

**Ancient Quarrying of Rare *in situ* Palaeogene Hertfordshire Puddingstone (Lovell and Tubb Mercian Geologist August 2006). An update**

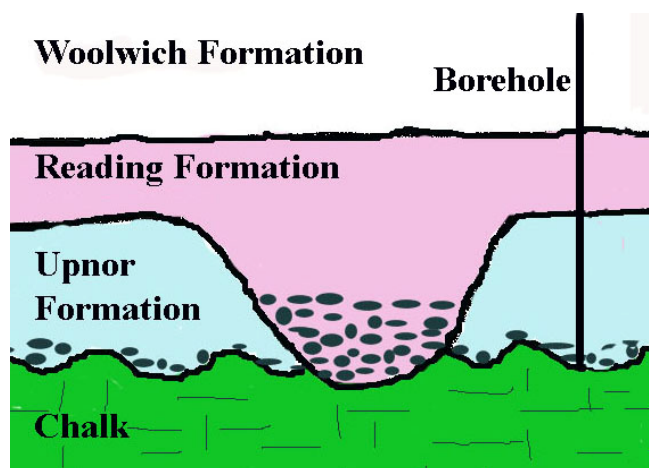
I now believe we were wrong to suggest the puddingstone at Colliers End was *in situ* in the base of the Upnor Formation. The assumption was made as the specimens were recovered from just below the 90m contour, which in this area is the Chalk – Upnor boundary.

The Upnor is marine but silcrete is terrestrial, formed by groundwater containing dissolved silica permeating through coarse deposits, so cementing did not happen as the Upnor was being deposited. It may have occurred after sea level fall, but the Dowsett's Farm borehole shows about 3m of Upnor, described as clayey sandy silt, with the presence of glauconite confirming its marine origin. It is very unlikely that silcrete could have formed at the base of 3m of this material, and the borehole is very close to the puddingstone site (see fig 2 of the paper).

The suggestion that the puddingstone was *in situ* was apparently supported by loose fine white sand on one of the blocks (fig 4 of the paper). However in the intervening time another of the recovered blocks, which appeared solid, has developed patches of loose sand and pebbles. Evidently cementing on the edges of some blocks is weak and breaks down on weathering so this can no longer be cited as evidence that the block had not been moved since it formed.

We are satisfied that the puddingstone was recovered from the top of the chalk, and I have been persuaded by local geologist Jack Doyle that it was from the fluvial Reading Formation, which overlies, and has reworked and in places cut down into the Upnor Formation.

This sketch (not to scale) illustrates how downcutting Reading Formation deposits can occur on top of the chalk, close to 3m of Upnor Formation at the same level.



But was it *in situ*? Loose pebbles in the Reading Formation in the Colliers End outlier are rounded and stained, but in silty clay, not clean sand. Perhaps following the marine regression pebbles were mixed with sand on a beach on top of the Upnor, and patchily cemented, then as the sea continued to retreat the area became a delta environment where the loose sand was replaced by silty clay, and then as rivers cut into the Upnor, blocks of puddingstone sank to the river bed.

Assuming cementing was soon after deposition of the sand and pebble mix this would date it to the early Eocene around 56 Ma (the Palaeocene Eocene boundary is set at 55.8 Ma). Bryan Lovell suggests the Palaeocene Eocene Thermal Maximum was significant, and it may have been silica mobilised in that warming event which cemented the puddingstones.

N.B. This does not necessarily mean all Palaeogene puddingstone is in the Reading Formation. Silcrete can form wherever there are coarse permeable deposits at or near the surface, when high temperatures and alkaline conditions dissolve silica in percolating groundwater. There are other pebbly deposits in Palaeogene sediments, and there may have been more than one silcrete event

Jack Doyle's theory is supported by photographs he took of cuttings through the Colliers End outlier during road widening in 1965 and 1971.

The chalk/Upnor junction  
The basal conglomerate of the Upnor is a mixture of rounded and unrounded pebbles, including some fresh flint, still with its white coat, something never seen in Hertfordshire Puddingstone.

Photo © Jack Doyle 1965



The pebbly Reading Formation cutting down through the Upnor Formation. In parts of Hertfordshire the Reading Formation is known to cut down into the chalk, so puddingstone could occur anywhere from above to below the level of the Upnor.

Photo © Jack Doyle 1971



In close up these Reading Formation pebbles are all rounded, and look like uncemented puddingstone though in a silty matrix

Photo © Jack Doyle 1971



This still leaves many unanswered questions, including, where did the beach pebbles come from? They must have been transported in as there would not have been a local source above the Upnor, this could have been achieved by longshore drift, with the pebbles getting their internal staining and black rims en route, but how did this happen?.

A group of East Herts Geology Club members are working on these and other questions, updates will be posted as more information becomes available.

Jane Tubb  
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