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Using geoarchaeological deposit modelling as a framework for archaeological evaluation and mitigation in alluvial environments

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A B S T R A C T

The pace of anthropogenic development on floodplains and adjacent valley floors is still increasing and in many countries this is accompanied by a requirement for heritage mitigation and management. The result is an increased demand for effective and efficient archaeological evaluation and mitigation strategies, which can only be achieved in alluvial environments through the application of geoarchaeological methods. This paper uses lidar data combined with deep geophysical survey (electrical resistivity), gouge coring and limited borehole data to derive a three dimensional geoarchaeological deposit model, which provided a vehicle for archaeological evaluation and mitigation. Significantly, the results of this deposit model are compared to the results from the subsequent archaeological evaluation trenching, a methodological next step that has not received sufficient attention within the (geo)archaeological literature. The deposit model is refined using radiocarbon dating and artefactual evidence derived from the archaeological evaluation trenching. The results demonstrate how geoarchaeological deposit modelling can be integrated with archaeological evaluation trenching and provides discussion of the importance and difficulties of integrating geoarchaeological sediment units (archives) with archaeological contextual excavation data, with conventional stratigraphic matrices.

1. Introduction

The ability to understand, predict or model the distribution of archaeological remains, whether landscape or site based, is a key concern for all sectors of the heritage community (e.g. Hey and Lacey, 2001; Fry et al., 2004; Howard et al., 2015; Demján and Dreslerová, 2016), and is critical for practitioners and their funders ahead of major infrastructure projects. The capacity to detect archaeological sites located within geologically and geomorphologically simple terrain units such as calcareous bedrocks, the classic dryland context, has undergone wide-scale development during the twentieth century using a variety of prospection techniques such as aerial photography (e.g. St Joseph, 1977; Barber, 2011), and more recently airborne remote sensing technologies (Challis and Howard, 2006; Ninfo et al., 2009; Rowlands and Sarris, 2007; Parcak, 2009). These airborne techniques have been complemented by the development of ground-based geophysical survey methods, primarily gradiometer survey, earth resistance survey (Aitken, 1958; Gaffney, 2008; David et al., 2008) and ground-penetrating radar (Conyers, 2004; Hermann, 2013). Such techniques have revealed a wealth of archaeological resources demonstrating the rich nature of the historic environment record.

Alongside this increasing knowledge of site detection and identification, there has been a growing realisation of the importance of understanding geomorphological processes, landform assemblages and four dimensional stratigraphic architecture to facilitate the interpretation of archaeological distributions and preservation potential (Howard and Macklin, 1999; Howard et al. (2003); Brown, 2008; Arnaud-Fassetta and Carcaud, 2014). The topography and resources of alluvial palaeolandscapes exert a significant, but not yet fully understood, influence on past societal choices and opportunities; therefore, mapping and understanding landform assemblages such as palaeochannels and river terraces can offer insights into the distribution of archaeological remains (Passmore et al., 2006; Ayala et al., 2007; Mozzi, 2012) and facilitate resource-based modelling (Brown et al., 2013a).

Critically, geomorphological processes and complexity can dictate the visibility of archaeological sites to conventional methods of archaeological prospection, through factors such as erosion, sedimentation and burial (Howard et al., 2008). However, established methods for mapping archaeological remains, such as aerial photography and magnetic gradiometer survey, are shallow prospection techniques and will not penetrate sediment depths of >1 m (Clark, 1990; Gaffney and

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Gater, 2003). The use of these techniques to map shallow buried archaeological structures and features is followed by evaluation trenching, used to ground truth results and recover datable material. However, where archaeology is stratified within deeper sedimentary sequences (>1 m), detection is more problematic (Bates and Bates, 2000). Such sediment sequences render archaeological remains undetectable to these conventional methods of archaeological prospection such as gradiometer survey, field walking, aerial photography and shallow test pitting (Macklin et al., 1992; Passmore et al., 2002). Therefore, these vertically accreted sediment environments require the use of geoarchaeological deposit modelling (see Section 2.2) to understand sediment architectures and depositional environments, which in turn, can be related to archaeological potential (e.g. Chapman et al., 2009).

To plan effectively for the mitigation of impacts to historic environmental resources, baseline knowledge of the richness and complexity of the archaeological resource within an area is fundamental (Chapman, 2006, 10), which must utilise methods tailored to the specific circumstances of the environment in question. In terms of alluvial environments, this can be conceptualised as an idealised typical temperate river valley (Fig. 1), where the archaeological and palaeoenvironmental potential is intimately linked to geomorphological processes, which in turn, dictates the methods suitable for revealing the historic environmental resources and planning suitable investigation strategies. In alluvial landscapes, geoarchaeology should be seen as the vehicle for the design and implementation of any overarching historic environment mitigation programme, providing understanding of the sediment chronology, the depositional environment and the archaeological and palaeoenvironmental resources.

2. Geoarchaeological deposit models and archaeological predictive models

It is important to make a distinction between archaeological predictive modelling (sensu Espa et al., 2006) and geoarchaeological deposit modelling, also called geoarchaeological predictive modelling, (sensu Bates and Bates, 2000). This terminology is significant as it reflects a substantive difference in approaches to understanding and mitigating

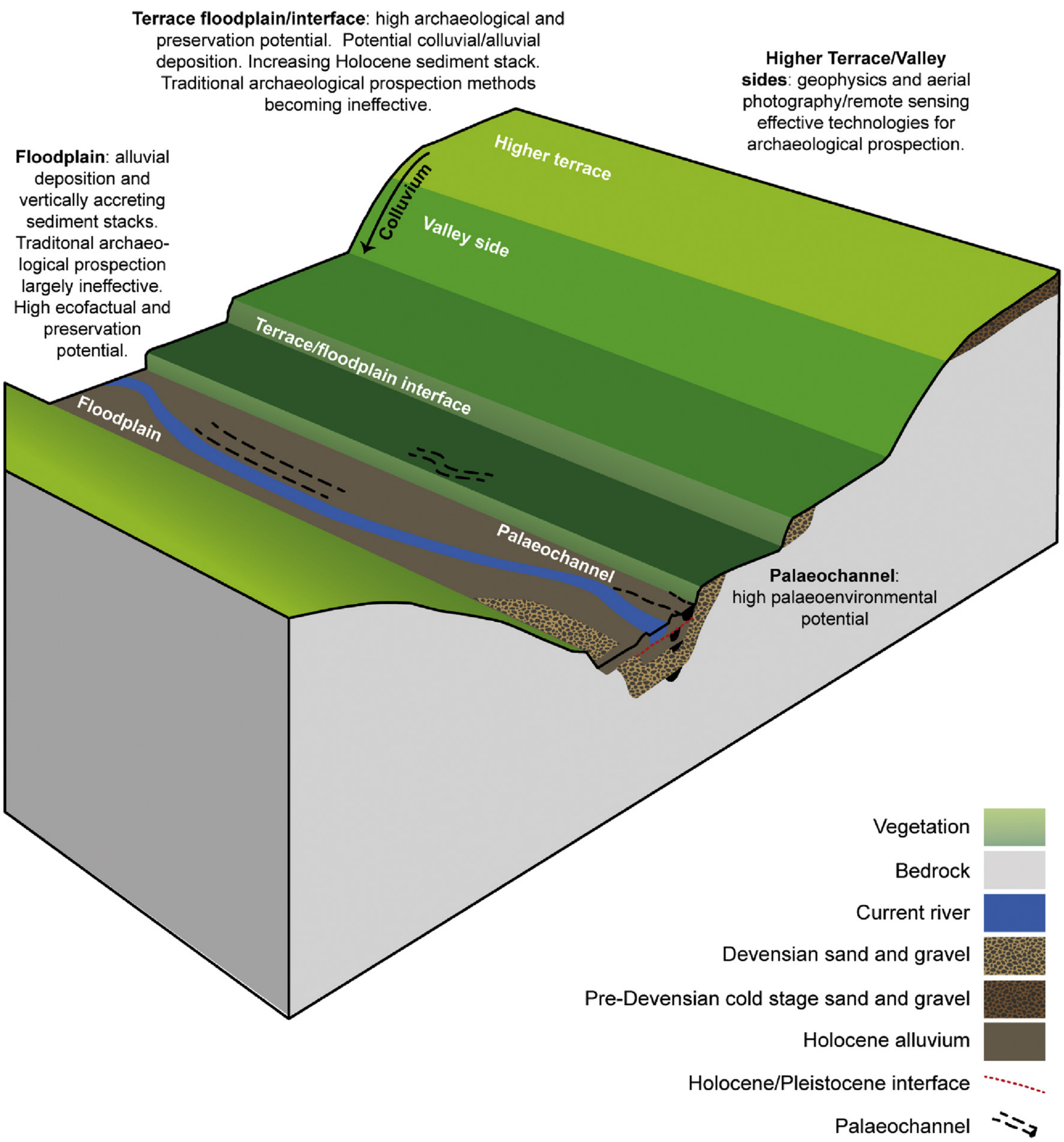

Fig. 1. Idealised cross section of a temperate river valley, highlighting key geomorphological and archaeological prospection issues.