

FIRST RESULTS OF THE COMPLEX ^{14}C AND $^{230}\text{Th}/\text{U}$ DATING OF ORGANIC MATTER IN THE REFERENCE SECTIONS OF THE LATE-MIDDLE PLEISTOCENE LOOSE SEDIMENTARY DEPOSITS OF THE CENTRAL KAMCHATKA

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Reference sections of the Middle and Late Pleistocene of Kamchatka are located in the Central Kamchatka Depression (CKD) in the Kamchatka river valley and its affluents. Reference sections are represented by the high (up to 100 m height) yars, built by the loose deposits. It is considered that natural events imprinted in the Yars form the basis of the paleogeography, paleoclimatology, history of volcanism and glaciations, as well as tectonic activity of the whole Kamchatka for the last 400 Ka (Braitseva et al., 2005; State Geological Map, 2009; Modern ..., 2005, etc.). Unfortunately, isotopic (radiocarbon) data were available only for the upper part of the section up to now. Estimates of the age of the middle and lower “Middle Pleistocene” parts of Yars has been done only by indirect data (Pevzner et al., 2018).

Due to the highly questionable age of the deposits represented in the discussed sections, we started complex work aimed on isotopic (^{14}C and $^{230}\text{Th}/\text{U}$) dating of the buried organic horizons in the sections of the Kamchatka river and its affluents. Here we discuss first results of the modern isotopic dating of the buried organic deposits in the Central Kamchatka Yars. Fig. 1 shows schematical structure of the Yars.

^{14}C dating was done in the Geological Institute RAS (indexed as GIN at fig. 1); in 2016-2017 a series of new age definitions was obtained (fig. 1, samples 15292-15314). Dates received in 1980-1990 and published in (Braitseva et al., 2005) were revised (samples 3401-5303). AMS-dating was done in Ottawa university, Canada (indexed as UOK). $^{230}\text{Th}/\text{U}$ dating has been done in Saint-Petersburg University; for age definition we used version of the isochronous approximation of $^{230}\text{Th}/\text{U}$ -method based on quantitative definition of U and Th isotopes in a series of the samples of the same age using leaching method (L/L-model) and full dilution (TSD-model) (Maksimov, Kuznetsov, 2010; Maksimov et al., 2017a, b).

Middle Yar (N 55°01'10.52", E 158°59'25.86") is located on a right bank of Kamchatka river in its middle course. Cross-bedded sands layer is up to 40 m thick here. In its lower part we have found two horizontally consistent buried peat layers up to 20 cm thick each, which contained several thin undisturbed layers of the volcanic ash. A crossover ^{14}C and $^{230}\text{Th}/\text{U}$ dating have been done for the “Upper” (20 m above the river) and “Lower” (10 m above the river) peat layers (table).

Table. Results of the crossover ^{14}C and $^{230}\text{Th}/\text{U}$ dating of the buried peats in the cross-bedded sands layer of the Middle Yar, Kamchatka

Sample №	Material for dating	^{14}C age (years)	Calibrated age (Ka)	$^{230}\text{Th}/\text{U}$ (Ka) L/L model	$^{230}\text{Th}/\text{U}$ (Ka) TSD model
15311	«Upper» peat	43250±700	44.4±0.7	46±4 (8 samples)	43±4 (8 samples)
15308	«Lower» peat	43000±600	44.2±1.1	34±3 (3 samples) 40±3 (5 samples)	66±9 (3 samples) -

Conclusions:

1. Massif of ^{14}C ages is consistent in its most part and demonstrates natural increase of age down the section. According to the ^{14}C dating we can conclude that most part of sedimentary deposits were formed in MIS-3, i.e. in the Late Pleistocene (not in the Middle Pleistocene, as it was considered before).
2. Results of $^{230}\text{Th}/\text{U}$ dating confirm that age of the lower part of the cross-bedded sands may be as well MIS-3. Received data (^{14}C and $^{230}\text{Th}/\text{U}$) are well correlated between themselves for the “Upper” (sample 15311) and satisfactory well for the “Lower” peat layer (sample 15308), which were investigated in the cross-bedded sands of the Middle Yar.

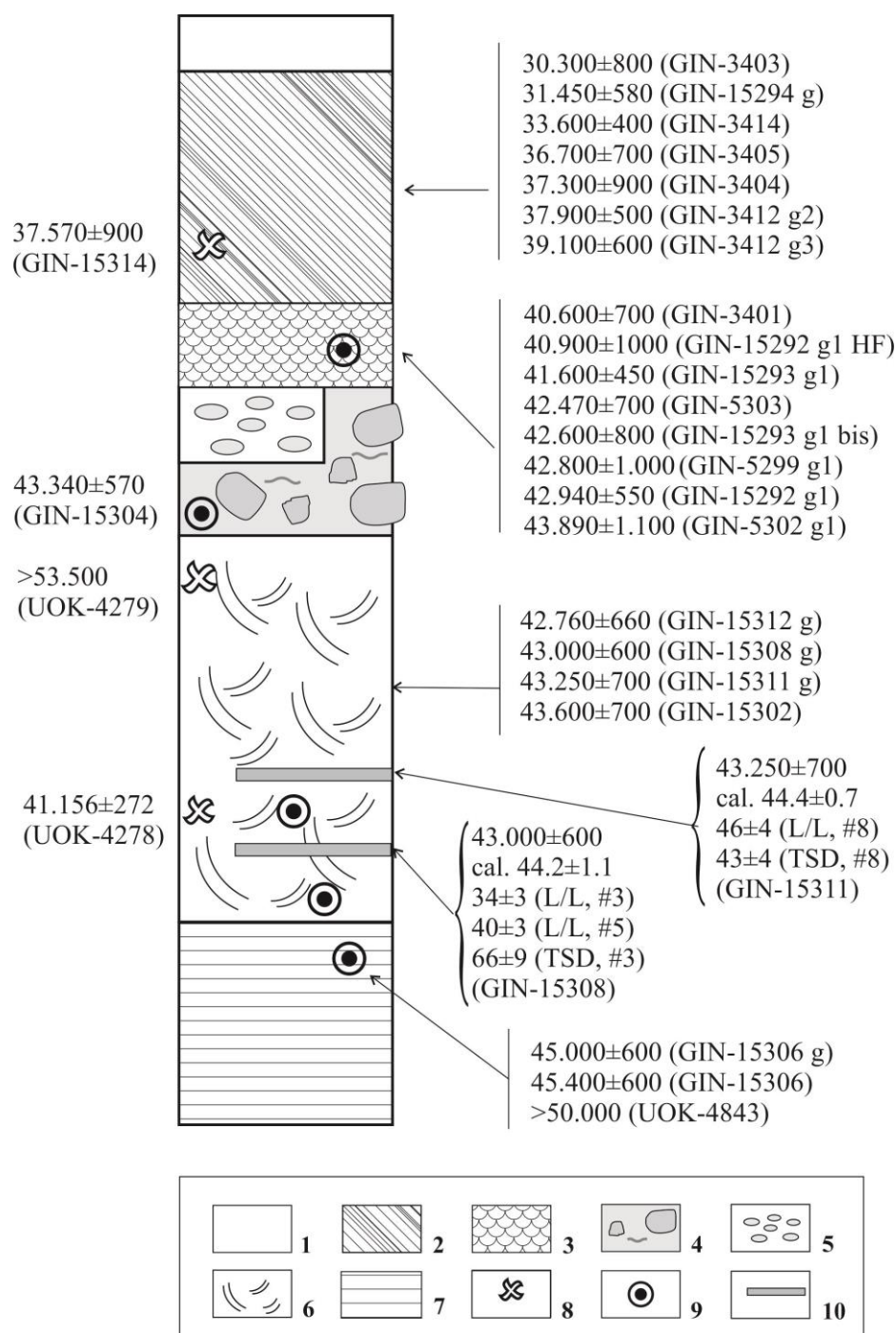


Fig. 1. Schematic composite section of the reference sections of the loose sedimentary deposits of the Central Kamchatka Depression with ^{14}C and $^{230}\text{Th}/\text{U}$ ages, received for the samples in situ. Names of the layers by (Braitseva et al., 1968, 2005; Kuprina, 1970). 1- Holocene soil-pyroclastic sheet; 2 – cover sandy loam up to 30 m thick; 3 – “intra-glacial alluvial deposits” up to 25 m thick; 4 – “moraine-like” layer, up to 50 m thick; 5 – pebbles, which stratigraphically substitute “moraine-like” layer; 6 – cross-bedded sands, up to 40 m thick; 7 – “blue” clays, 10 m visible; 8 – bones of mammals; 9 – buried woods; 10 – buried peat layers.

^{14}C dates were received from the consequent alkaline extracts (g1, g2, g3), one hot extract (g), after treatment in HF, repeated dating of benzole (bis), or from wood (not indexed) or bones collagen (to the left from the column at Fig.1. Knowingly rejuvenated ages are not shown. For the cover sandy loams and “intraglacial” deposits age definitions are provided as massifs without stratigraphical binding. Calibration of ^{14}C ages is done after (Reimer et al., 2013).

- Substantial variations of $^{230}\text{Th}/\text{U}$ ages for the sample 15308 are most likely caused by the violation of the preconditions of the isochronous approximation of $^{230}\text{Th}/\text{U}$ method. This may result from the existence of more than one source of detritus pollution of the peat (for example, volcanic ash may serve as such additional source). For the peats, we also do not exclude partial non-compliance of the

conditions of the closed radiometric system in relation to the isotopes of uranium and thorium during the post-sedimentary times.

4. Age of formation of the bottom part of the section ("blue clays" layer) must be considered as uncertain despite two available ^{14}C dates.

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