Available online at www.sciencedirect.com
ScienceDirect
Sedimentary Geology 193 (2007) 203–209
Sedimentary Geology
www.elsevier.com/locate/sedgeo

The Pleistocene climate-controlled fluvial sedimentary record in the Bełchatów mine (central Poland)

Tomasz Zieliński *

Institute of Geology, Adam Mickiewicz University, Maków Polnych 16, 61-606 Poznañ, Poland

Abstract

Sedimentological analyses of fluvial formations in the Bełchatów mine have yielded results that have more than regional significance. They concern the reaction of rivers to climatic changes in the Pleistocene. Changes in river geometry and their depositional records are examined from two fluvial formations. These formations represent different times, but show similar palaeoenvironmental changes. Cool temperate climate conditions resulted in meandering (or anastomosing) river sedimentation, which was controlled by equalized precipitation and by a well-developed vegetation cover. Cold periglacial climate conditions resulted in braided river sedimentation immediately before the Glacial Maximum, with high discharges and a high sediment load. The palaeoclimatic and palaeohydrologic analyses of the Weichselian fluvial deposits in Bełchatów provide additional information to that from similar studies in Germany and the Netherlands, thus jointly resulting in a consistent palaeogeographic model of western-middle Europe.

Keywords: Sedimentology; Alluvium; Palaeoclimate; River metamorphosis; Pleistocene; Central Poland

1. Introduction

Quaternary deposits in the Bełchatów opencast brown coal mine (Fig. 1) have been investigated for nearly 30 years. The Bełchatów brown coal excavation is the largest "hole" in Europe, and the sediments accumulated above the brown coal represent a large part of the Quaternary as well as a wide variety of facies. Pleistocene deposits reach up to 270 m in thickness, reflecting active subsidence in the Kleszczów Graben throughout the Cenozoic.

Six or seven alluvial formations have been recognised that formed in cold and warm Quaternary climates, from over the last 2 million years (Fig. 2). The palaeovalleys in which these fluvial sediments were deposited are oriented parallel to the long axis of the Kleszczów Graben (WWN–EES).

The fluvial deposits at Bełchatów have been studied extensively (Brodzikowski and Baraniecka, 1982; Zieliński, 1982; Brodzikowski, 1987; Goździk and Krzyszkowski, 1987; Krzyszkowski, 1990a,b,c, Krzyszkowski, 1991; Goździk, 1992; Baraniecka, 1993; Goździk and Balwierz, 1993; Krzyszkowski and Nita, 1993, 1995; Goździk, 1995; Brodzikowski et al., 1997; Kasse et al., 1998; Zieliński and Goździk, 2001; Goździk, 2006-this issue). The objective of the present contribution is to examine the relationship of the fluvial depositional style to climate changes, a generic issue that is of global importance.

* Fax: +48 61 8296074.
E-mail address: zielu@amu.edu.pl.

0037-0738/$ - see front matter © 2006 Elsevier B.V. All rights reserved.
doi:10.1016/j.sedgeo.2005.06.016

Fig. 1. Location of the Kleszczów Graben and the Bełchatów mine.

2. Evolution of fluvial environments controlled by climatic changes

The influence of climatic changes recorded in fluvial deposits will be demonstrated by reference to the sedimentology of the Chojny and the Piaski Formations (Fig. 2).

2.1. The Chojny Formation

The Chojny Formation has been the object of many studies, in many profiles of the mine (Brodzikowski and Baraniecka, 1982; Brodzikowski, 1987; Krzyszkowski, 1990a; Goździk, 1992; Baraniecka, 1993; Goździk and Balwierz, 1993; Krzyszkowski and Nita, 1993, 1995; Zieliński and Goździk, 2001). These studies yielded, schematically, the following results. The formation records in its lower part a relatively warm Treene Interstadial (which in Poland is called Lublin or Pilica Interstadial, belonging to MIS 7), then passing into the deposits of Warthian (MIS 6). Consequently, the lower member represents deposits of a temperate river, whereas the upper member was formed under cold periglacial fluvial conditions. The lower member was deposited by a meandering river, whereas the upper one was deposited by a river with a braided pattern (Fig. 3).

2.1.1. Lower member of the Chojny Formation

The lower member has an erosional base, sometimes with a lag gravel. Distinct palaeochannels approx. 3 m deep and 35 m wide are characteristic of this part of the succession (Fig. 4). They are infilled with sandy/silty packages composed of large-scale low-angle cross-stratification oriented perpendicularly to the channel axes. Large tree branches are often found at their base, whereas the upper parts of the infills consist of humic silt or peat beds. This is characteristic of relatively deep and narrow ($9 < w/d < 12$), sinuous channels dominated by point-bar macroforms. A second diagnostic indication for a meandering river environment are the fining-upward cycles. These are approx. 2–4 m thick, and show a sequence from single *Gm* bed (channel lag) → *St* coset (megaripples in a channel facies) → *Sh*, *Fl*, *C* association (floodplain assemblage) (Fig. 3). Each cycle reflects successive channel erosion, upfilling and abandonment phases. Horizontally laminated silty sand, silt, humic silt and peat deposits (lithofacies *Fl*) are characteristic fine-grained floodplain assemblages. This overbank facies constitutes typically 30% of all beds in the lower member (Fig. 5).

Summarizing, this lower part of the Chojny Formation represents a medium-scale, typical sand-bed meandering river, dominated by point-bar deposition. The channels migrated laterally within the wide floodplain that was frequently submerged. The thickest peat packages represent the *in situ* organic record of the Treene Interstadial optimum. The floral succession during this

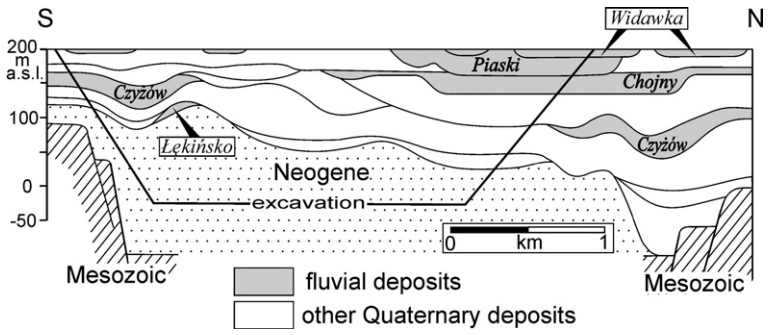

Fig. 2. Composite schematic cross-section through the Kleszczów Graben (modified after Brodzikowski, 1995). The names of fluvial formations are indicated.