PLANETARY CHEMISTRY AND ASTROBIOLOGY

Research in planetary chemistry and astrobiology spans a wide range of topics, including the study of the interplay between biology and mineralogy, age dating of solar system materials, determining the age of the solar system, identification of biosignatures including identification of extinct and extant single-celled organisms, the detection of life in extreme environments, and the identification of trace gases that are a result of biological processes. Additionally, we work on every facet of future chemistry and astrobiology-based missions, from the development of long-term mission concepts to working on the instruments and methods that will perform the analysis of robotic platforms, and finally, developing the hardware for future missions. JPL researchers are currently involved in upcoming missions, such as Mars Science Laboratory, and end-of-decade missions (MoonRise, Mars Astrobiology Explorer-Cacher, Europa Jupiter System Mission) and exploring the possibilities for far-future missions and instruments, such as a Mars drill or Titan aerobot.

RESEARCH AREAS

- Identification of trace gases and isotopic ratios that are present in planetary atmospheres
- Unraveling the intricate relationship between microbial communities and their geological surroundings in extreme environments
- Understanding the formation and interpretation of traces of primitive microbial life in extremely ancient rocks
- Detection of life in extreme environments
- Study of correlated isotopic anomalies in meteorites and their connection with specific nucleosynthetic processes
- Understanding how sample acquisition and tool-interactions alter analysis

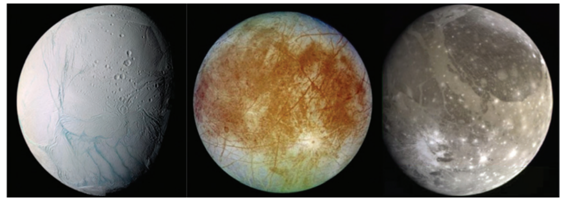
Images of stromatolites from Australia, ancient rocks that carry signatures of the early bacterial life on Earth. Understanding the interplay of microbial organisms and the environment is a main focus of researchers within the group.

PLANETARY ICES

Ices are found in numerous locations in the universe and play a key role in the chemistry, physics, and evolution of bodies within planetary systems. Our researchers in this area of planetary ices are a group of scientists with diverse backgrounds who investigate icy solar system bodies such as the outer planet icy moons (Europa, Ganymede, Enceladus, Titan, and Triton), comets, and the polar regions of Mars. Researchers use a variety of tools to study the surfaces, interiors, and atmospheres of icy bodies, including space-based observations, theoretical modeling, and laboratory experiments. Ultimately, this work seeks to aid in the interpretation and analysis of observational data, support existing missions, and assist in preparation and planning of future missions to these icy worlds.

RESEARCH AREAS

- Astrobiology of icy worlds
- Photolytic and radiolytic chemistry of planetary ice analogs
- Mechanical and rheological properties of ice
- Remote sensing of icy bodies
- Geophysical modeling



Three prominent examples of icy bodies in the solar system. From left to right: Enceladus, Europa, and Ganymede.

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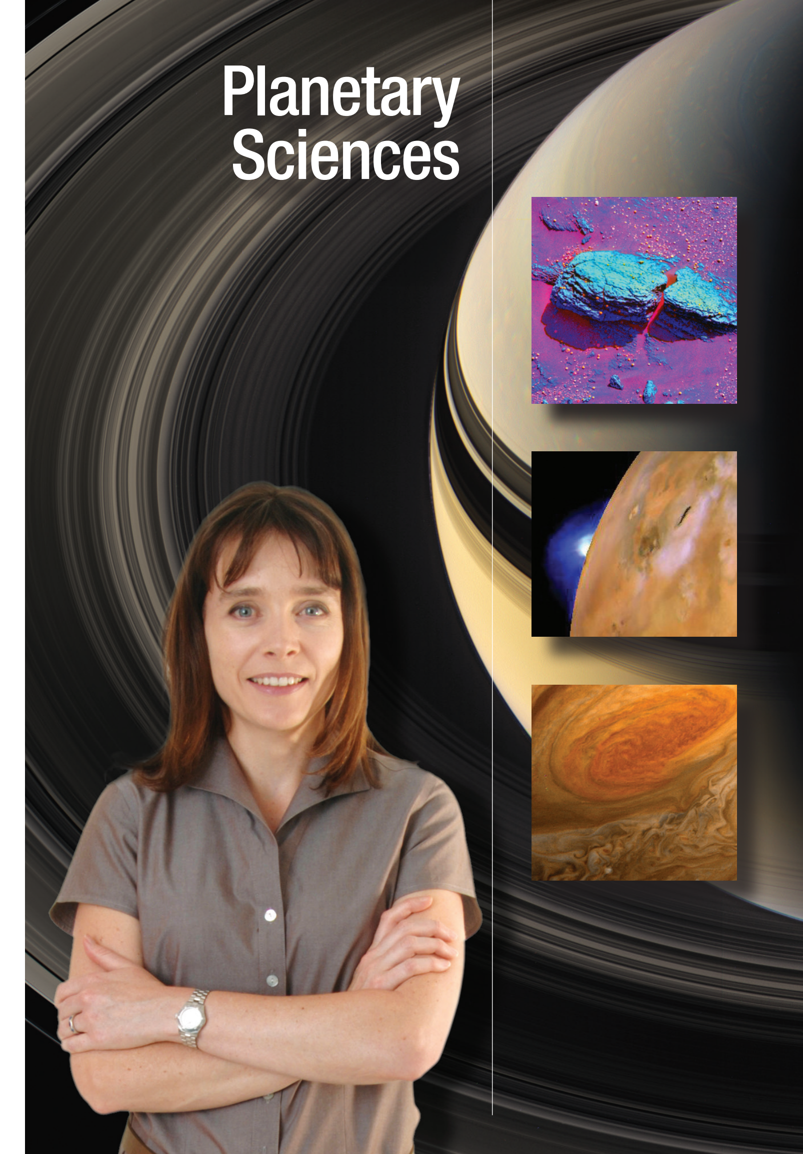
Planetary Sciences



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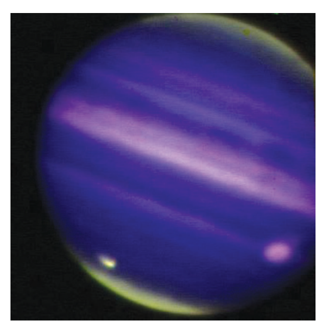
Planetary Science research at JPL covers a broad spectrum of topics, including all the planets and planetary objects in the solar system outside the Earth, and exoplanets, those outside our solar system. Our scientists engage in theoretical studies, observations, laboratory experiments, data analysis, and advanced instrument development, all generally focused on existing or future NASA missions. As one of the major centers for robotic exploration of the solar system, JPL offers a world of possibilities in planetary science. As a scientist here, you'll have opportunities for research not possible anywhere else.

EARTH AND PLANETARY ATMOSPHERES

JPL atmospheric scientists seek to obtain a quantitative understanding of the climate, dynamics, and chemistry of atmospheres in our solar system to study the origin and evolution of habitable worlds, how planetary systems work, and natural and anthropogenic forcings of the terrestrial atmosphere. We pursue this research program through ground-based telescopic observations, development of and observations with spacecraft experiments, and the creation of computer simulations to reproduce observations. We are heavily involved in flight missions, including Cassini, Hubble Space Telescope, Mars Reconnaissance Orbiter, Rosetta, and Earth Observing System (EOS) Terra.

RESEARCH AREAS

- Modeling the coupled chemistry and dynamics of Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Titan
- Observing the chemistry and dynamics of Jupiter, Saturn, Uranus, Neptune, and Titan at visible, infrared, and longer wavelengths
- Mapping the distribution of Martian atmospheric temperature, water vapor, and dust from orbit and surface observations
- Measuring asteroid and cometary surface and coma thermal and chemical properties at submillimeter wavelengths
- Compiling a water climatology for the terrestrial atmosphere

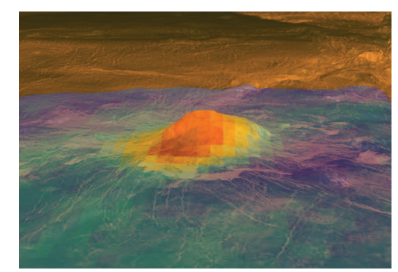


Exactly 15 years after the Comet Shoemaker–Levy 9 impacts, evidence for another bombardment of Jupiter was detected near the south pole. The impactor may have been an asteroid. This image was taken at a near-infrared wavelength of 1.65 microns using the NASA Infrared Telescope Facility.

Explore the Possibilities

GEOPHYSICS AND PLANETARY GEOSCIENCES

JPL scientists in the Geophysics and Planetary Geosciences group study the solid bodies of our solar system, including Mars, Earth, Venus, the Moon, Io, Europa, and Titan, and our methods include image interpretation (visible, infrared, radar), laboratory work, field work, infrared spectroscopy, geophysical data interpretation, and modeling. We aim to understand how solid bodies evolved and how geologic processes have shaped their surfaces. Our expertise in geology and geophysics provides core science support for numerous current flight projects at JPL and for studies of future missions. Our scientists hold key positions in missions to Mars (including the Mars Exploration Rovers, the Mars Reconnaissance Orbiter, and the Mars Science Laboratory), the Moon (Lunar Reconnaissance Orbiter) and the Outer Solar System (Cassini).



This image shows heat patterns on Idunn Mons derived from data collected by Venus Express in 2006–2007. Brightness signals mineral composition changed due to lava flow.

RESEARCH AREAS

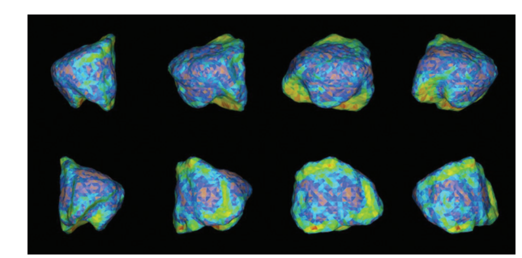
- Studying the distribution and relative ages of geologic processes on Mars, Venus, Io, and Titan through geologic mapping
- Modeling geologic process (e.g., volcanism, impact cratering, tectonism, and erosion) on solid planets and moons
- Characterizing candidate future landing sites on Mars by using high-resolution imagery of the Martian surface
- Modeling the interior structure of solid bodies using geophysical data (such as gravity and magnetic measurements)
- Studying the geochemistry and mineralogy of the Martian surface using orbital spectral measurements and data from rovers and landers

ASTEROIDS, COMETS, AND SATELLITES

JPL research on physical properties of small bodies in the solar system, including asteroids, comets, satellites, and rings involves a broad mix of observational techniques and modeling strategies. For example, we frequently combine visible, infrared, and radar observations of newly found small asteroids to maximize the information obtained. Improved understanding of these small bodies plays an important role in our overall attempt to decipher the processes of formation and continued evolution of the solar system. The data we use in these studies come from a broad range of Earth-based telescopes and spacecraft missions, including Voyager, Cassini, Deep Space 1, Stardust, and the Mars Exploration Rovers. Many group members are also involved in planning for future space missions.

RESEARCH AREAS

- Characterizing near-Earth objects
- Visible, infrared, and radar observations of planets, asteroids, comets, and rings
- Orbital and rotational dynamics of planets, asteroids, comets, and satellites



Radar observations allow reconstruction of the shape of near-Earth asteroids. This figure shows several views of the small, irregularly shaped asteroid 6489 Golevka, discovered by JPL observers in 1991. The colors represent slopes.