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ScienceDirect
Geomorphology 98 (2008) 55–70
GEOMORPHOLOGY
www.elsevier.com/locate/geomorph

Fluvial system evolution and environmental changes during the Holocene in the Mue valley (Western France)

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Received 11 January 2006; received in revised form 29 May 2006; accepted 20 February 2007
Available online 13 May 2007

Abstract

Geomorphological and palaeoenvironmental research on Holocene sedimentation in the Mue valley provides evidence for fluvial system changes related to climate and human activities in Normandy, a poorly studied area of the Paris basin. The 24-km long valley bottom has been investigated through a systematic survey. It shows an original longitudinal sedimentary pattern in relation with valley morphology and local geological controls. Minerogenic, tufaceous and peaty deposits provide opportunities for multi-proxy analyses and radiocarbon dating control. Sedimentation began around 9500 ^{14}C BP with silt deposition in a meandering system. The Boreal and the Lower Atlantic periods (8500–6000 ^{14}C BP) were mainly characterized by unlithified calcareous tufa. Locally, these deposits are very thick (7 to 13 m). The tufa formed barrages across the valley bottom, providing an autogenic control on upstream sedimentation. During the Upper Atlantic period (6000–4700 ^{14}C BP), the valley experienced a decrease in calcareous sedimentation and the development of organic deposits. At the beginning of the Subboreal (4700–3500 ^{14}C BP), peat deposits expanded, especially behind the tufa barrages. The valley bottom was characterized by large marshy areas whereas the regional vegetation was progressively modified by human activities. At the end of the Subboreal (3300–3000 ^{14}C BP) the infilling of the valley by calcareous silt was caused by an increase of river activity related to climatic and land use changes. From the Iron Age and Gallo-Roman periods (2800–1700 ^{14}C BP), the valley bottom was filled by silty overbank deposits related to an increase of soil erosion. The slopes and river system were once again coupled and the fluvial system functioned as a continuum from upstream to downstream. The alluvial record of the Mue valley reflects a broad regional pattern of environmental changes but presents particular features, which highlight the need of longitudinal studies to take into account spatial and temporal discontinuities of Holocene hydro-sedimentary systems, even in small order valleys.

Keywords: Fluvial System; Alluvial records; Longitudinal arrangement; Tufa; Holocene; Normandy

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doi:10.1016/j.geomorph.2007.02.029

1. Introduction

Research on the fluvial responses to climatic and anthropogenic changes during the Holocene have been numerous in Europe and give evidence of the role of the different controls (e.g. Starkel, 1983; Gregory et al., 1995; Brown, 1997; Benito et al., 1998; Maddy et al., 2001). Nevertheless, they also underline the complexity of Holocene fluvial archives and particularly their fragmentary pattern, which renders precise chronostratigraphic studies difficult, and the distinction between autogenic controls and external environmental influences (Brown, 1997; Lewin et al., 2005). To take into account the lateral variability of the valley-bottom alluvial filling, most investigations are based on extended cross-sections using backhoe trenches or closely spaced augers while, in lowland areas, the longitudinal complexity is more often neglected even if it appears important to understand the fluvial system as a whole (Brown, 1990; Macklin, 1999). Indeed, the discontinuity of sediment routes through a catchment and along a river is the norm (Brown, 1990; Harvey, 2002; Hooke, 2003; Kasai et al., 2006). In addition, in sedimentary basins, specific alluvial features like transverse tufa barrages can interrupt the continuity of sediment transfer (Pedley et al., 2000; Pentecost, 2005). These observations underline the necessity of systematic

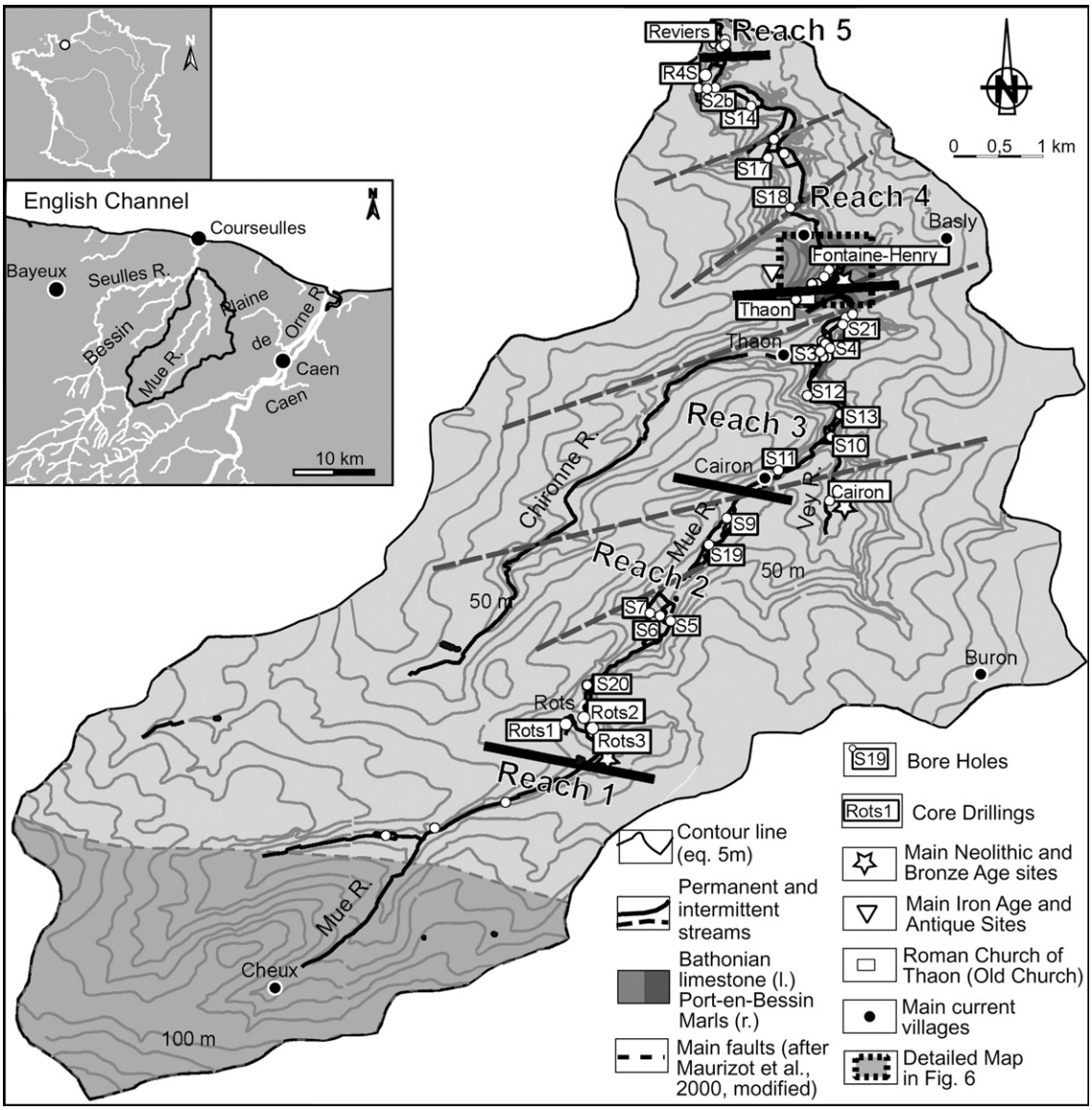

Fig. 1. Location of bore holes and core drillings in the Mue river basin.