

## Moving sands

The features seen along Malaysian coasts are the result of erosion and deposition. They reflect the dynamic equilibrium between the various forces at work in the coastal environment, such as tides, waves and currents. Constant movement of sand and shingle is a key process which creates some of Malaysia's characteristic coastline formations—golden strands of beach, barrier islands and mangrove-lined estuaries.

### Beach sediments

The sediments found on the beach as well as offshore are mostly derived from rocks through the processes of weathering, transportation and deposition. By far the largest supply is that brought in by rivers which transport and ultimately deposit their suspended load of sediments in the sea. These sediments are the products of erosion of rocks inland. The other source of sediments on the beach is the erosion, by wave action, of rocks along the coast. Such sediments are subsequently dispersed along the shore by longshore drift. The actual proportion of sediments from these two sources varies from locality to locality.

In addition to sand, which is the most common sediment and which is usually associated with



In Malaysia, there are beaches with sands of different colours (white, golden and black) depending upon the mineral composition of the rocks in the area. Beaches with golden sand, such as this one in Terengganu, are found all along the east coast of Peninsular Malaysia.

beaches, the sediments found in the coastal zone may also include coarser grain sizes such as pebbles, cobbles and boulders, as well as finer grains of silt and clay. As a consequence of wave action offshore and on the beach, sediments gradually become sorted according to grain size. Thus, coarse sand is usually found on the upper portion of a beach. This grades into fine sand near the shoreline and eventually into silt and mud farther offshore.



Top: The black sand beach at Pantai Hitam, Pulau Langkawi, gets its colour from the minerals magnetite and haematite, derived from the erosion of granite-rich rocks in the area.

Bottom: This white beach at Sungai Sembilang, Selangor, is made up of shell fragments which consist of calcium carbonate.

In terms of mineral composition, most beach sands consist principally of quartz, the most common durable mineral in rocks. The less resistant minerals are mostly removed by weathering. White mica or muscovite is sometimes found in varying proportions, depending on the locality, as fine white flakes. The other common component of beach sands is shell fragments which are made of calcium carbonate. One beach with abundant shell fragments is Pantai Raman, south of Jeram in Selangor.

## Man-made structures on the beach

### Effects of human activity

A number of structures have been built along the Malaysian coast to protect it from waves. Unfortunately, these man-made structures disturb the state of dynamic equilibrium between sediment deposition and erosion on the beach. Since they interfere with the natural transport of materials along the beach by longshore drift, these structures often cause undesirable deposition and erosion, not only in their immediate vicinity but much farther down-drift. Dredging can temporarily minimize the problems but does not solve them and is sometimes difficult and expensive.

### Groynes

A groyne is a low structure built on a beach, often at right angles to it, in order to check erosion on that particular stretch of the beach. Usually constructed in a series, turning a groyne field, groynes impede the normal longshore drift of sand and cause it to be trapped on the up-drift sides, thus eventually building a wider beach there. As a result of the interruption in the supply of sediment, severe erosion occurs farther down-drift. This effect can be seen at several beaches along the west coast of Peninsular Malaysia.

### Longshore drift



Longshore drift is the process that occurs when waves are driven obliquely against the coast. Sediments are washed up on the beach in a forward sweeping curve. The backwash then drags the material down the beach slope until it is caught by the next cycle of waves. By repetition of this zig-zag movement, sediments are moved along the shore.



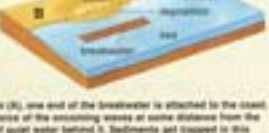
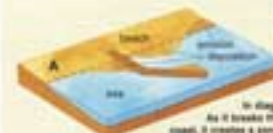
The deposition of sediments on one side of a groyne causes the unprotected side of the coast to be deprived of these sediments and to be eroded by waves.

### Breakwaters

A breakwater is a structure built out in the sea or into it to intercept waves and protect a harbour. It may be attached to the beach or detached from it. Such a structure interferes with the natural longshore transport of sediments because longshore currents are weaker behind it. Consequently, sediment deposition occurs there whilst severe erosion can take place down-drift. Sand trapped up-drift of an attached breakwater may eventually block the entrance to a harbour. This build-up has to be removed by dredging, which is expensive. Breakwaters have been built at various Malaysian river mouths and harbours, such as at Chendering in Terengganu.



A breakwater with sediments inside the harbour at Chendering, Terengganu.



In diagram (A), one end of the breakwater is attached to the coast. As it breaks the force of the incoming waves at some distance from the coast, it creates a zone of quiet water behind it. Sediments get trapped in this zone, while erosion occurs farther down-drift where the coast is unprotected. In diagram (B), the breakwater is built away from the coast, but the same process happens and sediments get trapped in the quiet zone behind and erosion occurs farther down-drift.

### Jetties

A jetty is often built at the mouth of a river to protect it from waves, to stabilize the channel, and to minimize the deposition of sediments there. However, increased deposition occurs on the up-drift side and may eventually obstruct the channel. On the down-drift side, erosion takes place and causes further problems. One example of this is at the mouth of the Melaka River before the recent land reclamation project.



A structural jetty made of rocks at Melaka.

## Typical depositional features along a coast



An elongated spit around a lagoon on reclaimed land at Port Dickson. A spit is a long ridge of sand or gravel extending out from a beach into open water.



A spit with a crescent-shaped bar at Pantai Mawar, Rompin, in Pahang. A spit is formed by longshore drift carrying sediments along a beach.



A sand bar at Tanjung Rhu, Pulau Langkawi. There are narrow types of bars which are usually exposed during low tide and submerged during high tide.



A baymouth is formed when a sand bar links an island or a block to the mainland. This example can be seen at Kemarak, Terengganu.



A small baymouth barrier in Baganak. A baymouth barrier is formed when a spit grows until it extends completely or almost completely across the mouth of a bay.



A bayhead beach at Teluk Semayang, Terengganu. This is formed where there are different types of rocks being eroded at different rates, thus forming an indentation.



Weathering and human activities such as forest clearance cause soil erosion whereby sediments are carried by rivers into the sea.

