

Constraints on the Martian Crust Away From the InSight Landing Site

Jiaqi Li¹, Caroline Beghein¹, Scott M. McLennan², Anna C. Horleston³, Constantinos Charalambous⁴, Quancheng Huang⁵, Géraldine Zenhäusern⁶, Ebru Bozdogan⁵, W. T. Pike⁴, Matthew Golombek⁷, Ved Lekić⁸, Philippe Lognonné⁹, and W. Bruce Banerdt⁷

¹ Department of Earth, Planetary, and Space Sciences, University of California, Los Angeles, CA 90095, USA. E-mail: jli@epss.ucla.edu

² Department of Geosciences, Stony Brook University, Stony Brook, New York, 11794–2100 USA

³ School of Earth Sciences, University of Bristol, Bristol, United Kingdom

⁴ Department of Electrical and Electronic Engineering, Imperial College London, London, UK

⁵ Department of Geophysics, Colorado School of Mines, Golden, CO, USA

⁶ Institute of Geophysics, ETH Zurich, Zurich, Switzerland

⁷ Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, USA.

⁸ Department of Geology, University of Maryland, College Park, Maryland, USA.

⁹ Université Paris Cité, Institut de physique du globe de Paris, CNRS, Paris, F-75005, France.

Abstract

The most distant marsquake recorded so far by the InSight seismometer occurred at an epicentral distance of $146.3 \pm 6.9^\circ$, close to the western end of Valles Marineris. In the seismogram of this event, we have identified seismic wave precursors, i.e., underside reflections off a subsurface discontinuity halfway between the marsquake and the instrument which directly constrain the crustal structure away (about 4,100 - 4,500 km) from the InSight landing site. Here we show that the Martian crust at the bounce point between the lander and the marsquake is characterized by a discontinuity at about 20 km depth, similar to the second (deeper) intra-crustal interface seen beneath the InSight landing site. We propose that this 20-km interface, first discovered beneath the lander, is not a local geological structure but likely a regional or global feature, and is consistent with a transition from porous to non-porous Martian crustal materials.

