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PREDICTING ARCHAEO-COLLUVIUM ON THE BERKSHIRE DOWNS

Abstract - This study uses a multi-disciplinary approach for prediction of ancient eroded soils (archaeo-colluvium) which combines the traces of ancient arable (Celtic fields), some topographic parameters and assumptions about past soils, erosion regimes and colluvial preservation in the development of a GIS based predictive model. The study focuses on the north-west part of the Berkshire Downs (58 km^2) in Southern Britain. The predictive model was checked in the field by an extensive auger and test trench survey. Archaeo-colluvial sequences were assembled and dated at 21 main sites throughout the project area. The field results program proved the model accurate at 71% of target sites. Some data proved contrary to the model – for example the lesser preservation of valley deposits within large Chalk valleys and thicker deposits in those of clay with flints. The latter offer windows of archaeological preservation across the otherwise thin and eroded soils of the Chalkland. This feedback allowed some modified principles to be briefly tested and verified on comparable landscapes at Stonehenge, Maiden Castle and the South Downs.

Key words - Colluvium, eroded soil, predictive model, GIS, Berkshire Downs, Great Britain.

Riassunto - *Studio predittivo degli archeocolluvi nei Berkshire Downs*. Questo studio utilizza un approccio multidisciplinare nello sviluppo di un modello predittivo basato su GIS per individuare l'ubicazione di antichi suoli erosi (archeocolluvio); vi si combinano dati quali le tracce di antichi campi arati (campi celtici), alcuni parametri topografici, ed assunzioni circa i suoli del passato, i regimi erosivi e la conservazione dei colluvi. Riguarda la parte nord-occidentale dei Berkshire Downs (58 km^2) nell'Inghilterra meridionale. Il modello predittivo è stato verificato sul terreno per mezzo di ricognizioni estensive effettuate con sonda a mano e trincee esplorative. In 21 siti principali sono state ricostruite e datate sequenze di archeocolluvi. Si è così dimostrato che il modello predittivo si è dimostrato affidabile nel 71% dei siti indagati. In alcuni casi i dati di campagna si sono dimostrati contrari al modello, ad esempio la peggior conservazione dei depositi di fondovalle nelle grandi valli della formazione dei Chalk, o depositi più sottili nelle argille con selci. Nella zona dei suoli sottili ed erosi dei Chalkland questi ultimi offrono «finestre» in cui il record archeologico è conservato. Alcuni aspetti modificati di questa ricerca sono stati verificati brevemente in paesaggi simili a Stonehenge, Maiden Castle e nei South Downs.

Parole chiave - Colluvio, suolo eroso, modello predittivo, GIS, Berkshire Downs, Gran Bretagna.

INTRODUCTION

The buried soils and sediments of dry valleys have been shown to bear the signature of long and sustained phases of prehistoric cultivation (Bell, 1983). While the general preservation of these valley soils has been fostered over the centuries by the relative stability of pastoral use in these upland settings, their distribution is nevertheless sporadic. At Stonehenge for example, in a landscape where evidence of settlement and agriculture is widespread, valley sediments seem to be absent. Locating these deposits therefore offers the prospect of adding greatly to the archaeological and land use history of a region.

This study uses the traces of ancient land use and some past and present landscape parameters to predict their location and draws some conclusions about both the processes of preservation and the archaeological implications of these deposits on a pilot project on the Berkshire Downs, Southern Britain.

The valley sediments of human origin to which this paper refers have been variably called colluvium, hillwash or ploughwash in previous research (Godwin, 1967; Avery, 1980; Allen, 1990) though these terms are ambiguous with regard to age and origin and even process. For the purpose of this paper the term *archaeo-colluvium* will be used and refers to dry valley and valley edge sediments derived from and containing evidence of human activity – predominantly erosion generated from ancient arable activity.

ARCHAEO-COLLUVIAL PREDICTION ON THE BERKSHIRE DOWNS

The Berkshire Downs, located some 30 km south west of Oxford in Southern Britain present a landscape of chalk soils and clay with flints with a widespread distribution of ancient fields, prehistoric and Roman period features. Such a region offers widespread evidence of past land use from which erosion might be implied and the presence of archaeo-colluvium expected (Fig. 1). The study area occupies some 58 km^2 of this region divided into 7 main dry valleys.

BUILDING THE MODEL. ASSUMPTIONS ABOUT PREHISTORIC EROSION AND THE PRESENT LANDSCAPE

The widespread distribution of prehistoric field boundaries or «Celtic Fields» across the Berkshire Downs would seem to be the most obvious indicator of the likely distribution of ancient erosion. Allied with some

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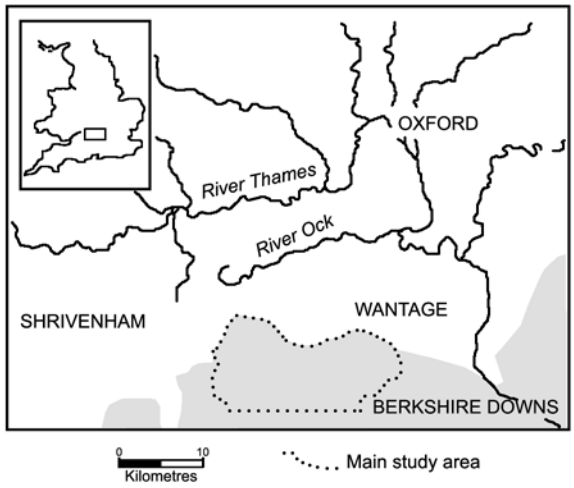

Fig. 1 - Location of Berkshire Downs in Southern Britain.

assumptions about erosion potential on different soils and slopes some simple parameters for locating prominent deposits of archaeo-colluvium were developed. These assumptions might be summarised:

1. Ancient fields are indicators of arable land use, thereby the distribution of ancient fields suggests a pattern of ancient erosion. It is widely held that the small size and layout of these fields, together with the presence of plough-formed lynchets indicates arable rather than pastoral use (Fowler, 1983; Bradley, 1978; Bowen, 1961). Bell (1986) and Bradley (1978) suggest that these small ancient fields were deliberately constructed to conserve soil, and whether deliberate or not, a certain proportion of the cultivated soils form positive field boundaries or lynchets – effectively conserving soil on the slope. It is reasonable however to assume that under the arable land use implied by these field systems, greater erosion would have been possible, even between fields and down perpendicular boundaries, than under pasture or forested conditions (Morgan, 1992). Even greater erosion would be likely during periods when the fields were abandoned as field boundaries were breached and lynchet deposits were redistributed.
2. Ancient fields on chalk soils (of which there is 70% overlap on the Berkshire Downs) are likely to have been the site of more erosion than those fields on clay with flints, according to relative erosion properties of calcareous and clay soils respectively. The silty loams common to chalk soils are several times more erodible than the heavier soils of clay with flints, according to Evans (1980), Hodgson (1967) and Moffat (1988). Evans' survey of colluvium across the United Kingdom supports the notion that chalk soils are four times more likely to produce colluvium than clay soils (Evans, 1992). The observation that soils in all the chalk landscapes of the Berkshire Downs have been eroded, in some places almost to bedrock, implies a long history of erosion.
3. The accumulation of eroded material was more likely on the gentle east facing slopes according to observations on the Berkshire Downs drawn from one-inch soils maps (Jarvis, 1973) and the pattern of drift soils within the assymetric valleys common to this and much of the Southern Chalkland.
4. Slope angle from which prominent soil movement was likely was assumed to be greater than 2 degrees.
5. The main valley bottoms of the project area were assumed to be the receptor sites of colluvial deposits – this assuming that large deposits do not remain preserved in mid-slope.

The Digital Landscape

The GIS based examination and analysis of terrain and archaeological information necessary for archaeo-colluvial prediction has certain demands and constraints. Foremost is the creation of a digital landscape (Digital Elevation Model) which was developed from 1:10,000 scale Ordnance Survey digital data with a 20 x 20 m grid cell. The GIS selection proceeded in five steps (Fig. 2):

– definition of all fields on chalk soils and exclusion of fields on clay with flints;
– definition of all east facing slopes and slopes exceeding 2 degrees;
– selection of all ancient fields with east facing slopes exceeding 2 degrees;
– definition of valley bottoms or receptor sites;
– overlay of all the specific sites of erosion (step 3) with valley bottoms produces map of predicted archaeo-colluvium (Fig. 3).

The main predicted archaeo-colluvium on the Berkshire Downs are in catchments 1 and 4 according to the distribution of ancient fields. In some localities there is less correlation between fields and predicted sites such as catchments 5 and 7 where fields are either not east-facing or lie on clay soils.

Field checking

To verify the accuracy of the prediction, a program of field checking was conducted in two phases.

Phase 1 involved 62 transects and 32 test pits across valleys where colluvium was both predicted and not predicted. Phase 2 involved excavation of 13 test trenches from which the age and nature of the target deposits might be confirmed. Artefacts were recorded and plotted, sediments were described and cores were taken for Optically Stimulated Luminescence (OSL) dating.

Results

21 trench or test pits were chosen as representative colluvial test sites across the project area (Fig. 4). Chronologies were arrived at by assignment of datable sherd sequences and OSL results. Pottery and artefacts of Bronze Age, Iron Age and Roman period were recovered and a summary of the age and archaeology of the colluvial sequences at each test site is shown in Plate 2.

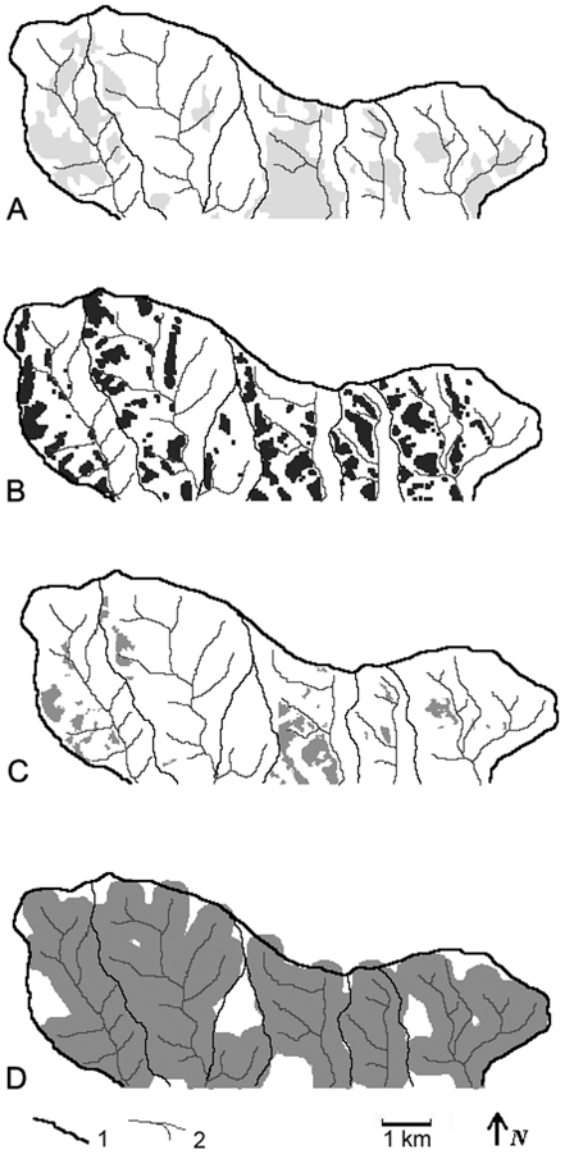

Fig. 2 - Four selection parameters for GIS-based prediction of archaeo-colluvium on the Berkshire Downs. A: fields on Chalk soils; B: East facing slopes, > 2 degrees; C: step 1 + 2, ancient fields on East facing slopes, > 2 degrees; D: 500 m buffer zone. 1: catchment boundary; 2: drainage.

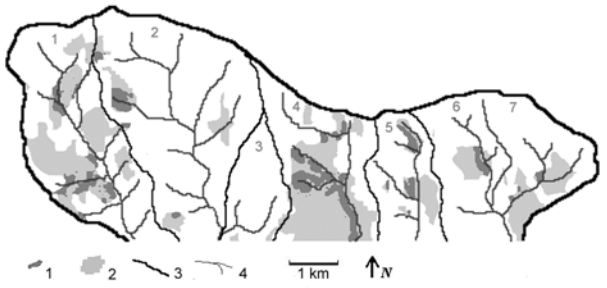

Fig. 3 - Predicted archaeo-colluvium. 1: predicted archaeo-colluvium; 2: ancient fields; 3: catchment boundary; 4: drainage; numbers: catchment numbers.

Fig. 4 - Dry valley test site on the Berkshire Downs.

DISCUSSION

The following discussion presents a summary of the implications and observations about the predictive process and the distribution of archaeo-colluvium on the Berkshire Downs.

Does the model work?
Using a simple test of whether archaeo-colluvium was found or absent according to the predictive criteria, the model proved accurate at 71% of the sites. This gave some encouragement that the assumptions of the model were a useful basis for locating ancient sediments in the modern landscape. As a first approximation it appears that prominent and dateable valley sediments might be found according to a simple systematic procedure.
The distribution and thickness of archaeo-colluvium.
Based on a comparison between colluvial depth, local soil type and valley shape (seen in Pl. 2) the distribution of archaeo-colluvuim on the Berkshire Downs suggests that colluvium is thin or absent from the open chalk landscapes and thicker in the more dissected clay with flints to the centre and west of the project area. The latter observation therefore contradicts one of the assumptions of the model.

Feedback and revised parameters
The contradiction of one of the assumptions of the model – namely that accumulation of colluvium appears less within clay catchments – suggests an alternative

process of colluvial accumulation and preservation on the Berkshire Downs. While the thickness and long history of cultivation and erosion on chalk landscapes is well attested, many of the open chalk valleys – such as Stonehenge, Maiden Castle and Dorchester (Sharples, 1991; Allen, 1995; Allen, 1997a) – are, like those of the Berkshire Downs, also almost devoid of valley deposits. Such an observation suggests that both accumulation and evacuation of valley sediments has occurred over time. This may be the result of topographic factors such as long slopes which generate accelerated overland flow in concert with (occurring over several millennia) catastrophic rainfall events, periodic springs or «lavants» (Bell, 1986, 1992), or watertable rises due to changes in either climate, farmed or forested regimes. The reason why archaeo-colluvium persists within clay landscapes may be a product of typically smaller and dissected valleys which may be less susceptible to evacuation of valley deposits or that these soils were cultivated later in prehistory.

Such field observations provide feedback for the model. A revised prediction which incorporates observations from the Berkshire Downs about the relative preservation of ancient valley soils might include the prospect that archaeo-colluvium is thicker within valleys of clay with flints and largely be absent from open chalk valleys. This new parameter was applied to landscapes at Stonehenge, Maiden Castle and the South Downs. An examination was made of soil maps of these regions and particularly to interpolated colluvial units (Drewett, 1982; Sharples, 1991; Allen, 1995). It became apparent that prominent archaeo-colluvium is distributed according to the revised predictions. In all of these landscapes colluvium is absent in open chalk valleys and is thicker adjacent clay with flints. While extensive field investigation of these areas would evaluate the precision of these assertions, it is notable that field trials were conducted within the Stonehenge landscape in 1999 that support the above prediction (Allen, pers. comm., 1999). It was a prominent observation of this project therefore, that while of lesser extent, archaeo-colluvium associated with clay with flints seem to provide unexplored windows of preservation on otherwise degraded chalk landscapes.

While preliminary and of broad scale the results suggest that some simple parameters about past and present land use and erosion might be used to locate archaeo-colluvium. These results emphasize the importance of including both surface and subsurface soils and landform observations for reconstruction of past cultural landscapes but also for strategic recovery of sources of buried primary and secondary archaeological material otherwise invisible to conventional field survey.

Summary and conclusions

A method for locating valley sediments on the Chalkland of Southern Britain has been proposed which uses the distribution of ancient fields and some soil and topographic assumptions about prehistoric erosion and past and present chalk landscapes. A trial of this method on the Berkshire Downs proved 71% accurate. The field-checking phase revealed further factors from which some of the predictive assumptions were revised. For example, the archaeo-colluvium located on the Berkshire Downs suggest that clay with flints are prominent sources of valley sediments that appear to have been otherwise evacuated from the open chalk valleys. Some of these observations were tested and verified by a preliminary survey of other landscapes in southern Britain.

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