History of Historical Geology
Uniformitarianism vs. Catastrophism; Neptunism vs. Plutonism
Actualism
Discovery of Geologic Time
Discovery of Continental Drift, Sea-Floor Spreading, Plate Tectonics
Discovery of Evolution
Be familiar with the contributions of:
Nicholas Steno, James Hutton, Charles Lyell, William “Strata” Smith, Lord Kelvin, Alfred Wegener & Alexander
du Toit, Harry Hess, J. Tuzo Wilson, Charles Darwin & Alfred Russel Wallace

Rock Cycles
Major classes of rocks, how they form, and the bases for their classifications:
Igneous: volcanic/extrusive/aphanitic vs plutonic/intrusive/phaneritic; ultramafic → mafic → intermediate → felsic
Metamorphic: regional vs. contact; metamorphic grade & metamorphic facies (concepts – not definitions or examples)!
Sedimentary: detrital (= clastic = siliciclastic), biogenic, chemical; strata
Detrital Sedimentary Cycle: Source → Weathering → Transport (Rounding/Sorting) → Deposition → Lithification
Sedimentary Structures: mudcracks, raindrop marks, ripples & crossbeds (wave, current, trough)

Sedimentary Environments
Know the types of lithologies & structures produced by:
Nonmarine: Paleosol, Lacustrine, Paludal, Glacial, Desert, Fluvial
Coastal: Deltaic, Barrier Island-Lagoon, Sabkha
Marine: Reefal, Carbonate Bank, Siliciclastic Shelf, Turbidites, Oozes
Facies concept
Transgressions (onlap sequences) & Regressions (offlap sequences)
Sources of coastline changes: progradation, tectonic, eustatic, isostatic
Walther’s Law

Geologic Time
Relative vs. numerical (“absolute”) time
Principles of Stratigraphy: Original Horizontality, Superposition, Lateral Continuity, Cross-Cutting Relationships,
Inclusions, Fossil Succession
Geopetal indicators
Unconformities: Disconformities, Angular Unconformities, Nonconformities
Radiometric dating: standard method, isochron method, radiocarbon, fission track
Other methods: transgression-regression, eustatic sea level changes, marker beds, stable isotope,
magnetostratigraphy

Lithostratigraphy
Supergroup
Group
Formation
Member
Bed
Lithostratigraphic Grammar: Morrison Formation, Karoo Supergroup, Keyser Limestone, etc.
Intertonguing
Isochrony vs. diachrony

Biostratigraphy
Index fossils: properties & uses; First Appearance Datum & Last Appearance Datum; Zone
Magnetostratigraphy
Chron

Geologic Column

<table>
<thead>
<tr>
<th>Chronostratigraphy (Rock)</th>
<th>Geochronology (Time)</th>
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<td>Stage</td>
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Geologic Column Grammar: Jurassic Period, Upper Jurassic Series vs. Late Jurassic Epoch
GSSPs and GSSAs

Plate Tectonics
Evidence for moving continents: distribution of fossil plants & animals, sediment patterns, glacial patterns, etc.
Continental drift vs. land bridges/sunken continents: models & predictions
Polar wander, Sea-floor spreading, paleomagnetism: evidence for moving surface
Cross-sectional structure and mineralogy/lithology of Earth: esp.: oceanic vs. continental crust; crust vs. mantle;
lithosphere vs. asthenosphere
Plate Tectonics: plate boundary types (transform, divergent, convergent); microplates

Orogenesis
Cycles of mountain building
Anatomy of a mountain range: trench, accretionary wedge (mélange), forearc basin, metamorphic belts, igneous arc,
foreland basin (flysch & molasse), fold & thrust belt
Continent-continent collisions, ophiolites
Examples in the modern world
Wilson (Supercontinent) Cycles

Geochemical Cycles
Energy sources for geology: solar, gravity, internal heat
Reservoirs (sinks) and fluxes; residence time
Examples of how plate tectonics drives geochemical cycles and climate: volcanoes; chemical weathering;
sedimentation and soils; position of the continents; rise and fall of mountain ranges; rise of fall of the seas

Fossils & Fossilization
Body fossil vs. trace fossils
Fossilization potential
Common hard part mineralogies
Taphonomy & modes of preservation: unaltered, permineralized, recrystallized, replaced, carbonized, impression
Lagerstätten

Ecology
Major life habits (producers, consumers, decomposers), suspension feeding
Plankton vs. Nekton vs. Benthos (infaunal vs. epifaunal; motile vs. sessile)

Evolution
Properties of life
DNA: its role as genetic code; alleles; variations; mutations
Evolution: diversity of living things is product of descent with modification
Natural Selection: differential survival and reproduction of variants in a population resulting in change of
phenotypes of the descendants:
  • Variations in all population, some of which is heritable
• More are born into populations than can possibly survive
• Traits which allow organism to survive and reproduce will be selected for, and will show up in increasing frequency over many generations

Evolution ≠ Simple-to-complex; Evolutionary fitness = reproductive success

Common ancestry Homologies Analogies Adaptations Vestigial structures
Sexual selection Lineage Divergence Correlated Progression
Adaptive radiation Niche Partitioning Hybrids Convergence
Extinction Mass extinction Living fossils Transitional fossils
Heterochrony: Paedomorphosis vs. Peramorphosis Evo/Devo
Macroevolutionary change from macroecological change

Taxon (taxa): basics of Linnean taxonomy
Cladistics & difference of taxonomic philosophy with Linnaean
Cladogram: be able to read one
Derived vs. primitive vs. reversed vs. convergent characters
Monophyletic, Paraphyletic