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## THE OLDEST PERIGLACIAL PERIOD IN POLAND

### Sommaire

Un des problèmes discutables en Pologne concerne la formation dite *préglaciaire*. Elle se compose de cailloux, de graviers, de sables et de dépôts pulvérulents situés à la limite entre Tertiaire et Quaternaire. Le manque de faune et de roches nordiques d'origine scandinave ne permet pas de préciser exactement l'âge de cette formation.

L'auteur a fait l'analyse de la formations en question dans quelques coupes du Plateau de Lublin et de la Basse Silésie. Il y a trouvé des traces de structures périglaciaires (solifluxion) ainsi que des manifestations de gélivation intense et un certain rythme de stratification. On y voit la preuve de changements climatiques contemporains au temps de la déposition de la formation étudiée. Enfin, dans la masse même de cette formation, on a constaté des traces bien visibles d'une éolisation intense.

L'auteur incline à conclure que les formations dites *préglaciaires* en Pologne ne sont pas toutes de même âge. Il y a des formations de ce type originaires de la limite entre Tertiaire et Quaternaire. Il y en a d'autres, surtout dans la Pologne méridionale qui doivent être rattachées à la glaciation la plus ancienne.

Toutes ces formations sont dues à un climat certainement sec et probablement froid, surtout s'il s'agit des formations détritiques dans les Sudètes.

Five years ago I came to the conclusion that in the Quaternary deposits of Poland we can distinguish — from the theoretical point of view — at least 10 periglacial horizons. The conclusion was based on the known fact that in the area between the Baltic coast and the Carpathian margin at least 10 glacial stratigraphical horizons have been found. They belong to separate glacial periods or glacial stages.

I am going to discuss the problem of the oldest periglacial horizons lying under the oldest glacial deposits. The problem is connected with the boundary between the Tertiary and the Quaternary formations. Gravels, sands and rubbles, free of Scandinavian material, and deprived of distinct features i. e. of Tertiary fauna and flora are called *preglacial* formations. In these deposits we find cryoturbations, which may be considered as evidence of the oldest periglacial zone.

I have examined profiles and exposures of preglacial deposits in different parts of Poland.

In Eastern Poland, on the Lublin plateau immediately under the oldest moraine we can distinguish two series of preglacial deposits. The lower part consists of river gravels, frequently containing Carpathian material, but having no distinct features of cold climate. The upper layer contains yellow silts of typical soliflual structure. It is the

oldest solifluction in Poland. The material, which is devoid of Scandinavian elements belongs, no doubt, to preglacial formations.

Remnants of old preglacial formations occur in the Sudetes Mountains. These deposits have been investigated by German geologists before the war. More recent investigation of the formations has resulted in the discovery of periglacial phenomena. In the vicinity of Jelenia Góra I have examined the following section. Rock debris and sand consisting exclusively of local material have been found to underlie boulder clay and a thick layer of varved clays. The type of material and the structure of deposits indicate the presence of rainwater acting under continental climatic conditions. Most characteristic of this layer is the rhythmic alternation of detritus and sand. Some traces of solifluction and also numerous granite blocks with wind-smoothed surfaces have been found in the same deposits on the slope of the former basin.

In another place of the West Sudetes near Złotoryja we have discovered a full section of Quaternary deposits which contain the oldest moraine and fluvioglacial sands. This formation is underlain with a large series of preglacial sediments consisting predominantly of slope rubble and rock debris. It has been established that the deposits mentioned above belong to the upper part of the preglacial formation. The lower part consists of quartz gravels. The two layers are separated by an erosional surface.

Taking these facts and other similar data into consideration I came to the conclusion that the preglacial sediments of the Sudetes indicate the same stratigraphic and climatic relations as the preglacial deposits of Eastern Poland: the lower part which occurs immediately above the Pliocene layers contains gravel consisting predominantly of quartz and unweathered feldspars. By the way, I should like to emphasize that the main difference between the Tertiary gravels and the preglacial ones appears most distinctly in the degree of weathering; in the Tertiary they are, as a rule, kaolinized feldspars. The lower horizon mentioned above of preglacial gravels in the Sudetes is deprived of distinct features of a periglacial character. These occur only in the upper part of the layer in the following form:

1. great masses of products of mechanical weathering
2. rhythmical alternation of finer and coarser material
3. wind-worn stones
4. more or less typical frost structures such as involutions or solifluction phenomena.

This upper series of preglacial formations was doubtless deposited under cold climatic conditions. The German geologist Genieser came to a similar conclusion. He has been recently investigating preglacial

gravels in the Elbe valley, not far from the Sudetes and found there two horizons of well developed involutions.

I have described the preglacial deposits in Southern Poland chiefly from the mountainous regions. Now I should like to discuss the same question in connection with the Polish Lowland i. e. Central and Northern Poland. Preglacial deposits were here investigated some years ago by the Polish geologist Lewiński. Preglacial gravels and sands occur in the Vistula valley near Warsaw; they are more than 30 metres thick. Unfortunately the deposits are known mainly from borings and not from exposures, and therefore we do not know exactly what their structural features are. It is obvious, however, that in these gravels there are distinct traces of strong mechanical weathering and furthermore some wind faceted stones were also discovered here. No cryoturbations or other clearly marked evidence of periglacial climatic conditions have ever been found.

In spite of that, Lewiński postulated that the gravels were deposited under conditions of cold climate. The accumulation occurred during the first glacial period i. e. the Günz glaciation. Here is a quotation from his paper written in German in 1929: „Die Ursache wäre vermutlich in der Frostverwitterung in einem rauhen Klima zu suchen. Da die untere mittelpolnische Moräne der Mindeleiszeit entspricht, wäre die Kiesbildung durch das Minimum der Günzeiszeit verursacht; da die zwei Kieselablagerungen vorliegen, wären sie vielleicht Zeugen einer Zweiteilung der Günzeiszeit, analog den älteren Eiszeiten.” (*Ztschr. f. Geschiebeforschung*, Bd. 5, 1929).

Summing up the foregoing description of the preglacial deposits in the Lublin plateau, in the Sudetes and in the Vistula valley near Warsaw, I want to stress some resemblances in their stratigraphical position and their climatic features.

The gravels immediately underlie the oldest glacial horizon i. e. the Cracovian or Mindel glaciation. It is noteworthy that preglacial formations in all these regions consist of two layers, separated by an erosional surface.

We can therefore speak of two preglacial phases which differ from each other in some respects. Both phases have some characteristic features in common; these are: relatively strong mechanical weathering, wind action and seasonal alternation in fluvial accumulation. These processes indicate a climate that seems to have been rather dry, at least with one distinct dry season during the year. Semi-arid climatic conditions prevailed in this region. The conclusion is derived from arguments which are more valid than the suppositions concerning temperature. A question still to be determined is that of climate: whether it was warm or cold, whether that of warm or cold desert. Because of the traces of chemical weathering

in preglacial gravels some authors have suggested that this period may have been rather warm. I cannot share that view. This type of chemical changes and such a rate of weathering may occur in cold climate as well; these have been observed to occur in the actual periglacial zone, particularly in Antarctica. I am inclined to believe that both series of preglacial deposits were formed in cold climate.

Nevertheless we can distinguish different climatic features in each of these series. The lower preglacial layer contains horizontally stratified gravels, without any distinctly developed frost structures. These occur only in the upper bed. This constitutes the main difference between the two layers.

Considering all climatic facts, recorded in the two beds, I believe that the younger i. e. upper preglacial phase had been more severe and colder than the older one. There were also changes in the amount of precipitation. The older phase seems to have been more humid. Distinct features of aridity are seen in the upper preglacial sediments. At the bottom of the whole formation prevail typically fluvial far-transported deposits. Higher up there is a predominance of local material washed from slopes. It became deposited either as a result of the alternation of dry and moist seasons or — which seems more likely — because of the action of melt-waters. All these deposits are attributable to solifluction.

As follows from what has been said, the changes in preglacial sediments may have resulted only from the development of periglacial climatic conditions. The upper bed seems to be more periglacial than the lower one, though both layers are on the whole of the same nature.

I want to stress that the deposits of this period display a similar character throughout practically the whole area of Poland. There is a large formation of preglacial sediments which consist of, at least, two separate series. The whole formation has been most probably deposited as a climatic sequel of the glaciations, that have not reached the territory of Middle Europe. Although both series have been formed during phases of cold climate, there is definite evidence of periglacial climate in the younger series. This horizon of preglacial gravels corresponds to the Günz glaciation.

One more conclusion may be drawn from the facts described above. The boundary between the Pliocene and Pleistocene in Poland is not conspicuous. There is a transitional Pliocene—Pleistocene sequence, which records a slow but steady development of periglacial conditions. The periglacial periods are definitely older than the glacial ones. This is the normal sequence of Plio-Pleistocene climatic evolution.