

Management of cliffed coasts

The provision of vital geoscience information for planners

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Many areas of the UK coastline are backed by cliffs of sediment or rock that are vulnerable to erosion. The composition and structure of the cliffs clearly influence the rate of erosion, as do other factors particularly wave climate, sea level rise, local water tables and the presence or absence of natural or man-made coastal protection.

We have the capability to prevent cliff erosion through the construction of sea defences, though these are expensive to build and maintain. They include barriers such as sea walls or constructions such as groynes which are designed to create protective beaches by trapping coastal sediments. The effective protection of all cliffs is not a feasible economic option and coastal zone managers need to decide which sections of cliff they should defend or leave susceptible to erosion. Whilst the socio-economic value of vulnerable land is the main consideration, the physical nature of the cliffs, as well as many other environmental factors also need to be reviewed.

The stability of cliffs is governed largely by their lithology, density, structural, hydrogeological and engineering characteristics as well as by their susceptibility to wave attack. The erosion of many hard rock cliffs, such as those of metamorphosed rocks in west Wales, is often imperceptible, even over a century. Softer rocks and sediments, especially those of Quaternary and Tertiary age, are of much greater concern as they erode much more rapidly. However, the rates and mechanisms of erosion are complex and commonly poorly understood. For

instance, coastal landslides, which are often very sudden and dramatically increase the susceptibility of adjacent cliffs to further recession, are commonly triggered from the landward side of the coast. This was well illustrated by the area surrounding Holbeck Hall in Scarborough which failed catastrophically in 1993.

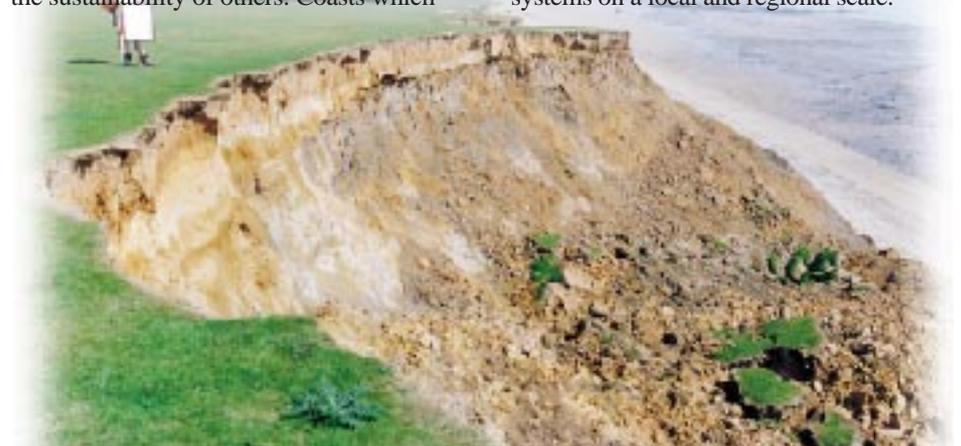
The BGS has been involved in several projects which have increased our understanding of the way in which coastal slopes and cliffs erode, and is currently researching the recession of till cliffs along the Holderness coast, Yorkshire, to determine the relative impact of geological factors which control cliff erosion. Such information will be of value to decision makers in determining sustainable usage of coastal areas.

Apart from understanding how fast, and in what manner cliffs recede, coastal managers need also to consider how erosion of one section of coast impacts on the sustainability of others. Coasts which

lie down-drift from eroding cliffs are commonly protected from erosion by the sediments derived from the cliffs. Hence, the loss of a few metres of sand- or gravel-rich cliff in an area of low value land may be very beneficial if the sediments end up protecting a coastal town or port downdrift. Coastal managers need to be able to predict the likely supply of sediments to the nearshore zone by cliff erosion and determine what proportion of the sediments will effectively defend adjacent coasts following littoral transport.

The BGS has characterised the composition of several sections of UK cliffs for such purposes in a number of projects, including that on the Holderness coast. Another project, undertaken for the Environment Agency, determined the volume of mud, sand and gravel in each section of cliff in East Anglia. This was done by visual inspection and calculation following particle size analysis. For areas and lithologies where this was not possible, for instance where the cliffs were covered by defences, promenades and vegetation, particle size data were extrapolated from adjacent exposures or from the scientific literature. The data collected were entered into the Environment Agency's Anglian Region Shoreline Management System GIS.

Planners are increasingly having to make decisions about sustaining coastal land which is vulnerable to erosion. The resolution of conflicts of interest which arise in these situations can only be made on the basis of a clear understanding of socio-economic values as well as the processes which control cliff erosion and coastal systems on a local and regional scale.



Active cliff erosion, Walton-on-the-Naze, Essex.