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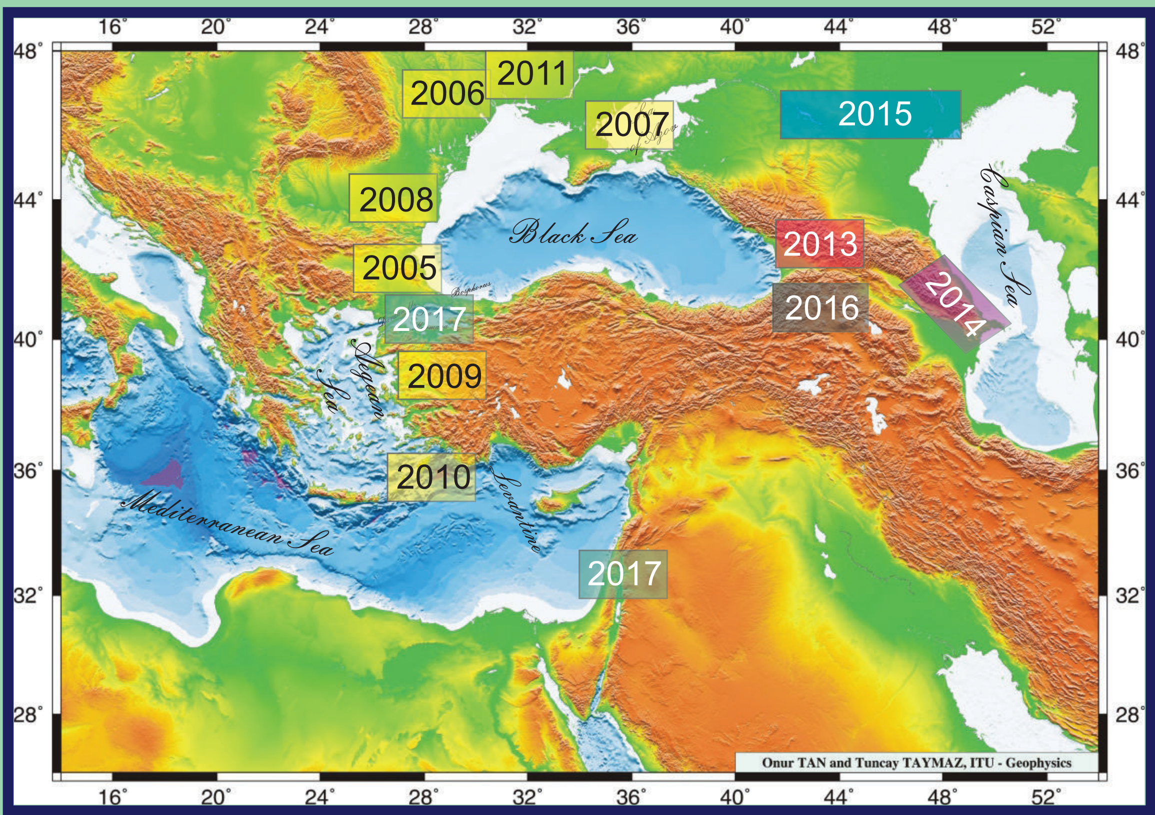

Proceedings of the Fourth Plenary Conference

IGCP 610 "From the Caspian to Mediterranean: Environmental Change and Human Response during the Quaternary" (2013 - 2017)

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IGCP 610 Fourth Plenary Conference and Field Trip, Tbilisi, Georgia, 2-9 October 2016

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FIRST OPTICALLY STIMULATED LUMINESCENCE DATING RESULTS OF LOWER VOLGA SEDIMENTS (SREDNYAYA AKHTUBA SECTION)

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Introduction

The Lower Volga is unique for understanding Caspian Sea Pleistocene history, and for correlating Caspian region paleogeographical events with glaciations of the East European plain and global climate change in the Quaternary (Yanina, 2012). Sections of recent deposits are representative because of their completeness, presence of both marine and subaerial sediments, and because of paleontological richness. That is why the Lower Volga region has been studied for many years by many researchers (Fedorov, 1957; Moskvitin, 1962; and others). Extensive material about the paleogeography of this region has been gained from the results of their basic research.

Chronology of paleogeographic events is one of the most controversial issues in the study region. There are currently age estimates of different stages, obtained by electron paramagnetic resonance spectroscopy (Molodkov, 1992), thermoluminescence, uranium-ionium (Arslanov et al., 2016), and radiocarbon (Arslanov et al., 2013; Tudryn et al., 2013; Svitoch, 2009), which often give contradictory results. The main purpose of this research is to obtain new dating results for the reference section of Srednyaya Akhtuba (Volgograd region, the left bank of the Akhtuba River). This location was selected for study as it most fully reflects the events of the late Pleistocene (see stratigraphic characteristics in Kurbanov et al., this volume).

Methodology

Complex paleogeographic analyses were conducted during the study of the reference section, and stratigraphic, lithological, paleopedological, and paleofaunal characteristics were obtained for the section during this study. Special attention was paid to sampling for OSL dating.

Samples were taken from each layer, with 15 cm distance from the boundaries between layers in order to exclude the mutual influence from radiation properties of the sediments. Sampling was carried out with plastic pipes of 5 cm diameter and a length of 30-35 cm. They were fully pounded into the deposits with a hammer at right angles to the side of the section and then packed in lightproof bags to avoid exposure to the sun. Some samples were selected during the night in the absence of sunlight in lightproof bags.

The OSL method is based on the principles of quantum mechanics, according to which energy accumulates in the crystal lattice of weathered minerals (usually quartz and feldspar) after their sedimentation. The amount of this energy can be measured and then divided by the rate of energy accumulation in the sediment. Laboratory processing of samples consists of determining the rate of energy storage in the sediments (dose rate) and the amount of stored energy (equivalent dose).

OSL dating was carried out in the DTU Nutech and Aarhus Nordic Luminescence Lab. Sample preparation for the measurements took place in the laboratory under red LED illumination. The samples were sieved to recover a fraction of 90-180 µm. The resulting material was sequentially treated with 10% HCl to remove carbonates, 10% H_2O_2 to remove organics, and 10% HF to clean the grains of any clay silicate coating. Quartz and feldspar grains were divided for each sample with heavy liquid of 2.58 g/m^3 density.

The luminescent signal was measured using quartz for the more recent Early Khvalynian and Atelian deposits and using feldspar for the loess-soil horizons, each employing an automated Risø TL/OSL-reader. The laboratory exposure was performed using a $^{90}Sr/^{90}Y$ source installed in the reader, with a capacity of 0.045 Gy/s.

A purity check was conducted previously for each sample to verify the results of quartz and feldspar separation; it consisted of quartz aliquot stimulation by infrared radiation. It is necessary to conduct a separation again if there is a fixed signal, as the infrared radiation responds only to feldspar. Since such signal was not recorded in any of the samples, we can affirm a successful separation.

For feldspar signal measurement, the Post-IR IRSL protocol was used (Thiel et al., 2011). Aliquots were submitted to preheating at 320°C followed by infrared stimulation at 50°C and measuring again at 290°C. Repeated measurement data were used to calculate the equivalent dose. The measurements for the quartz signal were performed with a standard SAR-protocol (Murray and Wintle, 2000).

Results

As a result, 11 OSL dates (Table 1) were obtained, covering ages from 720 years ("control" age) to 112 thousand years.

Table 1. Dating results

Riso laboratory №	*Altitude (m, a.s.l.)*	*Sediment*	*Age (ka)*	*Uncertainty (ka)*	*Equivalent dose (Gy)*	*Number of aliquots*	*Annual dose rate (Gy/ka)*
150801	16.8	modern soil	0.72	0.11	1.16	19	1.62
150806	14	upper part of chocolate clay	13.02	0.61	41.14	17	3.16
150807	12.7	lower part of chocolate clay	15.02	1.00	46.85	12	3.12
150809	11	paleosol #1	26.99	1.58	34.48	14	1.28
150810	8.6	alluvial sand	35.54	3.11	27.50	21	0.77
150812	7.3	alluvial sand	36.78	3.58	48.15	15	1.31
150814	6.5	untypical sandy loess	48.68	3.14	91.40	16	1.88
150822	1.8	paleosol #2	68.28	4.31	207.79	5	2.97
150824	0.4	loess-like	87.62	4.39	274.74	7	3.18
150827	-0.1	paleosol #3	102.50	5.16	325.53	6	3.18
150829	-0.8	loess-like	112.63	5.40	331.45	5	2.94

Seven of them were based on quartz, and four dates were derived from feldspar. Equivalent dose measurements using different aliquots give predominantly normal or log-normal distribution values (typical for them) (Fig. 1).

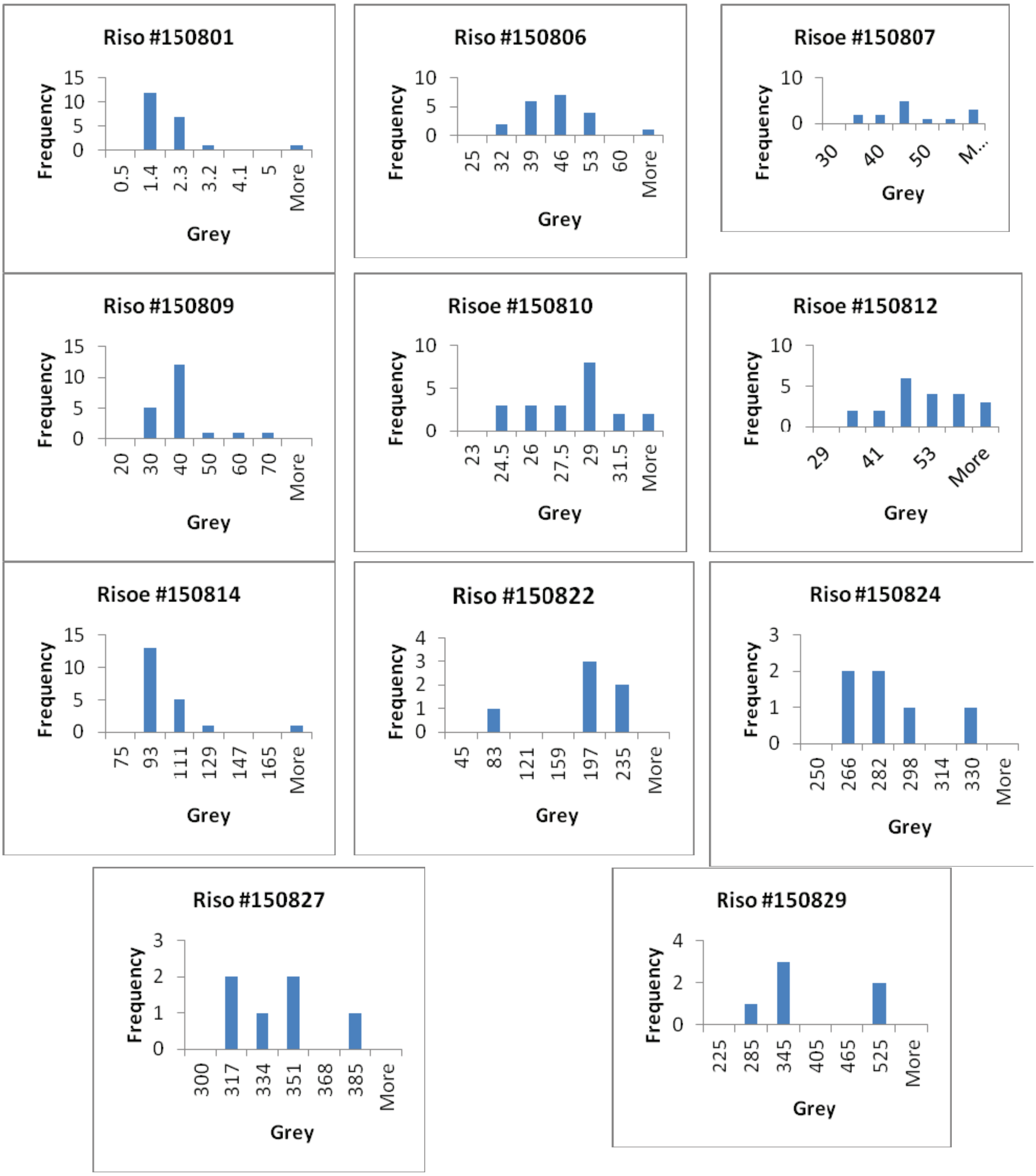

Figure 1. Results of measurements.

Conclusions

We obtained the first geochronological scheme of paleogeographic events for the Late Pleistocene of the Lower Volga region based on OSL using 11 dates obtained by the authors.

There are five stages of development in this territory during the Late Pleistocene (Fig. 2): Late Khazarian (MIS 5e; Mikulino or Eemian interglacial), Hirkanian (MIS 5d-a; the transition from the Mikulino interglacial to the Valdai glacial stage), Atelian (MIS 4-3 and the last glacial maximum, LGM), Khvalynian (MIS 2; degradation of glaciation), and Late Khvalynian to Holocene (the end of MIS 2 and MIS 1).

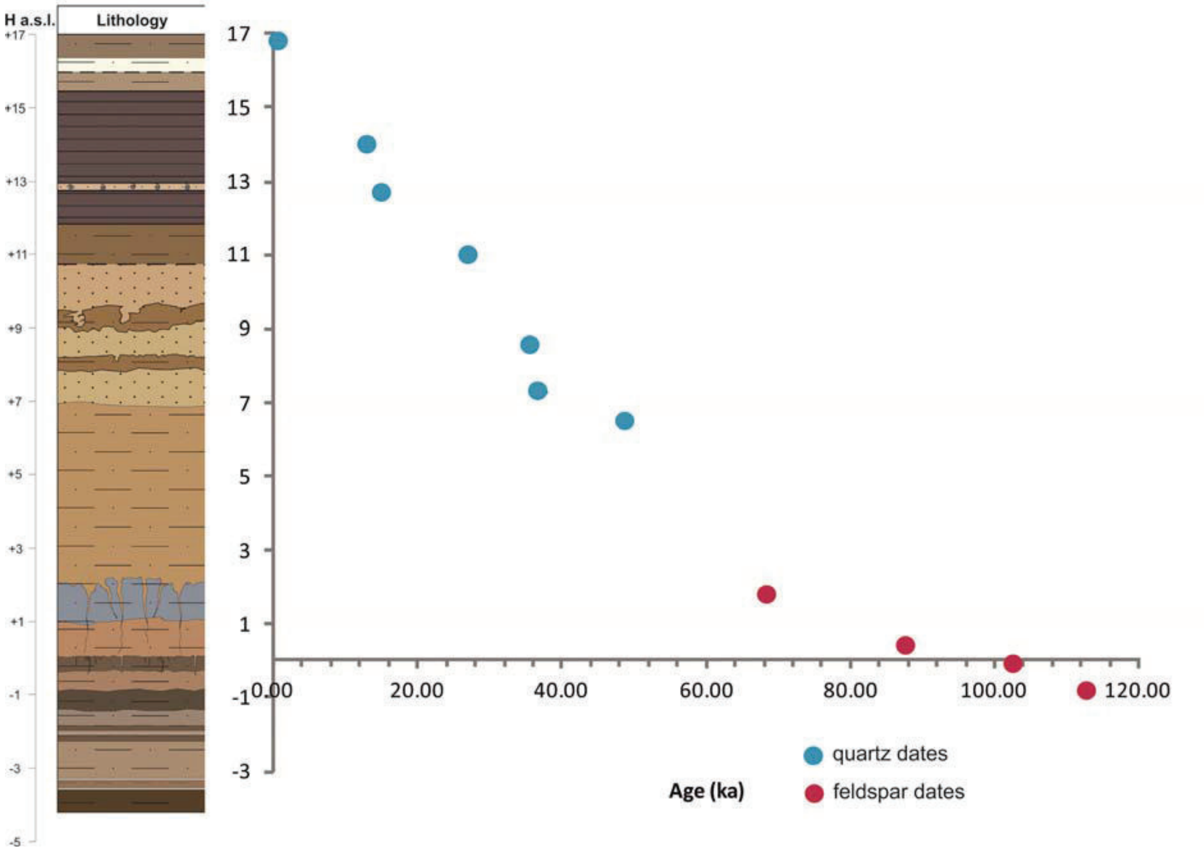

Figure 2. Scheme of the site and obtained OSL dates.

The age of the chocolate clays, which are widespread in the Lower Volga region, is usually considered as arguable and highly rejuvenated. Due to this research, the results of OSL dating of the chocolate clays confirms their average radiocarbon and uranium-thorium dating results.

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