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Luminescence Chronology of Late Quaternary Glaciations in the Verkhoyansk Mountains, NE Siberia

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The Verkhoyansk Mountains in North-Eastern Siberia are the eastern most mountain systems in northern Eurasian which receive precipitation mainly from the west. Late Quaternary glaciations in the area therefore not only reflect local climate changes but also change on the Eurasian continent to the west. Especially the Eurasian ice-sheet should have had a profound influence on the available moisture. The Verkhoyansk Mountains stretches for about 1500km from the Laptev Sea Coast at 72°N to Central Yakutia at 56°N, parallel to the large Lena and Aldan Rivers. The recent climate conditions in the area with mean temperatures in January of -40°C and +20°C in July represent a very continental environment. Precipitation values are around 700mm on the western side and only 130mm and less east of the mountains. Today only small valley glaciers are present in the northern part of the mountain system and larger ones in the Suntar Chajata area a south eastern branch of the Verkhoyansk Mountains. Here, maximum elevations are around 3000m asl. while in most other parts maximum elevations are around 2000m asl. and less.

Previous investigations based on radiocarbon dating in the 1960s and 70s highlighted several Late Quaternary glaciations in the central part of the Verkhoyansk Mountains at 64°N. Three major ice advances have been dated to the global last glacial maximum (gLGM, 20-18ka) and to the middle and early part of the last glacial cycle. However, new geomorphology mapping and dating by the use of Infrared Stimulated Luminescence (IRSL) indicate up to five large glacial advances on the western side of the mountains which are all older than the gLGM. The uppermost terminal moraine, which has been the smallest advance in terms of glacier length, has been deposited at least 50ka before present. The second terminal moraine several tens of kilometers downstream of the upper moraine has not been dated up to now. Aeolian cover sediments yielded an age of 46.8 $\pm$ 3.7ka, but according to the stratigraphic position of the sediments the moraine has been formed prior the moraine upstream. The third terminal moraine which has been deposited in the western foreland of the Mountains has an IRSL age of 80 to 90ka. An age of 100 to 120ka has been attributed to the fourth moraine. This one has been strongly eroded by fluvial and fluvioglacial processes and is only partly preserved. The outermost moraine which represents the largest glacier extend has been formed at the end of the previous glacial cycle. IRSL dating point to a formation of this moraine around 135ka. Glaciations on the eastern side of the Verkhoyansk Mountains are much smaller and only partly preserved. This indicates a dominant moisture source from the west throughout the Late Quaternary. This assumption is supported by the elevation of cirque floors in the area. Generally, the elevation of cirque floors is much lower on the western side of the Verkhoyansk Mountains than on the eastern side.

Taking into account the results of the geomorphological mapping and the IRSL dates it can be assumed that the Verkhoyansk Mountains have been extremely dry during the gLGM. This prevented a glaciation in the area. Moisture was most probably blocked by the large Eurasian Ice sheet and especially by its western sector. In the early part of the last glacial cycle the western sector of the Eurasian ice sheet was much smaller allowing moisture bearing air masses to reach the Verkhoyansk Mountains and supporting the buildup of large valley glaciers. With the growth of the ice sheet the moisture supply to the Verkhoyansk Mountains was reduced and the glaciations in the east of Siberia became smaller. East of the Verkhoyansk Mountains in the Russian Far East, moisture coming from the Pacific lead to the formation of glaciers during the global last glacial maximum.