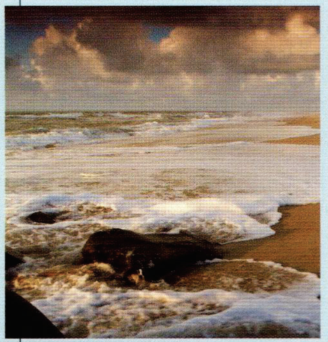
BEACHES AND DUNES

BEACHES ARE DEPOSITS OF SEDIMENTARY MATERIAL, ranging in size from fine sand to rocks, that commonly occur on coasts above the low-tide line. Sources of beach material include sediment brought to a coast by rivers, or eroded from cliffs or the sea floor, or biological material such as shells. This material is continually moved on and off shore and around coasts, by waves and tides. Wind can also influence beach development and is instrumental in forming coastal dunes.

DISSIPATIVE BEACH AND DUNE Dissipative beaches are usually made up of fine sand, and they slope at an angle of less than 5°.

BEACH ANATOMY

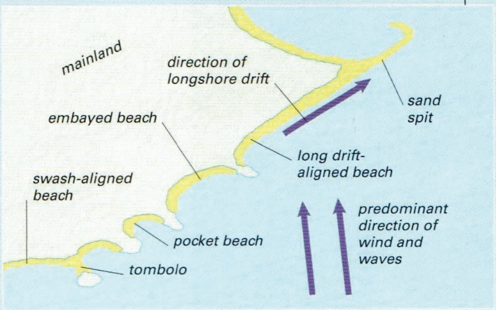
A typical beach has several zones. The foreshore is the area between the average high- and low-tide lines. On the seaward side of the foreshore is the nearshore, while behind it is the backshore; the latter is submerged only during the very highest tides and usually includes a flat-topped accumulation of beach material called a berm. The sloping area seaward of the berm, making up most of the foreshore, is the beach face. At the top end of the beach face there are sometimes a series of crescent-shaped troughs, called beach cusps. The swash zone is the part of the beach face that is alternately covered and uncovered with water as each wave arrives. Seaward of the swash zone, extending out to where the waves break, is the surf zone. The shape of a beach often alters as wave energy changes over the year.



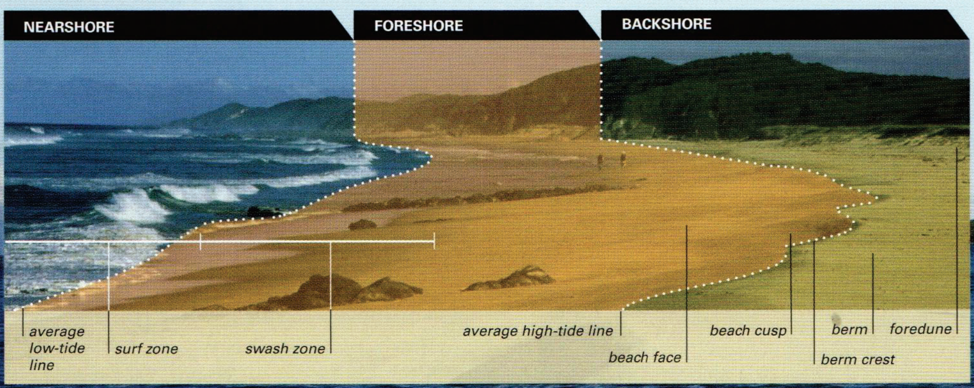
SWASH The surge of water and sediment up a beach when a wave arrives is called swash. If waves reach a beach at an angle, the combined effect of swash and backwash moves material along the beach.

TYPES OF BEACHES

The level of wave energy, the direction the waves arrive from, and the geological makeup of a coast all affect the type of beach that will form. Dissipative beaches are gently sloping and absorb wave energy over a broad area, while reflective beaches are steeper and shorter, and consist of coarser sediment. If a cliffed coast contains a mixture of both easily eroded and erosion-resistant rock, headlands tend to form, with crescent-shaped beaches within the bays (embayed beaches) or smaller "pocket" beaches. Both of these tend to be "swash-aligned"—the waves arrive parallel to shore and do not transport sediment along the beach. Many long, straight beaches are "drift-aligned"—the waves arrive at an angle and sediment is moved along the beach by longshore drift.



RANGE OF BEACHES This imaginary coast (right) shows several beach types, ranging from a tombolo (a sand deposit between the mainland and an island) to a drift-aligned beach.

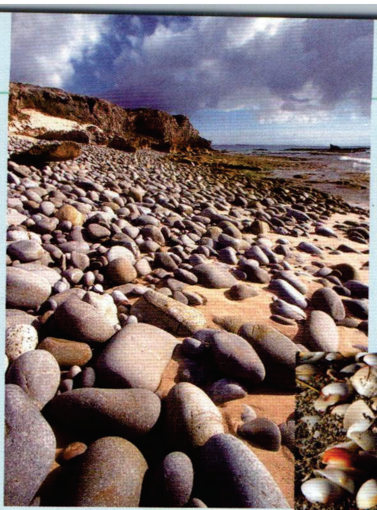


BEACH PARTS AND ZONES This photograph (left) shows the main zones on a beach and the locations of the berm, beach face, and beach cusps. It was taken when the sea was approaching low tide.

GRAIN SIZES
The silts, sands, and gravels that make up most beaches tend to become sorted by the action of waves, with material of different sizes deposited on different parts of the beach.

BEACH COMPOSITION

The composition of a beach at any particular location depends on the material available and on the energy of the arriving waves. Most beaches are composed of sand, gravel, or pebbles produced from rock erosion. Sand consists of grains of quartz and other minerals, such as feldspar and olivine, typically derived from igneous rocks such as granite and basalt. Other common beach-forming materials, seen particularly in the tropics, include the fragmented shells and skeletons of marine organisms. In general, higher wave energies are associated with coarser beach material, such as gravel or pebbles, rather than fine sand. Occasionally, large boulders are found on beaches—usually they have rolled down to the shore from local cliffs, but some boulders have ended up on beaches as a result of glacial transport or even backwash from tsunamis.



PEBBLES AND SHELLS
This high-energy beach (left) contains many large pebbles. Mollusk shells in the beach below reflect favorable offshore feeding conditions for the live mollusks.

MARRAM GRASS
This grass is a common colonizer of embryo dunes. It develops deep roots that allow it to tap into deep groundwater stores. The roots bind the sand together, while the grass traps more blown sand, assisting in foredune development.

COASTAL DUNES

Coastal dunes are formed by wind blowing sand off the dry parts of a beach. Dunes develop in the area behind the backshore, which together with the upper beach face supplies the sand. For dunes to develop, this sand has to be continually replaced on the beach by wave action. The actual movement of sand to form dunes occurs through a jumping and bouncing motion along the ground called saltation. Some coastal areas have more than one set of vegetated dunes that run parallel to the shoreline. The dunes closest to shore are called foredunes; behind them is a primary dune ridge, secondary dune ridge, and so on. These anchored, vegetated dunes are important for the protection they provide against coastal erosion. On some coasts, non-vegetated, mobile dunes occur; these move in response to the prevailing winds. They can often be anchored by planting with grasses.

REFLECTIVE BEACH
This beach in the Seychelles is an example of a reflective beach because of its quite steeply shelving face. It has a distinct berm and berm crest.