GEOLOGICAL INVESTIGATION IN SZTUM (STUHM) AREA – HISTORICAL REVIEW AND ACTUAL STATE.

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Sonntag published in 1919 a general overview of the geological knowledge in Western Prussia region. At least Paul Woldstedt concluded in the early 1944 all the results of the surface mapping campaign of German geologists in a unpublished general geological map of East Prussia region in scale 1:300 000 and published a general overview about the surface geology in 1942.

After the 1945 main studies in this area was made mainly by Aurelia Makowska (1979, 1986, 1989, 1990, 2004a, b, 2009). She recognized between Saalian and Vistulian (Weichselian) tills two marine sequence episodes – so called "Sztum" (older) and "Tychnowy" (younger) sea. Recent investigation (Marks et al. 2014) indicate that only the younger transgression in Poland have been investigated in detail and there is no doubt about its Eemian age. Lower marine series could be either connected with the pre-Eemian interglacial (Marks 2005) or it has been considered as an effect of glaciotectonic deformation (Marks et al. 2014).

Eemian marine sediments in the northern part of Lower Vistula Valley have been investigated for over 150 years (Berendt 1865; Jentzsch 1895). The Prussian geologist Alfred Jentzsch published in 1881 and 1896 a regional description of interglacial molluscs, so called 'Diluvialfauna' of Marienwerder (Kwidzyn), Marienburg (Malbork) and Dirschau (Tczew). Jentzsch (1895) described marine interglacial fauna from drillings as follows:- near railway station of Marienwerder (Kwidzyn) between 30 – 33 m below local surface level (all following depth are described as below the local surface level) including *Cardium echinatum, Cobula gibba* and *Cyprina;*- Marienburg (Malbork), near railway station in depth 24.5-25.5 m and from a drilling near town hall (56 – 61,5 m): *Cardium echinatum* and *C. edule*; - between 33 – 36.6 m from drilling near 'Johanniter hospital' in Dirschau (Tczew): *Cardium edule, Corbula gibba, Nassa* reticulata*, Cerithium lima and Mytilus.*

After minor revisions of the 1866 published molluscs Berendt (1867, 1874) described the interglacial molluscs of Vistula region as follows (cf. Fig. 1): *Ostrea edulis* L., *Cardium edule*, *Corbula gibba*, *Cobula gibba* Olivi (nucleus Lam.) and *Cyprina islandica* L., *Mactra subtruncata*, *Tellina solidula* Pult., *Venus virginea* L., *Buccinum* (*Nassa) reticulatum L., Ceritium lima Brug. (- reticulatum* Dac. Lov.) and *Scrobicularia piperata* Gmel. (Schum.). Also Jentzsch (1884) decribed marine 'North sea fauna' near Rothhof/Unterberg (Czerwony Dwór/Podzamcze) and *Cyprina* and other interglacial 'North sea molluscs' from Meislatein (Myślęcin) and concluded according to the position of interglacial 'Diluvialfauna' layer between tills multiphase glaciations of Scandinavian ice sheet, at least interrupted by one or more interglacial (marine) phases. Madsen (1893, cited in Jentzsch, 1896) investigated molluscs from outcrop Reimannsfelde (Nadbrzeże) N of Elbing (Elbląg) of so called 'Yoldienthon' (Yoldia-clay) *Miliolina seminulum (*L.), *M. subrotunda (MTG); Haplophragmium pseudospirale (Will.); Rotalia beccarii var. Lucida (*Madsen*); Nonionina depressula* (Walk et Jac.) und N. *depressula var. orbicularis (*Brady*)* and from clay pit (Schmidt's Ziegelei) near Lenzen (Łęcze) *Truncatulina lobatula* (Walk et Jac.) *and Nonionina depressula* (Walk et Jac.).

The first time the occurrence of marine deposits rich in Mollusca were found in the centre of city Sztum by the German geologist Konrad Keilhack. Keilhack described 1904 a profile from a well drilling Stuhm-Markplatz, drilled in in 1890ies, a gravel layer in 58,6-59,8 m including *Nassa reticulata*. Holst (1911 cited in Wolff 1914, p. 77) described from drilling in Stuhm (Sztum) between 59,6 – 61 m below

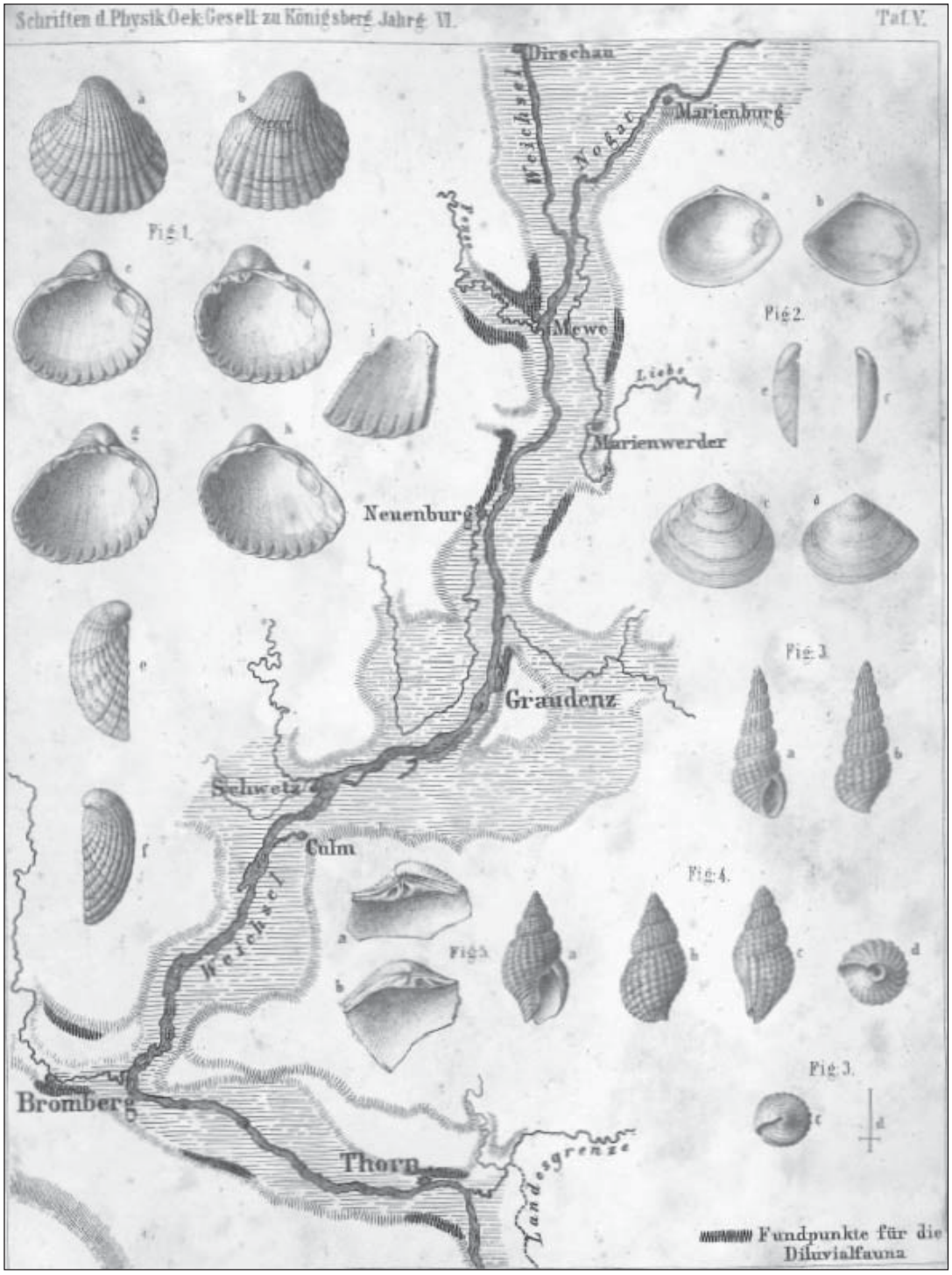


Fig 1. First investigated interglacial marine molluscs in Vistula area were drawn by Berendt (1865).

surface a gravel layer including marine molluscs like *Cardium edule, C. echinatum, Tapes aureus* and *Nassa reticulata* (interpreted as redeposited material) and between 90,5 – 100 m in primary deposition *C. edule,* single specimen of *Nassa reticulata, Mactra, Mytilus, Tellina and 3x Hydrobia.* Wolff (1914) interpreted the marine 'Tapes fauna' of Stuhm as indicator of a moderate-temperated paleoclimate.

In years: 2010 -2014 a core from the now borehole at Cierpięta (~ 12 km SE from Sztum) was examined with sedimentological, palynological, plant macrofossil, diatom, malacological, and foraminiferal analyses and completed with radiocarbon, OSL and amino acid dating. Results of these analyses enabled reconstructions of the area since termination of the Odranian Glaciation (Saalian) until the first ice sheet advance of the Vistulian Glaciation (Weichselian) (Marks et al 2014).

Alfred Jentzsch mapped and published first detailed geological maps of this area (1889-1909).

In this region Jentzsch (1885) described glaciotectonical structures of dislocated Cretaceous rafts (Ober-Senon) near the village of Prothen (Protowo), Krapen (Krupin) and Trankwitz (Trankwice). Similar glaciotectonal structures Jentzsch (1885) found in a clay pit near Hansdorf (Janów) in the southern edge of Elbląg elevation area. Also Jentzsch (1886) mapped at first a Cretaceous raft near Kalwe village (Kalwa). "…zu Kalwe fand Verfasser nahe östlich von dem auf der geologischen Karte Sektion Elbing eingetragenen Kreidehügel, und zwar dicht östlich der Chaussee Kalwe-Altmark bei km 13,33-13,40 weisse Kreide. Unter einer kaum 0,1 m dicken lehmigen Krume voll von Fragmenten harter Kreide liegt hier Schreibkreide, welche bei 2 m Tiefe noch nicht durchbohrt wurde. [general translation: Author found east of country road Kalwe-Altmark at km 13,33-13,40 under 0,1 m loam white Upper Cretaceous marls (acc. to Belemnites fauna classified in Upper Senon todays stratigraphical position: Santonium, Campanium und Maastrichtium].

In 1905 Jentzsch gave a short describtion of the first finding of Cretaceous deposits on surface on a hill 'Steinberg' located nearby Lichtfelde (Jasna). A first report about the occurence and indistrial interest of Cretaceous merls of Kalwe vicinity gave the German geologist Scharf (1935a, b). Furthermore Bernhard Koernke (1938a-c, 1939) and Cramer et al. (1938a, b) investigated during a general geological mapping campaign a number of exploration drillings and mapped the occurence of Cretaceous raft near Kalwe in detail.

The big glacial rafts of Cretaceous marls in vicinity of Kalwa village at first investigated by Koernke (1939) were detailed recognized last autumn during mapping campaign by PGI-NRI using boring rigs (URB 2,5 A; WH). Maximal thickness of Cretaceous marls reach up to 30 m and occupies an area about 1,5 km^2. Few smaller rafts were "re-found" and mapped in vicinity of Jasna and Trankwice villages (Fig. 2). Additional information about scale of glaciotectonic deformation provide us new borehole profiles from Bukowo village vicinity where we find Eemian marine sediments almost 100 m higher, above its regular position.

First edition of Detailed Geological Map of Poland in scale 1:50 000, sheet Sztum was made by Rabek (1990). Since 2015 PGI-NRI was started cartographic works at new edition of Detailed Geological Map of Poland in scale 1:50 000, sheet Sztum. We were made 3 new boreholes (Pozolia, Kalwa, Szpitalna Wieś) up to 216 m deep which allow us to confirm coverage of Tychnowy marine sea deposits as well as the presence of large Malbork island or peninsula existed in northern part of investigated area during this time. There is no any evidence for presence of the Holstein sea deposits in Sztum area (Kondratiene and Gudelis, 1983; Marks, 1988) as well as for the so-called Krastudy Interglacial within the Vistulian (Weichselian) sequence which was recognized by Makowska (1986), Rabek (1990) and in borehole log Krastudy (Cierpięta) (Marks et al. 2014).

150 years of geological investigations made by geologist from Germany and Poland give us unique opportunity for good recognition of chronology for the last glaciation and Eemian interglacial in Northern Poland. Also for the todays mapping near surface occurence of mineral resources get an important input by the using of historical geological data.

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