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First results from the InSight FluxGate Magnetometer: Constraints on Mars' crustal magnetic field at the landing site

Anna Mittelholz (1), Catherine L. Johnson (1,2), Benoit Langlais (3), Philippe Lognonne (4), William T. Pike (5), Steven P. Joy (6), Christopher T. Russell (6), Yanan Yu (6), Veronique Ansan (3), Matthias Grott (7), Christian Krause (8), Tilman Spohn (7), Rudolf Widmer-Schnidrig (9), Suzanne E. Smrekar (10), and William B. Banerdt (10)

(1) The University of British Columbia, Earth, Ocean and Atmospheric Sciences, Vancouver, Canada (amittelh@eoas.ubc.ca), (2) Planetary Science Institute, Tucson, USA, (3) Laboratoire de Planétologie et Géodynamique, Université de Nantes, Faculté des Sciences et Techniques, Nantes, France, (4) Université Paris Diderot-Sorbonne Paris Cité, Institut de Physique du Globe de Paris, Paris, France, (5) Department of Electrical and Electronic Engineering, Imperial College, London, United Kingdom, (6) Earth, Planetary and Space Sciences, University of California, Los Angeles, USA, (7) German Aerospace Center (DLR), Institute of Planetary Research, Berlin, Germany, (8) MUSC, German Aerospace Center (DLR), Cologne, Germany, (9) Black Forest Observatory (BFO), Wolfach, Germany, (10) Jet Propulsion Laboratory, 4800 Oak Dr, Pasadena, USA

The Interior Exploration using Seismic Investigations, Geodesy and Heat Transport (InSight) mission successfully landed on Mars on 26 November, 2018 at 4.50°N, 135.62°E in Elysium Planitia. The Insight FluxGate magnetometer (IFG) is part of the Auxiliary Payload Sensor Suite (APSS) of instruments that will monitor environmental conditions at the lander, for the primary purpose of accounting for sources of wind, temperature, pressure and magnetic field noise in the seismic data. The IFG is the first magnetometer to be deployed on the surface of Mars, and thus affords unique opportunities for magnetic field-based studies of the martian interior, the ionosphere, and the extent to which conditions in the solar wind affect the martian surface environment. In this, and a companion paper *(Russell et et al., 2019*), we report on initial results from the IFG instrument. Here, we focus on approaches for estimating the local crustal magnetic field at the InSight lander, yielding the first surface-based estimates of Mars' crustal magnetic field.

We use two approaches to estimate the local crustal field: (1) In theory, IFG data can provide a direct estimate of the crustal field via the DC field. However, such estimates require accurate characterization of the DC spacecraft field, with instruments in their deck and/or deployed configurations. Characterization of spacecraft fields prior to landing provide estimates for the magnitude of the spacecraft field of ~700 nT. (2) Vibrations of the InSight lander in response to the daily winds have been recorded by the Short Period sensors of the seismic experiment SEIS. These high frequency tilts result in accelerations and magnetic field perturbations that may be detectable on the short-period seismometer, SP, and the IFG respectively. Calculations based on Viking data prior to InSight ground operations, suggested that wind speeds of at least 10 m/s expected at the InSight landing site, would produce lander tilts of $\sim 10^{-4}$ degrees. These in turn could produce magnetic field perturbations on the IFG resolvable with ~20 hrs of data. Measurement of the horizontal signals on SP and the horizontal perturbations to the magnetic field in the resonance frequency band of the lander allow a least squares solution for the vertical component, B_Z, of the ambient crustal magnetic field. Accordingly, over 40 hours of simultaneous IFG and SP data have been collected while the SP is on deck and we will report on results from these data.