NASAfacts

InSight

Into the Early Evolution of Terrestrial Planets

NASA's Interior exploration using Seismic Investigations, Geodesy, and Heat Transport (InSight) spacecraft is scheduled to land on Mars on November 26, 2018. Friction with the atmosphere will raise the temperature of the heat shield to 2,700 degrees Fahrenheit (about 1,500 degrees Celsius) as it helps to slow the spacecraft's entry; a parachute and retro-rocket thrusters will slow it down the rest of the way. By 11:54 a.m. PST (2:54 p.m. EST), engineers at NASA's Jet Propulsion Laboratory, in Pasadena, California, will be looking for signals indicating that InSight successfully touched down on Mars.

InSight 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 four billion years ago. By using sophisticated geophysical instruments, InSight 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 includes two instruments: the Seismic Experiment for Interior Structure (SEIS), provided by the French space agency (CNES) with the participation of the Paris Institute of Earth Physics (IPGP), the Swiss Federal Institute of Technology (ETH), the Max Planck Institute for Solar System Research (MPS), Imperial College London, and the Jet Propulsion Laboratory (JPL); and the Heat Flow and Physical Properties Package (HP^3), provided by the German space agency (DLR). 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. These instruments are carried by a spacecraft based on the proven Phoenix Lander design, 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 Deputy Project Manager is Chuck Scott, both at JPL. The SEIS Instrument PI is Philippe Lognonné of IPGP, the HP^3 Instrument PI is Tilman Spohn of the DLR Institute of Planetary Research, and the RISE PI is William Folkner of JPL. The international science team includes Co-Investigators from the United States, France, Germany, Austria, Belgium, Canada, Italy, Poland, Spain, Switzerland, and the United Kingdom.

Mission Partners

InSight is managed by the Jet Propulsion Laboratory, a division of Caltech. JPL is also responsible for science leadership, systems engineering, navigation, 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 spacecraft operations support. CNES managed, integrated, and delivered the SEIS, and DLR built and delivered HP^3. Centro de Astrobiología (CAB) of Spain supplied wind and air temperature sensors.

Astronika, Warsaw designed and integrated the hammering mechanism for the HP^3 mole, including parts manufactured at the Polish Academy of Sciences' Space Research Centre (Centrum Badań Kosmicznych, or CBK).

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 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

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 over four billion years (unlike Earth). 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.

InSight will address a fundamental issue of solar system science, not just specific questions about a single planet. By studying Mars, InSight would illuminate the earliest evolution of rocky planets, including Earth.

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