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DEPARTMENT OF GEOLOGY

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SEDIMENTARY ENVIRONMENTS

Sediments accumulate in a wide variety of environments, both on the continents and in the oceans. A sedimentary environment is a specific depositional setting where sedimentary rocks are deposited and is unique in terms of physical, chemical, and biological characteristics.

The physical features of a sedimentary environment include water depth and the velocity, persistence of currents etc. Chemical characteristics of an environment include the salinity (proportion of dissolved salts), acidity or basicity (pH), oxidation potential (Eh), pressure, and temperature. The biological characteristics are mainly the assemblage of fauna and flora that populate the setting.

These conditions, combined with the nature of the transporting agent and the source area, largely determine the properties of the sediments deposited within the environment.

A number of ways of classifying depositional environments exist, but most modern schemes employ a geomorphologic approach. That is to say, an environment is defined in terms of a distinct geomorphic unit or landform.

CLASSIFICATION

There are 3 kinds of depositional environments, they are *continental, Transitional (marginal marine),* and *marine environment.* Each environment is associated with a set of criteria that constitutes its distinguishing features. An environment may be further divided into sub-environments.

1) **CONTINENTAL**: (on land or in fresh water)

- **Fluvial:** rivers and streams

a) **Braided Rivers** - characterized by many channels separated by bars or small islands. Braiding results from rapid, large fluctuations in the volume of river water, and an abundance of coarse sediment. There are two main types of braided river facies: 1) rippled, cross-stratified gravels and coarse sandstones (bars) and 2) horizontally stratified, fine to coarse sands (channels). In a vertical section through an ancient braided river these will tend to alternate.

b) **Meandering Rivers** - confined to one, highly sinuous channel, and contain finer sediment load than braided rivers. Meandering rivers also form bars, but they are formed on the inside bend of meander loops. As a result these bars build outward, the streams become more and more sinuous and migrate across the river basin. There are two main types of meandering river facies: 1) rippled, cross-bedded, fining-upward sequences of gravel and sand (bars) and 2) fine-grained sediments, such as silt and clay, containing burrows and plant debris (overbank or flood deposits). In a vertical section through an ancient meandering system, these will tend to alternate.

- **Alluvial:** deposits that form at the base of mountains where rapidly flowing streams suddenly emerge from a narrow valley, spread out, slow down, and dump the larger particles in their sediment load. They are poorly sorted and clasts are frequently angular. The composition of the fragments is similar to the rocks exposed in the nearby mountains. Sedimentary structures are not well developed and fossils are very rare.

- **Glacial:** Deposited by glaciers. Range in size from small bodies deposited by valley glaciers (alpine glaciers) to large sheets dumped from continental glaciers. Characterized by a variety of facies, but the most unique is diamictites, or pebbly mudstones.

- **Eolian:** Deposited by wind (in deserts). Recognized by dune deposits, although the dominant sedimentary layering that is preserved is horizontal.

- **Lacustrine:** Lake deposits. Dominated by finely laminated clastic sediments Deposits. They may contain numerous sedimentary structures, including cross-bedding, ripples, graded beds, footprints, mudcracks, and raindrop impressions. Fossils may be common. Plant fossils and freshwater bivalves and gastropods are particularly abundant.

- **Paludal Swamp deposits:** Plant-choked, periodically inundated environments. Organic-rich shale and sandstone or coal deposits with thin stringers of silstone and shale. Plant fossils are common in all stages of preservation.

2) **TRANSITIONAL:** an environment showing influence of both fresh water or air and marine water i.e. where land meets ocean.

- **Deltaic:** Deposits at the mouths of large rivers. Form where rivers enter a standing body of water, slow down, and deposit more sediment than can be removed by waves and currents. Although deltas also from in lakes, the largest deltas occur in the oceans. Deltas are composed of several sub-environments, from the fluvial delta-top to the submarine base of the delta. Accordingly there are numerous types of fossils and sedimentary structures possible. Ancient delta deposits are most easily recognized by the larger package. Because of their formation process, there is a lateral gradation in particle size (and sedimentary rock type) along the delta, from sand near the river outlet to submarine clay deposits at the edges. As more sediment is added, the delta builds out into the standing body of water, with coarser sediments migrating across the clays that used to be at the delta edges. This results in a coarsening upward (regressive) sequence.

- **Esturine:** An estuary is a partially enclosed coastal body of brackish water with one or more rivers or streams flowing into it, and with a free connection to the open sea. Estuaries form a transition zone between river environments and maritime environments known as *ecotone.* Estuaries are subject both to marine influences such as tides, waves, and the influx of saline water and to riverine influences such as flows of freshwater and sediment. The mixing of seawater and freshwater provides high

levels of nutrients both in the water column and in sediment, making estuaries among the most productive natural habitats in the world.

- **Lagoonal:** Deposits in the waters separating barrier islands from the shore. Lagoonal is separated from terrestrial environment by reef, barrier island, sandbank, and spit. The lagoon has low energy, so sediment that are dominant is fine grained.

- **Beach:** Deposits in shallowest marine water influenced by waves. Beach facies are composed primarily of fine- to medium-grained, well-sorted sand that displays subhorizontal parallel laminations and low-angle, seaward-, landward- and alongshore-dipping crossbeds. The variously dipping crossbeds are a result of the back-and-forth action of tides and longshore currents. Burrows are common in sediments of the transition zone between the beach and open shelf.

3) **MARINE:** depositional environment influenced by sea water.

- **Shallow marine clastic** shelf - bounded by coastal environments on the landward side and by the continental slope on the seaward side. Sediments consist mainly of sand and mud, and nearshore sands commonly grade seaward through a transition zone of mixed sand and mud to deeper-water muds. Cross bedding is common in the sands and bioturbation is common in the muds. Regions near the mouths of rivers are usually clastic dominated because the critters that secrete $CaCO_3$ tend to have trouble living in muddy water.

- **Carbonate shelf:** located primarily at low latitudes in clear, shallow, tropical seas where little continental, clastic sediment is introduced. These are regions with clear water shallow enough to be penetrated by sunlight are often dominated by the skeletons of marine organisms (fish, coral, mollusk shells, sponges, echinoderms). Most common rocks are limestone, shale, sandstone.

- **Continental slope and abyssal plains:** Dominated by the deposition of submarine landslides (canyons). Most common rocks are mudstone, greywackes and sedimentary structures such as graded beds, turbidites are present.

- **Deep marine:** Very thin sediments formed by the slow accumulation of skeletons and clasts dropped into the ocean by wind.Thin beds of chert, chalk, limestone, mudstone along with microscopic plankton.

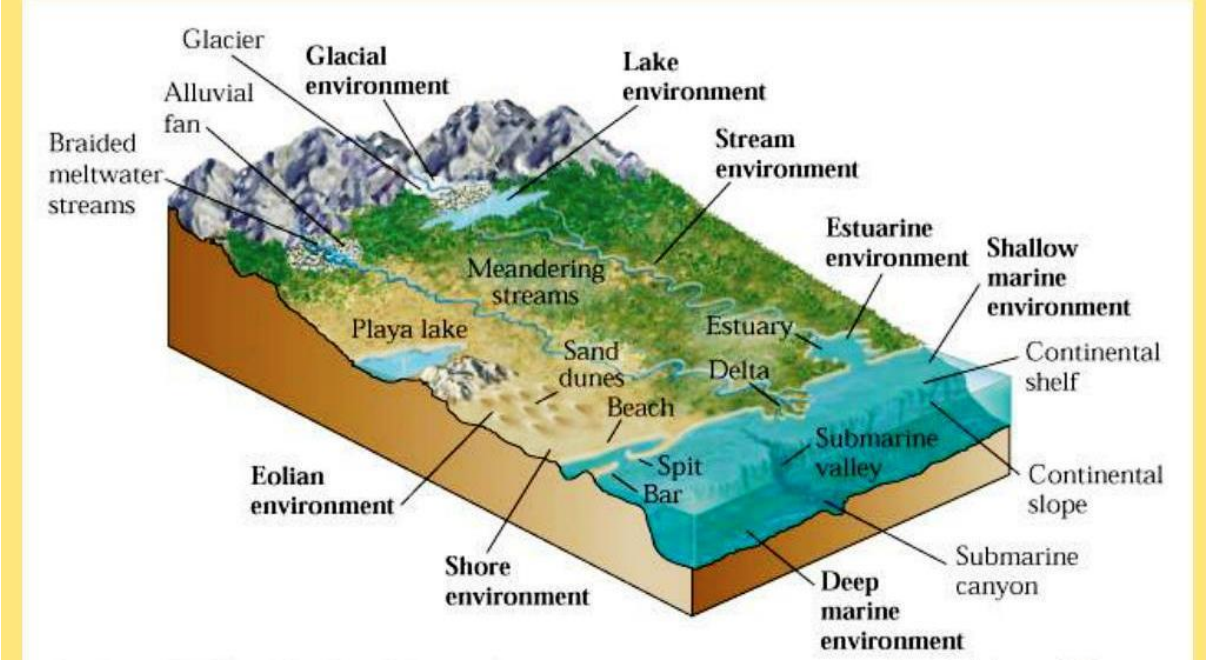

Figure1- Depositional environments.