1 Sediments and Sedimentary Rocks

Earth, Chapter 7

2 Sedimentary rocks: summary in haiku form

Lithification -

glue particles together.

Was sand, now sandstone.

3 What is a sedimentary rock?

- Products of mechanical and chemical weathering
- Account for about 5 percent of Earth's crust (by volume)
- Contain evidence of past environments
 - ■Provide information about sediment transport
 - **■**Often contain fossils

4 What is a sedimentary rock?

- Important for economic considerations may contain:
 - \mathbb{X} Coa
 - ■Petroleum and natural gas
 - Sources of iron, aluminum and manganese

5 Turning sediment into rock

- Many changes occur to sediment after deposition
- Diagenesis
 - ■All of the changes that take place after sediments are deposited
 - ■Occurs within the upper few kilometers of the earth's crust

6 Turning sediment into rock

- Diagenesis includes:
 - **■**Recrystallization
 - Development of more stable minerals from less stable ones
 - **X**Lithification
 - Unconsolidated sediments are transformed into solid sedimentary rock by compaction and cementation
 - ◆Natural cements include calcite, silica, and iron oxide

7 Types of sedimentary rock

- Sediment originates from mechanical and/or chemical weathering
- Rock types are based on the source of the material
 - ■Detrital rocks (= "clastic")
 - Sediment transported as solid particles (clasts)
 - ■Chemical rocks
 - Sediment that was once in solution

8 Detrital sedimentary rocks

- Chief constituents include:
 - **■**Clay minerals
 - Quartz
 - ■Feldspars
 - Micas
- Particle size is used to distinguish among the various types of detrital rocks

9 Clastic (detrital) particle size classification

10 Detrital sedimentary rocks

- Common detrital sedimentary rocks (in order of increasing particle size):
 - Shale
 - •Mud-size particles in thin layers commonly referred to as laminae
 - fissility
 - Most common sedimentary rock

- **Mudstone**
 - Breaks into chunks or blocks
- **■**Siltstone
 - Not fissile
- 11 Del Mar fm. / Torrey Pines ss.
- 12 Del Mar fm.
- 13 Mudstone
- 14 Mudstone
- 15 Detrital sedimentary rocks
 - Sandstone
 - ■Composed of sand-sized particles
 - Formed in a variety of environments
 - ■Sorting, shape, and composition of the grains can be used to interpret the rock's history
 - **■**Quartz is the predominant mineral
 - \times
- 16 Torrey Sandstone
- 17 Esplanade Sandstone
- 18 Esplanade Sandstone
- 19 Esplanade Sandstone
- 20 Detrital sedimentary rocks
 - Conglomerate and breccia
 - ■Both are composed of particles greater than 2 mm. in diameter
 - ■Conglomerate consists of rounded gravels
 - ■Breccia is composed mainly of large angular particles
 - X
- 21 conglomerate
- 22 conglomerate
- 23 Breccia in ABDSP
- 24 Breccia in GCNP
- 25 Chemical sedimentary rocks
 - Consist of precipitated material that was once in solution
 - Precipitation of material happens in two ways:
 - ■Inorganic processes
 - ■Organic processes (biochemical origin)
 - \mathbb{X}

26 Chemical sedimentary rocks

- Common chemical sedimentary rocks
 - **■**Limestone
 - Most abundant chemical rock
 - Composed chiefly of the mineral calcite
 - Marine biochemical limestones form as coral reefs, coquina (broken shells), and chalk (microscopic organisms)
 - ◆Inorganic limestones include travertine and oolitic limestones
 - \times
- 27 Redwall Limestone, Grand Canyon
- 28 Redwall Limestone, Grand Canyon
- 29 Vasey's Paradise
- 30 Tyndall Limestone (Manitoba)
- 31 Fossils in Tyndall Limestone
- 32 coquina
- 33 coquina-to-be
- 34 Chalk Dover, England

- 35 Travertine malachite and rhodochrosite
- 36 Travertine in Arroyo Zamora, near El Marmol
- 37 Travertine in Elves' Chasm, GCNP
- 38 Travertine in Elves' Chasm, GCNP
- 39 Chemical sedimentary rocks
 - Common chemical sedimentary rocks
 - **■**Dolostone
 - Typically formed secondarily from limestone
 - **⊠**Chert
 - Made of microcrystalline quartz
 - Varieties include:
 - Flint
 - Jasper
 - Agate
- 40 dolostone
- 41 Chert Nodules in Limestone
- 42 Chert Nodules in Limestone
- 43 Chert (agate)
- 44 Chert (agate)
- 45 Chert ("coprolite")
- 46 Chemical sedimentary rocks
 - Common chemical sedimentary rocks
 - **■**Evaporites
 - Evaporation triggers deposition of chemical precipitates
 - **Examples**:
 - Rock salt
 - Gypsum
- 47 Rock salt (halite)
- 48 Halite "soda straws" in the Grand Canyon
- 49 Gypsum
- 50 Gypsum
- 51 Fish Creek Gypsum Mine
- 52 Chemical sedimentary rocks
 - Common chemical sedimentary rocks
 - Coal
 - Different from other rocks because it is composed of organic material
 - Stages in coal formation:
 - Plant material
 - Peat
 - Lignite
 - Bituminous
- 53 Successive stages in coal formation
- 54 Coal depositional environment?
- 55 Coal depositional environment?
- 56 Coal depositional environment ?
- 57 Coal depositional environment?
- 58 Classification of sedimentary rocks
 - Classified according to the type of material
 - Two major groups
 - ■Detrital (clastic)
 - ■Chemical
- 59 Classification of sedimentary rocks

- Two major textures are used in the classification of sedimentary rocks
 - ■Clastic
 - Discrete fragments and particles
 - All detrital rocks have a clastic texture
 - ■Nonclastic
 - Pattern of interlocking crystals
 - May resemble an igneous rock
- 60 Classification of sedimentary rocks
- 61 Sedimentary environments
 - Geographic settings where sediment is accumulating
 - Determine the nature of the sediments that accumulate (grain size, shape, etc.)
- 62 Sedimentary environments
 - Types of sedimentary environments
 - ■Continental
 - Dominated by erosion and deposition associated with streams
 - Glacial
 - Wind (eolian)
 - **Marine**
 - Shallow (to about 200 meters)
 - Deep (seaward of continental shelves)
- 63 Sedimentary environments
 - Types of sedimentary environments
 - ■Transitional (shoreline)
 - Tidal flats
 - Lagoons
 - Deltas
- 64 Sedimentary environments
- 65 Sedimentary environments
 - Sedimentary facies
 - ■Different sediments often accumulate adjacent to one another at the same time
 - ■Each unit (called a facies) possesses a distinctive set of characteristics reflecting the conditions in a particular environment
 - ■The merging of adjacent facies tends to be a gradual transition
- 66 Sedimentary facies
- 67 Sedimentary structures
 - Provide information useful in the interpretation of Earth history
 - Types of sedimentary structures
 - ■Strata, or beds (most characteristic of sedimentary rocks)
 - ■Bedding planes that separate strata

 - ■Graded beds
 - ■Ripple marks
 - ■Mud cracks
- 68 Strata, or beds
- 69 Formation of Cross Bedding
- 70 Cross-bedding
- 71 Cross-bedding
- 72 Ripple marks
- 73 Graded bedding
- 74 Mud cracks (modern)
- 75 Mud cracks (ancient)
- 76 Fossils: evidence of past life

- Traces or remains of prehistoric life now preserved in rock
- Generally found in sediment or sedimentary rock
 - ■Rarely in metamorphic rock
 - Never in igneous rock (almost)
- 77 Fossils: evidence of past life
 - Geologically important for several reasons
 - ■Aid in interpretation of past environments
 - ■Serve as important time indicators
 - ■Allow for correlation of rocks in different places
- 78 Natural casts of shelled invertebrates
- 79 Natural casts of shelled invertebrates
- 80 Dinosaur footprint in limestone
- 81 Dinosaur footprint in limestone
- 82 More trace fossils
- 83 End of Chapter 7