



1. How is Earth's internal magnetic field generated?

Understanding what has powered the geodynamo through time and what controls its rate of change is crucial for understanding interactions from Earth's interior to the atmosphere, as well as the human activities that are impacted by the geomagnetic field.



2. When, why, and how did plate tectonics start?

Plate tectonics produces and modifies the continents, oceans, and atmosphere, but there remains a lack of fundamental understanding of when plate tectonics developed on the Earth, why on the Earth and not on other planetary bodies, and how plate tectonics developed through time.



3. How are critical elements distributed and cycled in the Earth?

The cycling of critical elements essential for geologic processes creates suitable conditions for life and provides the ingredients for materials necessary for modern civilization, yet fundamental questions remain about how elements are transported within the Earth across a range of spatial and temporal scales.



4. What is an earthquake?

Earthquake rupture is complex, and the deformation of the Earth occurs over a spectrum of rates and in a variety of styles, leading Earth scientists to reconsider the very nature of earthquakes and the dynamics that drive them.



5. What drives volcanism?

Volcanic eruptions have major effects on people, the atmosphere, the hydrosphere, and the Earth itself, creating an urgent need for fundamental research on how magma forms, rises, and erupts in different settings around the world and how these systems have operated throughout geologic time.



6. What are the causes and consequences of topographic change?

New technology for measuring topography over geologic to human time scales now makes it possible to address scientific questions linking the deep and surface Earth and urgent societal challenges related to geologic hazards, resources, and climate change.



7. How does the critical zone influence climate?

The reactive skin of the terrestrial Earth influences moisture, groundwater, energy, and gas exchanges between the land and atmosphere, and its influence on climate is therefore a vital component of understanding the Earth system and how it has responded and will respond to global change.



8. What does Earth's past reveal about the dynamics of the climate system?

Evidence of both long-term and rapid environmental change in Earth's history provides key baselines for comparison to modern change, helps to elucidate Earth system dynamics, provides magnitudes and rates of change, and plays a critical role in predicting future change.



9. How is Earth's water cycle changing?

Understanding current and future changes to the water cycle requires fundamental knowledge of the hydro-terrestrial system and how the water cycle interacts with other physical, biological, and chemical processes.



10. How do biogeochemical cycles evolve?

To quantify the role of biology through time in the formation and weathering of rocks and minerals, the cycling of carbon, and the composition of the very air we breathe requires a deeper understanding of biogeochemical cycles.



11. How do geological processes influence biodiversity?

The diversity of life on the Earth is a major characteristic of the planet and yet we do not fully know how it came to be. We need to understand how and why diversity has varied over time, environment, and geography, including major events like extinctions.



12. How can Earth science research reduce the risk and toll of geohazards?

A predictive and quantitative understanding of geohazards is essential to reduce risk and impacts and to save lives and infrastructure.