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Preliminary study of a new upper cretaceous phosphatic chalk deposit in southern England

ATTREE Kevin1, JARVIS Ian1, MORTIMORE Rory2

1 – School of Earth Sciences & Geography, Kingston University London, Kingston upon Thames, KT1 2EE, UK: k.attree@kingston,ac.uk, i.jarvis@kingston,ac.uk

2 – School of Environment, University of Brighton, Brighton, BN2 4AT, UK: r.n.mortimore@bton.ac.uk

Small amounts of phosphorus (P) occur in the oceans, lakes, seas and rivers, and are a constituent of rocks, minerals and soils. Phosphorous availability is a limiting factor in biological productivity, and hence influences the demand for CO_2, a major greenhouse gas. It is thought that variations in P supply and removal impact climate by mediating the drawdown of CO_2. However, the forcing mechanisms and long-term feedbacks between phosphate accumulation and environmental change remain poorly understood.

During 2003, a borehole near the Stonehenge monument on the World Heritage Site in Wiltshire intersected Santonian – Campanian chalks containing 20 m of dark brown phosphatic chalk (defined as having $\geq$5 % P_2O_5, due to the presence of significant amounts of granular phosphate). This unexpected and exciting geological find represents the thickest known phosphate deposit of this age in NW Europe. Subsequent borehole and excavation work provides a unique opportunity to document for the first time the detailed anatomy of a European Upper Cretaceous phosphate deposit, and thereby determine the palaeoenvironmental causes and consequences of its formation.

The preliminary study described here is based on 45 m long Stonehenge core R142. The core displays considerable vertical lithological variability. The top of the Cretaceous section consists of white chalks interspersed with flint and marl seams. The chalks coarsen down-core, and phosphatic chalk-filled burrows become evident. The mid-section of the core consists of friable, dark brown, coarse granular chalk, with concentrated phosphatic grains and white chalk burrow mottling. Below this, the phos-

phate concentration diminishes, with the reappearance of interspersed marl seams. No basal hardground facies has been identified. Correlation with adjacent boreholes suggests that the phosphatic chalk was deposited within a synsedimentary erosion channel, similar to those described from coeval deposits in northern France. However, considerable lateral variation occurs in the number, extent and phosphate content of phosphatic chalk beds in adjacent boreholes, and the sedimentological relationships are complex.

In order to investigate the sedimentological and environmental conditions that prevailed across the sediment — water interface around the time of deposition, a number of studies have been implemented to determine: water current energy levels; elemental occurrence and distribution; and post-depositional conditions. To achieve this, 23 samples taken at 1 m intervals through the R142 core have been the subject of petrographic thin section, particle-size, and geochemical analysis. ICP - AES and ICP - MS techniques were employed for the determination of major- minor- and trace-elements. SEM - EDX elemental maps have provided evidence for the occurrence and distribution of elements within a phosphate- rich horizon, and sub-samples from the same horizon have been sieved to study the composition of the sand-size fractions. In addition, thin sections have been produced from the sieved sub-samples and these have been subjected to cathodoluminesence to determine the diagenetic condition of the phosphatic chalk. Preliminary results of this work will be presented.

The overall aim of this research is to improve understanding of ‘greenhouse’ systems, and provide a basis for interpreting the environmental causes and consequences during the Cretaceous.