

The Reply to a New Approach to the Stratigraphy of the Pleistocene Sequence Along the Baltic Sea Coast, Westernmost Latvia

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Abstract: New conception offered by Tomas Saks, Andis Kalvāns, Vitālijs Zelčs [14] about the stratigraphic interpretation of the Pleistocene sequence in the area of westernmost Latvia along coast of the Baltic Sea cardinaly differs from recognition of real stratigraphic units proved on the basis of the biostratigraphic principles. Present article deals with the critical remarks of main aspects of a new stratigraphic conception.

Keywords: New Conception, Remarks, Coast of Westernmost Latvia

1. Introduction

Westernmost Latvia adjoining to the coast of the Baltic Sea is an extensive unique stratotypical area that is characterized by the widespread Pleistocene sequence containing the thick series of the intertill marine sediments including sediments with the Holshteinian pollen spectra, lying above the Elsterian till unit and below the Saalian till unit [10, 21]. Maximal thickness of intertill sediments sequence (70–80 m) coincides with the deeper part of the vast depression in the bedrock surface that is situated in the area of westernmost Latvia and is opened towards the Baltic Sea. As it will be noted below the total intertill thick includes the sediments of three consecutive age intervals – the Late Elsterian, Holshteinian and Early Saalian which are identified by characteristic complexes of pollen spectra.

Below, authors reply to specific points raised by Tomas Saks, Andis Kalvāns, Vitālijs Zelčs [14] that several years ago have offered the new conception of interpretation of a stratigraphy of the Pleistocene sequence in westernmost Latvia. Offered stratigraphic structure began to be applied in the researches of Pleistocene in this part of Latvia [15, 16]. This Pleistocene sequence is a key for an insight of stratigraphic and palaeogeographic glacial and nonglacial

events during the Elsterian with Late Elsterian and Middle Pleistocene (Holshteinian, Early Saalian and Saalian), not only for this area but also for the neighboring Baltic Regions. This is the cause of much attention to the question about the reliability of a new conception which revises the stratigraphy of the Pleistocene sediments sequence in the key area of westernmost coast of the Baltic Sea. In the reply, the attention focuses on the criticism of the arguments that are used by Tomas Saks, Andis Kalvāns, Vitālijs Zelčs [14]). The authors of a new stratigraphic conception don't take into account the priority of the biostratigraphic records, namely, the Holshteinian records which allow to determine correctly the age of parts of the common intertill thick widespread in this area as well as age of over- and underlying till units, respectively.

2. Main Original Researches and Their Results

The first detailed study of structure of the coastal bluffs of the Baltic Sea along their length was made by Aleksis Dreimanis [5]. Here the gray and bluish till beds of penultimate (Saalian) glaciation and underlying basin

sediments with numerous glaciotectionic deformations have been investigated and mapped [5]. It should be noted that the compositional properties of till beds to which Aleksis Dreimanis has paid attention subsequently have been analyzed in more detail by petrographic, mineralogic and textural methods. Obtained analytical data have shown that the composition of this till bed contains initial material derived from the source areas from Fennoscandia, southwestern Finland and the bottom of the Baltic Sea (Åland Archipelago) and also from the Ordovician/Silurian carbonate bedrocks located on the bottom of the Baltic Sea and from local Devonian and the Holshteinian marine sediments. Holshteinian marine sediments have been of strong affecting on the formation of the Saalian till compositional properties [17, 18].

Georgy Konshin, Alexander Savvaitov [9], Georgy Konshin, Alexander Savvaitov, Vladimir Slobodin [10], Georgy Konshin, Alexander Savvaitov, Jan Straume [11], and Alexander Savvaitov, Ints Veinbergs, Milda Krūkle [21] have carried out the special researches of Pleistocene in westernmost Latvia. Based on stratotypical core at Ulmale and others of numerous test-drilling cores they for the first time in this part of Latvia have established wide spatial distribution of the marine intertill sediments the thickness of which reaches up to 60–70 m as well as their succession in the stratigraphy and conditions of accumulation. They have also explained the insight of stratigraphic structure of the total Pleistocene sequence. A succession of the nonglacial sediments lying between two till bed have been demonstrated by the Ulmale test core together with the outcropping sediments of coastal bluffs between Ulmale and Labrags [20]. The total structure of Pleistocene in this area represents a lithological and stratigraphical succession, starting with the Elsterian till bed (1.7 m thick) and finishing by the Saalian till bed (0-1,5-2 and more m). Elsterian brown till bed overlies bedrock and upward is replaced by the Late Elsterian brown clay with thin interlayers of silt [4.6 m] containing the cold climatic pollen spectra and the foraminifera. Interval composed by the brown clay reflects the beginning of transgression of the Palaeobaltic Pleistocene Ulmale Sea [19]. Following layer with a thickness of 8.1 m is the gray, bluish gray silt and rich in organic material and vivianite is characterized by the typical optimal complexes of the Holshteinian pollen spectra and high content of the numerous shells of the foraminifera. The sandy sediments with layers of silt form the following thickest part of the common intertill sequence (52.1 m) that is overlain by the Saalian till bed (0–1.5-2.0 and more m). The upper sandy part of intertill thick reflect final stages of the Ulmale Sea when Early Saalian period had been started. These sediments in their upper part contain both cold climatic flora and the Holsteinian flora as well [2, 3]. The features of cross-bedding characterizing the sandy sediments exposed in the coastal bluffs allow to consider that the sediments of top part of the intertill thick were accumulated in the conditions of the lower and upper parts of the coastal underwater slope, and in the beach and in lagoons [23]. Saalian till bed wash out in many places by the

wave processes of the Lateglacial and Holocene stages of the development of the Baltic Sea.

Further, the problems of biostratigraphy, spatial distribution of the intertill sediments and till beds became a subject of the detailed researches by Valdis Segliņš [22], Zigfrīd Meirons [12], Valdis Juškevičs, Sarmīte Kondratjeva, Atis Mūrnieks, Silvija Mūrniece [6] and Laimdota Kalniņa [7, 8]. As the result of these studies the data of the earlier investigations on the stratigraphy of the thick series of the intertill sediments, their spatial distribution between till beds also the compositional properties of till beds have been complemented and specified by the new test cores south Ulmale (Akmeņrags and others). In particular, the pollenstratigraphic records have shown that the sediments composing the intertill sequence were accumulated, as mentioned, during the age intervals of the Late Elsterian, Holshteinian and Early Saalian, respectively.

Igoris Danilāns [4] has named the intertill thick of marine sediments as the Ulmale Formation. The thick of marine intertill sediments was accumulated in the Middle Pleistocene Palaeobaltic Ulmale Sea that existed in the depression of the Baltic Sea and also covered westernmost mainland of Latvia [19].

3. Revised New Stratigraphy

Revised new stratigraphy [14] mainly is based on the OSL dating results (25–52 ka BP) for the upper part of intertill sediments lying in the coastal bluffs and the assumption about the hypothetical second gray till bed in the middle part of intertill thick as well. Based on these data, the authors of revised stratigraphy identify the first till bed overlying the basin sediments fixed in the base of bluffs as the Late Weichselian and not Saalian. The sandy sediments that occur between the first and possible second till beds are attributed by a new stratigraphy to the Middle Weichselian time and the second till bed – to the Middle Weichselian Glaciation. The following thick composed by the sandy and silt sediments are dated as the Early Weichselian. This thick overlies the silty sediments that are attributed to the Eemian Interglacial and not the Holshteinian Interglacial. The lowermost part of the Pleistocene sequence covering bedrock by mind of Tomas Saks, Andis Kalvāns, Vitālijs Zelčs [14] is represented by the Saalian till unit rather than Elsterian.

The revised stratigraphy essentially contradicts the generally accepted stratigraphy of the Pleistocene sequence widespread in westernmost coastal part of Latvia.

4. Critical Arguments to New Conception

Despite the provisional presumptions which are noted by authors of the new conception the aspects stated by them demand the criticisms from the point of view of the biostratigraphic principles.

Aspiration to date the deposits of top part of the

Pleistocene sequence by the OSL method, authors of present article does not discuss. Undoubtedly, the obtained data deserve attention. However, for more reliable conclusion about the age of these sediments it would be useful and necessary to discuss these data together with other indicators, such as: the biostratigraphic, namely, palynologic records, ^{14}C dating results from the organic bearing sediments (e.g. Gudenieki) as well as the TL dating results from grey and bluish grey tills lying in the top of coastal bluffs. In addition, it would be desirable to carry out the determinations of age on the shells of the foraminifera. Besides, data described by Albertas Bitinas, Marijonas Repečka, Laimdota Kalniņa [1] show that the intertill sandy sediments in the structure of nearshore boreholes in Lithuania were formed approximately 140–160 ka BP (OSL dating results).

Critical analysis mainly is focused on the interpretation of buried part of the Pleistocene sequence composed by the sediments of the intertill thick and lower brown till bed overlies the surface of bedrock. Two important aspects should be considered for the insight of raised problem. On the one hand, it is impossible to ignore the precise stratigraphic position of the sediments occur at the bottom of the Pleistocene sequence. Based mainly on the typical culmination of vegetation (pollen succession) the age of intertill sediments was most certainly defined here as the Holshteinian Interglacial. The accumulation of these deposits containing the rich microfauna of foraminifera and diatom flora was happened in the optimal marine conditions [7, 9, 19, 22]. The formation of brown varve like clay (Late Elsterian) and brown till (Elsterian) was foregoing to the Holshteinian Interglacial. Therefore, these sediments are dated as the Late Elsterian and Elsterian, respectively. But Tomas Saks, Andis Kalvāns, Vitālijs Zelčs [14] based on indirect signs attribute the age of these two intervals as Eemian (brown clay together with sediments lying above) and Saalian (brown till). On other hand, the hypothetical grey till in the middle part of common Pleistocene sequences by their opinion is attributed to the Middle Weichselian. It is very doubtful that this till bed occurs in some sections. Authors of present message studying the sediment sequences in many boreholes (cores), located along shore line of the Baltic Sea did not find there such reliable till. Zigfrīd Meirons [12, 13] has also abstained from the establishing of this till and doubts that this till lie in situ as well as pays attention on the Lihvinian (Holshteinian) flora contained in the top part of intertill marine sediments which have been discussed by Aija Ceriņa [2, 3]. The offered age of till bed lying above the common intertill thick as the Late Weichselian [14] is questionable as well.

5. Conclusion

Results reveal that a new conception essentially differs from the real biostratigraphic records, namely, palynological records grounding stratigraphic units of the Pleistocene sequences along coast of the Baltic Sea in westernmost Latvia. The specified critical remarks give ground for

cautious relation to the assumed conclusions about the reinterpretation of the Pleistocene sequence in westernmost Latvia along shore line of the Baltic Sea.

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