generate changes of global consequence.

Likewise, Earth’s geologic evolution, as well as catastrophic events like meteorite impacts, has clearly affected the evolution of life. But even when extinctions and major evolutionary changes can be documented, the causes still remain a mystery. To what extent were they caused by geological as opposed to biological processes?

Exactly how geological events have affected evolution, and how much control life has had on climate, are still topics of debate. Understanding the interrelationships between life and the processes that shape the land presents a critical challenge.

Living with an Active Earth

9. Can earthquakes, volcanic eruptions, and their consequences be predicted?

Earthquakes and volcanic eruptions are the most sudden and hazardous manifestations of the gradual movements of Earth’s interior. The need to predict such events has escalated as human populations increasingly concentrate in volcano- and earthquake-prone areas.

Thanks largely to new instruments and better understanding of causes, geologists are moving toward predictive capabilities for volcanic eruptions. For earthquakes, progress has been made in estimating the probability of future events, but we may never be able to predict the exact time and place an earthquake will strike. Continuing challenges include deciphering how fault ruptures start and stop, simulating how much shaking can be expected near large earthquakes, and increasing the warning time once a dangerous earthquake begins.

10. How do fluid flow and transport affect the human environment?

The presence and placement of many of Earth’s most valuable resources are determined by processes of fluid flow and transport. The ability to assess and extract minerals, petroleum, natural gas, and groundwater and to safely dispose of wastes depends on understanding fluids, both at the surface and below ground. Some of the scientific questions associated with fluids also have application to earthquake prediction, climate prediction, the evolution of continents, the behavior of volcanoes, and the properties of Earth materials.

New experimental tools and techniques, plus airborne and space-borne measurements, are offering an unprecedented view of the processes that affect Earth’s fluids. But many questions remain. The ultimate objective—to produce mathematical models that can predict the performance of natural systems far into the future—is still out of reach, but attaining it will be critical to making informed decisions about the future of the land and resources that support us.

Kilauea volcano, HI, 9/19/84.
Source: C. Heliker, USGS.