

## **COURSE OUTLINE**

**GEOLOGY 101, Sec 002**

**Fall 2008, Diecchio**

**Text: Lutgens, Tarbuck and Tasa, *Essentials of Geology*, 10<sup>th</sup> edition**

### **Overview Of Earth**

ch 1

Earth's place in solar system, galaxy, universe

Atmosphere, hydrosphere, biosphere, lithosphere

Earth's interior

Earth's surface

internal processes

plate tectonics

isostasy

surficial processes

ch 17 (411-413)

ch 11 (246-248)

ch 12 (272-274)

### **Matter & Minerals**

ch 2

atoms

elements

atomic number

isotopes

atomic mass

molecules & compounds

bonds

ionic bonds

covalent bonds

states of matter

minerals

chemical composition

crystalline structure

properties of minerals

chemical composition of earth's crust

major groups of minerals

silicate minerals

structural groups

chemical trends

## **Igneous Rocks**

ch 3

- composition
  - variation of minerals (reflected in color)
  - variable composition of magma
  - cooling history (related to silicate structural groups)
- crystal size/texture
  - rate of cooling
    - volcanic (extrusive)
      - rapid cooling
      - fine crystalline (aphanitic), glassy, or fragmental texture
    - plutonic (intrusive)
      - slow cooling
      - coarse crystalline (phaneritic) texture
  - porphyritic - variable cooling rates
  - other textures

## **Surficial Processes**

- hydrologic cycle
  - atmospheric circulation patterns
    - wind systems
    - climate belts
- ch 12 (272-274)

## **Weathering & Soils**

ch. 5

- weathering
  - mechanical weathering
    - clastic particles
    - particle size classification
  - chemical weathering
    - stability series
    - products
      - clays (particles)
      - oxides (particles)
      - dissolved ions
- soils
  - soil profile
  - development of soils
    - types of soils
      - pedocal – pedalfer - laterite
  - controls of soil type
    - P - parent material
    - P - process - weathering
    - T - time
  - soil properties
  - soil as a resource

**Sedimentary Rocks**

ch 6

- weathering
  - clastic sediment → clastic rocks
    - pieces of original rock
    - clays
    - oxides
  - chemical sediment → chemical rocks
    - solutions & sedimentary precipitates
    - carbon cycle and limestones
- erosion
- transportation
- deposition
  - stratification
  - sedimentary environments
- diagenesis
  - lithification
  - porosity & permeability
- interpreting earth history
- fossil fuels

**Metamorphic Rocks**

ch 7

- contact metamorphism (high temperature)
- regional metamorphism (high pressure)
  - foliation
  - metamorphic grades
  - mountain belts

**Rock Cycle**

**Geologic time**

ch 18

- relative time
- absolute time
  - today (0 my ago)
  - Cenozoic Era
    - 65 my ago
  - Mesozoic Era
    - 250 my ago
  - Paleozoic Era
    - 540 my ago
  - Precambrian Eon
    - 4600 my ago
- geologic timespans
- rates of geologic processes

**Mass Wasting**

ch 8

- causes & conditions
- types of slope failures
- recognition of unstable slopes
- slope stabilization

**Wind and Deserts**

ch 12

- climate belts
- location of deserts

wind

- erosion
- deposition
- sorting

hydrologic cycle

**Rivers and Streams**

ch 9

- drainage basins (watersheds)
  - drainage divides
  - headwaters
  - stream order
  - baselevel(s)
  - mouth

- source of water
  - runoff
  - springs

- mechanics of streams
  - gradient
    - graded stream profile
  - channel size (cross-sectional area)
  - velocity
  - discharge
    - variability
    - floods

- stream sediment
  - coarser upstream, finer downstream
  - sorting
  - erosion vs. deposition

- stream landforms
  - erosional
    - valleys
  - depositional
    - bars, floodplains, deltas, fans, terraces

- evolution of landscapes
  - P - parent materials
  - P - process
  - T - time

- drainage basin evolution
  - erosion cycles
  - climate belts
    - humid stream erosion cycle
      - importance of groundwater
    - arid erosion cycle
      - importance of wind

fig 10.5  
p 275-278

- differential erosion
  - Valley & Ridge topography

## **Groundwater**

ch 10

- water table
- porosity and permeability
  - aquifer vs. aquiclude/aquitard
- movement of groundwater
- climate
  - influent vs. effluent streams
- geologic complexities
  - what geologists do
- practical considerations
  - utilization of groundwater
  - contamination of groundwater
- landforms – karst
  - PPT
  - carbon cycle
  - erosion of soluble rocks
  - deposition by groundwater

p. 158-159

## **Glaciers**

ch 11

- global distribution
  - high latitude glaciers
    - continental
  - high elevation glaciers
    - alpine
  - snowline varies with latitude
- mechanics of glaciers
  - ice budget
    - accumulation vs ablation
    - glacial advance, retreat (recession)
  - glacier movement
  - glacial erosion
  - glacial deposition
    - glacial sediment
      - lack of sorting
- glacial landforms
  - recognition of past ice ages
- widespread effects of glaciation
  - sea level changes
  - isostatic adjustment
  - modification of land surface
- ice ages
  - evidence of climate change
  - history of climate change
  - causes of ice ages & climate change
  - carbon cycle

fig. 1.12

p. 411-413

marine processes

**Shorelines**

ch 13

processes

cyclical

waves, tides, seasons

concept of equilibrium shoreline

non-cyclical

storms, tsunami

global sea-level change

coastal landforms

PPT

coastal evolution

primary coasts

secondary coasts

clastic shorelines

energy vs. sediment supply

finer sediment seaward

high vs. low energy shorelines

carbonate shorelines

carbon cycle

p. 158-159

deep sea

p. 377-381

calm environment

deep marine sediment

submarine "landforms"

origin not due to surficial processes

plate tectonics

## INTERIOR PROCESSES

### **Earthquakes**

ch 14 (318-337)

- seismic waves
- intensity vs. magnitude
- focus (hypocenter)
- epicenter
  - locating earthquake epicenters
    - maximum intensity
    - triangulation
- earthquake zones = zones of deformation = plate boundaries
  - intra-plate seismicity

### **Earth's Interior**

ch 14 (337-339)

- $D=VT$  (distance = velocity x time)
- seismic refraction
  - know D, measure T, calculate V
    - $V_{sol} > V_{liq} > V_{gas}$
    - V increases with density
  - predict nature of earth's interior regions
    - seismic discontinuities
- seismic reflection
  - know V, measure T, calculate D
  - depth to seismic discontinuities
- characterizing earth's interior
  - oceanic crust
  - continental crust
  - MOHO (M-discontinuity)
  - mantle
    - low velocity zone
  - outer core
    - P-wave shadow zone
    - S-wave shadow zone
  - inner core
    - weak P-waves in P-wave shadow zone

### **Crustal deformation**

ch 17 (394-403)

- types of geologic structures
  - folds
  - faults
    - tensional - normal fault
    - compressional - reverse fault
    - translational - strike-slip fault



## **Plate Boundaries**

ch 15 (342-361)

Types of plate boundaries

divergent

oceanic ridges & continental rift zones

normal faults

shallow focus, low magnitude earthquakes

associated with transform faults (strike-slip)

process: rifting

convergent

submarine trenches

reverse faults

shallow to deep focus earthquakes (Benioff zone)

low to high magnitude earthquakes

process: subduction

translational

transform faults & fracture zones

shallow focus earthquakes

very low to very high magnitude earthquakes

strike-slip faults

earthquake prediction

spatial, temporal, severity

## **Volcanism**

ch 4

review igneous rocks

generation of magma

partial melting

mantle source

crustal source

crystallization of magma

differentiation

volcanism

properties of magmas

density

viscosity

gas content

types of eruptions - relationship to plate boundaries

divergent plate boundaries

mantle source

mainly basaltic volcanism

lava flows

convergent plate boundaries

crustal source

mainly andesitic to rhyolitic volcanism

pyroclastic eruptions

batholiths

hot spots

prediction of volcanoes

spatial - temporal - severity

**Plate tectonics**

**Paleomagnetism**

ch 15 (362-369)

- earth's magnetic field
  - magnetic inclination
- remanent magnetization
  - determination of paleo-latitude
- ancient pole positions
  - polar wandering
  - continental drift
- polarity reversals

**Evolution of Oceans**

ch 16 (382-391)

- geology of Iceland
- magnetic stripes
- patterns of stripes
- mechanics of rifting
- age of the sea floor
- evolution of ocean basins & oceanic crust
  - sea floor spreading
  - reconstruction of past 200 my

**Mountain Building**

ch 17 (404-411)

- geology of Himalayas and Indian Ocean
- patterns of magnetic stripes at trenches
- relationship between mountain belts and subduction zones
  - destruction of oceanic crust
  - evolution of volcanic arcs
- relationship between oceans and continents
  - Wilson cycle

**evolution of continents & continental crust**

ch 19 (452-456)

- continental crust
  - mountain belts
  - platforms & shields
    - model of growth of continents
    - origin of continental crust

**Past, present & future earth**

**Energy & Mineral Resources**

- energy resources
  - renewable vs. non-renewable resources
  - exploration, extraction, processing
  - utilization vs. environmental preservation
    - fossil fuels
      - carbon cycle
    - alternate energy resources
- mineral resources & mining