

Geoscience's Crucial Role in National Security Strategies

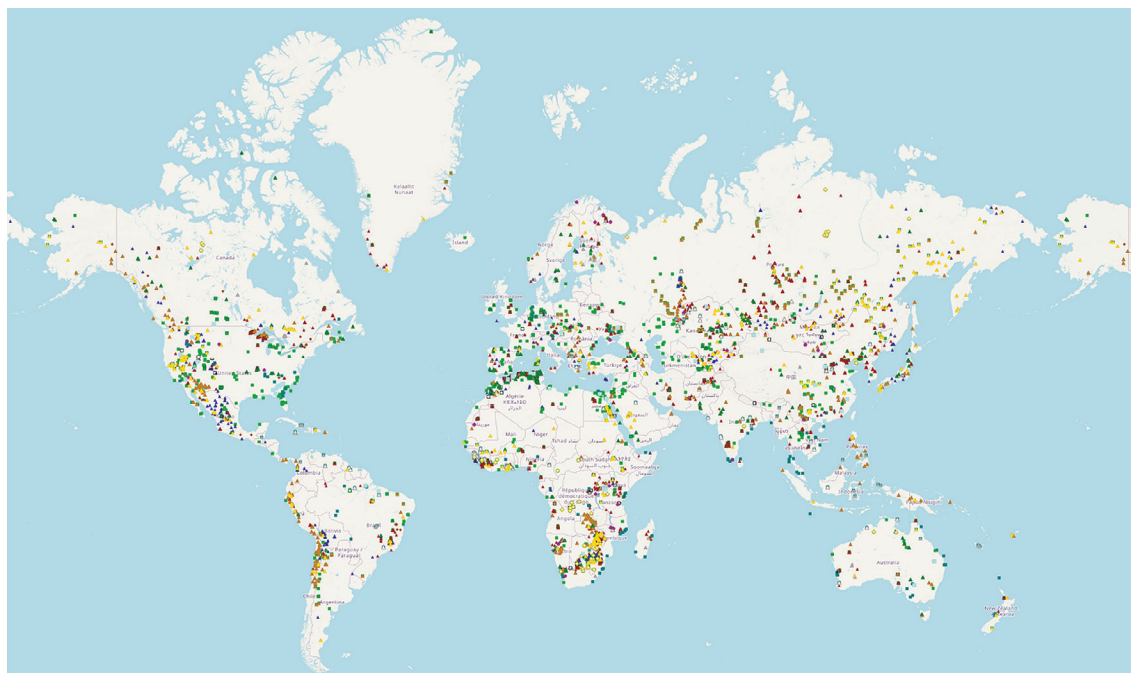


GEOSCIENCES IMPACT ON NATIONAL SECURITY

In the realm of national security, geoscientists play crucial roles in addressing a range of strategic imperatives. Ensuring global stability, for instance, demands an acute understanding of agricultural resilience, water security, and the potential destabilizing impacts of climate change. These insights guide policy and aid decisions, helping to preempt conflict and humanitarian crises before they escalate. Operational readiness across defense and security sectors also relies heavily on comprehending and anticipating natural conditions—from terrestrial and space weather to terrain stability to oceanographic conditions—which can significantly influence the effectiveness

of military and security operations. Moreover, the procurement and sustainable management of reliable energy and critical minerals are foundational for equipping and maintaining a mobile, technologically advanced military. Geoscientists locate and assess these essential resources, ensuring that the armed forces have timely access to the energy and material sources necessary for defense technologies. Together, these geoscience inputs are integral to shaping a responsive and informed national security strategy that addresses both immediate and long-term challenges on a global scale within which geoscientists operate intrinsically.

Mineral deposits are not uniformly distributed across the world. As seen from the U.S. Geological Survey's Mineral Resources Data System, ready access to needed minerals requires the expertise of geoscientists and diplomats to secure access to the resources to ensure National Security. (<https://mrddata.usgs.gov>)



Climate Adaptation

Geoscientists help us understand climate patterns and their impacts, aiding the national security apparatus in preparing for and mitigating the effects of climate change, such as increased frequency of extreme weather events, implications on global stability, and threats to force readiness.

Disaster Preparedness and Response

Geoscientists are crucial in predicting natural disaster risks like earthquakes, tsunamis, and volcanic eruptions, which enables better preparedness and response strategies to protect populations and critical infrastructure.

Environmental Monitoring

Monitoring environmental degradation and its security implications, such as soil erosion, deforestation, and water shortage or contamination, which can lead to food and water scarcity and drive mass migrations.

Oceanography for Naval Operations

Oceanographers develop the data that assists naval operations in navigation, submarine warfare, and the deployment of marine assets, enhancing maritime security.

Critical Minerals

Critical minerals are essential to national security due to their irreplaceable role in manufacturing defense technology, renewable energy systems, and advanced electronics. These minerals, including rare earth elements, lithium, and cobalt, are integral components in everything from jet engines and communication satellites to missile guidance systems and electric vehicle batteries. The availability and security of these mineral supplies are vital to maintain technological superiority, economic stability, and strategic autonomy.

Energy Security

Geoscientists are central to the exploration and development of energy resources, including fossil fuels and renewables such as geothermal, uranium for nuclear power, and helping to ensure a stable and independent energy supply.

Geopolitical Analysis

By mapping territorial waters and land boundaries, geoscientists aid in resolving territorial disputes and in strategic military planning, particularly in regions where borders are contested.

Space Weather Monitoring

Geoscientists involved in studying atmospheric sciences and solar-terrestrial interactions help predict space weather events that can disrupt satellite communications, navigation systems, and even power grids, all of which are critical to national security operations.

EXEMPLARS OF IMPACTS OF GEOSCIENCE ON NATIONAL SECURITY

Critical minerals are indispensable for both economic vitality and technological advancement, impacting national security directly. Direct investments by the U.S. Defense Department in securing future cobalt supplies from a developing mine in Idaho to advances in brine-based lithium production are ways geoscientists are securing future supplies of minerals crucial for manufacturing advanced military hardware, from stealth technology to communication systems, and critical civilian technologies like smartphones and electric vehicles. A secure and sustainable supply of these resources ensures that a nation does not become overly dependent on potentially unstable foreign sources, thereby maintaining its strategic autonomy and technological edge.

Geoscientists significantly enhance national security by providing accurate weather, space weather, and other geological hazard forecasts. These capabilities are essential for planning and

conducting military operations safely and effectively. Weather forecasting helps in strategic deployment of troops, while space weather alerts are critical for protecting satellites and communication systems from solar flares. Additionally, early warnings of geological hazards like volcanic eruptions or earthquakes can safeguard both military and civilian infrastructure, ensuring operational continuity.

Geoscience plays a pivotal role in promoting global stability by providing crucial data on climate change and environmental degradation, which can lead to food and water scarcity, impacting millions. By predicting these changes, geoscientists enable proactive international aid and intervention strategies, mitigating the risk of conflicts and unrest. Additionally, their work helps anticipate mass migrations caused by natural disasters or resource shortages, allowing for better preparedness and response, thereby preventing potential security crises before they arise.



CASE STUDIES

The Department of Defense's Climate Risk Analysis is a comprehensive document that assesses the various risks posed by climate change to U.S. military operations and infrastructure. The analysis highlights how rising sea levels, increased flooding, and extreme weather events threaten military bases and other infrastructure. Both Naval Station Norfolk and Cape Canaveral Space Force Station are facing risks of ongoing flooding, and projected annual major floods by 2050. Total expected climate-related risk to bases is estimated at \$387 billion. New initiatives emphasize the need for resilient designs and retrofitting existing facilities to withstand these changes. Additionally, climate change impacts are expected to complicate operational readiness and execution as altered weather patterns could affect training, logistics, and the ability to project force.

Geoscientific input is crucial in geopolitical analysis, where the management of transboundary natural resources can influence regional relations and stability. For example, the dispute over water rights in the Nile Basin involves several countries and requires detailed geological and hydrological data to negotiate equitable water sharing arrangements that can prevent conflicts and foster cooperation among the nations involved.

Space weather forecasting is critical for protecting satellite communications and navigation systems which are integral to national security. A notable example is the U.S. Air Force's use of space weather data to anticipate and mitigate the effects of solar flares on satellite functionality and communication systems, crucial for both military and civilian technologies.

U.S. military bases, National Laboratories, and munition test sites have long and continuing legacies of subsurface contamination of soils and groundwater. Geoscientists play a critical role in the characterization of the geologic framework beneath these sites, designing monitoring systems, and designing plans for the environmental cleanup and reclamation of these sites.



EXAMPLES OF RELEVANT LEGISLATION AND POLICY

Executive Orders

- ▶ **E.O. 13817:** Focuses on America's critical minerals. It mandates the identification of critical minerals and formulates a strategy to decrease the nation's dependency on foreign sources. This EO underscores the importance of geoscience in assessing and developing domestic sources of these essential minerals to enhance national security (USGS).

Congressional Legislation

- ▶ **118th — S. 2031:** This bill requires the Department of Defense (DOD) to develop supply chains that are not dependent on mining or processing of critical minerals in or by specified countries (e.g., China) to achieve critical mineral supply chain independence by 2035.
- ▶ **117th — H.R. 4559:** Requires the DoD to consider climate implications on its contracting, both from the standpoint of reduction of carbon emissions and on making strategic decisions for basing based on climate resilience.

Relevant Federal Agencies

- ▶ U.S. Department of Defense
- ▶ U.S. Department of State
- ▶ Army Corps of Engineers
- ▶ U.S. Geological Survey

Related National Academy Reports

- ▶ Climate Intervention in an Earth Systems Science Framework: Proceedings of a Workshop—in Brief (2024)
- ▶ Planning the Future Space Weather Operations and Research Infrastructure: Proceedings of a Workshop (2021)
- ▶ Managing Materials for a Twenty-first Century Military (2008)
- ▶ Minerals, Critical Minerals, and the U.S. Economy (2008)
- ▶ Climate Security in Central America: Proceedings of a Workshop (2005)

Non-Partisan Non-Profit Expertise

- ▶ American Association of Petroleum Geologists
- ▶ American Institute of Professional Geologists
- ▶ American Geophysical Union
- ▶ American Institute of Hydrology
- ▶ Association of American State Geologists
- ▶ Association of Environmental and Engineering Geologists
- ▶ Geological Society of America
- ▶ National Groundwater Association
- ▶ National Sand, Stone, and Gravel Association
- ▶ Society of Economic Geologists
- ▶ Society of Exploration Geophysicists
- ▶ Society for Mining, Metallurgy, and Exploration