission of Orbiter

- Analysis of Mars atmosphere, ionosphere and exploration of interplanetary environment
- Mars surface and underground water ice detection
- Mars soil type distribution and structure detection
- Mars topographic and geomorphologic features and their variation detection
- Investigation and analysis of Mars surface composition

Scientific mission of Orbiter and data characteristics

Scientific Tasks	Payloads Equipped
(1) Analyze the Martian atmospheric ionosphere and detect the interplanetary environments	Mars Magnetometer
	Mars Ions and Neutral particle Analyzer
	Mars Energetic Particles Analyzer
	Very low frequency radio receiver (integrated in the Mars Subsurface Exploration Radar)
(2) Detect the water-ice upon and under the Martian surface	Mars Subsurface Exploration Radar
(3) Detect the Martian soil type distribution and structure	Mars Subsurface Exploration Radar , Mars Mineral Spectrometer
(4)Detect the Martian topography and landform features, and evolution of them	Medium-resolution Camera, High-resolution Camera
	Mars Subsurface Exploration Radar
(5) Investigate and analyze the material composition of Martian surface	Mars Mineral Spectrometer

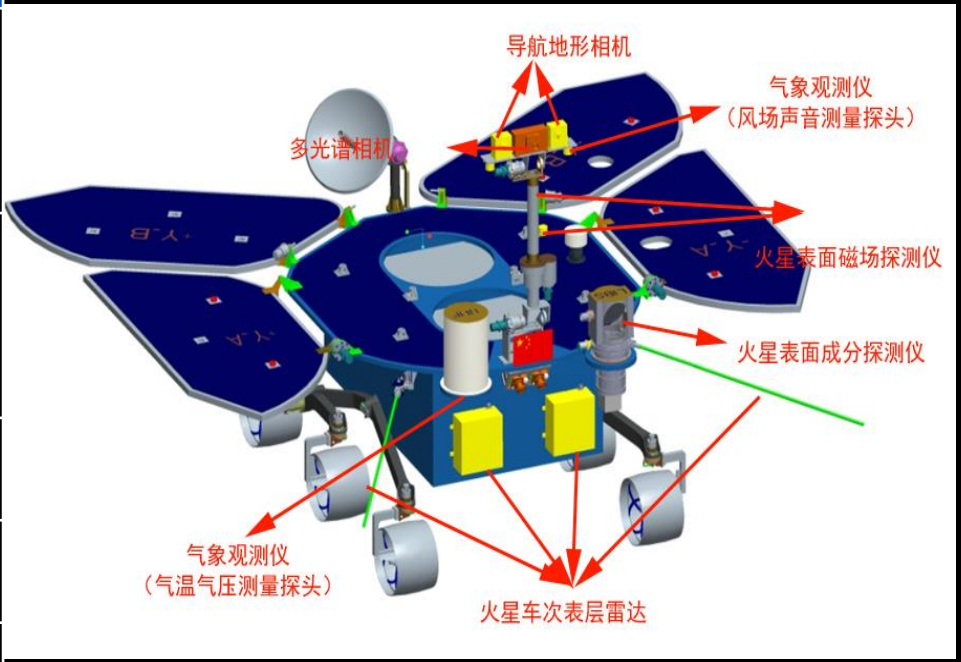


Scientific Mission of the Mars rover

1. Topography and geological structure detection of rover exploration area
2. Soil structure and water ice detection
3. Surface elements, minerals and rock types detection
4. Atmosphere physical characteristics and surface environment detection

Scientific Mission of the Payloads on Orbiter

Scientific Tasks	Payloads Equipped
Detect the topography, landform and geological structure around the roving area	Topography Camera
Detect the soil structure(geologic section) and the water-ice in the roving area	Subsurface detection radar
Detect the type of the element, mineral and rock on the surface of roving area.	Mars Surface composition detector
	Multispectral Camera
Detect the atmospheric physics features and surface environment around the roving area	Mars magnetic field detector
	Mars climate detector



China Mars 2020 Mission Payloads

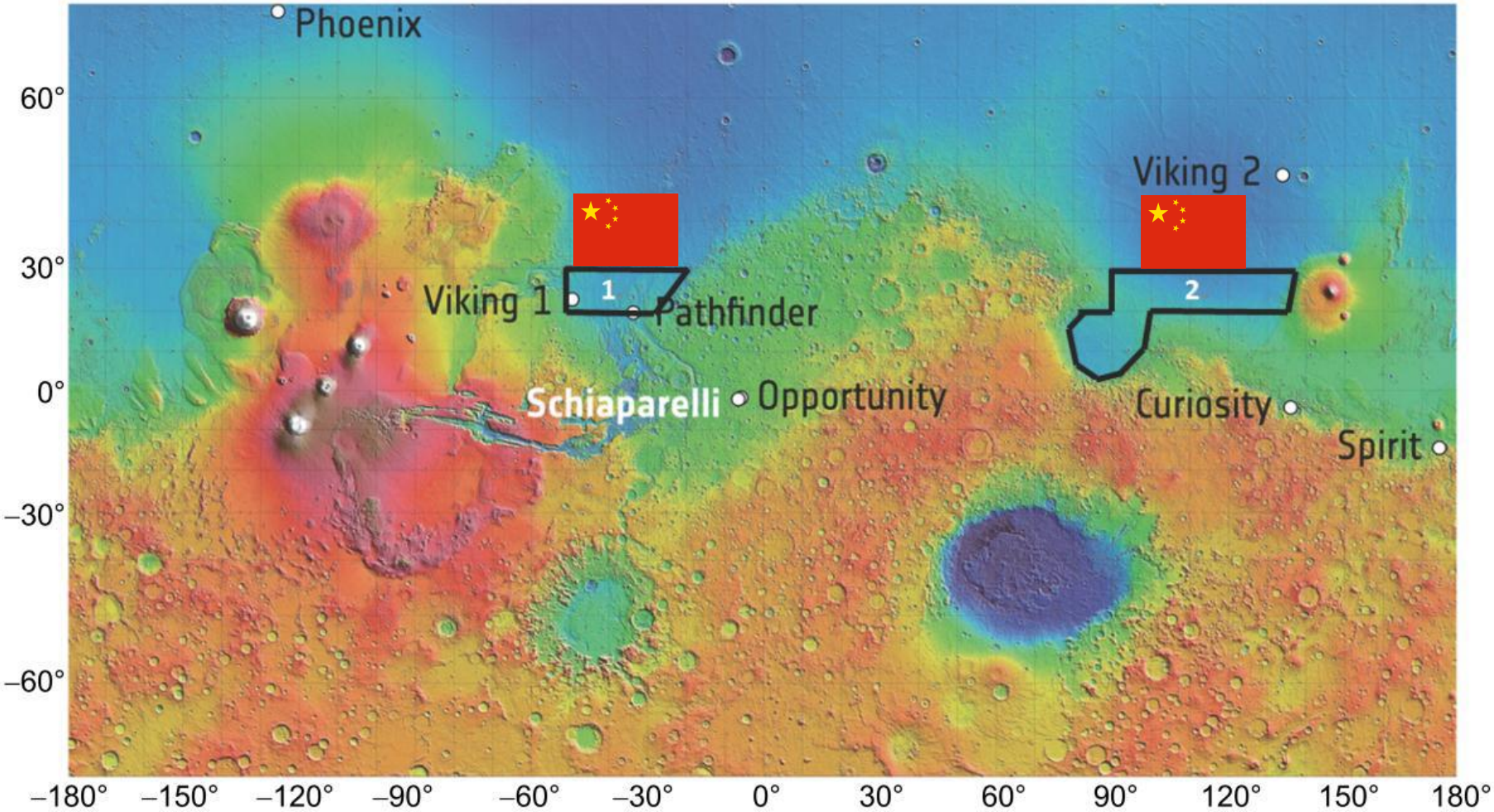
Rover (6)

-Topography Camera
-Navigation camera
-Rover-based Martian Subsurface Penetrating Radar (RMSPR)
-Mars Surface Composition Detector Multispectral Camera
-Mars magnetic field detector
-Mars climate detector

Orbiter (7)

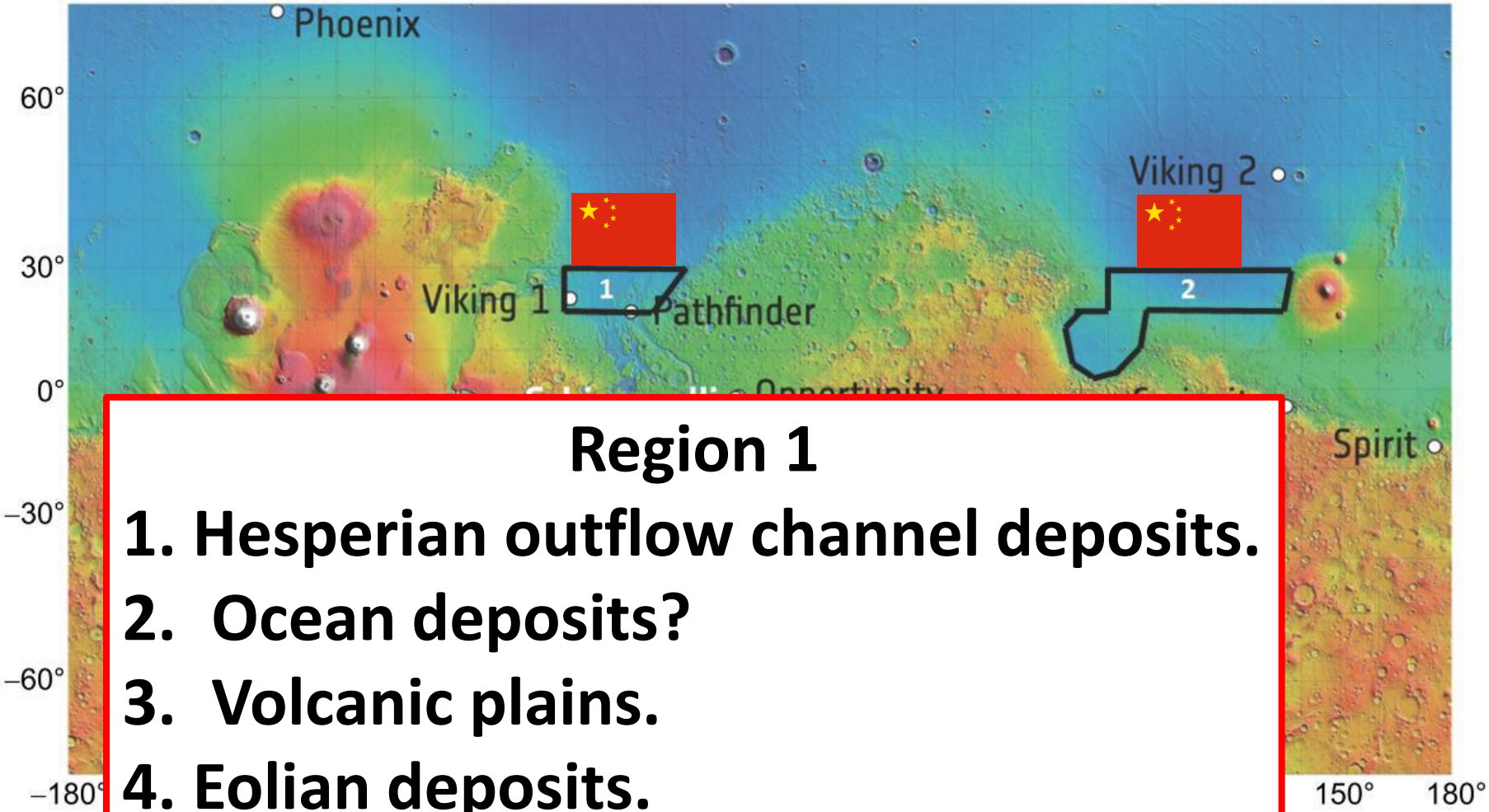
-Mars Orbiter Scientific Investigation Radar (MOSIR)
-Medium-resolution Camera
-High-resolution Camera
-Mars mineral Spectrometer
-Mars Magnetometer
-Mars Ions and Neutral particle Analyzer
-Mars Energetic Particles Analyzer

Landing Sites on Mars



China Mars 2020 Landing Site Regions

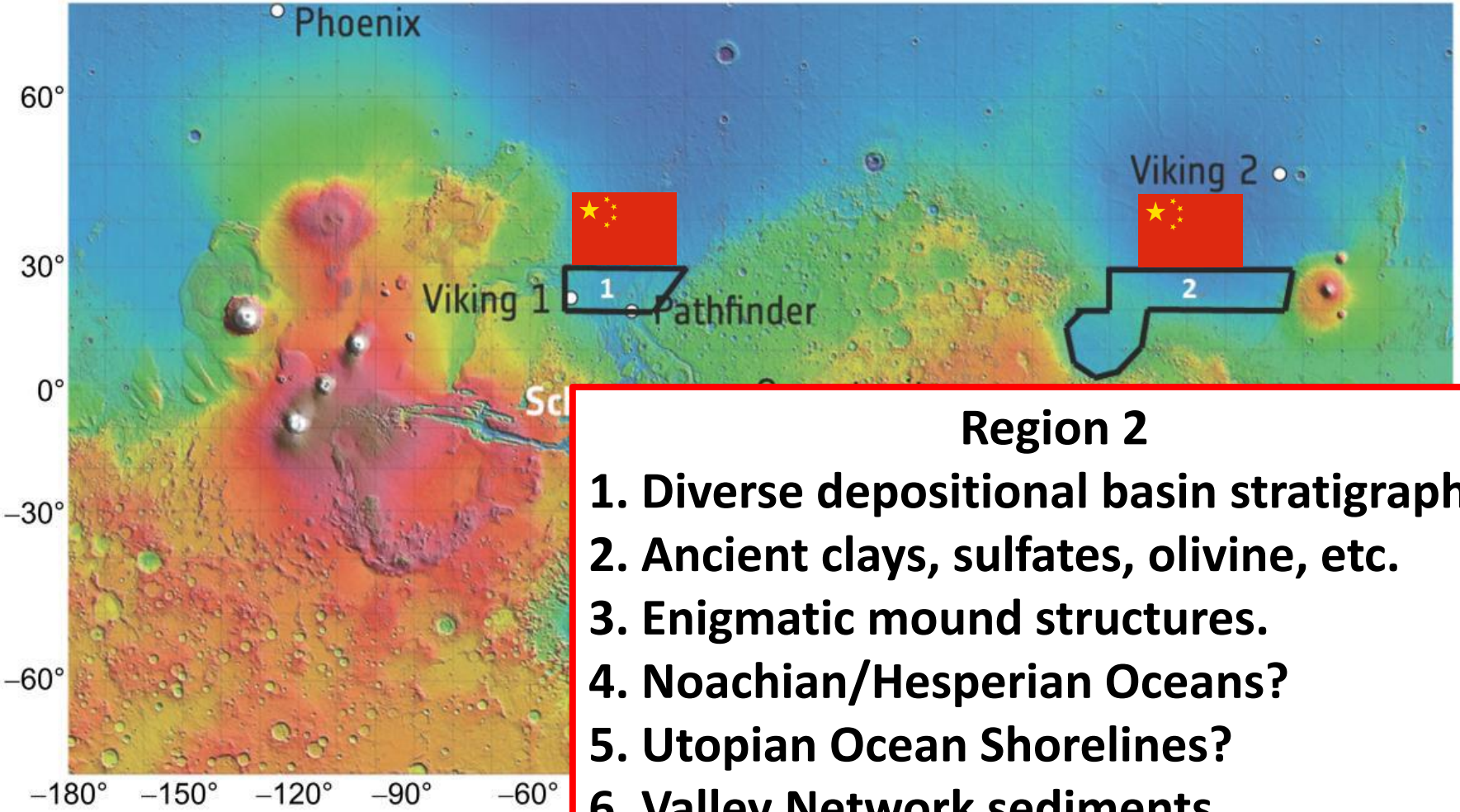
Landing Sites on Mars



Region 1

1. Hesperian outflow channel deposits.
2. Ocean deposits?
3. Volcanic plains.
4. Eolian deposits.
5. Vastitas Borealis Formation.
6. Similar to Viking 1, Pathfinder?

Landing Sites on Mars



China Mars 2

Region 2

1. Diverse depositional basin stratigraphy.
2. Ancient clays, sulfates, olivine, etc.
3. Enigmatic mound structures.
4. Noachian/Hesperian Oceans?
5. Utopian Ocean Shorelines?
6. Valley Network sediments.
7. Ancient glacial deposits?
8. Hesperian volcanism.
9. Possible habitats for life?

Professional Meetings

LDSE
BEIJING

北京月球与深空探测国际论坛
International Forum on Lunar and Deep-space Exploration

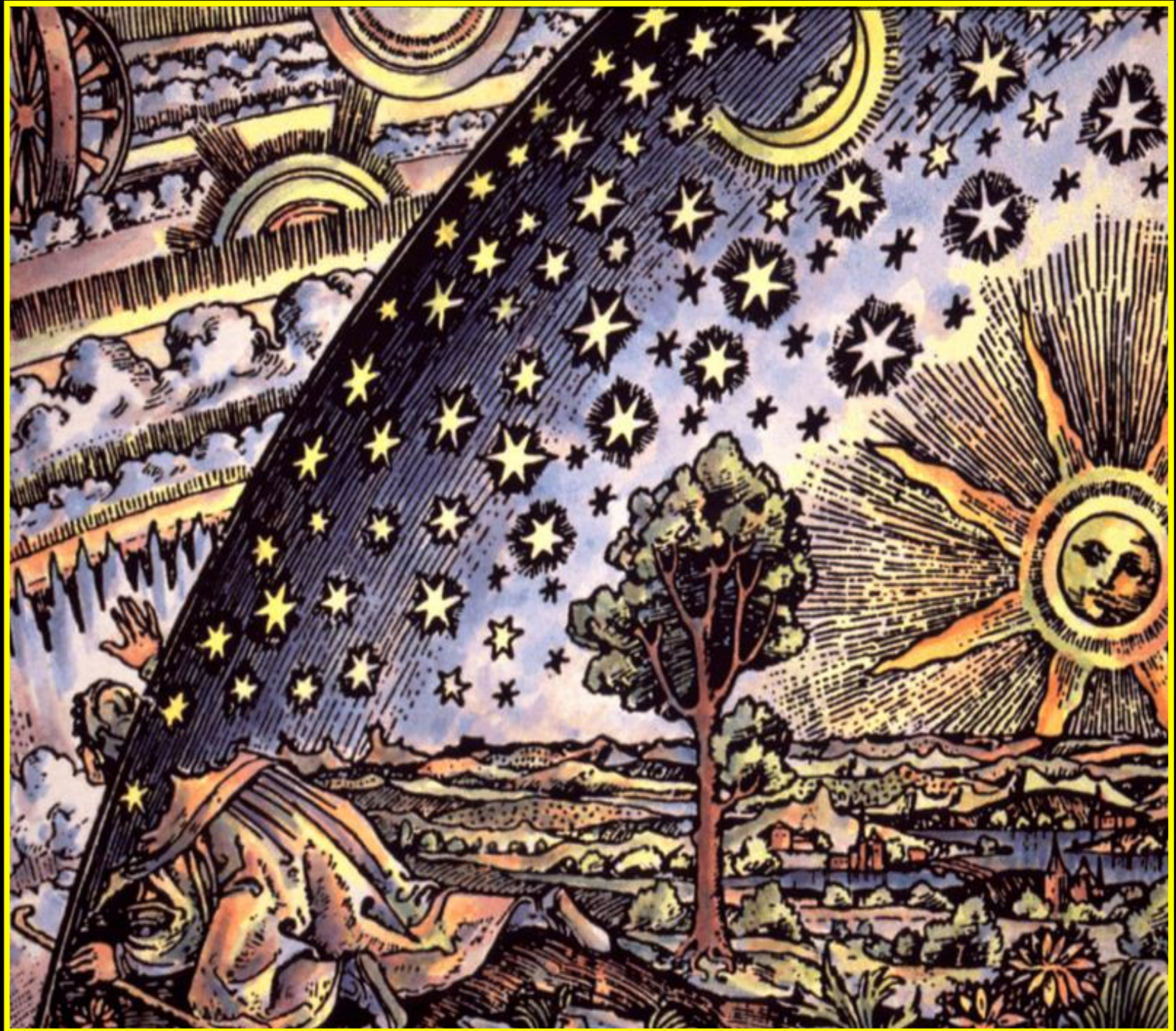
Ouyang Ziyuan, General Chair
Science and Technology Committee of LDSE

International Symposium on Lunar and Planetary Science (ISLPS 2016): (June 9-10, 2016):

Summer School for Planetary Science and Exploration in East Asia

Would be glad to expand on any of these topics in future MEPAG meetings:

- -Key organizations and institutions.
- -Details of Chinese Mars 2020 mission and beyond.
- -Details of future Chinese Lunar Exploration Program.
- -Plans for future PRC professional meetings.
- -Other?

http://www.planetary.brown.edu/html_pages/micro59.htm

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