

LANDSLIDE MECHANISMS IN THE CLIFFS AROUND SIDMOUTH, DEVON AND THE ROLE OF GROUNDWATER



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Sidmouth seafront is dominated by red cliffs of mid-Triassic sandstones and mudstones. Their continual erosion threatens the coastal footpath and local businesses and property. There are conflicting views on the rate of cliff erosion, but a consensus that this has increased in recent years. The more sensitive area is to the east of the River Sid outfall where failure mechanisms are significantly influenced by rock lithology. Sandstones are broken into blocks through the erosion of sub-horizontal slots and the fragmentation of these competent rocks along faults and joints. Locally perched groundwater within sandstone/siltstone/mudstone sequences leads to increased pore pressure in the mudstones and the development of overhangs which eventually fail. It is suggested that perched groundwater, visible as seepages on the cliff face, is a significant, but previously unrecognised, factor in the erosion of the Sidmouth cliffs.

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INTRODUCTION

Sidmouth, an attractive Georgian seaside town at the mouth of the River Sid, in east Devon, is justly renowned for the red cliffs of Triassic sandstones and mudstones which dominate the coastline. To the west are Peak Hill Cliff (155 m in height) and High Peak (157 m), and to the east Salcombe Hill Cliff (160 m) and Higher Dunscombe Cliff (156 m): see Figures 1 and 2. Over the whole of this section the cliffs are unstable and landslides have been a common hazard. For example, the *Western Morning News* of June 10th 1893 reported on a large fall which had occurred at High Peak, two days earlier. About 100 members of the Sidmouth Branch of the Church of England Temperance Society were holding an open-air meeting nearby at the time. There was a rumbling noise, resembling an express train at full speed, followed by a loud crash, which startled those present and must have left them wondering what message their maker was trying to send them! The noise of falling rock continued for some ten minutes and coloured the sea red for 2 miles (3.2 km) out from the coast. Such a cliff fall was locally called a rusement (Butler, 2010), derived from the verb ruse, rooze or rowse, meaning to fall or slide down. According to Hutchinson (1893) the fall mirrored a previous one, which had taken place in 1875, and such falls continue to occur.

Cliff erosion is significant to Sidmouth residents because of the continuing destruction of the coastal footpath and the threat to businesses and property in the town. This threat is particularly acute immediately east of the mouth of the River Sid where the promontory, known as Pennington Point has been eroded back, so that little remains. The footbridge over the River at this point has already been severely damaged and it is a question of 'when' it will be destroyed, rather than 'if'.

There are conflicting views on the rate of cliff erosion and how this has varied over the past 200 years. In 1882, at its meeting in Southampton, the *British Association for the Advancement of Science* set up a committee to inquire into the *Rate of Erosion of the Sea-Coasts of England and Wales and the influence of the artificial abstraction of shingle and other material in that action*. A questionnaire was circulated and was completed for Sidmouth by local resident and amateur geologist Peter Orlando Hutchinson (1810–1897). He estimated an erosion rate of an inch (0.025 m) a year for the previous 50 years, whilst acknowledging that there were softer places where erosion rates were twice or three times this and harder places where rates were not half as much (Hutchinson, 1886; Mather and Symes, 2006). More recent studies by consultants are summarised by Gallois (2011). These show wide variations in the estimated rate of erosion but there seems to be a consensus that rates have increased during recent years with erosion rates of between 1 and 2 m per year at Pennington Point and the cliffs over a distance of 300 m to the east. However, an analysis of topographic maps by Gallois (2011) suggested that this was an over-estimate and that in the 70 years prior to 2006 the erosion rate over this stretch of coast was about 0.2 m per year. Personal observations over the last 4 to 5 years, immediately east of the River Sid outfall, show that there are continual small-volume falls from the cliff, resulting in local retreat of the cliff top by up to 2 m in any one year with a probable average erosion rate between 0.5 and 1 m per year.

The increase in the rate of erosion has been blamed on civil engineering works carried out in the nineteenth and twentieth centuries to protect a gravel storm-ridge that acts as a natural sea defence. Although these works have been effective in