


1  **Sediments and Sedimentary Rocks**


Earth 9th edition, Chapter 7

2  **Sedimentary rocks: summary in haiku form**


Lithification -

glue particles together.


Was sand, now sandstone.

3  **Key Concepts**

- Formation of sedimentary rocks: Diagenesis and lithification of sediment.
- Detrital sedimentary rocks.
- Chemical sedimentary rocks.
- Further classification and interpretation of textures in sedimentary rocks.
- Sedimentary environments.
- Sedimentary structures.

4  **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

5  **What is a sedimentary rock?**

- Important for economic considerations – may contain:
 - ✗ Coal
 - ✗ Petroleum and natural gas
 - ✗ Sources of iron, aluminum and manganese

6  **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

7  **Turning sediment into rock**

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

8  **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

9  **Detrital sedimentary rocks**

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

10 **Clastic (detrital) particle size classification**

11 **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

12 **Del Mar fm. / Torrey Pines ss.**

13 **Del Mar fm.**

14 **Mudstone**

15 **Mudstone**

16 **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



17 **Torrey Sandstone**

18 **Esplanade Sandstone**

19 **Esplanade Sandstone**

20 **Esplanade Sandstone**

21 **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



22 **conglomerate**

23 **conglomerate**

24 **Breccia in ABDSP**

25 **Breccia in GCNP**

26 **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)



27 **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



28 **Redwall Limestone, Grand Canyon**

- 29 ***Redwall Limestone, Grand Canyon***
- 30 ***Vasey's Paradise***
- 31 ***Chert Nodules in Limestone***
- 32 ***Chert Nodules in Limestone***
- 33 ***Tyndall Limestone (Manitoba)***
- 34 ***Fossils in Tyndall Limestone***
- 35 ***coquina***
- 36 ***coquina-to-be***
- 37 ***Chalk – Dover, England***
- 38 ***Travertine – malachite and rhodochrosite***
- 39 ***Travertine in Arroyo Zamora, near El Marmol***
- 40 ***Travertine in Elves' Chasm, GCNP***
- 41 ***Travertine in Elves' Chasm, GCNP***
- 42 ***Chemical sedimentary rocks***
 - Common chemical sedimentary rocks
 - ☒ Dolostone
 - ◆ Typically formed secondarily from limestone
 - ☒ Chert
 - ◆ Made of microcrystalline quartz
 - ◆ Varieties include:
 - Flint
 - Jasper
 - Agate
- 43 ***dolostone***
- 44 ***Chert (agate)***
- 45 ***Chert (agate)***
- 46 ***Chert ("coprolite")***
- 47 ***Chemical sedimentary rocks***
 - Common chemical sedimentary rocks
 - ☒ Evaporites
 - ◆ Evaporation triggers deposition of chemical precipitates
 - ◆ Examples:
 - Rock salt
 - Gypsum
- 48 ***Rock salt (halite)***
- 49 ***Halite "soda straws" in the Grand Canyon***
- 50 ***Gypsum***
- 51 ***Gypsum***
- 52 ***Fish Creek Gypsum Mine***
- 53 ***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
- 54 ***Successive stages in coal formation***
- 55 ***Coal depositional environment ?***
- 56 ***Coal depositional environment ?***
- 57 ***Coal depositional environment ?***

- 58 **Coal depositional environment ?**
- 59 **Classification of sedimentary rocks**
- Classified according to the type of material
 - Two major groups
 - ☒ Detrital (clastic)
 - ☒ Chemical
- 60 **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
- 61 **Classification of sedimentary rocks**
- 62 **Sedimentary environments**
- Geographic settings where sediment is accumulating
 - Determine the nature of the sediments that accumulate (grain size, shape, etc.)
- 63 **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)
- 64 **Sedimentary environments**
- Types of sedimentary environments
 - ☒ Transitional (shoreline)
 - Tidal flats
 - Lagoons
 - Deltas
- 65 **Sedimentary environments**
- 66 **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
- 67 **Sedimentary facies**
- 68 **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
 - ☒ Cross-bedding
 - ☒ Graded beds
 - ☒ Ripple marks
 - ☒ Mud cracks
- 69 **Strata, or beds**
- 70 **Formation of Cross Bedding**

- 71 ***Cross-bedding***
- 72 ***Cross-bedding***
- 73 ***Ripple marks***
- 74 ***Graded bedding***
- 75 ***Mud cracks (modern)***
- 76 ***Mud cracks (ancient)***
- 77 ***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)
- 78 ***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
- 79 ***Natural casts of shelled invertebrates***
- 80 ***Natural casts of shelled invertebrates***
- 81 ***Dinosaur footprint in limestone***
- 82 ***Dinosaur footprint in limestone***
- 83 ***More trace fossils***
- 84 ***End of Chapter 7***