Sedimentary Structures

Sedimentary structures: Features preserved in sedimentary strata that indicate physical, biological, and/or chemical processes during and after deposition. These features may be indicative of sedimentary depositional environment.

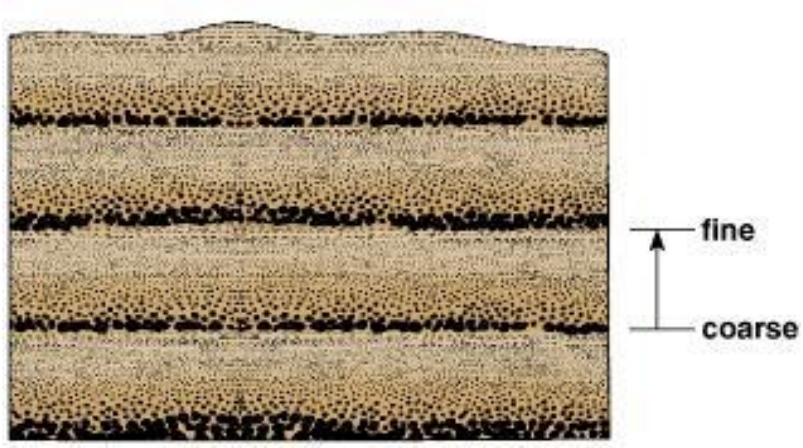
I. Primary

Bedding – Tabular or lenticular layers of sedimentary rock having characteristics that distinguish them from strata above and below

- Beds are a function of and are distinguished by the composition, size, shape, orientation, and packing of sediment
- Beds are separated by **bedding planes** (well defined planar surfaces that separate one layer from another in sedimentary rocks, each plane marks a break in deposition)

Massive Bedding – Beds of sedimentary rock contain few or no visible forms or structures.

Graded Bedding – Strata characterized by gradual but distinct vertical changes in grain size.



The figure above shows *normal* grading, where grain size gets smaller moving up section.

Imbrication – Sedimentary structure consisting of a preferred orientation of clasts such that they overlap one another in a consistent fashion, like toppled dominoes.

Planar Bedding – Layers of sediment with flat, parallel bedding planes that were originally deposited nearly horizontal. **Lamination** is bedding that is <1 cm thick.

Cross-bedding – One of the most common structures in sedimentary rocks, which is usually occurs in sandstone (but not always). This is strata in which internal layers dip at a distinct angle to the surface that bound the sets of cross-beds. **Tabular cross bedding** has bounding surfaces that are planar. **Trough cross beds** have bounding surfaces that are curved**.** *To distinguish tabular and trough cross beds you must have an exposure that is cut perpendicular to flow direction.* Cross bedding forms by deposition of migrating bedforms.

Ripple cross-lamination – A type of cross-stratification that has the general appearance of waves when viewed in outcrop sections cut perpendicular to the wave (ripple) crests.

Flaser bedding – A special type of ripple cross-lamination in which thin streaks of mud occur between sets of mud occur between sets of ripple laminae. **Lenticular Bedding** is used instead of flaser bedding for interbedded mud and ripple cross-laminated sand in which the reipples or sand lenses are discontinuous and isolated in both vertical and lateral directions.

Flaser Bedding

Lenticular Bedding

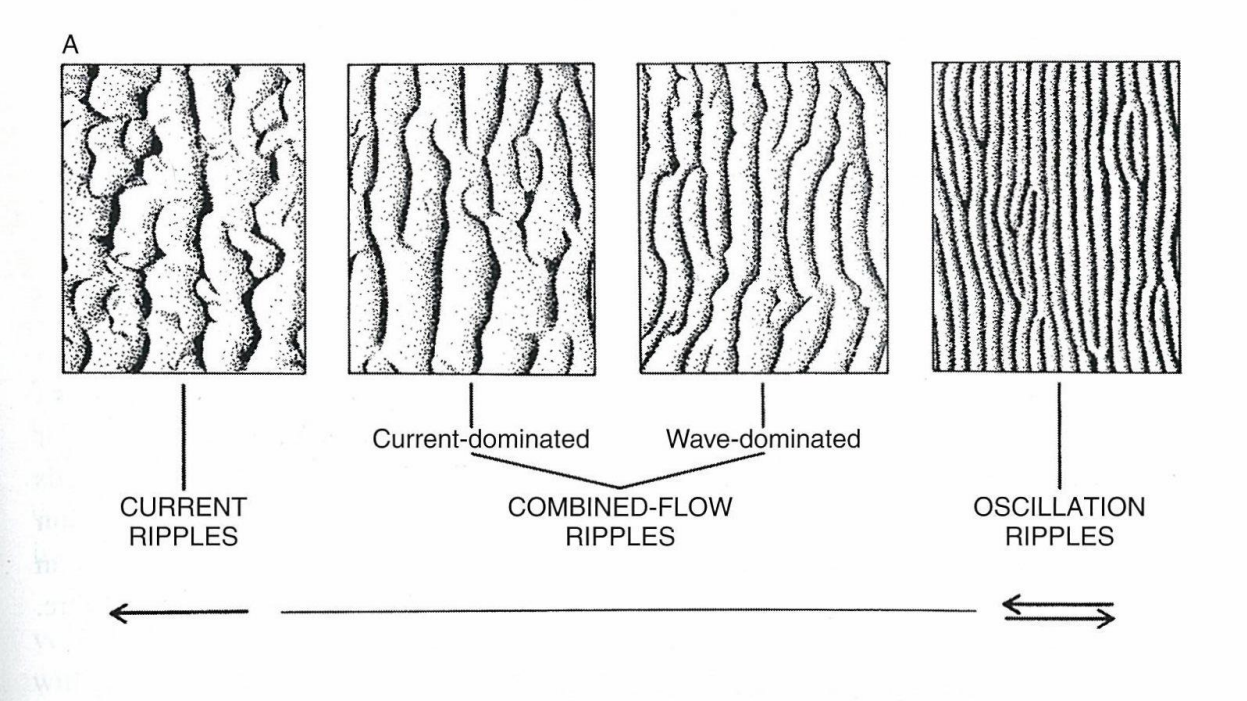
Stromatolitic bedding – Organosedimentary laminated structures commonly composed of fine silt or clay size, more rarely sand-size, carbonate sediment.

Ripple marks – Sedimentary structure formed by agitation by flowing water, wave action, or wind. These are similar to cross-beds, but they are smaller.

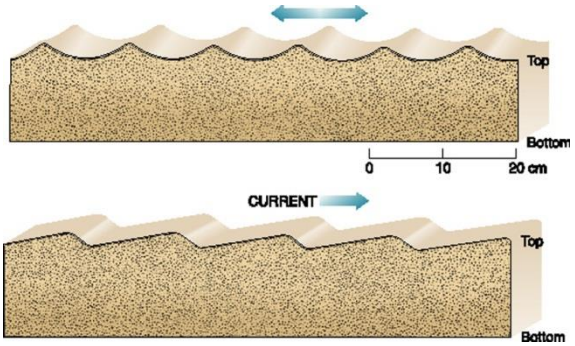
Current Ripples – Formed by a unidirectional current. Common depositional environments include fluvial and eolian dunes where there is a single wind direction. Ripples are asymmetric in cross section.

Combined-Flow Ripples – Intermediary between current and oscillation ripples. Generally formed in an environment with two current directions and one is dominant.

Oscillation Ripples – Formed by two-directional current. Ripples are symmetric in cross section. This structure is usually formed in a shoreline or shallow marine environment.



The above figure shows ripples in **plan (or map) view**.



Oscillation Ripples

Current Ripples

II. Irregular Stratification

Convolute bedding lamination – Complexly folded or intricately crumpled beds or laminations that are commonly, although not invariably, confined to a single sedimentation unit.

Flame structures – Flame-shaped projections of mud that extend upward from a shale unit into an overlying bed of different composition, commonly sandstone.

Ball and pillow structures – The basal portion of sandstone beds, which overlie shales, that are broken into masses of various sizes packed vertically and laterally in a mud matrix

Synsedimentary folds, faults, and rip-up clasts (soft sediment deformation) – Deformation caused by the influence of gravity on unconsolidated sediment.

Dish and pillar structures – In cross-section, these are thin, dark-colored, subhorizontal, flat to concave-upward clayey laminations. In plan view, these features are polygonal, circular, oval, or elliptical.

III. Secondary Structures

Concretions – Perhaps the most common secondary structure. These structures are typically composed of calcite or hematite; however, concretions made of other minerals are known. Concretions form by precipitation of minerals around a nucleus (or central point) while groundwater percolates through sediment undergoing diagenesis.

Nodules – These are closely related to concretions. They are small, irregularly rounded bodies that commonly have a warty or knobby surface.

Stylolites – Suture or stylus like seams, as seen in cross-section, in generally homogenous, thick bedded sedimentary rocks.

IV. Bedding-plane markers

Groove cast – Elongate, nearly straight ridges that result from the infilling of grooves produced by some object dragged over a mud bottom in continuous contact with the bottom.

Bounce brush prod roll and skip marks – Markings related in origin to groove casts, but they are produced by tools that make intermittent contact with the bottom rather than continuous contact.

Flute casts – Elongated welts or ridges that have at one end a bulbous nose that flares out toward the other end and merges gradually with the surface of the bed.

Current crescents – Narrow semicircular or horseshoe-shaped troughs, which form around small obstacles such as pebbles or shells owing to current scour

Load casts – Rounded knobs or irregular protuberances on the soles of sandstone beds that overlie shales

Bioturbation structures –Disruption of sediment by organisms, seen either as a complete churning of the sediment that has destroyed depositional sedimentary structures, or in the form of discrete and clarly recognizable burrows, trails, and traces.

Mudcracks – The polygonal-shaped cracks developed in mud which has dried out in a terrestrial environment. They are most often preserved when loose sand infills the cracks and then buries the desiccated mud surface. These structures are typically found in environments subjected to periods of wetting and drying, such as tidal flats, lake beds, and stream beds.

Also raindrop imprints, bubble imprints, etc.

Sandstone sills/dikes – Tabular bodies of sandstone that fill fractures (dikes) or space between beds (sills) in any kind of host rock

Tracks and trails – Imprints left by animals that are filled in with sediment.

V. Other Structures

Reduction –band – In beds that were originally oxidized (and thus red). After burial, migration of ground water caused reduction of some ferric oxide (Fe_2O_3) to ferrous oxide (FeO), which is slightly soluble. Leaching of the reduced iron caused the color to change to green, or colorless.

Salt casts - Salt casts represent periods of aridity during the time of the deposition of a fine grained sedimentary rock. Drying of the sediments is an indication of very arid conditions allowing the development of the salt crystals. The salt crystals were later dissolved away and the voids were then filled with sand to produce the casts.

***Remember:** A cast is a shape formed by a mold, and a mold gives shape to a cast.