Asteroid regoliths: The development of a database

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There is a variety of evidence that asteroids, including the smallest asteroids, possess regoliths. This layer is our interface between the asteroid's interior physical processes and its exterior manifestation. By going beyond the remote study of asteroids with Hayabusa's brief touchdown onto Itokowa's surface, scientists, engineers, mission planners have new immediate questions and concerns about the asteroid regolith. For example: What if some asteroid surface features are transient due to dust transport? What are the risks about electrostatically sticky dust? Which alteration process (impact cratering, tectonics, shaking, dust levitation, and space weathering) can best explain the regolith properties of a particular asteroid?

To address these questions, a method has been developed which will lead to a database of asteroid regolith properties to aid asteroid investigators. The method is illustrated in the flowchart below. Three types of information is included: spacecraft-based in-situ data, laboratory-based meteorite samples, and telescopic remote data provide a system of cross-checking to increase the accuracy and the probability of gaining new information. Theoretical studies can provide additional cross-checking. A critical perspective, included here, is the assignment of the spatial scales where the bulk density and porosity of an asteroid is related to the average density and porosity of its constituent rocks, which is further distinguished from the average density of the mineral assemblages within the rocks.

This presentation will step through the method and provide first regolith database results of the regolith properties: grain density, size, thermal conductivity, porosity, and volume filling factor for the asteroids (1) Ceres, (2) Pallas, (21) Lutetia, and (4) Vesta.
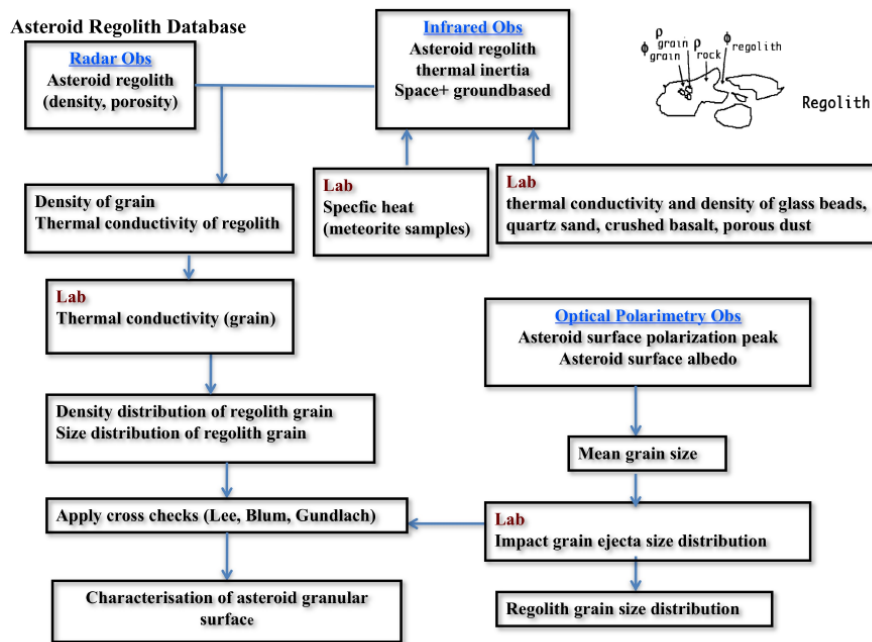

Figure: Data processing flowchart for an asteroid regolith database.

References: "Regolith properties of asteroid surfaces" (2012), http://www.boulder.swri.edu/~amara/ Graps_QuickLookResults.pdf.