

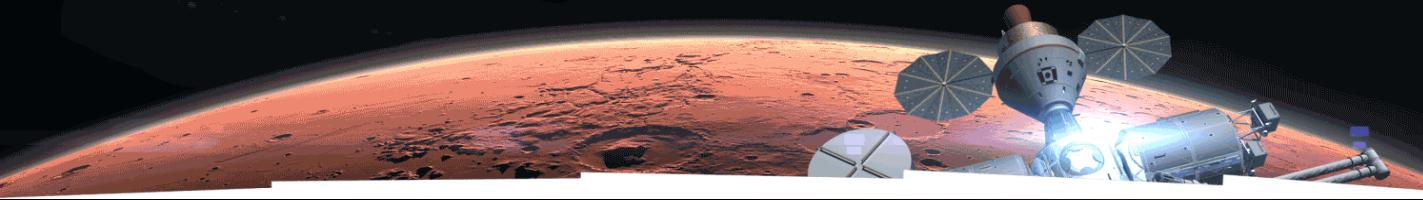


Exploring Mars

With Human Missions

Pradip Gatkin

HUMANS ON MARS



- *Mars is the proving ground where we will discover whether humanity can become a multi-planet species*
- Arthur C. Clarke (Scientist, writer)
- *Humanity was born on Earth. Are we going to stay here? I suspect—I hope—the answer is no. —Ann Leckie*

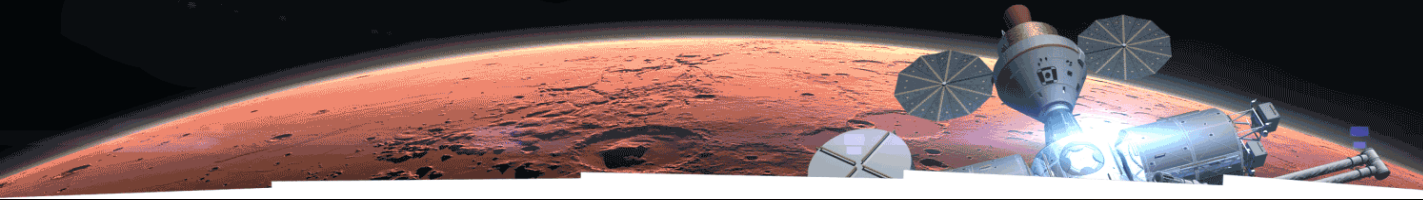
HUMANS ON MARS



Why?

- Humans can do some serious exploration! We have barely scratched the surface!
- Can perform complex experiments: Geology, chemistry, astrobiology? All together!
- Real-time decision making: Considering several factors, in unanticipated situations: Instinctive decisions - *Remember Apollo 13!*

HUMANS ON MARS



Why?

- *Exploration enables science and science enables exploration*
- New land, new opportunities! Future colonization: We have to start somewhere!
- Humans have good brains and rovers have good tools, together they can explore new landscapes!

NEWS ITEM: Rover 'Curiosity' lands safely on Mars.

NO EVIDENCE OF
LIFE FORMS
DETECTED
SO FAR...



News
newscartoons
@gmail.com

Sometimes, machines can't see the full picture!



HUMANS ON MARS



Challenges?

- Absence of a livable natural environment
- Narrow window of return: the commitment to launch is a commitment to three years in space.. (Remember Martian?)
- Large communication time-lag (20-40 minutes): Emergency decisions!
- Necessary to develop systems with high reliability and robustness: Habitat, harvesting Martian resources (using microbes?)

"NO TRAVEL INSURANCE"??
WHAT DO YOU MEAN,
"NO TRAVEL INSURANCE"??!!



"NO TRAVEL INSURANCE"??
WHAT DO YOU MEAN,
"NO TRAVEL INSURANCE"??!!



Just one of the many challenges!

HUMANS ON MARS

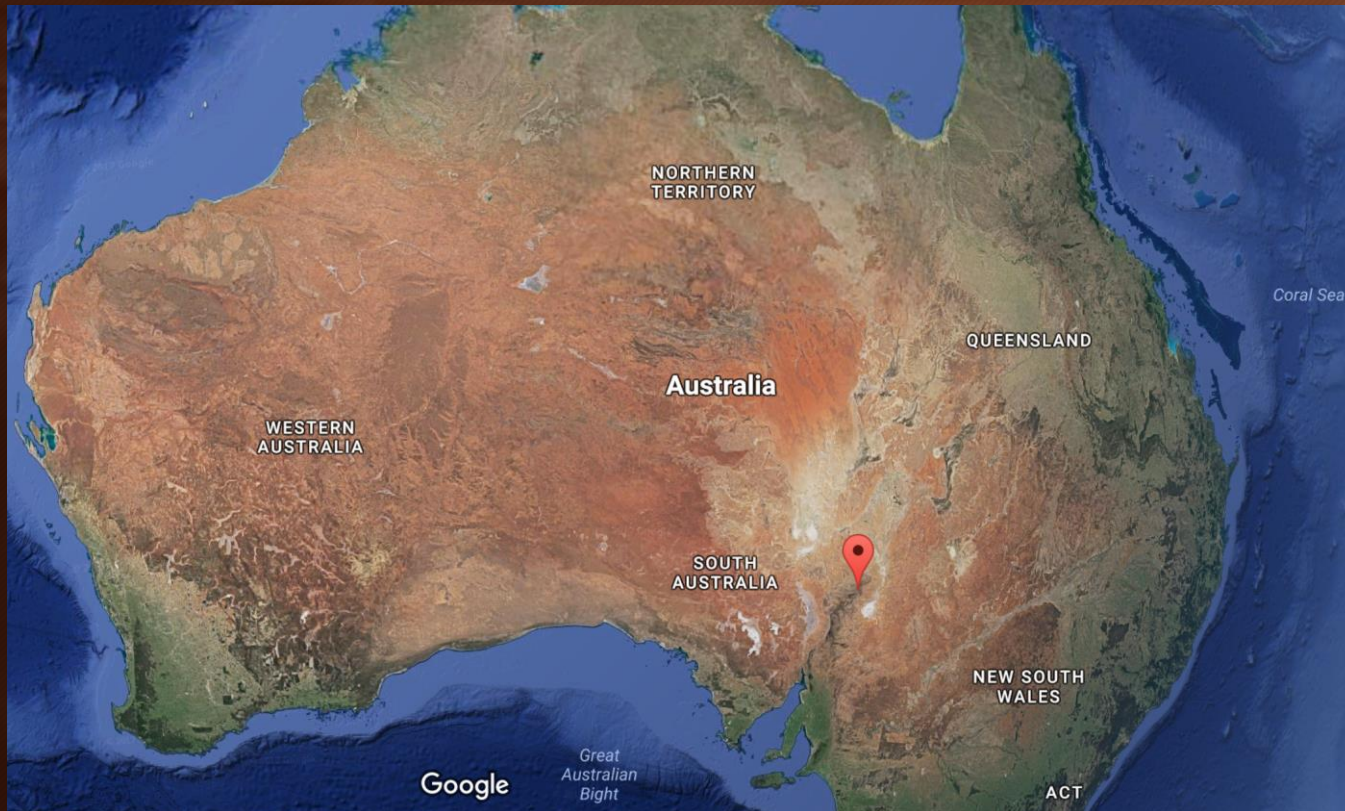
Preparation

- How should the first mission look like? How to setup the first base? Carrying raw materials vs mining? 3D printing, Martian farming.
- Crew composition
- Human-machine (rover) interaction for the best exploration



Mars Analogue Expedition in Australia (2014)

- In Arkaroola dessert of Southern Australia:



Why here? Geology, Biology, Terrain

- its many scientific features of interest to planetary geologists, geomorphologists, and astrobiologists
- a diversity of different terrains, materials and surfaces ideal for engineering tests
- Mock landscape exploration
- Rover maneuverability tests
- Human + Rover interaction: Mock Extra-habitat Activities
- Geological evidences + fossil hunting

Martian Ocean!



BBC NEWS

NASA
MARS
OCEAN

Martian water flow



Site selection:





Pebbles! Ancient flowing water?





Fossils: Almost a billion year old!

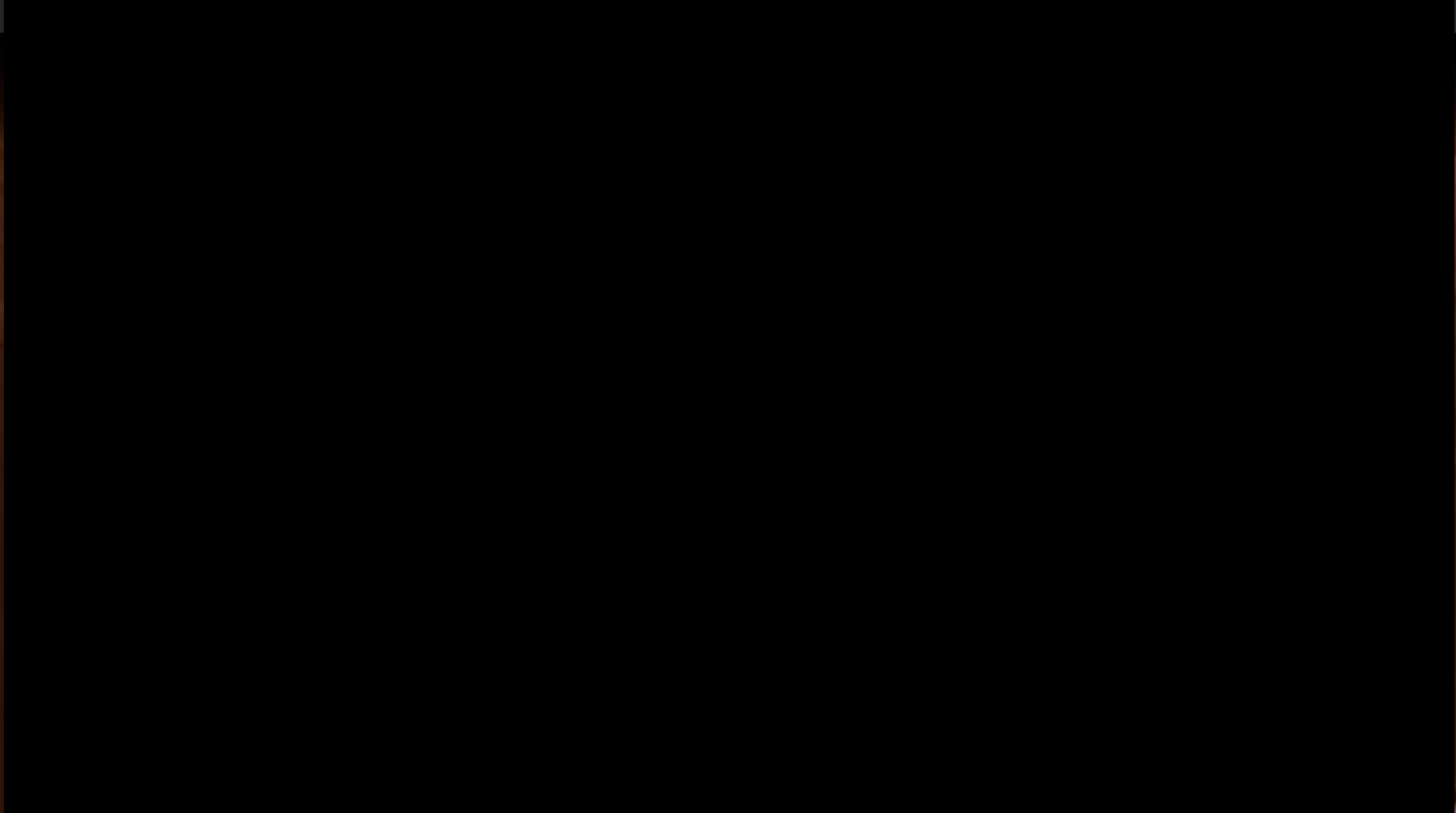




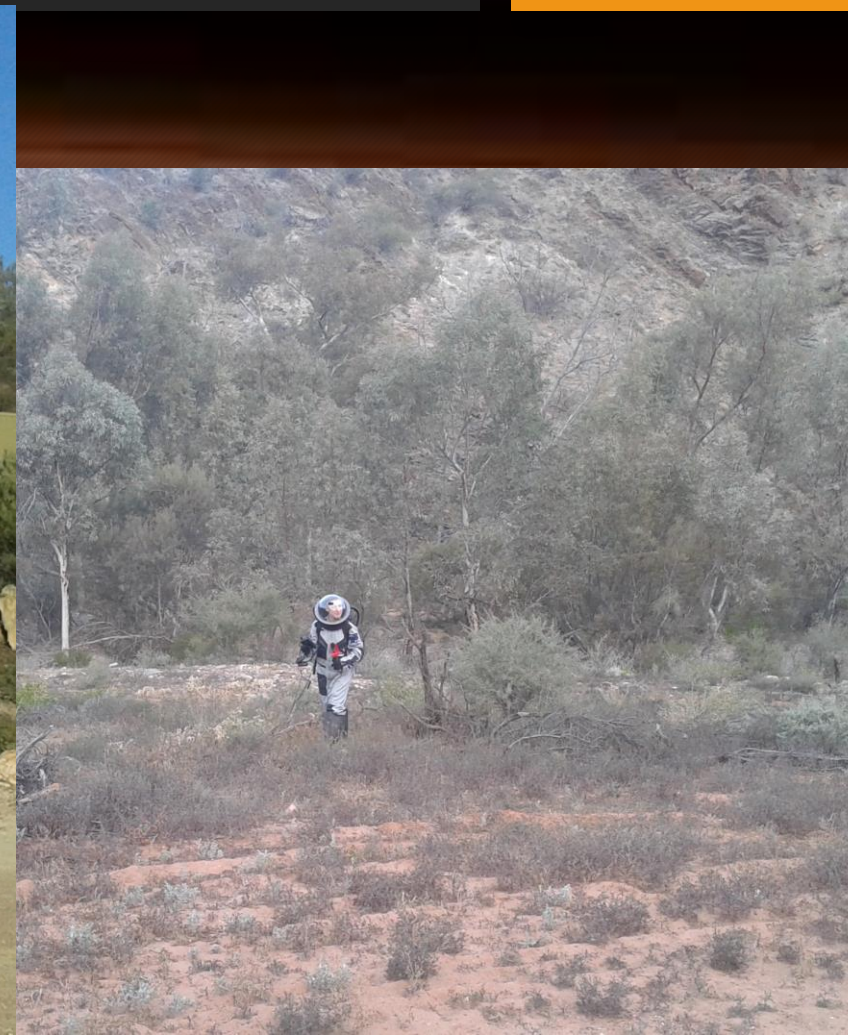
Our oldest fossils: Stromatolites



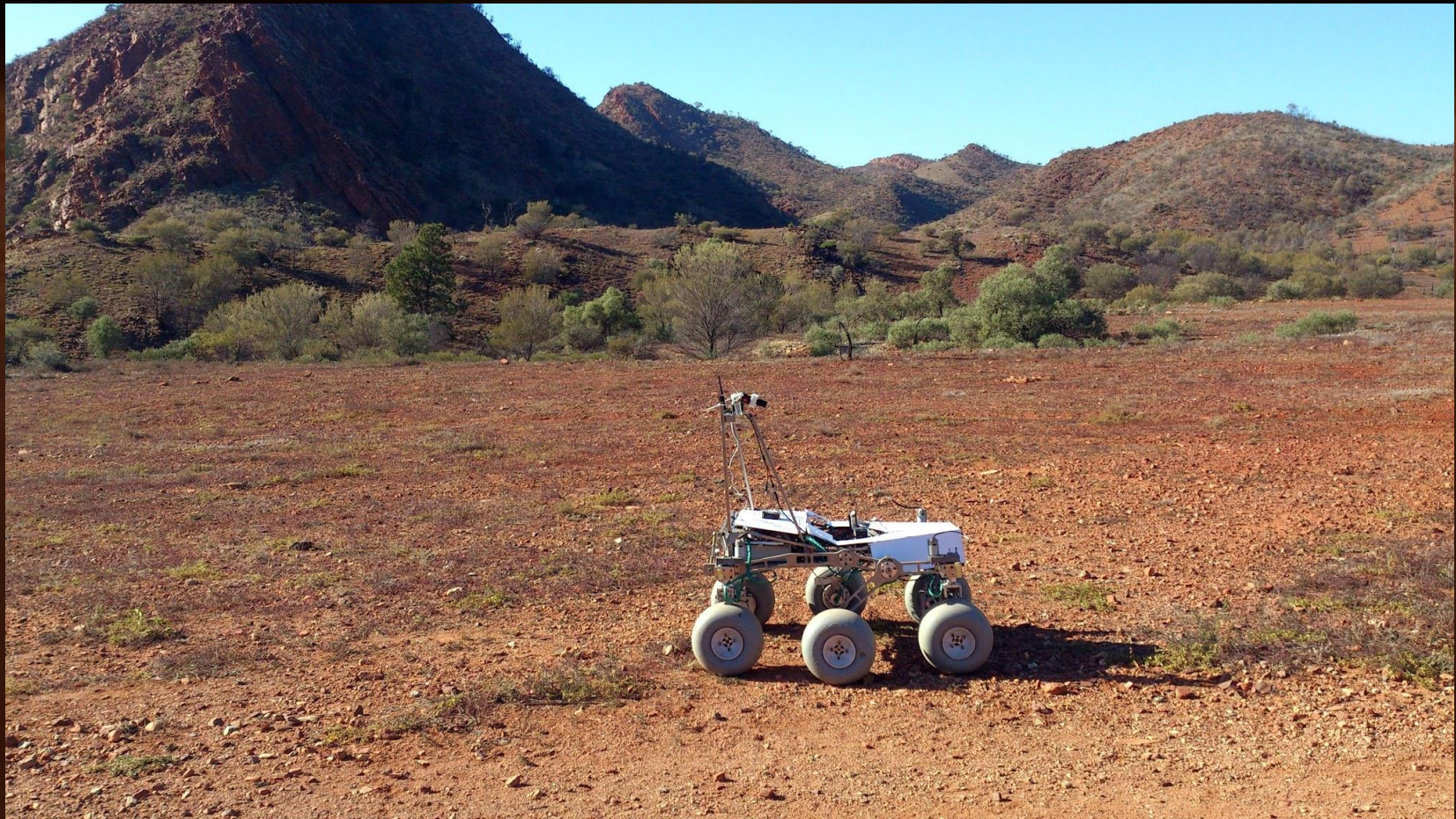
Our oldest fossils: Stromatolites



Expedition: Mock landscape survey



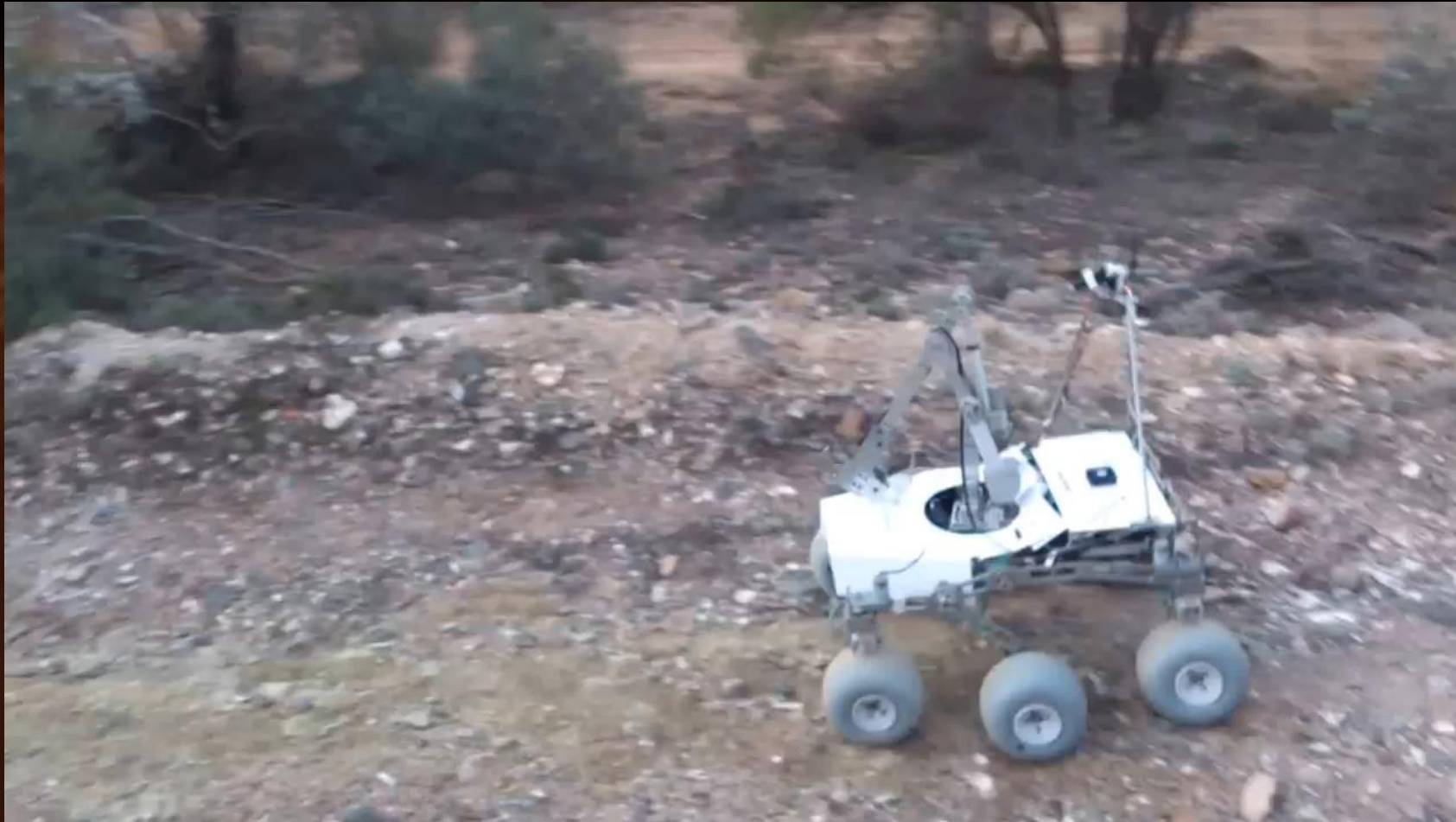






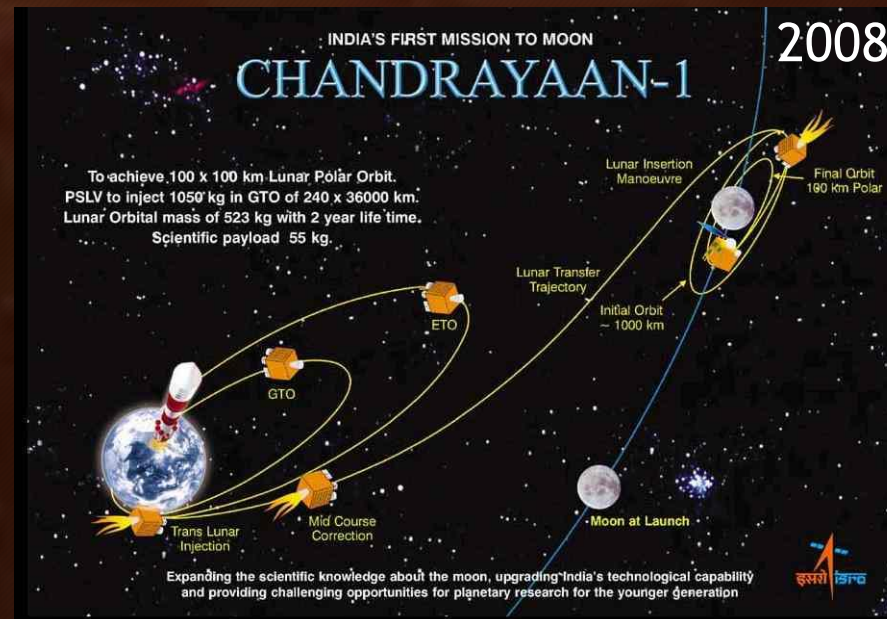


Rover video



Indian Space Program:

- Started in 1962
- With humble beginning
- Sent several earthbound satellites: Communication, weather, survey : agriculture, resource mapping



2015
ISRO launches foreign satellites with **ASTROSAT** space observatory

So, you think India has made a dent in the Space world?
India is going to launch **six foreign satellites at one go**. The rocket polar satellite launch vehicle (PSLV) will launch the country's own **ASTROSAT** weighing 1,513 kg, apart from **four from the US** and **one each from Indonesia and Canada**.

You are talking about India's first space observatory! Really?
Yup! ASTROSAT, with a lifespan (mission) of five years, is India's **first dedicated multi-wavelength space observatory** that will help in understanding our universe.

ASTROSAT will observe the universe through **optical, ultraviolet, low and high energy X-ray** components of the electromagnetic spectrum, whereas most other scientific satellites are capable of observing through a narrow wavelength band.

What other Foreign satellites will be with us on this journey?

The PSLV will carry a total payload of 1,631 kg during this mission

INDONESIAN CANADIAN U.S.s 4

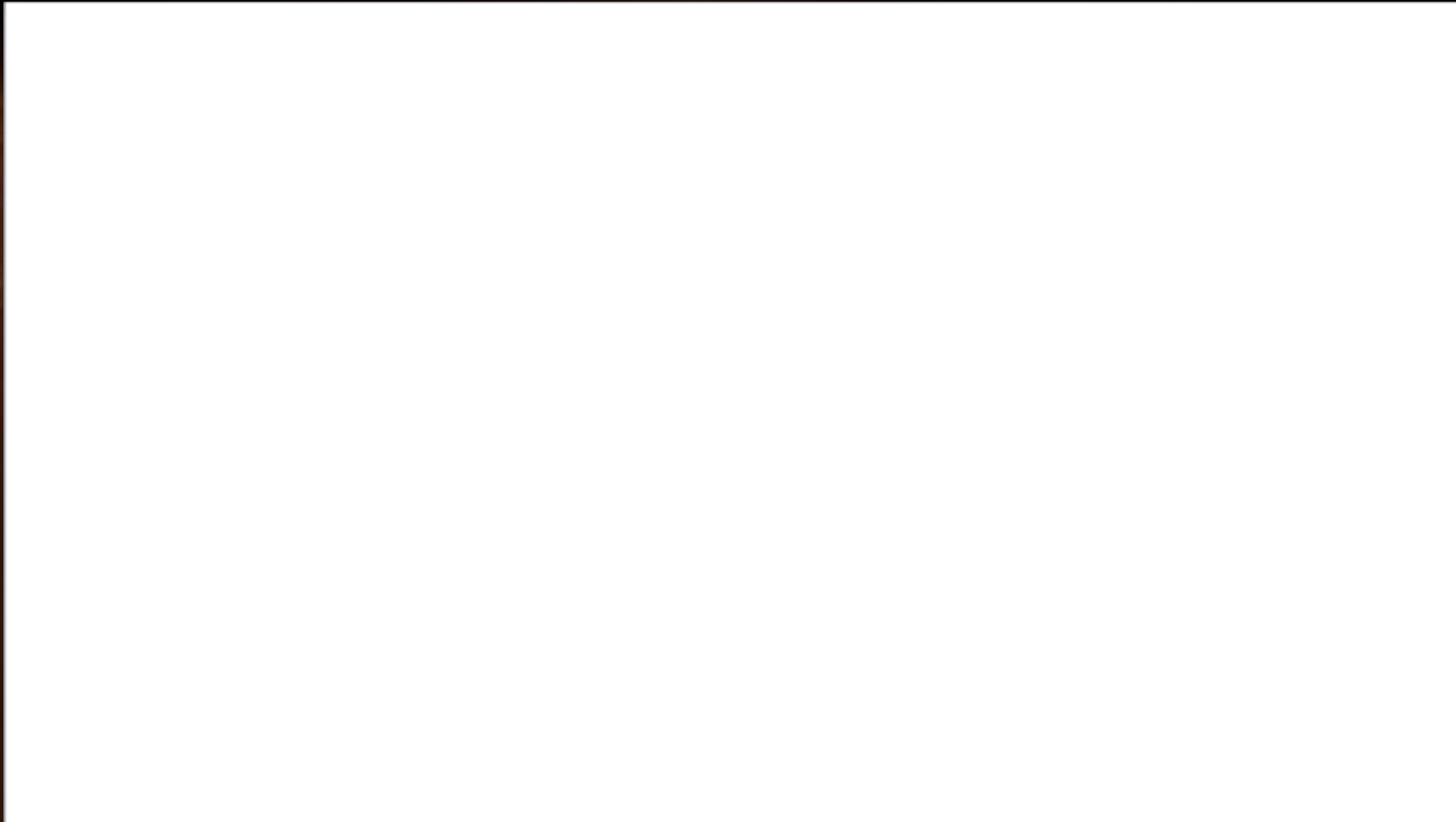
The infographic features a large illustration of the PSLV rocket launching the ASTROSAT satellite. The text provides details about the mission, including the launch date (2015), the satellite's weight (1,513 kg), and the fact that it is India's first dedicated multi-wavelength space observatory. It also mentions that six foreign satellites will be launched alongside ASTROSAT: four from the US and one from each of Indonesia and Canada. The infographic includes a table at the bottom listing the countries of the foreign satellites: Indonesian, Canadian, and U.S.s (4).

Indian Space Program:



- Mission to Moon: Chandrayaan: Lunar orbiter + lander probe
- Mission to Mars: Dec 1st 2013 -> Sept 24, 2014
- One of the cheapest launch facility for small satellites in space market
- Recent record of 104 satellite launches in one go (101 nanosatellites)

Mangalyaan: Mission specifics



Mangalyaan



Objectives:

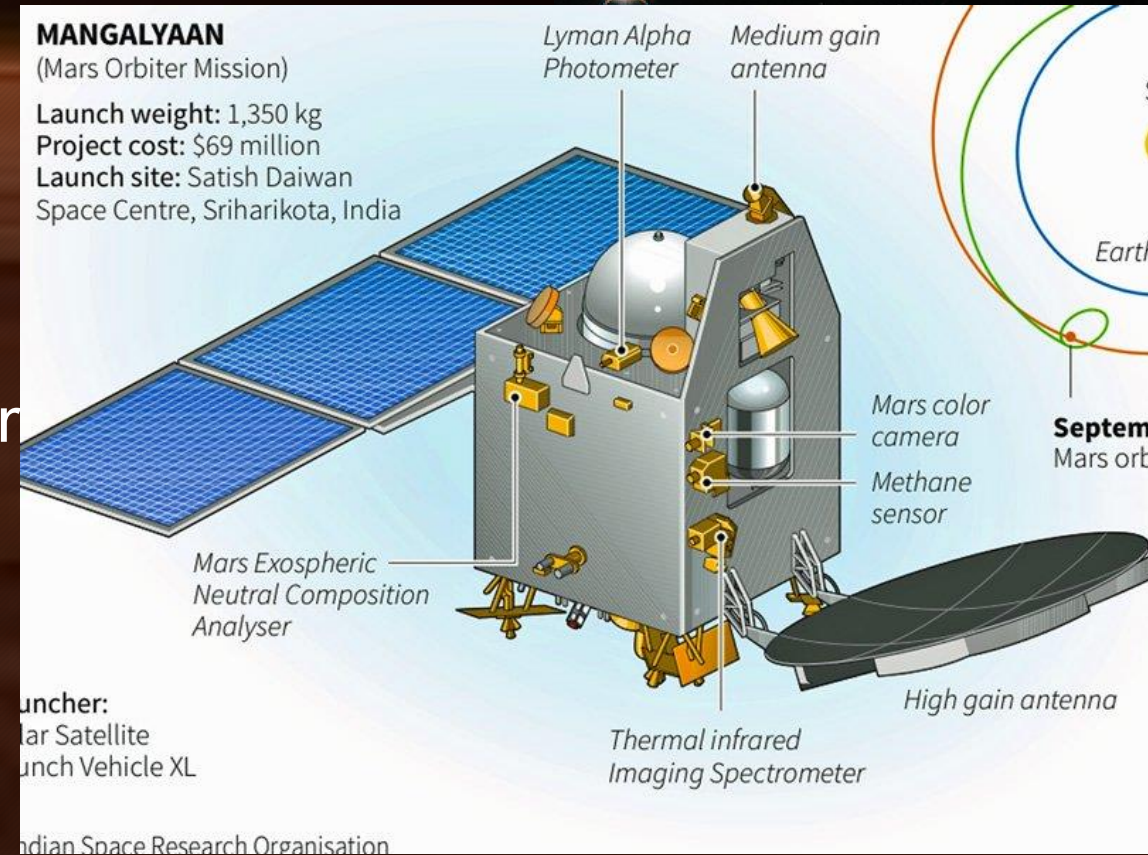
- Technological: Orbital maneuvers, Deep space communication, autonomous operations in mars capture orbit
- Scientific: Terrain mapping, mineralogy, atmospheric composition, methane

Mangalyaan



Instruments:

- Mars Color Camera
- Methane Sensor for Mars,
- Lyman Alpha Photometer
- Mars Exospheric Neutral Composition Analyser
- Thermal Infrared Imaging Spectrometer



ISRO: Future Plans



- Chandrayaan - 2 : Lunar mission: will include a rover
- Aditya: Solar observatory in space: 1.5 million km from earth (at L1 location)
- A Mars rover (Hopefully soon!)

Where AM I?

