
Supporting Planetary Exploration

Position Statement. The Geological Society of America (GSA) supports planetary exploration to advance research concerning the evolution of Earth, our solar system, and beyond; to collect geologic and geophysical data on planets, moons, and other objects in the solar system; to explore Earth from space, like other planets, by remote sensing to detect processes and changes not easily observed on the ground; to deepen and expand human understanding of our place in the universe; to reinforce science, technology, engineering, and math (STEM) education and effective training of the next generation of scientists; to increase U.S. competitiveness in science and technology development; and to enhance the quality of life through technological innovation.

Purpose. This position statement: (1) summarizes the relevance and benefits of planetary exploration to national and international leadership in science and technology research, development, and education; (2) describes workforce development and the key role that geoscientists play in both historical and future exploration missions through continued civilian exploration programs; and (3) provides recommendations for policy decisions related to the importance of science support for both U.S. and international collaborative space exploration missions to the Moon and to other solar system bodies beyond Earth.

RATIONALE

Early planetary exploration missions (including the first human explorations on the Moon) were initially designed as demonstrations of technology development and global leadership in space. The underlying science, although only a tertiary objective, was largely geologic and geophysical in nature, with additional studies on the biology of humans in space. The 50 years of space exploration and planetary missions have supported a growing population of planetary scientists. Planetary science also has an increasing appeal to students in geology and astronomy classes. Over this time, the U.S. and other nations have launched many successful exploration missions to planets, moons, comets, and other objects throughout our solar system and beyond, with return to Earth of samples of solar wind particles, asteroids, and comets. Today, planetary missions are designed to collect data on planetary materials by remote sensing (orbiters) and in situ (landers, rovers) to better understand the history and workings of our entire solar system, to gain insight into the formation and evolution of Earth and the other planets, to understand how and when life began on Earth, and to determine whether extraterrestrial habitable environments and life forms exist (or ever did exist) elsewhere in the solar system or beyond. To deepen our understanding of life in the universe, scientists also make efforts to contact extraterrestrial civilizations (SETI). The search for and study of exoplanets is also carried out within the context of geologic knowledge.

To support these missions and to provide context, planetary scientists engage in both terrestrial field studies and Earth observation to examine geologic features and processes that are common to Earth and other planets, such as impact structures, volcanic landforms, tectonic structures, and glacial and fluvial deposits and landforms. Geochemical studies include investigations of extraterrestrial materials now on Earth, including returned lunar samples, tens of thousands of meteorites, cosmic dust particles, and, most recently, particles returned from comets and asteroids. It is clear that planetary exploration has successfully stimulated research across diverse geoscience topics and disciplines, including research on terrestrial analogs of planetary environments, studies that relate to early Earth environments, as well as the definition and study of "extreme environments" and the life that they may harbor.

Although a majority of the U.S. electorate knows of and takes pride in space program accomplishments, few reflect on or know about the fundamental geoscientific research conducted during exploration and the importance of geoscientists in

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creating new knowledge that bears directly on our understanding of Earth's formation and habitability as well as that of other objects throughout the solar system. It is a natural extension of the basic goals of GSA to extend geosystems knowledge of the rest our solar system, as well as to the exoplanets now being discovered around other stars.

RECOMMENDATIONS

- Informed public advocacy of continued government investment in planetary exploration missions. Support for planetary studies of necessity requires large, sustained expenditures at local, state, national, and international levels.
- Increased interactions between the geoscience community and all elected government officials and lawmakers, managers, and scientists at all space agencies (e.g., NASA, ESA, etc.), as well as higher education institutions (especially those with planetary sciences in their curricula), space grant consortia, K–12 educators, and, most importantly, the general public. Planetary exploration and research require scientific literacy, intellectual support, and thoughtful dialogues with policy makers.
- Expansion of public programs that utilize space exploration results to maintain science and technology growth. Most of the world populace do not appreciate how planetary exploration has stimulated advances in numerous fields of study and supported the development of new technologies and economic growth across a broad portfolio (e.g., imaging systems, geographic information systems, new materials).
- Expansion of education programs using examples and results from planetary missions. The integration of all basic sciences (i.e., chemistry, physics) into planetary research endeavors is essential to the scientific literacy of the populace, and a major emphasis should be placed on engaging the STEM student population.

REFERENCES AND RESOURCES

- National Aeronautics and Space Administration, www.nasa.gov. For information specific to planetary exploration, see either www.nasa.gov/topics/journeytomars or www.nasa.gov/topics/solarsystem.
- European Space Agency, www.esa.int/ESA.
- Planetary Science Decadal Survey, solarsystem.nasa.gov/2013decadal. Results of a recent survey of planetary scientists for plans for the next ten years.
- NASA Planetary Photojournal, photojournal.jpl.nasa.gov. Site to access images and explanatory text for publicly released planetary data.
- Chronology of Lunar and Planetary Exploration, nssdc.gsfc.nasa.gov/planetary/chrono.html.
- NASA Spin-offs: www.sti.nasa.gov, spaceplace.nasa.gov/en/menu/spinoffs/.

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ABOUT THE GEOLOGICAL SOCIETY OF AMERICA

The Geological Society of America, founded in 1888, is a scientific society with more than 25,000 members from academia, government, and industry in more than 100 countries. Through its meetings, publications, and programs, GSA enhances the professional growth of its members and promotes the geosciences in the service of humankind. GSA encourages cooperative research among earth, life, planetary, and social scientists, fosters public dialogue on geoscience issues, and supports all levels of earth science education. Inquiries about the GSA or this position statement should be directed to GSA's Director for Geoscience Policy, Kasey S. White, at +1-202-669-0466 or kwhite@geosociety.org.

OPPORTUNITIES FOR GSA AND ITS MEMBERS TO HELP IMPLEMENT RECOMMENDATIONS

To facilitate implementations of the goals of the position statement, The Geological Society of America recommends that its members take the following actions:

- Become informed about opportunities to meet with elected officials at all levels; tell them about the importance of sustained support by space-faring nations for exploration missions and the analysis of scientific data obtained from planetary exploration efforts. Elected government officials need to hear from their constituents that continued support is essential for the maintenance of a healthy planetary exploration program, with specific information regarding planetary exploration initiatives. Highlight the broad scientific value derived from planetary exploration, and emphasize the need for consistent funding levels to sustain long-term exploration efforts. Letters, phone calls, and emails to representatives make a difference, particularly when they come from constituencies not in proximity to a major space facility.
- Encourage all scientists to take more active roles in various governmental agencies and in interactions with Congress. Not every GSA member can be a congressional liaison, but everyone can take an active role in participating in various governmental efforts at local, state, and federal levels. In particular, planetary scientists should get involved in whatever aspect of government might interest them, and watch for any opportunity to highlight the broad scientific value derived from planetary exploration.
- Look for any opportunity to share the results of planetary exploration. The GSA community represents a very special intellectual medium through which the science knowledge of all people can be expanded. GSA members can play a pivotal role in communicating both the scientific and educational benefits derived from space exploration missions to the worldwide populace, including to elected officials. Members are encouraged to take advantage of all venues of communication regarding what has been learned during five decades of planetary exploration. Both in the classroom and in public forums, GSA members can be proactive in emphasizing how results from planetary exploration have contributed to science in general and the geosciences in particular and how this exploration has provided exciting new media for education. GSA members should consider including planetary exploration subjects in their public lectures, in articles in popular magazines and newspapers, in talks given to K–12 school classrooms, as well as within undergraduate- or graduate-level science courses, particularly any subject related to the geosciences.
- Be prepared to explain how technological spin-offs derived from planetary exploration are a part of modern life. For example, spacecraft camera design has stimulated many developments in charge coupled devices (CCDs), the basis for practically every modern imaging device, whether used in a pocket camera, a smart phone, or security systems. The scientific and technological advancement of a nation is often greatly benefited by developments used to support various aspects of planetary exploration.