



Lower Vistula fluvial lakes as possible places of deep groundwaters effluence (Grudziądz Basin, North Central Poland)

Jaroslaw Kordowski (1), Katarzyna Kubiak-Wójcicka (), Adam Solarczyk (), and Sebastian Tyszkowski ()

(1) Institute of Geography and Spatial Organization, Polish Academy of Sciences, Toruń, Poland (jarek@geopan.torun.pl), (2) Nicolaus Copernicus University, Institute of Geography, Toruń, Poland

Regarding the outflow the Vistula River is the largest river in the Baltic catchment. In its lower course, below Bydgoszcz, in the Late Holocene Vistula channel adopted an weakly anastomosing fluvial pattern destroyed by intensive human hydrotechnical activity and by the regulation which have intensified about 200 years ago. Channel regulation have left many artificially separated fluvial lakes. Part of them infilled rapidly but the majority have persisted to present day almost unchanged. It has also arised the question: what drives the resistance for silting? To solve the problem there were conducted simultaneous hydrological and geomorphological investigations, because there were two concepts: one that the mineral material is removed from fluvial lakes while high stands by flood waters and second that the material is removed due to high groundwater “exchange” rate when the fluvial lake has a sufficient hydrological connectivity to the main Vistula channel.

The Vistula valley crosses morainic plains of the last glaciation. On the average it has about 10 km width and is incised about 70 - 80 m deep, compared to neighbouring plains, dissecting all the Quaternary aquifers. On the floodplain area the Quaternary sediments lay with a layer of only 10-20 m thickness over Miocene and Oligocene sands. In favourable conditions, particularly while a low stand there exists the possibility of Tertiary water migration toward the surface of fluvial lakes provided they have not continuous flood sediments cover on their floors.

As an example of such a lake with an intensive water exchange rate by supposed deep groundwaters was chosen the Old Vistula lake (Stara Wisła) near Grudziądz town. The lake has an area of 40 ha, mean depth 1,73 m, maximum depth 8 m, length about 4 km and medium width about 100 m. In the years 2011-2014, with two weeks frequency, in its surficial water layer were conducted measures which included temperature, pH, Eh, suspended matter amount, total and carbonaceous mineralization. Similar measurements were also conducted in other fluvial lakes and Vistula tributaries.

Investigations carried proved the general similarity between physical and chemical properties of lakes and watercourses analysed. However, there exists distinct gradient of carbonaceous mineralization from small values in the Vistula channel to high values at the valley edges. PH and Eh parameters in the Old Vistula lake were different than in all other surveyed sites what leads to conclusion that it is fed by deeper groundwaters than in the case of other fluvial lakes and Vistula tributaries, particularly in low water stand times.

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