CONCEPT OF THE HIGH PRECISION IN-SITU MEASUREMENTS OF THE FOUR MAGNETIC CHARACTERISTICS OF THE LUNAR NEAR-SURFACE WITHOUT TOUCHING THE REGOLITH.

, R. Kavkova[3], G. Kletetschka[1,2,3], M. Takac[3], V. Petrucha[4], M. Dressler[4], N. Hasson[1]. [1] Geophysical Institute, University of Alaska Fairbanks, AK, USA (gkletetschka@alaska.edu), [2]Institute of Geology, Czech Academy of Sciences, Czech Republic, [3]Department of Applied Geophysics, Charles University, Czech Republic. [4]Faculty of Electrical Engineering, Czech Technical University in Prague, Czech Republic

Introduction: Moon's regolith needs 1. Measurement of magnetic susceptibility over a 1 m radius without the need to touch the regolith or take samples. Such ability allows measuring the concentration of iron. 2. Measurement of magnetic remanence that relates to the geological formation history of the Moon. Moon is entirely covered with magnetic anomalies which signify changing magnetic environment that remanent measurements can reveal without handling the samples. 3. Estimate of paleofield that once magnetized the rocks on the Moon's surface. 4. Measurement of near surface magnetic field. Such measurement allows finding magnetic shields that would serve as potential human presence on the Moon.

This measurement methods are useful tool for answering fundamental lunar science questions that fill a special niche as it provides the bulk magnetic composition of materials, both on and beneath the lunar surface and thus can separate the effects of space weathering. This is because the space weathered material is characterized by superparamagnetic iron which contributes significantly to magnetic susceptibility but not to remanence [1]. In addition magnetic remanence sensor allows sensing the subsurface magnetic composition. Such method produces significant science in both static lander and lunar rover configurations.

New method provides the local concentrations of iron and nickel, important geolocation constraints on the location of regolith mixed with nickel and mixed with only iron. Method also answers outstanding science questions about lunar formation through its measurements of the magnetic field caused by electrostatic discharge (ED). ED happens in the shadows of the Moon due to higher mobility of electrons in the plasma flow along the Moon's surface [2]. Because shadow regions are with likely volatile accumulation, EDs would in longer time scale cause repeated condensation of the volatiles and thus volatile preferred accumulation in the EDs locations. This way new method indirectly maps distribution of lunar volatile elements at both polar and middle latitudes. This is because ED magnetizes on a local scale the Lunar regolith due to magnetic fields of incident electric currents [3]. In addition to these scientific contributions, method will also provide in situ ground truth validation for orbital iron composition maps obtained by multiple missions. Finally, method will also provide useful information about near-surface resources and dangers, important for future lunar exploration.

Methods and results:

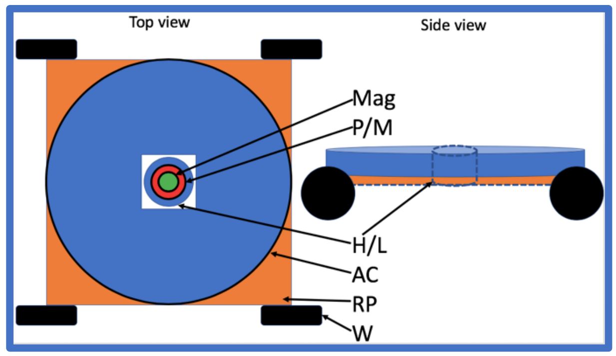
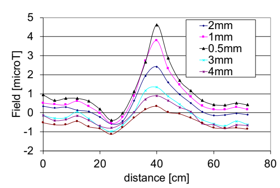
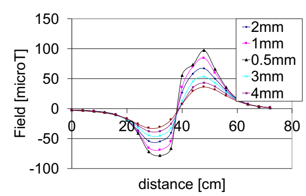


Fig. 1: components are shown above: Mag – Magnetometer, P/M – Pulse/Magnet, H/L Heater/Laser, AC – Alternating current Coil, RP – Rover Platform, W – Rover's Wheel. Wheels are about 1 m apart.

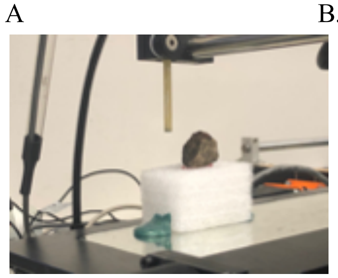
Instrument (Fig. 1) measures magnetic field over the rocky surface. Preliminary test the Hall probe magnetometer over the 2 terrestrial volcanic rocks showed it can detect its natural remanent magnetization as well as saturation remanence. They differ by two orders of magnitude (Fig. 2) and this indicates good potential for sensing the paleomagnetic field value recorded in the Lunar rock.



A



B.



C.

Fig. 2: Testing the concept of measuring the terrestrial gabbro rock using the Hall probe sensor shows variation in A. natural magnetization and B. saturation remanence depending on the proximity of the Hall sensor from the volcanic rock surface, C shows the laboratory setup when moving Hall probe over the ~2 cm in size Gabbro rock.

Discussion and conclusion: Paleointensity estimates [1] from measurements over different volcanic rocks at 5 distances between 0.5mm and 5mm (Gabbro and Dolerite, see Fig. 2) gave estimates between 25 uT, and 20 uT, the correct order of magnitude for terrestrial field. While the Lunar rocks may be much less intense, this test indicated that the paleomagnetic intensity measurement is possible for planetary rocks containing remanent magnetization.

Acknowledgements: Support for GK came from the Czech Science Foundation 20-08294S, 20-00892L, Ministry of Education, Youth and Sports LTAUSA 19141, and institutional support RVO 67985831.

References: [1] Kletetschka G. and Wieczorek M. A. (2017) *PEPI*, 272, p. 44-49. [2] Calle C. I. (2017) Electrostatic Phenomena on Planetary Surfaces. San Rafael, CA: Morgan & Claypool Publishers. [3] Wasilewski P. & Kletetschka G. (1999) *GRL 26/(15*), p. 2275-2278.