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Simulating Near-Surface Environments of Solar System Bodies in the Laboratory

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Thermal infrared (TIR) emissivity measurements are sensitive to a planetary body's near-surface (upper hundreds of microns) environment, porosity and particle size, which make the interpretation of thermal infrared remote sensing observations of planetary surfaces challenging. Thus, well-constrained laboratory TIR measurements of analogue samples for a range of particle sizes, porosities and near-surface environments are needed. Near-surface environments and porosities for a range of solar system bodies can be simulated using facilities within University of Oxford's Planetary Spectroscopy Facility (PSF). The Simulated Lunar Environment Chamber (SLEC) within Oxford's PSF is a vacuum chamber capable of simulating near-surface conditions for a range of solar system bodies by varying atmospheric pressure and incident solar irradiation. By varying the near-surface environment, the thermal gradient in the upper hundreds of microns of the sample is varied, which can affect the position and contrast of diagnostic features in TIR spectra. The atmospheric pressure inside the chamber is varied between $\sim$1000, $\sim$5 and < 10-4 mbar to simulate Earth, Mars and airless bodies (e.g. the Moon, Mars' moons and asteroids) conditions. The solar-like irradiation is varied by adjusting the power of the halogen lamp until the brightness temperature of the sample is similar to the brightness temperature of the simulated planetary body. Varying the sample packing in the sample cup simulates a range of near-surface porosities. Here we present laboratory emissivity spectra of a suite of well-characterized rock, soil and mineral samples (< 25 microns in particle size) measured under a range of simulated planetary conditions including Earth, Mars, Moon and asteroids. These well-controlled laboratory measurements enable the interpretation of remote sensing observations, which help in determining a planet's surface composition as well as the consolidated nature of its regolith.