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A reconsideration of the origin of the early Pleistocene 'Pebble Gravel Formation' at Nettlebed, Oxfordshire, south central England

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ABSTRACT

It is proposed that the meagre 'Nettlebed Gravel' does not merit its designation as the earliest sedimentary archive of the River Thames, nor is it a degraded river terrace. Rather the character of the gravel supports a derivation by slope processes with a quartz/quartzite component primarily sourced by the underlying Palaeogene Reading Formation. The associated Priest's Hill pollen bearing sediments are probably the infill of either a local palaeochannel or a doline. Although the 'Nettlebedian Interglacial' is likely to be early-middle Pleistocene in age, it bears no direct relationship to the Thames fluvial chronology. As a consequence any marine oxygen isotope stage assignment is unrealistic.

1. Introduction

Nettlebed village lies on the dip slope of the western part of the Chiltern Hills some 2 km southeast of the main Chalk escarpment crest (Fig. 1). In the landscape it occupies the southern sector of a positive relief feature c 1 km in diameter and the summit, Windmill Hill (SU 703872) at 212 m OD, is the highest point in the vicinity. Formerly the hill was a popular viewpoint but is now inaccessible due to the construction of a palisade around a covered water reservoir and tree growth has much reduced visibility. Some 300 m southwest of the main hill is a subsidiary low hillock called Priest's Hill (SU 701872).

The solid geology of the immediate area comprises a lower Tertiary outlier, with Reading Formation (Lambeth Group) capped by London Clay Formation lying unconformably on the Chalk beneath (Fig. 2). From at least the 14th century, the clays and sands forming the outlier supported an industrial complex undertaking the manufacture of tiles, bricks and pottery, although this activity finally ceased in the early 20th century. An iconic brick kiln has been preserved, Fig. 3. The area surrounding Windmill Hill is now a relict mining landscape consisting of several old works and many abandoned quarries with areas of both highly disturbed and made ground. The outlines of some of the former clay quarry faces are still discernible although tree colonisation has lessened their visual impact. The history of Nettlebed brick making has been reconstructed by Bond et al. (1980) and the potteries by Stebbing et al. (1980). As was usual practice with Chiltern brick manufacture where chalk often formed some 20% of the blended raw material, allied underground chalk mining was undertaken and a Geologists' Association visit to one of the Nettlebed mines used 'candles and magnesium strips' for lighting (Blake, 1891). Strangely the presence of these chalk mines appears to have escaped the attention of industrial historians although a reminder came in January 2014 when following a period of heavy rain, a crown collapse failure suddenly occurred (SU 70458685). Nearby an area of complex depressions probably marks earlier collapses into former mine galleries and also natural dolines (SU 70488705).

There are two kinds of superficial deposit on the outlier per se, both very poorly exposed. First, an apron of head surrounding the Reading Formation core and secondly, scattered small patches of thin clay-rich gravel. This gravel – the Nettlebed Gravel – has great significance for Quaternary geology, since Bridgland (1994), in a highlight statement written for site selection justification purposes, considered it to be 'the earliest true Thames gravel, derived through an early Goring Gap'. Two years later, the British Geological Survey's Thames Valley handbook stated 'At Nettlebed, high on the Chilterns, a small outcrop of flint-rich gravel is thought to be the oldest surviving deposits of the River Thames' (Sumbler, 1996) p115. In a similar vein, Catt and Cheshire (2010) considered the Nettlebed Gravel to be 'the highest and therefore oldest knownThames gravel

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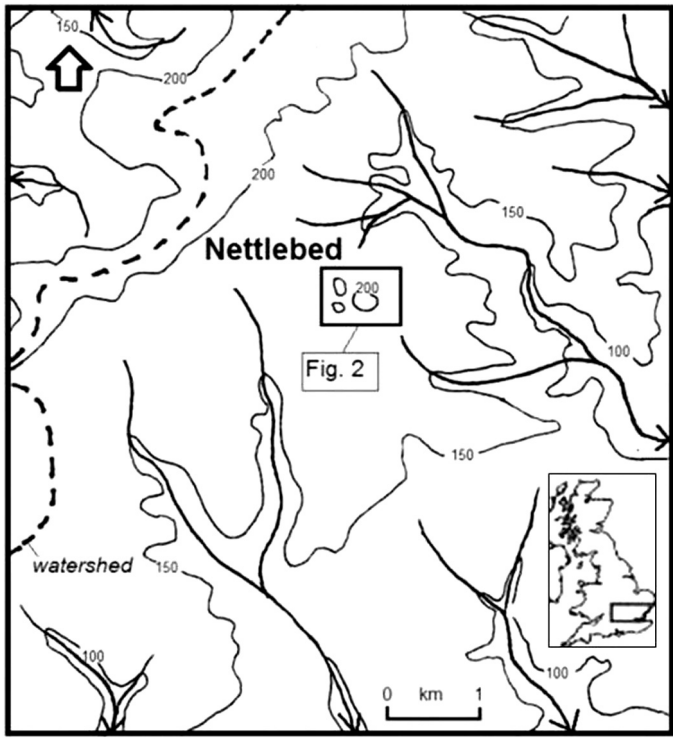

Fig. 1. A sketch map showing the topographic position of Nettlebed on the Chiltern dip slope just southeast of the main watershed and allied escarpment. Note the dry valley network.

aggradation'. Given that the middle-lower Thames valley is regarded as having the longest terrestrial sedimentary record in the British Quaternary, its status can be readily appreciated. The modern Thames channel is located c 10 km to the southwest at an elevation some 150 m lower than modern Nettlebed.

This paper arose from field work prior to an 'Anatomy of an outlier' demonstration to the Reading Geological Society in November 2013. During this process, an ancestral Thames interpretation for the Nettlebed surficial deposits became increasingly unconvincing, whereas a more plausible explanation appeared to be their derivation from the Reading Formation, probably in conjunction with subsidence related to chalk dissolution. This latter scenario was later found to have been first been

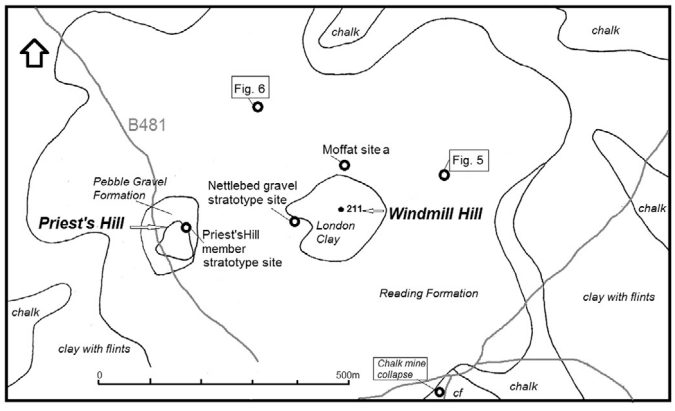

Fig. 2. Geological map of the Nettlebed outlier (adapted from British Geological Survey mapping). The map also shows the positions of the two stratotype sites and the clast sampling locations of Gibbard, Horton and Moffat. The Priest's Hill 'Pebble Gravel' outcrop as mapped by Blake is shown and inside this is the smaller area of 'Sand and Gravel of Unknown Origin' as identified by Kemp. Note how the stratotype lies on the margin of Kemp's lithostratigraphical unit.

Fig. 3. The iconic up-draught bottle brick kin at Nettlebed built in 18th century. Later in 1927 it was converted for lime burning but finally closed in 1938. It was restored to its original form in 1974.

advocated over a century earlier by Osborne White (1895). A widespread characteristic of the Chiltern chalk karstic terrain, particularly around the margins of Tertiary outliers, is the presence of numerous sink holes and other subsidence features (Whitaker, 1864; Edmonds, 2008). The premise advocated here is that the subsidence mechanism better accounts for the preservation of locally derived gravels than the established wisdom of a hypothetical river channel/terrace related to an ancestral Thames aligned northwest-southeast. Related to this, the known presence of biogenic-rich lacustrine-type sediments could be explained as a doline related infill succession.

The 'established wisdom' concerning the distribution of the Kesgrave Group sediments of the River Thames valley is shown by Fig. 4a. This group embraces a range of terrace units which include the Sudbury and Colchester Formations. The figure also places Nettlebed in the context of the Thames catchment as a whole. Similarly, the pre Anglian glaciation diversion flight of terraces, as expressed by their reconstructed long profiles in the upper-middle Thames part of the catchment, is shown in Fig. 4b. The so-called 'Nettlebed Terrace' stands out by having a steeper gradient (1–1.4 m km^{-1}) than the lower terrace aggradations and this property was used to suggest that it might have been close to the river headwaters at the time. These two figures are an adaptation of Fig. 5 of Rose et al. (2012).

2. History of investigation

The geology of Nettlebed was first mentioned in the geological literature by Joseph Prestwich, who was particularly struck by