Delta

A delta is an accumulation formed by a river at its mouth. The alluvial deposits laid down by the river contribute to generating a delta formation extending over a variable distance into a body of water that may be the sea, a lake, a lagoon, or even another water course. The term delta, derived from the name of the Greek capital letter, in the form of a triangle, appears to have been used for the first time by Herodotus in the 5th century BC to refer to the triangular alluvial plain of the Nile estuary. In English and in French, the word was indeed first of all used as the geographical name of the Nile coastal area, and it was only in the 16th and 19th centuries respectively that it took on its modern meaning referring to the formation resulting from at the mouth of a river.

Like an estuary, a delta is a contact formation between a river and the body of water into which it flows, but while the «estuary» is an open environment where« marine currents» penetrate over some distance, a delta is a sedimentary construction that tends to obstruct the river mouth, as it extends out into the body of water beyond. The scale of the phenomena leading to the filling up of the river mouth, and hence the size and the volume of the delta formation, depends not only on the sediment load of the river (which in turn depends on geographical, climatic, geomorphological and hydrological factors that are specific to the «drainage basin» concerned) but also on the hydrodynamic characteristics of the receiving expanse of water (waves, currents, tides) which result in variations in how well the material carried by the river is dispersed. Because of the very wide variation in the sedimentary loads of rivers, and in the efficacy of the dispersing agents, it can easily be seen that deltas vary greatly in size, with the smallest covering very small surface areas, while the largest delta in the world, that of the Ganges-Brahmaputra, covers more than 90 000 square kilometres.

The morphology of deltas is also very variable, and mainly depends on the type of hydrodynamic agents liable to disperse sediments at the river mouth. Generally, three main type of delta are distinguished, depending on whether it is fluvial elements, waves or tidal currents that are predominant. River-dominated deltas are the commonest, with their branched, fan-like form, occurring when rectilinear channels flowing towards the river mouth divide over time into new channels as a result of the mouth bars forming at the coast. These deltas, of which the most representative example is the Mississippi, form when the fluvial agents responsible for the transport of sediment have the upper hand over over dispersing agents in the receiving body of water. Wave-dominated deltas are the result of wave action, which reshapes the river mouth bars and redistributes sediment along the coastline, forming beaches, spits or coastal bars. These deltas have a massive morphology, with convex protrusions into the receiving body of water, as is the case for the Rhone delta or the Sao Francisco delta in Brazil. With tide-dominated deltas, the sediments are redistributed in sand bars and ridges parallel to the rising and falling tidal currents, forming, in the case of the large deltas, alluvial islands that can be several kilometres long. Among the most characteristic examples of tide-dominated formations are the Ganges-Brahmaputra delta or the River Fly delta in New Guinea.

Whatever the morphological type, all deltas have parts that are submerged and parts that are emergent land. The emergent part of the delta is the delta plain, an expanse of land that is virtually flat and very low-lying, cut across by channels of varying density according to climate and the type of delta. The deposit of alluvium leads to the formation of ridges along the banks, and a filling-up if the river bed, which can favour flooding during river spates. This results in changes in course, which may become permanent and lead to the formation of a new, active delta formation, while other areas in the delta plain become inactive and subject to erosion for lack of sedimentary deposit. This occurred, for instance, in the course of recent millennia, in the Mississippi or Danube deltas. While the section upstream of the delta plain is only subjected to fluvial processes, the downstream part extending to the outer delta front, also undergoes the effect of the tides, at least to some extent. Certain authors therefore consider that the delta margin, forming the transition zone with the submerged part of the delta, should be distinguished from the rest of the delta plain. The submerged part of the delta includes the delta front or foreset bed, a fairly shallow part where the river currents deposit the coarsest part of their load, and the bottomset beds where much finer sediments suspended in the water accumulate. The sub-aquatic part of the delta can be enormous, greatly exceeding the size of the delta plain, as in the case of the Amazon delta, which is mainly sub-marine, and covers a surface area of 470 000 square kilometres.

Deltas are areas of very marked biological production, generally favourable to agriculture. Thus humans have long been settled in these spaces, some of which are among the most densely populated areas in the world (1000 to 2000 inhabitants /km2 in south-east Asia or the Indian sub-continent). The "anthropisation" of deltas is therefore often a long-standing feature, and at the outset generally consisted in bringing these spaces under cultivation and protecting them from flooding. The exploitation and development of deltas accelerated in the 19th and above all the 20th century (construction of hydro-electric dams, dredging and gravel extraction in channels or on shores, dyke construction etc.). These different actions have resulted in a decrease in the sedimentary load, which has caused or aggravated the phenomenon of receding coastlines. Certain deltas have considerable fossil fuel deposits (Mississippi,

Niger, Mackenzie) and gas and petroleum extraction can cause subsidence. Because they are very flat areas (nine tenths of Bangladesh lies under an altitude of 30 metres) deltas are highly exposed to flooding, whether from the river or from the sea. Their very low altitude above sea level, their natural tendency to subsidence, and the considerable amounts of accumulated sediments also mean that they are areas that are threatened by the present rise in sea levels.

Bibliographie

-VERGER F., 1991. Les deltas et leur aménagement, Annales de géographie, n°561-562, p. 730-769.
-SYVITSKI, J.P.M., 2008. Deltas at risk, Sustainability Science, 3, p. 23-32.

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