Green Lane Pits

[SK 165 626]

Highlights

The Green Lane Pits are four collapse dolines which were infilled with Pliocene, or very late Miocene, sands. These large-scale Tertiary karst features are unique to Derbyshire, and the Green Lane Pits are notable as they admirably show the geomorphology of the depressions. The deposits are of major importance in elucidating the Tertiary history of the area.

Introduction

Over 60 solution collapse dolines occur across the southern end of the Derbyshire limestone plateau. Many of these contained sediments of the Tertiary Brassington Formation, and have been worked for the manufacture of refractory bricks. The quarrying of the sand has revealed the limestone morphology of these dolines (Figure 4.14). The Green Lane Pits are notable in that the rock walls may now be seen with uncommon clarity, and little backfilling has taken place. The dolines all occur in dolomitized Carboniferous limestone, and are infilled with clays, sands and gravels from a fluvial depositional environment. These deposits have been preserved because solution of the underlying limestone caused collapses, into which the sediments sagged or slumped.

The dolines and their deposits are of major importance in elucidating the Tertiary history of upland Britain, and also provide evidence of the scale of Pliocene uplift in the southern Pennines. The 'Pocket Deposits' (Howe, 1897) were worked at least as early as the eighteenth century (Pilkington, 1789). They were once considered to be Triassic palaeokarstic features (Kent, 1957), but more recent studies have revealed the true nature of the deposits (Ford and King, 1969; Boulter, 1971; Boulter *et al.,* 1971; Walsh *et al.,* 1972, 1980; Wilson, 1979; Ford, 1984). The earlier work is reviewed by Ford (1977a).

Description

The four dolines at Green Lane, in the centre of the Peak District karst (Figure 4.1), have had most of their sand infillings removed by commercial operations. All lie in dolomitized facies of the Carboniferous limestone, at an altitude of 335 m, adjacent to the floor of a dry valley which feeds into Long Dale. The southern doline is a circular pit 90 m across and 25 m deep, with almost vertical sides in limestone. The largest of the northern dolines is elliptical in plan, over 150 m long and 12 m deep; the two smaller dolines adjacent to it are also about 12 m deep. All four dolines have been almost totally excavated, to reveal rock walls, with rock saddles and pinnacles exposed between them (Figure 4.14). Some of the original Tertiary sands and the overlying Quaternary loess deposits remain preserved in the walls of the southern doline and along the margins of the northern dolines. The floors of the dolines are now obscured by vegetation, tyre dumps or slumped sediment.

Boulter *et al.* (1971) examined the Tertiary deposits preserved in the solution hollows of south Derbyshire and termed them the Brassington Formation. This was subdivided into three members:

Kenslow Member	plant-bearing clays	c. 6 m
Bees Nest Member	coloured clays	c. 7 m
Kirkham Member	sand and gravel	c. 30 m

The Kirkham Member consists largely of white, fluvial, cross-bedded sands with many quartzite pebbles, reworked from the conglomerates of the Triassic Sherwood Sandstone Group (formerly known as the Bunter Pebble Beds). The Bees Nest Member is dominated by red, yellow and white clays, and the Kenslow Member is mainly grey clays, with abundant fossil plant debris. The sediments are generally folded into small synclines, as a result of sagging into the collapsing

dolines in the limestone. Commonly these fluvial deposits are underlain by remnants of the Namurian Edale shales and up to 5 m of angular chert gravels, derived from solution of the chert-rich limestones. Parts of the Brassington Formation are present in at least 60 of the limestone depressions, but there is no complete sequence in the Green Lane Pits. A small thickness of glacial till covers the Pliocene sands in some of the Brassington pits, and this shows evidence of sagging through continued subsurface solution.

Interpretation

The doline deposits were long regarded as features of a fossil karst surface with Triassic sands unconformably overlain by Tertiary clays (Kent, 1957), until Ford and King (1969) recognized that the Kirkham Member was a Tertiary deposit derived from Triassic conglomerates. The stratigraphy and paleobotany of the deposits were examined by Boulter (1971) and Boulter *et al.* (1971), who recorded 60 species of plant from the Kenslow Member, including *Sphagnum* and logs of *Sequoia;* they inferred an early Pliocene environment of a sandy heathland with scattered ponds.

The implications of the doline deposits for the paleogeographic history of upland Britain were recognized by Walsh *et al.* (1972), who regarded the subsidence outliers as small relics of a once continuous sheet of sands and clays. They calculated that subsidence of the Brassington Formation into collapse dolines, such as those at Green Lane, was in the order of 200 m. This indicated that the highest beds of the Brassington Formation were deposited at an altitude around 460 m. Thus the limestone block has been uplifted, during the Pliocene, by up to 250 m relative to the Triassic source areas at elevations around 240 m to the south; the uplift was probably much less than 250 m as the source could have been Triassic rocks once overlapped onto higher parts of the limestone upland. Paleocurrent structures in the Kirkham Member confirm the southerly provenance of the sands (Walsh *et al.,* 1980), while SEM analysis of the quartz grains suggested a short distance, low-energy fluvial regime with little chemical weathering (Wilson, 1979).

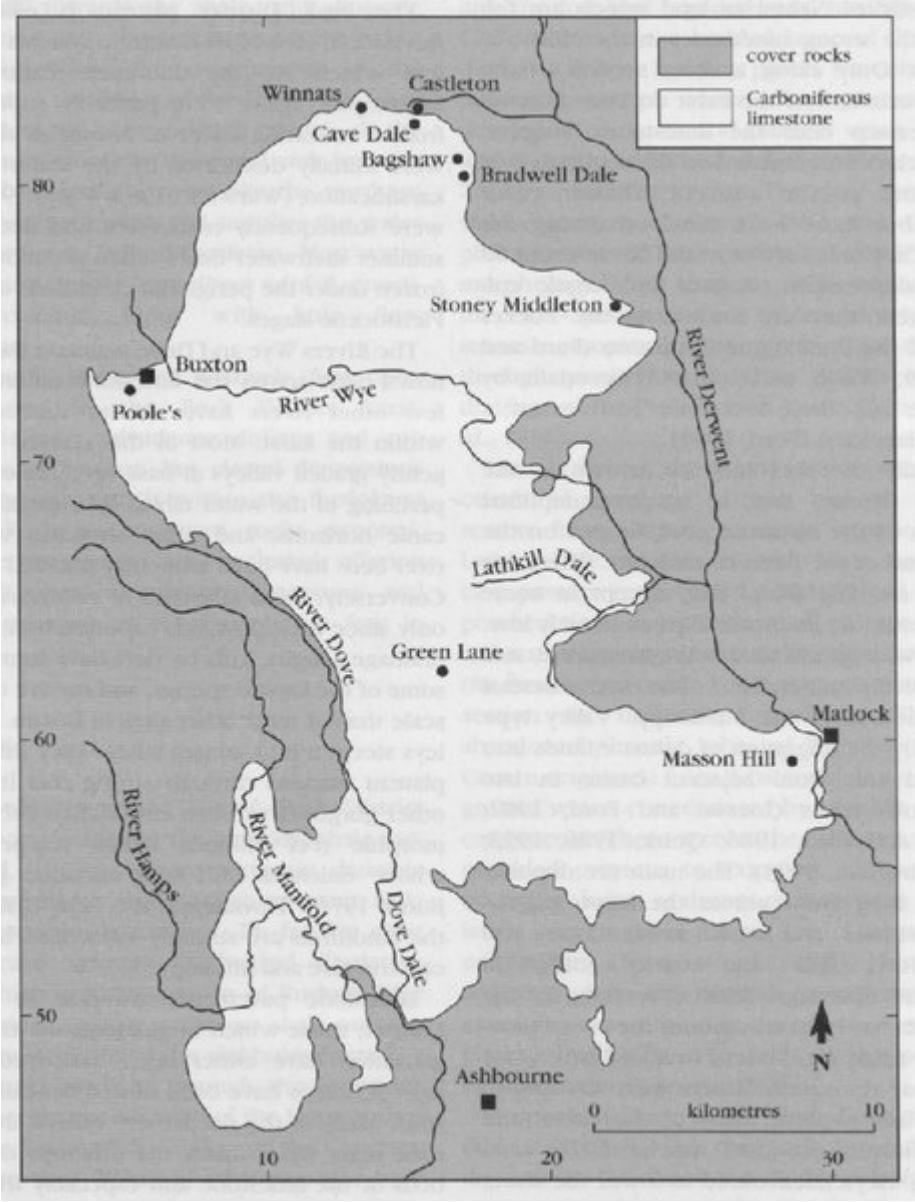
The synclinal bedding in the sediments preserved in the Green Lane Pits indicates that most of the limestone solution was underground, and was followed by progressive collapse and upward stoping of the voids (Figure 4.15). The Neogene sediments subsided into the dolines when the cavity roofs finally failed and dropped onto the accumulated piles of fallen debris. At some sites, they were later covered by glacial till which has been slightly disturbed by subsidence, indicating continued solution at depth. The collapse must postdate the initiation of a major karst drainage system, which produced the solution cavities. This was probably initiated following the incision of a major valley which provided the hydraulic head needed to start underground circulation. The dolines at Green Lane admirably show the nature of the solution during late Tertiary times.

Conclusions

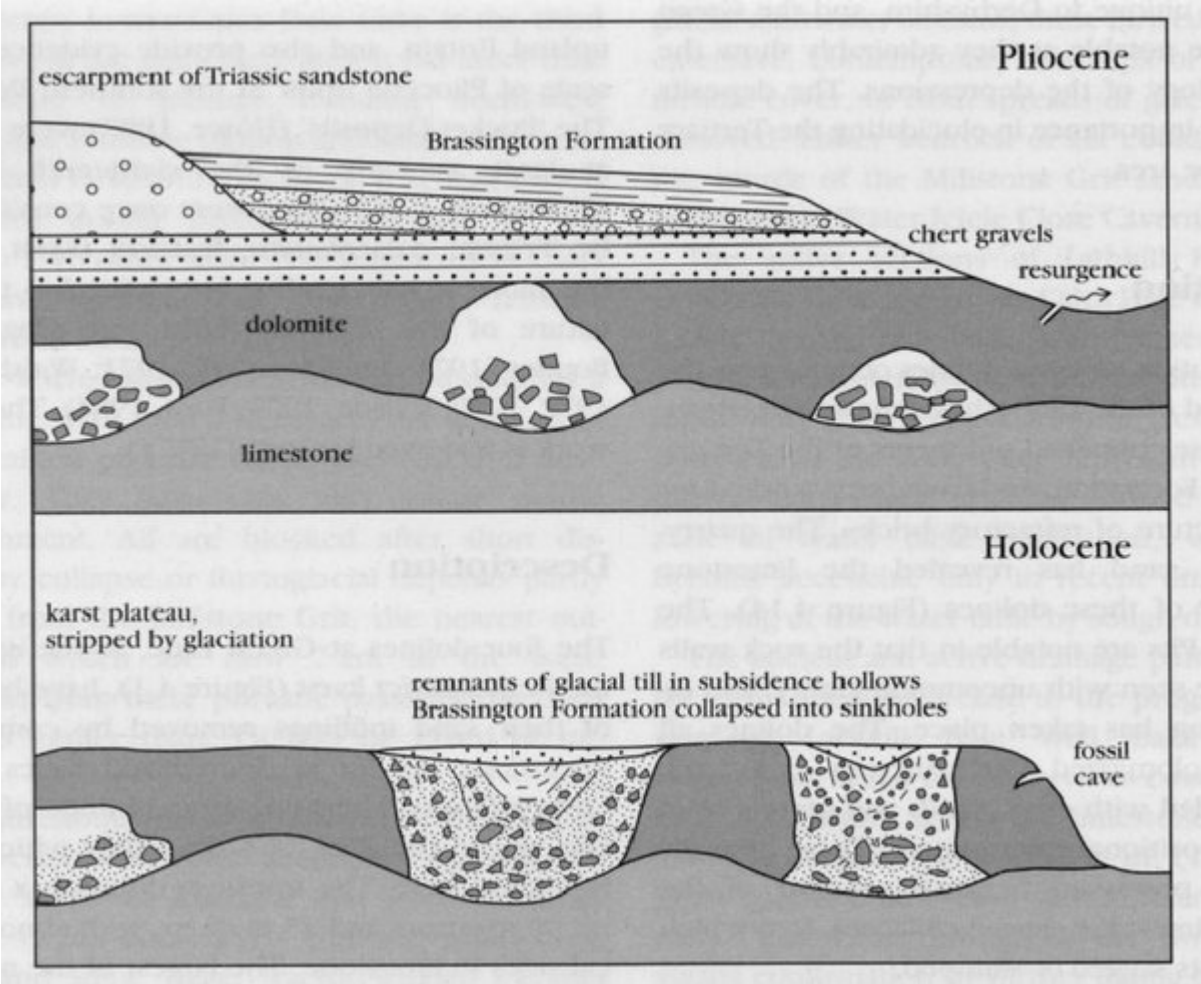
The dolines exposed in the Green Lane Pits show the limestone morphology better than any other similar feature in Derbyshire. They provide an excellent example of this type of large-scale Tertiary solution and collapse feature. The sediments preserved in the dolines, and in 60 other similar pocket deposits, represent an important component in the Tertiary geomorphic evolution of Derbyshire. They provide evidence of Pliocene rivers draining a receding Triassic scarp in the south, and indicate that the limestone block has subsequently undergone perhaps as much as 250 m of relative uplift.

References

(Figure 4.14) Limestone walls and some remnants of the Pliocene sediment fill left after quarrying of the northwestern of the Green Lane Pits. (Photo: T.D. Ford.)



(Figure 4.1) Outline map of the Peak District karst, with locations referred to in the text. The cover rocks are Namurian shales and sandstones, and younger stratigraphic units.



(Figure 4.15) Diagrammatic sections of two stages in the formation of the Brassington Formation and their preservation in the collapse dolines in the limestone (after Ford, 1984).