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Geoarchaeological records in temperate European river valleys: Quantifying the resource, assessing its potential and managing its future

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ABSTRACT

Throughout the Quaternary, episodes of glaciation and associated low sea level have resulted in the connection of the terrestrial landmasses of Britain and mainland Europe. The river systems that established themselves across these newly emergent land surfaces of the coastal plain would have created important migration corridors for both animals and humans, a point corroborated by the affinity of Palaeolithic remains across Britain and Europe. Technological developments within the last decade have allowed these now submerged valley floors and adjacent terrestrial landscapes associated with the last cold stage and early and middle parts of the current (Holocene) interglacial to be explored and their archaeological legacies unravelled, providing geoarchaeologists with an opportunity to contribute to major cultural debates. However, in order to maximize knowledge, it is essential that geoarchaeologists working within river valleys across both Britain and the European continent are addressing similar research questions by collecting data using comparable methodologies. This paper reviews the approach taken in different regions and provides a baseline assessment to allow the development of a coherent European-wide framework for alluvial geoarchaeology and geoprospection, particularly with respect to the Holocene record.

1. Introduction

During the Last Glacial Maximum (LGM), globally low sea levels resulted in the connection of the terrestrial landmasses of Britain and continental Europe, repeating a pattern observed in earlier cold stages. The similarity of Upper Palaeolithic lithic assemblages between sites in mainland Europe with those in Britain together with evidence from cave paintings demonstrate significant cultural associations between geographically distant hunter gatherer groups and, by implication, mobility between these two regions. During the last four decades, the interpretation of large amounts of geological data, swathes of geophysical (seismic) and bathymetric data collected across the North Sea basin and English Channel (D'Olier, 1975; Jergersmsa et al., 1979; Henriet and De Moor, 1989; Bridgland and D'Olier, 1995; Gibbard, 1995; Gupta et al., 2007; Gaffney et al., 2009; Cohen et al., 2012a; Hijma et al., 2012) have provided insights into the landscape between mainland Europe and Britain, the former area popularly known as Doggerland (Coles, 2000). Within this now submerged landscape, the river valleys that dissected the region would have been important migratory corridors, extending well beyond the established alluvial systems of the present day (Hijma et al., 2012; Cohen et al., 2013).

Climatic amelioration and deglaciation associated with temperature rises in the Late Weichselian and at the onset of the Holocene resulted in global sea-level rise and the isolation of

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continental European and British river systems (Sturt et al., 2010; Hijma et al., 2012). Numerous empirical studies in both Britain and north-western Europe have demonstrated that, immediately prior to this, the rivers transformed from braided to meandering systems during the alternating warm and cold phases of the Late Weichselian and Lateglacial (Rose et al., 1980; Kiden, 1991; Collins et al., 1996; Mol et al., 2000; Andres et al., 2001; Cohen et al., 2002; Kasse et al., 2005; Nádor et al., 2007; Bogemans et al., 2012). During the LGM and colder phases of the Lateglacial, the deflation of fine-grained sediments from exposed surfaces led also to the deposition of extensive coversand (and loessic) deposits across eastern Britain and the low-lying alluvial plains of central and northern Europe (Bateman, 1995; Bateman and Van Huissteden, 1999; Meijs, 2002; Haesaerts, 2004; Bogemans and Vandenberghe, 2011; Tolksdorf et al., 2011; Derese et al., 2012; Turner et al., 2013; Vandenberghe et al., 2013). In the low countries numerous archaeological excavations have proved that 'river dunes', wind-blown deposits from and next to the Lateglacial braided river system, were important foci of settlement during the Upper Palaeolithic and Mesolithic (Mol, 2003; Weerts et al., 2012; Bos et al., 2013).

In the past few decades, relative sea-level (RSL) rise and shifting coastlines along the North Sea margins have been intensively investigated. Several Holocene RSL curves for the UK, France, Belgium, the Netherlands, Germany and southern Denmark have been developed (Van de Plassche, 1982, 1995; Denys and Baeteman, 1995; Kiden, 1995; Lambeck et al., 2002; Shennan and Horton, 2002; Van de Plassche et al., 2005; Gehrels et al., 2006; Vink et al., 2007; Pedersen et al., 2009) and palaeogeographical reconstructions published (e.g. Baeteman and Declercq, 2002; Baeteman, 2008; Sturt et al., 2010; Vos et al., 2011; Vis et al., in press). It is now generally accepted that the coastal evolution of the southern North Sea mainland coast has strong temporal and regional aspects and the extrapolation from one region to another is not justifiable (Bungenstock and Weerts, 2010, 2012; Baeteman et al., 2011; Weerts, 2013). This arises from the fact that the development of a coastal plain is controlled by the changing rate of RSL rise, sediment budget, the topography of the pre-transgressive surface and human-activities during the Late Holocene. The relative impact of these controlling factors has changed through time and can be different for each region (Baeteman et al., 2011; Weerts, 2013). RSL change at any given location is a function of global eustatic sea-level change (Cronin, 2012) and land-surface movement (influenced by structural control, tectonics, glacio-and hydro-isostatic effects and the compaction of soft sediments and oxidation of peats) that has a local to regional component. Moreover, regional and local effects such as the flood-basin effect (Makaske et al., 2003), estuary effect (Vink et al., 2007) and avulsion effect (Kiden et al., 2008), influence local 'Mean High Water' conditions and should all be assessed when making palaeo-reconstructions (Weerts, 2013).

These conclusions regarding the complexity of landscape evolution and marine transgression/regression are corroborated by radiocarbon dates from the southern North Sea (Ward et al., 2006; Weerts, 2013) and more recent dating of sediments using OSL (Mauz et al., 2010; Tappin et al., 2011), which suggest that some parts of the southern North Sea basin may have remained dry land until the Neolithic (Busschers et al., 2007). The distinction of 'wetland' and 'dryland' environments has significant implications for how these areas may have been exploited and settled in the Early and Mid-Holocene as well as the connectivity of populations and the exchange of new ideas and cultural practices between Britain and the near continent (Sturt et al., 2010; Garrow and Sturt, 2011; Cohen et al., 2012a).

Therefore, knowledge of the occupation of river valleys is important in understanding key patterns of adaptation within the archaeological record, particularly in the Early and Mid-Holocene (Cummins and Harris, 2011). Decades of university program drilling activities in the Holocene Rhine-Meuse delta in the central Netherlands have delivered a geological-geomorphological map of Holocene stratigraphy and a palaeogeographic reconstruction of the whole delta highly relevant to archaeological reconnaissance from the Mesolithic to recent times (Berendsen and Stouthamer, 2001; Cohen et al., 2012b). Although challenges still remain (Bates et al., 2007a), the methodological advances over the past decade are beginning to provide geoarchaeologists with an opportunity to map and correlate sites across the terrestrial and submerged zone and to extend knowledge of European river valleys into hitherto unexplored areas. However, if geoarchaeologists studying alluvial landscapes are to contribute towards wider European archaeological debate, it is essential that they are investigating landscapes using comparable methodological approaches and with similar research questions in mind. Therefore, using selected examples from across temperate Europe, the aim of this paper is to consider the geoarchaeological approaches, opportunities and challenges facing researchers attempting to elucidate settlement patterns, understand preservation and geoprospecting for archaeology in the river valleys of Britain and the near continent, particularly with respect to the Holocene record. It is hoped that such a review can contribute to the development of a European wide research framework for investigating alluvial environments. This paper will therefore focus on: a) reconstructing landform elements; b) understanding vegetation history, climate change and sediment supply; c) securing chronologies and event correlation; and lastly d) approaches to mapping and geoprospection.

2. Reconstructing landform elements

Since the advent of aerial photography and systematic large-scale surface collection during field surveys, archaeologists have recognised that the visibility and spatial distribution of archaeological remains within alluvial landscapes is intimately related to superficial geology (Potter, 1976; Gladfelter, 1977). Therefore, understanding landform elements, geomorphological processes, particularly erosion and sedimentation histories, as well as the subsurface three-dimensional record are essential starting points for geoarchaeological study (e.g. Berger, 2011; Meylemans et al., 2013). Furthermore, as Brown (2008) has noted, the advancement of radiometric dating and development of high-resolution multiple chronologies have allowed these reconstructions to become four-dimensional.

In Britain, a review of Holocene river system development by Howard and Macklin (1999) demonstrated that rivers had responded in a variety of ways to the effects of sea-level change, glacio-isostacy, changing vegetation dynamics and sediment supply, natural climate change and human impacts. Depending on geographic location, rivers were demonstrated to have evolved through either: (1) progressive incision, punctuated by periodic, initially coarse sedimentation by mobile braided or wandering gravel bed channels in the upland and piedmont zones; or (2) overbank, largely fine-grained sedimentation associated with relatively stable, single or anastomosed channels in lowland and perimarine zones. In a recent paper based on the analysis of radiocarbon-dated fluvial sequences, Macklin et al. (2013) have suggested that extreme floods may be responsible for initiating entrenchment and terrace formation on the British mainland during the Holocene, rather than as a direct response to glacio-tectonic uplift or incremental valley lowering by combined incision and lateral reworking. Whilst providing a mechanism for incision, it is notable that the distribution of the terraces described by Macklin et al. (2013) appears closely associated with the imprint of