# SEIS-InSight on Mars: results and first constrains on Mars' s seismic noise, seismicity and crust/subsurface structure after one year of operation

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SEIS, InSight' s seismometer, is monitoring Mars' seismic activity and noise since January 2019 and its installation with a Wind Shield protection has been completed in early February, 2019. We present here results and findings after the first year of monitoring

During the first part of the night, Mars is extremely quiet. Seismic noise is ~500 times lower than Earth' s micro-seismic noise between 4-30 seconds, with ground velocity below $10^{-10}$ m/s/$Hz^{1/2}$ at 2.5 seconds. The recorded seismic noise increases during the second part of the night and then during the day due to ground deformations induced by convective vortices and ground transferred wind-generated lander noise. During these noisy times, pressure data shows significant coherency with the recorded seismic signals and can therefore be used to perform noise decorrelations.

The subsurface below the landing site has been constrained with seismic signals from dust-devil-like vortices, long period atmospheric signals and from the hammering of the Heat Flow and Physical Properties ($HP^3$). These analysis reveals a 2-3 meters of very low rigidity materials, possibly associated to eaolian deposition in a eroded crater above more rigid layers. The subsurface is also constrained by shallow site effects, generating ground resonances.

We recorded 389 events until December 31, 2019, with mostly two distinct populations of seismic: mostly small-magnitude events with High or Very high frequencies, and more than 30 Low frequency or Broadband events with signals at and/or below 1 Hz. These have the signature of Marsquakes of magnitude 3-4 located near the crust-mantle interface and with waves propagating at different depths in the mantle. The two larger events are near the Cerberus Fossae system, and preliminary focal inversions have been found to be coherent with the local tectonics, as constrained from remote sensing data.

 

The three largest quakes detected until September 2019, on sols 128, 173 and 235 have been used for crustal analysis. Receiver function analysis suggested a 8 to 11 km thick superficial layer of highly altered and/or fractured crustal material and multi-scattering analysis constrained the crustal diffusivity and intrinsic attenuation using and find a crustal seismic attenuation ~3 times larger than on the Moon suggesting a crust with small amounts of volatiles.
All data and Activity catalogue of SEIS are available to the community through request on the SEIS data portail (http://seis-insight.eu), IRIS-DMC or NASA PDS.

Keywords: Mars, seismology, InSight

 