NEOPLEISTOCENE DEPOSITS IN THE KOLA REGION: STRATIGRAPHY AND THE KEY-SECTIONS – A CONTRIBUTION TO THE DATABASE OF THE QUATERNARY TERRESTRIAL EUROPEAN STRATIGRAPHY (DATESTRA)

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In recent years, the Neopleistocene stratigraphy arouses interest in the context of the DATESTRA Project (Database of Terrestrial European Stratigraphy) [6], which has been supported by INQUA. Neopleistocene deposits in the Kola region have accumulated under conditions of recurrent glaciations and the following interglacial warming with marine transgressions, which appeared here in the coastal areas. The interglacial-glacial cyclicity offers an opportunity to apply climatostratigraphic methods for subdivision of corresponding deposits. Accompanied by biostratigraphic and geochronometrical methods, this approach enables definition and correlation of short-term (about tens of thousands years) stratigraphic units. Using this approach, middle and the upper Neopleistocene units have been identified in the sediment successions in the Kola Region. The aim of this paper is to review the available data (published mainly in Russian), which are applicable to the Database of Terrestrial European Stratigraphy.

Material and methods

A review of the available data includes only the key-sections with stratigraphic units that were identified according to lithological, palaeontological (pollen, diatoms, foraminifera and others) features and geochronometrically (C^{14} , U-Tr, ESR, IR-OSL) dated. The data have to be published in scientific papers or books that are accessible to the public. Fig. 1 shows 10 key-points that have been taken into account [1-5, 7-14]. All stratigraphic units correlate with the marine isotope stages (MIS).

Fig. 1. Location of the middle and late Neopleistocene key-sections in the Kola region.

The key localities are shown by Arabic numerals: 1 – the right bank of the Kamenka River valley, 2 – the western outskirts of the town of Kovdor, 3 – Seidozero-Lovozero height of land, East of the Lovozero Tundra mountain mass, 4 – the right bank of the Chavanga River valley, 5 – the right bank of the Strelna River valley, 6 – the left bank of the Chapoma River valley, 7 – the left bank of the Ponoj River valley, 8 – the upper reach of the left tributary of the Malaya Kachkovka River, 9 – the head of the Svyatoi Nos Bay, Barents Sea, 10 – right bank of the Varzuga River valley.

According to the current Quaternary System subdivisions for European Russia [15], the **upper Neopleistocene** includes **Mikulinsky** (MIS 5), **Podporozhsky** (MIS 4), **Leningradsky** (MIS 3), and **Ostashkovsky** (MIS 2) **Horizons**; **middle Neopleistocene** associates with **Likhvinsky** (MIS 11), **Kaluzhsky** (MIS 10), **Chekalinsky** (MIS 9), **Vologodsky** (MIS 8), and **Gorkinsky** (MIS 7) **Horizons**.

Middle Neopleistocene key-sections

The available data from the Kola Peninsula evidence the Neopleistocene (the middle and late Pleistocene in West Europe) stratigraphy record begins here with the **Chekalinsky** (MIS 9) **Horizon** [10, 11]. The most ancient deposits are known from only one locality. The corresponding unique key-section is situated in the southern Kola Peninsula on the right bank of the Lower Varzuga River (10 in Fig. 1). The basal part of the Varzuga section is represented by superposition of consolidated clay, loam, sandy loam with subfossil mollusc shells ESR dated between 319 and 316 ka, and lenses of coarse-grained sand, and pebbles. Recurring vegetative assemblages are characterized by increasing quantity of *Betula* sect. *Albae* with occurrence of mesophilous and thermophilous components (*Alnus*, *Quercus*, *Tilia*, *Ulmus*, *Carpinus*, *Corylus*, *Osmunda*, *Nuphar*, *Nymphaea*) indicate several middle Neopleistocene warm climatic events. The middle Neopleistocene **Chekalinsky** (MIS 9), **Vologodsky** (MIS 8), and **Gorkinsky** (MIS 7) **Horizons** are probably presented in the Varzuga key-section.

In the interglacial marine clay sediments exposed in the Varzuga outcrop, Knipowich and Lavrova [12] found 24 mollusc species; 25% are boreal and mainly boreal species, with *Dentalium entalis* L., *Mytilus edulis* L., *Panopaea norvegica* (Spengl), which currently do not inhabit the White Sea; 46% are arctic-boreal species, 29% – arctic ones [3, 9]. Diatoms are represented by polygalobs, methogalobs, oligogalobs (galophils, indifferents). Twenty three foraminifera species with dominating boreal-arctic *Criboelphidium goesi* (Stshedr.) and warm-water *Cassidulina subacuta* (Gud.), *Elphidium* aff. *subclavatum*, *Islandiella islandica* (Norv.), *Asrtionion gallowayi* Loeb. et Tappan ones were identified. Some cold-water species (*Buccella frigida* (Cushm.), *Nonionellina labradorica* (Dawson), *Protelphidium orbiculare* (Brady), *Criboelphidium goesi* (Stshedr.) were also found [3].

Till and melt-water deposits of the **Moskovsky** (MIS 6) **Horizon** are known in numerous outcrops from the western and central parts of the Kola region, and on the White Sea coast. Four key-sections are situated in the head of the Svyatoi Nos Bay of the Barents Sea (9 in Fig. 1), in the valleys of the Lower Chapoma (6 in Fig. 1), Ponoï (7 in Fig. 1), and Malaya Kachkovka (8 in Fig. 1) Rivers. Moskovsky Horizon deposits are overlaid here by interglacial sediments attributed to the Mikulinsky (MIS 5) Horizon.

Late Neopleistocene key-sections

In the current Russia Quaternary System subdivisions, the interglacial **Mikulinsky** (MIS 5) **Horizon** correlates to the NW European Eemian (MIS 5e) subdivision and the lower Weichselian (MIS 5a-d) one [15]. Generally represented by marine and brackish-water sediments, the Mikulinsky Horizon includes both the Ponoï and Strelna Beds identified in the Kola upper Neopleistocene Stratigraphy. The ESR/OSL-age of the Ponoï and Strelna Beds ranges from approximately 120 – 130 to 100 – 105 ka (MIS 5e-d) and 100 – 105 to 70 – 80 ka (MIS 5c-a), respectively [7, 9]. The key-section with the Ponoï and Strelna Beds is situated in the valleys of the Strelna (5 in Fig. 1), Chapoma (6 in Fig. 1), Ponoï (7 in Fig. 1), and Malaya Kachkovka (8 in Fig. 1) Rivers and in the head of the Svyatoi Nos Bay, Barents Sea (9 in Fig. 1). Palynological proxies and diatom data from the Ponoï Beds indicate a more favorable environment as compared with the modern one [1–5, 7–14]. Palaeontological remains enclosed in the Strelna Bed sediments indicate environment conditions close to the modern ones or colder [3, 12].

The interglacial Mikulinsky lacustrine sediments and peat were drilled on the slopes of the Lovozero Tundra (5 in Fig. 1) in the central part of the Kola region [4]. Interglacial deposits are overlaid here by till (MIS 4?) and lacustrine sand (MIS 3?).

Glacial deposits of the **Podporozhsky** (MIS 4) **Horizon** are known from the central, north-western, western, and southern parts of the Kola region [2, 4, 7–10]. Natural exposures with the Podporozhian deposits have been found on the Tersky Coast of the White Sea, represented by till, probably glaciomarine sandy loam and sand, glaciofluvial and glaciolacustrine sand and sandy loam in the outcrops. As key-

sections we can only take into account the depositional successions from the Kamenka (1 in Fig. 1) and Chavanga (4 in Fig. 1) River valleys [7, 9], and from the Seidozero-Lovozero height of land (3 in Fig. 1); the Podporozhsky Horizon has the lower stratigraphic boundary here. The upper boundary is identified in the Kamenka sedimentary succession (1 in Fig. 1); the glaciolacustrine sand here was IR-OSL-dated at 63.6 ± 8.0 [9].

Interstadial peat and lacustrine and fluvial sand of the **Leningradsky (MIS 3) Horizon** are known from the Kovdor open pit (2 in Fig. 1) in the western Kola region, from boreholes in the Lovozero Tundra Mountains (3 in Fig. 1) [2, 14], and from the Kamenka sedimentological succession (1 in Fig. 1) [7, 9]. Providing a record of Valdaian (middle and late Weichselian in western Europe) marine and glacial sedimentation, the key-section in the Kamenka River valley is the most informative. Fragments and valves of shells of the arcto-boreal and arctic molluscan species, such as *Chlamys islandicus* Mll, *Astarte crenata* Gray, *A. crenata* var. *crebricostata*, *Mya* sp., and *Pecten islandicus* have been found here. Among diatoms, polygalobs, and sparse methogalobs, and oligogalobs species (*Isthmia nervosa* Ktr., *Isthmia* sp., *Rhabdonema* sp., *Melosira sulcata* (Her.) Ktz.) have been identified; no thermophilic diatoms have been found here [4]. Scarce palaeontological data suggest littoral and sublittoral conditions of a rather cold sea reservoir. Spore and pollen data evidence the environment conditions were more severe than at the present time; terrestrial area was dominated by forest-tundra (*Betula*-*Pinus* sparse growth of trees) and tundra [3, 4, 14]. The ages of the sediments from the Kamenka section [9] and the Kovdor industrial open pit [14] were determined by ESR and ^{14}C dating of mollusc shells and humus between 31 and 59 ka.

Tills and melt-water sediments of the glacial **Ostashkovsky (MIS 2) Horizon** are the most common in the Kola region. Nevertheless, the corresponding key-sections or stratotypes have not been referred yet.

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