EVIDENCE FOR A WET MARTIAN INTERIOR FROM MAGNETIC SOUNDING WITH THE INSIGHT MAGNETOMETER. Y. Yu[1], P.J. Chi[1], C.T. Russell[1], M. Fillingim[2], W. Banerdt[3], [1]Earth, Planetary and Space Sciences, UCLA, 603 Charles Young Drive, Los Angeles, CA 90095-1567, USA, yyn@g.ucla.edu, [2]Space Sciences Laboratory, University of California, Berkeley, CA 94720, USA, [3]Laboratoire de Planetologie et Geodynamique, 44330 Nantes, France.

The martian magnetic field oscillates at frequencies from once per day to periods of only 100s of seconds. The interior of Mars is electrically conducting, and the time-varying magnetic fields create induced currents in the electrically conducting subsurface of Mars. The diurnal periods are little affected by the interior conductivity, but at periods less than about 1000 sec, the reflection of the magnetic wave energy is strong, and the vertical component of the oscillating magnetic field approaches zero as the frequency increases. Figure 1 shows the low-frequency spectral signature produced mainly by the daily variation of the solar illumination as the planet rotates. Electromagnetic waves are also produced by the nighttime currents such as those flowing on and within the Mars magnetotail.

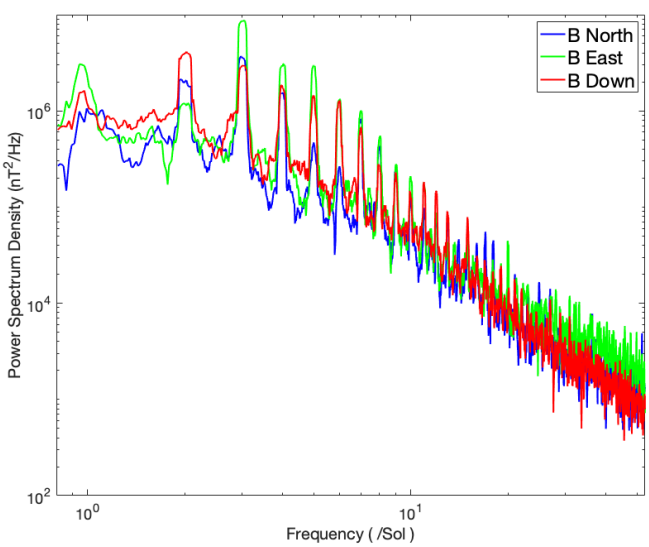

Figure 1. The spectrum of the magnetic field from frequency 0.8 /Sol to 5 /Sol, from mid-December to mid-February, covering all local times.

Figure 2 shows an example of the time series of these higher frequency waves. Figure 3 shows the spectra obtained from the two horizontal components and the vertical component. The weakness of the fluctuations in the vertical component of the waves is associated with the restriction of the currents to flow horizontally as the wave period grows shorter.

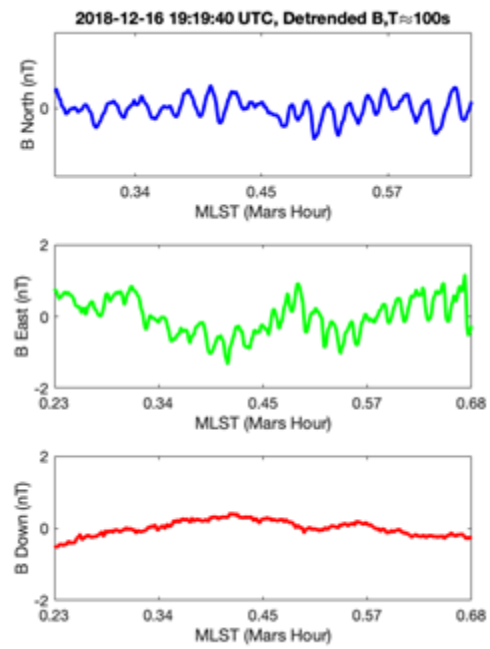

Figure 2. Waves in the magnetic records of December 16, 2018.

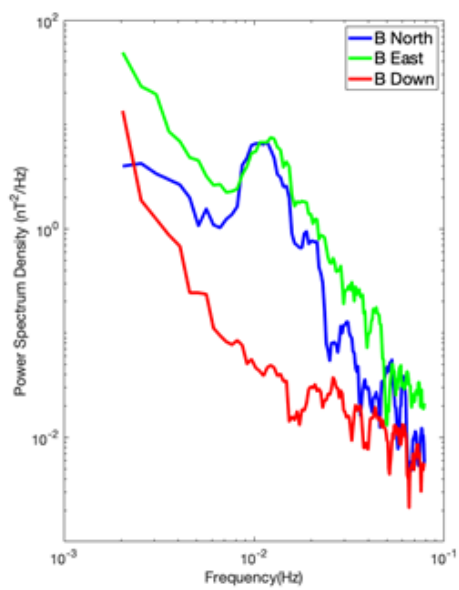

Figure 3. Spectrum of oscillating field during the December 16, 2018 wave event.

This phenomenon is also seen on Earth and has been well characterized there. The attenuation of the

vertical component is consistent with a finite skin depth. At the InSight landing site, it is consistent with a skin depth of 3.4 km for the expected conductivity of terrestrial seawater. We have seen no variation of this skin depth with season. These observations are consistent with the many manifestations of the occasional presence of water on or near the surface of Mars and strengthen the case for permanent water in the soil only several kilometers beneath the surface.

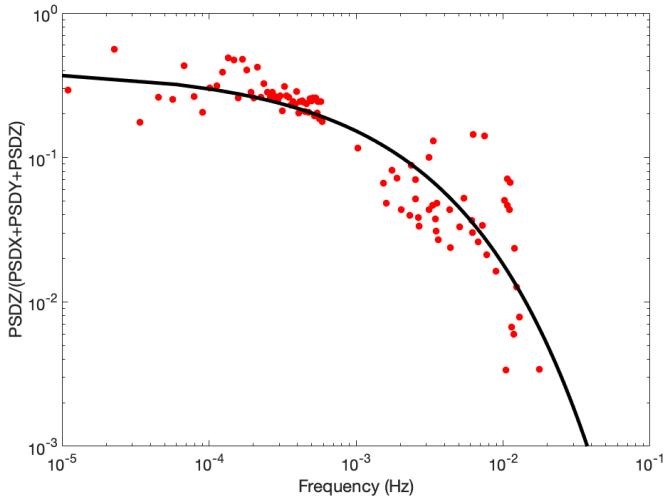

Figure 4. Ratio of the power spectrum density with the vertical component to the sum of the power spectrum density in three components. The power spectral density ratios for frequencies from 10^{-5} to 10^{-3} Hz are obtained from the power spectrum shown in Figure 2. The power spectral density ratios above 10^{-3} Hz were obtained from individual time series of varying lengths during the nighttime hours.