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# Inferences of Strength of Soil Deposits along MER Rover Traverses

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As the two Mars Exploration Rovers ‚Spirit' and ‚Opportunity' traverse terrains within Gusev crater and at Meridiani Planum, respectively, they leave behind wheel tracks that are routinely imaged by the different sets of cameras as part of the ATHENA instrument suite. Stereo observations of these tracks reveal wheel sinkages which are diagnostic of the strength of the soil-like deposits crossed by the vehicles, and observations of track morphology at different imaging scales – including that of the Microscopic Imager – allow to constrain soil grain size distributions.

This presentation will discuss results of systematic analyses of MER-A and –B wheel track observations with regard to solutions for soil bearing strength, cohesion, and friction angle which are obtained by fitting sinkage measured in rover stereo images to wheel-soil theory calibrated to the shape of the MER wheel and by consulting comparisons with terrestrial soils. Results are applicable to the top 1...5 cm of the soil deposits as this is the depth range ‚sampled' by sinkage of the wheels. The large number of wheel track observations per distance travelled enables investigations of variations of soil physical properties as a function of spatial scale, type of surface feature encountered, and local topography.

Exploiting relationships between soil strength and degree of soil consolidation known

from lunar regolith and dry terrestrial soils allows to relate inferred soil strengths to bulk density which provides a means to ground-truth radar reflectivities obtained for the landing sites from Earth-based observations. Moreover, bulk density is correlated with soil dielectric constant, being of relevance also for Mars-orbiting radars.

The obtained estimates for soil bulk density are used to determine local thermal conductivity of near-surface materials, based on correlations between the two quantities, and to subsequently estimate thermal inertia. This represents an independent method to provide ground truth to thermal inertia determined from orbital thermal measurements of the MER landing sites (MGS TES, MODY THEMIS, MEX PFS & OMEGA), in addition to that offered by thermal inertia retrievals from the Mini-TES instrument being part of the rover ATHENA payload suite.