Sediments
Key Concepts

- Sediments are loose accumulations of particulate material.

- The depth and composition of marine sediments tell us of relatively recent events in the ocean basin.

- The most abundant sediments are terrigenous (from land) and biogenous (from once-living things).
Key Concepts

• Marine sediments have been uplifted and exposed on land (e.g., The Grand Canyon).

• Because marine sediments are usually subducted along with the seabed on which they lie, the oldest sediments are relatively young—rarely older than 180 million years.
Ocean Sediments Vary Greatly in Appearance

- Particles of organic or inorganic matter that accumulate in a loose, **unconsolidated form** that vary according to:
  - **Size**
  - **Source**
  - **Location**
  - **Color**

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Sediments are classified by particle size.

<table>
<thead>
<tr>
<th>Size Class</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gravel</strong></td>
<td></td>
</tr>
<tr>
<td>Boulder</td>
<td>&gt;256 mm</td>
</tr>
<tr>
<td>Cobble</td>
<td>64–256 mm</td>
</tr>
<tr>
<td>Pebble</td>
<td>4–64 mm</td>
</tr>
<tr>
<td>Granule</td>
<td>2–4 mm</td>
</tr>
<tr>
<td><strong>Sand</strong></td>
<td></td>
</tr>
<tr>
<td>Very coarse sand</td>
<td>1–2 mm</td>
</tr>
<tr>
<td>Coarse sand</td>
<td>0.5–1 mm</td>
</tr>
<tr>
<td>Medium sand</td>
<td>0.25–0.5 mm</td>
</tr>
<tr>
<td>Fine sand</td>
<td>0.125–0.25 mm</td>
</tr>
<tr>
<td>Very fine sand</td>
<td>0.0625–0.125 mm</td>
</tr>
<tr>
<td><strong>Mud</strong></td>
<td></td>
</tr>
<tr>
<td>Coarse silt</td>
<td>0.0310–0.0625 mm</td>
</tr>
<tr>
<td>Medium to very fine silt</td>
<td>0.0039–0.0310 mm</td>
</tr>
<tr>
<td>Clay</td>
<td>&lt;0.0039 mm</td>
</tr>
</tbody>
</table>

Waves and currents generally transport smaller particles farther than larger particles.
Sediments Are Classified By Particle Size

To dislodge and carry a particle (A), the speed of a current must exceed 20 cm/sec (8 in/sec). When current falls below 1 cm/sec (1/2 in/sec), the particle will be deposited.
Sediments May Be Classified By Source

- Terrigenous sediments come from land
  - Erosion and deposition

- Cosmogenous sediments come from space
Sediments May Be Classified By Source

- Biogenous sediments form from the remains of marine organisms

- Hydrogenous sediments precipitate directly from seawater

- Marine sediments are usually a combination
  - Terrigenous and biogenous most common
Total sediment thickness of the ocean floor
Neritic Sediments

- Neritic sediments overlie continental margins
- Neritic – on the continental shelf
- Most neritic sediments are terrigenous – from land
  - Currents distribute sediments along the coast, wave action, glacial deposits
- Lithification
  - Sediments converted to sedimentary rock
    - Pressure-induced compaction
    - Cementation
Pelagic Sediments

Vary in composition and thickness

- **Turbidites** – deposited by turbidity currents
- **Clays** – most easily transported land sediment
- **Oozes** – remains of *living* creatures
  - **Calcareous**
    - Cannot exist below the CCD (calcium Carbonate Compensation depth), *dissolve*
  - **Siliceous**
    - Radiolarians, diatoms
Turbidity currents and formation of Turbidites

- Storm winds
- Sea level
- Wave base
- Substrate liquefied by wave activity
- Turbidity current

Key Turbidity currents
- Submarine canyon
- Deep-sea fans

Continental slope
Continental rise
Abyssal plain

Sediment slump masses
Graded beds of turbidites
Underlying basaltic crust

Each graded layer is the result of one turbidity current event.

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At this depth, usually about 4,500 meters (14,800 feet), the rate at which calcareous sediments accumulate equals the rate at which those sediments dissolve.
Pelagic Sediments Vary in Composition and Thickness

- **Hydrogenous (Authigenic) sediments** precipitate out of seawater
  - Manganese nodules

- **Evaporites**
  - Include many salts

- **Oolite sands**
  - Form when calcium carbonate precipitates from seawater
Specialized Tools to Study Ocean Sediments

- Clamshell sampler
- Piston corer

Samples are relatively undisturbed.
Sediments Are Historical Records of Ocean Processes

- **Stratigraphy** – analysis of layered deposits
- **Paleoceanography** – study of the ocean’s past
  - Microfossils
  - Dating deep-sea sediments
  - Relative analysis of stable isotopes
Marine Sediments Are Economically Important

- Components of building materials
- Crude oil and natural gas
- Sand and gravel
- Manganese nodules