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Viewpoint

Holsteinian Interglacial = Marine Isotope Stage 11?

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Abstract

The problem of correllating the Holsteinian Interglacial with the Marine Isotope Stage (MIS) is still disputed. Generally, a view persists that this interglacial should be linked with MIS 11, although this approach has many adversaries. Palynologic and geochemical data from well preserved fossil lake deposits from the Holsteinian Interglacial in eastern Poland have enabled their correlation with MIS 11.

Quaternary Science Reviews, vol. 24 (2005) contains on pp. 631–644 a paper by J. Nitychoruk, K. Bińka, J. Hoefs, H. Ruppert and J. Schneider ''Climate reconstruction for the Holsteinian Interglacial in eastern Poland and its comparison with isotopic data from Marine Isotope Stage 11''. In this paper, the authors compare the isotopic curves obtained from fossil lake deposits in eastern Poland with isotopic curves obtained for the ODP 980 core from the North Atlantic Ocean. The comparison included palynology, geochemistry, TL dating and dating of the larger part of the Holsteinian Interglacial based on counting annual laminae within the deposit.

In effect, it was shown that the warm interval known in Europe as the Holsteinian Interglacial corresponds to Marine Isotope Stage 11 (MIS 11) of the North Atlantic.

The same volume of Quaternary Science Reviews (vol. 24 (2005), pp 1861–1872) contains a paper by M. A. Geyh and H. Müller ''Numerical ^{230}Th/U dating and palynological review of the Holsteinian/Hoxnian Interglacial''. In their paper, based on ^{230}Th/U dating and age reinterpretation of pollen successions from Germany and Great Britain, the authors considered the Holsteinian/Hoxnian Interglacial to be younger than the Rhumian Interglacial, and to represent Marine Isotope Stage 9 (MIS 9).

The inconsistencies presented in both papers refer to some of the mostly discussed issues in Quaternary stratigraphy; therefore, it seems of interest to present to the readers of Quaternary Science Reviews a discussion about some problems of correlating the Holsteinian Interglacial with the MISs.

We are in agreement with the Global chronostratigraphical correlation table (see Subcommission on Quaternary Stratigraphy (SQS), 2004 and Gibbard et al., 2005) constructed for the Quaternary of North West Europe, that the discussed Holsteinian Interglacial can be correlated with MIS 11, and that the Eemian Interglacial corresponds to MIS 5e.

Some problems exist with the identification of continental equivalents of MIS 7 and MIS 9 and determination of their palaeoclimatic signature. Surprisingly, no reliable polleniferous sites with interglacial deposits have been found between the Holsteinian Interglacial (MIS 11) and the Eemian Interglacial (MIS 5e) in the Central European Lowlands. In western Europe, pollen sequences, which are invoked as potential parallels of the warm MIS 9 and MIS 7 stages, are usually based on fluvial/estuarine deposits. They were accumulated in a very dynamic environment, with high possibility of redeposition (cf Thomas, 2001) and they are not a good source of pollen record. It seems that only long high-resolution lacustrine deposits provide the most complete pollen sequences for the reconstruction of palaeoclimate. A more meaningful example is the review of ''Hoxne'' type sites arranged for England (Thomas, 2001). Almost all fluvial and estuarine sites are attributed to MIS 9 or MIS 7. They represent fragmentary and difficult to

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interpret pollen sequences and the only reliable pollen-iferous deposits are connected with the infill of kettle holes of the Anglian (MIS 11) till sheet. It is very striking that apart from these fluviatile/estuarine sites attributed to the MIS 9 or MIS 7 stages, no lacustrine and bog sites representing warm phases between MIS 11 and MIS 5 were found. Thus, we can say that the resulting sub-divisions have almost no evidence in pollen data. Attempts of correlating various continental deposits with MIS 7 and 9 are in part speculative and often based only on the analysis of geological data (cf Ber, 2005) or/and mammalian and molluscan biostratigraphy of terrace deposits (Schreve, 2001; Bridgland, 2000). The best evidence in northwest Europe for the correlation of the Hoxnian Interglacial with MIS 11 comes from the combination of lithostratigraphy and biostratgraphy (Bridgland, 2000; Schreve, 2001; Thomas, 2001; Bridgland et al., 2004). There is no doubt that the systems of terraces (Bridgland, 2000) with mammalian/molluscan record can be correlated with MIS 11–MIS 5 stages. The main problems are, however, palaeoclimatic conclusions arising from the presence of such fauna in terraces correlated with MIS 9 and MIS 7. Are we justified when we attribute this faunal record to interglacial units? Palaeoenvironmental reconstructions based only on mammalian and molluscan faunas give, as a rule, less valuable conclusions about the course of climate, in comparison with high-resolution lacustrine sites. On the basis of faunal record we can say what occurred in specific periods (e.g. interglacial or interstadial), rather than tracing and reconstructing climatic change. It is not excluded that molluscan and mammalian fauna found in terraces attributed to MIS 9 and MIS 7 may represent a somewhat colder period with a boreal signature or short temperate periods rather than the 'classic' interglacial.

One of the strategic areas for resolving stratigraphic issues in the Quaternary is the Massif Central in France, where long sequences of lake deposits have been found and well correlated with tephra horizons (Reille et al., 2000). After authors the sequence shows that the Eemian (Ribains) Interglacial is preceded by three undoubtedly 'classic' interglacial units—La Bouchet, Landos and Praclaux, of which the lowermost one (Praclaux) is correlated with the Holsteinian Interglacial and MIS 11. Pollen analyses demonstrate similarities to the studied interglacial successions from Western Europe. According to Reille et al. (2000) these interglacials correspond to MIS 5, 7, 9 and 11, respectively. This view is commonly accepted.

However, Geyh and Müller (2005) have questioned correlation of the Pracleaux Interglacial with MIS 11. According to them, re-analysis of the Massif Central successions has shown that the Praclaux Interglacial (after Reille et al., 2000) is older than the Holsteinian Interglacial, corresponding with the Rhumian Interglacial in Germany, whereas the Holsteinian Interglacial itself is correlated with the Landos Interglacial—MIS 9.

Despite variation in the development and dominance of some plant types, the Holsteinian Interglacial in Europe has several commonly occurring characteristic features. One of these, as correctly assumed by Geyh and Müller (2005) is the presence of a mid-interglacial cooling after the *Taxus* phase, expressed in some European successions which are characterized by continental climate, pine dominance and increased NAP values. This signature is typical of successions in Germany (Müller, 1974), England (West, 1956; Turner, 1970; Thomas, 2001) and Poland (Bińka and Nitychoruk, 1995, 1996). Thus, obviously, such cooling can be found also in other European sequences that are, without stratigraphic gaps, and represent deep-water deposits. In turn, the temperate stages of the Praclaux succession from the *Quercus* phase until the end of the *Abies-Fagus* phase comprise 1.15 m of strata (Reille et al., 2000). It is obvious that even with dense sampling, as in the discussed case, the recognition of such a short—several hundred years long (after Müller, 1974)—mid-interglacial cooling is unlikely. This problem is compounded by bioturbation of bottom-dwelling organisms. According to Geyh and Müller (2005), the mid-interglacial cooling missing in the Praclaux succession is present in the Landos Interglacial (Reille et al., 2000), which in turn is linked with MIS 9. This view is, however, controversial. The only visible potential evidence of the cooling (between 32.60— and 32.56 m—Landos Interglacial, Reille et al., 2000) is the decrease in the content of *Taxus* pollen, but without any changes in the curve of other thermophilous trees. The grass curve, supposed to confirm the cooling, displays only one peak, which may be of local nature. Such behaviour is not exceptional in a shallow basin, and is additionally supported by a high content of *Apiaceae* pollen.

More convincing evidence for correlating the successions of the Holsteinian Interglacial of Europe with the Praclaux sequence is the presence of *Pterocarya* grains. In the European successions, *Pterocarya* pollen appears always quite late, by the end of the *Abies* period, similarly as in the Praclaux succession. In the Landos Interglacial *Pterocarya* pollen does not occur (Reille et al., 2000).

Some additional features of the Praclaux Interglacial point to its link with the Holsteinian Interglacial of Central and Eastern Europe. They include the short and abundant *Taxus* phase linked with the large transgression of the Holsteinian Sea. This phase, however, is completely different from that of the Landos Interglacial (Reille et al., 2000). Other similarities refer to the cool interval after the Holsteinian Interglacial. In pollen successions from the Massif Central, three distinct events with a high content of *Juniperus* have been observed. They are identical with those preserved in the Ossówka succession in eastern Poland (Krupiński, 1995; Nitychoruk et al., 2005).

In conclusion, it seems most probable that the Praclaux Interglacial should be linked with the Holsteinian Interglacial and MIS 11, as assumed by Reille et al. (2000).

Similar conclusions can be drawn for the fossil lake deposits from the Mazovian = Holsteinian Interglacial in