

Rebuilding natural coastlines after sediment mining: the example of the Brittany coasts (English Channel and Atlantic Ocean).

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A large part of the coasts of Brittany (western France) have been very heavily impacted by sand mining for the building of military equipments and of a large tidal power station. In some places more than 90 % of the sediment has been extracted during the late 40ies up to the 60ies. The mined sites were all sink sites, where sediment had been accumulating for centuries. After the sand and or gravel extraction was stopped the coastal sites were largely used for tourism and most of the eroded dune fields were turned into car parks. Storms produced large floods inland as most of the gravel or sand barrier didn't exist any more. Some local outcrops of inherited Holocene periglacial material with archaeological remains were eroded, some disappeared. During the 80ies a complete shift in planning policies took place and these sites were progressively changed into nature preserves. The aim was to make them behave in a "natural" way again. The "natural" behaviour was intended in a very precise way: barriers should be able to withstand storms again and to protect inland fields from floods. In order to allow for dune re building wooden fences were erected and marram grass was artificially planted.

As, from a sedimentological point of view, these sites were sink sites, accumulation was rather rapid (up to 0.25m a year behind wooden fences) and new barrier began to build. The only problem is that they did not always build-up exactly in the same place or with the same material. Some parts of the coasts were left "unprotected" by these new barriers, ancient exposed sites became protected. Today the system as a whole may be considered as having been able to reach some level of equilibrium with the average wave conditions. It has been able to construct a real resilience if no intense event takes place.

Though, as the storm frequency and direction has slightly changed the present system is not the equivalent of the former one. In Baie d' Audierne the new barrier is set in the same place but is totally different as it is not any more made of gravel but of sands. In Saint Malo, the new barriers are comprised of sands (as the ancient ones) but are not located in the same places.

There is a site-specific way of reacting to human-related hazards and to organize resilience to natural hazards such as storms. Sedimentological analysis of cores in different sites allows reconstructing the ancient ways to react to storms and to compare it with the present one. Air photos analysis allows to precise the different steps of the re building after the sand and gravel mining ceased. This makes possible to compare the evolution of the sites on the long (centuries) and medium (decades) terms, before and after a drastic human impact. Though the system behaves now in a "natural" way, it must not be forgotten that large parts of the coasts, (especially cliffs carved into soft periglacial material) have irremediably been lost. Eroded sediment may be replaced by new sediment but the stratigraphical and archaeological information that was inside is definitively lost. It means that coast lines must not only be considered as changing dynamic elements with sediment fluxes but should also be thought of as in situ heritage sites with buried scientific data.