A new Early–Middle Weichselian palaeoenvironmental record from a lacustrine sequence at Svirkanciai, Lithuania

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The Middle Weichselian (OIS 4-3) and the transition from Early to Middle Weichselian are the most problematic and disputed time intervals of the Late Pleistocene with regard to the palaeogeography of the Fennoscandian glaciations. The number of sites with sediments of Middle Weichselian age in the Baltic region is very limited. An extensive area (77 km²) of lacustrine sediments (sand, clay, silt with humus and interlayers of peat), under the relief-forming Upper Weichselian till, was discovered in the vicinity of the Venta settlement, northwestern Lithuania, and named the Venta Palaeolacustrine Basin. The Svirkanciai outcrop (56°18′05″N, 22°53′00″E) (15 m in height) of this palaeobasin is composed of two sediment complexes of different genesis and age. The lower part consists of silt and very fine-grained sand of lacustrine origin. According to palynological data, the lacustrine sediments accumulated under boreo-arctic climatic conditions. The pollen records suggest that local vegetation was sparse forest with open areas. An Optically Stimulated Luminescence (OSL) date of the lacustrine sand yielded an age of >79±6 ka, which indicates that lacustrine conditions may have occurred during part of the Early Weichselian Oderade Interstadial (Jonionys 2). However, the palynological data from Svirkanciai suggest a Middle Weichselian age, possibly correlating with the Oerel Interstadial (Jonionys 3) 55 ka ago. No traces of early Middle Weichselian Schalkholz (Nemunas 2a) stadial glacial advance have been found in the Venta sections. This also suggests a Middle Weichselian age for the Svirkanciai lacustrine sediments.

Knowledge of climato-stratigraphic events of the Middle Weichselian (Pleni-Weichselian, Pleniglacial) in the Baltic region is quite limited, especially compared with the Early Weichselian. The latter is known from a number of sites with freshwater sediments discovered in the central parts of the Fennoscandian glaciation in Norway, Sweden and Finland (Nenonen 1995; Donner 1996; Lunkka et al. 2004; Välirinta et al. 2009).

The Middle Weichselian (OIS 4–3) and the transition from Early to Middle Weichselian are the most problematic time intervals of the Late Pleistocene Fennoscandian glaciations from the palaeogeographical point of view. Especially contentious are the extents of glacial advances during the Middle Weichselian (Lunkka et al. 2001; Mangerud 2004; Kalm 2006) and the character of palaeoenvironmental changes in the transition from OIS 5 to OIS 4. Glacial deposits attributed to the Middle Weichselian have been reported from Estonia (Liivrand 1991), southern Finland (Nenonen 1995), Poland (Marks 1997, 2004, 2012) and Denmark (Houmark–Nielsen 2011). Based on glaciological modelling, Zelcs & Markots (2004) proposed a possible early Middle Weichselian glaciation in western Latvia (the so-called Talsi Stadal) between 74 and 59 ka ago; however, no direct evidence was reported. Recently, the Talsi stadial was placed between 68 and 54 ka, and this interval was followed by the Lejasciems interstadial between 54 and 24 ka (Zelcs et al. 2011).

Kalm (2006), summarizing published ¹⁴C and OSL data, indicated that Estonia was ice-free at least between 43.2 and 26.8 ka ago and assumed that the time period for a possible early Middle Weichselian glaciation in Estonia could be between 68 and 44 ka (Kalm et al. 2011). However, this approach is challenged by recent data, which suggest ice-free and warm conditions in major parts of eastern Fennoscandia in early MIS 3 c. 53 ka (Helmens & Engels 2010). Radiocarbon dates suggest that there was a larger ice-free area in Fennoscandia during the Middle Weichselian from c. 44 to c. 22.5 ka than previously assumed (Ukkonen et al. 1999, 2007).

Previous studies show the presence of non-glacial (periglacial and interstadial) palaeoenvironments in Lithuania during the Early and Middle Weichselian, since the end of the Eemian interglacial (Figs 1, 2). It was proposed that non-glacial conditions probably also existed until the Late Weichselian in the main part of the Eastern Baltic; however, this assumption was based only on data from southeastern Lithuania (sections Jonionys, Medininkai, Mickunai, Rokai) (Satkunas & Grigiene 2000; Satkunas et al. 2003; Fig. 1), which were...