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G203 Lecture Notes

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Fossils, Fossilization and Evolution

Fossils – The remains or traces of organisms that have been preserved in rocks.

Body Fossils – Remnant of the actual body, skeleton, bones, teeth, shells, soft-tissue, altered remains (per mineralization or replacement), carbon films left behind by bodies and impressions (casts and molds) of body parts.

Trace Fossils – do not preserve any part of the body, but preserve an indication of those organisms' activities. These include trails, burrows, borings, nests and coprolites.

Coprolites – Fossil fecal material

To become fossilized the organism or trace must be protected. Usually this occurs by deposition of sediments or volcanic ash. Fossils are very rare in metamorphic and most volcanic rocks.

Image found at: http://100falcons.files.wordpress.com/2008/10/pompeii-dead.jpg

Image found at: http://lovingthebigisland.files.wordpress.com/2009/06/fossil-fish-1.jpg

Generally Fossilization requires:

Death or rapid transport to an anoxic (oxygen-poor) environment

Rapid Burial

The Presence of Hard Parts (not always the case)

Types of preservation include:

1. Unaltered Remains:

Some pollen sand spores of plants are chemically resistant to weathering and are found unaltered in sediments and sedimentary rocks.

2. Insects Trapped in Amber:

Image found at: http://www.don-lindsay-archive.org/creation/amber_work.jpg

Slow Moving insects and plant fossils

3. Mummification and Freezing:

As found with Siberian Permafrost

4. Altered Remains – Recrystallization:

Where the crystal structure has changed. Changed from one polymorph to another polymorph. Example – graphite and diamond.

5. Altered Remains – Per Mineralization:

Minerals precipitate in cavities and pore spaces of bones, teeth and shells. Some

petrified wood is per mineralized

6. Altered Remains – Replacement:

The replacement of original organic or shell material with another material such as silica or iron sulfide. Able to see the original shape, but often the fine details are lost with this method. Again some petrified wood falls into this category.

7. Carbonization:

Living organisms made of material containing hydrogen, nitrogen, oxygen, phosphorus, Etc. The volatile ingredients vaporize leaving behind a thin film of carbon.

8. Molds and Casts:

A mold is simply the outline of a fossil, a cast would be pouring a substance into the mold to create a cast of the fossil. Example – the casts pictured above of Pompeii.

In the Traditional System there are 5 kingdoms of life

Animals/Plants/Fungi/ Protistans/Monerans

These were replaced by the 3 domains:

Prokaryotic Organisms (Bacteria and Archaea)

Eukaryotic Organisms (Eukarya)

Archaea Domain - prokaryotic, no nuclear membrane, distinct biochemistry and RNA markers from eubacteria, possess unique ancient evolutionary history for which they are considered some of the oldest species of organisms on Earth; traditionally classified as archaebacteria; often characterized by living in extreme environments

- Kingdom Archaebacteria
  Examples:
  - Methanogens - metabolize hydrogen and carbon dioxide into methane
  - Halophiles - thrive in salt
  - Thermoacidophiles - thrive in acid and high temperatures (up to 110 degrees Celsius)

Bacteria Domain - prokaryotic, no nuclear membrane, traditionally classified as bacteria, contain all known pathogenic prokaryotic organisms, studied far more extensively than Archaea

- Kingdom Eubacteria
  Examples:
  - Cyanobacteria - photosynthesizing bacteria
  - Spirochaete - Gram-negative bacteria that include those causing syphilis and Lyme disease
  - Firmicutes - Gram-positive bacteria including *Bifidobacterium animalis* which is present in the human large intestine

Eukarya Domain - eukaryotes, nuclear membrane

- Kingdom Protista or protists
  Examples:
  - Rhodophyta - red algae
  - Chromalveolata - includes dinoflagellates
    - Kingdom Fungi or fungi
      Examples:
      - Saccharomycotina - includes true yeasts
      - Basidiomycota - includes shiitake mushrooms

- Kingdom Plantae or plants

  Examples:

- Bryophyta - mosses
- Magnoliophyta - flowering plants

- Kingdom Animalia or animals

  Examples:

- Arthropoda - includes insects, arachnids, and crustaceans
- Chordata - includes vertebrates and, as such, human beings

Examples found at: http://en.wikipedia.org/wiki/Three-domain_system