

## **Knowledge Base and Textbook Readings for Geology 2C, Historical Geology Spring 2006**

The following is a list of topics, ideas, and vocabulary that you are responsible for learning in this class. Much of this material will be discussed in lecture, but you must read the textbook for the remainder, as well as a more detailed treatment of the lecture topics. Page number refer to Wicander and Monroe, *Historical Geology*, 4<sup>th</sup> Ed.

### **1. Introduction and Deep Time**

Wicander (Ch.1, pg 1-14)

Age of the Earth (4.6 GA) – Geologic or “deep time” vs. human timescale

Principle of Uniformitarianism

### **2. A Brief History of Historical Geology**

Wicander (Ch.4: 56-62, Ch.5: 73-74, 81-87)

Archbishop Ussher – biblical age of the Earth

Nicholas Steno – 3 principles (superposition, original horizontality, lateral continuity) and the principle of cross-cutting relationships

William Smith – correlation of rocks using fossils

Georges Cuvier – proof of extinction, successive ages of animal life separated by catastrophes.

Abraham Werner – neptunist theory of the formation of the Earth.

James Hutton – plutonist theory for the development of the Earth.

Unconformity at Siccar Point – significance to Hutton and geology.

Charles Lyell – uniformitarianism, *Principles of Geology*

### **Lab 1 – Geologic Timescale**

Wicander (Ch.4.: 56-62, Ch.5: 81-87)

Development of the modern geologic timescale in the late 1700's and early 1800's.

Geologic systems – correlation of systems based on fossils (William Smith).

Principle of faunal succession (extinction is forever).

Eons, Eras, Periods, Epochs, law of superposition, correlation

Relative dating (putting events in order) vs. absolute dating (measuring age in years)

### **3. Charles Darwin and the Origin of Species**

Wicander (Ch.7: 114-133)

Evolution vs Creation as an explanation for the existence of different species.

Lamarckian Evolution – inheritance of acquired characters

Darwinian Evolution – evolution by natural selection

Darwin's voyage on the Beagle, influence of the Galapagos Islands on his ideas.

Natural selection is analogous to artificial selection, variation, adaptation, differential survival and reproduction, reproductive isolation, homologous structures

## **Lab 2 and 3 Paleontology**

Wicander (Appendix B, Ch.5: 79-81)

Marine invertebrate fossils, major groups:

Foraminifera (microfossils)

Porifera – sponges

Cnidaria, Anthozoa – corals, rugose and tabulate corals (Paleozoic), scleractinian corals (modern, reef-forming)

Bryozoa

Graptolites

Brachiopoda (lamp shells – common in the Paleozoic)

Echinodermata – starfish, sea urchins, sand dollars, and crinoids

Mollusca – pelecypods (clams, oysters, scallops), gastropods (snails), cephalopods (ammonites, nautiloids – shelled squids)

Arthropoda (insects, crustaceans, trilobites)

How fossils form: death, decay, burial, lithification of sediment

Hard parts (often fossilized), soft parts (rarely fossilized), plant tissue (sometimes)

Modes of preservation: original hard parts, recrystallized hard parts, replacement (silicification, pyritization), carbonization

Trace fossils – footprints, trackways, burrows, eggs, nests, coprolites

## **4. Evolution and Extinction**

Wicander (Ch.7: 125-127)

Modern synthesis: how was Darwin's theory modified by modern genetics?

Sexual reproduction: why bother? – generates variability in offspring

Evidence for evolution: fossil record, pattern of molecular similarity among organisms, homology, vestigial structures, embryonic history, biogeography.

Adaptive radiation: different causes of.

Extinction, causes of mass extinctions. Major mass extinctions – End Permian, End Triassic, End Cretaceous.

## **6. Origin of Plate Tectonics**

Wicander (Ch.3: 32-38)

Structure of the Earth: core, mantle, crust (continental and oceanic)

Alfred Wegener, Alexander DuToit: evidence for continental drift (fit of coastlines, distribution of Permian fossils, distribution of Permian climate indicators), Pangea

Remnant magnetism and polar wandering

## **7. Plate Tectonics and the Rock Record**

Wicander (Ch.3: 39-54)

Tectonic plates: lithosphere (upper mantle + crust) supported by asthenosphere

Plates are driven by mantle convection, new ocean floor forms from rifting and old ocean floor is recycled by subduction

Divergent margins, continental rifting: geologic evidence for rift valleys – faults, lava flows, lake deposits. Evidence for passive margin – thick carbonate deposits.

Convergent margins, ocean-ocean, ocean-continent, and continent-continent collisions

Geologic evidence for plate collisions: metamorphism, granite plutons, filling of foreland basins with eroded sediment

#### **Lab 4 Clastic Sedimentary Rocks**

Wicander (Ch.6: 94-112)

Clastic sedimentary rocks – how do they form?

Depositional environments

Sediment maturity

Sedimentary structures: ripple marks, mudcracks, trace fossils

Color in sedimentary rocks: red = oxidized iron, black = unoxidized carbon

Sediments, conglomerate, sandstone, mudstone

#### **Lab 5 Chemical Sedimentary Rocks**

Wicander (Ch.6: 94-112)

Chemical sedimentary rocks – how do they form?

Carbonates – limestone and dolostone, evaporates (halite, gypsum), organic rocks (coal)

How are carbonate sediments produced? (corals, algae, marine organisms)

Chemical precipitation, grainstone, packstone, wackestone, lime mudstone

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**Exam 1**