INVESTIGATION OF THE IMPORTANCE OF STARUNIA PALEONTOLOGICAL LOCATION OF THE PLEISTOCENE FAUNA OF THE RHINOCEROSES AND THE MAMMOTHS FOR QUATERNARY GEOLOGY

Kateryna Radlovska
PhD
Department of ecology[1]
katolrad22@gmail.com

Sofiia Kachala
PhD
Department of tourism[1]
Pernerolik@gmail.com

[1]*Ivano-Frankivsk national technical university of oil and gas*
15 Karpatska str., Ivano-Frankivsk, Ukraine, 76019

Abstract: The first finds of mummified carcasses of the hairy rhino, mammoth, horse, roe deer and other animals were carried out at a depth of 12 m when passing the mines for the production of ozokerite near the village. The expedition of the Academy of Skill from Krakow, when passing a mine at a depth of 17 m, found the remains of 3 more hairy rhinos. There were also numerous bones of small vertebrates (rodents), artichokes, numerous insects, beetles, parasitic worms, slag, butterflies, spiders, snails, vascular plants, seeds and branches of dwarf birch, alder, and other representatives of tundra flora. After the earthquake in the Vrancha Mountains (Romania), the first and still unique mud volcano in the Carpathians, which gave the Starunia paleontological location a new "sound", arose on the ozokerite deposit.

An important result was the discovery of the most desirable area, where the remains of giant mammals and even the Cro-Magnon Pleistocene could still be found at the depths. All the numerous interdisciplinary traces of Polish and Ukrainian scientists confirm the uniqueness of Starunia on a global scale, requiring the preservation and further study of paleontological finds and the only mud volcano in the Carpathians. Such findings can only be made by organizing the Starunia geodynamic ground International Ecological and Tourist Center «Geopark Ice Age».

Keywords: upper Pleistocene, hairy rhino, mammoth, tundra, natural-human-made geosystems, paleoclimate, Starunia area, Geopark.

1. Introduction

The ecological status of the environment in the Western region of Ukraine has deteriorated significantly over the last decades. It is caused by excessive recreational load, pollution of water objects by domestic runoff, increasing emissions of vehicles into the atmospheric air, disordered felling of forests, influence of technogenically dangerous objects: Burshtyn TPP, Kalush Salt Mine, Dombrovsk karst and Karvyshev karst oil and gas production and petrochemical processing, unauthorized selection of sand-gravel-pebble deposits from river beds, active development of landslide, suffusion, karst and erosion processes. A new significant environmental threat may be the construction of hydroelectric power plants on mountain's rivers and the Dniester river, which provides for the construction of dams and reservoirs, water pipelines along the riverbeds. Catastrophic floods on the Dnister, Prut, Siret and Tisza rivers, which have increased significantly in recent years, have been a particular threat to natural geosystems, the economy, transport infrastructure and the population, due to global warming and increasing technogenic load on geosystems. The western region of Ukraine is located in the zone of developed storm activity of the atmosphere and, accordingly, in the zone of increased risk of water elements and manifestations of their harmful effects, which causes different in scale, including catastrophic, flooding and waterlogging of territories, destruction of engineering devastating consequences.

2. Methods

Therefore, it is important to map natural anthropogenic structures on the basis of Quaternary sediment maps, geomorphology, landscapes, which are based on detailed stratigraphic dismemberment of Pleistocene and Holocene supporting sections. One of these sections is Starunia – paleontological location of the Late Pleistocene fauna of rhinoceroses and mammoths near the eponymous village of Bogorodchany district, Ivano-Frankivsk region, 18 km from the city of Ivano-Frankivsk.

The first research findings are connected with the remains of woolly rhinoceros, mammoth, horse, roe deer and other Pleistocene mammals which had been found in the ozokerite mine at the depth of 12 m near Starunia (Bohorodchany district, Ivano-Frankivsk region).

The investigations enable the scientist to describe the history of Starunia researches, characterize the collection of paleontological discoveries, archaeological data, represent history of petroleum exploration, portray the geological location of the mammoth fauna, depict the role of saline deposits of *Miocene* in the formation of subsoil structure, represent geomorphological and neotectonic situation, Holocene terraces of the Velykyi Lukavets River, sedimentary rocks, dendrochronology dating, and start geophysical and geochemical studies as well as radiocarbon dating.

An idea to create the Park of the Ice Age at the Starunia area was published in fourth volume of the novel "EcoEurope is Our Future Home", in Polish journal, and in a number of articles [1–3].

In 2005 a joint scientific conference devoted to the 100th anniversary of paleontological discoveries was held in Krakow (Poland), and in 2008 – in Ivano-Frankivsk. The excursion to Starunia was organized where a lot of scientific results of expeditions carried out in the years 2004 to 2005 were discussed and represented in scientific journals and mass media content.

The research results were published in the scientific collection "Interdisciplinary studies (2006–2009) at Starunia (Carpathian region, Ukraine) – the area of discoveries of Wolly Rhinoceroses". The main results are represented in 17 articles which deal with geological environment, geomorphology, lithology, stratigraphy and paleogeography of the Upper Pleistocene and Holocene deposits, palynology, paleobotany, radiocarbon dating, description of plant and mussels remains, chronostratigraphy and environment changes during the late Pleistocene and Holocene. As well as with different methods such as electric probe, gravity and microgravity, geochemical analysis of gases, carbon isotope analysis, microbiological characteristics of Quaternary deposits and bitumen [4–6].

Complex investigations of Ukrainian and Polish scientists prove unique features of the Starunia area on a global scale and require the preservation and further study of paleontological remains and of the only Carpathian mud volcano. Future investigations may be conducted only by establishing Starunia geodynamic grounds and International Ecological Tourist Centre "Starunia: Park of the Ice Age". This idea is supported by the active position of IFNTUOG administration. The scientist of

IFNTUOG made a Park's Landscape Architecture Project which is displayed in the Geological Museum of the University.

We hope that there will be investors who will help to save such unique phenomenon as the Starunia area for the future generation.

3. Results

Starunia's paleontological location was identified [3] as a geodynamic landfill located on an area of 60 hectares in the southwestern vicinity of the village where in the second half of the nineteenth century and by the 1940s, they were producing ozokerite. The local was called Ropyshche and then the Factory.

In tectonic terms, the Starunia Geodynamic Landfill is located in the Pokut-Bukovyna or Inner Zone of the Pre-Carpathian Trough. From the southwest it is adjacent to Carpathians Hills, and from the northeast – Bilce-Volytske region, or the Outer Trough Zone, and further – the southwestern outskirts of the ancient Eastern European Platform. The polygon corresponds to the Starunia anticline fold, bounded by two elevations with a fall to the southwest. In fact, it is one of the scales of the folded-chipped structure of the Carpathians.

Starunia's slice – the fold formed by flysch sand-siltstone-mudstone deposits of the marginal and Paleogene periods. The flysch section of the Oligocene-Early Miocene Menilite World, which is oil-producing, is coming to an end. The oil fields of Gvizdetsk, Yuzhno-Gvizdetsk, Monastyrchany, Bytkov-Babchinsky, Pasichnians are associated with it.

Above the flysch lies the so-called molasses – the sand-conglomerate-breccia collared Miocene world, fragile rocks of which are cemented and strewn with cracks of rock and potassium salts. On the blurry erosion and karst processes of the surface of the Vorotyshcha world a valley of the river Velykyi Lukavets was formed, which formed a giant meander bent to the west and deepened by 5 m relative to the current water level in the rivers. The deepening of the valley began with the second floodplain terrace in the Emsky age, that is, at the beginning of the late Pleistocene. Before that the Lukavets Velikiy river did not exist, and in the neighboring valley of Bystrytsa the Solotvinsky terraced series began to form much earlier, from the late Pliocene, as evidenced by the terraces: VII (Red level) and VI (Loeva level) - both Late Pliocene and V (Galician) – Early Pleistocene, IV (Mariampol) and III (Jesuit) - Middle Pleistocene. At the level of the 2nd terrace, the valley of the Velykyi Lukavets River was formed.

The valley of the latter is located between the gentle slopes of the inter-interstitial spaces, composed of Middle-Late Pleistocene eolian-deluvial clays, loamy loam and sandy loam and sand eoldQ2-3 sand (**Fig. 1**). From the northeast to the inter-annual slope is adjacent a narrow strip of Late Pleistocene-Holocene deluvial loam and clay dQ3-4, and then a wide field of late-Eocene man-made sediments tQ34 – mining, represented by gravelly-claystone deposits, alluvial deposits. The relief decreases accumulated the products of the anthropogenic sediment washing in the form of late-Eocene deluvial-muddy-muddy-oil streams dptQ43 flowing into the valleys of the Rinne stream and the Velykyi Lukavets river. At the same gypsum level lie the upper-Eocene salt-mud flows of mud volcano vQ43 and oil emissions from wells and volcanics pQ43. All these technogenic-deluvial-proluvial formations and dumps of mining work cover the surfaces of II and I alluvial terraces [4–9].

The alluvium of the Prussian-Busk horizon [4] II of the aQ31 II sub-floodplain terrace is represented by sands, gravel, loam, mounds, peat. Section II of the terrace, as indicated above, begins in the recessed meander with well-washed pebbles. Above, they alternate with 3–4 bundles of dark gray imprints with plant imprints, including tundra – dwarf birch, alder, etc. The cut is completed with gray loam. The total capacity of the alluvium II terrace is up to 12–15 m.

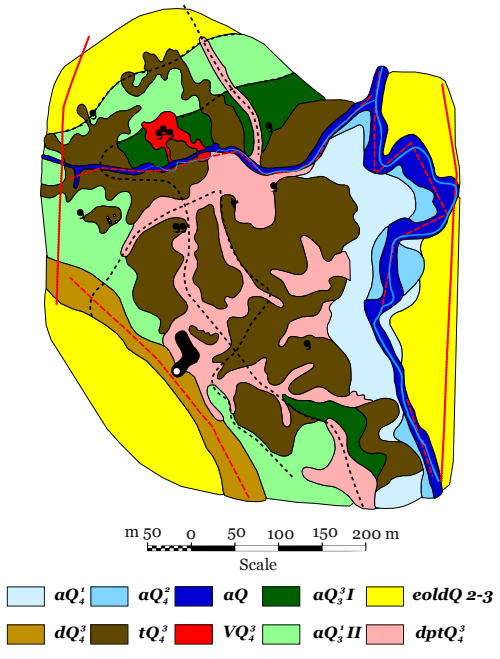

Fig. 1. Geological map of Starunia geodynamic landfill

And the Velykyi Lukavets river floodplain is embedded in the body of the 2nd terrace, with a water height of 8–10 m, and an alluvial capacity of up to 5 m. Its sediments of the aQ33I Dauphin-Black Sea horizon [4] are represented by sands, gravel, loam and peat. In total in the thickness of pebble alluvium, according to the data of drilling, up to 3 lenticular packs of nails are accrued. The lower bundle is associated with the findings of fossil Pleistocene fauna of 4 hairy rhinos and one mammoth, embalmed carcasses of which were found in 1907, in the mine No. 4 (mammoth) and in the specially dug in 1929 at 10–15 m from the previous one.

The sole of the alluvium I terrace is 5–8 m from the surface, and the fauna was found at depths of 12 and 17 m. The carcasses may have been found in the karst depressions of the salty collared world. Much remains to be seen.

The Holocene section of the section of the Starunia Geodynamic Landfill is represented by the alluvium of three floodplain terraces aQ41 – lower Holocene, high floodplain, sands, gravel, loam, clay, mudstones 2–3 m thick; aQ42 – average Holocene, average floodplain, sands, mudstones, 0.5–1 m thick; aQ43 – Upper Holocene, low floodplain, sands, loam, sandy loam 0.5–1 m thick.

Completing the description of the structure of the Starunia Geodynamic Landfill, consider that the stratigraphic scheme of the Starunia Quarter is a "bridge" between similar schemes of Western Europe and the plains of Ukraine. Therefore, the detail of the structure and age of the deposits of Starunia should be continued [5–8].

4. Discussion and conclusions

All the numerous interdisciplinary findings of Polish and Ukrainian scientists confirm the uniqueness of Starunia on a global scale, demanding the preservation and further study of

paleontological findings and the current unique mud volcano in the Carpathians. Such researches can be carried out by organizing the Starunia Geodynamic Landfill and the International Ecological and Tourist Center "Geopark of the Ice Age". This idea is supported and practically implemented thanks to the active position of the Rectorate of the Ivano-Frankivsk National Technical University of Oil and Gas. GeoPark architectural and landscape project was created by scientists of Ivano-Frankivsk National Technical University of Oil and Gas and is displayed in the Geological Museum of the University. The author of the article hopes that there will be investors who will help preserve the unique Starunia phenomenon for future generations.

Working together will achieve significant results in solving many problems:

– environmental and scientific – reconstruction of paleo-ecological conditions of biota development over the last 100-150 thousand years, which is important for forecasting global climate change;

– tourist and recreational – substantiation of development of ecological and scientific tourism, rural green tourism and tourist business in the recreational zone of the Carpathian region;

– social and medical – expanding the possibilities of salt-mud-ozokeritotherapy and organization of the respective sanatorium in the district and creation of new jobs for the population of the Starunia and Starobogrodchan united territorial community, improving the demographic situation, reducing the anthropogenic (technogenic) ecosystem impact on the population [8–10].

References

1. Adamenko, O. (2016). Our Future House is Ekoeurope the System of Ecological Security of the European Union, Carpathian Euroregion and Ukraine. Scientific Bulletin Series D: Mining, Mineral Processing, Non-Ferrous Metallurgy, Geology and Environmental Engineering, 30 (2), 7–20.
2. Kyrpach, Yu. V. (2009). Geological structure of south-west part Predkarpatian foredeep (Rozsilna - Dzvinjach - Starunja area) and structural-lithological model of salt deposits. Collection of scientific works of the IGS NAS of Ukraine, 2, 78–81.
3. Matyszkiewicz, J., Kotarba, M., Krzak, M., Wendorff, M. (2016). Department of Environmental Analyses, Geological Mapping and Economic Geology. Geology, Geophysics & Environment, 42 (2), 226. doi: https://doi.org/10.7494/geol.2016.42.2.226
4. Adamenko, O. M. (2019). The Upper Pleistocene stratigraphy of the Starunya site as a "bridge" between the stratigraphical frameworks of Western Europe and the plain area of Ukraine. Journal of Geology, Geography and Geoecology, 28 (2), 213–220. doi: https://doi.org/10.15421/111922
5. Adamenko, O. M., Kryzhanivsky, Y. I., Vekeryk, V. I. et. al. (2005). A concept of an International "Ice-Age Yepark" as an ecological-tourist center in Starunia former ozokerite mine, fore- Carpatian region, Ukraine In. Polish and Ukrainian geological studies (2004-2005) at Starunia-the area Discoveries of Wolly Rhinoceroses. Warszawa; Krakow, 205–209.
6. Menshov, O., Kuderavets, R., Vyzhva, S., Maksymchuk, V., Chobotok, I., Pastushenko, T. (2016). Magnetic studies at Starunia paleontological and hydrocarbon bearing site (Carpathians, Ukraine). Studia Geophysica et Geodaetica, 60 (4), 731–746. doi: https://doi.org/10.1007/s11200-016-0621-2
7. Woch, M. W., Trzcińska-Tacik, H. (2014). High occurrence of rare inland halophytes on post-mining sites in western Ukraine. Nordic Journal of Botany, 33 (1), 101–108. doi: https://doi.org/10.1111/njb.00607
8. Ziemianin, K., Brzuszek, P., Słoczyński, T., Jankowski, L. (2015). Dispersed organic matter in shales from Menilite Beds within Polish Outer Carpathians – preliminary diagnosis. Nafta-Gaz, 71 (9), 615–623.
9. Palmer, D. (2005). Earth. Kyiv: Entsyklopediya, 847.
10. Gębica, P., Jacyszyn, A., Krąpiec, M., Budek, A., Czumak, N., Starkel, L. et. al. (2016). Stratigraphy of alluvia and phases of the Holocene floods in the valleys of the Eastern Carpathians foreland. Quaternary International, 415, 55–66. doi: https://doi.org/10.1016/j.quaint.2015.11.088

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