Parts of our coastline are eroding at an alarming rate. **Peter Balson** explains how an improved understanding of the processes involved is leading to better management of the problem.

Coastal retreat

Many of the most rapidly retreating sections of Britain's coastline consist of geological formations composed of fine-grained cohesive sediments such as clays and silts. In some places cliffs may be retreating at long-term average rates in excess of two metres per year. These eroding cliffs may play an important role in the local sediment budget, providing large quantities of silt and clay for deposition on tidal flats and salt marshes which form important, and increasingly protected, habitats.

Cliffs represent only the upper part of a cross-shore profile which is retreating landwards. Vertical lowering of the intertidal and subtidal parts of the profile must accompany horizontal retreat if equilibrium is to be maintained. Often the role of the intertidal and subtidal parts of this profile is overlooked in studies of coastal retreat. The focus is often on land and property which is directly threatened by retreat of the cliff top. Mitigation of coastal retreat usually consists of engineered toe protection at the foot of the cliff. Such interventions however do not protect the intertidal and subtidal parts of the profile and can in some cases actually exacerbate erosion of the shore platform below the beach sediments.

When the platform is eroded this leads to a lowering of its elevation and therefore a deepening of the water in front of the shoreline. This allows larger waves and more wave energy to strike the cliffs thus accelerating the rate of retreat. The effects of future climate change, such as increased wave heights or an increase in



Bioerosion of London Clay, Walton-on-the-Naze, Essex.



Till platform at Easington, East Yorkshire.

storminess, may further enhance the rate of retreat.

The beach plays an important role in controlling this process. When erosion rates increase, more sediment is released and the beach volume may be increased, affording additional protection to the cliff toe. Conversely, where cliffs are defended this source of beach material may be cut off and beach volumes decrease. A healthy beach may also serve to protect the platform from erosion. On retreating coastlines where beaches have decreased in volume the platform may become exposed. On some popular tourist beaches the exposure of a muddy platform at times of low water becomes an unwanted side effect of the erosion process.



Glacial erratic boulders on pedestals of till as a result of rapid downcutting of the platform surface at Easington.



London Clay platform at Sheppey, Kent.



Shrink-swell polygons in London Clay.

The erosion of shore platforms is an irreversible process which is strongly linked to the overall retreat of the coastline. Where shore platforms are formed of relatively non-resistant cohesive materials such as clays or silts and lateral retreat is rapid, the rate of downward erosion may be rapid, of the order of tens of centimetres per year. The erosion of the platform is driven by a variety of processes including wave and current action and physical abrasion by mobile beach sediments.

The resistance of the platform to erosion is controlled by the overall geological material strength which in turn is related to its lithology, fabric and post-depositional history. Subaerial processes may also affect the material strength when the platform is exposed at low water; for example from the drying and shrinkage of clay, especially during the summer. Biological activity from boring organisms may also weaken the surface of the platform. Cohesive shore platform erosion can also make a major contribution to local sediment budgets and in some cases is a significant source for adjacent beach sediments.

The BGS has been contributing geological and geotechnical expertise to a project funded by the UK Department of the Environment, Food and Rural Affairs. This project is attempting to determine the key processes, geological constraints and linkages involved in cohesive platform erosion and assess their significance to the understanding of long-term coastal retreat. It would appear that platform lowering may be an important driver for coastal retreat on both cliffed and non-cliffed coastlines. Platform downcutting may be seen as a precursor to cliff instability resulting in episodic retreat of the cliff line.

In most cases it is impracticable to use engineered solutions to arrest or even slow down the process of platform erosion. Beach nourishment, where beach sediment dredged from offshore is pumped onto the existing beach and platform, is seen as the main management technique for protecting the platform from erosion but this is only considered to be economic at a relatively small number of sites.

For further information, contact:

Peter Balson, BGS Keyworth, Tel: +44(0)115 936 3485 e-mail: psba@bgs.ac.uk



The main features of coastal retreat on a cliffed coastline.