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The U.S. Geological Survey Astrogeology Science Center

In 1960, Eugene Shoemaker and a small team of other scientists founded the field of astrogeology to develop tools and methods for astronauts studying the geology of the Moon and other planetary bodies. Subsequently, in 1962, the U.S. Geological Survey (USGS) Branch of Astrogeology was established in Menlo Park, California. In 1963, the Branch moved to Flagstaff, Arizona, to be closer to the young lava flows of the San Francisco Volcanic Field and Meteor Crater, the best preserved impact crater in the world. These geologic features of northern Arizona were considered good analogs for the Moon and other planetary bodies and valuable for geologic studies and astronaut field training. From its Flagstaff campus, the USGS has supported the National Aeronautics and Space Administration (NASA) space program with scientific and cartographic expertise for more than 50 years.

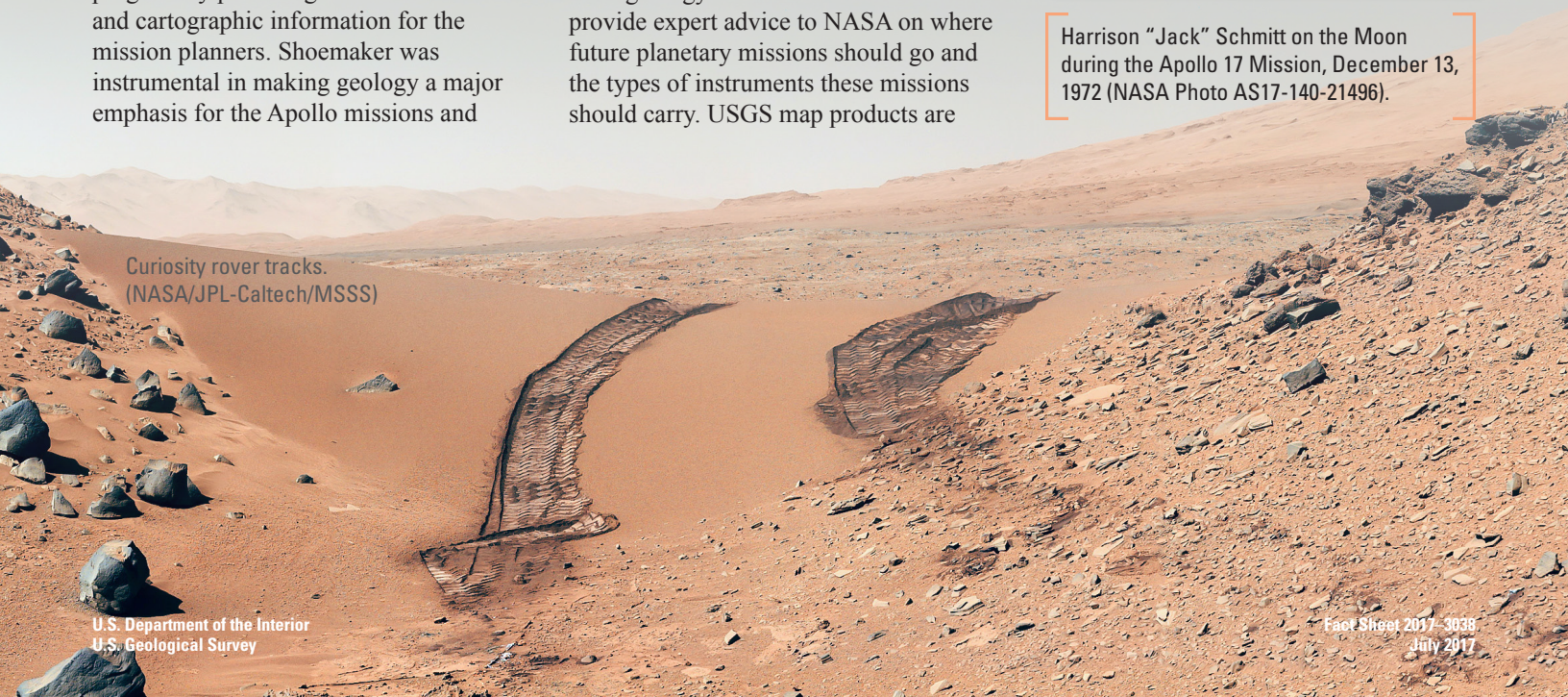
In its early years, the Branch of Astrogeology supported NASA's Apollo program by providing critical scientific and cartographic information for the mission planners. Shoemaker was instrumental in making geology a major emphasis for the Apollo missions and the USGS was at the heart of training the astronauts to look at the Moon through the eyes of a geologist. The only geoscientist to walk on the Moon (so far), Harrison "Jack" Schmitt, hailed from the USGS Branch of Astrogeology. The Branch, now called the Astrogeology Science Center, supports a host of U.S. and international robotic missions as they explore the solar system. Recent and current missions include visits to Mercury, Venus, the Moon, Mars, asteroids, Jupiter and its moons, Saturn and its moons, Pluto, and the Kuiper Belt.

The Earth is a planet, too, and Astrogeology Science Center scientists also use remote sensing data from Earth-observing satellites and aircraft, in combination with fieldwork, to study environments and processes on Earth to better understand natural hazards, potential resources, and geologic features that may be analogous to those on other planetary bodies.

Astrogeology Science Center staff support planetary science missions by providing scientific expertise, instrument design and spacecraft operations, software development, cartography, photogrammetry, and ready access to the archives of data acquired by space missions. As a vital part of the international planetary science community, Astrogeology Science Center scientists provide expert advice to NASA on where future planetary missions should go and the types of instruments these missions should carry. USGS map products are

Eugene Shoemaker training astronauts at Meteor Crater, Arizona, May 1967 (USGS Open-File Report 2005–1190, fig. 46b; https://pubs.usgs.gov/of/2005/1190).

Harrison "Jack" Schmitt on the Moon during the Apollo 17 Mission, December 13, 1972 (NASA Photo AS17-140-21496).



Curiosity rover tracks. (NASA/JPL-Caltech/MSSS)

U.S. Department of the Interior
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Fact Sheet 2017–3038
July 2017

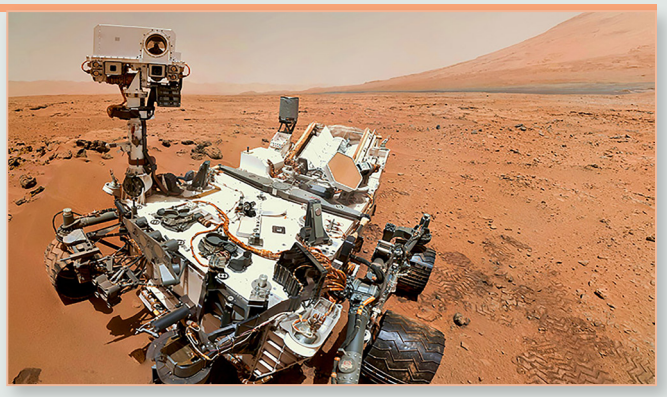
widely considered to be of the highest quality and exceptionally reliable, and the Center leads the planetary geologic mapping program for NASA. This involves creating mapping standards, monitoring national digital mapping efforts for the planets, and managing production of geologic and topographic maps of potential landing sites for spacecraft.

Astrogeology Science Center staff play a direct role in the operation of cameras on the Mars Reconnaissance Orbiter, the Mars Exploration Rovers (Spirit and Opportunity), the Mars Science Laboratory rover (Curiosity), and on missions to asteroids. As part of larger tactical operations teams, Astrogeology Science Center scientists analyze new data, select specific sites to investigate, and generate commands for various cameras to image those sites.

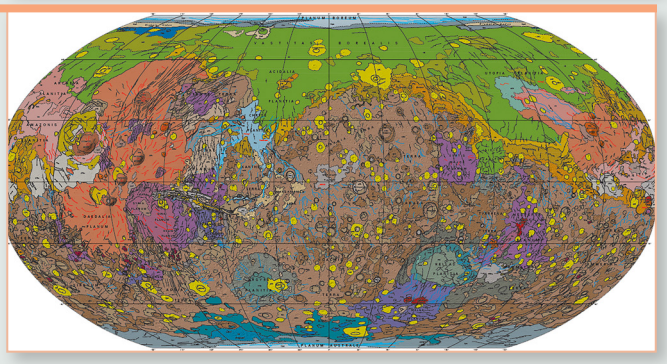
Many planetary missions and instruments rely on the Integrated Software for Imagers and Spectrometers package developed by the Astrogeology Science Center. This software package is the foremost freely available software for mapping image data collected by NASA spacecraft onto the surfaces of planetary bodies—an essential step in converting these data into scientific knowledge for planetary exploration.

The Astrogeology Science Center's planetary nomenclature project coordinates requests for naming planetary features through the International Astronomical Union's approval process; maintains the database of approved names of planetary features, satellites, and rings; and serves this information through the Gazetteer of Planetary Nomenclature web site.

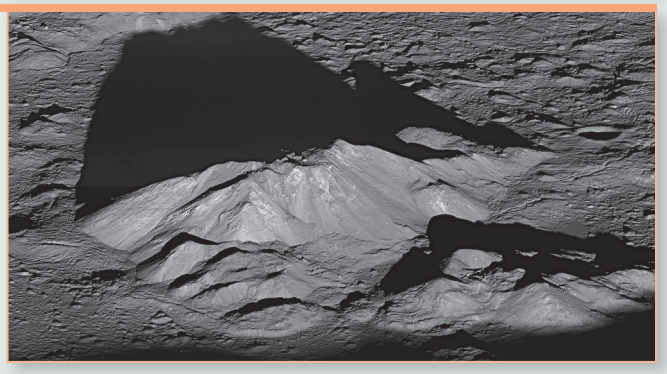
As host to the Cartography and Imaging Sciences node of NASA's Planetary Data System and as a node of NASA's Regional Planetary Image Facility (RPIF) network, the Astrogeology Science Center also plays a key role in archiving data and making them readily available to planetary scientists, mission engineers, NASA managers, and the general public. The Center currently houses about 1 petabyte of digital storage, two large compute clusters, and various web services; the RPIF node contains more than 100,000 printed lunar and planetary images and maps, a reference library, assorted artifacts, and a photo and document archive that chronicles the history and ongoing activities of the Astrogeology Science Center.



Self-portrait of the Mars Science Laboratory Curiosity rover, taken by the Mars Hand Lens Imager instrument on the rover's robotic arm, October 31, 2012 (NASA image PIA16468; image credit NASA/Jet Propulsion Laboratory-Caltech/Malin Space Science Systems).



Geologic Map of Mars, published in 2014 (USGS Scientific Investigations Map 3292; https://doi.org/10.3133/sim3292).



Oblique image of sunrise over the central peak within Tycho Crater, on Earth's Moon, acquired by the Lunar Reconnaissance Orbiter Camera, June 10, 2011 (Narrow Angle Camera image M162350671R; image credit NASA/Goddard Space Flight Center/Arizona State University).

Funding for the Astrogeology Science Center comes almost exclusively (more than 95 percent) from NASA through a variety of agreements with short time frames (none lasting longer than 5 years). This arrangement requires the Astrogeology Science Center to continually demonstrate that it is responsive to NASA's current needs and is providing excellent value to the government and the public. The fact that the Astrogeology Science Center has become a fixture in humankind's exploration of the solar system is an enduring testament to the skill, ingenuity, and effectiveness of generations of its staff.

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Vision Statement

The USGS Astrogeology Science Center is a national resource for the integration of planetary geoscience, cartography, and remote sensing. As explorers and surveyors, with a unique heritage of proven expertise and international leadership, we enable the ongoing successful investigation of the solar system for humankind.

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ISSN 2327-6932 (online) ISSN 2327-6916 (print)
https://doi.org/10.3133/fs20173038