In-Situ Investigation of Asteroid (162173) Ryugu by the Hayabusa2 MASCOT Lander

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After a journey of almost four years to the C-type asteroid (162173) Ryugu, the MASCOT lander of the Hayabusa2 mission was delivered to the asteroid’s surface on October 3rd in 2018 and successfully performed in situ investigations. MASCOT was released from the mother spacecraft at an altitude of 41 m and came to rest on the surface at a site located at 22.31±0.05°S, 317.16±0.05°E. MASCOT observed the surface for a full day-night cycle using its four science instruments until batteries ran out after 17h and 7min. The payload consisting of a wide angle camera (MASCAM), an imaging IR spectrometer (MicrOmega), a multi-channel radiometer (MARA), and a magnetometer (MasMAG) provided a wealth of data which helped to characterize the asteroid’s surface down to millimeter scale. MasCAM images revealed a surface dominated by rocks and boulders without showing fine-grained material. Boulders appeared either bright with smooth faces and sharp edges or dark with cauliflower-like crumbly surfaces. Inclusions observed in high-resolution images showed that rocks had strong similarities with carbonaceous chondrites. Temperatures of a ~60 cm diameter rock that have been measured in situ, were found to be consistent with a thermal inertia of 282(+93, -35) J m^{-2} K^{-1} $s^{-1/2}$, much lower than anticipated when compared to samples in our meteorite collections. This indicated that rocks on Ryugu were highly porous and likely very friable. The remnant magnetization of Ryugu's surface material on scales larger than 1 m was estimated to be lower than $3 \cdot 10^{-6}$ Am^2/kg (the measurement limit of MasMAG). A preliminary analysis of the induction effect in Ryugu caused by the variation in the solar wind magnetic field revealed significantly high electrical conductivity (of the order 1 S/m).

Keywords: Ryugu, Hayabusa2, Asteroid Surface, Lander, Carbonaceous Chondrites, High Porosity

