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Geologic Time and Earth's Biological History (Evolution)

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Abstract:

The geologic time scale divides up the history of the earth based on life-forms that have existed during specific times since the creation of the planet. These divisions are called Geochronological units (geo: rock, chronology: time). Most of these life-forms are found as fossils, which are the remains or traces of an organism from the geologic past that has been preserved in sediment or rock. Without fossils, scientists may not have concluded that the earth has a history that long precedes mankind. Questions about the origins and nature of Earth have long preoccupied human thought and the scientific endeavor. Deciphering the planet's history and processes could improve the ability to predict catastrophes like earthquakes and volcanoes, to manage Earth's resources, and to anticipate changes in climate and geologic processes. This report captures, in a series of questions, the essential scientific challenges that constitute the frontier of Earth science at the start of the 21st century.

Keywords: Geochronological units, fossils, How did Earth and other planets form? Climate Changes.

How did life begin?

Introduction

The Geologic Time Scale is divided by the following divisions:
Standard 8-2.4: Recognize the relationship among the units—era, epoch, and period—into which the geologic time scale is divided.-

- Eons: Longest subdivision; based on the abundance of certain fossils
- Eras: Next to longest subdivision; marked by major changes in the fossil record
- Periods: Based on types of life existing at the time
- Epochs: Shortest subdivision; marked by differences in life forms and can vary from continent to continent.

Earth is an active place. Earthquakes rip along plate boundaries, volcanoes spew fountains of molten lava, and mountain ranges and seabed are constantly created and destroyed. Earth scientists have long been concerned with deciphering the history—and predicting the future—of this active planet. Over the past four decades, Earth scientists have made great strides in understanding Earth's workings. Scientists have ever-improving tools to understand how Earth's internal processes shape the planet's surface, how life can be sustained over billions of years, and how geological, biological, atmospheric, and oceanic processes interact to produce climate—and climatic change

1. How did Earth and other planets form?

The Solar System is composed of a set of radically different types of planets and moons— from the gas giants Jupiter, Saturn, Uranus, and Neptune to the rocky inner planets. Centuries of studying Earth, its neighboring planets, and meteorites have enabled the development of models of the birth of the Solar System. Astronomical observations from increasingly powerful telescopes have added a new dimension to these models, as have studies of asteroids, comets, and other planets via spacecraft, as well as geochemical studies of stardust and meteorites. While it is generally agreed that the Sun and planets all coalesced out of the same nebular cloud, little is known about how Earth obtained its particular chemical composition, or why the other planets ended up so different from Earth and from each other. For example, why has Earth, unlike every other planet, retained the unique properties—such as the presence of water—that allow it to support life? New measurements of Solar System bodies and extrasolar planets and objects, will further advance understanding of the origin of Earth and the Solar System.

2. How did life begin?

In The Origin of Species, Charles Darwin (1859) hypothesized that new species arise by the modification of existing ones—that the raw material of life is life. But somehow and somewhere, the tree of life had to take root from nonliving precursors. When, where, and in what form did life first appear? The origin of life is one of the most intriguing, difficult, and enduring questions in science. Scientists have toiled to create life from sparks and gasses in the laboratory to illuminate how life first formed in Earth's early conditions. But even pinning down what those early conditions were remains an elusive goal. From what materials did life originate? Did life, as Darwin speculated, originate in a "warm little pond," perhaps a tidal pool repeatedly dried and refreshed? Or might life be rooted among hydrothermal vents? Could life's origins even lie beyond Earth? Developing an accurate picture of the physical environments and the chemical building blocks available to early life is a critical Earth science challenge. Clues to shed light on these mysteries stem largely from investigations of Earth's ancient rocks and minerals—the only remaining evidence of the time when Earth's life first emerged.

3. The study of Fossils

♣ A fossil is the preserved remains of an organism that has died. Fossils tell scientists, called paleontologists, about living things such as their biology and environmental conditions over earth's history through the rock record. In addition, they give clues to the conditions of the earth (i.e. climate) at the time that the fossil was preserved and possibly relate changes of an organism over time. ♣ Definitions of fossil types: ♣Mold fossils: when sediments bury an organism and the sediment hardens into rock. The organism decays slowly inside the rock, leaving an cavity in the shape of the organism. ♣ Cast fossil: The cavity or mold mentioned above can filled in with mud. When the mud hardens, it takes on the shape of the organism. ♣ Petrified fossil or per mineralized fossil: Minerals like calcium can soak into the buried remains of an organism. The mineral replaces the remaining bone and changes it into rock. ♣ Carbonized fossil: When organism parts are pressed between layers of mud or clay that hardens over time, squeezing the decaying organism away and leaving a carbon imprint in the rock, since all living things contain carbon. ♣ Trace fossil: When the mud or sand hardens into rock where a footprint, trail or burrow was left behind. Table of Contents 30 Standard 8-2.2 ♣ The fossil record, like the rock record, is an important record for understanding life on earth before the dawn of man. ♣ Extinctions and new life forms are also found within the fossil record. ♣ Fossils can also show structural similarities and differences in organisms over time revealing the diversity of life forms on earth. Nearly 90 percent of organisms that have lived on the earth are now extinct. Carbon imprint of fish remains, age unknown Belemnite fossil (cast), cut and polished. Related to present-day squid. Extinct. Brachiopods in a sandstone matrix and an individual brachiopod cast. Extinct. A trilobite cast from the Mississippian Period. Extinct. Ammonite fossil (cast), cut and polished. Related to present-day snail. Extinct.

4. Climate Changes

♣ Climate has always been a constantly changing phenomenon. The earliest atmosphere was devoid of free oxygen, and it wasn't until the earliest life forms evolved that the present-day atmosphere began to form approximately 600 million years ago. ♣ During the Paleozoic, warm shallow seas and tropical climates were common. Life forms that could not adapt to these conditions disappeared. ♣ Throughout the Mesozoic era, plate movement shifted the continents and only the animals and plants with the greatest ability to adapt could survive the extreme changes in temperatures that occurred as a consequence. Plants with seed coverings and animals with constant internal temperatures (warm-blooded) lived during this era. ♣ Climate continued to change during the Cenozoic and continues to change to this day, as issues of "Global Warming" have been on the fore-front for over a decade. It was only ~12,000 years ago that the world was in an "ice age" mode. Also, many mountain ranges formed during this era, causing climate differences due to elevation changes. ♣ Ice ages have occurred many times in Earth"s history. Climate shifts like these may be caused by magnetic polar reversals or variation in the tilt of the earth (called Milinkovic cycles). Obviously, not all life can adapt to the extreme cold. Also, not all animals can adapt to the warming climate at the end of an ice age, which probably contributed to the extinction of the wooly mammoth.

earth's deep history: a retrospective By the early 21st century the Earth's particular planetary his-tory had been reconstructed in impressive detail, and had been found to be surprisingly eventful throughout. The e main outlines of the Earth's deep history had become uncontroversial, at least in the sense of establishing the correct sequence of distinctive periods and notable events, if not of working out all their underlying causes. Once geologists had recognized that their geological periods and other named spans of time were matters of convention and convenience, any arguments about their defer -nation could be, and generally were, settled by discussion and negotiation. A hierarchy of time-spans—eons, eras, periods, epochs, and still briefer units—had been agreed upon as useful for describing and explaining the broad features of the Earth's history and also its details. They were invaluable for describing this lengthy and eventful history, despite not being, at least in the fi rst instance, dated in years. During the 20th century the Phanerozoic aeon, with its fairly complete and continuous fossil record, was recognized as just the most recent major part of a history that extended back into no fewer than three vast earlier eons (Proterozoic, Archaean,

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