EPSC Abstracts
Vol. 13, EPSC-DPS2019-1066-1, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

InSight - Early results from the first geophysical station on the surface of Mars

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Introduction

After a flawless launch and a quiet half-year cruise to Mars, the InSight spacecraft landed safely in Elysium Planitia [1] on 26 November, 2018, carrying a scientific payload focused on the exploration of the deep interior of the planet. The three core experiments are SEIS [2] (Seismic Experiment for Interior Structure), a six-sensor, broad-band seismic instrument to detect global seismic [3,4] and impact [5] activity and use this to probe planetary structure [6,7]; HP^3 [8] (Heat flow and Physical Properties Package) for measuring the ground temperature/gradient, thermal conductivity and mechanical properties from the surface to 5 m depth; and RISE [9] (Rotation and Interior Structure Experiment), a geodetic planetary rotation investigation using sub-decimeter-scale precision tracking. These are augmented by APSS [10] (Auxiliary Payload Sensor Suite), an environmental sensor suite comprising a pair of wind and air temperature sensors (TWINS, Temperature and Winds for INSight), a pressure sensor (PS) and a magnetometer (IFG, InSight FluxGate); and an Instrument Deployment System (IDS) [11,12], including a robotic arm, a mid-resolution color camera (IDC, Instrument Deployment Camera) and a wide-angle color camera (ICC, Instrument Context Camera). Although the latter two subsystems were included in the mission to aid in the deployment and data interpretation of SEIS and HP^3, they also provide compelling science in their own right, providing continuous monitoring of surface meteorology [13] and magnetic field, and supporting investigations of the lander's surroundings [14].

Results

In-situ imaging with InSight's cameras has been combined with orbital data to investigate the character and history of the landing site. InSight appears to have come to rest in a "hollow", a filled, quasi-circular depression that is inferred to be a highly-degraded impact crater.

This landing site turned out to be remarkably well-suited for the deployment of SEIS. After full installation of the seismometer and its protective shield was completed on sol 70 and calibration and tuning around sol 90, the sensors have been operating with unprecedentedly low noise levels during the quietest parts of the day (roughly 6 PM to midnight, local time). At the time of this writing at least one probable marsquake and several additional likely

events, all extremely small, have been detected. These are already starting to reveal aspects of the martian interior.

HP^3 was deployed to the surface near the end of February of 2019, but mole penetration stalled very soon after the start of hammering, at a depth of >40 cm. Several months were spent acquiring additional data and planning a recovery campaign. This talk will describe the latest status and prospects for the heat flow experiment.

The atmospheric sensors have been operating nearly continuously at high acquisition rates since shortly after landing. This has allowed the detailed observation of atmospheric phenomena at time scales ranging from months to seconds. Synergistic observations with the seismometer have proven to be particularly valuable for boundary layer studies.

Finally, the first magnetic measurements from the surface of Mars have revealed a number of exciting results, including a background field many times larger than that observed from orbit and dynamic field variations that have not been previously observable.

Summary

In this presentation we will discuss these and other key scientific results from the first six months of science operations, along with the latest mission status

Acknowledgements

These results would not have been possible without the dedication and hard work of the engineers, scientists and many others of the InSight project, spacecraft, science, and instrument teams over the past 10 years.

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