

**See also:** ATMOSPHERIC SCIENCES, CLIMATE CLASSIFICATION

### Further reading

Oliver, J.E., 1991. The history, status, and future of climate classification. *Physical Geography* 12, 235–251.

## COASTS

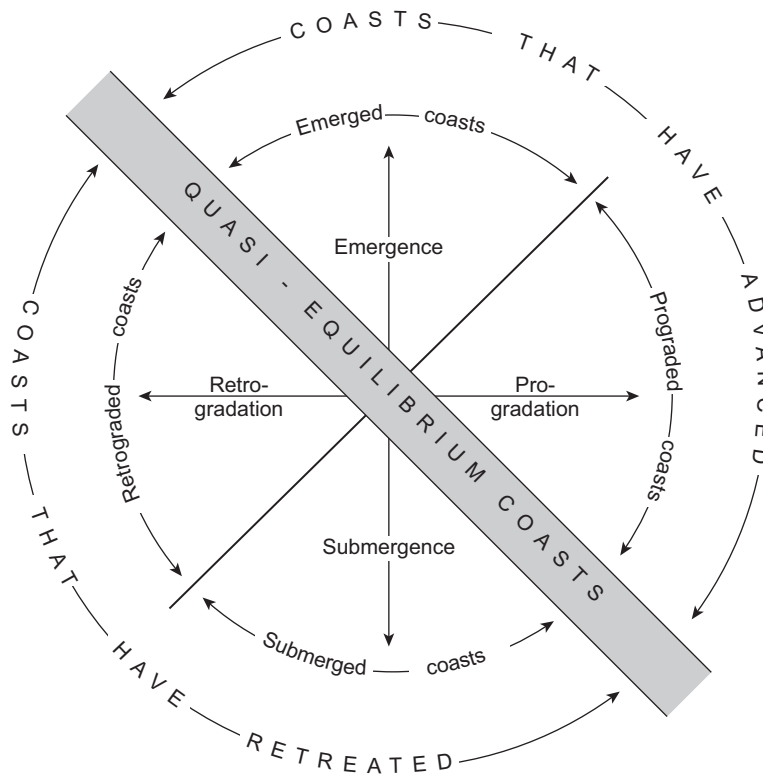
Some of the most dynamic environments on Earth are where the ocean meets the land. The coastal landscape, because it is so dynamic, is capable of very rapid change. It is not unusual, in terms of one person's lifetime, to see many coastal changes in a particular area. Sea cliffs retreat, coastal sand dunes erode, new inlets to barrier islands form, and beaches significantly widen or narrow.

Coastlines of the world may be divided into those that are emerging and those that are experiencing submergence (Fig. 15). Emergent coastlines may be related to active tectonic processes that uplift the land, volcanic eruption that builds new land into what was the sea, and rapid deposition of sediment that allows the land to move seaward, as for example active deposition on a delta. Submergent coastlines may also be related to tectonic processes that cause the land to sink as well as other processes of subsidence, some of which may be human induced. For example, if coastal wetlands are drained, the soils may dry out and compact over time causing subsidence. With the loss of coastal wetlands, the land loses an important buffer to coastal erosion. Fresh and saltwater marshes buffer the impact of water and waves further inland.

From an environmental perspective, the biggest concern in coastal areas today is coastal erosion. Coastal erosion is a world-wide problem today for several reasons, including that sea-level is rising in response to global warming. Most of the rise is a result of thermal expansion of warming oceans, but melting of glacial ice also contributes water to the ocean basins. It seems apparent that some low-lying islands in coming decades may completely disappear as the sea-level rises and inundates them from below and all sides.

A major environmental question is how are we going to respond to coastal erosion that is bound to increase in both magnitude and intensity in the future. Several options are available to try to minimize coastal erosion:

- » The so-called hard solution, which involves building structures such as seawalls
- » The soft approach, which involves a plan to retreat from erosion or nourishing beaches with sand
- » Some combination of the hard and soft approach depending on specific conditions.



**Figure 15** Genetic classification of Coastlines. Coasts are categorized along two axes from emerged to submerged, and from prograded to retrograded. (After Valentin, 1970. Paper read at the Symposium of the IGO Commission on Coastal Geomorphology: Moscow)

What solutions we apply to a particular erosion problem will in part reflect our values. For example, when we build a sea wall, the beach generally narrows over a period of decades and there is also a loss of biodiversity of coastal ecosystems. This must be balanced at a particular site with what structures and infrastructure must be protected from erosional processes. In order to make decisions concerning future coastal erosion, it is necessary to recognize some general principles.

- » Coastal erosion is a natural process. Problems occur when we build too close to the active coastal area where erosion is more likely to occur. It is recognized that erosion is naturally occurring on most coastlines and so we need to encourage human activities that are more compatible with expected changes. Some of these activities may include recreation in coastal parks rather than building homes right on frontal sand dunes or coastal bluffs.
- » We need to recognize that when we choose a hard control structure to minimize erosion, we will cause changes to the coastal environment. When we interfere with coastal processes, then

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- we can expect other changes to also occur. For example, if we interfere with the flow of sand along a coast, then erosion is likely to occur in the direction the sand was initially moving.
- » When we choose to protect the coastline from erosion through building engineering structures, we admit that what we are doing is protecting the development, not the beach. These structures are often built to protect the property of a few people, often at the expense of the public at large.
  - » Engineering structures such as sea walls that are designed to control erosion may in fact eventually damage a beach. A series of hard structures to protect coastline will eventually produce a coast that scarcely resembles a natural environment.
  - » Coastal engineering and building of walls and other structures to retard erosion sets in force a path of development that is difficult if not impossible to reverse. With time, structures may fail and they are generally replaced by larger and more expensive structures. Given enough time, the coast and environment will be irreversibly changed. This may result in loss of natural coastal areas for future generations. There are many opportunities for applying principles of environmental science to coastal problems. Of particular importance is the linkage of physical and biological systems leading to a better understanding of coastal ecosystems and what is necessary for them to be sustainable. For example, we are painfully learning the importance of coastal wetlands to protecting inland areas from wind and waves. Choosing to work with coastal processes rather than against them will result in lower cost and losses in the coastal zone in years ahead.

### **See also:** COASTAL MANAGEMENT

### **Further Reading**

Flanagan, R., 1993. Beaches on the brink. *Earth* 2(6), 24–33.

McDonald, K.A., 1993. A geology professor's fervent battle with coastal developers and residents. *Chronicle of Higher Education*, 40(7), A8–89, A12.

Lipkin, R., 1994. Weather's fury. In *Nature on Rampage*. Smithsonian Institution, Washington, DC, 20–79.

Neal, W.J., Blakeney, W.C., Jr., Pilkey, O.H., Jr. and Pilkey, O.H., 1984. *Living with the South Carolina shore*. Duke University Press, Durham, NC.

Pilkey, O.H. and Dixon, K.L., 1996. *The Corps and the shore*. Island Press, Washington, DC.