Introduction to Geology Physical Geology First year students 2022-2023

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Why is geology different from other sciences?

- Often lacks experimental control
- Incompleteness of data
- Methodologies and procedures used to test problems rather than the generation and testing of universal laws
- GEOLOGY WORKS
- (everyone wants to drive to Sainsburys)



3

FIGURE 12.4



Two kinds of ages

- Relative know order of events but not dates
 - Napoleonic wars happened before W.W.II
 - Bedrock in Scotland formed before the glaciers came
- Absolute know dates
 - Civil War 1803-1815
 - World War II 1939-1945
 - Glaciers finally left Scotland About 11,000 Years Ago

Two conceptions of Earth history

- Catastrophism
 - Assumption: great effects require great causes
 - Earth history dominated by violent events
- Uniformitarianism
 - **Assumption**: we can use *cause and effect* to determine causes of past events
 - **Finding:** Earth history dominated by small-scale events typical of the present.
 - Catastrophes do happen but are uncommon

Principles of Relative Dating

Law of superposition

- Undeformed section of sedimentary or layered igneous rocks
- Oldest rocks are on the bottom
- Principle of original horizontality
 - Layers of sediment are generally deposited in a horizontal position
 - Rock layers that are flat have not been disturbed (deformed)
- Principle of cross-cutting relationships
 - Younger features cut across older features

Superposition Strata in the Grand Canyon





A.

Horizontality



Cross-cutting Relationship



Cross-cutting Relationship



Which crater is youngest?

Cross-cutting Relationships



Principles of Relative Dating

Inclusions

- A piece of rock that is enclosed within another rock
- Rock containing the inclusion is younger
- Unconformity
 - Break in rock record produced by erosion and/or non-deposition of rock
 - Represents period of geologic time

Principles of Relative Dating

- Types of unconformities
 - Angular unconformity
 - tilted rocks (disturbed) are overlain by flat-lying rocks
 - Disconformity
 - strata on either side of the unconformity are parallel
 - Nonconformity
 - metamorphic or igneous rocks in contact with sedimentary strata



A. Angular Unconformity

Angular Unconformity



Angular Unconformity



Uniformitarianism

Continuity of Cause and Effect

- Apply Cause and Effect to Future Prediction
- Apply Cause and Effect to Present Technology
- Apply Cause and Effect to Past Uniformitarianism

The present is the key to the past

Fossil Mud Cracks



The makings of good Index Fossils

- Abundant
- Widely-distributed (Global Preferred)
- Short-lived or rapidly changing

Correlation



The Geologic Time Scale

Quaternary	Latin, "fourth"	1822
Tertiary	Latin, "third"	1760
Cretaceous	Latin <i>creta</i> , "chalk"	1822
Jurassic	Jura Mountains, Switzerland	1795
Triassic	Latin, "three-fold"	1834
Permian	Perm, Russia	1841
Carboniferous	Carbon-bearing	1822
Devonian	Devonshire, England	1840
Silurian	Silures, a pre-Roman tribe	1835
Ordovician	Ordovices, a pre-Roman tribe	1879
Cambrian	Latin <i>Cambria</i> , "Wales"	1835