PRESS RELEASE

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A SURPRISING FIRST YEAR OF SCIENCE FROM THE MARS INSIGHT MISSION

A new understanding of Mars is beginning to emerge from the first year of NASA's InSight lander mission. Findings described in a set of six papers published today reveal a planet alive with quakes, dust devils and strange magnetic pulses.

Five of the papers were published in Nature Geoscience. An additional paper in Nature Communication details the InSight spacecraft's landing site, a shallow crater in a region called Elysium Planitia (nicknamed "Homestead Hollow").

InSight is the first mission dedicated to looking deep beneath the Martian surface. Among its science tools are a seismometer for detecting 'marsquakes', sensors for gauging wind and air pressure, a magnetometer and a heat flow probe designed to take the planet's temperature.

While the team continues to work on getting the probe into the Martian surface as intended, the ultra-sensitive seismometer has enabled scientists to "hear" multiple trembling events from hundreds to thousands of miles away.

Seismic waves are affected by the materials they move through, giving scientists a way to study the composition of the planet's inner structure. Mars can help the team better understand how all rocky planets, including Earth and its Moon, first formed.

Below are some of the key findings from this set of papers.

Underground

Mars trembles more often, but also more mildly, than predicted by models. SEIS has recorded more than 400 seismic signals to date, the vast majority of which are probably microquakes (as opposed to data noise created by the environment, like wind). The largest quake was about magnitude 4.0 in size, not quite large enough to travel down to the lower mantle and core. Those are "the juiciest parts of the apple" when it comes to studying the planet's inner structure, said Bruce Banerdt, InSight principal investigator at NASA's Jet Propulsion Laboratory (JPL).

Scientists are ready for more: it took months after InSight's landing in November 2018 before they recorded the first seismic event. By the end of 2019, SEIS was detecting about two seismic signals a day, suggesting that InSight just happened to touch down at a particularly quiet time. Scientists still have their fingers crossed for "the big one".

Mars doesn't have tectonic plates like Earth, but it does have volcanically active regions that can cause rumbles. A pair of quakes was strongly linked to one such region, Cerberus Fossae, where scientists had already noticed in high-resolution images from Mars Reconnaissance Orbiter boulders that may have been

shaken down cliffsides. Ancient floods there carved channels nearly 800 miles (1,300 kilometres) long. Lava flows then seeped into those channels within the past 10 million years—the blink of an eye in geologic time.

Some of these relatively young lava flows show signs of having been fractured by quakes less than two million years ago. "It's just about the youngest tectonic feature on the planet," said planetary geologist Matt Golombek of JPL/NASA. "The fact that we're seeing evidence of shaking in this region isn't a surprise, but it's very cool."

You can listen to the rumblings of these two quakes, recorded by SEIS and known as events 173a (22 May 2019) and 235b (25 July 2019), here.

At the surface
Billions of years ago, Mars had a magnetic field that is no longer present. But it left ghosts behind: this field magnetized ancient rocks that are now between 200 feet (61 metres) to several miles below ground. InSight is equipped with a magnetometer—the first on Mars—to detect such magnetism at the surface.

The lander's magnetometer has found that the magnetism at Homestead Hollow is ten times stronger than expected, based on data from orbiting spacecraft that were averaged over a couple of hundred miles; InSight's measurements home in on an area far more local.

Because most rocks at InSight's location are too young to have been magnetized by the planet's former field, "this magnetism must be coming from ancient rocks underground," said Catherine Johnson, a planetary scientist at the University of British Columbia and the Planetary Science Institute. "We're combining these data with what we know from seismology and geology to understand the magnetized layers below InSight. How strong or deep would they have to be for us to detect this field?"

InSight has also detected mysterious magnetic pulses, typically around midnight. These pulses likely originate in space above Mars, as opposed to rocks below ground—something that scientists weren't sure they would be able to detect all the way at the surface.

In the wind
InSight's weather sensors have detected hundreds of passing whirlwinds, which are called dust devils when they pick up grit and become visible. "This site has more whirlwinds than any other place we've landed on Mars while carrying weather sensors," said Aymeric Spiga, an atmospheric scientist at Sorbonne University in Paris. InSight measures wind speed, direction and air pressure nearly continuously, thus yielding more data than previous landed missions.

Despite all that activity and frequent imaging, InSight's cameras have yet to see dust devils, even though traces left by them have been seen on certain days. But SEIS can feel these whirlwinds pulling on the surface like a giant vacuum cleaner. “Whirlwinds are perfect for subsurface seismic exploration,” said Philippe Lognonné of the IPGP[1] global physics institute, principal investigator of SEIS and professor at the University of Paris.

The core
InSight has two radios: one for regularly sending and receiving data, and a more powerful radio designed to measure the "wobble" of Mars as it spins. This X-band radio, also known as the Rotation and Interior Structure Experiment (RISE), could eventually reveal whether the planet's core is solid or liquid. A solid core would cause Mars to wobble less than a liquid one.

This first year of data is just a start. Watching over a full Martian year (two Earth years) will give scientists a much better idea of the size and speed of the planet's wobble.

About InSight and SEIS

JPL/NASA manages InSight for NASA's Science Mission Directorate. InSight is part of NASA's Discovery Program, managed by the agency's Marshall Space Flight Center in Huntsville, Alabama. Lockheed Martin Space in Denver built the InSight spacecraft, including its cruise stage and lander, and supports spacecraft operations for the mission.

CNES is lead contractor for SEIS and IPGP (CNRS/University of Paris/University of Réunion/IGN) is the instrument principal investigator. CNES is funding French contributions to the mission, coordinating the international mission consortium[2] and was responsible for integrating, testing and supplying the complete instrument to NASA. IPGP designed the very-broad band (VBB) sensors and tested them before delivery to CNES. Several research laboratories attached to the French national scientific research centre CNRS—the LMD dynamic meteorology research laboratory (CNRS/ENS Paris/Ecole polytechnique/Sorbonne University), the LPGN planetology and geodynamics laboratory (CNRS/University of Nantes/University of Angers), the IRAP astrophysics and planetology research institute (CNRS/University of Toulouse/CNES), the LGL-TPE Earth, planets and environment geology laboratory (CNRS/ENS Lyon/Claude Bernard University Lyon 1), the IMPMC mineralogy, materials physics and cosmochemistry institute (Sorbonne University/National Natural History Museum/CNRS) and the J.L. Lagrange laboratory (CNRS/Côte d'Azur University, Cote d'Azur Observatory)—are working with IPGP and the ISAE-Supaero aeronautics and space institute to analyse the mission's science data, with support from CNES and ANR, the national research agency (for the MAGIS project).

1 Institut de Physique du Globe de Paris

2 In collaboration with Sodern for the VBB sensors, JPL, the Swiss Federal Institute of Technology (ETH Zurich) and the Max Planck Institute for Solar System Research (MPS, Göttingen, Germany), and Imperial College London and Oxford University, which supplied subsystems for SEIS and are involved in exploiting the mission's science data.

Learn more about the InSight-SEIS papers HERE

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