Testimony of

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for the
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Regarding the

National Science Foundation

and

National Aeronautics and Space Administration

FY 2017 Appropriation

to the

U.S. House of Representatives

Committee on Appropriations

Subcommittee on Commerce, Science, Justice, and Related Agencies

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Summary

The Geological Society of America (GSA) supports strong and sustained investments in geoscience research and education at the National Science Foundation (NSF) and National Aeronautics and Space Administration (NASA). We encourage Congress to appropriate $8.0 billion and fully support geoscience research at NSF. We support the increase proposed for Earth science research at NASA in the request but are concerned about proposed cuts to planetary science in the request. Investment in NSF and NASA is necessary for America's future economic and science and technology leadership, both through discoveries that are made and the talent developed through their programs. Earth and space science at these two agencies play a vital role in understanding and documenting mineral and energy resources that underpin economic growth; researching and monitoring potential natural hazards that threaten U.S. and international security; and determining and assessing water quality and availability.

The Geological Society of America, founded in 1888, is a scientific society with over 26,000 members from academia, government, and industry in all 50 states and 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.

National Science Foundation

The Geological Society of America (GSA) urges Congress to provide the National Science Foundation (NSF) $8.0 billion in fiscal year 2017. Sustained increases beyond research inflation are necessary to regain America's economic and science and technology leadership. Facing a budget that does not keep pace with inflated costs of research over the past few years, NSF has reduced the number of awards funded each year. This decline is particularly burdensome for early career scientists. Limiting funding opportunities for early career researchers today places our position as a science and technology leader of tomorrow in jeopardy.

Geoscience research is a critical component of the overall science and technology enterprise and should be funded without restriction. NSF's Directorate for Geosciences is the largest federal supporter of basic geoscience research at universities. NSF's programs in geoscience research and graduate and undergraduate student support contribute significantly to the education and training of the geoscience workforce. A recent report by the American Geosciences Institute, *Status of Recent Geoscience Graduates 2015*, illustrates the diversity of careers supported by geoscience research. For example, the report found that 67 percent of master's graduates found jobs in the oil and gas industry, while environmental services, which includes fields such as environmental consulting and remediation of land assets such as water and soil, hired the highest percentage of bachelor's graduates. Other industries hiring geoscientists include manufacturing, trade, construction, information technology services, and agriculture.

Increased investments in NSF's geoscience portfolio are necessary to address such issues as natural hazards, energy, water resources, and education; geoscience is a key contributor to groundbreaking research across disciplines at NSF. Specific needs include:

- The recent National Research Council report *Sea Change: 2015-2025 Decadal Survey of Ocean Sciences* highlights research questions to guide NSF investment. Tasked "to identify areas of strategic investment with the highest potential payoff," the report identifies questions that will guide our understanding of risks to our planet including: What are the rates, mechanisms, impacts, and geographic variability of sea level change? How different will marine food webs be at mid-century? In the next 100 years? How can risk be better characterized and the ability to forecast geohazards like megaearthquakes, tsunamis, undersea landslides, and volcanic eruptions be improved?

- Natural hazards are a major cause of fatalities and economic losses. Landslides alone, which occur in every state, cause more than $3 billion in damage each year. NSF research improves our understanding of these geologic hazards, which allows for effective planning and mitigation. We urge Congress to support NSF investments in fundamental Earth science research and facilities that underpin innovations in natural hazards monitoring and warning systems through Risk and Resilience initiative such as "Prediction of and Resilience Against Extreme Events."

- Recent studies have shown that rare earth elements are essential to the production, sustainment, and operation of U.S. military equipment. Reliable access to the necessary material is a bedrock requirement for the Department of Defense. In addition, many emerging energy technologies – such as wind turbines and solar cells – depend upon rare

earth elements and critical minerals that currently lack diversified sources of supply. The Division of Earth Sciences supports research on the structure, composition, and evolution of the Earth and the processes that govern the formation and behavior of the Earth's materials. This research contributes to a better understanding of the natural distribution of mineral and energy resources for future exploration.

- The devastating droughts in the western United States highlight our dependence on water. NSF's research addresses major gaps in our understanding of water availability, quality, and dynamics, and the impact of both a changing and variable climate, and human activity, on the water system. The initiative "Innovations at the Nexus of Food, Energy and Water Systems" highlights the important linkages and research needs between these systems.

- The Division of Atmospheric and Geospace Sciences provides critical infrastructure and research for understanding our planet, such as weather and precipitation variability on multiple time scales and atmospheric and space weather hazards.

National Aeronautics and Space Administration

GSA supports increased investment in Earth science and planetary exploration research at National Aeronautics and Space Administration (NASA). We support the increases proposed for Earth science research in the FY2017 request. The National Academies' Earth Science Decadal Survey begins with an explanation of the importance of this research:

"Understanding the complex, changing planet on which we live, how it supports life, and how human activities affect its ability to do so in the future is one of the greatest intellectual challenges facing humanity. It is also one of the most important challenges for society as it seeks to achieve prosperity, health, and sustainability."

The data and observations from Earth observing missions and research are a tremendously important resource for natural resource exploration and land use planning, as well as assessing water resources natural disaster impacts, and global agriculture production. GSA supports interagency efforts to ensure the future viability of Landsat satellites, including Landsat 9 and 10, as well as funding to increase the capabilities and uses of multi-spacecraft constellations of small scientific satellites.

Two missions – Pre-Aerosol, Clouds, and Ocean Ecosystem (PACE) and Surface Water and Ocean Topography (SWOT) – will provide valuable information to decision makers on water. PACE will help monitor oil spills and detect algal blooms, which have a significant negative impact on human health, ocean ecology, and fisheries. The global survey of Earth's surface water by SWOT could provide key data for flood and drought management; improve risk assessments by the insurance industry; harness energy; and optimize both military and commercial marine operations.

GSA is concerned, however, about proposed cuts to planetary science in the FY 2017 request; we appreciate past congressional support for this area and urge you to continue to increase this important area to support priority areas identified in the Planetary Science Decadal Survey.

Planetary research is directly linked to Earth science research and cuts in either program will hinder the other. To support missions to better understand the history and workings of the entire solar system, planetary scientists engage in both terrestrial field studies and Earth observation to examine geologic features and processes that are common on other planets, such as impact structures, volcanic constructs, tectonic structures, and glacial and fluvial deposits and landforms. In addition, geochemical planetary research studies include investigations of extraterrestrial materials now on Earth, including lunar samples, meteorites, cosmic dust particles, and, most recently, particles returned from comets and asteroids.

Exploration of other planets in the solar system requires major national and international initiatives, significant funding levels, and long timelines for mission planning and collaborative research. For scientists, the funding cycle is much shorter than typical mission cycles, and in particular, graduate student and career-development timelines are much shorter than mission timeframes. Therefore, the growth and continued development of a robust workforce capable of conducting complex space missions and analyzing the scientific data returned from such missions does not depend on individual missions as much as it depends upon a consistent, sustained program that educates and develops planetary scientists.

Support Needed to Educate Future Innovations and Innovators

Earth science research and education are fundamental to training the next generation of Earth science professionals. We are very concerned that cuts in Earth science funding will cause students and young professionals to leave the field, potentially leading to a lost generation of professionals in areas that are already facing worker shortages.

A 2013 report by the National Research Council, *Emerging Workforce Trends in the Energy and Mining Industries: A Call to Action*, found, "In mining (nonfuel and coal) a personnel crisis for professionals and workers is pending and it already exists for faculty." Another recent study, *Status of the Geoscience Workforce Report 2014*, found an expected deficit of approximately 135,000 geoscientists by 2022.

Increased NSF and NASA investments in Earth science education are necessary to meet these workforce needs and develop an informed, science-literate electorate. Earth scientists will be essential to meeting the environmental and resource challenges of the twenty-first century. NSF's Education and Human Resources Directorate researches and improves the way we teach science and provides research and fellowship opportunities for students to encourage them to continue in the sciences. Similarly, NASA's educational programs have inspired and led many into science careers. GSA fully supports these efforts, as well as new and existing programs to make the geoscience workforce more diverse.

Please contact GSA Director for Geoscience Policy Kasey White at kwhite@geosociety.org for additional information or to learn more about the Geological Society of America – including GSA Position Statements on water resources, planetary research, energy and mineral resources, natural hazards, climate change, and public investment in Earth science research.