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Psyche mission to provide new insights into the formation, evolution, and inner workings of the cores of terrestrial planets

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Because they are inaccessible, our understanding of the inner workings of terrestrial cores is incomplete. For example, light-element chemistry, which influences core structure and dynamics, must be inferred from geophysical constraints. The NASA Psyche mission aims to shed new light on terrestrial cores by exploring the asteroid (16) Psyche. Psyche is thought to be the relict core of an igneous protoplanet, similar to Vesta. If so, Psyche formed within the dry, inner solar system early enough that heating by short-lived radionuclides melted the accreted silicates. This led to the formation of an iron-nickel core and igneous outer layers. Early on, perhaps within the first 10 Ma of the first condensates, the outer layers were stripped away by collisions, exposing the core. Psyche currently resides in the outer main belt, where it was likely implanted by dynamical mixing resulting from growth/migration of the giant planets. The Psyche spacecraft will travel to and orbit Psyche, providing the first look at the interior of a terrestrial body. Mission science objectives are met by radio science to probe the interior structure of Psyche and three payload instruments: a multispectral imager to investigate surface geology, mineralogy, and topography; a gamma-ray and neutron spectrometer to measure and map subsurface elemental composition; and a magnetometer to characterize the magnetic field. Although aspects of Psyche's formation differ from that of Earth's core, Psyche represents the initial conditions. The data acquired by the Psyche mission complements efforts to understand terrestrial cores through laboratory experiments and meteorite studies.