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Invited review

The postglacial Pleistocene of the northern Russian mainland

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ABSTRACT

The paper summarizes the results of recent studies of Late Pleistocene postglacial geological events which occurred in the flatlands of northern Russia stretching from the Timan Ridge to the Laptev Sea coast. The available sedimentary record includes thawed and perennially frozen subaerial sediments and in places lacustrine and fluvial formations. Hundreds of geochronometric measurements by radiocarbon and luminescence techniques place this record within the time span of 50–11 ka BP which confirms an Early–Mid-Weichselian age of the underlying glacial complex first established by the QUEEN programme. The spectrum of proxies includes sedimentary facies, pollen data, plant macrofossils, oxygen isotope values, megafauna remains, insect assemblages, traces of DNA, paleosols and permafrost properties. Together they indicate a continental, progressively deteriorating climate with very cold winters and warmer than present summers through the second half of the Late Pleistocene. Minor climatic fluctuations are largely due to slightly changing humidity during MIS 3. These changes are more pronounced in periglacial European Russia in the vicinity of the Barents–Kara ice sheet where the Mid-Weichselian biotic maximum contrasts with conditions in the Late Weichselian polar desert. In Siberia, the periglacial environments were more stable and beneficial for biota inspite of the increased continentality. The recent data accumulated by various researchers are incompatible with the conventional correlation of the Karginsky interglacial strata of Siberia with MIS 3 or any part of the European Pleniglacial.

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1. Introduction

The postglacial history of northern Eurasia is comprehensively studied only in the area of Fennoscandian glaciations where it is rather short, 15 ka at most. The remaining larger and older part of the Eurasian North, ice-free since at least 50–60 ka BP (Svendsen et al., 2004), is far less known. The main stages of the Holocene history of northern Russia have been extensively discussed (e.g. Velichko et al., 1997; Andreev and Tarasov, 2007), whereas the Pleistocene postglacial events were only briefly reviewed in the summary of the Late Weichselian periglacial environments with reference to Middle Weichselian climates by various QUEEN (Quaternary Environment of the Eurasian North) research teams (Hubberten et al., 2004). In the wake of the QUEEN projects the chronological control of the postglacial sedimentary record has improved both quantitatively, owing to numerous chronometric measurements, and qualitatively due to new proxies obtained by several international research teams. New results have been largely published in the Russian literature (e.g. Astakhov and Mangerud, 2007; Nazarov, 2007; Astakhov and Nazarov, 2010; Derevyagin et al., 2010; Astakhov and Svendsen, 2011).

Apart of the QUEEN overview (Hubberten et al., 2004) most recent studies were restricted to limited areas or focused on especially important or interesting cases studied by investigators with different agendas. Therefore, to outsiders many new results would seem contradictory or derived from unrelated topics. It is my contention that despite the different methods applied and sometimes different conclusions suggested for various parts of the Russian Arctic the general succession of geological events of the postglacial Pleistocene history is basically the same for different terrains of the glaciated territory.

The following overview is aimed at collating published evidence of the nature, succession and timing of geological events postdating the last regional glaciation of northern Russia mostly between 48° and 110°E (Fig. 1). To fulfil the task some geological results from the periglacial zone are included, drawing on my own research findings. For the more problematic area of East Siberia I refer to literary

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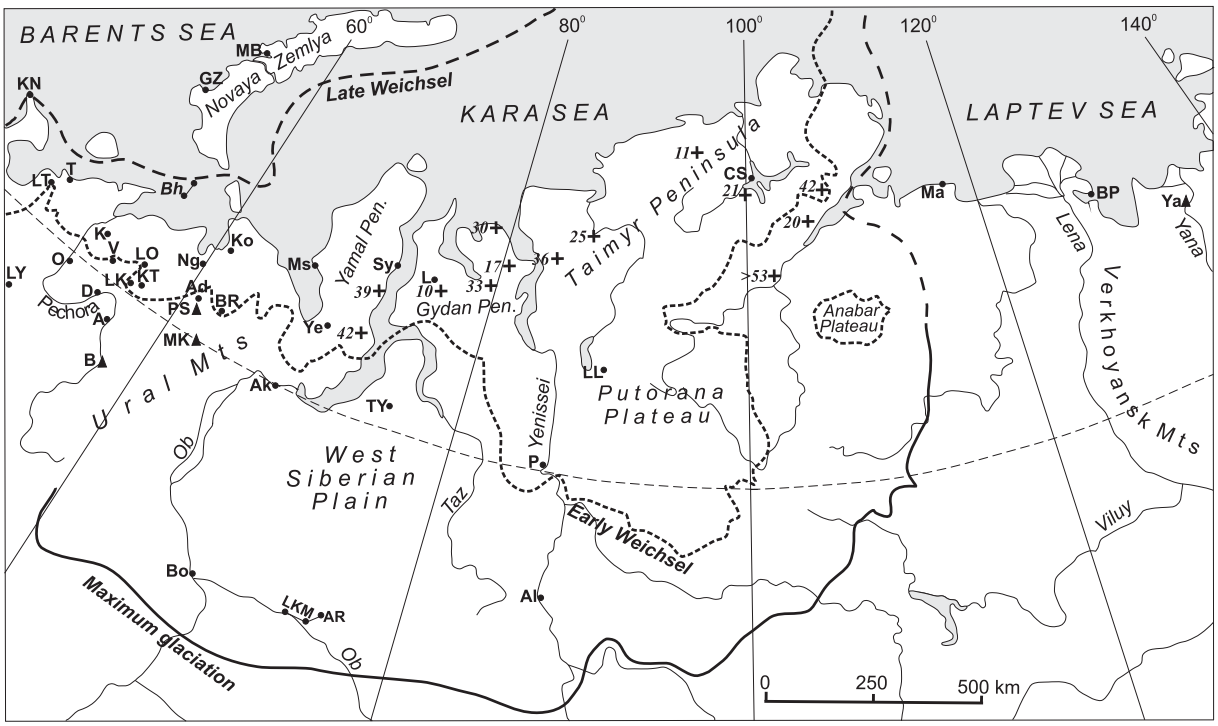

Fig. 1. Dated sections of the postglacial Pleistocene of northern Russia. **European part:** A – Akis, Ad – river Adzva, K – river Kuya, Ko – river Korotaikha V – river Vonda (Astakhov and Svendsen, 2011); B – Byzovaya (Heggen et al., 2012); *Bh* – borehole profile *210–234* on sea floor (Polyak et al., 2000); BR – river Bol. Rogovaya, Ng – river Ngutayakha (Astakhov et al., 2007); D – Denisovka, O – Okunyovo (Lavrov and Potapenko, 2005); GZ – Gusinaya Zemlya, MB – Mityushikha Bay (Serebryanny and Malyasova, 1998); KN – Kanin Nos (Demidov et al., 2006); KT – terraces of river Kolva, PS – Pymva-Shor, T – Timan Coast (Mangerud et al., 1999); LK – lake Kormovoye, LO – lake Oshkoty (Henriksen et al., 2003); LT – lake Timan (Paus et al., 2003); LY – lake Yamozero (Henriksen et al., 2008); MK – Mamontovaya Kurya (Svendsen et al., 2010). **Siberia:** Ak – Aksarka, TY – river Tab-Yakha (Astakhov and Nazarov, 2010); Al – Alinskoye (Sukhorukova et al., 1991); BP –Bykovsky Peninsula (Sher et al., 2005); CS – Cape Sabler (Kind and Leonov, 1982; Möller et al., 1999); I – Igarka (Kind, 1974); LKM–AR – profile Lokosovo–Kiryas–Mega to Agan Ridge (Astakhov, 1992); L – Lysukanse (Bolikhovsky, 1987; Astakhov and Nazarov, 2010); LL – lake Lama (Hahne and Melles, 1999); Ma – Mamontov Klyk (Schirrmeister et al., 2008); P – Poloy (Astakhov and Mangerud, 2007); Ms – Marresale (Forman et al., 2002); Sy – Syoyakha (Vasilchuk et al., 2000); Ya – river Yana (Pitulko et al., 2004; Pitulko and Pavlova, 2010); Ye – river Yerkata (Astakhov, 2006). Crosses indicate mammoth carcasses with their radiocarbon ages, ka BP: river Khatanga – >53.2, Lyuba – 41.9, Masha – 39.1, river Mokhovaya– 35.8, Schmidt – 33.5, Cape Leskin – 30.1, river Pyasina – 25.1, river Mongoche – 17, river Mamonta – 11.5, river Yuribei – 10 (Astakhov and Nazarov, 2010 and references therein); lake Arilakh – 42.4, Fish Hook – 20.6, Jarkov – 20.2 (MacPhee et al., 2002). Black triangles are Palaeolithic sites. Thick lines are major ice limits.

sources but this information is necessary because a couple of sections in this region contain uniquely continuous records of Late Pleistocene history. For chronological control I rely on previously published dates from the international literature with lists of ages obtained by ^{14}C, OSL and other chronometric techniques, supplemented by dates available only from Russian sources.

The geographic names used in this text for the major parts of the continental landmass are northeastern European Russia including the Pechora Lowland, Cis-Uralia and the Barents Sea coast, West Siberia for the area between the Urals and Yenissei river, Central Siberia for the area between the Yenissei and Lena rivers, and East Siberia for the lands farther eastwards.

2. Existing knowledge

There are contradictory conclusions regarding the second half of the northern Late Pleistocene. The most evident are different ideas regarding the chronology of postglacial events that are connected with different genetic labels, i.e. glacial and marine origins ascribed to certain surficial features support the short version of the postglacial history. In contrast, the focus on subaerial and permafrost processes has led to the adoption of a much longer succession of postglacial events.

The Late Pleistocene of northern Russia was originally viewed as fundamentally different from the Fennoscandian history. The classical viewpoint acknowledged the thick sedimentary cover of postglacial formations and the finds of frozen mammoth carcasses as evidence of a much longer time interval that had elapsed since the disintegration of the last regional glaciation. The latter was considered as an early Weichselian event preceding the maximum ice advance in north-western Russia correlative with the Late Weichselian (Yakovlev, 1956; Zubakov, 1972).

However, the advent of conventional radiocarbon dating led to a new paradigm of a younger glaciation which, it was thought, covered all northern plains and coalesced with the Late Weichselian ice sheet of Fennoscandia. The main argument for a short postglacial history was provided by several finite radiocarbon dates that were recovered from beneath the uppermost diamicton in various sections (e.g. Kind, 1974; Arslanov et al., 1987; Arkhipov, 1998).

The concept of a short postglacial history was criticized as contradicting the statistical distribution of the entire population of radiocarbon ages and the megafauna remains with old radiocarbon dates found near the surface (Astakhov, 1992, 1998a). The restoration of the classical concept of a long postglacial history, however, was not eagerly accepted in the Russian literature, in which the idea of a young continental glaciation dominated since the 1970s. Thus, the MIS 2 age of the last regional glaciation called Polar on the Pechora and Late Zyryanka (Sartan) in Siberia has now been accepted by various official stratigraphic schemes (Guslitser et al., 1986; Isayeva et al., 1986; Volkova and Babushkin, 2000).

The recent efforts of the international community in stratigraphic studies of the Late Pleistocene of the Russian Arctic (Fig. 1) within the QUEEN program, summarized by Svendsen et al. (2004),

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