Why Phobos and Deimos?

After decades of intensive exploration of Mars, fundamental questions about the origin and evolution of the martian moons, Phobos and Deimos, remain unanswered. Their spectral characteristics are similar to C- or D-class asteroids, suggesting that they may have originated in the asteroid belt or outer solar system. Perhaps these ancient objects were captured separately, with orbits circularized by the action of gas drag in the solar nebula or early martian atmosphere, or maybe they are the fragments of a captured asteroid disrupted by impact. Various lines of evidence hint at other possibilities: one alternative is co-formation with Mars, in which case the moons contain primitive martian materials. Another is that they are re-accreted ejecta from a giant impact and contain material from the early martian crust. Thorough characterization of their global composition is required to determine their origins. The Phobos ANd Deimos ORigin Assessment (PANDORA) mission, proposed in response to the 2014 NASA Discovery Announcement of Opportunity, will acquire new information needed to determine the provenance of the moons of Mars.

Finding an answer to the origins question.

The mission design provides a powerful and robust framework for this investigation. PANDORA will travel to and successively orbit Phobos and Deimos to map their chemical and mineral composition and further refine their shape and gravity. Geochemical data, acquired by nuclear- and infrared-spectroscopy, can distinguish between key origin hypotheses. High resolution imaging data will enable detailed geologic mapping and crater counting to determine the timing of major events and stratigraphy. Data acquired by the instrument suite will be used to characterize regolith properties, determine the nature of and relationship between "red" and "blue" units on Phobos, and determine how Phobos and Deimos are related. After identifying appropriate material representative of their bulk composition, careful analysis of the mineralogical and elemental composition of this material will allow discrimination between the formation hypotheses for each Moon.

Implications for the early solar system.

The information acquired by PANDORA can be compared with similar data sets for other solar system bodies, including Mars, Mercury, the Moon, Vesta and Ceres, as well as data from meteorite studies. Understanding the formation of the martian moons within this larger context will yield a better understanding of processes acting in the early solar system, including the distribution of planetesimals. PANDORA’s data will provide new constraints on the conditions that existed near the end of Mars’ accretion and/or on the mode of Mars’ final growth itself.