Soviet Lunokhod 1 and 2 missions and things around

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Lunokhod 1 and 2 rovers and scientific instruments on them

Space race to the Moon

Cold war time flights to the Moon



USSR Attempts 48 Successful 21

From Huntress, Moroz, Shevalev, 2003

USA

Lunokhod 1



Lunokhod 1 payload

- Frame & Panoramic TV cameras
- RIFMA X-ray Fluorescence Spectrometer
- X-ray Telescope
- PROP Soil Mechanics Sensor
- Radiation Detector
- Laser Retroreflector





Lunokhod 2 and its payload

- Frame & Panoramic TV cameras
- RIFMA X-ray
 Fluorescence
 Spectrometer
- X-ray Telescope
- PROP Soil Mechanics Sensor
- Radiation Detector
- Laser Retroreflector
- UV/Visible Astrophotometer
- Magnetometer
- Photodetector



Lunokhod 1 and 2 missions

Lunokhod 1

Lunokhod 2

November 17, 1970 Mare Imbrium January 16, 1973 Crater LeMonier Mare Serenitatis

Lunokhod-1 landing site Lunokhod-1 rover traverse mapped by J. Plescia on LROC NAC-L/R image M150749234/M150756018





Lunokhod 1

- traveled 10,540 m,
- sent to Earth more than 50,000 pictures of the navigation TV cameras and more than 200 TV panoramas,
- conducted more than 500 lunar soil mechanics tests,
- made numerous measurements of the chemical composition of the soil by X-ray-fluorescence technique,
- it also had the French-made laser retroreflector for high-precision measurements of the distances between the Moon and Earth.

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www.moon-phases.com

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Lucian

Chacornac

Le Monnier

Dorsa Smirnov Sarabhai

3

Deseilligny

MARE

SERENITATIS

Rima Plinius

Plinius

1 TOTAL

Land

2

Dawes Vitruvius Beketov —

> MARE TRANQUILLITATIS Jansen

Cajal

BONITATIS

Carmickoel AMORIS

> Pres PALUS SONTI

Lyell

Ross

Lunokhod -2 traverse

Lunokhod -1 traverse







Lunokhod 2 landscapes



Lunokhod 2

- traveled 37,450 m, partly along the mare-like surface, partly intruding into hilly terrain of highland type and studying the edges of a 15 km long tectonic trough
- sent to Earth more than 80,000 pictures of the navigation TV cameras and 86 TV panoramas,
- conducted more than 150 lunar soil mechanics tests,
- conducted numerous chemical analyses,
- made numerous magnetometric measiurements,
- using a photometric standard in the field of view of the panoramic TV cameras measured albedo of various landforms,
- using special up-looking photometer studied brightness of the night sky of the Moon as indicator of levitated dust.

The analysis of TV images led to better understanding of the geologic and geophysical processes on the Moon:

- It was found that the surface gardening by meteorite impacts was accompanied by a variety of down-slope mass-wasting phenomena.
- Joint consideration of local geology, measurements of the soil mechanics, chemical composition and soil albedo led to conclusions on lateral and vertical mixing of lunar mare and highland materials.
- Magnetic measurements along the route and on the observation stations led to discovery of small spots of residual magnetization probably formed by the impacts.
- Analysis of time variations of the interplanetary magnetic field also registered by the magnetometer led to estimates of the large-scale (100's km) structure of the Moon interior.

Lunokhod 1 and 2 control center





Lunokhod crew and their chiefs

Five days after landing of Lunokhod 1







Alexander Kemurdzhian, Chief Designer of Lunokhods

Georgii Babakin, Chief Designer of Lavochkin Association





Alexander Kemurdzhian, Ivan Kozhedub, WW2 Hero, Oleg Ivanovsky, Deputy Chief Designer of Lavochkin Assoiciation



Oleg Ivanovsky: WW2, work at NPO Energia, escorted Gagarin, work at Lavochkin NPO



Исполняется 90 лет Олегу Генриховичу Ивановскому - конструктору ракетно-космической техники



Lunokhod tests and crew trainings

Tests in Kamchatka

TI Int







Crew training in Shkol'naya







Rover's varieties done by VNIITRANSMASH



Six-wheel version

Caterpillar-type version



Number 4

July/August 1990



Rover for Mars 71

Hopper for Phobos 2



Number 4

July/August 1990



Walking rover



Number 4

July/August 1990



Mockup of wheel-walking rover



Number 4

July/August 1990



Wheel-walking rover with changing body

Clean-up in Chernobyl



Tests of Russian Mars rover in Mohave





ABOVE: At the beginning of the test program, at Dumont Dunes, the tracks of the rover seemed strange and alien, almost as if they were the marks of a robot from another world. By the end of the program, they were as familiar as our own footprints, and the tracks wending their way up Mars Hill were symbolic of the success of our tests. On this hill in Death Valley, there is also an ancient Native American site that we roped off. Both the test team and the spectators carefully avoided it.

INSET: The Mars Rover misbehaved only once during the entire test program: when NASA Administrator Daniel Goldin came to visit. At the Pasadena setup facility, the rover's handlers attempted to demonstrate

Tests of Russian Mars rover in Mohave



Rovers of the Future:

- High trafficability and long lifetime.
- Reasonable self-dependence.
- Ability to study targets of interest:
 - Contact analyses using robotic arm.
 - Remote analyses with laser and so on.
- Combination of rover(s) with sample return.





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Prof. Mikhail Malenkov can be achieved for questions and discussion by e-mail m.i.malenkov@gmail.com

Thank you for your attention!

This presentation can bt downloaded from: https://dropbox.brown.edu/download.php?hash=6475d758