Conditions for the formation of the large barrier-lagoon systems in Eastern and South-Eastern Baltic Sea

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Curonian and Vistula Spits
Granulometric composition of the Curonian Spit deposits

A

1 – aeolian sand
2 – sand of «palve»
3 – sea coast
4 – coast of the Curonian Gulf
The angle of approach of the wind to the general direction of the coastline is important to saturate the sand-wind flow when it moves over the beach. To achieve the effect of maximum saturation of the sand wind flow necessary angles of approach of the wind to the direction of the coastline between 30 and 75 degrees.
Landscape of the Curonian Spit from Zelenogradsk towards Lesnoe
Fluvio-glacial deposits in the proximal part of the Curonian Spit

The boreholes drilled in a southern part of the Curonian Spit:
No. 9K, 10K – (from Kozlovich (Козлович, 2009); No. 32 – (from Chubarenko and Chubarenko (Чубаренко и Чубаренко, 1995); No. 8, 16, 17 – (from Kabailene (Кабайлене, 1967); 1–9 –(from Kunkskas (Кунскас, 1970):
1 – moraine, 2 – lacustrine clay and aleurite of pre-Holocene age, 3 – Aeolian sand, 4 – sapropel (lagoon silt, gyttja), 5 – peat.
I–VII – spores-pollen zones; Anc – limnic deposits of the Ancylus age; ED – Early Dryas; PB – Preboreal; B – Boreal; AT – Atlantic; SB – Subboreal; SA – Subatlantic; L – Litorina; PL – Post-Litorina
A summary sequence of the outcrop in the sea cliff between Zelenogradsk and Lesnoe:

1 – modern and buried soils; 2 – Aeolian sand; 3 – grey-ashy fine-grained sand; 4 – red-brown sand cemented in its roof; 5 – green-grey different grained sand; 6 – gyttja; 7 – moraine

Longitudinal geological profile of a southern part of the Curonian Spit (from Kharin et al., 2006, with some changes):

1 – sand, medium-grained quartz-feldspar; 2 – lacustrine-glacial deposits; 3 – glacial deposits; 4 – peat-brown, reedsedge, various degree of decomposing; 5 – boreholes

So the geological structure of the proximal part of the Curonian Spit it is not an accumulative barrier created by the wave and aeolian processes in the Holocene, but it is narrow part of the coastal plain.
Geomorphological map of the Curonian Spit
Tomczak, 1988
Boreholes and profiles across the Vistula gulf

Bogachuwich-Adamchak, 1982
Granulometric composition of the Vistula Spit deposits

1 – aeolian sand
2 – sand of «palve»
3 – sand of the sea coasts
4 – sand of the gulf beach
Lake silty clay and clay with the malacofauna in the Vistulian Gulf coast
According to our records, this part of coastline (23 km) has preserved a fragment of the deltaic plains of the Pra-Vistula river. There is a decrease in slope of the surface in this flooded part of delta, which is about 0.003, and probably even less.
Lagoon Puck

Uscinowicz et al., 2003
Baikal
Central part of the Poland coast

Kazsubowski, 1992
Lithuanian and Latvian coastal plains

Damušytė, 2014
Gerasimov et al., 2015

Markov, 1931
Conclusion

1. Barriers formed on the edge of deltaic plains when sea-level rise in the Littorina transgression.

2. Gulfs formed during transgression by the flooding of the low deltaic and coastal plains. It was not the open sea.

3. Curonian an Vistula Spits, except for the beaches, low marine terraces, moraine, fluvioglacial and lacustrine deposits consist of aeolian sands up to minus 2-3 m amsl. Hence the barriers already existed when the sea level was - 4 m abs.

4. Barriers development was predetermined by sea level fluctuations: increasing the area of the barriers occurred due to the formation of regressive terraces (so called palve) with a series of avandunes on their surface. Sea level rise contributed the formation of large aeolian ridges.

Thank you for attention