Moston Long Flash

[SJ 719 620]

Highlights

Moston Long Flash is a lake lying in one of a pair of well developed linear subsidence depressions above the Triassic salt beds of Cheshire. These are two of the clearest examples of this landform, which characterizes the Cheshire salt karst, and they are still deepening by active subsidence.

Introduction

The lake of Moston Long Flash lies on the Cheshire Plain 4 km south of Middlewich (Figure 1.2), at a site underlain by the Triassic salt beds. Natural subsidence features on the salt include linear depressions a few metres deep and several kilometres long, cutting across both hills and valleys, and also broader areas of ground lowering. Moston Long Flash is an example of an actively subsiding linear depression; initially its development was slow and natural, but accelerated greatly within the last 70 years as a result of brine abstraction. The salt beds of the Cheshire basin have been extracted since the Middle Ages, both by mining and by brine pumping.

The geology of the Cheshire basin salt deposits is outlined by Evans *et al.* (1968) and Earp and Taylor (1986). The subsidence features of the Cheshire basin were described by Calvert (1915), Wallwork (1956, 1960) and Waltham (1989), while the specific processes behind the subsidence at Moston Long Flash were examined by Oates (1981).

Description

Moston Long Flash is developed on over 20 m of permeable glacial till and glaciofluvial drift, of Devensian age. The underlying Triassic Mercia Mudstone sequence includes the Wilkesley Halite, which is a formation over 100 m thick consisting of alternating beds of mudstone and halite: individual beds of almost pure halite are 0.5–20 m thick, and the whole formation contains about 50% soluble salt.

The flashes of the Cheshire karst are lakes which form rapidly in depressions which subside below the water table due to subsurface salt solution. Moston Long Flash is a recently formed lake within an active linear subsidence (Figure 7.16). The whole subsidence landform extends for over 3 km, and is about 200 m wide and 3–10 m deep. Its gently curving cross-profile, remarkably uniform along its length, is asymmetric; a gently graded slope lies opposite a steeper bank which is often scored by a series of small slip scars as the depression subsides and enlarges in its direction. Some parts of the linear subsidence feature have the topographic appearance of a valley, but it is totally independent of the valleys of the area which have been formed by surface water erosion since the Devensian.

Subsidence has persisted over the last 70 years, often at rates in excess of 77 mm year^{-1} (Waltham, 1989); this was measured at a reference post on the edge of the depression, and subsidence rates were certainly higher in the centre of the flash. The lake first appeared in the 1920s, expanded first to the south and then extended to the north. Active subsidence continues to affect the adjacent farmland and farm buildings, and is clearly demonstrated by the repeated repairs to the road which crosses the flash (Figure 7.17). A second linear subsidence feature lies north-east of, and almost parallel to, the flash. It is smaller, less active and contains only a few small ponds where it crosses shallow valleys on the drift terrain. Subsidence rates in both features greatly reduced when brine abstraction stopped in 1978, but slow movement does continue today.

Interpretation

Where halite beds reach rockhead, the exposed salt is dissolved by groundwater flow at the base of the drift cover. The remaining insoluble mud-stone beds collapse to create a permeable breccia zone, which may deepen to reach a thickness of over 50 m (Figure 7.18). Groundwater flows through the breccia, as a layer of saturated brine in contact with the halite, along the buried surface locally known as the wet rockhead. Solution is negligible where the impermeable halite is buried beneath impermeable mudstone, at the contact misleadingly known as the 'dry rockhead'. The brine is overlain by fresh water of lower density, and continued solution is dependent on an inflow of fresh water reaching the halite, usually after the brine has flowed out to natural brine springs or has been artificially pumped out (Calvert, 1915; Waltham, 1989).

The commonest type of subsidence feature is the linear trough of which Moston Long Flash is the prime example. These depressions are formed where solution of the underlying salt beds has been accentuated along zones of concentrated groundwater flow, locally known as brine streams, at the rockhead interface of the halite and breccia, usually 50–120 m below the surface. Slow natural subsidence does occur along these brine streams; but this is greatly accelerated where the saturated brine is artificially abstracted, so that unsaturated groundwater flows into contact with the halite. Wild brining is the process of pumping from bore-holes sunk into the natural underground brine streams, and one of their effects has been that Cheshire's brine springs have all ceased to flow.

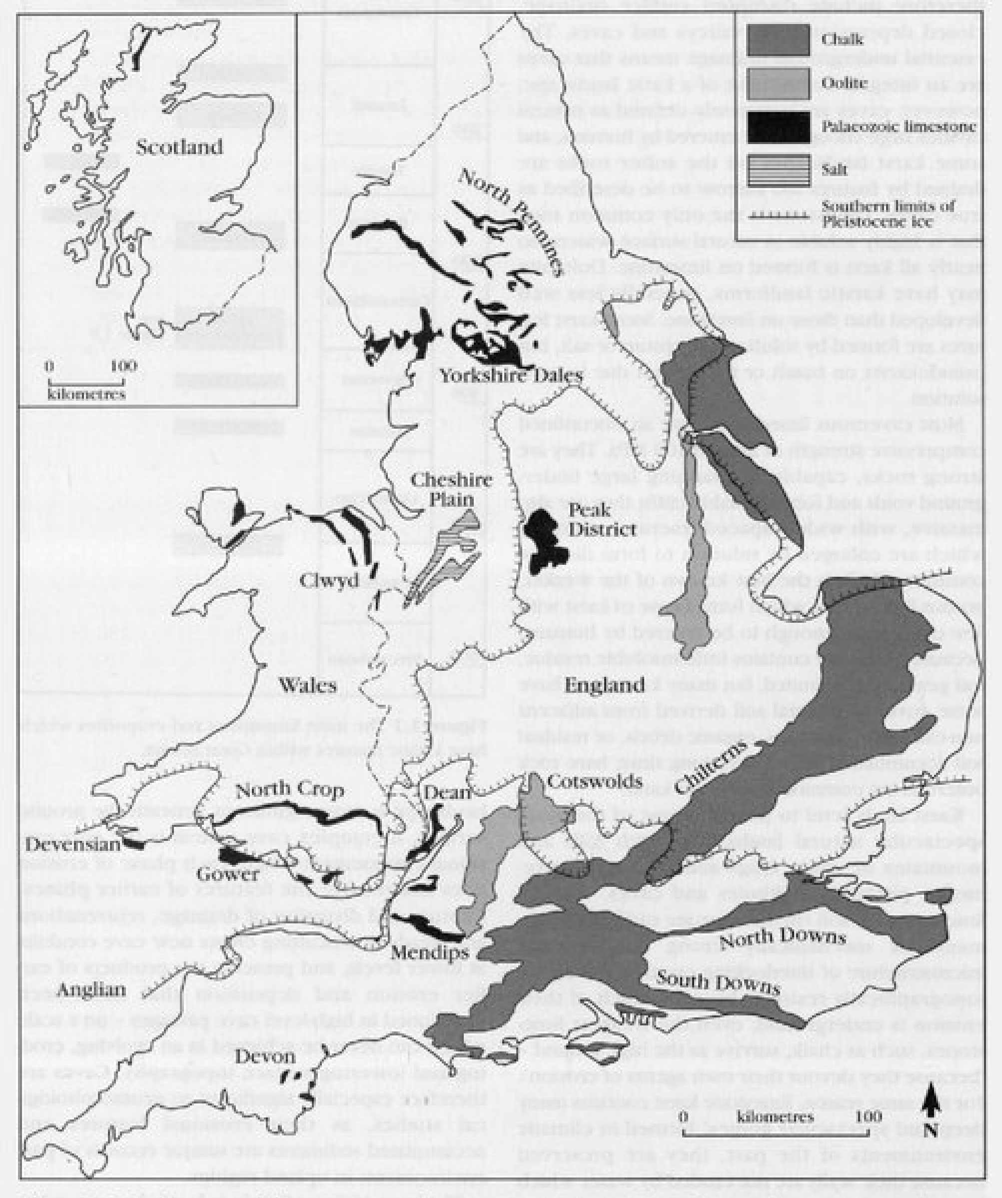
By correlation of the increasing volume of the subsiding depression with the volumes of pumped brine at nearby wells, Oates (1981) showed that the recent rapid subsidence of Moston Long Flash was due largely to brine pumping at a well 2 km to the north (Figure 7.16), and that the subsidence lagged about a year behind the pumping. The pumping draws fresh groundwater laterally through the surface drift and breccia, and solution and subsidence occur where it first meets the halite, far from the abstraction borehole. Saturated flow in a brine stream causes no subsidence. The linear subsidences are broadly aligned with the regional groundwater flow, but most appear to be located over the rockhead outcrops of individual beds of pure salt or along fracture zones. Moston Long Flash appears to follow the bedding until its brine stream turns parallel to a fault. The Elton Flashes are in areal subsidences, which are broad, less well defined depressions formed where fresh water is drawn into contact with the halite rock-head beneath surface streams and valleys (Figure 7.16).

The linear subsidence containing Moston Long Flash is almost certainly post-Devensian, formed after the salt rockhead was scoured by ice and then blanketed with drift. Subsidence has accelerated since the Middle Ages, and especially over the last 70 years, as a result of brine abstraction.

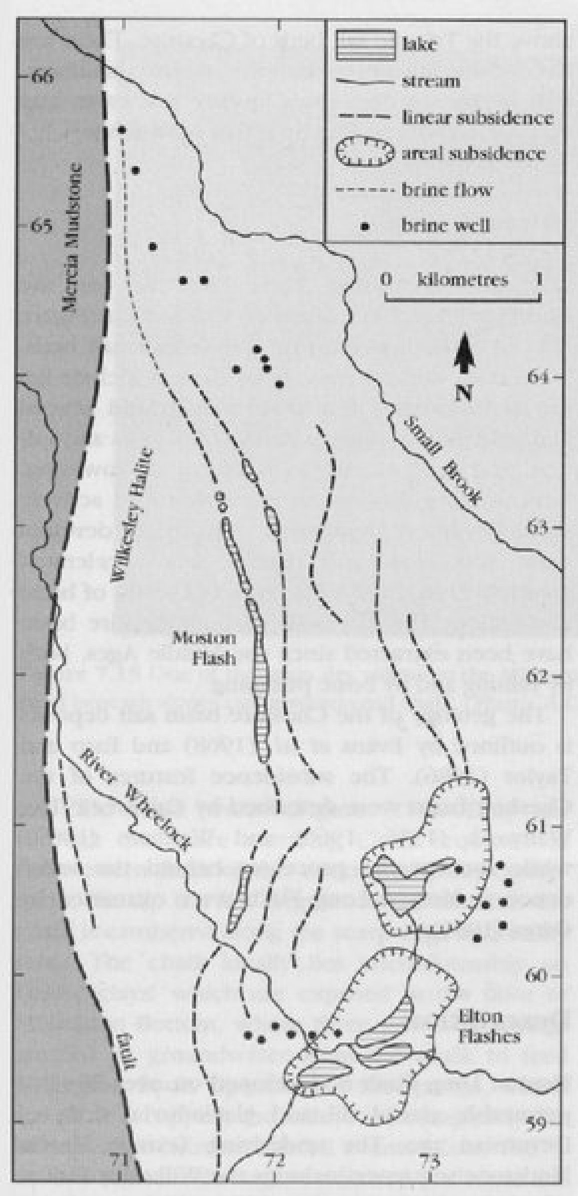
Conclusions

The active linear subsidences of Moston Long Flash and its smaller neighbour are excellent examples of the landforms developed by solution of underlying salt beds; they are characteristic of the Cheshire salt karst. Both features are clearly identifiable, and Moston is the largest active flash in the Cheshire Plain.

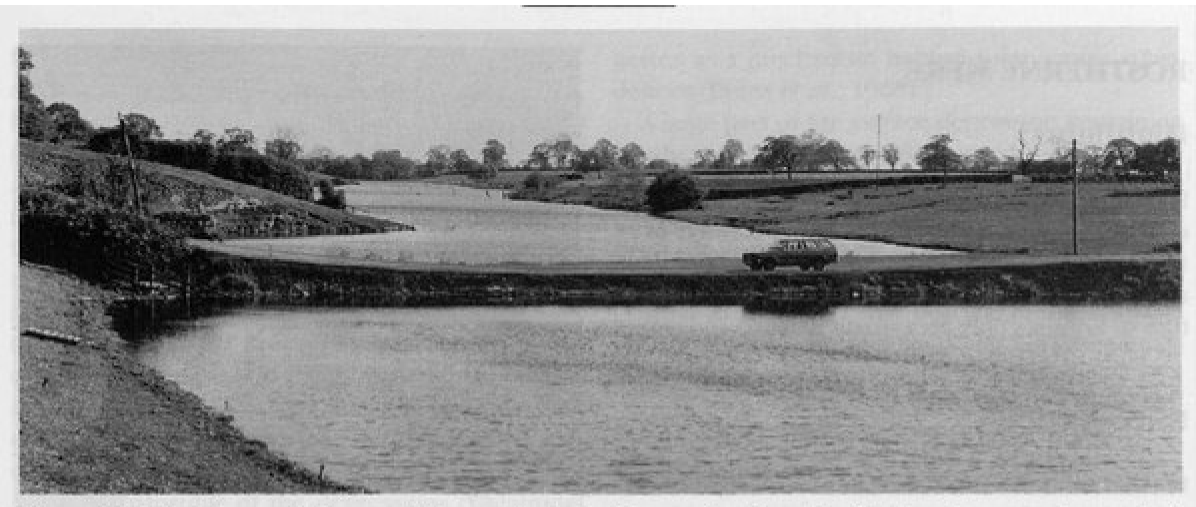
References



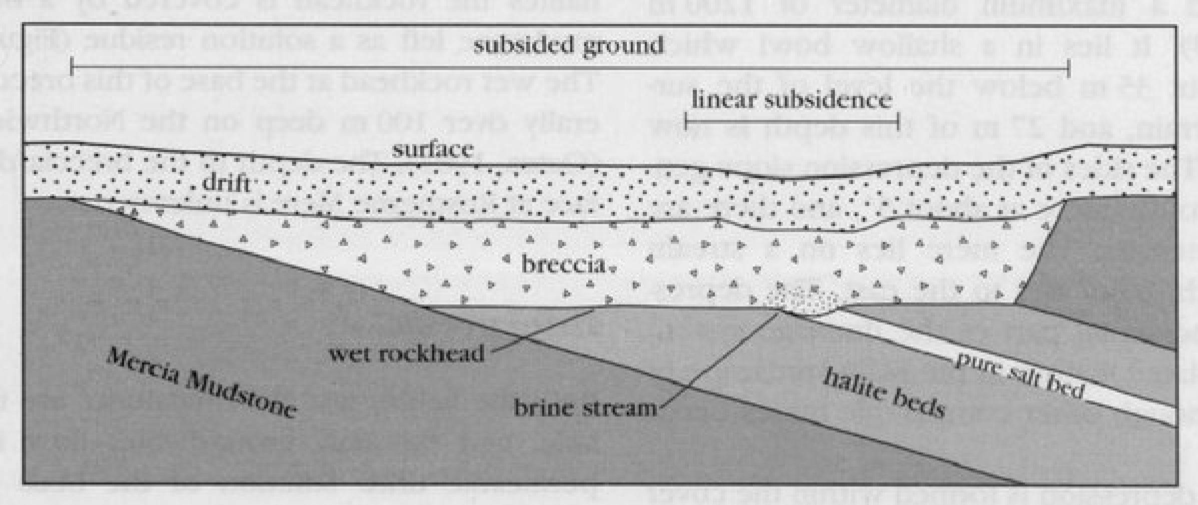
(Figure 1.2) Outline map of the main areas of karst in Great Britain. The Palaeozoic limestones are of Lower Carboniferous age, except for the Devonian limestone in Devon, and the Cambrian–Ordovician limestone in Scotland.



(Figure 7.16) Outline map of Moston Flash and the adjacent linear and areal subsidences formed over the Wylkesley Halite. There is no solid outcrop as the entire area is covered by about 20 m of glacial till and glaciofluvial gravels. All the brine wells have now ceased pumping (after Oates, 1981, and Waltham, 1989).



(Figure 7.17) The linear subsidence of Moston Flash, looking south where the left face is steeper because it is retreating in the direction of dip as the depression enlarges. (Photo: A.C. Waltham.)



(Figure 7.18) Diagrammatic section through the breccia of solutional residue at the rockhead in salt karst, with a brine stream flowing beneath an active linear subsidence like Moston Long Flash (from Waltham, 1989).