On Genesis of the Lower Kolyma Yedoma Based on New AMS 14C Dates from Duvanny Yar

V.V. Spektor, E. Bulygina, A. Bunn, S. Chandra, S. Davydov, K. Frey, R. M. Holmes, J. Schade, W. Sobczak, A. Falina

Introduction
In recent years, careful attention has been paid to the study of ice complex (loess-like silts enclosing thick ice wedges) as one of the most significant sources of organic matter incoming to the Arctic watershed rivers. In this connection in 2008-09, in the scopes of the POLARIS project, we conducted studies aimed to refine structure, genesis and ancient organic material of this complex, widespread on the Kolyma Lowland (Fig 1).

Fig. 1. Location of the Dynany Yar exposure (regional map) and Section 3 (cut-in map).

Aim
For better understanding linkages between yedoma, as one of the main sources of organic matter, and modern content of organic in the Lower Kolyma, as well as to precise paleoclimatic and geodynamics history of the region, new radiocarbon data were obtained on the upper yedoma part from the stratotype exposure Duvany Yar, situated on the Kolyma River right bank, 40 km downstream of the Omolon River mouth (Fig 2, 3).

Materials and Results
The studied section (N68 37’8” E159 08’6”) is located on the eastern end of a big thermokarst cirque which had formed at the margin part of the gently sloping accumulative plain cut by the Kolyma River (Fig 3). Here, from the edge of slope (32.35 m a.s.l.) downward to the depth of 70 cm, a soil layer of brownish silt with relatively low ice content is distributed (Fig 4). Downward, in the interval 70-75 cm, a transfer layer of ice-rich dark-grey silt pinching out in this section is observed. The transfer layer is underlain at the depth of 75 cm by ice complex, composed of ice wedges and enclosing dark grey silts.

Results
Samples of organic matter (thread-like roots in situ) were collected from frozen silts above an ice wedge head and from enclosing silts. AMS 14C analysis was performed in the National Ocean Science AMS laboratory. The dates are presented in the table below.

<table>
<thead>
<tr>
<th>Interval, cm from the top</th>
<th>Field #</th>
<th>NOSAMS #</th>
<th>14C Age</th>
<th>Age Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>70</td>
<td>3.4</td>
<td>OS-72599</td>
<td>260</td>
<td>30</td>
</tr>
<tr>
<td>90-95</td>
<td>3.5</td>
<td>OS-72594</td>
<td>2900</td>
<td>200</td>
</tr>
<tr>
<td>90-95</td>
<td>3.5</td>
<td>OS-72593</td>
<td>2600</td>
<td>170</td>
</tr>
<tr>
<td>130-135</td>
<td>3.7</td>
<td>OS-72598</td>
<td>3200</td>
<td>250</td>
</tr>
<tr>
<td>165-170</td>
<td>3.8</td>
<td>OS-72697</td>
<td>3200</td>
<td>220</td>
</tr>
<tr>
<td>195-200</td>
<td>3.9</td>
<td>OS-72598</td>
<td>3340</td>
<td>240</td>
</tr>
<tr>
<td>230-235</td>
<td>3.10</td>
<td>OS-72584</td>
<td>3200</td>
<td>310</td>
</tr>
<tr>
<td>255-260</td>
<td>3.11</td>
<td>OS-72595</td>
<td>2700</td>
<td>270</td>
</tr>
</tbody>
</table>

Discussion
The obtained data indicate that the accumulation of the ice complex upper part took place during MIS3 (Karginsky interglacial period; Arkhipov et al., 1997). The age inversions observed in the section in such a close range (2 m) attest to repositioning of the material downslope, supporting a deluvial-solifuction hypothesis of the Yedoma formation (Konischesk, 1983). The lack of dates referred to MIS2 (Bartian glacial period) assumes erosion of yedoma which began in the end of MIS3. It could be supposed that the recognized erosion is explained by an uplift of the territory. Thus, an input of organic matter to rivers began, presumably, as early as the end of Late Pleistocene due to erosion and increased in Holocene in the result of thermokarst processes induced by global warming. Radiocarbon dating results clearly show a zone of interaction between the ancient permafrost carbon and the active layer of modern landscapes, where organic matter of Late Pleistocene age actively enters into the modern carbon cycle of Siberian Arctic.

Fig. 2. Ekomna (ice complex): exposure Duvany Yar and the location of the Section 3.

Fig. 3. Thermokarst circuit with the exposing ice wedges and enclosing silt deposits at the Duvany Yar, Section 3.

Fig. 4. A - geological sketch of the section 3. B - image of the active layer, perennially frozen transition layer and the upper part of the ice wedge with the samples locations; C - image of the ice wedge and enclosing perennially frozen silts with the samples locations; D - image of the thread-like roots in the enclosing silts.

Literature Cited
Korshikov, Yu. V., 1983. Cryotectonic evidence of the heterogenous texture of the ice complex deposits in the Duvany Yar exposure. In: Problem of cryotectonics. Moscow State University. 56-64. [In Russian].

For further information
Please contact:
1. Mezhkov Bernoulli Institute SR 886, Yakutsk, Russia, velimir.spektor@yakat, RU
2. Wesley Hall Research Center, Falmouth, MA, USA, bulygina@wesleyhall.org
3. Western Washington University, Seattle, WA, USA, sgh@uw.edu
4. University of Nevada-Reno, Reino, NV, USA, davydov@unr.edu
5. Northeast Science Station, Chersky, Russia, davydov@unr.edu
6. Yaku Institute of Geography, Yakutsk, Russia, sgh@yus.ru

More information on this topic and related projects can be obtained at www.thepolatisproject.org

Acknowledgements
We thank the World Wildlife Federation (WWF) for financial support of the POLARIS project.