



# InSight

## ... into the Early Evolution of Terrestrial Planets

InSight (Interior exploration using Seismic Investigations, Geodesy and Heat Transport) is a NASA Discovery Program mission that will place a single geophysical lander on Mars to study its deep interior. But, InSight is more than a Mars mission — it is a terrestrial planet explorer that will open a window into the processes that shaped the rocky planets of the inner solar system (including Earth) more than 4.5 billion years ago. By using sophisticated geophysical instruments, it will address fundamental questions about the formation

of Earth-like planets by detecting the fingerprints of those processes buried deep within the interior of Mars.

The science payload comprises two instruments: the Seismic Experiment for Interior Structure (SEIS), provided by the French Space Agency (CNES), with the participation of the Institut de Physique du Globe de Paris (IPGP), the Swiss Federal Institute of Technology (ETH), the Max-Planck-Institute for Solar System Research (MPS), Imperial College and the

# NASAfacts



*InSight is based on the proven Phoenix Mars spacecraft and lander design with state-of-the-art avionics from the Mars Reconnaissance Orbiter and Gravity Recovery and Interior Laboratory missions.*

### **InSight Mission Overview**

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**Launch — May 2018**

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**Landing — November 26, 2018**

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**Surface operations — 720 days / 700 sols**

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**End of primary mission — November 2020**

Jet Propulsion Laboratory (JPL); and the Heat Flow and Physical Properties Package (HP<sup>3</sup>), provided by the German Space Agency (DLR), with the participation of the Polish Space Agency (CBK). In addition, the Rotation and Interior Structure Experiment (RISE), led by JPL, will use the spacecraft communication system to provide precise measurements of planetary rotation. This instrumentation will be carried by a lander based on the proven Phoenix Lander designed and built by Lockheed Martin Space, providing low-cost, low-risk access to the surface of Mars.

## Science Goals and Objectives

### 1. Understand the formation and evolution of terrestrial planets through investigation of the interior structure and processes of Mars by:

- Determining the size, composition and physical state (liquid solid) of the core.
- Determining the thickness and structure of the crust.
- Determining the composition and structure of the mantle.
- Determining the thermal state of the interior.

### 2. Determine the present level of tectonic activity and meteorite impact rate on Mars:

- Measure the magnitude, rate and geographical distribution of internal seismic activity.
- Measure the rate of meteorite impacts on the surface.

## Project Team

The InSight Principal Investigator (PI) is W. Bruce Banerdt of the Jet Propulsion Laboratory (JPL); the Deputy PI is Suzanne Smrekar (JPL). The Project Manager is Tom Hoffman and the Mission Systems Manager is Rick Welch. The SEIS Instrument PI is Philippe Lognonné of IPGP, and the HP<sup>3</sup> Instrument PI is Tilman Spohn of the DLR Institute of Planetary Research. The international science team includes Co-Investigators from the United States, France, Germany, Austria, Belgium, Canada, Poland, Spain, Switzerland and the United Kingdom.

## Mission Partners

NASA's Jet Propulsion Laboratory, a division of the California Institute of Technology manages InSight for NASA's Science Mission Directorate. InSight is part of NASA's Discovery Program, managed by the Marshall Space Flight Center. JPL is also responsible for science leadership, systems engineering, naviga-

tion, mission operations and the instrument deployment arm and camera. Lockheed Martin Space is responsible for spacecraft development, spacecraft assembly, integration and test, launch operations and mission operations support. CNES managed, integrated and delivered the SEIS instrument; DLR built and delivered HP<sup>3</sup>. Centro de Astrobiología (CAB) of Spain supplied wind and air temperature sensors.

## The Structure of Terrestrial Planets

Terrestrial (rocky) planets all share similar structures, with chemically distinct crusts, mantles and cores. Although their bulk compositions are roughly the same as that of meteorites, the primitive building blocks of the solar system, their "construction" is far from uniform and none of the rocks found in them today are at all like meteorites. These bodies reached their current overall structure through the process of melting and differentiation, a process that is poorly understood.

During differentiation, the molten outer portions of the planet (sometimes called a "magma ocean") cool and crystallize into various minerals, depending on the temperature, pressure and the chemical composition of the melt, all of which vary with time. Lighter minerals rise toward the surface to form the primary crust, while heavier minerals sink to form the mantle, and much of the iron and nickel form a metallic core at the center of the planet. Many of the fundamental characteristics that define the planets today, such as the composition of the surface rocks, the level of volcanic and tectonic activity, the composition of the atmosphere and the presence or absence of a magnetic field, depend on the details of how these processes acted in the first hundred million years after formation.

## Studying Mars to Understand Planet Formation

It happens that Mars is in the "sweet spot" — big enough to have undergone most of the early processes that fundamentally shaped the terrestrial bodies (Mercury, Venus, Earth, Earth's Moon and Mars), but small enough to have retained the signature of those processes for the next 4.5 billion years (unlike Earth, with its active plate tectonics and mantle convection). That signature is revealed in the basic structural building blocks of the planet: crust thickness and global layering, core size and density, and mantle density and stratification. The rate at which heat is escaping from the interior provides an additional valuable constraint on the energy driving geological processes.

InSight addresses fundamental issues of solar system science, not just specific questions about a single planet. By studying Mars, InSight illuminates the earliest evolution of rocky planets, including Earth.

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