Press Release

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World first
French SEIS instrument detects ‘marsquake’

19 December 2018, NASA’s InSight lander set down the French SEIS seismometer on the surface of Mars. On 6 April, on the 128th Martian day or ‘sol’ of the mission, a quiet but distinct seismic signal was detected similar to quakes detected on the surface of the Moon by the Apollo missions.

The Sol 128 event detected by SEIS is the first quake to appear as if it's coming from inside Mars—as opposed to shaking from wind, for example—although scientists still aren't entirely sure of its cause. The seismic event is too small to provide useful data on the Martian interior, one of InSight's main objectives. Such a quake wouldn't even have registered on Earth, but the Martian surface is almost dead still, allowing the seismometer’s highly sensitive sensors to pick up this faint rumble.

Several features of the Sol 128 event fit the profile of moonquakes. NASA astronauts measured thousands of quakes while exploring the Moon between 1969 and 1972, revealing that it was still geologically active. Different materials can change the speed of seismic waves or reflect them, allowing scientists to learn about the interior of the Moon and the size of its core. These investigations enabled a closer understanding of the impact between Earth and the proto-Moon, and how the Moon subsequently formed from the debris disk. With the SEIS seismometer, scientists will be able to gather similar data about Mars and gain deeper insights into the formation of rocky planets.

“InSight’s first readings carry on the science that began with the Apollo missions," said InSight Principal Investigator Bruce Banerdt of NASA's Jet Propulsion Laboratory in Pasadena, California. "We've been collecting background noise up until now, but this first event officially kicks off a new field: Martian seismology.”

Three other signals, which occurred on 14 March (Sol 105), 10 April (Sol 132) and 11 April 1 (Sol 133), could also be of seismic origin. The signals were far more ambiguous to the InSight team, but at least two do not appear to have been caused by wind or other unwanted sources of noise. These signals are a lot weaker than those on Sol 128 and were only detected by SEIS’s ultra-sensitive VBB sensors. The mission team is working flat out to uncover where these new signals came from.

JPL leads the InSight mission. SEIS (Seismic Experiment for Interior Structure) was provided for InSight by CNES. Philippe Lognonné, a Professor at Paris Diderot University and geophysicist at the IPGP Earth physics institute in Paris, is the Principal Investigator for SEIS with teams from CNRS, the French national scientific research centre.

“We've been waiting months for our first marsquake,” said Lognonné. “It's so exciting to finally have proof that Mars is still seismically active. We're looking forward to sharing detailed results once we've studied it more and modelled our data.”

While Mars doesn't have tectonic plates, which cause most of Earth's quakes, both planets and the Moon experience the kind of quake caused by faults, or fractures in their crusts. As heavy masses and slow cooling add stress to the crust, it cracks, releasing energy.

Detecting these quakes was a real feat of engineering. On Earth, high-quality seismometers are often placed underground to insulate them from changes in temperature and weather. But this couldn't be done with SEIS on Mars. As a result, it has several ingenious barriers, including a cover built by JPL, called the Wind and Thermal Shield, to insulate it from the planet's winds, dust, extreme temperature swings and other sources of noise. To date, SEIS has surpassed all the team's expectations in terms of its sensitivity.

On the occasion of this event, CNES President Jean-Yves Le Gall commented: "The French SEIS seismometer is the cornerstone of space cooperation between France and the United States. The instrument has barely begun its mission and it has already hit pay dirt with this world first revealing new insights into Mars, a planet that was habitable in its ancient past. The teams at the SISMOC mission control centre in Toulouse are working around the clock to operate SEIS and analyse the data beamed back from the red planet. Once again, congratulations to all of the scientists and engineers to whom we owe this fantastic success on the surface of Mars!"

Antoine Petit, CEO of CNRS, also underlined the importance of this result: "Earth is no longer the only planet continuously monitored by seismometers. The SEIS instrument deployed on Mars at the start of this year is now recording the slightest ground vibrations day and night, be they due to the atmosphere and its winds sweeping the surface or to quakes and meteorite impacts. Mars is thus the third rocky planetary body in the solar system to be studied by seismologists, 130 years after the beginnings of instrumental seismology on Earth and 50 years after the first seismometer deployed by Apollo 11 in July 1969. No fewer than 11 CNRS laboratories, in partnership with universities, are working with these exceptional data. In the months and years ahead, their research will tell us more about how Mars formed and why its volcanic activity ceased to leave the cold, dry desert surface we see today."

CNES is lead contractor for SEIS and IPGP is the instrument principal investigator. CNES is funding French contributions to the mission, coordinating the international mission consortium[1] and was responsible for integrating, testing and supplying the complete instrument to NASA. IPGP designed the Very Broad Band (VBB) sensors built by Sodern and tested them before delivery to CNES. Several CNRS-affiliated laboratories, the LMD dynamic meteorology research laboratory (CNRS/ENS Paris/Ecole Polytechnique/Sorbonne University) and the LPGN planetology and geodynamics laboratory in Nantes (CNRS/University of Nantes/University of Angers) and the ISAE-SUPAERO aeronautics and space institute are involved in analysing data from InSight.

1 In collaboration with Sodern for the VBBs, 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 its science data.

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