



Palaeogene conglomerates (puddingstones) in the Colliers End outlier, East Hertfordshire, UK – evidence for age



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ARTICLE INFO

Article history:

Received 21 April 2015

Received in revised form 30 November 2015

Accepted 9 December 2015

Available online 21 January 2016

Keywords:

Puddingstone

Silicification

Lambeth Group

Upnor Formation

Reading Formation

Pebble beds

ABSTRACT

The siliceous conglomerate called Hertfordshire Puddingstone is rare in situ, hindering the dating of its formation; most finds are made in fields or stream beds. The Colliers End outlier on the northern rim of the London basin yields many finds of puddingstone with a fine grained pale matrix containing rounded brown and grey coated, internally stained flint pebbles and some cobbles. The Palaeogene succession of the outlier includes Upnor (resting unconformably on the Chalk), Woolwich/Reading, Harwich and London Clay Formations. There are pebble beds at the base of the Upnor Formation and between the Upnor and Reading Formations. Large quantities of loose 'puddingstone pebbles' (flint pebbles which appear identical to those in concretions), some with patches of matrix adhering to them, occur on surfaces around +89 m to +90 m OD, the height of the boundary between the Reading and Upnor Formations. Pits in one such area are interpreted as dug by Romans quarrying puddingstone (Lovell and Tubb, 2006; Green, 2016).

The level of the loose 'puddingstone pebbles', borehole records, data from road widening and the Roman quarry suggest that a layer of pebbles were deposited on top of the Upnor Formation, then stained, mixed with fine white sand and patchily cemented early in Reading Formation times during a depositional hiatus in a seasonally dry sub-tropical climate. Further work is needed into (a) the mechanism which stained the pebbles, (b) why silicification was patchy and (c) the stratigraphic position of many large puddingstones removed during construction of the A10 (Colliers End bypass).

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1. Introduction

The Colliers End Palaeogene outlier in East Hertfordshire (TL 3820) (Fig. 1) produces many finds of puddingstone (e.g. Fig. 2) in fields and stream beds. The stones have probably moved downslope by erosion – with or without human assistance (Green, 2016). However, there have been no proven in situ examples from this area, so there is no direct evidence for its original stratigraphical position. It must be younger than the Chalk as it contains rounded flint pebbles, and so was deposited and silicified during the intermittent deposition of Tertiary sediments when fluctuating sea level repeatedly brought a shallow sea from the east across south east England. Part of this sedimentary sequence, now known as the Lambeth Group, was deposited around 55–56 Ma (Table 1).

Bateman and Moffatt (1987) refer to the pebble bed between the Upnor and Reading Formations as the 'Upper Conglomerate', which Hopson et al. (1996) placed at the base of the Reading Formation. More recent work suggests the Upper Conglomerate

originated as Upnor Formation sediments which were pedogenically altered and cemented during early Reading Formation times, when base level fell, leading to a depositional hiatus (Entwisle et al., 2013). This paper follows Entwisle et al. in regarding the Upper Conglomerate as a Woolwich and Reading Formation pedostratigraphic unit superimposed on an Upnor Formation lithostratigraphic unit, places it at the top of the Upnor Formation (Table 1) and uses the modified name 'Upper Upnor Conglomerate' (UUC). Lovell (2016) refers to the same bed as 'The Colliers End Pebble Bed'. Entwisle et al. (2013, page 23) stated that 'the boundary of the Lower Mottled Clay with the underlying Upnor Formation is usually diffuse and difficult to place precisely because of pedogenic alteration that may include migration of clay particles into the Upnor Formation and/or colour mottling. The degree of alteration may be such that it is impossible to identify the boundary accurately'. The available sections in the Colliers End outlier suggest that in this area the boundary is usually a sharp contact between the sandy glauconitic sediment of the Upnor Formation and the Lower Mottled Clay of the Reading Formation with the UUC occurring between them (Fig. 3). The Reading facies of the Woolwich and Reading Beds was regarded by Hester (1965) as a fluvial/partly deltaic sequence deposited by a braided river

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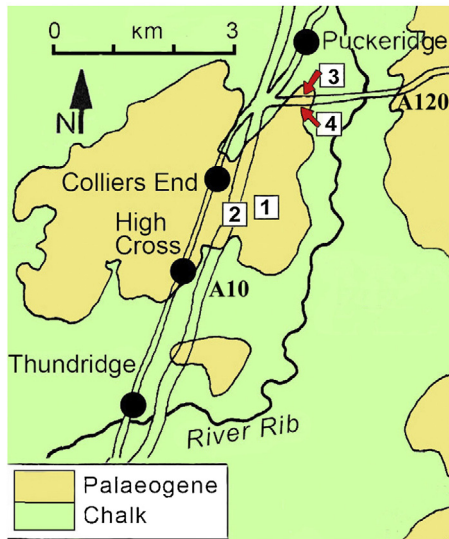


Fig. 1. The Colliers End Palaeogene Outlier showing locations referred to in this paper. (1) Dowsett's Farm borehole. (2) Section of the A10 north from Plashes Wood Underpass where the 'A10 Bypass Puddingstones' were found. (3) 1965 and 1971 road cuttings described and photographed by Jack Doyle. (4) 9 m borehole drilled in 2014. From Lovell and Tubb (2006).



Fig. 2. A puddingstone from the Colliers End outlier with very well rounded, internally stained pebbles in a fine pale matrix. The rock is cohesive and fractures evenly across pebbles and matrix. Grey and brown coated pebbles stand out on the edges of the concretions where the cement ends.

system flowing into a swampy delta, which lay at the margin of the shallow sea in which the Woolwich facies accumulated. Entwisle et al. (2013) suggested the Lower Mottled Clay was laid down on marshy mudflats that formed an alluvial floodplain crossed by river channels and liable to intermittent flooding and water table fluctuation. The bright mottling of the Reading Beds was suggested by Buurman (1980) as the result of desiccation, weathering, and

Table 1
The Lambeth Group units in the Colliers End outlier after Entwisle et al. (2013).

Formation	Previous nomenclature	Units in this paper
Woolwich and Reading (55.8–55 Ma)	Woolwich Beds Reading Beds	Not present Upper Mottled Clay Lower Mottled Clay
Upnor (56–55.8 Ma)	Bottom or Basement Bed	Upper Upnor Conglomerate Upnor Formation (glaucanitic sands/silts) Basal pebble bed

pedogenesis during subaerial exposure in a tropical environment. Entwisle et al. (2013) suggest the prevailing climate was warm sub-tropical with pronounced wet and dry seasons.

2. The outlier and its puddingstones

2.1. The Dowsett's Farm borehole

This is at TL38062079 in the highest point of the Colliers End outlier (+113.36 OD) and is used as the basis for the stratigraphy in this paper. No attempt is made to correlate this borehole sequence with reports from other parts of the London Basin because of the 'differing gaps and overlaps across the area' (Aubrey et al., 1986). The borehole log (Hopson et al., 1996) shows Upnor Formation unconformable on eroded Chalk around +86 m OD overlain by younger Lambeth Group units. The Thanet Sand Formation, which is older than the Upnor Formation, is absent in the area. Catt and Doyle (2010, page 64) state that 'the Thanet Sand transgression could have extended westwards to cover much of Hertfordshire but any deposits it left were probably thin and almost entirely removed by subsequent erosion before deposition of the Lambeth Group'. The Upnor Formation in this area is described as a marine facies of sandy silt/silty sand containing glauconite and the Reading Formation as interbedded clays, clayey silts and fine sands all strongly mottled (Hopson et al., 1996). Pebble beds were encountered at the base of the Upnor Formation (~+86 m OD) and (in the terminology of Hopson et al., 1996) at the base of the Reading Formation (the UUC) (~+89 m OD). Possible desiccation cracks were recorded in clay immediately above the UUC (Fig. 3).

2.2. Field observations

On valley sides traversing the Colliers End outlier where chalk is near the surface, disturbance by ploughing and burrowing exposes silt containing black and reddened flint pebbles mixed with fresh flint and green coated flints. The green coated flints may be derived either from the Chalk, and then green-coated by reaction with seawater at the base of the Upnor Formation, or from the green-coated flints of the Bullhead Bed at the base of the Thanet Formation, which may have extended across the area before the Upnor transgression (Catt and Doyle, 2010). This deposit is correlated with the pebble bed at the base of the Upnor Formation (Fig. 3). Hopson et al. (1996, page 66) stated that 'the base of the Upnor Formation in this district is marked by a pebble bed dominated by well rounded black and red patinated 'chatter

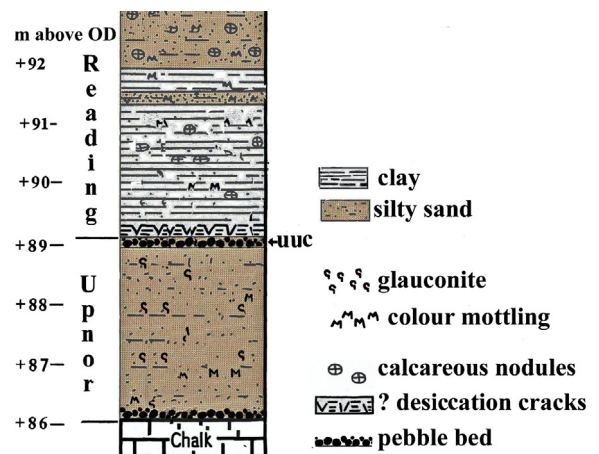


Fig. 3. Lower part of Dowsett's Farm borehole log. Adapted from Hopson et al. (1996).

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