Chapter 1 Introduction

1.1 Pleistocene environments and British coastal lowlands

The coastal lowlands of Britain are primarily depositional sites at the boundary between marine and terrestrial environments. Many coastal lowland environments can therefore be expected to contain a relatively abundant, well-preserved sedimentary archive that makes high-resolution reconstructions of a region's depositional response to Pleistocene climatic change possible (Bowen 1978, Lowe & Walker 1997). However, this is also an environment from which evidence may be lost to erosion, transport and reworking of sediments (Jones & Keen 1993) and the imprint of subsequent events may be superimposed on earlier evidence, which presents challenges in unravelling its history. This is especially true for the Severn Estuary region where erosional, transport and depositional processes are driven by a semi-diurnal tidal range in excess of 14 m (Haslett *et al*. 2001, Allen 2002). Furthermore, although developments over recent years have permitted increasingly sophisticated reconstructions of Pleistocene palaeoenvironments, knowledge of the timing, pattern and amplitude of Pleistocene environmental change is often limited partly due to inadequate sampling resolution (Mayle *et al*. 1999) and partly to the limitations of the available dating techniques (Lowe *et al*. 2008).

In Britain the most complete sedimentary records of coastal lowlands are those covering climate change during the transition from the Devensian cold stage following the start of ice retreat after 21 ka (Chiverrell & Thomas 2010, Rose & Coxon 2010) to the present day. For example Llanilid, South Wales, where organic sediments from an ice-marginal kettle-hole overlying glacigenic deposits have provided a multi-faceted record of environmental change (Walker *et al*. 2003). The temporally longest sedimentary records are those of the coastal lowlands of East Anglia (Rose *et al*. 2001, Lee *et al*. 2004, 2006, Pawley *et al*. 2004, Hamlin *et al*. 2005, Candy *et al*. 2006, Preece *et al*. 2009, Rose 2010) where multiple cold and temperate stage sediments are recorded over >780 ka.

1.2 Study area description

This research focuses on the Pleistocene sedimentary archive of the Gordano Valley (UK National Grid Reference ST 450735), a funnel-shaped, low-lying valley marginal to

the Severn Estuary in southwest England. Bounded by the Clevedon–Portishead ridge to the north and the Tickenham ridge (Failand ridge or Clevedon-Bristol ridge of other authors) to the south, the valley forms a natural topographical unit (Jefferies *et al.* 1968, Mills 1984) discrete from both the Severn Estuary and the northern Somerset Levels (Figure1.1). The valley lies less than 20 km from the accepted Devensian ice front in South

Figure 1.1: Location of the Gordano Valley (after: Hill *et al*. 2008)

Wales and 4 km north east of Kenn, north Somerset, (Figure 1.2) where sediments interpreted as evidence for an Anglian (Marine Isotope Stage (MIS) 12, 450 ka), or earlier (possibly MIS 14 or 16, >560 ka) glaciation are found (Gilbertson & Hawkins 1978a, Campbell *et al*. 1998, Clark *et al*. 2004, Harrison & Keen 2005). A southwest to northeast axial alignment, mirroring that of the Severn Estuary, provides a regionally unique preservational environment, sheltered from the effects of erosion, transport and reworking

that many shoreline sites suffer from in the macrotidal Severn Estuary region. The Gordano Valley therefore lies at the limit of Pleistocene glacial expansion and the threshold of terrestrial, marine and fluvial environments, and potentially contains an important archive of palaeoenvironmental information reflecting a range of Pleistocene environments.

Figure 1.2: Proximity of the Gordano Valley (red) to the maximum extent of Devensian ice in south Wales (blue line; source: Bowen 2005)

During the Quaternary period the direct and indirect influence of glacial and interglacial episodes led to the deposition of a variety of unconsolidated beds interpreted as tills, coversands, breccias, estuarine and beach deposits (ApSimon & Donovan 1956, Gilbertson & Hawkins 1974, 1978a, 1978b, Green 1992, Hunt 1998a). Sediments at the top of the valley floor sequence, characterised by peat and marine alluvium, represent the Holocene epoch (Hill 2006). A summary of the geology of the Gordano Valley, together with a full discussion of the relevant literature on Pleistocene environmental change in the Gordano Valley, is provided in Chapter 3.

1.3 Relevance of this research

Most research on the Pleistocene environments of the Gordano Valley was conducted during the mid-twentieth century. During the intervening years there has been an improved understanding of the timing, magnitude and frequency of glacial and interglacial climate changes and the rapid nature of climatic oscillation (Lowe & Walker 1997).

Increasingly high-resolution palaeoclimate records have revealed a succession of rapid warm-cold oscillations. Decadal resolution of climate change from Antarctic ice-core records has been achieved (McCabe 1996, Stenni *et al*. 2003), whilst records from the Greenland ice-cores have allowed almost annual resolution of climatic events (Gibbard & West 2000, Hoek & Bohncke 2001, Ehlers & Gibbard 2003), with up to sub-annual resolution for the Late Pleistocene and Holocene (Steffensen *et al*. 2008, Orombelli *et al*. 2010).

Previous research on Pleistocene environments of the Gordano Valley has been confined to the valley margins, whilst research on the valley floor has focused on Holocene sedimentary environments. This has resulted in uncertainty surrounding the nature of Pleistocene environments, processes and resulting valley floor landforms in both spatial and temporal contexts; little is known of the interval between the Middle Pleistocene and the Late Devensian cold stages or of valley floor environments prior to Devensian Lateglacial time.

This research therefore makes a significant contribution to understanding the provenance and depositional environments of Pleistocene sediments within the immediate region of the Gordano Valley through interpretation of their geomorphology, sedimentology, geometries, stratigraphy and age.

1. 4 Research aim and objectives

The research aim is:

To determine the provenance, depositional environments and age of the Pleistocene sediments of the Gordano Valley.

In order to address this aim, a number of objectives have been identified that enable a clear understanding of the temporal and spatial evolution of the Pleistocene Gordano Valley to be reached:

- To determine the aerial extent, surface morphology and geometries of the Pleistocene sediments.

- To establish the stratigraphy and ages of the Pleistocene sedimentary units.
- To characterise the Pleistocene sediments and interpret their depositional environments.
- To review and revise as appropriate the current models of Pleistocene events and environments of the Bristol Channel/Severn Estuary region.

1. 5 Thesis structure

In Chapter 2 the context for this study, the broader theories and framework of British Quaternary environmental change, are presented and existing interpretations of Pleistocene environments in the Bristol Channel/Severn Estuary region are summarised. Chapter 3 introduces the study region, with regard to its geology and known Pleistocene deposits. Chapter 4 provides a justification of the sampling strategy and fieldwork techniques adopted, and the laboratory and data analysis techniques that were subsequently applied in order to address the aim and objectives of the study. In Chapter 5 evidence for the aerial extent, surface morphology and geometry of the Gordano Valley Pleistocene minerogenic sediments is presented. Chapter 6 presents the stratigraphy and ages of the Pleistocene sedimentary units. The sediments are characterised and interpreted in terms of their depositional and post-depositional environments in Chapter 7 and an overarching synthesis of Gordano Valley palaeoenvironments is provided in Chapter 8. In Chapter 9 the research findings are placed in a regional context and discussion is broadened to consider the findings within wider contexts. Chapter 10 concludes the thesis, outlining clearly the findings and contribution to existing knowledge.