8.2 ka event and others cold climate oscillations in middle Holocene – evidence from Suchar Wielki Lake, NE Poland

Magdalena Fiłoc[1*], Mirosława Kupryjanowicz[1], Magdalena Suchora[2] and Monika Rzodkiewicz[3]

[1] Department of Palaeobotany, Institute of Biology, University of Białystok, Ciołkowskiego 1J, 15-245 Białystok, Poland, mfiloc@op.pl

[2] Department of Hydrobiology, University of Life Sciences in Lublin, Dobrzańskiego 37, 20-262 Lublin, Poland

[3] Department of Quaternary Geology and Paleogeography, Institute of Geoecology and Geoinformation, Adam Mickiewicz University, Dzięgielowa 27, 61-680 Poznań, Poland

The best-known climate change in the middle part of the Holocene is an abrupt cooling around 8200 cal. yrs BP (e.g. O'Brien et al., 1995; Bond et al., 1997). This oscillation, known as the 8.2 ka event, was recognised in all most important past climate records, i.e. in the Greenland ice cores (GRIP and GRIP2) and in North Atlantic deep sea cores (O'Brien et al., 1995; Bond et al., 1997), and then it was demonstrated in many records in the world.

Fig. 1 Location of sites mentioned in the text: 1 – Conney Lough, Lake NCY1, Ireland (Ghilardi and O'Conell, 2013); 2 – Bog Brunnboden and Krummgampen, Austria (Kofler et al., 2005); 3 – Lake Preluca Tiganului, Romania (Feurdean et al., 2008); 4 – Lake Steregoiu, Romania (Feurdean et al., 2008); 5 – Bog from Ic Ponor, Romania (Grindean et al., 2015); 6 – Lake Suchar Wielki, Poland (Fiłoc et al., 2016).

However, on the European continent, many different records suggest that during climatic optimum of the Holocene not one, but several cold periods occurred between 9200 and 5800 cal. yrs BP. In Scandinavia, this is indicated, among others, by a 5 glacier advances (Nesje, 2009). Moreover, in several European profiles the vegetation changes are registered for this period. From 3-5 cold climate oscillations were recorded in profiles of Ireland (Ghilardi and O'Conell, 2013), Austria (Kofler et al., 2005) and Romania (Feurdean et al., 2008; Grindean et al., 2015) (Fig. 1). These oscillations were expressed usually as changes in shares and concentration of pollen of thermophilic taxa. The fluctuations in cited records were observed in areas particularly vulnerable to climate change. From this it follows that choice of research area is very important in studies on climate changes.

Good example of this is our research, where study area is located in the transition zone between oceanic and continental climate in north-eastern Poland. It is the best place to study influence of climate changes, because the natural environment is particularly sensitive to climate changes and very quickly responds to them. Therefore, on this area, thermophilous tree species occur at their ecological tolerance limit so that their abundance, regeneration, and pollen production are constrained by climate.

Our multi-proxy data (pollen, diatoms, Cladocera, ^{14}C) from the sediments of Lake Suchar Wielki (8.9 ha, 9.6 m max depth, 54°01'41" N, 23°03'21" E) representing the period ca. 9200-5800 cal. BP have allowed the reconstruction of the influence of five Atlantic cold oscillations on terrestrial and aquatic environments, including the 8.2 ka event. These events were registered as a temporal increase in *Pinus* and/or *Betula* representation and transient decrease in *Corylus* proportion – concentration and pollen percentage values. Pollen data were mostly confirmed by results of Cladocera and diatom analyses, suggesting different intensity of theses climate oscillations. The most pronounced cold climatic anomaly in our study was dated to 8600-7900 ka and lasted about 7 centuries. It is equated with the 8.2 ka event (Bond et al., 1997). Such a long duration of this oscillation is recorded quite rare in the literature. However, the climate proxy records of this oscillation in Europe and the world confirm that the duration of this event in different regions amounted from 400 to 600 years (Rohling and Pälike 2005), This allows for very accurate tracing changes in vegetation and aquatic communities at this time precisely showing the heterogeneous nature of this cooling.

References

Bond, G., Showers, W., Cheseby, M., Lotti, R., Almasi, P., de Menocal, P., Priore, P., Cullen, H., Hajdas, I., Bonani, G.,1997. A pervasive millenial-scale cycle in North Atlantic Holocene and glacial climates. Science 278, 1257–1266.

Feurdean, A., Klotz, S., Mosbrugger, V., Wohlfarth, B., 2008. Pollen-based quantitative reconstructions of Holocene climate variability in NW Romania. Paleogeography, Paleoclimatology, Paleoecology 260, 494–504.

Fiłoc, M., Kupryjanowicz, M., Rzodkiewicz, M., Suchora, M., 2016. (Accepted Manuscript) Response of terrestrial and lake environments in NE Poland to Preboreal cold oscillations (PBO). http://dx.doi.org/10.1016/j.quaint.2016.02.052.

Ghilardi, B., O'Conell, M., 2013. Early Holocene vegetation and climate dynamics with particular reference to the 8.2 ka event: pollen and macrofossil evidence from a small lake in western Ireland. Vegetation History and Archaeobotany 22, 99–113.

Grindean, R., Feurdean, A., Hurdu, B., Fărcaş, S., Tanţău, I., 2015. Lateglacial/Holocene transition to mid-Holocene: Vegetation responses to climate changes in the Apuseni Mountains (NW Romania). Quaternary International 388, 76–86.

Nesje, A., 2009. Latest Pleistocene and Holocene alpine glacier fluctuations in Scandinavia. Quaternary Science Reviews 28, 2119–2136.

O'Brien, S. R., Mayewski, P. A, Meeker, L. D., Meese, D. A., Twickler, M. S., Whitlow, S. I., 1995. Complexity of Holocene climate as reconstructed from a Greenland ice core. Science 270, 1962–1964.

Rohling, E.J., Pälike, H., 2005. Centennial-scale climate cooling with a sudden cold around 8200 years ago. Nature 434, 975-979.