MECHANICAL WEATHERING OF ASTEROID REGOLITH

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Introduction: The presence of a fragmental layer of rock debris, of regolith, covering asteroid surfaces suggests that one or more processes acts to mechanically weather the surfaces of these airless bodies. Meteoroid impacts [1] and thermally-induced stresses [2] have both been suggested as relevant processes acting on asteroids. If both processes are active, then the extent of weathered regolith is expected to be dependent on the size, rotation period, composition, and surface age. Table 1 shows which process is affected by each of these factors.

	Meteorioid Impacts	Thermal Stress
Size	X	
Rotation Period		X
Composition	X	X
Surface Age	X	X

Table 1. Impoartant factors influencing the mechanical weathering of regolith and the processes that depend on them.

The size of the regolith grains heavily influence the thermophysical properties of the surface [3]. In particular, the size of the grains directly determines the size of the pore spaces between them, which act to alter the surface bulk thermal conductivity over many orders of magnitude. Estimation of thermal inertia, dependent on both the thermal conductivity, provides insight into the regolith grain size. Since thermal inertia is also dependent on the volumetric heat capacity, simple assumptions about the composition can lead to a reasonable estimation of the thermal conductivity and regolith grain size [4].

Methodology: We aim to estimate thermal inertias of a few hundred asteroids in order to build up the largest database of asteroid thermal inertia estimates (next section). Using the model of [3] we will estimate regolith grain sizes, which will be used in a multiple regression model, with the independent parameters being the size, rotation period, composition (with spectral class used as a proxy), and surface age (assumed to be the same as the dynamical family age [5]).

Thermophysical Modeling Approach: Traditional approaches for thermal inertia estimation rely on using a shape/spin axis model for an object. We show that with multi-epoch thermal observations taken at pre- and post-opposition, thermal inertia can still be reasonably estimated. The effectiveness of this approach is demonstrated for a synthetic dataset of thermal flux from asteroids of different shapes and spin orientations. With this modeling approach, the diameter, albedo, thermal inertia can be estimated, with reasonable estimates of an object's spin and a/b ellipsoid ratio.

Initial Results: With thermal inertia values of a few hundred asteroids, we investiagte which factors are correlated with the regolith grain size. Initial results show that all factors are correlated with thermal inertia, with rotation pertiod being the most influential. We also see a detectable difference of thermal inertias between spectral classes.

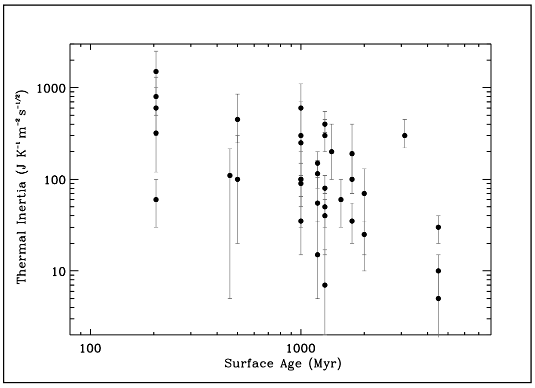

Figure 1. Thermal inertia as a function of dynamic family age. A preliminary maturation timescale of 2000 Myr can be inferred.

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